



IT'S SHOW TIME!

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ROSE SHOW PROGRAM

May 6, 2026

Academic Program: Biology & Biomedical Engineering

(Table 45) Flexible Easel

Presenter(s): Elizabeth Johnson, Marina Cadilli
Program: Biology & Biomedical Engineering
Faculty Advisor(s): Prof(s). Alhalawani, Chiu, Dee
Sponsor: Amanda Gargac

Abstract:

Our client is a professional painter with fibromyalgia, a chronic pain condition that leads to heightened musculoskeletal pain and muscle fatigue. Amanda experiences many symptoms and is often exhausted after painting for extended periods. Amanda's range of motion is affected by the paint in her shoulder, so she cannot raise her arm above her shoulder for extended periods. Our device is intended to reduce her pain by providing an easel design that can ensure comfortable positions during extended painting sessions.

(Table 46) EEG Band Power Dynamics During Lexical Retrieval: Effects of Word Complexity and Speech Impairment

Presenter(s): Allison Kirk
Program: Biology & Biomedical Engineering
Faculty Advisor(s): Prof(s). Chiu

Abstract:

Over 12% of the world population has a speech impairment, yet it is underrepresented in both research and public understanding. Most existing research focuses on language processing, whereas little has been reported on the neural mechanisms of language production and learning. Electroencephalogram (EEG) data were collected from subjects as they completed the Boston Naming Test (BNT), in which they verbally identified images and used them to formulate sentences. While certain EEG band powers have been linked to the task complexity of language comprehension, they do not appear to exhibit a strong and consistent correlation with sentence formation and word complexity.

(Table 47) Music Biofeedback device

Presenter(s): Allison Kirk, Narindwa Semakula, Columba Rodriguez Real
Program: Biology & Biomedical Engineering
Faculty Advisor(s): Prof(s). Alhalawani, Chiu, Dee
Sponsor: BE department

Abstract:

Traumatic brain injuries (TBIs) often impair posture and motor control, reducing

independence. This project developed a wearable music-based biofeedback device to promote upright head posture during rehabilitation for a TBI patient. A head-mounted tilt sensor connected to an Arduino UNO REV4 Wi-Fi monitors head position and adjusts music volume on an Apple device: increasing volume for goal posture and decreasing it when insufficient. This non-intrusive system leverages motivational feedback to encourage rehabilitation, supporting autonomy and consistent posture correction at home.

(Table 48) PneumaNode

Presenter(s): Tommaso Calviello, Alyssa McGauley, Connor O'Connell, Katie Choi

Program: Biology & Biomedical Engineering

Faculty Advisor(s): Prof(s). Alhalawani, Chiu, Dee

Sponsor: ResperCare LLC

Abstract:

The PneumaNode, developed by Team TACK in collaboration with ResperCare LLC, is a skin-adhering biosensing patch engineered for continuous monitoring in the NICU. The device integrates a MEMS microphone, PPG sensor, and an ESP32-S3 microcontroller on a custom PCB to acquire multiple vitals including heart rate, SpO₂, temperature, and respiratory sounds. Embedded C++ firmware enables Bluetooth Low Energy transmission for real-time analysis. A TPU housing and multilayer adhesive provide structural integrity. The PneumaNode will reduce clinician workload and improve diagnostic consistency.

(Table 49) Temporary Pacemaker Training Device

Presenter(s): Jonathon Croker, Cade Zonin, Austin Daly

Program: Biology & Biomedical Engineering

Faculty Advisor(s): Prof(s). Alhalawani, Chiu, Dee

Sponsor: Rural Health Innovation Collaborative Simulation Center

Abstract:

Our device is a versatile medical training simulation system designed to provide realistic, hands-on procedural practice for healthcare professionals while remaining affordable and easily accessible to institutions. This system is intended to simulate key aspects of surgical and clinical procedures, allowing users to develop technical skills and build confidence before performing procedures in real clinical settings. Unlike many existing commercial simulators, this training system prioritizes cost efficiency and ease of use without sacrificing educational value. The device is designed to be quickly assembled and deployed, making it suitable for simulation centers, classrooms, and resource-limited environments. Its durable construction allows it to withstand frequent use, while its intuitive interface ensures that both learners and instructors can focus on skill development rather than complex setup or operation. By providing a safe environment for repeated practice this system helps reduce the risk of errors associated with insufficient preparation, ultimately supporting improved patient outcomes and healthcare safety.

(Table 132) The Boulder Buster Offroad Mobility Solution

Presenter(s): Ezekiel Groom, Kevin Tang, Gregory Hippely

Program: Biology & Biomedical Engineering

Faculty Advisor(s): Prof(s). Alhalawani, Chiu, Dee

Sponsor: Project S.E.R.V.E

Abstract:

This project addresses the mobility needs of a 6'5" veteran with paraplegia, adhesive arachnoiditis, who sought to return to off-road driving and outdoor exploration. The team modified a TrailMaster XRS 200E by integrating a custom hand-control system that transfers all throttle and braking functions to the upper body, eliminating the need for leg input. Additional modifications include a repositioned seat mount for improved ergonomics, vibration-reducing components, and a reinforced transfer platform for independent entry and exit. The completed solution restores the client's ability to safely and independently participate in off-road recreational activities.

Academic Program: Civil & Environmental Engineering

(Table 41) Investigating the Impact of Soil Additives on Phosphate Removal from Stormwater in Engineered Wetland Systems

Presenter(s): Juliana Carragher, Sabrina Mari Alberty, Colby Belzer, Travis Judson, Palmer Schmidt

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Marincel Payne

Abstract:

This project investigates phosphate removal in constructed wetland systems treating synthetic stormwater, with a focus on understanding baseline wetland performance and evaluating the effectiveness of additive materials. Previous research at Rose-Hulman has shown that wetlands can reduce turbidity and nitrogen compounds, and other studies suggest that materials like calcium carbonate, fly ash, and shale can help remove phosphorus from water. This project focuses on improving phosphorus removal by first measuring how much phosphate the wetland soil can remove on its own and then testing different soil additives in both lab experiments and a small-scale wetland model. This research combines laboratory-scale recipe development and analytical calibration with pilot-scale wetland hydraulic testing to develop and validate protocols for nutrient removal under controlled flow conditions. The study aims to better understand how soil additives can be used to optimize phosphate removal in wetland systems.

(Table 53) West Lafayette Food Waste Handling Facility Project

Presenter(s): Amelia Thieman, Erin Glowatz, Travis Judson

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Bryant, Marincel-Payne

Sponsor: Wessler Engineering

Abstract:

The City of West Lafayette owns and operates a 10.5 million gallon per day (MGD) Water Resource Recovery Facility (WRRF) and has hired Wessler Engineering to expand the plant capacity to 15 MGD. The City is a big proponent of “waste-to-energy”, and the WRRF captures the biogas created from the anaerobic digesters to produce electricity via microturbines which is then utilized by the facility to reduce the City’s cost of purchased power. To help create more biogas and to divert landfill waste, the facility accepts fats/oils/grease (FOG) from area restaurants and food waste from Purdue University cafeterias. Wessler Engineering began the expansion design in July 2025 and must be finished by summer 2026.

(Table 54) Riverside Road Improvement Project

Presenter(s): Everett Attaway, Sage Brown, Brianna Brunk

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Bryant, Sutterer

Sponsor: City of Terre Haute

Abstract:

The Riverside Road Revitalization Project provides improvements along a 2.7-mile long corridor, comprising Riverside Road from Cherry Street to Honey Creek Drive within Terre Haute, Indiana. The City of Terre Haute plans to transform the areas near and along the project corridor into a vibrant riverfront district, and Riverside Road will form the backbone of this new development. Currently, the existing site conditions along the Riverside Road corridor do not feature adequate infrastructure for pedestrians, cyclists, or other vulnerable road users. This project modifies Riverside Road to be more accommodating for these alternative modes of transportation, to allow the riverfront district to be welcoming for all members of the community.

(Table 55) Ghumaune-Gaidakot Alternate Road

Presenter(s): Kenneth Song, Peytyn Brooks, Katelyn Sarvis, Benjamin Barrett

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Aidoo, Bryant

Sponsor: Kishor Thapa from RID Engineering

Abstract:

An alternate route for the major Mugling-Narayanghat Highway in Nepal, from Ghumaune to Gaidakot.

(Table 56) Magnus Engineering Head Quarters

Presenter(s): Benjamin Coons, Jady Winkler, Cobi Harris, Meropi Gkiouzelopoulou

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Bryant, Lovell

Abstract:

Magnus Engineering is a structural engineering firm located in Mishawaka, Indiana. The company specializes in the analysis and design of structural systems for a wide range of projects, emphasizing technical excellence, efficiency, and innovation. As Magnus Engineering continues to grow and expand its practice, the firm plans to relocate to a newly constructed office building that reflects both its professional identity and forward-looking vision. The new facility is intended to embody the character of the company while supporting collaboration and future expansion. At present, Magnus Engineering has purchased a site with existing development plans in place for the future headquarters. While there are buildings located in the surrounding area outside the property boundaries, the site itself is supported by existing infrastructure, including a parking lot, utility and electrical lines, and a septic system. These existing conditions provide a functional starting point for development while requiring careful evaluation to ensure compatibility with the proposed expansion and long-term operational needs. The proposed Magnus Engineering Headquarters will serve as the future home of the firm and consist of a modern, functional, and creative 8,000-square-foot office building featuring a basement, a partial second floor, and a covered outdoor patio. The architectural and structural design will reflect the company's identity through the use of exposed glue-laminated timber, composite Fiber Reinforced Polymer (FRP), and structural steel elements, accentuated by an extended entryway canopy. The interior layout will include a dedicated executive wing, a production wing for design staff, and shared spaces such as conference rooms, collaboration areas, a kitchenette, and restrooms. Site improvements will involve evaluation of the existing stormwater management system and assessment of parking lot capacity to accommodate potential future expansion. The project will be completed under the supervision and expertise of Magnus Engineering's professional staff.

