Vaughn College Journal of Engineering and Technology
May 2023

SUCCESS

"One Important key to success is self-confidence.
An Important key to self-confidence is preparation" – Arthur Ashe

The Vaughn College Journal of Engineering and Technology (VCJET) is published annually in preparation for the Technology Day Conference. This journal includes events and activities of the Department of Engineering and Technology such as faculty professional development, student engagements, robotics competitions, UAV activities, poster competitions, conference presentations, and the best student research papers.

Given the rapid pace of technological change, the Journal is intended to assist Vaughn engineering students in the development of an appreciation of lifelong learning to meet their future professional challenges. The ultimate goal of the journal is to engage and prepare students for their future in engineering research and innovation. VCJET further strengthens student learning outcomes related to critical thinking, problem solving, communication, and teamwork. These learning outcomes, embedded in engineering and engineering technology programs are further developed through the activities outlined in this publication. The events reported in this journal also contribute to student development of leadership and entrepreneurial skills.

A journal paper project must be produced and investigated in a manner that satisfies the learning objectives of engineering education. Some of the learning objectives emphasized in the development of a technical paper are:

1. Intention plan (Abstract): Developing a proposal that outlines the details of a project and its impact on local and global society
2. Application: Identifying the use and application of the project in global society
3. Methodology: Providing a brief description of methods and solutions
4. Teamwork: Identifying team members and their responsibilities in the project's development
5. Modeling: Providing a complete and precise drawing of the project
6. Analysis: Providing all necessary analysis and analytical tools used to satisfy the system's safety and computing requirements
7. Conclusion: Presenting the results of the project, as well as their contribution to local and global society
8. Reference: Identifying research references
9. Presentation: Presenting the selected design paper in a Microsoft PowerPoint format to the industry advisory members, faculty, and other members in the audience during the Technology Day Conference

The Journal's topics include technical papers related to computational mechanics, solid mechanics, mechatronics, robotics, avionics, electronics, and other topics pertinent to the engineering and engineering technology fields.

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Contents

A Brief Review of Vaughn College's Fourteenth Annual Technology Day Conference, May 20, 2022

Vaughn students, faculty, alumni, and industry professionals convened on May 20, 2022 for the Fourteenth Annual Industry Advisory Meeting and Technology Day Conference. Advisory Council members were given updates on recent developments in the Engineering and Technology Department such as the EAC-ABET final accreditation statement for Vaughn's Mechanical Engineering and Electrical engineering programs, HSI-STEM grant activities including the development process of stackable manufacturing certificate programs in CNC machining, Composite, and 3D additive and subtractive manufacturing and UAS design, the application and operation as well as the establishment of manufacturing centers (CNC machining, composite, additive manufacturing, and PLC & automation, and UAS) to support courses within these certificate programs. Dr. Rahemi, Project Director of the title III HSI-STEM grant **"Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students"**, updated advisory members with the development process of a BS degree program in computer science, as well as providing them with an update on grant-supported STEM activities, student engagement, and STEM outreach. Also, he talked about the implementation process of recently NYSED-approved computer engineering program that are supported by the Title V HSI grant. Each technical club (Robotics and UAV) and Vaughn's student chapter of professional societies (SWE, SHPE, and NSBE) provided their annual activities and accomplishments to the 2022 Technology Day Conference audience. In the afternoon session, capstone design presenters talked about their innovative design projects. The top 2 capstone design papers were selected by our Industry Advisory members as the recipients of the Best Student Paper awards of this session. Also, the work-in-progress capstone design projects and CSTEP undergraduate projects were presented during the afternoon poster session of this annual gathering. The following council members, faculty, and staff were in attendance:

Carlo Asaro - Lockheed Martin/Sikorsky Corp.
Max Gross, SciMax Technologies LLC
Rajdeep Singh, Lockheed Martin/Sikorsky Corp.
Jeff Hull, Tech Ed Systems
Dr. Aparicio Carranza – NY College of Technology (City Tech.), CUNY
Terry Jack – Lockheed Martin/Sikorsky Corp.
Ivan Stamatovski, Easy Aerial
Muhammad Noman – Lockheed Martin/Sikorsky Corp.
Manny Santana, Naval Sea (NAVSEA)
Beant Singh – Siemens
Mustafa Aboali – Pratt & Whitney
Felipe I. Munoz - Lockheed Martin/Sikorsky Corp.
Jason Becker – Brookhaven National Lab
Diogenes A. Ramos – FAA
Chaundra Daniels– Director of Vaughn's Career Service Dept.
Dr. Sharon DeVivo - President
Dr. Hossein Rahemi - Chair, Engineering and Technology Dept.
Dr. Amir Elzawawy – Associate Professor, Engineering and Technology Dept.
Dr. Shouling He - Associate Professor, Engineering and Technology Dept.
Dr. Douglas Jahnke – Assistant Professor, Engineering and Technology Dept.
Dr. Mohammed Benalla – Assistant Professor, Engineering and Technology Dept.

Dr. Miguel Bustamante - Assistant Professor, Engineering and Technology Dept.
Dr. Ghania Benbelkacem - Assistant Professor, Engineering and Technology Dept.
Dr. Amar Khoukhi - Assistant Professor, Engineering and Technology Dept.
Dr. Oluwaseyi Ajayi - Assistant Professor, Engineering and Technology Dept.
Prof. Khalid Mouaouya - Associate Professor, Engineering and Technology Dept.
Prof. Manuel Jesus – Associate Professor, Engineering and Technology Dept.
Gerard Sedlak –Engineering and Technology Dept (Retired Faculty).
Prof. Jonathan Sypeck – Assistant Professor, Engineering and Technology Dept.
Ryan Bobby Tang Dan – Vaughn's FAA Drone Training Faculty
Francesca Marricco - Assistant, Public Affairs
Donald Jimmo – Vaughn's writing center Faculty
Debbie Bari – Engineering Technology Senior Administrative Assistant

Prof. Manuel Jesus hosted this event and introduced all presenters as well as serving as moderator for the clubs and capstone presentation sessions of this annual gathering.

Vaughn College's President, Dr. Sharon DeVivo, welcomed the guests and thanked our advisory members and alumni for their active participation and support of the institution and student success and their involvement as an advisory board to the Engineering and Technology department.

Dr. Hossein Rahemi, Chair of the Engineering and Technology Department, thanked the advisory members for their continuous support and valuable feedback on every aspect of the department's programs and on students' success. He updated the advisory members about the 2021 EAC-ABET final accreditation statement for both Mechanical Engineering and Electrical Engineering programs, and on the ABET findings that both programs are in full compliance with all ABET criteria requirements.

Dr. Rahemi updated advisory members about the Department of Education title III HSI-STEM grant funded activities including the establishment of four manufacturing centers (PLC & Automation, 3D additive manufacturing, composite, and CNC machining), completion of four stackable certificate programs in Computer Aided Design & Additive Manufacturing, Composite Manufacturing, CNC machining, UAS design, application & operation and their current approval by New York State Education Department (NYSED). He added that in spring 2021, our institution developed and submitted a proposal for a new Tittle III HSI-STEM grant "Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students" to develop a BS degree in computer science program, and in the fall of 2021 the Federal Department of Education approved funding support for this project. In fall 2021, the Project Director conducted several meetings with the curriculum committee to research and propose a new BS program in computer science. This committee solicited advice from related industry partners in development process of this program. In spring 2022, the PD, with input from both the curriculum committee and the advisory board, completed the NYSED application for a BS degree, with a total of 128 credits in computer science. In March 2022, with approval of NYSED, Dr. Impagliazzo has been appointed as an external reviewer for this program, and we expect by mid-summer to submit Vaughn's BS in computer science program with external reviewer feedback and all other supporting documents to NYSED for their review and approval.

Dr. Rahemi's presentation provided an insight into the implementation process of the new NYSED-approved computer engineering program, the development process of the BS in computer science program, students' professional and scholarly activities, including the success of the Vaughn College Robotics team as the **"Excellence Award"** recipient of the **2022 VEX U Robotics World Championship**, and this team's invitation to be finalists in the virtual Design-Build-Vertical Flight competition of the 2022 Vertical Flight Society. Also, he talked about student involvement and success in scholarly activities including participation, presentation, and publication in technical conferences such as SWE, LACCEI, NSBE, SHPE, and Southern Biomedical Engineering.

Engineering Department's Annual Activities Presentation

Dr. Rahemi's presentation covered student participation and success in Robotics and UAV competitions as well as their involvement and accomplishments in scholarly activities and in the student chapter of professional societies (SHPE, NSBE, and SWE). Below is a list of student accomplishments during the academic year 2021-2022

- ✓ **2022 VEX U Robotics World Championship** - Vaughn's Robotics team received qualification to participate in the 2022 VEX U Robotic World Championship in Dallas Convention Center. For nine years in a row, Vaughn's robotics team advanced to the world robotics championship. Invitation to the VEX U Robotics World championship is granted only to a team that is a tournament Champion or "Excellence" award recipient of a regional competition as well as top place in “Robot Skills”. Vaughn’s Robotics team won the **“Robot Skills Award”** and the **“Excellence Award”** of both WPI and Vaughn College VEX U Robotics Regional Qualifier Competitions. These intense three days of competition were challenging, and Vaughn’s team won 9 out of 10 matches in the qualifying round and advanced to the top 16 playoff round. Vaughn’s team eliminated their competitors during the top 16 and quarter final matches and advanced to the Semifinal (final four) of the World Championship. In an intense exciting semifinal game in the tournament, team Wisconsin (WISCO) defeated Vaughn’s team and advanced to the world tournament championship matches, winning the 2022 World tournament championship. Vaughn College’s Robotics team won the highest award **“Excellence Award” of 2022 VEX U Robotics World Championship.** Vaughn’s team won this award because they “best exemplify, the best overall robotics program” and judges “want the team be emulated by other teams.” A team must demonstrate success in every aspect of their performance during an event, in order to win the Excellence Award.

2022 VEX U Robotics World Championship “Excellence Award”

- ✓ **LACCEI 2021 International Conference, Virtual Edition:** From July 19-23, Vaughn’s engineering and technology students, along with Dr. Hossein Rahemi, the department chair and PD of HSI-STEM, attended the LACCEI 2021 Virtual Conference. Two of Vaughn’s student team research papers were accepted for presentation and publication in the LACCEI 2020 international conference. Both of Vaughn’s student papers listed below were selected to compete among ten finalists for the student paper session as well as the student poster session of LACCEI 2021.
  - ✓ **“Intelligent Robot Design for VEX U Skills Challenge”** by Misael Marquez
  - ✓ **“BrailleBud - Transitional Learning Tool from Pre-Literacy to Braille Literacy”** by Tatiana Jaimes, Alina Santander Vinokurova, August Rodriguez.
- ✓ **2021 Society of Hispanic Professional Engineers (SHPE) National Conference -** From Nov 10–14, a group of thirteen engineering students from Vaughn College attended the 2021 Society of Hispanic Professional Engineers (SHPE) in-person Conference at Orlando, Florida. Vaughn’s students participated in Innovation, Nissan Design, and Extreme Engineering challenges as well as in various professional development workshops which aimed to promote leadership, unity, and exposure to the diverse career opportunities in the STEM fields. Also, Vaughn participated in the career fair session of the SHPE national conference, and Vaughn’s SHPE chapter received a total of 11 interviews for both internship and full-time positions with companies such as DuPont, Lockheed Martin, Rockwell Automation, Cummins, Tesla, Honeywell, Amazon, and Raytheon, seven of which resulted in pending Internships and two internship offers. Several of the Vaughn HSI-STEM grant-supported students also had the opportunity to participate in the

Innovation Challenge, Cybersecurity Challenge, and Nissan Design Challenge. Vaughn's student, **Kevin Kenta Osada, won second place in the Nissan Design Challenge** and **Kirill Sokolov won third place in the Innovation Challenge** of the SHPE national Conference

- ✓ **Women Engineers Conference, October 21 to 23, 2021 -** The Vaughn College chapter of the Society of Women Engineers (SWE) attended the 2021 Women Engineers Conference in Indianapolis, Indiana from October 21st through October 23rd, 2021. During the conference, nine members of the chapter had the opportunity to attend leadership seminars and technology talks. In addition to attending those, SWE students attended the in-person and virtual career fairs, where some interviewed with industry-leading companies such as Honeywell, Carrier, Raytheon Technologies, Accenture, and EBI. The conference was successful as 7 internship positions were offered on-site; interview opportunities were given both on-site and during the remote career fair.
- ✓ **2021 Southern Biomedical Conference -** From December 2-5, 2021, four Vaughn engineering students, Alina Santander, Tatiana Jaimes, Aaron Arana, and Mariah Villalon, along with Dr. Hossein Rahemi, engineering department chair, and engineering faculty Drs. Mohammed Benalla, Shouling He, and Prof. Khalid Mouaouya participated in the 37th Southern Biomedical Engineering Conference in New Orleans, LA. Three Vaughn student team research papers were accepted for publication and presentation in this annual gathering. Vaughn's student papers as listed below were presented in the 37th Southern Biomedical Engineering conference on Saturday December 4th from 2:15 to 2::45 PM**.**
    - "Electromechanical Device for Inceptive Braille Learning" by Alina Santander, Tatiana Jaimes, and August Rodriguez.
    - "Non-Invasive Glucose Monitoring System with Server Link" by Mariah Villalon, Isa Al-Maktoum, and Rebeca Snyder.
    - "Assistive Partial Limb Exoskeleton (APLE)" by Aaron Arana.

2021 LACCEI Virtual Conference

2021 SWE and SHPE Conferences

2021 NSBE and SBME Conferences

Robotics, UAV, SWE, NSBE, and SHPE Clubs' presentation
11:00 am to 12:00 pm

Each technical club and student chapter of these professional societies provided 10 minute presentations of their annual activities, including their involvement in technical competitions, organizing and hosting STEM workshops, community outreach activities, assisting Vaughn College in hosting regional High Schools and College Robotics competitions, hosting Robotics and Drone workshops during Vaughn's Annual Manufacturing Day and Annual STEM Day, hosting STEM workshops during SWE and SHPE annual conferences, participating in extreme engineering, Nissan design, and Engineering Innovation challenges of the SHPE annual conference as well as other activities that helped them with internship and career opportunities. Also, they talked about their involvement in scholarly activities including participation, presentations, and publications in technical conferences. After their presentation, each club received the "Excellence Award" for their active involvement and participation in STEM related activities, including STEM workshops, technical competitions, and conference participation and presentation. .

Annual Activities Presentation by Robotics and UAV Clubs

A Presentation by Vaughn's Student Chapter of Professional Societies SWE, NSBE, and SHPE Annual Activities Presentation

Robotics, UAV, SWE, NSBE, SHPE "Excellence Award" Recipients

Student Technical Paper Presentation, 1:00 pm to 3:30 pm

A total of five capstone degree projects, listed below, were selected for publication in the 2022 VCJET Journal, and among those a total of three design degree projects were selected by our industry advisory members as finalists for the **Best Paper and Presentation Award** of the 2022 Vaughn College Annual Technology Day Conference. In addition, two CSTEP posters were selected as finalists for the **Best Poster presentation Award** during this annual gathering.

Capstone Degree Projects

1. **SAD: Slice and Dice**

   Finalist for the Best Paper and Presentation Award

   Authors: Jack Sze, Kang Jiang, Wiktoria Harkot
   Program: Mechatronic Engineering
   Advisor: Dr. Shouling He

2. **Robot Path Planning and Decision-Making Subsystem for VEXU Competition**

   Finalist for the Best Paper and Presentation Award

   Author: Nicholas Bentancur, and Misael Marquez
   Program: Mechatronic Engineering
   Advisors: Drs. Shouling He and Hosein Rahemi

3. **The Braille Educational Tablet (BET)**

   Finalist for the Best Paper and Presentation Award

   Authors**:** August Rodriguez, Manpreet Anand, Bryan Gordillo
   Program: Mechanical Engineering
   Advisor: Dr. Amir Elzawawy

4. **Smart Home Electrification**

   Authors: Wole Barnarde, Ankit Mistry, Adem Bunardizu
   Program: Electrical Engineering
   Advisor: Dr. Mohammed Benalla

5. **Solar Energy for Smart House**

   Authors: Tika Tamang, Matteo Salamone
   Program: Electrical Engineering
   Advisor: Dr. Mohammed Benalla

CSTEP Poster Presentation

1. Virtual Reality and Augmented Reality in Academia

   Finalist for the Best Poster Presentation Award

   Authors: Amanda Camacho, Jacky Chang, Kang Jiang,
   Advisor: Prof. Manuel Jesus

2. Autonomous Drone Package Delivery System for Urban Environment

   Finalist for the Best Poster Presentation Award

   Authors: Jairo Andrew Ramos, Kevin Tsang
   Advisor: Prof. Bobby Tang and Dr. Amir Elzawawy

3. Scavenging Energy to Measure and Transmit Water Temperature

   Authors: Daniel Garcia
   Advisor: Dr Douglas Jahnke

4. Scavenging Energy to Measure and Transmit Water Temperature

   Authors: C. Sorto, J. Sze, J. Rosa
   Advisor: Dr. Ghania Benbelkacem

Students' Capstone Design Papers Presentation

Students' Poster Session Presentation

Best Paper and Presentation Award Recipients

The top two research papers were selected by our Industry Advisory members as the recipients of the Best Student Paper and presentation awards of this session. The winning papers included: **First place Design Paper and Presentation winner,** "Robot Path Planning and Decision-Making Subsystem for VEXU Competition" by Misael Marquez and Nicholas Bentancur, and there were two **Second Place Design Paper and Presentation winner,** "Slice and Dice" by Jack Sze, Kang Jiang, and Wiktoria Harkot; and "The Braille Educational Tablet (BET)" by August Rodriguez, Manpreet Anand, Bryan Gordillo, and **First Place Best Poster presentation winner**, "Virtual Reality and Augmented Reality in Academia**"** by Amanda Camacho, Jacky Chang, Kang Jiang

Best Student Paper, Poster, and Presentation Awards

In conclusion, Dr. Rahemi congratulated all capstone design paper, poster, and technical club presenters, and he announced that the Vaughn community is very proud of their accomplishments. He extended his gratitude to the federal department of education Title III HSI-STEM and Title V HSI funding support for all STEM activities and students' engagements in hands-on technical clubs, competitions, and scholarly activities. He thanked the industry advisory board and alumni for their participation, feedback and continuous support in every aspect of department and student success. Finally, he expressed his sincere gratitude to those advisory members who served as judges to evaluate student capstone design projects as well as to those who served as reviewers for Vaughn's new computer science program.

Supplemental Instruction

Supplemental Instruction (SI) is a student academic assistance program which increases academic performance and retention through the use of collaborative learning strategies. The SI program at Vaughn targets challenging mathematics, engineering, and physics courses and provides regularly scheduled, out-of-class, peer-facilitated sessions giving students further opportunity to process the information learned in class. Supplemental instruction is a proactive approach to student learning and engagement which increases student persistence and retention. In an effort to increase learning effectiveness, during the spring of 2009, a formal supplemental learning program was introduced. In addition, during the spring of 2012, as part of the Hispanic-Serving Institution (HSI) STEM grant, the SI program has been further enhanced to assist and improve student understanding in fundamental engineering and engineering technology courses. In these courses, such as statics, dynamics, strength of materials, AC/DC circuits, Robotics, automation, and Computer Aided Design, highly talented students who have already completed those courses are selected to sit-in on the classes for a second time, with the instructor, and to serve as a designated Supplemental Instructor (SI) for these courses and laboratory exercises. The student SI is assigned the task of reviewing class lectures, conducting problem solving sessions and communicating with the faculty member about the areas where students need reinforcement for successful course completion. This SI program was initiated in conjunction with the Teaching and Learning Center (TLC). The current HSI-STEM title III grant provides additional funding ($60,000/year, 2016-2021) to further enhance the SI program through more fundamental courses that can improve the attainment of student learning outcomes in all STEM related programs.

The student SI is scheduled for ten hours per week to assist students in the fundamental engineering and engineering technology courses. This schedule includes three hours per week that the SI attends the class with the instructor for the second time, and another seven hours per week to assist students with problem solving sessions. For spring 2022, the student supplemental instructors and their schedule are presented in the following table.

Table 1: Spring 2022 SIs for the Corresponding Courses and Course Schedule

Course	Faculty	Supplemental Instructor	Class Schedule	Out-of-Class Zoom SI Work
MEE210 Thermodynamics	Ghania Benbelkacem	Ariel Ferrera	Mon: 1:30-3:30pm Wed 1:30-3:30pm	Monday – 5-7pm Tuesday: 5-7pm Wed: 5-7pm Thursday:5-7pm Friday:4:30-6:30pm
ELE326 Microprocessors	Shouling He	Almaz Abdrasulov	Monday: 12-2:50pm Wed: 12-2:50pm	Monday:9am-11am Tuesday: 11am-2pm Thursday: 3pm-5pm
MEE215 Engineering Mechanics II	Douglas Jhanke	Jack Sze	Tuesday: 12-1:30pm Thursday: 12-1:30pm	Tue 12-1:30pm, 4-6pm Thursday: 12-3:30pm Friday: 1-4pm
MEE115 Engineering Mechanics I	Douglas Jhanke	Alanke Perrera		Monday: 4-7pm Tue: 12-1pm 4:30-5:30pm Wednesday: 12-5pm Thursday: 12-1pm Friday: 9-10am

MEE345 **Fluid of Mechanics**	Ghania Benbelkacem	Almaz Abdrasulov	Tue: 12pm-1:30pm Thur: 12pm-1:30pm	Monday: 5-7pm Tuesday: 5-7pm Wednesday: 12-2pm Thursday: 12-4pm
EGR220	Hossein Rahemi	Atalay Erem	Tuesday: 9-10:30am Thursday: 9-10:30am	Tuesday: 6-9pm Thursday: 6-9pm Friday: 1-6pm
MEE220 **Mechanics of Materials**	Douglas Jhanke	Misael Marquez	Monday: 12-1:30pm Wed: 12-1:30pm	Monday 5-8pm Tuesday: 12-2pm Wednesday: 5-8pm Thursday: 12-2pm
ELE350/350L	Miguel Bustamante	Tatiana Jaimes	Monday: 9-11:50am Wed: 9-10:50am	Monday: 2-5pm Tuesday: 2-4pm Wednesday: 2-5pm Thursday: 12-2pm
MEE440	Hossein Rahemi	Bryan Gordillo	Tuesday: 2-3:30pm Thursday: 2-3:30pm	Tuesday: 11-1pm Wednesday: 11-2pm Thursday: 11-1pm Friday: 10-1pm
ELE230/ELE230L	Shouling He	Daniel Doscher	Tuesday: 9-11am Thursday: 8-11am	Monday: 5-7:30pm Tuesday: 9-11am Wednesday: 2:30-5pm Thursday: 8-11am

2022 Department's Activities and Highlights

1. **STEM related student engagement (Technical Competitions, STEM workshops and Conferences):**
   - **2022 WPI Vex U Robotics Regional Qualifier Competition:** On Sunday, January 30, 2022, Vaughn College's Robotics team participated at the WPI VEX U Tournament. The team was composed of nine members (Misael Marquez, Christopher Walker, Daniel Doscher, Tatiana Jaimes, Amanda Camacho, Ataly Erem, John Sutera, Cristian Sorto, and Samuel Aremu). Vaughn's team finished 1st in "Robot Skills." With this win, the team is currently ranked 3rd in the world in "Robot Skills. The team also won the Excellence Award which qualifies the team to participate in the 2022 World VEX U Robotics Championship.
   - **2022 Vaughn College VEX U Regional Robotics Tournament:** On Sunday Feb 13, 2022, the PD and faculty along with Vaughn College Robotics team hosted its Eighth Annual VEX U College Regional Robotics Tournament. A total of nine teams participated in this regional robotics competition. Vaughn's Robotics Team wins 2022 VEX U Skill Challenge, Tournament Finalist, and Excellence Awards
   - **2022 National Society of Black Engineers Conference -** The Vaughn College chapter of the National Society of Black Engineers (NSBE) attended the 2022 NSBE Conference in Anaheim California from March 23rd through 27th 2022. During the conference, eight members of the chapter had the opportunity to attend a variety of STEM workshops. In addition to attending those, NSBE students attended the in-person and virtual career fairs, where some interviewed with industry-leading companies such as Boeing, Caterpillar, Delta, Eaton, Honeywell, Raytheon Technologies, Southern

Company, and Qualcomm. Vaughn's students were supported by the HSI-STEM grant to attend this conference.

- **2022 AUVSI-XPONENTIAL Annual Conference:** From April 25-28, Vaughn's UAS curriculum developer, Dr. Amis Elzawawy, along with three members of Vaughn's UAV team participated in the 2022 AUVSI annual conference. Vaughn's UAV team and the UAV club advisor attended the annual conference to learn more about the fast-moving field of the UAS and drone technology
- **2022 In-Person VEX U Robotics World Championship:** From May 3-5, the PD and 13 members of Vaughn's Robotics club traveled to Dallas, Texas.to participate in the 2022 VEX U Robotics Championship. Seventy-two (72) national and international universities and colleges were invited to the 2022 World Robotics Championship. Invitation to the VEX U Robotics World championship is only granted to a team that is a tournament champion or excellence award recipient of a regional competition. The VEX U Robotics World Championship was an intense three-day competition where our team was continuously modifying their robots and autonomous programming to be competitive with other top teams in this tournament. During the qualifying matches, Vaughn's team (VCAT) competed against 10 teams, and they won 9 out of the 10 matches and received **6th place overall ranking**, advancing to the Thursday afternoon single elimination playoff round. Also, on Tuesday and Wednesday Vaughn's team participated in the skills challenge and won **3rd place in the VEX U World Skill ranking and 1st place in autonomous programming**. In the top 16 playoff round, Vaughn's team eliminated Mt. San Antonio College (NTSAC2) and advanced to the quarter final. In the quarter final the top eight teams competed, and Vaughn's team defeated a team from University of Illinois at Urbana Champaign (ICTRL) and advanced to the semifinal of playoff round against a team from University of Wisconsin (WISCO). In an intense exciting semifinal game of the tournament, WISCO defeated the VCAT team and advanced to the world tournament championship matches, winning the 2022 World tournament championship. Vaughn's team won the 2022 Technology Division Skills Award and the World Excellence Award.
- **2022 Annual Tech Day Conference (In-person Meeting):** Vaughn students, faculty, alumni, and industry professionals convened on May 20, 2022 for the Fourteenth Annual Industry Advisory Meeting and Technology Day Conference. Advisory Council members were given updates on recent developments in the Engineering and Technology Department, such as the 2021 EAC-ABET final accreditation statement for Vaughn's Mechanical Engineering and Electrical engineering programs and ABET found both programs are in full compliance with all ABET criteria requirements. An update was provided on HSI-STEM grant activities, including the development process of stackable manufacturing certificate programs in CNC machining, Composite, and 3D additive and subtractive manufacturing and UAS design, application and operation as well as establishment of manufacturing centers (CNC machining, composite, additive manufacturing, and PLC & automation, and UAS) to support courses within these certificate programs. Dr. Rahemi, project director of the title III HSI-STEM grant "Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students", updated advisory members with the development process of a BS degree program in computer science as well as provided an update on grant-supported STEM activities, student engagement,

and STEM outreach. Also, he talked about the implementation process of the recently NYSED-approved computer engineering program supported by the Title V HSI grant. Each technical club (Robotics and UAV) and Vaughn's student chapter of professional societies (SWE, SHPE, and NSBE) provided their annual activities and accomplishment to the audiences of the 2022 Technology Day Conference. In the afternoon session, capstone design presenters talked about their innovative design projects. The top 2 capstone design papers were selected by our Industry Advisory members as the recipients of the Best Student Paper awards of this session. Also, the work-in-progress capstone design projects and CSTEP undergraduate projects were presented during the afternoon poster session of this annual gathering (Attachment #4-Tech Day PP Presentation and Attachment #5-Tech Day Meeting Minutes). In conclusion, Dr. Rahemi, congratulated all capstone design paper, poster, and technical club presenters and he emphasized the pride of the Vaughn community in their accomplishments.

- **2022 Annual Vertical Flight Society (VFS) competition:** From June 1st through June 3rd, Vaughn College's UAV club participated in the 2nd annual DBVF student competition of the Vertical Flight Society (VFS). The Vaughn-UAV Team qualified last March as one of the competition's finalists, along with Penn State, Maryland University, Ohio State University and McGill University. In the final technical presentations, the judges praised Vaughn's team for their engineering design simplicity, light weight, and technical knowledge**.**
- **2022 ASEE Annual Conference and Exposition:** From June 26 through June 29 Vaughn faculty and three engineering students attended the American Society for Engineering Education (ASEE) 129th annual conference in Minneapolis, Minnesota. On Wednesday, June 29, from 1:00 to 4:00 pm Vaughn's engineering students August Rodriguez, Manpreet Anand, and Bryan Gordilo presented their project **"The Braille Educational Tablet,"** during the **ASEE Student Showcase Poster Session** of this annual gathering. Their presentation detailed the development process of an innovative braille block tablet that teaches children the alphabet and basic 4 letter words to enhance the fundamentals of pre-literacy and to allow visually impaired and legally blind children to have equal access to educational products and learning methods
- **2022 LACCEI International Conference:** From July18-22, 2022 Vaughn's engineering students, along with Dr. Hossein Rahemi engineering department chair, and engineering faculty members Prof. Khalid Mouaouya, and Prof. Miguel Bustamante attended the 20th LACCEI International Multi-Conference in Boca Rotan, Florida. Three of Vaughn's student team research papers were accepted for presentation and publication in the LACCEI 2022 international conference. Vaughn's student papers as listed below were selected to compete among ten finalists for the student paper session, and all submitted papers were accepted for the poster session of LACCEI 2022.
  - ✓ ReGenBot: "Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests" by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto
  - ✓ "Competitive Design Process for VEX U Competition -Tipping Point", by Misael Marquez.
  - ✓ **"**VEX Robotics Competition STEM Summer Camp for High School Students: An Engineering Approach", by Bobby Dan Tang

a) **2022 LACCEI Student Paper Session Competition:** From 11am to 2pm on Thursday July 21, Vaughn's student team papers, as listed above, were presented as finalists to the international conference audience during the student paper session of LACCEI 2022. Alina's, Tatiana's and Cristian's team paper addressed design process and features of the ReGenBot, a low-cost autonomous robot intended to collect data from burnt soil to analyze its characteristics, especially deficiencies, and to distribute fertilizer or nitrogen to revitalize and balance the soil's composition. The objective is to design and develop a robot that is programmed with Arduino and includes an ultrasonic sensor, a servomotor, NPK, moisture, and temperature sensor for South American forests which record a high number of wildfires every year. Judges selected their paper as a recipient of the **first place award** in the LACEEI 2022 student paper session competition.

b) **2022 LACCEI Student Poster Session Competition:** From 11:00 am to 1:00 pm on Wednesday July 20, three of Vaughn's student team posters were selected as finalists for the LACCEI 2022 poster session competition. Vaughn's student poster by Ryan Tang Dan provided insight into his STEM summer camp program to prepare high school students for the VEX Robotics Competition. Judges selected his poster as a recipient of the **third-place award** in the LACEEI 2022 student poster session competition

- **2022 Summer Engineering Experience Bridge Program (SEE-STEM):** From June 27 to August 11, Vaughn's engineering department is offered its Summer Engineering Experience (SEE-STEM) bridge program to high school seniors, community college transfer, and Vaughn freshman students. The summer program is a six-week residential initiative. The purpose of the summer program is student development through building leadership skills, while preparing incoming students for college life both academically and socially. Students take courses in Writing Composition and participate in STEM workshop sessions which provide an introduction to cybersecurity, and to AI. In addition, students take the First Year Initiative course, which introduces them to the resources needed to successfully complete their careers at Vaughn College. Students are also introduced to various careers via hands-on activities. All participants are required to present an exhibition based on their learning experience in final workshop sessions presented to Vaughn College professors, administrators and industry professionals, who provide them with feedback on their presentations and an opportunity for students to network.
- **2022 SWE Annual Conference:** From October 20-22, 2022, with the support of title III HSI-STEM funding, the Vaughn College chapter of the Society of Women Engineers (SWE) attended the 2022 Women Engineers Conference in Houston, Texas. During the conference, nine members of the chapter had the opportunity to attend leadership seminars and technology talks. In addition to attending those, SWE students attended the in-person career fairs, where some interviewed with industry-leading companies such as Honeywell, Carrier, Northrop Grumman, Lockheed Martin, Boeing, and Tesla. The conference was successful, as over 25 positions were offered and over 50 interviews were held.
- **2022 Society of Hispanic Professional Engineers (SHPE) National Conference:** From Nov 2nd – 6th, a group of 22 engineering students from Vaughn College attended the 2022 Society of Hispanic Professional Engineers (SHPE) in-person Conference in

Charlotte, North Carolina. Vaughn's students participated in innovation, Nissan Design, and Extreme Engineering challenges as well as in various professional development workshops that aimed to promote leadership, unity, and exposure to the diverse career opportunities in the STEM fields. Also, Vaughn students participated in the career fair session of SHPE national conference and Vaughn's SHPE chapter received a total of 57 interviews for both internship and full-time positions with companies such as Medtronic, Lockheed Martin, Northrop Grumman, Rockwell Automation, Cummins, Boeing, Tesla, Honeywell, Amazon, Qualcomm, Pratt & Whitney, L3Harris, John Deere, and Raytheon, thirty-three of which resulted in internship and full-time position offers. Also, seven of the Vaughn HSI-STEM grant-supported students had the opportunity to participate in the Extreme Engineering competition and the Nissan Design Challenge. Vaughn's student, **Daniel Doscher's team won first place in the Nissan Design Challenge** and **Christopher Walker won third place in the Nissan Design Challenge** of the SHPE national Conference.

- ❖ **The 2022 20 Twenties of Aviation Week Award:** In Early Spring 2022, the department chair wrote recommendations for and nominated two Vaughn engineering students, Alina Santander and Tatiana Jaimes, who are actively involved in STEM and outreach activities to be considered for the 2022 20 Twenties Aviation Week Award. In fall of 2022, both students were selected as winners of the 2022 20 Twenties Award.

2. **Lab Equipment, Laboratory Enhancement and Development:**

- ❖ **Vericut CNC Software:** In January 2022, as part of the Title III HIS-STEM project, the grant team, with the recommendation of CNC/3D curriculum designer, placed a purchase order for the Vericut CNC software **($2000)**. Vericut software is used in high end aerospace manufacturing as a safe method to debug and troubleshoot CNC programs. Our industry advisory board partners specifically requested we add Vericut CNC software to our course curriculum. They have positions ready for students well versed in the Vericut workflow. Most importantly, Verticut is an important tool for the safety first mantra of modern machine shops, where program verification is used to prevent tool breakage, machine damage, or injury to the machine operator. Our configuration will feature three complete replicas of our HAAS Mill, StepCraft Mill, and Okuma Lathe for rapid verification simulations to alleviate the time, expense, and potential danger of running unproven CAM programs.
- ❖ **Additive Manufacturing Lab Equipment:** April 14, 2022, the PD with the coordination of the 3D and additive manufacturing lab tech placed a purchase order for a Flashforge Creator 3 Pro 3D printer ($3,432.23). Addition of this 3D printer to our manufacturing center will further assist both students and club members in the completion and manufacturing of parts and components for their design projects.
- ❖ **HASS Desktop Mill Trainer:** On Nov 4, 2021, with the support of supplemental HSI-STEM title III grant funding and with the recommendation of the 3D/CNC curriculum developer and CNC lab tech, the PD placed a purchase order (**$12,694.75**) to acquire a HAAS Desktop Mill Trainer. The HAAS CNC Desktop Mill is an educational version of the popular HAAS VF2 SS CNC and MCU control system. In fall 2022, we received and installed the HASS Desktop Mill Trainer equipment in Vaughn's Additive Manufacturing center. This equipment allows instructors to teach the HAAS CNC MCU (Microcomputer / Machine Control Unit) interface to students in a lecture / lab

classroom environment, before moving on to the full-size industrial HASS VF2 SS milling machine.

- ❖ **Data Science Center:** In April, 2022, the PD and grant management team placed and purchased 13 advanced level computer workstations, hardware, software, and related accessories **($50,882)** to support the Mathematics/Data Science lab of the MCS center.. This state-of-art computer center will allow students to conduct their data science, programming, and related class research work.

3. **Hosting STEM related Conferences, Workshops, Seminars, STEM Outreach and other Department related Activities:**
   - ❖ **2022 Vaughn College 8th VEX U Robotics Regional Tournament:** On Sunday Feb 13, 2022, the department chair, along with the Vaughn College Robotics team, hosted the VEX U College Regional Robotics competition. A total of nine teams participated in this regional robotics competition. <u>Vaughn's Robotics Team wins 2022 VEX U Skill Challenge, Tournament Finalist, and Excellence Awards</u>
   - ❖ **2022 Vaughn College 8th High School Robotics Competition:** On Saturday, February 12th, 2022, the department chair along with the Vaughn College Robotics team hosted the High School VEX skills Robotics Tournament. A total of 25 regional high schools from Queens, Brooklyn, Bronx, Nassau, and Suffolk and other NY counties attended the February VEX state qualifier at Vaughn College.
   - ❖ **2022 Vaughn's STEM Day Workshop:** On Friday, April 8, 2022, the department chair along with faculty, lab techs, and the STEM pathway Liaison hosted its **4th annual STEM Day workshop** for community colleges and high school students. The participants of Vaughn's STEM Day virtual workshop event were students and faculty from Passaic CC, Queensborough CC, Aviation High, and Thomas Edison high school. For this virtual event, Vaughn's STEM Liaison and 3D/CNC curriculum developer, Prof. Manuel Jesus, introduced participants with a video tour of Vaughn's 3D Makerspace and CNC manufacturing centers. Finally, he organized and hosted several virtual STEM workshops related to 3D Scanning, CAM and CNC, and Virtual Reality
   - ❖ **P-TECH ANIMATION WORKSHOP, September 30, 2022:** On September 30th, the Vaughn College Engineering and Technology Department hosted students from the Freeport Long Island High School District as part of an outreach activity for the P-Tech Program. This program brings AAS degree college credits from the Animation and Digital Technologies AAS degree program to high school students. This first live in-person event introduced students to the college through activities such as a hands-on Computer Graphics Workshop, a school tour, and luncheon in the new school cafeteria.
   - ❖ **P-TECH Kickoff Event, October 7, 2022:** On Friday, October 7th a kickoff event for the P-Tech Consortium was held in Long Island NY. The P-Tech initiative enrolls high school students into Associates level degree programs in New York State College. Vaughn College partnered with the P-Tech initiative through the Freeport Long Island District High School and Wyandanch High School districts to offer Associate Degrees. Animation and Digital Technology and Electrical Engineering Technology programs were selected by the students as areas of study.
   - ❖ **Annual Long Island Manufacturing Day, Friday, October 7, 2022:** Prof. Manuel Jesus, Vaughn College faculty and 3D/CNC curriculum developer and STEM activity liaison, participated as a representative of our engineering department at the Annual

Long Island Manufacturing Day in the Cradle of Aviation Museum. The event started with an open house where colleges and manufacturers were able to connect with students and share insight on local high-paying manufacturing jobs. Long Island manufacturing has many opportunities in aerospace manufacturing and STEM related careers. This was apparent though the dozens of cutting-edge manufacturers on site. After the open house, local schools such as Suffolk Community College, Farmingdale College, and Vaughn College led a panel discussion that informed the audience how local schools are preparing students for the manufacturing workflow. In the case of Vaughn College, Prof. Jesus mentioned how we aggressively sponsor our club activities, conference participation, and hands-on CNC and AM lab work to inspire our students. Such engagement builds a foundation for our students who are often presented with job offers on the spot and who are ready to work in industry after they graduate

- **Program presentation to Hostos Community College, October 21, 2022:** On Friday, October 21st, Vaughn College Engineering and Aviation Departments met with Hostos Community College via a ZOOM meeting to discuss the articulation agreement between the two schools. Hostos students and faculty joined the meeting to ask Vaughn Faculty questions regarding program offerings. The Engineering Department shared insights on engineering programs and student research opportunities.
- **Eighth Annual Manufacturing Day Conference, Friday, October 28, 2022:** The Engineering and Technology department hosted its 8th Annual Manufacturing Day conference on Friday October 28th from 10am to 3pm to celebrate the National Manufacturing Day. Vaughn College invited seven industry leaders to address invited guests and the Vaughn community about manufacturing innovation. The presentation featured a diverse variety of presenters in the field of manufacturing and topics such as Autonomous Mobile Robot in Logistics; Additive Manufacturing in Aerospace; Data Science, Data Analytics, and Its Importance to Business; and How to get into the Career Field; Base 11 Program, Digital Transformation and What It Means to Organizations; Introduction to Digital Twins; and Scanning & Reverse Engineering.
- **Eighth Annual Manufacturing Day STEM Workshops:** On Friday, October 28. 2022, in a parallel session, from 10 am to 1:00 pm, Vaughn's Robotics, UAV, SWE, and SHPE clubs organized and hosted STEM workshops for the Community Colleges and high school students. These in-person workshops covered the following topics
  - ✓ Robotics Workshop - Robotics design & autonomous programing
  - ✓ An informational session about the basics of drones and the design considerations
  - ✓ Build a Drone Workshop and A Drone Practice Flying Session.

  More than 120 high schools and community colleges students and their mentors from Freeport, Bayside, Thomas Edison, Wyandanch, Uniondale and Hostos Community College attended the in-person STEM workshops.
- **14th Annual Tech Day Conference (In-person Meeting):** Vaughn students, faculty, alumni, and industry professionals convened on May 20, 2022 for the Fourteenth Annual Industry Advisory Meeting and Technology Day Conference. Advisory Council members were given updates on recent developments in the Engineering and Technology Department such as 2021 EAC-ABET final accreditation statement for Vaughn's Mechanical Engineering and Electrical engineering programs, and ABET's finding that both programs are in full compliance with all ABET criteria requirements.

They were also updated on the HSI-STEM grant activities including the development process of stackable manufacturing certificate programs in CNC machining, Composite, and 3D additive and subtractive manufacturing and UAS design, application and the operation as well as establishment of manufacturing centers (CNC machining, composite, additive manufacturing, and PLC & automation, and UAS) to support courses within these certificate programs. Dr. Rahemi, project director of title III HSI-STEM grant “Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students”, updated advisory members with the development process of a BS degree program in computer science as well as provided an update on grant-supported STEM activities, student engagement, and STEM outreach. Also, he talked about the implementation process of the recently NYSED-approved computer engineering program that is supported by Title V HSI grant. Each technical club (Robotics and UAV) and Vaughn’s student chapter of professional societies (SWE, SHPE, and NSBE) provided their annual activities and accomplishments to the audiences of the 2022 Technology Day Conference. In the afternoon session, capstone design presenters talked about their innovative design projects. The top 2 capstone design papers were selected by our Industry Advisory members as the recipients of the Best Student Paper awards of this session. Also, the work-in-progress capstone design projects and CSTEP undergraduate projects were presented during the afternoon poster session of this annual gathering. In conclusion, Dr. Rahemi, congratulated all capstone design paper, poster, and technical club presenters, and he emphasized how we in the Vaughn community are very proud of their accomplishments.

❖ **Industry Connection and Engineering Seminar Series:**

- **Trends in Sustainable Infrastructure, Artificial Intelligence (AI), Digital Twins, & Opportunities for the Aspiring Innovator and Engineer:** On Thursday, April 28^{th,} from 11am to 12pm, as part of the College’s industry connection seminar series, Mr. Edward Sutton III, leader of AI+Innovation of Sustainable Infrastructure for Black & Veatch, updated the Vaughn community on "Trends in sustainable Infrastructure, Artificial Intelligence (AI), Digital Twins, and Opportunities for the Aspiring Innovator". He shared valuable insight into this emerging aspect of the engineering landscape.
- **Cybersecurity Career Paths:** On Thursday, September 22, 2022, Dr. Gale Pomper, the Director of Cybersecurity Operations (DCO) in a DoD Cybersecurity Operations Center, addressed the Vaughn College Faculty and Students as part of the College's Industry Connection Seminar series for Fall 2022. Her presentation covered "Cybersecurity Career Paths". Dr. Pomper shared valuable insight on the Cybersecurity career field, in an engaging presentation based on the perspective of government, industry, and academia. .
- **Artificial Intelligence (AI):** On Thursday, October 20, 2022, Dr. Wright addressed the Vaughn College Faculty and Students as part of the College's Industry Connection Seminar series. His presentation covered topics pertaining to AI and outlined to the Vaughn College audience how artificial intelligence (AI) is a buzzword in the industry and for a good reason; artificial intelligence has already made so much progress within the technological field.
- **Linear Power Supply:** On Thursday, November 3, 2022, Mr. Carlo Asaro, an

Aircraft Avionics Systems Engineer, addressed the Vaughn community as part of the College's Industry Connection Seminar series. In this seminar, Mr. Asaro's presentation covered the most important topics pertaining to both Linear and Switching power supplies and their efficiency and application in a wide range of industries, including aerospace and medical fields.

- **Cryptography:** On Thursday, November 10, 2022, Dr. Dustin Fraser, Cybersecurity and risk management, Matrix Applications LLC, addressed the Vaughn community as part of the College's Industry Connection Seminar series. His presentation discussed Cryptography, and he explained why Cryptography is important to businesses, citizens, and governments and how cryptography helps these entities communicate and store information securely.
- **Data Analytics:** On Thursday, December 8, 2022, Dr. Gale Pomper, US Department of Defense (DoD), Computer Sconce Skill Community Director, addressed Vaughn Community on topics pertaining to Data Analytics. In her presentation, she explained the study of examining unprocessed data to draw inferences about such information, a field known as data analytics. Many data analytics methods and procedures have been mechanized into mechanical procedures and algorithms that operate on raw data for human consumption.
- **ePowertrain Systems Validation:** On Thursday, Feb 16, 2023, from 11am to 12 pm, as part of the engineering seminar series, Tatiana Jaimes, a current graduate of Mechatronic engineering who participated in a summer internship program with Daimler Truck North America, presented her summer internship project titled "ePowertrain System Validation" to the Vaughn Community. In this seminar, she talked about her assigned tasks and career-building experience that she gained through her involvement in this internship project.
- **Sensor Processing, Fabrication, & Testing for Characterization and Development Applications:** On Thursday, March 9, 2023, from 11am to 12pm as part of the engineering seminar series, Yusuf Rafi, a senior Mechatronic engineering student who participated in an internship program with NASA Jet Propulsion Laboratory, presented his internship project titled "Sensor Processing, Fabrication, & Testing for Characterization and Development Applications" to the Vaughn Community. In this seminar, he talked about his assigned tasks and career-building learning experience that he gained through his involvement in this internship project.
- **Automated Systems in Material Handling:** On Thursday, March 23, 2023, from 11am to 12pm, as part of the engineering seminar series, Alina Santander, a senior Mechatronic engineering student who participated in an internship program with Honeywell Intelligrated, presented her internship project titled "Automated Systems in Material Handling" to the Vaughn Community. In this seminar, she talked about her experience as a Project Engineering Intern in the Mechanical Engineering Department at Honeywell Intelligrated, as well as her assigned tasks and career-building experience that she gained through her involvement in this internship project.
- **Sustainability:** On Thursday, April 13, 2023, from 11am to 12pm, as part of the engineering seminar series, Isa Al-Maktoum, a senior Mechatronic engineering student who participated in a summer internship program with PSEG

ISS at Montclair State University, presented his internship project titled "Sustainability" to the Vaughn Community. In this seminar, he discussed sustainable development across various industries and demonstrated the importance of sustainability as well as the career-building learning experience he gained through his involvement in this internship project.

- **Orientation - Curriculum Advisement with Engineering Students:** On Friday, January 13, 2023, the engineering and technology department, as part of the department's orientation, had a zoom meeting with new and transfer students to welcome them, as well as to provide them with some insight and advisement about their programs. In this virtual event, Dr. Rahemi, along with the STEM Liaison and program coordinators in the engineering and technology department, met with students and covered topics related to curriculum as well as to activities in which students should participate in order to enhance their engineering education while studying at Vaughn.

- **STEM Outreach:**
  - ✓ **Freeport High School Regional State Qualifier Robotics Competition:** On Saturday, February 4th, 2023, Freeport High School hosted its regional state qualifier robotics competition and brought 24 robotics teams from Long Island and New York City, including an international team from Turkey. Dr. Shouling He was invited as a judge for the competition. She worked with other judges to interview all robotics teams, closely observe teams' competitions, and carefully evaluate the performance of each team.
  - ✓ **Vaughn College VEX High School Robotics Qualifier Tournament:** Vaughn College hosted its 2nd VEX VRC Robotics High School Competition on December 17th, 2022. A total of 32 regional high schools from Queens, Manhattan, Bronx, Westchester and Nassau counties attended the December 2022 VCAT VRC Tournament at Vaughn College. The teams competed in the tournament and skills competition where the top competitors qualified for the state championship
  - ✓ **Drone Awareness and Tiny Whoop Race:** On Saturday, February 26th 2023, Vaughn's UAV team organized and hosted its fourth annual "Community Outreach Drone Awareness" event at the Cradle of Aviation Museum. The event was free and open to the community. Many drone hobbyists and FPV pilots, as well as the locals from the area, attended this event.
  - ✓ **Vaughn College Hosts "The Spin UP High School State Robotics Championship":** On Saturday, March 11th, 2023, Vaughn College hosted the Southern New York VEX Robotics Competition High School State Championship Event. More than 50 regional high schools from Queens, Brooklyn, Bronx, Nassau, and other New York counties attended the 2023 State Championship at Vaughn College
  - ✓ **2023 Annual STEM Day Workshop:** The engineering and technology department hosted its fifth Annual STEM Day workshop event for community colleges and high school students on Friday, April 21, 2023. The participants of Vaughn's STEM Day workshop event were students and faculty from both community colleges and high schools (Aviation High, Freeport, Bayside, Thomas Edison, Wyandanch, Uniondale and Hostos Community College). For

the morning session, Vaughn's STEM Activity Liaison and 3D/CNC curriculum developer, Prof. Manuel Jesus, introduced participants to hands-on sessions on topics related to 3D Additive Manufacturing, drone 3D scanning, and Photogrammetry. Dr. Benalla introduced students to an interactive hands-on circuit board design workshop. From 12 to 2:30 pm, Vaughn's Robotics and UAV clubs organized and hosted Build a Drone and Robotics Workshops. More than 100 high schools and community college students were part of this in-person STEM Day workshop.

- ❖ In October 2022, the engineering and technology department chair provided the academic VP with an executive summary to update the board of trustees on department annual activities, including Vaughn's Robotics Club success as the recipient of the Excellence Award in the 2022 VEX U Robotics World Championship. Vaughn's student success in the 2022 LACCEI International conference, Vaughn's UAV team participation in 2022 Vertical Flight Society (VFS) competition, Vaughn's 8^{th} Annual Manufacturing Day, Fall 2022 Connection Seminar Series, Title III HIS-STEM grant supported activities and the development process of the new BS in Computer Science program were all detailed in this report.
- ❖ In September 2022, the department chair and project director of the new Title III HSI-STEM, with the assistance of the Grants Manager, completed and submitted a first-year carryover balance report to the project officer. The PD and grant management team provided recommendations for the carryover balance, budget narrative, and project activities that can be implemented during the 2^{nd} year of the grant project (2022-2023 academic year)..
- ❖ On February 2022, the engineering and technology department chair provided the academic VP with an executive summary to update the board of trustees on department annual activities, including activities related to the new title III HIS-STEM grant award and the submission of a BS in computer science program to NYSED for their review and approval, the 8^{th} annual manufacturing day conference, student professional engagement and accomplishments in the 2022 SWE conference and 2022 SHPE national conference, the industry connection seminar series, and the completion of additive and subtractive manufacturing laboratories supported by the existing Title III HIS-STEM grant..

Laboratory Development, Upgrade and Enhancement

For the past several years, as a result of the Title III grant funding support, the engineering technology department has been able to establish several state-of-the-art-laboratories such as the Thermo-Fluid lab, the Robotics and Control System lab, the automation lab, the Energy Conversion and Smart Grid Power Systems lab, and the 3D innovation Center. These new facilities and upgraded existing facilities contribute to student success in both scholarly activities and technical competitions. From 2016-2022, the title III grant "**Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students,**" enabled the engineering department to develop stackable certificate programs and state-of-the-art laboratories in CNC machining, 3D Additive and Subtractive manufacturing, composite manufacturing, and UAS Design, Application and Operation.

The current title III grant "**Developing Guided STEM Degree Pathways to Prepare Hispanics and Low-Income Students for the Careers of the Future**," will further enable the engineering department to develop a BS degree program in Computer Science with a focus on Cybersecurity, Artificial Inelegance, and Data Science. Also, the title III HSI-STEM grant funding support will allow Vaughn College to develop a state-of-the-art Mathematics and Computer Science (MCS) Center, and this will allow the engineering department to establish three designated spaces for 1) a Data Science and Applied Math Computer Lab, 2) a Computer Science Lab, and 3) a Student Undergraduate Research Lab. We expect the renovation and establishment of the MCS center to be completed in the academic year 2022-2023. The establishment of a new MCS center will further expand student involvement in computing and STEM-related scholarly, practical hands-on, STEM workshops and community outreach activities. In addition, grant-supported initiatives such as supplemental instructors and recitation sessions will help to further improve student outcomes and consequently both retention and graduation rates in STEM and computing fields. These initiatives will allow Vaughn College to develop a much-needed pathway to increase accessibility for Hispanic and low-income students to enroll in the College's engineering degree programs that engage them in career-building STEM related activities. Vaughn's grant supported BS degree in computer science, computer engineering, and MCS center will have a long-term impact on our institution in attracting and graduating student in STEM and computing fields.

In the 2021-2022 academic year, the department completed purchase of the following laboratory equipment:

1. **Vericut CNC Software:** In January 2022, as part of Title III HIS-STEM project, the grant team, with the recommendation of CNC/3D curriculum designer, placed a purchase order for the Vericut CNC software **($2000)**. Vericut software is used in high end aerospace manufacturing as a safe method to debug and troubleshoot CNC programs. Our industry advisory board partners specifically requested we add Vericut CNC software to our course curriculum. They have positions ready for students well versed in the Vericut workflow. Verticut is an important tool given the safety-first mantra of modern machine shops where program verification is used to prevent tool breakage, machine damage, or injury to the machine operator. Our configuration will feature three complete replicas of our HAAS Mill, StepCraft Mill, and Okuma Lathe for rapid verification simulations that reduce the time, expense, and potential danger of running unproven CAM programs.
2. **Additive Manufacturing Lab Equipment:** In April 2022, the PD, with the coordination of the 3D and additive manufacturing lab tech, placed a purchase order for a Flashforge Creator 3 Pro 3D printer **($3,432.23)**. Addition of this 3D printer to our manufacturing center will further assist both students and club members to complete and manufacture parts and components for their design projects.
3. **HASS Desktop Mill Trainer:** In Nov 2022, with the support of supplemental HSI-STEM title III grant funding and with recommendation of 3D/CNC curriculum developer and CNC lab tech, the PD placed and purchased a HAAS Desktop Mill Trainer. The HAAS CNC Desktop Mill is an educational version of the popular HAAS VF2 SS CNC and MCU control system. It allows instructors to teach the HAAS CNC MCU (Microcomputer / Machine Control Unit) interface to students in a

lecture / lab classroom environment before moving on to the full-size industrial HASS VF2 SS milling machine (**$12,694.75**).

4. **3D Scanner for manufacturing lab:** In Nov 2022, with the support of supplemental HSI-STEM title III grant funding and with the recommendation of the 3D/CNC curriculum developer, we purchased a metrology grade 3D scanner. This state-of-the-art metrology grade 3D scanner will be used for precision measuring, alongside our CMM station to inspect production CNC parts and 3D scan parts for reverse engineering ($**18,849**).
5. **Data Science Center:** In April, 2022, the PD and the grant management team placed and purchased 13 advanced level computer workstation, hardware, software, and related accessories **($50,882)** to support the Mathematics/Data Science lab of the MCS center.. This state-of-art computer center will allow students to conduct their data science, programming, and related class research work.
6. **Mathematics and Computer Science (MCS) Center:** Currently, the institution is designating two rooms on the second floor of the Library for the Mathematics and Computer Science (MCS) Center and planning for construction will start in spring 2023. This will allow the department to establish three designated spaces for the 1) Data Science and Applied Math Computer Laboratory, 2) Computer Science Laboratory, and 3) Student Undergraduate Research Laboratory. We expect the renovation and establishment of the MCS center to be completed in summer 2023.

This laboratory equipment allows Vaughn to provide students with practical STEM and computing hands-on training in CNC, Composite, UAS, and 3D additive and subtractive manufacturing as well as with the means to acquire knowledge of algorithm, programming, data science, cybersecurity, and AI using Vaughn's State-of-the-art MCS computing center.

CNC Equipment with Hass Control Simulators

Vaughn's CNC Manufacturing Center

Automation Lab with SIMATIC S7-1200 PLC equipment

Vaughn's Additive and Subtractive Manufacturing Center

Additive and Subtractive Manufacturing Center with Metal X 3D Printer

Vaughn’s UAS Center

Vaughn’s Computer Engineering & Cybersucurity Center, Established in Spring 2022

Industry Advisory Council

The department of engineering and technology at Vaughn College has always recognized the value of external review of our curriculum to ensure that we are satisfying the needs of our constituents. The Industrial Advisory Committee (IAC) convenes every year, usually in the spring semester, and has met every year for the past 25 years. Since fall 2017, in addition to the annual technology meeting, we hold a fall meeting with our advisory members to discuss issues related to curriculum, laboratory development and program assessment. Also, through email communication, we continually inform our advisory members and alumni about department activities, new program development, student professional engagement, and any issue related to accreditation and program assessment.

The IAC is comprised of representatives of industry, government agencies, academia and other segments of the profession who are able to advise the program on current industry trends and the latest state-of-art technologies that we can incorporate into our program. Their mission is to act as an advisory group to the program on specific academic issues and to act as a link between the program and its industry partners, providing an input to current and future industry needs for the program. Members of the IAC are a select group of representatives from Lockheed Martin, Pratt & Whitney, CYIENT, Blue Origin, Dassault Systemes, ArcBest Technologies, Bakery Innovative Technology, Easy Aerial, FAA, CPI-Aerospace, COX and Company, SciMax Technologies, Micro Merchant Systems, Defense Contract Management Agency, Pavon Manufacturing Group, and US Didactic. The close partnerships with these industrial companies allow our students to explore careers or internship opportunities with top engineering enterprises.

Some of the IAC members are past graduates and are deeply involved in the professional needs of the department. The Table below summarizes the membership of IAC, and after every annual meeting, minutes are produced along with an oral debriefing to the engineering department.

INDUSTRIAL ADVISORY COUNCIL COMMITTEE

Name	Company	Title	Member Since
Ariel Ferrera	Blue Origin	Mechanical Design Engineer	2022
Peter Kalaitzdis	New York Power Authority	UAS-Robotics Program Manager Operations	2022
Marvin Blackman	CARBON RKAYD Control & Systems Integration	Lead Onsite Service Specialist	2013
Robert Anderson	Bakery Innovative Technology	Control Engineer	2016
Oliver Scheel	U.S. Didactic	Director of Educational & Training Systems	2000
Michael A. Joseph, II	Corning, Incorporated	Sr. Project Engineer	2001
Muhammad Noman	Lockheed Martin/Sikorsky Corp	CH-53E PBL Aftermarket Chief Engineer	2020
Moustafa Aboali	Pratt & Whitney	Aftermarket Sales – Commercial Engines	2021
Michael Wroblewski	Stark Products	Manufacturing Engineer	2016
Raul Telles	Pratt & Whitney	Sr. Design Engineer	2012
Al Bunshaft	3DS, Dassault Systemes	SVP Global Affairs, Americas President, DS US Foundation	2017
Di Yang	FAA	N.Y. / N.E. Comm. Engineering Center Manager	2017
Jefferson Maldonado	ArcBest Technologies	Director, Robotics and Automation	2022

Max Gross	SciMax Technologies, LLC	Principal	2015
Ivan Stamatovski	Easy Aerial	Chief Technology Officer	2022
Matthew Pearce	NASA	NASA Education Program Specialist	2015
Dr. Aparicio Carranza	CUNY-NYC College of Technology	Professor of Computer Engineering Technology	2011
John Pavon	Pavon Manufacturing Group	President	2007
Waseem Hussain	Union Crate	Co-Founder & VP	2017
Arya Ranasingh	Micro Merchant Systems	Computer Systems Analyst/ Sr. Team Lead	2009
Carlo Asaro	Lockheed Martin/Sikorsky Corp	Aircraft Electrical and Avionics Engineer	2015
Nick Visciotti	Cyient Inc.	Technical Leader	2013
Jonathan Zubarriain	Cox & Company, Inc	Test Equipment Engineer	2018
Felipe I. Munoz	Lockheed Martin/Sikorsky Corp	Technical Lead- Platform Systems Integration (PSI)	2016
Manny Santana	Defense Contract Management Agency	Quality Assurance	2013
Rajdeep Singh	Lockheed Martin/Sikorsky Corp.	Deputy Chief Engineer	2010
Terry Jack	Lockheed Martin/Sikorsky Corp.	UAEW – Chief Engineer	2015
Hitesh Shah	Cyient Inc.	Business Unit Manager	2015
Beant Singh	Siemens	Project Engineer	2014
Diogenes Ramos	FAA	Executive Team Lead	2008
Omar Eldeebo	Lockheed Martin/Sikorsky Corp.	Harness Design Engineer Lean Six Sigma Green Belt	2016
Shiva Lall	FAA	Aerospace Engineer	2010
Robert Isoldi	CPI Aero	Manager of Manufacturing Operations	2016
Rich Brown	Lockheed Martin/Sikorsky Corp.	CH-53K/E Aftermarket Chief Engineer	2017

Internship Programs

Vaughn’s internship program is a key part of an engineering curriculum to prepare students for the workplace. For the past several years, our students were involved with both summer and school year internship programs with top engineering companies such as Daimler, John Deere, NASA, Sikorsky, Northrop Grumman Corporation, Lockheed Martin, RCM-Tech, Rockwell Collins, Federal Aviation Administration (FAA), Alken Industries, Cummins Engine, MTA, GE, Pall Corp., Pavon Manufacturing Group, Raytheon, Safe Flight Instruments, Toyota, Robotics Education and Competition Foundation (RECF), and Naval Research Enterprise Internship Program (NREIP). These internships provide students with a greater appreciation for engineering education and expand their hands-on and career-building experiences. As a result of these internships, many of our graduates are currently working with these companies as new advisory members for our programs and assisting our current students in pursuing internships with these companies.

Faculty Professional Engagements and Workshop Participation

To improve the quality and effectiveness of instructional delivery and student learning, the engineering and technology department encourages faculty members to participate in conferences and workshops designed to enhance faculty understanding of new technological discoveries and innovations to maintain teaching quality. For the past few years our faculty members have been active participants in many educational and technical conferences and workshops such as the American Society for Engineering Education (ASEE), Latin American and Caribbean Consortium of Engineering Institutions (LACCEI), Aircrafts Electronics Association (AEA), Institute of Electrical and Electronics Engineers (IEEE), American Institute of Aeronautics and Astronautics (AIAA), Society for Experimental Mechanics (SEM), and American Society of Mechanical Engineers (ASME). Also, faculty were involved with the development and implementation process of two new mechanical and electrical engineering programs, laboratory development/enhancement, and learning communities for NSF and CSTEP scholarship recipients. Faculty also established the summer bridge program to prepare students for the core courses in STEM and computing fields. .

During the calendar year 2022–2023, faculty in the engineering and technology department participated in the following professional engagements and workshops:

Hossein Rahemi

1. **CNC Manufacturing Laboratory Equipment and Supply:** In January 2022, the department chair, based on the recommendation of the CNC/3D curriculum designer, placed a purchase order for the Vericut CNC software. Vericut software is used in high end aerospace manufacturing as a safe method to debug and troubleshoot CNC programs. Our industry advisory board partners specifically requested we add Vericut CNC software to our course curriculum. They have positions ready for students well versed in use of the Vericut workflow. Based on the safety-first mantra of modern machine shops, Vericut is an important tool, since verification is used to prevent tool breakage, machine damage, or injury to the machine operator. Our configuration will feature three complete replicas of our HAAS Mill, StepCraft Mill, and Okuma Lathe for rapid verification simulations that reduce the time, expense, and potential danger of running unproven CAM programs.
2. **Assessment of Recitation session:** In early January, the department Chair emailed a rubric survey to faculty to measure the effectiveness of recitation sessions in fundamental STEM courses. As a summative evaluation, we used recitation survey results and faculty comments to assess the impact of recitation sessions on student performance and on the attainment of student outcomes through courses within STEM programs. Overall, based on a summative evaluation, 80% of students who were in failure risk were able successfully to pass those courses
3. **2022 WPI VEX U Robotics Regional Qualifier Competition:** On Sunday, January 30, 2022, Vaughn College's Robotics team participated at the WPI VEX U Tournament. Vaughn's team finished 1st in "Robot Skills." With this win, the team is currently ranked 3rd in the world in "Robot Skills". The team also won the Excellence Award which qualifies the team to participate in the 2022 World VEX U Robotics Championship.
4. **STEM Community Outreach - 2022 Freeport High School Regional State Qualifier Robotics Competition:** On Sunday, February 5, 2022, Vaughn's robotics team, along with

the department chair and two engineering faculty members, assisted Freeport High School with their regional State Qualifier Robotics competition. In this regional event, Vaughn's team served as judges, referee, announcers, and field and tournament managers. In addition, both Vaughn's students and faculty interacted with high school students to increase awareness of Vaughn's STEM programs

5. **STEM Community Outreach – 2022 Drone Awareness and Tiny Whoop Race:** On Sunday, February 27st 2022, Vaughn's UAV team organized and hosted its 2nd Drone Awareness Tiny Whoop Race for middle and high school students, in partnership with the Cradle of Aviation Museum. All participants had the opportunity to fly a drone at the event. In this event, Vaughn's engineering faculty and students interacted with participants to increase their awareness of Vaughn's Engineering and Engineering Technology programs
6. **STEM Outreach - Vaughn College VEX High School Robotics Qualifier Competition:** On Saturday, February 12th, 2022, the department chair and engineering faculty along with Vaughn College Robotics, SWE, and SHPE teams hosted its Eighth Annual High School VEX Robotics competition. A total of 25 regional high schools from Queens, Brooklyn, Bronx, Nassau, and Suffolk and other NY counties attended the February VEX state qualifier at Vaughn College
7. **STEM Outreach - Vaughn College VEX U Robotics Tournament:** On Sunday, Feb 13, 2022, the PD and faculty along with the Vaughn College Robotics team hosted its Eighth Annual VEX U College Regional Robotics Tournament. A total of nine teams participated in this regional robotics competition. <u>Vaughn's Robotics Team won the 2022 VEX U Skill Challenge, Tournament Finalist, and Excellence Awards</u>
8. **Annual progress Report** (**PR Award # P031C160021):** In spring 2022 (March 01, 2022), the Project Director submitted an annual progress report for the Title III STEM grant "Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students" that included information/updates on facilities, faculty and staff, and the development process of stackable manufacturing certificate programs.
9. **STEM Community Outreach -Vaughn College Co-Hosts "The SNY Tipping Point High School State Robotics Championship":** On Saturday, March 12th, 2022, Vaughn College, in partnership with Overclock Robotics and Coast to Coast Robotics, hosted the Southern New York VEX Robotics Competition High School State Championship Event at the Cradle of Aviation. This event was the first in-person state championship event since the start of the COVID-19 pandemic. A total of 57 regional high schools from Queens, Brooklyn, Bronx, Nassau, and other New York counties attended the 2022 State Championship at the Cradle of Aviation**.**
10. **STEM Outreach - Vaughn's Virtual Pathway to STEM Day Workshop:** On Friday, April 8, 2022, the department chair along with faculty, lab techs, and the STEM pathway Liaison hosted its **4th Annual STEM Day workshop** for community colleges and high school students. The participants of Vaughn's STEM Day virtual workshop event were students and faculty from Passaic CC, Queensborough CC, Aviation High, and Thomas Edison high school. For this virtual event, Vaughn's STEM Liaison and 3D/CNC curriculum developer, Prof. Manuel Jesus, introduced participants to a video tour of Vaughn's 3D Makerspace and CNC manufacturing centers. Finally, he organized and hosted a couple of virtual STEM workshops related to 3D Scanning, CAM and CNC, and Virtual Reality.

11. **Additive Manufacturing Lab Equipment:** On April 14, 2022, the PD along with the coordination of the 3D and additive manufacturing lab tech placed a purchase order for a Flashforge Creator 3 Pro 3D printer ($3,432.23). Addition of this 3D printer to our manufacturing center will further assist both students and club members to complete and manufacture parts and components for their design projects.
12. **Interim progress Report** (**PR Award # P031C210018):** On April 23, 2022, the Project Director submitted an Interim progress report for the Title III STEM grant "Developing Guided Pathways to Prepare Hispanic and Low-Income Students for the Careers of the Future" that included information/updates on facilities, faculty and staff, and the development process of a BS in Computer Science program.
13. **BS Computer Science Program:** On April 28, the engineering department completed and submitted a Computer Science application with all supporting materials (evaluation report by NYSED-approved external reviewer, CV of program evaluator, Faculty Vitae, and syllabuses for computer science courses) to the VP for submission and registration of a new program with NYSED. The establishment of Vaughn's computer science program is supported by the Title III HSI-STEM Department of Education Federal grant.
14. **2022 In-Person VEX U Robotics World Championship:** From May 3-5, the PD and 13 members of Vaughn's Robotics club traveled to Dallas, Texas.to participate in the 2022 VEX U Robotics Championship. Seventy-two (72) national and international universities and colleges were invited to the 2022 World Robotics Championship. Invitation to the VEX U Robotics World championship is only granted to a team that is a tournament champion or Excellence award recipient of a regional competition. The VEX U Robotics World Championship was an intense three-day competition where our team was continuously modifying their robots and autonomous programming to be competitive with other top teams in this tournament. During the qualifying matches, Vaughn's team (VCAT) competed against 10 teams, winning 9 out of the 10 matches and receiving the **6th place overall ranking** and advancing to the Thursday afternoon single elimination playoff round. Also, during Tuesday and Wednesday, Vaughn's team participated in the skills challenge and won **3rd place in VEX U World Skill ranking and 1st place in autonomous programming**. In the top 16 playoff round, Vaughn's team eliminated Mt. San Antonio College (NTSAC2) and advanced to the quarter final. In the quarter final the top eight teams competed and Vaughn's team defeated a team from University of Illinois at Urbana Champaign (ICTRL) and advanced to the semifinal of playoff round against a team from University of Wisconsin (WISCO). In an intense exciting semifinal game of the tournament, WISCO defeated the VCAT team and advanced to the world championship, winning the 2022 World tournament championship. **Vaughn's team won the 2022 Technology Division Skills Award and the World Excellence Award.**
15. **VCJET Annual Journal:** In May 2022, the department chair published the Fourteenth Annual Vaughn College Journal of Engineering and Technology (VCJET). This journal includes annual department activities, laboratory upgrades, faculty and student professional engagements, graduate success stories, industry tours, engineering seminar series reports, industry connection seminar series reports, and student capstone design papers.
16. **Department's Executive Summary to update the board of trustees:** In May, the department chair submitted an executive summary to the VP to update the board of trustees with department annual activities. This report includes an update on the 2022 VCJET journal, preparation & planning for Vaughn's 14th Annual Technology Day Conference,

2022 STEM outreach, student professional & engagement accomplishments, activities pertaining to the Title III HSI-STE and Title V STEM grants, industry connection seminar series and other related department issues.

17. **14th Annual Tech Day Conference:** On Friday, May 27, 2022, the Engineering and Technology department chair together with the 3D/CNC curriculum designer hosted the **Fourteenth Annual Industry Advisory Meeting and Technology Day Conference**. In this virtual conference, Dr. Rahemi updated Advisory Council members on recent developments in the Engineering and Technology Department such as: 2021 EAC-ABET final accreditation statement for Vaughn's Mechanical Engineering and Electrical engineering programs, and ABET's findings that both programs are in full compliance with all ABET criteria requirements, HSI-STEM grant activities including the development process of stackable manufacturing certificate programs in CNC machining, Composite, and 3D additive and subtractive manufacturing and UAS design, application and operation as well as establishment of manufacturing centers (CNC machining, composite, additive manufacturing, and PLC & automation, and UAS) to support courses within these certificate programs. Dr. Rahemi, project director of title III HSI-STEM grant "Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students", updated advisory members with the development process of a BS degree program in computer science as well as provided an update on grant-supported STEM activities, student engagement, and STEM outreach. Also, he talked about the implementation process of the recently NYSED-approved computer engineering program that is supported by Title V HSI grant. Each technical club (Robotics and UAV) and Vaughn's student chapter of professional societies (SWE, SHPE, and NSBE) provided their annual activities and accomplishments to the audience of the 2022 Technology Day Conference. In the afternoon session, capstone design presenters talked about their innovative design projects. The top 2 capstone design papers were selected by our Industry Advisory members as the recipients of the Best Student Paper awards of this session. Also, the work-in-progress capstone design projects and CSTEP undergraduate projects were presented during the afternoon poster session of this annual gathering. In conclusion, Dr. Rahemi congratulated all capstone paper and technical club presenters.
18. **2022 ASEE Annual Conference and Exposition:** From June 26 through June 29, the department chair, Vaughn faculty and three engineering students attended the American Society for Engineering Education (ASEE) 129th annual conference in Minneapolis, Minnesota. On Wednesday, June 29, from 1:00 to 4:00 pm Vaughn's engineering students August Rodriguez, Manpreet Anand, and Bryan Gordilo presented their project **"The Braille Educational Tablet,"** during the **ASEE Student Showcase Poster Session** of this annual gathering. Their presentation detailed the development process of an innovative braille block tablet that teaches children the alphabet and basic 4 letter words to ensure good fundamentals of pre-literacy and which allows visually impaired and legally blind children to have equal access to educational products and learning methods
19. **2022 LACCEI International Conference:** From July 18-22, 2022, Vaughn's engineering students along with Dr. Hossein Rahemi, engineering department chair, and engineering faculty members Prof. Khalid Mouaouya, and Prof. Miguel Bustamante attended the 20th LACCEI International Multi-Conference in Boca Rotan, Florida. Three of Vaughn's student team research papers were accepted for presentation and publication in the LACCEI

2022 international conference. Vaughn's student papers, as listed below, were selected to compete among ten finalists for the student paper session, and all submitted papers were also accepted for the poster session of LACCEI 2022.

- ✓ "ReGenBot: Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests" by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto
- ✓ "Competitive Design Process for VEX U Competition -Tipping Point", by Misael Marquez.
- ✓ **"**VEX Robotics Competition STEM Summer Camp for High School Students: An Engineering Approach", by Bobby Dan Tang

a) **2022 LACCEI Student Paper Session Competition:** From 11 am to 2 pm on Thursday, July 21, Vaughn's student team papers, as listed above, were presented as finalists to the international conference audience during the student paper session of LACCEI 2022. Alina, Tatiana, and Cristian's team paper addressed the design process and features of the ReGenBot, a low-cost autonomous robot intended to collect data from burnt soil to analyze its characteristics, especially deficiencies, and distribute fertilizer or nitrogen to balance and revitalize the soil's composition. The objective is to design and develop a robot that is programmed with Arduino and includes an ultrasonic sensor, a servomotor, NPK, moisture, and temperature sensor for South American forests that record a high number of wildfires every year. Judges selected their paper as a recipient of the **first place award** of the LACEEI 2022 student paper session competition.

b) **2022 LACCEI Student Poster Session Competition:** From 11:00 am to 1:00 pm on Wednesday, July 20, three of Vaughn's student team posters were selected as finalists for the LACCEI 2022 poster session competition. Vaughn's student poster by Ryan Tang Dan provided insights into his STEM summer camp program to prepare high school students for the VEX Robotics Competition. Judges selected his poster as a recipient of the **third-place award** of the LACEEI 2022 student poster session competition

20. **2022 Summer Engineering Experience Bridge Program (SEE-STEM):** From June 27 to August 11, Vaughn's engineering department offered its Summer Engineering Experience (SEE-STEM) bridge program to high school seniors, community college transfer, and Vaughn freshman students. The summer program is a six-week residential initiative. The purpose of the summer program is student development through building leadership skills while preparing incoming students, both academically and socially, for college life. Students take courses in Writing composition, a STEM workshop session introducing cybersecurity, and an intro to AI. In addition, students take the First Year Initiative course, which provides them with the resources needed to successfully complete their careers at Vaughn College. Also, students are exposed, via hands-on activities, to various careers. All participants are required to do a presentation, based on their learning experience in workshop sessions, to Vaughn College professors, administrators and industry professionals, who provide them with feedback and students then have the opportunity to network. As a summative assessment, a rubric survey is used to assess student outcomes and instructor teaching effectiveness through the SEE-STEM program.

21. **HSI-STEM Monthly Progress Report:** From spring to fall 2022, the PD submitted a monthly progress report for the Title III STEM grant "Developing Guided Articulated

Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students" that includes information/updates on student engagement, facilities, faculty and staff, and the development process of the stackable manufacturing certificate programs.

22. **Department's Executive Summary to update the board of trustees:** In October, the engineering and technology department chair submitted an executive summary to the Academic VP to update the board of trustees on department annual activities. This report includes an update on Vaughn's student success as Excellence Award recipient of 2022 VEX U Robotics World Championship, student success as 1st place award recipient of the student paper session of the LACCEI International Conference, preparation & planning for Vaughn's 8th Annual Manufacturing Day Conference, 2022 STEM outreach, activities pertaining to the Title III HSI-STEM industry connection seminar series and other related department issues.
23. **8th Annual Manufacturing Day Conference:** The Engineering and Technology department chair and Title III HSI-STEM project director together with the STEM Activity Liaison hosted the 8th annual manufacturing day conference on Friday, October 28, 2022 (10 am to 3 pm) to celebrate national manufacturing day. Seven guest speakers of the leadership session addressed Vaughn community, faculty, and invited guests about manufacturing innovation in the area of Autonomous Mobile Robot in Logistics, Additive Manufacturing in Aerospace, Data Science, Data Analytics, and Its Importance to Business, Base 11 Program, Digital Transformation and What It Means to Organizations, Introduction to Digital Twins, and Selecting Scanning & Reverse Engineering Hardware. In a parallel session, from 10 am to 1:00 pm, Vaughn's Robotics, UAV, SWE, and SHPE clubs organized and hosted STEM workshops for the Community College and high school students. These in-person workshops covered the following topics
    - ✓ Robotics Workshop - Robotics design & autonomous programing
    - ✓ An informational session about the basics of drones and the design considerations
    - ✓ Build a Drone Workshop and A Drone Practice Flying Session.

    More than 120 high school and community college students and their mentors from Freeport, Bayside, Thomas Edison, Wyandanch, Uniondale and Hostos Community College attended the in-person STEM outreach workshops on building a drone, robotics design, and autonomous programming.
24. **2022 Women Engineers Conference:** From October 20 to 22, 2022, with the support of title III HSI-STEM funding, fifteen students from the Vaughn College chapter of the Society of Women Engineers (SWE) attended the 2022 Women Engineers Conference in Houston, Texas. During the conference, members of Vaughn's SWE chapter had the opportunity to attend leadership seminars and technology talks. In addition to attending those, SWE students attended the in-person career fairs, where some interviewed with industry-leading companies such as Honeywell, Carrier, Northrop Grumman, Lockheed Martin, Boeing, and Tesla. The conference was successful as over 25 positions were offered on-site, and over 50 interviews were held.
25. **2022 Society of Hispanic Professional Engineers:** From Nov 2 – 6, 2022, with the funding support of the Title III HSI-STEM grant, a group of twenty-two engineering students (10 supported by HSI-STEM) from Vaughn College attended the 2022 Society of Hispanic Professional Engineers (SHPE) in-person Conference in Charlotte, North Carolina. Vaughn's students participated in innovation, Nissan Design, and Extreme Engineering challenges as well as various professional development

workshops that aimed to promote leadership, unity, and exposure to the diverse career opportunities in the STEM fields. Also, Vaughn participated in the career fair session of SHPE national conference, and students from Vaughn's SHPE chapter received interviews for both internship and full-time positions with companies such as DuPont, Lockheed Martin, Rockwell Automation, Cummins, Tesla, Honeywell, Amazon, and Raytheon. The conference was successful as over 20 positions were offered on-site, and over 35 interviews were held. Also, several of the Vaughn HSI-STEM grant-supported students had the opportunity to participate in Innovation Challenge, Cybersecurity Challenge, and the Nissan Design Challenge. Vaughn student, **Daniel Doscher won first place in the Nissan Design Challenge** and **Chris Walker won third place in the Nissan Design Challenge** of the SHPE national Conference.

