New Paltz
STATE UNIVERSITY OF NEW YORK
School of Science & Engineering

DIVISION OF ENGINEERING PROGRAMS

2024 ENGINEERING DESIGN EXPO

Friday, May 3, 2024

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Welcome to the 2024 Annual Engineering Design Expo!

The Senior Design Expo showcases the efforts of our students to design and manufacture projects that address real-world challenges. It represents an opportunity for our students to demonstrate their skills, knowledge, and passion for engineering to a diverse audience comprising of industry experts, esteemed faculty members, fellow students, and members of the public.

This year, 60 students from computer, electrical, and mechanical engineering majors have worked collaboratively on 12 projects focusing on various applications ranging from smart robotics, signaling systems, surveillance devices, drink makers, and battery chargers.

To our sponsors, ELNA Magnetics and Central Hudson Gas & Electric Corporation, we extend our gratitude for your financial support and invaluable collaboration throughout this journey.

To our industry partners, your guidance and real-world insights have played a pivotal role in shaping the success of our students' projects. We are immensely grateful for the opportunity for our students to engage with industry professionals, fostering connections that will undoubtedly shape their future careers.

To the faculty members who have served as project advisors, thank you for your dedication, mentorship, and tireless efforts in guiding our students through this transformative experience. Your expertise, wisdom, and commitment to excellence have empowered our students to achieve their fullest potential.

And to our guests, we invite you to immerse yourselves in the innovation and creativity on display today. As you explore the exhibits, interact with our students, and witness firsthand the impact of their projects, we hope you will be inspired by the possibilities of engineering to create positive change in the world.

Finally, congratulations to our graduating seniors for their remarkable achievements. As they graduate, it is our hope that they will use the knowledge skills and experiences they have gained during their time at SUNY New Paltz to drive innovation, solve complex problems, and shape a brighter future for everyone.

Once again, welcome to the 2024 Annual Engineering Design Expo. We hope you enjoy this celebration of ingenuity, collaboration, and excellence.

Warm regards,

Heather L. Lai

Heather Lai
Acting Co-Chair

Rachmadian W

Rachmadian Wulandana
Acting Co-Chair

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SENIOR DESIGN II

Team 1

Autonomous Library Scanning and Inventory Robot

Michael Perry (CE), Benjamin Jon (CE), James Gordineer (ME),
Shane Lapp (ME), John Duffy (EE)

Advisor: Dr. Damodaran Radhakrishnan

Co-Advisor: Anthony Denizard

Stakeholder: SUNY New Paltz Library

Abstract

A robot was designed to autonomously move around the SUNY New Paltz library to scan bookshelves and keep inventory of books. This allows library employees to work more efficiently on more urgent tasks. The project involves building upon the robot's electrical components, mounting a tower-like structure to the robot's frame, and programming movement, sensors, and autonomous navigation for the robot. The first few weeks of the project were spent on design preparation. During the rest of the year, significant progress has been made on the robot's design and components. Side plates have been designed for the robot's base to secure electronic components and prevent dust and debris from interfering with the components. Brackets were designed to secure the side plates to the chassis and mount the camera tower to the top plate. Mounts were designed for the lead-acid batteries, cameras, and Surface Pro. The safety factor of the internal wiring and electrical components has been improved, as has compatibility between components. Several components were connected to a custom-made PCB to reduce the overall size of the electrical system. A charging system was designed for multiple lead acid batteries in parallel and series. An object detection model was implemented for the robot, which was fine-tuned to better recognize common items in the library. A simplified path routing system uses the object detection model to give the robot knowledge of its location and where it should travel next. A web interface and mobile app were designed to allow humans to view and control aspects of the robot. Both interfaces communicate with a program in the robot that allows for fine motor control, movement control, automated turns, and cruise control.

Team 2

Recovery Apparatus for High Altitude Balloons (RAHAB)

David “Eli” Reid (EE), Andrew Sykut (CE), Amir Movahedi (ME),
Anthony Ksar (ME), John Bowers (ME), Suliman Hindiyeh (EE)

Advisor: Dr. Wafi Danesh

Co-Advisor: Graham Werner

Abstract

The goal of this project was to develop a recovery apparatus for a high-altitude balloon (RAHAB). This system was designed to withstand extreme atmospheric conditions at altitudes up to 100,000 feet and relay the landing location of the payload to team members on the ground. While in the air, the payload of the balloon is collected and locally stored, as well as temperature, three axes of acceleration, and coordinates. The unique challenges of operating at high altitudes included sub-zero temperatures, high winds, and precipitation. The thermally insulated shell housed all electronics safely during its flight and protected them from low temperatures. The electrical systems and Arduino code stored and processed the collected data and sent landing coordinates to team members’ phones. This project spanned two semesters, with the autumn of 2023 dedicated to designing and testing multiple payload prototypes and the spring of 2024 dedicated to refining prototypes and conducting a final test. The significance of the RAHAB lies in its potential to enhance atmospheric research and climate study by providing a cost-effective and reliable recovery apparatus that can be used with any type of weather balloon. The project’s success could pave the way for more frequent and diverse HAB missions, contributing valuable insights into our atmosphere’s behavior and composition.

