MICHIGAN STATE UNIVERSITY COLLEGE OF ENGINEERING **SPRING 2024**

DESIGN DAY

MICHIGAN STATE UNIVERSITY

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Executive Partner Sponsor

Welcome to the MSU College of Engineering Design Day Booklet!

On behalf of Michigan State University Federal Credit Union (MSUFCU) in partnership with the College of Engineering, and Michigan State University, we **welcome** you to explore this booklet to see the **extraordinary** work of MSU students.

MSUFCU is **proud** to partner with MSU on many programs, especially those that highlight the talents of MSU's outstanding students. As you look through this booklet, you will see the work of MSU students demonstrating their abilities to be **creative**, **innovative**, and **problem solve** - traits that we all seek in our next generation of employees.

Design Day projects showcase the students' unique skills exhibited in their **intellect**, **ingenuity**, **teamwork**, and core engineering knowledge learned during their academic tenure in the MSU College of Engineering. The students' projects this semester provide insight into their **inspiring solutions** to the real-world challenges presented. As a result, we have great confidence in their futures as engineers and **leaders** in our global workforce.

We wish everyone our **congratulations** on your successes and accomplishments. And, a special **thank you** to the parents, families, faculty, and staff that have supported the students as they **achieve their dreams**.

Sincerely,
April M. Clobes, President/CEO, MSUFCU

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dreamBIG

With a Credit Union You Can Trust

Since 1937, MSUFCU has been an integral part of the MSU community. We believe supporting programs such as Design Day helps prepare students to achieve their goals and dreams.

Wherever life takes you after graduation, MSUFCU can help. From the convenience of direct deposit to your free checking account to purchasing your first home, we have the financial tools to help you engineer your next chapter.

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Welcome from the Dean

As Dean of the College of Engineering, on behalf of the entire faculty, staff, and students, I welcome you to Design Day!

Since the first Design Day in 1994, it has grown into the premier undergraduate academic event of the semester, featuring over 100 capstone teams and over 600 seniors from all 10 of the College's academic programs.

We are pleased to acknowledge MSU Federal Credit Union as our Design Day Executive Partner Sponsor and Urban Science as our Design Day Directing Partner Sponsor. Our Design Day Supporting Partner Sponsors include Amazon, Anthropocene Institute, Meijer, Roosevelt Innovations, and TechSmith. We thank all of our sponsors for their generosity and their ongoing commitment to Design Day.

As you explore the exhibits throughout the Engineering Building, you are encouraged to take time to learn about the projects by talking with our students. They are an incredible group of people who love to share their enthusiasm for engineering.

Starting in their first semester, our freshmen learn about the importance of engineering and the positive impact that engineers make on society and the world around them in our Cornerstone and Residential Experience for Spartan Engineers program. Be sure to stop by and see how they innovate, communicate, and perform at the highest levels in an increasingly global and demanding world.

The headliners of Design Day are our graduating seniors as they present their design projects through exhibits, posters, and presentations. Their projects represent the capstone of their educational career. You will see that our graduating MSU engineers are ready to lead, create and innovate.

Our capstone programs and Design Day would not be possible without the continued support of our capstone project sponsors who provide both funding and a professional experience for our capstone design teams. We appreciate their generosity and their time.

Please join us for the Design Day Awards Ceremony in Anthony Hall Room 1281 at 1:15 pm when we will honor all of our talented Spartans, the best of the best.

Dr. Leo Kempel
Dean of the College of Engineering
Dennis P. Nyquist Endowed Professor of Electromagnetics
Michigan State University

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Anthropocene Institute

Design Day Events Schedule:
Friday, April 19, 2024

EVENTS	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon	1 p.m.
Audio Enthusiasts and Engineers		2nd Floor Rm 2228 8:00 a.m. – Noon					
Engineering Students Organizations		Engineering Students Organizations 1st Floor West Wing Lobby 8:00 a.m. – Noon					
ECE 410 Demonstrations			2nd Floor 2200 Hallway 9:00 a.m. – Noon				
EGR 100 Demonstrations			2nd Floor 2300 Hallway 9:00 a.m. – 11:30 a.m.				
ME 412 Demonstrations		1st Floor Room 1252 8:00 a.m. – 11:30 a.m.					
ME 470 Competition		1st Floor Room 1345 8:00 a.m. – 11:00 a.m.					
ME 478 Competition						1st Floor Room 1240 11:30 a.m. – 1 p.m.	

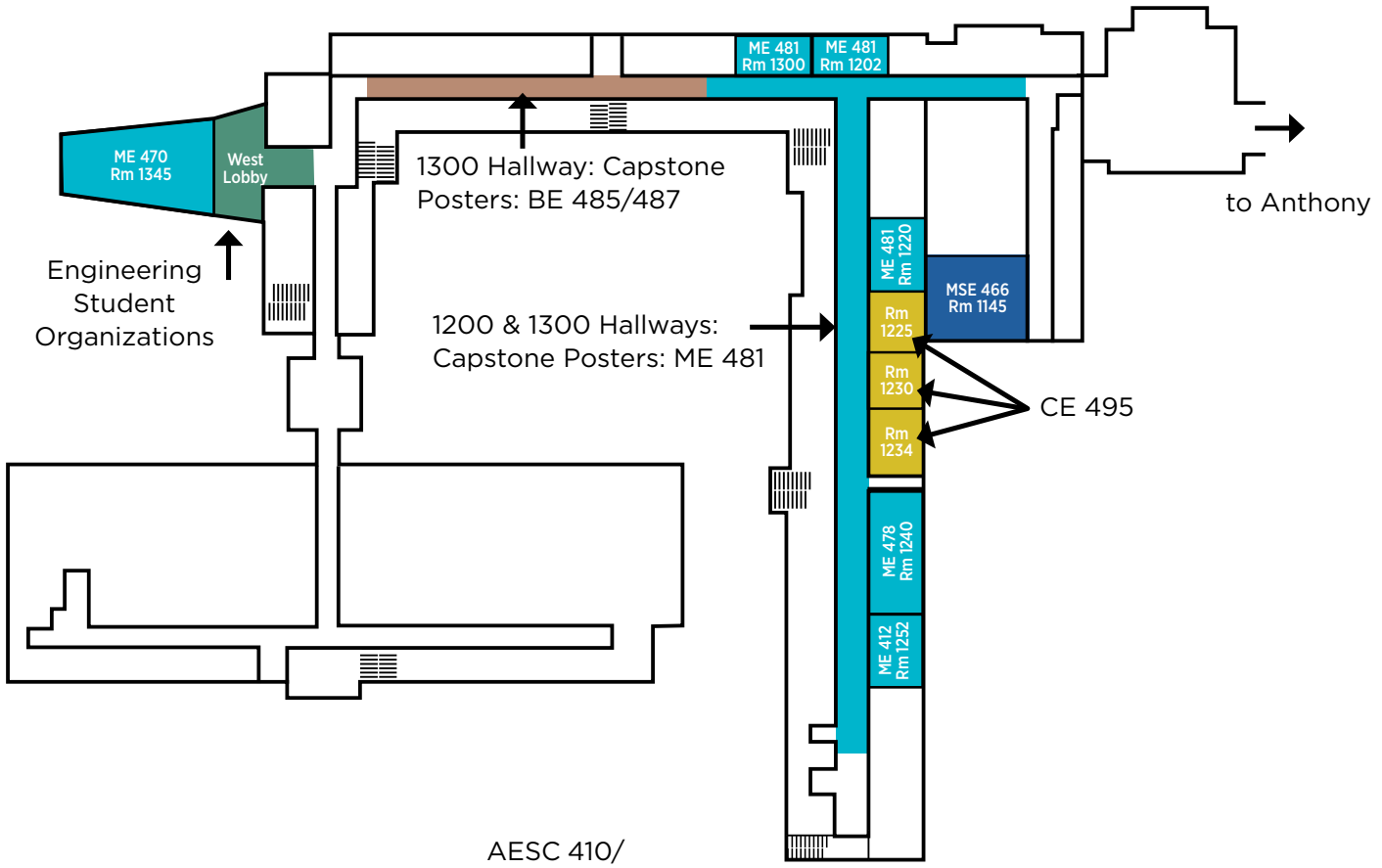
CAPSTONE COURSES							
All Capstone Posters for most projects, including BE485/487 and ChE 434		BE and ME 1st Floor 1200/1300 Hallways ECE on 2nd Floor 2200 Hallway ChE on 2nd Floor 2400 Hallway CSE on 3rd Floor 3200/3300 Hallways 8:00 a.m. – Noon					
AESC 410/SCM 472 Project Presentations		2nd & 3rd Floors – Rooms 2320, 2400, 3400 8:00 a.m. – 11:30 a.m.					
CE 495 Project Presentations		1st & 2nd Floors – Rooms 1225, 1230, 1234 & 2243 8:00 a.m. – Noon					
ECE 480 Project Presentations		2nd Floor Rooms 2245 & 2250 8:00 a.m. – 11:30 a.m.					
ME 481 Project Presentations		1st & 2nd Floors – Rooms 1202, 1220, 1300, 2435 8:00 a.m. – Noon					
MSE 466 Project Presentations			1st Floor Room 1145 8:30 a.m. – 11:00 a.m.				

OPENING AND AWARDS							
MSU Awards					1st Floor Anthony Room 1281 1:15 p.m. - 2:00 p.m.		

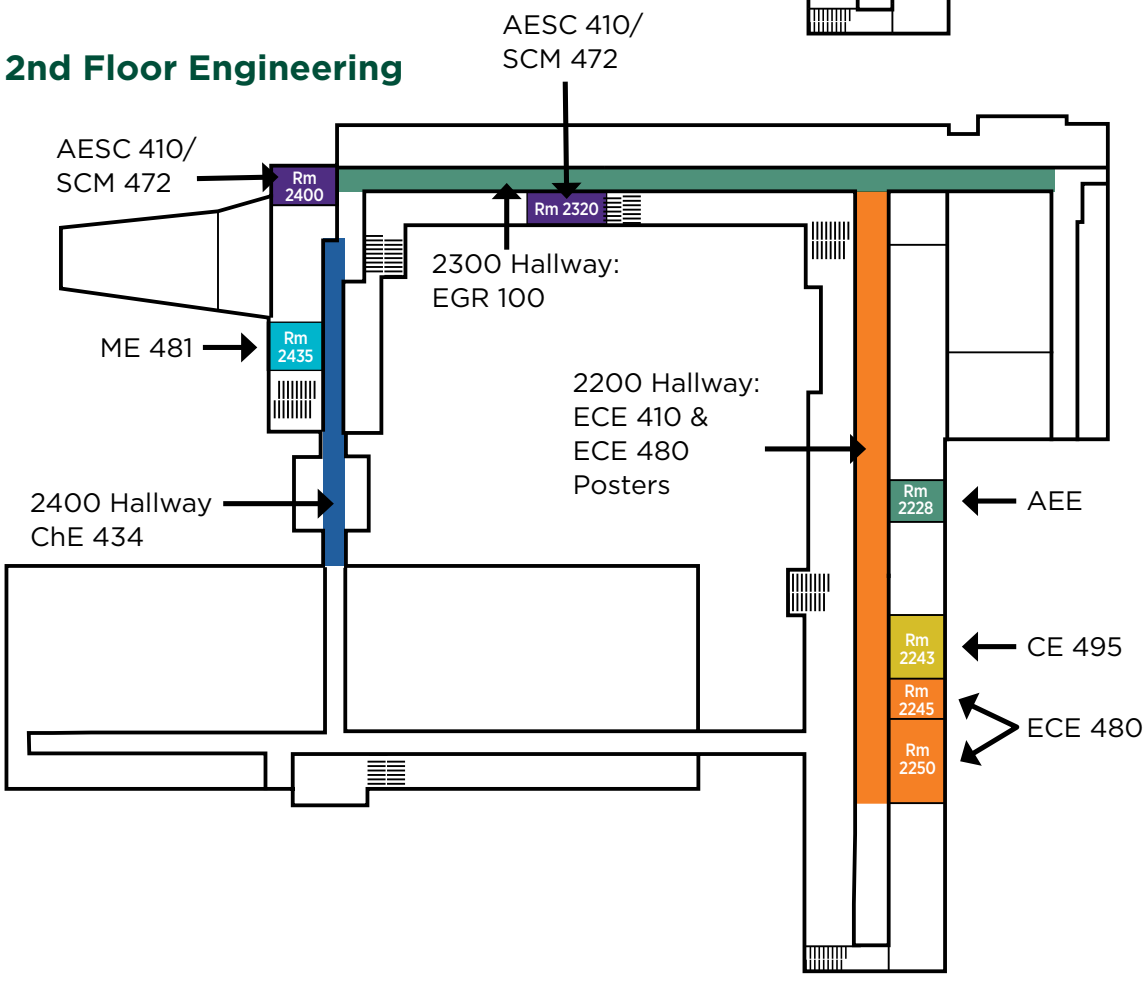
Social Media Links:
"Like" the College: facebook.com/MSUEGRS
"Follow" the College: twitter.com/MSU_EGR

To stay up to date w/Careers in Engineering:
“Like” Us facebook.com/MSUEngineers
“Follow” Us: twitter.com/msuengineers

1st Floor Engineering

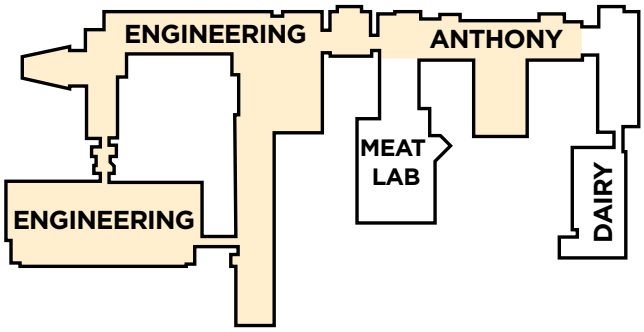


2nd Floor Engineering

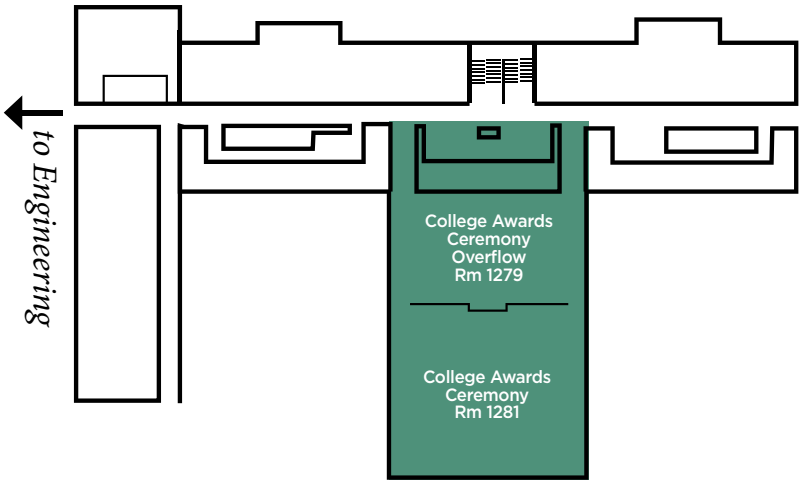


Design Day Floor Plans of the MSU Engineering Building

Overview



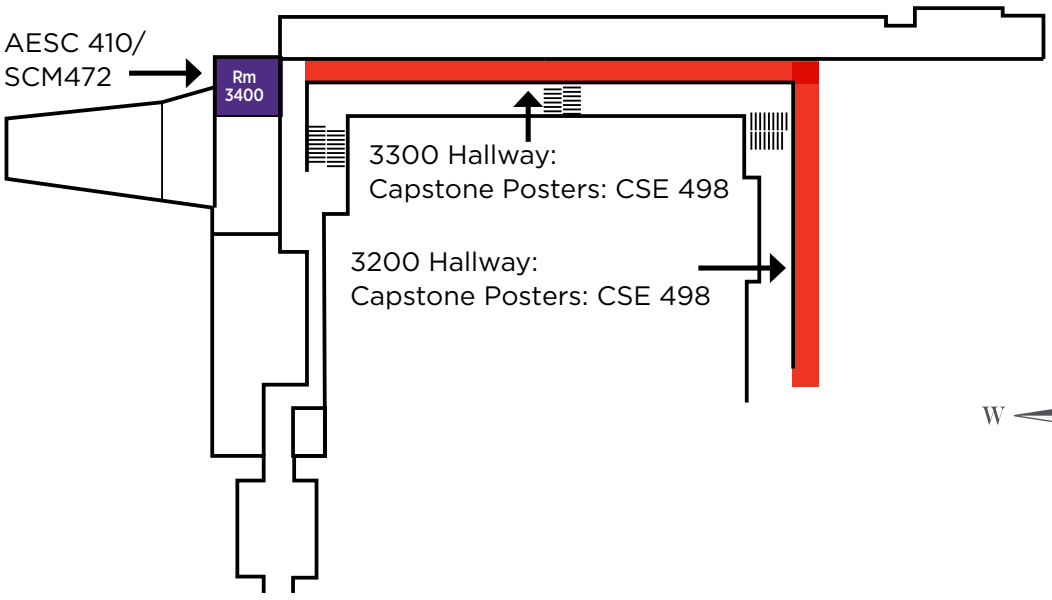
1st Floor Anthony

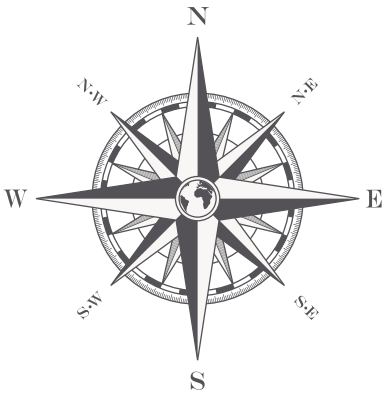


Color Legend:

- AESC/SCM
- CSE
- BE
- ECE
- CE
- ME
- ChE & MSE
- Joint/Other

3rd Floor Engineering





EGR 100 Introduction to Engineering Design

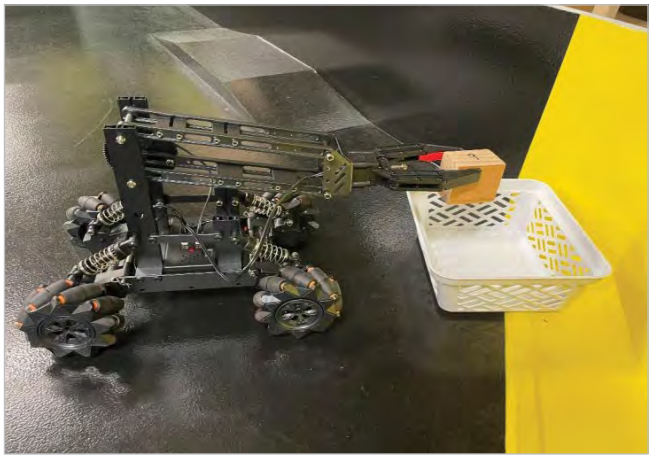
Dr. Jenahvive Morgan
Course Instructor

Course Project

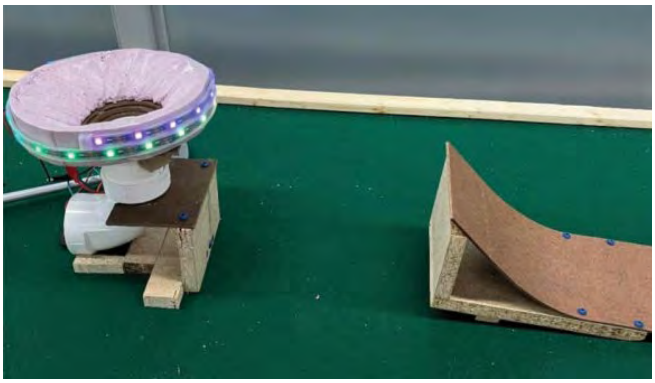
EGR 100, Introduction to Engineering Design, is a college-level course required of all incoming first-year engineering students. It is an integral part of the CoRe (Cornerstone and Residential) Experience. The course introduces students to the engineering profession and the engineering design process through team-based, interdisciplinary design projects and assignments. There are 767 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from seven project types: (i) Create a Phone App, (ii) 3D Printing CAD Drawing, (iii) Design a Mini Solar Car, (iv) Water Filtration System Design, (v) Mini Golf LED Design Project, (vi) Design a Robot, and (vii) CoRe Industry-Sponsored Projects. CoRe Industry-Sponsored Projects involved collaborations with Eli Lilly on Drug Manufacturing Requirements.

Fall 2023 EGR 100 Project Designs



Robot Completing a Challenge: Student Robot Design



Mini Golf LED Project: Student Mini Golf Design

Applied Engineering Sciences

Capstone Course Sponsors

We thank the following sponsors for their generous support of the Applied Engineering Sciences senior capstone course. We gratefully acknowledge the Supply Chain Council for their project support.