26. **The 2022 20 Twenties of Aviation Week Award:** In Spring 2022, the department chair wrote recommendations for and nominated two Vaughn's engineering students, Alina Santander and Tatiana Jaimes, for the 2022 20 Twenties Aviation Week Award. In Fall 2022, both students were selected as winners of the 2022 20 Twenties Award.
27. **Industry Connection and Engineering Seminar Series:** The department chair organized and invited several industry leaders as guest speakers for the fall and spring Industry Connection and Engineering Seminar Series. The names, dates, and topics of presentation are as follows:
12. Electronics Breadboard Hands-on Learning, Mr. Carlo Asaro, Aircraft Avionics Systems Engineer with Sikorsky, a Lockheed Martin Company, February 17, 2022.
13. Cybersecurity, Dr. Gale Pomper, US Department of Defense (DoD), Computer Sconce Skill Community Director, September 22, 2022.
14. Artificial Intelligence, Dr. Donovan Wright, a senior digital transformation, cyber, and cybersecurity consultant with DOD, October 20, 2022.
15. Linear Power Supply, Mr. Carlo Asaro, Aircraft Avionics Systems Engineer with Sikorsky, a Lockheed Martin Company, November 3, 2022.
16. Cryptography, Dr. Dustin Fraser, Cybersecurity and risk management , Matrix Applications LLC, November 10, 2022
17. Data Analytics, Dr. Gale Pomper, US Department of Defense (DoD), Computer Sconce Skill Community Director, December 8, 2022
18. ePoertrain Systems Validation - A summer internship program with Daimler Truck North America, Tatiana Jaimes, graduate of December 2022 Mechatronic Engineering, February 16, 2023.
19. Sensor Processing, Fabrication, & Testing for Characterization and Development Applications – A summer internship program with NASA Jet Propulsion Laboratory, Yusuf Rafi a senior Mechatronic engineering student, March 9, 2023.
20. Automated Systems in Material Handling – A summer internship program with Honeywell Intelligrated, Alina Santander a senior Mechatronic engineering student, March 23, 2023.
21. Sustainability - A summer internship program with PSEG ISS at Montclair State University, Isa Al-Maktoum, a senior Mechatronic engineering student, April 6, 2023.
28. **Program presentation to Hostos Community College, October 21, 2022:** On Friday October 21st, Vaughn College Engineering and Aviation Departments met with Hostos Community College via a ZOOM meeting to discuss the articulation agreement between the two schools. Hostos students and faculty joined the meeting to ask Vaughn Faculty questions regarding program offerings. The Engineering Department shared insights on engineering programs and student research opportunities.

29. **Orientation - Curriculum Advisement with Engineering Students:** On Friday, January 13, 2023, the engineering and technology department, as part of the department's orientation, had a zoom meeting with new and transfer students to welcome them as well as to provide them with some insight and advisement about their programs. In this virtual event, Dr. Rahemi, along with the STEM Liaison and program coordinators of engineering and technology, met with students and covered topics related to curriculum and activities in which students should participate to enhance their engineering education while studying at Vaughn.
30. **Title III HSI-STEM Carryover Report:** In September 2022, the department chair and project director of the new Title III HSI-STEM, with the assistance of the Grants Manager, completed and submitted a first-year carryover balance report to the project officer. The PD and grant management team provided recommendations for the carryover balance, budget narrative, and project activities that can be implemented during the 2nd year of the grant project (2022-2023 academic year).
31. **BS Computer Science NYSED program Application (PR Award # P031C210018):** On January 6, 2023, the engineering department chair and project director of the Title III HSI-STEM grant worked closely with the Academic Vice President and submitted a new BS Computer Science program application with all supporting materials (evaluation report by NYSED-approved external evaluator, CV of program evaluator, Faculty Vitae, and syllabuses for computer Science courses) to the NYSED for their review and approval. The establishment of Vaughn's computer Science program is supported by the Title III HSI-STEM department of education grant.
32. **Department's Executive Summary to update the board of trustees:** In February 2022, the engineering and technology department chair provided the academic VP with an executive summary to update the board of trustees on department annual activities, including activities related to the new title III HSI-STEM grant award and submission of a BS in computer science program to NYSED for their review and approval, 8th annual manufacturing day conference, student professional engagement and accomplishments in 2022 SWE conference, and 2022 SHPE national conference, the industry connection seminar series, and completion of additive and subtractive manufacturing laboratories supported by the existing Title III HSI-STEM grant..

Amir Elzawawy

1. Attended 8th Annual Manufacturing Day Conference, Vaughn College, Flushing, NY, October 28th, 2022
2. Participated in IEEE Entrepreneurship Workshop on Sustainable Development June 15th to June 19th, 2022- Vaughn College.
3. Attended open houses and Commencement Ceremony for fall and spring of the academic year 2021/2022
4. Advised students to present at the 14th annual technology day and publish in the Vaughn College Journal of Engineering and Technology (VCJET)
5. Attended Society of Hispanic Professional Engineers (SHPE) Annual Conference, November 10-14, 2021, Orlando, FL.
6. Served in the faculty senate for the academic year 2021/2022
7. ME Program Coordinator:
    - Participated in the implementation of the ME program assessment process

- Provided data collected for the ME assessment and evaluation
- Supervised Fall and Spring semester scheduling
- Conducted course evaluations for transfer students
- Conducted ME curriculum modifications
- Advised ME students professionally and academically

8. CSTEP Project Director: Involves more than 103 students,
   Major activities in 2022:
   - 2022 Summer Research Program: 15 students selected to work on various research topics under the supervision of Vaughn's 5 faculty members
   - Organized Extended Workshop Series and Mini-Courses to improve students in the following topics: Fundamental Engineering Mechanics, Fundamentals of Electrical Engineering, Calculus and Differential Equations Review, and Introduction to Cybersecurity
   - Provided tutoring and exam review sessions to CSTEP students.
   - Organized CSTEP Seminar Series
   - Collaborated with Career Services Office to organize Career development workshops
   - Conferences and professional networking events (SHPE, NSBE, SWE, ASEE etc.)
   - Monthly meeting with CSTEP program participants
   - All program activities planning, staff hiring and budgeting.
9. Participated with UAV club in the VFS DBVF student competition June 3, Aberdeen MD.
10. Attended ASEE Annual Conference June 26-29, 2022 in Minneapolis, MN
11. Advised students to participate in the Student Show Case Poster session at the ASEE annual conference June 28, 2022 in Minneapolis, MN
12. Advisor for AIAA Student Chapter and UAV Club.
13. Senior Member of American Institute of Aeronautics and Astronautics (AIAA)

<u>Ghania Benbelkacem</u>

1. Starting 2023, extend FAA Grant to recruit more high school students into the UAS program, some of whom might become future Vaughn students.
2. Continue involving our students in outreach activities at elementary, middle and high schools along with SWE, UAV and Vaughn Micromouse Team (VMT).
3. Attended Vaughn's 8th Annual Manufacturing Day, a one-day event for networking with industrial leaders in engineering, aviation, and manufacturing October 28th, 2022. Vaughn College, NY.
4. Participated, with Vaughn Micromouse Team, in 2022 IEEE Region 1 Micromouse Competition. October 1st, 2022. MIT, Boston. The Team won the 1st Place.
5. As a FAA Grant Director, lead Unmanned Aircraft Systems (UAS), a certificate program that provides students with a foundation in UAS. Since September 2022.
6. Advised students through the CSTEP research project, Summer 2022.
7. Attended IEEE Interpreneurship workshop organized by board of trustees' members Surya Raghu and Ken Stauffer. June15-17, 2022. Vaughn College, NY.
8. Attended the 14th Annual Technology day, May 20th. Vaughn College, NY.
9. Supervisor for Vaughn Micromouse Team, and articipated in 2022 IEEE Region 1

Micromouse Competition. April 9th, Union College, Schenectady, NY.

10. Attended Vaughn's 4th Annual STEM Day, for networking with industrial leaders in engineering, aviation, and manufacturing April 8th, 2022.
11. Attended WIE International Leadership Conference sponsored by Women in Engineering at IEEE to celebrate international Women's Day. March 8th, 2022.
12. Organized and hosted with UAV club, SWE club, and CSTEP students outreach activities at elementary schools. Under a form of workshops, 4th and 5th graders benefitted from a fun and immersive learning experience. Spring 2022.
13. Developed and hosted Fundamentals of Engineering Mechanics Workshops as part of the CSTEP – College Science Technology Program, to support Vaughn student's success, Spring 22.
14. Elected Member of the Senate representing Engineering Department for the academic year 2022/2023.
15. Co-Chair of Integrity and Affairs Committee as part of Senate activities (since 2021).
16. Attended all of Vaughn's Spring and Fall 2022 Industry Connection Seminar Series, and Engineering Seminar Series.
17. CSTEP Advisory Committee member since Sprin2021.
18. Working on building an automated grading system for Engineering drawing courses in collaboration with NYU - Tandon school of Engineering and NYU – Teaching and Learning Services. The aim is to develop an Automatic Grading Platform that benefits both students and instructors. 2022/2023.
19. Attended Research and Teaching Webinars offered by NYU – Tandon School of Engineering and it's partners, 2022/2023.
20. Member of American Society of Rheology. ASME, IEEE, WIE, and ASAA.

Shouling He

1. Worked as a fellow in the Cohort #9 of NSF Mentor-Connect, a highly regarded mentoring program for faculty preparation of competitive proposals to National Science Foundation Advanced Technological Education (NSF/ATE) Program, and developed the NSF proposal Developing PLC and Robotic Automation Technician Training For Service Industries, including logic model, narrative, new course syllabi, Business and Industry Leadership Team (BILT), budget, time schedule and program assessment with the external evaluator. (Dec. 2020- Nov. 2021)
2. Participated Vaughn College Technology Day, May 20, 2022.
3. Participated the 4th Annual STEM Day Workshop with the presentation (1) Virtual Reality (2) Makerspace and CNC Lab Video tours; (3) 3D Printing and Additive Manufacturing Workshop; (4) 3D Scanning; (5) CAM and CNC Workshop, by Robotics Club, SWE and UAV club, April 8, 2022.
4. Participated in the 7th Manufacturing Day Conference, October 29, 2021, and discussed the presentations:
   - ✓ Manufacturing of Surgical Masks by Diogo R. Osorio
   - ✓ Cyber Security and AI by Michael Nager
   - ✓ Autonomous Mobile Robots from Design to Production by Jefferson Maldonado
   - ✓ AM in Electronics by George Kyriakou
   - ✓ 3D Scanning & Precision Measurement Tools used in Manufacturing by Christ Gerbick and Dan McConnell
5. Participated Industry Connection Seminar:

- ✓ Trends In Sustainable Infrastructure, AI, Digital Twins, & Opportunities for the Aspiring Innovator and Engineer, by Edward Sutton, April 28, 2022
- ✓ Electronics Breadboard Hands-on Learning by Carlo Asaro, Feb. 7, 2022
- ✓ Osam-1: Servicing Satellite Mission (NASA), by T. Jaimes, Dec. 7, 2021
- ✓ Solar and Datalogger (InstaHUb), by A. Santander, Dec. 7, 2021

6. Participated one-week workshop of MANUEVER – Manufacturing Education Using Virtual Environment Resources supported by NFS GRANT, January 10-14, 2022.
7. Participated one-week workshop: Future of Mechatronics & Robotics Engineering Education (FoMRE) – Unified Curriculum and Course Design for Mechatronics and Robotics Engineering and obtained a CERTIFICATE, Robotics Engineering, WPI. The workshop was supported by NSF, EEC GRANT, Dec. 29-30, 2021, and January 5-7, 2022.
8. Successfully completed one-month Winter Education Workshop "Internet of The Things" with six sections, the grade +97.8/100, the courses taught by STCC team, Massachusetts. The project was supported by NSF ATE GRANT, December 2021-January 2022.
9. Participated the workshop: 2021 Fourth Smart Manufacturing for America's Revolutionizing Technological Transformation (SMARTT). The workshop was supported by NSF Award No. 1801120, with 8 modules and drone programming, July 15-22, 2021.
10. Worked as a technical judge for VEX Freeport High School Robotics Competition held on February 5, 2022, and February 11, 2022, at Vaughn College and evaluated the performance of middle and high school students from more than 24 teams and 25 schools, respectively.
11. Served as a Mechatronic Engineering (MCE) Program Coordinator and completed the following tasks during 2021-2022 academic year:
    - ✓ Monitored MCE annual course scheduling, examined the MCE curriculum and collected exit/internship surveys for the continual improvement of the program.
    - ✓ Updated the MCE Capstone Degree Project courses (MCE401 and MCE409) with the consideration of social, economic, and other factors in design to fulfil ABET requirements.
    - ✓ Continually improve MCE courses MCE410/MCE410L Industrial Manufacturing Automation and Lab, MCE420/MCE420L Autonomous Mobile Robots and Lab by new approaches to teach timers, path planning and localization.
    - ✓ Evaluated the MCE program by providing the updated course map for the ABET outcomes, collecting the faculty FCAR reports with samples and conducting assessment, developing FCARs with course samples for ELE230 /ELE230 (MCE/EE programs), ELE450/ELE450L (MCE/EE programs) and MCE409.
    - ✓ Evaluated transfer students' transcripts and advised MCE students in their professional (career goals) and academic (course selections) development.
12. Applied for FAA Aviation Workforce Development Aircraft Pilots Grant by modifying the grant proposal and providing relevant documents. The grant of $498,000 was approved by FAA on January 18, 2022, and Prof. He served as the director from January to the end of August 2022. She successfully organized the courses in Summer I (with 68 high school students) and II (with 43 high school students) and also taught UAS231/UAS231L Introduction to Aeronautics and Labs in Summer II and wrote Quarter I and Quarter II Performance Reports to FAA administration.
13. Worked as the Principal Investigator to apply for NSF ATE (Advanced Technology Education) grant with the proposal of Developing PLC and Robotic Automation Technician Training Program for Service Industries and have been awarded with $284,549 from NSF

Foundation.

14. Advised thirteen MCE students for six capstone degree projects. Two student projects, Robot Path Planning and Decision-Making Subsystem for VEXU Competition and The Slice and Dice, were presented at 2022 Vaughn Technology Day Conference and got the first place and second place award, respectively. The projects were published in 2022 Vaughn College Journal of Engineering and Technology. The student's project, Assistive Partial Limb Exoskeleton, was presented at 37th Southern Bio-Medical Engineering Conference, New Orleans, LA, Dec. 2-5, 2021, and published in Biomedical Science Journal Volume 57(4).

Yougashwar Budhoo

1. Member of ASME – The American Society of Mechanical Engineers, New York, NY, 2010 – present.
2. Attended Open House during fall and spring 2022 to assist faculty in providing information to potential future incoming students.
3. Attended Vaughn's Engineering and Technology department Technology day on May 20th, 2022.
4. Completed a linkedIn online learning course titled "Teaching Technique: Classroom Management" in June, 2022.
5. Completed a linkedIn online learning course titled "Teaching Complex Topics" in July, 2022.
6. Completed a linkedIn online learning course titled "Teaching Online: Synchronous Classes" in August, 2022.
7. Completed a linkedIn online learning course titled "Teaching Technique: Writing Effective Learning Objectives" in September, 2022.
8. Attended Vaughn's Engineering and Technology department 8th Annual Manufacturing day Conference on October 28th, 2022.
9. Served in the faculty senate for the academic year 2022/2023.
10. Attended Vaughn's Industry connection seminar on "Linear Power Supply" presented by Mr. Carlo Asaro on November 3rd 2022.
11. Attended Vaughn's 4th Annual STEM Day, April 8th, 2022.
12. Attended Vaughn's spring engineering seminar on "ePowertrain Systems Validation" by Tatiana Jaiimes, Feb 16, 2023.

Douglas Jahnke

1. Co-PI, Award Number 2202107, NSF 21-598 Advanced Technological Education Grant, $285,000, June 2022 – May 2025, "Developing PLC and Robotic Automation Technician Training for Service Industries"
2. Attended ATE Connects Post-Conference Virtual Track, 2022 ATE Principal Investigators' Conference Reconnecting & Advancing the Skilled Technical Workforce, November 4, 2022
3. Attended ATE Connects Virtual Kick-Off, 2022 ATE Principal Investigators' Conference Reconnecting & Advancing the Skilled Technical Workforce, October 21, 2022
4. Member of Cohort 9 of the NSF-ATE Mentor Connect Program, NSF Advanced Technological Education (ATE) program, 2021
5. Alternate Senator, Vaughn College Faculty Senate, 2021-2022

6. Undergraduate research mentor, Vaughn College CSTEP Summer Research Program, Vaughn College, Flushing, NY, 2022
7. Recitation program instructor, Title III HIS-STEM grant, 2022
8. Attended 8th Annual Manufacturing Day Conference, Vaughn College, Flushing, NY, October 28, 2022
9. Attended 4th Annual STEM Day Presentation Session, Vaughn College, Flushing, NY, April 8, 2022
10. Attended 14th Annual Technology Day Conference, Vaughn College, Flushing, NY, May 20, 2022
11. Attended "F-18 Super Hornet Counter Measures System IDECM AN/ALQ-214," Engineering Seminar Series, Vaughn College, Flushing, NY, February 24, 2022
12. Attended "Artificial Intelligence" Industry Connection Seminar Series, Vaughn College, Flushing, NY, October 20, 2022
13. Attended "Cyber Security" Industry Connection Seminar Series, Vaughn College, Flushing, NY, September 22, 2022
14. Attended Assessment Day, Vaughn College, Flushing, NY, December 3, 2021
15. Attended Vaughn College Spring Open House, Vaughn College, Flushing, NY, April 9, 2022
16. Attended Vaughn College 2022 Commencement Ceremony, Vaughn College, Flushing, NY, May 21, 2022
17. Undergraduate research mentor, Vaughn College CSTEP Summer Research Program, Vaughn College, Flushing, NY, 2021
18. Recitation program instructor, Title III HIS-STEM grant, 2021
19. Developed materials for the Vaughn College CSTEP Tutoring Program, Vaughn College, Flushing, NY, 2021
20. Attended "An Overview of Summer Internship Programs with NASA and InstaHub," Engineering Seminar Series, Vaughn College, Flushing, NY, December 7, 2021
21. Attended Office of Grants Faculty/Staff Open House, Vaughn College, Flushing, NY, October 22, 2021
22. Participated in Vaughn College Annual Assessment Day, Vaughn College, Flushing, NY, December 3, 2021

<u>Mohammed Benalla</u>

1. New Position as Project Director of Title III HSI-STEM, February 10th 2023.
   - Close follow up and training with Dr. Rahemi during the Spring 2023.
   - Every other Tuesdays Title III Meetings with Ms. Bulone and Mr. Williams.
   - Monthly meeting with the MSP Program Lead - Program Specialist, Dr. Dabney
2. STEM Community Outreach: Workshops on Electrical breadboard Circuit design for middle school students
   - Uniondale middle school; Tuesday, November 29th 2023.
   - Wyandanch middle school; Friday, February 10th 2023.
3. Attended the fall open house for the academic year 2021 – 2022, December 11th 2022
4. Developed new course "Data Acquisition and Applied Control System Design - ELE450 & ELE45L"
5. EE Program Coordinator:

- Supervised Fall and Spring semester scheduling
- Completed course evaluations for transferred students.
- Completed EE curriculum modifications still in progress
- Conducted the EE program continuous improvement process along with program evaluation.
- Advised EE students professionally and academically.
- Developed EE ABET assessment, Spring 2023, in progress.

6. CSTEP Instructor for different electric course workshops and summer research mentor, project title “Smart House”.
7. Attended 8^{th} Annual Manufacturing Day Conference, Vaughn College, Flushing, NY, October 28^{th}, 2022.
8. Faculty Workshop: Identifying and Supporting Students in Distress, Friday, August 26, 2022
9. New Student Orientation - Synchronous Faculty Panel, Engineering Technology Department,
    - Friday, January 7, 2022
    - Monday, August 22, 2022
10. Reviewer and Chair of Biomechanics session, 37th Southern Biomedical Engineering Conference 2022, New Orleans LA, December 2-5, 2021
11. Oral presentation and conference journal publication *2021*: “*Electromechanical Device for Inceptive Braille Learning”, Alina Santander, Tatiana Jaimes, August Rodriguez and Mohammed Benalla, 37^{th} Southern Biomedical Engineering Conference, New Orleans, LA, December 2 - 5, 2021*.
12. Oral presentation and conference journal publication *2021*: “Non-invasive Glucose Monitoring System with Server Link”, *Mariah Villalon, Isa Al-Maktoum, and Rebeca Snyder and Mohammed Benalla, 37^{th} Southern Biomedical Engineering Conference, New Orleans, LA, December 2 - 5, 2021*.
13. Oral presentation and conference journal publication *2021: “Assistive Partial Limb Exoskeleton (APLE)”, Aaron Arana and Mohammed Benalla, 37th Southern Biomedical Engineering Conference, New Orleans, LA, December 2 - 5, 2021*.
14. Journal publication: “*Electromechanical Device for Inceptive Braille Learning”, Alina Santander, Tatiana Jaimes and Mohammed Benalla, Biomedical sciences Journal, January 2021, Volume 57(4)*
15. Attended the 4th Annual STEM Day Workshop with the presentation (1) Virtual Reality (2) Makerspace and CNC Lab Video tours; (3) 3D Printing and Additive Manufacturing Workshop; (4) 3D Scanning; (5) CAM and CNC, STEM Workshops, by Robotics Club, SWE and UAV club, April 8, 2022.
16. Attended 14^{th} Annual Technology Day Conference, Vaughn College, Flushing, NY, May 20, 2022

<u>Miguel A. Bustamante</u>

1. Wednesday, January 26, attended a technical assistance workshop on Title III & Title V Annual Performance Report. This workshop provided a guided tour of all five sections of the APR, including: the Executive Summary; GPRA Indicators; Grant Activities, Objectives and Performance Measures; Budget; LAAs; and Institutionalization.
2. March 25, 2022, attended a webinar on embedded systems development using the C programming language. This webinar explored the key features of C++ and showed where

they provide useful advantages over traditional C approaches while producing code with comparable size and performance. We did look at how to start using these features (with practical examples using the Renesas Synergy™ Platform), as well as look at some common pitfalls and misunderstandings that embedded developers may encounter.

3. Transitioning to C++. Content Summary: Encapsulation by classes and namespaces; Automatic initialization with class constructors; Function overloading; Improved reuse with class inheritance and virtual functions; Safe flexibility with class templates; Stronger checking by compiler; Standard library of containers and algorithms; and Integration with existing C code.
4. April 4, 2022, attended a webinar on IEEE Education Society Webinar - Publishing in Engineering Education Journals. The aim of the session was to give participants insight into the requirements of publishing educational research work in engineering education journals with a specific focus on the IEEE Transactions on Education. It covered the areas of work and types of papers typically considered in scope for the journal and gave guidance on what is typically expected of papers by reviewers. The audience was Engineering Academics and Education researchers looking to develop their current educational research or educational conference papers into journal articles.
5. On May 4, 2022, attended a webinar on Seal of Excelencia given by the U.S Department of Education. The U.S. Department of Education's Hispanic-Serving Institutions (HSI) Division presents the Seal of Excelencia Forum in Education. In this forum, we had the opportunity to hear from Excelencia in Education about the Seal of Excelencia, what it means for our institution and the students we serve, and how we can earn the Seal of Excelencia certification. This was followed by an exciting panel discussion and Q&A session with institutions who have received the Seal certification
6. On June 7, 2022, attended AWS Summit in New York City. The AWS Summit New York was a free one-day event that brough the cloud computing community together to connect, collaborate, and learn about AWS. At the AWS Summit New York, I did learn how to choose the right database, modernize the data warehouse, and drive digital transformation using AI. I discovered how AWS can help innovate quickly and deliver flexible, reliable solutions at scale. I heard from organizations about how and why they migrated to the AWS Cloud. I learned and practiced with experts and peers.
7. On June 12-14 attended ECC 2022 14th Annual Enterprise Computing Community National Conference hosted by Marist College. One of the conference themes was: Cybersecurity: strategies, technologies, training, and solutions that companies utilize in dealing with security threats. We presented a paper on cybersecurity: “Testing of Cybersecurity Technologies with Parrot OS”.
8. July 20-22, 2022, 20th LACCEI International Multi-Conference for Engineering, Education and Technology “Education, Research and Leadership in Post-pandemic Engineering: Resilient, Inclusive and Sustainable Actions” While in the conference I did attend: Workshop Online labs Integrating a local lab station to the Online Laboratory Management System SARL. This Workshop was created to provide basic knowledge about Online laboratories used in the context of education, serving as a tool to motivate and facilitate the process of implementation and integrating a laboratory station to a OLMS, providing basic knowledge about Online laboratories to teachers of higher education. Physical laboratories are commonly part of government agencies, companies, educational institutions, and science museums. There exist two types of physical laboratories: onsite traditional stationary laboratories, sometimes called real laboratories, constructed in a fixed physical

place; and mobile laboratories, which can be hosted on vehicles, such as boats, airplanes, cars, satellites (for climate monitoring, surface sensing for example). Science museums and educational institutions sometimes place experiments and computers in vehicles to create mobile labs that can be shared by traveling to the student site to provide hand-on experience. These also are called mobile labs nut are accessed directly by the student on-site.

9. March 29, 2021, Attended "Online Delivery of a Control Theory Course During the Pandemic". A major challenge in the online delivery of engineering courses was the implementation of the lab component. With most campuses being closed due to COVID-19, many of the engineering courses' labs were either cancelled or converted to simple simulations. This webinar detailed how the labs for a third-year control theory course were converted to suit online delivery. Most of the labs utilized MATLAB/Simulink and the Quanser Virtual QUBE-Servo 2 digital twin. By using a 3D gaming engine to animate a virtual motor, engaging and immersive control experiments were performed by students from home. Theory Course During the Pandemic. The guest presenter, Dr. Mostafa Soliman, professor at McMaster University, discussed this topic in detail.
10. 11. On March 31, 2021, I attended a webinar hosted by Red Hat Academy for all RHA faculty and instructors to learn about the importance of certifications from consultants and a former hiring manger. The topic of discussion was "Hear why Red Hat Certifications are important from a former hiring manager and current Red Hat Consultants" We learned the importance of certification for students in the cybersecurity and computer engineering field.
11. 12. April 7, 2021, MATLAB seminar: "Systems Engineering and Controls with Simulink and Simscape". Simulink has been used for over 30 years to help design the world's most complex engineering systems. We learned on how to build a model from scratch and simulate it to find design flaws in minutes, and then use that same model for both component- and system-level tests. They demonstrated how Simulink and Simscape can improve your modeling and simulation workflow. Also, how can we incorporate SIMULINK in engineering classes.

Oluwaseyi Ajayi

1. On Wednesday, Feb 16 and 23, 2022, attended a virtual hands-on training workshop on **P4 programming switches** organized by the University of South Carolina, Energy Sciences Network (ESnet), The Engagement and Performance Operations Center (EPOC), and Great Plains Network sponsored by National Science Foundations (NSF). This program focuses on implementing a programmable switch and its advantage
2. On Friday, March 25, 2022, attended a webinar migrating embedded C to C++. This webinar explores the key features of C++ and shows where it provides valuable advantages over traditional C approaches while producing code with comparable size and performance. It also highlights some common pitfalls and misunderstandings that may be encountered when transitioning to C++. Renesas Synergy organized this webinar
3. May 16- 27, 2022, attended a hands-on workshop on Cybersecurity Skills Academy Virtual Train-The-Trainer. This 2-week Cybersecurity workshop provided a guide to better understanding Cybersecurity through a blended approach combining lectures, labs, and enterprise design thinking. It was intended to assist faculty instructors in preparing to teach an IBM Skills Academy course to train students who seek to gain better positioning in the

job marketplace through the acquisition of skills in the field of Cybersecurity. IBM organized this workshop through the IBM Global University program.

4. August 8 - August 25, 2022, Dr. Oluwaseyi Ajayi and Dr. Miguel Bustamante developed, organized, and taught the Summer Boot Camp for High school and college students. This summer boot camp features a 1-week lecture and hands-on class on Blockchain basics, a 1-week lecture and hands-on class on Artificial Intelligence basics, and one week lecture and hands-on class on Cybersecurity basics.
5. June 1st - 4th, 2022, attended the ***2022 IEEE International IoT, Electronics and Mechatronics Conference (IEMTRONICS 2022),*** *Toronto, Canada, where I presented a paper titled* "Enhancing SARS-CoV-2 variants Research with Blockchain Architecture,"
6. November 15-16, 2022, attended the **CYBERTECH NYC 2022** Conference, which is slated to hold at Javits center in New York. This conference focuses on innovation and the future of cyber. It is the most significant cyber security meeting in New York, which brings together prominent cyber leaders from the New York City cyber ecosystem and around the globe. The conference features exhibitions from giant and startup companies in Cybersecurity.
7. Co-authored a conference paper titled: "Performance Evaluation of Secured Blockchain-Based Patient Health Records Sharing Framework." presented at ***the 2022 IEEE International IoT, Electronics and Mechatronics Conference (IEMTRONICS 2022), June 1-4, 2022,*** *Toronto, Canada,*
8. Develop course syllabi for Bachelor of Science, Computer Science Program, and its associated cybersecurity courses January 2022
9. Testing the Computer Engineering courses and modifying as them as appropriate. January 2022
10. Served as committee member that oversees the cybersecurity lab setup and running. November 2021.
11. Attended 8th Annual Manufacturing Day Conference, Vaughn College, Flushing, NY, October 28th, 2022.

Manuel Jesus

1. As STEM Activity Liaison, Prof. Jesus assisted engineering department to organize and host the following Industry Connection seminar and Engineering Seminar series during academic year 2022-2023.

22. Electronics Breadboard Hands-on Learning, Mr. Carlo Asaro, Aircraft Avionics Systems Engineer with Sikorsky, a Lockheed Martin Company, February 17, 2022.
23. Cybersecurity, Dr. Gale Pomper, US Department of Defense (DoD), Computer Sconce Skill Community Director, September 22, 2022.
24. Artificial Intelligence, Dr. Donovan Wright, a senior digital transformation, cyber, and cybersecurity consultant with DOD, October 20, 2022.
25. Linear Power Supply, Mr. Carlo Asaro, Aircraft Avionics Systems Engineer with Sikorsky, a Lockheed Martin Company, November 3, 2022.
26. Cryptography, Dr. Dustin Fraser, Cybersecurity and risk management , Matrix Applications LLC, November 10, 2022
27. Data Analytics, Dr. Gale Pomper, US Department of Defense (DoD), Computer Sconce Skill Community Director, December 8, 2022
28. ePoertrain Systems Validation - A summer internship program with Daimler Truck North

America, Tatiana Jaimes, graduate of December 2022 Mechatronic Engineering, February 16, 2023.

29. Sensor Processing, Fabrication, & Testing for Characterization and Development Applications – A summer internship program with NASA Jet Propulsion Laboratory, Yusuf Rafi a senior Mechatronic engineering student, March 9, 2023. Advised students on degree project tasks related to additive manufacturing, 3D Scanning, and CAD related tasks. (Ongoing)
2. Participated and co-hosted Vaughn's 14th Annual Technology Day Conference, a one-day event and presentation of department annual activities, presentation of technical clubs, annual activities, accomplishments, and presentation of students' capstone degree projects as well as networking with industrial leaders. May 27th, 2022.
3. Participated in, developed, and presented engineering department programs offerings and contents during the Spring 2022 and Fall 2022 Open House Sessions.
4. Co-hosted Manufacturing Day Leadership Session Conference. Presentations were given by industry experts and successful alumni for the purpose of sharing inspirational success stories, technical expertise and mastery in their field, student engagement, and networking. The conference centered around about manufacturing innovation in the area of Autonomous Mobile Robot in Logistics, Additive Manufacturing in Aerospace, Data Science, Data Analytics, and Its Importance to Business, Base 11 Program, Digital Transformation and What It Means to Organizations, Introduction to Digital Twins, and Selecting Scanning & Reverse Engineering Hardware, October 28, 2022.
5. Participated in Long Island Manufacturing Day and presented information regarding Vaughn's club activities, conference participation, and hands-on CNC and AM lab work to inspire our students. Such engagement builds a foundation for our students who are often offered job on the spot and ready to work in industry after they graduate, October 7, 2022.
6. CSTEP Program
    - ✓ Conducted a CSTEP CATIA V5 Workshop to prepare students for certification exams. Summer 2022
    - ✓ Worked with students to explore and learn about Virtual Reality (VR), Drone Mapping, CNC and subtractive manufacturing, Summer 2022
7. Contributed activity reports related to ongoing student engagement events for use in the Vaughn College Journal of Engineering Technology. (Ongoing)
8. Contributed further time and effort into development of CNC, Additive Manufacturing, and Computer Graphics for VR in STEM lab spaces and course offerings. (Ongoing)
9. Contributed further time and effort into development of CNC, Additive Manufacturing, and Computer Graphics for VR in STEM lab spaces and course offerings. (Ongoing)
10. From June 27 to August 11, Prof. Jesus assisted engineering department to host Summer Engineering Experience (SEE-STEM) bridge program to high school seniors, community college transfer, and Vaughn's freshman students. This is a six-week residential program. The purpose of the summer program is student development through building leadership skills while preparing incoming students for college life both academically and socially. Students took courses in Writing composition, and a STEM workshop session pertaining to intro to cybersecurity, and intro to AI. In addition, students took the First Year Initiative course, which gave them the resources needed to successfully complete their education at Vaughn College. Students were exposed to various careers via hands-on activities. All participants presented an exhibition based on their learning experience in workshop

sessions to Vaughn College professors, administrators and industry professionals, who gave them feedback on presentations.

11. On Friday, April 9, 2021, as the STEM pathway Liaison along with the department chair and additive manufacturing lab techs hosted Vaughn's **3rd annual STEM Day workshop** for community colleges and high school students. The participants of Vaughn's STEM Day virtual workshop event were students and faculty from Passaic CC, Queensborough CC, Bergen CC, Aviation High, and Humanities & Arts high school. For this virtual events, Vaughn's STEM Liaison and 3D/CNC curriculum developer, Prof. Manuel Jesus, introduced participants to Vaughn College's program offerings in engineering and engineering technology disciplines as well as student involvement in various STEM related clubs and professional activities. Prof. Jesus provided participants with a video tour of Vaughn's 3D Makerspace and CNC manufacturing centers. Finally, department hosted couple of virtual STEM workshops related to 3D Scanning, CAM and CNC, and Virtual Reality.
12. During academic year 2022, Prof. Jesus upgraded both CNC and Additive manufacturing centers with the following state-of-the-art equipment.
    - ✓ **Vericut CNC Software:** In January 2022, as part of Title III HIS-STEM project, with the recommendation of Prof Jesus, CNC/3D curriculum designer, department purchased Vericut CNC Software, Vericut software is used in high end aerospace manufacturing as a safe method to debug and troubleshoot CNC programs.
    - ✓ **Flashforge Creator 3 Pro 3D printer:** In April 2022, with coordination of 3D and additive manufacturing lab tech, department placed a purchase order for a Flashforge Creator 3 Pro 3D printer **($3,432.23)**. Addition of this 3D printer to our manufacturing center will further help both students and club members to complete and manufacture parts and components for their design projects.
    - ✓ **HASS Desktop Mill Trainer:** In Nov 2022, with the support of supplemental HSI-STEM title III grant funding and with recommendation of 3D/CNC curriculum developer, we placed and purchased a HAAS Desktop Mill Trainer. The HAAS CNC Desktop Mill is an educational version of the popular HAAS VF2 SS CNC and MCU control system. It allows instructors to teach the HAAS CNC MCU (Microcomputer / Machine Control Unit) interface to students in a lecture / lab classroom environment before moving on to the full-size industrial HASS VF2 SS milling machine (**$12,694.75**).
    - ✓ **3D Scanner for manufacturing lab:** In Nov 2022, with the support of supplemental HSI-STEM title III grant funding and with recommendation of 3D/CNC curriculum developer, we purchased a metrology grade 3D scanner. This state-of-the-art metrology grade 3D scanner will be used for precision measuring alongside our CMM station to inspect production CNC parts and 3D scan parts for reverse engineering ($**18,849**).

Khalid Mouaouya

1. Attended 14th Vaughn's Annual Technology Day Conference, a one-day event and presentation of annual activities from departments and technical clubs, accomplishments and presentations of students' capstone degree projects and networking with industrial leaders, May 20, 2022.

2. Attended Vaughn's 8th Annual Manufacturing Day Conference, a one-day event for networking with industrial leaders in engineering, aviation, and manufacturing, October 28, 2022.
3. Attended Open House during fall 2022 to assist faculty in providing information to potential future incoming students.
15. Attended Vaughn's Industry Connection and Engineering Seminar Series:
    - ✓ Trends In Sustainable Infrastructure, AI, Digital Twins, & Opportunities for the Aspiring Innovator and Engineer, by Edward Sutton, April 28, 2022
    - ✓ Electronics Breadboard Hands-on Learning by Carlo Asaro, Feb. 7, 2022
    - ✓ Electronics Breadboard Hands-on Learning, Mr. Carlo Asaro, Aircraft Avionics Systems Engineer with Sikorsky, a Lockheed Martin Company, February 17, 2022.
    - ✓ Cybersecurity by Dr. Gale Pomper, September 22, 2022.
    - ✓ Artificial Intelligence by Dr. Donovan Wright, October 20, 2022.
    - ✓ Linear Power Supply by Carlo Asaro, November 3, 2022.
    - ✓ Cryptography by Dr. Dustin Fraser, November 10, 2022
    - ✓ Data Analytics by Dr. Gale Pomper, December 8, 2022
    - ✓ ePoertrain Systems Validation - A summer internship program with Daimler Truck North America by Tatiana Jaimes, February 16, 2023.
    - ✓ Sensor Processing, Fabrication, & Testing for Characterization and Development Applications – A summer internship program with NASA Jet Propulsion Laboratory by Yusuf Rafi, March 9, 2023.
4. Attended 4rd Annual STEM Day Workshops, Vaughn College, Flushing, NY, April 8, 2022.
5. Attended "Internship Experience: F-18 super hornet counter measures system IDECM AN/ALQ-214" Engineering Seminar Series, Vaughn College, Flushing, NY, February 24, 2022

Jonathan Sypeck

1. Advised and mentored several Associates Degree students in their final Degree Project, relating to the fields of Conceptual Aircraft Design and Flow Simulation using SolidWorks.
2. Attended 13th Technology Day Virtual Conference, Vaughn College, a one-day event and presentation of annual activities from departments and technical clubs, accomplishments and presentations of students' capstone degree projects and networking with industrial leaders, May 28, 2021.
3. Helped conduct Virtual Open Houses for undergraduate students at Vaughn College during spring and fall 2021 and presented engineering and engineering technology program offerings.
4. Attended IEEE "Effective Remote Instruction: Reimagining the Engineering Student Experience" Webinars over the course of five days in Summer 2020 to gain extensive knowledge on how to pivot traditional Engineering lecture and lab teaching techniques to meet the virtual-environment requirements of today's COVID-19 world.
5. Attended ASEE "Thinking Outside the Box: Alternative Assessment Methods" Webinar in Fall 2020 to gain valuable information regarding how to assess students through virtual learning.
6. Attended ASEE "How Boise State University Provides Engineering Students with Remote Access to Applications & Desktops" Webinar in Fall 2020 to gain important information regarding how to migrate traditional Engineering software from on-campus offerings to

virtual desktops and web-apps.

7. On Thursday October 7, 2021, attended the **3rd Annual Curriculum and Career Advisement day** with students in engineering and engineering technology programs. This virtual meeting discussion covered activities in which students should participate in order to enhance their career opportunities while studying at Vaughn. In this virtual gathering, we discussed several career strategies for obtaining a successful career in STEM fields.
8. Attended Vaughn's 7th Annual Manufacturing Day Virtual Conference, a one-day event for networking with industrial leaders in engineering, aviation, and manufacturing, October 29, 2021.
9. Participated in all Vaughn's spring and fall 2021-2022 Industry Connection Seminar Series, and Engineering Seminar Series.

Hagos Kifle

1. Attended Vaughn's 8th Annual Manufacturing Day Virtual Conference, a one-day event for networking with industrial leaders in engineering, aviation, and manufacturing, October 28, 2022.
2. Attended Open House during fall 2022 and spring 2023 to assist faculty in providing information to potential future incoming students.
3. Attended the following Vaughn's Industry Connection and Engineering Seminar Series:
   - ✓ Cybersecurity by Dr. Gale Pomper, September 22, 2022.
   - ✓ Linear Power Supply by Carlo Asaro, November 3, 2022.
   - ✓ ePoertrain Systems Validation - A summer internship program with Daimler Truck North America by Tatiana Jaimes, February 16, 2023.
   - ✓ Sensor Processing, Fabrication, & Testing for Characterization and Development Applications – A summer internship program with NASA Jet Propulsion Laboratory by Yusuf Rafi, March 9, 2023.
   - ✓ Automated Systems in Material Handling – A summer internship program with Honeywell Intelligrated, Alina Santander a senior Mechatronic engineering student, March 23, 2023.
   - ✓ Sustainability - A summer internship program with PSEG ISS at Montclair State University, Isa Al-Maktoum, a senior Mechatronic engineering student , April 6, 2023.
4. As a member of new applied math and data science curriculum committee, developed, reviewed, and updated course syllabuses for applied math and data science courses of BS Computer Science program.
5. Attended a meeting with the external evaluator about the Title III HSI-STEM grant activities pertaining in development process of a BS degree program in Computer Science, September 29, 2022.

Randolph Archbald

1. Attended Open House during spring 2023 to assist engineering department in providing information to potential future incoming students.
2. Attended the following Vaughn Engineering Seminar Series:
   - ✓ ePoertrain Systems Validation - A summer internship program with Daimler Truck North America by Tatiana Jaimes, February 16, 2023.

- ✓ Sensor Processing, Fabrication, & Testing for Characterization and Development Applications – A summer internship program with NASA Jet Propulsion Laboratory by Yusuf Rafi, March 9, 2023.
- ✓ Automated Systems in Material Handling – A summer internship program with Honeywell Intelligrated, Alina Santander a senior Mechatronic engineering student, March 23, 2023.
- ✓ Sustainability - A summer internship program with PSEG ISS at Montclair State University, Isa Al-Maktoum, a senior Mechatronic engineering student, April 6, 2023.

3. As a new faculty member of EET and Avionics program, attended online workshops related to radar system, navigation system, and flight control systems.
4. Planning to attend more in-person workshops pertaining to microcontroller and avionics during summer 2023.

Alaric Hyland – Mechatronics and 3D Printing Lab Specialist

1. Advised several Mechatronic Engineering degree project teams in the design and manufacture of their additively manufactured/CNC Laser Cut projects (currently ongoing)
2. Served as a liaison with multiple Vaughn student body clubs (such as UAV, Robotics, and SWE) for additive manufacturing/CNC Laser Cut goals (currently ongoing).
3. Enrolled in one four-credit course at Pennsylvania State University with the intent to acquire a Masters in Additive Manufacturing degree (three courses remain after December 2022)
4. Markforged Metal X 3D printing suite is now online and accepting requests from students for clubs and degree projects.
5. Assisted in conducting Vaughn's Fall 2022 Open House for incoming undergraduate students, demonstrating lab equipment and course offerings.
6. Completed implementation complete of new Mechatronics Lab utilizing two Siemens PLCs in network communication, similar to in-industry scenarios. Further advancements are planned to network all devices together, allowing complete access to any device from anywhere in the room..
7. Attended Vaughn's 8th Annual Manufacturing Day Virtual Conference, a one-day event for networking with industrial leaders in engineering, aviation, and manufacturing, October 28, 2022.
8. Implemented BotFactory SV2 PCB Printer to W152 to supplement the Electrical Engineering curriculum's PCB design aspects.
9. On standby for Computer Science curriculum's finalization, will be performing lab technician/equipment purchasing duties once complete.
10. Purchased hardware for the new Robotics-Kinematics course, implementation awaiting hardware delivery.
11. Attended 14th Vaughn's Annual Technology Day Conference, a one-day event and presentation of annual activities from departments and technical clubs, accomplishments and presentations of students' capstone degree projects and networking with industrial leaders, May 20, 2022.

Graduate Success Stories

In order to prepare students for the growing demands of today's technology and to aid them in their future careers, the Engineering and Technology Department at Vaughn College adopted a set of in-class and out-of-class academic activities reflective of ongoing technological change. These activities are designed to instill in students an awareness of the importance of lifelong learning in meeting the challenges in their future professions.

Whatever path our engineering and engineering technology students choose, their Vaughn education provides them with an edge for success.

Jason Becker Class of 2020
Mechatronics Engineer
Brookhaven Nation Laboratory, Upton NY
Bachelor's Degree in Mechatronics Engineering, 2020

As a kid I always had a great interest in Engineering and Automation. When I reached middle school, a mentor invited me to join the high school robotics program. From this point on I was hooked on automation and robotics. During senior year of high school, we had a college fair. I was just about ready to leave when Tom Gleeson at the Vaughn College table noticed my shirt that said, "Sag Harbor". That little interaction seemed quite trivial, but the rest is history.

When I started at Vaughn in 2016, I was set on joining the Robotics Club, and finding a job in the field of automation by the time I left. I cannot mention my time at Vaughn without mentioning the huge impact both Dr. Rahemi and Dr. He had on my college experience. Between Dr. Rahemi's motivation and support to Dr. He's vast knowledge of the field of automation, I was in good hands from the very start. I found great inspiration and success in the Robotics Club, ultimately becoming president in the 2019-2020 college year. In between my years at Vaughn, I found internships at EJ Electric as an Electrical Engineering Intern, Check-Mate as a Mechanical Engineering Intern, and finally at Brookhaven National Laboratory as an Engineering Intern. These internships helped me decide my career goals, as I now had experience in construction, production, and research and development industries.

After completing my studies at Vaughn and missing out on many opportunities to COVID-19 like many others, I was hired as a Robotics Engineer for RevolutioNICE. At RevolutioNice I design, build, and program automation systems for construction, healthcare, and fitness. I currently work at RevolutioNICE as the Lead Robotics Engineer and CTO.

In February of 2021, I accepted the role of Mechatronics Engineer at Brookhaven National Laboratory. At BNL I design and program automation devices used in the creation of magnets for insertion regions of colliders and similar projects. Many of the devices I develop and program at BNL are original and can only be found at BNL. I currently work at Brookhaven National Laboratory as the Mechatronics Engineer for the Superconduction Magnet Division.

My advice for future students is this: Do not underestimate the worth of experience and networking. These two pieces are incredibly important in furthering your career. Do not be afraid to get your hands dirty and learn how things work because employers want an engineer that also understands the technical side of the work.

Chamathke Perera, Class of 2019
Engineer II - Drone Engineer
Easy Aerial, Brooklyn, NY
Bachelor's Degree in Mechanical Engineering

As a child, I was always fascinated by the inner workings of my toys and would often break them by opening them up to see what was inside. Eventually, I became captivated by aircraft and was convinced that my ideal profession was to be a commercial pilot. In 2013, my family moved to the US from Sri Lanka immediately after I completed my GCSE O-Level examinations. I attended high school for two years in the US, where I had to adjust to a new life in a foreign country. By the end of my senior year in 2015, I had to decide whether to pursue higher education in aviation or follow my initial childhood interest. My college research led me to various institutions that offered engineering courses with a focus on aeronautics and aviation. Vaughn was one such institution that accepted my application and provided me with an affordable education and the assistance of two scholarships. The campus was relatively close to my home in New Jersey and offered a convenient dormitory that allowed me to fully immerse myself in campus life.

During my first year at Vaughn, I mostly kept to myself as I was still adjusting to life in the US. My days were spent in class and in the dorms, except on weekends when I would return home. However, I stumbled upon YouTube videos that featured aerial photography and became interested in recreating some of the cinematic shots that I watched online. This led me to try my hand at building a UAV, and I knew that Vaughn had an active UAV club where I could learn more about making one. I joined the club with the intention of building my own aircraft but soon became more involved in the organization. Constantly learning and improving my knowledge in mechanical hardware, electrical design, and software engineering allowed me to develop a well-rounded skill set that not only assisted me in my academics but also prepared me to tackle any challenge I would face in the workplace.

In the summer of 2018, I interned at Easy Aerial, a company I found through a connection I made in the UAV club. During the interview, my skill set impressed the interviewer, and I was offered a position in production and QC. Working at Easy Aerial felt like an extension of my club activities, and my previous experience at Vaughn allowed me to quickly adapt to the workflow, and build process. As I continued to learn and improve myself, I implemented new features and technologies that enhanced Easy Aerial's products. My internship led to a permanent position at the company, which eliminated the need for me to spend time job hunting.

Over the years, I have gained experience designing PCBs, such as GPS receivers, battery management systems, communication systems, and power electronics while also working on embedded hardware systems that require programming expertise. These systems have made their way to companies such as Norfolk Southern, the US Military, and defense contractors all over the world to provide inspection, data collection, and overwatch.

I am grateful for my experience at Vaughn and overwhelmed by the opportunities that were provided to me. My time at Vaughn prepared me for the real-world workplace in a budding field, and I am excited about the new opportunities that await me.

Nicholas Bruce Kumia, Class of 2016
DevOps Engineer, REI Systems
Bachelor's Degree in Mechatronic Engineering, 2016
Master's Degree in Computer Science, 2018 (Hofstra University)
https://kamutiv.com/kumia

The quality of life is not only determined by what you choose to do, but also how you choose to do it. As a second generation American born and raised on Long Island, NY, I've witnessed many families and friends struggle with the historical American Dream. While the Dream is arguably very different today, many of the foundational elements surrounding the pursuit of happiness, access to opportunity, and freedom to live on your own terms are very much alive today. Most of the formulative years of my life were defined by the experiences of my elders trying to protect me from the harsher realities of the world. Upon graduating high school at the age of 16, Vaughn became my first step into the unknown. It was pure chance that Vaughn appeared in my life, and the main intrigue that drew me was the flexibility of potential careers in Mechatronic Engineering.

My life at Vaughn felt like an eternity starting out. Irrespective of the degree work, there was so much to learn about social interactions, finances, self-care, personal identity, and how the world works. All of these questions culminated into what I should do after graduation. I kept myself busy, participating in as many opportunities as I could (i.e., research internships, the famed VCAT Robotics club, writing research papers with professors and attending conferences, tutoring and becoming a student instructor, helping to form the UAV Club and much more). As it was coming to an end, I wondered where all the time had gone and I still felt dubious in choosing a career. I dodged this decision by pursuing more education in the form of a Master's Degree.

After two years completing my Computer Science degree, I started working as a fulltime civilian Computer Scientist at NAVAIR, primarily in the Robotics and Intelligent Systems Engineering (RISE) Lab. There were a lot of interesting projects and many opportunities to collaborate on exciting challenges (e.g., deep learning for object detection, tracking and localization, verification and validation of software, command, control and communication [C3] of robots, cybersecurity of various systems and natural language processing [NLP] to extract information from large corpora like maintenance logs). Since then, I've held positions as a Cybersecurity Engineer and now as a DevOps Engineer with my total work experience coming on 5 years now. Without my background in Mechatronics, I would not feel confident enough to work at every level of the technological pipeline, from hardware to software to integration and deployment. Being able to apply myself so broadly brings a sense of satisfaction.

With all of my experience and my recent acceptance into a Computer Science Doctoral Program, I am not much closer to figuring out what to do or where to go. However, I am certain my time at Vaughn gave me tools without which I could not ask the questions that I'm asking nor have the foundation in the different realms of engineering and technology. At Vaughn, you learn, through engineering, that solving a problem is an optimization of cost and safety, strength and reliability, accessibility and security, elasticity and rigidity. Dr. Rahemi, Dr. LaVergne, Dr. Elzawawy, and especially Dr. He were integral to my success at Vaughn, since they always looked for opportunities to help us grow and evolve.

Everyone has their own path to lead. I don't have a one-advice-fits-all piece of wisdom for guiding a person's life. It's important to learn through your own experience as well as the experience of others. My story is meant to help with the latter and highlight that sometimes you might not have a clear direction, but you can still make the most of it by being present and embracing each moment as it comes. Life is so much more than the career you choose after you graduate.

Ariel A. Ferrera P.E., P.S.E.
Mechanical Design Engineer
Blue Origin, Kent WA
Bachelor's Degree in Mechanical Engineering, 2020

I remember vividly the day I embarked on my journey to pursue my greatest passion, engineering, by taking the New York City subway. Pursuing Mechanical Engineering in my undergraduate education was driven by my profound interest in physics, mathematics, and science, with the ultimate goal of contributing back to society. Growing up on a small farm in Cuba, I was fortunate enough to come to the United States. However, the high school I attended offered limited STEM education, and I was unaware of the extensive skills and knowledge required for engineering at that time.

At the start of my Mechanical Engineering Program, my daily commute consisted of purchasing numerous NJ transit tickets and standing in line on chilly winter mornings for the M60 bus. Along with juggling multiple part-time jobs, I endured a grueling commute that added up to almost four hours each day. Upon setting foot on campus, the possibility of pursuing a career in engineering became evident, as I was fortunate enough to come across Dr. Rahemi, Dr. Elzawawy, Dr. Addabbo, Dr. Budhoo, Dr. Lavergne, and many other professors who consistently provided support for both me and my classmates. The faculty at Vaughn went in-depth on every subject and provided me with critical life lessons that have made me prosperous along the way. During my undergraduate studies, I was able to intern in the medical device industry designing implants and orthopaedic tooling at Stryker. Vaughn's engineering seminars sanctioned me to become a co-op research assistant at NASA's Marshall Space Flight Center, analyzing desultory random vibration loading for space hardware utilization.

After completing my undergraduate program here, I transitioned to multiple different industries. I started my career in designing flight-qualified propulsion controls utilized in stage separation, fin control actuation, and pressurization systems. I later went on to analyze critical heat transfer cooling methods for gas turbine single and second-stage turbine blades. After focusing on FEA and Machine Design, I received my P.E in Machine Design & Materials and my Professional Simulation Engineering Certificate for Core FEA. These certifications have helped me grow my career in the aerospace/engineering consulting industry where I plan to eventually start my own engineering firm and give back to the STEM community with the same passion it gave to me.

My advice to students is to stay consistent, set your goals, and never be afraid to ask *why*. Your motivation determines how much you are inclined to do, but your discipline determines how well you achieve your goals. The road may seem endless, but the light is always at the end of the tunnel. I encourage students/future engineers to enjoy the journey of a student and to push for dreams high above your current reach; you will surprise yourself with how much you can accomplish with consistency and the knowledge learned in this industry. Engineering is not about perfect solutions, instead, it's about doing the best you can with limited resources.

Orientation - Curriculum Advisement with Engineering Students

Friday, January 13, 2023
11 am – 12 pm
Virtual Zoom Meeting

The engineering and technology department as part of the department's orientation had a zoom meeting with new and transfer students to welcome them as well as to provide them with some insight and advisement about their programs. In this virtual event, Dr. Rahemi, along with the STEM Liaison and the program coordinators in the engineering and technology department met with students and covered topics related to curriculum as well as to activities in which students should participate in order to enhance their engineering education while studying at Vaughn.

Department chair, STEM pathway Liaison, program coordinators, and faculty discussed, in detail, the following curriculum related issues with students.

1. Know your curriculum – Review the curriculum sheet, learn about the curriculum offerings and contents (Math and Science, technical, and general education), technical electives, and prerequisite and corequisite requirements.
2. Curriculum Advisement – Meet your curriculum advisor at the Student Advisement Center (SAC) and get curriculum and registration advisement.
3. Avoid taking courses out of sequence – Many core courses require prerequisites, taking courses out of curriculum sequence may result in missing prerequisites and consequently may delay graduation.
4. Get advised by a program faculty – Meet program faculty during their office hours and get course and curriculum advisement.
5. Attend Engineering and Industry Connection Seminar Series – These seminars will help all students to learn about current technological advancement and engineering innovation, as well as provide an opportunity for students to interact with industry leaders. The main objective of this seminar series is to provide our students with a greater appreciation for engineering education.
6. Attend Annual Vaughn College Technology Day Conference – This annual conference helps all students interact with Vaughn's industry advisory members as well as learn about graduating student capstone projects presented in the afternoon session. Attending and presenting in this annual conference helps students to enhance their career opportunities.
7. Keep Grades Up – Having a GPA of 3 or better increases a student's chances of obtaining an interview for an internship and of employment with many engineering industries.
8. Build hands-on teamwork and communication skills – These career building skills can be attained through hands-on laboratory projects, capstone courses, and involvement in technical clubs (Robotics, UAV, SAE, et) and student chapters of professional societies (SWE, SHPE, EWB, NSBE, LACCEI).
9. Build Analytical and Computer Skills –Analytical and computer coding knowledge and capabilities are two important skills for pursuing a successful career in STEM Fields.

10. Participate in Extra-Curricular Activities – To further enhance career opportunities and cultivate creative ideas, one should consider involvement in extra-curricular activities such as technical clubs, competitions, and STEM workshops.
11. Participate in an Internship Program – Internship programs not only introduce one to the industry environment but also expose one to real-world engineering projects and career-building skills. The department supports and encourages all students to attend career fair conferences. In the past couple of years, those students who attended in SWE, SHPE, and NSBE Career Fair conferences, received both internship and full-time position offerings.
12. Participate in Student Chapters of Professional Societies - Involvement in student chapters of professional societies introduces one to innovations in the STEM fields and provides professional networking opportunities with engineering industries.
13. Participate in Technical Club Activities – Involvement in technical clubs such as Robotics, UAV, SAE, increase creativity and provide an opportunity to apply classroom knowledge to the actual building of an engineering system. The creative mindset acquired through these experiences provides a lifelong edge in one's professional career.
14. Participate in STEM outreach activities - Organizing and hosting STEM workshops during Vaughn's Annual Manufacturing Day, Annual International Drone Day, SWE Annual Conference, and Vaughn's Regional High School and College Robotics competitions further enhance leadership and career opportunities in STEM fields.
15. Participate in Scholarly Activities - Publications and presentations at technical conferences such as ASEE, SEM, LACCEI, ASME, SWE, AHS, COMSOL, IEEE, and VCJET integrate career-building skills and contribute to success in professional careers and in continued education.
16. Connect with Vaughn's Career Service Department – We encourage everyone to be in touch with Vaughn's Career Service and to participate in their workshops and events related to resume writing, internships, career fairs, and graduate school fairs.

Vaughn's Annual Assessment Day, December 2, 2022
Title: Engineering and Engineering Technology Programs Assessment

Dr, Amir Elzawawy, program coordinator of Mechanical Engineering program, provided an insight about the engineering and engineering technology department program assessment to the Vaughn community on Friday, December 2nd, 2022. In academic year 2021-2022, the Engineering and Technology Department conducted annual assessment for all programs within the department. The department's roadmap for a successful assessment and continuous improvement involved 1) developing and distributing assessment documentations, 2) collecting and analyzing assessment data, 3) identifying shortcomings in student outcomes, and 4) introducing and implementing action plans for improvement.

His presentation addressed the following items required to achieve EAC and ETAC of ABET accreditations for all programs within Engineering and Engineering Technology department. .

- **Student Outcomes Assessment:** Our assessment process for engineering programs is conducted based on "1 through 7" EAC ABET student outcomes and for the engineering technology programs is based on "1 through 5" ETAC ABET student outcomes. As a direct measure, courses within the program are used to assess these student outcomes. Also, surveys such as employer, internship, and Tech Day evaluation of capstone project are used to measure attainment of these student outcomes
    - ✓ **Student Outcomes Assessment for Engineering Programs:** For engineering programs, the department uses an outcomes-based assessment process to determine its success in preparing students for entry into the profession. The student outcomes are those specified by the Engineering Accreditation Commission (EAC) of ABET, Inc. in the *Criteria for Accrediting Engineering Programs.* These outcomes are listed below:
        1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        3. an ability to communicate effectively with a range of audiences
        4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
        5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
        6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
    - ✓ **Student Outcomes Assessment for Engineering Technology Programs:** For engineering technology programs, the department uses an outcomes-based

assessment process to determine its success in preparing students for entry into the profession. The student outcomes are those specified by the Engineering Technology Accreditation Commission (ETAC) of ABET, Inc. in the *Criteria for Accrediting Engineering Technology Programs.* These outcomes are listed below:

1. An ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems
2. An ability to design systems, components, or processes meeting specified needs for broadly defined engineering problems appropriate of an engineering technology related system
3. An ability to communicate written, oral, and graphical in broadly defined technical and non-technical environments; and an ability to identify and use appropriate technical literature
4. An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results.
5. An ability to function effectively as a member as well as a leader on technical teams

The curriculum supports the attainment of the program outcomes through courses offered within those programs (map of curriculum to student outcomes). Course content provides the material or develops the skill or knowledge necessary for the students to attain the program outcomes by the time of graduation. Some courses address multiple outcomes, and multiple courses address some outcomes. This is necessary to ensure curricular coverage, consistency from year to year and a form of redundancy.

- **General Assessment Methodology:** The Faculty Course Assessment Report, known as FCAR, is a tool that is used by the course instructor to assess the overall effectiveness of the course and is used primarily as a vehicle to improve the course. Recently, courses that assess specific student outcomes based on performance indicators using individual assignments, test problems, reports, etc., include those assessment results as part of the FCAR. A program wide scoring rubric is used to measure the attainment of each performance indicator using student performance and consequently the attainment of the prescribed student outcomes. The initial goal or threshold for percent of students meeting or exceeding expectations (a rubric score of 2 or better) is 70%. These results will form the basis for which evaluation of the results may motivate program improvements. The Assessment Committee will perform the evaluation of the assessment results and compile them into a report demonstrating the degree to which students are attaining the Student Outcomes. This occurs in May/June with the report disseminated in July. The results of the assessment, together with other input, such as alumni surveys, exit surveys, internship surveys, employer surveys and suggestions emanating from the Industry Advisory Committee will be used to motivate program improvements.
- **Outcomes' performance Indicators (PIs):** The program faculty determine the appropriate performance indicators and the subsequent assessment tools for each outcome. As shown the table below, each outcome was subdivided into performance indicators (PI) to provide additional fidelity into the outcome with which the faculty can subsequently target improvement, should it be warranted. These tools were finalized and approved by the faculty. **Error! Reference source not found.**1 shows the performance

indicators for each outcome. Table 2 shows the tools used to assess each outcome. With performance indicators defined, a scoring rubric was also devised for each PI by the program faculty. Course tasks and assignments are used as a direct measure to assess performance indicators of each specific outcome

Table1A: Performance Indicators for each Student Outcome for engineering programs

Student Outcome	**Performance Indicator**	
1. Ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics	PI-1A	Able to take a complex engineering problem and set up an approach to solve it
	PI-1B	Able to apply principles of engineering, science, math and solving complex engineering problems.
2. Ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	PI-2A	Understanding requirements
	PI-2B	Developing design space or conduct trade studies
	PI-2C	Applying design constraints, standards and other factors
	PI-2D	Obtaining an effective solution that satisfies the requirements
3. Ability to communicate effectively with a range of audiences	PI-3A	Possess good writing skills and organization
	PI-3B	Possess good oral presentation skills and effective data presentation format
	PI-3C	Informative and succinct content targeted to the intended audience
4. Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	PI-4A	Identifying relevant global, economic, environmental, societal issues when proposing an engineering solution
	PI-4B	Understands consequences of poor work quality or omissions
	PI-4C	Understands the potential consequences of unethical behavior
	PI-4D	Understands what to do if others exhibit unethical behavior
5. Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	PI-5A	Demonstrates ability to set goals and plan tasks
	PI-5B	Completes assigned tasks on time and with quality
	PI-5C	Open to other disciplines' issues and input and constructively participates in team meetings/discussions
	PI-5D	Supports team decision process and supports final decisions to meet objectives
6. Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to	PI-6A	Demonstrate knowledge of experimental approaches
	PI-6B	Demonstrate knowledge of data collection methods
	PI-6C	Has experience conducting experiments

draw conclusions	PI-6D	Demonstrate ability to analyze and interpret data using modern engineering tools and equipment
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	PI-7A	Demonstrate ability to acquire new knowledge and skills that are important to an engineer
	PI-7B	Can list ways to continue learning and maintaining currency in the field

Table1B: Performance Indicators for each Student Outcome for engineering Tech programs

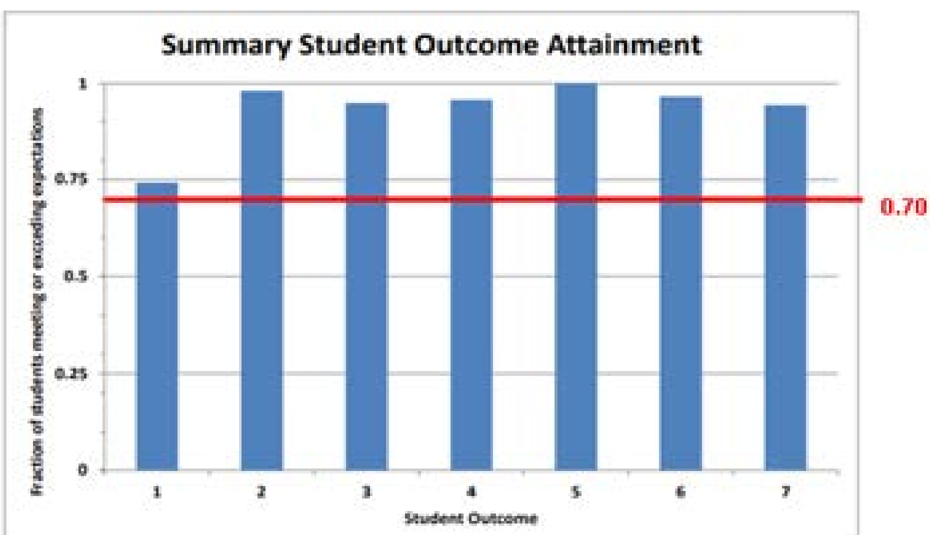
Student Outcome	**Performance Indicator**	
Ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems	PI-1A	Able to take a broadly defined engineering problem and set up an approach to solve it
	PI-1B	Able to apply principles of math, science, engineering & technology for solving broadly defined problems.
Ability to design systems, components, or processes meeting specified needs for broadly defined engineering problems appropriate of electronics & avionics engineering technology related systems	PI-2A	Understanding requirements and apply design constraints, standards and other factors
	PI-2B	Obtaining an effective solution that satisfies the requirements and needs for broadly defined engineering technology problems
Ability to communicate written, oral, and graphical in broadly defined technical and non-technical environments; and an ability to identify and use appropriate technical literature.	PI-3A	Possess good writing skills and organization
	PI-3B	Possess good oral presentation skills with effective data presentation and graphical illustrations format
	PI-3C	Understand and identify appropriate technical literature resources
Ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results	PI-4A	Demonstrate knowledge of experimental approaches and data collection methods
	PI-4B	Demonstrate ability to conduct experiment, analyze and interpret results
Ability to function effectively as a member as well as a leader on technical teams	PI-5A	Demonstrates ability to set goals, plan tasks, and complete assigned tasks on time and with quality
	PI-5B	Open to other disciplines' issues and input and **constructively** participates in team meetings/discussions
	PI-5C	Supports team decision process and supports final decisions to meet objectives

Table 2: Assessment Tools

	Student Outcome						
Assessment Tool	1	2	3	4	5	6	7
Student Work (Quiz, Exam, Project, etc)	X	X		X			X
Student Laboratory Reports			X		X	X	
Student Capstone Report and Presentations		X	X	X	X		X
Student Report			X	X	X		
Observation					X		
Simulation						X	

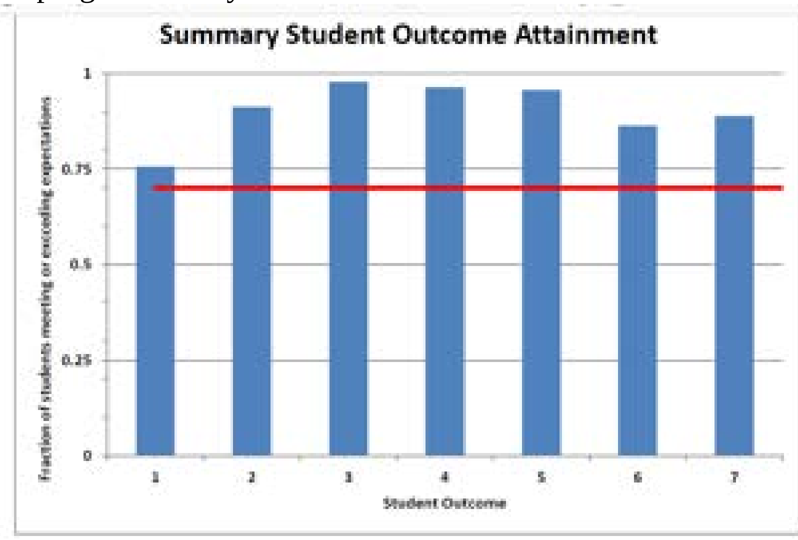
Continuous improvement: Our Continuous improvement process is based on both course and program level assessment. In course level, 3 to 4 higher level core courses are used to assess each student outcome based on assigned course tasks. In program level, questions from constituents' surveys are used to address attainment of each student outcome. The department collect course and program data, evaluate results, and develop assessment-motivated and constituent-motivated actions to address and improve any shortcoming through the program.

Summary of Student Outcome Assessment Results for ME Program: The student outcome level of attainment results were combined to show the percentage of students who met or exceeded the expectations (% scored ≥ 2) according to the scoring rubrics for each outcome. The program faculty set the goal that at least 70% of students should meet or exceed expectations for each outcome to be acceptable. Figure below shows the combined results for each outcome. Outcome (1) has the lowest percentage of students attaining the expectations of the scoring rubrics for this outcome. While Outcome (1) meets the threshold with 74%, it should be reviewed in depth as a candidate for program improvement



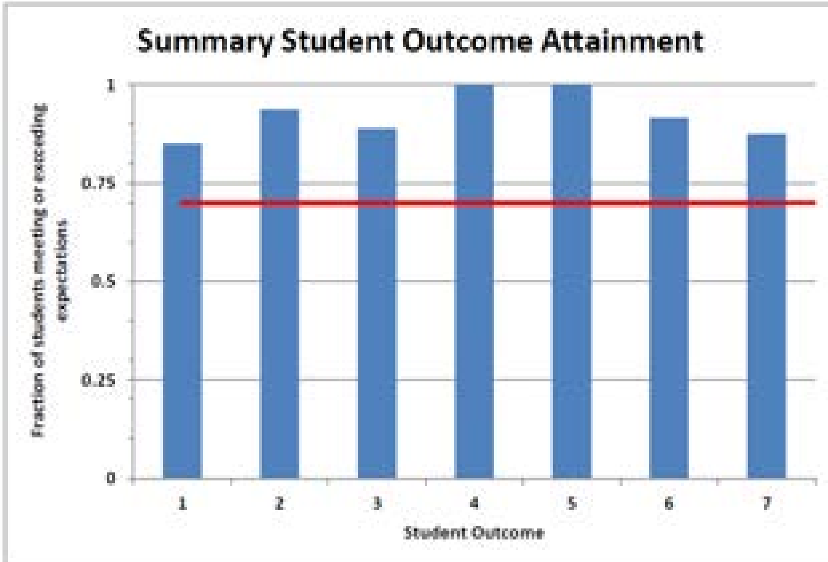
Summary of ME Outcome Attainment 2021-2022

Summary of Student Outcome Assessment Results for Mechatronic Engineering Program: The student outcome level of attainment results were combined to show the percentage of students who met or exceeded the expectations (% scored ≥ 2) according to the scoring rubrics for each outcome. The program faculty set the goal that at least 70% of students should meet or exceed expectations for each outcome to be acceptable. Figure below shows the combined results for each outcome. Outcome (1) has the lowest percentage of students attaining the expectations of the scoring rubrics for this outcome. While Outcome (1) meets the threshold, it should be reviewed in depth as a candidate for program improvement. The specific candidate areas within each outcome for improvement can be discerned by reviewing the level of attainment on the individual performance indicators. The other outcome assessment results show that the students in the program are attaining the other student outcomes in significantly greater percentages than the goal set by the program faculty.



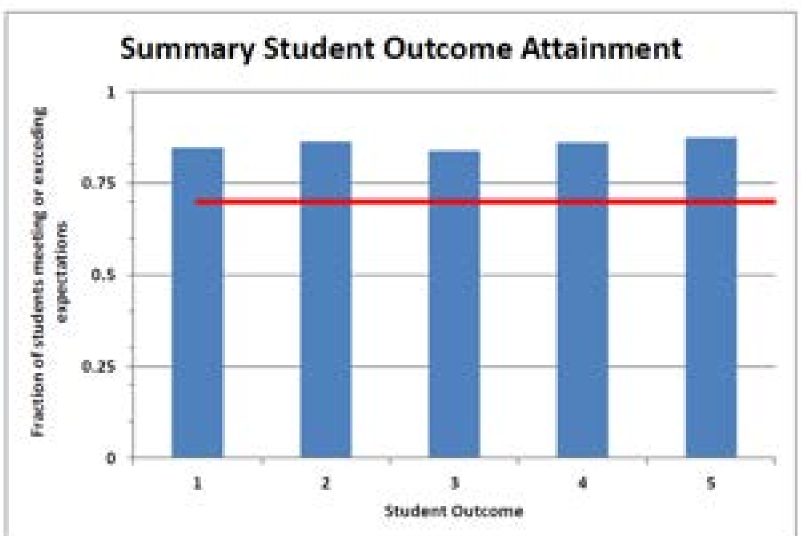
Summary of Mechatronic Outcome Attainment 2021-2022

Summary of Student Outcome Assessment Results for EE Program: The student outcome level of attainment results were combined to show the percentage of students who met or exceeded the expectations (% scored ≥ 2) according to the scoring rubrics for each outcome. The program faculty set the goal that at least 70% of students should meet or exceed expectations for each outcome to be acceptable. Figure below shows the combined results for each outcome. The specific candidate areas within each outcome for improvement can be discerned by reviewing the level of attainment on the individual performance indicators. The outcome assessment results show that the students in the program are attaining all of the student outcomes in significantly greater percentages than the goal set by the program faculty. It is recognized that because the program is relatively new, with very few students graduating, the sample size is small for each student outcome, usually 2 to 4 students. Once more students have moved through the program, the results will have more bearing on the effectiveness of the program preparing the students to attain the student outcomes.



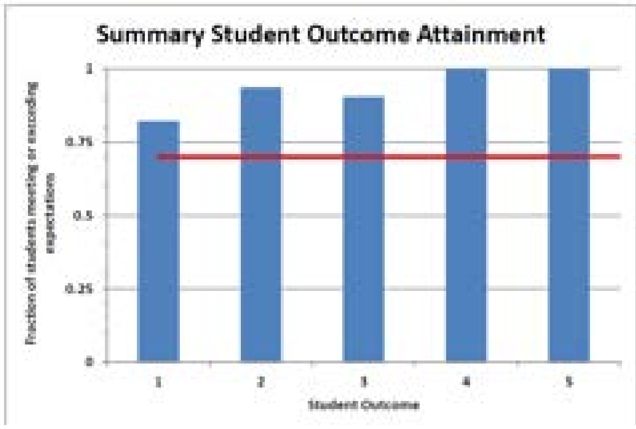
Summary of EE Outcome Attainment 2021-2022

Summary of Student Outcome Assessment Results for MET Program: The student outcome level of attainment results were combined to show the percentage of students who met or exceeded the expectations (% scored ≥ 2) according to the scoring rubrics for each outcome. The program faculty set the goal that at least 70% of students should meet or exceed expectations for each outcome to be acceptable. Figure below shows the combined results for each outcome. All outcome assessment results show that the students in the program are attaining student outcomes in greater percentages than the goal set by the program faculty. The specific candidate areas within each outcome for improvement can be discerned by reviewing the level of attainment on the individual performance indicators, although all performance indicators appeared to meet the threshold.



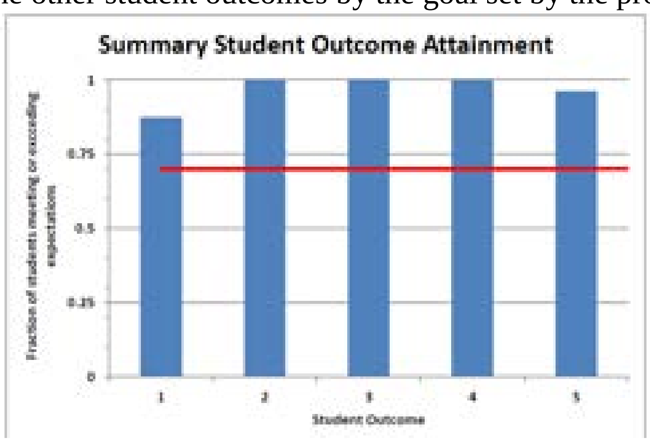
Summary of MET Outcome Attainment 2021-2022

Summary of Student Outcome Assessment Results for EET – Avionics Program: The student outcome level of attainment results were combined to show the percentage of students who met or exceeded the expectations (% scored ≥ 2) according to the scoring rubrics for each outcome. The program faculty set the goal that at least 70% of students should meet or exceed expectations for each outcome to be acceptable. Figure below shows the combined results for each outcome. Outcome (1) has the lowest percentage of students attaining the expectations of the scoring rubrics for this outcome, but it still easily exceeds the threshold of 70%. The specific candidate areas within each outcome for improvement can be discerned by reviewing the level of attainment on the individual performance indicators. The other outcome assessment results show that the students in the program are attaining the other student outcomes in significantly greater percentages than the goal set by the program faculty.



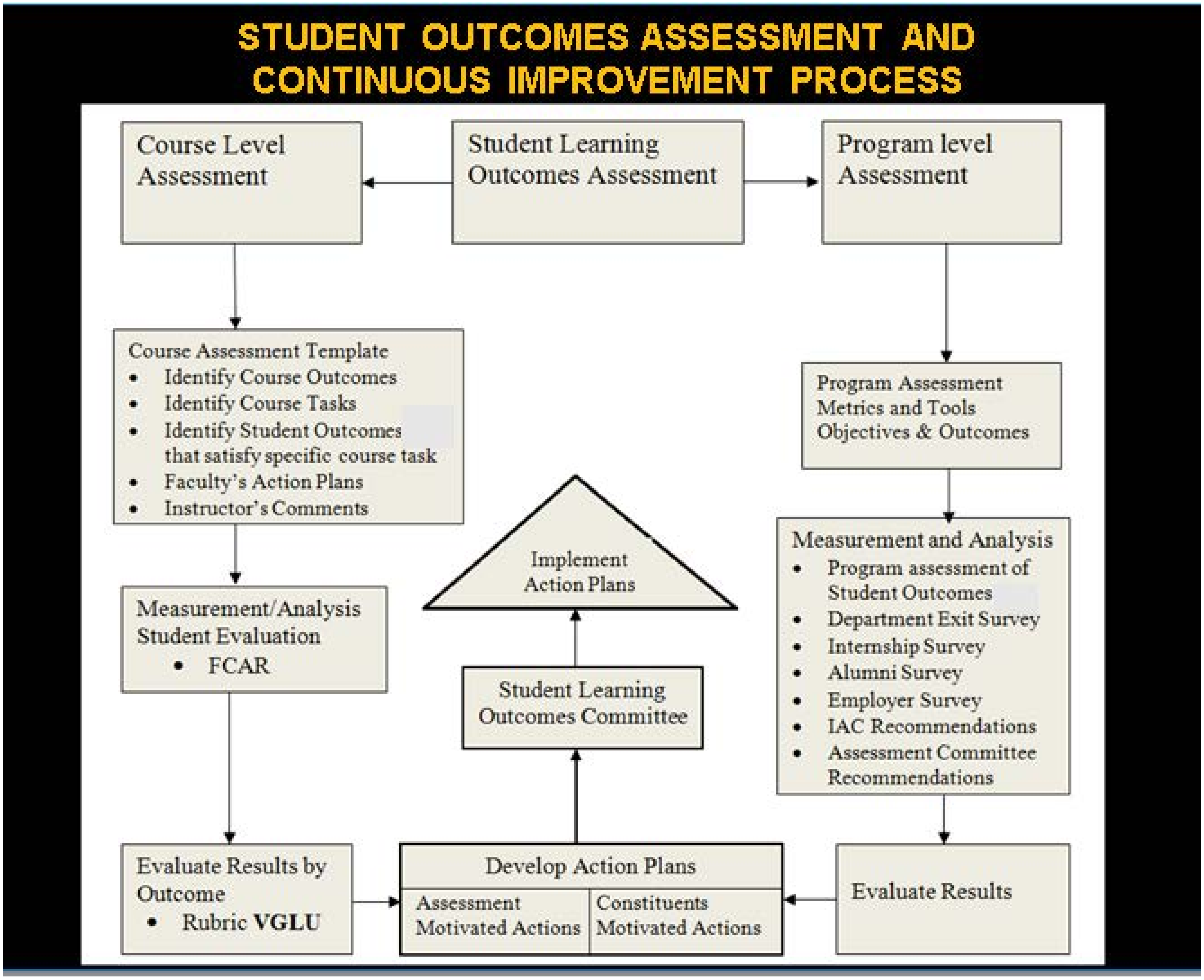
Summary of EET-Avionics Outcome Attainment 2021-2022

Summary of Student Outcome Assessment Results for EET – Electronics Program: The student outcome level of attainment results were combined to show the percentage of students who met or exceeded the expectations (% scored ≥ 2) according to the scoring rubrics for each outcome. The program faculty set the goal that at least 70% of students should meet or exceed expectations for each outcome to be acceptable. Figure below shows the combined results for each outcome. Outcome (1) has the lowest percentage of students attaining the expectations of the scoring rubrics for this outcome. The specific candidate areas within each outcome for improvement can be discerned by reviewing the level of attainment on the individual performance indicators. The other outcome assessment results show that the students in the program are attaining the other student outcomes by the goal set by the program faculty.



Summary of EET-Electronics Outcome Attainment 2021-2022

Student Outcomes Evaluation by Constituents Surveys: In constituents' table, department used results of questions from constituents' surveys (exit, alumni, internship, employer, and tech day) to measure attainment of each student outcome, and in the continuous improvement column we discuss the results and develop necessary action plans, if the result is below our threshold for success.