(Table 62) Wabash Valley Emergence Response Facility

Presenter(s): Alexis Willour, Aslan Henderson, Carter Schutte, Garrett Stegenga

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Bryant, Mueller

Sponsor: 181st Intelligence Wing

Abstract:

The 181st Intelligence Wing of the Indiana Air National Guard has contracted G.C.A.A. Engineering for the design of a combined facility to house multiple Air National Guard entities under the same roof. The Air Guard Base is located at 800 Petercheff St, Terre Haute, IN 47803. These lots total roughly 69 acres, and our site takes up approximately 3 acres of this Air Guard Base. The current design has the Vigo County Emergency Management Agency (EMA), Civil Air Patrol Wing, and the Air Guard in

separate facilities. It has been decided that it would be beneficial to combine these departments into one, multipurpose building. The client has provided us with some requirements for the project. They want the building to have an Emergency Operations Center, administrative areas for Vigo County EMA and Civil Air Patrol, a classroom space capable of converting to an operations floor, a climate-controlled storage space, and a small, but functional aircraft hangar designed for a small aircraft. They have also asked that we tie this hangar in with the runway through aircraft apron improvements, add a fenced parking area, and a fenced parking area.

(Table 63) Monroe County Maintenance Facility

Presenter(s): Owen King, Matthew Neville, Casey McQueen, Noah Gerschutz

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Bryant, Kershaw

Sponsor: Monroe County Airport

Abstract:

The Monroe County Airport Authority has requested the design of a year-round airport maintenance facility at Monroe County Airport in Bloomington, Indiana. The 15-acre site features significant east-west slopes and high erosion. The facility will include multiple operational bays and require new access roads connecting to Airport Entrance Road, the apron adjacent to BMG Aviation's hangar, and Taxiway A. Due to the steep topography, a retaining wall system will be necessary to stabilize the site and control erosion while supporting airport operations across all seasons.

(Table 64) Westside Community Church Expansion

Presenter(s): Connor Johansen, Trey Repogle, Jacob Pohl

Program: Civil & Environmental Engineering

Faculty Advisor(s): Prof(s). Bryant

Abstract:

Westside Community Church is a non-denominational Christian church located in Sullivan, Indiana. The church had approximately 30 parishioners on a given Sunday, and over the last 2 years have grown to between 400 and 500 people during Sunday services. Due to this growth the church is looking to design and construct a new church building that contains a sanctuary with baptismal, classrooms, nursery, mechanical, etc. The existing building will be repurposed for church offices, youth services, an expanded kitchen and a fellowship hall. The two buildings will be connected at the south end of the existing structure. In addition to the new and renovated buildings, a parking lot expansion with drives is required as parking is currently a significant issue that, at times, requires church members to direct traffic and parking in and out of the lot. With the proposed site development, stormwater management considerations are required including a retention pond, infiltration trenches, etc. Lastly, the church would like to plan for additional structures including a storage barn and a gymnasium for future growth. These structures will be incorporated into the proposed site plan.

Academic Program: Computer Science & Software Engineering

(Table 10) Mutation Tester

Presenter(s): Eli Leser, Mingjian Qin, Ellie Jin, Kenny Lee, Connor McDonald

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Stouder

Sponsor: Mark Hays

Abstract:

Testing code is a vital step to ensure its correctness, but how do you know you have tested thoroughly? That's where mutations come in. We can mutate the code to create a fake bug in the program. If tests fail because of the mutation, we know that section is tested well. If the tests still pass the buggy code, we know that our tests are not thorough enough. Our universal mutation tester will perform mutations in every language with the capability to describe new type of mutations to run against the code. This tool will allow users to verify the strength of their tests and write better code.

(Table 11) Rose Data

Presenter(s): Weston Seybold, Caleb Lehman, Jay Smith, Colin Flannagan

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth, Ludden, Stouder

Sponsor: Ian Ludden, Jason Yoder

Abstract:

Rose Data is an integrated platform for the Rose-Hulman Institute of Technology community, focused on student scheduling and degree planning. Students can view courses, create multi-term paths, explore AI-assisted degree plans, and coordinate schedules with peers. Advisors see student progress, degree plans, and enrollments to guide decisions. By linking schedules to degree requirements, Rose Data helps users stay on track and avoid conflicts. It serves as a lighter, more intuitive complement to Degree Works.

(Table 12) Compliance Guide Assistant

Presenter(s): Noah Shuler, Bryce Tekulve, Kyle Wang, Larsen Morehouse

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Mohan, Tracy

Sponsor: Megan Goforth-Harmon

Abstract:

The Compliance Guide Assistant (CGA) website aids software developers with implementing security requirements throughout the software development lifecycle, rather than after systems are determined to be out of compliance with security standards (NIST-800). Our client wrote a guide to address these concerns, and the CGA website hosts this

guide in a digestible and searchable form. Additionally, it allows teams to track project progress towards compliance with the security goals stated in the guide.

(Table 67) All About Food: Interactive Voice Cooking Recipe Application

Presenter(s): Renato Prado, Marlon Mendez-Yanez, Manuel Lopez, Edward Kang

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth, Stouder

Sponsor: Rick Gollhofer, AllAboutFood Inc.

Abstract:

All About Food helps home cooks manage and navigate recipes without touching their phone or cookbook. You can upload recipes by snapping a photo of a cookbook page and our Google Gemini Vision parses ingredients, steps, and other data automatically. Once saved, you browse and search recipes on the app, or ask Alexa or Siri to read them to you step by step while you cook. The app runs on iOS, Android, and web. The app was built with Flutter, a Go backend on Google Cloud Run, and Firebase. We also built Stripe-based token payments, an admin panel, and a full CI/CD pipeline with GitHub Actions.

(Table 68) Time Traveling Debugger

Presenter(s): Anish Pai, Kayden Pierre, Brody Smith, Ryan Trubey

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth

Sponsor: Omar Roth

Abstract:

The Time-Traveling Debugger is a post-mortem debugging tool for Python that allows developers to step both forward and backward through a program's execution history. Unlike traditional debuggers, it records a complete execution trace via a C extension hooked into Python's trace system, then provides an interactive viewer to navigate that trace at any point in time. It supports breakpoints, watchpoints, and an eval command for inspecting program state. The tool requires no modifications to the target program and is distributed with a Docker-based setup to eliminate dependency friction across environments.

(Table 69) GLADOS (Automated Science Pipeline)

Presenter(s): Bella Yu, Helena Donaldson, Khai Anh Phung, Sam Fruechtemeyer

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Chenoweth

Sponsor: Jason Yoder, Eduardo Torres Izquierdo

Abstract:

GLADOS is an open-source pipeline for running computational experiments with the goal to help automate science. GLADOS works by distributing computation across available machines, collecting and organizing data, and visualizing and analyzing results — steps

that facilitate the labor researchers perform to parallelize and visualize their code. This year, the GLADOS team improved usability by developing a Command Line Interface, experiment tags, and an evolvable hardware experiment, as well as increasing the maintainability of the system through refactoring and security improvements.

(Table 70) health data tool website

Presenter(s): Borui Liu, Hunter Freeland, James Kaunas, Jacob Steimle

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Chenoweth, Steve

Sponsor: Carl Myers

Abstract:

HealthData.Tools is a web-based platform designed to help users collect, visualize, and analyze personal health data such as heart rate, glucose levels, and activity data. The system is built using Django and React and provides interactive charts and data analysis tools to help users better understand long-term health trends. The platform focuses on usability, scalability, and data visualization, enabling users to monitor their health data and make more informed decisions about their lifestyle and health management.

(Table 71) Psychology Chatbot Research Platform

Presenter(s): Yash Anand, Connor Mackey, Braydon Noble

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy

Sponsor: Prof. Amanda Stouder

Abstract:

Psychology researchers currently do not have and need an accessible platform to perform research on human chatbot interactions and its emotional impact. This application was created to help study this relation in a unique style in comparison to other available platforms as none of these allow researchers to investigate effective methods. However, before this application can be deployed for active research, development must be completed in several key areas, including security work/HIPAA compliance, front-end polish, and various other smaller areas of work across the application.

(Table 72) Moodle Scheduler Front-end

Presenter(s): Jacob Cross, Kate Herod, Cooper Magnotta, Dan Seiler

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy

Sponsor: Prof. Amanda Stouder

Abstract:

The project is a web-based front-end application that enhances the course import process for instructors from Moodle. The new system will enable instructors to visualize, edit, and export these JSON files through a calendar graphical interface to facilitate course planning.

This system is also Gradescope compatible, and allows users to push and pull course dates from the course calendar UI.

(Table 73) Requirements Manager System Updates

Presenter(s): Ryan Kim, Alexander Mohler, Henry Morin, Austin Vesich

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Mohan, Tracy

Sponsor: Prof. Amanda Stouder

Abstract:

Requirements Manager is a tool used in CSSE371 (Software Requirements Engineering) to help students practice tracing needs, features, and software requirements in a term project. It also enables instructors to efficiently review student work and provide feedback through the system. This capstone project modernizes the system by redesigning the user interface, addressing user feedback, and refactoring the database to support reusable project templates. These changes improve the user experience and allow instructors to more easily create and modify project templates.

(Table 74) Visa Mapper

Presenter(s): John Dickinson, Ethan Hutton, Ryan Jin, Wesley Schuh

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Mohan, Tracy

Sponsor: Arjun Mahajan

Abstract:

Visa Mapper simplifies global travel by analyzing complex visa rules using a traveler's full profile, including passports, visas, and transit conditions. It uncovers hidden exemptions (e.g., visa waivers based on third-party visas) often buried in fine print. The system extracts and structures data from semi-structured sources using AI, fine-tuned to optimize accuracy and consistency. An intuitive interface lets users explore entry options, filter destinations, and view eligibility instantly, turning complicated regulations into clear, actionable travel insights.

(Table 75) TA Selection App

Presenter(s): Temi Akinselure, Naziia Raitova, Sofia Caston, Shane Nguyen

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy

Sponsor: Dr. Stephen Sher

Abstract:

The TA Selection App is a website that serves to aid the Rose-Hulman CSSE department in hiring TAs such as graders and in-class assistants. As the needs of the CSSE department grow, the TA Selection App will be updated to grow with it. Our goal is to provide a safe and

secure website that allows students to apply to be a TA, instructors to provide their needs for their classes, and administrators to manage TA applications and instructor requests.

