FRESNO STATE ENGINEERING 100 1922 - 2022

FRESNO STATE
Lyles College of Engineering

16TH ANNUAL PROJECTS DAY

RESEARCH
INNOVATION
DESIGN

MAY 3, 2023
2 to 6 p.m.

FRESNO STATE SATELLITE STUDENT UNION

Free admission and open to the public

engineering.fresnostate.edu

WELCOME ATTENDEES!

Thank you for attending Lyles College of Engineering's 16th Annual Projects Day. It is an honor and privilege for our students to showcase their hard work and innovative designs to the community.

The projects showcased are a culmination of at least one year of research and design activities in the disciplines of civil, computer, electrical, geomatics, and mechanical engineering as well as architectural studies and construction management. Student projects are supported by Lyles College faculty advisors, staff and industry liaisons and are funded by internal and external grants, companies and students. Thank you to the numerous industry professionals for their generous gift of time and mentorship.

Please, enjoy the showcase.

Dr. Ram Nunna
Dean, Lyles College of Engineering
Fresno State

16TH ANNUAL

PROJECTS DAY

RESEARCH • INNOVATION • DESIGN

Projects Day Coordinator
Hernan Maldonado
Director of Pathways Student Services

Communications Coordinator
Yesenia Fuentes

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Lyles College of Engineering

ARCHITECTURAL STUDIES AND CONSTRUCTION MANAGEMENT

1 California State University, Fresno | New Student Housing

Students: **Denilson Torres Cruz, Cassie DuFur, Kiet Duong, Everardo Gonzalez, Ivan Reyes, Melissa Perez Rojas**
Advisors/Mentors: **Molly Smith, Lloyd Crask**

Project Summary: Our project is a 4-story residential building aimed to provide the Fresno State students living on campus with a comfortable housing option integrated into the campus lifestyle. The building will successfully house over 625 students in bunk beds and single beds contained within over 300 dorm rooms. This luxury building features elements designed to allow each person to socialize with their fellow students. The design flow and multiple study areas will maximize student success by providing quiet spaces needed for studying. A recreation lounge, three multipurpose rooms of varying sizes, a learning center, a large communal kitchen, multiple classrooms, common areas, laundry facilities, and a coffee house on the first floor will create a "home away from home" for newly independent students. Deluxe Builders designed this building with the goal of LEED Gold status. We will build it with sustainability in mind. A structural steel superstructure with a brick veneer and metal siding exterior will create a visually appealing and efficient building located on the Southwest corner of the Fresno State campus. Multiple windows will allow for sufficient light and serve as a cost and energy-efficient method for maintaining a comfortable interior atmosphere that reduces the need for excess lighting. Deluxe Builders is a company experienced in residential facilities and design-build projects. We are excited to work with Fresno State to create their vision of a functional and elegant housing option for their students.

2 California State University, Fresno | Student Housing (Phase 1)

Students: **Kimberly Almaraz, Erick Baeza, Patty Casas, Julia Godinez, Jose Guerrero, Karley Hager, Vidal Madrigal**
Advisors/Mentors: **Molly Smith, Lloyd Crask**

Project Summary: Our capstone project, for construction management and architectural studies undergraduates, is to design, estimate and schedule a new student housing project. The project is to demolish the existing Baker, Graves and Homan Hall with the intention of replacing them with new and improved student living quarters. This is to be done in a matter of three phases and our focus is on phase one. The plan for phase one is to demolish Homan Hall and the existing pool. Our team's approach is to focus on incorporating sustainability, student input, efficiency, accessibility and overall unity. Our team believes that these capstones will ensure that the new design will be utilized to its full potential and be embraced by everyone who uses it. To give you a sneak peek, we plan on making the new dorms complement the new architecture popping up on campus while still implementing elements that pay homage to the history of the site and what still remains on campus.