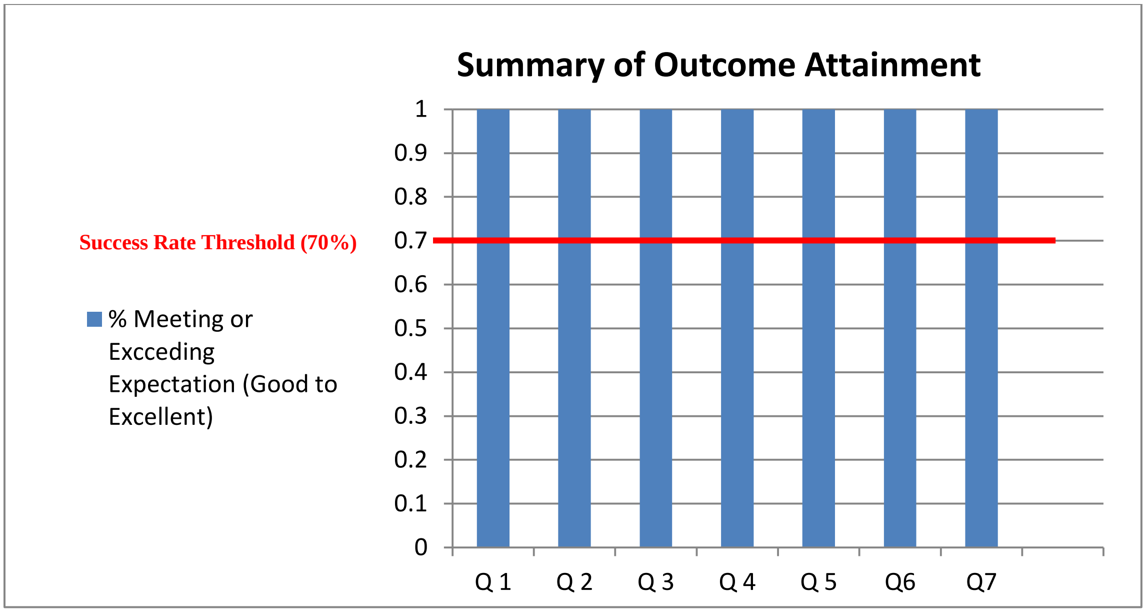


Assessment of Department's STEM Reinforcement Programs: To further prepare students for the core courses in engineering and technology programs, department developed a couple of STEM reinforcement programs such as supplemental instructions (SI), recitation sessions, and a Summer Bridge (Summer Engineering Experience - SEE-STEM program). The main objective of these programs is to improve students' performance, persistence, and retention in STEM fields. A feedback rubric survey based on contents of those programs has been developed and distributed to students to assess the effectiveness of these programs. The data has been collected and the assessment result and discussion for each STEM reinforcement program is provided below.

1) **Supplemental Instruction Feedback Surveys Evaluation:** In this section we will analyze the impact of the title III HSI-STEM grant supported supplemental instruction (SI) based on the result of collected students' feedback surveys. The main objective of this program is to improve student persistence and retention in STEM fields. Students' feedback and comments about SIs will help us to introduce and implement necessary instructional techniques to further improve and enhance student learning through engineering and engineering technology courses and consequently improve and enhance student retention and graduation rates through all STEM programs.

STUDENTS' SURVEY'S RESULT AND ANALYSIS FOR SIS– SPRING 2022

Questions	**Total Survey participants=10 Students Number & percent of students in each category**			
	Poor 1	**Good 2**	**Excellent 3**	**Score**
1. How would you rate SI sessions in improving your understanding with the lecture materials?		1=10%	9=90%	2.90
2. How would you rate SI sessions in improving your performance with problem solving?		3=30%	7=70%	2.70
3. How would you rate SI's knowledge and skills in helping you with the course contents?		1=10%	9=90%	2.90
4. How would you rate SI availability?		3=30%	7=70%	2.70
5. How would you rate your performance in the course after receiving help from SI?		3=30%	7=70%	2.70
6. Overall, how would you rate continuation of SI program as part of fundamental courses in engineering and engineering technology programs?		1=10%	9=90%	2.90
7. Did meeting with the SI help you to get a passing grade?		3=30%	7=70%	2.70
Overall average for questions 1 through 5		**21.43%**	**78.57%**	**2.79**



Evaluation: The survey results and students' comments are an indication that supplemental instructors are helpful to improve student learning through the fundamental engineering and engineering technology courses. For question #6, --- continuation of SI program in fundamental STEM courses, 90% rated as excellent, and for question #7, did meeting with SI help you passing the course?, 70% rated as excellent and **overall 100% of survey participants rated all questions related to supplemental instructions as good to excellent to improve student learning within all STEM related courses.** Hence, outcomes measured by students satisfied our criteria for success (70% attaining a rubric score of 2.0 out of 3). All students' feedback surveys are attached

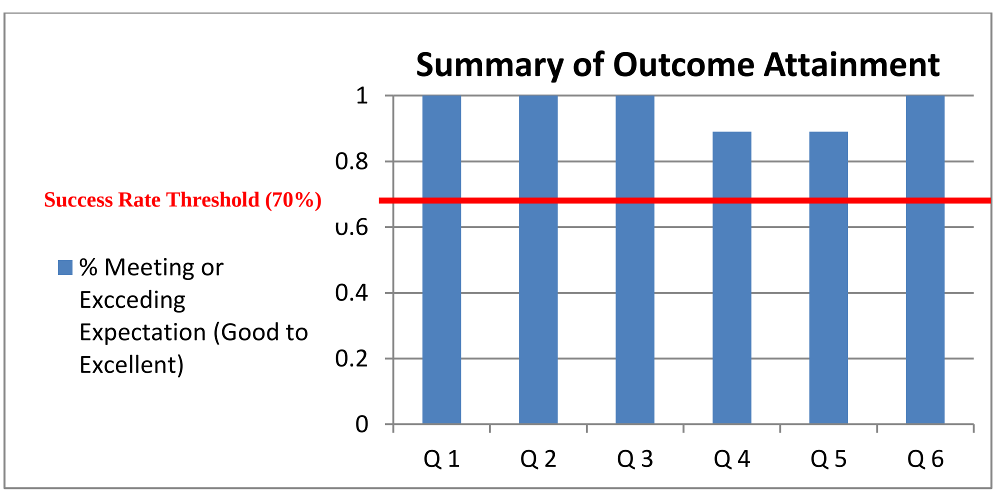
Students' comments about supplemental instructors: Each paragraph represents a student comment about the supplemental instructor and its impact on student progress through the course.

- Heat Transfer is a hard class; he was able to help me with some basic concepts when needed.
- Helped a lot.
- Bryan Gordillo was an excellent help in my understanding of Heat Transfer.
- Tatiana Jaimes was a great help in my understanding of Control Systems. o.
- It was extremely helpful to have a SI with such availability for MEE345 (Fluid Mechanics) course.
- I appreciate Atalay Dennis Erem tutoring help, which was worthwhile going to and very helpful. I'm glad to say that I will pass EGR220 class this semester.

2) **<u>Recitation Feedback Surveys Evaluation:</u>** In this section we will analyze the impact of the title III HSI-STEM grant supported recitation sessions based on the result of collected faculty's feedback surveys. The main objective of this program is to improve student persistence and retention in STEM fields. Certainly, faculty's feedback and comments about recitation sessions will help us to develop and implement necessary teaching strategies and introduce proper action plans to further improve and enhance student learning through recitation sessions and consequently improve and enhance student learning outcomes through all STEM programs. During spring 2022, based on faculty recommendation, a total of 9 fundamental STEM related courses received an hour per week recitation with faculty. Overall based on a summative evaluation, 77% of students who were in failure risk were able to pass those courses. This result is an average of all collected feedback surveys.

RECITATION SURVEY'S RESULT AND ANALYSIS – SPRING 2022
A SUMMATIVE MEASURE

Questions	**Total Survey participants=9 Number & percent of participants in each category**				
	Poor 1	**Fair 2**	**Good 3**	**Excellent 4**	**Score**
1. How would you rate recitation sessions in improving students' performance though the Course?			5=56%	4=44%	3.44
2. How would you rate recitation sessions in improving students' understanding with the lecture materials in your course?			5=56%	4=44%	3.44
3. How would you rate recitation sessions in improving students' performance with problem solving?			5=56%	4=44%	3.44
4. How would you rate recitation sessions for some students who were in failure risk passing the course?		1=11%	3=33%	5=56%	3.44
5. How would you rate student attendance in your recitation sessions?		1=11%	7=78%	1=11%	3.00
6. Overall, how would you rate continuation of recitation sessions as part of fundamental courses in engineering and engineering technology programs?			4=44%	5=56%	3.56
Overall average for questions 1 through 5		**3.7%**	**53.8%**	**42.5%**	**3.39**



Evaluation: The survey results and faculty comments are an indication that recitation session are helpful to improve student learning through the fundament engineering and engineering technology courses. For question #4, --- students who were in failure risk passing the course, 89% rated recitation session as good to excellent to prevent students from failure risk. <u>Overall 96% of survey participants rated all questions related to recitation session as good to excellent to improve student learning within all fundament STEM related courses. Hence, outcomes measured by recitation faculty satisfied our criteria for success (70% attaining a rubric score of 3.0 out of 4). All faculty feedback surveys are attached</u>

Faculty's comments regarding Recitation Session: Each paragraph represents a faculty comment regarding recitation session and its impact on student progress through the course.

- Faculty of Computational Method with MATLAB, MEE340: The recitation sessions were very helpful for my students to get a better understanding of problem solving. In this course, much of our time is dedicated in learning the background theory, so it was good for the students to have dedicated time to working with MATLAB and programming exercises. About 20% of the students were at risk of failure in the beginning of the semester, but by the end it dropped to about 5%.
- Faculty of Dynamics course – MEE215: Students were evaluated as at-risk based on early course performance. Six students were identified as at-risk representing 29% of the students. Of those six students, five students achieved a passing grade representing 83% of the at-risk students. Based on the experience of this semester at-risk students have benefited from recitation time.
- Faculty of Statics course - MEE115: Students were evaluated as at-risk based on early course performance. Three students were identified as at-risk representing 33% of the students. Of those three students, one student achieved a passing grade representing 33% of the at-risk students. While previous semesters showed better outcomes (i.e., a higher percentage of at-risk students went on to pass, this semester's experience, perhaps counterintuitively, also reaffirms the effectiveness of the program. Of the three at-risk students, the two who did not pass the class had low levels of participation. Additional effort will be made to encourage at-risk students to participate in the program as it can help them succeed. Based on the experience of this semester at-risk students have benefited from recitation time.
- Faculty of Thermodynamics, MEE210: Recitation hours for Engineering students were required as part of the MEE210 class time. Students, who put commitment and efforts, benefited from the extra time, in particular those students with challenges or in need to close some gaps such as understanding basic physics and/or math. Those students need relatively a slower pace in order to acquire new engineering topics. Recitation hours helped to enhance student's outcome as among 75% of students who were in the failure risk in the beginning of the semester, 50% of this group end up passing the course. It would be of a good help to use recitation hours for some other fundamental classes such as freshman Math classes to support student learning.
- Faculty of General Chemistry for Engineers -CHE231: Additional recitation is recommended because it allows students enough time to process the information reviewed and proceed to the application. There were about 10% of my students at risk of failing, but with the additional intervention that percentage was improved preparing them

for an effective performance on the final exam. The course of Physics is recommended for recitation because like chemistry it is based on process and application

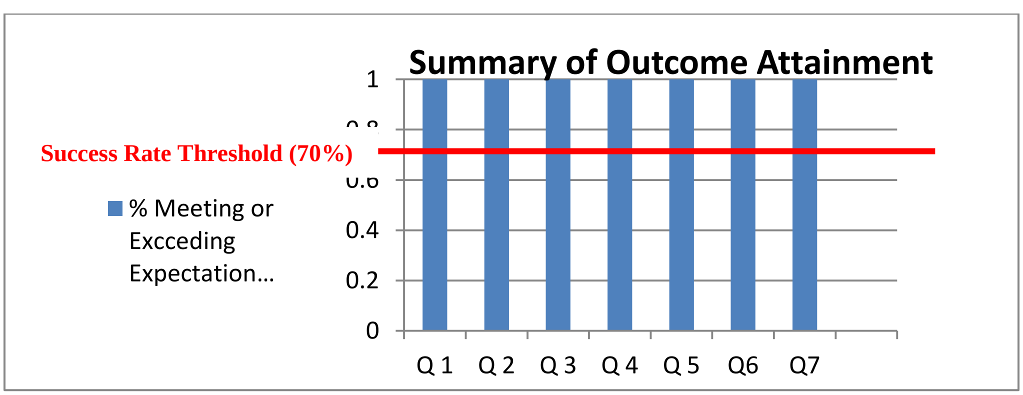
- Faculty of Engineering Mechanics I (EGR115): In general, I believe that providing the students with an additional recitation period was incredibly beneficial in helping them grasp and better understand the material covered during the lecture period. As a result, all students in EGR115- Engineering Mechanics- Statics were interested and eager to attend the assigned recitation period to learn problem solving techniques needed to reinforce and understand clearly the concept learned during the class session. At the beginning of the semester, 33% of students were not doing well in keeping up with their assignments and class participation, but with an additional period of problem-solving throughout the semester all students showed great progress in their understanding of the subject which in turn was reflected in the improvement of their grades. Recitation hours were very beneficial, important and effective in helping the weak students absorb and understand the subject matter taught in class. In the end, 100% of my students passed this course.
- Faculty of Strength of Materials course – EGR220: After first quiz, 3 out of 7 students (43% of class) had weak performance and 2 out of 7 students (29%) were in failure risk, and I was able using the recitation session, an hour a week to review complex course topics as well as helping students with problem solving skills. As a result of both a problem-solving session and additional help through supplemental instructor, all students were able to pass the course.
- Faculty of Thermodynamics course – EGR210: In general, I believe that providing the students with an additional recitation period was incredibly beneficial in helping them grasp and better understand the material covered during the lecture period. As a result, all students in EGR210 – Thermodynamics were interested and eager to attend the assigned recitation period to learn problem solving techniques needed to reinforce and understand clearly the concept learned during the class session. At the beginning of the semester, 40% of students were not doing well in keeping up with their assignments and class participation, but with an additional period of problem-solving throughout the semester all students showed great progress in their understanding of the subject which in turn was reflected in the improvement of their grades. Recitation hours were very beneficial, important and effective in helping the weak students absorb and understand the subject matter taught in class. In the end, 100% of my students passed this course.

3) **Summer Bridge Program (SEE-STEM) Feedback Surveys Evaluation:** The Summer Engineering Experience (SEE-STEM) program is supported by the title III HSI-STEM grant and is designed with the objective of enhancing students' hands-on, computational, programming, communication, and problem-solving skills. The 2022 SEE-STEM program covered topics related to an Intro to Cybersecurity, Artificial Intelligence, the First Year Initiative, Computer- aided design (CAD) & Additive manufacturing, and Technical writing. A rubric survey based on contents of SEE programs has been given to students to assess the effectiveness of the SEE programs. Table below provides the results of these evaluations.

Survey's Result and Analysis

Questions	**Response in percent of participants (Number of participants: 5)**				
	Poor 1	Fair 2	Good 3	Excellent 4	**Success Rate(SR); % of student with score ≥ 3**
1. Rate SEE program in introducing and preparing you with the concept and application of CAD, Additive Manufacturing, Cybersecurity, and Artificial Intelligence.				5	Score=4.00 100%
2. Rate your professor ability in introducing you with Cybersecurity and Artificial Intelligence			2	3	Score=3.60 100%
3. Rate your professor ability in introducing you with CAD and additive manufacturing				5	Score=4.0 100%
4. Rate your professor ability in introducing and preparing you with technical writing and presentation				5	Score=4.00 100%
5. Rate this SEE program in providing you with skills in communication, critical thinking, problem solving, and teamwork				5	Score=4.00 100%
6. Rate this SEE program in providing you with adequate knowledge and skills for your program of study			1	4	Score=3.80 100%
7.Rate the industry and workshop session of SEE program in providing you with adequate technical skills			1	4	Score=3.80 100%
Overall average Learning Outcome Attainment			**11%**	**89%**	

Success Rate (70% of students attaining a score greater than 3): An outcome above a rubric score of 3 out of 4 indicates students have a good grasp of important concepts of the materials in Summer STEM Program and our overall goal is to ensure that at least 70 % of the students (success rate) achieve a score of above 3.0 for each outcome. An outcome with a success rate below 70% required action plans for improvement.



Analysis: The survey results and student comments are an indication that the SEE program has been satisfactory and provided students with a profound appreciation for engineering education. Overall, 89 percent of the survey participants rated the SEE program as excellent and 11 percent rated their instruction as good. **Overall 100% of survey participants rated all questions related to SEE-STEM program as good to excellent.**

Students' comment regarding Summer STEM Program:

1. I would definitely recommend the SEE-STEM program to someone. I'm a transfer student and being a part of this program really guided me deeper into my engineering field. I was able to gain experience through hands-on projects which really helped. The faculty were very helpful with making sure that we understood the material being presented to us. I had an amazing time during the program and I strongly believe other students can benefit from being involved with the program.
2. I really enjoyed the experience I gained and would highly recommend it to everyone.
3. The SEE-STEM experience was a good one that I believe was necessary to advance my future career in Engineering. The program has great opportunities within it and it could use some changes for the better of it. I feel as if there was more advertisement to high schoolers the program would have a lot more participants and it would be a better experience for all. The CAD portion of the program was great, very hands-on, great professor who is very knowledgeable of the subject and if something like that can be done with the cybersecurity/ AI portion of the program, it will have improved so much more.
4. I strongly recommend this program to everyone in Summer. Not only for the High school seniors also for college freshman students. It is very interested. But I think the classes were tough.
5. Yes the program was very helpful! Professor Jesus introduced us to CAD design using SolidWorks and a little bit of 3Ds Max. He also used the workshop to let us work on our drawings and allowed us to do face scanning with explanations behind how it works. Mr. Rachid Nafaa showed us a walkthrough of the CNC machine workshop at the ATI building. He showed us how he used CATIA to design a part, and then we saw him manufacture it through CNC. Professor Ducharme showed us sentence breakdowns in ENG 110. I ended up having a better understanding of how to write up passages and became a better writer because of it. I appreciated it when she helped me with the questions I had with my essays and exercises. She also allowed for us during class to have an open discussion about how we felt with the material and certain articles that we were assigned in class. It allowed us to have a better understanding of the article and knowledge of what we can write about. I am looking to have Professor Ducharme as my teacher in following English classes if possible, for the program I am currently pursuing. Dr. Wright introduced us to the courses of Intro to Cybersecurity and Intro to Artificial Intelligence. He provided us with a video for both courses to have an idea of what they entail. I overall enjoyed the program and glad it gave me a refresher on the material to be prepared for the upcoming Fall semester.
    1.

Analysis: After reviewing students' comments, we will continue to offer this program every summer to all High School seniors and Vaughn's freshman students who are planning to pursue a BS program in STEM and computer science. Also, we will add more hands-on classes related to Cybersecurity and Artificial intelligence.

STEM Community Outreach: P-TECH ANIMATION WORKSHOP

On September 30th, the Vaughn College Engineering and Technology Department hosted students from the Freeport Long Island High School District as part of an outreach activity for the P-Tech Program. This program brings AAS degree college credits from the Animation and Digital Technologies AAS degree program to high school students. This first live in person event introduced students to the college through activities such as a hands-on Computer Graphics Workshop, school tour, and luncheon in the new school cafeteria.

The Computer Graphics workshop taught students about the world of visual effects using Autodesk 3DS Max as a VFX tool. Our workshop titled "Kitbashing 3D Sci-Fi Robots" showcased traditional and CGI model making techniques. A brief history of practical traditional model making revealed the scope of work required for traditional VFX compared computer graphics modeling. In both methods kit bashing enabled rapid model development in a technique where pre-existing parts are used to fashion new models. A practical model VFX breakdown was shown with a special emphasis on solid storytelling instead of an over reliance on visual effects techniques.

For our 3D CGI Kit Bashing Workshop students were provided with a parts matrix with 10 groups of robot parts consisting of upper bodies, waists, arms, legs, and accessories. Students were separated into two groups and after a 10-minute lecture and 3DS Max software demo they were tasked with creating their own Sci-Fi Robot design. Due to limited time, students were given a brief tutorial on 3DS Max Basics such as viewport navigation, transforms, and visualization. They were then left to experiment and constructed some pleasing combinations from the supplied geometry. At the end of the course the two best designs were judged by a panel of Vaughn College students and faculty members. The winning designs will be 3D printed with high resolution 3D printers at the Vaughn College Additive Manufacturing Lab and gifted to the winners. As an instructor it was satisfying watching students perform in a positive and proactive attitude given the time limit and design constraints.

Our first contact event was a success and students arrived on time in two groups where Vaughn College staff and faculty attained all our goals for the day. At the end of the event a leisurely luncheon was held in the school cafeteria where Vaughn Admissions staff and I chatted with the high school students about the school and program offerings. More engagement events are planned as students transition into the P-Tech program by visiting Vaughn College and participating in workshops and seminars in this academic year.

STEM Community Outreach: P-TECH Kick Off Event October 7th, 2022
By Professor Manuel Jesus, STEM Activity Coordinator

On Friday, October 7th, a kickoff event for the P-Tech Consortium was held on Long Island, NY. The P-Tech initiative enrolls high school students into Associates level degree programs in New York State College. Vaughn College partnered with the P-Tech initiative through the Freeport Long Island District High School and Wyandanch High School districts to offer Associate Degrees. Animation and Digital Technology and Electrical Engineering Technology programs were selected by the students as areas of study. Participants will take High School courses mapped to Vaughn College first year associate degree level courses to facilitate entry into higher education and STEM careers. In addition to degree programs, students are offered internships, industry events participation, and internships with Long Island businesses.

The event kicked off with a meet and greet between students, NY State Department of Education administrators, Vaughn College instructors, and high school representatives followed by an afternoon luncheon. Presentations from Vaughn College instructors and NY state administrators congratulated students and inspired them to follow through on this great opportunity and start a career path in STEM education. This kickoff event was a great way to connect with P-Tech students and N.Y. education professionals who are stakeholders in the long-term success of this program.

STEM Community Outreach: Long Island Manufacturing Day, Friday October 7^{th}
By Professor Manuel Jesus, STEM Activity Coordinator

On Friday, October $7^{th,}$ Vaughn College was invited by the Stony Brook Small Business center to advocate for Long Island Manufacturing for current college students and college bound high school students. This event was held in the Cradle of Aviation Museum in the afternoon to early evening hours so that high school students and parents could attend. Representatives from the Vaughn College Admissions and Engineering Departments were on site to educate students on Vaughn College life and Engineering program offerings. Most importantly the event was open and free to the public so that anyone interested could participate.

The event started with an open house environment where colleges and manufacturers were able to connect with students and share insight on local high paying manufacturing jobs. Long Island manufacturing has many opportunities in aerospace manufacturing and STEM related careers. This was apparent though the dozens of cutting-edge manufacturers on site. After the open house, local schools such as Suffolk Community College, Farmingdale College, and Vaughn College led a panel discussion that informed the audience how local schools are preparing students for the manufacturing workflow. In the case of Vaughn College, we mentioned how we aggressively sponsor our club activities, conference participation, and hands-on CNC and AM lab work to inspire our students. Such engagement builds a foundation for our students who are often offered job offers on the spot and ready to work in industry after they graduate. Student presenters expressed gratitude and shared their experiences working with local manufacturers first as interns, then later as full-time hires. There is a tremendous set of opportunities for growth when a student enters the workforce with the right credentials and a proactive attitude.

After the discussion, we moved back to the main hall where it was particularly interesting to hear what students can expect when working in Long Island manufacturing. Best of all, employers were eager to hear what Vaughn College students had to offer and they were happy to attend the first live and in person event after the pandemic.

STEM Community Outreach: Articulation agreements and program presentation to Hostos Community College, Friday October 21st

On Friday, October 21st, Vaughn College Engineering and Aviation Departments met with Hostos Community College via a ZOOM meeting to discuss the articulation agreement between the two schools. Hostos students and faculty joined the meeting to ask Vaughn Faculty questions regarding program offerings.

The Aviation Department spoke of all course offerings related to aircraft operations and the industry need for pilots due to an aging aviation work force. The Engineering Department shared insight on engineering programs and student research opportunities such as the CSTEP program where students perform summer research projects with faculty members. A strong focus on industry connection was emphasized where students are sent all expenses paid to engineering conferences. UAV and Robotics Club activities, industry connection seminars, and national competitions were showcased as hands-on methods of student engagement in industry. Lastly, we shared a list of companies that regularly recruit Vaughn College students such as Lockheed, Sikorsky, and SpaceX.

STEM Community Outreach
Women in Aviation at Aviation High School Outreach Event Oct 29th, 2022
By Professor Manuel Jesus, STEM Activity Coordinator

On Saturday, October 29th, Prof. Jesus attended the Women in aviation event at Aviation High School in Queens, NY to participate in a great opportunity to connect with community high school students. The entire occasion focused on showcasing clear examples of aviation career paths for women. Representatives from JetBlue, Air Traffic Control Professional Organizations, and Regional Airports were on hand in the school cafeteria to answer questions and offer guidance to students interested in aviation careers.

The Vaughn College Women in Aviation Club chapter attended as well to promote their club chapter activities and Vaughn College program offerings. An orientation was held in the auditorium where a panel discussion highlighted career paths for women in aviation. Female pilots, mechanics, and aviation industry journalists shared their career paths and advice followed by a Q and A session. Senator, NASA Administrator, and former astronaut Bill Nelson spoke about new opportunities for women at NASA. Senator Nelson explained how much has changed at NASA since the Apollo program and the Shuttle program where he served as Mission Specialist on Columbia Shuttle Mission STS-61C in 1986. In the modern-day inclusive NASA, women and professionals of all ethnicities are welcomed due to an ever-increasing push for diversity in STEM related career paths.

My contribution to the event centered around a Quad Rotor Drone UAV Indoor demonstration in the school hangar. The aim of my presentation was to educate students about drone flight and design as both a hobby and career path. Special attention was given to Vaughn College drone and UAV offerings. To ensure safe operation, drones were set to run indoors a safe distance away from attendees just a few feet off the ground to briefly demonstrate the ease of use and setup of flight controls. This was a great opportunity to share drone related Vaughn College opportunities such as the Drone Certificate Program, and our High School drone training program. Further to this, I mentioned drone related club activities that are supported by the Title III HSI-STEM and CSTEP workshops where students perform research and learn about drone related topics in addition to CAD and CNC. I also shared drone tips and tricks to obtain TRUST certification and acquire low-cost high-performance drones. Such inexpensive equipment is now capable of recreational and commercial flight for drone photography and 3D scanning.

The event was really satisfying as many students really hadn’t seen a drone up close and I was able to share that experience with them. Parents were impressed by the low-cost of ownership and easy setup. A few families in attendance were surprised by how accessible drone ownership has become for a family activity. I shared contact information for follow up advice on drone purchases and Vaughn College UAV program offerings with a few parents. This sort of engagement was a great event to make strong connections with the community, and I am grateful to share my enthusiasm for technology as an instructor and aviation technology enthusiasts alike.

Women in Aviation at Aviation High School, Oct 29, 2022

STEM Community Outreach: NYC Transit Tech Career High School's College Fair
By Professor Manuel Jesus, STEM Activity Coordinator

On November 9th, 2022, Vaughn College Engineering and Admissions departments were invited to participate in the NYC Transit Tech Career High School's College Fair. This evening event allowed parents and students to connect with local higher education institutions. Many peer institutions were on site, such as SUNY Maritime College, NYIT, and Farmingdale State College. A good number of students were sophomore and juniors, so we introduced students to Vaughn College program offerings and high school engagement events. As an Engineering faculty member, I explained the academic programs and the Summer Engineering Experience Program to students. This free summer program allows students to take first year engineering courses for free during an intensive summer session over a 5-week period. Other summer programs include a Drone Technology Program and Cybersecurity Course. Many students were interested in taking all the summer program offerings, so we invited students to provide contact information for follow-up. To round out the presentations, the admissions team educated attendees on Vaughn College history, lifestyle, academic offerings, college sports, and financial aid options. This was a fun evening experience and a pleasant environment to connect with future Vaughn College students of all ages.

STEM Community Outreach

Freeport High School VEX Robotics Competition, February 4, 2023

Judge Team at the Competition

Team Interview

On February 4, 2023, Freeport High School hosted the annual VEX Robotics Competition - Spin Up. The tournament brought 24 robotics teams from Long Island and New York City and included an international team from Turkey. Throughout the daylong competition, all teams competed in field challenges where robots faced off against each other to score points and complete skills challenges where the robots were required to demonstrate their maneuverability.

Dr. Shouling He was invited to serve as a judge for the competition. She worked with other judges to interview all robotics teams, closely observe students' competitions, and carefully evaluate the performance of each team. As the day ended, the judge team selected the middle school team 16699Y from Flushing to receive the excellence award; the design award went to Long Island Middle and High School for their unusual development of the robot; the innovative award and think award were given to Farmingdale Senior High School to acknowledge their creative hardware and software design. Finally, the building award was presented to the Freeport High School team for their high construction quality with a robust, clean, and efficient usage of materials as well as high reliability on the field.

The judges were deeply impressed by the students' brilliant performance. The competition truly takes the middle/high students to the next level of a STEM education so they can be more creative and use the 21st century skills to achieve their full potential. Besides the robotics competition, students from the various schools also had the opportunity to see how robotics plays a role in daily life as the robotic dog, Ashes, from the FDNY Robotics Division, visited all robotics teams throughout the day.

STEM Community Outreach: Hands on Electrical Circuit design experiences for Wyandanch middle school students, Friday, February 10th

Vaughn College STEM Program team composed of Professor Mouaouya and Dr. Benalla offered a workshop in electrical circuit design with hands-on breadboard for Wyandanch middle school students on Friday 02/10/2023. The workshop was an opportunity for the middle school students to know first what engineering is and have hands-on electric circuit design for the first time. For this reason, sixty students were divided into different groups of three to four mates. Working in groups made the students learn how to dive deeper into engineering teamwork by exercising some of the tools such as discussion, analysis and sharing their knowledge and understanding.

The electric circuit the students were asked to design was a simple circuit composed of a voltage source (9V), a resistance (100Ω), and an LED (different collars) along with a breadboard. The first thing the students learned was the concept of the electric circuit and the

two conditions for an electric circuit to be on. Basically, The LED component was used as a visual indication to show these future engineers when their design was successful. The first condition is that the circuit should be closed while the second was the diode, LED, should be polarized correctly. In other words, the anode terminal of the LED should be connected to the positive side of the battery. In parallel with that, the student learned how to set the diode forward bias by determining the anode and the cathode terminals of the LED.

"*Wow, we did it!!!*" a group of four students shouted when their LED turned on after they correctly built their circuit and right after another group followed up "*Wow, it is working here as well!!"*. After that, the students were happy with their achievement, and they kept opening and closing their circuits.

At the end of the workshop Professor Mouaouya opened the same discussion we started in the beginning, but this time the students were more responsive and voluntarily shared with us their familiarization with some scientific subject such Physics, Natural Science and Math. Professor Mouaouya willingly expanded the math discussion, and based on the students' intervention he did some clarification and simplification of system equations and solving solutions along with some function plots technics.

Outcome

In the beginning of this session few questions were asked about engineering and how interested the students were in the scientific subjects. Only a handful of students were responding. At the end of the workshop the same discussion was extended but in contrast to the beginning most of the students were responding positively and showed exceptional interest as described above. Based on this experiment, inviting such students to our college for at least a half day workshop in one of our electronic labs will have the beneficial effect of making them more interested in becoming engineering majors.

Acknowledgment

We are thankful to the Department of Education Federal grant (Title III, Part F, HIS-STEM and Articulation grant) which provided necessary funding support to engage students in STEM related scholarly and professional activities. In addition, we are thankful to the New York State – Education department. Collegial science and Technology Entry Program grant (CSTEP – Vaughn College) which provided necessary funding support to engage students in STEM related scholarly and professional activities.

STEM Community Outreach: Drone Awareness Day at Cradle of Aviation

On Sunday, February 26, 2023, Vaughn's Unmanned Aerial Vehicle (UAV) Club hosted its 4th Annual Drone Awareness Day at Cradle of Aviation. Cradle of Aviation is an aviation museum located in Long Island, NY which owns various decommissioned aircrafts and memorabilia with historic backgrounds. During this event, Vaughn's team along with other local professional drone teams were able to fly around decommissioned Grumman F-11A Tiger while visitors looked on. Towards the second part of the day, our team showed children from the ages of 8-15 how to fly using the DJI Tello's. The children also had the opportunity, through our first person view cameras, to discover what it feels like to fly in the cockpit of an aircraft.

Our team also held a small competition for children to participate in. The competition was held later in the day after the children learned the fundamentals of flying. The competition consisted of the kids flying a preplanned racing course designed not to be too hard but still to provide some challenges. In this competition, the kids were granted access to use the DJI Tello's to fly the course. We chose the DJI Tello's due to its integrated obstacle detection to ensure safety from unexpected collisions. In addition, we also held a free-fly portion where everyone was able to fly in a closed off section in the main lobby, Parents and their children enjoyed this portion of the day the most.

STEM Community Outreach: Vaughn College Hosts "The Southern New York VRC Spin Up Middle School State Championship" on Saturday March 11th, 2023

Vaughn College hosted the Southern New York VEX Robotics Competition Middle School State Championship Event on Saturday March 11th, 2023, at Vaughn College. This event was the second in-person state championship event since the start of the COVID-19 pandemic. Teams who competed at this event had to first receive an invitation through winning specific awards at regional qualifier events. A total of 8 regional middle schools from Queens, Manhattan, Nassau, and other New York counties attended the 2023 State Championship. The list of middle schools participants are as follows:

Team List — 8 Teams

Team	Team Name	Organization	Location
955N	Checkmate	Play Ideas NY	New York, New York, United States
33628	MS Tiger Robotics Team 2	Lawrence Woodmere Academy	Woodmere, New York, United States
166999	Overclock MS	NY Youth Tech	Flushing, New York, United States
20196A	Spiky Dinos	Northshore Coding and Robotics Club	Great Neck, New York, United States
32563C	Port Jervis Middle School	PORT JERVIS MIDDLE SCHOOL	Port Jervis, New York, United States
62880B	Xiao Man Tou (小馒头)	Coast 2 Coast Robotics	Bayside, New York, United States
99561Z	Apples	FALLSBURG JUNIOR SENIOR HIGH SCHOOL	Fallsburg, New York, United States
99588M	Checkmate	PIA Tech League	Great Neck, New York, United States

John Sutera from Vaughn College was the Event Partner, Event Planner, and Electronics Manager. Members from the VCAT robotics team prepared and ran the event as referees, judges, and event staff. Daniel Dosher and William Zeng were scorekeepers. Maharshi Patel was the head referee, Tatiana Jaimes, Alanke Perera, Rebecca Snyder, Atalay Erem, Al Birnbaum made up the judging panel.

The two teams that won the tournament were Coast 2 Coast Robotics from Great Neck and Overclock from Flushing. The Tournament finalists consisted of another team of Checkmate from Manhattan and Northshore Coding and Robotics Club from Great Neck. The excellence and skills awards were given to one of the tournament champions, Overclock. The design award was given to Coast 2 Coast Robotics from Bayside. The Judges award was given to the Northshore Coding and Robotics Club from Great Neck. The following is a list of the awards given to the winning teams:

VEX Robotics Competition - SNY Division

Award	Team #	Team Name	Affiliation	Location
Excellence Award (VRC/VEXU/VAIC)	16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
Tournament Champions (VRC/VEXU/VAIC)	62880B	Xiao Man Tou (小馒头)	Coast 2 Coast Robotics	Bayside, New York, United States
Tournament Champions (VRC/VEXU/VAIC)	16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
Tournament Finalists (VRC/VEXU/VAIC)	20196A	Spiky Dinos	Northshore Coding and Robotics Club	Great Neck, New York, United States
Tournament Finalists (VRC/VEXU/VAIC)	955N	Checkmate	Play Ideas NY	New York, New York, United States
Design Award (VRC/VEXU/VAIC)	62880B	Xiao Man Tou (小馒头)	Coast 2 Coast Robotics	Bayside, New York, United States
Robot Skills Champion (VRC/VEXU)	16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
Judges Award (VRC/VEXU/VAIC/ADC)	20196A	Spiky Dinos	Northshore Coding and Robotics Club	Great Neck, New York, United States

Below is the list of awards and three Awards qualify for the World Championship, thus giving three Spots to teams.

Award	Qualifies for
Excellence Award (VRC/VEXU/VAIC)	World Championship
Tournament Champions (VRC/VEXU/VAIC)	World Championship
Tournament Finalists (VRC/VEXU/VAIC)	Does not qualify for any events.
Design Award (VRC/VEXU/VAIC)	Does not qualify for any events.
Robot Skills Champion (VRC/VEXU)	Does not qualify for any events.
Judges Award (VRC/VEXU/VAIC/ADC)	Does not qualify for any events.

The SNY Spin Up Middle School State Robotics Championship, Saturday March 11th, 2023

STEM Community Outreach: Vaughn College Hosts "VIQC Slapshot Blended State Championship" on Sunday March 12th, 2023.

Vaughn College hosted the Southern New York VIQC Slapshot Blended State Championship Sunday March 12th, 2023, at Vaughn College. This event was the second in-person state championship event since the start of the COVID-19 pandemic. Teams who competed at this event had to first receive an invitation through winning specific awards at regional qualifier events. A total of 22 regional teams from Queens, Nassau, and other New York counties attended the 2023 VIQC Slapshot State Championship. The list of VIQC participants are as follows:

Team List — 22 Teams

Team	Team Name	Organization	Location
1876A	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876B	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876C	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876X	1876X	FRIENDS ACADEMY	Locust Valley, New York, United States
1876Y	1876Y Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876Z	1876Z Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
2500A	Checkmates	Play Ideas NY	Jericho, New York, United States
62772	62772 RoboCave	THE HARVEY SCHOOL	Katonah, New York, United States
11442A	Hewitt Robotics	THE HEWITT SCHOOL	New York, New York, United States
11442E	Hawks Robotics	THE HEWITT SCHOOL	New York, New York, United States
11442F	Hewitt Robotics	THE HEWITT SCHOOL	New York, New York, United States
12357X	Beyond Infinity	Infinite Robotics	Jericho, New York, United States
65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
65950B	PeeWee Tater Tots	Coast 2 Coast Robotics	BAYSIDE, New York, United States
78273A	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273B	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273C	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273D	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273E	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273F	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273G	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
84501A	Fallsburg Comets Team A	FALLSBURG JUNIOR SENIOR HIGH SCHOOL	FALLSBURG, New York, United States

John Sutera from Vaughn College was the Event Partner, Event Planner and Electronics Manager. Members from the VCAT robotics team prepared and ran the event as referees, judges, and event staff. Daniel Dosher served as Head Referee, Maharshi Patel as scorekeeper. Al Birnbaum, Ariel Santos, Romaim Hernandez, Adam Marzak and Rebecca Snyder made up the judging panel. The following is a list of the awards given to the winning teams and the list of awards qualifying for the World Championship:

Award	Team #	Team Name	Affiliation	Location
Excellence Award - Middle School (VIQC)	2500A	Checkmates	Play Ideas NY	Jericho, New York, United States
Excellence Award - Elementary School (VIQC)	65950B	Pee Wee Tater Tots	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Teamwork Champion Award (VIQC)	65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Teamwork Champion Award (VIQC)	2500A	Checkmates	Play Ideas NY	Jericho, New York, United States
Teamwork 2nd Place Award (VIQC)	78273A	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
Teamwork 2nd Place Award (VIQC)	78273C	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
Design Award (VIQC)	78273C	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
Robot Skills Champion (VIQC)	65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Judges Award (VIQC)	12357X	Beyond Infinity	Infinite Robotics	Jericho, New York, United States
Innovate Award (VIQC)	1876Y	1876Y Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
Think Award (VIQC)	65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Amaze Award (VIQC)	78273A	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
Build Award (VIQC)	78273F	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States

Award	Winner
Volunteer of the Year Award (VIQC)	David Lenitzer

Award	Qualifies for
Excellence Award - Middle School (VIQC)	World Championship
Excellence Award - Elementary School (VIQC)	World Championship
Teamwork Champion Award (VIQC)	World Championship
Teamwork 2nd Place Award (VIQC)	World Championship
Design Award (VIQC)	World Championship
Robot Skills Champion (VIQC)	Does not qualify for any events.
Judges Award (VIQC)	Does not qualify for any events.
Innovate Award (VIQC)	Does not qualify for any events.
Think Award (VIQC)	Does not qualify for any events.
Amaze Award (VIQC)	Does not qualify for any events.
Build Award (VIQC)	Does not qualify for any events.
Volunteer of the Year Award (VIQC)	Does not qualify for any events.

Team During the Award Ceremony

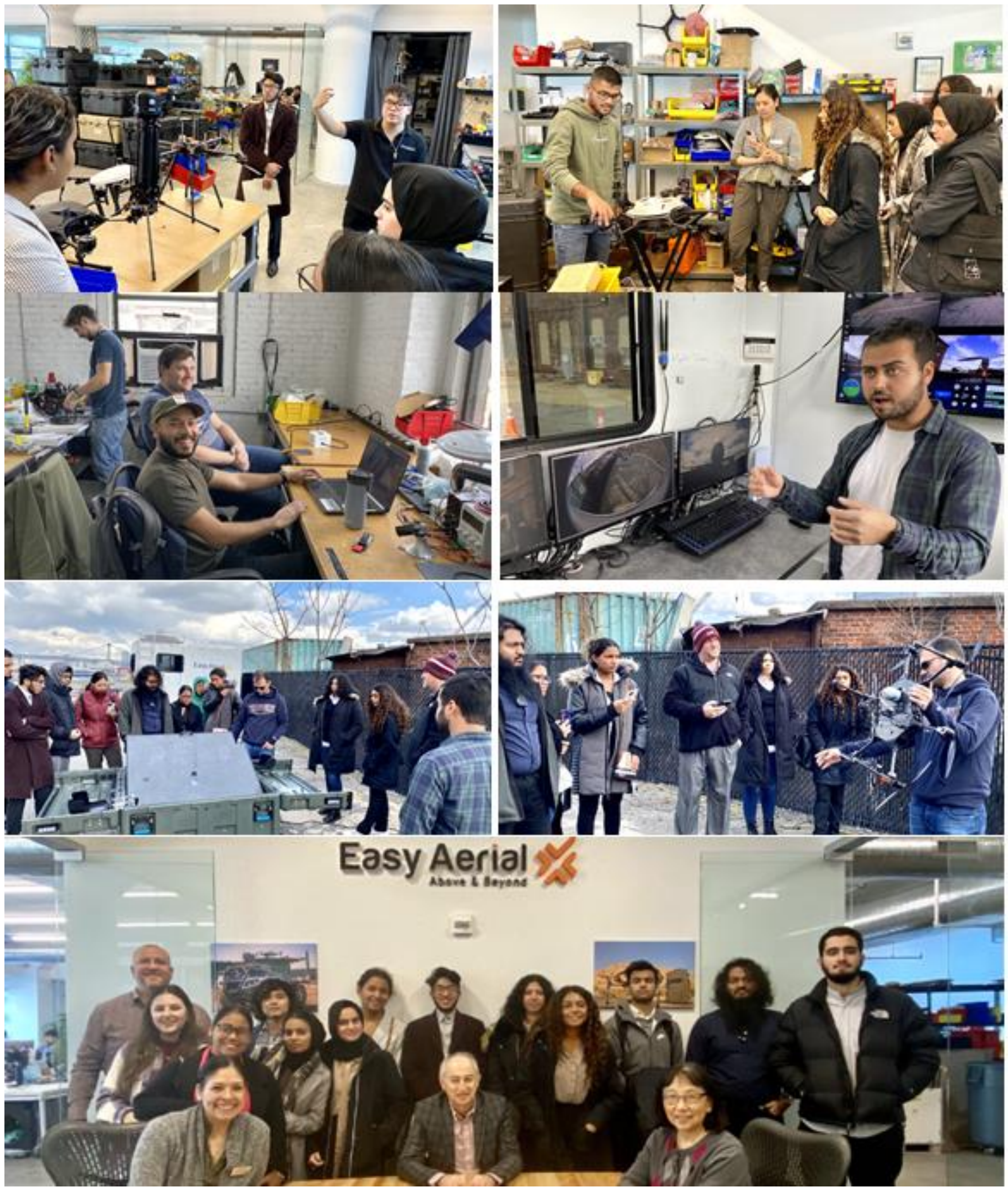
Industry Tour

1. **Engineering department Field trip to the Easy Aerial, Brooklyn, NY**

On January 27, 2023, Dr. Hossein Rahemi, Dr. Shouling He, and Vaughn's Career and Internship coordinator, Rosario Sutton, along with several Vaughn engineering students traveled to Brooklyn, New York for the Easy Aerial field trip visit. The SWE club, in coordination with the Engineering Technology department and Career Services organized this tour.

In this trip, Vaughn's team visited the Easy Aerial R&D and Manufacturing centers. During our visit to R&D center, the Easy Aerial Chief Technology Officer, Mr. Ivan Stamatovski, provided us with an insight about history of Easy Aerial as a start-up company in 2016 and its advancement to a current drone development and manufacturing company with a total of 100 employees in the United States, Israel, and Russia. The company designs, develops, and manufactures products and drones for the use of both commercial and defense industries. Then, the Easy Aerial team lead manager, Mr. Ryan Tang, a Vaughn Alumni, explained his responsibility and daily tasks as a project manager. He explained the constant communication with clients, and his team is key to designing and developing a drone that satisfies the needs of our clients. He continued to explain how AI can be implemented in the design and product development process of a drone, for specific use in the commercial and defense industry.

In this visit, we met with several Vaughn Alumni, Chamathke Perera, Sebastian Valencia, Brandon Duran, Muhammad Galib, Nicholas Bentancur and they provided us with insights into their daily work activities and involvement in research, design, programming, product development, and the manufacturing process of a drone.



The field trip to the Easy Aerial was a great opportunity for all of us and especially for our students to learn about current technology and advancement in the field of drone engineering, design, research, product development and manufacturing.

Industry Tour

2. Engineering department Field trip to Marotta Control, February 8, 2023, Boonton, NJ

On February 8, 2023, Dr. Amir Elzawawy, and Vaughn's Career and Internship coordinator, Ms. Rosario Sutton, along with ten Vaughn College engineering students, visited Marotta Control Inc. in Boonton, NJ. Marotta Control is specialized in high-precision products such as Electromechanical Actuation Systems, Flow Control Valves that are supplied to both military and commercial space industries. The company has a strong presence in the space and the marine industry and is known for its high-quality high-precision product line.

The visit began with a welcoming presentation discussing the company's past, present, and future, followed by a Q&A session that Patrick Marotta, CEO, headed. The company tour included visiting the vibration and thermal testing, the mechanical engineering design office, the CNC and machine shop, hydraulic and pneumatic testing, and the quality and inspection department.

Students had a comprehensive overview of the production of such high-precision components that involve the design, manufacturing, testing, and inspection of critical components to identify and eliminate all possible reasons for failure. In the final stage of this tour, the HR staff collected the students' resumes and confirmed they would visit Vaughn during the upcoming career fair in March 2023. At the end of the visit, HR staff discussed with the students the current and future job opportunities at the company and answered the students' questions regarding their internship program.

Industry Connection Seminar

Thursday, April 28, 2022
11 a.m. to 12 p.m., Room W101 & 103

Presenter: Edward Sutton III, P.E, Leads AI+Innovation of Sustainable Infrastructure for Black & Veatch
Topic: Trends in Sustainable Infrastructure, Artificial Intelligence (AI), Digital Twins, & Opportunities for the Aspiring Innovator and Engineer

Mr. Edward Sutton III addressed the Vaughn community on Thursday, April 28th 2022 as part of the College's Industry Connection Seminar series. His talk discussed "Trends in Sustainable Infrastructure, Artificial Intelligence (AI), Digital Twins, and Opportunities for the Aspiring Innovator". He shared valuable insight into this emerging aspect of the engineering landscape.

Mr. Sutton manages this effort at Black and Veatch, a firm with a century of experience in building crucial infrastructure ventures. These critical projects require efficient solutions. Digital services are a means to help solve multifaceted challenges. His work at Black and Veatch centers around managing this complex orchestra of technology.

Edward showcased some interesting best practices in modernization. One key example was data analytics and A.I. Whereas people might analyze information well enough, A.I. proved a valuable tool for infrastructure optimization. Consider the case of electricity line management. While humans could find power distribution pole locations, the results were inefficient. A.I. leveraged rapid data processing of geospatial data for fast results. All of this was done with better accuracy and efficiency than humans could achieve. The A.I. tracking solution came out a clear winner.

Modernization was further explored through the notion of the “digital twin”. This concept means a virtual recreation of a physical location. Black and Veatch used AutoDesk Revit integration of drone photography point cloud and lidar data. The scans help re-create an industrial plant facility as a VR experience with Occulus Quest VR headsets. Another burgeoning field shown was UAV piloting for infrastructure. With surveying and photogrammetry, 3D scans and UAV aviators are in great demand.

Edward stressed that his career path wasn't a simple start with a position as a power system engineer. His passion for lifelong learning was a driving force. He sought out continuous self-improvement leadership workshops. During this exploration phase, he chose to become an engineer, since he was so passionate about this profession. His journey was inspiring to hear as he went from college grad to successful expert through a process of investigation. With so many opportunities out there today, it was good for our students to witness Edwards’s path of progression.

At the conclusion of the presentation, the discussion was opened up for questions from students and faculty.

Industry Connection Seminar

Thursday, September 22, 2022
11 a.m. to 12 p.m., Room - E101, and Zoom

Presenter: Dr. Gale Pomper, MCSE, MCT, CTT, Server+, EMA, MCTS Sharepoint, Security+, CISSP-ISSEP. Serves as the Director of Cybersecurity Operations (DCO) in a DoD Cybersecurity Operations Center – a 24/7 365 national-level entity, directing the fight against malicious cyber activity, every day of the year. Working closely with U.S. Cyber Command (USCYBERCOM) and other national cyber centers, the team prevents, detects, and responds to cyber events and incidents through integrated cybersecurity operations.

Topic: Cybersecurity Career Paths

Dr Pamper addressed the Vaughn College Faculty and Students on Thursday September 22nd, 2022, as part of the College's Industry Connection Seminar series for Fall 2022. Her presentation discussed "Cybersecurity Career Paths". Dr. Pomper shared valuable insight on the Cybersecurity career field in an engaging presentation based on the perspective of government, industry, and academia.

Dr. Pamper's presentation focused on cybersecurity certification and training for beginners, highlighting the International Information Systems Security Certification Consortium (ISC)² which is an international, nonprofit membership association for information security leaders. The organization is committed to helping their members learn, grow, and thrive. With a current membership of more than 168,000 certified members, the organization strives to empower cybersecurity professionals who touch every aspect of information security.

ISC^2 recently initiated a new Candidates program for individuals pursuing or considering a career in cybersecurity or already seeking an (ISC)^2 certification. Upon enrolling as an (ISC)^2 Candidate, participants receive access to exclusive programs and services, including discounts on official (ISC)^2 certification education courses, self-study materials and conferences. The (ISC)^2 annual due of U.S. $50 will be waived for the first year of the initiative (until September 2023) as (ISC)^2 Candidates work toward earning an (ISC)^2 certification like the (ISC)^2 CISSP® or (ISC)^2 Certified in CybersecuritySM entry-level certification. Upon enrolling as an (ISC)^2 Candidate, individuals have the opportunity to take the (ISC)^2 online, self-paced, education course for Cybersecurity certification and the exam for free. All (ISC)^2 Candidates are required to apply online and affirm that they will abide by the (ISC)^2 Code of Ethics.

Dr. Pomper also outlined that (ISC)^2 announced that (ISC)^2 Candidates is the first opportunity for individuals to participate in the One Million Certified in Cybersecurity^{SM} program. This is a new initiative that (ISC)^2 has pledged to put one million people through its entry-level Certified in Cybersecurity certification exam and education program for free.

How to Become an (ISC)^2 Candidate
All (ISC)^2 Candidates are required to apply online and affirm that they will abide by the (ISC)^2 Code of Ethics. To learn more and to become an (ISC)^2 Candidate at no cost for the first year (until September 2023), visit www.isc2.org/candidate.

Dr. Pomper also addressed other entry level cybersecurity programs that students could investigate and use as a means of getting in the cybersecurity career field. She outlined CompTIA IT Fundamentals (ITF+), which is an introduction to basic information technology

(IT) knowledge and skills that helps professionals decide if a career in IT is right for them. It also helps organizations prepare non-technical teams for digital transformation and could be used as a first year certification for a Vaughn College student resume. Along the same idea of getting entry level certification, she outlined the new SANS Institute's GIAC SEC275: Foundations - Computers, Technology, & Security, a brand-new course with an "entry level" GIAC certification. The course features a comprehensive variety of innovative, hands-on labs, and practical exercises that go far beyond what is offered in any other foundational course in cybersecurity. These labs are developed by leading subject-matter experts, drawing on the latest technology, techniques, and concepts in cybersecurity.

Who Should Attend SEC275?

The course provides exactly what students need to go from zero technical and security knowledge to a level of sufficient theoretical understanding and applied practical skills that will enable students to speak the same language as industry professionals.

Dr. Pomper closed the presentation by outlining the push by cybersecurity certification and training organizations like ISC², CompTIA, GIAC. The Biden administration is pushing to fill hundreds of thousands of cybersecurity jobs in the United States as part of a bid to close a talent shortage US officials describe as both a national security challenge and an economic opportunity. The time is right for Vaughn College students to take advantage of these opportunities to excel in cyber and cybersecurity.

Industry Connection Seminar

Thursday, October 20, 2022
11 a.m. to 12 p.m., Room: 101, and Zoom

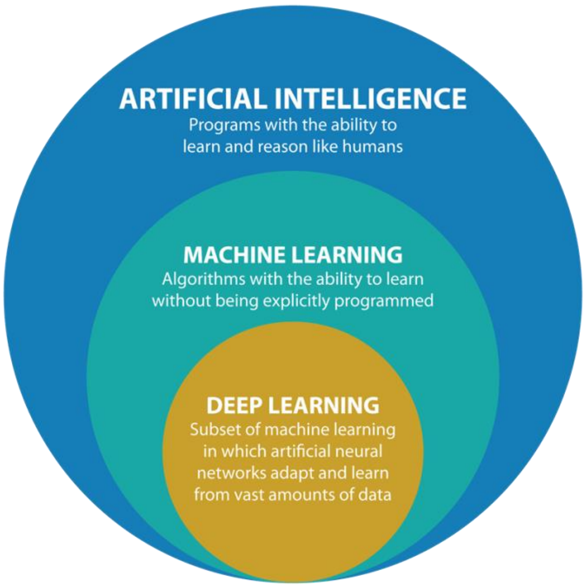
Presenter: Dr. Donovan Wright is retired US Army Officer with 24 years of service who is currently a Peraton Inc. consultant working with the US Department of Defense (DoD) as a senior digital transformation, cyber, and cybersecurity consultant at the Joint Force Headquarters-Department of Defense Information Network (JFHQ-DODIN). He is a Doctoral adjunct faculty member at Capitol Technology University and a Professor of Practice at Vaughn College of Aeronautics and Technology. Dr. Wright has extensive experience and education in digital transformation technologies, cyber, cybersecurity, data analytics, and artificial intelligence (AI).

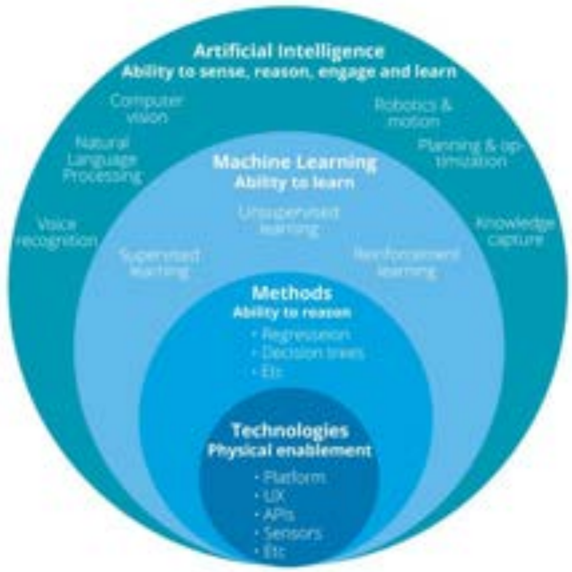
Topic: Artificial Intelligence (AI)

Dr. Wright addressed the Vaughn College Faculty and Students on Thursday, October 20, 2022, as part of the College's Industry Connection Seminar series for Fall 2022. His presentation discussed "Artificial Intelligence (AI)".

Dr. Wright started the presentation by using the YouTube video from Edureka on "Artificial Intelligence (AI) Tutorial" https://www.youtube.com/watch?v=WZVAfLreIwM to provide a detailed and comprehensive understanding of Artificial Intelligence (AI) and to provide real-life examples where AI is being used and the various Job Profiles one can apply if they have the right skill.

The video outlined to the Vaughn College audience the fact that artificial intelligence (AI) is a buzzword in the industry and for a good reason. Artificial intelligence has already made so much progress in technological fields and according to a Carnot report artificial intelligence is going to create 2.3 million jobs by 2020. The video highlighted the difference between Artificial Intelligence (AI), machine learning, and deep learning, as well the importance of artificial intelligence and how it is useful in our day-to-day.





Artificial intelligence as outlined in the video presentation, is a technological capability that enables machines to mimic human behavior. Artificial intelligence is the theory and development of computer systems able to perform tasks normally requiring human intelligence such as visual perception, speech recognition, decision-making, and translation between languages. This is a simulation of human intelligence conducted by machines programmed to learn how to reason and do some self-correction as needed along the way, and artificial intelligence is accomplished by studying how the human brain thinks and solve problems.

The video introduced the audience to examples of AI within our homes, which was best demonstrated by the widespread home technologies like Siri, Alexa, and Google Assistant. Compared to standard chatbots that are pre-programmed with responses to common questions, these conversational AI bots are more sophisticated. In contrast to chatbot interactions, these virtual assistants are set up to be more human-like, producing responses that are more believable and in line with actual human dialogues. Dr. Wright was able to make the presentation interactive by communicating with the Alexa machine, which captured the essence of the impact of AI technology with real-time display of input and output from the technology.

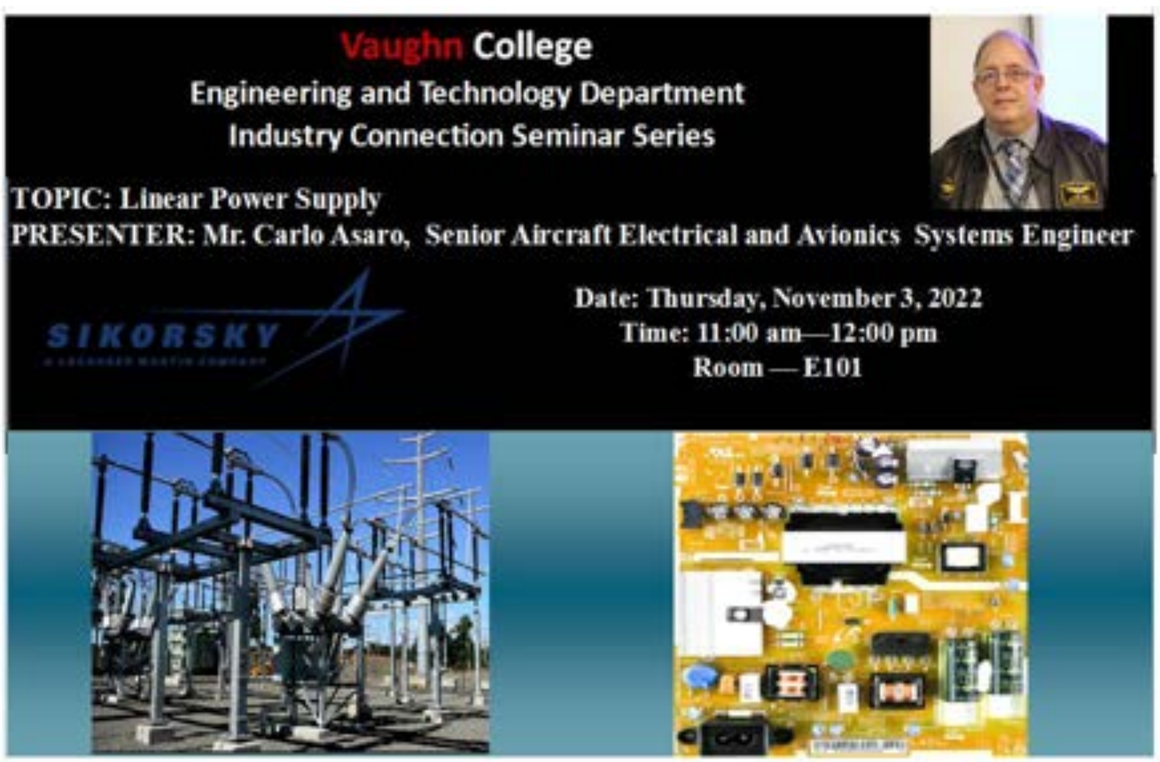
Dr. Wright closed the session off with a thirty (30) minute question and answer phase where he answered questions about AI. The main questions were centered around cybersecurity, as the audience outlined their fears of interacting with the AI technologies within their homes and what was perceived as a potential risk and exposure of their personal information. The audience was relieved of their fears as they were informed that the technology though not one hundred percent safe in respect to cybersecurity, fears of the risk could be alleviated by understanding how and when to use the technology, addressing any potential risk of information getting out by using the functions on the machines to allow input and output as needed. The bottom-line is the technology is very safe to use but it is important that the user understands the functions of the system which are built to protect the user, for example knowing how to turn off the input from systems like Alexa and Siri so that the system is only allowed to capture any voice or video input based on the user's need. Another major shortcoming highlighted by the presenter was the fact that even though artificial intelligence (AI) will touch every facet of life in our homes, work, and leisure, there are not enough laws or regulations to protect people within our society against unethical practice by AI driven organizations like Social Media Platforms. Dr. Wright highlighted instances of unethical practices by named social media and retail companies who have exploited public trust by using the AI Technologies for their own advantage and financial gain. He outlined a need for laws to be developed and implemented, so the social media and retail companies are held to ethical practices, hence protecting the best interest of citizens in the US and the World.

Industry Connection Seminar

Thursday, November 3, 2022
11 a.m. to 12 p.m., Room E101

Presenter: Mr. Carlo Asaro, Aircraft Avionics Systems Engineer with Sikorsky, a Lockheed Martin Company
Topic: Linear Power Supply

Mr. Carlo Asaro, an Aircraft Avionics Systems Engineer, addressed the Vaughn community on Thursday, November 3rd as part of the College's Industry Connection Seminar series. Mr. Asaro, has more than 30 years of experience in the industry in research and development, testing and evaluation of rotor-wing electronics with primary focus on power electronics and weapon systems. In this seminar, Mr. Asaro's presentation covered the most important topics pertaining to both Linear and Switching power supplies and their efficiency and application in a wide range of industries including aerospace and medical fields



The main focus of this seminar was to explain the differences between linear and switching power supplies. All engineers need to have a full understanding of what type of power supply they will need to use based on their specific application.

There are numerous pros and cons of both power supplies. However, the use of the wrong power source can lead to confusion or worse than that- damage to the design or system under test.

In conclusion, before proceeding to test a new design, the engineer with a good understanding of the differences between Linear and Switching Power Supplies can evaluate, based on the designed circuit, what power supply should be used to obtain a positive result.

At the conclusion of the presentation, the discussion was opened up for questions from students and faculty.

Industry Connection Seminar

Thursday, November 10, 2022
11 a.m. to 12 p.m., Room E101, and Zoom

Presenter: Dr. Fraser has over 15 years of IT and Cybersecurity experience which includes software engineering, system administration, and information security program integrity. He proposed a framework for economic development that is achieved by a country's resilient cyber workforce. In addition, he currently researches new ways to protect Financial Services' critical infrastructure. Dr. Fraser is the Chief Compliance Officer at Matrix Applications, a fintech leader in the fixed-income capital markets.

Topic: Cryptography

Dr. Fraser addressed the Vaughn College Faculty and Students on Thursday, November 10, 2022, as part of the College's Industry Connection Seminar series. His presentation discussed: Cryptography. Dr. Fraser started the presentation by defining cryptography and discussing why it is important to businesses, citizens, and governments. He explained how cryptography helps these entities communicate and store information securely. He discussed social and technical systems that support society and how the integrity of these systems is achieved by cryptography.

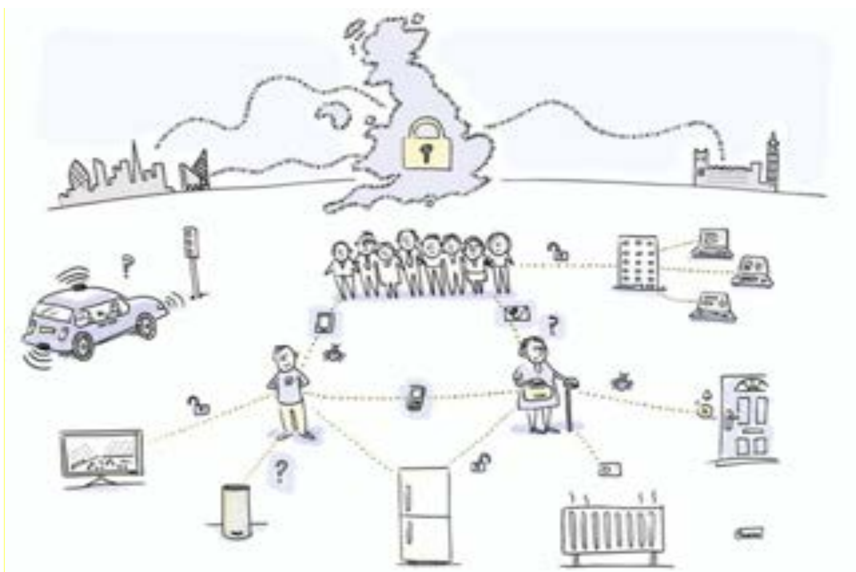
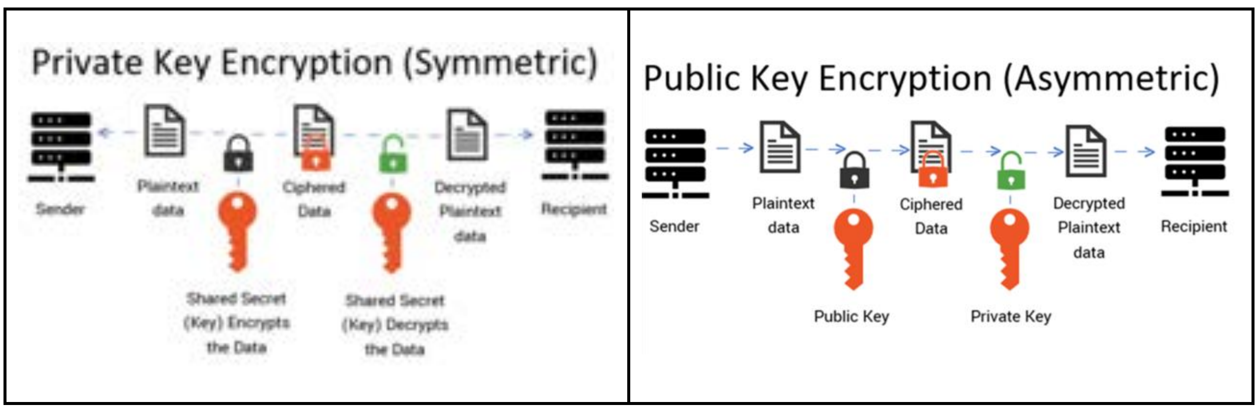


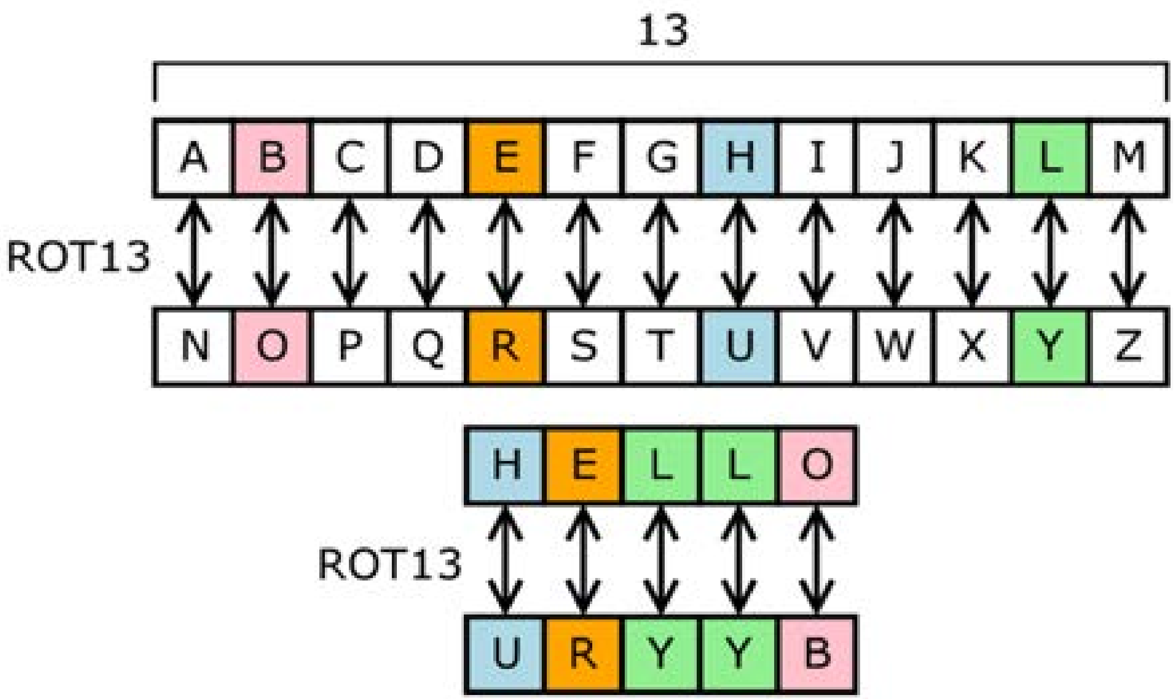
Image is taken from A sociotechnical approach to cyber security - NCSC.GOV.UK

The discussion explained how data privacy and laws protect people, their interactions, information, and the systems facilitating communications and services. He explained that in "secure communication" or crypto, there are typically two hypothetical people involved: a sender and a receiver. In order to achieve the desired protection, information is encrypted by the sender and decrypted by the receiver using mathematical techniques. Several uses of cryptography were discussed, including surfing the internet over the Hypertext Transfer Protocol Secure (HTTPS), a protocol used for secure communication over computer networks.

Cryptography as discussed in the presentation is the practice of concealing information by turning it into an unreadable code - enabling secure data communication and storage techniques. It is accomplished using two types of cryptography: symmetric and asymmetric. The symmetric approach requires that both sender and receiver of a message possess the same key. This technique is of limited use for the Internet where individuals with no prior contact require secure communication. To solve this problem the asymmetric or public-key approach uses key pair: a public key available to anyone and a private key held only by the key owner. These schemes provide confidentiality, integrity, authentication, and nonrepudiation in data management.



An example presented - Caesar's Cipher - is one of the oldest and most widely known. Also considered a shift or rotation cipher, the meaning of each letter is shifted by some set amount.
In this technique, the values of letters are shifted by 13 places. Thus 'A' ↔ 'N', 'B' ↔ 'O', and so on. This technique subtracts each letter by 13 places. For example, "S" - 13 = "F".



Dr. Fraser shared a ten (10) minute video that introduced the mathematics of cryptography. This video explained the use of Rivest Shamir Adleman (RSA) and the Diffie-Hellman Protocol "https://www.youtube.com/watch?v=xmwxDHX6xUc" to achieve encryption. Two algorithms that use random prime numbers were explained to show how mathematical calculations are essential to developing secure cryptographic schemes. It also underscored the importance of permutations and keeping cryptographic keys secure.

Dr. Fraser closed the session off with a ten (10) minute question and answer phase where he answered questions about blockchain, cryptography, and quantum computing. He was asked which year to begin teaching the subject in college, and he explained that cryptography can be taught to students entering freshman year. This is because its application is diverse and not all students will pursue advanced mathematics and cryptography. Learning cryptography early in college provides knowledge of techniques that can be used to accomplish information security in different areas of technology.

Dr. Fraser shared several encryption-cracking and data-protection tools. In addition, he provided links to Cryptographic Storage and Key Management Cheat Sheets. He provided a lab and associated reading resources for students to complete in order to better understand and observe cryptography.

Lab: https://vaughnedu-my.sharepoint.com/:f:/g/personal/dustin_fraser_vaughn_edu/EmxLFIUDN0ZNmxW2czGQ-gkB5JMoNAyuGiPP4yCoc08zYg?e=xwNaU6

Industry Connection Seminar

Thursday, December 8, 2022
11 a.m. to 12 p.m., Room: 101, and Zoom

Presenter: Dr. Gale Pomper, MCSE, MCT, CTT, Server+, EMA, MCTS Sharepoint, Security+, CISSP-ISSEP. Serves as the Director of Cybersecurity Operations (DCO) in a DoD Cybersecurity Operations Center – a 24/7 365 national-level entity, directing the fight against malicious cyber activity, every day of the year. Working closely with U.S. Cyber Command (USCYBERCOM) and other national cyber centers, the team prevents, detects, and responds to cyber events and incidents through integrated cybersecurity operations.

Topic: Data Analytics

Dr Pomper addressed the Vaughn College Faculty and Students on Thursday, December 8, 2022, as part of the College's Industry Connection Seminar series for Fall 2022. Her presentation discussed "Data Analytics". Data analytics is the study of examining unprocessed data to draw inferences about such information. Many data analytics methods and procedures have been mechanized into mechanical procedures and algorithms that operate on raw data for human consumption.

KEY DATA ANALYTICS TAKEAWAYS

- Companies, organizations, and individuals can increase productivity, maximize profit, or make more strategically sound decisions with the use of data analytics.
- Data analytics methods and procedures have been mechanized into mechanical procedures and algorithms that operate on unprocessed data for human consumption.
- Data analytics can take many different forms, such as looking at what happened, why something happened, what will happen, what should be done next, or all the above (descriptive analytics, diagnostic analytics, and predictive analytics) (prescriptive analytics).
- For the most extensive data manipulation, data analytics relies on a number of software tools, including spreadsheets, data visualization and reporting tools, data mining applications, or open-source languages.

Four fundamental categories of data analytics are distinguished.
Descriptive analytics: This explains what has occurred over a specific time period.
Diagnostic analytics: This is mainly concerned with the causes of events. This requires more varied data inputs as well as some speculation.
Predictive analytics: This shifts to what is most likely going to soon occur.
Prescriptive analytics: This offers advice on how to proceed.


There are several different analytical methods and techniques data analysts can use to process data and extract information. Some of the most popular methods are listed below.

Regression analysis entails analyzing the relationship between dependent variables to determine how a change in one may affect the change in another.

Factor analysis entails taking a large data set and shrinking it to a smaller data set. The goal of this maneuver is to attempt to discover hidden trends that would otherwise have been more difficult to see.

Cohort analysis is the process of breaking a data set into groups of similar data, often broken into a customer demographic. This allows data analysts and other users of data analytics to further dive into the numbers relating to a specific subset of data.

Monte Carlo simulations model the probability of different outcomes happening. Often used for risk mitigation and loss prevention, these simulations incorporate multiple values and variables and often have greater forecasting capabilities than other data analytics approaches.

Time series analysis tracks data over time and solidifies the relationship between the value of a data point and the occurrence of the data point. This data analysis technique is usually used to spot cyclical trends or to project financial forecasts.

Data analytics has rapidly advanced in terms of technological capabilities, in addition to a wide range of mathematical and statistical methods for crunching numbers. Data analysts can now gather data, store information, process data, and publish conclusions with the use of a wide variety of software tools. Microsoft Excel and spreadsheets have long had a tenuous relationship with data analytics. Now, to convert and manipulate databases, data analysts frequently work with unstructured programming languages. Python and other open-source languages are frequently used. Statistical analysis or graphical modeling can be done using more specialized data analytics tools like R.

Data analytics assists individuals and organizations in ensuring the accuracy of their data in a world that is relying more and more on information and statistics collection. A set of raw numbers can be turned into instructive, educative insights that guide decision-making and considerate management using a range of tools and methodologies.

At the conclusion of the presentation, the discussion was opened up for questions from students and faculty.

Engineering Seminar Series

Thursday, Feb 16, 2023
11 a.m. to 12 p.m., Room E101

Presenters: Tatiana Jaimes, a current graduate in Mechatronic Engineering Program
Topics: An Overview of Summer Internship Programs with Daimler Truck North America
Project: ePowertrain Systems Validation

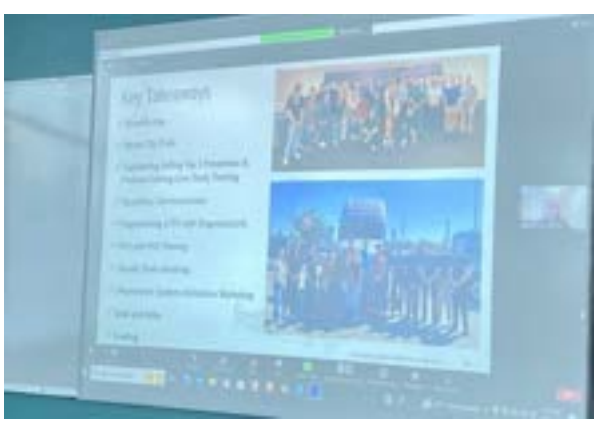
On Thursday, February 16th, as part of Engineering Seminar Series, Tatiana Jaimes presented to an audience of students and faculty regarding her internship working on e-Powertrain Systems Validation at Daimler Truck North America in Detroit Michigan. Tatiana was part of a 12-week internship over the summer of 2022 on the Research and Growth Fleet or (RG) for short and on-board diagnostics (OBD) systems. Tatiana delivered a detailed presentation about her time at Daimler.

After an onboarding session, Tatiana was put to work straight away on tracing fault comments from the RG drive cycles. Canopy software was used as tool to record and interpret incoming signals from Daimler's E-Truck platform fitted with an electronic control unit. The aim of her work was to correlate driver fault comments recorded during drive cycles to a fault signal and ensure proper system functionality.

To achieve this, daily driver fault comments were collected from each drive cycle and assigned to an error or caution pop up. These error conditions were then exported to a database along with the VMM signal name responsible for the error condition pop up. One of the most common error conditions was a “Charger Plugged In, Start Inhibited”; put simply, this means the truck isn’t charging as it should. Once the connection between the charger plug in error and VMM signal was established the error could be examined in greater detail. For example, one could search the database for other instances of this error and develop a detailed report of the fault so the engineering team could solve the problem. Tatiana was also tasked to find applicable solutions using a troubleshooting databased called “JIRA”. If an error condition was a new occurrence it would be added to the JIRA system to notify the engineering team. Tatiana was able to track and identify the issue and completely map its history into an easy-to-read table format. Later she validated the corrective actions with the engineering team.

Troubleshooting using the Canopy software system was the core of her work at Daimler. Most importantly Tatiana gained valuable experience working in the plant facility interacting with test drivers, manufacturing, and engineering teams. Interns from Purdue University and other schools were present as well. This allowed Tatiana to gain valuable teamwork experience by interacting with a diverse group of Daimler engineering mentors and student peers from around the country.

After an informative report of her work with Daimler, Tatiana fielded student questions about the logistics of getting an internship. She revealed tips on obtaining housing and how to develop a unique internship application and pique the interest of recruiters. This was Tatiana’s second internship activity after a previous NASA Johnston Space Center Internship. As faculty we were proud to host Tatiana’s presentation and look forward to hearing about her future achievements, since she is a recent graduate of our Mechatronics program.



Industry Connection Seminar

Thursday, Feb 23, 2023
11 a.m. to 12 p.m., Room W143

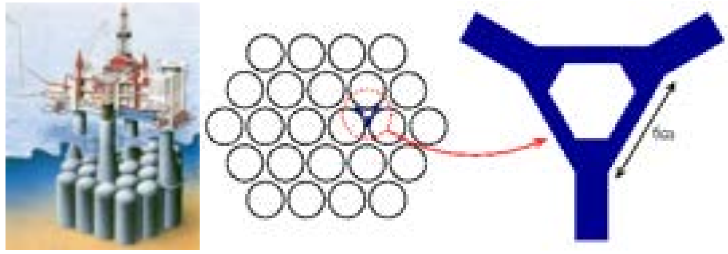
Presenter: Ariel Ferrera, P.E., Mechanical Design Engineer, Blue Origin
Topic: Common Industry-Specific Mechanical Engineering Design Principles Using Finite Element Method

Mr. Ariel Ferrera, a Mechanical Design Engineer for Blue Origin and a Vaughn Alumni, addressed the Vaughn community on Thursday, February 23rd as part of the College's Industry Connection Seminar series. His talk discussed "Common Industry-Specific Mechanical Engineering Design and Analysis Using Finite Element Method". He shared valuable insight about finite element modeling and the use of various software for both 3D CAD Modeling (PTC Creo, CATIA, NX Siemens, and SolidWorks) and finite element analysis (ANSYS, Siemens Femap, and PATRAN/NASTRAN).

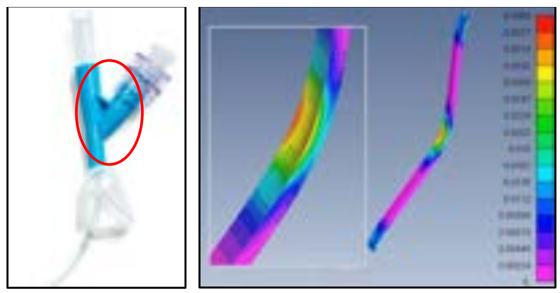
In this seminar, Ariel covered the most important topics in selecting a proper finite element model and conducting analysis based on underlying assumptions. His presentation provided insight into the application of Finite Element Method (FEM) in a wide range of industries that he was involved, including gas turbine design, pressure vessel analysis, and aerospace applications.

His presentation provided some real-world examples of failure due to incorrect FEA modeling/conditions such as:

1) Sinking of Sleipner, an offshore platform - The main culprit of the failure in the engineering investigation report was found in the finite element analysis (NASTRAN) of the Tricell region of the model where "Unfavorable geometrical shaping of some finite elements that led to an underestimation of the shear forces at the wall supports by some 45%".