(Table 76) RESOLVE Verifying Compiler

Presenter(s): Nicco Scanu, Chris Lardner, Carson Holscher, Brian Pascente

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth

Sponsor: Dr. Murali Sitaraman, Dr. Bill Ogden

Abstract:

The RESOLVE Verifying Compiler is a compiler designed not only to compile code but to mathematically prove that it works as intended. Being able to prove code works by design allows us to ensure that no valid input to a program can lead to unexpected output. This type of compiler would be applicable for use with critical system projects such as banking systems or navigation systems for spacecraft, where the margin of error has to be close to zero, as any error could have severe consequences. The goal of this project is to make progress on the prover component and enhance the efficiency of it.

(Table 77) Puzzle Hunt

Presenter(s): Ian Sawyer, Ian Samsa, Lucas Watson, Sylvia Granade

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth, Stouder

Sponsor: Eric Liobis

Abstract:

Running puzzle hunts currently requires using multiple disconnected tools to manage puzzles, teams, submissions, and progress. Our project addresses this by developing a centralized web-based platform that allows puzzle hunt creators to manage all aspects of a hunt, including a puzzle creation and contestant progress tracking, within a single integrated system.

(Table 78) Enhancements to the ficsit.app Mod Repository

Presenter(s): Jack Silkaitis, Tyler Moore, LiFu Zhang, Will Daugherty

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy

Sponsor: Rob Budak & the Satisfactory Modding Team

Abstract:

Our team has worked on open-source repositories for the ficsit.app organization, which is a modding repository for the Satisfactory game, improving its capabilities and adding features for the userbase of 100,000 active members of their Discord. This included implementing a modpack feature for users to group mods together for a more cohesive gameplay experience, improving their Discord bot for better user controls, improvements

to image recognition to help users automatically debug errors, and allowing mod creators to disclose the AI usage of their mods.

(Table 80) GitLab Merge

Presenter(s): Riley Vallier, Seb Alejandro, Duncan Adkins, XinRui She

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth

Sponsor: Ben Hochstedler, GE Healthcare

Abstract:

This project presents a Chrome extension designed to enhance the merge request (MR) workflow on GitLab for GE HealthCare teams. While GitLab is widely used for code management, it lacks key features needed for efficient usage within a highly regulated environment. Our extension addresses two major gaps: enabling visual diffs for binary files (such as documents and spreadsheets) and supporting batch export of MRs into offline reports. These capabilities reduce reliance on external tools and manual scripting, streamline developer workflows, and simplify audit preparation by allowing secure, accessible review of project data outside internal systems.

(Table 81) RealityLib - A VR game framework

Presenter(s): Harrison Carpenter, Irvan Wang, Wenbo Yang, Ian Zhu

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy

Sponsor: Steve Hoelle

Abstract:

RealityLib is an open-source virtual, mixed, and augmented reality framework developed as an extension of Raylib. The project addresses the lack of native C libraries for VR development by providing developers a fun and simple framework for building VR games. Development progressed through a series of game jams that evolved from Raylib exploration to OpenXR demos, eventually resulting in a library that maintains Raylib's philosophy as a framework rather than a full game engine. The framework focuses on adding OpenXR support for Meta Quest devices while intentionally avoiding advanced game engine features. The result is a library that simplifies VR development through native C code, enabling the creation of 3D objects, controller input tracking, hand-tracking, and basic collision support in VR environments.

(Table 82) AssetAtlas

Presenter(s): Nathan Yang, Aaron Fan, Emile Marois, Ian Steiner

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth

Sponsor: Rob Budak

Abstract:

AssetAtlas is a self hosted inventory and asset management app that helps you organize, track, and manage everything you own. From everyday individual household items to a high level overview of your entire house, AssetAtlas gives you a clear, centralized view—so you always know what you have and where it is. AssetAtlas is built with flexibility and ease of use in mind, allowing you to attach custom information to items quickly and easily.

(Table 89) Megaton: Nintendo Switch Modding Framework for Rust

Presenter(s): Luke Buchanan, Michael Chalupiak, Andrew Petersen, Brian Pfeifer

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth

Sponsor: Michael Zhao

Abstract:

Megaton aims to simplify the process of creating mods for the Nintendo Switch. The framework consists of a build tool and a support library which allow mod developers to embed Rust code into Switch-native binaries (NSOs). The build tool uses parallelization and incremental compilation to greatly reduce build times, and it simplifies the process of generating FFI code and linking Rust and C++ into a single binary. The library provides low-level implementations for the Switch platform, enabling the use of many features from the Rust Standard Library.

(Table 90) Consumer Home Care Referral Portal with Duett (Care4Me)

Presenter(s): Dean Monroe, Fred Hamer, Zilu Fan, Evan Hu

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Tracy

Sponsor: Duett

Abstract:

Care4Me is a B2C SaaS platform that simplifies finding in-home care. The project addresses a common challenge of identifying trustworthy caregivers. The system includes a community directory and a referral tool. The system includes a greenfield frontend built in React and TypeScript and a brownfield backend build in Python/Django. The software seeks to improve senior's access to reliable care, reduce stress for caregivers, and improve in-home healthcare transparency.

(Table 91) Mobile EMR

Presenter(s): Joshua Jue, Orin Hayes, Ethan Parsons, Maxwell Mahaffey

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Hollingsworth, Stouder

Sponsor: Jimmy McKanna

Abstract:

We are working with Union Health in Terre Haute to develop a mobile electronic medical record system. Union Health runs a monthly clinic in Terre Haute for those who would normally not be able to access medical services, but their current system involves carrying paper records to each clinic where clinicians would need to search through boxes of records to access the correct record. Our solution is a mobile application that allows clinicians to create and search for electronic patient records and record each visit to reduce the workload of clinicians and make it easier to lookup records.

(Table 92) Virtual Reality Environment for Brain-Computer Interface

Presenter(s): Brian Beasley, Garrett Doolittle, Jared Kagay, Jacob Van Dyke

Program: Computer Science & Software Engineering

Faculty Advisor(s): Prof(s). Mohan

Sponsor: Dr. Alan Chiu

Abstract:

Developed to advance Dr. Chiu's neuroprosthetic research, this high-fidelity virtual reality environment leverages the Unity engine and Varjo hardware to investigate how visual feedback impacts reaching motion accuracy. The system immerses subjects in customizable reaching tasks while seamlessly synchronizing precise three-dimensional motion data with an integrated Brain-Computer Interface and EEG headset. By enabling researchers to intuitively modify trial parameters and providing immediate data visualization and analysis, the software streamlines experimental workflows for future studies.

Academic Program: Electrical & Computer Engineering

(Table 1) AuralVision

Presenter(s): Ethan Powell, Anica Cao, Jada Hunter-Hays

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Miller

Sponsor: John Marum

Abstract:

AuralVision is an assistive wearable technology project designed to improve the lives of individuals who are visually impaired. This initiative is driven by a shared mission by our team and client, which is to build a solution that is not only effective but also accessible and affordable. Our team brings together strong interdisciplinary expertise in embedded systems, software engineering, robotics, and systems engineering.

(Table 2) Quad-RX Adaptive Gaming Controller

Presenter(s): Ethan Bennett, William Metcalf, Ben Werdmann, Jaxon Naviaux

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Sammoud

Sponsor: RxGaming

Abstract:

In the past fifty years, gaming has become a greater and grander part of our culture. However, the vast majority of the most popular gaming peripherals are designed to be operated by individuals capable of using both hands. Those who are physically impaired will have to either make do with a controller with sub-optimal setups for their specific disabilities or be forced to shell out hundreds of dollars for a handmade controller. We do not believe that culture should be accessible only for those who are physically able, so this project aims to give them a more affordable alternative than what is currently on the market.

(Table 3) Common Mode Filtering Applied to Data Transmission Structures

Presenter(s): Cami Lovelace, Rebecca Testa, Jacob Fields, Yejia Hao

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Cracraft, Walter, Wheeler

Sponsor: Dr. Michael Cracraft, Dr. Edward Wheeler

Abstract:

Differential signaling is a method commonly used to transmit data at high speeds and with high signal integrity. Unfortunately, this method is highly susceptible to common mode noise, which can degrade the signal quality and increase data errors in large systems. This project aims to develop filtering structures for PCIe 5.0 (Gen 5) devices operating at 16GHz, attenuating common mode noise while allowing the desired differential mode signal to pass.

(Table 4) Milwaukee Tool's Automated FMEA Senior Design Project

Presenter(s): Ellis Lyons, Zoe Millen, Steven Reese

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Brooks

Sponsor: Milwaukee Tool

Abstract:

Milwaukee Tool develops various types of power tools, each requiring a different PCB. After creating designs for these PCBs, a Failure Mode and Effects Analysis (FMEA) must be carried out on the circuit board, which is currently done by manually populating an Excel spreadsheet with relevant data about the PCB components. Our project will significantly reduce the time PCB designers spend manually completing FMEA documentation. In addition, the standardization of FMEA severity and the ability to detect rankings will help limit confusion for new hires.

(Table 5) LANL Telemetry Link

Presenter(s): Florence Medley, Thomas Newland, Jacob Reshan, Elisa Simoni

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Walter

Sponsor: Christopher O'Daniel, Los Alamos National Laboratory

Abstract:

Los Alamos National Laboratory (under the US Department of Energy) is looking to redesign a component of their data acquisition system to follow a distributed architecture. The goal of this project is to create a prototype of a flight remote module (FRM) that is suitable for this model. Each module will collect and condition live acceleration and temperature data, and then transmit a digital output signal following the SpaceWire protocol.

(Table 6) Operational Technology Rehosting with PENGUIN

Presenter(s): Kunaal Tyagi, Isaac Mierow, Brooke Spurlock

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Miller

Sponsor: Dr. Estrada, MIT Lincoln Lab

Abstract:

This project demonstrates a rehosted Operational Technology (OT) device connected to a simulated water tank to demonstrate a cyber security vulnerability. The device monitors tank parameters and responds to sensor feedback through the Modbus protocol. A malicious actor is then introduced to exploit Modbus vulnerabilities, altering data transmissions and device responses. This demonstration highlights weaknesses in common industrial communication protocols and emphasizes the importance of cybersecurity measures in protecting critical OT systems.

