DIVISION OF ENGINEERING PROGRAMS

Virtual Engineering Project Review

Friday, December 15, 2023

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

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Table of Contents

SENIOR DESIGN I

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 is being designed to autonomously navigate the SUNY New Paltz library to scan bookshelves and keep inventory of books. This will allow library employees to work more efficiently on more urgent tasks. The project involves building upon the robot's existing electrical components, mounting a tower-like structure to the robot's frame, and programming movement, sensors, and autonomous navigation for the robot. The individuals working on this project include not only the senior design team, but also a computer science capstone group, who are working primarily on scanning and taking inventory of books into a database. Their work will be integrated with the senior design team, which will result in a reliable, comprehensive design. The design team has been working with the experience and knowledge gained from previous courses and is further developing those concepts as well as new concepts addressed through research and implementation of this project. The first few weeks of the project have been spent on design preparation. This required coordination of the team, effective channels for communication, and discussions on the scope and roadmap. Effective devices and methodologies have been used to manage the large project and hold the team together: a Gantt chart to keep track of milestones and progress, and the Agile Scrum methodology. The Agile Scrum methodology is implemented using Jira, a software that makes it easier to plan two-week periods of work, from which the team can reflect and improve our processes for the following sprint.

Engineering SENIOR DESIGN I Fall 2023

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 the project is to develop a modular recovery payload that can be attached to a high-altitude balloon (HAB). This system is designed to withstand extreme atmospheric conditions and relay the balloon's landing location while collecting and storing data such as temperature, location, and acceleration during flight. Relaying the balloon's landing location with high accuracy allows it to be recovered more successfully by its operators. The modular recovery payload design addresses the unique challenges posed at high altitudes, including sub-zero temperatures, low pressure, high winds, and the inability to communicate data. A thermally insulated shell will protect the electronics from low temperatures and any impact upon landing. The use of sensors, including an accelerometer, temperature, and position sensors, ensures comprehensive data collection. An Arduino-based system manages data processing and communication. The team adheres to strict safety factors, such as payload weight restrictions, according to FAA regulations. The project schedule spans two semesters, with the fall dedicated to designing and testing multiple payload prototypes and the spring focused on refining the design and conducting final tests. RAHAB's significance lies in its potential to enhance atmospheric research, climate study, and educational outreach by providing a cost-effective and reliable recovery method for HABs. 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

Our Smart Portable Traffic Signal System for Single Lane Roadside Construction is designed to have low power consumption and use ultrasonic sensors to detect when a car pulls up to either end of the construction zone. Our design will help improve traffic flow and the safety of construction workers on site. To make the traffic sign portable, a lifting dolly-style design will be used so construction workers can easily move the lights to and from the site. To minimize power consumption, we decided against using LEDs and instead opted for a reflective double-sided sign. One side will display "Slow" the other will say "Stop."
To rotate the sign automatically, a continuous servo will be used. This was decided so that the sign could last a whole workday without recharging.
To improve traffic flow, we will be utilizing ultrasonic sensors to help detect when a car is approaching the construction zone. The sensors will also count the number of cars within the zone to ensure the light will only turn green when all cars have left the lane. This is preferred to timers because cars will not have to wait unnecessarily at the stop when no cars are coming from the other direction, and more importantly, the sign cannot switch to go when a car is still in the lane.
We will present a small-scale model with 3D-printed components of a simulated traffic signal system. Additionally, a full-scale sign will be produced for the Engineering Expo.

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

Our aim is to develop 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, temperature, pH, turbidity, current, and potentially lidar/sonar and 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 (SD1), we successfully implemented a cohesive sensor integration, and 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. Moving forward, our next steps involve 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.
By providing a cost-effective and accessible solution, our ROV contributes meaningfully to the larger field, appealing 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 RC boat that will be used to gather information about a body of water. The boat will have the capacity to be piloted across a small body of water by the operator, then lower a tube into the water to a user-defined depth. The tube will collect water samples using a syringe-like mechanism, which can be used for water quality testing. Our project will help environmental scientists, such as the SUNY New Paltz Biology Department, take water samples from bodies of water that are not easily reachable by conventional means. These samples can be tested for contaminants and other parameters to determine the quality of the water and indicate what can be done to improve it, if necessary. The team has determined the optimal shape for the boat and is coding a servo motor to power and steer the craft. Also, the team is ordering more parts and components for the boat. We aim to have all components gathered by the end of the first semester. As for the next steps, we plan to begin building a prototype at the beginning of the spring semester. Once it is fully developed, we test and refine our design. We hope to add other sensors (for example, a pH meter), but our focus is to have a working RC boat that can take water samples.