2) Y-Adapter Design Recall - Leak from the septum assembly or the canister may burst under high pressure which could result in fluid exposure during use. Linear elastic finite element model underpredicts failure due to material nonlinearity.



In conclusion, he provided some industry standards pertaining to ASME boiler and pressure vessel codes, finite element analysis V&V, and ASTM FE Modeling Standards, that need to be followed for verification and validation in finite element model selection and analysis.

At the conclusion of the presentation, the discussion was opened up for questions from students and faculty.



Engineering Seminar Series

Thursday, March 9, 2023
11 a.m. to 12 p.m., Room E101

Presenters: Yusuf Rafi, Senior in Mechatronic Engineering Program
Topics: An Overview of NASA Internship Program at NASA Glenn Research Center
Project: Sensor Processing, Fabrication, and Testing for Characterization and Development Applications

On Thursday, March 9th, as part of Engineering Seminar Series, Yusuf Rafi presented to an audience of students and faculty regarding his NASA internship program. He spoke about his internship at the Glenn Research Center, a facility established in 1958 as a response to Soviet era advances in aerospace. Today the research facility is used for a wide range of technical expertise in propulsion, power systems, and communications systems. His internship was performed in the Smart Sensing and Electronic Systems branch where he was part of a team working on instrumentation for ongoing and future space exploration and propulsion systems.

The aim of this lab centers on research and development for high end space worthy sensors. This is achieved through use of a state-of-the-art microsystem fabrication facility complete with class 100 clean rooms, chemical testing labs, and hard environment labs capable of nanostructure fabrication, analysis, testing, and evaluation. In this lab, technology is developed, tested, and evaluated to validate its effectiveness for use in space exploration. One prime example of this technology is the Smart Sensor. In short, a smart sensor is a sensor element with an embedded microprocessor. Although the sensors are basic, their functions are augmented through inclusion of embedded intelligence.


Yusuf conducted hands-on work in the lab producing test sensors through training from his NASA mentors. Photolithography is used to embed the sensor design onto a silicon wafer with UV light. Once the sensor is imaged onto the silicon a sputtering gun applies titanium and gold metal deposition to the sensor geometry. Later the wafer is placed into an acetone solution and ultrasonic bath to clean the sensor package. Great care must be shown when using the ultrasonic bath. Bathing the sensor for too long can result in a damaged sensor, as prolonged ultrasonic vibration can damage the metal deposition layer resulting in a scrapped wafer.


Vaughn College training was put to good use in developing documentation for the High Vacuum Deposition System as original documentation was lost. SolidWorks CAD knowledge attained in CDE117 allowed Yusuf to create detailed CAD models suitable for training new lab techs. Other deliverables included the sensor wafers, sensor-related experimental data, and an intern mid-term presentation delivered to experts at NASA. The documentation on all internship related work was turned into NASA so that future teams could reproduce all the tasks performed by Yusuf and his mentors.


Later in the presentation, Yusuf shared some top tips on how to attain an internship with NASA. Surprisingly, recommendations weren't required and the whole process was quite straightforward and enjoyable. He stressed how important technical writing and presentation skills were to operating within NASA's work culture. Yusuf ended his presentation by encouraging student audience members to apply for NASA-paid internships. Although chip fabrication isn't his area of study, the experience enriched his college experience and Yusuf would love to work with NASA as a professional. Most of all, the internship opened his eyes to the soft skills requirements for anyone considering a career with NASA.

Engineering Seminar Series

Thursday, March 24, 2023
11 a.m. to 12 p.m., Room E101

Presenters: Alina Santander, Senior in Mechatronic Engineering Program
Topics: An Overview of Summer Internship Program with Honeywell Intelligrated
Project: Automated Systems in Material Handling

On Thursday, March 24th, as part of Engineering Seminar Series, Alina Santander Vinokurkova presented to an audience of students and faculty about her internship as a mechanical team project engineer with Honeywell and their Automated Systems and Material Handling Division. This company has developed warehouse systems and supply chain setup for Amazon.com since the early 2000's. They specialize in conveyor systems, control systems, and robotics integration. This technology facilitates automation and lifecycle support for massive online retailers that run express fulfilment centers.

Alina explained the organizational structure of Honeywell and her participation in the mechanical engineering division during the summer internship. Presently she is working with the electrical division team and recently trained with the control system division. All the interns at her division were given a presentation on the history of the company and its strong relationship with their most renowned customer, Amazon.com. During this orientation Alina also learned about company nomenclature along with all the various three- and four-letter acronyms specific to their projects and services. Part of the internship included 3-week training with AutoCAD and HCAD for conveyors, cage training for conveyor training, engineering standards, PLC programming, and company related professional skills development.

As part of her journey, Alina identified several personal goals to attain as part of her internship. Key among them were improvement of communication skills, growth in leadership, and most important, a return job offer. Her work centered around office-based design drawing correction and optimization of conveyor systems. Cost reduction methods were explored using Excel to SCRUB operations on duplicate orders. A huge part of this position was time management and prioritization of project tasks. Hands-on activities included on site visit warehouse audits and OSHA safety training,

At the end of the presentation Alina reflected on her time at Honeywell by sharing a performance review bristling with successfully completed job tasks. This report verified how she delivered the scope and sequence of her job requirements on time and under budget. She was able lower costs by optimizing the delivery process. As an engineer, she achieved social and global impact through improvement of her teamwork skills and contributing to the global supply chain with efficiency.

We are extremely proud of Alina's accomplishments and how her time in Vaughn College Mechatronic program really prepared her for professional engagement in industry. At the conclusion of her presentation, the discussion was opened up for questions from students and faculty.

Engineering Seminar Series

Thursday, April 13, 2023
11 a.m. to 12 p.m., Room E101

Presenters: Isa Al-Maktoum, Senior in Mechatronic Engineering Program
Topics: An Overview of Summer Internship Program with PSEG ISS at Montclair State University
Project: Sustainability

On Thursday, April 13th, as part of Engineering Seminar Series, Isa Al-Maktoum a senior student in Mechatronic Engineering presented to an audience of students and faculty about his summer internship program with PSEG ISS at Montclair State University. In this seminar, he focused on sustainable development across various industries and demonstrated the importance of sustainability as well as career-building learning experience that he gained through his involvement in this internship project.

As part of this internship program, Isa talked about several important goals to attain as part of his summer internship project, including topics pertaining to 1) Sustainability and a process for sustainable development, 2) Objectives, goals and outcomes of PSEG ISS (Institute of Sustainability Studies), 3) Who are the PSEG ISS green teams and what are the PSEG ISS deliverables. In addition, Isa expressed that this internship not only provided him with an insight about sustainable research but also helped to improve his soft skills.

At the conclusion of the presentation, the discussion was opened up for questions from students and faculty.

Summer Engineering Experience (SEE-STEM) Program, June 27th to August 11th

SEE-STEM Exhibition Day, August 10, 2022

On Wednesday, August 10, 2022, students, guests, attended a SEE-STEM student exhibition. From June 27 to August 11, a total of five combined high school seniors and college freshman students enrolled and participated in a six-week summer residential program, the Summer Engineering Experience (SEE – STEM) program. This program is supported by the title III HSI-STEM grant and is designed with the objective of enhancing students' hands-on, computational, programming, communication, and problem-solving skills. The 2022 Summer Engineering Experience program covered topics related to an Intro to Cybersecurity, Artificial Intelligence, the First Year Initiative, Computer- aided design (CAD) & Additive manufacturing, and technical writing.

The morning session of the SEE-STEM Exhibition Day was devoted to a presentation by students about their learning experiences throughout the 2022 Summer Engineering Experience Program. During this event, each student provided a detailed 7-to-10-minute presentation about their learning experience on topics pertaining to Cybersecurity, Artificial Intelligence, Computer-aided Design, Additive manufacturing, and CNC machining. After each student presentation and Q&A session, a feedback rubric survey was distributed to faculty judges, so they could evaluate the student learning experiences in the SEE-STEM program.



The afternoon session of the SEE-STEM Exhibition Day was devoted to the poster session, and for this session each student discussed a specific topic of interest to them. Below is a brief description of each poster presenter.

SEE Manufacturing Workshop Poster

Fernando Saez discussed manufacturing procedures with faculty and family members. His poster presentation was the result of a six-week program. Students learned technology such as CNC, Additive Manufacturing, and 3D scanning. Workshops ran every Friday and included hands-on activities.

Rachid Nafaa, our resident machinist, did demonstrations of CNC tool, machine, and CMM part inspection as part of the workshop. The hands-on experience explored part design for CNC, blueprint reading, and CAM. Lastly, Vericut CNC software was used to examine CAM programs for errors. By Using Vericut in our labs we ensure compliance with industry standards. Prototype design and iteration with consumer grade 3D printers was a main topic. The instructor advocated a “Maker’s Mindset” using a low-cost printer for maximum accessibility.

Reverse engineering with 3D scanning used off-the-shelf PC’s, Artec and Shinning 3D range of scanners. We demonstrated 3D scanning for a few different outcomes, such as 3D scanning for consumer hard goods and entertainment graphics. Later, inspection grade scanning showcased the Shinning 3D range of scanners. Scan data post-processing and clean up was done with proprietary software solutions included with each scanner. By the end of the workshop students learned a variety of tools. Students scanned their peers with Artec scanners and learned top tips through real-world examples and procedures.

Manufacturing Workshop Poster by Fernando Saez

CAD SOLIDWORKS and 3DS Max poster

Matthew presented his poster on "CAD: SOLIDWORKS and 3DS Max". Both are popular computer-aided design software offerings from market leaders in the field. SOLIDWORKS and 3DS Max cater to different areas of 3D content creation. SOLIDWORKS is engineering grade CAD software. It uses fully defined dimension driven 2D sketches and sketch based parametric 3D feature creation as the basis for its part making. 3DS Max relies on the direct editing of polygonal 3D geometrical elements such as points, edges, and polygons. This process offers a free-form part creation experience. These two distinct and rigorous approaches to 3D part making strengthen student CAD abilities.

Through this course, students worked on industry standard CAD procedures. SOLIDWORKS course tasks covered 2D sketch creation with geometric and dimensional constraints. Part design and assembly methods stressed best practices for project documentation with SOLIDWORKS drafting. 3DS MAX tasks leveraged the software's robust object creation tools. 3Ds MAX's Architectural interior design tools allowed creation of scenes for VR. The VR DATASMITH CAD export plug-in offered real time graphics with its GPU rendering engine.

The use of two computer graphics software packages in the SEE program emphasized the concept of lifelong learning. As part of their instruction, we coached students to seek out educational material on their own outside the scope of class work. They were also reminded that industry trends change. Software packages in favor today may lose market share resulting in a somewhat diminished skill set. Instructors encouraged students to explore CAD and computer graphics applications on their own. Time and effort spent on such activity can help build the skills required to remain current with industry trends.

CAD SOLIDWORKS and 3DS Max poster by Matthew Flores

Engineering Tech writing poster

Tchanari presented the topic of our English and First Year Experience course offering. For Tchanari English is a second language. To master his public speaking skills, he volunteered as the group PowerPoint team leader in order to improve his expertise. Effective writing standards are applicable to all aspects of the engineering curriculum, since clear communication is essential within this industry.

The FYE course trained students how to navigate the transition to college life. Tours of the facilities and topics such as proper registration methods, dorm life, and club offerings prepared students for the upcoming fall term. All this instruction emphasized the importance of maximizing time and effort. Tchanari shared that running both these courses during the summer session allowed him to concentrate more fully on course tasks. Smaller class sizes and one-on-one access to the professor helped him achieve course outcomes. The SEE version of the English class was quite useful, as he was able to focus more on course content with this direct contact with the instructor.

Engineering Tech writing poster by Tchanari Kombieni

Intro to Cybersecurity Poster

Ryan Kurkela opted to create a poster based on the Cybersecurity workshop run by Dr. Donovan Wright. In this course, Dr. Wright served as an industry expert and mentor to the students. The experience consisted of lectures and a collection of online course content aggregated by Dr. Wright. At the end of the class, learners earned Cybersecurity certificates from Coursera and IBM.

Students learned the best practices for safe internet navigation with antivirus methods and strong firewalls. The course covered cybersecurity threats such as Viruses, Spyware, Adware, and Ransomware. Crucial best defense tactics against exploits offered hope to guard systems for many industries.

Intro to Cybersecurity Poster by Ryan Kurkela

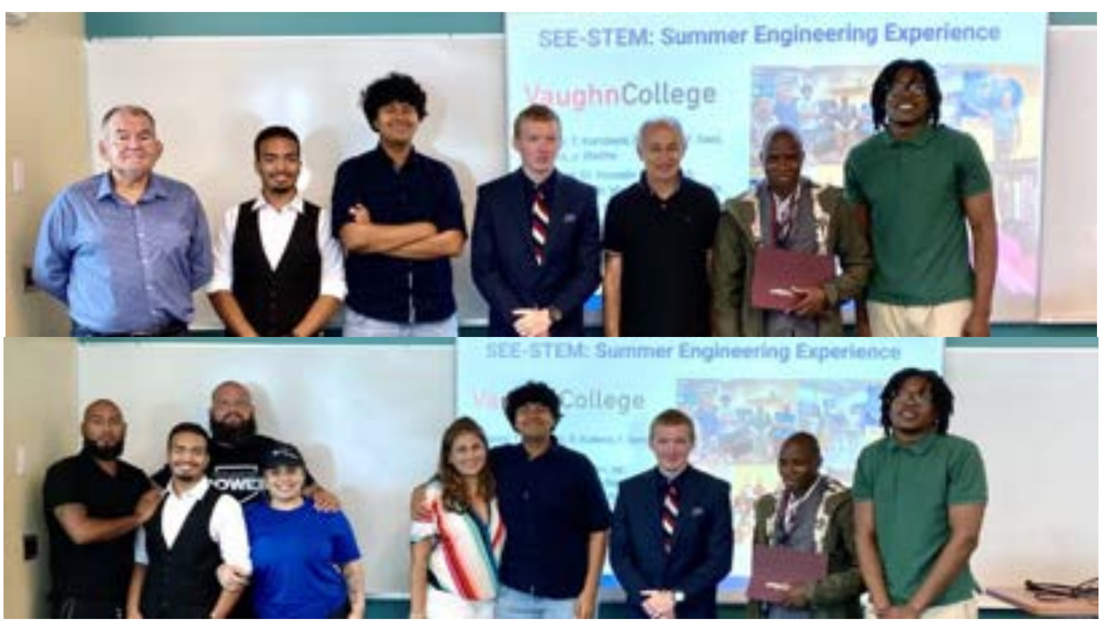
Introduction to Artificial Intelligence

Joshua provided an overview of the A.I. workshop offering developed by Dr. Wright. The introductory course discussed A.I. at the technology level. Topics such as machine learning, robot ethics and neural networks offered prime examples of A.I. Video game characters, robotics, and voice recognition exposed how A.I. has become mainstream. Joshua was an engaged presenter. He was both knowledgeable and enthusiastic regarding the course content. At the end of the presentation, he led a conversation about the ethics of A.I. and he debated the topic of A.I. consciousness with the audience.

Introduction to Artificial Intelligence by Joshua Waithe

All students in the SEE-STEM program were able to register for the IBM Introduction to Cybersecurity Essentials and successfully completed and received the IBM Coursera certificate.

In conclusion, Dr. Rahemi, congratulated all SEE-STEM presenters, and he emphasized how proud the Vaughn community is for their accomplishments. He thanked Vaughn's STEM Activity Liaison, Prof. Jesus, and all other SEE-STEM faculty mentors who worked passionately with students through their presentation to prepare them for this event. Finally, he extended his gratitude to the federal department of education Title III HSI-STEM funding support for all STEM activities, including this summer bridge program which enhances student learning and prepares them for their future career path.



Vaughn's 8th Annual Manufacturing Day, Virtual Conference and STEM Workshops October 28th 2022, 10 am to 3 pm

Leadership Session of Manufacturing Day Conference – Presentation of Industry Leaders

The Engineering and Technology department hosted its 8th Annual Manufacturing Day conference on Friday, October 28th from 10 am to 3:00 pm to celebrate the National Manufacturing Day. Vaughn College invited seven industry leaders to address invited guests and the Vaughn community about manufacturing innovation. The presentation featured a diverse variety of presenters in the field of manufacturing and topics such as Autonomous Mobile Robot in Logistics; Additive Manufacturing in Aerospace; Data Science; Data Analytics, and Its Importance to Business and How to get into the Career Field; Base 11 Program; Digital Transformation and What It Means to Organizations; Introduction to Digital Twins; and Scanning & Reverse Engineering Hardware were covered in 25-minute presentations followed by 5 minute question-and-answer sessions.

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Professor Manuel Jesus, 3D & CNC curriculum developer and STEM Activity Liaison assisted the department chair and HSI-STEM project director with organizing and hosting the 8th Annual Manufacturing Day conference, and he also served as a moderator for this event. Dr. Sharon DeVivo, the School President opened the ceremony with introductory remarks and welcomed the guests and thanked our advisory members and alumni for their active participation and support of the institution and student success

Autonomous Mobile Robot in Logistics

Our first presenter was Jefferson Maldonado, a Vaughn College Mechatronics Engineering Program graduate. Jefferson is Director of Robotics and Automation at ArcBest, a logistics company using robotics as a core part of their business. At ArcBest creativity, integrity, and growth form the basis of their core values.

Jefferson discussed the difference between AMR and AGV robotics systems that are designed to dynamically change to different workflows. AMRs include the processing ability to deploy robotics without infrastructure changes due to their great level of autonomy and flexibility. AMR's will detect objects and classify obstacles as "costs". The robot will always plan to navigate a path with the least cost and dynamically adjust along the way.

In addition to autonomous control, ArcBest is innovating in remote control operation of forklift vehicle driving. This company made a $25 million-dollar investment in Phantom Auto, experts in low latency video streams that facilitate remote vehicle piloting; with this acquisition ArcBest can now offer remote vehicle piloting as an option. In this scenario, a human can remotely jump into the driver's seat when autonomous navigation won't work. At the end of the presentation, Jefferson invited students to apply for employment with ArcBest as they are always looking for creative minds and competent engineers.

AM Market Trends and Opportunities for 2020-2030

Davide Sher presented “3D Printing Business Media (3DPBM) and AM Market Trends and Opportunities for 2020-2030”. His company researched the AM landscape after identifying a lack of quantified data on the market. In his presentation he subdivided AM into the various core industry segments of equipment manufacturers, materials manufacturers and service bureaus. Materials were identified as a major driving force for the industry, in particular, popular metal, polymers, ceramics, and composite materials.

The entire AM industry market share is valued at $9.56 Billion, with 65% of the market share dedicated to hardware and materials and the remaining 35% dedicated to service providers. Despite a combined annual growth rate of 29% over the next 30 years AM still remains a small segment of the overall manufacturing industry. However, within this framework there is still a huge growth opportunity for AM.

Materials growth is most high with polymers and metals. Political instability and the pandemic actually increased the adoption rate of AM as many companies diversified. Companies evolved to offer both materials and AM services. Automation of post processing was identified as a growth opportunity. It's now cost effective to produce up to 50,000 units depending on part volume. The presentation closed with a Q and A session with questions related to public health factors. Particulate matter powder-based materials, and liquid photopolymers were identified as a potential toxic material.

Data Science, Analytics and Its Importance to Business

Data Science, Analytics and Its Importance to Business was covered by Leonard Manhanga. Much of Leonard's time was spent at Toyota and the banking sector before joining Grainger, a prominent maintenance, repair, and operations firm. Data science was presented as a multi-disciplinary field, since it combines business knowledge, mathematics, and computer science. The ultimate goal of data science is to extract knowledge and gain insight from both structured and unstructured data. Algebraic modeling was identified as a core skillset where mathematics shapes the foundation of all aspects in data science. Within this emerging field, full stack data science for product development has become a hot "in demand" specialty in which practitioners focus on product development and artificial intelligence. Students who wish to pursue data science should focus on business, mathematics, and mastery of programming languages at the college level. Academics are important, but an attractive employment candidate should be a motivated positive proactive student. Engagement in internships and business networking activities are key achievements to pursue. Involvement in data science, student academic publications, and conferences remain great methods to brand students as emerging experts in their field. Master's degree programs in Computer Science are still the best continuing education path to pursue. Although certifications offer vendor specific credentials, they can't replace the rigors of a strong graduate degree program.

Base 11 Program

Al Bunshaft spoke of his work with Basse 11, a nonprofit STEM workforce development organization. Its ultimate focus is to accelerate 100,000 underrepresented African American students into next frontier industries such as AR/VR, Autonomous Systems, and Advanced Manufacturing. B11 attains sponsorships from corporations and connects students with mentorships, develops curriculums, and offers academic partnerships to position students as valuable STEM workforce assets.

MR. Bunshaft described how corporate sponsors such as intel, Honda, and 3M arrange opportunities through internships. He shared the success stories of Breanna Allen, an Automation Engineer with Precision Castparts and Michael Allotey, a Cloud Engineer with Amazon. Various student engagement levels were discussed. Students will start with the member engagement funnel where they attend B11 events, create linked in profiles, and eventually complete a B11 STEAM course to seek job opportunities. Lastly, Al extolled the virtues of involvement with Base 11 as a way to give back to communities and propose STEM education program offerings to students.

Digital Transformation and What It Means to Organizations

Dr. Donovan Wright is a consultant with the US Department of Defense as a Cyber Security Consultant. With many years of professional experience and post graduate level studies he is uniquely positioned to comment on the effects of digital transformation in manufacturing. The core of Dr. Wright's presentation dealt with the 4th Industrial revolution where automation, semi-autonomous and autonomous systems all function to provide next generation manufacturing systems. This is achieved through adoption of a strong digital transformation (DX) strategy that skillfully navigates the optimization of people, process, technology, and data governance. DX is important to all organizations and when done well it reduces operating expenses and inefficiency in a rapid adaptable fashion. Enabling technologies in the DX landscape include computing power, artificial intelligence, and cybersecurity. Workforce skills center around data science and analytics, digital literacy, and digital marketing. IBM Skills Academy and The American Dream Academy were presented as organizations where current Vaughn College students could get started with DX. This goal is realized by taking online skill building course certifications in design thinking, cloud computing, quantum computing, and the internet of things.

Introduction to Digital Twins

Florent Salako from Dassault Systems USA spoke about the Dassault 3DExperience Cloud Platform. This cloud-based software suite consists of 13 brands covering 11 industries through collaborative software, simulation, and 3D modeling apps. Dassault was presented as a technology leader enabling industrial transformation via CAD 3D Design, digital mockups of complex systems, and product lifecycle management. The 3DExperiece platform emphasizes product usage through development of engaging user experiences.

Various digital twin experiences were explored. Factory planning, part machining, and logistical architecture were shown as optimal system process and physical modeling examples. In this digital twin model, a manufacturing process is simulated before real world production begins to optimize the production and costs. Process simulation was covered with examples of factory layouts, robot programming, process validation, and ergonomics. Lifelike experiences rounded out the presentation with Virtual Reality exercises in training, process validation, and product operations. Job examples such as a production programmer, product designer, and process planner were covered. In all scenarios students start with one core app such as CATIA V5 then diversify their skills by learning various apps in the 3DExperience platform.

Selecting Scanning and Reverse Engineering Hardware

Joel Pollet from Cimquest, an additive manufacturing and reverse engineering solutions vendor, held a discussion about selecting a 3D scanner for reverse engineering. With many scanners on the market, various factors drive 3D scanner purchase decisions. Firstly, object size is the most important factor when selecting a scanner. Next, we must consider the application of things such as reverse engineering, artistic preservation, 3D printing, or metrology. In inspection metrology we navigate the most demanding requirements as the scan data is compared to nominal scan data during precision manufacturing. The most critical aspect of choosing a scanner is understanding accuracy vs. resolution problem. Accuracy refers to positional accuracy of acquired 3D scan data relative to the original surface. Resolution refers to the number of points collected when scanning. Smaller detailed structures require higher resolution and a dense point cloud. Ideally one must choose the best accuracy and resolution combination within their budget. Software requirements also play an important role in making scan data useful. Scanners must be able to export the scan data into a file format accessible by CAD and 3D design software. Color 3D scanning was identified as a possible drawback since use of color 3D texture data can hide low resolution object geometry. In this scenario RGB pixel texture data is overlaid onto lower resolution scans to fake higher resolution scan data. Lastly one must verify scanner manufacturers have published accuracy specifications before purchasing. Any reputable vendor should be willing to perform a test scan of the parts you want to work on in your projects. The output quality should help you finalize your purchase decision.

In conclusion, Dr. Rahemi expressed his sincere gratitude to all guest speakers, industry advisory members, and invited guests for their participation at Vaughn's 8^{th} annual manufacturing day conference as well as for their continuous support in every aspect of the department and institution. Dr. Rahemi expressed his gratitude for the support provided by the Department of Education federal fund as part of Title III, HSI-STEM and Title V STEM grant.

STEM Outreach Workshops

In a parallel session, from 10 am to 1:00 pm, Vaughn's Robotics, UAV, SWE, and SHPE clubs organized and hosted STEM workshops for the Community Colleges and high school students. These in-person workshops covered the following topics

1. Robotics Workshop - Robotics design & autonomous programing
2. An informational session about the basics of drones and the design considerations
3. Build a Drone Workshop and A Drone Practice Flying Session.

More than 120 high schools and community colleges students and their mentors from Freeport, Bayside, Thomas Edison, Wyandanch, Uniondale and Hostos Community College attended the in-person STEM outreach workshops on building a drone, robotics design, and autonomous programming. The UAV club workshop consisted of mechanical, electrical, and programming parts of a drone. The Build a Drone workshop introduced participants to the building and manufacturing process of flying robots. A drone practice flying session allowed the participants to fly their drones in the Vaughn hangar flying arena. Overall, students had the opportunity to experience the different disciplines of engineering. The robotics club conducted a workshop related to robotic design using SolidWorks and instructed students in the structural design process necessary for the creation of a robot that will perform quickly and accurately during a competition.

In conclusion, Dr. Rahemi thanked all participants and the Department of Education Title III HSI-STEM and Title V STEM grants for the funding support in developing innovative programs, laboratories, and engaging students in STEM.

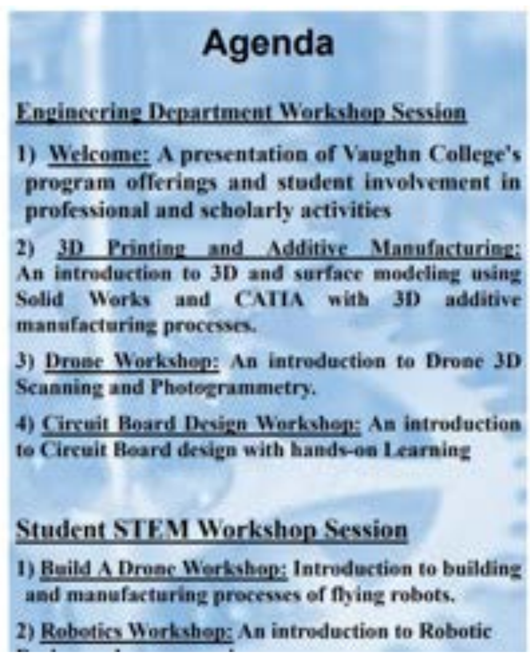
UAV and Robotics STEM Workshops Session

Vaughn’s Annual STEM Day Workshop
April 21, 2023, 10 am to 1 pm

The engineering and technology department hosted its Fifth Annual STEM Day workshop event on Friday, April 21.

This event introduced participants to the following STEM related activities:

- **Welcome:** A presentation of Vaughn College's program offerings and student involvement in professional and scholarly activities.
- **Drone Workshop:** Participants were introduced to drone 3D scanning and photogrammetry.
- **Avionics Workshop:** Introduction to avionics with hands-on experiences related to aircraft radar, communication, and navigation systems.
- **Circuit Board Design Workshop:** Participants were introduced to a hands-on session related to the proper circuit board design for an engineering application..
- **Robotics and Drone Workshops:** Vaughn’s Robotics and UAV clubs organized and hosted Robotics and Build a Drone Workshops for the Community Colleges and high school students.



The participants of Vaughn’s STEM Day workshop were students and faculty from Vaughn College and Wyandanch high school. For this in-person event, Vaughn’s STEM Liaison and 3D/CNC curriculum developer, Prof. Manuel Jesus, introduced participants to Vaughn College’s program offerings in engineering and engineering technology disciplines, and he talked about student involvement in various STEM related clubs and professional activities. Prof. Jesus provided participants with an overview of drone mapping technology such as the DJI Phantom 4 Pro, DJI Mavic Air, and Skydio 2 drones. Special focus was given to lower cost drones such as the second-hand market DJI Mavic Air. This affordable solution is appropriate for student enthusiasts on a budget who are looking to transition into the world of drone mapping. On the software side, applications such as PIX4D, Drone Deploy, and Reality Capture offered a combination of manual and autonomous flight modes for mapping missions. Every application presented was capable of generating high resolution 3D assets from photogrammetry. Pix4D offered the best 3D geometry output quality.

Lastly, animation was covered using Autodesk 3DS Max. In this scenario, drone mapped 3D generated meshes served as foreground and background landscape elements. UAS acquired 360-degree panoramic High Dynamic Range Images were mapped into the 3DS Max Arnold renderer environment background. The image-based lighting solution provided both an accurate physics-based lighting system and a background plate. Animation was achieved using the 3ds Max animation “Constrain to Path Controller”. This function was assigned to an aircraft model and Bezier spline curve such that the aircraft moved along the path of the spline curve. Animation concepts such as clean curves, ease in, ease out, and secondary animation were covered as tools to strengthen the aesthetic appeal of the final animation.

Finally, Prof. Randolph Archbald gave participants a tour of two Avionics lab rooms and while providing them with insights into various lab experiments pertaining to courses within avionics programs such as, aircraft radar systems, communication, flight instruments, and aircraft navigation systems.

STEM Outreach Workshops

From 11:00 pm to 1 pm, Vaughn's Robotics and UAV clubs organized and hosted STEM workshops for students. These workshops covered the following topics:

1. Robotics Workshop - Robotics design & autonomous programming
2. Build a Drone Workshop and A Drone Practice Flying Session.

Fifteen students and their mentors from Wyandanch high school attended in-person STEM outreach workshops on robotics design, autonomous programming, and building a drone. The robotics club conducted a STEM workshop related to robotic design and instructed students in the structural design process necessary for the creation of a robot that will perform quickly and accurately during a competition. They provided a demonstration of two robots designed by Vaughn's Robotics team which were constructed and programmed for the 2023 VEX U World Championship.

The UAV club provided students with a STEM workshop pertaining to design, construction, and programming of a drone to satisfy all criteria and requirements for both Vertical Flight Society (VFS) and AUVSI competitions. Vaughn's UAV team provided students with a demonstration of a drone that they designed and constructed for the upcoming AUVSI competition.

Acknowledgement: In conclusion, Prof. Jesus thanked all participants, and he expressed his sincere gratitude to the Department of Education federal grant (Title III, Part F, HSI-STEM and Articulation grant) which provided necessary funding support to engage students in hands-on STEM activities that prepare Vaughn's engineering graduates for their professional career path.

Award Recipient of 2022 Aviation Week's 20 Twenties

Vaughn College mechatronic engineering seniors Alina Santander Vinokurova and Tatiana Jaimes were recently honored at Aviation Week's Laureate Awards gala, which took place on November 3rd at the National Building Museum. The gala recognized more than 350 innovators and innovations in the aviation, defense, and space industries. At the event, the 20 Twenties class of 2022 was presented, a workforce initiative that aims to cultivate, inform, and inspire the next generation of aerospace and defense professionals. The 20 Twenties program recognizes the top 20 aerospace-bound STEM students in their twenties who have the potential to transform the aerospace and defense industry. Santander and Jaimes were among the 20 students selected based on their academic performance, civic contribution, personal challenges, and the value of their research or design project. As the first award recipients from Vaughn College of Aeronautics and Technology, they have made the school proud with their achievements.

Vaughn College 20 Twenties award recipients at the Aviation Week luncheon

Alina Santander Vinokurova

Santander Vinokurova was the first Bolivian to compete in the NASA Rover Challenge, which she has participated in since 2016. At her university in Bolivia, she worked with a team at the Condensed Matter Laboratory to design a mechanical rover inspired by the Andean hairy armadillo for the challenge. She is also the founder and president of Vaughn College's NASA Rover Club. Vinokurova was elected president of Vaughn College's Society of Women Engineers chapter. She has given more than 70 professional talks, including two TEDx talks about her experiences and perspectives on the aerospace industry. Her volunteer efforts have focused on reducing the gender gap in STEM and improving access to STEM education in Latin America, including leading virtual and in-person STEM events for children.

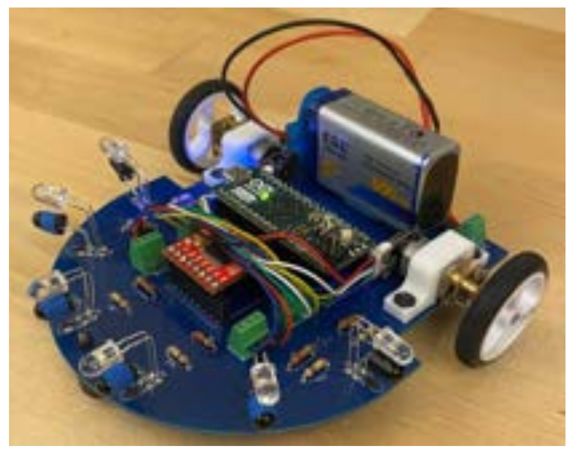
Tatiana Jaimes
Through NASA's Human Exploration Rover Challenge, Jaimes is designing and constructing a mechanical rover with a telemetry system capable of collecting data about the status of the driver, rover, and operating environment. She was an electromechanical systems pathways intern at NASA's Goddard Space Flight Center, where she worked on robotic spacecraft systems. Jaimes is vice president of Vaughn College's chapter of the Society of Women Engineers and secretary for the school's robotics team, through which she volunteers to teach K-12 students about 3D printing and robotics. She participated in a project for the Latin American and Caribbean Consortium of Engineering Institutions to create a low-cost agricultural robot to analyze soil data and balance its composition preparation for reforestation following wildfires.

Aviation Week's 20 Twenties at the award luncheon

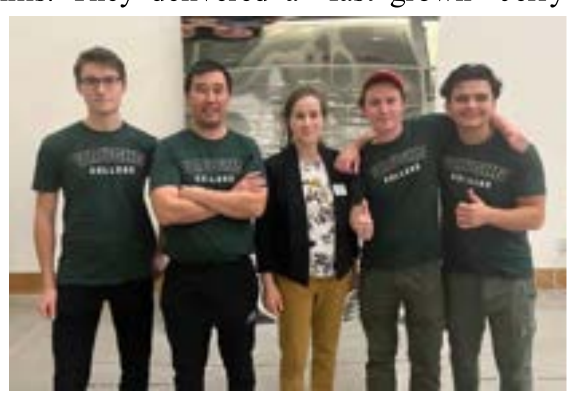
Dr. Hossein Rahemi, Engineering Department Chair, nominated both Alina and Tatiana for this award and supported their trip to Aviation Week's Laureate Awards gala, and Dr. Sharon DeVivo's, President of Vaughn College, participation at the event highlights the institution's commitment to nurturing and recognizing the outstanding achievements of its students in the field of aerospace and engineering. Their support undoubtedly added to the excitement and pride of the students and their families on this exceptional occasion.

Vaughn's Micromouse team participated in 2022 IEEE - Region 1 Micromouse Competition, Oct 1st, 2022 - Vaughn's Team wins 1st Place of this regional Competition

Vaughn Micromouse Team was back to 2022 IEEE - Region 1 Micromouse Competition held on October 1st, 2022 at MIT, Cambridge, MA. It is about an autonomous robotic "mouse" that negotiates a maze of standard dimensions from a specified corner to its center. This is Vaughn's second participation to this event. Our Micromouse – Jerry - has grown since the first participation on Spring 2022, and came back with a modern electrical system as well as an innovative design. Lead by Dr. G. Benbelkacem, students have been working on this project during Summer 2022. In fact, the project's goal is to apply what was learned from a previous experience to help Jerry grow. The main focus points are an electrical system using a PCB, enhanced design, and implementation of a PID for control system.



This fun project has increased student motivation and learning. From sketching and researching, to building and coding, and then testing, students showed perseverance and great critical thinking skills. They delivered a "fast grown" Jerry reflected by its performance during the competition. Vaughn Micromouse Team was among nine registered teams and won the **1st Place!** Dr. Benbelkacem is proud of the group's persistence, work ethic and commitment to reach the project goal. Vaughn College Micromouse Team will continue to make improvements to Jerry and compete in future Micromouse competition events. This is an exciting and fun learning experience for students.



Acknowledgement

We are thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM and Articulation grant) and CSTEP program, which provided necessary funding support to engage students in this project.

Vaughn’s UAV team attend the AUVSI annual conference, April 25th to 28th

AUVSI XPONENTIAL

April 25 – 28 | Orlando, FL
Orange County Convention Center

Students from the UAV Club at Vaughn College were invited and supported by Easy Aerial Inc. to attend the AUVSI annual conference, which was held at Orange County Convention Center in Orlando, FL, from April 25th to 28th. The invitations were extended to Vaughn's UAV club members because of the club's contribution to the UAS field and its impact on UAS career opportunities for the students.

UAV club president Jairo Ramos, V.P. Alanke Perera, Treasurer Kiran Boodhoo, and the UAV club advisor Dr. Amir Elzawawy attended the annual conference to learn more about the fast-moving field of the UAS and drone technology. The team attended several sessions, such as Law-Tech Connect Workshop, a full-day workshop produced by PTECH consulting. The UAV team had the chance to connect with several industry leaders and get more sponsorship opportunities for the club activities and competitions.

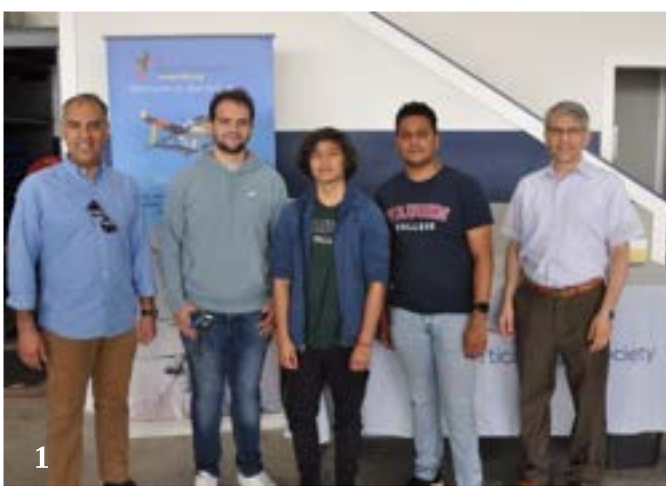

1: Vaughn UAV club with Ivan Stamatovski, CTO of Easy Aerial at AUVSI Xponenotial April 2022
***2**: Vaughn UAV club with Ido Gur, CEO of Easy Aerial at AUVSI Xponenotial April 2022*

Vaughn's UAV team participated in the Vertical Flight Society (VFS) 2nd Design-Build-Vertical Flight Student Competition, **Army Research Laboratory (ARL) Aberdeen, MD, June 1st to 3rd, 2022**

From June 1st through June 3rd, Vaughn College's UAV club participated in the 2nd annual DBVF student competition of Vertical Flight Society (VFS). Vaughn-UAV Team was qualified last March as one of the competition's finalists along with Penn State, Maryland University, Ohio State University and McGill University. In the final technical presentations, the judges praised the Vaughn team for their technical knowledge, engineering design simplicity, and light weight design.

Members of Vaughn College UAV club (Jairo Ramos, Nicholas Bentancur, Kiran Boohoo, Johanna Morales, Alanke Perea) along with their advisor, Dr. Amir Elzawawy, represented the Vaughn team at this competition. **Although the Vaughn Team was not able to participate on the final fly-off competition due to setbacks in flight testing compounded with the short supply of electronic components, the team was acknowledged during the award ceremony for their commitment to compete and their eagerness to participate in next year's competition. The award ceremony was held at SURVICE Engineering in Churchville, Maryland.**

This year DBVF competition is the first to be held in-person in collaboration with Army Research Laboratory (ARL) at The US Army's Combat Capabilities Development Command (DEVCOM) Robotics Research Collaboration Campus (R2C2) near Aberdeen, Maryland. In this competition, the teams are required to build an electric VTOL aircraft weighing no more than 15 lb (6.8 kg) and capable of carrying a payload of at least 2 lb (0.9 kg), with sufficient endurance to complete the demanding competition requirements. In addition, the aircraft had to be capable of flying manually and autonomously. For the full RFP visit http://www.vtol.org/fly



3: VFS Executive Director, Michael Hirschberg (on the right) with Vaughn UAV Team and Dr. Amir Elzawawy
***4**: Tour of SURVICE Engineering, Churchville MD*

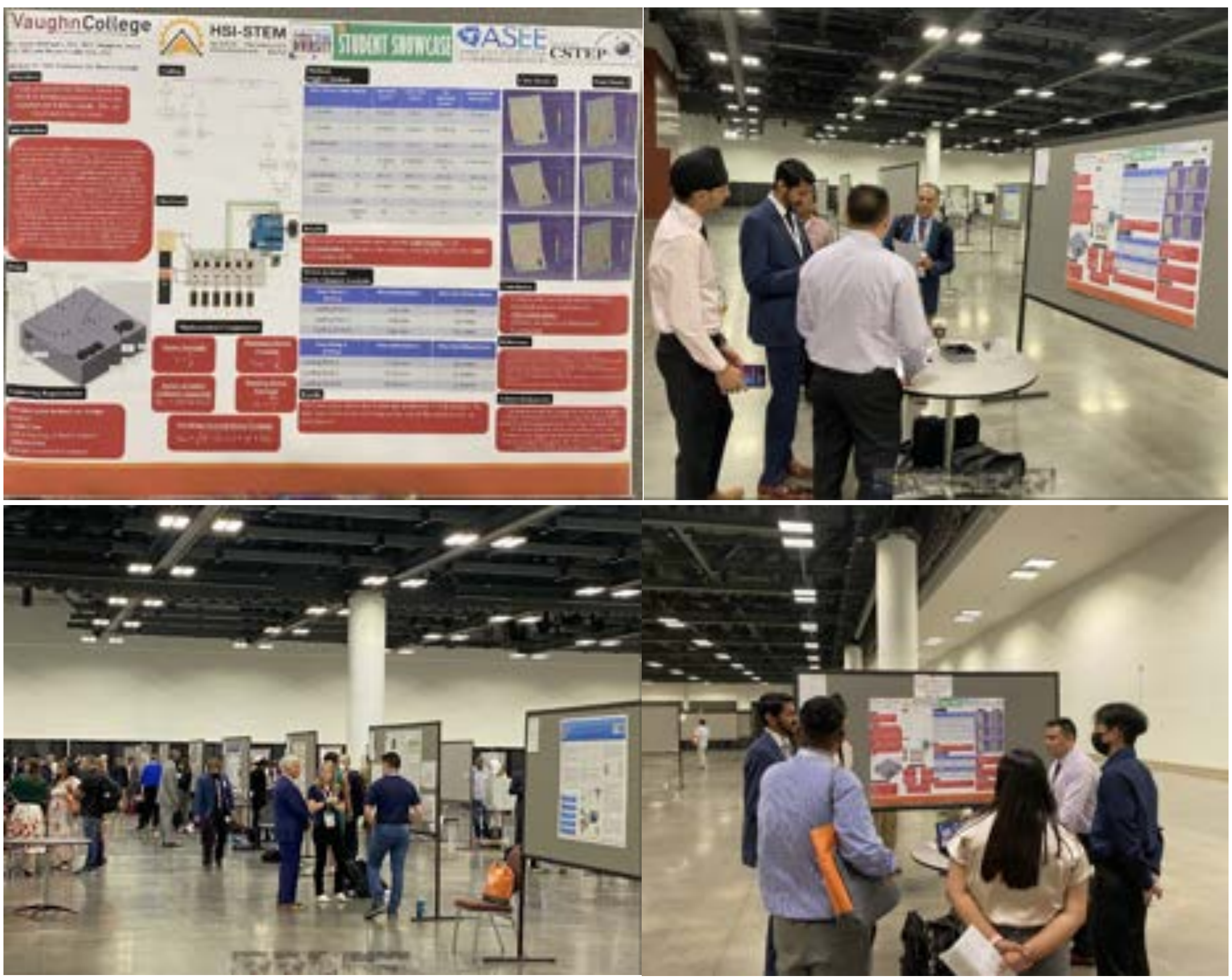
The Vaughn UAV team has shown resilience and perseverance to remain in the competition, despite the challenges of COVID-19 and the supply chain problems that affected several teams participating this year. "Every one of the teams had to overcome formidable obstacles in this competition," said VFS Executive Director Mike Hirschberg, "All the students learned a tremendous amount, and they taught us all even more."

***5**: Vaughn UAV team outside SURVICE Engineering facility*
***6**: Vaughn UAV team and Ohio State team discussing Vaughn's team design*

Vaughn's engineering students and faculty attainted the 2022 ASEE Annual Conference and Exposition, June 26th to June 29th, 2022

From June 26 through June 29 Vaughn's faculty and students attended the American Society for Engineering Education (ASEE) 129th annual conference in Minneapolis, Minnesota.

On Wednesday, June 29, from 1:00 to 4:00 pm Vaughn's engineering students August Rodriguez, Manpreet Anand, and Bryan Gordilo presented their project **"The Braille Educational Tablet,"** during the **ASEE Student Showcase Poster Session** of this annual gathering. Their presentation detailed the development process of an innovative braille block tablet that teaches children the alphabet and basic 4 letter words to ensure good fundamentals of pre-literacy and to allow visually impaired and legally blind children to have equal access to educational products and learning methods. The main objective of their project is to develop an inexpensive, small, user-friendly braille block tablet learning device. Their presentation covered braille block tablet design concepts, the working mechanism of design, the manufacturing process using 3D printing, electrical construction, and coding of the braille block tablet.



From June 26 – 29, the Department Chair along with two other faculty members of Vaughn's engineering and technology department attended at the 2022 ASEE annual conference and participated in several technical and workshops sessions as well as ABET accreditation sessions of this annual gathering.

We at Vaughn College are thankful to the Department of Education federal grant, Title III HIS-STEM for providing necessary funding support to engage students in scholarly and STEM related activities

Vaughn's Engineering Faculty and Students Participated in LACCEI2022 Conference; Vaughn's Students Take First Place in LACCEI 2022 Student Paper session Competition and Third Place in Poster Session Competition

From July 18-22, 2022, Vaughn's engineering students along with Dr. Hossein Rahemi, engineering department chair, and engineering faculty members Prof. Khalid Mouaouya, and Prof. Miguel Bustamante attended the 20th LACCEI International Multi-Conference in Boca Rotan Florida. Three of Vaughn's student team research papers were accepted for presentation and publication in the LACCEI 2022 international conference. Vaughn's student papers, as listed below, were selected to compete among ten finalists for the student paper session, and all submitted papers were accepted for the poster session of LACCEI 2022 as well.

<u>Finalist for LACCEI Paper Session</u>

1. ReGenBot: "Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests" by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto
2. Competitive Design Process for VEX U Competition "Tipping Point" by Misael Marquez

From 11 am to 2 pm on Thursday July 21, Vaughn's student team papers, as listed above, were presented as finalists to the international conference audience during the student paper session of LACCEI 2022.

Alina, Tatiana, and Cristian's team paper addressed design process and features of the ReGenBot, a low-cost autonomous robot intended to collect data from burnt soil to analyze its characteristics, especially deficiencies, and to distribute fertilizer or nitrogen to balance the soil's composition and revitalize it. The objective is to design and develop a robot that is programmed with Arduino and includes an ultrasonic sensor, a servomotor, NPK, moisture, and a temperature sensor for South American forests that record a high number of wildfires every year. Judges selected their paper as a recipient of the **first place award** of LACEEI 2022 student paper session competition.

Misael's paper addressed the design and development process of a robot for the VEX U World Championship and skills challenge competitions. His paper and presentation detailed the design, manufacturing, and development process of a robot, as well as autonomous programming that allowed his team to compete successfully in both the regional and world championship of VEX U Robotics. The overall objective is to have a robot with an effective mechanism and score consistently through both autonomous and driver-controlled modes. His robot competed in VEX U World Robotics championship and received both the Excellence Award and third place ranking in the 2022 world skills challenge. His paper was selected as a finalist in the LACCEI 2022 student paper session competition.

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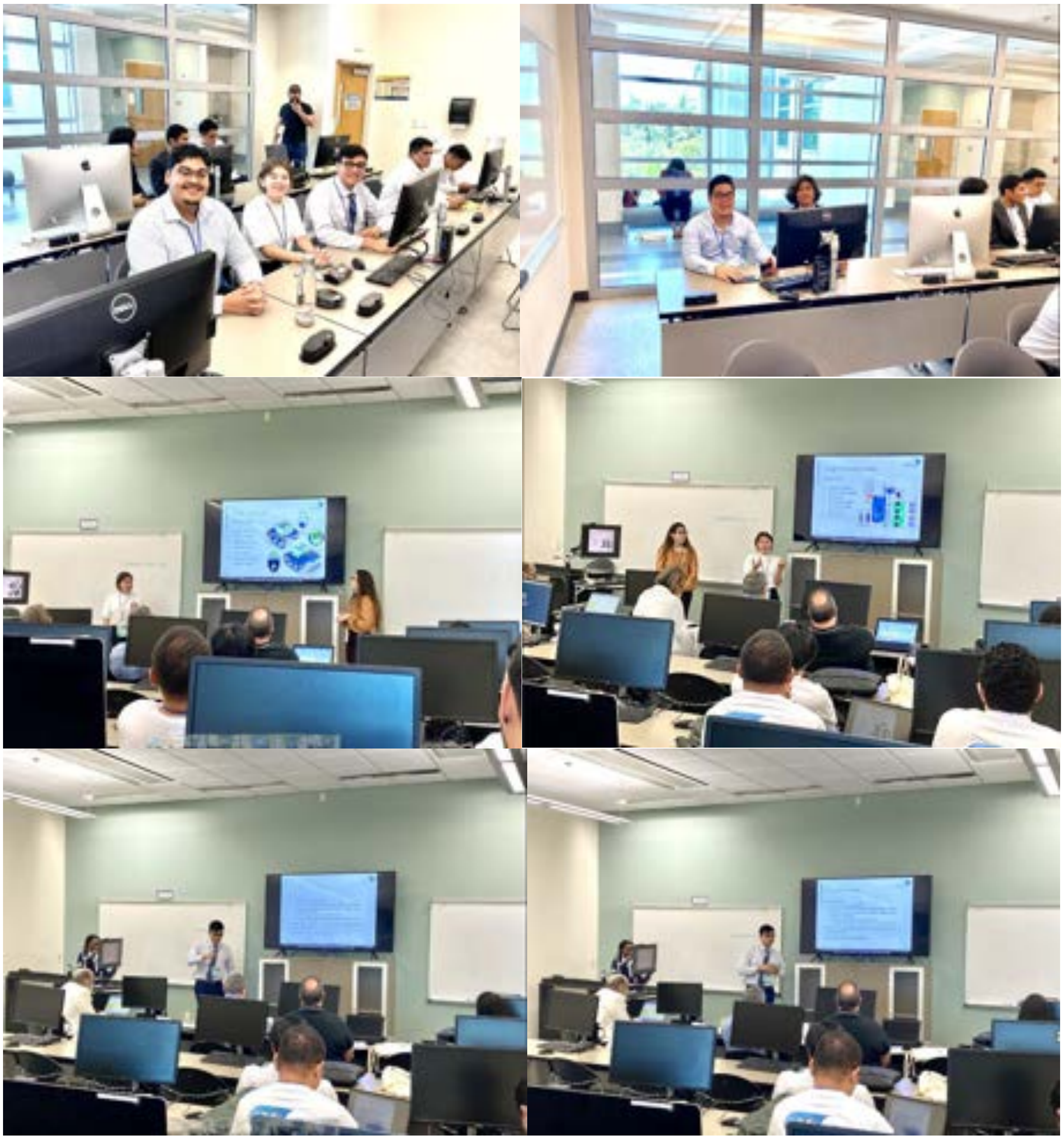


LACCEI2022 Student Paper Session Presentation

LACCEI 2022 Poster Competition

<u>Finalist for LACCEI Poster Session</u>

1. Vex Robotics Competition STEM Summer Camp for High School Students: An Engineering Approach by Ryan Tang Dan
2. ReGenBot: Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto
3. Competitive Design Process for VEX U Competition "Tipping Point" by Misael Marquez

From 11:00 am to 1:00 pm on Wednesday, July 20, three of Vaughn's student team posters were selected as finalists for the LACCEI 2022 poster session competition. Vaughn's student poster by Ryan Tang Dan provided an insight about his STEM summer camp program to prepare high school students for the VEX Robotics Competition. Judges selected his poster as a recipient of the **third-place award** of LACEEI 2022 student poster session competition.

The poster by Misael Marquez outlined development and design of a robot for VEX U World Championship and skills challenge competitions. His poster presentation provided an insight about robot design, manufacturing, and autonomous programming that improves the competition outcomes. The third Vaughn student poster by Alina, Tatiana, and Cristian outlined the conceptual design of an autonomous robot to revitalize burnt soil in South American forests**.** Their presentation provided an insight about their design concept, development, and programming process of a ReGenBot Robot. Both posters were selected as finalists of 2022 LACCEI student poster session competition.




LACCEI2022 Student Poster Session Presentation

Awards Ceremony

From 1:00 pm to 2:00 pm, during the award ceremony on Friday, July $22^{ndy,}$ award recipients for the best paper and poster presentations were introduced. This year, Vaughn's student paper "**ReGenBot: Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests**" by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto won the first-place award for the best paper presentation of LACCEI student paper session competition.

Vaughn's student poster **"Vex Robotics Competition STEM Summer Camp for High School Students: An Engineering Approach"** by Ryan Tang Dan received the **third-place** award of LACEEI poster session competition.

The First Place Winner of the LACCEI 2022 Student Paper Session Competition
"ReGenBot: Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests." by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto

Society of Women Engineers Conference 2022

The Vaughn College chapter of the Society of Women Engineers (SWE) attended the 2022 Women Engineers Conference in Houston, Texas, from October 20th through October 22nd, 2022. During the conference, fifteen-chapter members had the opportunity to attend leadership seminars and technology talks. In addition to attending those, SWE students attended the in-person career fairs. Some were interviewed by industry-leading companies such as Honeywell, Carrier, Northrop Grumman, Lockheed Martin, Boeing, and Tesla. The conference was successful as over 25 position offers were made, and over 50 interviews were held.

From back left to right and front left to right, the WE22 attendees are Daniel Doscher, Christian Sorto, Alanke Perera, Kevin Velasquez, Bryan Arias (Assistant Director of Career Services), Chasisty Melo, Suraiya Nawaz, Carlo Ovalle, Joshua Harripaul, Amanda Camacho, Tatiana Jaimes, Alina Santander, and Emily German (SWE Chapter Alumni)

THE OVERVIEW OF THE SUCCESS OF WE22 CONFERENCE

Below are the interviews and offers that SWE members got from the WE22 Conference.

Note: Some of the SWE members are still in the process of doing interviews and receiving offers.

NAME	MAJOR	YEAR	COMPANY	FULL TIME OFFER	INTERNSHIP OFFER
Chasisty Melo	Mechatronics Engineering	Junior	Northrop Grumman		Yes
			Carrier		Yes
			Lockheed Martin		Yes
			Boeing		Yes
			Delta		Yes
Suraiya Nawaz	Mechatronics Engineering	Junior	Daimler Trucks North America		Yes
			Carrier		Yes
			Whirlool		Yes
			Wolfspeed		Pending
			ITW		Pending
			Tesla		Yes
			Honeywell		Pending
Alina Santander	Mechatronics Engineering	Senior	Daimler Trucks North America		Yes
			Novanta	Yes	
			ASML	Pending	
			Milwaukee	Pending	
			Trimbler	Pending	
			Schneider	Pending	
Tatiana Jaimes	Mechatronics Engineering	Senior	Honeywell	Yes	
			Northrop Grumman	Yes	
			Raytheon Technology	Yes	
			Boeing	Yes	
Carla Vasquez	Electrical Engineering	Junior	Lutron		Pending
			Wolfspeed		Pending
			ITW		Pending
Arayana Khelewan	Mechanical Engineering	Junior	Lockheed Martin		Pending
			Boeing		Yes
Alanke Perrera	Mechatronics Engineering	Senior	Daimler Trucks North America	Pending	
			Battle Motors	Pending	
Amanda Camacho	Mechanical Engineering	Senior	Oshkosh	Pending	
			L3Harris	Yes	
			Linde	Pending	

			Boeing	Yes	
			Northrop Grumman	Yes	
Aisling O'Sullivan	Mechanical Engineering	Junior	Lockheed Martin		Pending
			Boeing		Pending
			ITW		Pending
Joshua Harripaul	Mechanical Engineering	Senior	Lockheed Martin	Yes	
			Delta	Yes	
			L3Harris	Yes	
			Boeing	Yes	
Cristian Sorto	Mechatronics Engineering	Senior	Northrop Grumman	Pending	Pending
Carlo Ovalle	Mechatronics Engineering	Junior	Wolfspeed		Pending
			Polaris		Pending
Kevin Velasquez	Mechanical Engineering	Senior	Northrop Grumman		Pending
			Rockwell Automation		Pending
Mariah Villalon	Electrical Engineering	Senior	GE Aviation	Yes	
			Northrop Grumman	Yes	
			Lutron	Pending	
			Boeing	Pending	
			ASML	Pending	
			Lockheed Martin	Pending	
			Stellantis	Pending	
Daniel Doscher	Mechatronics Engineering	Senior	Lockheed Martin	Yes	
			Northrop Grumman	Yes	

Seminars

WE chapter members' conference started with the Opening keynote by Dr. Phyllis Schneck, a current computer engineer and Vice President of Information Security and Cyber at Northrop Grumman. Members attended this keynote to hear about "Career Planning when the Sky is the Limit," where Schneck gave insight on her career path. After this session, members attended the Rapid Resume Session hosted by Siemens, Raytheon Technologies, and Lutron engineers. Others also attended the Ford Ride & Drive Sessions, where students got the opportunity to test drive some of Ford's newest vehicles.

Hospitality Suites and Mixers

This year, students had many options to go for hospitality suites. Since Covid restrictions were lifted, students were granted the opportunity to attend hospitality suites by companies such as 3M, Amazon, Daimler, Boeing, Corning, Eaton, Lockheed Martin, Northrop Grumman, Medtronic, Milwaukee Tools, Novanta, and more. These events allow students to showcase themselves beyond their resumes. These informal settings allowed many SWE chapter members to meet with recruiters, get an insight into the different positions that the company offers, and depict how their personality and work ethic can allow them to grow at different companies.

Students Suraiya Nawaz and Daniel Doscher were also invited to Tesla Mixer on October 20th from 7-9PM. In that mixer, students got the opportunity to network with Tesla engineers and talk with fellow students and listen to what Tesla has to offer. The mixer helped students understand what Tesla's mission is and work toward it. Along with that, Amanda Camacho was invited to Boeing's breakfast invitation on Oct 22nd upon her offer from Boeing.

Hosted Events and Keynotes

The conference also offered keynotes sponsored by 3M, ExxonMobil, Intel, Amazon and many other companies. Members attended the opening and closing keynotes hosted by Dr. Phyllis Schneck and Michele Sullivan. They talked about how each one of us can make an impact. Michele showed a unique perspective and inspiration for individuals and said we thrive because of others and should use each other's support.

Closing ceremony

Alina Santander and Tatiana Jaimes got the chance to attend the WE22 closing celebration on October 22nd at the Hilton Americas hotel following the last keynote speaker. There was food, drinks, music, and a retro arcade featuring classic games such as Galaga and Space Invaders. They met the SWE President Dayna Johnson. The organization hosted a special segment, Engineers Make (and Sometimes Bake) The Impossible, featuring contestants from Netflix's Baking Impossible.

Events the SWE Chapter Participated In

Throughout the course of the three-day conference, students were able to attend events varying from key notes to professional advice from engineers in the industry. An event attended by Suraiya was the "Career Fair Tips and Tricks" event. This provided information on how to target employers at the Career Fair. Other events hosted by the SWE Chapter were the information sessions hosted by many companies such as Lockheed Martin. These events varied from educational growth in youth to creating a balance between a work life and personal life. Each event was hosted by different companies, and guest speakers often discussed some of their past experiences in the industry.

Leadership Section: Networking session

VCAT SWE E-board members had the opportunity to attend different network sessions. The president, Chasisty Melo, along with Suraiya Nawaz, Alina Santander, Carla Vasquez, Arayana Khelewan and Tatiana Jaimes were invited to the SWE Collegiate Leaders Reception. The E-board members had the chance to meet with other college chapters and discuss future collaborations to host workshops and events.

Extra activities: Tour to NASA Johnson Space Center

Since the conference was held in Houston, Texas, SWE also offered a NASA Johnson Space Tour on Wednesday, October 19, 2022, at an extra cost.

Acknowledgement

The VCAT SWE chapter is extremely thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM and Articulation grant) which provided necessary funding support to engage Vaughn's students in STEM related scholarly and professional activities.

HSI-STEM

Science Technology

Engineering Math

2022 Society of Hispanic Professional Engineers National Convention, November 2nd to November 6th, 2022

SHPE Leading Hispanics in STEM | Vaughn College of Aeronautics and Technology | HSI-STEM Science . Technology Engineering . Math

The Vaughn College SHPE Chapter sent a group of 22 engineering students to the 2022 Society of Hispanic Professional Engineers (SHPE) Convention in Charlotte, North Carolina from November 2nd-6th. Attending this convention allowed the chapter members to speak and connect with real engineers from hundreds of different companies, giving more insight into what is required to be successful in the industry. This convention also gave students the opportunity to attend various professional development workshops aimed at developing skills in leadership, teamwork, and professional confidence and gave them exposure to diverse STEM career opportunities. The result of this convention was 33 offered positions and 57 on-site interviews.

The Vaughn College SHPE Chapter is part of a large organization called, The Society of Hispanic Professional Engineers. This organization hosts major conventions known as the SHPE National Convention for STEM chapter students and professionals. The annual SHPE National Convention is the largest annual gathering of Hispanics in STEM, providing chapter students and professionals the opportunity to engage with a variety of corporate representatives through attendance at workshops, hospitality suites, career expos, and participation in STEM competitions. These are significant opportunities for Vaughn College students who have been highly active and successful in their major. This convention is an opportunity for STEM students to showcase their talent to leading companies who are looking to recruit top STEM talent for their organizations through SHPE's impressive career fairs. At these SHPE hosted conventions members can network with major engineering companies, leading towards the fulfillment of SHPE's mission to "impact the world through STEM awareness, access, support, and development."

Convention Readiness/Professional Development Workshops

The SHPE executive board organized and presented a series of workshops in collaboration with the Society of Women Engineers (SWE). This was done in an effort to prepare members who were going to be attending each organization's respective conference. These workshops are meant to guide members in the development of their resumes, elevator pitches, effective methods for researching companies of interest and mock interviews in preparation for the career fair. It was important that these workshops be designed and presented by members who have had firsthand experience in attending conferences, in order to ensure that new attendees can avoid making similar mistakes made in the past and to take note of advice that has helped these other members grow both professionally and confidently in presenting their talents.

Conference Workshops

The workshops and information sessions available at the SHPE National convention were hosted by the engineering professionals at varying stages of their careers, many representing companies such as 3M, Amazon, Honeywell, Discover, Milwaukee Tool, DuPont, Raytheon Technologies, and Spectris HBK. The overall objectives of the presentations were to prepare the STEM students and professionals for the industry and the career fair. For the Vaughn College SHPE Chapter, the conference workshops served as a reinforcement of the conference preparation workshops hosted on campus. The SHPE National Conference workshops were spread across each of the conference days with the earliest starting at 8am and final ones ending around 6pm, with a break before the opening of the hospitality suites. The company representatives would share their personal stories and their involvement with SHPE. The representatives would then continue to explain the value of confidence and networking when beginning to create opportunities in the industry.

Hospitality Suites

One of the greatest benefits of being able to attend the SHPE National Convention is the networking opportunities presentation at almost every part of the conference. The conference gathers a diverse group of STEM students and professionals with a common background and interest in helping each other succeed. Networking is highly encouraged across careers, education level, and cultures; from waiting in line for registration to walking around the career fair, the people attending are all open to hear each other’s story and goals. The hospitality suites are a great example of this prioritization at the conference, with certain companies such as Amazon, Honeywell, Boeing, and Citibank having company representatives and refreshments to welcome undergraduates and professionals. Vaughn College SHPE Chapter members were able to attend both open-invite and invite-only hospitality suites, events which were hosted on-site and at private venues in Charlotte.

On-Site Career Fair and Graduate School Expo

The career fair and graduate school expo at the SHPE National Convention is one of the highlighted main events of the conference, with over 170 exhibitors present this year. The career fair was held on November 4^{th} and 5^{th} providing the Vaughn College SHPE Chapter members the opportunity to have a conversation directly with recruiters to market themselves to a wide range of companies for internships and full-time interviews and offers. With a separate area for on-site interviews, the recruiters can either schedule the applicants or walk them over for an immediate interview. The Vaughn College members achieved a total of 57 interviews and from those interviews were able to secure 33 offers and still counting, as some companies take longer to process offers. The list of members with their respective company interviews and offers is shown below under the section labeled, SHPE National Attendees Outcomes.

At the career fair, the president of the Vaughn College SHPE Chapter had come across a Vaughn College Alumni, Hector Sabillion, who had received a full-time position at John Deere through a previous National SHPE Convention, and he had returned to the conference as one of the recruiters for the company. This demonstrates the legacy of the opportunities presented at the conference, where Hector had felt such a positivity and gratitude from being a part of the Vaughn College Chapter and the SHPE organization, that he was excited to see the current chapter's level of involvement at the 2022 National Convention.

<u>SHPE National Attendee Outcomes</u>

Job/Internship Outcomes:

Attendees Name	Major	Year	Company	Full Time Offer	Internship Offer	Interviews
Kevin Velasquez	Mechanical Engineering	Senior	Medtronic Honeywell	Yes Yes		Yes Yes
Cristian Sorto	Mechatronics Engineering	Senior	Honeywell	Yes		Yes
Alanke Perera	Mechatronics Engineering	Senior	Cummins	Yes		
Kirill Sokolov	Mechatronics Engineering	Senior	Northrop Grumman Honeywell Arconic Raytheon MITRE	Pending Pending Yes Yes Pending		Yes Yes Yes Yes Yes
Tatiana Jaimes	Mechatronics Engineering	Senior	JPL	Yes		Yes
Alina Santander Vinokurova	Mechatronics Engineering	Senior	Cummins Honeywell	Yes Yes		Yes Yes
Daniel Doscher	Mechatronics Engineering	Senior	Cadence Tesla Rockwell Automation Raytheon Missiles & Defense Honeywell L3Harris	 Yes Yes Yes 		Yes Yes Yes Yes Yes Yes
Samuel Aremu	Mechanical Engineering Technology	Senior	Honeywell Northrop Grumman Aerojet Pratt & Whitney	Yes Yes Yes 		Yes Yes Yes

Kiran Boodhoo	Mechanical Engineering	Senior	Northrop Grumman Arconic Trane Technologies Honeywell Airbus	Yes Yes Pending Pending Pending		Yes Yes Yes Yes Pending
Andres Vacas Marquez	Mechanical Engineering	Senior	Medtronic LLNL	Yes Yes		Yes Yes
Mariah Villalon	Electrical Engineering	Senior	Exelon BP Ameren	Yes Pending	 Yes	Yes Yes Yes
Amanda Camacho	Mechanical Engineering	Senior	Honeywell Pratt & Whitney	Yes Pending		Yes Yes
Jairo Ramos	Mechanical Engineering	Senior	Honeywell Walt Disney Northrop Grumman Lockheed Martin Raytheon L3Harris	Yes Pending Yes Pending Pending Pending		Yes Yes Yes Yes Yes Yes
Erem “Dennis” Atalay	Mechanical Engineering Technology	Junior	Raytheon Tech Northrop Grumman Boeing		Yes Pending Yes	Yes Yes
Chris Walker	Mechatronics Engineering	Junior	MITRE Rockwell Automation Pratt & Whitney Honeywell Cummins		Pending Pending Pending Pending Pending	Yes Yes Yes Yes Yes
Daniel Velez-Gomez	Mechanical Engineering Technology	Senior	L3Harris	Pending		Yes
Mina Morcos	Mechatronics Engineering	Senior	John Deere Nucor Boeing	Yes Yes Yes		Yes Yes
John Morales	Mechanical Engineering Technology	Senior	Northrop Grumman Raytheon	Yes Yes		Yes Yes
Nigel John	Mechanical Engineering	Senior	Qualcomm Northrop Grumman Raytheon Trane Technologies Honeywell		Yes Pending Pending Pending Yes	Yes Yes Yes Yes Yes
Matthan Mbanefo	Mechatronic Engineering	Sophomore	Honeywell		Yes	Yes
Yostina Ishak	Mechanical Engineering	Sophomore	Boston Scientific Corning		Pending Pending	Yes
John Sutera	Mechanical Engineering	Senior	Northrop Grumman	Pending		Yes

SHPE Engineering Competitions

Some the events that take place at the SHPE National Convention making it stand out from other conventions are the variety of competitions that are available for attendees to participate in for cash prizes and recognition. SHPE chapter members had the opportunity to compete in the Engineering Science Symposium, Extreme Engineering Challenge, Cyber Security Challenge, and the Nissan Design Challenge. It was a requirement for each Vaughn College attendee to sign up for at least one of these challenges as it grants them early exposure to recruiters and the opportunity to actively work with professionals leading these challenges. These experiences are exceptional at helping prospective engineers adapt to the real-world problems they will face when working for the companies participating in the convention. From previous years, the Vaughn College SHPE Chapter has earned multiple awards from SHPE chapter members who have pushed their talents to their limits, successfully earning a spot as one of the top three winners. This year, to qualify for the engineering challenges students were required to take part in vigorous interviews from partner companies like Nissan, Walmart, John Deere, and Boeing. We had four Vaughn College SHPE members (Alanke Perera, Christopher Walker, Daniel Doscher, and Andres Vacas Marquez) qualify for the Nissan design challenge and three other chapter members (John Sutera, Samuel Aremu, Nigel John) qualify for the Extreme Engineering competition.

The goal for the Nissan Design challenge was to innovate, develop and refine a pitch design in automotive safety and sustainability in eight teams of three that were created from the 24 qualified SHPE members over the span of two days (November 2nd-4th). For the Extreme Engineering Challenge, 100 qualifying students were put into teams of 10 in order to define a money-making concept that would utilize provided outer space platforms. Once an idea was established, each team had 24 hours (November 2nd-3rd) to generate a prototype that clearly communicates the concept to an investor audience, along with an engineering, marketing and business plan that accompanies the prototype.

For the second year in a row, there were two competition winners from the Vaughn College SHPE Chapter. This year we had acquired both first and third place in the Nissan Design Challenge due to the efforts and talents from Daniel Doscher (1st place) and Christopher Walker (3rd place). Daniel Doscher's team came up with a method to manufacture a single-pieced chassis for a vehicle, which would cut back on both cost and the amount of material that is consumed to create modern chassis.

Christopher Walker's team figured out a new and unique way to create a battery using different materials and chemicals for vehicles which result in a battery that is more sustainable and easier to produce than modern batteries that are used today in electric vehicles. With both of these ideas, along with a well-developed presentation based on cost analysis, design parameters, and in-depth research, both Vaughn College SHPE Chapter members were able to lead their teams towards victory with a successful and winning idea.

SHPE Collaboration

Title III HSI-STEM

Impact of the Title III HSI-STEM on student success: The Title III HSI-STEM provided funding to support expansion of student involvement in STEM-related scholarly, practical hands-on, and community outreach activities including student engagement in paper and poster sessions and engineering challenge competitions at technical conferences—American Society for Engineering Education (ASEE), Latin American and Caribbean Consortium of Engineering Institutions (LACEEI), Institute of Electrical and Electronics Engineers (IEEE), American Institute of Aeronautics and Astronautics (AIAA), Society of Women Engineers (SWE) and Society of Hispanic Professional Engineers (SHPE).

HSI-STEM

Science . Technology

Engineering . Math

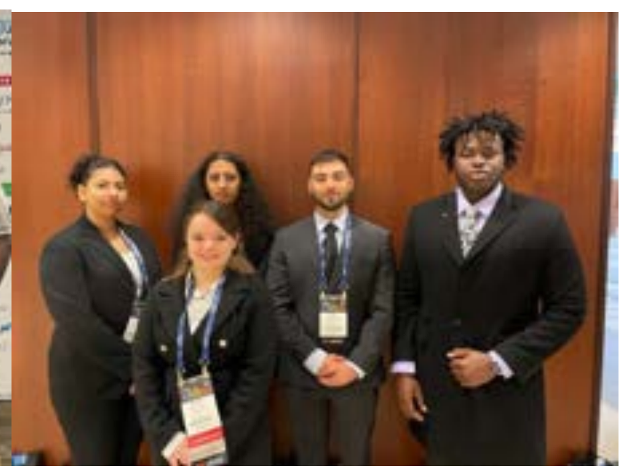
The Vaughn College SHPE Chapter is extremely thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM and Articulation grant) for their assistance and continuous support over the years. Their involvement within the Vaughn College SHPE Chapter continues this year with the provided sponsorship for 10 Vaughn College SHPE Chapter members (Kevin Velasquez, Cristian Sorto, Alanke Perera, Kirill Sokolov, Tatiana Jaimes, Alina Santander Vinokurova, Daniel Doscher, Samuel Aremu, Kiran Boodhoo, and Andres Vacas Marquez) to attend the 2022 SHPE National Convention. The students listed all received **full-time job offers from companies such as Honeywell, Medtronic, Raytheon, Cummins and Northrop Grumman, etc**., which would have not been possible without the support of the HSI-STEM title III grant. This sponsorship also allowed the several chapter members to participate in both the Nissan Design Challenge and the Extreme Engineering Challenge. Without this granted opportunity Vaughn College would not have been able to support student, **Daniel Doscher, who won first place in the Nissan Design Challenge.**

Vaughn College CSTEP Program

The Collegiate Science and Technology Entry Program (CSTEP) is a program intended to increase access by minority and economically disadvantaged students to academic programs at the college level in scientific and technical fields. This year the CSTEP department sponsored four Vaughn College SHPE Chapter students (Jairo Ramos, Amanda Camacho, Mariah Villalon, and Erem "Dennis" Atalay) to attend the 2022 SHPE National Convention. After attending professional workshops, hospitality suites, and the two-day career fair, all four of these sponsored attendees had the opportunity to receive multiple interviews from industry-leading companies like Honeywell, Northrop Grumman, Boeing, and Exelon. We are grateful for CSTEP's interest in our Vaughn College SHPE Chapter and appreciate their efforts and continued support for our members and program, especially the CSTEP Project Director, Dr. Amir Elzawawy for his support and cooperation.

NSBE 49th National Convention

The National Society for Black Engineers (NSBE) hosted its 49th national convention from March 22–26, 2023, in Kansas City, Missouri. That was the first totally in-person gathering since the group emerged from the Covid 19 pandemic, and it was a huge stride forward for the organization. The conference's subject was “I am a S.T.E.M.”, and it included a wide range of activities aimed at the all-around growth of engineers, including educational and certification courses, lectures, and career fairs. Sixteen students from the NSBE chapter at Vaughn College had the opportunity to attend this convention, where everyone who went received the opportunity for interviews—both in-person and online—and some even received job offers.



Opening and closing Keynotes

An entirely online-based banking corporation called Discover sponsored the opening session, and the NSBE group hosted the closing session. Both seminars were attended by our members, who left inspired to learn more about engineering and have a greater impact on the industry. Engineers should exercise caution both in public and private, according to the opening speaker (Brent DeMar), because what we do not only affects us but also those around us. An elegant awards ceremony was held as part of the closing session to honor the organization's leadership and significant contributors for their exceptional efforts throughout the year.

Workshops and seminars

Workshops at the convention were diverse and catered to everyone's interests. The Boeing Additive Manufacturing event, which focused on using innovative production techniques to boost efficiency at the corporation, was one of the most significant workshops. They discussed the use of powder bed fusion, a 3D printing technique that builds out complicated parts by layer-by-layer melting and fusing of a bed of metal and alloy powder using a laser beam.

Activities Attended by Members

Name	Date	Events
Josiah Lovell	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing, Career Fair and Hospitality Suite by Rockwell Automation
	3/24/2022	Career Fair
	3/25/2022	General Session
Bibi Khan	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing, Career Fair and Hospitality Suite by Rockwell Automation
	3/24/2022	Career Fair

	3/25/2022	General Session
Joshua Harripaul	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing, Aerospace in the Caribbean and Career Fair
	3/24/2022	Career Fair and Hospitability Suite by Boeing
	3/25/2022	General Session
Brian Benjamin	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing, Aerospace in the Caribbean and Career Fair
	3/24/2022	Career Fair and Hospitability Suite by Boeing
	3/25/2022	General Session
Delano Donaldson	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing and Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session
Matthan Mbanefo	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing and Career Fair
	3/24/2022	Career Fair and Hospitability Suite by Boeing
	3/25/2022	General Session
Frankelina Nunez	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing and Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session
Efrain Magana	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick off
Rebecca Snyder	3/22/2023	Opening Session by Discover

	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick
Isa Al-Maktoum	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick
Huzaifa Naveed	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick
Lilidania Rodriguez	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick
Samuel Aremu	3/22/2023	Opening Session by Discover
	3/23/2022	Additive Manufacturing by Boeing, Career Fair and Hospitality Suite by Honeywell
	3/24/2022	Career Fair and Hospitality Suite by Boeing
	3/25/2022	General Session and NSBE50 Kick
Ariel Santos	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick
Romaim Hernandez	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair
	3/25/2022	General Session and NSBE50 Kick
Daniel Garcia	3/22/2023	Opening Session by Discover
	3/23/2022	Career Fair
	3/24/2022	Career Fair and Hospitality Suite by Honeywell
	3/25/2022	General Session and NSBE50 Kick

Career Fair

On the second and third days of the conference, the career fair was held. It was a significantly bigger event than the one the year before, with more employers showing up in person to meet potential hires rather than participating virtually. Several organizations actively seeking new employees are represented at the career fair, including Delta, Raytheon Technologies, Boeing, Caterpillar Inc., General Motors, Amazon, Cummins, etc. The career fair was a great success because it led to interviews and job offers for our guests.

Career Fair Results

Name	Major	Company	Job Offer	Internship Offer
Josiah Lovell	Mechatronics Engineering	John Deere	Pending	
Bibi Khan	Mechanical Engineering	Amtrak	Pending	
Joshua Harripaul	Mechanical Engineering	Boeing	Yes	
		Daimler	Pending	
		Nucor	Pending	
Brian Benjamin	Electrical Engineering	Boeing	Yes	
		Northrop Grumman	Yes	
		Raytheon Technologies	Pending	
Delano Donaldson	Mechatronics Engineering	Cummings	Pending	
Matthan Mbanefo	Mechatronics Engineering	Boeing		Pending
		General Dynamics		Pending
Efrain Magana	Mechanical Engineering	Boeing		Yes
		General Electric	Pending	
		John Deere		Pending
		Lockheed Martin	Yes	
Rebecca Snyder	Mechatronics Engineering	MARS	Pending	
		Caterpillar	Yes	
		John Deere	Pending	
Huzaifa Naveed	Mechatronics Engineering	Boeing		Pending
		Lockheed Martin	Pending	
		Northrop		Yes

		Grumman		
Samuel Aremu	Mechanical Engineering	Boeing	Yes	
		Airbus	Yes	
		General Electric	Pending	
Ariel Santos	Mechanical Engineering	Northrop Grumman	Pending	
Romaim Hernandez	Mechatronics Engineering	John Deere		Pending
		Northrop Grumman		Pending
Daniel Garcia	Mechatronics Engineering	Cummins		Pending
		Honeywell		Pending

Note: Pending status is assigned to individuals who are currently interviewing for positions

Acknowledgement

We are thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM) which provided necessary funding support to engage Vaughn's NSBE students in STEM related scholarly and professional activities.

We extend our gratitude to the CSTEP organization for their continuous support towards our club in aiding our chapter with workshops and development activities.

AIAA SCI-TECH FORUM, National Harbor, MD, January 23-27, 2023

Dr. Amir Elzawawy participated in the AIAA SCI-TECH forum, an annual conference that focuses on the development and innovations in the aerospace industry. With over 700 technical sessions and 2,707 published papers, the conference attracts major players in the industry, as well as research agencies and universities. Dr. Elzawawy's interests were in the aerodynamics and aerospace sessions, which highlighted experimental techniques and CFD simulations.

This year's conference also featured sessions focused on Diversity, Equity, and Inclusion, including "Workforce of the Future - What Does Successful Diversity, Equity, and Inclusion Look Like?" The panelists for this session included Rhom Erskine, Vice President of Global Diversity & Inclusion at Lockheed Martin, and Steven Holz, Assistant Project Manager of the University Innovation (UI) Project at NASA Langley Research Center.

Dr. Elzawawy found the sessions involving student projects particularly interesting, as he sought new ways for Vaughn's students to participate in AIAA professional events.

MEEd
ASME Mechanical Engineering
Education Summit
GLOBAL

2023 ASME Mechanical Engineering Education (MEEd) Summit conference, San Juan, Puerto Rico, March 23-25, 2023

It was my pleasure to attend the 2023 ASME Mechanical Engineering Education (MEEd) Summit conference in San Juan, Puerto Rico from March 23rd to March 25th, 2023. This year's conference contained a great deal of important information and discussions, ranging from how hybrid and digital learning has evolved since the beginning of the Covid-19 Pandemic, to the current state of students' mental health on college campuses.

