DIVISION OF ENGINEERING PROGRAMS

Virtual Engineering Project Review

Friday, December 16, 2022

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

Thank you

to the following Division of Engineering Programs EXPO sponsors

People. Power. Possibilities.
Central Hudson
A FORTIS COMPANY

ELNA
MAGNETICS

selux

Table of Contents

SENIOR DESIGN II

Formula New Paltz 1

Secure Package Delivery System with Android App Interfacing 2

Autonomous Light Sensitive Window Shade 3

Three-Pound Combat Robot 4

Remote Controlled Competitive Combat Robot 5

Design and Analysis of an Underwater Drone 6

Solar Powered 3D Printed Centrifugal Pump 7

Noise Cancelling Headphones 8

Self-Balancing Exoskeleton 9

High-Rise Escape System 10

Lamothermic Corp. Wax Cutter 11

Assistive Device for the Application of a Prosthetic Limb 12

Library Robot 13

Mechanical Stress Monitor 14

Solar Powered Mobile Pond Fountain 15

d33 Meter with Combined Torquing 16

Team 1

Formula New Paltz

Timothy Pforzheimer (ME), Brandon Barna (ME), Corey Spallino (ME), Liam Woods (ME), Tyler Hall (ME)

Advisor: Dr. Ghader Eftekhari (EE)
Co-Advisor: Mr. Graham Werner (ME)

Abstract

This project involves designing and constructing a single-seat, open-cockpit, open-wheel race car, with major engineering contributions going into the chassis and suspension components, while following both budget and timeline considerations. This will be completed with the utilization of abandoned components, not originally intended for this purpose, that must be re-engineered to assimilate into the new design. This car is set to be unveiled at the 2023 Senior Design Expo in New Paltz as a “ready-to-go” working vehicle. In the process, we as a group will learn and utilize all the techniques and face the challenges that engineers experience in the automotive design process, and we will be able to apply these skills to future “large-scale” automotive projects.

Team 2

Secure Package Delivery System with Android App Interfacing

Gabriel Nemeth (EE), Daniel Kennelty (EE), Acacia Mastropaolo (CE),
Matt Krumholtz (ME), Nicole Morales (ME)

Advisor: Professor Mike Otis (CE)

Abstract

This project addresses a growing need for package security and remote home access. Two potential solutions for the secure delivery of small packages without home entrance will be designed by the mechanical engineers. The mechanical designs will utilize sensors to alert the homeowner of a package delivery with an Android app that will be developed by the design team with unique and open-source code. The Android app is a human-machine interface that provides security solutions for the resident. The design will accommodate the secure delivery of large packages by allowing an authorized delivery person to have controlled access to the residence. Authorization is granted with an NFC (near-field communication) reader or by the resident manually from the app. The design team collaborated to create a plan to achieve the design with the goal of demonstrating a successful inter-curricular collaboration of varied forms of engineering with the physical creation of a functional system. The progression of the design project is managed with multiple organizational tools that provide a continuous path to completion. The design should provide an away resident with the ability to remotely secure the delivery of any size package and control home entry, satisfying the growing demands of the homeowner away from home.

Team 3

Autonomous Light Sensitive Window Shade

Eugene Gladoun (CE), Md Islam (EE), Kevin Lorenzo (ME), Mark Murillo (ME)

Advisor: Dr. Julio Gonzalez (EE)

Abstract

Light is one of the most important factors for growing plants in households or greenhouses. One of the main purposes of a greenhouse is to control the growth of plants. All plants require light for photosynthesis. Some plants do not need direct sunlight to grow, and these plants are known as low light plants. However, with light comes heat energy, and heat is harmful for all greenhouse plants. In this project, an autonomous light-sensitive window shade/blind system will be designed, in which the window shade will roll up or down depending on the intensity of the light sensed by the system. The goal for the fall 2022 semester was to design a prototype that can close the blinds depending on the intensity of the light at a controllable speed and stop based on the positioning of the blind. The prototype design was successful at autonomously closing the blind at a desired light intensity and stopping the motor when fully closed. The design mechanism and circuitry that relate to the opening of the blind at a desired light intensity will be explored and incorporated into the current prototype during the spring 2023 semester to complete the overall prototype design. This project was fundamental in incorporating the use of a DC motor and light sensors for real-life applications using a combination of electromechanical fundamentals.

