ROSE SHOW PROGRAM

May 1, 2024

Academic Program: Biology & Biomedical Engineering

(Table 76) Blood Patches Arm

Presenter(s): Ashley Black, Jenna Myers, Payton Williams, Maggie Witt
Program: Biology & Biomedical Engineering
Faculty Advisor(s): Prof(s). Buckley, Chiu, Rogge
Sponsor: Rural Health Innovation Collaborative

Abstract:
The Blood Patches Arm was created for use on standardized patients (SPs) to provide a realistic IV simulation for healthcare professionals at the Rural Health Innovation Collaborative (RHIC). The RHIC is a training center located in Union Hospital of Terre Haute, IN which provides simulated training systems to mimic real life scenarios for various trainees. Because intravenous (IV) lines are performed on a majority of patients in a hospital, our device aims to protect SPs from the puncture of a needle but also allows users to practice IV protocol to gain invaluable experience interacting with live actors and receiving positive and negative feedback.

(Table 77) Eye-Tracking Ride in Toy Car

Presenter(s): Jacob Dirienzo, Kai Moore, and Neil Bhasin
Program: Biology & Biomedical Engineering
Faculty Advisor(s): NA
Sponsor: Rebecca Kidwell

Abstract:
Making Headlines is a team of three highly motivated biomedical engineers at Rose-Hulman Institute of Technology working closely with Geeks for Kids, a non-profit organization with the passion for giving kids with mobility challenges the Power2Play. Making Headlines is assisting the Geeks for Kids initiative by designing improvements to their current Eye-Gaze system. The Eye-Gaze system is used for kids with mobility limitations below the neck to track eye movement to steer a custom-made ride-in toy car. The team focused on four components of the car to implement design changes: the headrest, the mounting system, lighting and power, and eye and facial detection.

Academic Program: Civil & Environmental Engineering

(Table 34) MSA Expansion Project

Presenter(s): Makayla Ray, Joey Bueno, Peter Jacob, Devin Rayl
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Miss Softball America

Abstract:
For the last nine months Sports Facility Solutions has researched the Miss Softball America property, located in Terre Haute, Indiana, and developed a design for expanding the capacity of the on-site facilities while maintaining the local aesthetic of the park. This proposal includes the design of a two-story concession stand, the layout of a restroom and batting facility, the development of a stormwater management system, recommendation for a pump, the design of a wastewater management system, the design of a retaining wall, the development of a parking lot and the design of three fields accompanied by walkways connecting the structures. The ground floor of the two-story concessions stand will operate like the existing concession stand, while the second floor will be used as an announcers box for each field. The restrooms have been disproportionally designed to allow for more opportunities for women, as the softball fields have a higher percentage of women in attendance. The stormwater management system and retaining wall were designed to increase the safety and longevity of the site and its facilities.

(Table 35) Boankra Integrated Logistics Terminal

Presenter(s): Nathan Andrews, Will Lawton, Grayson Lincoln, Mira Randolph
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: ABP Consult Ltd

Abstract:
The project includes infrastructure design for Ghana Ports and Harbor Authority site development. This includes a commercial warehouse, road network, drainage and water supply networks, and waste management.

(Table 36) Huntington Community Swimming Pool

Presenter(s): Brandon Green, Sara Leahy, Zoe Sterr
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Mayor Richard Strick

Abstract:
The City of Huntington requested from our team a design of a natural swimming pool which uses biofilters in a regenerative basin rather than chlorine to maintain its water

quality. The site of the project is Drover Park, in Huntington, Indiana. In addition to the design of a pool, an extension to the parking lot on site and renovations to the bathroom facilities to include outdoor showers was also requested. Currently the site is a mainly flat, open green space with facilities such as a splash pad, basketball court, and picnic area which are to be left alone.

(Table 37) White Pine Manor Site Improvements

Presenter(s): Kaleb Adams, Ben Brown, Jake McRoberts, Sam Lowrance
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Jo Ann Wilkerson of White Pine Manor

Abstract:
White Pine Manor is an affordable and scenic event space just south of Brazil, Indiana, serving the local community and beyond. Currently, weddings are the main event held at White Pine Manor due to its picturesque nature. However, due to there being no hotels in Brazil and a large portion of the site not being easily accessible due to a ravine, White Pine Manor often only serves as a short-term venue. Our client would like to change this and turn White Pine Manor into more of a destination location. To help achieve this goal, our client requested the design of multiple on-site developments. Upon completion of this project, White Pine Manor will continue to serve its purpose as an affordable event space while also being able to offer more services to its clients.

(Table 38) San Francisco Pier 96 Rehabilitation

Presenter(s): Sydney Craft, Bailey Johnson, Bradley Harden, Santiago Lopez
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Moffatt and Nichol, Port of San Francisco

Abstract:
The San Francisco Pier 96 Seawall replacement Project is currently part of cargo shipping facility constructed in the early 1970s that is under lease by a waste management company, Recology. The facility sits on the eastern intercoastal side of the San Francisco Bay on top of roughly 20 to 40 feet of artificial fill with another 80 feet of Young Bay Mud below it. Due to the rising sea levels, corrosion, and seismic activity, the seawall is in desperate need of redesigning to ensure the safety of operation of the current facility. The purpose of this project is to develop multiple designs of the current 1600-foot-long steel sheet pile seawall that spans east to west along the southern part of the site. The design addresses the current flooding, settlement, and corrosion issues but also includes a plan for both future industrial operations on Pier 96.

(Table 39) Chitwan Hotel Project

Presenter(s): Kyra Hicks, Kate Wood, Aaliyah Briggs, Tyler Sommer
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Bipin Gaire

Abstract:
A local entrepreneur purchased land adjacent to the Seti Gandaki River, near the Narayani River Bridge. He envisions a mixed-use structure with several floors of retail and enough stories to provide 150 hotel rooms. The building will likely be between 15 and 18 stories tall, making it the tallest in the area. This is to be signature structure that people will associate with the city.

(Table 40) Riley Recreation League Expansion Project

Presenter(s): Julius Salinas, Jakey Ovanic, Zach Zbonski, Isaac Wanninger
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Riley Recreation League

Abstract:
The Riley Recreation League (RRL) has been long standing in Vigo County just west of Riley, IN, providing many generations the opportunity to play the game of baseball. The RRL has witnessed significant growth over the past few years and must expand its current facilities to meet the increased demand. Recently, RRL has obtained an agricultural field adjacent to the existing park(which totals 16 acres) to better help new players find a spot on the field.For the project, weproposed an expansion design that includes three T-ball fields, two little league fields, and one high school (also known as Babe Ruth) sized field. In addition to the baseball fields, a concession stand with a press box, batting barnwith a conference room and restrooms, pipe networks, and stormwater infrastructure to manage runoff are also proposed in our design. Lastly, the expansion project is the result of an influx of new players so parking, roads, and walkways are also proposed in order to provide the community with an ease of access to better traverse the facility.Through this design, we strive to provide a functional area for families to watch, play, and enjoy what the RRL has to offer for many years to come.

(Table 41) Twelve Points Transportation Improvement Project

Presenter(s): Christian Meyer, Lucas Chesney
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Twelve Points Revitalization Initiative

Abstract:
TheTwelve Points Transportation Improvement Projectimprovesthe safety and ease of

travel for pedestrians and cyclists traveling from Twelve Points Historic District to the Indiana State University campus. The project is along Lafayette Avenue in Terre Haute, Indiana, a city of about 58,000 people in west-central Indiana. The design includes a street design for safe passage of pedestrians and cyclists, the redesign of the intersection where Lafayette Avenue, 8thAvenue, and N 9thStreet all meet, and a design of additionalstormwater management features to reduce the likelihood of standing water in the corridor.

(Table 42) Niagara Falls Power and Overflow

Presenter(s): Tyler Pessler, Allie Fults, Carter James
Program: Civil & Environmental Engineering
Faculty Advisor(s): Prof(s). Mueller
Sponsor: Niagara Falls Water Board

Abstract:
The purpose of the Niagara Falls Overflow and Power project is to assist the Niagara Falls Water Board (NFWB) in a way that will be cost effective and protects the existing infrastructure so that heavy storm conditions will no longer endanger its water treatment plant and its homes. A 100-foot-long culvert has been designed to divert excess water from the inlet junction box before it can be overwhelmed and allow combined sewer overflow (CSO) to flow back into residential homes or flood the WWTP. Along with this culvert, an energy dissipation system has been designed to limit erosion in the International Paper Tunnel, which is where the culvert is diverting the overflow water to. In a different part of the plant a turbine has been selected to be placed near the plant's effluent in order to generate electricity for the WWTP so that it can depend less on energy from the local energy grid. Within our desk study of the site and its surrounding area, the team found that the site has had previous owners and that there had been previous buildings that may have not been demolished properly. The primary owner that the team was concerned with was the International Paper Company, who had previously had a paper mill located at the current site and potentially contaminated the soil with chemical discharge from the mill. After further investigations consisting of boreholes and other soil tests the area appears to be good for construction. The entire design of this project consists of the concrete box culvert, the turbine, and the energy dissipation system. The estimated cost for this project is just over $481,000 and accounts for labor and the necessary materials. In terms of constructability, the main concerns would be the potential chance of finding contaminated soil or old foundations from the International Paper building that previously stood on this site. This design would require minimal maintenance since the box culvert and energy dissipation system will be below grade and not experiencing the elements in a way that would cause them to deteriorate. The turbine would be the only component that would need to be maintained regularly due to its technical nature and to keep the plant as efficient as possible. The Niagara Falls Overflow and Power project creates the opportunity to benefit the community of Niagara Falls by keeping their houses from being flooded with CSO and keeping their WWTP operating. While going through the decision-making process ACT Engineering kept potential environmental impacts at the forefront of our minds. In order to prioritize the minimization of harm to the environment, the team limited the

amount of disturbance to the land and recommends hands-off tactics, such as aromatic and sound strategies, to deter the nesting swallows. The implantation of the turbine would also economically benefit the plant by making it less reliant on the power grid.