Alpine

American Axle & Manufacturing

Applied Materials

Creative Foam

DRiV

Ford Motor Company

John Deere

Kautex Textron

KLA

Microsoft

Munters FoodTech

NASA/ASU

Perrigo

SLB

Trane Technologies

YUNEV

The Capstone Projects

Dr. Laura J. Genik
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Applied Engineering Sciences

Dr. Sri Talluri
Professor of Operations and Supply Chain Management
The Eli Broad Graduate School of Management

Graduate Teaching Assistants

Yashasvi Chauhan
MBA 2024

Grant Freeman
MBA 2025

Alyse Hines
MBA 2024

Mikayla Norton
MS Data Science 2024

Chaitanya Shankaragallu
MBA 2024

Presentation Schedule – 2nd floor Engineering Building, Room 2320

Time	Team Sponsor	Project Title
8:25 a.m.	Perrigo	Machine Vision Test Unit
8:50 a.m.	SLB	Evaluation of Procurement Taxonomy to UNSPSC
9:15 a.m.	SLB	Mastering Material Group Mapping
Break		
9:50 a.m	NASA Psyche Mission - ASU	Post-Launch Public Engagement
10:15 a.m.	NASA Psyche Mission - ASU	Social Media Analysis
10:40 a.m.	NASA Psyche Mission - ASU	Traveling Space Art Exhibit Implementation Planning
11:05 a.m.	NASA Psyche Mission - ASU	Web Game Portal Analysis

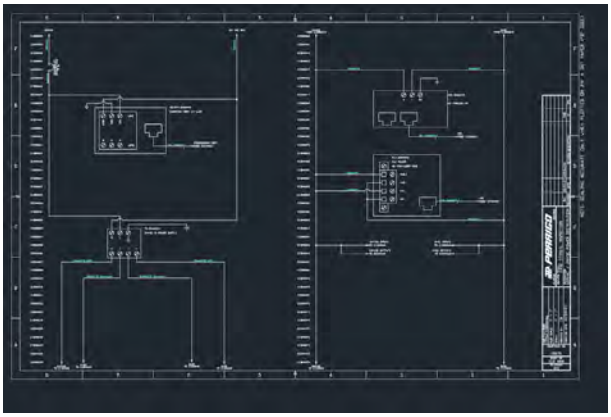
SCM 472 Experimental Learning with Industry Problems in Supply Chain

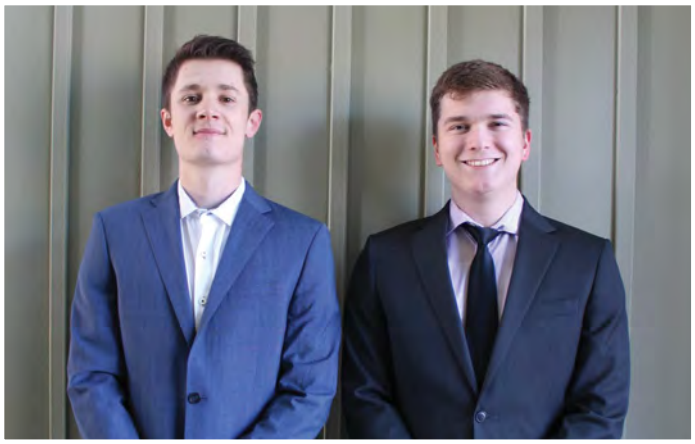
Supply Chain Management seniors in the Broad College of Business have the opportunity to work in a multidisciplinary team with Applied Engineering Students by enrolling in SCM 472 for their capstone experience. This collaborative opportunity has been in place since 2015.

Perrigo
Machine Vision Test Unit

Perrigo is a global pharmaceutical company focused on creating quality and affordable self-care products. Most of these products such as ibuprofen, allergy relief, and cold medication can be purchased in stores. One of the key technologies leading to Perrigo's success is the effective use of machine vision systems. Due to the positive impacts machine vision has on manufacturing, Perrigo requested our team to create a machine vision test unit that would allow for more efficient testing of new vision systems. Prior to the creation of the machine vision test unit, Perrigo manufacturing lines were required to be shut down before testing of new vision systems could occur. These shutdowns are due to the processes that are required to connect new vision systems to the manufacturing lines.

With a portable test unit, Perrigo engineers will be able to connect to the vision systems and have no need to connect to the programmable logic controllers (PLCs) on the manufacturing line, thereby reducing line shutdowns. The test unit will have the capability of connecting directly to the camera or vision system being tested. This unit enables more research leading to major improvements in implementing new vision systems without causing manufacturing line downtime during testing. We have designed and assembled the electrical panel and created a portable assembly that will enable simple transportation of the unit between manufacturing lines. After the design was successfully assembled, we ran tests on the unit to ensure that it is working properly. The test unit will now be used to support the implementation of new vision systems at Perrigo's packaging plant located in Allegan, Michigan.





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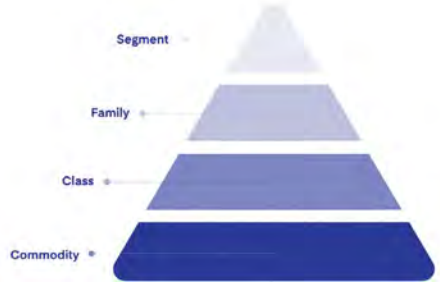
SLB
Evaluation of Procurement Taxonomy to UNSPSC

SLB is one of the world's leading providers of technology for drilling, production and processing to the oil and gas industry. SLB is known for its innovative solutions and services that help the energy industry maximize recovery and efficiency while minimizing environment impact. Efficient handling, analysis, and sharing of extensive and diverse datasets is critical for operational success and innovation at SLB.

SLB currently utilizes their own customized taxonomy for all their resources. While this has worked for most of SLB's resources, SLB has been experiencing problems with their maintenance, repair, and operations (MRO) supplies. This is due to the plethora of MRO materials that exist, which often can be classified differently by company. SLB specifically cited lack of clear communication with their suppliers as a major issue with their current taxonomy alongside analyzing overall spend clarity.

SLB is interested in converting to United Nations Standard Products and Services Code (UNSPSC), which is a universally utilized taxonomy system that uses an 8-digit numeric code to identify all products and services involved with a business and can be used to mitigate the communication issue at SLB. The project will entail looking into how various MRO resources are categorized in this system and helping SLB define the motivation they have for utilizing UNSPSC, also highlighting the pros and cons this system provides.

This project will affect several business functions, including procurement, supplier relations, and purchasing, saving each group valuable time when communicating and analyzing spend for the various MRO categories. This will require comparing the findings from the UNSPSC system to the current approach SLB is utilizing to recommend whether keeping their current system, switching completely to UNSPSC, or adopting a hybrid taxonomy will be most beneficial to providing clarity to the firm.



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Chaitanya Shankaragallu

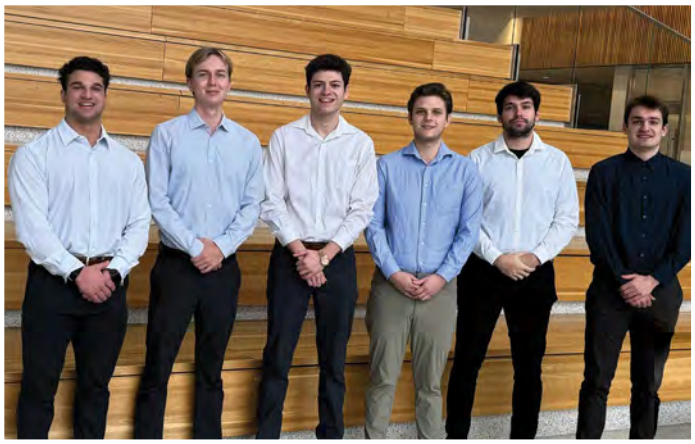
SLB
Mastering Material Group Mapping

SLB is a multinational energy technology corporation that is not only the largest offshore drilling company in the world, but also the largest offshore drilling contractor by revenue. With a goal of creating technology that can unlock energy benefits for everyone around the globe, SLB emphasizes the importance of innovation to assist in their efforts of achieving this organizational-wide mission statement. From oil drilling and production to developing and scaling new energy systems, SLB's vast array of intricate operations highlights the importance of streamlined supply chain processes.

This project revolves around the mastery of material group mapping (simply defined as the categorization of organizational materials based around a standardized set of criteria). Optimizing material group mapping processes will enable increasingly streamlined procurement, more effective inventory management, and overall, more accurate resource planning.

This project's main goal is to take a more in-depth look at SLB's current standardized material group mapping processes to discover a more efficient use for their current systems (which currently revolve around the SAP software). With the main sources of our findings centering around academic literature and organizational case studies, this project will not necessarily rely on metric-based quantification of how efficient processes can impact SLB's systems, but will provide an overall proposal for SLB to improve on incorporating group material mapping into their company's present work structure.

SLB is looking for this project to have a meaningful, research based, supportive conclusion, backed with data analysis from outside sources. Through our analysis of the current material group mapping systems, efficiency in procurement, inventory management, and resource planning will increase.



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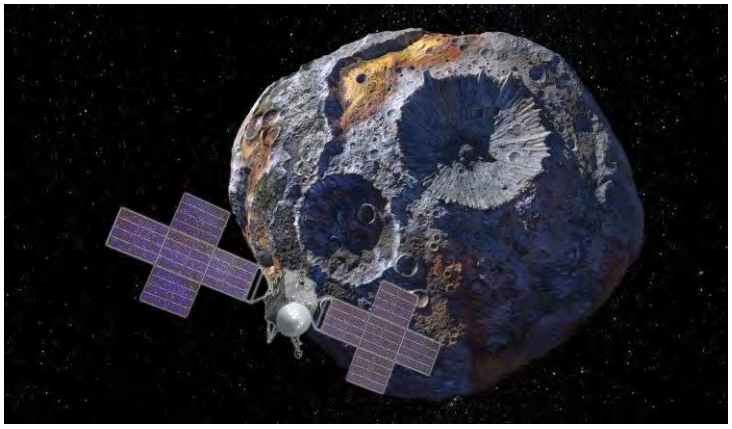
AESC 410/SCM 472 | 9:50 a.m. Engineering Building, Second Floor | Room 2320

NASA Psyche Mission - ASU
Post-Launch Public Engagement



The NASA Psyche Mission is a space exploration endeavor led by Arizona State University aimed at studying the metallic asteroid Psyche. On October 13, 2023, the Psyche spacecraft successfully launched and began its voyage to a unique metal-rich asteroid, orbiting the Sun between Mars and Jupiter. The mission's primary objective is to gain insights into the history of our solar system and the formation of terrestrial planets. Unlike typical rocky or icy asteroids, Psyche is composed primarily of metallic elements, similar to Earth's core. Scientists hope that studying Psyche will provide valuable information about the early solar system and the processes that led to the formation of planets.

The objective of this project is to refine and maximize the efficiency of a 2021 capstone team project. This end-product consisted of a cause-and-effect matrix to help the Psyche Student Collaborations team quantify decision-making about high-impact public engagement efforts in the lead-up to launch.

With the now-successful launch, the Psyche Mission has requested our team to revisit, revise, update, and extend the cause-and-effect matrix to make it relevant for this next phase of the mission: the 5.5-year cruise to the Psyche asteroid. This refined version will take into consideration what activities and opportunities would be appropriate to pursue now that the spacecraft is on its voyage. Additionally, our team will be revisiting the cause-and-effect matrix rating scheme, as well as identifying modern blueprints for increased digital, educational, communal, and limited-edition strategies. We will deliver a final report of our findings with updated criteria definitions, SWOT analyses, and rating systems, among others.

Michigan State University
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NASA Psyche Mission - ASU
Project Sponsor

Cassie Bowman
Tempe, Arizona

Teaching Assistant

Alyse Hines

NASA Psyche Mission - ASU
Social Media Analysis

The NASA Pysche Mission is an exploratory initiative led by NASA and Arizona State University. The mission launched in October 2023 on its journey to the Psyche Asteroid in an attempt to learn more about the unique metal-rich asteroid. The asteroid's metallic makeup is likely to provide information about the history of planet development and formation, including potential insight into how the Earth's core was created.

Arizona State University has created a social media presence surrounding the mission to spread awareness and increase public interest in the mission. Due to mission completion scheduled for 2029, it is important that engagement across all social media platforms is fostered and continued for years to come.

Data will be gathered from the mission's social media platforms (Instagram, Facebook, X, YouTube) and analyzed to provide insight into what factors increase engagement in order to predict and provide suggestions for the future. Analyzing the impact of the Psyche Mission's social media presence before the launch versus current will be a highlight in analysis.

The goals of the social media analysis include: ensuring long-term engagement by understanding the current audience and finding areas to expand audience; creation of a data visualization tool to compare and contrast pre- vs post-launch metrics; and formulation of suggestions relating to content that will increase engagement.

Michigan State University
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Grant Freeman

NASA Psyche Mission - ASU

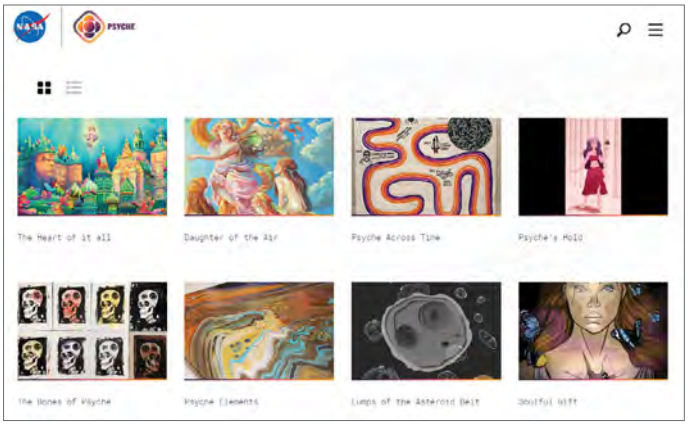
Traveling Space Art Exhibit Implementation Planning

NASA is the United States government agency responsible for the nation's civilian space program and for aeronautics and aerospace research. Its mission encompasses exploration of space, understanding Earth's systems, advancing technology, and inspiring the next generation of scientists and engineers.

NASA's Psyche Mission aims to explore a unique metal asteroid named Psyche, located between Mars and Jupiter. By studying this asteroid, scientists hope to gain insights into the early solar system and the formation of terrestrial planets.

Our team's project aims to enhance the accessibility and reach of artwork inspired by the NASA Psyche Mission. Spearheaded by a collaborative effort between our team, a team from Arizona State University, and NASA Psyche, the initiative revolves around the creation of pre-curated exhibit kits. These kits feature a diverse array of artwork inspired by the mission, ranging from jewelry and sculpture to digital art. The project also entails the development of a sophisticated matching system to pair interested venues with curated kits best suited to their environment, location, and capabilities. By fostering partnerships with various institutions across the U.S., our project is working to facilitate the loaning of these kits, thereby expanding the mission's exposure, and fostering collaboration among artists, educators, and space enthusiasts.

Emphasizing community engagement and educational outreach, the curated exhibits and associated events aim to inspire interest in space exploration, scientific discovery, and artistic expression while forging valuable networks within the broader community. Through meticulous planning and logistical coordination, our project seeks to maximize the impact of the artwork and promote a deeper understanding of the Psyche Mission's goals and achievements.



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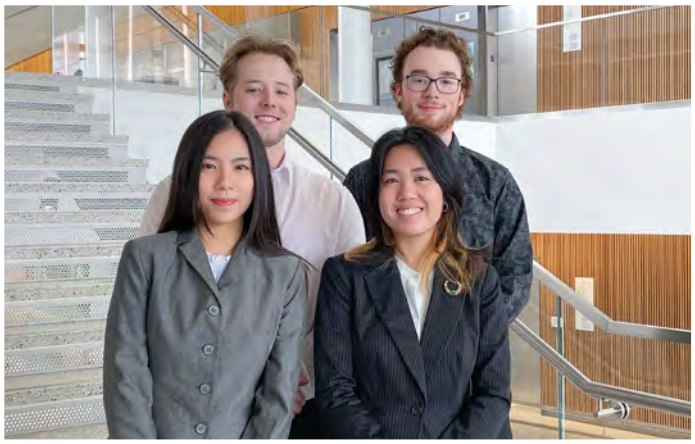
NASA Psyche Mission - ASU
Web Game Portal Analysis

NASA's Psyche Mission launched on October 13, 2023, and is an Arizona State University (ASU)-led initiative. The mission seeks to learn more about the solar system in its earlier stages, especially the core, as it is similar to Earth's core. By studying Psyche's unique metallic makeup, NASA hopes to learn more about how Earth became what it is today.

Our team was tasked with analyzing the portal for web-based game – Mission: Psyche. The web game portal was soft-launched in the summer of 2023, showcasing web-based games developed by Psyche capstone teams nationwide. The portal itself was designed by capstone students from ASU, with over two dozen games to date representing the contributions from the capstone teams.

The goal of this project is to analyze the current state of the web portal and formulate recommendations about the site's functionality, as well as user interface, naming conventions, metadata, game layouts, and feasibility of mobile/VR games. This project aims to help NASA reach new audiences through online games and to further spread the purpose and future of NASA. Our team applied recommendations through A/B testing. By having different website designs tested simultaneously while collecting feedback in the form of reviews, we used the data being tested to determine which site design best suits the demand of current users.



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The Eli Broad Graduate School of Management

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Grant Freeman
MBA 2025

Alyse Hines
MBA 2024

Mikayla Norton
MS Data Science 2024

Chaitanya Shankaragallu
MBA 2024

Presentation Schedule – 2nd floor Engineering Building, Room 2400

Time	Team Sponsor	Project Title
8:00 a.m.	Munters	Product Packing Design Optimization
8:25 a.m.	Kautex Textron	Identifying a Circular Economy for Plastic Composites
8:50 a.m.	Alpine Supply Chain Solutions	Storage Type Analysis and Goods-to-Person Evaluation
9:15 a.m.	American Axle & Manufacturing	Warehouse Mapping, Evaluation and Consolidation
Break		
9:50 a.m.	Ford	Production Vehicle Compliance Fresh Eyes Review
10:15 a.m.	John Deere	Raw Steel Total Landed Cost
10:40 a.m.	Trane	Scrap Metal Circularity
11:05 a.m.	Applied Materials	Leveraging Forecasting/AI in Supply Chain

AESC Engineering Program

Since its inception, the Applied Engineering Sciences program has been successful in attracting students with diverse interests and varied backgrounds. Employers have especially responded positively to the graduates who bring a unique blend of courses and experiences to the workplace. These students are heavily recruited by a wide range of organizations with starting salaries comparable to those of other engineering programs.

Munters FoodTech

Product Packing Design Optimization

Munters is a distinguished global leader in climate solutions, offering processes for industries where precise control over indoor humidity, temperature, and energy efficiency is paramount. With a commitment to environmental sustainability, Munters provides customers with climate control systems designed to optimize energy and water usage, thereby minimizing climate and environmental impacts.

Munters operates within three primary business sectors: AirTech, FoodTech, and Data Center. Within the realm of FoodTech, Munters is renowned as a world-leading supplier of innovative and energy-efficient climate systems tailored for livestock farming and greenhouse cultivation. Additionally, Munters FoodTech offers software solutions crafted to oversee and optimize the entire food production value chain, ensuring efficiency and sustainability at every step.

Currently, the Lansing branch of Munters FoodTech faces challenges with the packaging of their Atlas Fan. Their current method involves the use of expensive materials and complex assembly. This not only increases labor hours and production costs, but also diminishes warehouse capacity, and limits potential revenue streams. Furthermore, the packaging consists entirely of lumber, which contradicts Munters' sustainability objectives.

Our team has developed a packaging solution that decreases labor hours, increases the use of sustainable materials, and increases packaging cost savings, as Munters self-finances the packaging for their fans.

Implementing this solution has the potential to reduce Munters' packaging carbon footprint. Moreover, given the similarity in shape between the Atlas Fan and other fan designs, there is an opportunity to develop a scalable packaging design. This approach would decrease labor hours not only for one fan, but for all models.

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Kautex Textron

Identifying a Circular Economy for Plastic Composites

Founded in 1935, Kautex Textron is known worldwide as being a pioneer in polymer processing. Today, they are one of the top automotive suppliers to Original Equipment Manufacturers (OEMs) across the globe, manufacturing battery systems, plastic fuel systems, as well as industrial packaging.

This project is centered around identifying a circular economy for plastic composites with the goal of Kautex Textron's research being to repurpose scrap or end-of-life composite material to eliminate landfill waste. With the increasing demand for a circular economy that strives to heighten the plastic recycling ratios, Kautex Textron has aimed to create a positive cash flow from the repurposed material, while staying on track to reach their goal of becoming net zero by 2050.

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A Textron Company

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Alpine Supply Chain Solutions

Storage Type Analysis and Goods-to-Person Evaluation

Alpine Supply Chain Solutions, a consulting firm focusing on operational improvement, has asked our team to perform a storage type analysis and conduct a high-level Return On Investment (ROI) analysis for the respective client, Abt Electronics. Abt is a one-stop-shop for appliances, furniture, and electronics. Abt is consulting with Alpine, and our team, to better utilize a picking and packing warehouse. Expecting renovations, Abt wants to know the best options to increase ROI, among other selected performance measures.

Our team will be uncovering multiple statistics in over a year's worth of data provided by Abt. This includes the data cleansing of nearly ten-thousand individual SKU entries to find both the busiest times of year and ideal measurements of rows (among other factors). With this new information, the OptiSlot program will be used in accordance with the newfound data to run possible iterations for Abt. This will help find Abt's ideal size and quantity of the pick and reserve storages within the warehouse. Finally, Abt is interested in automation, so multiple means of automated alternatives will be evaluated.

In doing this, Abt will be presented with several data-backed methods of how to better utilize an 80,000 sq. ft. section of a picking and packing warehouse. Abt will be shown the optimal layout for rearranging the warehouse space and will be presented with accompanying ROI changes. This will also include time estimates of just how long it will take to get an order through the new and better-utilized picking and packing warehouse. Finally, methods of automation will be analyzed, and these will be presented similarly.