3 California State University, Fresno | Student Housing Project (Phase 1)

Student: **Matthew Ernesto Bayaca, David Jimenez, Jose Antonio Padilla, Avainoor Sidhu, Jaclyn Tapia, Said Torres, Jeitsson Morales Villarreal**
Advisors/Mentors: **Dr. Vivien Luo, Loren Aiton**

Project Summary: The 2022-2023 construction management and architectural studies senior capstone project is centered around the design and construction of a student housing project for Fresno State. Each team is functioning as a design-build company. In the fall of 2022, the teams created a Statement of Qualifications (SOQ) that detailed their qualifications and design-build experience. Currently, in the spring of 2023, the teams have advanced to the Request for Proposal (RFP) phase. The architects on each team are challenged with conceptualizing and designing a comfortable and functional living space that prioritizes sustainability and achieving Fresno State's LEED Gold Certification goals. The construction management students are working closely with the architectural studies students to develop a detailed project estimate and construction schedule. Despite the expected challenges for a project of this size, the teams have learned to collaborate and value each other's ideas, enabling them to overcome obstacles and move forward toward project completion. The poster presentation will showcase the project proposal highlights developed by the "Prestige Design Build" team.

4 California State University, Fresno | Housing Project by Valley Prestige

Students: **Osiris Zepeda-Castro, Julio Lopez, Jose Angel Martinez, Darshani Patel, Fernando Velasco, Anthony Villagomez**
Advisors/Mentors: **Dr. Vivien Luo, Loren Aiton**

Project Summary: This senior capstone experience offers students the chance to apply the knowledge and skills they have gained throughout their construction management and architectural studies programs to a real-world project. By working on a multidisciplinary team, students can collaborate and contribute to the success of the project while developing essential communication skills in written, verbal and collaborative contexts. The project's goals are to enhance the first-year experience for Fresno State freshmen, promote sustainability and set a model of quality housing for the University and the CSU system. Each team member has a specific role to play in achieving these goals, with Julio leading the construction team and overseeing the project's completion, Osiris responsible for the design group and preliminary design, and Fernando serving as both the Superintendent and Sustainability Coordinator. Darshani will focus on safety measures while Angel will assist in planning the project before construction and participate in cost estimation and scheduling. Anthony will validate the project's scope of work and prepare estimates and budgets. Overall, this senior capstone experience will enable students to demonstrate their proficiency in professional construction project planning and management while preparing them for success in the construction industry.

5 Collaborative Learning in Agnostic Learning Modalities

Student: **Ninad Doke**
Advisor/Mentor: **Dr. Wei Wu**

Project Summary: The proposed work, titled "Collaborative Learning in Agnostic Learning Modalities," aims to investigate and assess different cutting-edge immersive platforms for their potential to teach students how to collaborate virtually using project-based learning as a teaching strategy. The study will focus on collaboration using three different learning modalities: in-person, online (Zoom), and virtual reality (Engage, Spatial), to examine the potential drawbacks and best practices of virtual collaboration in engineering and construction education. The study will address three research questions related to distinguishing features of virtual collaboration, identifying variables affecting the learning process and results, and examining the role of immersive platforms in improving virtual collaboration. The outcomes of the study can be used to create integration techniques for mixed reality in the classroom to teach architectural design and construction graphics, and help students improve their decision-making abilities in user-oriented design and construction. The deliverables of the project will include data analysis of previous research, YouTube tutorials on collaborative modalities, and submission of interim and final project reports. The study is expected to be completed by May 2023, and it will involve students from relevant courses such as construction management, architectural design and building technology. The proposed study will contribute to the emerging area of virtual collaboration and project-based learning, and it has the potential to enhance students' skills and knowledge in engineering and construction education.

6 Fresno State Student Housing By Hard Hat Crew

Students: **Ivan Cid, Connor Huber, Leonardo Juarez, Colton Nulick, Miguel I. Ramirez, Christina Vang, Christopher White**
Advisors/Mentors: **Dr. Vivien Luo, Loren Aiton**

Project Summary: A team of construction management and architectural studies students, also known as the "Hard Hat Crew," was assigned to design student housing for Fresno State as a capstone project. The purpose of the project is to help students gain a better understanding of the design-build method and the bidding process involved in a construction project, by applying the knowledge they have acquired in the program. Over the past two semesters, the Hard Hat Crew has created a conceptual design of a four-story residential building and a two-story community building, with a proposed budget of $55,000,000. Their design includes accommodations for 512 beds, as well as public spaces such as a coffeehouse, study rooms, and multipurpose rooms. Furthermore, they have developed a strategic plan to achieve LEED Gold certification by implementing sustainable materials and practices into their design. The project also required them to create an estimate, schedule and site-specific safety plan for the bid. At the end of the school year, they will present their project to the owners in order to compete for the project bid.