Team 4

Three-Pound Combat Robot

Michael Peragine (ME), Michael DiNardi (CE), Louis Reyes (ME), Justin Rosado (EE)

Advisor: Dr. Mahdi Farahikia (ME)

Abstract

A fully functional, three-pound combat robot is being developed to compete in the Norwalk Havoc Robot League (NHRL) on May 6, 2023. The bot must follow design rules defined by the league to qualify for entry. Structural analysis, finite element analysis, kinematics, power analysis, and embedded system design are utilized to achieve this. This bot features a front vertical-spinning device intended to launch its opponent. The movement is controlled using a PlayStation 4 controller, and Bluetooth connectivity allows joystick data to be transmitted to an ESP-32 microcontroller. The body is printed using PETG, whereas the prototype was 3D printed using PLA+. Three brushless motors are used, two with gearboxes for movement and one for the spinner. The materials and components were carefully selected to ensure the best effectiveness-to-weight and cost ratio. As a result, the efforts of SUNY New Paltz will be shown to other competitors at the competition, as well as becoming a tradition at the school to grow their reputation.

Team 5

Remote Controlled Competitive Combat Robot

Darren Jackson (CE), Mike Cavaluzzi (EE), Brandon Davenport (ME), James Schramm (ME)

Advisor: Dr. Vincent Liao (EE)
Co-Advisor: Professor Ken Bird (ME)

Abstract

As a culmination of various disciplines of engineering, our senior design project focuses on the design and manufacturing of a three-pound combat robot. The plan is to design and construct a competitive combat robot with drive components, combat equipment, and a custom-made phone application for remote control. The robot is planned to be entered in a beetle-weight combat robot tournament and therefore must weigh three pounds or less. This low weight limit constrains the robot to small and lightweight components, but these components still need to withstand heavy impacts. Points of failure that the design process will focus on are the wheel connections, keeping the electrical system intact while in combat, and smooth communication between the remote control and the robot. Analysis will be used to determine the materials, dimensions, weights, and placements for each. Required torque will be calculated as well as moments of inertia, centers of mass, moduli of elasticity, stress, and strain. Software such as SolidWorks, Ansys, and MATLAB are used to aid development by helping create and analyze our robot and determine its strengths and weaknesses.

Team 6

Design and Analysis of an Underwater Drone

John Scalo (EE), Ahmed Shidid (ME), James Nelms (EE), Ethan Bonney (CE), Avery Holland (ME)

Advisor: Dr. Mohammad Zunoubi (EE)

Abstract

An underwater drone is being developed, starting with a pool vacuum. It will contain underwater camera capabilities using a GoPro camera attached to the hood of the vacuum. The drone will have full underwater operation using a remote control that connects to the vacuum through wiring. The purpose of the underwater drone is to be able to capture underwater footage for swimmers. This allows swimmers to have a way to review film and assess their technique. We found this would increase the overall performance of a swim team by providing vital feedback on their technique. We also found that being able to attach the GoPro camera will allow for live feedback of the footage through a cellular device. This is important because it can be an easily accessible way to film underwater. The main concern is going to be safety in order to make sure the drone can operate with people in the water. This means the electrical components will all be enclosed in a protective clear covering. This is to ensure that no electricity can interact with the water if something goes wrong. In the future, developers can use this idea to improve underwater capture techniques for sports that involve being submerged in water.

Team 7

Solar Powered 3D Printed Centrifugal Pump

Jacob Hulinsky (ME), Paulina Wiater (ME), Jean Mendoza (EE), Matt Skelly (EE), Christian Martinez (ME)

Advisor: Dr. Rachmadian Wulandana (ME)

Abstract

The objective of this project is the design and construction of a 3D-printed solar-powered centrifugal pump for use in the Thermofluids Lab at SUNY New Paltz. We will produce a laboratory-quality centrifugal pump and fluid/piping system to be used in a lab environment as a learning tool for mechanical engineering students. The pump will be classed for standard 2-inch PVC fittings and constructed out of a 3D-printer compatible material, such as, PLA, ABS, or PVC, with a 4-inch diameter impeller. The usage and mounting configuration, as well as the output flow rate range and mode of flow rate adjustment, will be designed with accessibility, convenience, and durability in mind to maintain ease of access and safety for any students interacting with the pump in a lab setting. The pump will accelerate water to a range of 0.5 to 1.5 m/s, or 1.1 to 3.2 kg/s, at a maximum head of 1m, requiring a power input of 25 to 63 W. Since solar panels provide direct current, the motor used to spin the impeller will have to be a DC motor. This project will inform the usage of sustainable energy and additive manufacturing technology in the design of mechanical components of fluid systems and serve as a reference point for any similar projects involving the design of dynamic fluid systems that rely on solar or other sustainable power sources.