The end result will be a presentation with recommendations for Abt's next moves. Based on the ROI and operation speeds of choice, Abt will soundly be able to choose their method of renovation.

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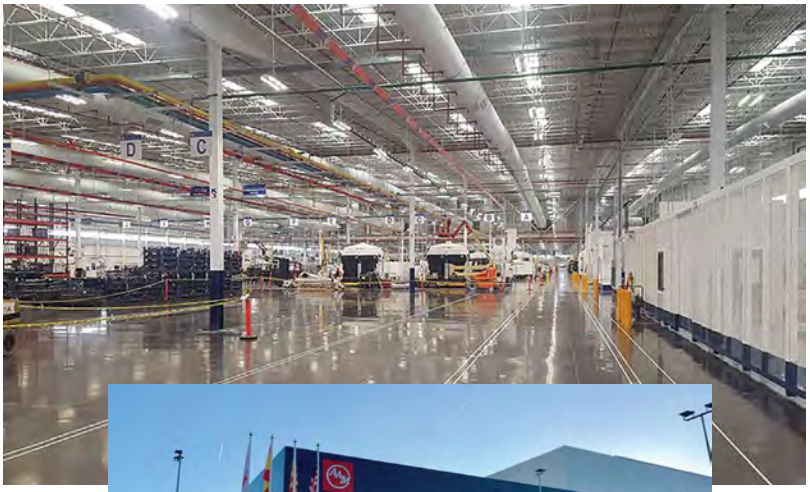
AESC 410/SCM 472 | 9:15 a.m. Engineering Building, Second Floor | Room 2400

American Axle & Manufacturing
Warehouse Mapping, Evaluation and Consolidation

American Axle & Manufacturing (AAM) is a fast-growing Tier-1 automotive supplier that has 80 warehouses operating globally, with 29 located in North America. AAM serves a broad customer base, specializing in multiple products and technologies through the Driveline and Metal Forming divisions.

In recent years, AAM has acquired other corporations/warehouses to strengthen the company. These warehouses include many products and services such as Gear Development, Benchmarking, Prototype Build, and much more. The warehouses and operations vary from the different acquired companies, so it is difficult to see how each warehouse is utilized. The expansion of AAM created a mass amount of information in multiple Enterprise Resource Planning systems that is difficult to manage. With information being scattered, AAM does not know where resources are being allocated on a corporate scale.

The focused goal of this warehouse consolidation project is to cut global warehouse expenses for the sponsor by potentially consolidating warehouses and optimizing operational costs in all North America. The team is also looking to improve the transparency of warehouses by analyzing the intended function of each warehouse and assessing possible capacity and services. Through those goals, the team is hoping to improve sustainability and reduce transportation costs by evaluating warehouse locations and current transportation routes, potentially reducing necessary transportation between the warehouses and other facilities.



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Ford Motor Company

Production Vehicle Compliance Fresh Eyes Review

Ford is in need of a modernization of its current process of conducting compliance audits on production vehicles. The current process is called the "Fresh Eyes Review" and it does not satisfy the needs of the company in terms of efficiency and organization. This model is a lengthy Excel spreadsheet that serves as a checklist for an employee to thoroughly go through. The user may spend multiple hours on just one vehicle, which is not efficient, and is why this transition will help that. Ford is seeking guidance to revamp the "Fresh Eyes Review" tool and ensure that it will stay in tune with their vision of services, experiences, and software.

Our team will be creating a Microsoft based app to provide a clear overview of what is expected in each audit. The current auditing system is in Excel and is difficult to use since it is very tedious and often confusing to Ford employees. The transition will be very important in enhancing what is already offered. This app will display pictures of the certain deliverables that are needed for each audit to better understand what is exactly being reviewed. There will also be images to show good and bad outcomes of each audit so that the user can clearly see what meets passing standards. Links will be attached to each audit to provide information for users of what and why this specific area is being audited. Organization and accessibility are priorities for Ford, and this app will store the results and data in an organized manner so that they are easy to access and read by any user at any given time. The goal of this app is to give a simple and clear process that will allow less of a disconnect between the audit and the user with an organized app.

The current system takes longer because of the uncertainties with part checks and if something passes or fails. By making a new and improved "Fresh Eyes Review" tool, vehicles will be able to be audited faster, allowing more vehicles to be audited within a certain amount of time.

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John Deere
Raw Steel Total Landed Cost

John Deere stands at the forefront of the global agricultural machinery and heavy equipment industry, renowned for its production of diesel engines, heavy-duty drivetrains, and lawn care equipment. Operating in sectors where precision and reliability are paramount, the company relies heavily on steel, particularly rolled steel sheets, to craft its machinery and equipment.

For John Deere, strategic decisions regarding steel procurement hinge upon various critical factors, including the volatile nature of steel prices in the market, logistical considerations such as shipping distances, the steel adder price, and the sustainability practices of potential suppliers, particularly concerning their greenhouse gas emissions.

The objective of this project is to develop a sophisticated tool tailored to optimize John Deere's annual steel procurement strategy on a per-mill basis. By leveraging data-driven insights and advanced analytics, this tool aims to enhance profit margins and operational efficiency. Ultimately, it is poised to generate substantial cost savings, thereby bolstering bottom-line revenue returns for the company.

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Trane Technologies
Scrap Metal Circularity

Trane Technologies is a global leader in manufacturing HVAC and refrigeration systems, with their headquarters based in Davidson, North Carolina. Trane is focused on efficient and sustainable climate solutions for buildings, homes, and transportation, and has set sustainability goals that are centralized on reducing emissions in their products and operations. As part of these 2030 objectives, they have an increased focus on circularity, specifically their scrap metal, and believe that there is an opportunity to apply circularity principles/closed-loop recycling to these materials.

Currently, Trane Technologies buys parts made of steel, aluminum, and copper, and those parts generate over 50 million pounds of scrap metal per year in North America. That scrap metal is then sold to scrap metal vendors. But after the scrap metal is sold to these vendors, Trane does not know what happens to the recycled material after it has been processed in the scrap metal mills.

Our project is focused on determining where these recycled materials end up after processing, how Trane can improve their current scrap metal processes, and the potential environmental benefits of returning the scrap metal to their original manufacturers to be incorporated into the products that they purchase. Trane aims to leverage the insights gained from this project, centered on their Southeast region, across all manufacturing plants to identify cost-saving opportunities.

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Applied Materials

Leveraging Forecasting/AI in Supply Chain

Applied Materials is a global leader in materials engineering solutions founded in 1967. Based in Santa Clara, California, the company provides equipment, services, and software to enable the manufacturing of advanced semiconductor chips, flat panel displays, and solar photovoltaic products. The company is committed to creating innovative technologies to help with the creation of advanced processes and manufacturing systems, along with advancing customers' technology roadmaps while maintaining sustainability.

Prior to the project launch, Applied Materials had limited forecasting capabilities regarding Non-Standard Orders (NSOs), which are irregular purchase orders that arrive with little notice. The complexity of the orders varied significantly as the requests can be anything from a singular part to a full assembly. Because NSOs are ordered without much advance notice and are customizable, Applied Materials was looking for a better way to forecast these order types, so that the company could better prepare and allocate materials to its customers.

To achieve success in this project, our team worked to analyze different forecasting methods to formulate a solution that led to increased visibility and planning to coordinate the production of consumer products in a timely and efficient manner regarding NSOs. Through enhanced NSO tracking and forecasting, the project created opportunities for increased visibility and preparation for NSOs, promoting more seamless operations and lowered supply chain uncertainty. By creating a forecasting model specifically for projecting future NSOs, the project improved Applied Materials' ability to adapt to the shifting global landscape by increasing efficiency in supply chain management and the adaptability of the global supply chain network.

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Presentation Schedule – 3rd floor Engineering Building, Room 3400

Time	Team Sponsor	Project Title
8:00 a.m.	DRiV	Artificial Intelligence and Machine Learning Solutions for Global Purchasing
8:25 a.m.	Creative Foam	Capacity Planning
8:50 a.m.	Creative Foam	Value Stream Mapping
9:15 a.m.	YUNEV	Battery Cell Strategic Sourcing Database for the E-Mobility Market
Break		
9:50 a.m.	KLA	Machine Learning Sales Forecasting Model
10:15 a.m.	KLA	Procurement Automation Sourcing Recommendation
10:40 a.m.	KLA	Global Logistics Environment Modeling
11:05 a.m.	Microsoft	Cloud IT Hardware Sustainability: Reusable Packaging Solutions

AESC 410 Capstone Course

Senior Capstone Project

The culmination of course work in engineering and business, the Capstone course for Applied Engineering Sciences focuses on a semester-long project from a sponsor (industry or non-profit) typically at the confluence of modern business operations and engineering or technical issues. The course is interdisciplinary with Supply Chain Management.

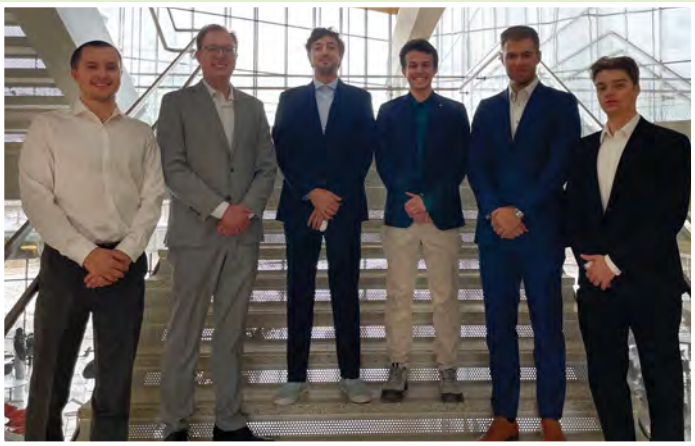
DRiV

Artificial Intelligence and Machine Learning Solutions for Global Purchasing

Tenneco incorporates more than 30 of the automotive industry's widely known brands. Its four business groups include Performance Solutions, DRiV, Clean Air and Powertrain. DRiV is responsible for Tenneco's aftermarket product solutions group. Their goal is to help people get the most out of every vehicle.

The DRiV capstone project revolves around integrating artificial intelligence (AI) and machine learning tools to enhance human purchasing decisions within the company's framework. DRiV, a forward-thinking enterprise, recognizes the potential of leveraging advanced technologies to streamline and optimize its purchasing processes. By implementing AI algorithms and machine learning models, DRiV will analyze vast amounts of data and redefine their decision-making process. The tools offer opportunities to identify cost-saving opportunities, predict future demand, mitigate supply chain risks, and improve overall efficiency in global purchasing operations. Through the integration of AI and machine learning, DRiV empowers its purchasing professionals with data-driven decision-making capabilities, ultimately driving competitive advantage and sustained growth in the dynamic marketplace, while reducing manual human efforts and enabling their team to devote more time to clients and customers. The team's overarching goal for this project was to find an AI software that will maximize the efficiency of the purchasing process for car parts across the board.

Based on the needs and benchmarks, we ultimately picked the best option to help DRiV with their purchasing decisions. DRiV will use these software capabilities to power purchasing decisions for the after-market. Our team created a report on the top choice, highlighting all the productive features and why it is the best fit for DRiV.



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Creative Foam Corporation
Capacity Planning

Creative Foam has been around since 1969 as a manufacturer and supplier. They offer engineering, design, tooling, and shipping services, all being done in-house. Creative Foam is integrated into multiple markets, transportation, industrial, and healthcare. Some of the services supplied are compression molding, vacuum forming, die cutting, lamination, and other industry needs. One of Creative Foam's key principles is being sustainable and reducing environmental impact by using environmentally friendly materials and practices. To better serve their customers Creative Foam would like to improve equipment utilization.

Capacity planning involves evaluating and optimizing the current utilization of equipment, material, and personnel to ensure efficiency. This process has drastically changed through the years, and it has adapted to new and emerging technologies. Due to the advancements of real-time data analyses, globalization, and supply chain management, capacity utilization has grown more important to manufacturing facilities worldwide.

This project will be focusing on capacity planning for two Creative Foam production plants. The scope of this project is to improve equipment utilization from open/available capacity by creating a tool/reporting dashboard for the leadership team related to equipment capacity, while maintaining Creative Foam's reputation for responsiveness and creating multiple solutions. The tool/reporting dashboard will allow Creative Foam leadership to use and help make their equipment capacity more efficient. With successful implementation of the dashboard on both analyzed plants, Creative Foam will expand to all other facilities, ensuring a standardized and effective approach across the entire organization.

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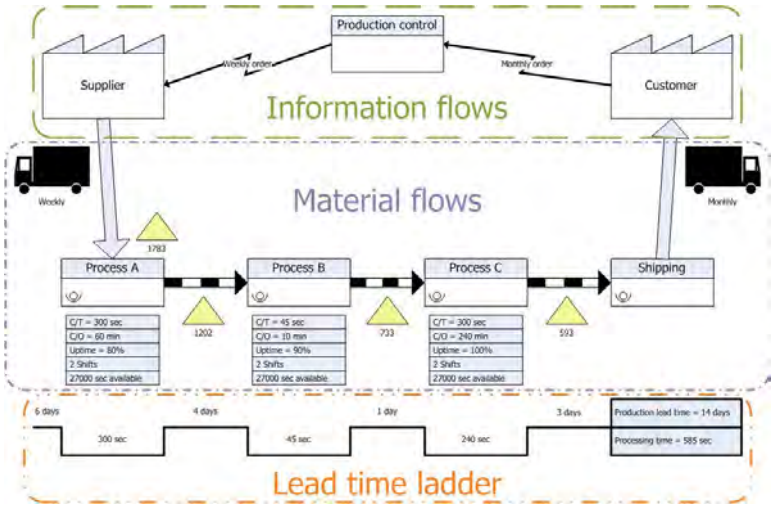
Creative Foam Corporation
Value Stream Mapping

Creative Foam, a leading foam fabricator with 50+ years of experience based in Fenton, Michigan, specializes in custom foam solutions for automotive, medical, packaging, and consumer goods industries. Their expertise includes polyurethane, polyethylene, and expanded polystyrene (EPS) foam materials. With locations across the U.S. and Mexico, they offer advanced engineering and fabrication capabilities, such as CNC routing, waterjet cutting, die cutting, and custom foam molding.

Collaborating with our team, Creative Foam is undergoing a transformative project to optimize their Engineering and Design (E&D) facility's value stream. The initiative involves assessing current processes, envisioning future states, and implementing efficiency measures for enhanced competitiveness. The project includes Kaizen event training sessions, focusing on lean methodologies and cost-efficient process development.

Our team conducts in-depth process analysis, identifies improvement opportunities, and collaborates with Creative Foam to develop a future state vision using data-driven decision-making and stakeholder feedback. A key component is the creation of a Value Stream Map (VSM) for the E&D Design and Production Tooling Facility, utilizing the Kaizen Event Process. This visual representation helps identify inefficiencies and optimize processes for tangible results.

Through ongoing monitoring and evaluation, the collaboration aims to empower Creative Foam to achieve operational excellence and transform its facility into a production powerhouse for long-term success in the foam and plastics industry.



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YUNEV

Battery Cell Strategic Sourcing Database for the E-Mobility Market

Founded in 2014, YUNEV is a venture development firm focused on building better battery supply chains. Currently, lower volume Original Equipment Manufacturers (OEMs) find it difficult to source necessary batteries as larger volume companies are served first and a lack of visibility within the industry with regards to critical battery cell availability and information makes the whole process difficult. This project is to assist YUNEV in offering a solution to the industry-wide lack of visibility in relation to information and sourcing of battery cells for these lower volume OEMs with the hope of accelerating the electrification of the mobility industry. Furthermore, this database aims to become a source that a wide variety of professionals can use to source and compare batteries.

The first aspect that was investigated was the quality of information currently in the database by checking existing specs with the information found in their sources' websites. After collecting the error rates, the team discussed possible solutions that would reduce error from future inputs. Furthermore, our team investigated possible ways to optimize and structure the database using the current program that the database resides in, along with other possible programs. After a multitude of options were discussed, the most optimal structure based on findings was recommended.

Another area under investigation was the design of a secure interface to enable the sharing of YUNEV's proprietary data with external industry partners. This data interface needed to be able to electronically query and extract data in a secure, efficient, and error-free manner. The last of the objectives was in the sector of commercial data exchange with cell suppliers where we devised possible forms of communication with YUNEV's partners. This aspect of the project hopes to maintain accuracy of the database and keep it up to date with consistent checks for years to come.

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KLA
Machine Learning Sales Forecasting Model

KLA is a manufacturer and service provider for capital equipment for the semiconductor industry. The company specializes in the process control and yield management aspects of microchip manufacturing.

The semiconductor industry has become essential to many industries and geographies and is expected to grow and change in ways that are beneficial to KLA. Until 2016, the majority of growth for semiconductors was led by advances in PCs and mobile phones, and then in 2020 by the explosion of data and analytics. Semiconductor revenue is expected to double and to exceed one trillion dollars by 2030.

This growth and diversification serve as an opportunity for KLA, but also presents a challenge. Understanding the demand for process control and yield management equipment, which configurations will be needed, and how to enter the market at the right time, are some of the things that KLA needs to consider. Therefore, precise sales forecasting is a top priority for KLA.

To help KLA maintain success in the semiconductor industry and anticipate their future sales, our team was given the task of finding external factors to predict future demand by using publicly sourced information. The scope of the project is to understand the external factors and leverage them along with selective internal data to create a machine learning model capable of predicting sales.

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KLA
Procurement Automation Sourcing Recommendation

KLA Corporation, headquartered in California, stands as a frontrunner in the field of integrated circuits, semiconductors, and nanoelectronics. Driven by a mission to propel human progress through technological innovation, KLA has amassed a workforce of over 14,000 individuals spread across 19 countries, united in their commitment to revolutionize solutions that positively impact lives globally.

Given the ever-evolving nature of KLA's dynamic industry landscape, their indirect procurement team asked us to help optimize their procurement processes. Presently, a significant portion of the team's resources is dedicated to managing tail spend, an area ready for efficiency improvements through automation. By automating these processes, we aim to liberate valuable time for employees to concentrate on strategic capital expenditures.

The ultimate objective of this project is to develop an evaluative matrix for potential software replacements. This matrix will be created by finding key factors and assessing them against the performance metrics that gauge user success. Our recommendation will pinpoint the software solution best suited for integration into KLA's indirect procurement operations, aligning closely with their organizational goals and objectives.

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KLA
Global Logistics Environment Modeling

KLA is a global technology leader that develops equipment and services that enable innovation throughout the electronics industry. KLA's business spans across different industries, including automotive, chip manufacturing, artificial intelligence, and many more. Focusing on cost savings, KLA has established a need for a transportation management system (TMS) that will further help not only manage transportation of goods throughout the business but will also better analyze company spend on logistics on a regular basis.

In KLA's logistics department, the goal for this TMS is to predict market behavior, consolidate processes for stakeholders to use across manufacturing, and enable access to all shipment details on a single platform. This system will also be able to eliminate the need for third-party reporting, better assisting KLA to meet their needs. Our team also strives to optimize costs for KLA through the implementation of this system by streamlining demand planning and improving accuracy.

To help KLA address this business need, our team has been tasked with finding a TMS application suitable to meet the business requirements. Through initial research, our team has been able to identify top TMS applications used in the market today, as well as their key capabilities. Further analysis on the current state of KLA logistics, through data provided by KLA as well as meetings with key stakeholders, will provide a greater understanding of KLA's need for a TMS. This will enable an appropriate TMS to be selected and recommended by our team for implementation into KLA. After recommending the appropriate TMS, KLA will be able to facilitate all information on the single platform and create automated reports from the consolidated source.

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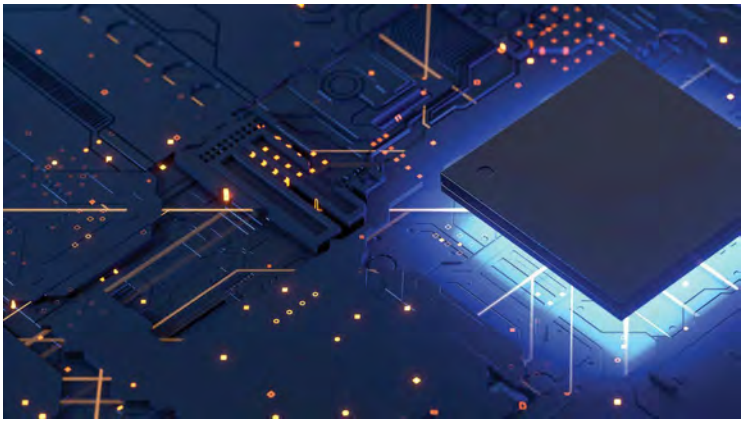
Microsoft

Cloud IT Hardware Sustainability: Reusable Packaging Solutions

Microsoft Corporation is a leading developer of computer software, operating systems, cloud computing, and artificial intelligence applications, dedicated to driving sustainability within its operations. Guided by the mission to empower every person and organization to achieve more, Microsoft has set forth ambitious sustainable packaging goals. These goals include packaging to have a minimum of 50% recycled content along with 100% of all packaging to be reusable, recyclable, or compostable. Additionally, Microsoft is aiming to eliminate single-use plastics within all cloud packaging in datacenters and reduce packaging weight by a minimum of 10% from the December 2020 baseline.

