COLLEGE OF
ENGINEERING, ARCHITECTURE AND TECHNOLOGY

SENIOR DESIGN EXPO

Fall 2021 Team & Projects Guide

Friday, November 19

A Word from the Dean

The College of Engineering, Architecture and Technology is continuing its transformation as a leading innovator in education, research and extension services. Our ENDEAVOR and North Campus labs have become launching points for hands-on interdisciplinary education, driven by faculty and student efforts. Looking around the Senior Design Expo today, you will get a glance at some of the results of those efforts.

Our faculty are engaged at the cutting edge of energy, aerospace, computing, sustainable building technologies and our nation's future, and they are building on a long-established land grant university mission of profession-oriented education that also educates the broader person to enable our graduates to lead the industries and communities of the 21st century.

We have awarded 966 degrees this year and have worked with students, administration and alumni to continue delivering world-class engineers and design professionals. By expanding our facilities and our undergraduate research opportunities, we are pushing forward in creating leaders for the next generation of industry.

The college could not be at the forefront of innovation without the accomplishments and investments of alumni, friends and industry partners in scholarships, internships, equipment and faculty support. In the coming year we will be adding a Center for Competitive Leadership that will push our students even further into innovation with partner companies.

I hope that you enjoy getting a look into the bright young minds of these Oklahoma State seniors. They are preparing to solve the grand challenges that face us and become valuable contributors to their respective industries. Take some time to get to know them; you won't be disappointed.

Go Pokes!

Paul J. Tikalsky
Dean
College of Engineering, Architecture and Technology

Presentation Schedule

OSU-STILLWATER PROJECTS

Friday, November 19 from 8:00 AM-5:00 PM in the ENDEAVOR Lab (Stillwater, OK)

CIVE 8:30 AM-10:30 AM (2nd Floor Common Spaces)

DET

(MET)Hot Water Heater Cart 1pm-1:30pm (ENDV 302)
(MET) Landing Gear Dolly 1:30pm-2pm (ENDV 302)
(MET) Cable Measurement System 2pm-2:30pm (ENDV 302)
(MET) Antenna Test Structure System 2:30pm-3pm (ENDV 302)
(MET/EET) Team 1-Pink Prowlers: Autonomous Aircraft Rescue and Firefighting Vehicle 3pm-4pm (ENDV 310)
(MET/EET) Team 2-FAX: Autonomous Aircraft Rescue and Firefighting Vehicle 3pm-4pm (ENDV 310)
(FPSET) Medical Crash Cart 10:30am-12:30pm (ENDV 105)
(FPSET) "Suppressing" Recoil 10:30am-12:30pm (ENDV 105)
(FPSET) Finding Confidence in Hydraulic Modeling 10:30am-12:30pm (ENDV 105)
(FPSET) Portable X-Ray Fluorescence and the assessment of cadmium surface contamination 10:30am-12:30pm (ENDV 105)

ECE At least one individual will be present at each project from 9:00 AM-5:00 PM. All group members will be present at the following times:
RF Wireless Power Transfer 10:30am-11:30am (1st Floor Common Space)
The Smart and Cost-Effective In-Home Healthcare System 2pm-3pm (1st Floor Common Space)
Palm-Pale 3pm-4pm (1st Floor Common Space)
FAA Cable Tester 4pm-5pm (1st Floor Common Space)

Interdisciplinary (ID)

Autonomous Stage Wagon 9:30am-10am (ENDV 302)
Human Factors Workstation 11am-11:30am (ENDV 302)
Advanced Distillation Fixture 2:30pm-3pm (ENDV 302)
Sustainable UTV 3pm-3:30pm (ENDV 302)

IEM 1:30pm-3:30pm (2nd Floor Common Space)

MAE

Flammable Fluids Compressor Load Stand 10am-10:30am (ENDV 302)
Autonomous Golf Cart 10:30am-11am (ENDV 302)
The Orange Lasso 11:30am-12pm (ENDV 302)
Test Copter 12pm-12:30pm (ENDV 302)
Clarity 12:30pm-1pm (ENDV 302)
Multiaxis 3D Printer 1pm-1:30pm (ENDV 302)
Hazard Hood Robot 1:30pm-2pm (ENDV 302)
Iron Man Mk. 1 2pm-2:30pm (ENDV 302)
Pumpkin Propellers 3:30pm-4pm (ENDV 302)

OSU-TULSA PROJECTS

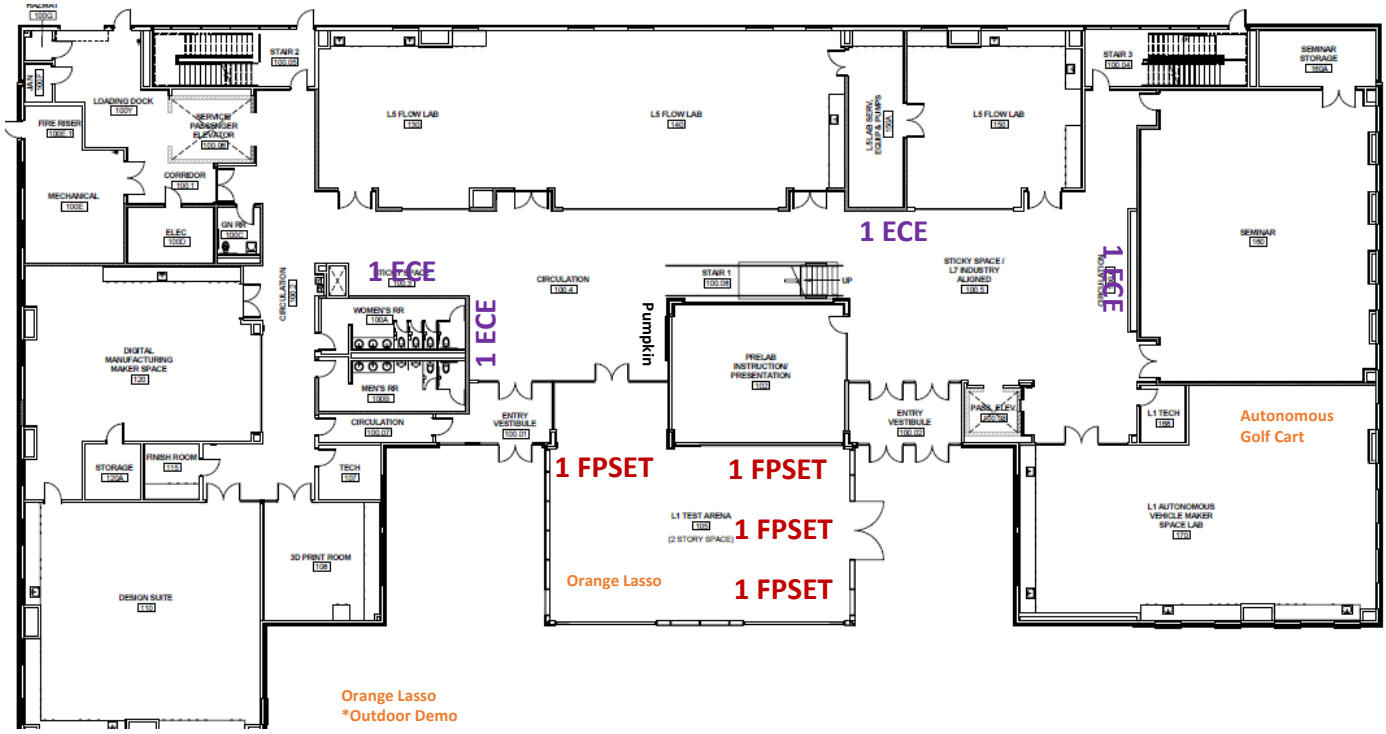
Thursday, November 18 from 5:00 PM-7:00 PM
in the Helmerich Research Center Atrium (Tulsa, OK)

