DIVISION OF ENGINEERING PROGRAMS

2023 Engineering Design Expo

Friday, May 5, 2023

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School of Science & Engineering

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Hello and welcome to the 2023 Engineering Design EXPO!

It has been a long year, and possibly a long few years, for our students who have made it here today to put their designs on display. We are all very excited to have this opportunity to celebrate this achievement with them.

While our Senior Design teams always work hard, we were able to follow the efforts and progress of this year's teams on our SUNY New Paltz Engineering Instagram account (follow us at https://www.instagram.com/newpaltzengr/). Many of these projects have been featured there throughout the year.

Though we hope you are enjoying the EXPO in person today, we continue to host this event on our website as well. There you will find a short (3-5 minutes) video detailing each project along with a downloadable copy of this abstract book. Encourage your family, friends, and colleagues to check it out if they were not able to attend today!

I would like to extend a very special thank you to our 2023 Engineering Design EXPO sponsors:

- **ELNA Magnetics**
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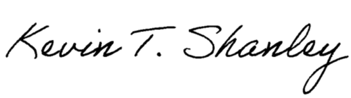
Without the continued support of our generous sponsors, we would not be able to produce such professional projects and host this special event each year.

Congratulations to all our engineers. Please enjoy the 2023 Engineering Design EXPO!

Sincerely,



Kevin T. Shanley, Ph.D.
Chair, Division of Engineering Programs

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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

While Formula 1 represents the highest form of competition, the base principles of the sport carry on to the lower levels of motorsport. This is where engineers are tasked to create the best - performing machinery that regulations allow, our team set out to accomplish this task, while adhering to the constraints set upon us, to the best of our ability.

We have designed and constructed a single-seater, open-cockpit, open-wheeled race car, with major engineering contributions going into the chassis and suspension componentry, while following both budget and timeline considerations. Completing the project required the utilization of abandoned components, not originally intended for this purpose, that were re-engineered to assimilate into the new design. In the process, we as a group, have learned and utilized all the techniques, and have faced the challenges, that engineers experience in the engineering design process, with the ability to further apply these skills in future "large-scale" automotive projects.

Team 2

Secure Package Delivery System with Android App Interfacing

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

Advisor: Professor Mike Otis (CE)

Abstract

This design provides secure package delivery and remote home access. The design allows interaction with the resident through an Android app developed by the design team with a unique and open-source code. Secure large package delivery is achieved by a successful NFC (Near field communication) card read from an authorized delivery person that will activate the front door unlock. A network of sensors in the front door area informs the resident about package arrivals and home entries through the app. A provision for the delivery of small packages without home entry is provided by two mechanical designs. Together, the design team planned to achieve the design and demonstrate a successful inter-curricular collaboration with a complete working system. The design provides 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 was designed where the window shade closes or opens 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 window blind when the system detects a desired amount of light, and the goal for the spring 2023 semester was to add on to the previously designed prototype and create a blind opening mechanism that can open the blind when the light intensity required to close the blind is not met. The final prototype design was successful at autonomously closing and opening the blind at the desired light settings, thereby blocking too much light from entering. 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 was developed to compete in the Norwalk Havoc Robot League (NHRL) on May 6, 2023. The bot's design must follow specific parameters defined by the league to qualify for entry, the most limiting constraint being the 3lb maximum weight. Structural analysis, finite element analysis, kinematics, power analysis, embedded system design, and CAD design are utilized to achieve this. This bot features a front-end vertical-spinning device intended to launch its opponent upon contact. 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 3D printed, along with motor mounts and circuitry housing, using PLA+. Three brushless motors are used, each with a 35A ESC (electric speed controller), 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, along with multiple design iterations to optimize efficiency and machinability. 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

This design focuses on a combat robot with drive components, combat equipment, a frame structure with wheels, and a Bluetooth module 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. The motors were selected to be lightweight yet with enough torque to control the equipment and drive. A turning speed controller, Drok motor driver, as well as resistors and wires, were selected to handle the currents needed to run the motors at peak efficiency. With the implementation of an HC-05 module, a Bluetooth controller was designed for smooth control and quick response. An Arduino Uno is used to convert the Bluetooth output to a signal the motor drivers can use. These components are supported by a structure designed to carry all the components, withstand heavy impacts and be lightweight. Using careful analysis with software such as SolidWorks, Ansys, and C++ an optimal design was selected for the combat robot. This is a true test of our engineering skills learned through the pursuit of our respective degrees, and it also develops skills in working in conjunction with other engineering disciplines.