Academic Program: Computer Science & Software Engineering

(Table 2) GlobalCopy

Presenter(s): Khyree Brooks, Marcus Henderson, Vuk Djuric
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Chenoweth
Sponsor: Carl Myers

Abstract:
GlobalCopy is a service which makes your clipboard global across all the machines you use.

(Table 1) Hospital At Home

Presenter(s): Jacob Wallis, Yuxuan Jiang, Ken Zheng, Yunzhe Wei
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Chenoweth, Hays
Sponsor: Jimmy McKanna

Abstract:
There are many hospital patients that need their vitals monitored, but otherwise do not need to be in a hospital bed. During the pandemic this became an issue due to the shortage of beds. To allow patients to go home sooner, but still let their doctor have access to their vitals, we created the Hospital at Home app. With the aid of MedM's SDK, our app allows patients to automatically take health measurements using Bluetooth devices. Whenever a doctor needs this data, they can load up our website to see it and much more!

(Table 3) Plan To Sew, Sew Do It

Presenter(s): Ruke Sam-Ogaga, Owen Trudt, Angelina Amato, Michelle Kenny
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Chenoweth, Hays
Sponsor: Eliza Marcum

Abstract:
PlanToSew.com aspires to revolutionize the sewing community by introducing a stunning, intuitive web and mobile platform tailored for sewing enthusiasts of all skill levels. The goal is to enhance the tracking of sewing projects, a crucial aspect often overlooked by existing applications in the market, which suffer from poor user experiences.

(Table 4) BIFROST, a tool for hardware verification of programmable network switches

Presenter(s): Richard Costa, Justin DeWitt, Elon Hu, Yuchen Cai
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Chenoweth, Hays
Sponsor: Mohammad Noureddine

Abstract:
Programmable data planes introduced a paradigm shift in modern network design, granting engineers the flexibility to design, test, and deploy custom packet forwarding pipelines on programmable switches. Unfortunately, this increase in programmability is accompanied by an expected increase in bugs, which can jeopardize network reliability and security. We present BIFROST, a tool that uses sequential circuit verification, rather than the software verification techniques of existing tools, to perform scalable and efficient verification of dataplane programs. We aim to highlight BIFROST's features and discuss the ways in which it can be used by network systems engineers.

(Table 5) Smart Garden Appliance Monitoring and Alerts

Presenter(s): Ryan Bowering, Matthew Greenberg, Rahul Siripuram, Nhan Tran
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Chenoweth, Hays
Sponsor: Anu

Abstract:
Anu is a leading player in the Ag-Tech revolution with their appliances that allow plants to be grown in your house with rotary aeroponics. These devices use a rotating tower to house various seed pods. Our system streamlines the process of creating different alerts to analyze the sensor data collected from these appliances and notify the plant science team of any issues via messages sent directly to Slack. Additionally, our system allows the plant science team to communicate with devices from their Slack channel.

(Table 6) RoseData

Presenter(s): Jaden Rigg, Hardy Lyu, Jinyoung Choi, Andrew Pascente, Jonathan Spychalski
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Chenoweth, Hays
Sponsor: Dr. Jason Yoder, Rose-Hulman Institute of Technology

Abstract:
There are many ways to access academic data at Rose-Hulman, this involves navigating multiple sources, causing inconvenience for students and faculty. Rose Data serves as a centralized platform for its users, allowing for easy access to academic data. Initially designed as a class schedule viewer and a student group planner, the project has evolved to offer a comprehensive Degree Planner tool for students, aiding in course selection and

graduation tracking. Utilizing a diverse tech stack including Postgres, TavaScript, Angular, and more, Rose Data aims to streamline academic processes.

(Table 10) AI Identification of Objects in a Robotic Workspace

Presenter(s): Ethan Brown, Jared Krauss, Liam Waterbury, Owen Greybill
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Hollingsworth
Sponsor: Beckman Coulter

Abstract:
We developed an AI model for Beckman Coulter that detects incorrect labware setups in automated liquid handling workstations by analyzing images. To create our dataset to train our model, we developed an automated process using computer vision to annotate over 4,500 images from raw experiment metadata. This process enables precise mapping of 3D labware coordinates to 2D images, accurately capturing intricate object overlaps with geometric analysis for near-perfect annotations. With the annotated dataset, we trained a Mask-RCNN model, a form of Instance Segmentation, using a custom training loop for multi-GPU efficiency in MATLAB. This instance segmentation approach enables the detection of setup errors without reference images, significantly enhancing lab efficiency and reducing experiment failures.

(Table 11) Rickshawclub / Drophouse:

Presenter(s): Yao Xiong, Wenzi Qian, Hanshuo Geng, Clint Zhu
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Hollingsworth
Sponsor: Drophouse

Abstract:
The Drophouse is a cloth selling website where every design is created by generative AI, ensuring that each item is one-of-a-kind and exclusive. The project covers frontend website building, backend server construction, security enhancements, and fine tuning on generative AI. Frontend development posed challenges, particularly in implementing image modification features and creating an appealing design. At the same time, backend work required significant time to ensure server reliability and optimize efficiency, balancing performance with cost-effectiveness.In addition, the tuning of an AI model is some of the cutting edge technologies that we just started to learn, so it is also a great challenge we have faced.

(Table 12) Web-Based Geospatial Image Viewer

Presenter(s): Evan Sellers, Jadon Brutcher, Dixon Ramey, Zack Gault
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Hollingsworth
Sponsor: Andrea Leichtman

Abstract:
The Geospatial Image Viewer is a system designed for Johns Hopkins Applied Physics Laboratory to help inform first responders about natural disasters. The system enables users to easily view, layer, and manipulate geospatial imagery (GeoTiff, NetCDF, SAFE, and shape filetypes) on a map. These manipulations include edge detection, contrast/histogram adjustment, and opacity for the image-based files along with allowing shape files to be filtered based on lines, points, fill, or clusters. Major challenges of this system include handling the extreme size of some of the files, ensuring that the data conforms to required standards, making the system easily extensible to add new filters or filetypes, and ensuring that the data can be accessed in a reasonable time. All of these required immense care and consideration in the design decisions that helped to structure our project.

(Table 16) Organize My Life

Presenter(s): Joseph Parsons, Kernan Lee, Zach Decker, Emma Brown
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Hollingsworth
Sponsor: Dr. Gloria Liou and Grant Ripperda

Abstract:
Organize My Life is a mobile app designed to allow people to organize receipts, invoices, and other records for their personal assets, such as their house(s) and car(s). Users can record expenses associated with a particular asset and search through and share the list of expenses with others. The frontend uses the React Native framework and Expo toolset to allow for cross-platform development. This communicates with an AWS backend for authentication and storage. React Native uses components, requiring a somewhat different approach to software design than an object-oriented language.

(Table 7) Worldclass

Presenter(s): Braedyn Edwards, Michael Huang, Brandon Kinnick, Aidan Matthews
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Liou
Sponsor: Worldclass

Abstract:
Worldclass focuses on providing an all-in-one, customizable software that can be designed to suit any business's needs without any additional overhead. During our work with Worldclass, we have added features supporting increased customization options, advanced payment and management options, many quality of life optimizations, and other features that enhance user experience. Many features implemented throughout the project were specifically requested by Worldclass customers. The development of these features helped Worldclass attract new businesses while satisfying existing client needs.

(Table 8) General Learning and Automated Discovery for Operationalizing Science (GLADOS)

Presenter(s): Alan Zhang, Byunghoon Ryu, Lyra Lee, Taisuke Sugiyama
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Liou
Sponsor: Jason Yoder

Abstract:
GLADOS (General Learning and Automated Discovery for Operationalizing Science), an automated computational science pipeline, is entering its third year with an established website that has simplified the process of generating and collecting experiment results for students and users. Building upon the foundation laid in the previous year, our team was tasked to make this project production ready. We implemented distributed systems which allow experiments to run in parallel and have the potential to run across multiple servers. Additionally, we transitioned from using Firebase as our primary database over to MongoDB for reduction in licensing fees. We also implemented quality-of-life features in the front-end and began work on automating the process of retrieving to running experiments located in GitHub repositories.

(Table 9) Gender Fair: Nonprofit Demographic Data

Presenter(s): Baba Diatta, Dillon Duff, Richie Eaddie, Hayden Mattick
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Liou
Sponsor: Gender Fair

Abstract:
Gender Fair is a public benefit corporation focused on giving users a simple and efficient way to inform themselves on companies and their gender fairness. Gender Fair recognized the need for an application to transparently display nonprofit organizations' demographic information including gender, race/ethnicity, and pay equality. This information is seldom conglomerated in a way that makes it accessible to the average person as well as prospective donors. We accomplished this by gathering and cleaning data from all available sources including IRS 990s and Candid's public Demographic Report, bench-marking and scoring organizations in various categories, and building a website from scratch to display our results with visualizations. This system will help support Gender Fair in accomplishing their mission of offering services to allow anyone to make decisions regarding donations and employment.

(Table 13) Gwen's Cookbook

Presenter(s): Gabe Corridore, Annelise Kezdy, James Koh, Sam Walsh
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Liou
Sponsor: Eliza Marcum

Abstract:
Gwen's Cookbook is a web application to create and share printable, kid-friendly recipes that use iconography and simple ingredient photos to make home cooking accessible to children who cannot yet read. It was inspired by our client's love of baking with her daughter, and her daughter's desire to be more involved in the kitchen. We built the website from scratch using Ruby, React, and PostgreSQL. We are excited to present an easy-to-use platform that brings families together in a meaningful experience that they can share with other families near and far.