ME

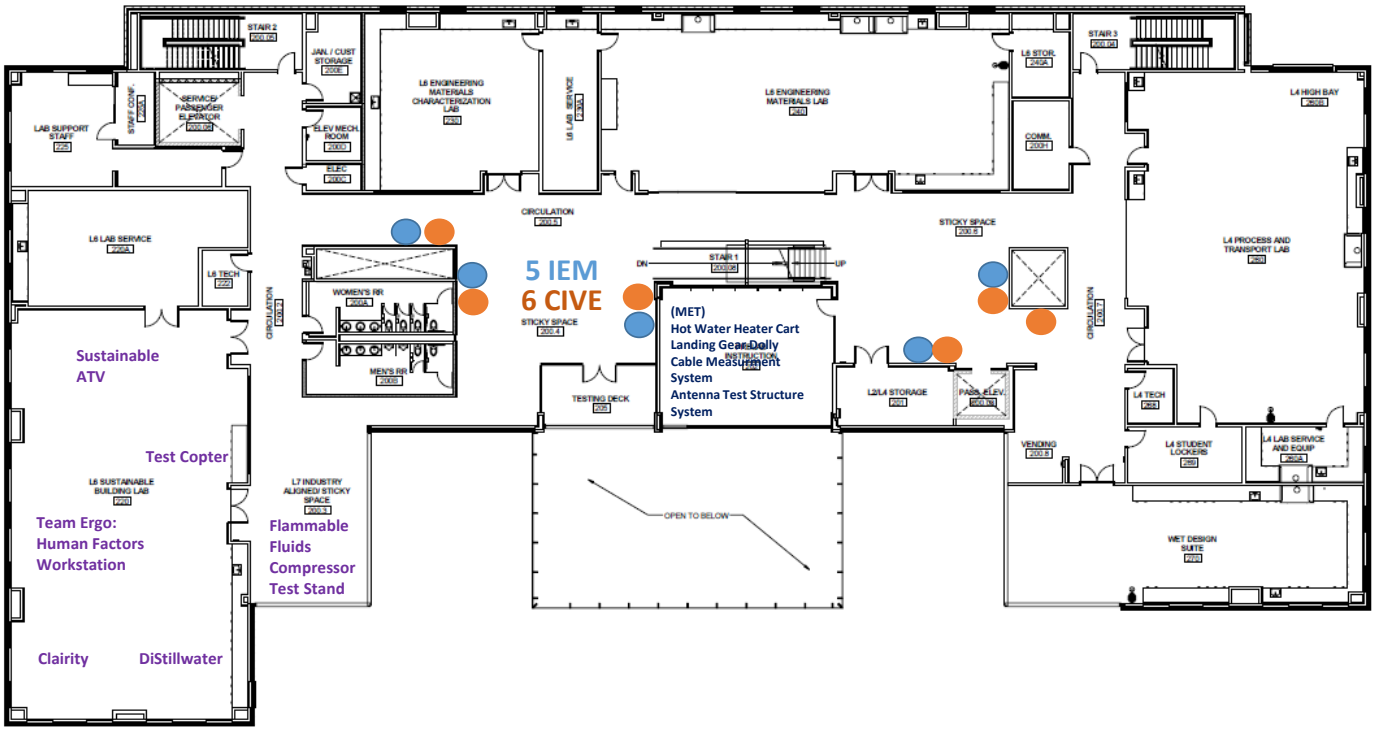
Team Blue (UVC Pesticide Analyzer) 5pm
Wear Your Air 5:30pm
High Speed Assembly Tool 6pm
Plastic Heroes (Plastic Composite Extrusion) 6:30pm

Project Locations

1st Floor



2nd Floor



3rd Floor

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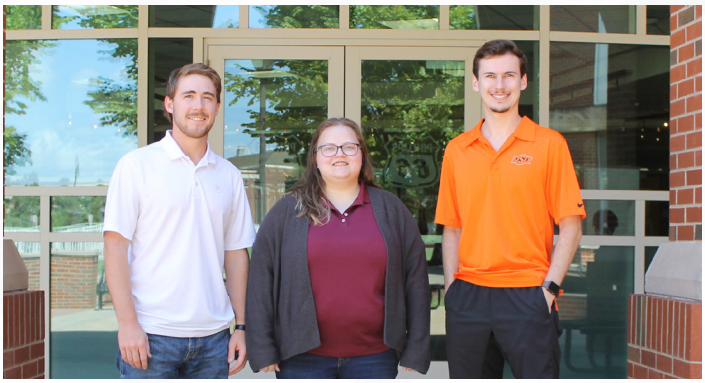
PROJECT: Duck.Miller Storm Drainage Solutions (CIVE)
ADVISORS: Dr. Norb Delatte, Bill Millis, Dr. Greg Wilber

(Left to Right) Megan McGregor, Josh Kennerly, Nathan Buzan, Jackson Slayter

Our project involves determining what size storm sewer is needed from the intersection of Duck Street and Miller Street to Main Street, and what size open channel or storm sewer is needed for Main Street and Miller Street, and then east to west Boomer Road.

PROJECT: Hydro-Design Inc.-Wastewater Treatment Plant Improvements (CIVE)
ADVISORS: Dr. Norb Delatte, Dr. Greg Wilber



(Left to Right) Isaiah Irby, Lizzie Long, Cade Ferguson

The Stillwater wastewater treatment plant has several operational improvements they would like our team to look into for them. There are currently three issues that we will be completing a design analysis for. First, there are snails accumulating in the aeration basin that need to be cleaned out every year. Second, algae is accumulating on the wires of the final clarifier which requires weekly cleaning. Third, the final clarifier will not drain completely for the yearly drain, clean, inspect report.

Sponsored by:

Stillwater Wastewater Treatment Plant

PROJECT: Kameoka Trail-Rails to Trails (CIVE)
ADVISORS: Dr. Norb Delatte, Dr. Greg Wilber

(Left to Right) Zachery Warner, Geoffery Henke, Logan Taber, Brian Riggione

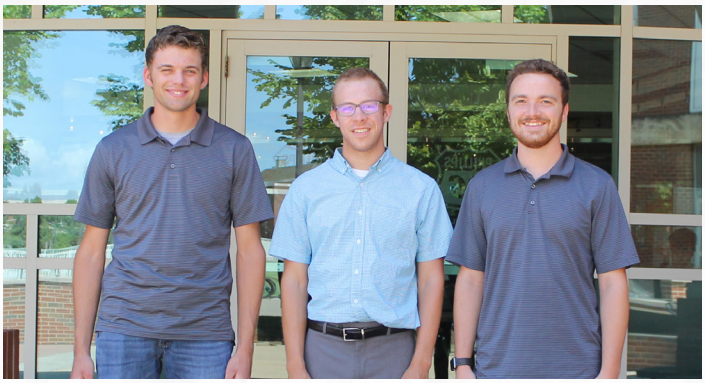
The Kameoka Trail Extension includes connecting the existing sections of the trail with new or reconfigured bike paths. The bike paths will take over the railroad tracks location. Major considerations include the conditions of the existing bridge and any potential street crossings.