The first session was a presentation from Autodesk where they discussed research they did on the future of engineering. Their conclusions were very interesting: they stated that the Mechanical Engineer of the future will have many more hard skills, such as AI/ML knowledge, data analytics and visualization processes, and the concepts of digital twin simulations. In addition, they pointed out that future engineers will have to have creative problem-solving skills, collaboration skills, and excellent communication skills.

Another important session was a presentation from a faculty member from the Singapore Institute of Technology on their approach to engineering curricula. At their institution, the concept of "pillars" is used where students choose a specific engineering route towards their graduation. I found the visuals very striking and easy to understand how their students move from one year to another.

Finally, the last session was a very important presentation on the current mental health status of engineering students. At this presentation, Prof. Karin Jensen presented some important numbers, but most importantly what we as faculty can do to help this situation: (1) we can shift the cultural narrative of surviving to thriving; (2) we can embed wellness education into our programs; (3) we should do more data collection on student well-being; and (4) we need more and better faculty training on how to handle student mental health issues.

Overall, I found this year's conference very enlightening. After three years of not having a MEEd conference due to the Pandemic and Climate Change, it was great to be able to get up to date with the current and future approaches to engineering education. I very much look forward to taking what I have learned this year into my classrooms and sharing it my fellow faculty, and I look forward to next year's conference!

Vaughn College Students Present Innovative Aerospace Research at AIAA Student Conference in Buffalo, NY, March 31-April 1, 2023

Dr. Elzawawy was accompanied by two Vaughn College students, Yusuf Rafi and Suraiya Nawaz, as they presented their research papers in the AIAA Student Conference Region I in Buffalo, NY on March 31-April 1.

The first paper presented was titled "Reconfiguring Cygnus Expendable Cargo Spacecraft into Mars Transit & Surface Habitat". The paper focused on the potential of repurposing the Cygnus Expendable Cargo Spacecraft, which is currently used to deliver supplies to the International Space Station into a habitat for astronauts during transit to and on the surface of Mars.

The paper discussed the various challenges and opportunities associated with this effort, including the need for thermal shielding and the potential for using the spacecraft's existing propulsion systems to navigate Mars' atmosphere.

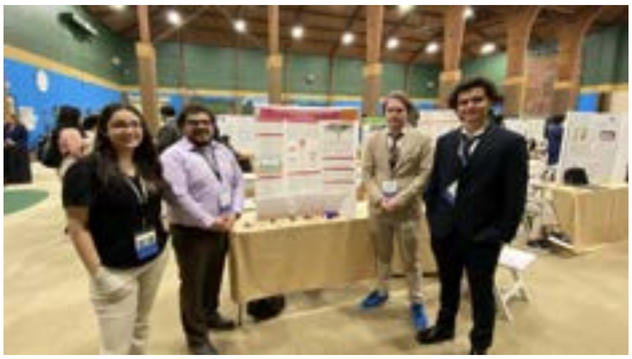
The second paper presented was titled "The Dust Cleaner". This paper focused on a potential solution to the issue of dust buildup on solar panels in space. Dust accumulation on solar panels can significantly reduce their efficiency, and current methods for cleaning the panels are both costly and time-consuming.

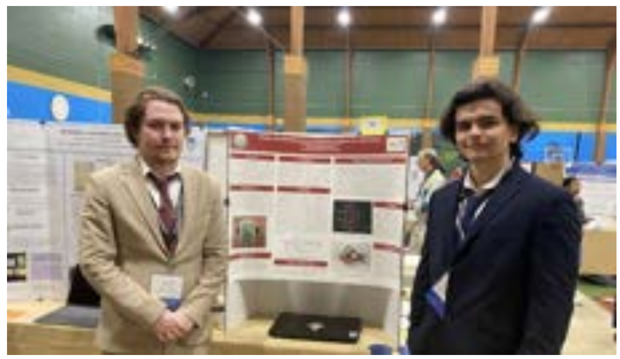
The Dust Cleaner proposed several novel solutions such as using a specially designed electrostatic brush to clean the panels. In the presentation, Suraiya showed promising potential for significantly reducing dust buildup on solar panels.

Attending conferences like the AIAA Student Conference Region I was an excellent opportunity for students to showcase their research and network with other professionals in their field. It also allowed them to gain valuable experience in presenting their work and receiving feedback from peers and experts.

Vaughn College Engineering Students Presented their innovative STEM Research projects at the CSTEP Conference in Sagamore, NY, April 14-16, 2023

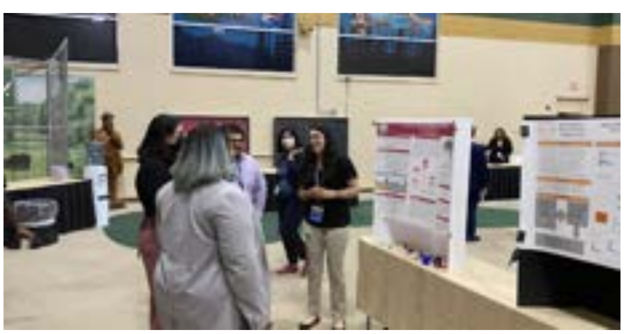
From April 14-26, 2023, Vaughn's engineering students along with Dr. Hossein Rahemi, engineering department chair, and Dr. Amir Elzawawy, the CSTEP project director and students' research projects advisor attended the 35th Collegiate Science and Technology Entry Program (CSTEP) annual conference in Sagamore Resort, Bolton Landing, New York. On Saturday, April 15, from 9 am to 12 pm, two groups of Vaughn's engineering students presented their STEM projects during the **CSTEP Student Showcase Poster Session** of this annual gathering.





The poster by Kirill Sokolov and Atalay Erem was titled "Design and Implementation of Obstacle Avoidance of a Small Robot". The project focused on designing and programming a small robot that satisfies all criteria requirements to compete in IEEE - Region 1 Micromouse Competition. For this Project Kirill, Atalay, and Almaz designed, developed, and programmed an autonomous robot "mouse" that negotiates a maze of standard dimensions from a specified corner to its center. The main focus points were an electrical system using a PCB, enhanced design, and implementation of a PID for control system. Vaughn's team competed in 2022 IEEE - Region 1 Micromouse and won the first-place award of this challenging competition.

The poster by Amanda Camacho and Kevin Velasquez was titled "Fluvial Instrument for Sample Harvesting (F.I.S.H.)". The purpose of this project is to develop an aquatic device that is capable of traversing through water to collect a soil sample to be tested for harmful contaminate known as polychlorinated biphenyls (PCBs). For this project Amanda and Kevin designed a remotely controlled device that utilizes two different types of propellers for vertical and horizontal movements, along with an auger drill and casing to collect and store the soil sample.



During Saturday's Gala dinner gathering, award recipients for the best oral and poster presentations were introduced. Vaughn's student poster by Kirill Sokolov and Atalay Erem that provided an insight about designing and programming a small robot for the purpose of the IEEE Micromouse Competition, won 2nd place award in the Computer and Technology poster session of the 2023 CSTEP student conference. This was the first time Vaughn's faculty and students attended the CSTEP conference; however, this conference provided our students with an excellent opportunity to showcase their CSTEP projects and share their experimental learning with other professionals in their field as well as to provide our students with an excellent networking opportunity.

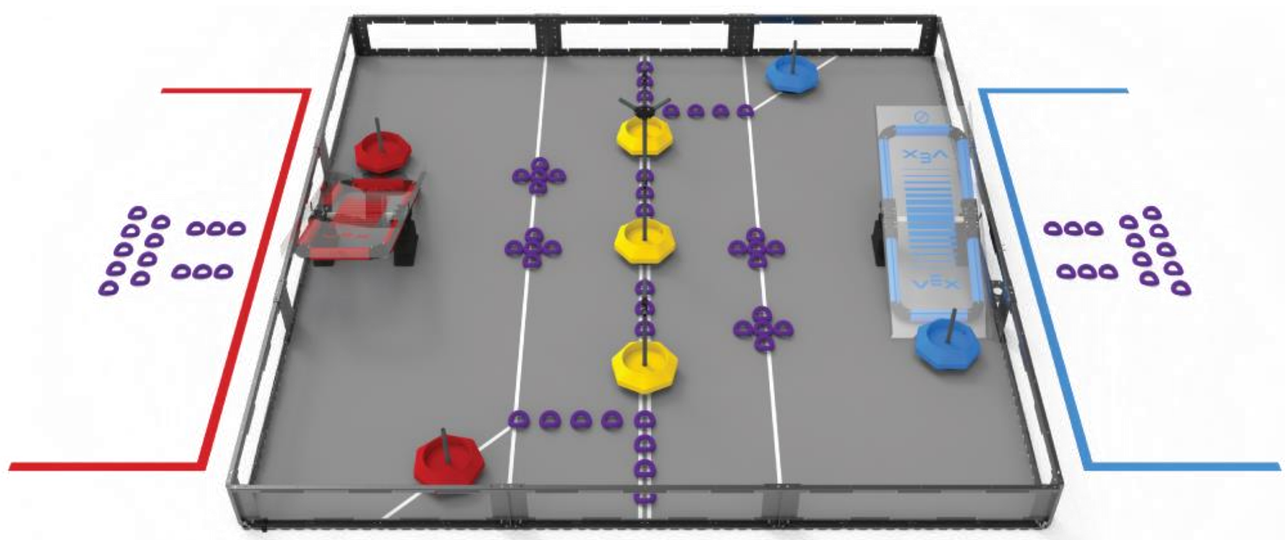
We at Vaughn College are thankful to both CSTEP and the Department of Education federal grant, Title III HIS-STEM for providing necessary funding support to engage students in scholarly and STEM related activities.

2022 VEX U Robotics World Championship "Tipping Point Game"
Vaughn Robotics Team wins the "Excellence Award" of 2022 VEX U Robotics World Championship

Every year, VEX Robotics challenges the problem-solving skills of science, technology, engineering, and math (STEM) scholars. Competition participants used robotics platforms and engineering processes to solve this year's challenge entitled "VEX Tipping Point Game." For this purpose, Vaughn's team designed, built, and programmed two robots to compete in matches consisting of a forty-five-second autonomous period, a minute and fifteen seconds of driver-controlled manipulation, and a skills competition. The team constructed their robots to attain the following objectives:

1. A robot with an effective mechanism that can intake rings to pass through a conveyor belt and on alliance branches.
2. A robot with control algorithms to score rings, possess goals, place goals on the platform and climb for a high skill score and rank.
3. A structurally reliable robot in compliance with the limitations and constraints of the challenge.

One of the biggest factors setting VCAT's robots apart from the other team robots at the world championships was VCAT's robots' wings. The intention behind designing both robots with wings was to allow the drivers to play defensively and to control opponents more easily. The wings folded down using one single-acting piston on each wing and could be used to block off access to a goal or to make it more difficult for opposing robots to get around Vaughn's robots. One common strategy was to unfold the wings to block a robot from escaping our side of the field so that any goals the robot was holding would count for us. The wings were made of sheets of polycarbonate, which is a type of plastic that is good at withstanding collisions, and they were supported by an aluminum c-channel mounted on the middle of the wings. The team chose this material because it would be able to handle hitting into other robots without breaking or permanently bending. Ultimately, wings greatly helped Vaughn's team to restrict their opponent's movement around the field, thus winning matches in both the qualifying and playoff round.



The Game: VEX Robotics Competition Tipping Point is played on a 12'x12' square field configured as seen above. Two (2) Alliances – one (1) "red" and one (1) "blue" – composed of two (2) Teams each compete in matches consisting of a fifteen (15) second Autonomous Period, followed by a one minute and forty-five second (1:45) Driver Controlled Period. The object of the game is to attain a higher score than the opposing Alliance by Scoring **Rings**, moving **Mobile Goals** to **Alliance Zones**, and by **Elevating** on **Platforms** at the end of a Match.

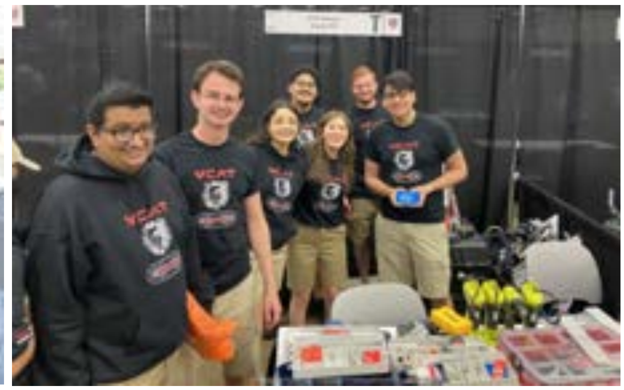
Scoring:

Each Ring Scored on a Neutral Mobile Goal High Branch	10 Points
Each Ring Scored on any other Mobile Goal Branch	3 Points
Each Ring Scored in a Mobile Goal Base	1 Point
Each Mobile Goal Scored in an Alliance Home Zone	20 Points
Each Robot that is Elevated	30 Points
Each Mobile Goal that is Elevated	40 Points
One Ring scored on/in each Alliance Mobile Goal and a Cleared AWP Line in Autonomous	1 Win Point

Game and Scoring Details

There are seventy-two (72) **Rings** and seven (7) **Mobile Goals** on a VRC Tipping Point Field. Each Alliance has two (2) **Alliance Mobile Goals**, with the remaining three (3) Goals being neutral. Each **Alliance** also has a **Platform** located in their **Home Zone**. Rings scored on an Alliance Mobile Goal will count for the respective Alliance, regardless of where it ends the match. However, Rings scored on Neutral Goals will only count for an Alliance if the Mobile Goal ends the match in their Home Zone. As the match draws to a close, Robots will start heading back towards their Alliance Platforms. Alliances can earn additional points for each Robot and Mobile Goal that ends the match Elevated on a **Balanced** Alliance Platform. The Alliance that scores more points in the Autonomous period is awarded with six (6) bonus points added to the final score at the end of the match. Each Alliance also has the opportunity to earn an additional Win Point by scoring at least one Ring on each of their Alliance's Mobile Goals, and "Clearing" their **Autonomous Win Point Line**. This Bonus can be earned by both Alliances, regardless of who wins the Autonomous Bonus.

From May 3-5, seventy-two national and international universities and colleges were invited to the 2022 VEX U World Championship at the Dallas Convention Center. Invitation to the VEX U Robotics World championship is only granted to a team that is a tournament champion or excellence award recipient of a regional competition, and Vaughn's Robotics team was a recipient of both the **"Excellence Award"** and the **"Robot Skills"** award in the Vaughn College Regional Robotics Tournament, as well as the **"Excellence Award"** recipient of the WPI VEX U Robotics Regional Tournament.

This intense three-day competition was challenging, and our team was continuously modifying their robots and autonomous programming to be competitive with other top teams in this tournament. During Tuesday and Wednesday, Vaughn's team participated in the skills challenge and won **3rd place in the VEX U World Skill ranking and 1st place in Autonomous Programming**. During Wednesday and Thursday qualifying matches, Vaughn's team competed against 10 teams, and they won nine out of the ten matches. With nine wins Vaughn's team received 6th overall ranking in the Technology division of the VEX U World Robotics championship and automatic qualification for the Thursday afternoon single elimination playoff round.



In the top 16 playoff round, Vaughn's team eliminated Mt. San Antonio College (NTSAC2) and advanced to the quarter final. In the quarter final, the top eight teams competed, and Vaughn's team defeated a team from University of Illinois at Urbana Champaign (ICTRL) and advanced to the semifinal playoff round against a team from University of Wisconsin (WISCO). In an intense exciting semifinal game of the tournament, WISCO defeated the VCAT team and advanced to the world tournament championship matches, winning the 2022 World tournament championship. Vaughn's team won the 2022 Technology Division Skills Award and the World Excellence Award.

2022 Technology Division Skills Award

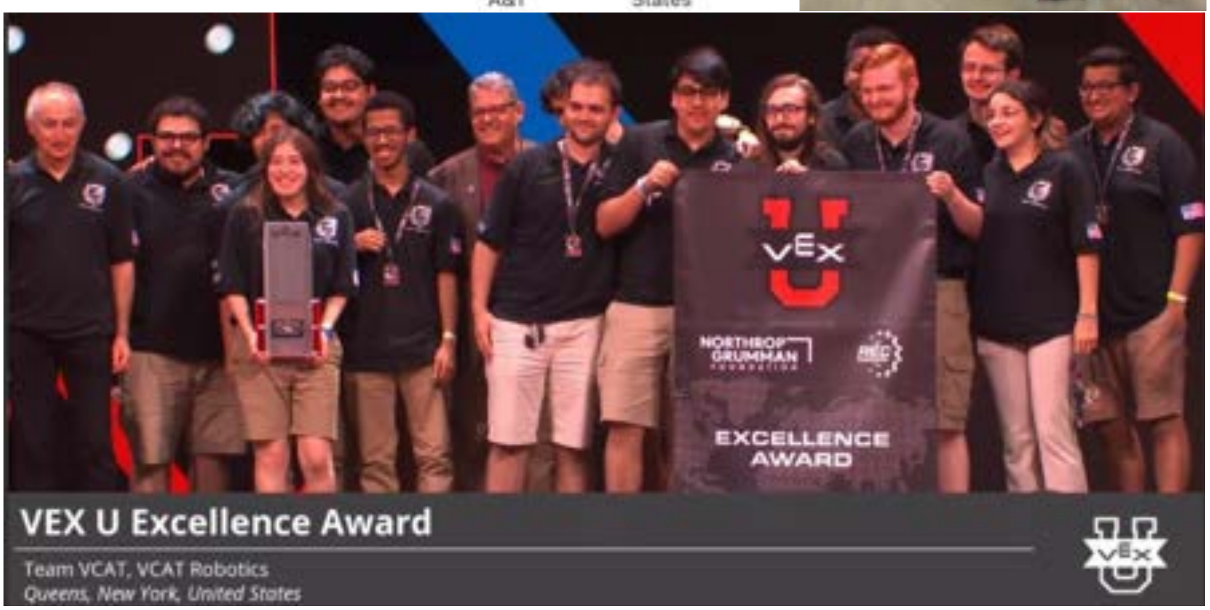
Vaughn College Robotics team won the highest award, the **“Excellence Award” of the 2022 VEX U Robotics World Championship**. Vaughn’s team won this award because their work “best exemplifies, the best overall robotics program” and because judges “want the team be emulated by other teams”. A team must succeed at most features of the competition during an event in order to win the Excellence Award. They must turn in an engineering notebook, and they are considered as a contender for the design and many other technical awards. They must rank considerably high in qualification and in the Robotics Skills challenge.

2022 VEX U Robotics World Championship “Excellence Award”

The world championship is a tough competition for which only the top US regional and world champions qualify for participation. The VCAT team has done an impressive job to be the third top world team in the robotics skills challenge competition and the first in autonomous programming. Congratulations to Vaughn’s robotics team members for keeping their standing as one of the top ranked competitors and best Robotics team in the 2022 world championship and for being able to advance to the semifinal playoff round (final four) of this intense, challenging competition, winning the “Excellence Award”.

VEX U World Championship				
Award	**Team #**	**Team Name**	**Affiliation**	**Location**
VEX U Excellence Award	VCAT	VCAT Robotics	Vaughn College of A&T	Queens, New York, United States
VEX U World Champions	WISCO	WiscoBots	University of Wisconsin - Platteville	Platteville, Wisconsin, United States
VEX U World Finalists	BLRS	Purdue SIGBots	Purdue University	West Lafayette, Indiana, United States

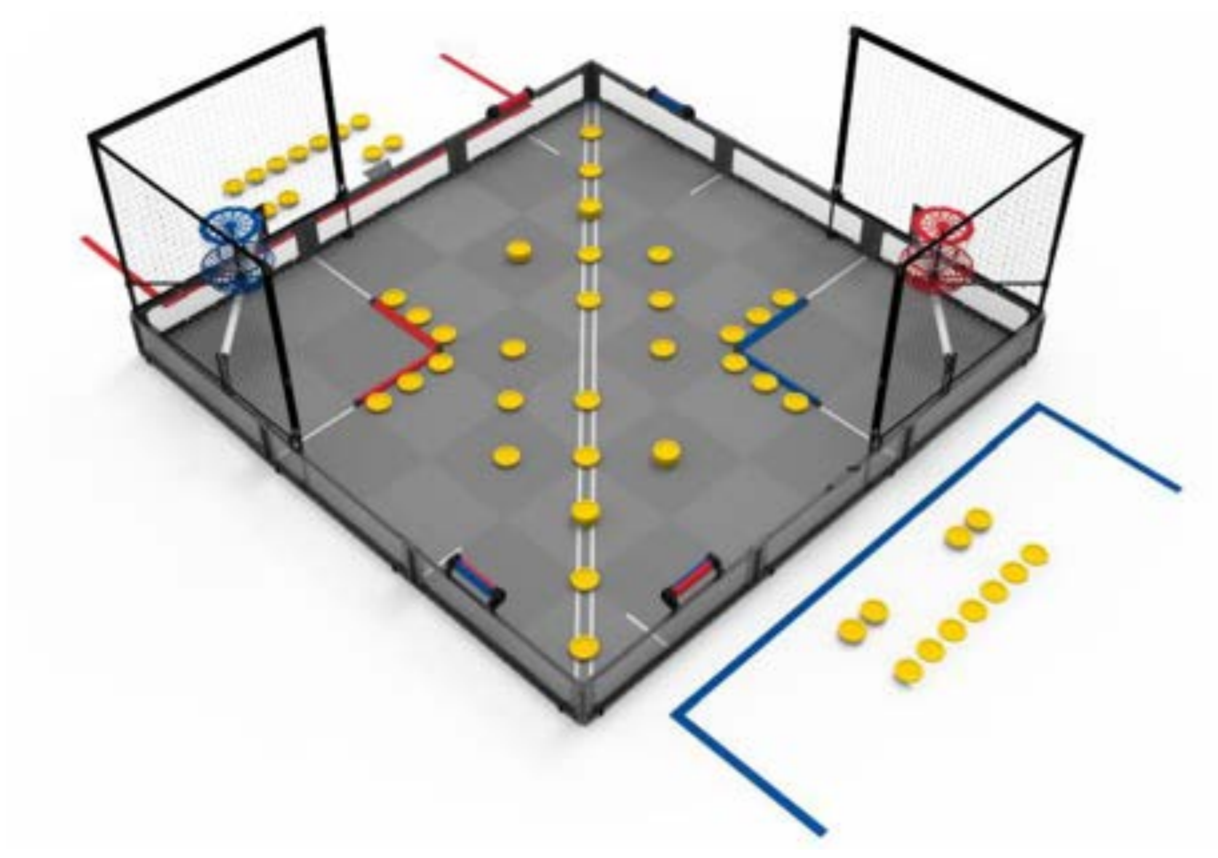
VEX U Skills Challenge Winners				
Award	**Team #**	**Team Name**	**Affiliation**	**Location**
VEX U Robot Skills World Champions	BLRS2	Purdue SIGBots	Purdue University	West Lafayette, Indiana, United States
VEX U Robot Skills 2nd Place	USC	USC Trojans	University of Southern California	Los Angeles, California, United States
VEX U Robot Skills 3rd Place	VCAT	VCAT Robotics	Vaughn College of A&T	Queens, New York, United States



Congratulations to Vaughn's robotics team members for keeping their standing as one of the top ranked competitors and best Robotics teams in the 2022 world championship, by advancing to the playoff round of this intense competition and winning the top "Excellence Award". I would like to extend my sincere appreciation to our advisory members, alumni, and Vaughn Community for their continuous support and contribution toward our programs and student engagements. Also, we are thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM, and Articulation grant) which provided necessary funding support to engage Vaughn's students in STEM-related scholarly and professional activities.

2022-2023 VEX Robotics "Spin Up" Game: Every year, VEX Robotics challenges the problem-solving skills of science, technology, engineering, and math (STEM) scholars. Competition participants used robotics platforms and engineering processes to solve this year's challenge entitled "VEX Spin Up Game." For this purpose, Vaughn's team designed, built, and programmed two robots to compete in matches consisting of a forty-five-second autonomous period followed by a minute and fifteen seconds of driver-controlled manipulation. The team constructed their robots to attain the following objectives:

1. A robot with effective mechanisms that can intake discs to be launched by a flywheel, expand at the end of the match to cover tiles on the field and rapidly change the rotational position of rollers located on the field.
2. A robot with control algorithms to target and launch discs into high goals and rapidly change the roller scored position.
3. A structurally reliable robot in compliance with the limitations and constraints of the challenge.



The Game: VEX Robotics Competition Spin Up is played on a 12'x12' square field configured as seen above. Two (2) Alliances – one (1) "red" and one (1) "blue" – composed of two (2) Teams each, compete in matches consisting of a fifteen (15) second Autonomous Period, followed by a one minute and forty-five second (1:45) Driver Controlled Period. The object of the game is to attain a higher score than the opposing Alliance by Scoring **Discs in low and high goals, owning Rollers** and by **Covering Field Tiles** at the end of a Match.

Scoring:

Each Disc Scored in a High Goal	5 Points
Each Disc Scored in a Low Goal	1 Points
Each Owned Roller	10 Point
Each Covered Field Tile	3 Points
Win the Autonomous Period	10 Points
Scoring at least two Discs in Alliance’s High Goals and owning Both Rollers on their side of the field.	1 Win Point

Game and Scoring Details

There are sixty (60) **Discs** and four (4) **Rollers** on a VRC Spin Up Field. Each **Alliance** has their low goal and the other alliance’s **High Goal** located in their **Home Zone**. As the match draws to a close, each disc in their respective alliance’s **Low Goal** will be worth one (1) point and each disc in their respective **High Goal** will be worth five (5) points. Each **Roller** which has a single color within the guides will be worth ten (10) points for the alliance whose color is within the guides and in turn owned by that alliance. The Alliance that scores more points in the Autonomous period is awarded with ten (10) bonus points, added to the final score at the end of the match. Each Alliance also has the opportunity to earn an additional Win Point by scoring at least two discs in their Alliance’s **High Goals** and owning both **Rollers** on their side of the field. This Bonus can be earned by both Alliances, regardless of who wins the Autonomous Bonus.

Vaughn College Hosted VEX High School Robotics Qualifier Competition on Saturday, Dec 17th, 2022

Vaughn College of Aeronautics and Technology hosted its second annual VRC high school robotics Tournament on Saturday December 27th, 2022. A total of 32 regional high schools from Queens, Manhattan, Bronx, Westchester and Nassau counties attended the December 2022 VCAT VRC Tournament at Vaughn College. The list of high school participants is as follows:

Team List — 32 Teams

Team	Team Name	Organization	Location
6992	Edison Robotics	THOMAS A EDISON CAREER AND TECHNICAL HIGH SCHOOL	Jamaica, New York, United States
955N	Checkmate	Play Ideas NY	New York, New York, United States
955A	Checkmate	Play Ideas NY	New York, New York, United States
1569A	OMEGA	OMEGA Robotics	Great Neck, New York, United States
1569B	The Discord Kittens	OMEGA Robotics	Great Neck, New York, United States
1008A	Red Devil Robotics	FREEPORT HIGH SCHOOL	Freeport, New York, United States
1008B	Red Devil Robotics	FREEPORT HIGH SCHOOL	Freeport, New York, United States
1008C	Red Devil Robotics	FREEPORT HIGH SCHOOL	Freeport, New York, United States
5059E	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
6277A	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
6277B	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
8000A	Adelphi STEP	Adelphi University STEP Program	Garden City, New York, United States
9932A	Hawks	JERICHO SENIOR HIGH SCHOOL	Jericho, New York, United States
9932F	Hawks	JERICHO SENIOR HIGH SCHOOL	Jericho, New York, United States
9932X	Hawks	JERICHO SENIOR HIGH SCHOOL	Jericho, New York, United States
11442V	Hewitt Robotics	The Hewitt School	New York, New York, United States
11442W	Hewitt Robotics	The Hewitt School	New York, New York, United States
11442Y	Hewitt Robotics	The Hewitt School	NEW YORK, New York, United States
12357A	Infinite Robotics	Infinite Robotics	Jericho, New York, United States
16999H	Overclock MS	NY Youth Tech	Flushing, New York, United States
19396A	Bayside Commodores	Bayside High School	BAYSIDE, New York, United States
24842A	Lawnmowers		Manhasset, New York, United States
38211B	Centereach Cougears	CENTEREACH HIGH SCHOOL	Centereach, New York, United States
62880A	Bing Chi Ling (冰淇淋)	Coast 2 Coast Robotics	Bayside, New York, United States
77628A	Mepham Robotics A	WELLINGTON C MEPHAM HIGH SCHOOL	Bellmore, New York, United States
77628C	1st Shock Army	WELLINGTON C MEPHAM HIGH SCHOOL	Bellmore, New York, United States
85045A	EBT High School	HIGH SCHOOL FOR ENTERPRISE BUSINESS & TECHNOLOGY (THE)	Brooklyn, New York, United States
97140A	Kennedy Gaels	Kennedy Catholic Preparatory School	Somers, New York, United States
97140B	Kennedy Gaels Too	Kennedy Catholic Preparatory School	Somers, New York, United States
99588A	Checkmate	PIA Tech Leagues	Great Neck, New York, United States
99588M	Checkmate	PIA Tech League	Great Neck, New York, United States
99588X	Checkmate	PIA Tech Leagues	Great Neck, New York, United States

The members of the VCAT robotics team organized and ran the event as referees, judges, and event staff. John Sutera served as manager and event planner; Ryan Tang served as the announcer; Maharshi Patel served as head referee. Chris Walker and Danial Doscher acted as secondary referees. Al Birnbaum acted as score keeper referee. VCAT members (Mariah Villalon, Rebecca Snyder, Nigel John, Anabil Biswas) and members of Vaughn's UAV Club (Mike Hefner, Huong Ho and Andrew Ramos) served as the judges for this competition.

High School VEX Robotics State Qualifier Competition, Saturday, December 17th, 2022

The table below provides the list of award recipients for the 2022 regional High School VEX Robotics State Qualifier Competition. An alliance of OMEGA Robotics won the tournament championship, an alliance of The Harvey School and Kennedy Catholic Preparatory School came in second as the tournament finalists, while a team from NY Youth Tech won the "Excellence" Award and "Robot Skills". Kennedy Catholic Preparatory School won the "Design" Award, Tournament champions, "Excellence" Award, "Tournament Finalists" and "Robot Skills" and qualified to participate in the New York State VEX Championship.

VEX Robotics Competition - VCAT

Award	Team #	Team Name	Affiliation	Location
Excellence Award (VRC/VEXU/VAIC)	16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
Tournament Champions (VRC/VEXU/VAIC)	1569A	OMEGA	OMEGA Robotics	Great Neck, New York, United States
Tournament Champions (VRC/VEXU/VAIC)	1569B	The Discord Kittens	OMEGA Robotics	Great Neck, New York, United States
Tournament Finalists (VRC/VEXU/VAIC)	6277B	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
Tournament Finalists (VRC/VEXU/VAIC)	97140A	Kennedy Gaels	Kennedy Catholic Preparatory School	Somers, New York, United States
Design Award (VRC/VEXU/VAIC)	97140A	Kennedy Gaels	Kennedy Catholic Preparatory School	Somers, New York, United States
Robot Skills Champion (VRC/VEXU)	16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
Judges Award (VRC/VEXU/VAIC/ADC)	77628A	Mepham Robotics A	WELLINGTON C MEPHAM HIGH SCHOOL	Bellmore, New York, United States
Innovate Award (VRC/VEXU/VAIC)	9932X	Hawks	JERICHO SENIOR HIGH SCHOOL	Jericho, New York, United States
Think Award (VRC/VEXU/VAIC)	97140B	Kennedy Gaels Too	Kennedy Catholic Preparatory School	Somers, New York, United States
Amaze Award (VRC/VEXU/VAIC)	1569A	OMEGA	OMEGA Robotics	Great Neck, New York, United States
Build Award (VRC/VEXU/VAIC)	6277B	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States

The 2022 regional VRC High School Robotics State Qualifier Competition Award recipients

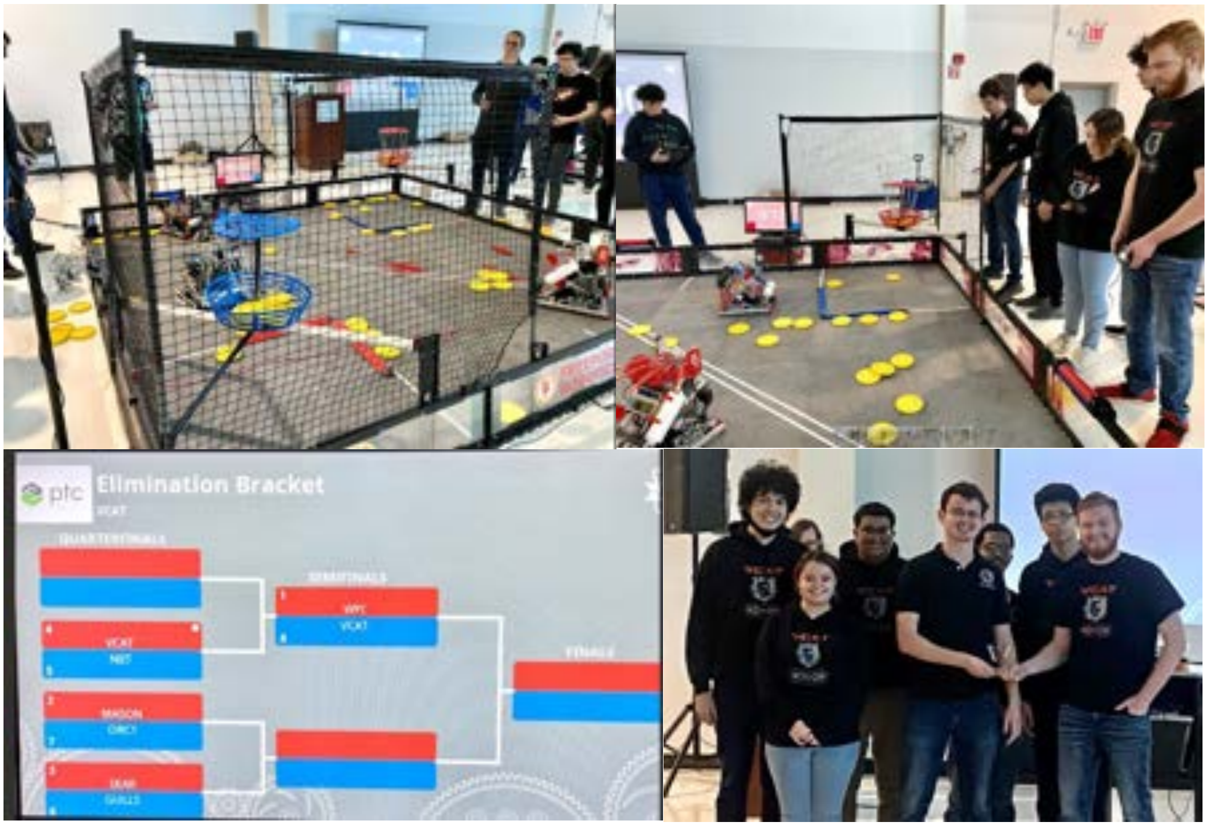
Vaughn College hosted VEX U Robotics Tournament on Friday, February 10th, 2023; Vaughn Robotics Team wins 2023 VEX U Design Award.

Vaughn College of Aeronautics and Technology hosted its Ninth Annual VEX U College Regional Robotics competition on Friday, February 10th, 2023. A total of eight college teams participated at this event. The participant teams included Worcester Polytechnic Institute (WPI-GOAT), George Mason University (MASON), Syracuse U (ORC1), Salisbury University (GULLS), New Jersey Institute of Technology (NJIT), Rutgers University (SKAR), Technological University of Matamoros (TMAT1), and Vaughn College of Aeronautics and Technology (VCAT)..

Members of Vaughn College robotic club (Maharshi Patel, Daniel Doscher, John Sutera, Christopher Walker, Amanda Camacho, Rebecca Snyder) represented the Vaughn team (VCAT) at this competition. Also, members of Vaughn's robotics team served as the event manager, announcer, and robot inspectors and also set up the fields and facilitated the implementation process for this event. Also, Drs. Shouling He and Hagos Kifle served as judges for this competition.

During the skills challenge matches, Vaughn's team finished third in "Robot Skills" (161 points). In qualification matches, Vaughn's team, with four wins, received fourth ranking and advanced to the playoff elimination round. During the quarterfinal of playoff rounds, VCAT defeated NJIT thus advancing to the semifinals where they faced WPI (QOAT). WPI defeated VCAT and advanced to the final playoff round and after defeating MASON, WPI won the tournament championship. MASON won the Excellence Award, and the VCAT team won the Design award.

In the 2022 World Robotics Championship, Vaughn's robotics team won the World "Excellence" award which automatically qualifies Vaughn's Robotics team for participation in the 2023 VEX U world championship.



VEX U Elimination Bracket, Vaughn's team wins Design Award

Rank	Team		Age	Total Score	Programming Score	Programming Attempts	Driving Score	Driving Attempts
1	WPI	The Notorious G.O.A.T.	COL	256	66	2	190	1
2	MASON	Scitech Robotics	COL	214	82	3	132	3
3	VCAT	VCAT Robotics	COL	161	53	2	108	2
4	SKAR	Scarlet Knights	COL	153	29	1	124	3
5	NJIT	NJIT Highlanders	COL	127	19	2	108	2
6	ORC1	Orange Robotics	COL	20	0	0	20	1

Vaughn's team finished 3rd place in Robot Skills

Acknowledgement: We are thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM and Articulation grant) which provided necessary funding support to engage Vaughn's Robotics students in STEM professional activities and competitions.

HSI-STEM
Science Technology
Engineering Math

Vaughn College Hosted VEX High School Robotics Qualifier Competition on Saturday, Feb 11th, 2023

Vaughn College of Aeronautics and Technology hosted its Ninth annual high school robotics competition on Saturday, February 11th, 2023. A total of 51 regional high schools from Queens, Bronx, Nassau, and Suffolk and other NY counties attended the 2023 VEX state qualifier at Vaughn College. The list of high school participants is as follows:

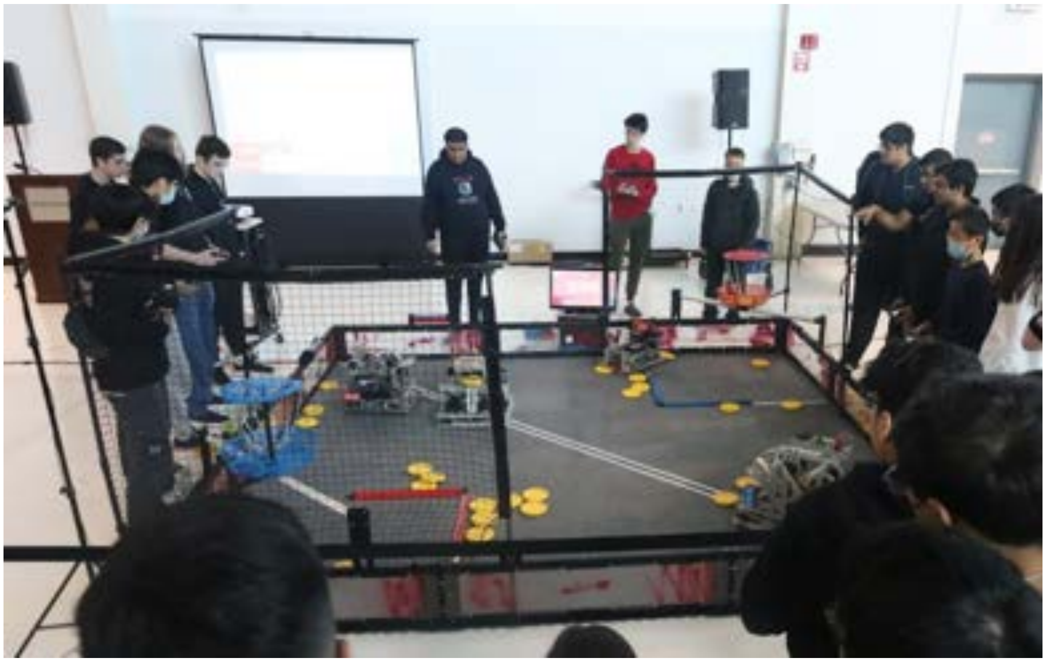
Team List

51 Teams

Team	Team Name	Organization	Location
699Z	Edison Robotics	THOMAS A EDISON CAREER AND TECHNICAL HIGH SCHOOL	Jamaica, New York, United States
1569A	OMEGA	OMEGA Robotics	Great Neck, New York, United States
1569B	The Discord Kittens	OMEGA Robotics	Great Neck, New York, United States
2156X	Hidden Network	Hidden Network	Garden City, New York, United States
3362A	Tiger Robotics Team 1	Lawrence Woodmere Academy	Woodmere, New York, United States
3362B	MS Tiger Robotics Team 2	Lawrence Woodmere Academy	Woodmere, New York, United States
5059B	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
6277B	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
6277D	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
6277E	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
9458A	Robo Chiefs	MASSAPEQUA HIGH SCHOOL	Massapequa, New York, United States
9458B	Robo Chiefs	MASSAPEQUA HIGH SCHOOL	Massapequa, New York, United States
9717A	St. Catharine Comets	ST CATHARINE ACADEMY	Bronx, New York, United States
9717B	St. Catharine Comets	ST CATHARINE ACADEMY	Bronx, New York, United States
9932A	Hawks	JERICHO SENIOR HIGH SCHOOL	Jericho, New York, United States
9932D	Hawks	JERICHO SENIOR HIGH SCHOOL	Jericho, New York, United States
11040A	HighlandBots	HERRICKS HIGH SCHOOL	New Hyde Park, New York, United States
11040B	HighlandBots	HERRICKS HIGH SCHOOL	New Hyde Park, New York, United States
11442V	Hewitt Robotics	The Hewitt School	New York, New York, United States
11442W	Hewitt Robotics	The Hewitt School	New York, New York, United States
11442X	Hewitt Robotics	The Hewitt School	New York, New York, United States
11442Y	Hewitt Robotics	The Hewitt School	NEW YORK, New York, United States

11570A	Cyclones Robotics	SOUTH SIDE HIGH SCHOOL	Rockville Centre, New York, United States
11570B	Cyclones Robotics	SOUTH SIDE HIGH SCHOOL	Rockville Centre, New York, United States
12357A	Infinite Robotics	Infinite Robotics	Jericho, New York, United States
16099A	Overclock	KG Computech	Flushing, New York, United States
16099B	Overclock	KG Computech	Flushing, New York, United States
16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
19383A	NewRo Bots	NEW ROCHELLE HIGH SCHOOL	New Rochelle, New York, United States
19383B	NewRo Bots	NEW ROCHELLE HIGH SCHOOL	New Rochelle, New York, United States
19383C	NewRo Bots	NEW ROCHELLE HIGH SCHOOL	New Rochelle, New York, United States
19396A	Bayside Commodores	Bayside High School	BAYSIDE, New York, United States
20196A	Spiky Dinos	Northshore Coding and Robotics Club	Great Neck, New York, United States
24842A	Lawnmowers		Manhasset, New York, United States
25565A	Seven	Riverdale Country School	BRONX, New York, United States
25565B	Seven Point One	Riverdale Country School	BRONX, New York, United States
38211B	Centereach Cougears	CENTEREACH HIGH SCHOOL	Centereach, New York, United States
38211C	Centereach Cougears	CENTEREACH HIGH SCHOOL	Centereach, New York, United States
47114A	Onyx	North Shore Coding and Robotics Club	Great Neck, New York, United States
55645X	ARSENAL	ARSENAL ROBOTICS	Jericho, New York, United States
62880A	Bing Chi Ling (冰淇淋)	Coast 2 Coast Robotics	Bayside, New York, United States
62880B	Xiao Man Tou (小馒头)	Coast 2 Coast Robotics	Bayside, New York, United States
70407R	Refraction	Meahagh Robotics	Buchanan, New York, United States
97140A	Kennedy Gaels	Kennedy Catholic Preparatory School	Somers, New York, United States
97140B	Kennedy Gaels Too	Kennedy Catholic Preparatory School	Somers, New York, United States
97871R	Roverines Robotics	NEWFIELD HIGH SCHOOL	Selden, New York, United States
99561A	Ambush	FALLSBURG JUNIOR SENIOR HIGH SCHOOL	Fallsburg, New York, United States
99561G	Dinos	FALLSBURG JUNIOR SENIOR HIGH SCHOOL	Fallsburg, New York, United States
99561X	Dreadless	FALLSBURG JUNIOR SENIOR HIGH SCHOOL	Fallsburg, New York, United States
99588M	Checkmate	PIA Tech League	Great Neck, New York, United States
99588X	Checkmate	PIA Tech Leagues	Great Neck, New York, United States

The members of the VCAT robotics team organized and acted as referees for the event. John Sutera served as manager and event planner; Maharshi Patel served as head referee. VCAT Robotics members (Rebecca Snyder & Nigel John) with members of the Vaughn community (Aisling O'Sullivan, Kristian Nievas, Alanke Perera, Valentino McLeod, Cristian Sorto, Daniel Garcia and Samuel Hernandez) served as the judges for this competition. Other VCAT members (Christopher Walker, Daniel Dosher) were assistant referees for the competition.

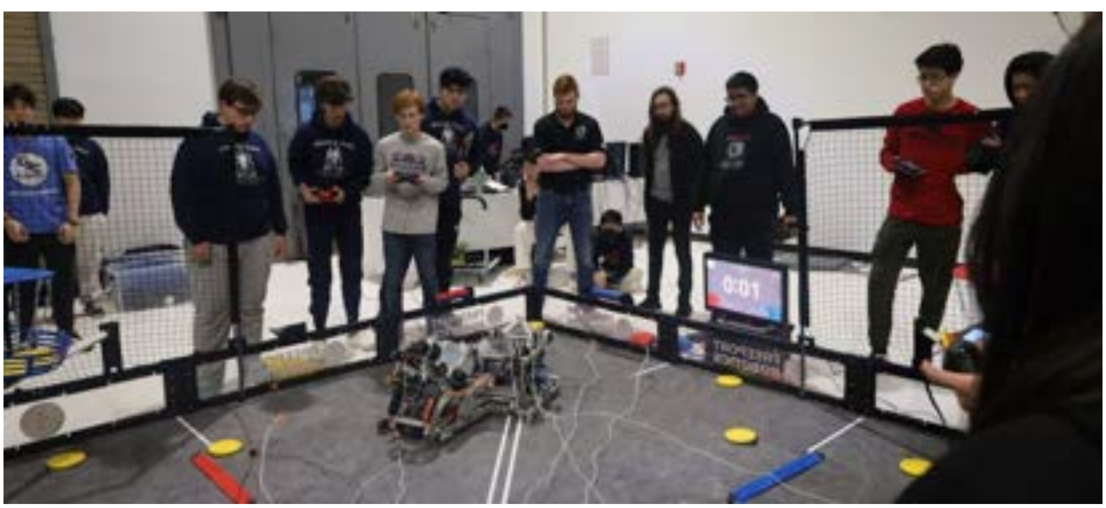


High School VEX Robotics State Qualifier Competition, Saturday, February 11th, 2023

The table below provides the list of award recipients for the 2023 regional High School VEX Robotics State Qualifier Competition. An alliance of teams from Flushing, New York Overclock (16099A & 16099B) won the tournament championship and 16099A won the “Excellence” Award and the “Robot Skills Champion” Award. The “Design” Award was awarded to Meahagh Robotics from Buchanan, New York. The “Innovate” Award was awarded to NY Youth Tech from Flushing, New York. The “Think” Award was awarded to Coast 2 Coast Robotics from Bayside, New York. The “Amaze Award was awarded to Kennedy Catholic Preparatory School from Somers, New York. The “Build” Award was presented to The Harvey School from Katonah, New York. Teams from PIA Tech Leagues from Great Neck, New York and Coast 2 Coast Robotics from Bayside, New York were tournament finalists. St. Catherine Academy from Bronx, New York won the “Judges” award. Tournament Champions, Tournament Finalists, “Excellence” Award, “Design” Award, “Robot Skills Champion” Award, “Innovate” Award, “Think” Award, “Amaze” Award Winners qualified to participate in the New York State VEX Championship.

Award Winners of Vaughn College VEX Robotics Competition

Award	Team #	Team Name	Affiliation	Location
Excellence Award (VRC/VEXU/VAIC)	16099A	Overclock	KG Computech	Flushing, New York, United States
Tournament Champions (VRC/VEXU/VAIC)	16099A	Overclock	KG Computech	Flushing, New York, United States
Tournament Champions (VRC/VEXU/VAIC)	16099B	Overclock	KG Computech	Flushing, New York, United States
Tournament Finalists (VRC/VEXU/VAIC)	99588X	Checkmate	PIA Tech Leagues	Great Neck, New York, United States
Tournament Finalists (VRC/VEXU/VAIC)	62880A	Bing Chi Ling (冰淇淋)	Coast 2 Coast Robotics	Bayside, New York, United States
Design Award (VRC/VEXU/VAIC)	70407R	Refraction	Meahagh Robotics	Buchanan, New York, United States
Robot Skills Champion (VRC/VEXU)	16099A	Overclock	KG Computech	Flushing, New York, United States
Judges Award (VRC/VEXU/VAIC/ADC)	9717A	St. Catharine Comets	ST CATHARINE ACADEMY	Bronx, New York, United States
Innovate Award (VRC/VEXU/VAIC)	16699Y	Overclock MS	NY Youth Tech	Flushing, New York, United States
Think Award (VRC/VEXU/VAIC)	62880A	Bing Chi Ling (冰淇淋)	Coast 2 Coast Robotics	Bayside, New York, United States
Amaze Award (VRC/VEXU/VAIC)	97140B	Kennedy Gaels Too	Kennedy Catholic Preparatory School	Somers, New York, United States
Build Award (VRC/VEXU/VAIC)	6277B	RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States



Competition Match in Progress

Competition Match Scoring

Award Ceremony

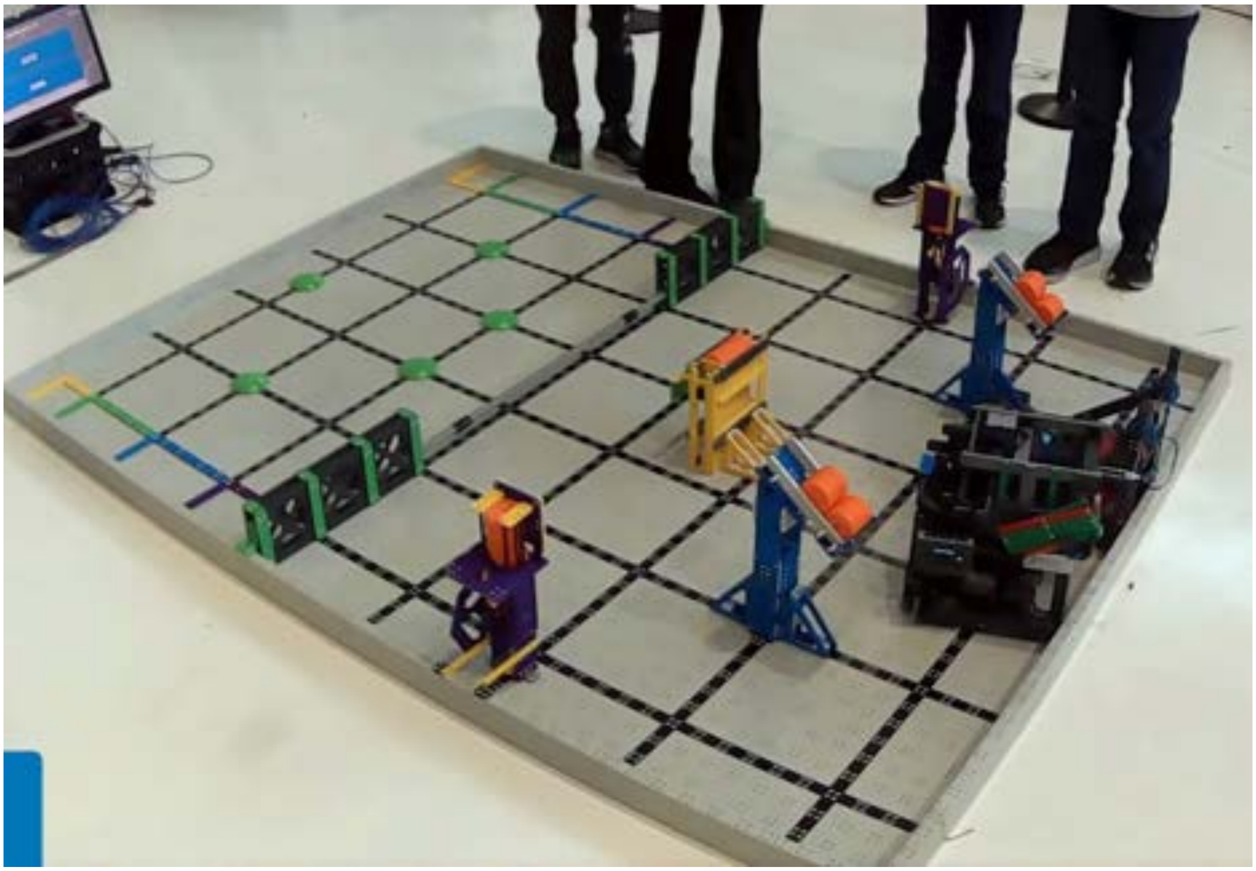
Vaughn College Hosted VEX IQ Middle & Elementary School Robotics Qualifier Competition on Sunday, Feb 12th, 2023

Vaughn College of Aeronautics and Technology hosted its third annual Middle & Elementary robotics competition on Saturday February 12th, 2023. A total of 22 regional schools from Queens, Nassau, and other NY counties attended the 2023 VEX state qualifier at Vaughn College. The list of Middle & Elementary school participants is as follows:

Team List — 22 Teams

Team	Team Name	Organization	Location
1876A	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876B	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876C	Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876X	1876X	FRIENDS ACADEMY	Locust Valley, New York, United States
1876Y	1876Y Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
1876Z	1876Z Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
2500A	Robo-Vengers	Play Ideas NY	Jericho, New York, United States
6277W	6277W RoboCavs	The Harvey School	KATONAH, New York, United States
6277X	6277X RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
6277Y	6277Y RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
6277Z	6277Z RoboCavs	THE HARVEY SCHOOL	Katonah, New York, United States
11442A	Hewitt Robotics	THE HEWITT SCHOOL	New York, New York, United States
11442D	Hewitt Robotics	THE HEWITT SCHOOL	New York, New York, United States
11442F	Hewitt Robotics	THE HEWITT SCHOOL	New York, New York, United States
12357X	Beyond Infinity	Infinite Robotics	jericho, New York, United States
41854A	Tiger Tronics	EAST NORTHPORT MIDDLE SCHOOL	East Northport, New York, United States
65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
65950B	PeeWee Tater Tots	Coast 2 Coast Robotics	BAYSIDE, New York, United States
78273B	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273D	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
78273F	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
84501A	Fallsburg Comets Team A	FALLSBURG JUNIOR SENIOR HIGH SCHOOL	FALLSBURG, New York, United States

The members of the VCAT robotics team organized and served as referees for the event. John Sutera served as manager and event planner; Daniel Dosher served as head referee. VCAT Robotics member (Rebecca Snyder) and members of the Vaughn community (Huong Ho & Kenny Harris) served as the judges for this competition. Other VCAT members (Christopher Walker & Kevin Velasquez) were assistant referees for the competition.



Middle & Elementary School VEX Robotics State Qualifier Competition, Sunday, February 12th, 2023

The table below provides the list of award recipients for the 2023 regional Middle & Elementary School VEX Robotics State Qualifier Competition. An alliance of teams TechTitans from South Ozone Park, New York and Coast 2 Coast Robotics from Bayside, New York won the Teamwork Championship and Coast 2 Coast Robotics won the "Excellence" Award and the "Robot Skills Champion" Award. The "Teamwork 2nd Place Award" was present to the alliance of teams Robo-Vengers from Jericho, New York and Coast 2 Coast Robotics from Bayside, New York. The "Design" Award was awarded to Friends Academy from Locust Valley, New York. Robo-Vengers from Jericho, New York won the "Judges" award. Teamwork Champions, Teamwork 2nd Place, "Excellence" Award, "Design" Award, "Robot Skills Champion" Award, winners qualified to participate in the New York State VEX Championship.

Award Winners of Vaughn College VEX IQ Competition

VEX IQ Competition - VCAT

Award	Team #	Team Name	Affiliation	Location
Excellence Award (VIQC)	65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Teamwork Champion Award (VIQC)	78273F	TechTitans	PS 124 OSMOND A CHURCH	South Ozone Park, New York, United States
Teamwork Champion Award (VIQC)	65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Teamwork 2nd Place Award (VIQC)	2500A	Robo-Vengers	Play Ideas NY	Jericho, New York, United States
Teamwork 2nd Place Award (VIQC)	65950B	PeeWee Tater Tots	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Design Award (VIQC)	1876Y	1876Y Quakers	FRIENDS ACADEMY	Locust Valley, New York, United States
Robot Skills Champion (VIQC)	65950A	Square Shaped Potatoes	Coast 2 Coast Robotics	BAYSIDE, New York, United States
Judges Award (VIQC)	2500A	Robo-Vengers	Play Ideas NY	Jericho, New York, United States

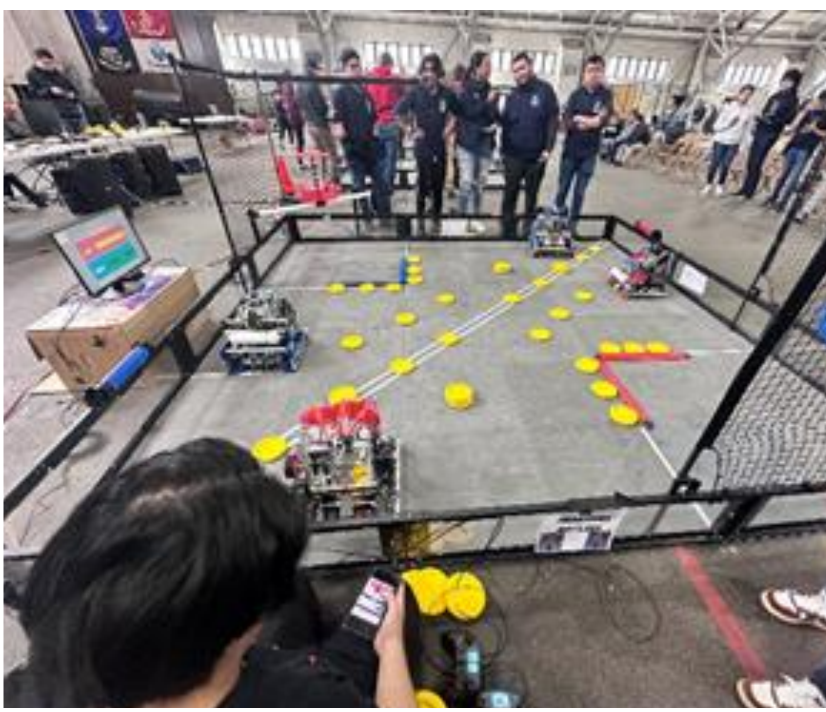
Vaughn College Robotics team attended Purdue SIGBots VEXU Midwestern Showdown on Saturday, Feb 25th, 2023; Vaughn Robotics Team wins 2023 VEX U Innovate Award.

Vaughn College of Aeronautics and Technology robotics team attended the Purdue SIGBots VEXU Midwestern Showdown. A total of twenty-two college teams participated at this event. The participant teams included VCAT, OWL1, WISCO, NUKE, BLRS, BLRS2, BLRS3, FOAB, BCUZ, EZPZ, SNDIT, TMAT1, TMAT3, RIT, PPA, MSOE1, ORDGR, ILLINI1, UNLVU1, ETC, BV1, and GHOST.

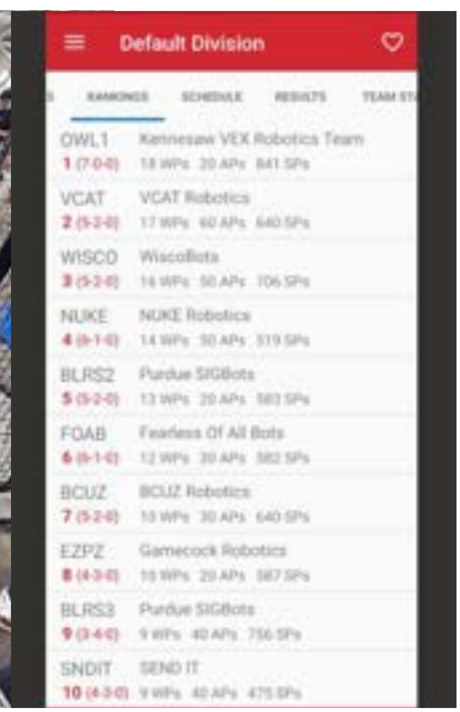
Members of Vaughn College robotic club (Maharshi Patel, Daniel Doscher, Kevin Tsang, Christopher Walker, Lilidania Rodriguez, Rebecca Snyder, Carlo Ovalle, Al Birnbaum, Adam Marzak, William Zeng) represented the Vaughn team (VCAT) at this competition.

In qualification matches, Vaughn's team with five wins and two losses received second ranking and advanced to the playoff elimination round. VCAT won the autonomous bonus and win points in every match, basically showing everyone that VCAT's autonomous routines are very consistent. During the 16th round of the playoffs, VCAT defeated MSOE1 thus advancing to the quarterfinals. During the quarterfinal of playoff rounds, VCAT was defeated by BCUZ and were thus eliminated from the playoff rounds.

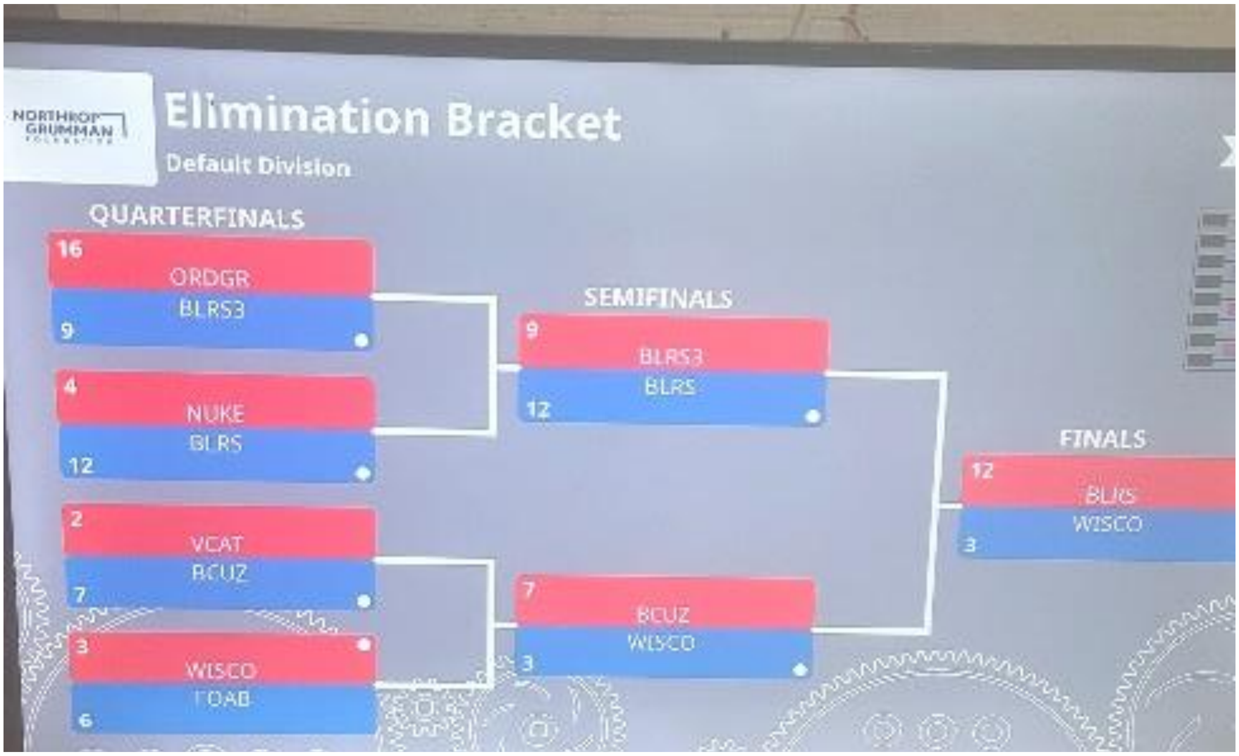
The tournament champions were BLRS; the Excellence award went to WISCO, the Design award to BCUZ, the Robot skills champion was OWL1, the Judges award went to TMAT1, the Build award went to SNDIT, the Create award went to FOAB, and VCAT received the Innovate award. VCAT will now spend the next two months preparing for the 2023 VEXU World Championship.



VCAT prepares for a match against TMAT3



Qualification Ranking



Elimination Bracket

Award Recipients

2022-2023 Rover Club Activities

The Vaughn College of Aeronautics and Technology (VCAT) Rover Club is an extracurricular club whose objective is to build a fully mechanical, human-powered rover to compete in the Human Exploration Rover Challenge (HERC) hosted yearly in Huntsville, Alabama. Through this club, students have complete creative freedom to design, build, manufacture, and test new systems with the help of design software such as CATIA and SolidWorks. Furthermore, with the club's participation at HERC, the members are expected to have solid STEM Outreach work to involve the community in STEM fields and to open the club's work to young children in order to inspire the next generation of engineers, scientists, and astronauts.

Club Timeline

The Vaughn College of Aeronautics and Technology's (VCAT's) Rover Club is newly established as of December 1st of 2022 under the student government presidency of John Sutera. The principal objectives of this club at Vaughn are: to provide a solid platform to reach future generations of engineers, to positively impact the college community by representing it in an international challenge, to establish Vaughn's name in a new sector, to produce an environment for the new Rover team members to expand their knowledge through exposure to real engineering problems, to apply engineering standards to complete the competition's requirement and restraint challenges and, ultimately, to promote STEM for middle and high school students. By competing in the NASA Rover Challenge, the team is expected to host STEM workshops for more than 200 children to encourage the next generation of engineers, scientists, and astronauts to take part in engineering challenges.

Furthermore, this new club is the first aerospace-related extracurricular at Vaughn, thereby opening the door to mechanical, electrical, and mechatronics engineering students to participate in the rover's design, manufacturing, and assembly as well as in the secondary system aboard the vehicle – its telemetry system. The rover concept was initially proposed at the beginning of September 2022 to be accepted as participants in HERC’s 2023 competition, and the team was selected by October. Once selected for the competition, the team presented its design review (DR) report in November and its operational readiness review (ORR) report at the beginning of March 2023 with a matured and complete vehicle design, along with the team’s task tool.

As of mid-March, the team is preparing all the final logistic decisions and system testing to compete at its first HERC competition at the end of April in Huntsville, Alabama.

Meetings

January 2023

Over the winter break, the team took advantage of their free time to work on their proposed designs for the rover and task tool in order to begin acquiring the necessary material to manufacture the components. During this same time, the team started to divide its members into various rover subsystems, with a leader for each. A general meeting was held every two weeks up to the end of February – near the ORR report's due date and the manufacturing period's end for all the rover subsystems and the rover’s assembly, while subsystem meetings were held weekly.

February 2023

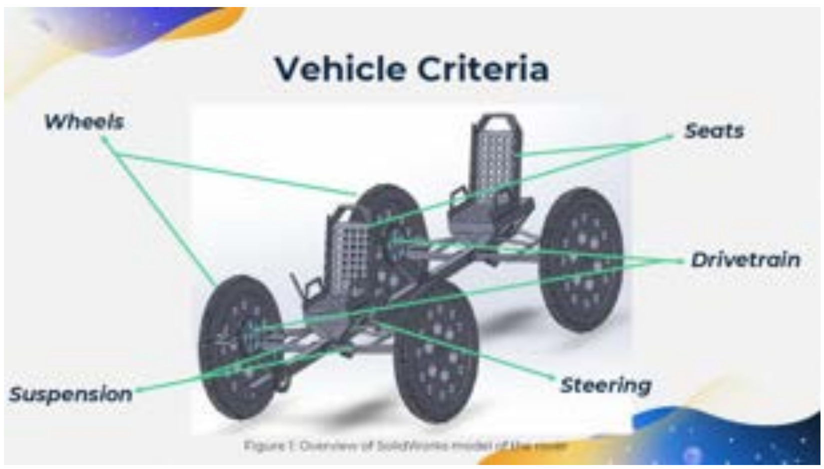
At the beginning of the month, the team received its room space in which the rover club set its tools, worked, and personalized the room with space-related decorations. As days passed, more meetings were held to ensure that the team was closely following the pre-established timeline and reaching its goals every step of the way. Detailing and designs for the rover and task tool were finalized, and orders were constantly sent to purchasing. The team’s first STEM outreach event was held, while others were ‘in the making.’

Presentations

To fulfill the requirements of the competition, the team was required to showcase their progress on the design and construction of the rover to the judges. This involved a detailed presentation of the various design aspects and subsystems of the rover.

Design Review

The team prepared a Design Progress Review presentation. They explained and analyzed the design process and design alternatives for the vehicle and its systems, such as wheels, drivetrain, and suspension. They also evaluated each subsystem in its components. After some feedback, they were able to make changes to the original design and proceed with the manufacturing process.



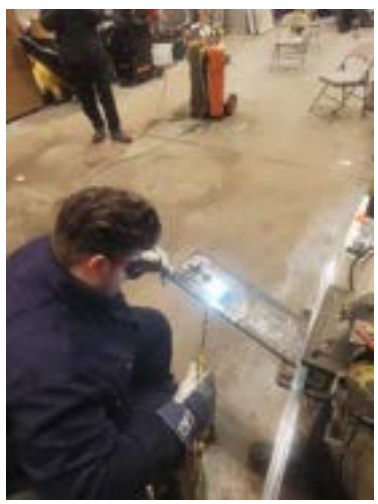
Operational Readiness

The team prepared an Operational Readiness presentation for the NASA Rover Challenge 2023 competition. The team presented the rover they built and conducted an in-depth analysis of each subsystem's manufacturing process, including the task tool. They also conducted a comparative analysis to highlight the changes they implemented since the Design Review. Additionally, the team performed a comprehensive study of the tasks and presented the resulting conclusions on strategy.

Rover Construction

The team worked diligently on constructing the rover. Each team member played an important role in the construction and ensured that it met the required specifications. The assembly was finalized as seen below.

Every day in February and March, active members of the club, led by their advisor Rachid Nafaa, would meet at the ATI building to support the manufacturing process of their rover. During these meetings, the students would work closely with the various machines and tools used in the manufacturing process, including CNC machines. Under the guidance of Rachid, the students learned about the intricacies of each machine and technique and gained valuable hands-on experience that would prove useful throughout the competition.



Working together as a team, the students also learned about the importance of communication and collaboration in the manufacturing process. They were able to identify and address potential issues before they became major problems and were able to work together to troubleshoot and solve any issues that did arise.

Community Outreach

"Get Noted": How to Build an Electric Piano Workshop *- In collaboration with HSI-STEM, CSTEP, and Vaughn's SWE Chapter for VCAT's Upward Bound Program*

Through the guidance of rover team members, high schoolers who form part of the Upward Bound program assembled an electric circuit piano. Before the "hands-on" portion of the workshop, the team presented slides with a summary of background information explaining the purpose of the elements used to make the piano. This workshop aimed to implement the basics of electrical circuits using push buttons, resistors, capacitors, and a 555 IC chip timer to mimic the basic functioning of a real-life piano. Through the activity, the members aimed to enrich students' STEM experience through a fun, immersive, and simple exercise that allowed them to apply building and troubleshooting skills.

"My STEM Journey": Alina's Path into STEM along with her Participation in HERC *– in collaboration with the NAPP Foundation*

The STEM outreach event organized by the NAPP foundation on Facebook was a wonderful opportunity for students and educators to learn about Alina Santander's experience at the NASA rover challenge. As a participant in the competition, Alina shared her inspiring journey and challenges she faced in bringing the project to her university in the US. Through her presentation, students were able to gain insights into the world of robotics and to learn about the opportunities available in the field of STEM. The online event also provided a platform for participants to interact with Alina and to ask questions, a process which fostered a sense of community and encouraged a love for learning. Overall, the STEM outreach event was a great success in inspiring 50+ students to pursue their interests in science, technology, engineering, and mathematics.

"Get Noted": How to Build an Electric Piano Workshop *–for the Bronx Mathematics Prep Academy's Robotics class*

Based on the outstanding response and feedback from teachers, volunteers, and students, the Rover club hosted the electric piano workshop for a different audience – middle schoolers from the Bronx Mathematics Prep Academy's Robotics class. This workshop was hosted on Thursday, March 2nd, during the students' robotics class time. Through the guidance of rover team members and an outline of the background information for the piano's contents, the students assembled an electric circuit piano. Through this activity, the members aimed to enrich students' STEM experience through a fun and immersive exercise that allowed them to apply design, building, and troubleshooting skills.

Upcoming Outreach Events

"Magic 8 Ball": Introduction to Circuitry Basics *– in collaboration with Vaughn's SWE Chapter for the Girl Scouts*

Through the guidance of SWE and rover team members, students in the Girl Scouts will assemble an electric circuit magic 6 ball. This, essentially, is a fortune telling system made of resistors, capacitors, a microchip, a diode, a push button, and light emitting diodes (LEDs). Through the circuit's internal connections, the push button serves as a trigger to activate the randomness of the result. Through the activity, the members aimed to enrich students' STEM experience through a fun, immersive, and simple exercise that allowed them to apply building and troubleshooting skills.

"Oobleck Madness": Understanding Non-Newtonian Fluids *– in collaboration with Vaughn's SWE Chapter for elementary 5th graders in Brooklyn*

With the close help of Dr. Ghania Benbelkacem, the club members put together an interactive and "silly" STEM workshop to introduce the idea of non-Newtonian fluids. Through this workshop, the students created a small sample of oobleck - made of water, cornstarch, and a small amount of tempura paint to personalize each child's sample - and put this sample's properties to the test. A presentation was shown before the commencement of the activity to allow students to understand the context of the event. This event took place in March 2022.

Campus Involvement

AIAA ASCEND in Las Vegas, Nevada – October 24th to the 26th

The club's President (Alina Santander Vinokurova) and Vice-President (Tatiana Jaimes) were selected as diversity scholars – whose program seeks to provide opportunities for underrepresented students interested in aerospace - in July 2022 to attend the American Institute of Aeronautics and Astronautics' (AIAA) Accelerating Space Commerce, Exploration, and New Discovery (ASCEND) conference held in Las Vegas, Nevada at the end of October. This conference brings together space's leading industry luminaries, thinkers, biggest companies, government leaders, top media outlets, educators and students, and enthusiasts. At this three-day conference, they had the opportunity to network with leading space enthusiasts and professionals, learn about orbital safety policies, national security space, space rescue services, and global cooperation to accelerate space exploration, and meet Ellen Ochoa – the first Hispanic woman in space, Julie Van Kleeck – the conference's executive producer and space domain lead, and many more space icons.

Aviation Network's 20 Twenties Class of 2022

Vaughn College mechatronic engineering seniors Alina Santander Vinokurova and Tatiana Jaimes were recently honored at Aviation Week's Laureate Awards gala, which took place on November 3rd at the National Building Museum. The gala recognized more than 350 innovators and innovations in the aviation, defense, and space industries. At the event, the 20 Twenties class of 2022 was presented, a workforce initiative that aims to cultivate, inform, and inspire the next generation of aerospace and defense professionals. The 20 Twenties program recognizes the top 20 aerospace-bound STEM students in their twenties who have the potential to transform the aerospace and defense industry. Santander and

Jaimes were among the 20 students selected based on their academic performance, civic contribution, personal challenges, and the value of their research or design project.

Engineering and Technology Department – Engineering Seminar Series

For this Engineering Seminar Series hosted by the Engineering and Technology Department of the college, Tatiana Jaimes was a guest speaker who discussed her summer internship experience with Daimler Truck North America, Detroit Diesel Corporation, including her tasks and details about the project(s). Tatiana presented her responsibilities and daily activities assigned to her as an ePowertrain Systems Validation intern engineer at Detroit Diesel, where she had the opportunity to support both Research and Growth fleet (RG) and on-board diagnostics (OBD) for the Freightliner eCascadias. These opportunities allowed the students to apply the skills they acquired in their engineering classes to solve real-life problems.

In this opportunity, Alina Santander presented her experience as a Project Engineering Intern in the Mechanical Engineering Department at Honeywell Intelligrated. She explained her daily tasks and training, as well as complex problems that she got to solve. Throughout the course of the internship, Alina was involved in various stages of the project, including creating and refining layout drawings, providing on-site support at Amazon warehouses, and managing inventory for the company. Overall, the internship was highly successful, with Alina meeting all the objectives, completing tasks to a high standard, and making significant contributions to both the company and society.

Preparation for the NASA Rover Challenge 2023

The team is eagerly preparing for the upcoming NASA Rover Challenge, working tirelessly on the design and construction of their rover, fine-tuning every aspect of its design to ensure that it is optimized for the various tasks and challenges that they will face during the competition.

The team is also preparing for the logistics of the trip, and as the competition approaches, they are also focusing on building their skills and expertise, both individually and as a group. They are taking part in various training sessions and workshops designed to help them build their technical knowledge and problem-solving abilities and they are also working on building their teamwork and communication skills.

Acknowledgment

HSI-STEM
Science . Technology
Engineering . Math

VCAT Rover Club is thankful for the Department of Education federal grant (Title III, Part F, HSI-STEM) which provided necessary funding support to engage Vaughn's students in STEM-related scholarly and professional activities.

Vaughn College UAV Club 2022-2023 Activities Report

The Unmanned Aerial Vehicles (UAV) club at Vaughn College had a successful year where the club participated in two competitions with various teams working towards different competition requirements. The UAV club attended the National VFS Design-Build-Fly student competition in Graces Quarters, Maryland. This competition has grown since its inception in 2016, with universities such as University of Maryland, Penn State University, and Drexel University attending. The UAV club also participated in the 2021-2022 student competition hosted by the Association for Unmanned Vehicle Systems International (AUVSI). Unfortunately, due to unforeseen circumstances involving the international political climate, the Fly-off was cancelled by order of the organization. The UAV Club now strives to build upon the initial design from the previous competitions to further achieve our goal of performing at our best and maintaining our educational footprint within the community of the growing Drone Industry.

Vertical Flight Society Design-Build-Fly Student Competition

The UAV Team has been working on outdoor package delivery navigation of drones as part of the Design-Build Vertical Flight student competition hosted by the Vertical Flight Society (VFS) at the 79th Annual Forum in Maryland. The outdoor navigational challenge is to deliver as much sand inside a SoftGrip weight as possible, using either manually operated or autonomous drones in a limited amount of time. The UAV Club has chosen to participate in both the Manual and Autonomous Category. Both teams have worked diligently to satisfy the Gate 1 proposal designs as well as the feasibility studies on both drones.

AUVSI SUAS

For the Third year at the AUVSI SUAS competition the UAV Team has begun the meticulous process of designing a system from the ground up to perform in the top percentile at the competition. The team equipped with the latest manufacturing machines provided by Vaughn College has chosen to design, build, and manufacture the UAS completely in-house. The 2020 AUVSI SUAS competition has requirements to build an autonomous UAS with the capability to execute long range missions while being equipped with high resolution cameras to perform image detection on the ground. Additionally, the UAS must also carry and deploy an autonomous rover at a specified point as part of the requirement. The AUVSI SUAS competition serves as a basis for leading-edge technology in the Search and Rescue (SAR) operations in humanitarian aid in the event of any catastrophe.

Youth and Community Outreach

Throughout the year, the UAV Club hosts various workshops and events during Vaughn Annual Manufacturing Day, Annual STEM Day, and Vaughn International Drone Day. These workshops were supported by the Title III HSI-STEM project to educate students about small unmanned aerial systems (sUAS). The UAV Club hosted a Build a drone workshop; this workshop taught students the intricate process of soldering components as well as techniques such as wire management, part selection, and build verifications. Students also had the opportunity to build with some of the advanced components such as Pixhawk Cube flight controller and single board computers that the club uses for its autonomous flight testing.

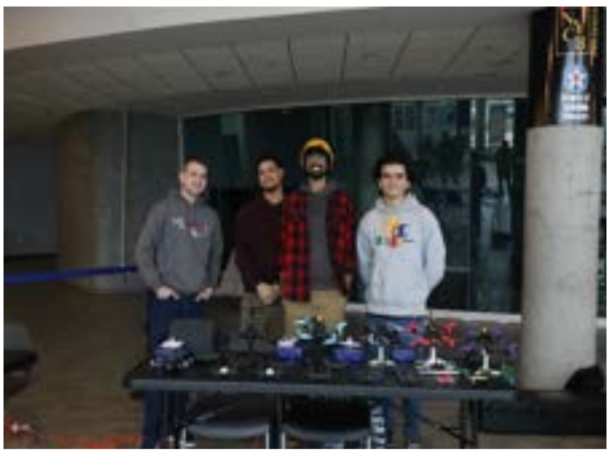
HSI-STEM
Science . Technology
Engineering . Math

The UAV Club has also partnered with the Vaughn College CSTEP Program to host a drone workshop at the CSTEP conference hosted at Vaughn College. CSTEP is a New York State funded program dedicated to preparing historically underrepresented and economically disadvantaged secondary school students for entry into a postsecondary degree. Through this workshop, the UAV Club strives to impact its community and to spark the interest of the young generation of students.

NEW YORK STATE STEP SCIENCE & TECHNOLOGY ENTRY PROGRAM
preparing science, technology & licensed professionals since 1986

The UAV Club will host its signature event, Vaughn Drone Day in May 2023. Vaughn Drone Day is an annual event held at Vaughn College, where everyone is invited to attend free of charge. At this event, the UAV Club has various workshops for participants to attend, and the hanger is set up with a net within which people can fly drones. Drone enthusiasts and professionals show off their drones and equipment at their booths and a discussion panel is held regarding drone rules and regulations. Every year people come from all over the 5 boroughs to take advantage of this event.