(Table 14) RetireSimple

Presenter(s): Brayden Davis, Ari Rosen, Grant Ripperda, Harrison Wight
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Liou
Sponsor: Kim Tracy

Abstract:
RetireSimple is a software product committed to simplifying retirement planning. Our application, the RetireSimple Retirement Planner, empowers users to take control of their financial future. Our values of simplicity, security, and transparency allow us to provide a unique retirement planning offering that is different from other applications in the market. Over the course of the last year, we rebuilt the backend to make the application more flexible and extensible. We also restructured the frontend, revamped the database, and simplified the system's architecture. Through our work, we have created a free and accessible retirement product for all.

(Table 15) Jenkins Git Plugins

Presenter(s): Joey Gawron, Derek Inskeep, Brandon Liu, Ben Roberts
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Liou
Sponsor: GE Healthcare

Abstract:
Jenkins is an open-source automation server that is widely used for building, deploying, and automating software development pipelines. GE HealthCare approached us with an integration issue between Jenkins and GitLab, which also affected many other users. We have fixed the existing deficiency by adding a new feature which will greatly increase the efficiency of build pipelines for the 270,000+ Jenkins users. We have also fixed numerous other issues that have been identified by open source users.

(Table 17) JPEG-2000 Image Decoder and Benchmarking

Presenter(s): Andrew Kosikowski, Seth Marcus, Campbell Garvin, Taylor Goldman
Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy
Sponsor: Johns Hopkins University - Applied Physics Lab

Abstract:
John Hopkins University seeks an efficient way to load and identify features in large satellite images. The primary goal was to develop a C library more efficient than current open source libraries at reading the JPEG-2000 image format. We designed a pipeline for processing images and used benchmarking tools to identify weaknesses in current designs. We reverse engineered other implementations to create our own six stage decoder. Lastly, we gathered an image dataset to benchmark each implementation on their speed and throughput dependent on the image size and part of the image we're reading.

(Table 18) Rethink Mobile App

Presenter(s): Myon McGee, Hailey Steward, Da Li, Luke Cesario
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Tracy
Sponsor: ReTHink Inc.

Abstract:
We are the ReTHink Mobile App team and are creating an app for ReTHink, a local business specializing in creating reusable products that produce zero waste. ReTHink aims to enhance environmental stewardship through community empowerment and raise awareness about using zero-waste products. With ReTHink being a small business, advertising their products, giving information about local recycling locations, and reaching the masses can be a problem. To solve these problems, we began development on the ReTHink App.

(Table 19) Orbital-Laser Simulator

Presenter(s): Sam Polonus, Matthew Ragland, Zach Humes, Drew Egler
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Tracy
Sponsor: iMetalX

Abstract:
Space debris accumulation has become increasingly problematic for space operations in recent time. Debris objects can be as small as 1cm and move at incredible speeds.The goal of project is to create a simulation of satellites and debris in low-Earth orbit. The satellites are equipped with with reflectors or lasers with the intention of deorbiting space debris, i.e. causing debris to fall back to earth and burn on reentry with Earth's atmosphere. The project serves as a proof-of-concept and experimental tool for designing satellites that can ultimately be launched.

(Table 20) Showem

Presenter(s): Yingeng Liu, Andy Yin, Thomas Yang, Leo Zhu
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Tracy
Sponsor: Faceless Labs

Abstract:
Show'em is a proprietary community-building and data platform built for web3 gaming communities. Show'em not only provides a place for players and creators to connect, it also drives community participation by encouraging users to Show'em what they've got, highlighting achievements and assets won in-game.

(Table 21) Weapon Systems Integration Support

Presenter(s): Kyle Brownell, Nathan Loafman, Will Sessions, Seth Wertz
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Tracy
Sponsor: V2X

Abstract:
Our Client V2X has a program written in Visual Basic that is hard to maintain and scale. We were tasked with creating a replacement program that is modern, maintainable, scalable, and configurable. With those requirements in mind we designed a system using modern languages (C# and C++) and modern frameworks (WPF) that is highly configurable with the use of config files. Our final product has an estimated feature parity of ~85% with the old software and an estimated 80+% of the software is configurable. Additionally, our design facilitates easy adaptation to support new tasks.

(Table 22) Startup Accounting Platform

Presenter(s): Grant Giles, Qingyuan Jiao, Luke McMahon, Adithya Ramji
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Tracy
Sponsor: Mike McDonald

Abstract:
The Startup Accounting Platform is a web application that allows companies to build and share basic financial models. An easy to use drag and drop UI allows users to connect inputs, functions, and outputs to perform financial modeling tasks ranging from interest rates to cash flow statements. Inputs can be numeric or series data, while outputs can be numeric or graphical. Any custom functions created can be used within other functions, allowing for a flexible, user-friendly experience. User information is protected by Google authentication and functions can be shared to specific users as templates.

(Table 23) Transformative Data Automation

Presenter(s): Quinlan White, Joshua Spevak, James Li, Qijun Jiang
Program: Computer Science & Software Engineering
Faculty Advisor(s): Prof(s). Tracy
Sponsor: Keller Schroeder & Associates, Inc

Abstract:
This project is to allow our client to automatically transform data into a more desirable form.

Academic Program: Electrical & Computer Engineering

(Table 47) Two PCB Structures for 6dB Common Mode Rejection in 16 GHz Differential Signal Transmission

Presenter(s): Zach Eckstrom, Robert Walker, Ed Wolski, Jason Su
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Cracraft, Wheeler
Sponsor: Rose-Hulman Institute of Technology

Abstract:
In modern high-volume, high-performance computer systems such as servers, the ability to transfer large amounts of data at rapid speeds is a paramount concern. These high speeds are supported at a hardware level by differential signal pairings, a PCB trace routing technique that allows for lower error and higher signal integrity in a small footprint by transmitting complementary copies of the same signal on two parallel traces. Unfortunately, differential signal pairings are plagued by common mode noise, which is composed of spurious signals that build up on both traces due to external field influences, variations in trace length, material properties, and a number of other design factors. Common mode noise adversely affects signal integrity and contributes heavily to increased levels of electromagnetic interference, leading to crosstalk and device malfunctions. The overarching goal of this project was to develop filtering structures that can be implemented at a hardware level in differential signal pairings to substantially eliminate this common mode noise as it arises. In particular, we aimed to design two differential signal pairing implementations and their associated common mode filters to support low loss transmission of information at 16 GHz, with less than 3dB of differential mode attenuation while attenuating the common mode noise by at least 6dB. We successfully designed, fabricated, and tested two differential signal pairings with common mode filters which provide at least 6dB of attenuation to common mode noise at 16 GHz. Our completed devices, which we fabricated by hand using only on-campus resources, attenuate the differential mode by slightly more than 3dB in some regions of operation. This shortcoming is addressable by off-site fabrication with low-loss dielectric materials to better support the differential mode signal integrity.

(Table 44) Refinement of Detection and Location of Linear and Non-linear Scatterers in Three Dimensions

Presenter(s): Patrick Townsend, Nathan Quets, Andrew Shaw, Noah Young
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Simoni
Sponsor: Dr. Ed Wheeler and Dr. Michael Cracraft

Abstract:
DORT (decomposition of the time reversal operator) is a signal decomposition technique that can provide information about the scatterers of waves (e.g., acoustic, electromagnetic) located within the observed medium. The Rose-Hulman DORT system modifies and supplements this technique to locate linear and non-linear targets using signals transmitted and received by an electromagnetic antenna array.The first modification, Time-of-Flight analysis, allows the system to monitor the amount of time between the transmission of an excitation signal sent to potential targets and the reception of the returning scattered waves, giving information about the distance between the antenna array and the targets. The distances between the targets and each array element are aggregated using optimization methods to find the most likely location of each scatterer. Pulse-Inversion is another form of modification done to the DORT system to allow it to distinguish linear and non-linear targets. Linear targets reflect any excitation signal they receive at the same frequency as it is transmitted to them, whereas non-linear targets, like diodes, cause non-linear effects like intermodulation distortion on the incident excitation pulses. This causes the waves reflected off them to have frequency content at harmonics above the fundamental frequency of the excitation pulse, which allows non-linear scatterers to be distinguished from linear targets. Unfortunately, this received harmonic content has less energy than the content at the fundamental, making non-linear targets more difficult to detect than linear targets. To solve this, the system uses pulse inversion (PI) DORT to transmit a signal and record the response, then transmit the inverse of the signal and record the response. When these responses are summed, odd-order frequencies, including the fundamental frequency, are effectively cancelled out and even-order frequencies like the first harmonic are enhanced. This frequency isolation process allows our system to effectively locate non-linear targets.In the current system, these techniques are being used to predict the position of linear and non-linear targets. Before our group's design work, the system struggled with detecting multiple non-linear targets due to low total received power. This low reception also limited the system to a detection range within 1.2 meters from the antenna array .To upgrade the current system and improve upon these issues, our redesigned system operates at a fundamental frequency of 6 GHz instead of the previous 3 GHz setup. By increasing the frequency and correspondingly decreasing the propagating pulse's wavelength, the system better meets our client's desire for a short far-field distance (defined as three wavelengths, and thus cut in half after the upgrade). This upgrade to the system required the implementation of an antenna array capable of transmission and reception at a fundamental frequency of 6 GHz, as well as reception of any reflected frequency content at the first harmonic of 12 GHz. The 2021-2022 DORT team previously fabricated an antenna array meeting these requirements, but they had not yet

integrated it into the DORT system, so we successfully completed this integration this year, updating both the hardware and software components of the system . Additionally, to address the low total received power, our team implemented a more powerful amplifier used to transmit the excitation pulses, boosting the maximum pulse power from 20W to 50W. We also investigated an improvement to the technique used by the system to detect non-linear targets with the goal of further narrowing the gap in detection accuracy between linear and non-linear targets.Beyond improvements to far-field distance and total received power at different frequencies, our team also sought to improve the quality of our research through better documentation for future groups, simplifications of the program used to implement the DORT system, and through the development of a target detection system that is similarly functional but mathematically distinct to the DORT system using a Rotman lens. A Rotman lens is a microwave device which behaves similarly to an optical lens, converting differences in phase on one side to differences in power on the other, and vice versa. This property can be used to determine the angles of scatterers from an antenna array with less software effort than DORT and associated methods; combined with time of flight, a single target can be located. In addition to providing a new research pathway for future teams, the development of the Rotman lens technology gives the group a point of comparison for the DORT system's performance. Since the two are mathematically distinct, their results can be compared, and their tradeoffs analyzed to yield even more improvements to both systems over time.