This project focuses on developing a sustainable packaging solution for the company's cloud infrastructure hardware. It targets the reduction of single-use plastics in Microsoft's supply chain, particularly focusing on replacing electrostatic discharge (ESD) bags used for hardware component packaging. Conducting thorough research will enable the exploration of alternative materials that better align with Microsoft's sustainability objectives. The approach involves evaluating the sustainability, feasibility, protection, and cost-effectiveness of various materials to identify the most suitable alternative to ESD bags. The analysis will be supported by a metrics system resembling a supplier scorecard, ensuring a robust assessment of each option. The end goal is to provide a sustainable packaging solution that contributes to Microsoft's broader sustainability goals and drives positive environmental impact.



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Bellevue, Washington

Teaching Assistant

Yashasvi Chauhan

AESC 410 Awards 2023

As punter for Michigan State University's football team, Mike Sadler was well known for giving his team a competitive edge by flipping the field with perfect punts that pinned the opponents back near their own end zone.

In addition to being well known as an outstanding punter, Mike was also well known for being an outstanding scholar, exemplifying what it means to be a true student-athlete. Mike was the first football player in Spartan history to earn Academic All-America honors four times. He was a two-time first-team Academic All-American, a National Football Foundation Scholar-Athlete, and a William V. Campbell trophy finalist.

Mike completed an undergraduate degree in Applied Engineering Sciences in just three years and then went on to earn a master's degree in Public Policy. After graduating from MSU in 2015, he was excited to begin Stanford Law School.

The Mike Sadler Competitive Edge Award is presented annually to the Applied Engineering Sciences capstone team that strives to achieve the highest possible outcome in order to attain the next level of success. The winning project is considered to have "flipped the field" with an innovative and creative solution that results in a competitive edge that not only solves the problem but distances itself from the competition.

"I am very proud to call myself an Applied Engineering Sciences alumnus. The program has fostered within me maturity, discipline, leadership, and a worldy sense of systems thinking."

- Mike Sadler

The AESC 2023 Mike Sadler Competitive Edge Award

Team Trane "Sustainability Reporting and Carbon Reduction Opportunities in Transportation"

Left to right: Riley Brownell, Madison Hall, Brandon Barrows, Audrey Ratliff, Anna Brandl, Joe Keller
Presented by: Karen Sadler and Jim Cotter

The AESC 2023 Most Impactful Award

Team American Axle & Manufacturing "TRMF – Forklift Free Facility"

Left to right: Haitau Yang, Leah Flores-Cabrera, Andy Park (SCM), Vivian Tran (SCM), Ryan Morgott, Paige Van De Grift (SCM)

The AESC 2023 Most Sustainable Award

Team Alpine SC Solutions "Guhring – Storage Type Analysis & Goods-to-Person Evaluation"

Left to right: Mario Kezi, Claire Szwabowski (SCM), Logan Kerry, Justin Tiburcio, DJ Akkala (SCM), Kareena Boyina (SCM)

Dr. Sanghyup Jeong, PE
Assist. Professor of Biosystems & Agricultural Engineering

Dr. Luke Reese
Assoc. Professor of Biosystems & Agricultural Engineering

About the Program

Graduates of the MSU Biosystems Engineering (BE) Undergraduate Program are expected to succeed in diverse careers where they integrate and apply principles of engineering and biology to a wide variety of globally important problems. MSU Biosystems Engineering graduates are expected to attain that success by:

- identifying and solving problems at the interface of biology and engineering, using modern engineering techniques and the systems approach,
- analyzing, designing, and controlling components, systems, and processes that involve critical biological components,
- demonstrating a professional foundation that includes vision, adaptability, creativity, a practical mindset, effective communication skills, continuing professional growth, and ethical conduct, and
- working inclusively and equitably in diverse, cross-disciplinary environments towards sustainable solutions.

BE 485 / BE 487 Courses

Biosystems Engineering student teams, enrolled in the two-semester biosystems design capstone experience, BE 485/487, develop, evaluate, and select design alternatives to solve real-world problems. Projects are diverse, but each reflects systems thinking by integrating interconnected issues affecting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. Teams present project designs to engineering faculty and a review panel of professional engineers for evaluation. Each BE 485/487 capstone design team prepares and presents a design solution in report, poster, and oral formats to industry, faculty, peers, and the public that:

- Requires engineering design
- Combines biology and engineering
- Solves a real problem
- Uses a holistic approach
- Interprets data
- Evaluates economic feasibility

2023/24 Projects

Full descriptions and project posters are at:
canr.msu.edu/bae/senior-design-2024
Public presentations at 116 Farrall Hall on April 19, 2024, 1 pm
or msu.zoom.us/j/96536868510

A Networked Geothermal Energy System for Residential and Industrial Consumption: Design and Analysis

Consumers Energy (project under Non-Disclosure Agreement)
Team Consumers Energy: Ryan Heileman, Andrew Hovey, Guy Sloan, & Liliana Valkner
Faculty Advisor: Dr. Chris Saffron

Ford Cove Shoreline Stabilization and Restoration

GEI Consultants
Team GEI: Ben Adams, Megan Kline, Jack Kujawski, & Zach Ostoin
Faculty Advisor: Dr. Pouyan Nejadhashemi

Process Modeling for a Wastewater Treatment Plant

Glanbia (project under Non-Disclosure Agreement)
Team S.L.U.D.G.E: Skyler Benczarski, Arthur Devota, Nicole Lambert, & Carter Monson
Faculty Advisor: Dr. Wei Liao, PE

Excess Brine Reduction in Continuous Corned Beef Production

E. W. Grobbel (project under Non-Disclosure Agreement)
Team Grobbel: Josephine Dukaj, Victoria Loomis, Sydney Richter, & Bilal Sabri
Faculty Advisor: Dr. Kirk Dolan

Ergonomic Sampling Tool to Obtain Bulk Feed Samples Safely

Michigan Department of Agriculture and Rural Development
Team MDARD: Erynn Brantley-Ridgeway, Vianney Medina-Gonzalez, Nathan Schrier, & Jordan Sheely
Faculty Advisors: Dr. Daniel Uyeh & Dr. Tim Harrigan

In Vitro Growth Chamber for Imported Chestnut Tissue

Nash Nurseries
Team Chestnut Crew: Braden Heimbaugh, Syd Jacobi, Christian Loveall, & Sydney Thompson
Faculty Advisors: Dr. Yuzhen Lu & Dr. Dan Guyer

Medical Device Irrigation System Innovations

Stryker (project under Non-Disclosure Agreement)
Team Stryker: Lillian Bieszke, Emily Buijink, Kaily Kao, & Xheneta Vitija
Faculty Advisor: Dr. Ilce Medina Meza

Curd Feed Rate Optimization for Improved Cheese Consistency and Operational Efficiency

Tillamook (project under Non-Disclosure Agreement)
Team Cheddar Masters: Matthew DeMartini, MeiLi Papa, Alexis Sawicki, & Jensen Tumas
Faculty Advisors: Dr. Jiyoon Yi and Dr. Bahar Aliakbarian

Industry Advisory Board

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

Board

Janelle Barnes - Target
Ellen Bornhorst, PhD - PepsiCo
Holly Bowers - Consumers Energy
Jessica Bruin - Kellanova
Lisa Buchholz - Corteva Agriscience
Matt Burtt - AbbVie
Shelley Crawford - Jiffy
Michelle Crook, PE - MDNR
Linnea Crowley (Riddell) - Kellanova
Laura Doud, PE (Chair) - MDARD
Cassaundra Edwards - Tillamook Creamery
Gene Ford - Standard Process
Jeremy Hoeh, PE - EGLE
Eric Iversen, PE - PEA Group
Kevin Kowalk, PE - EA Engineering, Science, and Technology (MI) PLC
Mitch Miller - General Mills-Yoplait
Amber Mostiller - E. W. Grobbel
Steve Radke - John Bean Technologies (JBT) Food Tech
Rob Yoder - BDI, Inc.
Dave Young - Perrigo

Board (Ex-officio)

Todd Forbush - Techmark, Inc. (ASABE MI Section)

BE Showcase Evaluations & Public Presentations

BAE 2022_23 Industry Advisory Board Meeting & Evaluators

BE Showcase 2023, see www.canr.msu.edu/bae/senior-design-2023

If you are interested in sponsoring a BE 485/487 capstone project for the 2024_25 Senior Design teams, please contact Dr. Sanghyup Jeong at jeongsa1@msu.edu or Dr. Luke Reese at reesel@msu.edu.

The Capstone Projects

Dr. Anthony Ingle
Teaching Specialist

Faculty Advisors: Professors Haider, Ingle, Kumar, Kutay, Li, Masten, Zockaie


Haider


Ingle


Kumar


Kutay


Li


Masten


Zockaie

Presentation Schedule Room 1225

Time	Team	Room 1225
8:00 a.m.	Team 3-Straits & Company	First Floor Room 1225
9:20 a.m.	Team 4-Horizon Engineers	First Floor Room 1225
10:40 a.m.	Team 5-Prestige Engineering	First Floor Room 1225

Presentation Schedule Room 1230

Time	Team	Room 1230
9:20 a.m.	Team 1-Red Cedar Engineering Group	First Floor Room 1230
10:40 a.m.	Team 2-East Lansing Engineering	First Floor Room 1230

Presentation Schedule Room 1234

Time	Team	Room 1234
8:00 a.m.	Team 9-Spartan Solutions	First Floor Room 1234
9:20 a.m.	Team 10-Midwest Momentum	First Floor Room 1234

Presentation Schedule Room 2243

Time	Team	Room 2243
8:00 a.m.	Team 6-Spartan Associates	Second Floor Room 2243
9:20 a.m.	Team 7-Precision Construction Company	Second Floor Room 2243
10:40 a.m.	Team 8-Engineers4Everyone	Second Floor Room 2243

CE 495 Senior Design in Civil & Environmental Engineering

Undergraduates in civil and environmental engineering must take CE 495. This capstone course prepares students for the workplace by providing an experience with the following challenges:

- A project with multiple issues that must be resolved using civil and environmental engineering knowledge;
- Formulation of conceptual solutions and resolution of conflicting design elements;
- Development of plans that comply with regulations and provide a basis for cost estimates;
- Balancing individual responsibility and group participation in a team based effort;
- Preparation of written reports and oral presentations.

Each team is responsible for developing a design that addresses environmental, hydrological, pavement, structural, and transportation issues for the project. A student project manager coordinates each team. Design reports are judged by the faculty; progress reports and the oral presentations are judged by a board of practicing professionals.

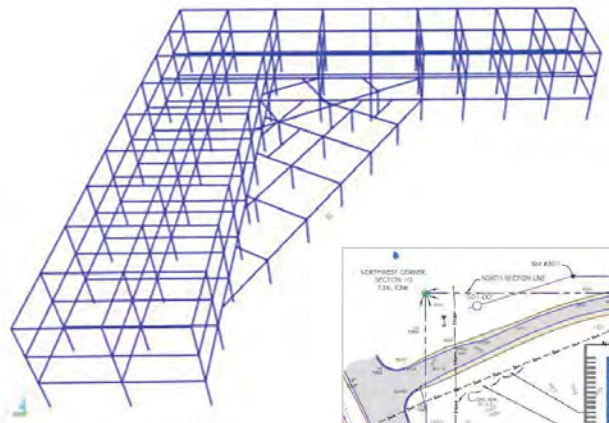
CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

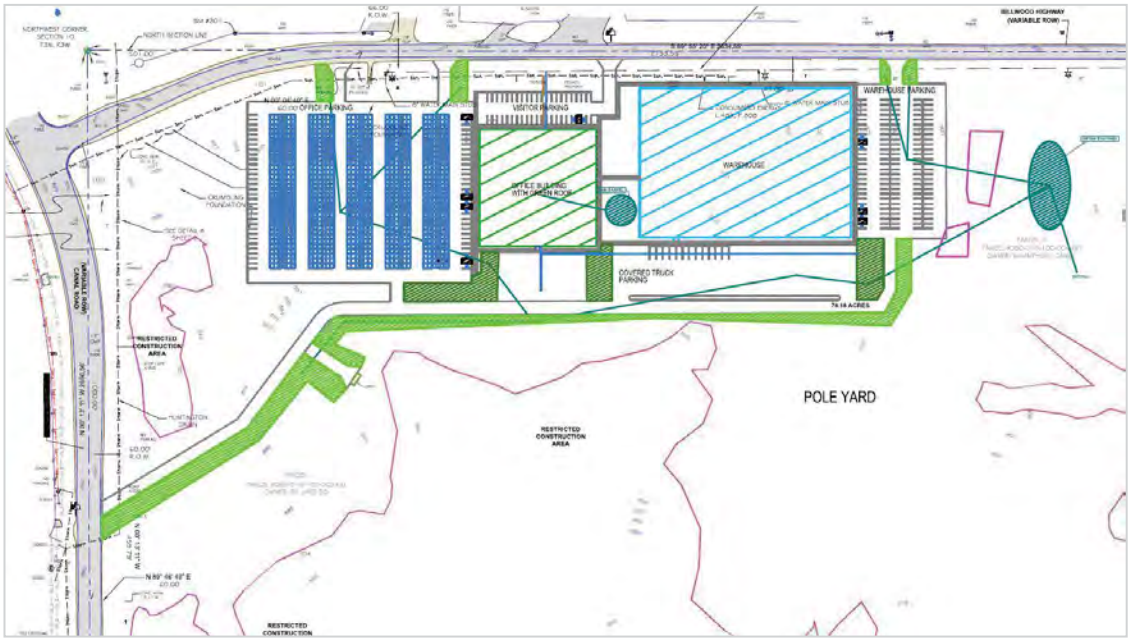
Consumers Energy New Lansing Operations Center

Consumers Energy is relocating their existing Lansing service center for gas and electric operations to a proposed site located at the southeast corner of Canal Road and Billwood Highway in Windsor Township, Michigan. The new facility will include office space for staff and work crews with an estimate of over 200 employees. Additionally, the new site includes critical warehouse storage space for materials and tools used in the maintenance, repair, and construction of gas and electric utility distribution lines. Exterior covered storage is required for operational vehicles and equipment, while additional indoor space is required for shop fabrication and repair work as well as heavy equipment repairs and maintenance.

The existing 78-acre site is mostly undeveloped and once housed a few small residential structures. The above ground portions of these former structures were previously demolished, and their foundations remain. The southern portion of the site contains large areas where development will be restricted due to the location of wetlands. Site development requirements include: a truck well and loading dock; fenced secure material and vehicle storage areas; new paved parking; storage yard; water detention; and solar power generation array.

Consumers Energy
Count on Us®

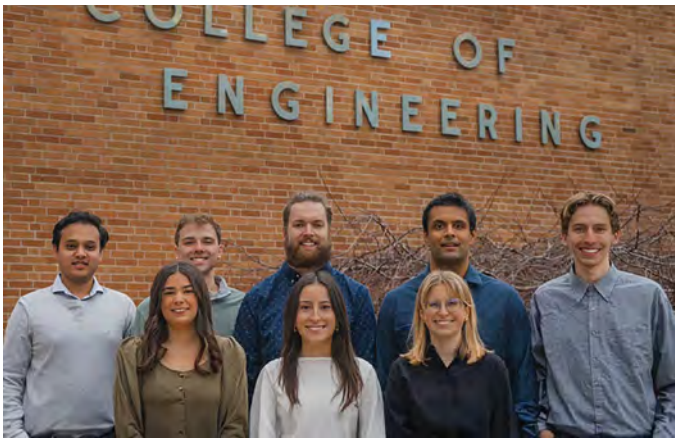




CE 495 | 8:00 a.m.- Noon Engineering Building Rooms, First and Second Floors | 1225, 1230, 1234, 2243

Team 1: Red Cedar Engineering Group
Left to right: Eddie Klenow (G), Gerrit Cramer (P), Bella Mara (H), James Roulo (S), Josh Finamore (PM), Kelsey Henry (E), Will Barrot (T)

Team 2: East Lansing Engineering
Left to right: Kahlil Turner (G), Hadeel Rass (E), Liam Murphy (P), Nowreen Kabir (E), Tawfeek Shetiah (S), Alya Alaskar (H), Khyrel Threlkeld (T), Ryanne Shaw (PM)



Team 3: Straits & Company
Left to right: Back Row, Pranesh Bhandari (G), Nick Broda (E), William Bailey (T), Matthew Meyers (P), Aaron Masacek (S), Front Row, Katy Foss (H), Madeline Rosenthal (PM), Emma Benedek (E)

Team 4: Horizon Engineers
Left to right: Spencer Litvin (T), Owen Wright (G), Grant Gattoni (E), Saige Phelps (E), Olivia Pauls (P), Suhail Saleem (H), Zach Gacioch (S), Adrien Jund (PM)

Team 5: Prestige Engineering
Left to right: Top row: Alex Wallace (E), Joe Baron (H), Tyler Mather (E), Avery Seling (S), Gracie Clark (PM), Bottom row: Kapricia Guice (P), Moe Moghrabi (T), Keagan Wendel (G)

KEY TO TEAM ROLES

E = Environmental
G = Geothermal
H = Hydrology
P = Pavements
PM = Project Manager
S = Structures
T = Transportation

Team 6: Spartan Associates
Left to Right: Colin Edwards (T), Dana LeFevre (PM), Andrew Carter (P), Olivia Hagan (E), Laura Hershauer (H), Sarah George t(E), Ryan Soto (S)

Team 7: Precision Construction Company
Left to Right: Enrico Lee (P), Trey Beauchamp (E), Madison Price (E), Dominic Battiata (G), Rachel Fagerman (H), Jimmy Kulas (S), Malia Evans (T), Alex Rhodes (PM)

Team 8: Engineers4Everyone
Left to right: Back row, Noah Hartman (T), Ansel Man (P), Matthew Stave (S), Drew Barnes (E), Front row, Natalie Sheen (E), Ashley Siluk (H), Renee Kehren (PM), Adam Gasiorek (G)

Team 9: Spartan Solutions
Left to right: Sean Duffany (G), Vicki McTaggart (T), Collin Jones (S), Jillian Gray (PM), Katie Tonielli (E), Abby Righter (H), Lillia Patrick (E), Tara Bourdage (P)

Team 10: Midwest Momentum
Left to Right: Nikki Williams (G), Nicole West (T), August Galasso (P), Hannah Calender (PM), Nicholas Kurniawan (S), Ryleigh Jackson (H), Alyssa Gruda (E)

KEY TO TEAM ROLES

E = Environmental
G = Geothermal
H = Hydrology
P = Pavements
PM = Project Manager
S = Structures
T = Transportation

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Talia Bellil, P.E.
Michigan Department of Transportation

Michele Buckler, P.E.
Diamler Automotive Group

Brad Ewart, P.E.
Soil & Materials Engineers, Inc.

Megan Jacobs, P.E.
Soil & Materials Engineers, Inc.

Steve Minton, P.E.
Michigan Department of Transportation

Leanne Panduren, P.E.
Rowe Professional Services

Robert Rayl, P.E.
RS Engineering LLC

Chuck Rolfe, P.E.
OHM Advisors

Kristen Schuster, P.E.
Michigan Department of Transportation

Dan Thome, P.E.
Nicholson Construction

Roy Townsend, P.E.
Washtenaw County Parks and Recreation

PROFESSIONAL EVALUATORS

Engineers and scientists associated with the following firms, municipalities, and companies donated time to provide students with a practicing professional's perspective. We gratefully acknowledge their generous contributions.

Casey Bonner, P.E.
HNTB

Michele Buckler, P.E.
Diamler Automotive Group

Ryan Butler, P.E.
Consumers Energy

Erik Carlson, P.E.
Michigan Dept. of Transportation

Ashlynn Cavines, P.E.
WSP

Dan Christian, P.E.
Tetra Tech MPS

Jim Corsiglia, P.E., S.E.
Carnaghi Structural Consulting

Brian Davies, P.E.
Hubbell, Roth & Clark

Tyler Dawson, Ph.D., P.E.
NTH Consultants

Erik Dickinson, P.E.
Fishbeck

Jordan Doddie, P.E.
HNTB

Max Drenth, P.E.
Carnaghi Structural Consulting

Andrew Dykstra, P.E.
Barr Engineering Co.

Michael Ellis, P.E.
Barr Engineering Co.

Adam Gerlach, P.E.
C2AE

Jayson Graves, P.E.
Soil & Materials Engineers, Inc.

Jordan Hankin
Hubbell, Roth & Clark

David Hayden, P.E.
DLZ

Jon Kolbasa, P.E.
Value Engineering, LLC.

Cole Moody, P.E.
HNTB

Jon O'Brock, P.E.
Materials Testing Consultants

Ralph Rezniek, P.E.
City of Dimondale

Lauren Roller, P.E.
Harley Ellis Devereaux

Sarah Ross, P.E.
Practical Engineers, Inc.

Brandon Simon, P.E.
Progressive AE

Steve Sorensen, P.E.
PEA Group

Michael Thelen, P.E.
Consumers Energy

Brandon Williams, P.E.
Spicer Group

Kyle Wilson, P.E.
Soil & Materials Engineers, Inc.

Design Day Awards Fall 2023

Rolla C. Carpenter Senior Design Award

The Rolla C. Carpenter Senior Design Award ($700 and plaques) is presented to the best team as judged by the faculty and a panel of practicing engineers.