(Table 8) Cryogenic Superconducting Thin Film Characterization Apparatus

Presenter(s): Bonde Borca, Chong-Yi Su, Yueqiao Wang, Quinton Wing

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Brooks

Sponsor: Dr. Nicole Pfiester Latham

Abstract:

As superconductor technology has become essential in fields such as quantum information science and engineering, our client, Dr. Nicole Pfiester from Rose-Hulman Institute of Technology, is conducting research on high-temperature superconducting thin film with her students. To characterize the thin film samples she fabricated in lab, we designed and built a system that houses the material in the required cryogenic temperature and in vacuum that can perform the Van der Pauw method to electrically characterize the sample, determining its superconducting material properties.

(Table 13) Project BSAFE

Presenter(s): Nikki Bonilla, Jiuzhou Lin, Ellis Gibbons, Nicola Ruiz

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Miller

Sponsor: Damien Center

Abstract:

Damien Center provides care to those who have been historically stigmatized and marginalized. One of the ways they do that is by providing services like medical care, case management, food pantry, and a harm reduction program. They are located in an area with a high rate of overdose death. Bathrooms are common locations for overdoses and other medical emergencies because of their privacy and isolation, which delays response times. The goal of this project is to implement a cost-effective, privacy-respecting bathroom monitoring system to prevent fatal overdoses and other medical emergencies by enabling rapid staff intervention. We will have two devices: a bathroom motion sensor to detect patrons, clients, participants, or Damien Center visitors becoming unresponsive and a receiver to alert staff when an emergency occurs.

(Table 15) Two Six Automated Assembly

Presenter(s): Nicholas Douglas, Owen Macrowski, Eliana Baker, Sean Rody

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Miller

Sponsor: Two Six Technologies

Abstract:

This project focuses on the development of an autonomous manufacturing system capable of performing component pick-place and screwdriving operations. An extensive market survey was conducted to evaluate potential solutions based on technical feasibility and return on investment, ultimately selecting the Universal Robotics UR5e and OnRobot end-of-arm tooling. Using a custom manufacturing jig, the robotic arm accomplishes key tasks such as placing a printed circuit board into its housing, positioning the lid, and fastening four screws to complete the assembly. This solution elevates the client's manufacturing capabilities from one-off products to small-scale integration.

(Table 16) AdaCore FPGA Programmer

Presenter(s): Ellie Harshany, Kaden Nutter, Bill Scholten, Connor Witkemper

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Brooks, Miller, Sammoud, Walter

Sponsor: Olivier Henley, Company: AdaCore

Abstract:

This project developed a custom FPGA programmer for AdaCore that is entirely written in Ada and fully open source. FPGA programmers are essential tools because they allow hardware designs to be loaded, tested, updated, and debugged on programmable devices,

making development more flexible and efficient. By using Ada, the project emphasizes strong typing, reliability, readability, and maintainability, which are especially valuable in low-level hardware tools. This work highlights the practicality of open-source Ada solutions for robust and trustworthy embedded systems development.

(Table 17) Hardware Acceleration of Heart Neuronal Cell Model Simulations

Presenter(s): Bryce Chen, CK Gallegos Rodriguez, Ben Olenick, Aster Zawaideh

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Sammoud

Sponsor: Dr. Mario Simoni & Dr. Daniel Chang

Abstract:

We are developing a low-cost, low-power parallelizable SoC ASIC based on the EFabless Caravel open-source architecture. The purpose of our architecture is to accelerate numerical simulations of neurons that make use of the Hodgkin-Huxley formalism. This project is a continuation of past capstone projects and is principally preoccupied with developing a module to handle computation for synaptic connections.

(Table 18) Geolocation of Radio Signals using Asynchronous TDOA with SDRs

Presenter(s): Elliot Anderson, Henry Stern, Cohen Woods, Jacob Richardson

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Walter

Sponsor: Booz-Allen-Hamilton/AFRL

Abstract:

In Electronic Warfare, knowing the location of uncooperative signals, such as radar scanners, is beneficial; but, if the transmitter is uncooperative, how can one determine its position? By using Time Difference of Arrival (TDOA) on data captured from multiple receivers, a precise location of the transmitter can be estimated. This project seeks to create a low-cost TDOA Geolocation system, using Software-Defined Radios (SDRs), that is applicable to signals in the S-Band (2-4GHz). The team was also selected to participate in the 2025-26 AFRL SDR Challenge.

(Table 19) Ultra-wideband Range Asset Tracking System (uRATS)

Presenter(s): Peter Borger, Catherine Hodge, Lauren Marquardt, Conner Tavares

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Walter

Sponsor: Todd Kuebelbeck, NSWC Crane

Abstract:

The Ultra-Wideband Range Asset Tracking System (uRATS), sponsored by NSWC Crane, provides quasi-real-time tracking of mobile assets in areas where electromagnetic interference is high. Ultra-Wideband (UWB) technology uses low-power, high-frequency, and a wide bandwidth to measure range between nodes through almost any potential

interference. The uRATS system includes a server to collect range data and perform geolocation algorithms to track mobile objects and a display to show location of the mobile object on a world map that is updated approximately every second.

(Table 135) FSAE EV BMS Firmware Development

Presenter(s): Braden Blanford, Henry Jung, Eric Soo-Yoshimura, Yicheng Zhu

Program: Electrical & Computer Engineering

Faculty Advisor(s): Prof(s). Brooks, Sammoud

Sponsor: RoseGPE / Powertrain Subteam

Abstract:

Formula SAE (FSAE) is a prestigious engineering competition where university students design, manufacture and race small scale Formula-style open wheel racecars. The competition is split into 3/8 'static' (cost judging, design judging, business case judging) and 5/8 'dynamic' (acceleration, skidpad, autocross, endurance and fuel economy) events. Thus, scoring points is a nuanced and multifaceted challenge. RoseGPE is Rose-Hulman Institute of Technology's FSAE team; with a history of over 14 years successfully competing at the main yearly North American event in Michigan, the team is currently amidst their transition from an Internal Combustion (IC) powertrain to an entirely electric one, and our senior design team has been commissioned to develop the firmware for their custom Battery Management System (BMS).

Academic Program: Engineering Design

(Table 32) RaceCar TacoCat

Presenter(s): Elliot Lim, Cana Brown, Rebecca Hale, Graham Behringer

Program: Engineering Design

Faculty Advisor(s): Prof(s). House, McCormack, Mutchler, Simoni

(Table 36) Fold-A-Bed

Presenter(s): Madilyn Steiger, Logan Fiorito-Zendejas

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, Ingram, Jelen

Abstract:

Fold-A-Bed strives to minimize the effects of anti-homeless infrastructure by providing an alternative sleeping and storage option for people who do not currently have access to a living space or a shelter. The design consists of an elevated platform for sleeping and resting, which can be folded into a mobile storage space for transporting belongings. FoldA-Bed facilitates an increased sense of comfort and security by preventing people experiencing homelessness from having to sleep on the ground and giving them a reliable way to protect and transport their necessities.

(Table 37) Lost in Transit

Presenter(s): Colden Roach

Program: Engineering Design

Faculty Advisor(s): Prof(s). Ingram, Jelen

Abstract:

Our target user audience is people from Peru which plan on traveling to Japan. Our app will address the challenges of using public transportation, more specifically using the rail and bus networks to get around major city locations. The information will be presented in both English as well as Spanish since it is the primary language spoken in Peru. This will be done by creating a software application in Java which a user can interact with and has all the required information which they might require on a trip.

(Table 39) Calvin's Time Jumper

Presenter(s): Benjamin Gleason

Program: Engineering Design

Faculty Advisor(s): Prof(s). Ingram, McCormack, Taylor

Abstract:

Calvin's Time Jumper is a project for the User Experience Design Studio. It serves as a demonstration of proficiency in emotional design, design for manufacturing, and addressing user needs.

(Table 40) Beach Rake

Presenter(s): Zach Easter, Jason Chung, Andrew Cowlin, Brian Yamada

Program: Engineering Design

Faculty Advisor(s): Prof(s). Ingram

Abstract:

To address ocean waste washed up on shore, the Beach Raker is a manually operated tool designed to maximize efficiency in removing trash and debris from beach surfaces. It uses a cylindrical drum made of spaced rods that remain stationary as the user pulls it behind themselves. Plates on the side support the drum structure, and an angled handle provides ergonomic control. This model emphasizes lightweight construction, simple assembly, and user-centered ergonomics to make beach cleanup process more efficient and less physically demanding. The goal is to encourage people to participate in beach cleanups.

(Table 42) Hydroelectric Emergency Light

Presenter(s): Ethan Moen, Aidan Truby

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, Ingram

Abstract:

In Tanzania, Ethiopia, and similar markets, power outages force families to spend limited income on kerosene, candles, and batteries — while students, small businesses, and health clinics lose critical hours of productivity. HEEL (Hydroelectric Emergency Light) is a faucet that harnesses existing water flow to generate hands-free, omnidirectional light — no grid, no fuel, no batteries. One installation means that as long as water runs, light follows. Our product enables individuals to cook, groom, and perform everyday tasks thanks to the hands-free light this faucet provides.

(Table 43) ENGD Studio 4 Remote

Presenter(s): Isaiah Rohrs

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, McCormack, Taylor

Abstract:

This remote is part of the ENGD Studio 4 remote project, where we were tasked with designing a remote for a fictional character. I chose to design my remote for Mark Watney from the novel and movie *The Martian*. The remote is meant to be viscerally attractive and usable for Mark due to the use of similar color to his own chestplate for his EVA suit, and its similar fastener layout to the NASA Pistol Grip Tool. (PGT) It includes an atmospheric sensor and soil tester to help Mark grow potatoes more effectively on Mars to improve his chances of survival.

(Table 44) Dehumidifier Planter

Presenter(s): Brooklyn Kiefer, David Wonderlich, Carrie Clore, Mary Sclafani

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, Imgram, Jelen

Abstract:

The Dehumidifier Planter is designed to increase the quality of life for people living in apartments and dorms, where higher humidity levels and limited resources can make plant care difficult. This design combines a small dehumidifier with a hydroponic planter, using moisture in the air to automatically water the plants while maintaining the appropriate reservoir water level. The system offers a simple, low-maintenance way to regulate indoor humidity while growing plants. The design supports healthier indoor environments and promotes sustainable urban living, contributing to UNSDG 11: Sustainable Cities and Communities.

(Table 51) Garden Hero

Presenter(s): Micaiah Walters, Elliot Harris, Anya Zhu, Abigail Ramsey, Henri Lebovic

Program: Engineering Design

Faculty Advisor(s): Prof(s). House, McCormack, Mutchler, Simoni

Abstract:

Garden Hero is a team-based rhythm game themed around gardening in which players perform a song together to make a flower bloom.