PROJECT: Kameoka Trail Bridge (CIVE)
ADVISORS: Dr. Norb Delatte, Dr. Greg Wilber

(Left to Right) Adam Ross, Jackson Olansen, Jake Moriarty, Jordan Weltzheimer

The goal of our project is to determine if the Kameoka bridge needs to be repaired or replaced and come up with a solution that will meet the needs of the City of Stillwater.

PROJECT: Oblon County-Tenessee Water Tank (CIVE)
ADVISORS: Dr. Norb Delatte, Dr. Greg Wilber



(Left to Right) Dawson Wiseman, Lukas Evans, Josh Caldwell

A water tank in Samburg, Tennessee is approaching failure. Repairs need to be made to the current foundation to stabilize the water tanks, or the tank needs to be relocated. This is a community engineering corps project, partnered with working engineers.

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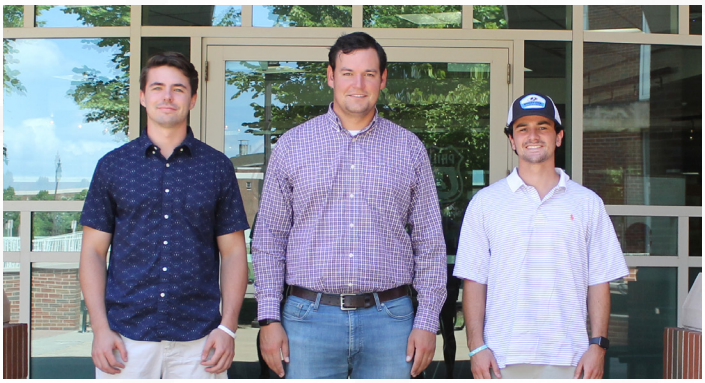
ENGINEERS WITHOUT BORDERS USA

PROJECT: Stillwater Electrical Vault Design (CIVE)
ADVISORS: Dr. Norb Delatte, Dr. Greg Wilber



(Left to Right) Jeffrey Collier, Brock Turner, Brody Compton

Our project is performing a structural assessment of existing electrical vaults under Stillwater. We will analyze the possibility of coring new holes for proposed duct banks. New engineering designs have already been created so we will ensure the safety of these designs.

PROJECT: Medical Crash Cart (FPSET)
ADVISOR: Dr. Diana Rodriguez Coca

(Left to Right) Bailey Wilhite, Cody Smith

In the medical field, specifically the emergency room, it is critical to have fast response times and remain calm under pressure. The purpose of this project is to determine if making changes to the crash cart will result in faster response times while also decreasing the likelihood for Musculoskeletal Disorders (MSDs). The crash cart, a cart stocked with emergency medical equipment, supplies, and drugs for use by medical personnel, is one of the most used pieces of equipment. (Merriam-Webster).

The purpose of this project is to redesign the crash cart to reduce the probability for MSDs in the medical field and decrease mental stress of employees. The redesigning aims to allow for a faster response for medications requiring refrigeration, elimination of items missing from the cart due to security issues that are currently in place, and an overall decrease in response times. After testing the redesigned crash cart, it can be established whether the modifications improved the medical personnel conditions or if further testing should be done.

PROJECT: Suppressing Recoil (FPSET)
ADVISORS: Dr. Rob Agnew, Dr. Aaron Alexander

(Left to Right) Alexander Brenner, Kevin Westhoff, John Mark Williams

Mitigation of felt recoil at the human-firearm interface is important in the prevention of subdermal hematoma, joint damage and general discomfort in firearm users. Particularly with those who use firearms regularly such as military personnel, law enforcement, hunters, as well as a focus in people with previous injuries or etiological problems such as arthritis. By adding a suppressor, which is designed mainly to reduce muzzle noise, the added benefit of a reduction in felt recoil is realized. Measurement with acceleration of the firearm and the shoulder using two accelerometers shows that shooting a high-powered cartridge from a suppressed weapon has the same effective recoil on the shooter's shoulder as shooting a medium-power cartridge non-suppressed. This work demonstrates that muzzle suppressors provide an additional benefit to firearm users beyond hearing protection.

Sponsored by:

LOUTHAN GUNWORKS

PROJECT: Portable x-ray fluorescence and the assessment of cadmium surface contamination (FPSET)
ADVISOR: Dr. Rob Agnew

(Not Pictured) Molly Spencer

Portable x-ray fluorescence (XRF) has successfully been used in the past to quickly and nondestructively evaluate occupational exposure to airborne and surface metal contaminants. Traditional methods of evaluating metal surface contamination involve the costly and time-consuming collection and laboratory analysis of wipe samples, thereby making XRF an attractive method to screen worksites and reduce delays in risk assessment decision making. Existing research into this use of XRF has primarily been centered on the analysis of airborne and surface lead contamination and there is very little literature which examines the use of XRF with other metals. The present study evaluated the use of XRF in the screening of cadmium surface contamination. Wipe samples were collected and screened with XRF prior to being sent to the laboratory for analysis to assess the correlation between XRF semi-quantitative readings in percent mass with laboratory quantitative results in µg/ft2. XRF readings were strongly, linearly correlated with laboratory results, as indicated by the R2 value of 0.9929. This linearity of the results demonstrates that with a more sensitive instrument and greater sample size, this is a fruitful avenue for research. The methodology described could be practically used as a screening tool of wipe samples for clearance.

Sponsored by:

lyondellbasell
Advancing Possible

PROJECT: Finding Confidence in Hydraulic Modeling (FPSET)
ADVISORS: Dr. Virginia Charter, Dr. Christian Contreras Nieto, Professor Floyd Luinstra

(Left to Right) Robert Astin, Garrett Nixon

Computer software models used to simulate an underground water supply exist to inform the design process of new buildings and additions to existing buildings. OSU Facilities brought to the groups attention the software model, which predicted the Williams Apartments' water supply drops below 25 psi, an Oklahoma Department of Environmental Quality (ODEQ) requirement to prevent backflow, which could contaminate the rest of the water supply and make water unsafe to drink. To determine the differences between the software model and the underground water supply, the group performed an analysis of the underground water supply. The group performed this study to verify the software model and the water supply's capacity to meet ODEQ requirements, and improve the model's inputs to better reflect actual pressures and flows. Previous work has failed to address if factors such as pump and tank capacity, flow rate and time of day affect the available water to Williams Apartments. The goal of this study is to determine if the campus water supply meets these ODEQ requirements and to verify the software model. The group performed a series of fire hydrant flow tests while measuring the static and residual pressures available to Williams Apartments, and then performed a detailed statistical analysis of how these factors affect the water supply. The group found data that can be used to refine the software model of the campus water supply, and highlight further areas of research.

PROJECT: Antenna Test Structure System (MET)
ADVISOR: Dr. Robert Taylor

(Left to Right) Chandler Sanders, Matt Anderson,
(Not Pictured) Cameron McCormick

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BOEING

PROJECT: ReelPower Cable Measurement System (MET)
ADVISOR: Dr. Robert Taylor

(Left to Right) Irene Landaverde, Caleb O'Neal,
(Not Pictured) Brock Hightower

We are improving the design of a cable length measurement system for Reel Power. We aim to make the measurement system more accurate when measuring cables and tubes of varying diameters ranging from 1/8 inch to 2 inches. The current system produces inaccurate measurements when measuring smaller diameter cable. Inaccurate measurements also happen when a cable or tube starts moving to the side and sticking to the walls of the device causing the measuring wheel to stop moving. We are working to understand why this happens and how to improve the system to avoid these inaccurate measurements. We also want to figure out if the running speed of the cables is having an effect on the measurement reading due to slip.