Rolla C. Carpenter, Renaissance Engineer, was a graduate of The State Agricultural College in 1873 with a Bachelor of Science degree. After earning a Master of Science Civil Engineering, he was appointed professor of the Department of Mathematics and Civil Engineering at The State Agricultural College, which would later become MSU. He designed bridges, built ice houses, taught students French, astronomy, mathematics, mechanical drawing, hydrostatics, hydraulics, survey, and civil engineering. He prepared the design and working drawings for the Farm Lane Bridge, laid a water supply pipe to Williams and Wells Halls, and designed a pile driver for a dam built across the Red Cedar River. He later designed several buildings on campus, including the Mechanical Building, which was constructed in 1885. Throughout all of his work on campus, he involved students throughout the analysis, design and construction, forming what was essentially the first senior capstone design class.

The faculty and students of the Department of Civil and Environmental Engineering gratefully acknowledge the generous contributions from Fishbeck, and Barr Engineering Co.

Rolla C. Carpenter Senior Design Award Winners, Fall 2023

Team 4: Red Cedar LLC – Consumers Energy New Lansing Operations Center

Left to Right: Angelina Suchoski, Bobby Armstrong, Alexzandria Furchi, Alex Morley, Miriam Riviera, Kevin Sachs, Jake Pozar

ENGINEERING AT

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We're always on the lookout for software engineers who are passionate about technology, who care about the work they do and the people they work with. People who aren't put off by a wild idea (in fact, they crave other perspectives) and love working with a team.

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TechSmith supports a portion of loan repayment and pays ⅔ of any tuition and books for qualified classes taken by full-time employees to improve their job skills, up to $5,250 per year.

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TechSmithies can participate in the company's 401(k) investment plan. TechSmith will match employee contributions up to 3% of your salary, and 50% matching for the next 2% of your salary you contribute.

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TechSmith offers quarterly and annual bonuses to full-time employees based on company profitability and increase in sales from the previous year for the same period.

As of 2022, TechSmith is now 30% employee owned through an Employee Stock Ownership Program

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ChE Process Design and Optimization

Dr. R. Mark Worden
Class Instructor and Professor of Chemical Engineering

Sankha Basu
Ph.D. Student and Teaching Assistant of Chemical Engineering

Course Description

The Chemical Engineering Program's capstone design sequence includes Process Design and Optimization I and II (433 and 434, respectively). In these courses, students integrate content from earlier courses to solve complex, open-ended design problems. As the students progress through CHE 433, completion of their assignments requires increasingly more effort, initiative, knowledge, and individual responsibility. In CHE 434, students typically design an entire commercial-scale chemical plant and perform detailed economic analyses to assess and optimize the plant's profitability.

For over 50 years, MSU's CHE 434 students have worked intensively for one to two months solving the annual American Institute of Chemical Engineering (AIChE) Student Design Competition problem. CHE 434 uses these realistic, industry-based problems to enhance chemical engineering students' capstone design experience for three reasons: 1) the AIChE problems provide real-world, open-ended design experiences typical of what students are likely to face after graduation; 2) the AIChE problems require students to do self-directed, active learning, including project-specific independent research, to solve the problem; and 3) the AIChE problems serve as a national benchmark for MSU's Chemical Engineering students to demonstrate excellence in their professional skills.

As the Chemical Engineering program's contribution to the College of Engineering's Design Day, several CHE 434 students typically present posters describing their solutions to the current year's AIChE Student Design Competition problem. Names and pictures of this year's presenters are provided at the end of this article.

2024 Design Competition Problem: "Power to Gas"

The Power to Gas chemical process to be designed in this year's AIChE Student Design Competition problem uses renewable energy to generate a sustainable fuel-gas supply while keeping greenhouse gas emissions in check. Some existing renewable power sources (e.g., solar and wind) have significant disadvantages. For example, the amount of electricity they produce is dependent on the availability of sunlight and wind, respectively, making it difficult to reliably match the power generation rate to the demand. Moreover, when the generation rate exceeds the demand, storage of the excess electricity in batteries is not cost-effective.

This year's AIChE problem addresses this issue by using excess electrical energy to generate fuel gases, such as hydrogen (H_2) and methane (CH_4), which can be compressed and stored cost-effectively for use whenever needed. A simplified flow diagram for the Power to Gas process is shown in Fig. 1. Excess electricity would first be used to split water into H_2 and O_2 gases, and then the H_2 would be reacted with the greenhouse gas carbon dioxide (CO_2) to produce CH_4. The CO_2 consumed would be derived from a waste-gas stream that would otherwise be released into the atmosphere. That way, the Power to Gas process would be carbon neutral.

CHE 434 students use a multi-step process to design and optimize a chemical plant. In the first step, they perform hand calculations to estimate the performance and size of the major required pieces of industrial equipment (e.g., reactors, condensers, and distillation columns).

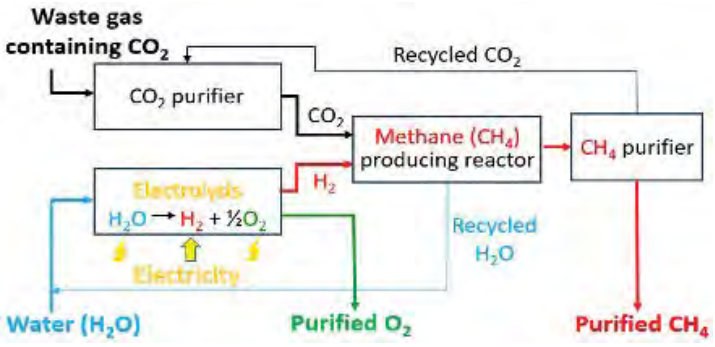


Fig. 1: Process flowsheet for AIChE Student Design Competition Problem

In the second step, they refine their estimates of equipment size and performance using a commercial computer-aided-design (CAD) program (e.g., ASPEN). The CAD programs are able to solve large systems of equations simultaneously. Finally, the students optimize the chemical plant's profitability using detailed economic calculations that account for changes in the value of money over time (e.g., inflation). The resulting discounted cash flow rate of return value calculated for the optimized process would be used by a company to assess whether to make a large investment in the designed production plant.

After completing their designs, CHE 434 students prepare professional-quality written reports up to 50 pages long. These reports include details of the manufacturing plant's equipment, operating conditions, personnel needs, capital investment, fixed costs, capital costs, and a detailed economic analysis. The reports are graded based on both their technical quality and their communication effectiveness. Because decisions on major capital investments (e.g., building a new production plant) are made by stakeholders having diverse academic backgrounds, the reports are expected to be understandable by a wide range of audiences.

Student Poster Presenters on Design Day

The nature of Chemical Engineering students' capstone design experience does not lend itself well to small-scale, hands-on models for Design Day demonstrations. Chemical Engineering seniors' Design Day contribution consists of presenting a lay-level poster of their design solution to the AIChE Design Competition problem and discussing with prospective students, current students, parents, and others the nature and advantages of careers in Chemical Engineering. This year's poster presenters are listed and shown below. Individual presenters are Matt Skulski, Lauren Petrie, Kendra Fowler, Jenny Lane, Amjad Mashmoushi, and Bran Codlin (not shown). Two-person team presenters are Yanni Williams and Paige Pilarski, Zoe Linko and Megan Giltmier, Sean Reid and Mohamed Mohamed, and Justin Hamlin and Mason Razz.


Matt Skulski


Yanni Williams (L) and Paige Pilarski (R)

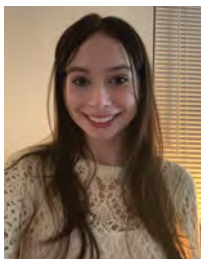

Zoe Linko (L) and Megan Giltmier (R)

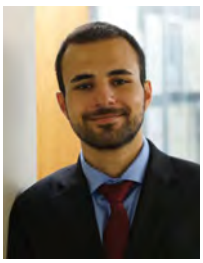

Lauren Petrie


Sean Reid (L) and Mohamed Mohamed (R)


Justin Hamlin (L) and Mason Razz (R)


Kendra Fowler


Jenny Lane


Amjad Mashmoushi

The Capstone Projects

Dr. Martin Crimp
Professor of Chemical Engineering and Materials Science

Amir Mirtaleb
Graduate Teaching Assistant

Course Description

MSE 466 is a senior level course for Materials Science and Engineering majors that provides students with a team-based capstone design experience. A major aspect of this course is having the students apply their course-learned background knowledge and critical thinking skills in materials science and other disciplines to real-life materials failure problems. Such failures are a major motivating factor for promoting more innovative designs or design changes. A failure analysis investigation provides a unique platform to design and solve real-world engineering problems via a systematic engineering approach. By focusing on specific component failures, the student teams learn how to confront open-ended problems that require them to develop a strategic design plan and to execute the methodology for assessing how and why the failure occurred. These open-ended studies are conducted using established investigative procedures and constraints for carrying out failure analysis. This semester, there are three 3-member teams and one 4-member team carrying out investigations on real materials failures.

Presentation Schedule – First Floor Room 1145

Time	Team	Project
9:00 a.m.	Snowboard Snow Problems	Capita D.O.A Snowboard Failure Analysis
9:30 a.m.	Brake Down	Examining the Failure of a 6KU Bike Brake Caliper
10:00 a.m.	Foilure Analysis	Analysis of Failure Mechanisms in a Fencing Foil
10:30 a.m.	Death by a Thousand Cups	Polycarbonate Cup Failure

MSE 466 | 9:00 a.m. - 11:00 a.m. Engineering Building, First Floor | Room 1145

(left to right) Nolan Kelly, Jack Martin, Kyle Henrikson, Brian Tijan

Team Name: Snowboard Snow Problems

Project Name: Capita D.O.A Snowboard Failure Analysis

Time: 9:00 a.m.

This study carried out a comprehensive failure analysis on a snowboard that experienced a fracture on the board just outside the binding region during routine use, rendering the board unusable. The fracture surfaces and surrounding materials were carefully documented, and a variety of analysis techniques were utilized to better understand what caused the failure. The investigation involved a series of tests, including fatigue testing, scanning electron microscopy (SEM) examination, bend testing, Charpy Impact testing, and chemical analysis, alongside other mechanical and chemical tests. Through these experiments, insights were gained regarding the underlying causes of failure, which may aid in advancements in product quality and safety in sports equipment manufacturing.

(left to right) Louis Booth, Nolan Hooper, Nicole Kelly

Team Name: Brake Down

Project Name: Examining the Failure of a 6KU Bike Brake Caliper

Time: 9:30 a.m.

Bike brakes work by adding friction to a wheel by way of a cable and caliper. This is achieved by pulling on the cable, which will bring the wheel into contact with the brake pads. A 6KU front bike brake caliper experienced a catastrophic fracture along the connection between the caliper and cable adjuster during a routine brake pad replacement. The part and its fracture surfaces were analyzed using a variety of techniques including microscopy, hardness testing, and chemical analysis. Through this examination, additional insights into the failure of this brake caliper were revealed.

(left to right) Alex Bakke, Sam Yoder, Imge Aktugan

Team Name: Foilure Analysis
Project Name: Analysis of Failure Mechanisms in a Fencing Foil
Time: 10:00 a.m.

Failures in fencing foils occur commonly, often resulting in injuries. This project investigated the mechanism by which a fencing foil failed in an unpredictable and dangerous manner. The detailed investigation behind the material design was expected to be helpful in preventing future injuries in fencing. In this study, the failure mechanisms were investigated through the examination of the fracture surfaces, using various testing methods such as geometric measurements, stereomicroscopy, scanning electron microscopy, hardness testing, metallographic analysis, chemical analysis, and Charpy impact testing.

(left to right) Drew Ingraham, Xavier Lewis, Emily England

Team Name: Death by a Thousand Cups
Project Name: Polycarbonate Cup Failure
Time: 10:30 a.m.

Polycarbonate (PC) is a relatively inexpensive and versatile thermoplastic material commonly used in the medical, automotive, and food industries. PC is valued for its optical clarity, strength, and thermal stability. Drinkware made out of PC is often advertised as "unbreakable" due to the material properties listed above. However, a polycarbonate cup was presented containing cracks around the circumference of the base. To determine how an "unbreakable" cup had failed, many analytical techniques, including multiple forms of microscopy, chemical analysis, and mechanical evaluation, were utilized. The investigation resulted in a clearer picture of the means of failure.

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CSE 498 Collaborative Design

CSE 498, Collaborative Design, provides the educational capstone for all students majoring in computer science. Teams of students build software systems for a variety of clients.

During the capstone experience, students

- design, develop, debug, document, and deliver a comprehensive software system,
- work in a team environment,
- become proficient with software development tools and environments,
- develop written and oral communication skills,
- build and administer computer systems, and
- consider issues of professionalism and ethics.

Our clients are local, regional, and national including Ally Financial, Amazon, Anthropocene Institute, Auto-Owners Insurance, Bosch, Dow, Elektrobit, Evolutio, General Motors, Google, HAP, Kohl's, Lockheed Martin Space, Ludus, Magna, Meijer, MillerKnoll, Microsoft, Mozilla, MSU Federal Credit Union, Roosevelt Innovations, RPM, Stryker, TechSmith, Union Pacific, United Airlines, Urban Science, UWM, Vectra AI, Volkswagen, Whirlpool, and WK Kellogg Co.

Ally Financial
Shareholder Engagement Chatbot

Ally Financial, headquartered in Detroit, Michigan, is a leading entity in the U.S. financial services industry, known for its extensive list of offerings including banking, investing, and auto financing. With a strong customer base that includes over 2 million depositors and 4.5 million individuals utilizing its financing and leasing options, Ally is at the forefront of revolutionizing financial interactions through technology.

In today's financial landscape, investors are faced with the daunting task of sifting through vast amounts of information to make well-informed decisions. As a result, investors sometimes struggle to obtain the specific information they need about Ally promptly and effectively. There is a need for straightforward access to financial insights without the constraints of traditional research methods.

Our Shareholder Engagement Chatbot is an artificial intelligence-powered solution that enhances investor relations and addresses the obstacles associated with obtaining financial information. It enables investors to navigate the complexities of dense financial reports in a quick and conversational manner, while staying on topic and protecting any private information.

Available to the public and equipped with the most up-to-date information, the chatbot provides real-time responses to financial queries. Source citations are provided that include document links for transparency, along with example questions to guide investors who may need a starting point for their inquiries.

Our system quickly and effectively answers shareholders' questions, improving relations and transparency.

Our software is written in Python and JavaScript, leveraging multiple Amazon Web Services for authentication, data storage, and deployment. Its generative capabilities derive from interfacing LangChain with Amazon Bedrock's foundation models.

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Amazon
Employee Badge Image Validation Tool

Amazon is a multinational technology company that has grown to become the world's largest retailer. Founded in 1994 by Jeff Bezos, Amazon has since expanded into various industries, including cloud computing, digital streaming, and artificial intelligence.

As Amazon continues to grow, ensuring a quality employee onboarding process is paramount to supporting Amazon's vision. An efficient onboarding process enables new employees to focus on transitioning without unnecessary delays or disruptions.

Currently, when Amazon hires a new employee, the employee uploads a photo to the employee badge verification system. This photo is manually checked against photo requirements by the Amazon verification team. This process can take days, slowing down the rate in which employees can join Amazon teams.

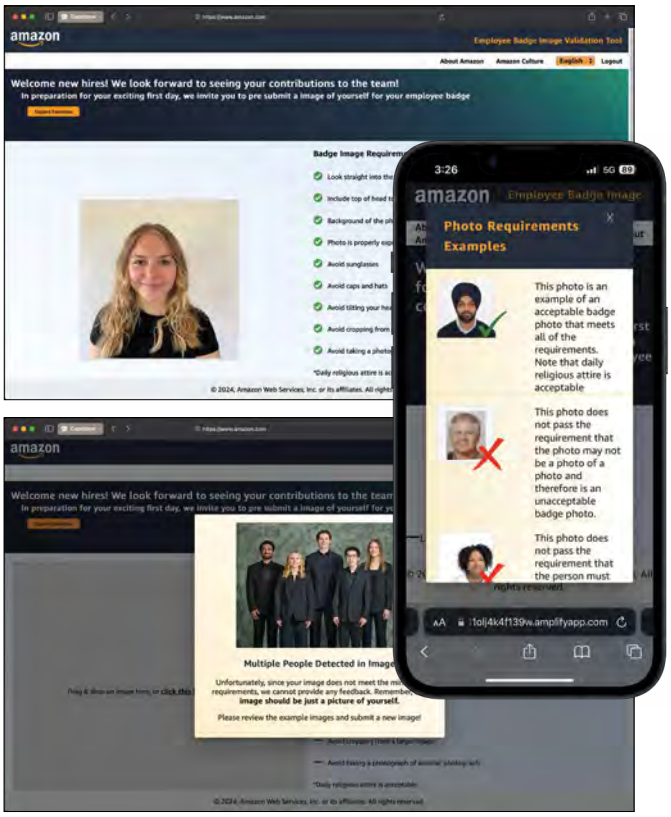
Our Employee Badge Image Validation Tool streamlines the new employee onboarding process by providing instant feedback on new employee badge photos.

Users simply need to upload their photo to the Employee Badge Image Validation Tool website in order to get feedback on their photo. When a photo is uploaded, our system uses machine learning models to test the validity of the new uploaded photo against standardized badge requirements.

The website displays feedback on photos and gives instructions on how they can improve their photo for the next upload.

Our tool not only saves time for new hires, enabling them to start faster and transition more smoothly into their roles, but also enables Amazon to dedicate more resources to delivering quality services to their customers.

Our web application is responsive and scalable due to a robust set of Amazon Web Services. The front end is hosted on AWS Amplify and back-end requests are handled by API Gateway, Lambda, Rekognition, and S3.



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Anthropocene Institute

Vessel Classifier for Marine Monitor (M2)

The Anthropocene Institute is an organization based in Palo Alto, California, focusing on exploring solutions to tackle climate change. With a goal of solving the climate problem by 2030, the Anthropocene Institute connects investors, entrepreneurs and policymakers with research groups and experts, while assessing research claims and viability.

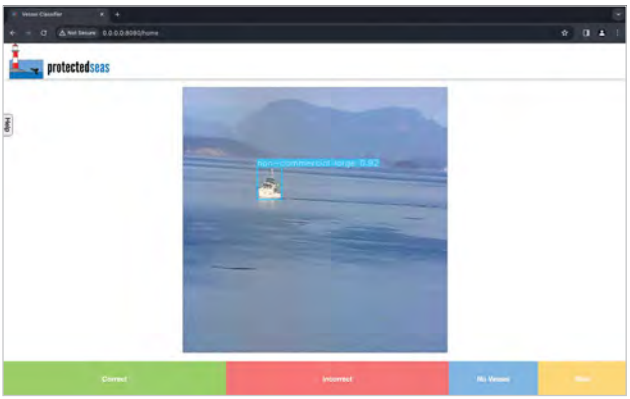
Marine conservation is a key part of maintaining and healing entire ecosystems and populations that depend on the ocean. Focusing on enforcing and monitoring marine conservation and no-fishing zones, ProtectedSeas, a partner of the Anthropocene Institute, utilizes cameras on their land-based radar systems to capture images of vessels near protected zones to ensure compliance. Using these images, ProtectedSeas is creating ship-identifying AI models and must perform the time-consuming task of hand-labeling thousands of images for model training.

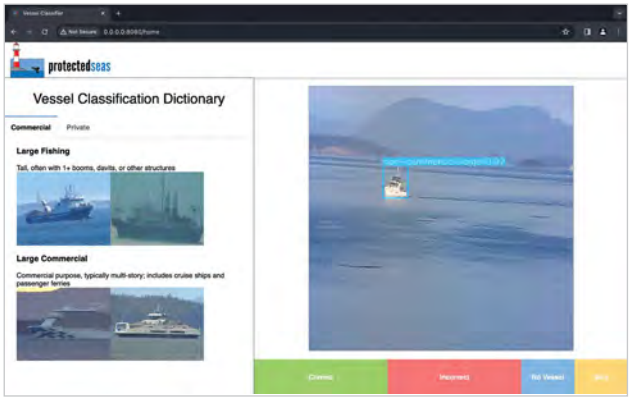
Our Vessel Classifier for Marine Monitor (M2) takes input images and identifies whether a ship is present using machine learning, automating the labeling process, saving time and effort.

The system runs on a website that takes in user images and automatically labels them using a model trained periodically on the vessel dataset. If the model is not at least 90 percent confident with its label, the user is prompted to manually classify said image. The user can also access all the images from that session to override their automated labels. The images and their labels are added to ProtectedSeas' database to train their ship-identifying models as well as the system itself periodically.

Using our system, training AI is more efficient than ever before, giving ProtectedSeas more time to keep the ocean protected.

Our Vessel Classifier for Marine Monitor (M2) runs on a Flask website containerized in Docker for ease of migration and uses a PyTorch computer vision model for image classification.





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Auto-Owners Insurance
Policyholder's Interactive Guide (PIG)

Founded in 1916, Auto-Owners Insurance is a Fortune 500 company employing more than 4,700 associates, and providing nearly 5.6 million insurance policies across 26 states. Auto-Owners has been headquartered in Lansing, Michigan for over 100 years.

Auto-Owners offers a wide range of vehicle coverage. Navigating through the intricacies of the various vehicle insurance policies can be overwhelming. To help mitigate this, Auto-Owners is looking to create comprehensive ways for policyholders to learn more about loss prevention and insurance for vehicle parts.