Team 8

Noise Cancelling Headphones

Jillian Dantona (ME), Stephanie Lewis (ME), Daniel Ivče (CE), Megan Sugar (EE)

Advisor: Dr. Mahdi Farahikia (ME)

Abstract

The Noise Cancelling Headphones project will result in a functioning pair of noise-cancelling headphones designed for machine shop safety. Traditional noise-cancelling headphones eliminate all sound and leave workers unable to hear instructions or safety alarms. These headphones will allow the user to hear noises from in front and behind, while cancelling out unwanted sounds that occur on either side of the user.

This design will feature two sets of two microphones—one set on each speaker side. The microphone sets will work independently of each other. The signals between the microphones on one side will be used in a pressure gradient equation. When the gradient value is zero, the noise will be cancelled as it is occurring on the side of the user. When the gradient has a value other than zero, the sounds will be amplified through a speaker as there is noise occurring in front of or behind the user.

The design of the headphones began in the fall of 2022. SolidWorks is being utilized to design the headband and electrical housing. The headband must be adjustable to fit different head sizes. The housing must be able to fit the microphones, speaker, microcontroller, charging circuit, and battery. The microcontroller is being coded in Arduino. A physical circuit containing all electrical components is being designed. Testing, development, and refinement will continue in the spring of 2023.

Team 9

Self-Balancing Exoskeleton

Stephen Gyurtis (CE), Osiris Petty (EE), Cielo Glynn (ME), Alexander Cefarelli (ME), Austin Khlaifat (ME)

Advisor: Dr. Ping Chuan-Wang (ME)
Stakeholder: Dana Jones, CEO, Accessadoor, LLC

Abstract

This exoskeleton project is designed to serve people with neuromuscular disorders by assisting them in the standing and balancing processes. The exoskeleton market is increasingly growing while technology is continuously advancing. With the improvements in sensors and microelectromechanical systems (MEMS), supporting and stabilizing a person who cannot do so on their own is now achievable. The MEMS used in the project include accelerometers, gyroscopes, and magnetometers, which were equipped in parallel to create an inertial measurement unit (IMU). This IMU is the backbone of the stability system, and the data from the IMU will be interpreted using C/C++ coding methods. From these interpretation methods, signals will be sent to the linear actuators to stabilize the position of the exoskeleton. The exoskeleton will be modular in design, with user-friendly features such as comfortable Velcro straps and harnesses. Further exoskeleton research is necessary for people affected by neuromuscular disorders to stand and stabilize at a more accessible level.

Team 10

High-Rise Escape System

Alexis Van Vorst (ME), Patrick Pinello (EE), Mia Waddell (ME), Johnathan Roberts (CE), Donovan Dalton-Fiallo (ME)

Advisor: Dr. Damodaran Radhakrishnan (EE)
Co-Advisor: Dr. Ghader Eftekhari (EE)

Abstract

The purpose of this high-rise fire escape system is to safely lower a person from a window to the ground in the case of a fire being present. This escape system is an alternate option to a staircase, for a situation where the staircase is unavailable and/or a person is unable to use stairs. The overall escape system consists of a pulley system powered by a motor. The motor is attached to a gearbox with a gear ratio designed to make the output speed slower than the motor speed. The system operates based on code that makes the end of the pulley go to the necessary floor, then to the ground, and back up to whichever floor is needed next. Throughout the process of developing this system, we found that it is more important to produce a project that upholds the ideals of engineering rather than to force a design idea where it is not needed. This is extremely important for understanding how to accurately assess the value of proposed features in a given project. In future design iterations of this project, a feature's ability to improve the system's functionality will be given more weight than how interesting or challenging it is.

Team 11

Lamothermic Corp. Wax Cutter

Michael Agunbiade (ME), Giovani Colindres (ME), Brendan Cunningham (ME), Leiden Luraschi (ME), Gregory Milks (EE)

Advisor: Dr. Kevin Shanley (ME)
Stakeholder: Garrett Noach, VP of Manufacturing, Lamothermic Corp.