(Table 45) Wireless Ultrasonic Sensor Liquid Level Indicator for IBC Tote

Presenter(s): JonMarc Ryu, Justin Pierson, Neha Vinesh, Precious Saelee
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Song
Sponsor: SpaceKraft

Abstract:
Our client, SpaceKraft, is an international paper company that makes intermediate bulk containers (IBC), that are made of eight-ply cardboard with a nylon plastic liner bag that can hold up to 275 gallons of liquid. The current competitor for our client uses a translucent hard plastic that allows the liquid to be easily visible at all times. Our client's product has an obstructed view from the liquid which slows down production time for their clients because they must manually check how much liquid is in the tote. They are looking for a product that will identify the amount of liquid in the container and provide the user with a visible indication. Our client wants our product to require little to no maintenance, last up to three months on a battery, be simple to install, be reusable for multiple containers, be contactless, and be able to withstand temperatures up to 200 degrees F.

(Table 54) Scale DIY Kit for Smart Espresso Profiling App

Presenter(s): Breanna Coultas, Bryce Bejlovec, Matthew Stepaniak, Rhian Seneviratne
Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Song
Sponsor: Mike McDonald

Abstract:
For manual espresso machines, pressure and time of extraction are crucial to the quality of the espresso output. Our system allows the user tomonitorthe pressure (via a pressure transducer) and flow rate and time (via a scale).The pressure sensor system consists of a microcontroller, atransducer,a battery,and a casing. The scale system consists of a load cell, LED screen, microcontroller,battery, HX711board, and a casing. There is also a custom PCB for all the scale connections. Both systems interact with the smartphone app via Bluetooth and runtheir own Arduino scripts.

(Table NDA E) 36V Parallel Discharge Pack from M18 Batteries

Presenter(s): Alex Brooks, Ethan Chastain, Jacob Goodhew, Andrew Hoch
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Song

(Table 43) Radar to Audio: Listening to Electronic Eyes

Presenter(s): Gideon Townsend, Jacob Fennell, Jonathan Vanderlyn, Thomas Hanna
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Walter
Sponsor: Booz Allen Hamilton

Abstract:
Modern weapon systems rely on radar technology to track and attack their targets. To protect against attack from these weapons, electronic warfare officers need to be able to detect the presence of a radar signal so they can deploy appropriate countermeasures. One important way to do thisis to receive RF signals and convert them to audio that the EWO can hear. Radar systems produce distinct audio signals that the EWO can identify. We created a testbed for processing RF signals into audio signals and automatically identifying radar emitter types. The system receives RF signals emitted from radar sources input from a software defined radio (SDR) or datafiles containing pre-recorded/simulated data. The system converts the RF into a form where characteristics of the signal can be audibly identified. The system will also use deep learning algorithms to assist the user in identifying the signal.

(Table 46) Testbed for Identifying Minimum Environment Resolution for RF Simulation

Presenter(s): Stephen Acomb, Stuart Atkinson, Chaitanya Singh
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Walter
Sponsor: Naval Surface Warfare Center - Crane Division

Abstract:
The Navy uses the software NRL Builder to simulate radio wave propagation through environments for mission planning and research. Using this software to research the impacts of multiple parameters is time consuming, involving running many simulations and recording metadata manually. We have developed an automated testbed which can run predefined sets of simulations sweeping all required parameters while recording results and resource use. Using it, we have answered our client's research question on the impact of environment data resolution on simulation accuracy, runtime, and memory usage.

(Table 48) Milwaukee Tool Beverage Container with Precision Temperature Control

Presenter(s): Matthew Hinman, Miguel Robertson, Eva Yin
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Walter
Sponsor: Milwaukee Tool

Abstract:
Our client has tasked us with designing a device that can adjust and maintain a specified temperature for his beverage and can be powered by the Milwaukee Tool family of battery packs. For this project we will be delivering our client a functional prototype which will take a desired temperature set by the user and use a control system to heat or cool the liquid to that desired temperature and keep it stable at that temperature. Our prototype will use a temperature sensing device to measure the current liquid temperature, and this data will be used in our control system to determine whether our circuit needs to heat or cool the liquid. The design uses the Milwaukee Tool M18 battery system because many individuals (including our client) have spare M18 batteries they would like to use to make their lives simpler and more convenient.

(Table 49) Affordable Electrosurgical Unit (ESU) Solutions for Low-income Developing Countries

Presenter(s): Theodore Mitz, Sadie Park, Harris Wu, Richard Zhou
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Walter
Sponsor: Dr. Richard Davis and Dr. Nathan Peterson, Kijabe Hospital, Kenya

Abstract:
Electrosurgery units (ESU) use high frequency electric current to achieve various tissue effects during surgical procedures. ESU handpieces, which directly interact with patients, are typically designed for single-use only. While inexpensive, their cost is not negligible and can hinder the adoption of ESUs in developing countries. To address this problem, we created a $7 handpiece design that can be sterilized and reused 100 times, and a low-power benchtop testing device that simulates a basic ESU generator.

(Table 50) NASA CubeSat Transceiver Module

Presenter(s): Morrison Gardener, Sarah Hoatson, Adam Korinek, Yue-Shan Lam, Tori Robinson
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Yoder
Sponsor: RHIT SmallSat Team

Abstract:
The goal of this project is to research and develop a CubeSat satellite transceiver module to aid in the future advancement of a newly developed, space-grade reusable adhesive. Our capstone team's purpose is to provide reliable uplink and downlink communication to the CubeSat in the form of physical data, such as temperature and telemetry, and images from the satellite. This will be done with a hybrid processor format using both a Field Programmable Gate Array (FPGA) and microcontroller, something many commercial companies and organizations have proven to be a reliable design in recent years for this type of application. However, many factors have prevented satellite hobbyists or educational institutions from using this hybrid processor format including cost, radiation caused bit-flipping, and power resources. Our desire is to create a communications module that is a low-cost, low-power, hybrid processor design.

(Table 51) Developing Computational Architecture

Presenter(s): Jailen Hobbs, Sean Hyacinthe, Kevin Lin, Clark Ren
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Yoder
Sponsor: Dr. Daniel Chang and Dr. Mario Simoni

Abstract:
Due to the complexities of the math involved in the most widely used and accurate neuron simulations, it is difficult to simulate neurons efficiently. Most existing simulations need to be run on expensive, dedicated equipment or run inefficiently on general purpose equipment. Our goal is to create and provide a time- and cost-efficient method of simulation for a network of neurons. We will be doing this on an FPGA to serve as a foundation for test benching and prototyping the design before fabricating it into a physical chip. The goals this year for the team were to continue the porting of the deprecated architecture started by the previous team last year, create a method of transferring data off the chip, create a method of communication between neurons, develop a synaptic model, and to port over our current configuration models to be NeuroML compliant. We were partly successful in finishing the porting job started by the previous team. The design currently runs correctly in simulation and is synthesizable but fails to run on the FPGA. We were successful in providing a method of transferring data off chip using a DMA. We were also successful in developing a synaptic model and porting our configuration models to be NeuroML compliant. We have also made significant progress in fully verifying and creating a method of communication between neurons using a custom I2C module as our communication method with next steps being to test our custom module on the FPGA. We

recommend that future teams continue working with what we've created and to join the eFabless Slack group for further assistance on things related to porting over the old architecture to the new one.

(Table 52) Milwaukee Tool Flashlight Mode

Presenter(s): Nicolas Gaither, Noah Lee, Owen Sapp, Michael Thede
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Yoder
Sponsor: Milwaukee Tool

Abstract:
This project, sponsored by Milwaukee Tool, successfully sought to improve the usability of the M18 Compact Brushless Drill by making the existing work light function like a flashlight. The addition of an ambient light sensor enables automatic brightness adjustment. These modifications provide significant value to users; they can now illuminate their work spaces without the need to run the drill motor. The independent work light function promotes precision, improves visibility in darker environments, and improves the battery life of the drill. The project culminated in a functional proof of concept, demonstrating the feasibility of this enhancement within the original drill housing. Accompanying this modified hardware is updated firmware with comprehensive documentation, with component decisions included, to guide future integration into production models.

(Table 53) Rowhammer Analysis, Detection, and Mitigation

Presenter(s): David Utsis, Alex Sloan, Jacob Hruska
Program: Electrical & Computer Engineering
Faculty Advisor(s): Prof(s). Yoder
Sponsor: Brendan Mulholland

Abstract:
Modern Dynamic Random Access Memory (DRAM) chips contain vulnerabilities to voltage leakage across cells caused by repeated memory refreshes. The Rowhammer family of cyber-attacks exploits this vulnerability by repeatedly accessing rows of cells to influence the state of adjacent rows. Our project aims to implement both standard and novel Rowhammer attacks on an Ubuntu system at both the operating system and Unified Extensive Firmware Interface (UEFI) level, classify the threat level of said attacks, and develop possible detection and mitigation techniques based on our findings.

Academic Program: Engineering Design

(Table 59) Wearable Infrared Near-searchinG Device for Information and Near-Dark Sealth

Presenter(s): Kyle McDuffie, Owen Smith, Tayte Turner
Program: Engineering Design
Faculty Advisor(s): Prof(s). Bhatta, Brackin, House, Mutchler

Abstract:
The Wearable Infrared Near-searchinG Device for Information and Near-Dark Sealth, or Project WINGDINGS, is a wrist/forearm-mounted device that enables the wearer to attain positional information about their surroundings without needing light. Project WINGDINGS acts as the wearer's eyes in a darkened environment, relaying data about surrounding objects to its display screen to enable navigation without an artificial light source in the surrounding area. Project WINGDINGS also displays convenient information to the user, such as the time and device parameters, enabling the user to maintain stealth navigation in many common environments.