Our Policyholder's Interactive Guide (PIG) is an augmented reality application that enables users to interact with vehicle parts and associated insurance coverage information in real time using the Microsoft Hololens 2.

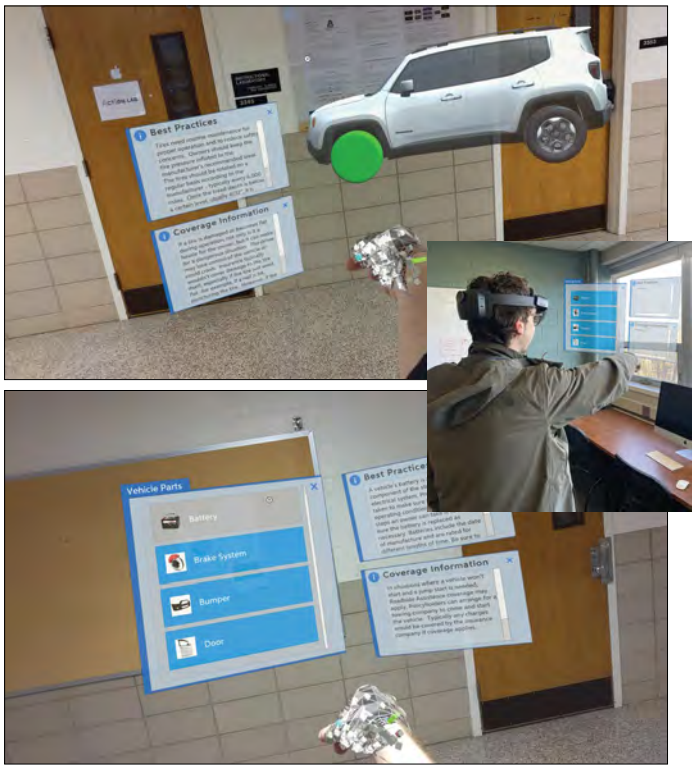
Once wearing the HoloLens 2, users select from three distinct modes: panel, full virtual object, and object detection. In panel mode, users are presented with a list of vehicle components in which they choose a component from a simple two-dimensional menu to learn more about.

In full virtual object mode, users select a fully virtual vehicle model. Once selected, the three-dimensional vehicle model appears and the user can view different vehicle components on the model to reveal in-depth insurance information about that object.

Lastly, in object detection mode, the user can approach various components on real-world vehicles and the system provides the user with coverage information.

Using our system, Auto-Owners' policyholders save time and money, and are provided the best possible customer service experience.

The PIG: Policyholder's Interactive Guide is built in Unity using the Mixed Reality Toolkit and is written in C#. Object detection uses Azure Custom Vision to detect real-world objects.



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DRIVEN-4

DRIVEN-4 Connect Application, Server and Backend

For over 30 years, DRIVEN-4, based in St. Joseph, Michigan, has focused on and specialized in the areas of product lifecycle management (PLM), connected product development (IoT), connected operations (IIoT) and cybersecurity. Today, DRIVEN-4 strives to create innovative software solutions for its clients.

The DRIVEN-4 Connect Module is a programmable logic controller (PLC) that, through on-board sensors and network connectivity, is customizable to fit end-user needs. Managing user modules, providing connectivity to modules, and analyzing data collected from modules requires an equally customizable solution.

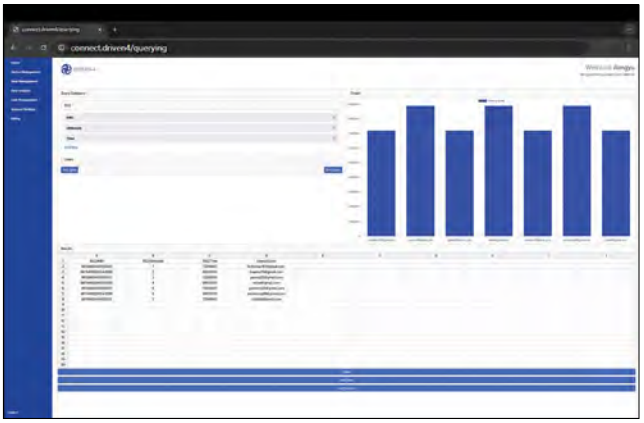
Our DRIVEN-4 Connect Application provides a customizable and streamlined solution for end-users to interact with DRIVEN-4 Connect Modules. Through the Connect system, users can view provisioned modules, update module firmware, and analyze data collected and uploaded from modules.

A provisioned module is set up by the end-user and specifies the schema of collected data. Once set up, the Connect system generates a unique endpoint to facilitate the connection to the Connect Module. Through the generated endpoint, the Connect Module sends collected data for storage.

Collected data can be queried, analyzed, and visualized through a spreadsheet that enables for mathematical functions and visualizations through graphing.

Additionally, users can create custom dashboard widgets to display the most relevant data in a convenient location. A learning center is available for users to view tutorials, to view code snippets, and to download code libraries.

The DRIVEN-4 Connect web application front end uses HTML, CSS, and JavaScript. The back end is implemented using the Flask framework, MySQL databases, and SQLAlchemy to interact with databases.



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Elektrobit

Automotive Software Integration In Virtual 3D

Founded in 1988, Elektrobit is a global automotive software company, headquartered in Erlangen-Tennenlohe, Germany with locations across multiple continents. Elektrobit is an industry-leading supplier of automotive software products and services, with their products powering over five billion devices in over 600 million vehicles.

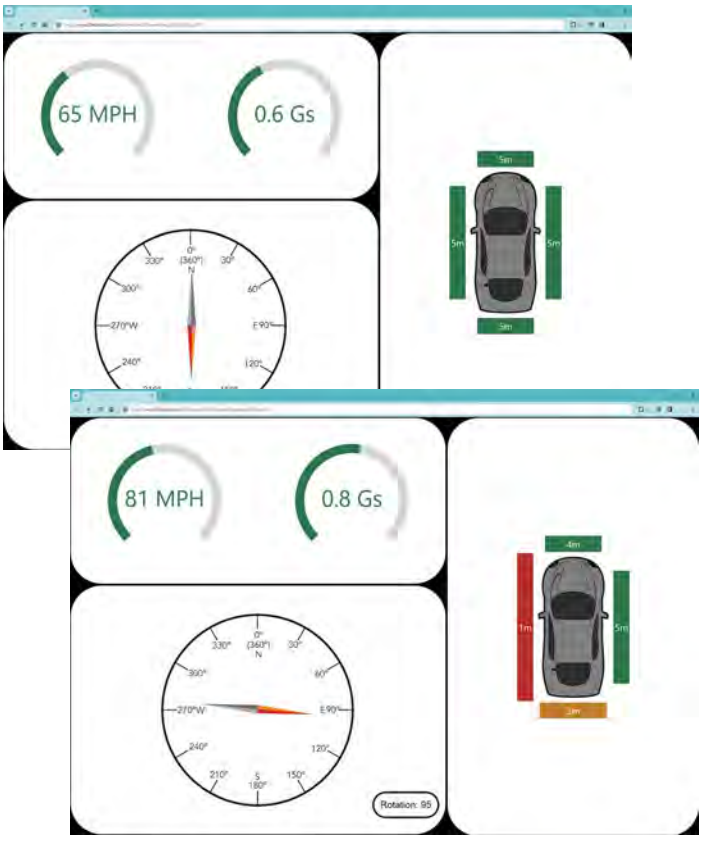
To ensure safe driving, new vehicular innovations are constantly being researched. However, it is very costly to test these innovations in the field. Recently, Elektrobit released Corbos, a software suite that developers utilize in creating programs to be run on automobiles. These programs can include anything from infotainment displays to autonomous driving features. Elektrobit seeks a means to demonstrate the powerful and dynamic capabilities of their new Corbos product to customers.

Our Automotive Software Integration In Virtual 3D system demonstrates the capabilities of Corbos by responsively displaying important metrics from simulated vehicles to automotive engineers and testers through a dashboard-like interface.

The website displays several important features: A top-down view of the vehicle displays the distance and direction of nearby obstacles, a compass is used to dynamically show the direction of a simulated vehicle, and speed and RPM dials are displayed to illustrate these metrics as they would in a real vehicle.

Through our system, Elektrobit is able to display how Corbos is able to help the development of future vehicular innovations.

CARLA simulator, an open-source automobile simulator, is used to generate sensor data that is sent through a Python API to a Docker container. The data is processed and sent to a second Docker container, where a React user interface fetches data from a C++ application running alongside it. Communication between the containers is facilitated by the HPC Dev-Kit from Elektrobit.



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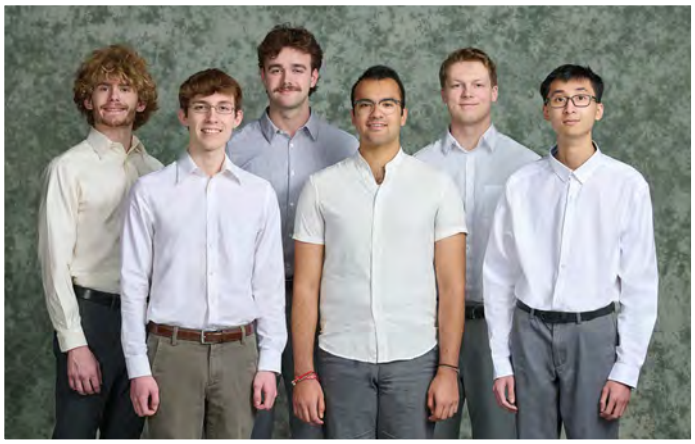

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Evolutio
Evo Project Reporting Tool

Evolutio is a software consulting company that specializes in delivering innovative solutions to complex technological challenges, empowering businesses to thrive within the tech industry. With approximately 33 employees, the company operates two offices, one in Chicago, and one in Manchester, UK.

Evolutio has many important clients who need data on their projects presented attractively in reports. However, exporting the relevant data from their internal tools and formatting it in a visually appealing and professional manner is a time-consuming process for the consultants and architects working on projects. Much of this work is repetitive and is the same from week to week.

Our Evo Project Reporting Tool makes report generation easy with a web-based report generation tool that integrates with Evolutio's existing project management tools. Our tool pulls the necessary data for a project and produces high quality PDF reports alongside other exportation formats such as JSON and CSV, that can be provided to stakeholders at all stages of an engagement.

Utilizing the Asana API for real-time data extraction, our software ensures information is consistently updated, providing users with the most current project insights. Our software meticulously processes this data, facilitating its smooth presentation for an intuitive user experience.

Through our tool, Evolutio generates attractive reports with ease, allowing them to focus on making technological strides.

The technological backbone of the Evo Project Reporting Tool includes Next.js and ReactJS for a responsive front-end interface, complemented by a Node.js and Express framework back end. This setup is optimized for efficient data management and seamless user interaction. Okta's authentication system enhances security, while Asana's API integration ensures real-time project updates, maintaining operational efficiency and data accuracy.

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Ford Motor Company
Dealer Experience Dashboard

Ford Motor Company is an international automotive manufacturer headquartered in Dearborn, Michigan. With nearly 175,000 employees and producing about 6.4 million vehicles globally, Ford stands as one of the top ten automakers worldwide.

Dealerships are facing stiff competition in the market. Tracking performance across dealerships is pivotal in our modern information age. Ford dealers need to be constantly innovating and improving to ensure success in the automotive industry.

Our Dealer Experience Dashboard streamlines and modernizes the access and analysis of critical information to drive future sales for Ford dealers.

Dealers interact with our dashboard to generate reports of the key data metrics they are interested in analyzing, for example, sales, repair orders, vehicle deliveries, etc.

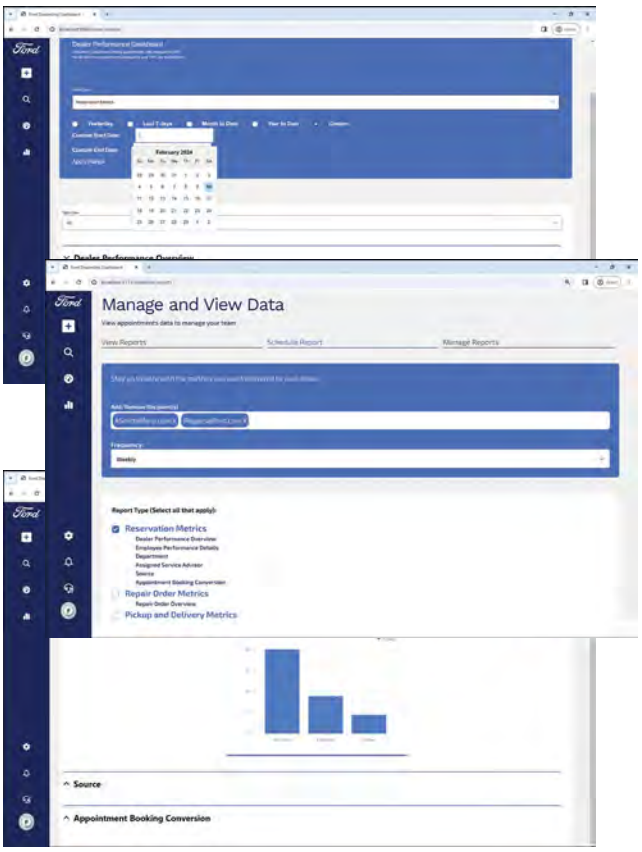
We offer significant customization options so that each dealer can focus on what matters to them. Our dashboard also boasts extensive data visualization tools, enabling users to quickly and effortlessly comprehend complex data through charts and graphs.

After a dealer finishes their data analysis, our dashboard generates a report of the data, visualizations, and overall analysis. This report is then shared with any relevant entities to help improve the overall dealer performance.

Our system automates real-time updates, keeping dealers informed of any changes or trends in dealership performance.

Our software shows sales trends and identifies key areas of growth in dealerships, improving sales and increasing revenue. All the information analysts need to see is now condensed in a few easy-to-use web pages along with easy ways to share these reports.

Our UI is primarily written in JavaScript and developed using React for the front end, Express to talk to the server, and Google's BigQuery to handle the data.



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General Motors
Recovery of Lost and Stolen IT Assets

General Motors (GM) is a multinational automotive company based in Detroit, Michigan. GM produces and sells some of the top performing vehicles including Buick, Chevrolet, GMC and Cadillac totaling 2.6 million vehicles sold worldwide.

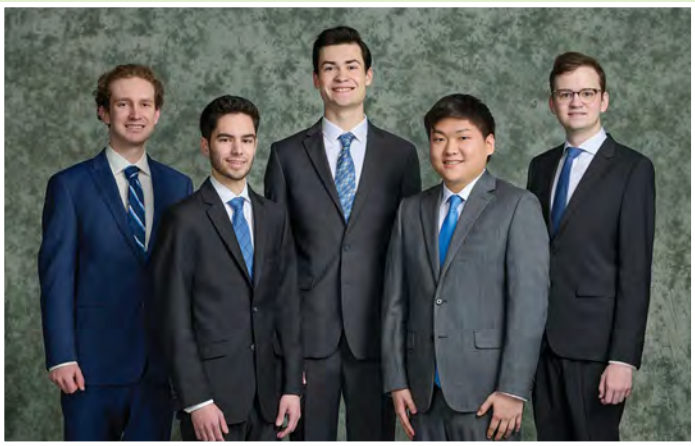
With over 165,000 employees internationally, GM provides a variety of devices to their employees to assist with their work. With all these devices it is inevitable that some are lost or stolen, exposing vulnerabilities to proprietary data and applications. To mitigate this vulnerability GM must go into the device and perform a manual shutdown to revoke access.

Our Recovery of Lost and Stolen IT Assets system streamlines the process of remotely shutting down lost or stolen devices. Our software makes it easy to detect when a device has been misplaced, at which point the device is then automatically locked until it is returned or an administrator logs in.

Once an IT administrator marks a device's location as unknown, a signal is sent out to the device through network communications. On receipt, the lockdown initiation begins by disabling all other users except the administrator account, which is reset with a new password. After lockdown, a confirmation email is sent back confirming the device's status. Upon relocating the device, the IT administrator can log in and recover data held on the devices. This prevents the use of the device and incentivizes its return to GM.

Our software automates the remote lockdown process of GM devices and gives employees the ability to check the status of a device as well. This increases the security of the proprietary data and applications.

Our front end is built with JavaScript, HTML and CSS. The back end is built on a Dockerized Flask application running PowerShell scripts and Python. Finally, our database utilizes PostgreSQL.



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Google
Android Vulnerability Database

Google, founded by Larry Page and Sergey Brin in 1998, is the world's largest search engine with its 92% market share. Google offers more than 50 services such as Gmail, Chrome, and the Google Cloud Platform.

One of Google's many services is Android, an operating system designed for mobile devices. Every year, hundreds of security vulnerabilities are remediated on over three billion Android devices. Google's Android Security Bulletin communicates information on vulnerabilities to Google's partners and is matched to reports in the National Vulnerability Database (NVD). These data sets are critical to security experts, but additional effort is required to collect and combine the data from both sources.

Our Android Vulnerability Database consolidates information from the bulletins and data from the NVD in one place and enables users to access that information via the web.

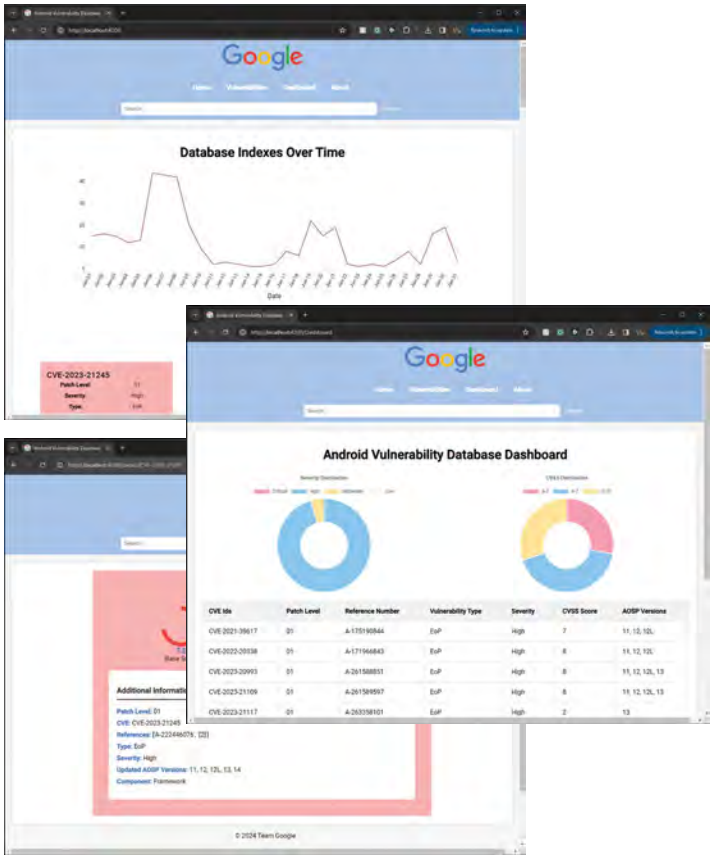
Our tool illustrates metrics that are found in the databases in an attractive, easy-to-use format so experts can survey vulnerabilities with ease.

The most important metric is the base score which indicates the overall severity of the vulnerability and helps security experts to prioritize certain vulnerabilities as they develop fixes.

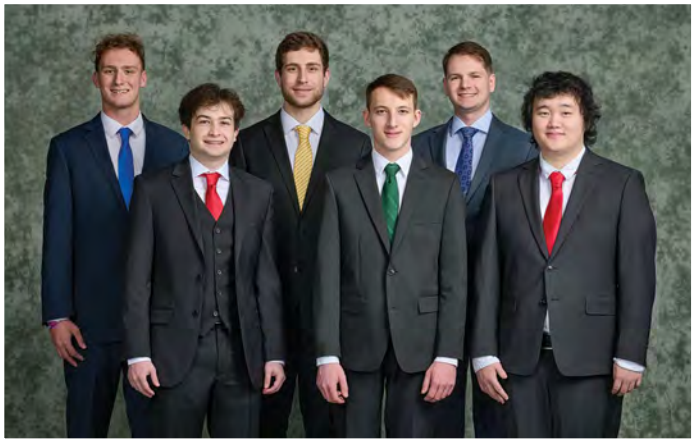
Security experts can access the consolidated data set via the web-facing application. They can retrieve information with prepared requests or tailor their requests to suit their specific needs.

The app also visualizes the data for users, helping them to analyze the information in an intuitive way, enabling Google employees to solve Android vulnerabilities easier than ever before.

Our tool is open source, hosted on Google Cloud Platform, and utilizes ETL methodology to manage the data. API calls are then used to retrieve data from cloud SQL databases.



Google



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HAP
Artificial Intelligence (AI) Training Course

HAP is a Detroit-based healthcare insurer that covers customers of all sizes whether they're a corporation or an individual. With a workforce of roughly 1,100 employees, HAP provides for over 430,000 members.

With such a large number of customers, HAP is looking for ways to increase the productivity of its employees, and artificial intelligence (AI) is a new option. HAP is looking for a way to teach its managerial staff the basics of AI, such as popular large language models (LLMs), and different ways of using them.