Sponsored by:

REELPOWER
INDUSTRIAL
PRECISION WINDING EXPERTS

PROJECT: Hot Water Heater Cart (MET)
ADVISOR: Dr. Robert Taylor

(Left to Right) Tyler King, George Jett,
(Not Pictured) Mason Owen

Our team was challenged with creating a system to assist in the installation and removal of a hot water heater. There were two reasons behind this; to assist in the general lifting of a hot water heater, and because hot water heaters are usually in very small spaces which makes it difficult to install and remove them. To alleviate these problems, our design uses a normal everyday dolly to which we attached a lift and securing system.

PROJECT: Landing Gear Dolly (MET)
ADVISOR: Dr. Robert Taylor

(Left to Right) Jesse Durham, Tre Banks, Greyson Harshman,
(Not Pictured) Jesse Oliveras

This project is primarily focused on the manufacturing and testing of a landing gear dolly for Boeing. The testing will consist of applying varying weights on the lifting bed, and then testing how the dolly's frame reacts under the increasing loads through strain gage analysis. We will also compare the results to SolidWorks simulations to verify that the structure is capable of withstanding the forces.

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BOEING

PROJECT: FAX: Autonomous Aircraft Rescue and Firefighting Vehicle (AARFF) (MET) (EET)
ADVISORS: Dr. Avimanyu Sahoo, Benjamin Worwang

(Left to Right) Brian Blackwood, Levi Deal, Cole Horton, Thomas Zacher, William Abel, Mitchell Wilson, Gabriel Guerra, Skyler Williams, (Not Pictured) Spencer Flora, Jacob Jester

The team will design an Autonomous Aircraft Rescue and Firefighting (AARFF) Vehicle, which can navigate through a prescribed ground course autonomously extinguish a pot fire and return to the "fire station" while avoiding obstacles. The team members will be involved in both electrical and mechanical design, manufacturing, and assembly of the scaled model of the AARFF vehicle. The team will also incorporate all necessary sensor controllers for navigation and mission objectives of extinguishing the fire.

PROJECT: Pink Prowlers: Autonomous Aircraft Rescue and Firefighting Vehicle (AARFF)(MET)(EET)
ADVISORS: Dr. Avimanyu Sahoo, Benjamin Worwang

(Left to Right) Sterling J. Hightower, Trenton Ging, Oceas Ortega, Stephen Higginbotham, Noah Zwillenberg, Christian Moyer, Tristin Yarber, Jackson Hahn, Hunter Hewitt

The team will design an Autonomous Aircraft Rescue and Firefighting (AARFF) Vehicle, which can navigate through a prescribed ground course, autonomously extinguish a pot fire and return to the "fire station" while avoiding obstacles. The team members will be involved in both electrical and mechanical design, manufacturing, and assembly of the scaled model of the AARFF vehicle. The team will also incorporate all necessary sensor controllers for navigation and mission objectives of extinguishing the fire.

PROJECT: FAA Cable Tester (ECE)
ADVISOR: Professor Nate Lannan

(Left to Right) Cassidy Goode, Sajjad Aljunaybi, Hussain Basha, Moatasem Alsahafi

The FAA is in need of an all-in-one solution for testing cables of multiple types of termination. Currently, they are using a Paladin PA1577 PC Cable-Check Pro but it has limited functionality as a stand-alone device only. This project is to build a device which can act as a battery-operated, stand-alone cable tester, as well as interface with a windows PC through a USB port and proprietary software. The device tests for discontinuities, shorts, crossed pins, and has been implemented using a modular design so that connector types that are not currently being used can easily be added in the future. The software associated with the device will display testing results as well as generate reports and save data.

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Project Video

PROJECT: The Smart and Cost-Effective In-Home Healthcare System (ECE)
ADVISOR: Dr. Weihua Sheng

(Left to Right) Dr. Weihua Sheng, Hunter Holstead, Mohammed Musaqlab, Mohammed Almarhoon, Stephen Potter

This project addresses some of the gaps in the home healthcare field. With traditional in-home healthcare, many patients see a group of health care professionals that address certain needs. However, those healthcare professionals can not be there all the time. That is where The Smart and Cost-Effective In-Home Healthcare System comes into play. The device is in its second semester of design and the team before did a great job of setting up the foundation for the project. When we stepped into the project, our task was to refine the system that was already in place, as well as add functionality. We have done this by improving the efficiency, size, and form factor of the wearable device, as well as adding a home server station in order to maximize both the efficiency of the system, and to add an interactive component for the user and the healthcare professionals that may interact with the system. Features of the devices will include heart rate monitoring, fall detection, food recognition, TTS (Text to Speech), and machine learning to name a few. To help improve the user's experience with the device, a GUI and website were created, each with their own corresponding databases that will provide methods to display healthcare data to the user and medical professionals. Our team feels that there are gaps in healthcare that could be filled by technology and engineering systems, and our mission is to use those ideas to enhance the ever changing field of healthcare.

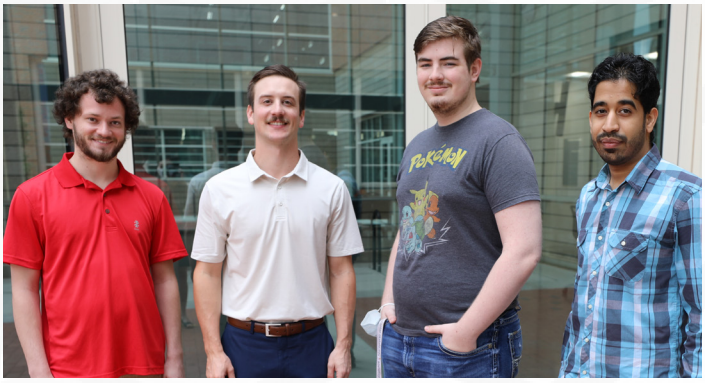
PROJECT: Palm-Pale (ECE)
ADVISOR: Dr. Daqing Piao

(Left to Right) Talal Binmansour, Abdulrazzaq Alhasan, Shawn Kester

Meat color is an important quality attribute that influences purchasing decisions. Any deviation from a bright-red color leads to less consumer acceptance, price reduction, and/or meat waste. The US meat industry lost $3 billion in 2019 due to discoloration (Maia, 2020). Hence, it is critical to develop techniques to segregate meat based on color stability at the processing plant to adopt packaging or other interventions to minimize losses. For retailers, knowing the freshness of meat that agrees with the visual perception of the meat helps make better retail decision. For the customer, conveniently knowing the freshness of meat that supports the visual perception of the meat assures the purchase.

The objective of this project is to develop a cell-phone attachment, including both hardware and software, for estimating the freshness of retail beef, by assessing the percentage of metmyoglobin in the myoglobin of meat.