ARCHITECTURAL STUDIES AND CONSTRUCTION MANAGEMENT

7 Fresno State New Student Housing

Students: **Jonathan Alvarez, Bidal Arteaga, Derrick Choun, Alejandro Cortez, Johnathon Gamber, Quincy King, Jacob Kuhlemeier**
Advisors/Mentors: **Dr. Vivien Luo, Loren Aiton**

Project Summary: This two-semester capstone project is a collaborative effort by a team comprising both architectural studies and construction management students. The team is working to design and develop a proposal for the replacement of student housing on the Fresno State campus, intending to identify the appropriate methods and workflow necessary for providing new student housing on campus. The team will be responsible for the conceptual design of an acceptable replacement, the development of LEED strategies, and the planning of construction activities while taking into account key factors such as cost, logistics, safety, and scheduling. This team project provides a valuable opportunity for students to combine their expertise and work together to solve real-world problems.

8 Fresno State Student Housing

Students: **Yazmin Guerrero, Ashley Ibarra, Jacob McIntosh, Lupe Mojica, Marcos Ventura**
Advisors/Mentors: **Molly Smith, Lloyd Crask**

Project Summary: As California State University Fresno grows exponentially, the new student housing center location becomes more critical as there are limitations in new land developments. As a result, the proposed student housing center will be at the demolished Homan Hall, south of the existing Graves Hall building. In addition, the proposed student housing center will have three different construction phases. For this project, Exico Construction will focus on student housing for phase one of the project. Phase one will be a student housing center with the capability of providing five hundred beds and a total of 6,000-square-feet of community space. The student housing building will consist of three floors and a basement that will include an assortment of commodities. The student housing center will maintain a budget under $55,000,000 while also achieving gold LEED certifications. Moreover, the student housing center will have an exterior enclosure of tilt-up concrete and tempered glass windows. In addition, the student housing center will have parking spaces for bicycles and eco-friendly landscaping. The student housing will also have a white roof finish which should lessen the need for air conditioning and electricity overall. All of our decisions have been based on the overall experience for the residents and community users by exceeding requirements and providing the most useful and multi-function building.

9 New Fresno State Housing

Students: **Anthony Sousa, Jordan Vasquez, Logan Fisher, Samantha Delgado, Daniel Delgado, YaQuelin Murillo, Michelle Veras**
Advisors/Mentors: **Molly Smith, Lloyd Crask**

Project Summary: CM 180B is the second part of the construction management major capstone class. In this class, students are supposed to use the knowledge they have gained during their studies and their group work abilities. Students are assigned different roles as part of their group company and given responsibilities based on that roles. Some important roles assigned are project executive, scheduler, estimator, architect, drafter, project manager, and preconstruction manager. During the first part of the class, CM 180A, students were divided into four groups of about 5-6 students and tasked with working as a company to put together a Statement of Qualifications (SOQ) to qualify to be able to bid on the new Fresno State Housing project. In the SOQ package, every company had to include their team resumes, previous projects completed/experience, team statements and licenses, and a conceptual design of the project. Once all required information was submitted, each team presented their project to the owners and answered any questions regarding their company or qualifications. During the second part of the class, CM 180B, each company is working on putting together a Request for Proposal (RFP) package for the owners in which they have to provide a proposed design, schedule, and estimate to try and secure the Fresno State Housing project. One of the best benefits of this class is getting to work in close-knit teams like we would in the real world. We also experience working between different disciplines like construction management and architects. Another benefit is getting to speak with industry professionals. This allows us to get real work feedback and helps us improve our skills and ultimately our final product for this project.