Team 3

Smart Portable Traffic Signal System for Single Lane Construction

Joshua Caufaglione (CE), Jimmy Curley (EE), Matthew Parra (ME),
Noah McDonough (ME), Junior Pierre (EE)

Advisor: Dr. Vincent Liao

Abstract

This project is comprised of two independent rotating signs. Each sign is positioned at a different end of the construction zone (one side “Slow” and the other side “Stop”) to direct traffic flow in a single lane like flaggers. The goal of this project was to minimize vehicle wait times while promoting the safety of drivers and workers. To achieve this, each sign contains a camera, a 180-degree servo motor, an ultrasonic sensor, and a microcontroller. The camera streams a video feed over Wi-Fi, and computer vision is used to detect when a vehicle approaches. The ultrasonic sensor counts the car as it enters or exits the lane. The microcontroller keeps track of this data and communicates over radio to the other sign accordingly. In addition, this data is displayed on a webpage so that the traffic scenarios can be monitored live. This webpage can also send messages to the signs for overriding and change them both to “Stop”. The system keeps track of how many cars are in the lane to ensure a sign never changes to “Slow” when a car is still passing through. This project successfully decreases vehicle wait time with the use of sensors and improves safety by removing two flaggers from standing in the flow of traffic. This project only touches the surface of computer vision, but with future improvements such as object tracking and a more efficient pretrained model for vehicle detection, vehicle wait times can be further reduced.

Team 4

Remotely Operated Submersible for Surveying, Information and Exploration—R.O.S.S.I.E

Kyle Kravitz (ME), Adam Hovling (ME), Braiden McDaniel (ME),
Hunter Wiedenkeller (CE), Jharred Lewis (EE)

Advisor: Dr. Mahdi Farahikia

Abstract

In this project, we developed a remotely operated vehicle (ROV) tailored for efficient, accurate, and cost-effective environmental data collection. Our ROV integrates key sensors, including strain gauges for pressure and depth, pH, turbidity, and lidar proximity sensors. Real-time data acquisition is facilitated, enabling comprehensive monitoring and study of underwater ecosystems and environmental conditions. The control system design prioritizes seamless maneuverability and precise data collection, empowering the ROV to navigate complex underwater terrains. Throughout the project's initial phase, we successfully implemented a cohesive sensor integration, data acquisition, and ROV control system, uncovering valuable insights into previously inaccessible underwater realms. Our focus on diverse underwater environments demonstrates the ROV's efficacy in data collection missions. The collected environmental data not only contributes to ecological studies but also holds significance for environmental monitoring and scientific and industrial research. The project's completion phase involved refining the ROV's capabilities and conducting further data collection missions to enhance its adaptability to various underwater scenarios. This project holds broader implications for marine science and technology, offering a unique tool for understanding aquatic ecosystems, biodiversity, and oceanography. Our ROV offers a cost-effective and accessible solution, making a meaningful contribution to the broader field. It appeals to a wide audience interested in advancing environmental research and exploration.

Team 5

Boat Sampler Apparatus

Aidan Ogden (ME), Bianca Bermudez (ME), Christian Martinez (ME), Danielle Matero (ME), Maira Nadeem (CE)

Advisor: Dr. Mohammad Zunoubi

Abstract

The Boat Sampler Apparatus is an innovative RC boat designed for efficiently gathering water samples in challenging environments. Our project involved engineering and testing the boat to ensure its effectiveness in collecting vital data for water quality testing. We embarked on this endeavor to provide environmental scientists, such as the SUNY New Paltz Biology Department, with a reliable tool for accessing hard-to-reach bodies of water. The samples collected with the Boat Sampler Apparatus are essential for analyzing contaminants and other factors impacting water quality, contributing to efforts toward environmental sustainability. Through our research, we found that the Boat Sampler Apparatus enhances our ability to gather water samples from previously inaccessible locations, thus expanding the scope of environmental research. This information is crucial for understanding and protecting aquatic ecosystems and guiding strategies for their conservation and management. In the future, we plan to utilize the data obtained from the Boat Sampler Apparatus to further our knowledge of aquatic ecosystems and inform evidence-based decision-making processes. By continuing to integrate this innovative technology into environmental research, we aim to contribute to the ongoing efforts to protect and preserve water resources for the benefit of both current and future generations. The advancements made through our project have the potential to drive positive change in environmental science, leading to more sustainable practices and improved stewardship of our precious water ecosystems.