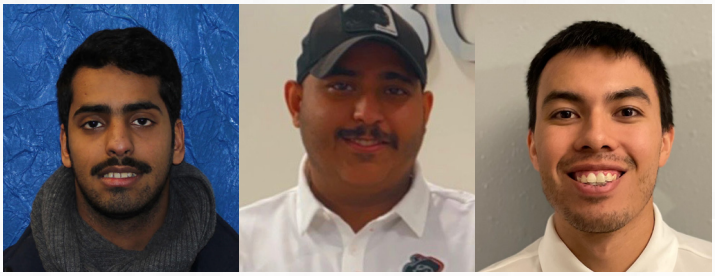
PROJECT: RF Wireless Power Transfer (ECE)
ADVISOR: Dr. Wooyeol Choi



(Left to Right) Kevin Koss, Bo Rogers, Caleb Cunningham, Mohammed Alhariri

Near-field power transfer and energy harvesting is used for cell phone apps requiring low-level power transfer over small distances. This project will demonstrate directed higher-power RF energy transfer over greater distances. You can imagine a base station dynamically delivers power to remote drones. Tentatively, the transmitter side will implement a four-element array with a beam steering function, each element including an antenna, a power amplifier, and a phase shifter. The receiver has a rectifier and some LED's to demonstrate the wireless power transfer. This will result in the ability to provide highly-directional power transfer between two devices.

PROJECT: Improving the Statistical Methods for Estimating the Index Rate for ArcBest (IEM)
ADVISORS: Dr. Chenang Liu, Tom Saunders



(Left to Right) Abduallah Alajmi, Ghazy Alatteer, Austin Douglah

Our client, ArcBest, is a leading logistics company based out in Fort Smith, Arkansas. ArcBest specializes in a variety of transportation services, including Less-than-Truckload (LTL) shipping. LTL services focus on consolidating shipments from different customers into the one truck, which go through nationally located distribution centers to get to their end locations. To estimate the prices of these LTL shipments, ArcBest uses a linear regression model that takes historical data on previous shipments to predict the Market Research Price. The Market Research Price is an estimate of the lowest price a competing carrier will offer for a shipment based on the details of the shipments (weight, size, destination, etc.). An accurate prediction is vital to ArcBest, as it gives them a good judgement on whether or not their offer on a shipment is competitive enough. Estimating the Market Research Price in the LTL business is a complex process. But, given the current regression model and the historical data used to calculate it, our team will improve upon the current model, and give ArcBest a more accurate reading of the Market Research Price.

Sponsored by: ArcBest

PROJECT: Eskimo Joe's Promotional Products Group Layout Improvement (IEM)
ADVISORS: Dr. Terry Collins, Bill Dueease, Frank Groenteman

(Left to Right) Dalal Almusbahi, Moraad Bilbeisi, Collin Browning, Nicholas Loy

Eskimo Joe's Promotional products group (EJPPG) is a company based in Stillwater, Oklahoma that specializes in screen printing and embroidery of apparel. EJPPG consists of 6 departments: Receiving, Screen Printing, Embroidery, Finishing, Fulfillment, and Shipping. Their operations take place in a 27,000 sq ft facility that also includes offices and separate storage bays that cannot be used by EJPPG. In October of 2021, they will get access to one of these storage bays, giving them 3,000 sq ft of new floor space. Eskimo Joe's Promotional Products Group requires a new facility layout to address organizational issues, flow issues, and to optimize the given space of the facility as it stands today. To address this problem, the team has prepared process flow diagrams, relationship matrices, and modeled the existing layout in AutoCad in order to better grasp how product moves through the facility and how important each departmental relationship is. With these diagrams completed, the team will be able to prepare a total of three to five new potential layouts that will help the flow of work at the facility become more linear and smooth, while reducing the amount of distance traveled by the employees. Of these potential layouts, the benefits and considerations of each will be presented to EJPPG, so that they may pick the facility design that aligns with their business model the best.

Sponsored by:

PROJECT: Application of IE Techniques to Reduce Cost for Mingo Aerospace (IEM)
ADVISORS: Dr. Sunderesh Heragu, Steve Kiester

(Left to Right) Abdalah Alkdeefy, Bailey Bretz, Matthew Edgeller, Nicole Koza

Mingo Aerospace is a maintenance and repair organization within the aerospace industry. They specialize in cargo-loading systems, HVOF thermal spray, and precision grinding innovation for their customers. Mingo Aerospace's customers fall into one of the following categories: passenger airlines, cargo airlines, and Department of Defense clients. Mingo Aerospace obtains some parts from various suppliers, but manufactures other parts in-house. Currently, there is no clear method for determining what parts should be manufactured in-house versus out-sourced. In this project, we performed cost analysis and utilized operations research strategies in order to build an optimization model in Microsoft Excel to determine the best way to obtain each part. Secondly, there are bottlenecks and/or delays in Mingo Aerospace's manufactured parts process. In this project, we used simulation modeling (specifically Simio software) to model the manufactured parts process and highlight potential areas for improvement. We also developed a model in Excel so that the client can utilize the model more easily. Lastly, the process of stripping old thermal plating produces hazardous waste, which is extremely expensive to dispose of.

Sponsored by:

MINGO AEROSPACE

PROJECT: Mint Turbines Facility Layout Design (IEM)
ADVISORS: Dr. Jennifer Glenn, Zach Roberts

(Left to Right) Maryam Husain, Madison Ohman, Abbie Winchester

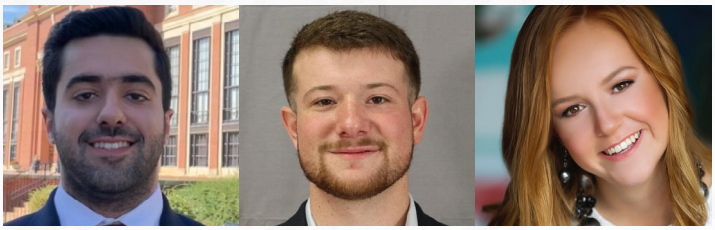
Mint Turbines LLC is an independent turbine engine repair, maintenance, overhaul and testing facility of the Honeywell T53 engine (both military and commercial), GE T700 and Pratt & Whitney PT6 and PT6T. With almost 70,000 square feet, Mint is located in Stroud, OK and has been serving the industry since 1981. Their repair station is FAA approved for both repair and overhaul. Mint has identified an area of improvement for their inventory space located within the logistics department.

The objective of this project is to redesign the inventory storage area for Mint Turbines. This will increase storage efficiency and mobility. The team aims to develop storage solutions for displaced warehouse parts, design systems for engine cart and reorganize current shelving locations to improve overall throughput. To achieve these objectives, the team is utilizing 5S, Lean Manufacturing and ABC analysis to generate possible solutions. Once the data is analyzed, the team will create alternative layouts and provide recommendations to Mint Turbines.

Sponsored by:

MINT TURBINES

PROJECT: Improving Trailer Avaliability for Interplant Material Transfer at Webco Industries (IEM)
ADVISORS: Dr. Manjunath Kamath, Ashley Estes



(Left to Right) Ali Ashkanani, Jackson Fife, Kaylyn Wells

Webco industries is a leading steel tube manufacturing company located in Sand Springs, Oklahoma. This project focuses on three locations, namely Southwest Tube, Star Center Tube, and Keystone. However, due to the proximity of Southwest Tube and Keystone, these locations will be treated as one. These locations house different manufacturing processes which create a need to transport products in different stages of manufacturing between these locations. Management has noticed a decrease in empty trailer availability, which disrupts material flow and causes delays. As material transportation occurs over public roadways, it requires drivers with a commercial driver's license, a trailer and truck cab approved by the US Department of Transportation (DOT) and must follow all DOT regulations.