10 Shallow Subsurface Artificial Groundwater Recharge (SSAGR)

Student: Sam Hawley
Advisor/Mentor: Cordie Qualle

Project Summary: Shallow Subsurface Artificial Groundwater Recharge (SSAGR) is a simple concept. We use leach lines to percolate recharge water in agricultural fields below the crop root zone. SSAGR utilizes the existing pump and filter infrastructure of a field's drip system to deliver water to the gravity-fed leach lines through a standpipe. The advantages of SSAGR are: 1) it is below the root zone, so it does not impact crop health and it does not leach residual chemicals and nutrients into the groundwater, 2) it does not impede access, or use of the field due to flooding, and 3) it delivers nearly 100-percent of the recharge water for percolation to the groundwater table. Our research will be successful if we can show that the cost per acre-foot for SSAGR is competitive with other forms of recharge which could open many acres of farmland for recharge where soil strata are appropriate. Our work is focused on researching the efficiency and cost of the SSAGR system in terms of acre-feet of water recharged as a function of the cost to recharge the water. A water balance is used to calculate the net water recharged and actual construction and operations costs are used to determine the cost to recharge the water. The poster presentation illustrates the SSAGR system, its groundwater recharge performance, and operations costs.

ELECTRICAL AND COMPUTER ENGINEERING

11 Handheld Vehicle Controls

Students: **Joe Garza, Anthony Herrick, Jesus Meza**
Advisor/Mentor: **Dr. Aaron Stillmaker**

Project Summary: The process of driving any type of motor vehicle has been virtually unchanged for about 100 years. One would use their feet to work the accelerator and brake pedal, whereas they would use their hands to turn a steering wheel to maneuver and control the vehicle. The process itself has not changed, but with advancements in driving technology, these "mechanical" actions have been digitized through electronic sensors, servos, motors and electric pumps. This begs the question, when does the process of driving evolve with the technology we are controlling? With driving being a full-body experience, nearly 25 million people of driving age possess some form of disability that limits or inhibits their ability to drive. Handheld Vehicle Controls, HVC for short, is intended to eliminate the need to use your legs to drive by putting all major vehicle controls at your fingertips. The HVC device would override the sensor inputs traditionally given by pressing one of the pedals by using triggers placed behind the steering wheel. The accelerator trigger would control the throttle using your fingers' pressure as an analog input and converting it to a digital signal between 0 volts and 5 volts. The braking pedal cannot be controlled with digital signals since it is mechanical feedback connected to a hydraulic pump. We will incorporate a digital method of applying the mechanical force to the pedal to bypass this barricade. We will use a 12V-rated DC brushed motor to drive a gear reduction set to apply the needed force to the brake pedal. The initial vehicle for testing and simulation would be a 2014 Honda Accord EXL V6, which utilizes J2534 OBDII communication protocols that can be read and written to using various softwares. Although not necessary for "rudimentary" implementation, the data from the OBDII port of the vehicle will be used to monitor live vehicle data and serve as "read" data rather than "write" data. Upon finalizing our materials, the HVC device will be centered around an STM32-Nucleo F446 microcontroller, several breadboard circuits that will control the braking and throttle overrides, triggers for input and OLED screens. Overall, the project is intended to be an accessibility device for those who cannot drive through traditional means or to change the driving technique that's been in use for so long.

12 Smart Ranch

Student: **Gabriel Aguilar, Oscar Vazquez De Leon, Anthony Sanchez, Brenden Simpkins**
Advisor/Mentor: **Dr. Shahab Tayeb**

Project Summary: To reduce the unused arable land in semi-rural neighborhoods, by reducing the manual labor required to work the land, an Internet of Things (IoT) network was created. A collection of sensors and actuators are networked together into two or more wireless local area networks (WLAN). The WLAN used within the target home uses WiFi as it is a common consumer IoT electronics protocol to allow compatibility with off-the-shelf IoT devices. The outdoor WLAN uses Long Range Radio (LoRa) to allow for packet transmission over an extended range resulting in more power-efficient transmission when compared to other protocols such as WiFi. All the devices on the garden WLAN are powered with rechargeable batteries and solar panels to allow for mobility. The garden network gathers agricultural related data (soil moisture, soil temperature, ambient temperature, ambient humidity, light intensity, etc) using sensors while regulating the water consumption used during irrigation with a valve and drip irrigation setup. Data-gathering sensors and actuators will automate many of the daily tasks that come with trying to raise a garden or farm. To support these features a remote server (Firebase) is used to manage the databases, host website, and generate analytics for the network. A graphical user interface (GUI) was developed using JavaScript, HTML, and CSS to allow the user to access the network remotely as a website. Access to the interfaces allows for the viewing of raw data, analytics, controlling actuators, configuring automated schedules and other systems. The created network will be tested to determine improvements in water consumption, power consumption, data throughput and other factors that can make the arable land easier to manage for crop growth for the landowner.