Abstract

In the metal casting industry, wax is used in the mold-making process. Lamothermic Corporation requires an apparatus that can reliably and safely cut the wax into blocks. Current market solutions do not meet the needs of the stakeholder. Lamothermic requested a fast, accurate, and repairable tool to meet production demands. A three-point bending test was done to determine the properties of the wax blocks at various temperatures. At a temperature of 35°C and above, the wax becomes ductile, producing a clean cut. At room temperature, the wax is very brittle and shatters. Using this data, different cutting methods were tested. The first cutting method, using friction with a serrated wire produced inaccurate cuts and was not reliable. The next cutting method featured shear stress, using a blade. This method causes the wax to shatter and is not viable. However, heating the blade allows for a clean cut. The last cutting method tested was a heated wire, which produced cuts comparable to the heated blade. From the information gathered future improvements include designing a frame, making the cutting tool faster and cleaner, and adding the ability to cut at various angles.

Team 12

Assistive Device for the Application of a Prosthetic Limb

Bryan Han (ME), Bailey Yewchuck (ME), Micailah Conway (ME), Jake Pennisi (ME), James Santo Salvo (ME)

Advisor: Dr. Heather Lai (ME)
Stakeholder: Billy Franz, Prosthetic and Orthotic Associates

Prosthetic & Orthotic Associates

Abstract

The focus of the project is to address three main issues users of prosthetic devices experience: volume change, overheating, and prosthetic alignment. Several ideas and prototypes were discussed, and it was decided that improving the prosthetic alignment would be reasonable. This is because an alignment device would not require the prosthetic socket or its main components to be heavily modified. Though addressing overheating and volume change was also proposed, it was learned that these approaches were outside the scope of the group's design intentions. Every patient has unique anatomy and physical capabilities, which makes it challenging to create a universal design. Iterations of the prototype must incorporate infinite adjustability, ease of use, and utilize the pre-existing geometry of the socket. The end goal is to create a device that someone could use without having to think about it extensively.

Team 13

Library Robot

Madison Gillis (ME), Nicole Kleinegger (ME), James Barry (EE), Justin Warner (EE), Michael Kowalchuk (EE), Andrzej Lisiecki (EE)

Advisor: Dr. Damodaran Radhakrishnan (EE)
Co-Advisors: Professor Anthony Denizard (CS), Professor Hanh Pham (CS)

Abstract

The function of this robot is to take pictures of the spines of the books and use software to determine which books are out of place. This information will then be sent to the librarian, so they know which books are out of place or missing. Librarians spend approximately three hours a day going around the library looking for books that were misplaced. Last year's group was able to complete the assembly of the base. The problem they ran into was not being able to get the base to function. We are continuing from where last year's design team left off. We are looking at what they left us with and working to debug and understand why the robot is not working. The circuit had to be redone, and the SolidWorks files had to be debugged. We need to find an alternative power source for our motors and build the top section of the robot. The top part consists of a 7-foot pole that holds the cameras. This semester, we looked at the inner workings of the different circuit components and configurations. From there, we found that an H-bridge circuit was used to control the direction and speed of the drive motors. We found out that we could control the direction and speed of the motors by programming and implementing a controller. Next semester, a pole will be added along with the cameras. Once that is complete, the robot will be debugged, and by May 2023, the robot will be completed and given to the library.

Team 14

Mechanical Stress Monitor

Antonio Zgombic (ME), Aidan Gregory (ME), James McGovern (ME), Maxwell Harris (EE)

Advisor: Dr. Ping Chuan Wang (ME)
Co-Advisor: Mr. Graham Werner (ME)

Abstract
One of the most important concepts in mechanical engineering is known as the theory of stress. Stress can be defined as the measure of what a material feels from externally applied forces and, in simple terms, can be described as the geometrically normalized force on an object. Stress can be broken up into four types: axial, torsion, bending, and shear. In the SUNY New Paltz Materials Lab, one of the experiments performed to conceptualize the four types of stress, along with strain, is the "Combined Loading Lab." For this design project, a modular three-pipe configuration will be designed to obtain numerical values for strain. The basis for this project is to obtain numerical values of strain in real time for students to use in order to calculate values of stress at given points on the system. Various strain gauges will be connected directly to the pipe configuration and wired into an STM32 microcontroller. An Arduino language code will then be uploaded onto the microcontroller to interpret a numerical value of strain from the voltage difference across each strain gauge using a Wheatstone Bridge circuit configuration. The digital signal from the microcontroller will then be connected into a 24-bit analog-to-digital converter, the HX711 load cell amplifier, to achieve a more accurate and stable reading. The board will then be wired to an LED display board for visual interpretation of the output strain value. The main goals for the design are to have a modular pipe configuration, ensure the safety of all users, achieve accurate numerical values, and allow for easy interpretation of values for all users.