Our investigations determined that trailers are currently scheduled to be transported after they are loaded and put into a staging area by a dispatcher who communicates to a driver the information and location of the load they need to pick up. The current method is reactive to the daily production schedule and the team is investigating the development of proactive trailer scheduling method using the available weekly production schedule. This new scheduling method is expected to facilitate flow of material between plants and increase the availability of empty trailers when needed.

Sponsored by:

WEBCO INDUSTRIES

Project Video

PROJECT: Autonomous Golf Cart (MAE)
ADVISORS: Dr. He Bai, Dr. Rushikesh Kamalapurkar

(Left to Right) David Brock, Fabian Flores

The Fall 2021 Autonomous Golf Cart project is a continuation of efforts to attain Level 3 Autonomy. This includes steering, speed control, and environmental detection. Previous semesters have incorporated the Robot Operating System (ROS) into an onboard computer that is able to communicate with speed sensors and servomotors that control steering and braking, as well as the vehicle motor. A camera mounted to the front of the golf cart also allows lane detection and navigation. This semester the goal is to redesign the interface between the steering servomotor and the steering shaft from an idler gear design to a see-saw style in order to more reliably engage and disengage autonomous steering, as well as upgrading the speed detection of the wheels from a friction based rotary encoder to hall effect sensors that monitor a ring of 32 magnets mounted on the front right and rear left wheels. We also incorporated a two-Dimensional LiDAR mounted to the front bumper of the golf cart to detect obstacles and either navigate around them or come to a stop safely.

PROJECT: Clarity (MAE)
ADVISOR: Dr. Christian Bach

Project Video

Poster Presentation

(Left to Right) Carly Adams, Macy Wohlgemuth

An aspirated psychrometer is used to measure the humidity within air and is a critical part of laboratories that measure heat exchanger and air conditioning system performance. The aim of this project is to design and construct two aspirated psychrometers to be used for research in CEAT's Psychrometric Heat Exchanger Testing Laboratory. That laboratory aims at investigating the effect of design changes, such as heat exchanger refrigerant circuitry and header design, onto their heat transfer and refrigerant side pressure drop. A psychrometer includes a variety of sensors: dry bulb and wet-bulb temperature, differential pressure, and velocity. All these values are used to set the psychrometric and thermodynamic state of the air being tested, with a redundant humidity measurement used as functional check. The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) provides standards 41.1, 41.2, and 41.6, which informed the design of the psychrometer and air sampling mechanism. This project will allow OSU to perform highly-accurate, air-side capacity measurements for heat exchangers and will conclude with a performance validation of the psychrometers.

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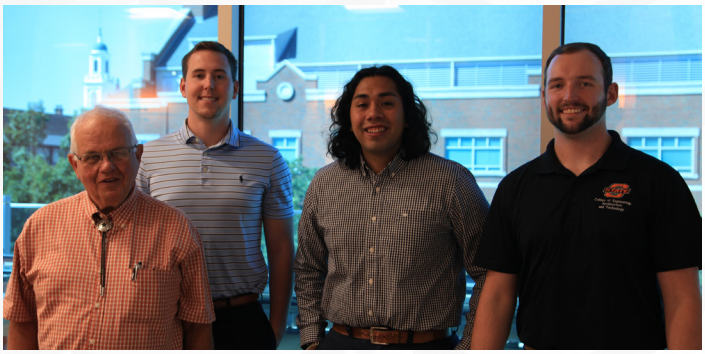
PROJECT: Flammable Fluid Compressor Load Stand (MAE)
ADVISORS: Dr. Craig Bradshaw, Kalen Gabel

Project Video



Vaughn Berkheiser, Armando Covarrubias, Nathan Janda, Landon Weber

The scope of our project is to design and fabricate a flammable fluid compressor load stand which is capable of loading and testing compressors with a capacity range of 1 ton to 3 tons. The load stand must also be applicable for working fluids R1234yf and R290 which both have semi flammable or flammable characteristics, respectively. The motivation for this project stems from the following question: 'Why test compressors?'. Efficiency standards for HVAC&R equipment are changing to phase out common refrigerants such as R410a and R134a. Some countries are required to reduce the use of these refrigerants by 85% in the span of 2019-2036. Since these refrigerants are becoming phased out, new systems are needed to be designed, manufactured and tested to be applicable for alternate solutions.

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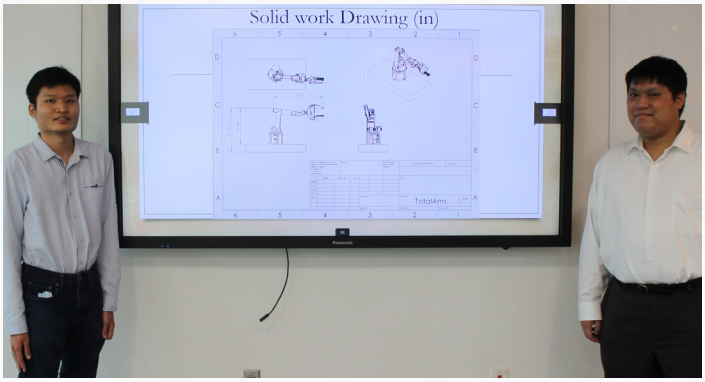
Project Video

PROJECT: Hazard Hood Robot (MAE)
ADVISOR: Dr. Joe Conner



(Left to Right) Jame Ming Tan, Philip Truong

We are working on a cheap robotic arm that can handle hazardous chemicals in fume hoods. The robotic arm can be controlled with an Xbox controller and every part of the robotic arm can be controlled via the Labview program interface. The robotic arm will be disposed into a 5 gallon bucket after a single use.

Project Video

PROJECT: High Speed Assembly Tool (MAE)
ADVISORS: Masoud Allahkarami, Dr. Jay Hanan, Mike Perzel

(Left to Right) Stephanie Hart, Michelle Dykeman, Ryan Thomas, Jonathan Akuma, Luis Vasquez, Carlos Matias

For our project, we were tasked with designing a system for a high speed assembly line that is able to heat and soften High Density Polyethylene (HDPE) bottle caps before they are placed onto plastic bottles. This is needing to be done in an extremely fast-paced environment. In achieving this, it will allow the capping process to be more efficient, which would potentially save wasted material and loss of profit. For our design, we will have an enclosure around the steel railing that the caps are traveling through. Two ceramic heat lamps will be mounted inside the enclosure facing the sides of the caps. These heat lamps will provide infrared radiant heat to the sides, or "skirt", of the caps as they are traveling through the system. To monitor the system, the lamps and temperature sensors will be connected to a control box. To account for the heat loss after leaving the enclosure, we have determined that it will take at most 10 second upon exiting the system before the caps are placed onto bottles. From our calculations, we have estimated that the temperature of the caps as they exit the enclosure should be around 78 Celsius. This temperature allows room for energy loss from the caps as they travel from the system to the capping plate.

Sponsored by: Mike Perzel

Project Video

PROJECT: Iron Man Mk. 1 (MAE)
ADVISORS: Asif Arefeen, Alvin Ngo, Dr. Mike Xiang

(Left to Right) Joaquin Rodriguez, Joel Quarnstrom

The purpose of this project it to develop and design a wearable elbow exoskeleton that is targeted to assist rehabilitation patients. There are many people who have undergone various elbow surgeries, have elbow sport injuries, or natural elbow fatigue from overuse. These people can experience weak elbow strength and limited range of motion. As a solution to aid in rehabilitation, we have developed an elbow exoskeleton prototype that will decrease the load and stress the elbow experiences while lifting, and the exoskeleton will assist patients in achieving full range of motion.