13 Smart Zoo

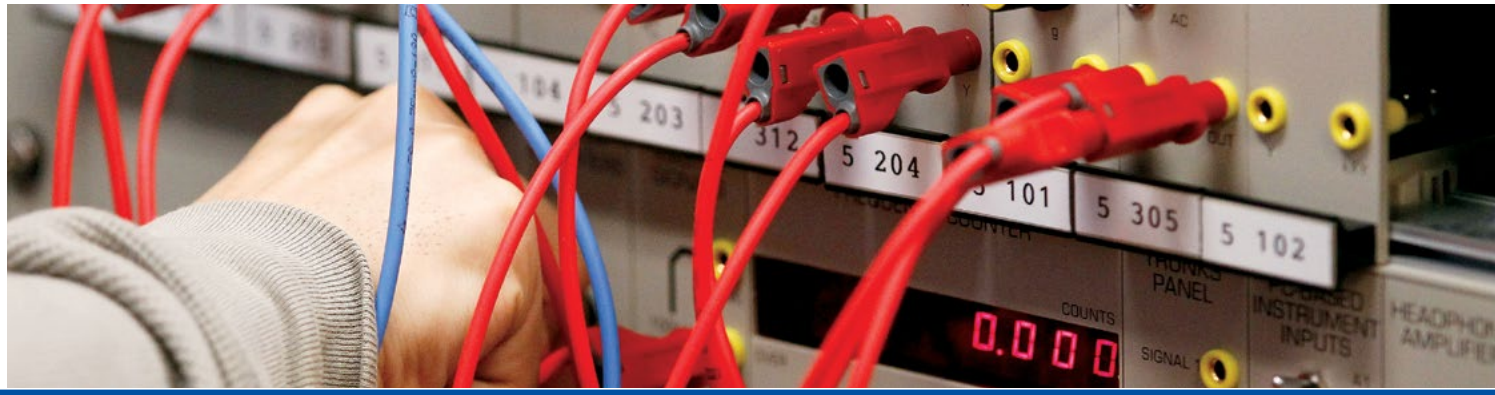
Students: **Puya Fard, Rafael Hernandez, Dominic Keifer, Sahildeep Singh**
Advisor/Mentor: **Dr. Shahab Tayeb**

Project Summary: This is a project conducted by three computer and one electrical engineering student. It is called the ”Smart Zoo” which will focus on monitoring, collecting, and storing data, which will be used for the purpose of controlling the system or environment. This project uses embedded systems, cloud-based programming, and a software-based user interface that will be developed using C++, Python and HTML. This project will aim to assist zoo workers and the zoo itself by creating a smart control environment that will protect sensitive zoo animals' safety. The method of design is described as the following: the data flow is done by first collecting data from the physical sensors configured in an Arduino UNO Rev2 microcontroller. Then the collected data will be stored in an external SD card storage that is also connected to our microcontroller. Moreover, the microcontroller will transfer this data to a collective database in the AWS cloud, which will also include machine learning to predict water and air temperature depending on other variables, along with storing all the data sent by a microcontroller. Finally, data stored in the cloud is going to be accessible via a permitted user connected to the internet using our own implemented website or mobile app. Ultimately the user will be able to monitor the data as well as send back an actuator input feedback to change the temperature of the corresponding habitat of the animal. From a safety perspective, this project emphasizes the need for an educated zoo keeper that will identify critical changes that occur to these habitats to take impactful action with the help of our controlling method. We must also keep in mind that the changes made to the environment will directly affect these animals on demand. Each smart system will cost between $250-300 depending on the quality of the sensors used for the designated zoo animal.