(Table 52) Escape to Greece

Presenter(s): Travis Zinzer

Program: Engineering Design

Faculty Advisor(s): Prof(s). Ingram

Abstract:

Greece presents an attractive option for retirement because of its low cost of living and low tax rates. This app is designed to be used by Italian people who interested in researching potential retirement in Greece. It allows them to explore retirement options and information about Greece translated into their native Italian. The app presents them with information about visa types, income requirements, information about the various regions and for sale home information.

(Table 61) Whittier Telephone Co

Presenter(s): Finley Hightower, Ryan Jacobi, Hal Roach, Jorge Luis Sol Casas

Program: Engineering Design

Faculty Advisor(s): Prof(s). McCormack, House

Sponsor: Engineering Design Studio 3

Abstract:

Whittier Telephone Co. is a computer based game where you play as a telephone operator in the 20th century, connecting calls by using cables on a hand built physical “switchboard”. We have an endless mode, where you must connect calls at an increasing rate, and a story mode where across a couple in game days you must solve a mystery by listening into calls and taking note of suspicious details. This game is completed as a part of Engineering Design Studio 3, and is designed to show our learning in analog circuits, programming for microcontrollers, and designing/implementing GUI elements.

(Table 99) All Sines Point to 2π

Presenter(s): Grace Trask, Abbey Hileman, Bridget Hollingsworth, Molly Townsend

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brakin, Ingram, Jelen

Abstract:

All Sines Point to 2π is a low-cost educational board game that helps students learn the unit

circle. High school students in low-income communities often experience a gap in their understanding of trigonometry. All Sines Point to 2π allows these students to bridge the gap in their understanding. This encourages students from lower-income schools to be less apprehensive in pursuing higher education that includes more complex math topics.

(Table 100) MAV Load Controller

Presenter(s): Yuanhe Wang

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, Dugan, McCormack, Taylor

Abstract:

This 4-week solo project explores human-system interaction under high-latency conditions through a speculative scenario inspired by <The Martian>. It focuses on precise mass control without real-time feedback. Task analysis, user-centered modeling, and emotional design guided DFM-informed hardware development. A functional prototype with hardware and control logic demonstrates a conceptual interaction framework for precision tasks. The project shows how speculative design connects engineering constraints with human-centered considerations in extreme scenarios.

(Table 101) On the Case

Presenter(s): Carter Werkema, Hayden Rogstad, Than Mather, Jeremiah Wenke

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, Ingram, Jelen

Abstract:

On The Case improves existing water testing strip with more user-centered features. Our prototype provides a simple water testing kit that allows users to check their water quality and make informed decisions about its safety. We changed the case from circular to flat and included a carabiner loop for efficient storage and travel, integrated the instructions for using and interpreting the test into the design, and installed a tilting tray to easily access the strips. Our case, with all of these features, is more reliably watertight than its predecessor.

(Table 112) UnKanny Krafter

Presenter(s): Jayne McCormack

Program: Engineering Design

Faculty Advisor(s): Prof(s). Brackin, Ingram

Abstract:

Aluminum cans are a great source of free material for crafting; however, it can be difficult and unsafe to work with these cans as there are no commercially available tools to easily break the cans into sheets. The UnKanny Krafter makes working with cans easier and safer. The guide sleeve and rotary blade allow for repeatable removal of can ends without creating jagged edges like when using freehand cutting tools. The stencil holder users to

clamp premade or homemade stencils to sheets for repeatable shapes. Cutting tools are hardness tested to ensure edge retention. Overall, the Unkanny Krafter aims to provide the best experience for crafters looking to work with aluminum cans in hopes of encouraging them to use their cans instead of simply throwing them out.

(Table 113) Space Place

Presenter(s): Beej Bowling, Noah Rasmussen, Addy Nolte, Santiago Lema O'Connor d'Arlach

Program: Engineering Design

Faculty Advisor(s): Prof(s). House, McCormack, Mutchler

Abstract:

Space Place is a turn based tile game where players seek to be the one with the most points at the end of the game. The game is played on a square grid board and played with tiles that are designed to fit into the grid spaces. Each one of these tiles has nodes on the edge of its surface. Players can earn points by connecting two nodes to each other on the grid. Each tile has different amounts of nodes that can earn the players different amounts of points. The primary challenge of the game is figuring out how to position and orient your tiles in a way to gain the most points, all while trying to not be blocked by your opponent.

(Table 114) Murder in the Mansion

Presenter(s): Greta Carlson, John Reese, Bridget Hollingsworth, Sami Kowalski

Program: Engineering Design

Faculty Advisor(s): Prof(s). House, McCormack, Mutchler, Simoni

Abstract:

A murder mystery board game with the overarching goal of the game is to solve the murder mystery and correctly identify the murder weapon used. Each room will present its own goal of figuring out the hints and/or puzzles to be able to unlock the next room and gain insightful hints into what might have committed the murder. The game is intended to be played by many players working together to solve the mystery but can also be played individually.

Academic Program: Extracurricular or Competition Teams

(Table 106) Computer Vision Ball Balancing Table

Presenter(s): Jeremiah Sweeny, Ethan Parsons

Program: Extracurricular Competition Team

Abstract:

To investigate manufacturing design, industrial control, and machine learning concepts, we developed a computer-vision-based ball-balancing table. The system uses both 80/20 hardware and custom-designed components. Software solutions include machine-learning calibration, a vision pipeline, and optimized motion pathing. Beyond the physical demo,

this project is a real-life example of emerging capabilities in automation control and their potential in future systems.

(Table 130) Rose-Hulman Aerial Systems Competition Vehicle

Presenter(s): Kevin Liu, Alex Huynh, Isaiah Rohrs, Christopher Hazell

Program: Extracurricular Competition Team

Faculty Advisor(s): Bryan Cantwell, David Essex

Abstract:

This exhibit presents a Prototype Experimental UAV designed and engineered for the upcoming Student Unmanned Aerial Systems (SUAS) competition. The project focuses on the integration of autonomous navigation, computer vision, and real-time data transmission. In addition to the primary competition aircraft, the display features a variety of student-led projects, including fixed-wing foam aircraft, which highlight iterative design and rapid prototyping techniques. The exhibit will also feature a live demonstration of First-Person View (FPV) technology, showcasing the hardware and telemetry systems used to maintain situational awareness during flight operations.

Academic Program: Mathematics

(Table 20) Minimizing Matrix Perturbations

Presenter(s): Angela Milkowski

Program: Mathematics

Faculty Advisor(s): Prof(s). Holder

Abstract:

Given an overdetermined system of differential equations and observed data, both assumed to be reliable, we develop a method to make them consistent. We start with a system $y' = Ay$ and data measurements $y(t_i) = y_i$. From the eigenvalues and eigenvectors of A we derive the linear system $Bx = b$. When this system is inconsistent, a rank-one perturbation is applied to the matrix B . Our objective is to minimize the perturbation while enforcing feasibility. From the perturbed system, a time dependent coefficient matrix $A(t)$ can be constructed.

(Table 21) Continuous Logic and Topometric Spaces

Presenter(s): Alexa Renner

Program: Mathematics

Faculty Advisor(s): Prof(s). Carlisle

Abstract:

The prime graph of a finite group is the graph with vertex set the set of prime divisors of and an edge between vertices if and only if there exists an element with order. Given a finite nonabelian simple group, a group is π -solvable if there exists a composition series of such that every composition factor is either abelian or isomorphic to. In this paper, we introduce

the prime graph of an infinite group, the graph with vertex set and an edge between if and only if there exists an element with order n , and generalize several results on the prime graphs of finite solvable and n -solvable groups to results on the prime graphs of members of certain classes of infinite solvable and n -solvable groups.

(Table 22) Learned League: An exploration into the statistics of online trivia

Presenter(s): Zach Whelan

Program: Mathematics

Faculty Advisor(s): Prof(s). McSweeney

Abstract:

Learned League is an online trivia competition where players face off in a head-to-head trivia competition. This league has many similarities with sports leagues, but there are notable differences as well. We use data from multiple seasons of Learned Leagues publicly available data sources to try and predict users ranking based their statistics from previous seasons. While users ranking compared to other players will be the primary concern, the data will also be used to model things such as users improvement over time, or what makes users more likely to leave the platform.

(Table 23) Optimal Control: Optimal Study Time

Presenter(s): Wenjian(Danny) Zhang

Program: Mathematics

Faculty Advisor(s): Prof(s). Green

Abstract:

This paper formulates exam preparation as an optimal control problem and derives mathematically precise study schedule model using the Pontryagin's Maximum Principle. Memory strength $m(t)$ is modeled as a state variable governed by a linear ODE, while the control $u(t)$ represents study intensity, the amount of effort you decide to take and study with. The student's objective is to maximize the payoff function, balancing exam performance against the quadratic cost of effort. The core challenge is that the optimization is over the function space of all admissible controls $u(t)$, which is infinite dimensional, making standard optimization techniques inapplicable. Applying the optimal principles yield a closed-form optimal control, showing that effort should increase exponentially approaching the exam, with a rate governed by the forgetting rate. We present parameter analysis on the base model for examining how the forgetting rate, study effectiveness, effort cost coefficient, weight of the exam, and the initial memory stage shape optimal behavior. The model is extended in two different directions: a dimensional extension in which a student allocates effort between two courses simultaneously, treating both related and unrelated subject dynamics, and a cost extension, in which the quadratic effort cost is replaced by alternative cost functions to test the robustness of the optimal strategy. The resulting framework produces interpretable, closed-form solutions and rigorous analysis that quantify how biological, economical, and motivational factors interact to determine an optimal study strategy.

(Table 24) Confidence Distributions and Bootstrapping P-Values

Presenter(s): Jacob Gerber

Program: Mathematics

Faculty Advisor(s): Prof(s). Reyes

Abstract:

The two predominant schools of thought within the field of statistics are those of the Frequentists and the Bayesians. However, the formalization of the term “confidence” provides an approach to inference that lies somewhere in-between. Confidence distributions lie at the forefront of this approach. These “frequentist distribution estimators” contain p-values for a range of hypotheses, and can be approximated directly by a bootstrap distribution. This direct approach is an alternative to the current standard of enforcing the null hypothesis before bootstrap resampling to obtain p-values.