(Table 57) Positive Reflection

Presenter(s): Neesa Bonham, Caledonia Coleman, Karsyn Kikta
Program: Engineering Design
Faculty Advisor(s): Prof(s). Bhatta, Brackin, House, Mutchler, Noffke

Abstract:
People need more positivity in their day-to-day life. Specifically, students at Rose-Hulman receive a lot of criticism; while this criticism is necessary for their learning, it can have a negative impact on their mental health. Studies have shown that this can be less of an issue with continued positive reinforcement. When Positive Reflection detects a viewer in its proximity, it uses Python programming to randomly select a compliment that is then relayed to the viewer through speakers. When the compliment is received, you can see your Positive Reflection!

(Table 61) Rear Projection Board Game Table for Simpler Gameplay

Presenter(s): Jeremy Bergman, Maxwell Danielson, Mikko Shaia, Sylvan Watson
Program: Engineering Design
Faculty Advisor(s): Prof(s). Bhatta, Brackin, House, Mutchler, Noffke

Abstract:
Our project involves a rear projection system used to display board games onto a table. We aim to reduce the need to store a large amount of physical game elements, and instead combine all of these game boards and pieces into one table that can be easily used and operated. Our project involves a computer interface that describes setup and play

instructions, and a button-controlled interface on the table itself that can open compartments to store game pieces.

(Table 63) Spider Gear Based EV Transmission

Presenter(s): Michael Wilson, Thomas Andrade
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin

Abstract:
Most current light-duty electric vehicles don't utilize multi-speed transmissions because of increased weight and complexity. This causes inefficiency at high speeds and undue motor stress when accelerating from low speeds. Our solution has reimagined the necessary mechanisms in a transmission and allows for the usage of multi-speed gearboxes in electric vehicles without the drawbacks. The product utilizes a spider-gear-based differential drive to provide multiple gear ratios and a neutral position, opening the door for a major leap in EV efficiency.

(Table 78) Napkin Ninja

Presenter(s): Emilia Diaz, Aaron Altman, Maddy Alfeldt, Quinn Johnson
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin

Abstract:
The Napkin Ninja is a fully automated utensil rolling device, designed to relieve restaurant employees of the time-consuming, monotonous, and unsanitary process.

(Table E1) Cortana Remote

Presenter(s): Henry Faris
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin

Abstract:
The Cortana remote is an in-game device for the Halo series that improves gameplay. The remote is used in game by the main character Master Chief who is controlled by the player. The remote removes unnecessary steps from missions for the user group.

(Table 60) Automated Catan

Presenter(s): Harrison Boerner, Rowan Hood, Colden Roach, Will Stephanouk
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin, House

Abstract:
Our project takes a board game called Catan and implements automation to improve the

experience of the gameplay. To win the game you need to collect victory points which can be obtained by collecting resources. Currently, available resources may be missed depending on the number that is rolled. Addressable LEDs are added to custom 3D Catan pieces allowing the user to view the appropriate tiles based on the number rolled. When a seven is rolled all of the LEDs light up red to indicate that the robber needs to be moved. These features improve the user experience while making the game more aesthetically pleasing.

(Table 62) Sucky Trashcan

Presenter(s): Ryan Driemeyer, Alex Seitz, Jacob Tuck, Andy Wagner
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin, House

Abstract:
Taking out the trash is a necessary and annoying part of life. The Sucky Trashcan aids the process of changing the trash bag. It uses a vacuum mechanism to create negative pressure to prevent billowing of the trash bag and the frustrations that follow. It also allows airflow back into the can when taking the bag out to counteract the suction, allowing for easy removal. The Sucky Trashcan makes the whole process easier for everyone, especially persons with disabilities and the elderly, who may have trouble with everyday tasks.

(Table 55) Autonomous Turret:

Presenter(s): Owen Chaffin, Schuyler Chew, Tristan Stephans, Deven Wells
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin, House, Mutchler

Abstract:
We have designed a robotic turret that can track and aim at objects and interact with targets in a variety of ways. It can shine a helpful light, point out details with a laser pointer, or even shoot a target with a small gel ball. In addition, it can be manually controlled using a wireless computer interface.We accomplish these tasks by using a Pico W microcontroller, and Huskylens AI-powered camera to record data, interpret data, and control our 2 DOF turret.

(Table 65) Light Lever

Presenter(s): Daniel Durrant, Kali Hurst, Steven Johnson
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin, House, Mutchler, Noffke

Abstract:
The product opportunity is to create a way to shut the lights off in any room remotely without having to be close enough to flip the switch. The Light Lever achieves this with a remote control as well as an online user interface that connects to a lever attached to the wall. When the button is pressed, the lever will rotate on a servo motor and flip off the light

switch. The lever will rotate the opposite way the next time the button is pushed to turn back on the light switch.

(Table 64) EcoBlaze Chainsaw

Presenter(s): Calvin Jorgensen, Lauren Jaracz, Connor Luce, Quinlan Walinder, Prabhat Vadlamani, Michael Wilson, Kaila James, Margo Leone
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin, Jelen, Noffke, Taylor

Abstract:
The EcoBlaze chainsaw enables California wildland firefighters to continue their life-saving work whilst forwarding the sustainability movement by minimizing the use of fossil fuels.The goal of the EcoBlaze is to fulfill the requirements of a severe-duty firefighting tool while avoiding the use of an internal combustion engine; taking and adapting current off-the-shelf parts to create an electric chainsaw with the capability of a gas saw.

(Table 56) FreshSure

Presenter(s): DJ Bernard, Jaxon Allen
Program: Engineering Design
Faculty Advisor(s): Prof(s). Brackin, Jelen, Taylor

Abstract:
The scope of this project was toward the James Dyson Engineering Challenge, with the aim to improve overall food safety.We were inspired by our personal experience of cleaning out the fridge at the end of the week with all the wasted food. After researching and learning there is no current product on the market to achieve such a task, we aimed to create a product that could provide users with simple visual feedback to inform them of food expiration to eliminate the guesswork associated with organic decomposition.The FreshSure container integrates temperature, pressure, and Co2 to estimate the decomposition of the user's food. Over time, all foods release a different amount of CO2 into the air as they go bad. To tackle this, we have our sensors set a baseline when food is put into the container and calculate the rate of change of the Co2 release over time. The data is analyzed by processing software, and relayed to its companion app, where all the info is neatly displayed. Within the companion app, our users can track all food stored in a FreshSure container, with various features, including a Fresh Sure community where you can share recipes and food with an AI that can give you an estimated date of food expiration.

(Table 66) Chinese Zodiac Animals

Presenter(s): Kaila James, Xiaoxi Lua, and Liz Puritin
Program: Engineering Design
Faculty Advisor(s): Prof(s). Jelen, Tayor
Sponsor: Swiss people

Abstract:
This project will introduce Swiss people to Chinese zodiacs.

(Table 58) AutoTune Remote

Presenter(s): Ian Frensemeier
Program: Engineering Design
Faculty Advisor(s): Prof(s). McCormack, Taylor

Abstract:
AutoTune is an aesthetic design of a new product: a tuning remote for a guitar. While non-functional, it is designed to be desirable to people in the user group because of how it looks and feels. It has visual elements that are inspired by amps and pedals. The controls are inputs that are frequently found on other musical instruments and tools. AutoTune is also a fully injection-moldable design.

(Table 72) DinoGuard

Presenter(s): Anya Cook
Program: Engineering Design
Faculty Advisor(s): Prof(s). McCormack, Taylor
Sponsor: EngD

Abstract:
For this project, I was tasked with designing and creating a hand-operated controller (a.k.a. a remote) for a user group of my choice, this could be fictional or non-fictional group. The remote needed to control a related set of tasks through the manipulation of several physical inputs by the user. The goal was to create a remote that is well designed with respect to manufacturability, interaction, and emotional appeal. I decided to choose my theme and scenario as Jurassic Park.

Academic Program: Extracurricular Competition Team

(Table 103) Adapted Lawn Mower

Presenter(s): Joey Denison
Program: Extracurricular Competition Team
Faculty Advisor(s): Prof(s). Bernal

Abstract:
After having a hemorrhagic stroke, the client lost motor control in the left side of his body. Prior to his stroke, he greatly enjoyed mowing his lawn. Now that he's in recovery he's began to start attempting to mow his lawn again. However, the lawn mower that he currently has is not suitable for his disability. He's fallen off of it twice because of it's unstable design and lack of adaptations to his disability. My project aims to take a more stable lawn mower and modify it so that he can operate it safely and effectively.

(Table 104) Human Powered Vehicles Team

Presenter(s): Ray Bates, Jacob Eve, Briggs Fultz, Riley Lopian, Evan Wassmann
Program: Extracurricular Competition Team
Faculty Advisor(s): Prof(s). Cunningham

Abstract:
Our team designs, builds, and races a bike at the ASME e-Human-Powered Vehicle Competition. This year we designed a recumbent bicycle around the goals of high top-speed and agile maneuverability. With the implementation of a Capstone Design Team this year, we conducted a thorough prototyping process and assessed the effects of bike geometry on bike handling to produce our most mechanically sound design yet. Our bike features a chromoly frame and roll cage, a carbon fiber seat and fairing, an electric bottom-bracket motor, and hand-built wheels. Team members gained experience with mechanical and ergonomic design, electrical systems, Computer Aided Design (CAD), and composite materials.