14 Solar Improved Electric Plane

Students: **Roberto Cazares, Raymond Kober, Jason Lawrence, Long Lor**
Advisor/Mentor: **Dr. Woonki Na**

Project Summary: Modern electric planes are limited in range and flight time due to the power density of batteries. The Solar Plane Team's project utilized a dual power system, panels along with auxiliary components, to improve the flight duration of electric aircrafts. The team utilized a scaled and modified version of the Magnix Electric Cessna Grand Caravan aircraft, showing that the addition of solar panels to the airframe of the aircraft would help improve the flight durations of modern electric aircraft. The team made modifications to the RC plane which involved adding solar panels and modifying the existing power system to accept the additional generated power. Solar panels were placed along the wing and fuselage of the aircraft. The battery was connected in parallel with the solar panels through a buck DC-DC converter. The power output of the solar panels were monitored by a Raspberry Pi Pico microcontroller to test power usage during the flight. This data was stored on a removable SD card and analyzed to determine the plane's overall power usage. Overall, the team presents a modified RC plane that has an extended flight range due to the addition of solar panels. These modifications could then be scaled up to electric aircrafts currently in production, adding to the impact that electric aircrafts have toward a more sustainable aviation future.



15 A Forward Compatibility Modular Universal Battery Pack for Electric Vehicles

Student: **Malindu Jayasekara**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: The 3-D Plasma CNC Machine is a joint effort between mechanical engineering and computer engineering students. The project was created to provide the Mechanical Engineering department with a low-cost CNC machine for use by the department. The mechanical engineering team was responsible for creating a robust platform to support the weight of stock materials and components. The system converted rotary motion to linear smoothly and accurately, utilizing rack and pinion gears for the horizontal axis and screw gears for the vertical axis. Safety features included were an emergency shutoff button to protect the user and a water table to extinguish burning debris. The computer engineering team was responsible for taking a CAD file, extracting the Cartesian coordinates, and passing the coordinates to a microcontroller that controlled the three stepper motors. An AD to DC power supply with full-bridge drivers was also created to power the microcontroller and stepper motors.

16 Battery Tester

Students: **Catalina Arriaga, Anthony Barba, Brandon Hill, Bien Ly, Rupinder Siddhu**
Advisors/Mentors: **Dr. Yuanyuan Xie**

Project Summary: To better optimize and improve the operations within Fresno State's battery lab, a universal battery tester was designed to simultaneously charge and discharge four batteries of various sizes from electric vehicle/hybrid battery cells to regular household batteries. The battery tester is controlled by a computer program housed in an Arduino UNO REV 3 microcontroller that will record time and collect the various resistance, current and voltage readings of the battery terminals. The readings from each terminal are displayed on a 20x4 LCD display. The battery tester is composed of a 3D-printed rectangular casing using Grey ABS filament 1.75mm. To formally hold the batteries in place, a spring system exists that allows adjustable sizing for batteries up to 3 inches in length while a clamping system will be used to hold the center of the cells. Additionally, batteries with different terminal shapes such as circular, square, and hexagonal are also accommodated. The tester utilizes potentiometer for altered charge/discharge rates in conjunction with breadboard.

17 Betts Spring Tester

Students: **Bilal Anwar, Tjuxci Miller, Thomas Rios, Fernando Rodriguez, Seth Williams**
Advisor: **Dr. Thế Nguyen**

Project Summary: The purpose of this project was to develop a life cycle spring tester for Betts Company. The cycle tester will be used to test and validate the calculated life by compressing spring(s) up to one million cycles. Spring testing is important as springs are used in everyday mechanical applications. The tester was designed to simulate real-world loading conditions to predict the lifespan of the spring(s). The tester consists of a motorized drive system, load cells, and feedback sensors. Spring manufacturers can utilize this tester to test the durability and reliability of their products which improves quality control, longer lifespan and customer satisfaction. The design process consisted of sizing components and selecting suitable materials for the three subsystems: the frame, preload and oscillation. This developed spring tester serves to further expand upon existing spring testing devices due to the unique design of an adjustable stroke length mechanism along with the ability to test multiple springs at high load capacities.