The entire system was designed in SolidWorks where all parts were modeled with the appropriate raw materials and manufacturing methods in mind. The motor and control system wiring was designed in NI Multisim which includes a square wave generator, limit switches, and a potentiometer control that all will be controlled through Arduino.

Sponsored by: OSU Biodynamics Optimazation Laboratory

Project Video

PROJECT: Multiaxis 3D Printer (MAE)
ADVISORS: Dr. He Bai, Dr. Hadi Noori

(Left to Right) Nick Blankenship, Sydni Schneberger, Evan Turley, (Not Pictured) Carson Ross

We set out to design and fabricate a two-nozzle FDM prototype 3D printer. The primary nozzle will be traditional oriented and the secondary nozzle will be orthogonal to the primary. These nozzles will work together simultaneously (when possible) to print parts faster than contemporary models.

Project Video

PROJECT: Plastic Heroes, Plastic Composite Extrusion (MAE)
ADVISORS: Masoud Allahkarami, Frank Blum, Dr. Jay Hanan, Dr. Laura Southard, Dr. Ranji Vaidyanathan, Chris Scott, Siddesh Chaudhari

(Left to Right) Ian Engle, Jorge Jasso, Trevor Womack, Brad Smith, Nikhil Verma

The design objective of this project was to completely re-design the process in producing composite board from polymers (HDPE) and carpet. The previous process involved using a compression mold which was shown to us by Chris Scott, Clinton Switzer, and Siddhesh Chaudhari. Although there is still on-going research over the process of compression mold, the objective of the new design is to scale up the composite design into a manufacturing process that that can make 48” x 10” x 1” planks.

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Project Video

PROJECT: Test Copter (MAE)
ADVISORS: Dr. He Bai, Dr. Jamey Jacob

(Left to Right) Jacob Brown, David Schneider

We were tasked with designing building, and implementing a modular updraft generator intended to test small scale quadcopters or other aircraft of similar scale in an indoor environment. The idea is that the designed device will allow university students and faculty to test aircraft in vertical airflows. Our design incorporates an array of 64 server cooling fans configured in four, 2 by 8 fan sections that are powered and controlled independently. A computer interface will allow for the fan speed to be varied. The goal is to have the device produce air speeds of 5 m/s 5 to 7 ft above the ground to allow adequate space for drone flight above the device. The fan arrays are mounted to a frame that can be elevated 30 degrees to the horizontal and rotated on casters mounted to the base of the device for additional testing configurations.

PROJECT: The Orange Lasso (MAE)
ADVISOR: Dr. Joe Conner

Project Video

(Left to Right) Anthony Cappel, Theodore Gustafson, Drew Wooten, Cole Schaffitzel

The Orange Lasso is a wind turbine blade cutter. At the end of a wind turbine's life cycle, the blade needs to be removed and cut to be recycled or transported to a landfill. Due to the large size of the wind turbine blades, the recycling process due to the large size of the wind turbine blades is difficult. Previous solutions include a blade that goes on machinery that cuts them into pieces but needs to be replaced. Our project was to find a solution for cutting the blades and making disposal easier.

PROJECT: Wear Your Air (MAE)
ADVISORS: Dr. Masoud Allahkarami, Dr. Jay Hanan

Project Video

Project Photos

(Left to Right) Blade Stimson, Dakota Rupert, Jadon Cook, Amber Helms, Colby Debo

The primary objective of our oxygen concentration project is to design and create a wearable device that will deliver concentrated levels of oxygen to the user. The device will take in natural environmental air, filter out the nitrogen from that air, and deliver oxygen-concentrated air through a short nasal cannula directly to the user. The device will be lightweight and convenient for travel, everyday activities and errands, as well as comfortable to wear while sitting and resting. This device is intended to replace large oxygen tanks and bulky concentrators that must be wheeled around or carried by the user with long hosing that can become entangled and problematic.

Sponsored by:

Innovative Safety and Performance Solutions (ISPS)

Bamidele Ali

Project Video

PROJECT: Team Blue (UVC Pesticide Analyzer) (MAE)
ADVISORS: Dr. Masoud Allahkarami, Dr. Jay Hanan, Dr. Francisco Ochoa, Dr. Laura Southard

(Left to Right) Chris Stauffer, Jarett Martin, Janelle Willits, Deianira Conte, Tim Roundtree

It is known that ultraviolet light in the C-range (UVC) with enough intensity and exposure time can inactivate viruses on a surface. However, application of low power LED UVC light with relatively short exposure times on airborne particles has not undergone enough testing to implement optimally in consumer breathing-air disinfecting devices. We designed and built the Chameleon to conduct this testing. It will be used to expose viruses (on a surface or in an air stream) to LED UVC light at specific distances and specific intensities of UVC for specific exposure times. This device will be used in the OSU Virology lab to develop emperical data that will lead to optimization of the use of LED UVC light for inactivation of viruses. The end goal is to make portable UVC air-disinfection more commercially viable.

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Innovative Safety and Performance Solutions (ISPS)

Project Media

PROJECT: Pumpkin Propellers (MAE)
ADVISORS: Dr. Joe Conner, Professor Laura Southard

(Left to Right) Pardeep Singh, Edwar Villarraga, Kevin Michael Wedge, Nick Long

We were given the task of designing and creating a system that can launch pumpkins accurately and precisely. The pumpkins will vary in weight (5-15lbs) and the targets can vary in distance (75-150ft). To ensure our design can still hit the targets with these ever changing variables, the design must be adjustable. To ensure our adjustments are going to work, the team has implemented our skills acquired in Physics, Dynamics, and Mechanics.

On top of the already stated requirements, here are some others the team must follow:

1. The system must be able to be transported in a standard pickup bed or standard SUV
2. Individual parts of the assemly must not exceed OSHA 1-person-carry limits (51 pounds)
3. No pre-loaded energy can be used in the assembly
4. Only one person can assemble/operate the system
5. The one person using the system must be able to perform a launch within five minutes
6. The entire design budget must not exceed $500

With this project we hope to promote STEM to the audience of the Punkin' Chunkin'.