Team 15

Solar Powered Mobile Pond Fountain

Luke Harrison (ME), Fernando Villamil (ME), Dalton Benn (ME), Mark Berlinger (ME)

Advisor: Dr. Rachmadian Wulandana (ME)

Abstract
The design and implementation of a pond fountain with self-propulsion capabilities will inhibit and prevent the growth of algae by aerating the water. Upon observing the algae bloom that occurred over the last summer and early fall in the interconnected ponds on the SUNY New Paltz campus, it was determined that a better solution to the problem of preventing the growth of the algae was required. It was apparent that the pond directly in front of the Atrium stagnated the most and thus was the most in need of aeration. This pond is in the direct view of the Atrium and the Student Union buildings, both of which are used by the school to host events, meaning that it has a high potential to leave an impact on guests and prospective students. This will be an improvement upon the currently implemented fountain as it will service a larger area. Ideally, the fountain will be solar-powered and fully autonomous. It is expected to prevent algae growth over a larger area. By the end of the first semester, a prototype of the fountain will have been produced that is capable of floating and of intaking and outputting water. For these, the hydraulic and electrical systems will have to be developed and implemented into a frame. During the second semester, additions will be implemented into the first prototype, including solar panels as the power source, a method of propulsion, and a method of navigation.

Team 16

d33 Meter with Combined Torquing

Christian DiPrima (EE), Sam-karis Oghenekome (EE), Jorben Luctamar (EE)
Cody Heller (ME), Christopher Coddington (ME)

Advisor: Dr. Heather Lai (ME)
Stakeholder: Sono-Tek Corporation

Abstract

This project will primarily include designing a meter to measure the piezoelectric strain coefficient of transducers and the electrical impedance of transducers at their respective resonant frequencies. This research and development is intended to improve the current method of assembling nozzles for the primary stakeholder, Sono-Tek. The d33 coefficient is a valuable property and will develop a method for measuring an exact value rather than relying on statistical analysis to provide a range of possible values. The primary design is split into three modes: measuring the d33 coefficient, displaying key data such as voltage and displacement, and torquing the final assembly to achieve the desired voltage. Upon further research, the Berlincourt method was deemed the most appropriate avenue for performing the measurement and allows for a compact design that does not require disassembly of the torquing unit. Our entire design is primarily broken into three (3) units: our torquing unit, our displacement unit, which we will be interfacing with our electronics unit that will house an OnLogic microcontroller with I/O interface, and our display unit that will be outputting the voltage, torque value, d33 value, and our impedance. When designing the displacement unit, it was decided that the best course of action would be to base it off the Berlin-Court method, which entails applying the same physical and electrical loads to two transducers, one of which is a reference transducer so the values can be known. The two transducers are oriented along the same line of action so that an identical static load can be applied to both. The static load is necessary to stabilize the transducers for measurement. Once the static load is applied, an AC load is applied to both transducers to excite them for measurement. Once the electrical load is applied, the resulting signals from each transducer can be measured and divided by a differential amplifier to find the d33 coefficient of the unknown transducer. Once the d33 coefficient is determined, the transducer will be put into the torquing unit, where it will be torqued to the specific voltage found from the d33 relationship between voltage and volume. The torque will be displayed on a readout in the display unit. The transducer is torqued using a MOOG motor, which is coded to torque the transducer at 1 RPM for accurate torque readings. The more accurate torque reading allows Sono-Tek to better pair transducers with similar torques together. The OnLogic Controller will process the signals and display the readouts of the d33 coefficient, the impedance from our displacement unit, the torque value from our torquing unit, and the voltage value our unit torques to, from our Logic controllers on the display screen for the user to see, and we can use that to accurately torque the nozzles. What we hope to achieve with this design is a better and more effective method of torquing piezoelectric transducers and a more accurate method of calculating the d33 coefficient of the transducer.

SUNY New Paltz
Division of Engineering Programs
Resnick Engineering Hall, 114
1 Hawk Drive
New Paltz, NY 12561
845-257-3720
engr@newpaltz.edu

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