Team 6

Self-Balancing Mechanisms

Tyler Miller (ME), Brenden Wisnewski (ME), Selina Dziewic (EE), Michael Taussig (EE), Yiwen Jia (CE)

Advisor: Michael Otis

Abstract

This project focuses on the design and fabrication of two self-balancing dynamic systems: a three-axis control system, referred to as the Cube, and a one-axis control system. The Cube utilizes a proportional, integral, and derivative (PID) controller to achieve stabilization on its edge and vertex and uses three inertia wheels powered by three brushless DC motors as its physical drivers. The fundamental concepts of control theory and system dynamics are widely used in robotics and automation, and the team's objective is to apply these principles on a smaller scale. Formulating a system of equations for the Cube on its vertex is beyond this project's scope; therefore, the team will employ a tuning approach for the PID gain values. The design and simulation of the one-axis system aim to demonstrate the students' grasp of the system dynamics and control theory utilized through the design of a space-state controller. Each engineering discipline is encapsulated in the Cube, balancing a physical object using motion generation and tracking the object's position using a system of sensors. Effective communication between all systems is ensured through a microcontroller. This interdisciplinary, research-oriented project is approachable for undergraduate students to comprehend complex system dynamics and control theory.

Team 7

Drinking and Mixing Unit (D.A.M.U)

Brandon Koszyk (CE), Giani Arias (CE), Zhipeng Zhong (ME),
Brett Hoenig (EE), Juliana Acevedo (EE)

Advisor: Dr. Damodaran Radhakrishnan

Co-Advisor: Dr. Ping-Chuan Wang

Abstract

The Drink and Mixing Unit, or D.A.M.U., is an automated mixed drink-making machine. It contains four beverage containers to hold the liquids of choice, an LCD display, and four buttons to choose from these four liquids. There will be a left, select, right, and power button, with the left button decrementing the current beverage choice and the right button incrementing the current beverage selection. The select button will choose the current beverage, with the left and right buttons now decrementing and incrementing the percentage of the cup the beverage will fill (0–100%). Once the percentage is selected with the select button, the left and right buttons now decrease and increase the cup size (default of 8 fl oz), respectively. Once the liquid amount has been specified and the select button is pressed once more, the solenoid valves controlling the beverage flow will open for the selected beverage container for the time needed to dispense the desired liquid amount via gravity. The power button turns the machine on and off. Aspects of electrical, computer, and mechanical engineering are in use in this project. The STM-Nucleo-F466RE board was wired up and powered by the electrical engineers, and the code to control the board was written by the computer engineers. The electrical engineers came up with the wiring design to power the board and valves, as well as a current amplifier for the communications between the board and the valves. The mechanical engineer designed the beverage containers and the case that will hold the electronics in a waterproof environment. The goal for this design was to provide a precise and easy-to-use automated mixed drink machine that will be designed with cost effectiveness and convenience in mind, which the D.A.M.U. encompasses.

Team 8

Pulse Width Modulation of a Robotic Arm with Pneumatic Gripper System

Yobani Castelan (CE), Rossmery Pesantez (EE), Katarina Tomich (ME), Melissa Topf (EE), Brandon Torres (ME)

Advisor: Dr. Julio Jorge González

Abstract

In robotics, pulse-width modulation (PWM), a method for controlling the duration of electrical pulses, is essential for optimizing efficiency and providing precise control over motors. This project implements PWM in a robotic arm, allowing the user comprehensive motion control, and is designed to effortlessly lift and place objects through its pneumatic gripper system. Inspired by Boston Dynamics' warehouse robot, 'Stretch,' this design caters toward modeling engineering practices used commonly in logistics, manufacturing, healthcare, and more. The final prototype features a three-linkage arm and vacuum suction head and is equipped with worm gear reduction boxes for enhanced torque and positioning, ensuring a minimum three-pound load capacity. The entire system is controlled by an STM32F446RETx microcontroller and integrates closed-loop current feedback to precisely monitor performance. Additional features include a Bluetooth user phone application and omni-directional wheels for increased mobility and user control. Developmental stages completed in the spring semester include finalizing designs and part selection, in addition to meticulous testing and final prototype assembly. This project bridges circuity, coding, and mechanism analysis, providing comprehensive knowledge of precision-driven robotic movements.