18 EV Battery Swapping

Students: **Ahmed Baluch, Taylor Heaton, Ayyaz Mahmood**
Advisor: **Dr. Thế Nguyen**

Project Summary: As electric vehicles have become more popular over the last two decades, several issues have arisen. For example, passenger vehicles like the Tesla Model 3 take on average 15 minutes to charge the battery enough to drive 200 miles. Faster charging can be used, but this comes at the expense of battery life. In order to overcome this issue, the team has developed a compartment that was designed to allow for modular battery swapping. Using the frame dimensions from the Tesla Model 3, three main subassemblies were developed for this compartment. The first assembly is the top cover assembly, and it is responsible for latching onto the swappable modules. It is driven by a belt and pulley system. The second assembly is the frame assembly, and it was designed to provide structural support for the modules and other assemblies. Custom cuts and brackets were used to assemble it. The last assembly is the door assembly. This assembly was constructed using a system of pneumatic cylinders, and it was designed to swing underneath the compartment and provide accessibility to two modules at a time. Materials were sourced from local vendors as well as online sources. Using Arduino boards, the systems were programmed to actuate the cylinders and other mechanical components. Finally, testing was done after the fabrication stage to check the viability of the prototypes. The designs were then updated using the results from the testing stage.

19 Field Van Chair Design

Students: **Liam Gutierrez, Atish Maman, Ian Rodrigues**
Advisor/Mentor: **Dr. Thế Nguyen**

Project Summary: Field Van, a custom camper van dealership, sponsored a project with the objective to design and build an attachment for their vehicle seat that would allow it to be used as an outdoor rocking chair. The design was projected to be either an attached and stowable mechanism on the seat itself or a separate detachable base that can be stored away within the vehicle. The product would be made available to new and existing customers either pre-installed or as an add-on option to their seats. First, a scaled 3D-printed model was made in order to grasp an overview of the design. Next, a full-scale wood model was constructed to observe the predicted motion of the system revealing movement constraints that were remedied in the final prototype. Penultimately, a final prototype was constructed out of aluminum to test the design in its entirety, including function and aesthetics. Lastly, the final product achieved was an attached, stowable, gliding mechanism capable of stowing away compactly and providing a comfortable seating experience inside the van and in the rigors of the outdoors.

20 Implementation of a Total Variation Diminishing (TVD) Scheme for Discontinuity- Capturing of a First-Order Advection Equation

Student: **Yi Hao Xie**
Advisor/Mentor: **Dr. Deify Law**

Project Summary: One-dimensional advection equation with a step wave (discontinuity) propagating to the right will be numerically captured using total variation diminishing (TVD) scheme with second-order Lax-Wendroff scheme. The numerical solution will be compared with the analytical solution of the one-dimensional advection equation with a step wave. The TVD scheme is a finite volume method that can provide highly accurate numerical solutions for a given system, even in cases where the solutions exhibit shock waves, discontinuities, or large gradients. Superbee, van Leer, and minmod flux limiter functions will be studied and compared. Applications include supersonic and hypersonic gas dynamics where shock waves tend to occur over the surface of flight vehicles or inside an isentropic nozzle.

21 Leprino Water Treatment

Students: **Wyatt Jones, Thathsara Kumara, Jonathan Swanson**
Advisor: **Dr. Thế Nguyen**

Project Summary: Water conservation is an important issue in California as water resources are limited and expensive. Leprino Foods proposed a project to recapture and treat drained water from their clean-in-place (CIP) systems. It will be reused for future cleaning in their whey production facility to increase their sustainability and water conservation. The company's estimated recapture CIP waste is approximately 600k gallons per day with an estimated savings of $633,706.6 per year ($3.74/1000 gallons) with an ROI of 18.1% per year and capital investment of $3.5 million. According to our current data analysis, the estimated average reclaim reaches 608,686.07 gallons per day with an estimated saving of $830,786.27 per year with an ROI of 23.74% per year. The final design is a 3-stage system: collection, filtration, and redistribution. The collection stage recaptures CIP water flushes that occur between chemical cleaning from several equipment centers and stores the water in one of two 60k gallon water silos. Average flow rates and operation times were analyzed to determine proper pump and pipe sizing. The filtration stage uses ultrafiltration, reverse osmosis, and ultraviolet treatment to restore the collected water to Pasteurized Equivalent Water (PEW) standard. Sampling and flow rate data provided by Leprino was used to determine the best options with vendors. The redistribution stage pumps the clean water to existing water silos that distribute PEW standard water to CIP equipment. Integration into the CIP delivery system allowed for the use of pre-existing pipe work. Analysis of Leprino's operation schedule was cross-examined with PEW water silo levels to time the delivery of filtered water.