In addition, Vaughn UAV has partnered with a local museum such as Cradle Aviation and the New York Hall of Science to further educate and expose drone technology to the community. This year Vaughn UAV hosted its fourth annual “Community Outreach Drone Awareness and Tiny Whoop Race” event at the Cradle of Aviation Museum on February 26th. The event was free and open to the community. Many drone hobbyists and FPV pilots, as well as the locals were in attendance.



2022-2023 Society of Women Engineers (SWE) Activities

The Vaughn College of Aeronautics and Technology (VCAT) Chapter of the Society of Women Engineers (SWE) is an organization supporting and empowering female students specializing in engineering. The Chapter seeks to reinforce its legacy in a highly competitive industry by highlighting the value of diversity. The Chapter not only develops its members' abilities as engineers, but also assists them in becoming well-educated professionals who will be extremely successful in their chosen career path. The Chapter also takes pride in its STEM Outreach efforts to boost present student interest in engineering and future female involvement in this field.

Society of Women in Engineering Conference 2022

From October 20th through October 22nd, 2022, Vaughn College's Society of Women Engineers (SWE) chapter, with the support of HSI-STEM grant funding, attended the Women Engineers Conference – WE22 - in Houston, Texas. Fifteen chapter members attended this conference in hopes of networking and landing internship and full-time offers. Furthermore, these members were able to attend leadership workshops, technological sessions, and a two-day in-person career fair. During this career fair, SWE members were interviewed by industry titans, including Honeywell, Carrier, Raytheon Technologies, Northrop Grumman, Lockheed Martin, Boeing, and Tesla. The success rate of this conference was impressively high, with 25 on-the-spot job offers and more than 50 interviews.

From back left to right and front left to right, the WE22 attendees are Daniel Doscher, Christian Sorto, Alanke Perera, Kevin Velasquez, Bryan Arias (Assistant Director of Career Services), Chasisty Melo, Suraiya Nawaz, Carlo Ovalle, Joshua Harripaul, Amanda Camacho, Tatiana Jaimes, Alina Santander, and Emily German (SWE Chapter Alumni)

The Overview of the Success of WE22 Conference

Below are the interviews and offers that SWE members got from the WE22 Conference.

Company	Offers
Northrop Grumman	7
Carrier	2
Lockheed Martin	5
Boeing	5
Delta	2
Daimler Trucks	3
Whirlpool	1
Wolfspeed	2
ITW	4
Tesla	1
Honeywell	2
Stellantis	1
Novanta	1
ASML	2
Milwaukee	1
Trimber	1
Schneider	1
Raytheon Technologies	1
Rockwell Automation	1
Battle motors	2
Oshkosh	1
L3 Harris	2
Linde	1
DOD	1
GE Aviation	1

Seminars

The SWE chapter members conference started with the Opening keynote by Dr. Phyllis Schneck, a current computer engineer and Vice President of Information Security and Cyber at Northrop Grumman. Members attended this keynote to hear about "Career Planning when the Sky is the Limit," where Schneck gave insight on her career path. After this session, members attended the Rapid Resume Session hosted by Siemens, Raytheon Technologies, and Lutron engineers. Others also attended the Ford Ride & Drive Sessions, where students got the opportunity to test drive some of Ford's newest vehicles.

Hospitality Suites and Mixers

Students this year had a variety of alternatives when choosing hospitality suites and mixers, hosted by leading companies such as 3M, Amazon, Daimler, Boeing, Corning, Eaton, Lockheed Martin, Northrop Grumman, Medtronic, Milwaukee Tools, and Novanta, among others. This was an excellent networking opportunity for students to meet up with engineers and recruiters outside of the career fair. Many SWE chapter members met with recruiters to learn more about the various jobs that each organization had to offer.

On October 20th, SWE members Suraiya Nawaz and Daniel Doscher were invited to the Tesla Mixer, where they had the chance to network with Tesla engineers, converse with other students, and learn more about the benefits and expectations of working at Tesla. The mixer assisted students in understanding and meeting Tesla's objective.

Site Tours

Easy Aerial

In partnership with Career Services and faculty, members of the VCAT SWE chapter got the chance to tour Easy Aerial, a top supplier of autonomous drone-based surveillance systems for business, governmental, and military applications. Students had the chance to see the company's latest drone models in action and were amazed by the drone's capabilities. Engineers from the company also showed off how drones may be used for various tasks, such as aerial photography, mapping, and search and rescue missions. The tour provided the engineering students with an invaluable learning opportunity.

Marotta Controls

SWE members, in collaboration with Career Services and Faculty, had the opportunity to visit Marotta Controls. This fully integrated solutions provider designs, develops, qualifies, and manufactures innovative systems and subsystems for the aerospace and defense sectors. During the visit, they were given a tour of the facilities and an insight into the company's workings. Marotta works closely with some of the biggest names in the aerospace and defense industry, collaborating on projects to create innovative solutions for clients. The students were impressed by Marotta's cutting-edge technology and highly skilled workforce.

Pictures from Site Tour Visits to Marotta Controls (right) and Easy Aerial (left)

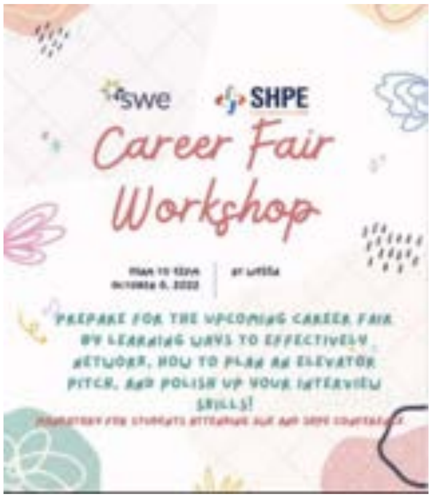
Professional Development Workshops

Conference Prep- Linked In

In preparation for the annual SWE Conference, SWE and SHPE hosted a joint workshop overviewing how to navigate LinkedIn. The presentation and in-depth discussion allowed students to identify what to add to their LinkedIn profiles to stand out among applicants to company recruiters. In additional preparation for the conference's success, members of SWE (Chasisty Melo, Tatiana Jaimes, and Alina Santander) and SHPE (Christian Sorto and Kevin Velasquez) held a presentation giving their insight on previous conferences. The information included elevator pitches, dressing for success, resume overviews, career fairs, dos and don'ts, and the importance of business cards. Towards the end of the event, the presenters held mock interviews with students and provided feedback for students to utilize for the conference.

Pictures form Conference Prep – LinkedIn workshop to prepare students better before SWE and SHPE Conference

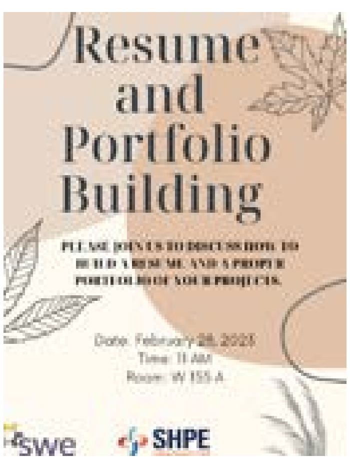
Career Fair Workshop



Once again, SWE and SHPE partnered to create a Career Fair Workshop, for club members and peers to increase their success rates at the Career Fairs for the upcoming national conference of each organization. Speakers Chasisty Melo, Alina Santander, and Kevin Velasquez provided tips and tricks to confidently approach employers and deliver an elevator pitch that will capture the recruiter's attention and leave a good impression. The groups gave their peers a general overview of how to conduct themselves for success, from their body language to their interactions with other organization members. In addition, a set of interview questions were given to students to practice and conduct mock interviews at the end of the presentation.

Salary Negotiation

In partnership with SHPE and NSBE (National Society of Black Engineers), Director Chaundra Daniels led this salary negotiation discussion in partnership with Career Services to aid senior organization members when considering full-time job offers. The event's overall purpose was to prepare students on how to properly negotiate their salaries with employers. This included an overview of the research that must be done beforehand and the proper approach for successful results.

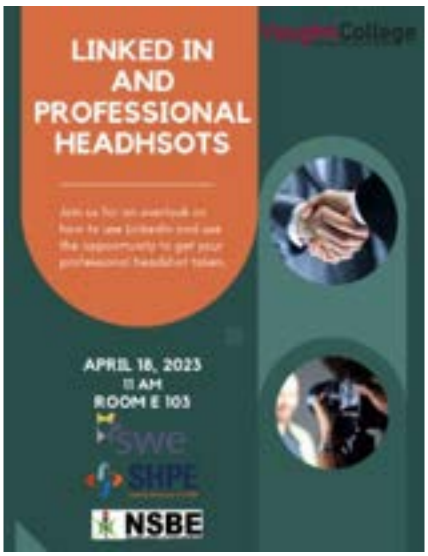


Resume and Portfolio Building

SWE and SHPE partnered with Professor Jimmo from the Writing services department to discuss the requirements for an eye-catching resume and the step to build a portfolio properly that efficiently displays the student's engineering capabilities, projects, involvement, and experience, as many Vaughn College students engage in separate engineering projects but do not have a portfolio to showcase their work. The presentation discussed formatting and displayed a sample portfolio. In addition, students were encouraged to participate in writing and publishing a proposal.

Upcoming Workshops

Speed Interview
In hopes of preparing students for the upcoming conference and follow-ups from the Career Fair, SWE held a speed interview workshop. This event consisted of mock interviews conducted by different peers. In addition, a list of the most common interview questions asked at conferences was created and given to students for preparation.



LinkedIn and Professional Headshots

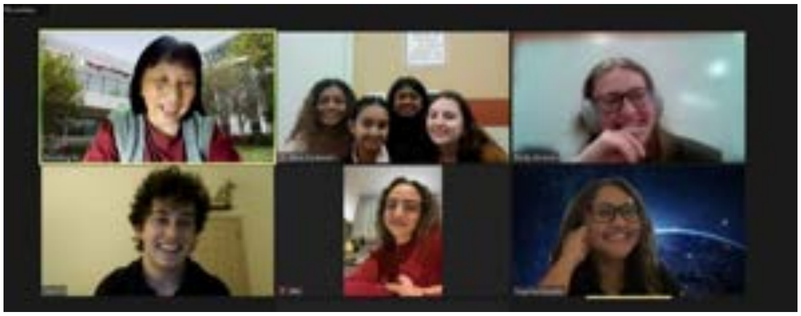
Partnering with professional organizations such as SWE, SHPE, NSBE, and Career Services, a LinkedIn event was held. The event started with a presentation to walk attendees through the process of creating a LinkedIn profile, including tips for crafting a strong headline, summary, and work experience section. This presentation covered strategies for making connections on LinkedIn and how to use the platform to search for job opportunities effectively.

Government Resume
SWE held a resume-building workshop with guest speaker Migdalia Gonzales from the Federal Aviation Administration (FAA). This event explained how to apply for federal jobs, mainly focusing on the application process, and how Federal resumes differ from private sector resumes. In addition, other guests from the FAA joined in to discuss their approach to a government resume for an Engineering position.

Social Events

SWE Alumni Dinner

SWE held an Alumni dinner in December with guest speakers: Niki Taheri, Dimitri Papazoglou, Saneela Rabbani, Sagufta Kapadia, and Emily German. These SWE alumni provided insight into their road to success, previous SWE projects, current careers, and upcoming projects. With this dinner, current SWE members had the opportunity to interact with the alumni and get tips and tricks for success, and how to find the work about which they are most passionate.



SWE Hot Cocoa and Movie Night

During the beginning of December, SWE held a social event in the West Wing Cafeteria. A hot cocoa bar was set up with additional snacks, while a Christmas movie was displayed on the large screens. Students were able to gather before their finals to interact, relax, and get in the “holiday spirit”.

Game Night

In partnership with SHPE, HIS-STEM, CSTEP, and SWE hosted a game night. This evening promoted the different STEM clubs in a fun and relaxed setting. The event included various video games and virtual reality simulations set up in different venue areas. These games and simulations were specifically chosen to appeal to students interested in STEM-related fields. This event was open to students and members from the NASA Rover Club, UAV, NSBE, SHPE, SWE, and Robotics. In addition to the video games and virtual reality simulations, the event also included representatives from various STEM clubs who were present to provide further information on becoming an active member of each club and to answer any questions. This event provided an excellent opportunity for students to learn more about campus clubs and organizations.

Community Outreach

Girl Scouts STEM Workshop

Through the guidance of SWE and rover team members, students in the Girl Scouts assembled an electric circuit “magic 6 ball” made of six light-emitting diodes (LEDs). This, essentially, is a fortune-telling system made of resistors, capacitors, LEDs, a microchip, a diode, and push-button. Through the circuit’s internal connections, the push button serves as a trigger to activate the randomness of the result. Through the activity, the members aimed to enrich students' STEM experience through a fun, immersive, and simple exercise that allowed them to apply building and troubleshooting skills.

Campus Involvement

Engineering Seminar Series

Hosted by the Engineering and Technology Department of the college, Tatiana Jaimes and Alina Santander presented their summer internship experiences to the Vaughn community, including their tasks and details about the project(s). On Thursday February 16th, Tatiana presented and talked about her summer internship project, including the responsibilities and assigned tasks as a Systems Validation Engineer at Daimler Truck North America. These opportunities allowed the students to apply the skills they acquire in their engineering classes to solve real-life problems. On Thursday March 23rd, Alina presented and talked about her experience as a Project Engineering Intern in the Mechanical Engineering Department at Honeywell Intelligrated. She explained her daily tasks, training, and the complex problems that she worked on solving. Overall, the internship was highly successful with Alina meeting all the objectives, completing tasks to a high standard, and making significant contributions to the company and society.

FAA Spotlight 2023

The FAA highlighted SWE Chapter member Chasisty Melo in a recent interview. The event was hosted by Migdalia Gonzalez from the FAA's Office of Civil Rights. The video shoot was approximately 30 minutes and gave a brief overview of the success of Vaughn College Engineering students. In addition, the recorded interview was meant to empower minorities and women in STEM.

Aviation Network's 20 Twenties Class of 2022

Vaughn College mechatronic engineering seniors Alina Santander Vinokurova and Tatiana Jaimes were recently honored at Aviation Week's Laureate Awards gala, which took place on November 3rd at the National Building Museum. The gala recognized more than 350 innovators and innovations in the aviation, defense, and space industries. At the event, the 20 Twenties class of 2022 was presented, a workforce initiative that aims to cultivate, inform, and inspire the next generation of aerospace and defense professionals. The 20 Twenties program recognizes the top 20 aerospace-bound STEM students in their twenties who have the potential to transform the aerospace and defense industry. Santander and Jaimes were among the 20 students selected based on their academic performance, civic contribution, personal challenges, and the value of their research or design project.

Other Conferences

AIAA Ascend 2022

SWE chapter member Alina Santander and Tatiana Jaimes had the opportunity to get the diversity scholarship and attend the AIAA ASCEND conference in 2022. AIAA, which stands for American Institute of Aeronautics and Astronautics, usually has three diversity scholarship yearly. This organization promotes diversity, equity, and inclusion within the aerospace industry by providing financial assistance to underrepresented communities who are pursuing careers in aerospace. Alina and Tatiana were both able to experience the aerospace industry with others who share their interests.

Preparation for WE23

SWE will also be prepping for the WE22 conference, which will be held in Los Angeles, California on October 26-28. To accomplish this, E-board will begin announcing the conference early in the next semester, ensuring that enough individuals will be able to attend. Following that, the SWE E-board will hold professional workshops with the assistance of career services, HSI-STEM, and CSTEP to help students prepare for the conference.

Guest Speakers

The impact of previous guest speakers was remarkably positive. SWE will invite people from engineering companies to speak about their experience. It will help people within this major to understand the work and life balance after college.

Acknowledgment

VCAT SWE is thankful for the Department of Education federal grant (Title III, Part F, HSI-STEM, and Articulation grant) which provided necessary funding support to engage Vaughn's students in STEM-related scholarly and professional activities.

2022-2023 National society of Black Engineers (NSBE) Club Activities

A global organization dedicated to its members' professional, intellectual, and social development is the National Society of Black Engineers. The national society of engineers seeks to "raise the number of culturally responsible Black Engineers who achieve academically, prosper professionally, and have a beneficial impact on the community." Every year, our group arranges and plans several events to help spread awareness of these advancements. Webinars, workshops, career fairs, conferences, and conventions are some examples of these occasions where participants can experience a variety of enriching activities. Each of these events exposes participants to numerous industry contacts and internship possibilities that will aid them in their pursuit of successful engineering careers.

The National Society for Black Engineers chapter at Vaughn College, which was founded in February 2017, offers growth chances to keep up with the organization's objectives. Although our organization works to train Black engineers, anyone of any race who is interested in getting useful experience for their professional path is welcome to join our club. To help our members develop the skills and abilities they will need on their journey to become professionals, our chapter arranged a few events and activities during the 2022–2023 school year in conjunction with other regional chapters. In the wake of the global pandemic, we observed an increase in attendance at activities that were held online, but face-to-face interaction is crucial for our members' social development. To accommodate all our members, we decided to organize hybrid events. Without the college's continued assistance and the heroic efforts of our club's leadership, these events would not be feasible.

Conference Preparation Workshop – February and March 2023

In alignment with our goal of professional development and in preparation for NSBE's Fall Regional Conference, NSBE held a workshop where our E-Board members spoke with conference attendees and club members about prior conference experience. The guest speaker of this workshop was Christina Giglio, who did a presentation on how to polish our brands. This workshop centered around how to present ourselves to employers and how to give an accurate representation of who we are as well as which skills we show to recruiters. This workshop taught attendees the basic and necessary skills, verbal and written, to communicate effectively to obtain the job or internship they are seeking.

Salary Negotiation Workshop – March 2023

The topic of compensation negotiations was covered in a session hosted jointly by the Society of Women Engineers and the Society of Hispanic Engineers. Tips and a few actions that should be taken throughout this process were covered in the workshop. One of the speaker's (Rosario Sutton) most important pieces of advice was that negotiation success is mostly dependent on preparation. To speak with confidence and to avoid being deceived by employers, it is crucial to conduct research on industry standard rates of pay based on levels of experience.

49th National NSBE Convention – March 2022

The National Society for Black Engineers (NSBE) hosted its 49th national convention from March 22–26, 2023, in Kansas City, Missouri. That was the first totally in-person gathering since the group emerged from the Covid 19 pandemic, and it was a huge stride forward for the organization. The conference's subject was I am a S.T.E.M., and it included a wide range of activities aimed at the all-around growth of engineers, including educational and certification courses, lectures, and career fairs. Sixteen students from the NSBE chapter at Vaughn College had the opportunity to attend this convention, where everyone who went received the opportunity for interviews—both in-person and online—and some even received job offers.

Acknowledgement

Vaughn College's NSBE chapter is thankful to the Department of Education federal grant (Title III, Part F, HSI-STEM) which provided necessary funding support to engage Vaughn's NSBE students in STEM related scholarly and professional activities.

We extend our gratitude to the CSTEP organization for their continuous support towards our club in aiding our chapter with workshops and development activities.

Department of Career Services: We are grateful for the Department of Career Services' ongoing assistance in planning activities that give our members the best possible preparation—both mentally and physically—as well as a wealth of networking opportunities.

Department of Student Affairs: We also want to express our gratitude to the Department of Student Affairs for continuing to aid in planning and presenting additional students with the opportunity to attend.

SHPE Leading Hispanics in STEM | Vaughn College of Aeronautics and Technology | VAUGHN COLLEGE HSI-STEM Science . Technology Engineering . Math

2022-2023 Society of Hispanic Professional Engineers (SHPE) Club Activities

SHPE NILA 2022 [August 2022]

This past August, Vaughn College SHPE president, Kevin Velasquez, went to Orlando, Florida to attend the SHPE NILA 2022 President's Summit. At this event, chapter presidents are given the opportunity to meet with other chapter/regional and organization leaders. The purpose of this event is to give insight into building and leading a successful chapter based on SHPE guidelines, while ensuring a strong sense of community. The success of this event led to a strong relationship with the Stony Brook SHPE Chapter from Long Island.

SHPE Summer BBQ [August 2022]

This past summer our chapter co-hosted our first main event with the Stony Brook SHPE Chapter, open to all of our chapter members and alumni. This community building event held at Eisenhower State Park in Long Island was a major success and great way to kick off the new semester. At this year's BBQ we had a total of 26 in attendance, which was a major improvement in numbers in comparison to the previous BBQ. There was a great mix of alumni from both schools who were open to sharing their experiences about how they transitioned from college into the STEM industry. This summer event is a tradition that is definitely worth continuing as the Vaughn College SHPE Chapter grows.

2022 Fall Activity Fair [September 2022]

In Early September of the fall 2022 semester, the Vaughn College SHPE Chapter was present at the Activity Fair hosted by the activities department. The executive board members and other active members were present to explain what the chapter is about and which opportunities are available to prepare them for their careers. The chapter displayed photos and information about the upcoming events for networking and conference preparations. The chapter members also provided the contact information of the executive board members and the date of the first general body meeting.

Manufacturing Day [October 2021]

At the start of the fall semester, with the support of HSI-STEM, the college hosted a schoolwide event in which clubs and chapters held presentations describing their organizations, as well as a STEM related demonstration. For the most recent Manufacturing Day, members of the VCAT SHPE chapter assisted the robotics and UAV teams in hosting interactive sessions. Local New York High School students were invited to participate in a build-and-fly drone, as well as a build-and-program a (vex) bot workshop. The chapter also set up a booth where students were invited to learn more about career, scholarship and academic opportunities offered by the national SHPE organization.

SHPE X SWE Career Fair Workshop [October 2022]

To prepare all the Vaughn SHPE Chapter attendees for the 2022 SHPE National Convention, the executive board hosted several convention readiness workshops with SWE that explained the importance of professional engineering resumes and career research, as well as assistance and tips for the interview process based on the personal experience of students who attended previous conferences. This session was then followed by mock interview practice. These workshops were open to members of SWE, since they had a conference planned close to the date of the SHPE National Convention.

SHPE X SWE LinkedIn Workshop [October 2022]

A workshop on LinkedIn etiquette was hosted in collaboration with SWE. This was a great opportunity for members from both chapters to learn how to effectively use the platform for networking and career advancement. The workshop covered topics such as creating an attention-grabbing profile, building a strong network of connections, and utilizing the platform to showcase skills and experience. Attendees also learned about best practices for reaching out to potential employers, as well as how to handle digital communication on the platform in a professional manner. The workshop was led by experienced members who have successfully used LinkedIn to advance their careers and provided attendees with valuable insights and tips for using the platform effectively.

SHPE National Convention [November 2022]

The Society of Hispanic Professional Engineers (SHPE) provides excellent opportunities for students to develop networking, soft skills, and leadership abilities. The SHPE National Convention is known as being the most technical and career-focused conference for professional development. The Vaughn College Chapter members attending this conference gain the opportunity to speak to several of the 300+ company exhibitors, in order to earn an interview and a job offer in the same day. The SHPE Vaughn College Chapter benefits the Vaughn community by allowing every student to become a member and to learn career readiness prior to the conference, so they can effectively exhibit their skills and achievements.

Nissan Design Challenge [November 2022]

Several challenges are offered to attendees of the SHPE National Convention, at which attendees are invited and encouraged to participate in an interactive event attempting to solve real world engineering challenges for prizes and recognition. The major event hosted at this year's convention was the Design challenge hosted by Nissan, where 24 students are selected out of nearly 150 applicants and split up into 8 teams of 3 to ideate and develop unique solutions to improve sustainability in the electric vehicle industry, including everything from materials sourcing, to manufacturing, to retail. This challenge forces participants into unknown work environments where they have to learn and work with peers and become leaders who can designate work according to each team member's unique skills. The competition is hosted over the course of two days, and participants present daily project reports/presentations to a panel of judges who score each briefing. The event is an excellent opportunity for students, not only due to the grand prizes, but also because it is a learning opportunity, providing real-world engineering experience to attendees before they even step foot into the industry.

Nissan Design Challenge Finalists [November 2022]

Chapter members Daniel Doscher and Christopher Walker participated in Team 5 and Team 4 respectively, and won 1^{st} and 3^{rd} place for their efforts. Daniel Doscher was able to take the 1^{st} prize of $9000 for his team with the idea of integrating a giga-press to manufacture the cars entire body, rather than manufacturing the parts of the body separately to then assemble. This idea would cut back on material and was calculated to save about 90% of energy. Christopher Walker was able to take the 3^{rd} place prize of $2000 for his team with the idea of replacing batteries in electric vehicles with liquid metal batteries to reduce the waste created by mining lithium, currently used in electric vehicles. Both of these ideas satisfied the task of creating and developing an idea for Nissan that would help make their electric vehicles more sustainable.

2nd Annual SHPE Engineering Paint Night [Dec. 2022]

Towards the end of the semester, our chapter wanted to hold an event where members could relax and take their mind off of the stress from finals week right before the holiday break. Our second annual Engineering Paint Night was a great event full of Latin music and food like pupusas, empanadas and birria tacos. The goal this year was to truly embrace the Latin roots and culture of this organization, while providing a great time. The models for this year involved the use of multiple resin printers from both the UAV club and 3D printing lab, with each model serving a purpose. There was a Super Mario mystery box that was a storage box, a family of musical frog instruments, an ornament duck, and a Christmas counter. With this event being RSVP, it was fantastic to have a total of 32 members sign up and 30 attend, including many new and existing members who were able to get to know each other throughout the night.

Vaughn College Game Night [February 2023]

This was the first school-wide event of the Spring 2023 semester and the largest event hosted by SHPE (45 attendees), with assistance from CSTEP. Our chapter put together a game night event that utilized the new west wing café and the large television. The goal of this event was to spread the word of all clubs present at Vaughn College, by having the club leaders give a quick briefing of what they do and can provide to new members. At this event, there were Nintendo Switches set up in each booth with a monitor and multiple controllers that were volunteered by students and staff. The games present at this event were Mario Kart, Mario Party Superstars, and Super Smash Bros. Ultimate, which also acted as the main event. The big screen was utilized to display the Super Smash Bros tournament, at which we had a total of 28 participants competing for prizes for the top three players. Overall, this event was a huge success that helped many clubs gain new members and assisted club leaders in building new and stronger relationships with the general student body.

2021-2022 HSI-STEM Grant Activities

HSI-STEM
Science . Technology
Engineering . Math

Through "Developing Guided STEM Degree Pathways to Prepare Hispanics and Low-Income Students for the Careers of the Future," Vaughn College continues to develop a much needed pathway for Hispanic and low-income students to increase accessibility to the College's engineering degree programs. Project goals include:

1. Develop an accessible and effective STEM pathway focused on Mathematical and Computer Sciences degrees with focus on closing academic achievement gaps for Hispanics and other low-income students
2. Expand focus on persistence to include the development or redesign of instructional programs and support strategies that facilitate Hispanic and low-income student transition through upper division studies in high demand STEM fields (MCS is one of them)
3. Strengthen college capacity for data-driven decision making that will lead to equitable opportunities for all STEM students.

Progress Summary: We are pleased with the noteworthy progress made toward meeting overall goals and objectives. The Engineering and Technology department is making considerable progress toward implementation of those goals. Below are current initiatives the College is implementing to attain those goals:

- **Supplemental Instruction** - SI and Mentoring group is a student academic assistance program that increases academic performance and retention through the use of collaborative learning strategies. The SI program at Vaughn targets challenging mathematics, engineering, and physics courses and provides regularly scheduled, out-of-class, peer-facilitated sessions that give students the opportunity to process the information learned in class. Supplemental instruction is a proactive approach to student learning and engagement which increases student persistence and retention (**attaining goals 1 & 2**).

  Under the college's current Title III grant, Vaughn assigned ten to fifteen SIs in spring and fall 2022 to assist and improve students' performance through fundamental engineering and engineering technology related courses. In April 2022, the Project Director of HSI-STEM, with the assistance of Supplemental Instructors, emailed a rubric survey to students who received help from supplemental instructors (SI) during the spring 2022 semester. As a summative evaluation, we used survey results and students' comments to assess the impact of SIs on students' performance and attainment of student outcomes through courses within STEM programs (**attaining goal 3**). Overall, 100% of students who responded rated all questions related to supplemental instructors as good to excellent in improving student learning within STEM courses.
- **Recitation Problem Solving Session -** In an effort to increase learning effectiveness for incoming freshmen and community college transfer students, the engineering and technology department, with the support of HSI-STEM title III grant, established a formal recitation Problem Solving session that increased academic performance and retention through the use of collaborative learning strategies. The Problem Solving program at Vaughn targets challenging mathematics, physics, engineering, computing, and engineering technology courses and provides regularly scheduled, peer-facilitated

sessions by faculty that give students the opportunity to process the information learned in class and to improve their problem solving skills. The main objective of this program is to enhance student performance and learning in STEM related fields to increase student performance, persistence, and retention (**attaining goals 1 & 2**). In May 2022, the PD emailed a rubric survey to faculty to measure the effectiveness of recitation sessions in fundamental STEM courses. As a summative evaluation, we used recitation survey results and faculty comments to assess the impact of recitation sessions on student performance and on attainment of student outcomes through courses within STEM programs. Overall, based on a summative evaluation, 77% of students who were in failure risk were able successfully to pass those courses (**attaining goal 3**).

- **Student Engagement -** The College's current Title III grant provided additional funding support to further expand student involvement in STEM related scholarly and practical hands-on activities. This includes student engagement in paper and poster session competitions of technical conferences (LACCEI, NSBE, SWE, and SHPE) as well as their involvement in robotics, UAV, and Rover club activities and competitions. As a result of this program, Vaughn's engineering students participated and presented their research papers in the 2022 LACCEI International Conference and received the first-place award for the student paper session competition of this international conference. One group of Vaughn's engineering students participated and presented their innovative project **"The Braille Educational Tablet,"** during the **Student Showcase Poster Session** of 2022 ASEE Annual Conference and Exposition. From May 3-5, Vaughn College Robotics team along with seventy-two national and international universities and colleges were invited to the 2022 VEX U World Championship in the Dallas Convention Center. Invitation to the VEX U Robotics World championship is only granted to a team that is a tournament champion or Excellence award recipient of a regional competition, and Vaughn's Robotics team members were recipients of both the **"Excellence Award"** and the **"Robot Skills" award** in the Vaughn College Regional Robotics Tournament, as well as the **"Excellence Award"** recipient of WPI VEX U Robotics Regional Tournament. Vaughn's Robotics team had an excellent performance during qualification, playoff, and robot skill matches in the World Championship and won the highest award, the **"Excellence Award" of the 2022 VEX U Robotics World Championship.** Also, Vaughn's team won **3rd place in the VEX U World Skill ranking and 1st place in autonomous programming**. Vaughn's SHPE student chapter participated in the 2022 Society of Hispanic Professional Engineers (SHPE) Conference, and Vaughn's students participated in Nissan Design, and Extreme Engineering challenges as well as various professional development workshops that aimed to promote leadership and unity, as well as to expose them to the diverse career opportunities in the STEM fields. Vaughn's students, **Daniel Doscher,** won **first place in the Nissan Design Challenge** and **Christopher Walker** won **third place of the Design Challenge** of the SHPE national Conference. The Vaughn College chapter of the Society of Women Engineers attended the 2022 Women Engineers Conference and Vaughn College Society of Black Engineers attended the 2022 NSBE conference (**attaining goals 1&2**).
- **2022 Summer Engineering Experience (SEE-STEM) Program**: From June 27 to August 11, Vaughn's engineering department offered its Summer Engineering Experience (SEE-STEM) bridge program to high school seniors, community college transfer, and Vaughn's freshman students. The summer program is a six-week

residential program. This program is supported by the title III HSI-STEM grant and is designed with the objective of enhancing students' hands-on, computational, programming, communication, and problem-solving skills. The purpose of the summer program is student development through building leadership skills while preparing incoming students for college life both academically and socially. Students took courses in Writing composition and in First Year Initiative and a STEM workshop session introducing them to cybersecurity, intro to AI, and Additive Manufacturing. All participants are required to present an exhibition based on their learning experience in workshop sessions to Vaughn College professors, administrators and industry professionals, who give them feedback on presentations and provide an opportunity for students to network.

From 10 a.m. to 2 p.m. on Wednesday, August 10, 2022, students, guests, and faculty gathered in room E101 for an SEE-STEM student exhibition. The morning session of the SEE-STEM Exhibition Day was devoted to a presentation by students about their learning experiences throughout the 2022 Summer Engineering Experience Program. During this event, each student provided a detailed 7-to-10-minute presentation about their learning experience on topics pertaining to Cybersecurity, Artificial Intelligence, Computer-aided Design, Additive manufacturing, and CNC machining. After each student presentation and Q&A session, a feedback rubric survey was distributed to faculty judges, so they could evaluate the student learning experiences in the SEE-STEM program (**<u>attaining goals 1,2&3</u>**).

- **Outreach -** For the academic year 2021-2022, students in Vaughn's technical clubs (Robotics and UAV) and Vaughn's student chapter of professional societies (SWE, NSBE, and SHPE) organized and hosted several STEM related workshops for middle school, high school, and community college students during Vaughn's Annual Manufacturing Day, Vaughn's Annual STEM Day, Vaughn's Annual International Drone Day, Vaughn's Annual High School Robotics Tournament, Vaughn's VEX IQ Middle School Robotics Tournament, and Vaughn's Annual VEX U Robotics Tournament. They also provided assistance to many high schools to host their regional robotics and drone competitions. Vaughn's UAV team continually assists the Cradle of Aviation Museum in developing and hosting drone awareness events and games for high school students. The Project Director of HSI-STEM along with faculty attended some of these events to increase awareness about Vaughn's engineering programs (**attaining goals 1 &2).**

- **Annual STEM Events and Workshops:**

  1. **4th annual STEM Day workshop: STEM Pathway Workshop by Department:** On Friday, April 8, 2022, the department chair along with faculty, lab techs, and the STEM pathway Liaison hosted the **4th annual STEM Day workshop** for community colleges and high school students. The participants of Vaughn's STEM Day virtual workshop event were students and faculty from Passaic CC, Queensborough CC, Aviation High, and Thomas Edison high school. For this virtual event, Vaughn's STEM Liaison and 3D/CNC curriculum developer, Prof. Manuel Jesus, introduced participants with a video tour of Vaughn's 3D Makerspace and CNC manufacturing centers. Finally, he organized and hosted virtual STEM workshops related to 3D Scanning, CAM and CNC, and Virtual Reality.

From 12 to 2:30 pm, Vaughn's Robotics and UAV clubs organized and hosted Build a Drone and Robotics Workshops for all participants. More than 80 high schools and community colleges students were part of this year's in-person and virtual STEM Day workshop.

2. **14th Annual Tech Day Conference:** Vaughn students, faculty, alumni, and industry professionals convened on Friday, May 20, 2022, for the Fourteenth Annual Industry Advisory Meeting and Technology Day Conference. Advisory Council members were given updates on recent developments in the Engineering and Technology Department such as the 2021 EAC-ABET final accreditation statement for Vaughn's Mechanical Engineering and Electrical engineering programs. ABET determined that both programs are in full compliance with all ABET criteria requirements; HSI-STEM grant activities including development process of stackable manufacturing certificate programs in CNC machining, Composite, and 3D additive and subtractive manufacturing and UAS design, application and operation as well as establishment of manufacturing centers (CNC machining, composite, additive manufacturing, and PLC & automation, and UAS) support courses within these certificate programs. Dr. Rahemi, project director of title III HSI-STEM grant "Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students", updated advisory members with the development process of a BS degree program in computer science as well as provided an update on grant-supported STEM activities, student engagement, and STEM outreach. Also, he talked about the implementation process of the recently NYSED-approved computer engineering program that is supported by Title V HSI grant. Each technical club (Robotics and UAV) and Vaughn's student chapter of professional societies (SWE, SHPE, and NSBE) provided their annual activities and accomplishments to the audience of the 2022 Technology Day Conference. In the afternoon session, capstone design presenters talked about their innovative design projects. The top 2 capstone design papers were selected by our Industry Advisory members as the recipients of the Best Student Paper awards of this session. Also, the work-in-progress capstone design projects and CSTEP undergraduate projects were presented during the afternoon poster session of this annual gathering. In conclusion, Dr. Rahemi, congratulated all capstone design paper, poster, and technical club presenters and he emphasized how proud the Vaughn community is regarding these accomplishments.

3. **8th Annual Manufacturing Day Conference, October 28, 2022**
   a) Leadership Session: The Engineering and Technology department hosted its 8th Annual Manufacturing Day conference on Friday, October 28th from 10 am to 3 pm to celebrate the National Manufacturing Day. Vaughn College invited seven industry leaders to address invited guests and the Vaughn community about manufacturing innovation. The presentation featured a diverse variety of presenters in the field of manufacturing and topics such as: Autonomous Mobile Robot in Logistics; Additive Manufacturing in Aerospace; Data Science, Data Analytics, and Its Importance to Business; Base 11 Program, Digital Transformation and What It Means to Organizations; Introduction to Digital Twins; and Scanning & Reverse Engineering.

b) **STEM Workshop Session:** in a parallel session, from 10 am to 1:00 pm, Vaughn's Robotics, UAV, SWE, and SHPE clubs organized and hosted STEM workshops for the Community Colleges and high school students. These in-person workshops covered the following topics
   - ✓ Robotics Workshop - Robotics design & autonomous programing
   - ✓ An informational session about the basics of drones and the design considerations
     - ✓ Build a Drone Workshop and A Drone Practice Flying Session.

   More than 120 high schools and community colleges students and their mentors from Freeport, Bayside, Thomas Edison, Wyandanch, Uniondale and Hostos Community College attended the in-person STEM workshops.

- **<u>BS Computer Science Program:</u>** During fall 2021, as part of the College's US Department of Education Title III HSI-STEM grant, Vaughn College established a curriculum committee to research and propose a new computer science program. This committee solicited advice from related industry partners. In multiple zoom meeting discussions during fall of 2021 and spring of 2022, our industry partners had an opportunity to review and provide feedback and guidance in the development process of the new BS degree computer science program. While the program addresses traditional computer science topics (programming, computer algorithms, networking, systems security, and software design), the curriculum committee designed this new program so students have a focus on artificial intelligence, cybersecurity, and data analytics. The curriculum in BS computer science has a total of 128 credits, and courses within the Computer Science program consist of two components, 62 credits in Liberal Arts and Math/Science Courses (21 credits in mathematics, 11 credits in science, and 30 credits in general liberal arts areas), and 66 credits are technical computer science related courses. Computer science graduates are expected to work in industry diverse positions such as data scientist, software design, algorithm development, machine learning, networking/security, system development, technical sales representative, and many other computer science related positions, either in civilian or government sectors.

  In spring 2022, the engineering department chair, with input from both the curriculum committee and the advisory board, completed the BS Computer Science program application for registration with New York State Education Department (NYSED). In March 2022, with the approval of NYSED, Dr. Impagliazzo has been appointed as an external reviewer for this program, and in late April he completed his review and assessed the program proposal with no major issues. On January 6, 2023, the project director of the Title III HSI-STEM grant worked closely with the Academic Vice President and submitted a new BS Computer Science program application with all supporting materials (evaluation report by NYSED-approved external evaluator, CV of program evaluator, Faculty Vitae, and syllabuses for computer Science courses) to the NYSED for their review and approval.

- **Laboratory Development:** From 2016-2022, the title III grant "**Developing Guided Articulated Completion Pathways in Leading Edge Aeronautics and Aviation Careers for Hispanic and Low-Income Students,**" enabled the engineering department to develop stackable certificate programs and state-of-the-art laboratories in

CNC machining, 3D Additive and Subtractive manufacturing, composite manufacturing, and UAS Design, Application and Operation. The current title III grant "**Developing Guided STEM Degree Pathways to Prepare Hispanics and Low-Income Students for the Careers of the Future**," will further enable the engineering department to develop a BS degree program in Computer Science with focus on Cybersecurity, Artificial Inelegance, and Data Science. Also, the title III HSI-STEM grant funding support will allow Vaughn College to develop a state-of-the-art Mathematics and Computer Science (MCS) Center, and this will allow the engineering department to establish three designated spaces for the 1) Data Science and Applied Math Computer Lab, 2) Computer Science Lab, and 3) Student Undergraduate Research Lab. We expect the renovation and establishment of the MCS center to be completed in the academic year 2022-2023. The establishment of the new MCS center will further expand student involvement in computing and STEM-related scholarly, practical hands-on, STEM workshops, and community outreach activities. In addition, grant-supported initiatives such as supplemental instructors and recitation sessions will help to further improve student outcomes and consequently both retention and graduation rates in STEM and computing fields. These initiatives will allow Vaughn College to develop a much-needed pathway to increase accessibility for Hispanic and low-income students to enroll in the College's engineering degree programs that engage them in career-building STEM related activities. Vaughn's grant-supported BS degree in computer science, computer engineering, and MCS center will have a long-term impact on our institution in attracting and graduating student in STEM and computing fields. In the 2022 academic year, the department completed purchase of the following laboratory equipment:

1. **Data Science Center:** In April, 2022, the PD and grant management team placed and purchased 13 advanced level computer workstation, hardware, software, and related accessories **($50,882)** to support Mathematics/Data Science lab of the MCS center. This state-of-art computer center will allow students to conduct their data science, programming, and related class research work.
2. **Mathematics and Computer Science (MCS) Center:** Currently, the institution is designating two rooms on the second floor of the Library for the Mathematics and Computer Science (MCS) Center and are planning construction in spring 2023. This will allow the department to establish three designated spaces for the 1) Data Science and Applied Math Computer Laboratory, 2) Computer Science Laboratory, and 3) Student Undergraduate Research Laboratory. We expect the renovation and establishment of MCS center to be completed in summer 2023.
3. **3D Scanner for manufacturing lab:** In Nov 2022, with the support of supplemental HSI-STEM title III grant funding and with recommendation of the 3D/CNC curriculum developer, we purchased a metrology grade 3D scanner. This state-of-the-art metrology grade 3D scanner will be used for precision measuring alongside our CMM station to inspect production CNC parts and 3D scan parts for reverse engineering ($**18,849**).
4. **HASS Desktop Mill Trainer:** In Nov 2022, with the support of supplemental HSI-STEM title III grant funding and with recommendation of 3D/CNC curriculum developer and CNC lab tech, the PD placed and purchased a HAAS Desktop Mill Trainer. The HAAS CNC Desktop Mill is an educational version of

the popular HAAS VF2 SS CNC and MCU control system. It allows instructors to teach the HAAS CNC MCU (Microcomputer / Machine Control Unit) interface to students in a lecture / lab classroom environment before moving on to the full-size industrial HASS VF2 SS milling machine (**$12,694.75**).

5. **Additive Manufacturing Lab Equipment:** In April 2022, the PD with coordination of the 3D and additive manufacturing lab tech placed a purchase order for a Flashforge Creator 3 Pro 3D printer **($3,432.23)**. Addition of this 3D printer to our manufacturing center will further help both students and club members to complete and manufacture parts and components for their design projects.
6. **Vericut CNC Software:** In January 2022, as part of Title III HIS-STEM project, the grant team, with the recommendation of the CNC/3D curriculum designer, placed a purchase order for the Vericut CNC software **($2000)**. Vericut software is used in high end aerospace manufacturing as a safe method to debug and troubleshoot CNC programs. Our industry advisory board partners specifically requested we add Vericut CNC software to our course curriculum. They have positions ready for students well versed in the Vericut workflow. Most importantly, Verticut is an important tool for safety in modern machine shops where program verification is used to prevent tool breakage, machine damage, or injury to the machine operator. Our configuration will feature three complete replicas of our HAAS Mill, StepCraft Mill, and Okuma Lathe for rapid verification simulations before the time, expense, and potential danger of running unproven CAM programs.

This laboratory equipment allows Vaughn to provide students with practical STEM and computing hands-on training current with today's manufacturing and computing industry standards.

- **Students' accomplishments and success:** Below is a list of student accomplishments and successes that are a direct result of the current HSI STEM grant and its implementation process:

1. The Vaughn College robotics team participated in numerous local, state, and world championship events winning or placing high in all of them. Vaughn's robotics team has been a great outreach tool, as well as a great means of increasing engineering student retention and success.
    - From May 3-5, seventy-two national and international universities and colleges were invited to the 2022 VEX U World Championship in the Dallas Convention Center. Invitation to the VEX U Robotics World championship is only granted to a team that is a tournament champion or Excellence award recipient of a regional competition, and Vaughn's Robotics team was the recipient of both the **"Excellence Award"** and the **"Robot Skills"** award of the Vaughn College Regional Robotics Tournament, as well as the **"Excellence Award"** recipient of the WPI VEX U Robotics Regional Tournament. This intense three-day competition was challenging, and our team was continually modifying their robots and autonomous programming to be

competitive with other top teams in this tournament. During Tuesday and Wednesday, Vaughn's team participated in the skills challenge and won **3rd place in the VEX U World Skill ranking and 1st place in autonomous programming**. During Wednesday and Thursday qualifying matches, Vaughn's team competed against 10 teams, and they won nine out of the ten matches. With nine wins, Vaughn's team received 6th overall ranking in the Technology division of the VEX U World Robotics championship and automatic qualification for the Thursday afternoon single elimination playoff round. In the top 16 playoff round, Vaughn's team eliminated Mt. San Antonio College (NTSAC2) and advanced to the quarter final. In the quarter final, the top eight teams competed, and Vaughn's team defeated a team from University of Illinois at Urbana Champaign (ICTRL) and advanced to the semifinal playoff round against a team from University of Wisconsin (WISCO). In an intense exciting semifinal tournament game, WISCO defeated the VCAT team and advanced to the world tournament championship matches, winning the 2022 World tournament championship. Vaughn's team won the **2022 Technology Division Skills Award** and the **World Excellence Award.** Vaughn College Robotics team won the highest award, the **"Excellence Award" of the 2022 VEX U Robotics World Championship**. Vaughn's won this award since the team "best exemplifies, the best overall robotics program" and judges "want the team to be emulated by other teams". A team must succeed at most features of the event competition in order to win the Excellence Award. They must turn in an engineering notebook and are also likely contenders for design and technical awards. They must rank highly in qualification for the Robotics Skills challenge.

- On Friday, February 10, 2023, the PD and faculty along with Vaughn College Robotics team hosted its Ninth Annual VEX U College Regional Robotics Tournament. A total of eight teams participated in this regional robotics competition. Vaughn's team finished 3rd in "Robot Skills" and won the 2023 VEX U design award. In the 2022 World Robotics Championship, Vaughn's robotics team won the World "Excellence" award which automatically qualifies Vaughn's Robotics team for participation in the 2023 VEX U World Championship tournament.
- On Saturday, February 25, 2023, Vaughn College's Robotics team attended the Purdue SIGBots VEXU Midwestern Showdown Tournament. A total of 22 colleges participated in this regional robotics competition. With 5 wins out of seven, Vaughn's team received 2nd overall ranking of qualification matches. In this regional VEX U tournament, Vaughn's team won the Innovate Award. Currently Vaughn's team has automatic qualification to participate in the 2023 VEX U world championship tournament.

- **<u>Robotics Outreach Activities:</u>**
  - ✓ On Saturday, December 17th, 2022, the Vaughn Robotics team assisted Vaughn College in hosting its second annual VRC high school robotics Tournament. A total of 32 regional high schools from Queens, Manhattan, Bronx, Westchester and Nassau counties attended this event.

The members of Vaughn's robotics team organized and ran the event as referees, judges, and event staff.

- ✓ On Friday, February 10th, 2023, the engineering department and Vaughn Robotics team hosted its ninth annual VEX U College Regional Robotics competition. A total of eight college teams participated at this event. Members of Vaughn's robotics team served as the event manager, the announcer, Robot inspectors, and facilitators of the implementation process for this event. Also, Drs. Shouling He and Hagos Kifle served as judges for this competition.
- ✓ On Saturday, February 11th, 2023, Vaughn College of Aeronautics and Technology hosted its ninth annual high school robotics competition. A total of 51 regional high schools from Queens, Bronx, Nassau, and Suffolk and other NY counties attended the 2023 VEX state qualifier at Vaughn College. The members of Vaughn's robotics team organized and ran the event as referees, judges, and event staff.
- ✓ On Saturday, February 12th, 2023, Vaughn College hosted its third annual Middle School VEX IQ robotics competition. A total of 22 regional schools from Queens, Nassau, and other NY counties attended the 2023 VEX IQ state qualifier. The members of the VCAT robotics team organized and served as referees for the event.
- ✓ Vaughn's Robotics team hosted a robotics workshop for high school and community college students during Vaughn's 5th Annual STEM Day Workshop on Friday, April 21, 2023.
- ✓ On Friday, October 28. 2022, Vaughn College hosted its 8th Annual Manufacturing Day Conference, and from 11:30 am to 1:00 pm Vaughn's Robotics team organized and hosted the robotics workshop "Robotics Design & Autonomous Programming" for the Community Colleges and high school students from Freeport, Bayside, Thomas Edison, Wyandanch, Uniondale and Hostos Community College. This in-person workshop brought more than 100 students to Vaughn College.

2. Since 2016, the Vaughn College UAV team participated in the Micro Air Vehicle competition of the Vertical Flight Society (VFS) Conference and has won top place in the MAV student challenge and Design-Build-Vertical Flight competitions.
   - For the past several years, Vaughn's UAV team project was selected as one of the finalists, along with other top engineering schools, for both Micro Air Vehicle (MAV) and Design-Build-Vertical Flight competitions, and the list below provides their accomplishments through this challenging competition.
     - ✓ In 2017, Vaughn's UAV team won 2nd place in the remote-control category of the VFS Vertical Flight Competition.
     - ✓ In 2018, Vaughn's team won first place in both remote-control and autonomous categories in the VFS Vertical Flight Competition.
     - ✓ In 2019, Vaughn's UAV team won second place in both remote-control and autonomous categories in the VFS Vertical Flight Competition.
     - ✓ In 2021, Vaughn's UAV team won "Honorable mention with the most Manufacturable Award" in the Design-Build-Vertical Flight competition.

- ✓ **In 2022, Vaughn's UAV Team was qualified as one of the competition's finalists along with Penn State, Maryland University, Ohio State University, and McGill University. In the final technical presentations, the judges praised Vaughn's team for their engineering design simplicity, light weight, and the team's technical knowledge. Although the Vaughn Team was not able to participate in the final fly-off competition due to setbacks in flight testing compounded with the short supply of electronic components, the team was acknowledged during the award ceremony for their commitment to compete and for their eagerness to participate in next year's competition.**

- **<u>UAV Outreach Activities:</u>**
  - ✓ Since 2016, Vaughn's UAV team assisted the **Cradle of Aviation** Museum with drone awareness events, games, and workshops for middle school and high school students. On Sunday, February 26th, 2023, Vaughn's UAV team organized and hosted its third annual "Community Outreach Drone Awareness and Tiny Whoop Race" event at the Cradle of Aviation Museum. The event was free and open to the community. Many drone hobbyists and FPV pilots, as well as the locals from the area, attended this event.
  - ✓ Since 2015, Vaughn's UAV team hosted several STEM workshops for high school students on learning how to build a drone, along with a drone flying session in Vaughn's hangar during **Vaughn's Annual Manufacturing Day conference**. On October 28, 2022, Vaughn's UAV team hosted a Build-A-Drone Workshop for high school students during the 8th annual Manufacturing Day conference.
  - ✓ Since 2016, Vaughn's UAV team organized a day of drone workshops related to Arduino Programming, CAD Modeling of Quadcopters, and Learn to Build a Drone to celebrate **International Drone Day.**
  - ✓ Vaughn's UAV team hosted a drone workshop for community colleges and high school students during Vaughn's Annual STEM Day Workshop on Friday, April 21, 2023.

3. **LACCEI 2022 International Conference:** From July 18-22, 2022, Vaughn's engineering students, along with Dr. Hossein Rahemi, engineering department chair, and engineering faculty members Prof. Khalid Mouaouya, and Prof. Miguel Bustamante attended the 20th LACCEI International Multi-Conference in Boca Rotan, Florida. Three of Vaughn's student team research papers were accepted for presentation and publication in the LACCEI 2022 international conference. Vaughn's student papers, as listed below, were selected to compete among ten finalists for the student paper session, and all submitted papers were accepted for the poster session of LACCEI 2022.
   - ✓ **ReGenBot: "Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests"** by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto
   - ✓ Competitive Design Process for VEX U Competition "Tipping Point" by Misael Marquez

From 11 am to 2 pm on Thursday July 21, Vaughn's student team papers, as listed above, were presented as finalists to the international conference audience during the student paper session of LACCEI 2022. Vaughn's student paper "**ReGenBot: Design of An Autonomous Robot to Revitalize Burnt Soil in South American Forests"** by Alina Santander Vinokurova, Tatiana Jaimes, and Cristian Sorto covered the design process and features of the ReGenBot, a low-cost autonomous robot intended to collect data from burnt soil to analyze its characteristics, especially deficiencies, and to distribute fertilizer or nitrogen to balance and revitalize the soil's composition won the **first place award of the 2022 LACEEI student paper session competition.** Also, from 11 am to 1:00 pm on Wednesday, July 20, all three of Vaughn's student team projects were selected as finalists for the LACCEI 2021 Virtual session competition and Vaughn's student poster "**STEM summer camp program to prepare high school students for the VEX Robotics Competition**" by Ryan Tang Dan won the **third place award of the LACEEI 2022 student poster session competition.**

4. **2022 ASEE Annual Conference:** From June 26 through June 29, Vaughn's faculty and students attended the American Society for Engineering Education (ASEE) 129th annual conference in Minneapolis, Minnesota. On Wednesday, June 29, from 1:00 to 4:00 pm, Vaughn's engineering students August Rodriguez, Manpreet Anand, and Bryan Gordilo presented their project **"The Braille Educational Tablet,"** during the **ASEE Student Showcase Poster Session** of this annual gathering. Their presentation detailed the development process of an innovative braille block tablet that teaches children the alphabet and basic 4 letter words to ensure good fundamentals of pre-literacy and to allow visually impaired and legally blind children to have equal access to educational products and learning methods.
5. **2022 Society of Hispanic Professional Engineers (SHPE) National Conference:** From Nov 2^{nd} – 6^{th}, a group of 22 engineering students from Vaughn College attended the 2022 Society of Hispanic Professional Engineers (SHPE) in-person Conference in Charlotte, North Carolina. Vaughn's students participated in innovation, Nissan Design, and Extreme Engineering challenges as well as various professional development workshops that aimed to promote leadership, unity, and exposure to the diverse career opportunities in the STEM fields. Also, Vaughn's participation in the career fair session of SHPE national conference and Vaughn's SHPE chapter yielded a total of 57 interviews for both internship and full-time position with companies such as Medtronic, Lockheed Martin, Northrop Grumman, Rockwell Automation, Cummins, Boeing, Tesla, Honeywell, Amazon, Qualcomm, Pratt & Whitney, L3Harris, John Deere, and Raytheon, thirty-three of which resulted in internship and full-time position offers. Also, seven of the Vaughn HSI-STEM grant-supported students had the opportunity to participate in the Extreme Engineering competition and the Nissan Design Challenge. Vaughn's student, **Daniel Doscher's team won first place in the Nissan Design Challenge** and **Christopher Walker won third place in the Nissan Design Challenge** of the SHPE national Conference.

In addition to the above accomplishments, because of the HIS-STEM grant, many of Vaughn's students were able to participate in scholarly activities and student paper and poster sessions in regional, national and international conferences and competitions (ASEE, LACCEI, SWE, ASME, SHPE, and IEEE) and receive top ranking in those events. Also, the HSI STEM grant provided necessary funding support for clubs such as Robotics, UAV, Rover, SWE, SHPE, and NSBE for students to be involved in professional development, activities, and STEM related workshops at Vaughn College. The student engagement section of the VCJET journal provides more details regarding these activities, student successes, and accomplishments.

List of 2022-2023 Placement Activity

The following table provides graduate career placement statistics within the Engineering and Technology Department for the 2022-2023 calendar years. This can be used as an indicator to evaluate the effectiveness of the program in producing graduates who are sought by the general engineering industry and by graduate schools. During the academic year 2022, our students obtained internships and accepted employment at several corporations, including Boeing, GE, NASA, Raytheon, Tesla, Space X, Department of Defense, Daimler, Sikorsky Aircraft, Marotta Controls, Brookhaven National Lab, General Dynamics, Toyota, Siemens, Cummins, Northrop Grumman, Lockheed Martin, Easy Aerial, Pratt and Whiney, John Deere, Rolls-Royce, Volvo, Stryker, Magellan Aerospace, SciMax Technologies, Collins Aerospace, FAA, Safe Flight Instruments, CPI-Aero, Cox & Company, Cyient, and many others. These corporations have employed our graduates as mechanical engineers, design engineers, mechatronics engineers, control engineers, structural engineers, avionics engineers, and project engineers. The department of engineering and technology views such placements as a strong indicator of our students' value to the industry and of our programs' success in meeting our objectives.

Student Name	Program	Industry - Internship	Industry - Full-time position	Graduate School
Mariah Villalon	Electrical Eng.	Ameren, Summer 2023	Northrop Grumman, Fall 2023	
Carla Vasquez	Electrical Eng.	Honeywell, Summer 2023		
Brian Benjamin	Electrical Eng.		Boeing, Summer 2023	
Wole Barnarde	Electrical Eng.		Delta, Summer 2022	
Tika Tamang	Electrical Eng.		AT&T, Summer 2022	
Kevin Velasquez	Mechanical Eng.		Cyient, Summer 2023	
Kiran Boodhoo	Mechanical Eng.		Northrop Grumman, Summer 2023	
Arayana Khelewan	Mechanical Eng.	Boeing, Summer 2023		
Amanda Camacho	Mechanical Eng.		Boeing, Summer 2023	
Nigel John	Mechanical Eng.	Honeywell, Summer 2023		
Andres Vacas	Mechanical Eng.		Magellan Aerospace, Spring 2023	
Cesar Valle	Mechanical Eng.		Snake Tray, Spring 2022	
Kevin K. Osada	Mechanical Eng.		Nissan, Spring 2022	
Efrain Magana	Mechanical Eng.	Boeing, Summer 2023		
Joshua Harripaul	Mechanical Eng.		Boeing, Summer 2023	
Nurullah Khan	Mechanical Eng.		Easy Aerial, Spring 2022	
Yusuf Rafi		NASA-JPL, Summer 2022		
ISA Al-Maktoum		PSEG ISS, Montclair State U Summer 2022		
Alanke Perera	Mechatronic Eng.		Ash Kash, Summer 2023	
Tatiana Jaimes	Mechatronic Eng.	NASA, Summer 2021	NASA-JPL, Summer 2023	
Alina Santander	Mechatronic Eng.	InstaHub, Summer 2021	Honeywell, Summer 2023	
Daniel Doscher	Mechatronic Eng.	Colins Aerospace, Summer	ArcBest Tech, Summer 2023	

		2021 and 2022		
Kang Jiang	Mechatronic Eng.		ArcBest Tech, Summer 2022	
Kirill Sokolov	Mechatronic Eng.		Raytheon Tech, Summer 2023	
Manolo Duenas Benavides	Mechatronic Eng.	KG Computech, Sum 2020	RevolutionNice-Spring 2022	
Samantha Vitez	Mechatronic Eng.	NASA propulsion Lab – Summer 2018	Department of Defense, Spring 2022	
Mina Morcos	Mechatronic Eng.		Boeing, Summer 2023	
Manhan Mbanefo	Mechatronic Eng.	Honeywell, Summer 2023		
Suraiya Nawaz	Mechatronic Eng.	Tesla, Spring 2023		
Jack Sze	Mechatronic Eng.		Tesla, July 2022	
Rebecca Snyder	Mechatronic Eng.		Caterpillar, Summer 2023	
Huzaifa Naveed	Mechatronic Eng.	Northrop Grumman, Summer 2023		
Cristian Sorto	Mechatronic Eng.		Honeywell, Summer 2023	
Pablo Mauricio Guzman-Moumtzis	Mechatronic Eng.		Magellan Aerospace, Spring 2022	
Chasisty Melo	Mechatronic Eng.	Carrier, Summer 2022		
Misael Marquez	Mechatronic Eng.		ArcBest Technologies, Sum 2022	
Samuel Aremu	MET		Boeing, Summer 2023	
Jairo Ramos	MET		Northrop Grumman, Summer 2023	
John Morales	MET		Raytheon Tech, Summer 2023	
Erem Atalay	MET	NASA L'Space, Summer 2022		
Maharshi Patel	MET	NASA-L'Space NPWEE Participant, Sum 2020	Mametuchen Fist Aid, Fall 2021 Stryker, June 2022	MS Biomedical Eng. Cornell
Hugo Arias	BS EET		Engineering Services FAA, Spring 2022	
Alex Penaranda	BS EET-Avionics	Safeflight, Summer 2023		
Ashley Nunez	BS EET-Avionics		Engineering Services FAA, Spring 2022	
Eben Rockwell	BS EET	L3Harris, Fall 2021	L3Harris, Summer 2022	
Wei Zhao	BS EET		Engineering Services FAA, Spring 2022	

Telemetry System for the NASA Rover Challenge

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ABSTRACT

This paper outlines the design, development, testing, and deployment of a telemetry system aboard Vaughn College's Human Exploration Rover Challenge (HERC) rover to collect information on the environment, rover, and drivers' status. Developing this telemetry system allows the team to acquire data from a unique rover design and analyze it, simulating what an actual space mission would be like. Based on the competition and design requirements, this system comprises a temperature and humidity sensor, an OV2640 camera, a Long Range (LoRa) module for communication, a Global Positioning System (GPS) sensor, and an ESP32 microcontroller. The system's transmitter acquires all the desired data, while the receiver displays the information on the Arduino Internet of Things (IoT) cloud for analysis.

1 INTRODUCTION

Aerospace is a broad and challenging industry where humans have built different spacecraft, sent them to outer space, and retrieved the measured data for various analyses. For this reason, telemetry techniques have been quickly developed in recent years to obtain remotely measured data efficiently. Telemetry systems are an alternative method to transmit data automatically from a remote source to an information technology (IT) system in a different location for monitoring and analysis. These systems may still benefit from improvement, due to their time delays, vast distances, and data collection and analysis. Among these, it is found that 28 percent of the failures in telemetry systems are attributable to lead and electrode problems, 25 percent to battery depletion, 22 percent to mechanical or electronic component failures, 12 percent to inappropriate control settings and frequency mismatching, and 13 percent to miscellaneous difficulties [1]. The main benefit of implementing a telemetry system is that it allows a user to monitor the state or environment of an object while being physically far from it. Telemetry is a valuable tool for ongoing performance monitoring and management, particularly for providing real-time data for improvements on future designs.

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1.1 OBJECTIVE

This highly useful technique for data collection in the aerospace industry can currently be implemented for smaller spacecraft such as a rover and, more specifically, a human-powered rover for NASA's HERC competition. This competition's primary objective is for student teams to design, develop, build, and test a human-powered rover and a task tool capable of traversing challenging terrain and completing mission tasks along the course's path. The competition requires two students to use the designed vehicle to traverse a course of approximately a half-mile that includes a simulated field of asteroid debris, boulders, erosion ruts, crevasses, and an ancient streambed [2]. Each team earns points by successfully completing obstacles and tasks, and the team with the highest accumulated points throughout the project year will be the winner.

2 BACKGROUND RESEARCH

Telemetry systems are an alternative method to transmit data automatically from a remote or inaccessible source to an IT system in a different location for monitoring and analysis. This can be relayed using radio, infrared, ultrasonic, GSM (Global System for Mobiles), satellite, or cable.

The system operates through sensors at the remote source that measures physical and/or electrical data to then convert to electrical voltages combined with timing data. The collected information forms a data stream transmitted through a medium. As previously discussed, this medium could be wireless, wired, or a hybrid of both. The main benefit of telemetry is that the system allows a user to monitor the state or environment of an object, while being physically far from it. It is a valuable tool for ongoing performance monitoring and management and, additionally, providing real data for improvements in future designs.

Telemetry works alongside monitoring and control to ensure an integrated solution for the environment for which it is selected. While telemetry measures data remotely, monitoring displays the measured data, leading to controls that can perform actions remotely – sometimes automatically.

Aerospace telemetry dates from the late 1930s, with the development of the balloon-borne radiosonde – measured meteorological data – that sent the information to an Earth station by radio. Later, telemetry for rockets and satellites was inaugurated with the Soviet satellite Sputnik. Since then, observatory satellites have performed as many as 50 experiments and observations, with all the data collected through telemetry, delivering data back to a ground station. These are some examples used as a reference and related to the competition's requirements:

Dropsonde (Fig. 1) is an expendable weather reconnaissance device [3]. It was designed to be dropped from an aircraft at a height over water to track and measure storm conditions as they developed. Along with pressure, temperature, and humidity (PTH) sensors to record atmospheric profiles and thermodynamic data, the dropsonde also includes a GPS receiver. This information is often transmitted through radio to a computer within the aircraft.

Figure 1: Dropsonde and its interiors

The Lunar Rover from Apollo 15 used telemetry to transmit video to its station through an S-band dish antenna. Mobility performance was evaluated through image analysis, creating estimated assessments of slope distributions encountered by the rover [4].

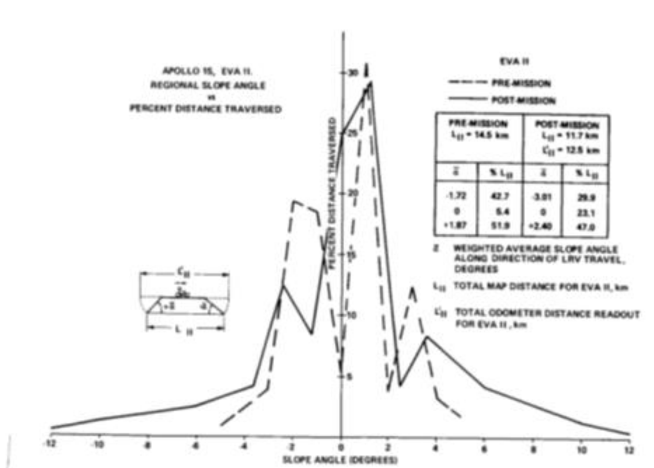

Figure 2: Slope distributions encountered during Apollo 15 mission

Telemetry is also applied to satellites, since it provides a connection between the satellite itself and the facilities on the ground. Its purpose is to ensure the satellite performs correctly through the monitoring of its health and status through the collection, processing, and transmission of data from the various spacecraft subsystems. The determination of the satellite's exact location is accomplished through the reception, processing, and transmitting of ranging signals, and the proper control of the satellite occurs through the reception, processing, and implementation of commands transmitted from the ground [5].

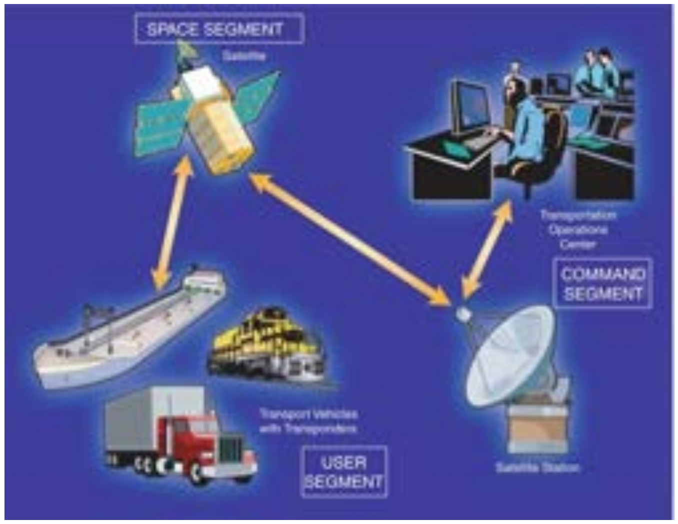

Figure 3: Segmented example of a space system

Based on this research, the proposed telemetry system will consist of an input device called a transducer, a medium of transmission (usually radio waves), equipment for receiving and processing the signal, and recording or displaying equipment.

3 ENGINEERING REQUIREMENTS

The team's telemetry system must meet the following requirements to meet its data collection purpose according to team and competition standards:

1) *Continuous broadcasting:* The system's video and sensor data must be broadcast and received by the central station to be accessible for real-time viewing.
2) *Continuous broadcasting*: The system's video and sensor data must be broadcast and received by the central station to be accessible for real-time viewing.
3) *Stable video transmission:* The system's camera must transmit at least 12 frames per second (fps) to relay a stable video stream.
4) *Fast transmission:* The system's data must be updated to the cloud every one to three seconds to maintain accurate readings of the dashboard's display.
5) *Long-range transmission:* The network from the transmitter to the receiver must range from 300 to 400 meters, equivalent to the furthest point from the rover to the central station during the competition's course.
6) *Long-range communication:* The system's wireless communication module must have a minimum bandwidth of 433 MHz
7) *Adaptable:* The system's temperature sensor must be capable of reading data ranging from approximately negative 30 °C to 60 °C.
8) *Compact design:* The transmitter circuit must fit within a housing of approximately 25 centimeters in length by 20 centimeters in width by 5 centimeters in height to allow a swift and secure mounting onto the rover.

4 ENGINEERING CONSTRAINTS

The project uses transceivers that can be set as emitters or receivers. This device can only send one signal at a time and receive up to 6 signals simultaneously. This gives a limitation for the number of sensors that the telemetry system can have and the amount of information that can be visualized at the same time.

5 ENGINEERING STANDARDS

1. *National Telecommunications and Information Administration's (NTIA) Manual of Regulations and Procedures for Federal Radio Frequency Management*: is considered for implementing telemetry at a great scale for federal projects (space missions) [6].
2. *528-2019 IEEE Standard for Inertial Sensor Terminology*: provides a source of definitions, manufacture, and test of inertial instruments used for navigation [7].
3. *2700-2017 IEEE Standard for Sensor Performance Parameter Definitions*: a common framework for sensor specification terminology, units, conditions, and limits [8].
4. *ISO 22672:2021 Space data and information transfer systems* - Space link extension (SLE) - Forward space packet service specification [9].

6 SYSTEM DESIGN

The telemetry system is equipped with all the necessary electrical components to retrieve information from the environment, the vehicle, and the driver.

Table 1: Data Collection

Collection	Data
Environment status	Humidity, Temperature, Pressure
Rover Status	Location, Orientation, Speed
Driver Status	Visual information from driver's face

Figure 4: Telemetry system

6.1 USER INTERFACE

The user-friendly interface chosen to display the collected data allows one to identify the status of the simulated mission. Arduino's IoT cloud allows access to real-time data and displays it on dashboards and gadgets, as seen in the figure below. This online software was chosen to show the data collected by the telemetry system, such as GPS location, speed, and temperature.

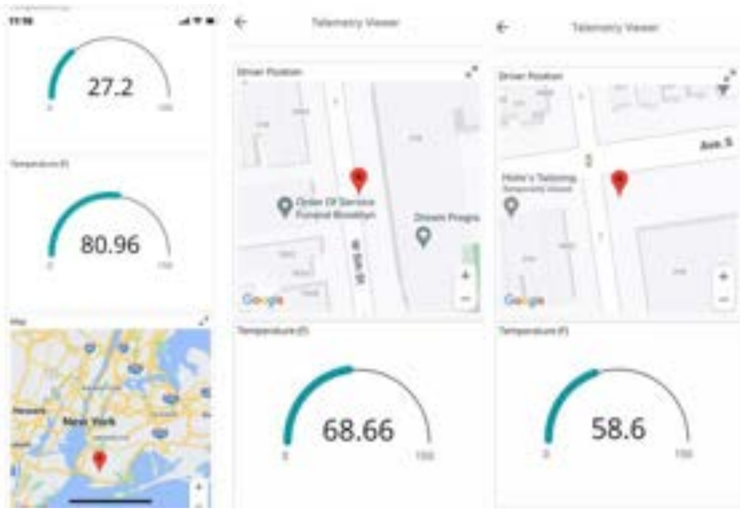

Figure 5: Arduino IoT web display

6.2 ELECTRICAL DESIGN

The electrical design consisted of a transmitter, a receiver, and a camera circuit.

1) Transmitter

This circuit collects all the information through the sensors and sends it to the receiver through the long-range (LoRa) module. Fig. 6 shows the design of the transmitter.

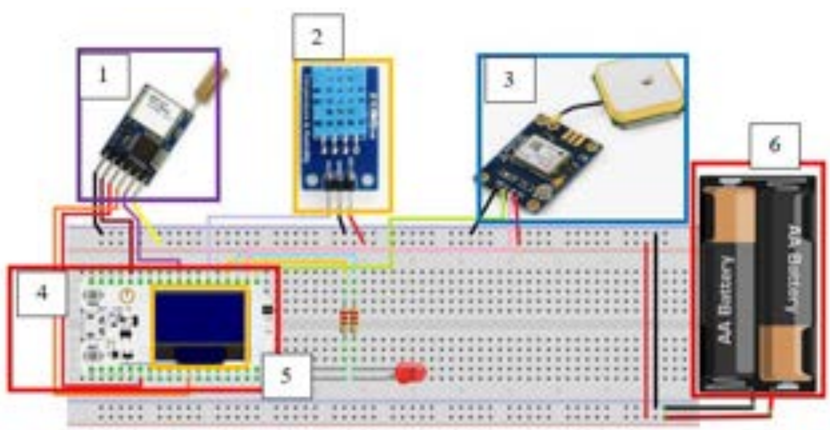

Figure 6: Model of the transmitter's circuit design

Where:

1. LoRa for wireless communication
2. Temperature and humidity sensor (before choosing the BME680 sensor)
3. GPS module for testing and validation of positioning

4. ESP32 microcontroller, the "brains" of the operation, update from the Arduino due to higher memory capabilities.
5. OLED (Organic Light Emitting Diode) display to demonstrate data acquired.
6. Power supply of the system

All circuit components were connected, tested, and validated in different opportunities. Fig. 7 shows the built circuit for the transmitter.

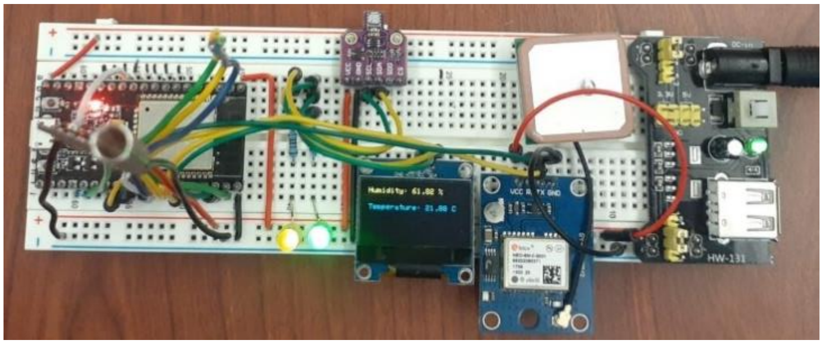

Figure 7: Implementation of the transmitter

6.3 HARDWARE DESIGN

The housing of the sensors is an important part of the project. In addition to the functionality, the system must be compact and aesthetically designed. The housing design is different for the transmitter and receiver, since the latter one is stationary it can have more features and take up more space.

The telemetry system is placed under the back seat of the rover, as seen in Fig. 8 and mounted to the frame with two crews on each side.

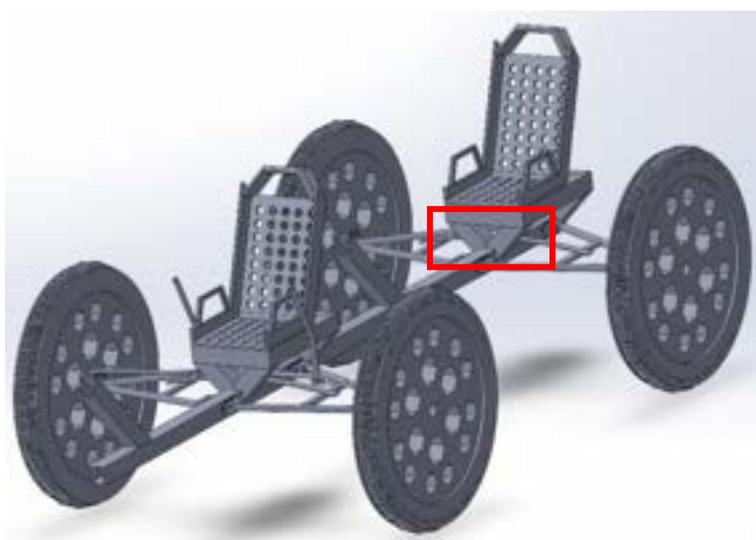

Figure 8: Location of telemetry system on the rover

The cover has holes for the modules and sensors, such as the GPS, LoRa, and temperature and humidity sensors. This housing is 23 cm by 19 cm, and 5 cm tall. The base is extended so it can be attached to the frame of the rover, and 4 screws attach both elements. For testing and demonstration purposes, the material for this housing version was PLA (Polylactic Acid) filament, as it is durable and lightweight, fitting within the housing requirements. The final prototype is made from 6061-T6 aluminum, and the stress analysis was performed on this material.

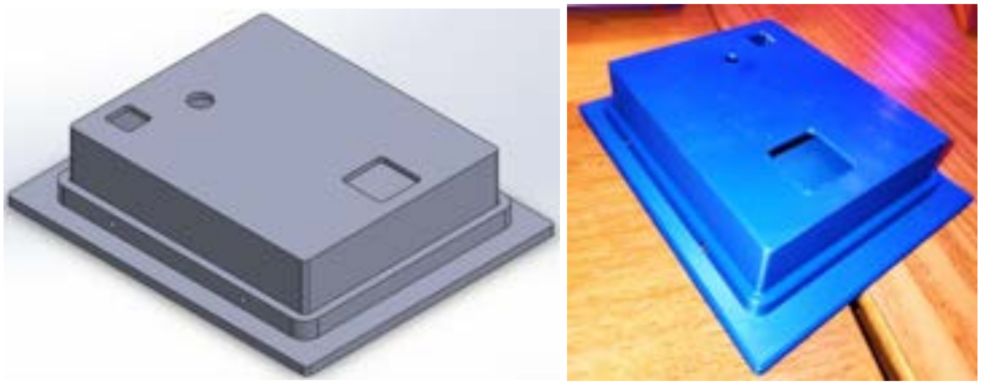

Figure 9: Final housing design

6.4 ALGORITHM DEVELOPMENT AND SOFTWARE DESIGNS

Programming the transmitter unit

The programming algorithm process of the transmitter unit is outlined below in Fig. 10, through which the system's microcontroller communicates with the peripheral devices using a serial peripheral interface (SPI), inter-integrated circuit (I2C), and universal asynchronous receiver/transmitter (UART) protocols.

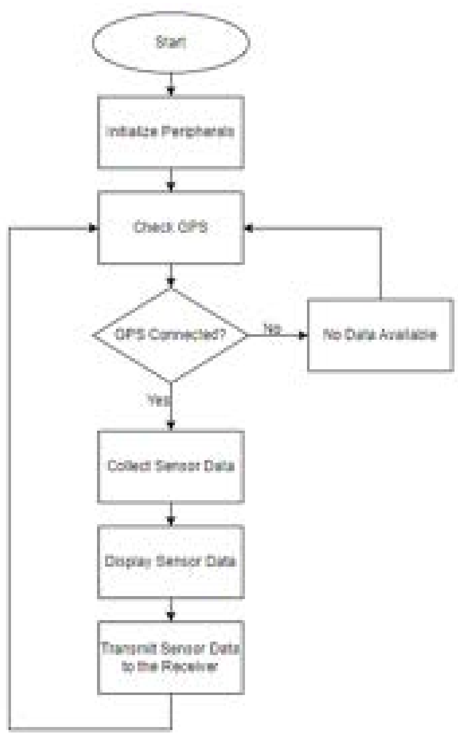

Figure 10: Transmitter Flow Chart

After initializing the peripheral devices, the program checks the GPS sensor's status. If locked, the microcontroller collects the sensor data, displays it to the driver, and sends it to the receiving station via LoRa; otherwise, no data is available or recorded. Once the GPS is online and functioning as expected, the data collection portion of the system begins. And the necessary libraries – including SPI, LoRa, Adrafruit_BME680, TinyGPS, and HardwareSerial header libraries were added to the program, as illustrated in Fig. 11, which enabled a successful connection to the sensors, displays, and modules.

```
#include "thingProperties.h"
#include <SPI.h>
#include <LoRa.h>
#include <Wire.h> // I2C for BME680 and OLED
#include <Adafruit_Sensor.h>
#include "Adafruit_BME680.h"
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <HardwareSerial.h>
#include <TinyGPS++.h>

//Pin definitions
#define CHIP_SEL  5
#define RST 14
#define DIO_0 2
#define LED 15

HardwareSerial neogps(1);
TinyGPSPlus gpsData;
Adafruit_BME680 bme;
```

Figure 11: Libraries included in Transmitter Unit

Four OLED displays were added to the unit to provide sensor and position data to the driver, and the position and display settings, including the text color, size, cursor, and print options, were established through the Arduino IDE. For the proper execution of the transmitter unit, six void functions – *TCA9548A*, *gps_update*, *displayHumid*, *displayTempF*, *displayTempC, and displayPressure* – were created to collect all the information of the environment, the rover, and the drivers throughout the course.

The *TCA9548A* void function is a one to eight I2C multiplexer that allows the I2C bus to expand, useful when controlling multiple I2C devices with the same I2C address. The *gps_update* function manages the GPS sensor's data collection to display the rover's speed in miles per hour, altitude in meters, latitude and longitude coordinates, and the number of satellites connected to the sensor to obtain the rover's location. And, finally, as the name suggests, the *displayHumid*, *displayTempF, displayTempC,* and *displayPressure* void functions oversee the data collection for the humidity in percentage, the temperature in Fahrenheit, the temperature in Celsius, and the pressure information, in kPa, of the environment.