(Table 25) Ehrhart Properties of the Laplacian Simplices of Threshold Graphs

Presenter(s): Eric Bender

Program: Mathematics

Faculty Advisor(s): Prof(s). Olsen

Abstract:

Laplacian simplices are lattice polytopes formed from the convex hull of the columns of the Laplacian matrix of a finite connected graph. This work studies Ehrhart theoretic properties of Laplacian simplices for a specific family of graphs known connected threshold graphs, which are naturally indexed by binary sequences. Our analysis focuses on the reflexive property, the integer decomposition property (IDP), and the Ehrhart series of these polytopes. We show that most connected threshold graphs do not have reflexive Laplacian simplices. For some specific fixed binary sequence patterns, we classify when these graphs produce Laplacian simplices which are reflexive and when they have the IDP. Moreover, in small number of cases, we can additionally obtain the entire Ehrhart series.

(Table 26) Multiplying Small Matrices

Presenter(s): Thor Catteau

Program: Mathematics

Faculty Advisor(s): Prof(s). Leader

Abstract:

Matrix multiplication is fundamental to linear algebra and all of its applications, which appear in a variety of science and engineering disciplines. The computational complexity of matrix multiplication is an open question in theoretical computer science; Volker Strassen created in algorithm in 1969 that is faster than the “schoolbook algorithm” given by the definition, and several asymptotic improvements to Strassen’s algorithm have been made since, but the true fastest method is still unknown. We explore improvements for multiplication of small matrices with entries of 0 or 1, and a way to apply these improvement to block matrices.

(Table 27) Constructing Block Designs from Strongly Regular Graphs

Presenter(s): Benjamin Glancy

Program: Mathematics

Faculty Advisor(s): Prof(s). Holder

Abstract:

Block designs are combinatorial structures in which each pair of a set of varieties appears together in a fixed number of blocks. Strongly regular graphs are graphs in which each vertex has the same number of neighbors and pairs vertices share fixed numbers of neighbors. There are many connections between the two structures. We present some new constructions of block designs using strongly regular graphs, including two infinite families of designs using edge sets of complete graphs.

(Table 28) Solving Social Deduction Games: Lessons Learned and Ongoing Research

Presenter(s): Daniel Leverett

Program: Mathematics

Faculty Advisor(s): Prof(s). Ludden

Abstract:

In the field of game theory, games of interest sometimes involve asymmetric player information. In this paper, we analyze Secret Hitler, a boardgame in the genre of social deduction games characterized by such asymmetric information. In a social deduction game, or hidden role game, each player is assigned a role placing them on one of two teams, but not every player is aware of others' role assignments. We develop a Bayesian inference model for an outside observer trying to determine players' roles. Computational experiments for a restricted set of available player and team strategies demonstrate that an outside observer can often learn most players' roles before the end of the game.

(Table 29) On the Cubic Subfield of the p th Cyclotomic Field

Presenter(s): Michael Morris

Program: Mathematics

Faculty Advisor(s): Prof(s). Billingsley

Abstract:

We study cubic reciprocity through looking at properties of the cubic subfield of the p th cyclotomic field and the subfield's ring of integers. Using the Galois group of the p th cyclotomic field, we explicitly construct the cubic subfield and determine a primitive element for the extension. Using properties of the discriminant of the field, we then find an integral basis of the ring of integers. Finally, we relate these results on the ring of integers to statements about cubic reciprocity.

(Table 30, 31) Central Path Art

Presenter(s): Connor Tasik

Program: Mathematics

Faculty Advisor(s): Prof(s). Holder

Abstract:

The central path revolutionized the study of optimization in the 1980s and 1990s due to its favorable convergence properties, and as such, it has been investigated analytically, algorithmically, and computationally. However, it has aesthetic qualities that are frequently forgotten, with exceptions being low dimensional depictions limned in textbooks. Since the usefulness of the path comes from that it converges nicely, few have looked into how to control the size of the steps to convergence. The paths are our brush strokes to create mesmerizing art so better control of them allows the art to flourish.

Academic Program: Mechanical Engineering

(Table 57) Evaluating Seating Metrics for Hip Surgery

Presenter(s): Colby Sanders, Ian Bowman, Tyler Cariola, Trong Pham

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bercich

Sponsor: Enovis

Abstract:

In hip replacement surgery, a femoral stem must be securely seated within the bone to ensure stability and long-term success. But determining when that “perfect fit” is achieved isn’t always straightforward, it often depends on experience and subtle feedback during the procedure. The procedure is often performed using an impactor gun or a mallet to apply impaction force. This project explores whether the moment of seating can be measured quantitatively for both automatic and manual impaction. By testing different metrics and signals during stem insertion, we aim to identify clear indicators of proper seating. Turning this critical decision into something measurable could help improve surgical consistency, implant performance, and patient outcomes.

(Table 58) Hobby Turbojet Engine Heat Exchanger

Presenter(s): Kolby Cockett-Nagamine, Andrew Leonard, Tim Swicord, Owen Wiesler, Max Wilking

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Mayhew, Sangelkar

Sponsor: U.S. Air Force Research Laboratory

Abstract:

Jet engines produce thrust and heat via the Brayton cycle. In aircraft, a portion of the

compressor stage air is bled off and utilized in systems such as cabin pressurization and anti-icing. We developed an air-to-air heat exchanger to capture energy from the hot compressor air. Key parameters such as cold air mass flow rate and surface area were evaluated to provide the best heat transfer and other scoring performance. Ultimately, this project highlights the importance of heat transfer optimization and propulsions, as well as providing experience with the design and manufacturing process.

(Table 59) reTHink Greenhouse Roof Replacement Project

Presenter(s): William Witalis, Antoine Cooper, Eric Billips

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: reTHink

Abstract:

reTHink is a local non-profit with the goal to live a cleaner and healthier life by reducing waste. A greenhouse built by a previous capstone team had succumbed to the elements and required a roof replacement. The team was tasked with replacing the existing greenhouse roof. The team settled on a simple roof design consisting of PVC slats, a single venting window, and twin-wall polycarbonate panels. This design minimized construction costs and logistics while meeting the client's project needs.

(Table 83) PRUSA 3D Printer Enclosures

Presenter(s): Crystal Chon, Garrett Roush, Neil Lau, Jonah Clark

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: KIC: Tom Rogge

Abstract:

The Prusa XL 3D printers within the KIC operate without protective enclosures. Commercial options are often costly and lack aesthetic appeal. The focus of this project is the design and implementation of a cost-effective and visually appealing enclosure system tailored specifically for the KIC's Prusa XL printers. The enclosure will provide easy access for print removal and maintenance while maintaining ideal internal conditions. Overall, the final design aims to enhance print reliability and printer safety, while integrating seamlessly within the environment of the KIC.

(Table 84) Optimized Battery Systems for the Battery Workforce Challenge and Eco-Car Competitions

Presenter(s): Wyatt Bell, Maralee Lockridge, Brian Fischer

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Brooks, Chambers, Herniter

Sponsor: Battery Workforce Challenge / Eco-Car

Abstract:

This capstone project details the design and creation of a custom battery system for automotive use. The goal is to provide a custom battery solution that ensures safety and reliability during competition. Our team will document every phase of the battery life cycle from component selection to final testing, with the goal of optimizing overall vehicle efficiency through the design and integration of electric motor systems and batteries. We will develop a clear step-by-step instruction guide alongside safety procedures and quality control metrics. The final design will be built for minimizing complex manufacturing and will serve as a reference for future years of competition.

(Table 85) Mechanical Rosie

Presenter(s): Brett Bellas, Cy Carrithers, Jacob Childres, Josh Pohle

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Career Services

Abstract:

Career Services at Rose-Hulman has requested a 6–8 foot tall mechanical elephant to serve as an engaging attraction at campus events. The goal of this project is to design and build a visually appealing, safe, and reliable system capable of capturing the attention of large crowds. The team will explore concepts including a remote-controlled mobile platform or a drivable configuration. Features such as a moving trunk, illuminated eyes, and expressive motions will be considered to enhance interaction and engagement while ensuring the system remains durable, transportable, and suitable for repeated use at campus events.

(Table 86) Battery Workforce Challenge: Vibration Testing and Isolation Monitoring of EV Battery Modules and Battery Disconnect Units

Presenter(s): Adam Ordway, Owen Littlejohn, Blake Ramsey, Colin Rogers, Connor Whitesell

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Brooks, Chambers, Herniter

Sponsor: Battery Workforce Challenge

Abstract:

This project develops a vibration test methodology for an EV battery module and a battery disconnect unit (BDU) constructed by the Rose-Hulman Battery Workforce Challenge team in order to verify their structural integrity and electrical isolation under dynamic loading. Custom fixtures were designed to constrain the devices and avoid resonance during testing. Voltage, temperature, and high-voltage isolation were monitored using a data acquisition system. The methodology aligns with UN38.3 and SAE J2380 testing guidelines.

(Table 87) Radial Piston Air Compressor for Compact, High-Flow Mobile Applications

Presenter(s): Marcus Ludwig, Ian Rose, Ben Egelseer

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Paladin Exo Bionics

Abstract:

This project develops a radial piston air compressor designed to improve flow rate, compactness, and operational flexibility compared to traditional inline compressors. By arranging multiple pistons radially, the design increases CFM output while reducing overall size and vibration. Key challenges include lubrication strategy, precision manufacturing, and thermal management. A functional prototype will be built and tested to evaluate pressure, flow rate, efficiency, and durability, comparing experimental results to theoretical predictions.

(Table 94) Using a Pump-as-Turbine to Recover Energy from a Sustainable Rainfall Irrigation System

Presenter(s): Juston West, Luke Gaston, Kyle Broeker, Alex Huynh, Shane Rumzis

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Dr. Jenny Mueller, Dr. Ben Mertz

Abstract:

The Rose-Hulman gardens utilize rainfall to maintain its plants and houses a PLA composter. After collecting rainwater from the roof and storing it in large tanks underground, the on-site solar panels will power a pump-as-turbine (PAT) to transport the water to a higher tank. The high tank will use gravity to feed the plants water. At the end of the growing season, the high tank will drain itself while passing through the PAT to recover the stored potential energy, all while clearing the water lines for winterization. Energy recovered through the PAT will power the on-site PLA composter.