Team 9

LED Daylight Simulator

Tristan Desilva (ME), James DiMauro (ME),
Jose Guerra (EE), Madison Schirripa (ME)

Advisor: Dr. Heather Lai

Stakeholder: Justin Pollak, Selux Corporation, Highland, NY

Abstract

The goal of this project is to design a functional daylight-simulating fixture that can fit into a standard ceiling tile for easy integration into existing commercial or residential spaces. This aims to create a better environment for people exposed to artificial lighting. People who regularly encounter light that is not full spectrum are at higher risk for disruptions in circadian rhythm, migraines, and decreased productivity. Focused on understanding the biological impacts that daylight has on humans, the team worked to develop a combination of RGBW and white LEDs that would closely mimic sunlight and put out the full electromagnetic spectrum. The team's research found that Selux drivers and programming had the capability of producing the spectral output required to closely mimic that of natural daylight. Using a spectrometer, the light spectrum distribution was measured from the designed fixture and compared to sunlight. The fixture also changes the intensity and spectrum throughout the day, as it would in the natural world. The LED fixture gives a solution for integrating natural daylight into environments that otherwise would not have it.

selux

Team 10

Disc Golf Performance Tracker

Adam Brawn (ME), Patrick Ford (ME), Anthony Abraham (EE),
Chris Nguyen (EE), Oren Wolff (ME)

Advisor: Graham Werner

Abstract

This project's goal was to create a small, detachable device that can record the statistics of a disc that is thrown. The project used the accelerations and rotation of a disc to record the motion of a throw and used that data to derive relevant statistics to help a player improve their game. The primary statics included are velocity, rotation speed, angle on release, and wobble of the disc. Using principles of dynamics, equations were then implemented that could find the required statistics from a single accelerometer and gyroscope sensor package. The sensor chosen for this application used MEMS technology to detect a force in one direction and calculate the acceleration using Newton's Second Law. With a single sensor package, the size of the whole device would remain small while still measuring the required acceleration by using different techniques and equations. This device can also store data on an SD card and can be extracted after the user is done playing their rounds of disc golf. This achieves the main goal of the project by outputting those invaluable statistics. The ability to read real-time statistics on a course gives the player a way to improve their game after every throw.

Team 11

Society of Automotive Engineers (SAE) Inspired Baja Car

Joey Aguiar (ME), Robert DeLaurentis (ME), Erin Downs (ME),
Jean Guillotin (EE), Evan Schafer (ME)

Advisor: Graham Werner

Abstract

The Society of Automotive Engineering (SAE) Baja Competition is an event that allows engineering students to apply the principles of automotive design to a competition-grade off-road vehicle. The competition consists of a rigorous off-road course demanding assessments of stability, handling, suspension travel, and overall build quality. Creating a vehicle requires strategic time management and advanced knowledge of automotive design. Our design goal was to produce a Baja-style vehicle while adhering to the SAE design constraints—to produce a well-rounded, high-performance vehicle. Using an SAE Baja-compliant frame and roll cage previously fabricated by students, our team has implemented new designs of vehicle systems into the existing frame. During this project, we adapted parts acquired to fit the frame, created a CAD model to assist with the analysis and fabrication process, and created drawings for parts that needed to be machined. The group learned how to face challenges with critical component design such as suspension mounting points, and found ways to optimize our design while adhering to SAE specifications. Completing the tasks associated with the project helped us improve on necessary skills such as networking, time management, and working as a team. This challenging yet extremely rewarding project will inspire engineering students to explore the world of automotive design and manufacturing.

Team 12

Efficient Electric Vehicle Charger

Daniel Matthews (EE), Lucas Seyoum (EE), Chris Chiera (ME), Harel Yosef (ME), Sean St. Lucia (ME)

Advisor: Dr. Ping-Chuan Wang

Stakeholder: Kai Di Feng, Lead Consultant, IKM Technology

Abstract

The aim of this project is to improve the performance of current electric vehicle charging apparatuses by addressing their limitations and introducing innovative features. The primary objectives are to reduce the increase in contact resistance of the charging prongs and implement a temperature monitoring and shutoff device. This reduction in resistance and operating temperature is accomplished through a decrease in friction at the points of contact as well as increasing pressure at those points. A clamping mechanism will be implemented to avoid wear and tear on the conductors, which will improve the long-term performance and reliability of the charger. Our project showcases an innovative mechanism that uses the principles of machine kinematics and electrical circuitry. The mechanical design is constructed through the combination of sliders, links, and rollers, enabling precise motion control and structural stability. The electrical design is optimized for safety and efficiency, employing a combination of switches and relays to facilitate an automatic shutdown of the device in the event of excessive temperature elevation. The mechanism developed within this project represents a scaled prototype, embodying the foundational concepts and technologies essential for the envisioned application. While this model demonstrates the feasibility and potential of our design, it also highlights the scope for further refinement and development.

IKM Technology

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