Furthermore, these functions are implemented within the system's main setup program, illustrated in Fig. 12.

```
void TCA9548A(uint8_t bus)
{
  Wire.beginTransmission(0x70);
  Wire.write(1 << bus);
  Wire.endTransmission();
}

void gps_update(float speed, float altitude, int number_of_satellites, float lattitude, float longitide
{
  display1.clearDisplay();
  display1.setTextColor(SSD1306_WHITE);
  display1.setTextSize(2);
  display1.setCursor(20, 0);
  display1.print("GPS DATA");
  display1.setTextSize(1);
  display1.setCursor(0, 17);
  display1.print("Speed: ");
  display1.print(speed);
  display1.print(" mph");
  display1.setTextSize(1);
  display1.setCursor(0, 27);
  display1.print("SAT: ");
  display1.print(number_of_satellites);
  display1.setTextSize(1);
  display1.setCursor(0, 37);
  display1.print("LAT: ");
  display1.print(lattitude,10);
  display1.setCursor(0, 47);
  display1.print("LNG: ");
  display1.print(longitide,10);
  display1.setCursor(0, 57);
  display1.print("ALT: ");
  display1.print(altitude);
  display1.print(" m");
}
```

Figure 12: Position function gps_update

```
void displayHumid(float hum)
{
  display2.clearDisplay();
  display2.setTextColor(WHITE);
  display2.setTextSize(2);
  display2.setCursor(15,0);
  display2.print("HUMIDITY ");
  display2.setCursor(16,25);
  display2.print(hum);
  display2.print(" %");
}


void displayTempF(float tem)
{
  display3.clearDisplay();
  display3.setTextColor(WHITE);
  display3.setTextSize(2);
  display3.setCursor(15,0);
  display3.print("TEMP (F) ");
  display3.setCursor(16,25);
  display3.print(tem);
  display3.print(" F");
}


void displayPressure(float pressure)
{
  display4.clearDisplay();
  display4.setTextColor(WHITE);
  display4.setTextSize(2);
  display4.setCursor(12,0);
  display4.print("PRESSURE");
  display4.setCursor(0,25);
  display4.print(pressure);
  display4.print(" kPa");
```

Figure 13: Display functions

```
void setup() {
  // Initialize serial and wait for port to open:
  Serial.begin(115200);
  // This delay gives the chance to wait for a Serial Monitor without blocking if none is found
  delay(1500);

  // Defined in thingProperties.h
  initProperties();

  // Connect to Arduino IoT Cloud
  ArduinoCloud.begin(ArduinoIoTPreferredConnection);

  /*
     The following function allows you to obtain more information
     related to the state of network and IoT Cloud connection and errors
     the higher number the more granular information you'll get.
     The default is 0 (only errors).
     Maximum is 4
 */
  setDebugMessageLevel(2);
  ArduinoCloud.printDebugInfo();

  pinMode(LED,OUTPUT);
  neogps.begin(9600, SERIAL_8N1, 16, 17);
  bme.begin(0x77);
  bme.setTemperatureOversampling(BME680_OS_8X);
  bme.setHumidityOversampling(BME680_OS_2X);
  Wire.begin();

  while (!Serial);
  Serial.println("LoRa Sender");
  LoRa.setPins(CHIP_SEL, RST, DIO_0);
  delay(1000);
```

Figure 14: Void setup

The void setup, displayed in Fig. 14, is the first function to be executed, only once in the sketch. All peripheral devices are initialized in this setup, and the I2C protocol, GPS module, environmental sensor, and LoRa transmitter are set up. Likewise, the Arduino Cloud connection is established to begin the data transmission from the transmitter unit to the central base computer. The OLED displays communicate with the system's microcontroller via I2C. And a multiplexer is used to allow each display to demonstrate different information, since all the display components contain the same address.

```
  // Set multiplexer to channel 0 and initialize OLED-1 with I2C addr 0x3C
  TCA9548A(0);
  display1.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  delay(100);
  display1.clearDisplay();
  display1.drawBitmap(0,0, bitmap_ab68wi,128,63,WHITE);
  display1.display();
  delay(5000);

  // Set multiplexer to channel 1 and initialize OLED-2 with I2C addr 0x3C
  TCA9548A(1);
  display2.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  delay(100);
  display2.clearDisplay();
  display2.setTextColor(WHITE);


  // Set multiplexer to channel 2 and initialize OLED-3 with I2C addr 0x3C
  TCA9548A(2);
  display3.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  delay(100);
  display3.clearDisplay();
  display3.setTextColor(WHITE);


  // Set multiplexer to channel 3 and initialize OLED-4 with I2C addr 0x3C
  TCA9548A(3);
  display4.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  delay(100);
  display4.clearDisplay();
  display4.setTextColor(WHITE);
```

Figure 15: Multiplexer channel setup

```
// Your code here
boolean newData = false;
for (unsigned long start = millis(); millis() - start < 1000;)
{
  while (neogps.available())
  {
    if (gpsData.encode(neogps.read()))
    {
      newData = true;
    }
  }
}

//If newData is true
if(newData == true)
{
  newData = false;
  Serial.println(gpsData.satellites.value());
  print_gpsData();
}
else
{
  display1.clearDisplay();
  display1.setTextColor(SSD1306_WHITE);
  display1.setCursor(0, 0);
  display1.setTextSize(3);
  display1.print("No Data");
  display1.display();
}
```

Figure 16: Void loop, main program

The main loop contains the code that checks for GPS connection. If GPS is connected, the microcontroller sends sensor data to the receiver unit. The *print_gpsData* performs sensor data reading and displays it to four OLED displays. OLED displays communicate with the microcontroller via I2C.

```
void print_gpsData()
{
  if (gpsData.location.isValid() == 1)
  {
    ArduinoCloud.update();
    digitalWrite(LED,HIGH);
    bme.performReading();
    location = {gpsData.location.lat(), gpsData.location.lng()}; // Update GPS location
    // Set multiplexer to channel 0 and display GPS data
    TCA9548A(0);
    gps_update(gpsData.speed.mph(), gpsData.altitude.meters(), gpsData.satellites.value(), gpsData.loca
    display1.display();

    // Set multiplexer to channel 1 and display humidity
    TCA9548A(1);
    displayHumid(bme.humidity);
    display2.display();

    // Set multiplexer to channel 2 and display temperature F
    TCA9548A(2);
    displayTempF((bme.temperature*9/5)+32);
    display3.display();

    // Set multiplexer to channel 3 and display pressure hPa
    TCA9548A(3);
    displayPressure(bme.pressure / 1000.0);
    display4.display();
```

Figure 17: print_gpsData function

__Programming the receiver unit:__

The programming algorithm process of the receiver unit is outlined below in Fig. 18, in which, after initializing the IoT properties, the microcontroller connects to the Internet via Wi-Fi. Once the Wi-Fi is connected, the program checks if LoRa is available, and, if so, the program reads the received data and outputs it to the dashboard for the team to observe.

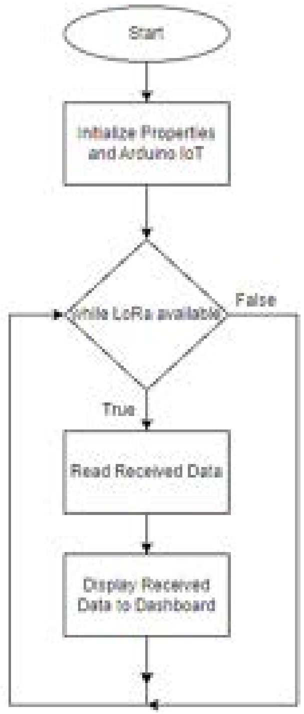

Figure 18: Receiver Flow Chart

The Arduino IoT utilizes variable synchronization that allows devices to communicate with each other by sharing variables. This feature is called a cloud variable, which can link variables of the same data type between two or more devices. The variable is linked between a multipoint control unit (MCU) and the Arduino IoT cloud. If a variable is updated on the MCU board, the Arduino Cloud will also receive this value, and vice versa. With this, the Arduino IoT Cloud automatically ensures that any change to their value is propagated among all linked devices.

```
  The following variables are automatically generated and updated when changes are made to the Thing

  float altitude;
  float humidity;
  float pressureKPa;
  float speed;
  float tempF;
  int number_of_satellites;

  Variables which are marked as READ/WRITE in the Cloud Thing will also have functions
  which are called when their values are changed from the Dashboard.
  These functions are generated with the Thing and added at the end of this sketch.
*/
```

Figure 19: Declaring variables for IoT

The void setup function for the receiver, displayed below in Fig. 20, includes an initialization of the Serial Monitor and properties using the Serial.begin and initProperties commands. The Arduino IoT Cloud connection is also initialized using the built-in ‘begin’ function, which uses methods from the Arduino IoT Cloud and the Arduino_ConnectionHandler libraries, included in the thingProperties header file. Finally, setDebugMessageLevel and ArduinoCloud.printDebugInfo are used for debugging and print information related to the network state and IoT Cloud connection and errors.

```
void setup() {
  // Initialize serial and wait for port to open:
  Serial.begin(9600);
  // This delay gives the chance to wait for a Serial Monitor without blocking if none is found
  delay(1500);

  // Defined in thingProperties.h
  initProperties();

  // Connect to Arduino IoT Cloud
  ArduinoCloud.begin(ArduinoIoTPreferredConnection);

  /*
     The following function allows you to obtain more information
     related to the state of network and IoT Cloud connection and errors
     the higher number the more granular information you'll get.
     The default is 0 (only errors).
     Maximum is 4
 */
  setDebugMessageLevel(2);
  ArduinoCloud.printDebugInfo();
```

Figure 20: Void setup

Since the receiver unit’s main purpose is to relay and confirm the information incoming from the transmitter, this portion of the system only utilizes one void function within the overall setup, loraRead, exemplified below in Fig. 21.

```
void loraRead()
{
  // try to parse packet
  int packetSize = LoRa.parsePacket();
  if (packetSize)
  {
    // received a paket
    Serial.println("");
    Serial.println("...................................");
    Serial.println("Received packet: ");

    // read packet
    while (LoRa.available())
    {
      ArduinoCloud.update();
      digitalWrite(LED, HIGH);
      String humidity_raw = LoRa.readStringUntil('|');
      Serial.print("Humidity: ");Serial.println(humidity_raw);
      humidity = humidity_raw.toFloat();

      String tempF_raw = LoRa.readStringUntil('|');
      Serial.print("    Temperature: ");Serial.println(tempF_raw);
      tempF = tempF_raw.toFloat();


      String speed_raw = LoRa.readStringUntil('|');
      Serial.print("Speed: ");Serial.println(speed_raw);
      speed = speed_raw.toFloat();


      String satellites_number_raw = LoRa.readStringUntil('|');
      Serial.print("Number of Satellites: ");Serial.println(satellites_number_raw);
      number_of_satellites = satellites_number_raw.toInt();

      String altitude_raw = LoRa.readStringUntil('|');
      Serial.print("Altitude: ");Serial.println(altitude_raw);
      altitude = altitude_raw.toInt();

      String pressure_raw = LoRa.readStringUntil('|');
      Serial.print("Pressure atm: ");Serial.println(pressure_raw);
      pressureKPa = pressure_raw.toFloat();
      digitalWrite(LED,LOW);
```

Figure 21: Main program for the receiver

The loraRead function checks if the LoRa is available for the program to read the incoming string message constantly. The message is then converted to a floating-point type using the toFloat built-in function. From this, the Arduino IoT accesses the incoming string and uploads it to the Arduino IoT Cloud dashboard for visualization.

7 STRUCTURAL SAFETY ANALYSIS

The telemetry housing undergoes different forces, to which the frame is exposed. For this, the design was analyzed on Catia simulation, where the load of the pilots was applied to the cover and the base separately.

A force of 3000 N was applied to the base and cover, which combines the approximate weight of the pilots. Tests for displacement and von-Mises were performed. A value known as the von-Mises stress is used to predict whether a certain material will yield or fracture. The results are shown below.

Displacement and von-Mises test for housing base:

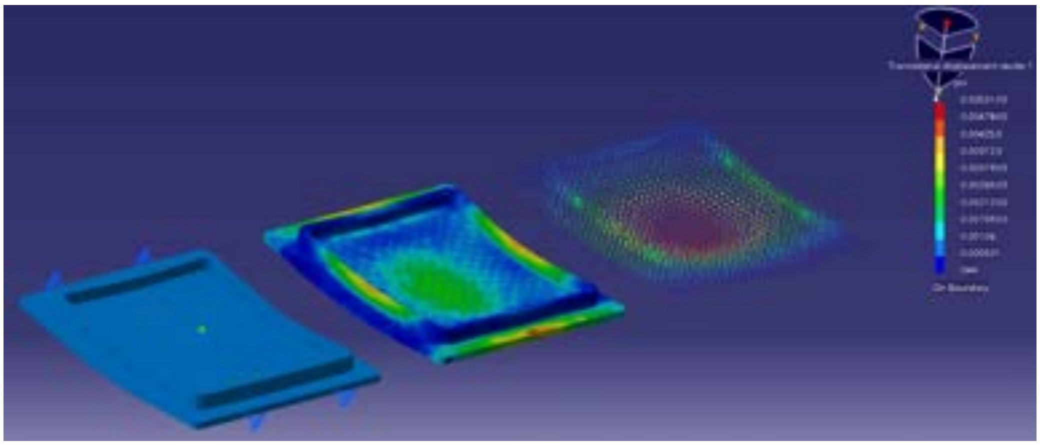

Figure 22: Displacement test for housing base

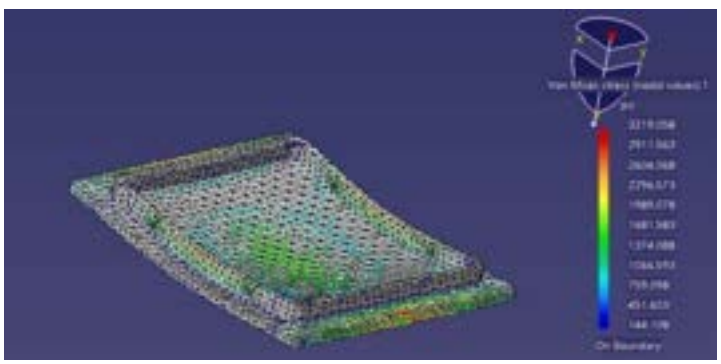

Figure 23: von-Mises test for housing base

It can be observed in Fig. 22 that the base will slightly bend under that force, but the greatest displacement is 0.0053103 in, which is significantly small and does not present a structural problem. In other words, the structure will remain intact under that load.

A comparable situation can be detected in Fig. 23, where the von-Mises stress reached approximately 3219 psi.

Displacement and von-Mises test for housing cover:

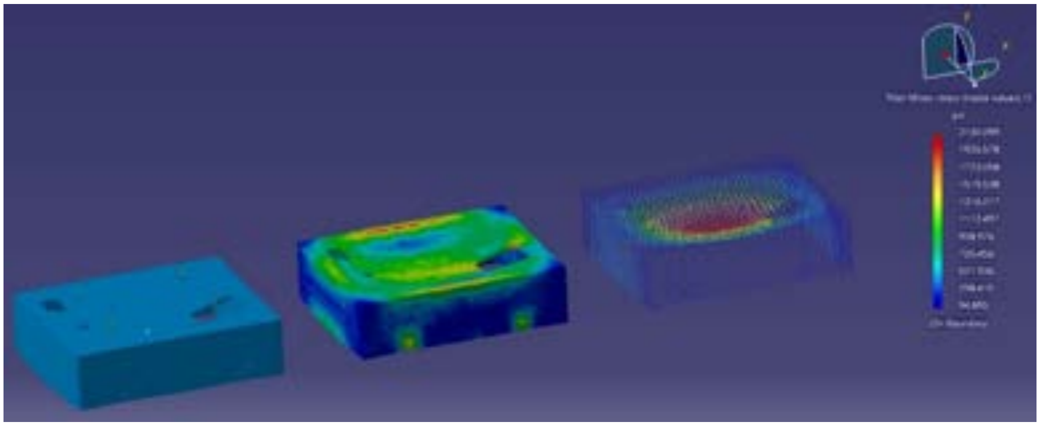

Figure 24: von-Mises test for housing cover

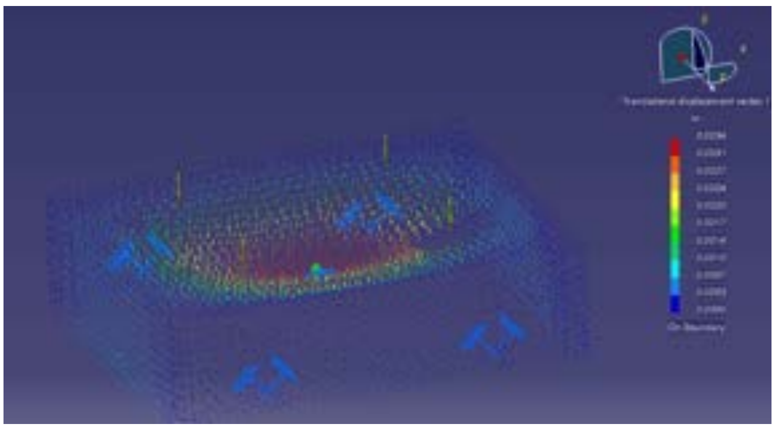

Figure 25: Displacement test for housing cover

Similar to the base, as seen in Fig. 24, the cover will somewhat flex in response to that force, but the largest displacement is only 0.0034 in, which is fairly negligible and poses no structural issues. The load will not do any damage to the structure. In Fig. 25, the von-Mises stress was about 2130 psi.

Factor of Safety of the Structure:

The factor of safety, which is the ability of a system's structural capability to remain stable beyond its anticipated or actual loads, was calculated using the following equation:

$$Factor\ of\ Safety = \frac{Material\ Ultimate\ Stress}{Allowable\ or\ Applied\ Stress} = \frac{21{,}000\ psi}{3{,}219\ psi} = 6.5 \qquad (1)$$

The allowable stress of 6061-T6 aluminum is 21,000 psi [10]. Using this value, the factor of safety result is 6.5.

Displacement test for the frame of the rover:

A stress analysis was also performed on the frame of the Rover, considering a load of 150 lb. per driver, a total of 300 lb. For the result of Von Mises stress in psi, the maximum value reaches 129. This corresponds to the 3rd frame on the figure. The first two frames show the translational displacement, which is minimal (0.00544) and can be seen in detail in Fig. 26.

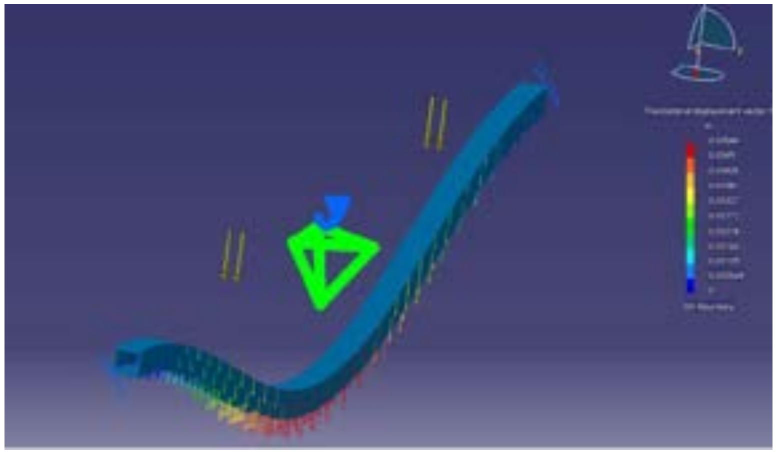

Figure 26: Load simulation – translational displacement

<u>Shear moment for the frame of the rover:</u>

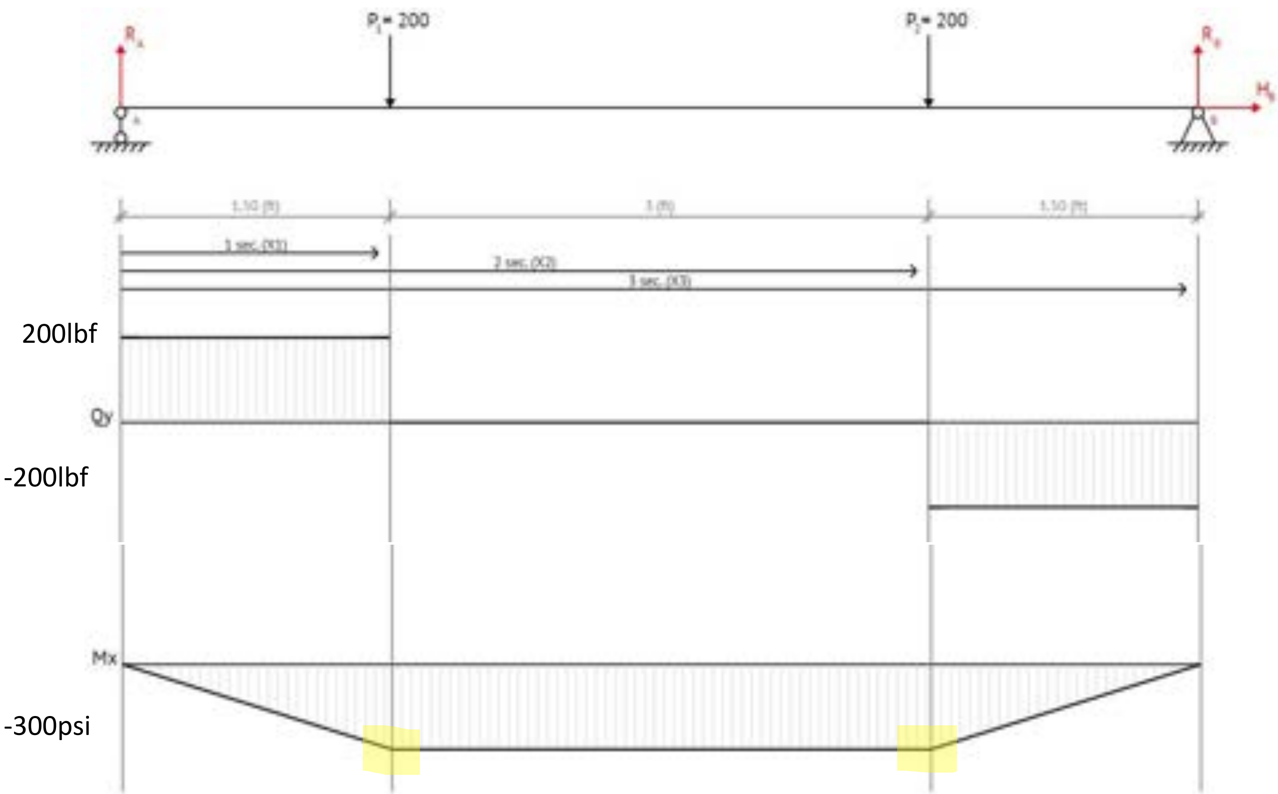

Figure 27: Shear-moment diagram of the hollow frame

The maximum bending moment the frame is exposed to is 300lbf from a foot and a half from the right and left ends of the frame, replicating the placement of the drivers and their seat mountings. This frame is composed of aluminum with a hollow square of 0.25-inch wall thickness and 2.25-inch height and length.

<u>Bending moment for the frame of the rover:</u>

To find the bending moment, completed to determine the strength and stability of the frame, the following equation was used:

$$\mathrm{Sb} = \frac{\mathrm{Mc}}{I} \qquad (2)$$

Where:

Sb is the bending stress in pounds per square inch
M is the maximum bending moment in pound-inches
I is the moment of inertia of the rail in (inches)4
c is the distance in inches from the base of rail to its neutral axis.

Using the following equation, the moment of inertia was calculated for the hollow rectangular shape of the frame.

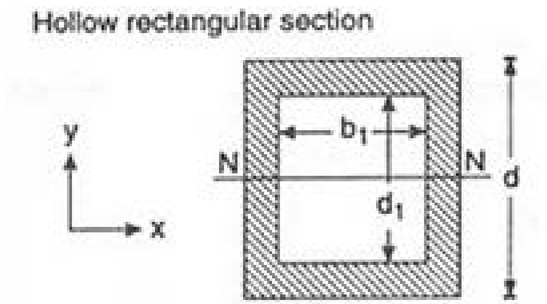

Figure 28: hollow rectangular section

$$I = \frac{bd^3}{12} - \frac{b_1 {d_1}^3}{12}$$

$$I = \frac{2.5*2.5^3}{12} - \frac{2*2^3}{12} = 1.92188$$

After obtaining this value, 300 lbs. were applied as the load, and the dimensions of the frame were considered:

$$Sb = \frac{Mc}{I} = \frac{300lb * 1.25in}{1.9219\ in^2} * \frac{12in}{1ft} = 2341.4\ \frac{lbf}{in^2}$$

$$Sb = 2341.4\, psi\ or\ 2.341\ ksi$$

With this information, the factor of safety for the frame was obtained:

$$Factor\ of\ Safety = \frac{Material\ Ultimate\ Stress}{Allowable\ or\ Applied\ Stress} = \frac{21{,}000\, psi}{2341.4\, psi} = 9$$

The allowable stress of 6061-T6 aluminum is 21,000 psi [10]. Using this value, the factor of safety result is 9, which is acceptable.

All these calculations helped to ensure the integrity of the structure of the rover and telemetry system.

8 SOCIETAL IMPACTS

8.1 SOCIAL

Through the team's close involvement with the HERC competition with the telemetry system, the project's goal is presented in three parts. First, to provide a solid platform for Vaughn College to reach future generations of engineers by representing its college community in an international challenge; second, to produce an environment for the new Rover Team members to expand their knowledge by exposing students to real engineering problems and applications through the implementation of a telemetry system and to complete the challenge based on its requirements and constraints; and, lastly, to promote science, technology, engineering, and math (STEM) to over 200 middle and high school students through outreach events, required for the STEM engagement portion of the competition, to encourage young students to take part in engineering challenges. Furthermore, implementing the proposed telemetry system gives the students a clear example of data analysis and communication systems implemented in the aerospace industry, which are essential to track the status of missions in space.

8.2 ECONOMIC

Although aerospace telemetry dates from the late 1930s, the development of the balloon-borne radiosonde sent measured meteorological data to an Earth station by radio that are currently exemplified in observatory satellites that have performed as many as 50 different experiments and observations over the last decades. Development of these telemetry systems is commonly led by large aerospace companies, and due to non-disclosure agreements (NDAs) for security purposes, little technical information is found online to recreate a simplified and inexpensive version of this system, with an approximate total cost of 207 USD. Compared to the market, the team's telemetry system is a personalized and brand-new design targeted to aid in the data collection of a unique rover at the yearly HERC competition.

8.3 ENVIRONMENTAL

The team aims to build a reusable and improvable telemetry system composed of assembled parts that are easy to change, replace, and repair. This extends the system's operational life and allows it to be reutilized and repurposed for future participation in the challenge.

8.4 GLOBAL IMPACTS

This is a big competition for Latin American teams, as their participation has greatly increased since HERC's first race in the mid-90s. Through the telemetry system project and subsequent participation, the team expects to expand its community outreach to Latin American schools and institutions to provide training and workshops that offer sufficient foundations to start new Latin American teams for future participation in competitions. Alongside the team's findings and system implementations, all the information relating to the telemetry system can be found online as a base for other teams or students to replicate the system for various purposes.

9 PROJECT TIMELINE

The goal was to complete the design and testing in time and to prove the concept of the team's degree project. For this reason, a Gantt chart was created in Fig. 29, where all the stages of the project were listed, assigned to a team member, and set to a deadline.

TASK	PROGRESS	START	END	DAYS	MARGIN
Project Proposals and Reports		5/15/22	1/6/23	236	23.6
HERC Proposal		5/15/22	9/8/22	116	11.6
MCE409 Proposal Presentation		6/1/22	9/19/22	110	11
MCE409 Proposal Report		6/1/22	9/26/22	117	11.7
Bi-weekly Memo #1		9/26/22	10/10/22	14	1.4
Progress Report #1		9/26/22	10/24/22	28	2.8
Bi-weekly Memo #2		10/10/22	10/31/22	21	2.1
Bi-weekly Memo #3		10/31/22	11/14/22	14	1.4
Progress Report #2		11/15/22	12/3/22	18	1.8
MCE409 Final Report Presentation		11/20/22	1/6/23	47	4.7
MCE409 Final Report		11/25/22	1/4/23	40	4
Telemetry Design		2/7/22	12/16/22	312	31.2
Research wirless communication		2/7/22	5/13/22	95	9.5
Research sensors for environment, rover, and driver status		2/14/22	5/13/22	88	8.8
Preliminary project proposal		4/4/22	5/13/22	39	3.9
Introduction to COSMOS and troubleshooting		4/11/22	6/24/22	74	7.4
Introduction to circuit design - a prerequisite to starting the electrical design		6/13/22	7/15/22	32	3.2
Virtual circuit design		7/25/22	8/26/22	32	3.2
Introduction to Arduino IoT Cloud		8/15/22	9/9/22	25	2.5
Electrical design: adding the heartbeat sensor, GPS, temperature, and humidity sensor		8/22/22	9/9/22	18	1.8
Testing the reading of the sensors		9/12/22	9/16/22	4	0.4
Troubleshooting the heartbeat sensor		9/19/22	10/14/22	25	2.5
Testing the new GPS sensor (validate location)		10/3/22	10/21/22	18	1.8
Electrical design: adding the camera as back-up system for driver status		10/7/22	10/28/22	21	2.1
Troubleshoot IoT connection issues to ensure proper system functioning		10/10/22	10/21/22	11	1.1
Electrical design: system testing (validating specification of each sensor are not exceeded)		10/31/22	11/11/22	11	1.1
Final range testing of the system		11/14/22	11/25/22	11	1.1
SolidWorks housing design		11/21/22	12/2/22	11	1.1
Housing testing to ensure structure rigidity		12/5/22	12/12/22	7	0.7
System validation for rover implementation		12/5/22	12/16/22	11	1.1

Figure 29: Time schedule for the development of the telemetry system

10 CONCLUSION

The telemetry system proved feasible to collect data for a mechanical rover for the NASA Rover Challenge, simulating a real mission in space and introducing college students to a new competition field. The designing and testing phases of the telemetry system allowed the team to demonstrate and prove the project's practicality for real-world applications. Further, this process allowed the team to find future features that could be added to the project.

Among the future system improvements, the team intends to implement printed circuit boards (PCB) to make the system's structure lighter and easier to transport, and to utilize Artificial Intelligence (AI) to make decisions, based on the collected data, useful for competition strategies to maximize the team's course completion time.

11 ACKNOWLEDGEMENTS

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EzKart: Electric Powered Shopping Carts

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ABSTRACT

Fully loaded shopping carts are often difficult to navigate through the aisle. Pushing a cart with a heavy load requires more force to push than an empty cart. This project aims to create a motorized pusher device that aids customers in navigating heavy shopping carts. It will be battery-powered and consumer-friendly, reducing the force required to push and stop the cart. The device will be controlled using a remote and our device secured to the bottom of any shopping cart. The design process will involve creating CAD renderings to determine the appropriate size, as well as tensile analysis to ensure the materials used can withstand the mass. The team will then test the machine's capabilities and make adjustments to create a reliable prototype that meets engineering requirements and constraints. The device will ultimately benefit customers by reducing energy use and avoiding collisions with other carts or customers.

1. INTRODUCTION

Since the dawn of the digital age, there has been a sharp increase in the popularity of eCommerce shopping and retail, through which customers expect the instant gratification of purchasing and having articles arrive at their doorstep, with as little effort as possible. This has resulted in a decrease in sales in physical brick and mortar store locations, such as grocery stores and shopping centers where consumers had to lug around a heavy shopping cart, moving from aisle to aisle in search of their goods. The original shopping cart design, patented by Sylvan Goldman in 1940, featured two baskets mounted on a foldable frame, as shown in *Figure 1*. At the time, grocery stores were smaller and had limited storage space for carts. All in one stores, more commonly dubbed "one-stop shops", carrying a variety of goods which consumers could pick-up in one trip, were uncommon during that time. Since the original design, there hasn't been much of evolution in the shopping cart to meet our demanding fast-paced society today.[1]

Figure 1 shows the original shopping cart design.

2. OBJECTIVE

Given the current state of shopping carts and market needs, we focused on two main goals to improve the shopping cart. Fully loaded shopping carts are often difficult to navigate through the aisle. Pushing a cart with a heavy load requires more force to push than an empty cart. Creating a device to assist with reducing the amount of force required to push a cart and to aid with power steering would be beneficial to society. This is achieved by, firstly, manufacturing a device that can assist customers in moving heavy shopping carts. Secondly, it should have a comfortable, intuitive, user-friendly design. Most importantly, the device can be easily implemented to existing carts and will not interfere with current shopping cart storing methods.

3. BACKGROUND

Many stores now have a small selection of motorized shopping carts, which are equipped with an electric motor and batteries, allowing it to move through user input. Motorized shopping carts typically have a control panel for the user to control the speed and direction of the cart. Some models also feature additional features such as a built-in seat, small shopping basket, and charging ports for electronic devices, such as the cart shown in *Figure 2*. This type of cart is often used by elderly and physically challenged customers who have difficulty pushing a regular shopping cart. Amazon recently developed a new generation of shopping cart called the AF Dash cart, pictured in *Figure 4*. This cart is designed to be used exclusively at Amazon Fresh grocery stores [2]. The cart is equipped with a number of advanced technologies, including computer vision and sensors that can recognize and track items as they are placed in the cart. The Dash cart is designed for small scale shopping and not for heavy loads. Although it has the latest technology for convenient shopping, it is not designed to carry heavy items that you would find in a wholesale store.

Figure 2 shows the Dash Shopping Cart.

4. ENGINEERING REQUIREMENTS & CONSTRAINTS

The EZ-Kart device should have several key features and functions. First, it should be easy to install onto the bottom of existing shopping carts. It should also have a retractable wheel with a torsional spring mounted to the base of the cart, which would improve stability and maneuverability. Additionally, the device should be easy to access, maintain, and service. The device should also be user-friendly, with an easy-to-use joystick for seamless shopping cart maneuverability. Finally, the device should be powered by a rechargeable battery, allowing for convenient and eco-friendly use. There are certain other constraints that need to be factored in to the design. The cost of each unit should be less than $1000. Secondly, the device should be able to pull at least 100 lbs. on a flat surface to ensure that it can handle the weight of groceries without any issues. Lastly, the battery should be able to charge from 0% to 100% within 8 hours, in order to provide a quick and efficient charging process. Meeting these minimum specifications will ensure that our EZ-Kart device is reliable and efficient for customers to use in grocery stores.

5. PROJECT DESIGN PROCESS

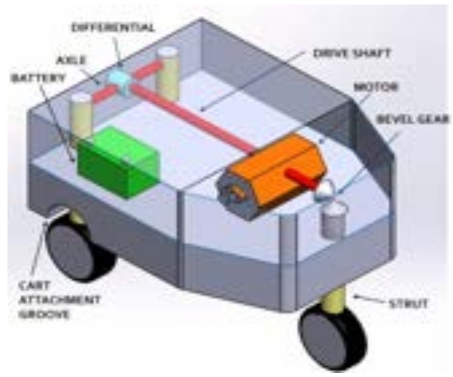


Figure 3 shows an initial conceptual design of the Ez-Kart.

Customers often struggle to navigate heavy shopping carts through the aisles in a supermarket. A preliminary design involved a three-wheel system utilizing a high torque motor to spin the drive shaft, which connects to the gears inside the differential. The device would be battery-operated, remote controlled, and rechargeable, whether the battery is removed or attached to the device. A critical disadvantage with this design is the distance it will stick out in front of the cart, which poses the risk of possibly hitting objects. Also, not all shopping carts are designed the same, and the front bar where this design attaches might not be functional.

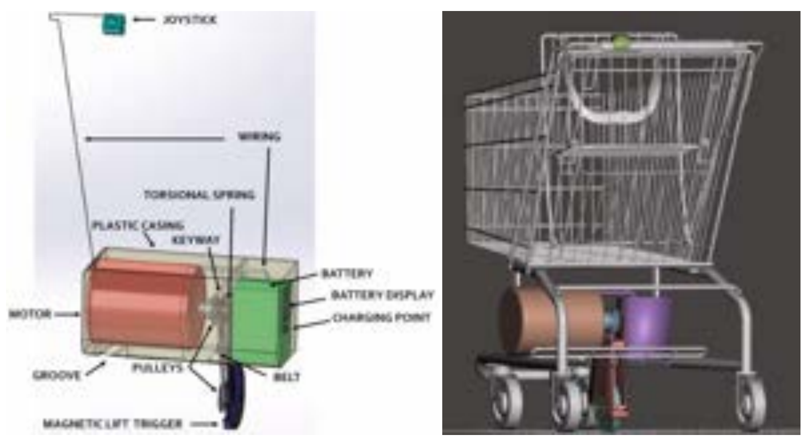


Figure 4 shows the detailed renderings of the Ez-Kart design with all components shown.

The final design of the Ez-Kart, as shown in *Figure 4*, includes a general purpose motor connected to a pulley and belt system that drives an additional caster wheel. The motor is located in the bottom compartment of the shopping cart and is operated by a remote control. The addition of a fifth wheel, along with the pulley and belt system and torsional spring, improves stability and weight distribution. The torsional spring connects the base to the additional caster wheel and allows for easy movement of multiple carts. The magnet on the cart snaps onto the incoming cart's front bar. The design meets all the project requirements and is mounted on existing shopping carts using secure straps for easy installation.

6. ENGINEERING STANDARDS

The following industry standards have been taken into account while designing the EZ-Kart device. The first standard utilized was the *ASME – Y.14-2018 – Dimensioning, and Tolerances*, which was used on mechanical drawings to efficiently, and accurately communicate geometry requirements for features on parts and assemblies. ASME-B30.27 outlines the construction, installation, operation, inspection, testing, and maintenance of material placement systems. ASME-PASE defines the safety standard for portable automotive service equipment, covering design, construction, marking, operation, maintenance, and owner or operation inspection. ASME-Y14.47 is for organizing a three-dimensional model and other associated information within the context of a digital model definition data set, for the purpose of conveying a product. ISO 97.130.30 is for trolleys for supermarket purposes, including baskets. ASTM F3176-20 outlines the standard specification for special-needs shopping carts, which should be followed when designing and/or modifying pre-existing products such as shopping carts [5]. ASTM A689-97(2018) outlines the standard specification for carbon and alloy steel bars for springs, which is applied to the wheel to allow existing shopping carts to be stored without any complications [6]. ISO 1081:2013 is the standard specification relating to V-belt drives, allowing for the motor to connect directly to the wheel related to the specifications of the product [7]. ASTM D378-10 defines the standard test methods for rubber (elastomeric) conveyor belting, flat type [8]. Finally, OSHA 1910.219(d) outlines the standards related to pulley applications, which is applied to the motor to allow the function of the V-belt to the wheel [9].

7. PROJECT MANAGEMENT

Table 1 shows the team members in the Ez-Kart Project and their primary focus areas.

Team Member	Responsibilities
Matthew Fadul	Prototype, Manufacturing, CAD Modeling
Pranav Bhat	Analysis, Theoretical & Numerical Analysis
Joshua Persaud	Testing & Feasibility Studies, Report, Presentation

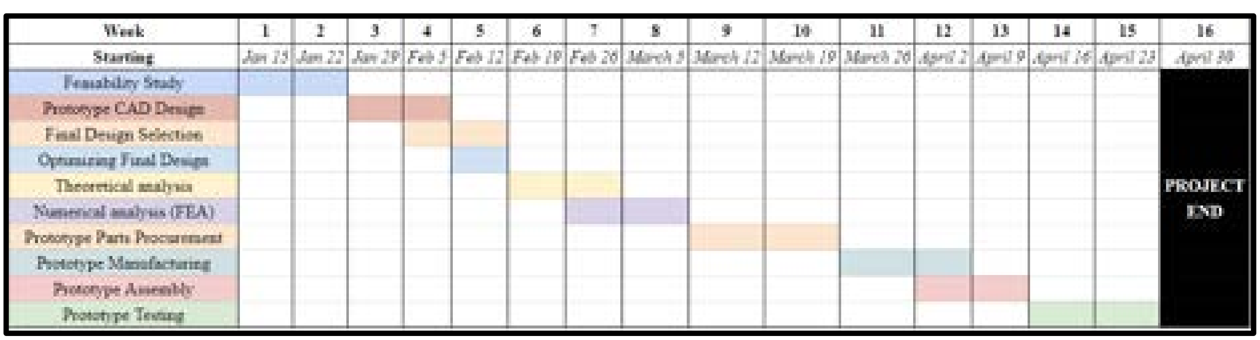


Figure 5 shows the Gantt chart for the Ez-Kart Project.

8. ENGINEERING ANALYSIS & SAFETY:
8.1 Factor of Safety

Factor of safety in engineering represents the ratio between the actual load a structure is expected to bear during use and the maximum load it can withstand before failure. For the Ez-Kart design, this was taken to be *1.452* as per *Eq1*.

$$FS = (FS_{material})\ x\ (FS_{stress})\ x\ (FS_{failuretheory})\ x\ (FS_{geometry})\ x\ (FS_{reliability}) \quad (1)$$

$$FS = (1.1)\ x\ (1.2)\ x\ (1.0)\ x\ (1.0)\ x\ (1.1) = \underline{1.452}$$

The below loads in *Table 2* were taken into consideration, and were multiplied by the factor of safety as per *Eq2* to get the Total Load the wheel will experience, computed to be approximately 289 lbs.

Table 2 shows all parts and their associated weight breakdown acting on the system

Item	Supplier	Catalog No#	Quantity	Total Price	Weight
Battery	XZNY	B09QKD4G6L	1	$59.39	5 lbs
Battery Charger	Haisito	B08K7GBDMT	1	$34.99	1.8 lbs
HD V-Belt Pulley	McMaster	6204K133 (2 Pack)	1	$32.32	2 lbs
4L V-Belt	McMaster	6191K96	1	$9.37	0.1 lbs
Joystick	Digi-key	COM-09032	1	$4.50	0.1 lbs
Torsional Spring	Digi-key	TO-5073 RSCS	1	$7.71	1.5 lbs
Motor	Grainger	19YW23	1	$352.52	25 lbs
18 Gauge Wiring	Tyumen	B07DDG7J9K	1	$16.99	1 lbs
Magnet 5lb	Grainger	B078YQ5TLH	1	$7.51	7 lbs
Keyway	McMaster	98500A360	1	$4.51	0.1 lbs
Casing	Custom 3D Print		1	N/A	1 lbs
Lift Trigger			1		0.5 lbs
Misc. Shopping Load	N/A				100 lbs
#200 Shopping Cart					52 lbs
			TOTAL	$525.30	197.1 lbs

$$L_{total} = (FS)\ x\ (\textstyle\sum additional\ load) = (1.452)\ x\ (197.1\ lbs) = \underline{286.2\ lbs} \quad (2)$$

FS = factor of safety from Eq1. (no units)
$\sum$additional load = summation of loads such as the weight of the cart, battery, motor, etc. (lbs)

8.2 Friction Force

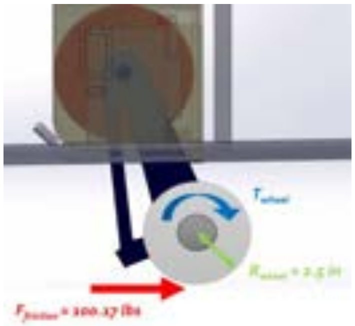
Friction Force is the force that opposes the relative motion between two surfaces in contact. A shopping mall environment was simulated for the friction coefficient between dry concrete and polyurethane castor wheel resistance experiment *[3]* and solved using *Eq3*.

$$F_{friction} = (N)\ x\ (\mu) = (286.2\ lbs)\ x\ (0.35) = \underline{100.17\ lbs} \quad (3)$$

N = Normal Force (lbs)
μ = friction coefficient. (no units)

8.3 Wheel Torque

Torque is the measure of the turning force, as seen in *Figure 6*, which takes into account the radius of the EZ-Kart's fifth wheel and the friction force, as solved in *Eq4*.



$$T_{wheel} = (F_{friction}) \times (R_{wheel}) \quad (4)$$

$$T_{wheel} = (100.17) \times (2.5)$$

$$\underline{T_{wheel} = 250.42 \text{ in-lbs}}$$

$F_{friction}$ = *friction force from Eq3. (lbs)*
R_{wheel} = *radius of the wheel. (in)*

Figure 6 shows the FBD of the fifth wheel.

8.4 Angular Velocity

Calculating the angular velocity, *Eq5*, between the motor and the wheel will help determine the speed ratio and the efficiency of the system. A maximum speed of the car based on average walking speeds and comfortable shopping speeds was established as 44.01 in/sec.

$$\omega = (R_{wheel}) \times (1/V) = (2.5) \times (1/44.01) = \underline{17.6 \text{ 1 per sec}} \quad (5)$$

V = *maximum anticipated velocity of the cart. (in/sec)*
R_{wheel} = *radius of the wheel. (in)*

8.5 Belt Selection

When it comes to power transfer efficiency in devices, there are two options: belt drives and chain sprockets. Belt drives are more flexible and offer long-term longevity, making them the ideal choice for shopping carts with varying loads. Chain sprockets, on the other hand, are more useful in heavy-duty applications where high loads and/or speeds are required. In the case of the EZ-Kart design, belt pulley systems were selected due to the nature of shopping carts and their relatively low speeds and loads. V-belts were specifically chosen for their trapezoidal cross-section and ability to transfer power between pulleys using friction. V-belts have great flexibility, low noise, high power transmission capacity, and reduced risk of slippage, making them an ideal choice for the EZ-Kart design. Keeping cost and power transmission efficiency in consideration, the XPZ V-Belt was chosen as the ideal belt for our design, shown in *Figure 7*. Converting the units of calculated torque yields approximately 41 NM, with an efficiency value found to be 97.5%.

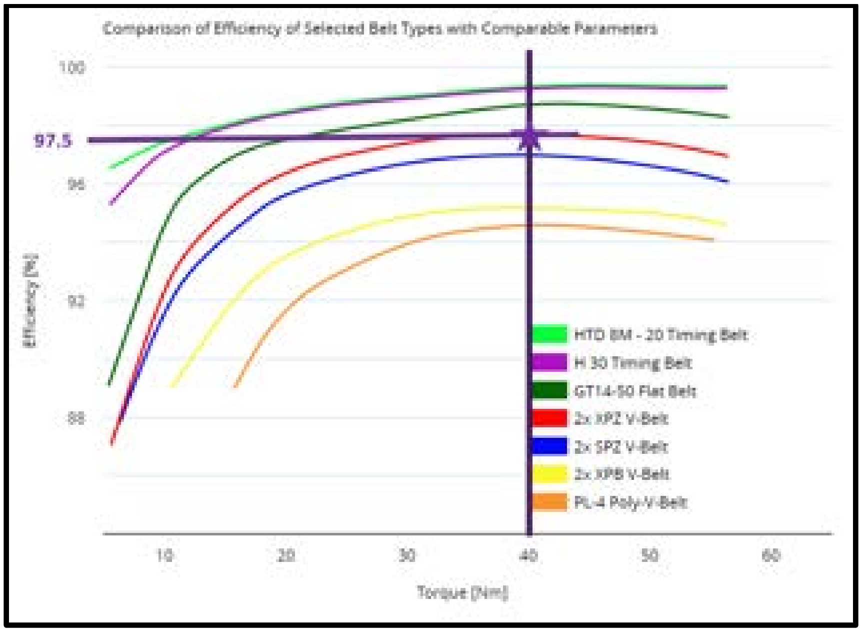


Figure 7 shows efficiency experiments of different types of V-belts [2].

8.6 Power Output

The power output in *Eq6* is the rate at which work is done per unit time, which takes into account the torque *Eq4*, angular velocity *Eq5*, and efficiency of the system, *figure 4*.

$P_{output} = (T_{wheel}) \times (\omega) \times (1/\eta) = (250.42) \times (17.6) \times (1/0.975) = 4520$ *in-lb/sec* = $\underline{0.678\ HP}$ (6)

T_{wheel} = *Wheel Torque from Eq4 (in-lbs)*
ω = *Angular Velocity from Eq5 (1/sec)*
η = *efficiency (%)*

8.7 Belt Tension

Belt tension refers to the degree of tightness of a belt in a system, as shown in *Figure 8*. Calculating the belt tension is essential to verify that the selected belt is capable of transferring the power of the motor. Maximum tension force in the belt must be greater than the tensile range of the belt. Calculating the belt tension using *Eq7* and *Eq8* required for the mechanical system involves first finding the ratio of the belt. Evidence from a power transmission experiment conducted by Masterdrive found the ration of the 4L V-belt to equal 2.5, given the dimension of the pulley.

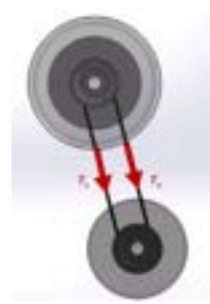


Figure 8 shows belt tension.

Belt Tension Ratio $= \frac{\square 1}{\square 2} = \underline{2.5}$ (7)

$T_1 - T_2 = T / R_{wheel} = (250.42) / (2.5) = \underline{100.17\ lbs}$ (8)

T_{wheel} = *Wheel Torque (in-lbs)*
R_{wheel} = *radius of the wheel. (in)*

Using systems of equations by rearranging and solving Eq11 and Eq12, the maximum tension in the belt was found to be 166.67 lbs.

$\underline{T_1 = 166.67\ lbs}$ $\underline{T_2 = 66.67\ lbs}$

To calculate the maximum force rated by a preselected belt, the ASTM elongation & tensile range for EPDM rubber of 1100 psi as well as the cross sectional area of the belt were taken into account to solve *Eq9*.

$$F_{max} = (\sigma)\ x\ (A) = (1100\ psi)\ x\ (0.5\ x\ 0.313) = \underline{172.15\ lbs} \qquad (9)$$

σ = *EPDM of rubber (lbs-in^2)*
A = cross section area of belt (in^2)
Maximum tension force in the belt must be greater than the tensile range of the belt.

$F < F_{max}$
166.67 lbs < 172.15 lbs (True)

F = force calculated with respect to belt tension ratio
F_{max} = *force calculated with respect to material tensile range*

8.8 Motor Selection

When it comes to selecting a motor for various applications, a couple of important parameters are considered, including the motor's torque capabilities, voltage, dimensions, certifications, and many more. The shaft is the main component that transmits the power to the equipment and requires computation, as per *Eq10*. The outer radius of the shaft was used rather than the inner radius, as shown in *Figure 9*, to theorize and create the safest design and highest safety margin in our maximum shear stress calculation. The ASME design code for shaft design of steel is 5800 psi, making this motor a good fit for the EzKart.

Figure 9 shows visualization of motor torque calculation

$$\tau_{max\ in\ shaft} = (2/\pi)\ x\ (T_{motor})\ x\ (1/R_{shaft}^3) = (2/\pi)\ x\ (250.42)\ x\ (1/0.3125^3) = \underline{5223.79\ psi} \qquad (10)$$

T_{motor} = *Motor Torque*
R_{shaft} = *Shaft Radius (Outer)*
$\tau_{max\ in\ shaft} \leq$ *ASME Design Code*
5223.79 psi $\leq$ 5800 psi

8.9 Key Selection

The purpose of the key in a system is to ensure that the motor shaft and drive train components rotate without slipping. The force on the key can be calculated using *Eq11*, the motor's torque and the shaft's radius, seen in *Figure 10*.

$F = T_{motor} / R_{shaft}$

$F = 250.42/0.3125 = \underline{801.34\ lbs}$ (11)

T_{motor} = *Motor Torque*

R_{shaft} = *Shaft Radius (Outer)*

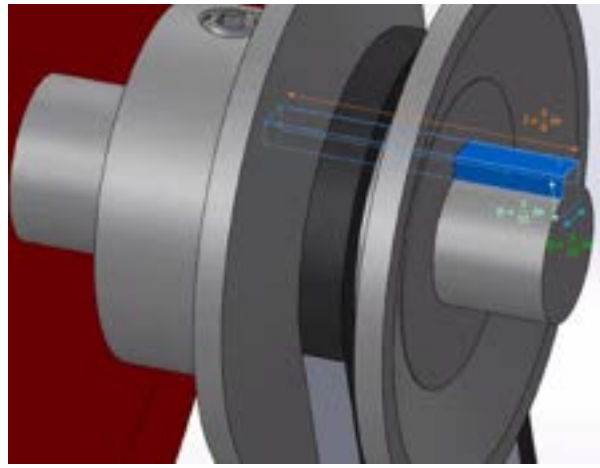


Figure 10 shows visualization of keyway selection calculation

The maximum shear stress needs to be calculated using *Eq12* to determine the key safety limits.

$$\tau_{max} = F / (b \times l) = (801.34) / (3/16 * 5/8) = \underline{6838.10\ psi} \quad (12)$$

Bearing stress is the force transmitted from the motor through the key to the driven component. The bearing stress needs to be within the limits of the same material chosen for the key, as shown below in *Eq13*.

$$\sigma_{bearing} = F / (h \times 0.5 \times l) = (801.34) / (3/32 * 0.5 * 5/8) = \underline{27358.83\ psi} \quad (13)$$

F = *Force (lbs)*

b = *base (in)*

l = *length (in)*

h = *height (in)*

τ_{max} = *Maximum Shear Stress*

$\sigma_{bearing}$ = *Bearing Stress*

So given the calculations, the ideal key needs to meet the following criteria

$\tau_{max} \leq \tau_{yp}$

$6838.10\ psi \leq \tau_{yp}$

$\sigma_{bearing} < S_{yp}$

$27358.83 < S_{yp}$

τ_{yp} = *Maximum Yield Strength for Key Material*

S_{yp} = *Ultimate Yield Strength for Key Material*

Some factors to consider when choosing a material for the key are strength, durability, price, etc. Material tensile experiments shown in *Table 2* found the yield strength of multiple materials. Brass is the ideal material for the key, due to its maximum and ultimate yield strengths meeting the max stress of the system's component. Copper and steel also meet the requirements, but copper is much more expensive, and brass is preferred as it will break first and absorb the energy, preventing damage to the steel shaft. This will save time and money in future repairs/maintenance, as replacing the key is more cost-effective than replacing the entire shaft.

Table 3 shows various materials and their maximum and ultimate yield strengths.

Material	τ_{yp} (psi)	S_{yp} (psi)
Aluminum	5076	13,053
Copper	10,007	29,007
Brass	10,877	43,511
Iron	18,855	37,999
Nickel	20,015	69,618
Steel	26,107	55,114

8.10 Pulley Selection

Similar to belt selection, pulleys must be carefully selected to pair well with chosen belts. A standard pulley is a simple, cylindrical pulley with a flat surface that can accommodate a V-belt [4]. The V-belt was paired with a standard pulley for several different reasons. Standard pulleys are typically less expensive than specialized pulleys, which can help to reduce the overall cost of the power transmission system. They are also easy to install and can be mounted directly onto our motor’s shaft, which is key to our design, as space constraints were a major concern that came up numerous times during the design process.

8.11 Battery Selection

A battery is a device that stores chemical energy and converts it into electrical energy. In order to calculate the size of battery required for different applications, *Eq14* can be used. Note that the Output Power is multiplied by 745.7 to convert from Horsepower to Watts.

$$A = (P_{output}) \times (t) \times (745.7/V) = (0.678) \times (4) \times (745.7/115) = \underline{17.59\ AmpHours} \qquad (14)$$

A = AmpHours
P_{output} = *Power (Horsepower)*
t = Time (Hours)
V = Voltage (Volts)

8.12 Spring Selection

The selection of an appropriate tensioner spring for the motor-assisted wheel of a cart is essential to ensure proper functioning. The spring constant needs to be calculated accurately, as selecting a spring with too little or too much force can cause problems. The average force needed to push an empty cart is approximately 5 lbs., and so a 5 lb. magnet is attached to the lift trigger to ensure that this force is not transmitted to the succeeding cart. The most suitable torsional spring is chosen to rotate the wheel from the ground into the storing area. This spring accommodates and maintains the current storing methods of shopping carts, as seen in *Figure 11*.

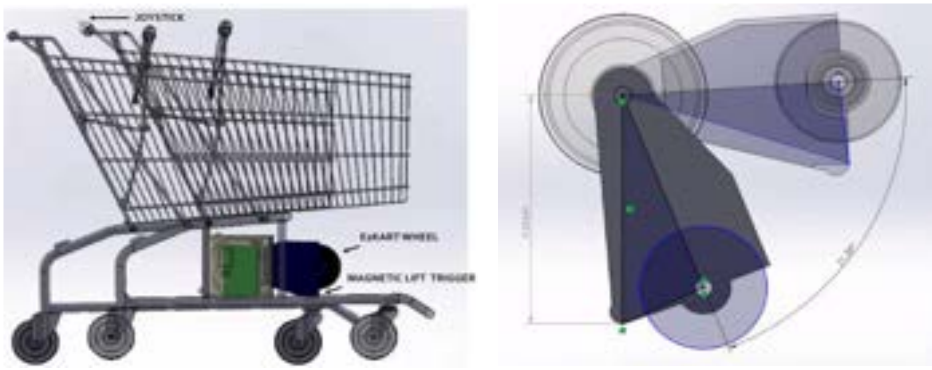


Figure 11 shows the distance and angle of the magnetic lift trigger to the motor.

$$T_{spring} = (F_{cart}) \times (d_{spring}) = (5) \times (9.324) = \underline{46.62 \text{ in-lbs}} \quad (15)$$

F_{cart} = Previous Cart's Projected Force (lbs)
d_{spring} = Distance from Magnetic Lift Trigger to Spring (in)

The spring constant *Eq16* is simply calculating the stiffness of the spring by considering the amount of force required to stretch or compress the spring by a certain distance. Note that degrees are converted to radians using a conversion factor of 0.01745.

$$k_t = (T_{spring}) / (\Theta) \times (0.01745) = (46.62) / (71.59) \times (0.01745) = \underline{37.32 \text{ in-lbs}} \quad (16)$$

T_{spring} = Spring Torque from Eq7 (in-lbs)
Θ = angle (degrees)
k_t = spring constant (in-lbs)

9. MANUFACTURE

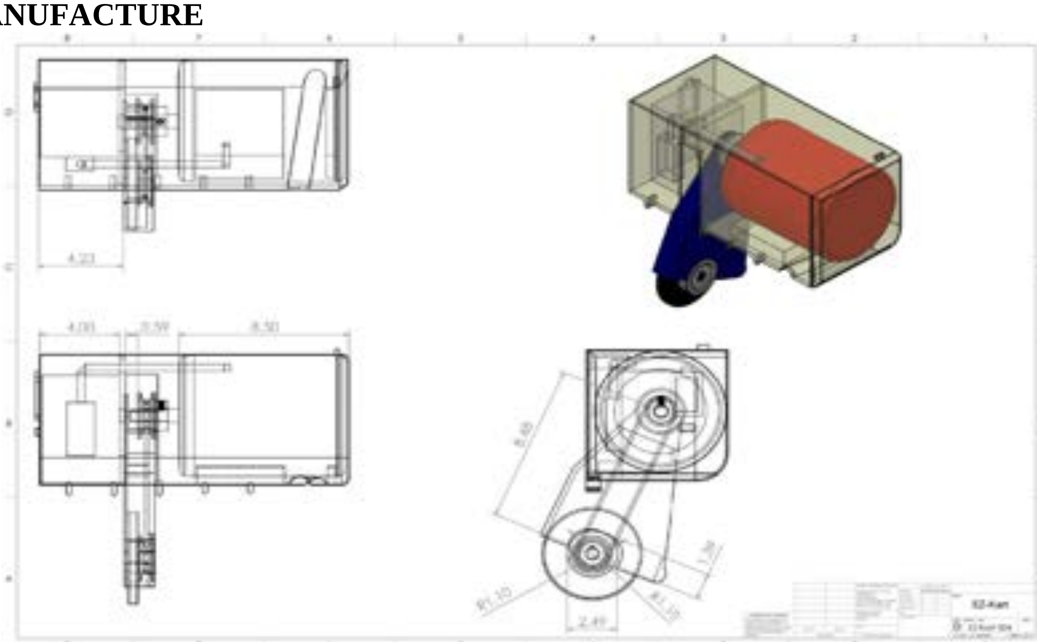


Figure 12 shows engineering drawing of Ez-Kart design.

The Ez-Kart project moved on to creating an operational prototype of the conceptual design per *Figure 12*, with the purpose of validating the idea's feasibility in reality. Structural details and modifications were not a concern, since the prototype would not be produced at a 1:1 scale, due to limited time and resources. The motor was secured to the base of the shopping cart, and a pulley was attached to the 5mm diameter shaft of the DC motor. A 610mm x 6mm belt was used to transmit the power from the motor to the wheel, and a rod was used to attach the wheel to the casing to keep it situated on the floor. A speed regulator module was developed to regulate the power the motor received and to adjust its speed. The prototype utilized an RC car with a wireless remote, but the conceptual design includes a wired controller attached to the cart's handlebar as seen in *Figure 13*.

Figure 13 shows the joystick (left), speed regulator module (center), and motor (right).

A limitation of the design was manipulating the functionality of a torsional spring. The open and close motion of the hinge duplicates the rotation of the mechanism from the wheel in contact with the floor, versus the position when it is being stored, as shown in *Figure 14*. A metal wire was coiled to represent the visualization of the spring covering within the casing.

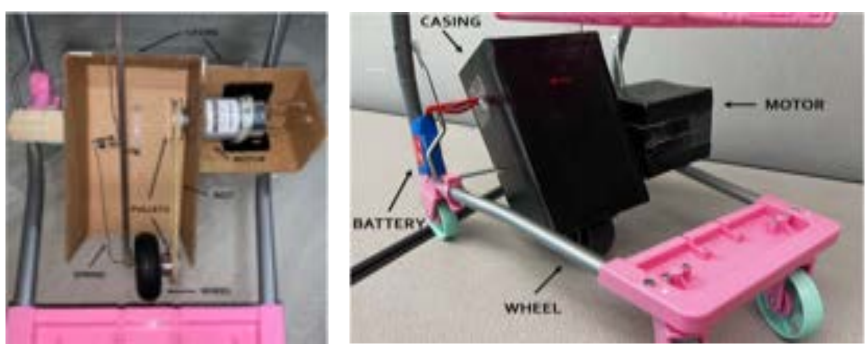


Figure 14 shows the EzKart Prototype components.

After all the components were assembled, the next step was comparing physical appearance to our CAD design, *Figure 15*, as well as testing. The shopping cart was first operated manually to make sure the fifth wheel was freely spinning on the ground and not being obstructed by the orientation. Power was then applied to the wheel, using the remote, and the cart successfully moved from point A to B, as shown in testing clips. Weight was then added to the basket, to test and confirm one of the requirements that the cart would aid customers with heavy loads. A bag with miscellaneous items, including 3 iPhones, a box cutter, a roll of paper tape and a screwdriver, items weighing approximately 4 lbs. were added. Without knowing the power output of the mini motor, in second testing with the weight added, the cart still moved from point A to B successfully.

Figure 15 shows the carts stacked on prototype (top left), carts stacked on Solidworks (top right), and individual components of Solidworks rendering (bottom)

10. IMPACT OF PROJECT

The Ez-Kart device has significant social, health and safety, economic, and environmental impacts. Socially, it makes shopping easier and more comfortable, especially for individuals shopping for a large number of items. It can also help to promote economic growth by increasing customer satisfaction and loyalty. In terms of health and safety, this device can prevent physical strain for the elderly, the disabled, or those recovering from injuries, enabling them to shop for groceries while also providing cart stability to avoid collisions. Additionally, the device is environmentally friendly as it is emissions-free, produces minimal noise pollution, and reduces the carbon footprint of the store. These combined impacts make shopping more enjoyable, convenient, and sustainable for customers and businesses.

11. DISCUSSION/CONCLUSION

The Ez-Kart is a promising solution to improve the shopping experience for consumers, by reducing the effort required to push a fully loaded cart, making shopping more convenient and enjoyable. It is a lightweight, compact, and user-friendly device that can be easily attached to any shopping cart, providing a universal solution that can greatly benefit both retailers and consumers. The final design units are affordable at $525.30 and can pull at least 100 pounds without any issues, ensuring the device can handle most shopping loads. It is an accessible solution that provides a more inclusive shopping experience for all, regardless of one’s physical abilities. With continued development, the Ez-Kart can become a widely adopted solution to revolutionize the shopping experience for everyone.

12. FUTURE WORK

The implementation of electric shopping carts has the potential to revolutionize the way people move around and transport goods. The carts can be used to eliminate physical strain associated with pushing a cart, making shopping, traveling, and transportation easier and safer. The electric cart can be used in airports, hotels, hospitals, and industrial and warehouse facilities, reducing the need for manual labor and improving efficiency. There are potential enhancements that can be made to the Ez-Kart project to improve its functionality and practicality, such as spring loading the bottom section to accommodate different cart sizes, implementing wireless charging technology, reducing the size of the equipment, and restructuring the design to make it more visually appealing and cost-effective. These modifications will make the Ez-Kart more practical, functional, and appealing to customers, allowing for its successful integration into the real-world setting.

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Integrated Manufacturing System

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ABSTRACT

The IMS project aims to provide education on automation technology for college students, given the significance of automation in production and industry. The project's goal is to enable students to understand the entire production pipeline process by comprehending the Siemens Sematic S7-300, S7-1200 PLC, Lucas Nülle’s stations, and the languages necessary. Additionally, the project aims to familiarize students with Mechanical, Electrical, Manufacturing, and Automation to assist them in the industry field.

INTRODUCTION

The IMS project is a prime example of the crucial role industrial automation plays in enhancing productivity, lowering costs, and improving product quality in the manufacturing industry. With the advent of Industry 4.0, automation and other advanced technologies have become integral parts of the manufacturing process, making it essential to develop the necessary skills and knowledge to design, implement, and maintain automation systems. The IMS project has addressed the shortcomings of the previous system by providing power distribution calculation, comprehensive testing/troubleshooting information, stress analysis, and higher efficiency. The use of TIA Portal software and Factory IO for 3D simulation has resulted in a more intuitive and effective system that enables students to better understand the manufacturing process and industry-related problems. With its emphasis on practical learning and cutting-edge technology, the IMS project is paving the way for a more productive, efficient, and innovative future for the manufacturing industry.

BACKGROUND STUDY

The manufacturing automation industry has become increasingly important in recent years, as technological advancements have allowed for improved efficiency, reduced waste, and increased safety in the manufacturing process [1]. The current system has improved upon the previous Lucas Nülle IMS, which lacked a program, power distribution calculations, and testing/troubleshooting information, resulting in slower productivity and limited student learning. In contrast, the current system has incorporated a program, power distribution calculations, a system manual containing testing/troubleshooting information, stress analysis, and higher efficiency. As a result, students now have access to extra information that empowers them to understand automation more accurately and precisely.

1 MODES OF THE AUTOMATED PIPELINE SYSTEM

The current system has two modes. Mode one demonstrates one product with one carrier per round, taking four minutes and thirty seconds to do four products in four rounds. Mode two demonstrates four products with four carriers in one round, taking two minutes and thirty seconds with only one station difference. Based on Lucas Nülle's documents, the previous system took six minutes and thirty seconds for mode one and three minutes and thirty seconds for mode two. It demonstrates two blocks concurrently in two rounds, with three non-functional stations between carriers.

2 SYSTEM EFFICIENCY

Efficiency is a critical concept for engineering students to understand as it helps them design and develop systems and processes that make the best use of available resources, reduce costs, promote sustainability, and drive innovation [2]. By understanding efficiency, students create products and processes that are better for the environment, the economy, and society. With the implementation of a new and faster assembly line, the production process has become more efficient, leading to various benefits such as reduced production costs and quicker task completion. By decreasing the time duration for four carriers, power consumption has also been reduced, leading to more efficiency in manufacturing.

3 POWER DISTRIBUTION FOR IMS OPERATION

The current system provides power distribution calculations that help students understand the importance of power distribution in the industry. In contrast, the previous system did not have power distribution calculations, which made it challenging for students to manage and troubleshoot power-related issues. Proper calculation of power distribution is crucial for the efficient and effective operation of a system, and balancing power distribution is essential for optimal system function. When under maximum load stress, uneven power distribution can lead to potential issues such as overheating, equipment failure, and shutdowns.

4 IMS SYSTEM MANUAL

The previous system manual did not provide comprehensive testing and troubleshooting information. This made it more challenging for students to diagnose and fix problems that might arise while working with the system. Without clear guidance on how to conduct proper testing, students were not able to identify the root cause of the issue or take the necessary steps to address problems. A lack of troubleshooting information may have left students uncertain about how to approach fixing problems, once identified.

IMS SYSTEM

The Integrated Manufacturing System (IMS) is an automated production line that includes [3] buffering, sorting, assembly, processing, testing, handling, and storage operations as shown in Figure 1 below. It allows students to gain hands-on experience and to improve their understanding of automated production line operations. The Siemens Sematic PLC S7-300 is used to control the various operations in the manufacturing process, and the TIA Portal is used as the programming environment for the PLC.

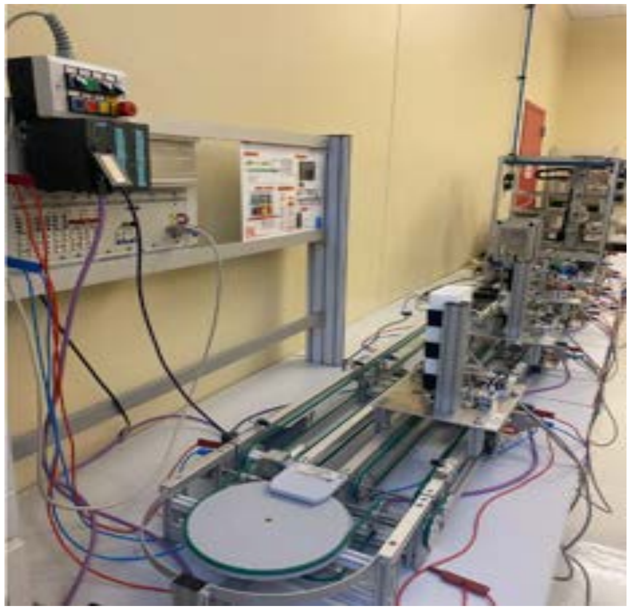

Figure 1: The Integrated Manufacturing System

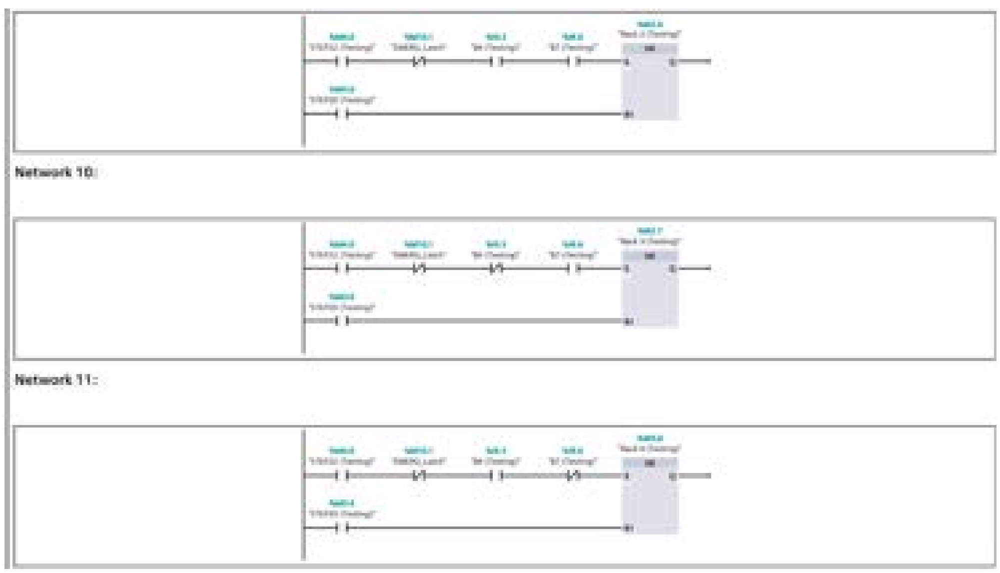

Figure 2: Part of the Testing Station Program

Figure 2 presents a part of the testing station program which can identify the colors of the top and bottom components of a product. This information is transmitted to the storage station, which then directs the product to the appropriate storage rack based on the colors detected. The storage station has also been enhanced to differentiate between various positions on the racks, assigning Case 1 to the first position, Case 2 to the second position, and so on.

ENGINEERING REQUIREMENTS

Integrated manufacturing systems (IMS) must meet several key engineering requirements to achieve Industry 4.0 goals such as interoperability, scalability, real-time monitoring, flexibility, predictive maintenance, cyber security, human-machine interface, and machine learning. These are necessary to ensure seamless communication, adaptability, efficient production processes, data protection, and a user-friendly interface to enhance the overall performance of the manufacturing process.

1 HARDWARE REQUIREMENTS

- 14 x Position sensor
- 14 x Magnetic sensor
- 14 x Proximity sensors
- 8 x DC Motor 24 V
- 7 x Pulse Sensor
- 4 x Lower stopper
- 4 x Mechanical sensor
- Optical sensor
- Piezoelectric sensor
- Siemens Sematic PLC S7-300
- Profibus Connection and Control Panel Unit
- External power supply via 4-mm safety sockets or co-axial power connector
- Double conveyor belt segment, with Length = 600 mm, width = 160 mm.

2 PRODUCTION LINE REQUIREMENTS

- Length Approx. 3000 mm
- Width Approx. 600 mm
- Height Approx. 710 mm
- 2-way valve block, 4/2-way valve, 3/2-way valve, 3/2-way manual stop valve.

3 PRODUCT REQUIREMENTS

- Workpiece Dimensions: L= 180 mm, W= 119 mm, H= 15 mm
- Bottom Piece Dimensions: L= 100 mm, W= 50 mm, H= 40 mm
- Top Piece Dimensions: L= 100 mm, W= 50 mm, H= 40 mm
- Middle Piece (bolt) Dimensions: D= 20 mm, L= 50 mm
- Final Product: L= 100 mm, W= 50 mm, H= 50 mm

Workpiece Bottom piece Top piece Blot Final product

4 MARKETING REQUIREMENTS

The system is designed with safety in mind, incorporating emergency stop buttons and a dedicated safety section in the manual. It is also visible and easy to navigate, enhancing the user experience. Users can control the system with adjustable settings and two modes, improving accuracy. Realistic simulations provide feedback and allow for learning from mistakes without consequences. Additionally, the system is affordable and accessible to educational institutions. Overall, these features make the system safe, user-friendly, controllable, realistic, and cost-effective.

ENGINEERING STANDARDS AND PROTOCOLS

IEC and Siemens timers control time delays, such as time on, time off, and time TP, and are compliant with international standards developed by IEC, an organization that creates standards for electrical and electronic technologies. A PLC is a specialized digital computer that is ideal for controlling industrial processes by managing input and output and storing program data in memory, leading to increased efficiency and cost reduction. IEC 61131-3 standards permit PLCs to be programmed using standardized programming languages such as Ladder Logic Diagrams, Function Block Diagrams, and Instruction Text [4]. The CATIA design of the conveyor belt system followed ASME Y14 Standards to determine the loads, stress analysis, and other factors of the conveyor belt stations. Finally, the Personal Protective Equipment protocol was utilized for the testing and evaluation of IMS's power distribution.

ENGINEERING CONSTRAINTS

When designing or building a product or system, engineers need to consider limitations or conditions known as engineering constraints. These constraints can include cost, materials, safety, performance, and regulations, as well as external factors such as environmental conditions, resource availability, and time constraints. Considering these constraints is essential for developing solutions that ensure the final product or system meets functional and design requirements.

- The life cycle of a Siemens S300 or S1200 PLC (Programmable Logic Controller) typically lasts between 15-20 years, 11 x digital inputs, and 8 x digital outputs.
- Optical sensors have versatile applications as they detect and measure light. Consumer electronic optical sensors can last for years, while industrial ones can last for decades. A reference point sensor is utilized to measure the position or displacement of an object with respect to a fixed reference point, and it is known for its reliability and long lifespan. However, regular maintenance and calibration are necessary to maintain accurate and consistent performance over time. Lastly, a vacuum generator with a vacuum sensor is another type of sensor used for various applications.
- The lifetime of the pneumatic cylinder is a range between 10 and 15 years.
- The life cycle of a DC motor for advancing and reversing a conveyor belt can vary depending on several factors, including the quality of the motor, the operating conditions, and the level of maintenance. On average, a DC motor for this purpose can have a life cycle of around 5-10 years. However, with proper maintenance and usage, the life cycle can be extended to around 20 years or more.

SYSTEM MANUAL

The IMS manual has been thoughtfully designed to assist students in conducting testing and troubleshooting with ease, while also providing a thorough explanation of the testing process. The manual is divided into three distinct sections for each aspect of the system: hardware, software, and 3D simulation. Each section includes three categories of tests: Successful Tests, Failed Tests, and Safety Tests. This segmented structure of the manual enables students to navigate through the testing process efficiently and with clarity.

Table1: Shows Test 2 of the System Manual

Stations Safety Measurement Cables	Test 2
Successful Test	
• Set your DMM to measure DC voltage. • Connect the red probe to the positive (+) terminal of the cable connector and the blue probe to the negative (-) terminal. • Turn on the PLC that is supplying the voltage to the cable. • Check the DMM reading to see if it displays the expected voltage. • The voltage level should be within the range of the cable's specifications.	
Failed Test	
• The DMM reading does not show any voltage, and then there may be a problem with the cable or the PLC. In this case, you may need to check the cable for damage, or check the PLC to make sure it is providing the correct voltage.	
Safety Test	
• Wear appropriate personal protective equipment (PPE) such as rubber gloves, insulated boots, and goggles. • Ensure that the equipment is properly grounded and that there is no chance of an electrical shock. • Make sure that the test area is clear of any debris or objects that could interfere with the test. • Identify the correct circuit and ensure that it has been properly de-energized. • Always handle the probes by their insulated handles, and avoid touching any bare metal parts.	

3D SIMULATION

Factory I/O software is a highly sophisticated application that relies on a diverse range of programming languages to ensure its optimal functioning. The simulation part of the degree project is done by using the Factory I/O software, which is a real-time simulation tool for industrial automation and control. Creating a manufacturing environment that consists of pick and place handling machines, a color sensor gate, a routing station, and a storage station allows students to see how a manufacturing system operates, including the interactions between the PLCs and other automation devices, as shown in Figure 3 below.

Figure 3: Factory I/O Manufacturing Environment

This helps students set up and configure a virtual manufacturing system with real Siemens or other PLCs. They can observe data flow between PLCs and controlled devices in real time. The simulation engages students in industrial automation and control, applying learned concepts in action.

1 PICK AND PLACE HANDLING MACHINE

Practical skills that are highly sought after in the modern manufacturing industry can be acquired by students through learning how to design and program Factory I/O Pick and Place Handling Machines, which are commonly used in manufacturing plants to automate assembly lines and improve productivity as shown in Figure 4 below. The ability to perform a wide range of tasks, such as assembly, packaging, and palletizing, can be included in these skills. Furthermore, a safe and controlled environment for students to test and refine their skills is provided using Factory I/O software, allowing them to learn at their own pace without risking damage to expensive machinery.

Figure 4: Pick and Place Handling Machine

2 COLOR SENSOR GATE

The color sensor gate on Factory I/O can also be used to differentiate between different products based on their color, as shown in Figure 5 below. This can be particularly useful in manufacturing and packaging industries, where different products may have similar shapes and sizes but different colors. By programming the color sensor gate to detect and sort products based on their color, students can learn how to improve efficiency and accuracy in production processes.

Figure 5: Color Sensor Gate

3 STORAGE STATION

The Storage Station in Factory I/O is a useful tool for students to learn about industrial automation and to develop practical skills in handling and managing materials. By simulating a storage area in a manufacturing facility, students can learn how to design and program a storage station that is capable of receiving, storing, and retrieving materials as required. They can also learn about the different types of storage systems commonly used in the industry, such as pallet racking, shelving, automated storage, and retrieval systems, as shown in Figure 6.

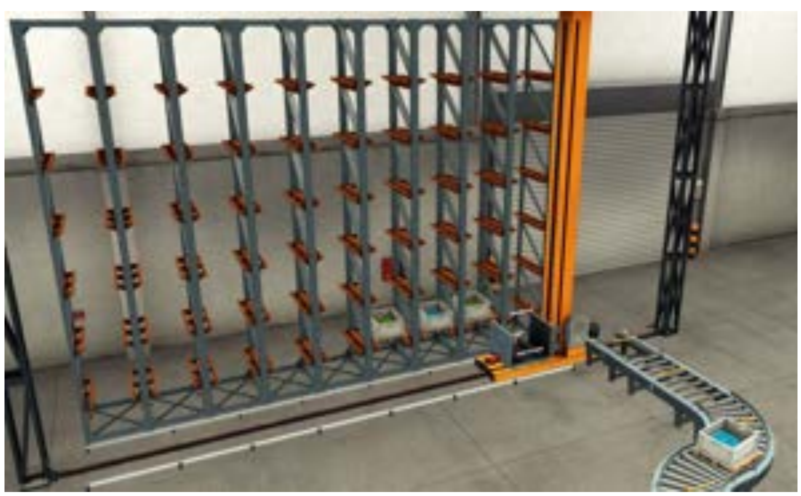

Figure 6: Storge Station

Figure 7: Programming Languages Used in Factory IO

Figure 7 shows how Factory I/O software communicates with the TIA Portal using Structure Text language. In addition, for intricate technical tasks that require advanced programming solutions, the Function Block Diagrams language is often necessary, especially for specific functions such as XOR. Furthermore, the Factory I/O software depends on the Ladder Logic Diagrams language to manage essential operations such as sensor readings, pivot arm operations, conveyor belt movements, storage station operations, and routing station operations. These programming languages are integral to the Factory I/O software and help ensure its reliable and efficient operation in various industrial settings.