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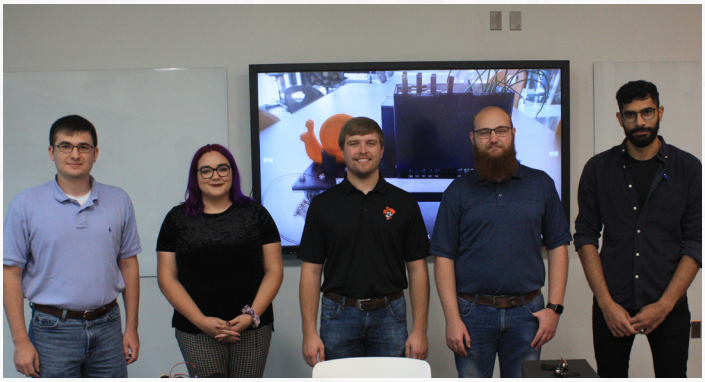
Project Video

Project Poster

PROJECT: Autonomous Stage Wagon (ECE, MAE)
ADVISORS: Dr. Joe Conner, Dr. Bingzhe Li

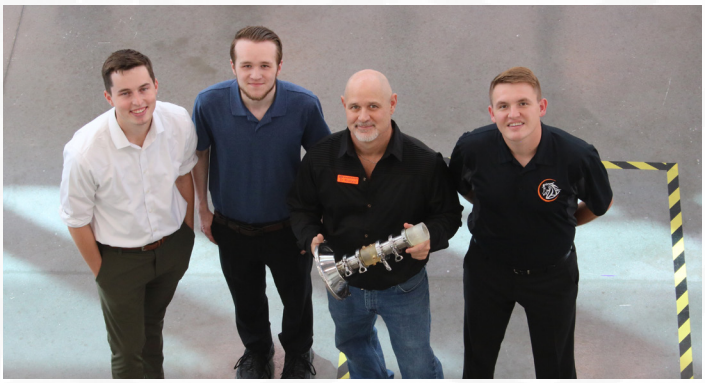


(Left to Right) Jackson Ball, Maria Collins, Clayton Henry, Adison Coffman, Mohammad Mowais

The main purpose of the Autonomous Stage Wagon (ASW) is to move stage props on and off stage without direct human control. The stage wagon can also be used to create dynamic scenes within the play. The swerve drive is serving as a test bed for future docking application. The Autonomous Stage Wagon Project has several moving parts that it encompasses. Those parts include working to improve the original 6′x6′ ASW, updating the Swerve drive vehicle, and creating a docking prototype. The 6′x6′ purpose is to improve upon what work was done in the spring of 2021. For the swerve, we will be updating its structure and adding code for it to function autonomously. On the docking prototypes, we will be creating scaled-down versions of the swerve drive to demonstrate several vehicles working in unison to mimic the 6′x6′ stage wagon.

Project Video

PROJECT: Advanced Distillation Fixture (CHE, MAE)
ADVISOR: Dr. Brad Rowland



(Left to Right) Jacob Everyly, Matthew Myers, Brad Rowland, Noah VanVolkinburg

The goal of this team is to design and assemble a lab-scale distillation column to be operated by students in a classroom setting. This design can operate with ethanol-water and may be upgraded to run with a three-component mixture with methanol. The trays are designed in SolidWorks and have holes that are threaded for fittings including a liquid sample valve, a sight glass, a reflux or feed stream, and an RTD sensor. The trays can be clamped onto the column along with steel tubing sections to easily control the tray height and the number of trays the column is operating with. Other variables may be easily adjusted such as an adjustable weir height by screwing in the downcomer tube and the area of the holes in the trays by changing out which tray is being used. All of these adjustable variables and an easy-to-use column will give the students a good experience in the lab and allow them to calculate and compare efficiency metrics which cannot be done on the current columns in the lab.

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Project Video

PROJECT: Sustainable UTV (EET, IEM, MAE)
ADVISORS: Dr. Dan Fisher, Dr. Tieming Liu, Professor Brian Norton, Dr. Robert Taylor

(Left to Right) Levi Weaver, Temidayo Folarin, Aaron Katada, Juston LaNoue, Cullin Snell, Cody Vinyard, Brandon Seodara, Braydon Leger, Michael Willhoite, Evan Brinegar, Kaiser Cleburn, Maggie Goodin

Our team consists of four sub teams working to modify the current UTV. The sub teams include the project management and human factors team; the battery cart redesign team; solar panel, generator, and speed measurement team; and the controller upgrade team.

The project management and human factors team worked to coordinate project scheduling for teams throughout the semester to make sure teams were staying on track with project tasks. This included creating an overall Gantt chart by compiling individual Gantt charts from each sub team. Additionally, this team designed a new HMI using human factors principles for desiging an intuitive user interface. The updated layout of the HMI improved ergonomic performance and overall user-friendliness. The display layout was simplified to give the operator only pertinent information. The mounting location was also addressed to minimize neck rotation and flexion to minimize operator fatigue and injury over time.

The battery cart team has worked to modify and optimize the Spring 2021 team's battery cart that is used to swap batteries between charging cycles for the Sustainable UTV. Design upgrades feature more robust terrain accessibility, user-friendly ergonomics with an electrically operated scissor lift, lighter materials, a more secure battery mounting system, and an upgraded tabletop that rotates to facilitate simultaneous battery module exchanges. Building on a great proof-of-concept, our team has utilized the existing design to enable safer, faster battery exchanges that increase UTV operability.

The solar, generator, and speed measurment team has worked to upgrade three main areas in this UTV's overall design. Within the solar panel design, we implemented an operational lockout to prevent operation of the UTV when the lower solar cell is not locked in the closed position. Secondly, several changes were implemented to the propane generator system to resolve an operating issue, as well as improve the utility of the generator's inherent functions. The first action item here was swapping the liquid service tank for the proper vapor service tank and refitting the system with durable fuel lines and new fail-safe components. We then removed redundant components (such as extra batteries and charge controllers) in order to consolidate operations. The generator's available 120V outlet was relocated to be utilized during normal operations. The last design was installing a speedometer built by the team which tracks the driveshaft rotation in order to calculate speed in miles per hour which is displayed for the driver of the UTV. These designs improve safety, increase function, and create utility.

The controller team upgraded the controller/UI system from the Spring 2021 semester while overhauling and redesigning the sub-energy charging system circuit. The original Arduino and Raspberry Pi setup was replaced by a Velocio contoller. Additionally, the original UI display was replaced with a Velocio HMI. The overall system for the battery charging, system control, circuit design, and user interface has been drastically simplified and made more efficient.

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PROJECT: Human Factors Workstation (FPSET, MAE)
ADVISORS: Dr. Diana Rodriguez Coca, Professor Laura Southard

(Left to Right) Grant Yardley, Kemi Rufai, Waverly Martin, Colton Spencer

Team ERGO will be designing and fabricating an industrial desk tabletop workstation to be used to demonstrate ergonomic design in the workplace. The workstation is intended to be utilized as an interactive tool that the students taking the FPST 3213 - Human Factors in Accident Prevention, and FPST 2023 - Occupational Safety, and even courses like IEM 3813 - Work Design Ergonomics and Human Factors taught at OSU can utilize to provide a hands-on demonstration of the different configurations of a typical workstation and how they can create different types of ergonomic, human factor, and occupational safety risks associated with various tasks. The station also demonstrates how to control or eliminate these risks by providing examples of how to tackle these real-world safety risk encounters with different workstation design configurations such as, adjustable heights specific to the student using the station.

The workstation will be constructed by using several different tabletop additions and features connected to a centralized adjustable crankshaft base. The different tabletops will include one with a textured spray paint cover, a resin tabletop with built-in LED lights, a plaster tabletop with the instructions molded into it, an aluminum tabletop with a heat lamp, a springboard tabletop, and a blackout tabletop. Each additional configuration added to the workstation will pose different controlled risks and hazards associated with each task. For teaching purposes, the students will work at these non-ideal workstations for only a short period of time before changing the workstations to the ideal working environment. Included in the workstation design will also be a rotating table on top of a small jack lift to demonstrate a common assembly line configuration that allows for teaching demonstration of proper safeguarding/machine guarding techniques. The machine guarding will be used to fully guard the pinch points on the jack lift. The task that they will be completing at these workstations will be similar to an assembly line process, where the students using the station will put together several model toys with common repetitive tasks like twisting a screwdriver or connecting pieces together.

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