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 was developed using an old pool vacuum. The underwater drone is meant to be submerged in the water and take footage of a swimmer using capabilities implemented into the design. The original pool vacuum was upgraded by attaching a GoPro camera, which will be controlled using a servo. The GoPro can provide live footage using Bluetooth to a cellular device. Additionally, using a Raspberry Pi, transistors, an inverting Op-Amp, and a PS4 controller, the system was given remote control capabilities that allowed the drone to go forward and backward. These design implementations allow for the swimmers to review recorded footage. assess their technique and allow for coaches to get a better view/perspective of their swimmers using the live footage displayed on a device connected to the GoPro. This in turn benefits the swim team and coaches so that they can see what techniques they need to improve, while allowing them to break down their technique. Throughout the implementation of the design, it was observed that when dealing with high voltages, it is important to design using parts that can withstand such high voltage; this provided new perspective when designing. This drone contributes to the development of the swim team while encouraging the implementation of "science and engineering" within sports that is beneficial to both the sports team and the group of engineers who worked on the development.

Team 7

Solar Powered 3D Printed Centrifugal Pump

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

Advisor: Dr. Rachmadian Wulandana (ME)

Abstract

The objective of this project was the design and construction of a 3D printed solar powered centrifugal pump for use in the Thermo-Fluids Lab at SUNY New Paltz. We have produced 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 is classed for standard 2-inch PVC fittings and constructed out of PLA with a stainless-steel driveshaft and ball bearing mounting system, as well as several coatings of waterproof liquid rubber seal, epoxy, and crack- sealing resin to ensure its structural integrity and prevent leaks over extended use. The mounting configuration is modular to ensure convenience and accessibility in use and storage: the pump mount attaches to the motor mount with a 3D printed bracket and screws, and the fluid storage tank has a built-in two-inch PVC pipe coupler allowing for any piping configuration. The pump accelerates 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, with an LCD display and an external voltage limiter allowing the output flow rate to be modified dynamically by the user. The results of this design project 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 which 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 were designed for machine shop safety. Traditional noise-cancelling headphones eliminate all sound and leave workers unable to hear instructions or safety alarms. However, the designed headphones will allow the user to hear important hazardous noises in front of and behind them, while also removing unwanted sounds that occur on either side of the user, such as loud noise caused by machinery.

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 each 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 that 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.

SolidWorks was used to design the headset. The headband utilized a flexible 3D printed material that allows the headband to be adjustable for different head sizes. The earpieces were printed with rigid material as they protect all electronics in the headset. The earpieces on each side both contain a speaker and two microphone PCBs. The left earpiece contains the volume adjuster knob, two digital-to-analog converters, an LED to indicate when the headset is on or charging, and a step-up voltage converter. The right earpiece contains the battery, charging circuit, battery percentage regulator, and the on/off switch. Arduino IDE is used to program the microcontroller.

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. 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. After the collection of IMU data, a BNO05 Absolute Orientation Sensor sends the data to the microcontroller (Arduino Uno) on loop, reading the orientation in real-time, and sends the appropriate signals to the linear actuators to stabilize the exoskeleton. The exoskeleton is modular in design, with user-friendly features capable of having comfortable Velcro straps and harnesses.

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 from 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 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 each 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

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 throughout the mold-making process. Wax blocks are used to create 'trees' to which the molded parts are attached to. Lamothermic Corporation requested a tool that can reliably and safely cut wax blocks, as current market solutions do not quite meet their demands. Because of the wax's brittle properties at room temperature, the wax shatters when cut unless heat is introduced. For this reason, a blade heated up through conduction from heating elements was used to cut the wax blocks. Finite element analysis was performed to determine the heat input required to get to the desired temperature in order to have an ideal operation. The chassis of the tool was designed in SolidWorks and manufactured with extruded aluminum, which was used for assembly due to its availability and functionality. The apparatus consists of a handle that has one degree of motion, horizontally, to which the aluminum blade is connected. The blade has two heating element housings that are made from aluminum due to its price and thermal properties. There is a flat base with a slit so that the blade can go completely through the wax pieces for cutting. The ability to cut the wax at various angles was added to the tool at the stakeholder's request. Testing was performed to verify the results of the FEA simulations, and

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

Abstract

The intent of this project is to make it easier for individuals to utilize their prosthetic devices. After consulting with experts in the field, two primary issues were identified. The first issue relates to releasing the tension in a BOA dial. These dials are used to secure prosthetics to the residual limb. Releasing the tension on the dials is very difficult and can cause issues for individuals with limited strength or mobility. As a solution, a BOA dial opener was developed. This solution operates similarly to a bottle opener and has been designed to be easy to use and not cause any damage to the prosthetic or any of its components. The opener was also designed to be easily 3D-printed. In doing this, it would allow for multiple iterations to be created and tested and would allow for the final design to be easily manufactured. The second issue identified was the difficulty in donning an upper arm prosthetic for double arm amputees. The current approach involves placing the prosthetic on a sticky mat, which often results in the prosthetic shifting when trying to do it. The mechanism was designed to have a quick and easy release mechanism. It was imperative that this design require minimal dexterity and movement to open and close it. Ultimately, the goal for both designs was to develop devices that can be given to patients and are simple to reproduce.