In summary, the Factory I/O simulation is an excellent tool for teaching industrial automation and control. It provides students with hands-on experience to reinforce the concepts they learn. Students can see how these technologies are used in real world manufacturing systems and gain a deeper understanding of industrial automation and control [5].

SYSTEM PATH DESIGN

The sequence of the IMS system has been thoughtfully crafted to align with both the programming and power distribution concepts. The system path has been structured as follows:

- Buffering Station
- Extension double conveyor belt segment
- Double conveyor belt segment with motor
- Extension double conveyor belt segment
- IMS 180° curve conveyor belt segment
- Selecting Station
- Assembly Station
- Processing Station
- Testing Station
- Storage Station
- IMS 180° curve conveyor belt segment
- Extension double conveyor belt segment

The sequence has been meticulously designed to optimize efficiency and productivity, facilitating the smooth transportation of materials and components at every stage of the production process.

The First Mode of the system demonstrates the production of one product with one carrier per round, taking four minutes and thirty seconds to complete four products in four rounds. In contrast, the Second Mode showcases the production of four products with four carriers in one round, taking only two minutes and thirty seconds, with only one station difference between the two modes.

Table 2: Shows the 2nd mode sequence for 4 products in 1 round

Positions	Buffering Down	Motor	Selecting	Assembly	Processing	Testing	Storage	Buffering Up
Scenario 1	1							
Scenario 2		1						
Scenario 3	2		1					
Scenario 4		2		1				
Scenario 5	3		2		1			
Scenario 6		3		2		1		
Scenario 7	4		3		2		1	
Scenario 8		4		3		2		1
Scenario 9			4		3		2	
Scenario 10				4		3		2
Scenario 11					4		3	
Scenario 12						4		3
Scenario 13							4	
Scenario 14								4

The addition of the second mode to the system has a significant impact, as it enables students to observe the differences between the two modes, providing a more comprehensive understanding of the system. Furthermore, the second mode covers different movements than the first, enhancing student knowledge. By decreasing the time required for the IMS process to complete four products, the system's efficiency has improved in various aspects, including cost and power consumption.

POWER DISTRIBUTION

The power distribution for both modes has been meticulously calculated. The process includes determining the minimum and maximum load, current, voltage, and power. The minimum load is calculated when the stations are performing their processes without the motor running, whereas the maximum load is calculated when the motor is running.

Table 3: Shows the PD for 1st mode

Stations	Minimum Load (Current) A	Maximum Load (Current) A	Voltage (V)	Power (W)
Buffering	0.79	1.79	24	42.96
	0.69	1.69		40.58
Selecting	0.64	1.64	24	39.36
Assembly	0.51	1.51	24	36.24
Processing	1.15	2.15	24	51.6
Testing	0.58	1.58	24	37.92
Storage	0.77	1.77	24	42.48
	0.67	1.67		40.08
Motor	0	1	24	24

Table 4: Shows the PD for 2nd mode

Scenarios	Buffering Down	Motor	Selecting	Assembly	Processing	Testing	Storage	Buffering Up	Min Current (A)	Max Current (A)	Voltage Tolerance %5 (V)	Power Range (W)
Scenario 1	1	-	-	-	-	-	-	-	0.89	1.82	24	21.36 - 43.68
Scenario 2	-	1	-	-	-	-	-	-	0.2	0.93	24	4.8 - 22.32
Scenario 3	2	-	1	-	-	-	-	-	1.53	2.65	24	36.72 - 63.6
Scenario 4	-	2	-	1	-	-	-	-	0.71	2.27	24	17.04 - 54.48
Scenario 5	3	-	2	-	1	-	-	-	2.68	3.99	24	64.32 - 95.76
Scenario 6	-	3	-	2	-	1	-	-	1.29	3.1	24	30.96 - 74.4
Scenario 7	4	-	3	-	2	-	1	-	3.4	4.23	24	81.6 - 101.52
Scenario 8	-	4	-	3	-	2	-	1	2.08	4.1	24	49.92 - 98.4
Scenario 9	-	-	4	-	3	-	2	-	2.51	3.67	24	51.6 - 88.8
Scenario 10	-	-	-	4	-	3	-	2	1.9	3.13	24	45.6 - 75.12
Scenario 11	-	-	-	-	4	-	3	-	1.87	2.86	24	44.88 - 68.64
Scenario 12	-	-	-	-	-	4	-	3	1.37	2.39	24	32.88 - 57.36
Scenario 13	-	-	-	-	-	-	4	-	0.89	1.82	24	21.36 - 43.68
Scenario 14	-	-	-	-	-	-	-	4	0.79	1.62	24	18.96 - 38.88

Equations used in the derivation are

$$\text{Ohm's Law: } V = (I)(R) \tag{1}$$

$$\text{Power Factor: PF} = \frac{(V)(I)(COS\ \theta)}{VA} \tag{2}$$

$$\text{Electric Power Formula: } P = (V)(I) \tag{3}$$

$$\text{Voltage Drop Expression: } V_d = (I)(R) \tag{4}$$

$$\text{Turning Ratio in a Transformer: } \frac{V_2}{V_1} = \frac{N_2}{N_1} \tag{5}$$

Where V is the voltage, I is current, R is the resistance, V_1 is the voltage in the primary coil, V_2 is the voltage in the secondary coil, N_1 is the number of turns in the primary coil, N_2 is the number of turns in the secondary coil, θ is the angle between the real power and apparent power.

HARDWARE DESIGN

Lucas Nülle designed the IMS with the objective of utilizing high-quality materials and efficient manufacturing processes, although this information was not provided. The conveyor belts are a critical component of the IMS system, as they are responsible for supporting loads of the stations. To ensure that the conveyor belts are designed to handle these loads, a stress analysis was performed, and the results were made available to students as a reference for further demonstrations. The design of the conveyor belts, along with the use of high-quality materials such as aluminum frames and rubber belts for the carriers, contributes to the system's overall efficiency and functionality. These design elements allow students to gain a better understanding of the testing process, while also ensuring the durability and strength of the system

CATIA DESIGN

The stress analysis of the conveyor belts was precisely conducted using CATIA software. The loads were distributed in a manner similar to the actual system load for each station, considering the specific loads for each station.

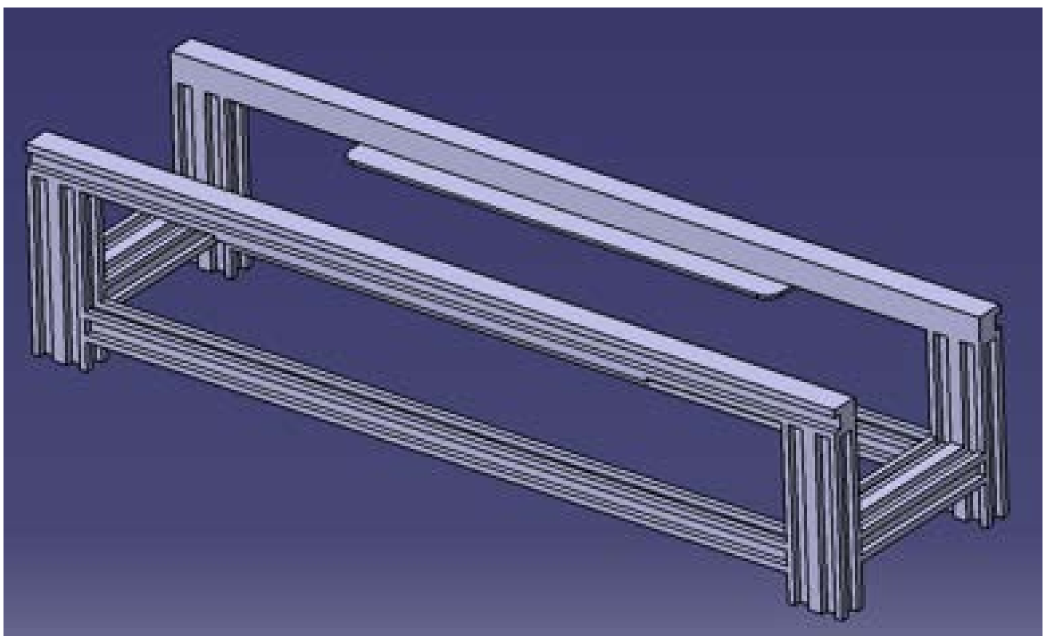

Figure 8: CATIA Design for the Conveyor Belt

Figure 8 shows the 3D design for the conveyor belt system. To ensure optimal performance and hold the weight of the product being transported, consideration must be given to the weight of the product, belt speed, and other relevant factors when designing the belt. Additionally, internal and external factors that may impact the belt's performance, such as tension and wind loads, must be taken into account in the belt's design. The forces and stresses that are generated within the belt as it moves along the system are considered in the internal design of the belt, while external factors that may impact the system's performance are considered in the external design.

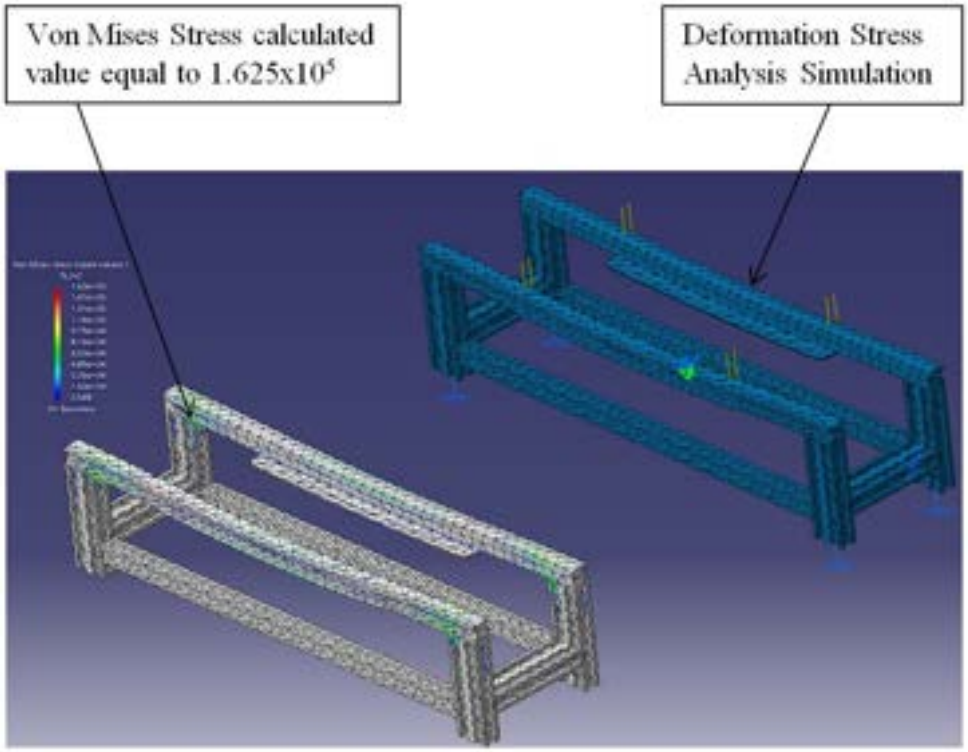

Figure 9: Conveyor belt station Von Mises Stress Analysis

Figure 9 shows the Von Mises Stress Analysis for the conveyor belt station showing the distribution of loads and stress on the system. The red color indicates areas of maximum stress, where the load on the conveyor belt is at its highest. By analyzing the stress distribution, Students can identify potential weak points in the system and make design improvements to ensure optimal performance and longevity. Overall, this type of analysis is an essential tool in designing and optimizing complex systems like conveyor belts.

Stress Analysis based on Analytical Approach

Using Singularity Function Moment Equation could be expressed as:

$$M(x) = 1.5x - 7.5 < x - 0.2 >^2 + 7.5 < x - 0.4 >^2 - M_D \tag{6}$$

$$EI\frac{d^2y}{dx^2} = M(x) \tag{7}$$

$$EI\frac{dy}{dx} = 0.75x^2 - 2.5 < x - 0.2 >^3 + 2.5 < x - 0.4 >^3 - M_D x + C_1$$

Knowing the slope at both ends are zeros, C_1 and M_D value can be obtained as follow:

$$C_1 = 0 \; ; M_D = 0.2167 \text{ N-m}$$

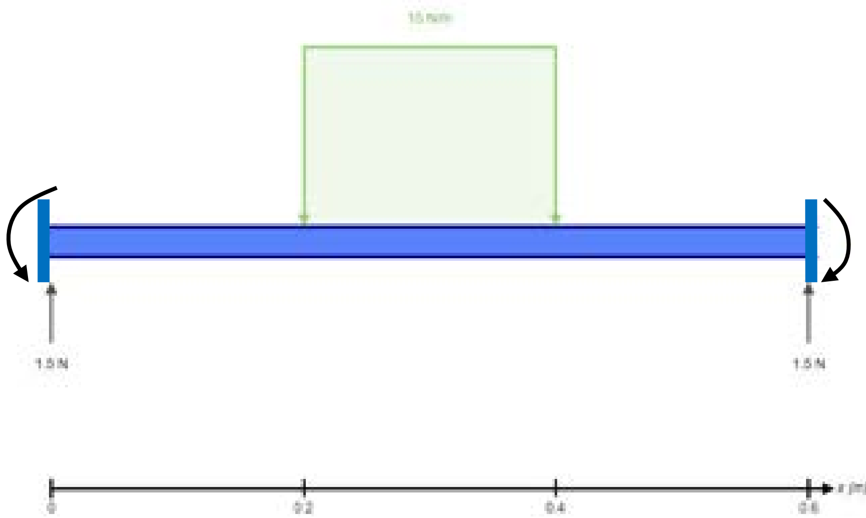

Figure10: Distribution load (15 N) from 0.2 m to 0.4 m

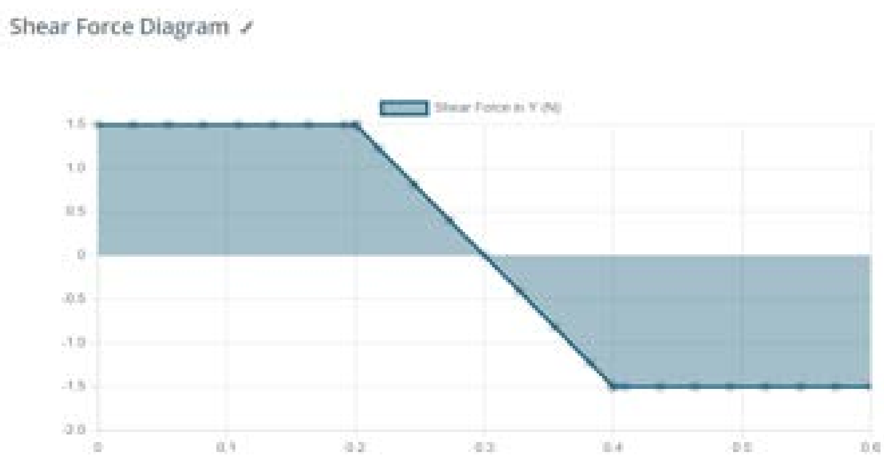

Figure 11: Shear Force Diagram

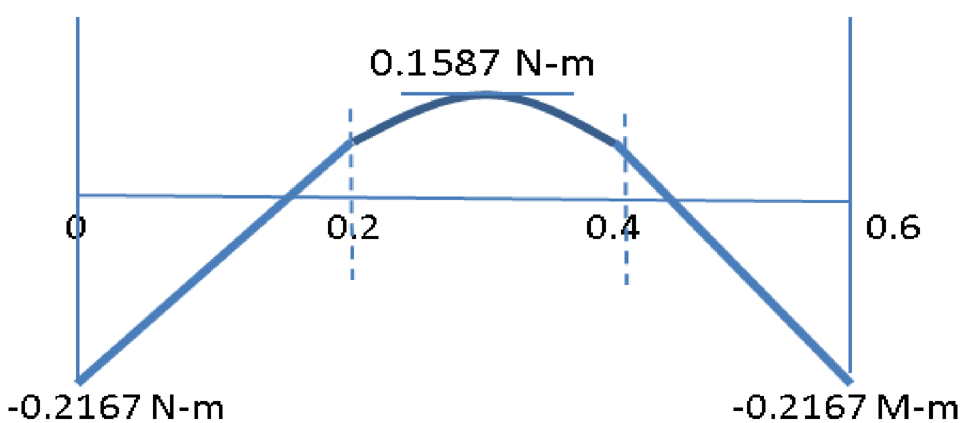

Figure 12: Moment Diagram

A moment diagram illustrates the variation of bending moment along the length of a beam subjected to a uniformly distributed load. It provides a graphical representation of the bending moment values at various points on the beam, as it can be calculated through the singularity function, the maximum moment occurs at both fixed end support locations.

Using equation 8, the value of maximum moment is used in calculating applied stress and it can be confirmed with the maximum stress analysis obtained through CATIA FEA.

$$\sigma_D = \frac{M_D C}{I} \ ; I = \frac{bh^3}{12} = \frac{(0.02)^4}{12} = \frac{(0.2167)(0.01)}{1.333x10^{-8}} = 1.625x10^5 \ {}^{N}/_{m^2} \tag{8}$$

$$F.S. = \frac{\sigma_{ULT}}{\sigma_{Appled}} = \frac{2710 \ x \ 10^5 \ {}^{N}/_{m^2}}{1.625 \ x \ 10^5 \ {}^{N}/_{m^2}} = 1667 \tag{9}$$

The factor of safety is calculated to be 1661, which means that the conveyor belt has been designed to handle a load or stress much greater than what it will likely encounter during its normal use. A higher factor of safety indicates a greater level of reliability and confidence in the design and a lower risk of failure or damage. In other words, a high factor of safety means that the system or structure has a significant margin of safety.

IMPACT

1 SOCIAL IMPACT

Industrial automation and Industry 4.0 technologies can have significant social impacts, including improved safety by replacing workers in hazardous roles and increasing the efficiency of production, which can lead to increased output, higher profits, and job creation, thereby stimulating economic growth in local communities.

2 ECONOMIC IMPACT

The implementation of automation technologies can help to reduce costs and increase efficiency, which can improve the competitiveness of manufacturers and stimulate economic growth. However, there may be initial costs associated with implementing new technologies, which could impact the profitability of businesses in the short term.

3 ENVIRONMENTAL IMPACT

Automation can improve energy efficiency and reduce waste, leading to positive environmental impacts. It enables the efficient use of resources and optimizes energy consumption, reducing costs and improving competitiveness, stimulating economic growth. But the initial costs of implementing new technologies could impact business profitability in the short term.

4 TECHNOLOGICAL IMPACT

The adoption of Industry 4.0 technologies can lead to rapid advances in automation and other fields, such as artificial intelligence and machine learning. This can lead to new opportunities for innovation and research, as well as new challenges in terms of data privacy and security.

5 EDUCATIONAL IMPACT

Integrated manufacturing systems benefit education by offering students practical experience and training in advanced manufacturing techniques and technologies. This helps them prepare for manufacturing careers and acquire versatile skills that are applicable in other fields. Such systems can also be used for research and development, leading to innovations and curriculum improvements. Overall, integrated manufacturing systems facilitate collaboration between industry and education, equipping students with the skills they require to succeed in their future careers.

CONCLUSION

In conclusion, the IMS project has effectively addressed the deficiencies of the previous system by implementing several enhancements, including the creation of a system manual, power distribution calculations, efficiency improvements, and a more realistic 3D simulation. As a result of these improvements, students will have a better understanding of the production pipeline process and develop crucial skills.

The IMS project is significant for education as it equips the next generation of students with the skills and knowledge needed to tackle the challenges of the modern world. Overall, the IMS project has successfully achieved its objectives and holds the potential to continue positively impacting automation education.

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AUTHORIZATION AND DISCLAIMER

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Fluvial Instrument for Soil Harvesting

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Abstract

Our waters have been contaminated by human error and negligence, specifically through the disposal of toxic manmade organic chemicals known as polychlorinated biphenyls, PCBs. Created for electronic components and consumer products, PCBs have been proven to be harmful to humans and wildlife. Currently, there are efforts being made throughout the United States to maintain and monitor water quality within various rivers and lakes. To address this issue, the Fluvial Instrument for Sample Harvesting (F.I.S.H) has been developed to collect soil samples from hard-to-reach or neglected locations. The F.I.S.H incorporates the simple movement patterns of motors and basic principles of buoyancy to effectively achieve buoyancy control by autonomously submerging itself 4 meters into water. This device also has the capability to drill into soil and to retrieve 16 oz samples while underwater and then autonomously return the sample to the surface. The production of this device increases the likelihood of increased mobility and versatility in the market of testing and monitoring water quality in most bodies of water.

1. Introduction

Polychlorinated Biphenyl's are a harmful man-made chemical manufactured between 1929 and 1977. With roughly 1.25 billion pounds of PCBs being disposed improperly, these chemicals are a danger to the ecosystem. PCBs have been disposed within municipal landfills and poorly maintained toxic waste sites and are often the result of leaks from electrical transformers [1]. The production of this harmful material is due to its high conductance, chemical stability, heat resistant properties, and electrical insulating [1]. It has been used throughout many different industrial and commercial industries, including in applications such as thermal insulation, hydraulic systems, oil for motors, plastics, and much more.

PCBs do not break down easily. They are not water soluble and therefore sit on the top of the soil affecting the ecosystem from the bottom up [2]. The chemical tends to build up in organisms due to its high fat insolubility, which then travels up the food chain. As the fish in the water are feeding on each other, the contamination spreads throughout. Due to this factor, PCBs have adverse effects not only the ecosystems but also in the humans who ingest the water and fish from these areas [2]. The effects of being exposed to this chemical are harm to the immune system, endocrine system, liver, and gastrointestinal system [2]. This creates the need for soil testing for contamination of waterways. The adverse effect to not only marine life, but to human life is enough for action to be taken. Through the usage of a remote-controlled device, soil samples will be taken from 4 inches into the soil and then returned.

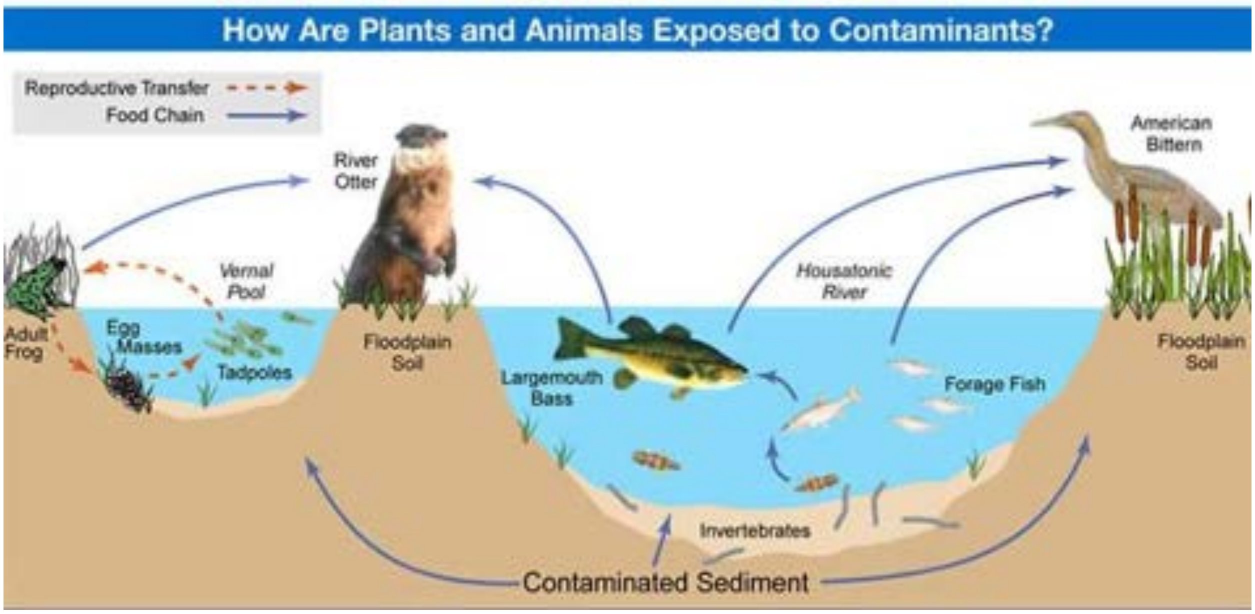

Figure 30: Contaminated Food Chain Cycle in the Aquatic Ecosystem

2. Environmental Impact

As stated previously, PCBs are persistent organic chemicals that have long lasting effects on our environment. Since they bioaccumulate, animals at the top of the food chain with high levels of PCBS in their bodies can affect the success and survival of their offspring or other animals, in turn leading to the extinction of species and the disruption of ecosystems. Another environmental impact of this contaminant is that it can leach into waterways from landfills to further contaminate other aquatics systems. More polluted waters result in more organisms becoming affected and increasing the chances of transferring these harmful chemicals into humans. Precautions have been taken to regulate the quantity of fish captured, but waterways also need to be tested efficiently [2]. PCBs are also denser than water, leading them to fall into the soil and fester within. When this chemical is absorbed by soil, it disrupts the growth of plants and reduces vegetation, cutting herbivores off their food source, while still being able to infect them. Additionally, air pollution occurs because PCBs are released during the industrial process. This makes the process of destroying this chemical significantly difficult, since dredging is one of the ways we discard PCBs. When dredging, machinery digs about a foot and a half into sediment without dispersing the soil lifted. After it is lifted, it is transported to a special location and incinerated [5]. The problem with incineration is that the PCB chemical is released into the air, and it can spread to areas far from the original source. Having PCBs in the air can cause harmful effects on human health including but not limited to respiratory health and cardiovascular disease. Furthermore, having it in the air contributes to climate change by trapping heat in the atmosphere. Climate change has a series of complications on our planet, as it causes a shift in our weather, rising sea levels, and the melting of polar ice caps [1]. If multiple samples could be collected and analyzed using a device such as F.I.S.H, the process of identifying the source of contamination would be accelerated, and action could be taken accordingly. It usually takes several months or years to determine the origin of contamination, but this device would significantly reduce the time needed to collect and test samples. This would have a positive impact on the environment, since it would allow for an efficient way to detect the issue and act on it.

3. Engineering Standards

When making crucial decisions, it is essential to support design considerations by following established engineering standards. For waterproofing, which is one of the most important aspects of the design, Ingress Protection (IPX-7 and 8) allows devices to be continuously submerged up to 1 meter of water for 30 minutes [3]. These IPX ratings will ensure that the device will be able to complete its major function of collecting a soil sample at a depth of 13ft (4m). The American Society of Mechanical Engineers' (ASME) promotes engineering standards/code and strategies that ensure security in the development of engineering projects. The American Society for Testing and Materials (ASTM) standards were strictly followed when selecting the method in which drilling would be conducted. The ASTM D6913-17: Standard for Soil Exploration and Sampling by Auger Borings, includes insightful information for both equipment selection, sampling procedures and safety considerations. Following these procedures, it was decided to design and size the auger drill based on soil conditions and drilling depth, specifically targeting wet soil and drilling a shallow hole [4]. In terms of material selection and ensuring the goal of cleaning our waters, it was imperative that the guidelines for the Environmental Protection Agency (EPA) were always taken into account. The EPA guidelines influenced the selection of polycarbonate plastic, as it would not release any chemicals into the water after long exposure from continuous usage [6]. The overall design also has some precautionary measures to prevent any damage to wildlife or to the user while the device is operational.

4. Design Concept

There have been 2 prior iterations of this project developed, that resulted in the following iterations displayed in the figures below. The three design concepts below are highlighted and developed iterations of the project, along with explanations as to how each iteration improved on flaws and oversights.

4.1 Initial Iteration: Automated Syringe Design

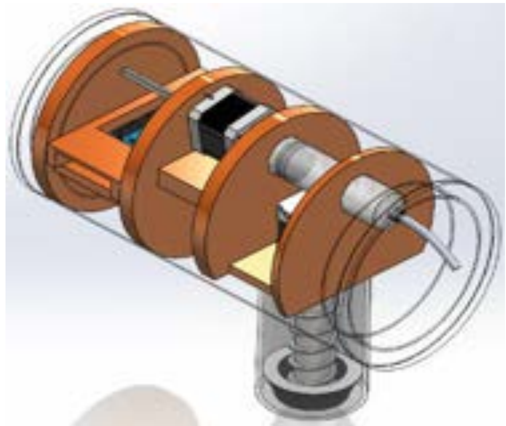

Figure 31: Automated Syringe Design

For the device to move up and down, a submarine approach is taken. Water is collected via suction with the syringe to submerge the device to its appropriate depth of 13ft. When the device reemerges, this occurs by pushing the water out and coming back to the surface. This pulling and pushing motion within the syringe is accomplished with a 12V stepper motor connected to the rubber stopper. The rotational and linear motion created by the stepper motor and buoyancy are key factors in the mechanical design of the F.I.S.H.

Figure 32: First Iteration of the Auger Drill

The drill mechanism is based off an auger drill powered by a 12V stepper motor. Like an auger drill, this mechanism will extend 1 inch, rotate into the soil, pulling soil up along the shaft of the drill as it further digs into the ground. The soil will be collected by falling off the shaft and caught in a mesh net that is hung above the perimeter of the black stopper. The mesh will be porous enough for water to fall through but small enough to hold the collected soil. This design, however, was not used, since the drill's design failed to dig properly. The stepper motor also does not provide the proper movement pattern required to create an effective drill, due to its inability to turn smoothly.

4.2 Second Iteration: Dual Water Chamber Design

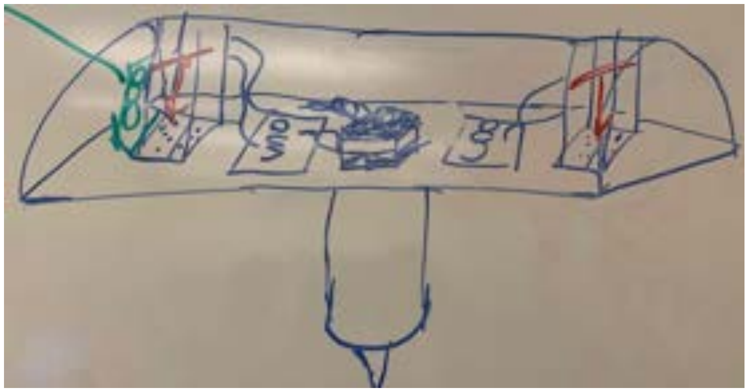

Figure 33: Dual Water Chamber Conception

The device was redesigned using the same concept, that intaking water would make the device denser, therefore allowing it to sink, and pushing out the water would fill up the system with air permitting the body to be lighter. This iteration required one to push down onto the device to get the chambers filled with water, using two cups, one filled with water and the other empty with holes on the bottom. The empty cup was placed on top of the water and would float, but once force was applied down onto it, the empty cup would take in the water. This idea was used for the chambers, and one was added to each side to add symmetry. To push out the water, two Arduinos would be used to power each side. The Arduinos would supply current to a 9V DC motor that would power an upper and lower gear connected by a VEX roller chain transferring mechanical energy to a shaft. The other end of the shaft would go inside of the chamber and connect to a scissor lift jack with a flatbed. While the shaft turns, the scissor lift would extend forcing the water out of the chambers.

Figure 34: First Prototype of Dual Water Chamber Design

The shape was changed to keep a flat bottom to limit the body from rotating while submerging in water. The length was chosen to have adequate space for all the components and for the chambers to be large enough to fit the required amount of water for the device to float. The issue that resulted was manufacturing; due to its size, it couldn’t be 3D printed all in one piece. 3D printers have a printing bed that averaged between 150mm-300mm, and the size of the body exceeded that, leaving the print in multiple components. This would cause insulation issues, leaving the components inside exposed. The flatbed inside the chambers would also need to be insulated efficiently by reducing tolerances between the flatbed and the walls of the chambers to reduce chances of water getting inside the device.

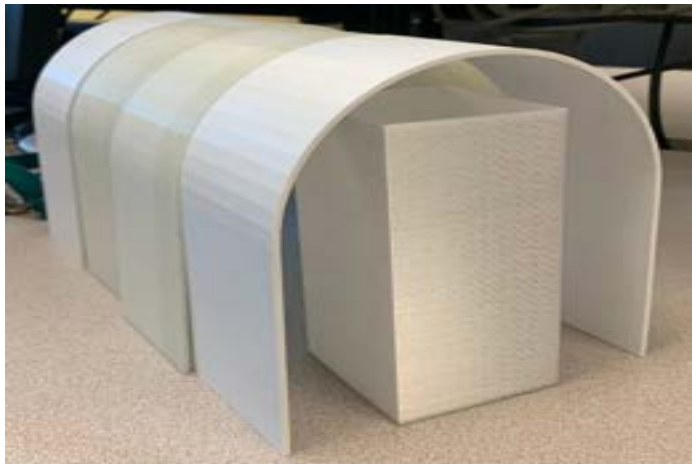

Figure 35: Second Prototype for Dual Water Chamber Design

The figure above depicts the dual water chamber iteration after being 3D printed. The casing was divided into four parts and the chambers were dimensioned to supply enough room for ample water to make the whole assembly dense enough to sink. While the model was being prototyped, it was noted that the chambers had to be part of the casing to limit complications when water entered. Originally the dimensions were 147.7mm x 73.73m x 66.78mm, but this didn't meet with the height of the casing, which left a gap. After calculations, it was found that the amount of force required to push out the water above sea level would need to be 74.47N; it would need a stronger motor affecting the weight of the whole assembly and the amount of free space within it. The scissor lift would also need to be made more robust to withstand the force being output by the motors. Since the water inside the chambers would need to be pushed out while below water around 13 feet, the water pressure would be significantly greater. This directly influenced calculations because pressure at 13 feet was equal to 37,421.62Pa, and after deciphering the force required, it resulted in 1.9KN. The motors being used would not be able to produce enough force to push the water out and would most likely cause other components to fail. In doing so the design was reconfigured to produce a more feasible approach.

4.3 Current Iteration: Remote Controlled Propeller Design

In this design, propellers were the focal point for movement and control. Stepping away from a mechanical system that takes in and pushes out water, the current iteration uses two types of propellers for vertical and horizontal movement. As the side propellers turn it will cause the device to turn if one side is activated, but if both sides are activated then the device will have forward movement. The back propellers will each turn in a different direction (left-counterclockwise and right-clockwise) causing the device to rise and sink while underwater, also producing stability while drilling.

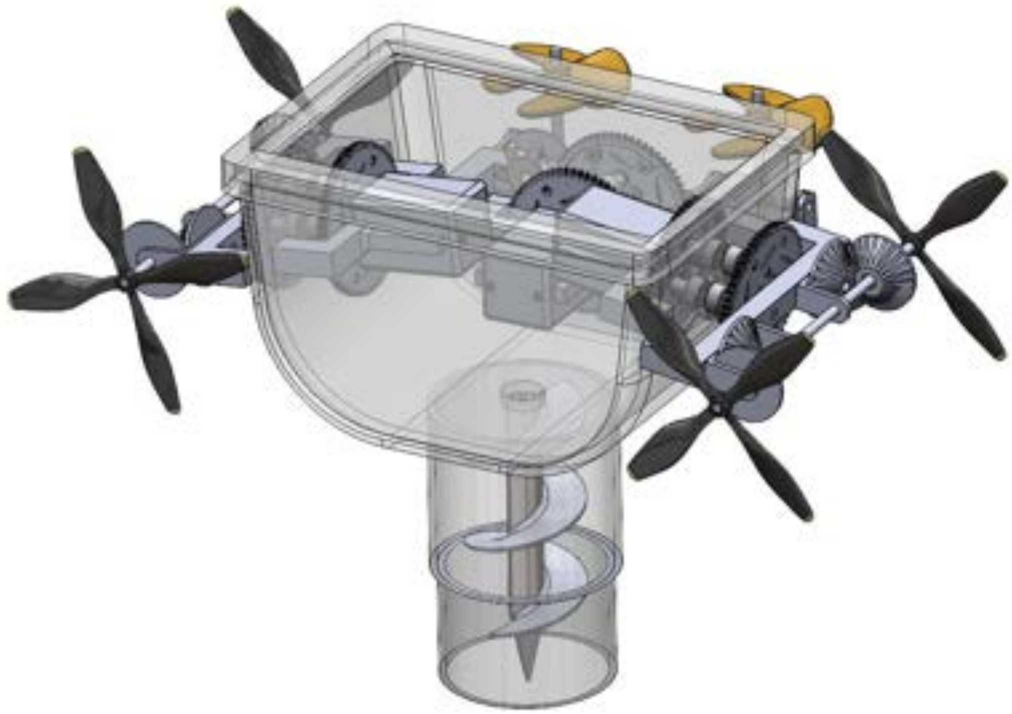

Figure 36: Current Model for the Remote Controlled Propeller Design

Regarding the manufacturing of the current iteration, it will be developed primarily of affordable PLA plastic, with an approximate weight of 2.36lbs. Aiming for this mass will ensure that the F.I.S.H can effectively move through the water using propellers that produce a thrust of 3lbs and move at a speed of 1.52 mph vertically and 0.76 mph horizontally. For waterproofing purposes, most of the connections between the major components utilize neodymium magnets. This will not have an effect on the motors and controls. However, it will reduce and simplify the need for extra sealing. While drilling into the soil (4in. deep), the propellers will assist in maintaining stability, decreasing chances of failure during the drilling process.

It will also include a plastic cover meant to protect wildlife from harm if an animal were to come in contact with the drill when it is in use; this is a precaution that is taken due to specific EPA guidelines. This same precaution will be taken to cover the propellers from potentially causing harm or becoming damaged, which could pose a problem to both the goal of the project and to the nearby environment. Considering that this project is still in development, these precautionary measures are still being finalized and designed.

5. Electrical Design

Electronically, there are a few major components. The first is the brain for the device, which will be the Arduino Uno. For the device to move vertically and horizontally, three propellers will be used. These propellers are used to create 6 degrees of freedom and mitigate the potential to create yaw on the device. The propellers will be driven by three 9V DC standard motors, and the drill mechanism will be using a brushless DC motor. The three 9V DC motors will be attached to an L298n motor driver. This will control the propeller's speed and direction at the same time, which is vital for the motion of the device.

The code for this device will be using C++ as well as the Arduino IDE app. The controls will be identified within the code, each button will denote a motion as well as the drill mechanism launching to start. The throttle of the drill will be adjusted to slow down and speed up. This is highly dependent on the torque that is required to drill into the soil.

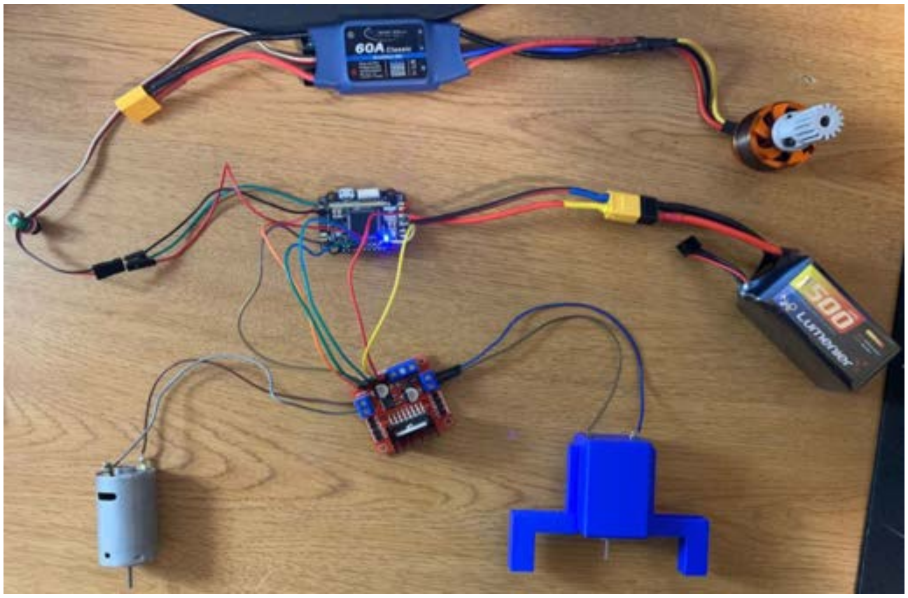

Figure 37: Connections between Flight Controller, ESC, DC and Brushless Motor, and Motor Driver Controller

For a fail-safe method of programming, Ardu-sub from mission planner is being used to auto create a mapped controller. It can maintain the depth with a tolerance of a few centimeters and supports both pressure and depth sensors, as well as having the built-in capabilities for underwater retrieval. The microprocessor Kakute F7 AIO is being used as the microcontroller for the submarine. The controller will be done through the mission planning software and will be fine-tuned for the needs of our device. The controller will need to be controlled using a high bandwidth telemetry system to make sure that it is always responsive to the submarine, so as to not lose control.

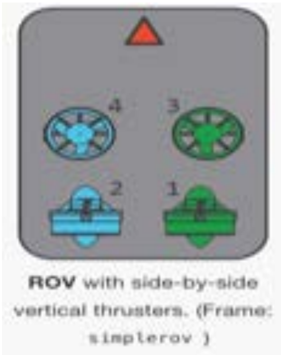

Figure 9: Remotely Operated Vehicle (ROV) with side-by-side vertical thrusters

Battery Life: A 4s LiPo battery at 1500 mAh will be used as the power supply.

Battery Life of Microcontroller: $\frac{Battery\ Capacity\ (mAh)}{Device\ Consumption\ (mA)} = \frac{1500mAh}{42mA} = 36\ hours$ (1)

Battery Life with DC motor: $\frac{Battery\ Capacity\ (mAh)}{Device\ Consumption\ (mA)} = \frac{1500mAh}{42mA+155mA} = 1\ hour\ 34\ min$

Battery Life with BLDC Motor: $\frac{Battery\ Capacity\ (mAh)}{Device\ Consumption\ (mA)} = \frac{1500mAh}{42mA+155mA+46785mA} = 3\ \mathrm{min}\ 48\ sec$

Expected Battery Life = 3 min 48 sec

Approximate battery life if each motor is controlled individually

The load is spread out between motors, and the battery life/power consumption is dependent on how many motors are being used at once. This expected battery life that was calculated is also in reference to when the power supply has used 85% of its charge, before it is required to be recharged to avoid permanent damage to the power supply.

Propeller Pitch

$$Pitch = \frac{(2.36)(Diameter)(Height)}{width} = \frac{(2.36)(2.7in)(0.700in)}{1.445in} = 3.09in \qquad (2)$$

The calculated pitch represents how far the device will be thrust vertically in one complete revolution of the back propellers.

$$Pitch = \frac{(2.36)(Diameter)(Height)}{width} = \frac{(2.36)(4.9in)(0.33in)}{2.46in} = 1.55in$$

The calculated pitch represents how far the device will be thrust horizontally in one complete revolution of the side propellers.

Speed

$$Speed = (RPM * Ratio) * Pitch = \left(10386 * \frac{1}{20}\right) * 3.09 = 1604.64\ in/\mathrm{min}(ipm) \qquad (3)$$

$$1604.64\ ipm \rightarrow 1.52mph$$

$$Speed = (RPM * Ratio) * Pitch = (10386 * 1{:}20) * 1.55in = 804.92\ in\ per\ \mathrm{min}(ipm)$$

$$804.92\ ipm \rightarrow 0.76mph$$

Based on the calculations using the motors and propellers parameters, the device is expected to travel at a speed of 1.52mph vertically and 0.76mph horizontally.

Drag of Device

$\rho = fluid\ density$

$v = relative\ velocity$

$C_D = drag\ coefficient$

$A = cross\ sectional\ area$

$D = Drag\ Force$

$$D = \frac{1}{2}\rho v^2 C_D A \qquad (4)$$

$$D = \frac{1}{2}\left(\frac{997kg}{m^3}\right)(.679m/s)^2\,(.42)(.006m^2) = 58.09N = 13lbf$$

Based on the calculations, it can be inferred that the drag force produced as the devices plunges into and pushes water is 13lb-f. Although the drag force is greater than the thrust produced by the propellers, the shape of the streamlined shape of the body will assist in reducing drag and maximizing the device's forward motion.

Density of Device

Mass of Device = 1070.478g

Volume of Body = 237.12 cm^3

$$\rho = \frac{m}{V} = \frac{1070.478g}{237.12cm^3} = 4.51g/cm^3 \qquad (5)$$

The density of the device, once all the components are in place, will be 4.51g/cm^3, which is heavier than water (1 g/cm^3). This means that the device is relatively heavy, resulting in the device sinking once placed in water.

6. Finite Element Analysis

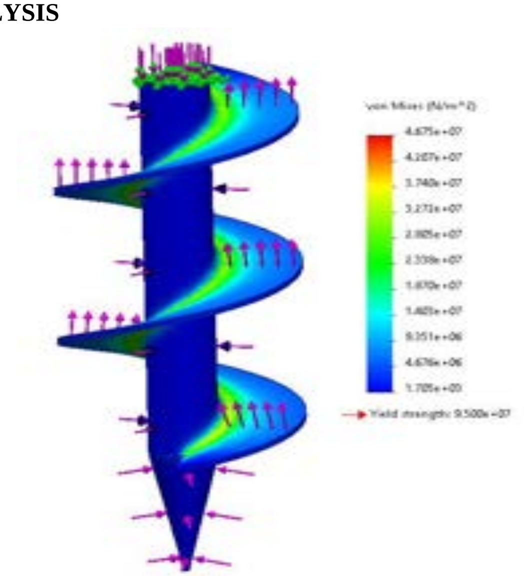

Figure 38: Stress Analysis of Auger Drill

The drill bit is subjected to a range of stress factors during the drilling process. A primary source of stress is the torque that is applied to the bit by the brushless DC (BLDC) motor. The torque was the rotational force that the BLDC applies on the drill, causing it to pierce the soil, spin out and dig into the soil. If the torque is too high, it can cause the bit to break or wear out prematurely. The drill is currently made out of PLA, but the goal would be to use 2014-0 Aluminum since it is a light metal and has a high resistance to corrosion.

7. Estimated Cost

Table 1: Cost of Materials

Equipment	Amount	Cost
Arduino Uno	**1**	**$20.70**
Easy Driver Stepper	**2**	**$33.00**
Motor Driver [L298n]	**1**	**$11.49**
Brushless DC Motor	**1**	**$19.99**
9V DC Motor	**3**	**$20.67**
O-Rings	**1**	**$14.99**
1600 mAh LiPo Battery	**1**	**$23.00**
Magnets	**24**	**$47.00**
Tupperware	**1**	**$16.28**
Filament	**1**	**$20.00**
TOTAL		**$ 227.12**

8. Conclusion

The presence of polychlorinated biphenyls in water systems across the world is a serious concern with negative impacts. Unfortunately, this issue is not being monitored as frequently as other water quality aspects. However, F.I.S.H provides a solution that allows for the collection of samples to test and monitor the total concentration of PCBs in different locations. This method would be more accessible and feasible compared to the current methods being used. The successful implementation of this device could have profound social and environmental impacts, as well as pave the way for new innovations in water quality control. Lastly, it can be a crucial step in reversing the damage caused to the environment from PCBs.

9. Future Improvements

The body of the device is not suited for water being made from PLA and 3D printed. Through the usage of additive manufacturing and SLS printing, the body will be a hard cast plastic. A hard cast plastic such as poly carbonate will ensure that no water has the chance to leak into the device and affect the hardware. It is also a strong, tough material that will be able to absorb impact from objects within water better than PLA or acrylic. Due to time and funding constraints, this was not pursued. SLS printing would cost $276 USD and take a few weeks to be shipped out. As a result, finalization of all the components was not a feasible task.

As the device stands, it gives about 3 minutes and 48 seconds of operation time. Realistically, if there were to be more of an underwater retrieval and exploration approach to this device, more battery power would be necessary. A higher mAh power supply can be used to extend battery power. The Kakute can take 7-28V of power. To ensure longevity of the device under water, a higher voltage can be supplied up to this threshold. However, the three DC motors would have to be exchanged for higher rated voltage. To add, the regular brushed DC motors will be changed to brushless to ensure longevity, as brushed motors tend to deteriorate more quickly than brushless.

The drill needed to be torqued down using a 1:20 gear ratio to create the proper amount of torque needed to successfully drill into the soil. Higher torque has been an obstacle for the team; the motor spins are roughly 1700 RPM's. A higher torqued brushless motor that would sit at around 150 KV is ideal for this type of application. These are heavier, expensive ($55 USD), and require more voltage (18-24V), but are vital to water sample collection.

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Authorization and Disclaimer

Authors authorize Vaughn College to publish the paper in the Vaughn College Journal of Engineering and Technology. The Authors are responsible for both the content and the implications of what is expressed in the paper.

Drone Mounted Antenna Tracker

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ABSTRACT

This report focuses on applied mechatronic engineering knowledge to design and manufacture a drone-mounted antenna tracker gimbal system. The purpose of creating a drone mounted antenna tracker subsystem is to provide greater accessibility and a lower cost barrier to entry for use of the antenna tracker technology, with little compromise on range and reliability of the signal. The scope of the design for this paper focuses on the mechanical design, selection of compatible electrical components, and software interfacing between components to process data and control the direction of the antenna. The subsystem has been designed, manufactured, and tested to show the antenna holding position in the direction of a two-point GPS vector. The future works for this project would be to establish a telemetry connection for data transmission between the ground station, tracker drone, and a receiving drone to compete the drone mounted antenna tracker system. This project seeks to make this technology more cost effective and accessible to general users, by mounting an antenna tracking system on-board a drone to track another receiver, in order to achieve the effect of extending radio signal ranges, in an inexpensive and compact manner.

INTRODUCTION

The UAV (Unmanned Aerial Vehicles) industry is rapidly growing at a rate of 7.9% per year, estimated to be valued at $38.3 billion by 2027. Some common uses of drones today involve large scale search-and-rescue, surveying, surveillance, and patrol missions which have applications in a variety of related industries such as defense, military, civilian, and land-surveying. Communications are typically conducted via wireless data links, which due to signal attenuating effects, becomes a limiting factor in long-range operations. To address this need, an existing technology known as “antenna tracking” is employed in a new application to extend signal ranges, effectively boosting the scope of these tasks. Traditional antenna tracking consists of a device on the ground that points a high gain (directional) antenna directly at the drone in the air, to increase signal transmission/receiving power in a specific linear direction between two devices. This is achieved by using GNSS (Global Navigation Satellite System), also referred to as GPS (Global Positioning System) to create a 3D vector between the two radios involved in real time. The main drawbacks of this setup include typically high equipment costs and increased susceptibility to multipath, caused by obstructions in the line of sight between the two antennas.

Many common implementations of drones today require extensive communication signal ranges to convey mission-critical information, such as vehicle position, heading, velocity, battery voltage, camera video streams etc., to and from the user on the ground. The need for long-range, stable, and consistent radio communications becomes increasingly apparent, as mission scope increases. However, to promote accessibility for both professional and hobbyist users, this needs to be achieved through a user-friendly and economical product that revolves around and readily interfaces with commonly sourced hardware. Furthermore, due to weight considerations being of utmost importance in the aerospace field, the solution also needs to be lightweight and compact, as well as modular to to suit a variety of customer requirements. First, the background and impacts of the project will be discussed. This will be followed by the team objectives, distribution, and the design approach for the subsystem.

BACKGROUND STUDY

Traditional antenna tracking systems involve a setup based around the ground control station unit. Much like the design of the on-board antenna tracker, this device tracks the 3D position of a drone in the air in real time and directs a high gain directional antenna in the line of sight of the drone telemetry receiver. However, the major difference is that the device is mounted on the ground as opposed to on-board in the air. Some examples of such antenna trackers available to purchase in the market currently include the XLRS Smart Antenna Tracker and the NexTech Antenna Tracker Digital Link, both pictured in the figures below.

Figure 39: XLRS Smart Antenna Tracker and NexTech Antenna Tracker Digital Data Link

One major drawback to this setup is high equipment costs. For instance, the two antenna trackers listed above are marketed at a cost of $6,000.00 & $9,000.00 respectively; both are able to achieve communication ranges of up to 10 km. In the present market, these price points limit accessibility of long-range and large-scale search and rescue operations to more professional and high-end users. Furthermore, another major drawback to this setup is an increased proclivity to obstructions and multi-path interference of radio signals, due to the two telemetry radios operating in two different horizontal planes, i.e., one on the ground and one in the air. For instance, a UAV conducting a surveillance mission over a wooded area may lose clear line of sight between the tree line. Introducing such obstructions may lead to signal interference and quality degradation, thus leading to the reduction of effective mission scope. However, the on-board antenna tracker would not be affected by this aspect of the mission, due to the two telemetry radios operating in the same playing field, i.e., in the air. Since no obstructions would be present between the two devices, the performance of this setup would not be impeded, allowing for the extension of mission range as intended by design.

The antennas typically selected for use in antenna trackers are called high gain directional antennas. According to antenna-theory.com, the term Antenna Gain describes how much power is transmitted in the direction of peak radiation of an isotropic source [1]. The gain of an antenna can be measured in decibels(dB) representing the peak gain in relation to the product of the antenna efficiency and directivity. The high gain antenna used in this project has a specific arrow-like shape to provide the directional signal radiation needed for the fundamentals of an antenna tracker. This shape is considered for the design, as the available space on a mid-size drone is usually limited.

OBJECTIVE

The goal of this project is to completely design, manufacture, and test a drone mountable antenna tracking system that holds a directional antenna to point it in the direction of the unit vector between the tracker drone and a simulated point representing the target drone. This process includes the scope of this design focusing on the proof of concept for the hardware and control system to manipulate the antenna as needed; however, the data transmission is a possible continuation of the project and will be discussed in the future improvements section.

IMPACTS ON ECONOMY

The economic impacts of a lower-cost drone mounted antenna tracker system can save the operating businesses and organizations money in many ways. A lower cost compared to the competing traditional antenna trackers mentioned earlier is an initial expense reduction for a system that will be just as reliable. This opens the possibility of the use of this technology in a wider market with lower budgets. The drone mounted antenna tracker would also provide better data transmission and collection for organizations from the decreased obstructions, leading to better educated decision making based on more reliable data. This system implementation would also result in job creation for the manufacturing and operation of the drones, in mounting on the antenna tracker system.

IMPACTS ON SOCIETY

All members on this project have their own experiences working on copter drones and have an appreciation for the technology, so one of the core reasons to create a low-cost system for this type of project was to make the antenna tracker technology more accessible to people and organizations with limited resources compared to the military or governments. One of the main advantages of a drone mounted Antenna tracker is to increase the overall range of operations of a singular or multiple drones at the same time. This would prove to be essential to a search and rescue operation in remote areas, as well as the improvement of response times in the event of natural disasters, by providing vital information for almost immediate attention possibly saving lives.

IMPACTS ON ENVIRONMENT

The wider range of operations granted by employing this type of system on drones would be a major help with environmental monitoring. This would allow for larger areas to be surveyed for important data metrics and updates on potential risks to the environment. This includes monitoring wildfires faster and with lower carbon emissions when conducted via drone, as opposed to helicopters or planes. This way helicopters and planes can be sent directly to areas in need of assistance.

MARKETPLACE REQUIREMENTS

The market requirements for the antenna tracker system consider the userbase of the drone mounted antenna tracker system. This could range from drone hobbyists to larger corporations; therefore, the following have been identified as requirements for the design.

1) Safety: The antenna tracker must be safe to install on any drone and should be manufactured from environmentally friendly materials.
2) Compact: Easier transportation and installation on varieties of drones.
3) Compatible: Hardware should connect to any drone under Pixhawk Communication Standards.
4) Weather-Resistant: The antenna tracker should not be affected by weather conditions in reasonable ranges of drone flight conditions.
5) Reliable: Antenna tracker should have a stable signal for communication between stations/drones

HARDWARE AND ELECTRICAL STANDARDS AND REQUIREMENTS

The final design of the On-Board UAV Antenna Tracker will consist of a servo tracking assembly and an antenna mount for the drone. The Yagi Antenna selected will need to have a communication range of up to 10 km capable of providing stable telemetry and consistent video streaming to compete with the more costly stationary antenna trackers. The antenna tracker assembly must have an operational voltage at 22.2V with a 3V tolerancing, and this is within the voltage range of the main power supply of carrier drone with a six-cell lithium polymer battery.
The antenna tracker system will need a compact casing and to be weather resistant, in order to endure the wide range of temperatures in which drones can operate. The materials used will also need to be lightweight to reduce overall payload weight and 3D printable using Fused Deposition Modeling (FDM) for easy and fast manufacturing.

The pitch and yaw motors need to have an axial rotational speed at or below 0.33 sec / 60 degrees with a motor resolution of less than or equal to 0.06 degrees. The rotational speed accounts for a target drone speed of 40 km/h. and the motor resolution are to reduce the granularity of the tracking and allow for smoother, more accurate tracking with proper tuning.

The axis of rotation of the motor shafts are to be placed directly in the same axis as the center of gravity for the antenna assembly. As a result, the motors are not designed to supply torque to leverage loads at a perpendicular distance away from said axis of rotation, but rather to purely drive the angular acceleration of the payload attached. The relationship between the torque (τ), acceleration (α) and rotational inertia of the antenna (I) are described by the following equation.

$$\tau = I * \alpha \tag{1}$$

Thus, to understand the torque needed to drive the antenna at a given required angular acceleration, the rotational inertia, or in other terms the resistance of the antenna to angular acceleration must first be found. Since this metric is a function of a given object's mass and surface area, the motor was designed and selected to drive the largest surface area of the antenna, also having the added benefit of providing additional headroom for faster rotational acceleration in the yaw axis. Furthermore, for the purpose of simplifying the calculations and analysis of the rotating object, the trapezoidal shape of the antenna was instead assumed to be a rectangle bounded by its largest perimeter dimensions (a and b) as described by figure 8. Correlating real life testing to manufacturer specifications, the center of mass of the object was found to be at a different location to that of the centroid of the rectangle, and so the rotational inertia about the center of mass was found using the parallel axis theorem, described by equation 2 below, where the rotational inertia of a rectangle about its centroid ($I_{centroid}$) is given by equation 3 and the distance between these two points (d) is shown also in figure 8.

$$I = I_{centroid} + Md^2 \tag{2}$$

$$I_{centroid} = \frac{M}{12}(a^2 + b^2) \tag{3}$$

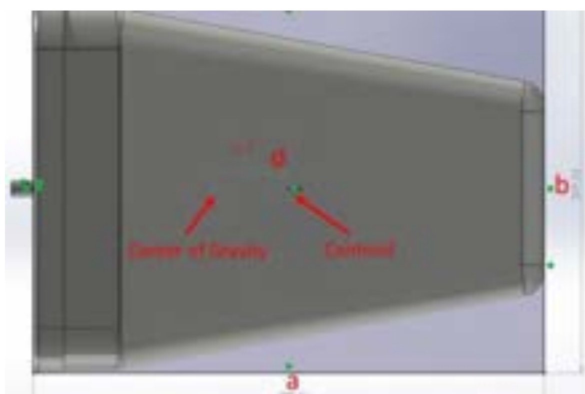

Figure 40: Largest Antenna Profile Area

Solving for I:

$$I = \frac{M}{12}(a^2 + b^2) + Md^2 = \frac{M}{12}(a^2 + b^2 + d^2) \tag{4}$$

$$I = \frac{0.91\ kg}{12}\left((0.29051\ m)^2 + (0.20955\ m)^2 + (0.04176\ m^2)\right) = \mathbf{0.00986\ kgm^2}$$

Following the requirements for the angular velocity of the tracking assembly as outlined above in section 2, the required torque can thus be found to be 3.52 Kg-cm by using the equation below:

$$\tau \geq I * \alpha = (0.00986\ kg - m^2) * \left(35\ \frac{rad}{s^2}\right) \qquad (5)$$

$$\tau \geq \mathbf{0.3451\ Nm \rightarrow 3.52\ Kgcm}$$

The overall requirements for the electronics of the system are in the interest of compatibility and the ability to have the antenna tracker system run for at least 30 minutes of consistent operation. The main components must be compatible with each other, having some communication busses in common to allow direct interfacing through an algorithm that runs to receive GPS positions of two points, calculating the vector between the two points and converting the vector into angles, then updating the motor outputs to match the angles for the pitch and yaw. The flight controller must be able to support Pixhawk firmware for copters to read the GPS position and filter out the GPS data through the MAVLINK Communication Protocol. Also, the gimbal board to control the servos must be able to accept angle inputs to direct the motors in the correct orientation.

ENGINEERING CONSTRAINTS AND STANDARDS

The constraints of this project are mainly set by the limitations of the technology and hardware selected. The directional antenna selected has a radio frequency range of 900MHz. The GPS module has a position error of 1 meter. The drone for testing (reference drone frame is the Tarot T960) has space limitation for the payload, meaning the maximum dimensions of the antenna tracker system are 500 x 200 x 100 mm (20 x 8 x 4 in). The weight of the overall assembly should total less than 10 lbs., since the weight of the drone's payload affects its overall effectiveness and range of operations. Another factor to consider for constraints is the method of production. Utilizing FDM 3D printing allows for rapid prototyping, lower cost to produce, and the ability to create complex shapes, but the drawbacks are the limitations of the printing space based on the printer. The tolerancing in FDM 3D printing is another factor which ranges up to 3 millimeters. The price to build the antenna tracker assembly is also limited to under $1600.

Engineering Standards [6] [7]

- ISO/TC 20/SC 16 – Unmanned Aircraft Systems Standards
    - ISO/TC 20/SC 16/ WG 1 [6] – General
    - ISO/TC 20/SC 16/ WG 2 [6] – Product Manufacturing and Maintenance
    - ISO/TC 20/SC 16/ WG 4 [6] – UAS Traffic Management
    - ISO/TC 20/SC 16/ WG 5 [6] – Testing and Evaluation
- Pixhawk – Flight Controller
    - DS-015 [7] – UAVCAN Drone Communication Standard
    - DS-014 [7] – Pixhawk Payload Bus Standard

TEAM ORGANIZATION AND BREAKDOWN

The project has been organized into three main aspects described as mechanical, electrical/ communications, and software. The responsibilities have been divided amongst the three team members based on previous experience and current interests. There have been weekly meetings on campus to discuss the progress on each aspect of the project, to be sure the team was constantly aware of the overall progress and the potential need to redesign based on troubleshooting.

The Bottom-Up method shown in Table 1 below is an alternative to a Top-Down Approach, where Bottom-Up is iterative with testing and corrections along the way, as it is meant for experimental systems that have not been created before. The work had been separated by the different categories of work in the design, each led by a team member. This outlines the bottom, mid, and top levels of the design, with the work needed to be completed to move on to the next level. The first level was most detailed, as the groundwork for the first prototype is established here, the work that follows the first prototype depended on the success of the first design and the changes required. This structure provided enough guidance and clarity for the next few steps for the team to be on the same page.

Table 2: Team Organization Bottom-Up Approach

Design Level	Software/Firmware	Electrical and Communications	Mechanical and Manufacturing
Bottom Level (Test components, continued research, primary design)	Familiarize with Drone Software and Firmware Confirm ArduPilot Configuration on all Flight Controllers Test Flight Controller IMUs on Mission Planner Apply Vehicle Type Configurations on Mission Planner for Flight Controllers Correct Parameters According to Accessory Components Establish MAVLink Communication Parameters Test Servo Communication on Copter Firmware Test Servo Communication on Antenna Tracker Firmware Test GPS Connection and Outputs Record Drone IMU Data to Determine Normal Vibration Frequencies of Different Size Drones Determine the Need for Dampening of the Antenna Tracker and Whether the Servos can Appropriately Compensate Test Multi-point telemetry configuration Test RSI (Received Signal Strength) Measurement	Upon Arrival, Check Order and Test Components Familiarize with Communication Protocols Begin Communications Testing Research 2 vs 3-Axis gimbals. Research vibration compensators (damping frequencies) Research New 900MHz Directional Antenna Begin Testing of Servo Motor control from Antenna Tracker Flight Controller Begin Communications Testing Test Multi-Point telemetry Record Drone IMU Data to Determine Normal Vibration Frequencies of Different Size Drones Wire Up All Necessary Electronics and Communications Test MAVLink Configuration and Signals Test GPS Integration to the System Connect GPS to Flight Controllers and Configure parameters Do outdoors test for value outputs Confirm Vector Calculation and Begin with Gimbal Movement	Find or Create CAD Models of Electronics Design for Physical Carrier Boards for Electronics Materials Selection Gather 3 Materials Contact Prof. Sypeck to Conduct Strength Tests Design and manufacture Specimens for Testing Conduct Tension Tests in Mech Testing Lab and gather Data Select Materials Generative Shape Design Manufacture Carrier Boards Practice Flow Simulations on Solidworks Practice Stress Simulations on Solidworks Create Testbed to Hold Reciever End GPS Create Flow Simulation of Design for the First Assembly Create Stress Simulations of Design for the First Assembly
Mid Level (First Prototype)	Testing and Analysis of Prototype 1 Test Servo Motion Within the Assembly and the Max Ranges of PWM Values Familiarize with PID Tuning the Servos Using Mission Planner Create Points for First Redesign Conduct First Redesign and Re-evaluate Scope of Project	First Prototype of Communication Network Design Communication Network Assemble and Confirm Safety of test First Communication Test Test Use of the Yagi Antenna and Connection Check GPS Vector Accuracy Check GPS Vector Create Points for First Redesign Conduct First Redesign and Re-evaluate Scope of Project	Manufacture and Assemble First Gimbal Prototype (Just for servos) Familiarize with PID Tuning for servos Testing and Analysis of Prototype 1 Create Points for First Redesign Conduct First Redesign and Re-evaluate Scope of Project
Top Level (Second and Final Prototypes)	Create New Algorithm for Control with the Redesign Troubleshoot interfacing issues Create Points for Final Redesign Test Algorithm for Final Assembly Build and Assemble Final Prototype Final Round of Tests and Results Record Demonstration Videos Complete Final Project Report	Create Wiring Harness for the Final Design with Brushless DC Motors Test GPS Position Refresh Time Create Points for Final Redesign Build and Assemble Final Prototype Final Rounds of Tests and Results Record Demonstration Videos Complete Final Project Report	Manufacture and Assemble of Second Gimbal Prototype (with Yagi Antenna) Troubleshoot Any Possible Production Issues Create Points for Final Redesign Build and Assemble Final Prototype Final Rounds of Tests and Results Record Demonstration Videos Complete Final Project Report

HARDWARE DESIGN PROCESS

The current design focuses on universality of standardized drone hardware, specifically on current operations and options of flight controllers. The antenna will be in a custom mount to the tracker's brushless DC motors and connected to a gimbal microcontroller, receiving a control signal for the roll and pitch angle values. The high-gain Yagi Antenna provides the necessary signal range and dimensions, with weight comparable to the relative size of the buffer drone. The goal of the tracker drone is to carry the Antenna Tracker as a payload and direct the antenna in a way that would enable a consistent signal between the ground station and the target drone with minimal disturbance. The difference in relative speed of target drone to the tracker drone should be in a range of 30 mph.

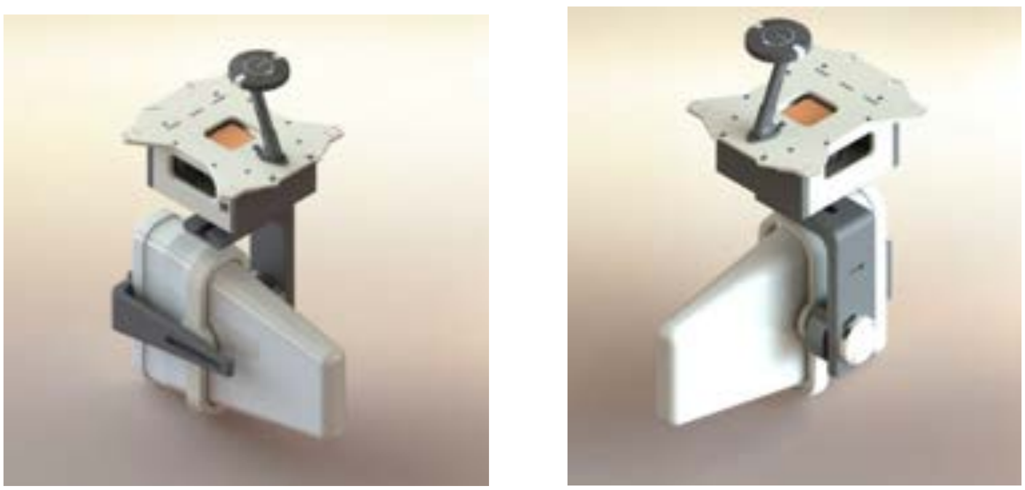

Figure 3: Two-Axis Gimbal Design

MATERIAL SELECTION & TESTING

Five candidate materials, namely HatchBox PLA, Low Weight PLA, Flexible PLA, Carbon Fiber ABS, and Resin, were selected for testing to determine the best material for manufacturing the antenna system. PLA is a biodegradable thermoplastic material that has limited strength and can warp when exposed to high temperatures. ABS is a strong and resilient polymer that can withstand higher temperatures and is commonly used for making automotive parts. Resin is a liquid photopolymer material that can produce highly detailed and accurate prints but requires a resin-specific 3D printer and post-processing steps such as washing and curing.

The materials were chosen based on their potential to meet the specific requirements of the antenna system, such as durability, weight, and flexibility. Mechanical stress-strain testing was conducted on 3D printed test specimens with 100% infill for each material to determine their mechanical properties. The resulting data was analyzed and recorded in Table 2, and a graphical representation of the data was provided in Figure 4 to aid in visualization of the results.

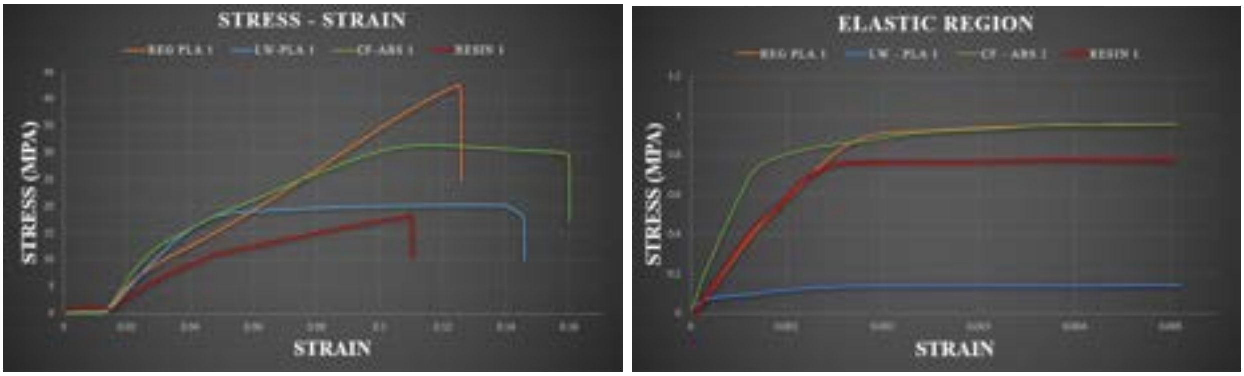

Figure 4: Stress-Strain and Elastic Region Graphs

$$E = \frac{\Delta\sigma}{\Delta\varepsilon} \qquad | \qquad \%Elongation = \frac{Final\ \Delta d}{Initial\ L} * 100\% \qquad (6)$$

Table 3: Mechanical Properties of Candidate Materials

Material	Modulus of Elasticity (MPa)	Yield Strength (MPa)	Ultimate Strength (MPa)	Percentage Elongation
Flexible PLA	26.1293	0.0523	6.5018	542.60%
Low Weight PLA	72.0199	0.1440	20.214	12.74%
Regular PLA	142.113	0.2842	43.209	10.43%
Carbonfiber ABS	509.196	1.0184	32.151	11.56%
Resin	700.018	1.4000	16.967	9.39%

A careful selection procedure using Pugh's Matrix methodology was carried out to find the best material for the antenna system. Printability was regarded as a secondary factor in this procedure, with mechanical qualities like modulus of elasticity and ultimate strength being given the highest weighted priority. After thoroughly testing and analyzing the results, it was determined that HatchBox PLA provided the most advantageous combination of features for the Antenna Tracker System.

Table 3: Pugh's Decision Matrix

Issue: Selecting most efficient		PLA	HatchBox PLA	Low Weight PLA	Flexible PLA	Carbon Fiber ABS	Resin
Mechanical Properties	20	Datum	1	0	0	1	0
Printabilaty	30		1	0	1	-1	1
Heat Resistance	10		1	0	-1	1	1
Weight	15		1	1	1	0	0
Environmental Impact	25		1	1	1	0	-1
		Total:	5	2	2	1	1
		Weighted Total:	**100**	40	60	0	15

SOLIDWORKS FLOW ANALYSIS

Through precise flow simulations, the assembly's aerodynamic shape and behavior were carefully analyzed. These simulations were run at varying wind speeds, enabling a full assessment of the assembly's performance under varied circumstances. The outcomes show that the assembly's structure, particularly the antenna, is significant in lowering and equally dispersing wind resistance, resulting in consistent performance in all evaluated conditions. Even with a wind speed of 10 km/h, it was found that the assembly's aerodynamic behavior remained within the range of even distribution and wind speed reduction. This emphasizes how crucial it is to incorporate aerodynamics into the design and testing of assemblies to guarantee their best effectiveness.

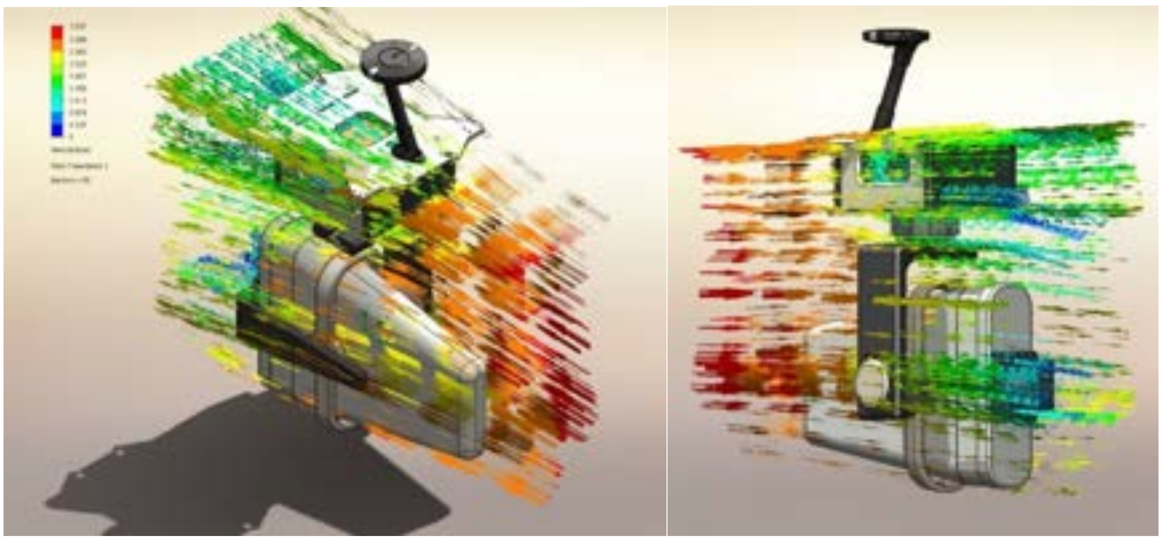

Figure 5: Aerodynamic Flow Simulation of Assembly Mk3.3 at 10kmph

ELECTRICAL COMPONENT SELECTION

As stated previously, a major focus of the design was the prioritization of standard drone hardware. For the operation of the antenna tracker, majorities of the electronics chosen are those that are commonly accessible and available to drone hobbyists, or at the very least able to interface with these devices for a simple “plug and play” architecture. Being the most popular type for drone rotor systems, BLDCs (Brushless DC Motors) were chosen to be the main driver of the tracking assembly motion, specifically the iFlight GM6208-150T (*Figure 6*), delivering up to 4 kg-cm of torque at speeds of up to 8000 rpm.

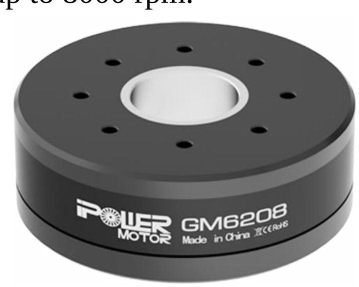

Figure 6: iFlight GM6208-150T Brushless Motor

The major advantages of this motor topology as compared to commonly used brushed DC servo motors are their superior precision, efficiency, and torque at higher speeds with less noise. The downside to the use of brushless motors however is that control of them is more complicated due to the fact they are driven by 3-phase electrical current. As such, the SimpleBGC brushless gimbal controller was chosen due to its ability to support up to three total motors (pitch, roll and yaw). In order to interface between the drone flight controller and the gimbal controller, a subsequent companion computer was needed. The Arduino Mega 2560 (*Figure 8*) was chosen to suit this need due to its widespread use and accessibility in various robotics applications. The specific functions of this microcontroller are to receive GPS positional data from the drone via MAVLINK communication protocol and to create a control vector that will be sent to the SimpleBGC via serial interface. A better depiction of this flow is described in Figure 7.

Figure 7: SimpleBGC Brushless Controller

Figure 8: Arduino Mega 2560

CIRCUIT SETUP

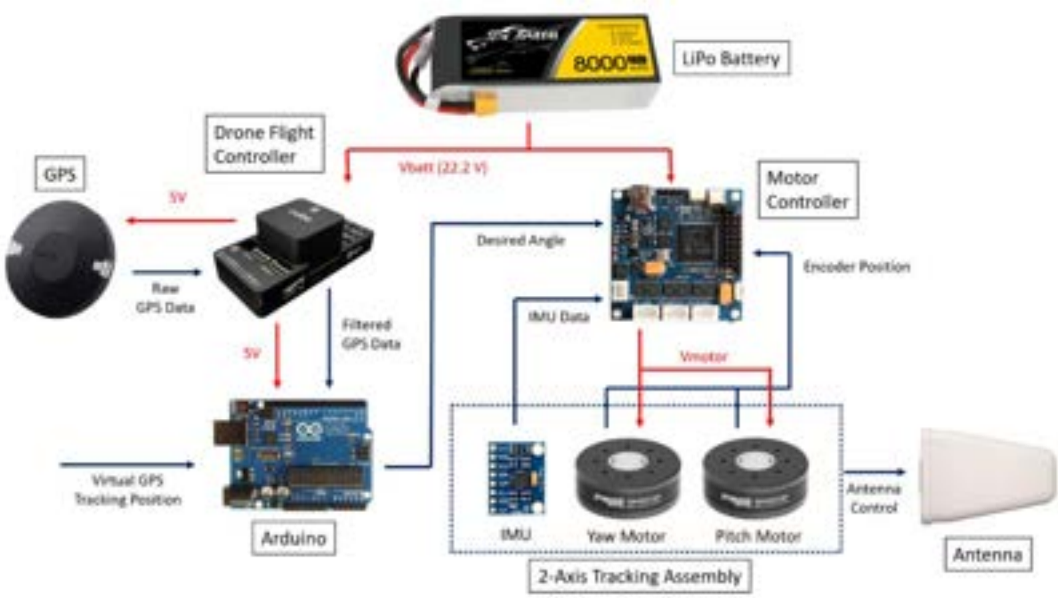

Figure 9: Wiring Schematic

SOFTWARE FLOWCHART

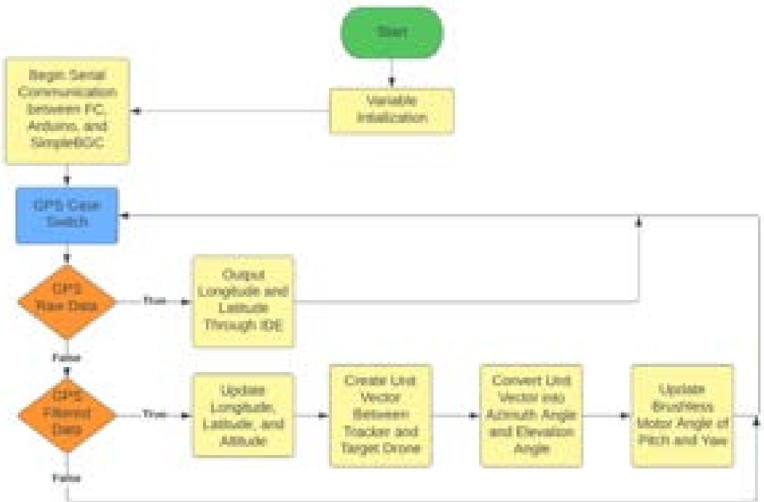

Figure 10: Software Logical Flowchart

The Ardupilot copter firmware on the flight controller, referred to as the CUBE, of the drone is common and allows for the filtering of GPS longitude, latitude, and altitude through a C++ library called mavlink.h based on the MAVLINK Communication protocol. This communication protocol hosts up to 255 concurrent systems transferring data between multiple computers. The Arduino microcontroller implements a C++ algorithm using the library to filter out the GPS point and calculate the unit vector between the tracker drone and the target drone. This vector provides the azimuth angle, the angle between North, measured clockwise around the observer's horizon, and the elevation angle to output values through UART pins that allow transmission and receiving. The Simple BGC Extended board is the compatible gimbal controller board that uses the UART signals to update the pitch and yaw signals through pulse width modulation (PWM), and it holds a stable position of the antenna as the positions continue to refresh each time the filtered GPS data is updated.

CONCLUSION

The project resulted in a completed assembly of a drone-mountable antenna tracker system that can control the direction the high gain antenna points based on the GPS position of two drones and maintain a stable position hold at a total production price of $1,532.01. This project has enormous potential for future works on a larger scope with more time to establish telemetry connections between the two drones and the ground station, completing the overall drone-mounted antenna tracker. The outcomes of this project can provide wider access to this type of reliable antenna tracker technology, provide longer ranges for search and rescue missions, and help with monitoring the environment for vital live updates. In addition to establishing telemetry to complete the functionality of the antenna tracker, future improvements include testing with a target drone to also provide the live feed of GPS positions through filtering of the data transmission and including a failsafe for the target drone in case signal is lost to return to the last known GPS of the tracker drone, as the antenna scans the airspace to lock back on to the target drone telemetry.

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Benjamin Franklin