Academic Program: Humanities, Social Sciences, and the Arts

(Table 105) Bellumscape

Presenter(s): Owen Greybill
Program: Humanities, Social Sciences, and the Arts
Faculty Advisor(s): Prof(s). Abas

Abstract:
“Bellumscape” is a surrealist artwork by Owen Greybill, inspired by the haunting imagery and narrative from Bruce Dale’s photographs and John Fetterman’s writings in the November 1971 issue of National Geographic Magazine. This piece reflects on the impacts of war and its ability to affect the people and landscapes it touches.Source: Adaptation and reinterpretation by Owen Greybill, inspired by “The People of Cumberland Gap,” photographs by Bruce Dale and text by John Fetterman, National Geographic Magazine, Vol. 140, No. 5, November 1971.

(Table 105) It Became Home

Presenter(s): Mackenzie Hunt
Program: Humanities, Social Sciences, and the Arts
Faculty Advisor(s): Prof(s). Abas

Abstract:
This piece is based on some of the on-campus scenery and its inspiration image was taken with some of my favorite people. Its organic form and use of mark making were intentional style choices to be a physical representation of the memories, choices, and circumstances that had to happen to make this school mean as much as it does to me. The small moments,

the variety of people, and the decision to keep trying new things has given me such a beautiful feeling when thinking of Rose, my home. This is what my piece tries to capture.

Academic Program: MDS

(Table 73) Telepresence Robot for the Office of Career Services

Presenter(s): Brighton Lee, Brayden Milner, Alejandro Marcenido, Noah Clippinger, Harman Singh
Program: MDS
Faculty Advisor(s): Prof(s). Berry
Sponsor: Rose-Hulman Career Services

Abstract:
The Office Robot is a telepresence robot that allows remote workers of Rose-Hulman Career Services to feel present in the office while working from home. The robot features two-way audio and video, intuitive joystick controls, a suite of sensors for safety, and automatic docking and charging. Users can connect to the robot through our secure Windows app and drive the robot around Career Services from anywhere in the United States. The ability to physically attend meetings and visit coworkers' offices facilitates more personal communication than alternatives like email, texting, or video calls.

(Table 67) Beyond Human Hands: Experience Armold, the Interactive Robotic Display

Presenter(s): Shelby Schipper, Andi Fiani, Dylan Dorman, Chris Steiner
Program: MDS
Faculty Advisor(s): Prof(s). Brackin, McCormack
Sponsor: Rose-Hulman

Abstract:
Armold is a humanoid robotic arm driven by a wireless control panel and will remain at Rose-Hulman indefinitely as an interactive display, beyond the graduation of its creators. It will be located in a space available for tours, future and current students, and staff to view and interact with. This will provide a professional example of the possible accomplishments of Rose-Hulman students.

(Table 71) Improving Milwaukee Tool Vacuum Pump Experience

Presenter(s): Richard Barker, Joe O'Connell, Dylan Settles
Program: MDS
Faculty Advisor(s): Prof(s). Brackin, McCormack
Sponsor: Ryan Denissen, Milwaukee Tool

Abstract:
The current oil change process for the M18 FUEL 5 CFM Vacuum Pump is messy, wasteful, and timely for users. Our goal is to improve the user experience. We iterated through many designs and gathered feedback from users at each phase to make decisions and improvements. At the culmination of our senior design experience, we have four prototype solutions: the Cartridge, Valve Bottle, Magnetic Cap, and Output Handle.

(Table 68) Wilson Dynamic Paddle Spin Rig

Presenter(s): Roka Brovick, Jackson Kabrick, Aaron Greve, David Manche, Souley Cissokho
Program: MDS
Faculty Advisor(s): Prof(s). McCormack
Sponsor: Wilson Sporting Goods

Abstract:
Our device captures the spin rate of a ball after collision with a moving paddle to simulate the conditions of a slice shot. This is a multidisciplinary project combining mechanical design, ballistics, and computer science principles. We used image recognition to capture ball movement immediately after impact with a dynamically swinging paddle. The paddle and ball can be interchanged to model both the sports of Padel and Pickleball. This project was made to fulfill the needs of Wilson R&D to more efficiently test paddles of these rapidly growing sports.

(Table 69) Smart Power Monitoring Family

Presenter(s): Swade Cirata, Magnolia Maurer, Brandon Taylor
Program: MDS
Faculty Advisor(s): Prof(s). McCormack

Abstract:
Our project introduces a Smart Circuit Breaker, Hub Breaker, and Smart Outlet system for enhanced residential safety and convenience. Employing features like GFCI protection and remote monitoring, these products share the same core technology for a streamlined design. A user-friendly website interface offers centralized oversight and control. The Smart Circuit Breaker provides real-time data insights via graphical display, while the Hub Breaker monitors home system voltage. The Smart Outlet enables scheduling and remote appliance control.

(Table 70) Dummy Strap: Wireless Monitoring Strap Tension Device

Presenter(s): Ayden Ayres, Ethan Rogers, Ike Farnsworth
Program: MDS
Faculty Advisor(s): Prof(s). McCormack

Abstract:
The Dummy Strap allows semi-truck drivers to monitor the tension in their cargo straps in real time, addressing a major safety risk in the trucking industry. Designed to ensure public

safety on highways, this innovative device alerts drivers to potential cargo shifts by detecting changes in strap tension. The driver can monitor the tension the strap experiences through a portable display inside the cab of the truck.The strap integrates seamlessly with existing cargo securing methods, offering peace of mind through enhanced load security.

(Table 75) Forget-Me-Not: A Memory Loss Care System

Presenter(s): Brad Fisher, Mackenzie Hunt, Aiko Sherman, Jenna Strassburger
Program: MDS
Faculty Advisor(s): Prof(s). McCormack

Abstract:
Forget-Me-Not is a product and app system designed to increase independence for those with memory loss. The goal of the design is to remind those with memory loss of daily tasks with familiar sounds and images. The caregiver can set the physical device to display images, reminders, current location, or weather to help orient the patient. Additionally, the user can switch out custom panels to change the aesthetics and appear normal to the space. For individuals with memory impairments, the alarm clock system provides a sense of familiarity that can help reduce distress and anxiety.

(Table 79) DriveTEK: A Portable, Flexible Driving Simulator Built to Safely Study the Driving Experience

Presenter(s): Zara Burns, Sebastein Hughes, Liz Fogarty, Chris Steiner
Program: MDS
Faculty Advisor(s): Prof(s). McCormack, Momenipour
Sponsor: Dr. Amir Momenipour

Abstract:
DriveTEK is a flexible, portable driving simulator that allows for collection of user experience data. While most driving simulators are built in-place, the DriveTEK frame is easy to store and transport with multiple points of adjustment which allows the simulator to fit most of the population. Attached to the frame are the steering wheel and pedals, which control a custom VR game that allows users to drive on various tracks. The purpose of the game is to test users' trust with self-driving cars by measuring the user's heartrate and the time between starting the game and when the user interacts with the brake pedal or steering wheel. DriveTEK is the continuation of Dr. Momenipour's user experience research.

(Table 74) Hampod/A Ham Radio Interface for Visually Impaired People

Presenter(s): John William Gardner, Brendan Perez, Evan Slater
Program: MDS

Faculty Advisor(s): Prof(s). Simoni
Sponsor: Rob Santello, Wayne Padgett

Abstract:
The Hampod is a device that allows visually impaired operators to use their ham radio equipment. The Hampod is a stand-alone, single board computer-based text-to-speech device designed to provide speech output and accessibility to station equipment. In the hardware, the Hampod is equipped with USB ports and a DB9 port, outputs text-to-speech for prompted actions, as well as takes inputs through a built-in keypad. Inthe software, the Hampod works a with variety of rigs over common rig functions stretching over a set of open source developed modes.

Academic Program: Mathematics

(Table 24) Special Units and Euler Systems

Presenter(s): Shyam Ravishankar
Program: Mathematics
Faculty Advisor(s): Prof(s). All

Abstract:
The interaction of the units of a number field and its ideal class group has long been a topic of study in algebraic number theory. In the 1980s, Rubin discovered the notion of "special units" and it was conjectured that they encode information about the exponent of the class group. Expanding on these ideas, Kolyvagin introduced the machinery of Euler systems, and they were subsequently used by Rubin to provide a new proof of the Main Conjecture of Iwasawa theory. We use the machinery of Kolyvagin and Rubin to study the properties of special units and provide evidence for Rubin's conjecture.

(Table 25) Cyclic Decoding Failures

Presenter(s): Joshua Roehm
Program: Mathematics
Faculty Advisor(s): Prof(s). Billingsley

Abstract:
In this study, we delve into the mathematical complexities inherent in BIKE, a fourth-round candidate in the NIST post-quantum cryptography standardization process. Our focus centers on the phenomenon of decoding failures that BIKE can encounter under real-world constraints, which could potentially diminish its security. Specifically, motivated by BIKE's potential vulnerabilities based on decoding failures, we examine cyclic decoding failures.%, aiming to investigate this particular type of error and its implications for BIKE's security. %Through this exploration, we seek to enhance our understanding of cyclic decoding failures as a potential vulnerability within BIKE's framework.

(Table 26) Modeling Disease Transmission using PDEs in the SIR Model

Presenter(s): Max Li
Program: Mathematics
Faculty Advisor(s): Prof(s). Finn

Abstract:
The thesis focuses on modeling non-lethal disease transmission through the population using the SIR Model, where S stands for Susceptible, I indicates Infective, and R refers to Recovery. Although we assume disease doesn't directly cause death, general death will be considered in the model to make the population a non-constant variable. Critical points, reproduction number, and the local stability of the Equilibria of the basic SIR Model will be mentioned. The age-structured SIR Model and control strategies (e.g. vaccination, isolation, and quarantine) will also be introduced, in which each age group will be treated differently.

(Table 27) Cohomology: de Rham, Singular, and their Equivalence

Presenter(s): Aden Shwa
Program: Mathematics
Faculty Advisor(s): Prof(s). Finn

Abstract:
The fundamental theorem of calculus guarantees the existence of an antiderivative for any continuous real-valued function. Assuming a smooth multivariable function has a sufficiently nice domain, it is known precisely when it has an antiderivative. After generalizing what we mean by a smooth multivariable function, we are able to develop an algebraic structure which measures the extent in which antiderivatives fail to exist. In particular, it measures when there exists holes within the domain of the function.