(Table 95) Pop Block Lens Deblocker

Presenter(s): Asher Blythe, Ryan Burch, Ethan Minckler, Jake Vincent, Mark Hankins

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Dugan

Sponsor: Zernike Precision Optics

Abstract:

The Pop Block project is focused on creating a partially automated affordable deblock system for integration into Zernike Precision Optics manufacturing process. Deblocking is a critical step in optics manufacturing removing the resin glues lens from its fixture without causing damage to the lens. The Pop Block system significantly reduces Zernike's current deblock time while maintaining a per lens cost of less than \$1.

(Table 96) Differentiating the Fire-Resilient Capabilities of Roofing Materials using Cone Calorimeter Testing

Presenter(s): Conor Fletcher, Jacob VanDorpe, Exia Sun, Noah Bast

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Steel Dynamics

Abstract:

Residential roofing fire-resistance classifications, particularly the widely used Class A designation, often fail to capture meaningful differences in material behavior under fire exposure. Roofing systems that meet the same classification criteria can exhibit significantly different responses in terms of ignition, heat release, and overall degradation. This limitation reduces the effectiveness of current standards for stakeholders seeking to make informed, performance-based decisions. This project explores an alternative approach to evaluating residential roofing systems through a quantitative, performance-oriented framework. By shifting focus from pass-fail classifications to measurable fire-response characteristics, the work aims to enable clearer differentiation between materials that would otherwise be grouped together. Central to this effort is the use of controlled laboratory testing to generate consistent, comparable data describing material behavior under thermal exposure. Representative roofing assemblies were developed to facilitate this evaluation, providing a basis for systematic testing and analysis. The resulting data are interpreted through a structured framework designed to highlight key trends, assess variability, and support meaningful comparisons across material types. The significance of this work lies in its potential to enhance how fire performance is understood and communicated within the residential construction industry. By introducing a more transparent and quantitative basis for comparison, this approach supports improved material selection, informs future standards development, and contributes to broader efforts to increase fire resilience in built environments.

(Table 97) Bin Buddy - A Device to Aid the Transportation of Trashcans

Presenter(s): Myra Duncan, Damian Komperda, William Wittich, Jack Murphy

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Dugan

Sponsor: Mike Hamilton

Abstract:

Bin Buddy is an open-source device designed to aid elderly people or people with disabilities in taking their trash out. The device reduces physical strain compared to moving a trash can to the curb manually. It provides a stable platform that allows users to efficiently attach the bin and transport it to and from the curb. As an open-source device, it can be built without specialized tools using common off-the-shelf parts.

(Table 102) Design and Fabrication of a Penny Press Machine for the Fowler Academic Building (FAB)

Presenter(s): Nicholas Fong, Andrew Fong, Jacob Ulewicz, Katie Fightmaster

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Michael Hamilton

Abstract:

This project presents the design and fabrication of a rolling penny press for installation in the Fowler Academic Building (FAB), allowing users to create engraved souvenirs through controlled plastic deformation. The machine showcases engineering design through a visible, interactive mechanism. The completed system operates smoothly and produces consistent engraved coins, providing an engaging, hands-on experience for the Rose-Hulman community.

(Table 103) Wonders With Worms: An Interactive Vermicomposting System

Presenter(s): Zach Applewhite, Anders Caldwell, Aidan Carter, Parker Kollar

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Dugan

Sponsor: The Montessori Academy of Terre Haute

Abstract:

The goal of our project was to build an interactive and educational vermicomposting system for the 3 to 8-year-old students of the Montessori Academy of Terre Haute. The aim is to teach these students about composting; how it is done, how it benefits the environment, and how worms play a crucial role in the breakdown of organic material. Our project aligns with the Early Childhood Education method that Montessori follows to be physically interactive in order to encourage well-rounded growth of every student.

(Table 105) Bearing Life Tester Expansion

Presenter(s): Jamie Grace, Gabe Muller, William Prusak, Jeremiah Sweeny

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Sponsor: thyssenkrupp Presta North America, LLC

Abstract:

Senior Design Team P45 was tasked with designing upgrades to thyssenkrupp Presta Fishers' Bearing Life Tester, which is used for verifying steering column durability. This machine was reverse-engineered, and upgrade proposals were delivered to fulfill additional testing requirements. Before Christmas, this team worked with thyssenkrupp on a different project to create a comprehensive packaging solution for their prototyping shipping.

(Table 107) Potato Slicer

Presenter(s): Paul Sampson, Josh Pearson

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Bon Appetit Catering

Abstract:

Our project focuses on improving the cleanability and maintainability of an existing automatic potato slicer used for high-volume food preparation. While the previous system effectively sliced potatoes using a motor-driven linkage mechanism, routine cleaning and maintenance presented challenges due to limited accessibility to critical components such as the blade assembly and internal surfaces. Our team developed a complete SolidWorks assembly of the machine to better understand its structure and identify key areas for improvement. The new design enhances user access to high-contact and high-maintenance regions without altering the core slicing functionality, allowing for reduced cleaning time.

(Table 108) Sample Acquisition from Metallic Asteroid Surfaces

Presenter(s): Adam Johnson, Abdullah Islam, Carter Kirtz, Ian Talbert

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Sponsor: NASA Psyche Mission

Abstract:

Psyche is an asteroid between Mars and Jupiter, hypothesized to be exposed core material of a planetesimal, and rich in metal. In the future, NASA scientists may propose to send a mission to extract surface samples from Psyche. Our goal is to prove a novel sample extraction mechanism that could offer benefits over conventional methods in the harsh mission environment, which includes non-uniform surfaces and low gravity. The design is a rover's end-of-arm-tool (EOAT) employing an oscillating blade to cut a pyramid-shaped sample and a microspine anchoring system for stabilization.

(Table 111) Pipe Center Point Projection for Commercial Applications

Presenter(s): Ashton Bennett, Kasey Canada, Kyle Chitwood, Samuel Otto

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Abstract:

Our device aims to project the center point of a pipe across a 20-foot distance, allowing operators to cut down the time and effort it takes for them to draw the hole they will eventually cut through to run a pipe along a ceiling. Currently, tradespeople must measure from the mounted pipe end to the floor, walk across to the wall, and measure back up the same distance to cut the hole. We hope to eliminate the need to use a tape measure at all, as they could simply mount the laser and project the center point across a distance of up to 20 feet.

(Table 116) Mechanical Roller Synchronization for Flat Roll Steel

Presenter(s): Alex Mullis, Jonathon Stadler, Tyler Wuestefeld

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Sponsor: Cliff Meyer – Mechtek

Abstract:

A hydrogen annealing furnace uses two pneumatically driven rollers which push the roller against a steel strip. A continuous strip passes through the rolls and features welds along its width. When welds occur, the rolls pulse out, possibly creating binding against the frame causing hydrogen leaks and combustion. To prevent this, we have bound each roller end via a rack and pinion with a shaft connecting each pinion gear. As one side moves the rack spins the pinion. The shaft transmits that rotation to the rack on the other roller end. This ensures that the roller ends are synchronized.

(Table 119) Wabash Valley Crew Rowing Shell Transportation Device

Presenter(s): Alex Moeder, Benjamin Essex, Evan Miller

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bercich

Sponsor: Wabash Valley Crew

Abstract:

This project is to assist younger kids with physical limitations with transporting a heavy rowing shell up and down a hill.

(Table 121) Junior Astronaut Training Center

Presenter(s): Michael Owens, Peter Gau, Kyle Colburn, Lance Fowler, Michael Hedenberg

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Dugan

Sponsor: Katie Miller

Abstract:

The Junior Astronaut Training Center is an interactive space-themed exhibit intended for entertaining children at the Gibson Allen Memorial Planetarium in Terre Haute, IN. This exhibit allows children to engage meaningfully without disrupting Planetarium showings. Young Planetarium goers are provided the opportunity to feel like an astronaut and learn about space through a thematic and interactive experience. A mass-switching activity provides the ability to feel the change in weight of the same object across different planets, a spirograph allows users to trace the trajectory of their spacecraft, and an orrery details the orbits of planets in the Milky Way.

(Table 122) Mobility System for Asteroid Exploration

Presenter(s): Andrew Dunleavy, Anthony Hoyt, Nathan Nepl, Karis Peringson

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Sponsor: ASU - NASA's Psyche Mission

Abstract:

Our capstone project aimed to develop a mobility system capable of traversing 16 Psyche, an M-type asteroid between Mars and Jupiter. Expected features of Psyche indicate rough terrain, so our mobility system must climb hills, navigate obstacles, and support an instrument payload. To achieve this, a shuffler-type robot was constructed with independent motor actuation and functionality in various orientations. The full-scale model dynamics were simulated with MATLAB Simscape Multibody, accounting for the expected asteroid conditions. This project is completed in association with NASA and ASU.

(Table 123) Electric Powertrain Upcycling: Saving Vehicles from the Scrapyard

Presenter(s): Kevin Cotelleso, Kevin Grady, Shaun Yamamoto, Sydney Lewis

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Sponsor: PCK Engineering Solutions

Abstract:

Many vehicles today are scrapped because of a single system failure. Electric vehicles with functioning motors are discarded due to collision damage, while gasoline vehicles with sound components are scrapped because of catastrophic engine failure. This capstone aims to develop a practical methodology for a solution to mounting electric powertrain components to the gasoline vehicle's engine bay. If proven cost-effective, this approach could extend vehicle life and lower the environmental impact of scrapping and manufacturing new automobiles.

(Table 124) RFEP Bonding Process

Presenter(s): Eathan Faust, Jayden Gibson, Erin Nolan, Tori Scales

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bercich

Sponsor: Cook Medical

Abstract:

Cook Medical required verified machine settings to bond two parts of different materials together for a sheath, which is used to introduce catheters and other medical equipment into the human body. We provided new optimized machine settings for numerous sizes to Cook that were verified through DOEs and statistical analyses. In addition to our project, we created an image recognition system by creating and training an AI model to help with the quality check procedure. We also designed a processing aid for assembly workers who have reduced dexterity.

(Table 125) Nitinol AF Test Stand

Presenter(s): Nicholas DeMaio, Aditya Reddy, Joshua McManus

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Motion Dynamics Corporation

Abstract:

Motion Dynamics Corporation determined its need to improve and extend the range of the current automated test system for characterizing the displacement behavior of Nitinol compression springs. The current test system they employ is highly manual, inefficient, and limited in temperature capabilities. Group P13 was tasked with solving this issue. The project goal is to design and fabricate an automated test stand that widens the current temperature range, reduces total test time, and minimizes human interaction.