22 Linear Membrane Welder

Students: **Mason Fraser, Colton Magill, Kelly Rodriguez**
Advisors/Mentors: **Dr. Sankha Banerjee, Mike Hawkins**

Project Summary: The purpose of this project is to provide Bay City Boiler (BCB) with an upgraded linear welding machine to develop a more efficient and safer manner in order to manufacture boiler tubes. An efficient process is necessary in manufacturing these tubes at BCB as an average of 1,000 tubes are manufactured yearly. One main objective includes providing BCB with an improved clamping mechanism to reduce the amount of preliminary methods needed before utilizing the machine. Another main objective includes improving the stability of the weld joint while providing four degrees of freedom of movement of the weld guns. Refining this product can reduce the man hours required per tube and provide BCB with the ability to manufacture more boiler tubes a year, resulting in a more profitable future.

23 Plasma-Based 3D Printing

Students: **Giancarlo Kamesch, Kaiyu Vang, Derek Xiong**
Advisor/Mentor: **Dr. Sankha Banerjee**

Project Summary: Polymer and polymer composite-based 3D-printed materials provides consumers with the opportunity to manufacture multiple prototypes and proofs of concept, making it an excellent method for testing design concepts. However, the layer-by-layer printing procedure can result in a weakness that reduces the strength of the finished printed pieces. To address this issue, the team will be treating the surface of the printed samples with room-temperature plasma Corona Discharge to evaluate the effects of plasma-treated plastic filament compared to non-treated surface samples. This will involve tailoring the polymer properties in the layer-by-layer process to create stronger and more cohesive bonds between each layer that is printed over the previous. By doing so, it is expected that the strength of the finished product will be increased. Additionally, the team will be conducting further tests to determine the optimal conditions for plasma treatment and to assess the durability of the printed pieces under various stress conditions. This will provide valuable insights into the potential of plasma treatment as a solution for improving the strength of 3D-printed pieces.

24 The Effectiveness of a MERV and Needlepoint Bipolar Ionizer Filtration System in Filtering Particulate Matters

Students: **Nadine Barton, Atish Maman, Jordan Ovando, Joshua Pulido, Ian Rodrigues, Jose Sandoval**
Advisor/Mentor: **Dr. Deify Law**

Project Summary: HEPA (High-Efficiency Particulate Air) filters are regarded as the best mechanical filters in the HVAC industry, often used in medical settings for their superior particle removal. MERV (Minumum Efficiency Reporting Values) air filters are the most popular filters for residential, commercial, and industrial use. The objective of this project is to test the effectiveness of an air filtration system using a MERV filter in conjunction with a needlepoint bipolar ionizer to remove smoke from a controlled environment.

25 Water Treatment System

Students: **Nadine Barton, Luis Cordova, Jose Guerrero, Abel Lopez**
Advisors/Mentors: **Dr. Yuanyuan Xie**

Project Summary: The lack of water resources is an ever-growing concern not only in California after years of recurring droughts but also in the rest of the United States and the world. The goal of this project was to integrate two preexisting water filtration systems to lower the total dissolved solids (TDS) in recovered irrigation water. One filtration system is a nanofiltration system composed of graphene nanoplatelets, activated carbon and filter paper. The other filtration system is a micro-plasma-based treatment process. A robotic arm is also used to monitor the system. The combined filtration system should lower the TDS levels of the water to under 500 parts per million (ppm). The final order and combination of these systems was determined by testing each system individually and in combination to determine the most effective integration.

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