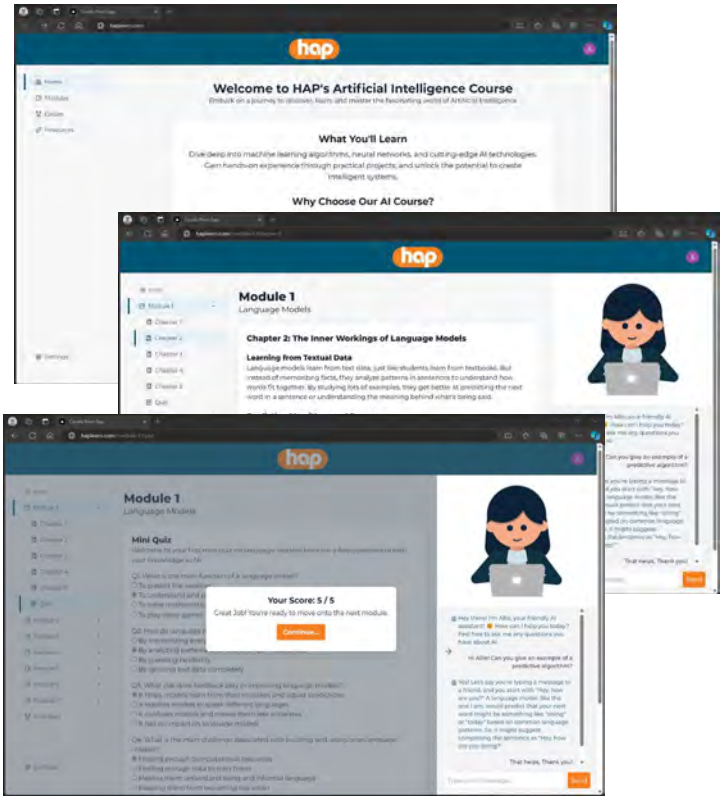
Our Artificial Intelligence (AI) Training Course is an education platform with multiple modules that HAP employees can complete to gain an understanding of AI basics.

Since this covers the basics exclusively, the entire course takes only 15-30 minutes to complete. Content is presented in both text and audio/video format. The audio/video content is exhibited by an AI powered avatar, or "professor." Additionally, the "professor" supports interaction with the user through a chat feature where the user can type or speak questions to receive specific and instant feedback.

Employees take the course module by module and test their retention of the content with mini quizzes. With the completion of this course, employees can leverage AI in their daily lives.

Training a work force to be proficient in the use of AI will enable HAP employees to be more efficient and more productive in the course of their work.

The front end of our application is powered by Next.js, TypeScript, and shadcn/ui for a professional user interface and experience. The back end of our application is powered by Python and FastAPI with MongoDB as the database for the course content. OpenAI powers the avatar's interactivity and Docker containerizes both the front end and back end to be deployed to GCP.



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Lockheed Martin Space
SmartSat™ AI Acceleration in Space

Lockheed Martin Space, a division of Lockheed Martin, is headquartered in Littleton, Colorado. Employing over 20,000 people, Lockheed Martin Space is one of the largest aerospace companies in the nation.

The advancements of satellite technology in recent years has assisted Lockheed Martin Space in developing the SmartSat™ software development kit. SmartSat™ enables for the rapid development and deployment of satellite software.

Cameras are a crucial component of satellite systems, and the images they capture can be utilized to run image recognition software. However, these operations can be expensive and time- consuming if not properly optimized, which is quite difficult due to the delicate and complex satellite hardware and software systems.

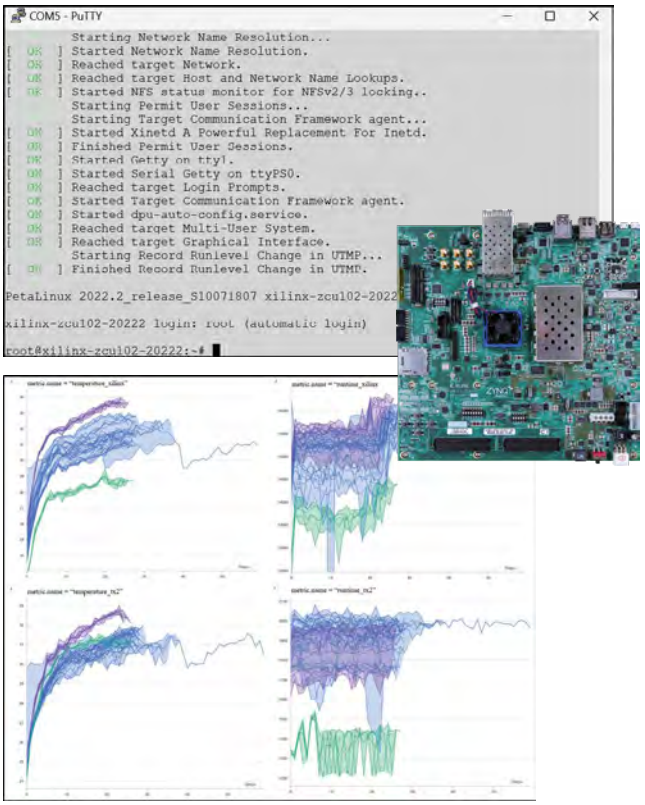
Our SmartSat™ AI Acceleration in Space system deploys various image recognition software onto SmartSat™ hardware to find the optimal hardware for each model.

Our software targets specific hardware components on a given satellite using hardware accelerators. It enables the resources needed in running models on a satellite to be tracked and minimized. Examples of tracked metrics include, but are not limited to, runtime, throughput, and temperature.

The resulting metrics are visualized in an easy-to-use dashboard so Lockheed Martin engineers can easily view optimal components.

Our software enables efficient deployment of image recognition models onto various satellite hardware components. Through our tool, Lockheed Martin Space can easily cut down on the cost of expensive satellite resources, ensuring they are able to keep making exciting advancements in satellite innovation.

Our AI models are compiled by Vitis AI and ONNX Runtime and deployed onto the Xilinx ZCU102 and NVIDIA Jetson TX2. Benchmarking results are displayed using an AimStack dashboard.



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Ludus
Digital Playbill Builder

Based out of Holland, Michigan, Ludus is a software-as-a-service (SaaS) company providing various services to 2000+ performing arts organizations of all sizes across the United States. Initially just a ticketing platform, Ludus has since expanded to include marketing, fundraising and streaming.

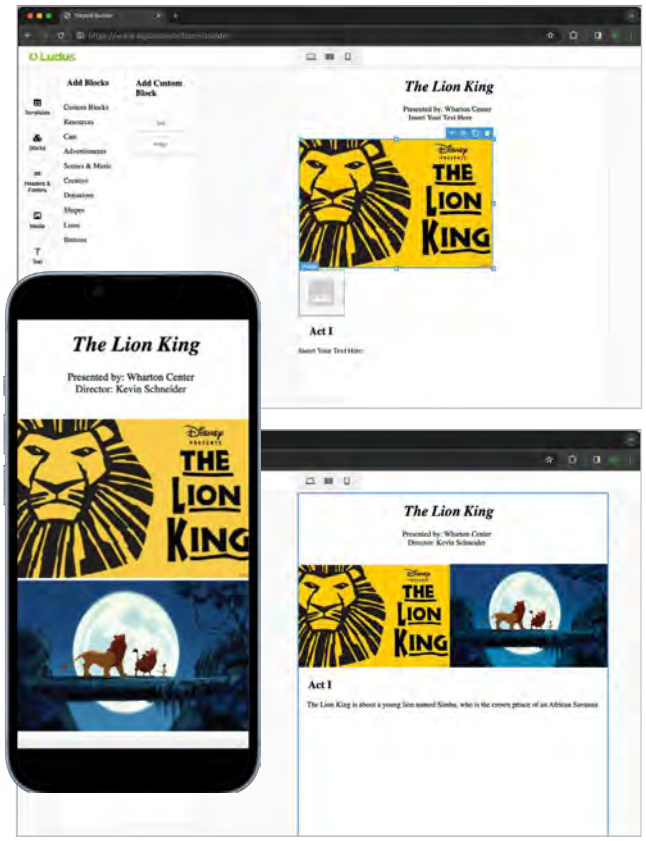
Many performing arts organizations now utilize digital platforms when selling and distributing tickets. However, paper is still the standard for playbills, which can be costly to develop and print. Ludus' latest initiative is to transition from the use of traditional paper playbills into a digital system.

Our Digital Playbill Builder is a web application that consolidates the creation and the distribution of playbills all in one easy-to-use tool. Organizations create custom playbills in a drag-and-drop document builder from a selection of premade elements such as images and textboxes. The user also has the option to upload custom media, designs, and advertisements.

Users can fully customize their digital playbills to be accessible on all devices. Once the design is ready to be viewed by the public, users publish their playbill with the click of a button and easily share a public URL or printable QR code where the playbill can be accessed by the audience.

Our playbill builder creates a unique way for theaters to distribute playbills, provides patrons with a new and exciting interactive experience, and eliminates the costs associated with standard paper playbills.

The Digital Playbill Builder is developed as a PHP application backed by the Laravel framework and standard web development languages, including JavaScript, HTML and CSS. The rendering engine for the interactive elements and playbill editor is powered by GrapesJS. All stored data for this tool lives within a secure and managed MySQL 8 database.



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Magna

3D Model for Factory Digital Twin Using WebGPU

Founded in 1957, Magna has established itself as a pioneering force in the global automotive industry. With over six decades of experience, it is more than just a supplier; it is a visionary leader, driving the evolution of the automotive industry.

Managing an entire factory is difficult. With moving machinery, containers, and various supplies, keeping track of everything means walking through the factory and locating objects as needed, which can be very time-consuming. While some of the necessary information is digitalized, Magna currently has no centralized resource for all its factory data.

Our 3D digital factory twin web app using WebGPU fixes this problem by creating a way for managers to view a digital model of their factory. The system enhances the efficiency and convenience with which floor managers can supervise their facilities.

Our system enables employees to create digital models of their factory by importing files to portray all the various parts and objects. Objects are then translated and rotated to be placed in their correct spot on the factory floor.

Once the model is built, an outline list on the screen displays all relevant objects within the digital factory twin. If more information on an object is desired, clicking the object in the list brings up a menu showing its position, name, object ID, and other relevant data.

Live data updates and alert statuses are visually represented. For a given object, if a sensor identifies readings above a set threshold, such as a high temperature, the alert system is triggered. The user is then notified with the object details and the object is highlighted within the digital twin so it can be monitored.

The front end is built with Vue for the UI and WebGPU via Orillusion for 3D Rendering. The back end is built in Docker with MongoDB for file storage and EMQX MQTT Broker for handling real-time data transmission.

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Meijer
Supply Chain Induction Visibility Using Witron

Meijer is the premier retailer of the Midwest, carrying over 220,000 different products at more than 270 supercenters. Offering such a robust collection of items for purchase, Meijer has and continues to make many innovations in the field of supply chain management, one such innovation being Meijer's automated warehouses.

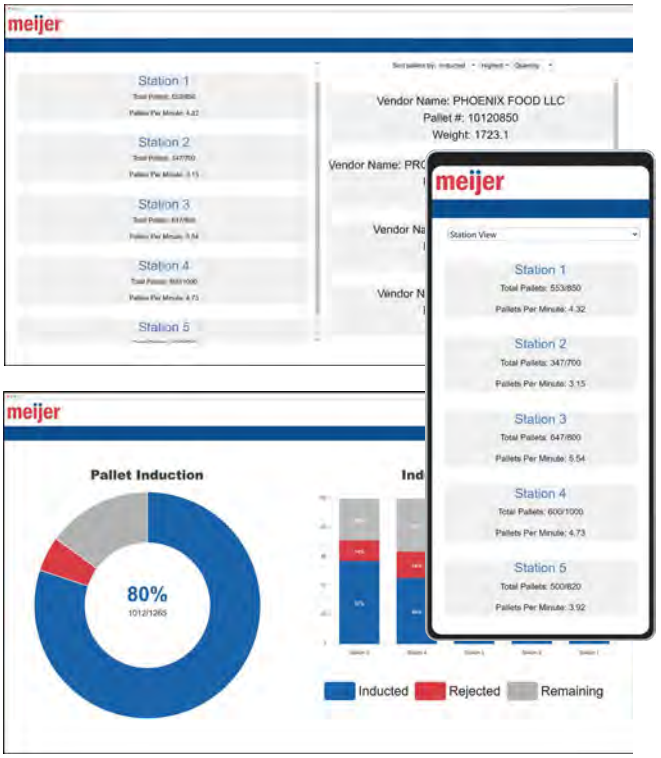
Through their partnership with the German engineering company Witron, Meijer has revolutionized the storage and management of dry groceries, ensuring operational efficiency. One challenge that Meijer faces is the lack of transparency and visibility that a hyper-efficient system creates. This lack of transparency can lead to difficulties pinpointing inefficiencies and disruptions in the supply chain.

Our Supply Chain Induction Visibility Using Witron dashboard improves transparency by visualizing real-time induction station data and displaying it to employees on the warehouse floor using wall-mounted monitors.

Our dashboard integrates data from both Witron and Meijer, streamlining it onto a singular and concise user interface. The data displayed offers detailed insights into pallet induction, including the number of pallets inducted, rejected, and remaining, ensuring a comprehensive view of each station's operations.

Additionally, the web version of our application enables users with the proper credentials to access an administration page that is configured for both desktop and mobile web browsers. This webpage provides more in-depth statistics for each station and shows efficiency across the entire warehouse, equipping administrators with the information needed to optimize operations.

Our web application is written in C# using .NET Core 8. It is connected to our front end using Microsoft Blazor and is updated on a MySQL database hosted on Microsoft Azure.



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Michigan State University

clUML: A Browser-Based UML Editor

Michigan State University's Department of Computer Science and Engineering (CSE) delivers acclaimed courses to over 2,000 students every semester in various computer science-related disciplines. Some of these courses use a system of in-house software called CourseLib to build custom websites.

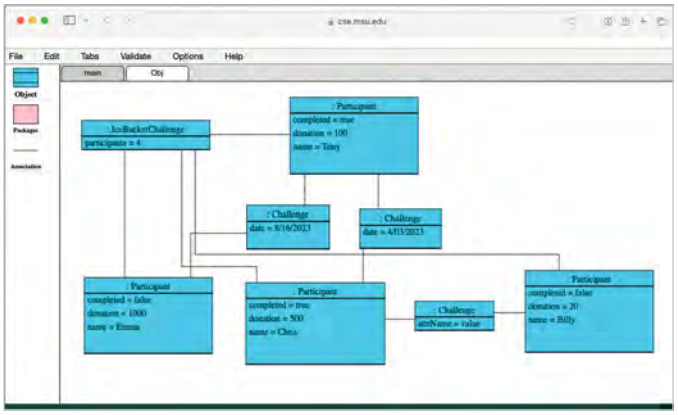
Students taking the department's software design course use Unified Modeling Language (UML) diagrams to visualize the structure of their software, which is a crucial step in the design process. Until now, CSE has relied on a third-party desktop application called Visual Paradigm to create UML diagrams.

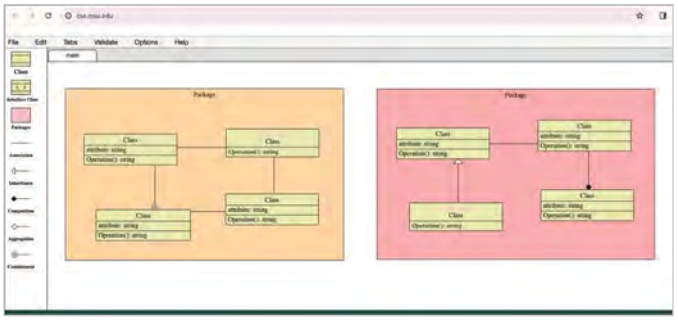
clUML is a browser-based UML editor. This eliminates the department's dependency on Visual Paradigm and provides a practical way for students and instructors to create and edit UML diagrams directly on the course website, using any modern web browser.

Students can check their diagrams for redundancy, improve their solutions based on instant feedback, and submit diagrams to be graded. Instructors can embed UML diagrams in assignment pages and quizzes, enabling more efficient grading and reducing the workload for course staff.

clUML supports editing multiple diagrams simultaneously in separate tabs. When creating a new tab, the user specifies whether it should hold a class or object diagram. This determines which components are available.

The front-end interface is implemented in JavaScript, HTML and Sass and works in all modern web browsers. The back end is a PHP package that the owner of a CourseLib website can install using Composer. We use DOMPurify to sanitize user input, Jasmine for JavaScript unit testing, and Karma to facilitate testing the user interface across multiple browsers.





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Michigan State University
Enviroweather Mobile

Enviroweather is a free online resource that provides Michigan farmers and agricultural stakeholders with weather-based tools to help them make pest, disease, plant-production and natural resource management decisions. Enviroweather provides more than 60 different weather, pest, disease and crop predictors.

These prediction models provide Michigan agriculturalists with essential data that they can utilize to make informed decisions regarding farm management.

Approximately half of Enviroweather's users access their website via a mobile phone while in the field. However, the current website is not optimized for mobile devices, which leads to difficulties loading and accessing data.

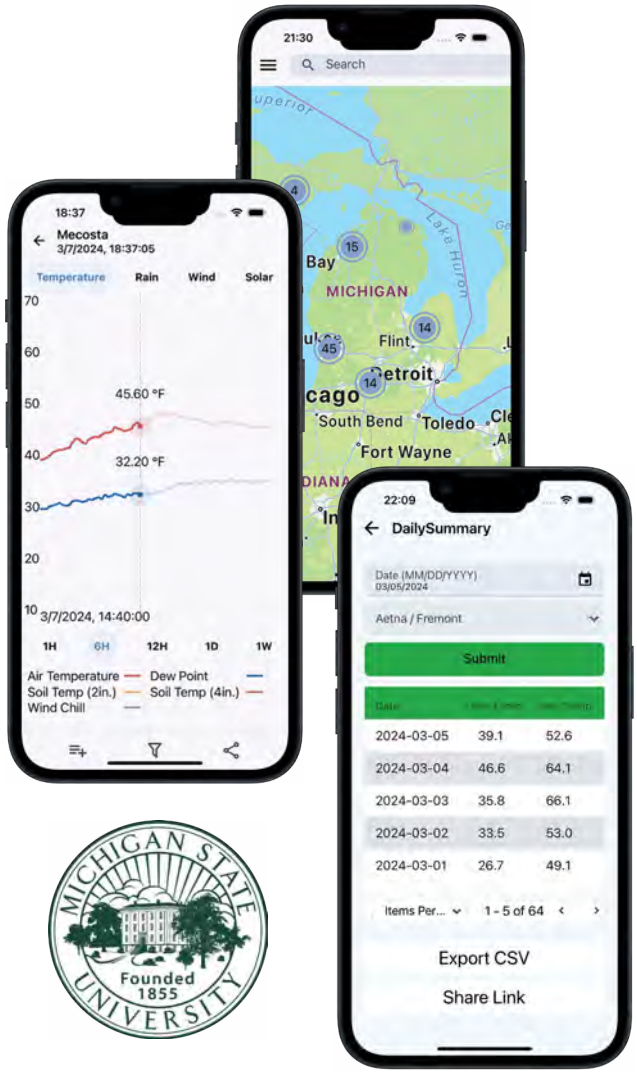
Our Enviroweather Mobile application solves this problem by providing users a way to access Enviroweather's models through an app that is designed and optimized for mobile use. The app is downloaded onto mobile devices and enables users to view all of Enviroweather's helpful metrics in a seamless and easy-to-use way.

Our mobile app contains all of the models that are found on the Enviroweather website. One example is a model that displays information about current and forecasted weather conditions such as temperature and precipitation.

Enviroweather Mobile also contains new and unique models that provide more specific information to agriculturalists to assist in crop management. These models include insights on leaf wetness, soil moisture, and crop pests and diseases.

Having these models in an easy-to-use mobile app enables agriculturalists to make informed decisions about crops, animals, plant diseases, and more.

The front end of our app uses React Native, JavaScript, and CSS. The back end is composed of Enviroweather's API and the National Weather Service's API.



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MillerKnoll
Product Lifecycle Tracing System

MillerKnoll, formerly known as Herman Miller, is renowned for its contemporary interior design and ergonomic furniture. Headquartered in Zeeland, Michigan, they are a leading producer of home and office goods and inventors of the office cubicle.

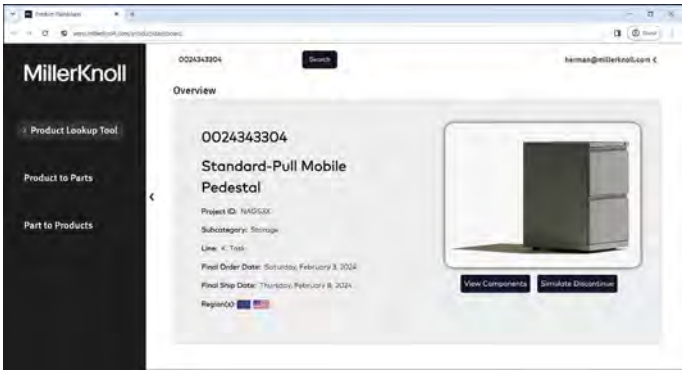
Businesses frequently require specialized furniture for their office space. MillerKnoll services this need with their made-to-order business model. Its level of customizability generates vast amounts of unique data about products and their corresponding components. Manually navigating this information requires a deep understanding of their current inventory and legacy data management systems.