(Table 28) Analysis of New York Real Estate Prices

Presenter(s): Joshua Mestemacher
Program: Mathematics
Faculty Advisor(s): Prof(s). Heyman

Abstract:
The New York real estate market is complex and many fortunes depend upon it. Work has been done on analyzing what factors predict the selling price of properties. However, not many models use advanced, cutting-edge data science machine learning models such as random forests or gradient-boosted decision trees. Most existing models use conventional techniques, like multiple linear regression, rather than data science modeling. We pursue using data science models to predict New York real estate prices, and find that using random forests and gradient boosted decision trees are preferred over a traditional linear model.

(Table 29) Counting Hamming-Graceful Labelings of Paths

Presenter(s): Ashka Dalal
Program: Mathematics
Faculty Advisor(s): Prof(s). Holden

Abstract:
A Hamming-graceful labeling of a graph with m edges labels vertices with binary strings of length m and the edge labels are induced by the Hamming distance between vertex labels. It is known that all paths have Hamming-graceful labelings, thus the question arises, how many possible labelings exist for a path of a given size? We develop an algebraic way to generate labelings, conjecture a method for counting, prove this for small examples, and verify larger examples using a Python program.

(Table 30) The Economic Impact of Government Health Care Spending

Presenter(s): Braelyn Stacy
Program: Mathematics
Faculty Advisor(s): Prof(s). Kim, Pavel

Abstract:
This study investigates the intricate relationship between healthcare spending and economic growth across various contexts. Utilizing a comprehensive dataset on 47 countries over the last 20 years, we employ advanced econometric techniques to explore the significant effects of government spending on key macroeconomic indicators. The findings suggest that government healthcare spending has a more substantial impact on economic growth and productivity than private healthcare spending. Overall, this study contributes to the ongoing discourse on the role of government spending in the healthcare sector in promoting growth and productivity.

(Table 31) Substance Abuse Survey Analysis

Presenter(s): Riya Bharamaraddi
Program: Mathematics
Faculty Advisor(s): Prof(s). Reyes

Abstract:
With marijuana being legalized in certain states, studying trends in use could help further understand and potentially prevent how it is being abused. Adolescents engage in risky behavior by not only consuming marijuana but also driving under its influence. We study the prevalence of driving under the influence of marijuana among adolescents, as well as the consumption of marijuana among pregnant women. Data over a range of six years from the National Survey of Drug Use and Health (NSDUH) is used. We fit logistic regression models to examine the association between DUI of marijuana and some correlates, including demographic subgroups, age groups, and racial groups.

(Table 32) Predicting the next pitch type in an MLB at-bat

Presenter(s): Michael Yager
Program: Mathematics
Faculty Advisor(s): Prof(s). Shibberu

Abstract:
This project serves as an extension of previous research into using machine learning techniques to predict future pitch types in an MLB at-bat. Using information about the state of the game, the pitcher's past, and the hitter's past, predictions are made about whether a fastball or offspeed pitch is coming next. Additionally, clustering is used to group the hitters together to attempt to increase prediction power in a way that has not been tried before.

(Table 33) Criticality in Banking

Presenter(s): Robert Rahr
Program: Mathematics
Faculty Advisor(s): Prof(s). Tarrant

Abstract:
In the banking sector, banks are interconnected via loans with other banks. By generating a stochastic model of these banks and their loans, we seek to determine what factors may be statistically significant in determining if there will be runoff effects from one bank defaulting on its debt that could result in subsequent defaults in connected banks. This information can then help inform future regulations.

Academic Program: Mechanical Engineering

(Table 80) Wind Turbine

Presenter(s): Reilly Foote, Paul Breiterman, Qianshuo Qiu
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal
Sponsor: Dr. Benjamin Mertz

Abstract:
The small-scale wind turbine is a project that has been continuously iterated upon for the past 3 years, in preparation for the Collegiate Wind Competition. This year, our team set out to improve on the wind turbines' power generation. To improve the power generation and efficiency we redesigned the blades for higher performance than the baseline model,and implemented a pitch control system to ensure stable power generation across varying windspeeds. While designing the blades and pitch control system, we conducted experimental testing to determine the most effective design for the blades and spring constant for the pitch control system.

(Table 83) Reclining Transfer Wheelchair

Presenter(s): Marc Belak, Sebastien Placide, Eric Marshalleck
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal
Sponsor: Rose-Hulman Institute of Technology

Abstract:
The advancement of wheelchair technology has reached a stage where standard models are affordable but lack features for easy transfer to the bed. Existing solutions with such functionalities can be costly, often exceeding $5000. Our proposal aims to address this gap by offering a wheelchair that prioritizes seamless patient transfer while remaining budget-friendly for most consumers. We plan to develop a wheelchair specifically designed to aid caregivers during patient transfers, focusing on safety and cost-effectiveness, particularly for elderly patients. Our approach involves enhancing an existing wheelchair design by incorporating mechanisms that enable full reclining functionality. This modification will significantly improve the efficiency of transferring patients from the wheelchair to the bed, thereby enhancing the quality of life for both patients and caregivers.

(Table 91) 3 Layer Billiards Table

Presenter(s): Andy Jacobi, Skyler Falkenstern, Zhengyang Bi
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal
Sponsor: Brian Brackee

Abstract:
3-layer pool table designed to be a fun attraction for an Indiana bar. New innovative game brings the old 2-dimensional game of pool into 3D. Balls move between 3 layers via an automated lift system. We aim to improve the lift system and make the table more fun and interesting.

(Table NDA B) Kalogon Cushion Cooling

Presenter(s): Taytum Newell, Naomi Reyes
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal

(Table 81) Psyche Asteroid Sample Return

Presenter(s): Mandy Chick, Kiana Martin, Kayla Martinez, Marisela Miranda
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal, Sangelkar
Sponsor: NASA

Abstract:
Psyche is a metal-rich asteroid, hypothesized to be core material of a planetesimal, currently orbiting the Sun between Mars and Jupiter. Arizona State University partners with NASA to oversee research and mission pertaining to the exploration of the asteroid. In the future, a team may propose a mission to obtain physical samples to gain a better understanding of the asteroid. Our project goal is to design a sealing system for collected samples from the Psyche asteroid. The final design consists of a fully automated sealing system that maintains the integrity of samples from the asteroid.

(Table 86) Loudspeaker Testing Kit

Presenter(s): Jon Barnes, Michael Martinez, Lauren Rexing, Aidan Sturgeon, Carl Quist
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal, Sangelkar
Sponsor: Dr. Eric Constans

Abstract:
The Loudspeaker Testing Kit is a redesign of an Analysis and Design of Engineering Systems (ADES) lab, a sophomore level mechanical engineering course offered at Rose-Hulman. The lab redesign focuses on providing real-world applications of mass-spring-damper systems. Our task was to create a loudspeaker testing kit that can accurately measure several Thiele-Small Parameters, acoustic parameters used in speaker design. Students will use these parameters to model a speaker driver as a lumped parameter mass-spring-damper system.

(Table 87) An Open-Source Syringe Pump for Anesthesia Delivery in Developing Countries

Presenter(s): Yulin Zhou, Charlie Fraga, and Kevin Lim
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal, Sangelkar
Sponsor: Dr. Goergen, Nate

Abstract:
The state of medical technology in developing countries is dire. There is a scarcity of devices that have the potential to save lives, and of the available devices, they are often not utilized because they are broken, or the hospitals lack the expertise to reliably use them.Working with both the Utah School of Medicine and the University of Nebraska Medical School, we aim to design a 3d printable syringe pump for application specifically in developing countries.

(Table 92) Design of a Hydraulic System

Presenter(s): Evan Hofer, Jack Seida, Luke Sheerin, Connor Patton
Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bernal, Sangelkar
Sponsor: Dr. Winck & Dr. Danesh-Yazdi

Abstract:
Analysis and Design of Engineering Systems (ES 205) is an ME course which has labs that are outdated and not applicable to industry. A new hydraulic system and bucket arm was created as a lab replacement. The system uses a power supply and electronic speed control to operate a pump that moves a hydraulic cylinder. Flow of hydraulic fluid to the cylinder is regulated using a servo valve controlled by a microcontroller. A rotary encoder measures the angular displacement of the excavator arm and proportional-integral-derivative control of the system allows the arm to reach desired positions.

(Table NDA A) Milwaukee Tool New Product Development

Presenter(s): Kyle Anderson, Kenny Gipson, Drew Huffman, Mayon Konijeti, Bailey Hicks
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Bernal, Sangelkar

(Table 82) Crumple Zone's CanSat

Presenter(s): Sam Betts, Eric Mao, Tyler Kessis, Jacob Braniger, Amara Green
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Noblitt Scholar's Program and Mechanical Engineering Department

Abstract:
CanSat is an international competition that has undergraduates designing a mock-satellite to be a payload in a hobby rocket. This year, the CanSat had to open an aerobrake, then later deploy a parachute to land a hen's egg safely. Throughout flight, it must transmit telemetry to a ground station that plots real-time data including speed, tilt, and altitude over time.Our team of only Mechanical Engineering majors learned software development, power systems, PCB design, and a traditional aerospace design process to develop a system that is reliable, robust and compact several weeks ahead of schedule.

(Table 84) All Terrain Wheelchair Carrier

Presenter(s): Will Atkins, Kade Metzka, Josh Wilmerding, Isaac Nuxoll, Jubal Harmon
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Steve Craig

Abstract:
For the disabled, the world is much less navigable. Hazards or obstructions that are not a problem for most can prove to be a tough issue. Curbs, foliage, hills, inclines, and more can prove inaccessible for the average wheelchair-bound person.Most powered wheelchairs struggle with stability on uneven or unpaved terrain. Expensive all-terrain wheelchairs, costing up to $14,000, require the handicapped individual to leave a standard chair and

enter another. These drawbacks can negatively affect a variety of stakeholders, including the wheelchair-bound themselves, as well as their families.Many handicapped people do not have access to low-cost, convenient outdoor freedom. We will design a wheelchair carrier from the basis of a zero-turn mower. The product will have accessible controls, be driven onto from a standard electric wheelchair, keep the rider safe, and provide greater access to the world for all.