(Table 126) From Waste to Packaging: Developing a Sustainable Paper Pulp Machine for Rose-Hulman Students

Presenter(s): Alex Adams, Katie Cleary, Jessica Henning, Diana Stirn

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Sponsor: Dr. McCormack and Dr. Dugan

Abstract:

The Mechanical Engineering and Engineering Design departments are seeking to implement sustainability into their curriculum by creating a machine that produces paper pulp packages. This paper pulp package molding machine promotes the reuse and recycling of paper and paperboard across campus. The machine gives students hands-on experience in reusing materials and giving trash a second life as an educational tool. Our machine utilizes a vacuum forming process that mimics what is used to make paper pulp packaging in industry while the adjustable mold allows students to create a unique package that can fit each student's uniquely sized and shaped product.

(Table 127) Horizon Health Hospital HVAC Improvement

Presenter(s): Aidan Kriek, Ian Powers, Matthew Schwartz, Wil Bell

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bercich

Sponsor: Company: Horizon Health, Clients: Von Lambert and Dave Snapp

Abstract:

Horizon Health is a critical access hospital in Paris, IL with an outdated HVAC system, particularly in the patient wing. Our project evaluates current HVAC performance against ASHRAE standards, focusing on temperature, humidity, particulate matter, and air changes per hour (ACH). We developed a solution that provides daily updates to hospital administrators, summarizing patient room conditions and identifying any deviations from

ASHRAE guidelines to support informed decisions on system improvements and patient safety.

(Table 129) Cavitation

Presenter(s): Andy Wagner, Cathrine Millwood, Jacob Bender, Jasper Rose

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Chambers

Sponsor: Dr. Allen White

Abstract:

Propellers create pressure changes as they rotate, and when pressure drops below the liquid's vapor pressure, cavitation occurs. Vapor bubbles form and collapse, causing wear, noise, vibration, and performance loss. Because real-world conditions vary, a controlled environment is needed to study cavitation. This project develops a cavitation pool and a semi-scale system using the KIC water tunnel to test propellers with and determine the best sensors and imaging to better understand and improve propeller performance.

(Table 131) KIC Mini Golf

Presenter(s): Ryan Goldstein, Daniella Ryther, Josh Walter, Colin Welsh

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bercich

Sponsor: Tom Rogge - Kremer Innovation Center

Abstract:

Our team has built a mechanical mini golf hole for the KIC. Intended for marketing and recreational use, this is a great way to have some fun while visiting the innovation centers. A core goal of this project was to showcase the spirit and ingenuity of Rose-Hulman students for prospective students visiting campus for the first time. This hole may seem simple at a glance, but with Plinko and other hidden features, there is a unique experience ready for everyone. With a combination of luck and skill, try to rack up as many points as possible!

(Table 133) RoseGPE Chassis Analysis Instructions

Presenter(s): Nolan Nierenhausen, Dane Blackburn, Kaden Waugerman, Victor Zhang

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Bercich

Sponsor: Rebecca Bercich

Abstract:

The purpose of this Capstone is to develop standardized Finite Element Analysis instruction manuals for the Rose Grand Prix Engineering team. The Capstone team conducted and created instruction manuals for torsional stiffness, harmonic, and frontal impact analysis on RoseGPE's chassis. The instructions provide step-by-step guidance and includes pictures,

that point out which buttons to press in the analysis software as well as common pitfalls, analysis of results, and other important content that RoseGPE requested.

(Table 134) Platform P1

Presenter(s): Davis Rubel, Adam Jirovec, Owen Clowney, Aaron Nadharajan

Program: Mechanical Engineering

Faculty Advisor(s): Prof(s). Sangelkar

Abstract:

The P1 project involves the design and development of a lightweight electric motorcycle that bridges the gap between e-bikes and full-scale electric motorcycles. Built around a structural carbon-fiber paneled chassis, the platform achieves high stiffness at low mass (~60–80 kg total) while remaining street-legal and capable of highway speeds (~75 mph). Engineering work includes FEA-based structural validation, fatigue modeling using material coefficients, and vibrational analysis of the rigid frame. The result is a manufacturable, high-performance platform optimized for urban transportation.

Academic Program: Multidisciplinary Design (MDS)

(Table 7) Unlayered 3D Mass-Market Multi-Axis 3D printing

Presenter(s): Alex Stedman, Philip Pounds, Alex Yim

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Chenoweth

Sponsor: Unlayered 3D, LLC

Abstract:

Desktop 3D printing has remained unchanged for the past 15 years in stacking layers vertically, leading to support waste material, bad surface finishes, and poor part strength. But what if there was a way to solve this problem——— and print Unlayered. Our patent-pending multi-axis 3d printing stack, from software to machine, gives engineers full control over their parts right off the build plate. And all of this is just a few clicks away at a price point that an engineer can afford without paid software.

(Table 33) Delphic AI Workstation

Presenter(s): Ryan D'Aquila, Jonathan David, Bryson Lee, Spencer Halsey

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin, Chenoweth

Abstract:

Delphic is an AI-powered workstation that integrates a projected workspace, voice interaction, gesture control, and contextual memory to enhance engineering workflows. The system bridges physical and digital tasks by enabling users to capture handwritten

notes, manage tasks, and interact with tools seamlessly. By combining hardware and software into a unified interface, Delphic reduces friction between ideation and execution while supporting efficient, intuitive, and reliable user interaction.

(Table 34) PCB Foundry - A Benchtop Multilayer PCB Fabricator

Presenter(s): DJ Bernard, Prabhat Vadlamani, Django Wardlow, Colin Young

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Walter

Abstract:

PCB Foundry is a benchtop manufacturing process designed to produce 4-layer PCBs within a single workday using a 5 step process. By enabling in-house fabrication, the system eliminates two-week shipping delays from overseas outsourcing, accelerating rapid prototyping for engineers.

(Table 38) Milwaukee Tool Trigger Optimization

Presenter(s): Henry Faris, Jimin Park, Margo Leone

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin, Chenoweth, Walter

Sponsor: Milwaukee Tool

Abstract:

This project is the redesign of the safety and trigger mechanism for the Milwaukee Tool M12 Brushless Pruning Shears. Based on user feedback, there was a need to improve the ergonomics and functionality for extended use of the tool. We broke down the problem into a list of requirements for safety, ease of use, and user comfort in addition to physical requirements from the client. We started off with multiple different design ideas and used rapid prototyping to test the designs. Each prototype was benchmarked against these requirements through multiple rounds of user testing with landscaping professionals on and off campus. The final design uses a rack and pinion system. The result of this project provides the client with a design platform to further improve the tool.

(Table 50) Glassboard X Rose-Hulman Vacuum Silicone Injection Molding System

Presenter(s): Sid Gion, Calvin Jorgensen, Alexander Nustad, Cale Royer, Quinlan Walinder

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin

Sponsor: Glassboard

Abstract:

Glassboard Product Development relies on rapid prototyping to deliver production-quality models for clients across industries, often using SLA-printed molds and two-part silicone. Their current silicone mixing and injection workflow is slowed by lengthy degassing times and inconsistent manual injection, which can trap bubbles and compromise prototype quality. This project aims to design a device that securely holds both mold and syringe,

seals the syringe for degassing, and uses a controllable actuator to inject silicone under vacuum. Enclosed within a custom vacuum chamber, the system will streamline degassing, improve injection precision, and enhance prototype reliability.

(Table 65) Quikburst: Speed Training Equipment Made Accessible

Presenter(s): Gabe Adams, Ian Frensemeier, Kallen Selby, Kobe Stoudemire, Ahaan Kothari

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin

Abstract:

Youth sports are becoming increasingly specialized. As sports training methods advance, access to high-end equipment has become increasingly financially out of reach for the everyday American. This high pricing is due to exclusivity of products on the market, not the cost of materials or intellectual property. Quikburst will address part of this issue with the Quikburst: a portable, battery powered machine that allows athletes to train both speed and agility under assistive and resistive loads, while measuring and saving performance on an iPhone app platform - all for a price of under 500\$.

(Table 66) Excavator Payload Estimation System: Developed for Renascent Inc.

Presenter(s): Michael Wilson, Jacob Cockerill, Toby Zhao, Connor Luce, Prithvi Vijaykrishnan

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin

Sponsor: Renascent Inc.

Abstract:

The Excavator Payload Estimation System is a loading aid designed to help excavator operators fill haul trucks to a target weight without relying on guesswork. It uses inclinometers, hydraulic pressure transducers, and a calibrated predictive model to estimate bucket payloads. By giving operators real-time feedback through an in-cab user interface, the system improves loading consistency while reducing haul trips and overweight liability.

(Table 110) Liquid Bipropellant Rocket Engine

Presenter(s): Cesar Osornio, Evan Eades, Kaila James, Will Geoghegan

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin

Sponsor: Rose Propulsion Laboratory

Abstract:

A liquid bipropellant rocket engine capable of 600 lbf of thrust is designed to compete in the Collegiate Propulsive Lander Challenge (CPLC) for the Rose Propulsion Laboratory (RPL) team at Rose-Hulman. The engine is designed to be additively manufactured using Inconel 718, uses Isopropyl Alcohol and Nitrous Oxide as fuel and is regeneratively cooled.

The propellant is fed into the engine using a pintile injector and ignited using an augmented spark igniter.

(Table 115) Artificial Pacer

Presenter(s): Alexander Spitzer, Andrew Cowlin, Abigail Leul

Program: Multidisciplinary Design (MDS)

Faculty Advisor(s): Prof(s). Brackin

Sponsor: Dr. Lui

Abstract:

Maintaining consistent pacing is essential for effective run training, yet many athletes struggle to regulate speed without external feedback. This project presents the design and development of an artificial pacing robot intended for use on a standard running track. The robot travels at a user-defined speed, providing runners with a reliable visual reference to help maintain optimal training intensity. The system integrates precise motor control, a user communication interface, and autonomous navigation to ensure consistent performance along the track. By reducing pacing variability, this robot aims to improve training efficiency and support athletes in achieving more targeted and repeatable workout outcomes.