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 in the library 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 misplaced books. This robot eliminates this task from the librarian's workload. Last year's group was able to complete the assembly of the base. The main 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 by analyzing and redesigning the circuit and debugging the movement system. This included repairing the tracks and implementing a gearbox to ensure the required torque is supplied to the drivetrain. Alternative batteries were chosen to better fit the power requirements for the robot, as well as more optimized motors for the robot's specific power and function requirements. A battery charging system has also been implemented that will be able to measure if the SLA batteries are fully charged or not, disconnecting itself from the power source once the peak voltage has been observed across the battery terminals. The new upper section consists of a 7-foot pole that holds the cameras. Specialty brackets, gears, and holders were designed and manufactured for this purpose. Last semester, the existing H-Bridge circuit was modified to be used in a new program that allows the operation of the motors based on percentages of power supplied to the motors. From this base program, a semi-autonomous self-driving program is being created with the use of sensors to identify objects and people in the robot's immediate vicinity so it can respond safely. The code is being assembled in Arduino C. An app is being designed to interface with the program. Once that is complete, the robot will be debugged in May 2023, at which point it 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, or 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 its relation to strain, is the "Combined Loading Lab." For this design project, a modular three pipe configuration was constructed using galvanized steel. Each of the pipes was configured with strain gauges to analyze all four types of stress. The basis of the project was to obtain numerical values of strain in real time to analyze the stress experienced at each of the strain gauge locations. To obtain strain values, the strain gauges were connected to the Arduino Uno microcontroller. An Arduino language code was then uploaded to interpret a numerical value of strain from the voltage difference using a Wheatstone Bridge circuit. 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 is wired to an LED display board for visual interpretation of the output strain value. A tare function was also incorporated to allow for the strain value to be zeroed prior to each reading. The main goals for the design were 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

One of the most common problems plaguing both artificial and natural bodies of fresh water is algal blooms. An algal bloom is where algae or cyanobacteria grow uncurbed, often caused by a myriad of factors both natural and human induced. This can have a multitude of adverse effects, ranging from the ruining of aesthetic and ambiance due to discolored water and foul smells due to undecomposed matter at the bottom of the body of water, to the death of other aquatic life, including both plants and fish. One of the factors that promotes the growth of algae and cyanobacteria is stagnant water, so one method to deter excessive growth would be to introduce movement into otherwise placid or slow-moving water. One common way of introducing such movement is through fountains, which come in both large stationary and smaller free-floating varieties. However, both options have limitations and drawbacks. Large stationery fountains are more expensive and can be impractical to install in many locations, while the smaller free-floating ones only service a small area. This project's aim was to create a small, relatively inexpensive fountain that could move under its own power to service a larger area of water. That way, in addition to the water displaced by the fountain, water would be disturbed by the motion of the device itself. This mobile fountain could then be diploid either solo or as a part of a larger fleet, depending on the size of the body of water, and could in theory be scaled up if necessary. To achieve this, two motors with propellers were attached to a buoyant fountain housing. This solution was primarily chosen to decrease the overall cost of parts and maintain overall simplicity. While this did allow for movement, control was

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 include designing a meter to measure the piezoelectric strain coefficient of transducers as well as impedance. This research and development is intended to improve the current method of assembling ultrasonic spray nozzles for the primary stake holder, Sono-Tek. What we hope to achieve is a more effective method of torquing nozzle sub-assemblies and increasing the consistency of nozzles.
The D33 coefficient is a valuable property used to develop a method for measuring the exact displacement value rather than relying on statistical analysis. The primary design is split into three modes: the displacement unit, which measures the D33 coefficient and impedance, Sono-Tek's Align 3 system, which displays key data such as voltage and displacement, and the torquing unit which torques the sub-assembly to achieve the desired voltage based on the D33 coefficient.

When designing the displacement unit, it was decided that the best course of action would be to base it on the Berlincourt method, which entails applying the same physical and electrical loads to two transducers, one being a reference transducer with known values. The two transducers are oriented along the same line of action so that an identical static load can be applied to both for stabilization. Once the static load is applied, an AC load is applied to the test transducer to excite both for measurement. Given a known D33 value and measured voltage, the displacement of the reference transducer can be found. Using this displacement, the D33 coefficient of the test piece can be found. Once the D33 value 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 Align will process the signals and display the readouts of the D33 coefficient, impedance, the voltage to be torqued to, and the final torque value.

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