(Table 85) Union Health Physical Therapy Car Simulator

Presenter(s): Naa Ashifia Anum, Mateen Afkhami, Nathan Dalton, Kaley Hart, Kiley Hart, Zak Koehler
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Union Health Hospital

Abstract:
The physical therapy team at Union Health Hospital needs a new car simulator to supplement the recovery process of their patients. A car simulator is used to simulate the entry and exit of a vehicle for patients who are rehabilitating from a stroke, hip replacement surgery, or similar condition. Union Health's current simulator lacks a sufficient amount of interior space to accommodate all patients, and the height of the simulator is fixed. Therefore, the Union Health Capstone Team has been tasked with developing a new, more spacious simulator that can be safely adjusted to various heights.

(Table 89) Immersion Cooling Research for EV Battery Packs

Presenter(s): Jackalyna Neuman, Evan Schimmel
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Danesh

Abstract:
The team was tasked with supporting a current competition team's EV battery development goal by assessing the viability of implementing immersion cooling in the pack's design. This includes identifying a viable cooling fluid among common industry offerings, determining the amount required, conducting a Design Failure Mode & Effects Analysis, and comparing cost to the existing cold plate method.

(Table 99) reTHink Vertical Garden

Presenter(s): Stephanie Osmanski, Sara Spade, Nick Appleton
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: reTHink

Abstract:
This vertical garden is designed for reTHink. It is meant to hold a variety of plants and is

intended for use both outdoors and indoors. The base is a large wooden planter, with an area for runoff water storage underneath. Attached to the base are four PVC pipes that smaller planters will hang from. Water is collected by a raincatcher and travels through the PVC pipes to all layers of planters, with excess water being stored in the water storage area. Wheels on the bottom of the base allow for easy transportation.

(Table 93) Battery Workforce Challenge

Presenter(s): Brayton Blackwell, Svarnika Bommakanti, Peter Espelien, Zixin Fan, Darrian Herniter, Kennedy Michnewicz, Antonio Ventresca
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Stellantis, Argonne National Laboratory, U.S. Department of Energy

Abstract:
The Battery Workforce Challenge is a 3-year student-led competition that challenges 12 universities and their vocational school partners across North America to design, build, test and integrate an advanced electric vehicle (EV) battery pack into a production Stellantis vehicle. Our team is responsible for designing and developing the packaging that will contain all internal battery components along with integrating that battery pack into an existing Stellantis vehicle. Additionally, we are responsible for designing an internal thermal management system, a battery module containing individual battery cells, cell module protection, and overall system failure modes.

(Table 90) reTHink Drip Irrigation System

Presenter(s): Rofiat Adeyemi, Kai Ellis, Reagan Knabe, Kaylee McGill, Peyton E Miller
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Shikha Bhattacharyya

Abstract:
reTHink is a non-profit organization in Terre Haute, IN with three community gardens focused on educating the community about sustainability. Their community gardens also serve as food sources for members of the community who do not have access to fresh produce. The gardens are run completely by volunteers, which means there is often not enough manpower to water the gardens. The purpose of this project is to design a drip irrigation system that harvests rainwater, is automated, and feeds the roots of the plants directly. Olla irrigation was the method of choice when designing the drip irrigation system. Olla irrigation consists of burring clay pots underground and filling them with water. Because of the porous material of the pots, the water seeps through the pots and feeds the roots of the plants, which are also underground. The final prototype for the system consists of four pots buried underground, all connected to a hosing system which is connected to a system of two 55-gallon barrels. Rainwater from the roof is collected in barrels through a diverter added to the downspout of the gutter system. A valve is connected to the barrels, so all the volunteers will have to do is open the valve, and close it

when the system is full. The system will supply a week's worth of water to the plants, so the volunteers will only have to open and close the valve once a week.

(Table 100) Haysled

Presenter(s): Isaac Strickland, Chris Wiemuth, Troy Hungerford, Andrew Jacobson
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers
Sponsor: Joe Batt

Abstract:
The Haysled is our team's solution to a known market gap in small-scale hobbyist farming. Our team has designed a sled because they are easy to load, easy to manufacture, and safe when compared to trailers. The Haysled is designed to allow smaller tractors to carry up to three bales at once safely and with ease. After this project is completed and handed over to our client, the Haysled design will be given to Falcon Industries, a high school fabrication company, so that they can manufacture and sell it as a product.

(Table 101) EROV

Presenter(s): Thomas Andrade
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers

Abstract:
Dr. Ashley Bernal has a 3 year old daughter who frequently plays with the windshield wipers, turn signals, and other features present in Dr. Bernal's car. Additionally, the daughter often plays with her 4 year old neighbor by towing each other's vehicles.Dr. Bernal has requested that the team create a child-sized vehicle for her daughter that contains many features from full sized vehicles, hoping to have the car be as entertaining and educational (fine motor skills) while the child is between the ages of 3 and 6.

(Table NDA C) Device and Procedure Optimization for Measuring Physical and Inertial Properties of Baseball Bats

Presenter(s): Cade Liehr, Brett Borcherding, Josh Erpenbeck, Ian Kline, Colter Couillard-Rodak
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers

(Table 98) Rose Grand Prix Engineering Senior Design Team

Presenter(s): Nick Edris, Zach Leedy, Dennis Moore, Charles Springer, Mason Wykes
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers, Constans, Estrada

Sponsor: Rose Grand Prix Engineering Team, Branam Innovation Center (BIC), Kremer Innovation Center (KIC)

Abstract:
The Rose Grand Prix Engineering team competes in the prestigious Formula SAE collegiate design series against schools worldwide to determine who built the best formula-style racecar. The Rose GPE senior design team provided focused development of three specific subsystems within the team: (1) a brand-new full-vehicle aerodynamic concept; (2) improvement of the suspension implementing an anti-roll bar system; (3) a team-wide vehicle electrification transition.

(Table 88) Shake Table for Model Suspension

Presenter(s): David Cormier, Jackson Morris, Jake Faraci, Courtney Peper, Rishi Singh
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers, McCormack, Sangelkar
Sponsor: Dr. Ryder Winck

Abstract:
Rose-Hulman values learning through doing: our project aims to create a new lab apparatus that mechanical engineering students can use to find frequency responses of an adjustable suspension system. We use a slider-crank mechanism to produce a vibratory input into a model of a car suspension system. Students can use the device to validate analytical models of the suspension system. Additionally, students can explore how changing the parameters affects the frequency response, identify natural frequencies, and investigate why analytical models do not perfectly predict the behavior of real systems.

(Table 94) Deep Space Metallurgy

Presenter(s): Jonah Fechner, Scott Hennarty, Mikaela Ikeda, Ryan Krieghbaum
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers, McCormack, Sangelkar
Sponsor: Dr. Cassie Bowman, Arizona State University

Abstract:
Deep Space Metallurgy is a collaborative project with the NASA Psyche mission, with the goal of enabling the far-future manufacturing of tools and equipment on the Psyche asteroid using its naturally metallic surface. Our project focuses specifically on melting the metal, assuming the metal can be inserted to our system and will exit the system to be manufactured. This design uses induction-based heating to efficiently melt the metal, accounting for the environmental conditions of melting metal in space and the power constraints on Psyche. If taken further, this system could be used on different bodies in deep space, allowing less raw material to be sent into space, and accelerating the possibility of on-site deep-space construction.

(Table 95) Solar Origami Array

Presenter(s): Rishon Shah, Max Jones, Hannah Richardsen, Oscar Almeida, Grayson Snyder
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers, McCormack, Sangelkar
Sponsor: Intelligent Systems

Abstract:
The Solar Origami Array capstone team was tasked with creating an apparatus to support and deploy a vehicle-roof-mounted solar array in the shape of a square origami twist by Intelligent Systems. To create this deployable solar panel mechanism, the design must be able to support its own weight, be operable manually or automatically, and must follow the square origami twist pattern.The team created a prototyped apparatus to deploy and stow the solar array automatically or manually, allowing for solar panels to be installed and used in both stowed and deployed states.

(Table 97) Bike Jig

Presenter(s): Daniel Laritz, Connor Lussow, Tim Youndt, Spencer Socoloski, Robert Royce
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers, McCormack, Sangelkar
Sponsor: Dr. Patrick Cunningham

Abstract:
This project aims to create bike frame welding and testing fixtures for a junior-level course. The frame fixture will hold the frame tubes for welding purposes, and the Stiffness tester will test responses in the bike frame caused by applied static loads. These fixtures will prove essential for the course, which will build a bike frame and evaluate its performance. The course will include measurement uncertainty analysis, statics analysis, and finite element analysis, which are consistent with other junior-levelcourses.

(Table NDA D) Filter Redesign

Presenter(s): Aron Murnane, Tunji Folayan, Mason Kiel, Jackson Baker, Reddick Herbert
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Chambers, McCormack, Sangelkar

(Table 102) EM103 Sections 08 and 10 Project Teams

Presenter(s): Prof. Dugan, Prof. McCormack
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Dugan, McCormack

(Table 96) Helicopter Engine Cutaway

Presenter(s): Braden Blackburn
Program: Mechanical Engineering
Faculty Advisor(s): Prof(s). Mayhew

Abstract:
This project consisted of modifying a Rolls-Royce M250 C28B helicopter engine to render its internal components visible. The primary goal is to create a cutaway section of the engine, allowing for a clear view of its intricate parts. Additionally, the modified engine will facilitate easy disassembly and reassembly of the components. The overarching objective of this project is to enhance the learning experience of students in ME 411, Propulsion Systems.