Engineering SENIOR DESIGN I Fall 2023

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 their 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 throughout this project. 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 connected to a PCB. Effective communication between all systems is ensured using 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. Damu 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. The goal of this design is to provide a precise and easy-to-use automated mixed drink machine that will be designed with cost-effectiveness and convenience in mind. It contains four beverage containers to hold liquids of choice, an LCD display, three buttons, and a slide potentiometer to choose from these four liquids. There will be a left, select, and right 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 selected beverage, and a slide potentiometer will allow the user to adjust the beverage's strength. At this point, the left and right buttons now increment or decrement the cup size (with a default of 8 fl oz). Once the liquid amount has been specified, solenoid valves controlling the beverage flow will open for the time needed to dispense the desired liquid amount. An STM-Nucleo-F466RE board will be harnessed to power and control the unit. Beverage containers will be designed as well as a casing that will hold the electronics in a waterproof environment. So far, all the required code modules have been completed, as have the test circuits to go along with them. An initial design for the case has been created in SolidWorks. With initial testing completed, a final code and circuit design will be integrated, combining all the code and circuit modules. A final design for the case will be completed, as well as designs for the beverage containers, during the spring semester.

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) is a method for controlling the duration of electrical pulses and is essential for its ability to optimize efficiency, provide precise control over motors, and enable explicit rotational adjustments. This project aims to implement PWM in a robotic arm, allowing the user to demonstrate comprehensive control of motion via an external keypad and movement interface, 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 robot aims for a five-pound load capacity and will consist of a three-linkage arm integrating a vacuum suction head, all controlled by an STM32F446RETx microcontroller. Potential design advancements include incorporating omni-directional wheels, a rotating base, and a phone application. Developmental stages, completed in the fall semester, include the selection of parts and materials, designing the arm linkage system, pneumatic system, electrical system, and part testing using microcontroller coding. This interdisciplinary approach targets an initial prototype capable of up/down motion with functional vacuum grippers by the end of the fall semester. The final model aims to include all design advancements and a printed circuit board (PCB) to simplify electrical components by the end of the spring semester. This project bridges circuity, coding, and mechanism analysis, through the application of knowledge in precision-driven robotic movement.

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 lighting fixture that can fit into a standard ceiling tile for easy integration into existing commercial or residential spaces. This creates a better environment for people who are 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 emit the full electromagnetic spectrum. The team's research found that Selux's LED drivers and programming have the capability of producing the spectral output required to closely mimic that of natural daylight. Using a spectrometer, the light spectrum distribution will be measured from the designed fixture for comparison to sunlight emission. A later goal aims to closely mimic how the spectrum of sunlight changes from sunrise to sunset using a microcontroller. This would change the intensity and spectrum throughout the day as it would in the natural world. Through this project, the team hopes to light the way toward more human-centric lighting solutions for the future.

selux

Engineering SENIOR DESIGN I Fall 2023

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

The goal of this project is to create a small, detachable device that can track the performance data of a disc that is launched by a player when it is attached to the disc. The device will transduce the rotational and linear accelerations of a thrown disc and use that data to derive relevant statistics to help a player improve their game. The primary parameters this device aims to determine are the linear velocity, spin rate, angle of release, and wobble of the disc in flight. Relevant dynamic equations can be implemented to find these parameters using a single accelerometer and gyroscope sensor package. The sensor chosen for this application uses MEMS technology to maintain a small form factor. Using a single sensor package allows the whole system to remain small while measuring all required accelerations using different techniques and equations. This device will also output legible data to the user in real time. The device will also store data onboard and transmit that information for processing and display to a GUI. The ability to read real-time statistics on a disc golf 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 is 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 will implement new designs of vehicle systems to the existing frame. In Senior Design 1, we have sourced many of the parts required to fabricate a rolling chassis, prepared the existing frame for additional fabrication, created a CAD model to assist with the analysis and fabrication process, and designed and fabricated mounting points for vehicle suspension. Thus far, the group has learned how to face challenges with critical component design such as suspension mounting points, and has found ways to optimize our design while adhering to SAE specifications. We plan to continue progressing our vehicle design and to reach out for more resources when needed. 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, Consultant for manufacturer

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 decrease contact resistance, minimize operating temperatures, and implement temperature monitoring and alerts. We aim to improve the overall reliability of the charger by developing a plug that satisfies the dimensions and specifications of existing charging stations. This will ensure compatibility with the current EV charging infrastructure. By reducing contact resistance and maintaining lower operating temperatures, increased efficiency and improved performance will be achieved. 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. The clamping mechanism will also be designed to maximize the pressure at the points of contact to keep contact resistance at a minimum. The implementation of this system will create a charging apparatus that is significantly more efficient than chargers on the present market. The risk of overheating will be reduced, which will allow for the development of even higher-powered, faster chargers in the future.

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