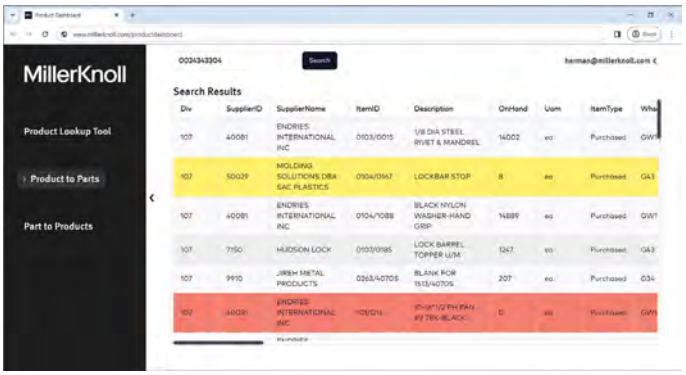
Our Product Lifecycle Tracing System is a web application that provides a centralized, user-friendly way to find product information. Users search for a component and receive basic information about the item, such as its current stock, manufacturing location, and latest order and ship dates.

When searching for a product, users are provided with a summary of its metadata. They can simulate the product's discontinuation and view the impacts on each of its associated components. The software displays components that can be safely removed from the supply chain, while flagging those that other products depend on.

Our system establishes relationships between parts and products. It determines how integral specific components are to the product lineup. It gives insight into how resources can be better allocated, supporting supply and product managers in making informed decisions regarding production volumes.

Our front-end software is built using Next.js, ensuring responsiveness when processing large quantities of data. The back-end software is built with Express.js, which queries a Snowflake database to serve information to the front end.





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MSU Federal Credit Union

Personalized Augmented Reality Experience

Established in 1937, MSU Federal Credit Union (MSUFCU) has been serving Michigan State University and the greater Lansing area for over 84 years. With over 20 branch locations statewide, 361,000 members, and managing nearly $7.71 billion in assets, MSUFCU strives to help its local communities thrive and achieve financial freedom.

When visiting a branch, MSUFCU currently provides a standard check-in process that requires a member to input their name and wait for an attendant to assist them. As modern technology continues to advance, MSUFCU is looking to introduce a streamlined and personalized on-site experience.

Our Personalized Augmented Reality Experience is a mobile application and web application that provides customers visiting a branch with a digital, yet personalized, experience by offering recommendations for their visit based on a customer's predicted purpose for visiting the branch.

The user begins the experience by using our iOS app to find a nearby MSUFCU branch. The app uses geolocation to recognize when a user approaches a branch. The user then authenticates their account with facial recognition and accesses the Personalized Augmented Reality Experience tool on an on-site screen.

The user is then presented with a list of services on their phone that they can perform at the branch. These include the ability to make deposits or withdrawals, request a loan, or any other common bank activity. The list of services provided by the application is tailored towards the specific user based on their banking history.

The web application displayed by the on-site screen is developed using Python Flask for the back end and HTML, CSS, and Vue.js for the front end. The database that is utilized by the web application is an Amazon Relational Database MySQL server. The iOS mobile application is developed with SwiftUI.

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Roosevelt Innovations
Microsoft Excel Data Extractor/Modeler

Roosevelt Innovations provides simple, seamless, and smart software solutions for calculating group rate coverage for dental insurance. Headquartered in Okemos, Michigan, Roosevelt Innovations serves over 23 million customers with 50+ years of claims experience.

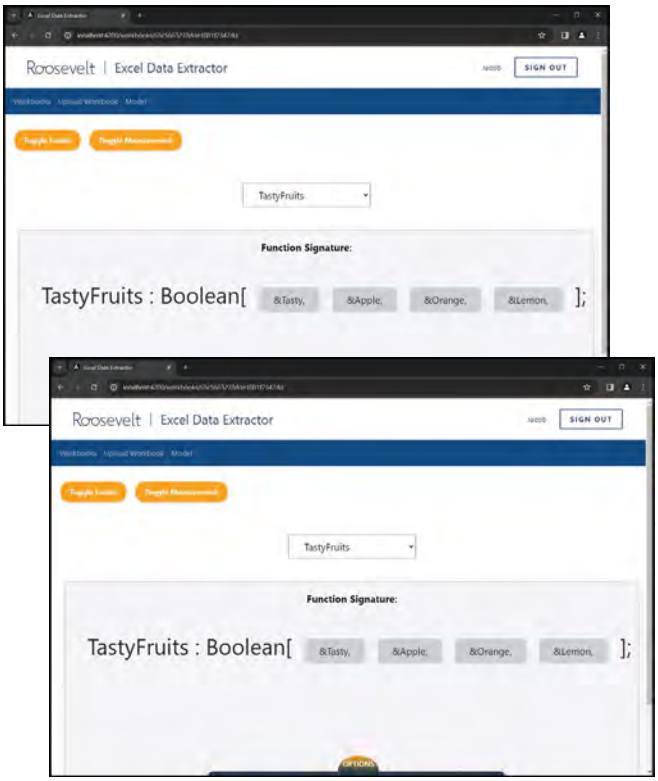
Insurance rates depend on a wide range of factors. Companies seeking to purchase group insurance deal with a large amount of information to calculate the cost for each employee. Microsoft Excel workbooks are a powerful tool for storing and calculating this information. However, rate calculation may become increasingly complex, thus Excel struggles to scale to match corporate demand.

Our Microsoft Excel Data Extractor/Modeler converts information from an Excel workbook to a company domain-specific language, known as GRACE. Users view the workbook in our system, then select groups of related cells, assigning a label to each group. The user also defines custom measurements of interest. Our system automatically converts this measurement information into a calculation using the labels defined in our system.

Diagrams are displayed that show all the labels and measurements defined within a workbook. These diagrams display how different items relate to one another in a graphical format. This deepens the user's understanding of the relationships between elements and the importance of certain factors on an insurance rate calculation. The user can also see redundant relations within the data and optimize their formulas.

Our software simplifies the data ingestion and viewing process, saving time and money.

Our web application is built with an Angular framework written in Typescript, HTML5 and Sass. The web app utilizes a MongoDB connection by communicating with a Quarkus API endpoint written in Java.



Roosevelt
simple. seamless. smart.

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RPM
Voice Transcription System

RPM is an international logistics and supply chain solutions company based in Royal Oak, Michigan. RPM specializes in freight transportation and vehicle logistics across North America, including Mexico and Canada.

As a non-asset logistics company, RPM invests heavily in supporting customers and carriers. RPM has 24/7 on-call representatives which aid carriers but increase operational cost. RPM wants to increase the efficiency of helping carriers and customers alike while reducing costs.

Our Voice Transcription System provides customer service by answering any inquiries the clients have over the phone. The system seamlessly addresses a diverse number of inquiries from carriers and customers without the need of a representative.

Furthering the goal of seamless customer service, our system boasts advanced caller recognition technology that identifies users by their voice. This eliminates the need for users to provide additional information, ensuring swift and hassle-free assistance.

Our system fosters natural interactions and supports Spanish conversations for non-English speakers. System administrators can view callers' data on the web portal. Our system also takes initiative while assisting callers to update crucial information from carriers and clients, again improving efficiency with little effort.

Our system provides high-quality assistance to carriers, reducing costs and increasing customer satisfaction.

The Voice Transcription API is a back-end service that is integrated with phone calls and an admin portal. The service utilizes Python Flask as well as OpenAI, Azure AI, Turvo, Twilio, and React. The Voice Transcription API is hosted on Python Flask. OpenAI's API provides natural language processing, Azure AI translates speech in real-time, Twilio's API manages incoming and outgoing calls, while Turvo's API pulls data from RPM's database.

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Stryker
Dynamic Visualization of Architecture Diagrams

Stryker is a Fortune 500 company that provides world class medical equipment to hospitals worldwide. From surgical equipment to neurotechnology, Stryker is active in over 100 countries and impacts more than 130 million patients annually.

The need to synchronize data across multiple applications, databases, and platforms is strategically imperative for Stryker to stay agile and competitive. With over 200 systems and thousands of integrations between them, Stryker employees need a visual way to display these relationships. The current modeling process relies on manual work done by an engineer, consuming valuable time and increasing the risk of errors.

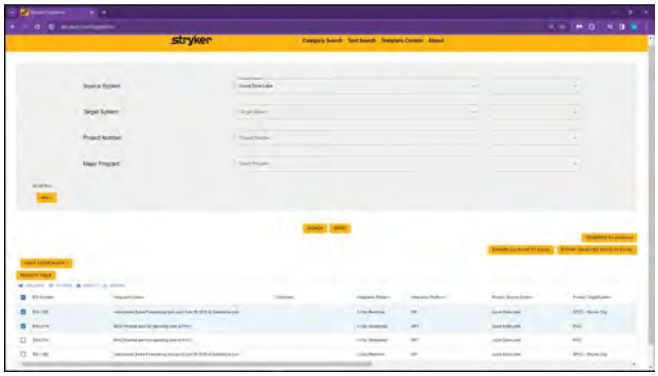
Our Dynamic Visualization of Architecture Diagrams is a web application that improves this modeling process by generating accurate and precise diagrams that represent Stryker's systems and the relationships between them.

Once navigated to the website, the user is presented with options for systems that they can filter to select only the elements they need in their diagram. The software then automatically creates a diagram showing the selected systems and what integrations are present between them. The resulting diagram is then displayed on the web page for viewing. Template diagrams can also be generated with generic information for users to edit.

Diagrams made by the web app can be exported to a Microsoft Visio diagram for further changes. The data can also be exported to a Microsoft Excel file.

Our system saves Stryker engineers time and minimizes opportunity for error by generating accurate architecture diagrams instead of having to do them manually.

The application's back end uses Flask. The front end uses React, hosted on Azure Web App Service. Data for the architecture diagrams is stored in Stryker's Azure SQL Server.



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TechSmith
Enhanced Video Assistant (EVA)

Founded in 1987, TechSmith is the global leader in screen recording and screen capture technologies. TechSmith creates software that empowers people to produce extraordinary videos and images. One of TechSmith's key software products, Camtasia, currently has over 39 million users.

As video editing can be time-consuming and difficult to learn, many people are unfamiliar with the process. Additionally, most video editing applications have a large learning curve requiring hours of practice. This creates a problem as many people find themselves unable to enhance or improve a video with ease.

To combat this issue, our Enhanced Video Assistant (EVA) web application enables users to upload videos to be edited by our AI systems. Our software receives a given video and, with a click of a button, seamlessly transforms it into a well-polished product, saving users' time and energy.

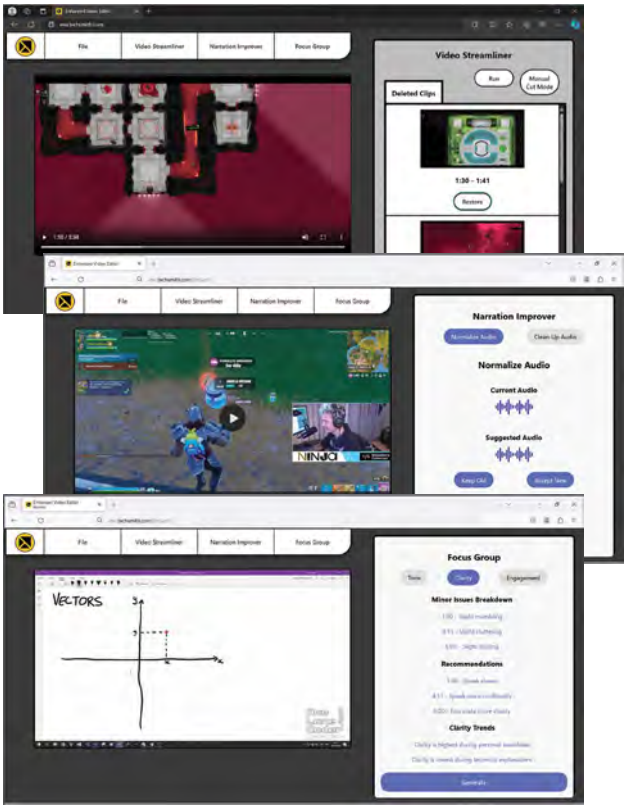
To do this, our system analyzes which segments of a video are most important by using voice recognition and computer vision. EVA removes the unnecessary clips from the video, while retaining the key segments, ensuring that only the best parts remain.

In addition to condensing the video, our software normalizes and balances the video's audio content by filtering out stuttering and background noises.

Finally, our platform contains an AI audience which provides an in-depth rating of the clarity, engagement, and tone of the video content, informing the user about the quality of their video.

Using our tool, video editing is seamless, enabling anyone to make an expertly crafted video regardless of experience.

The back end of our Enhanced Video Assistant is built using FastAPI, while the front end uses ReactJS. The web application is hosted on Microsoft Azure. EVA uses OpenAI Whisper and Azure AI Video Indexer to analyze the videos.



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Union Pacific
Rules Test Practice Tool

Union Pacific, headquartered in Omaha, Nebraska, is a leading railroad franchise in the United States, playing a pivotal role in the global supply chain. With an extensive network of railroads spanning 32,200 miles across 23 states, Union Pacific is a united team of over 30,000 employees committed to safe locomotive transport.

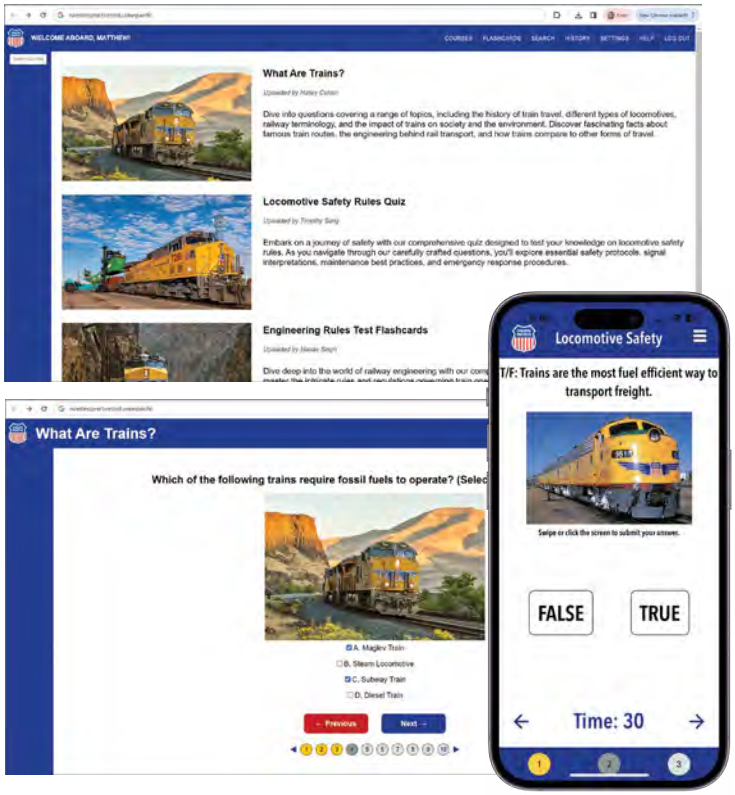
Every three years, Union Pacific requires their employees to review for an online license renewal exam that covers over 3,000 rules for railroad and locomotive operation. Studying for these exams is crucial to both success and operational safety.

Our Rules Test Practice Tool modernizes the training process for Union Pacific employees. Our software addresses the need for an accessible learning platform with an engaging user interface and flexible exam formats. By replacing old testing applications with a versatile web and mobile app, the tool's stimulating learning environment improves study habits and exam preparation.

Our tool features multiple testing options and an interface which simplifies navigation and makes learning more intuitive. The platform supports many question formats, including multiple-choice, true/false, and multi-select, as well as multimedia elements. Our software functions across desktop and mobile devices, providing users with access to study materials anytime, anywhere.

Our software consolidates the wealth of educational material Union Pacific holds, better preparing employees for their exams and increasing safety within the company.

The Rules Test Practice Tool is built using ReactJS and React Native for the front end and Firebase as the back end. With SCORM compatibility, the tool easily integrates into existing learning management systems. Our software draws JSON and CSV files from Firebase and uses a standardized format to generate and distribute exams.



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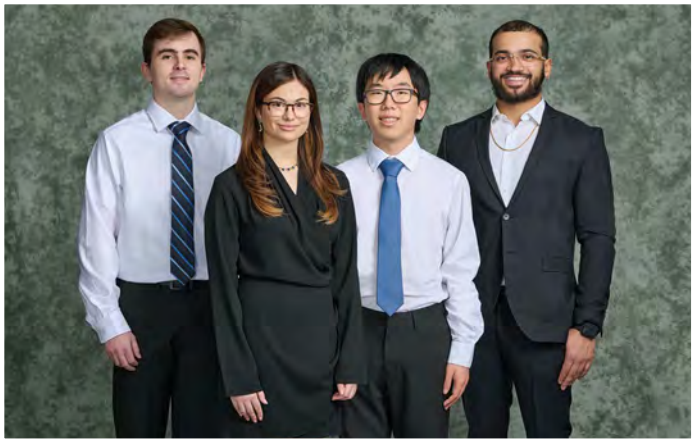

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United Airlines
Airworthiness Release Management System

United Airlines is one of the world's top commercial airlines. With a fleet of over 900 aircraft, they rank as the world's third largest airline. United Airlines deploys this fleet to conduct 4,500 flights a day that reach over 300 cities.

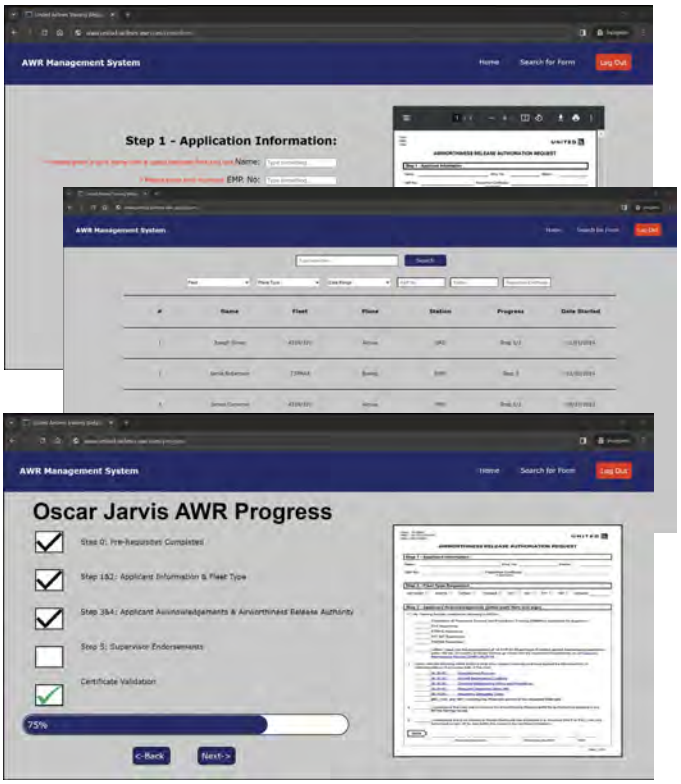
United Airlines employs many technicians who work on both the aircraft, as well as the systems in place necessary for successful flights. To work on aircrafts, technicians must be certified airworthy. The process of becoming airworthy involves the technician completing certain trainings and tracking their completion. Once those steps are complete, a supervisor signs off an authorization request to finalize the certification.

This process consumes time and is tracked with paper records. Our Airworthiness Release Management System digitizes the entire airworthiness process, including tracking completion.

Our system manages the creation, signing, and storage of the airworthiness release authorization requests. An employee can easily create the initial form by filling out their basic information. Then, both the technician and supervisor can sign and complete the newly-created form. Incomplete and complete forms are stored online and can be easily searched for using our system. During the form completion process, reminders are sent out to employees if a form requires an action from them. The entire process now requires no paper forms or signatures.

Our system streamlines the airworthiness release process, increasing efficiency and reducing user error.

The user interface for our Airworthiness Release Management System is developed using HTML, CSS, and JavaScript. The back end is developed using Flask, MySQL, REST APIs, and Python algorithms. Completed forms are stored in SharePoint, technician training records are stored in MTISe, and our web application is containerized and deployed using Docker.



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Urban Science
AuditBuddy

Urban Science is a leading global consulting firm headquartered in Detroit, Michigan that has provided tailored insights and solutions for the automotive industry worldwide since 1977. They leverage data and business science to help clients increase market share, improve profitability, and enhance customer satisfaction.

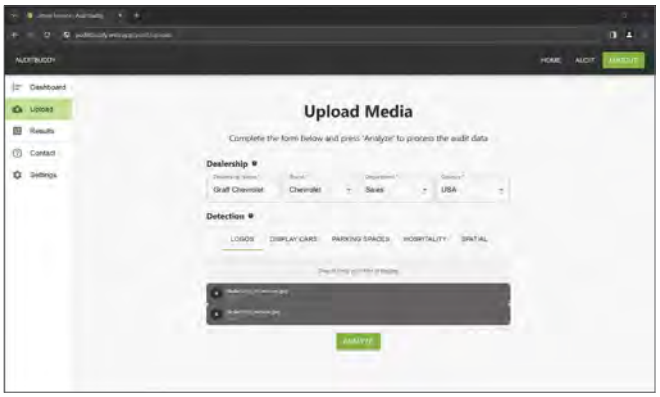
Automotive companies rely on car dealerships to make a strong first impression on potential customers. They recruit Urban Science to audit their dealerships for compliance with brand standards. The traditional audit process requires auditors to conduct an in-person inspection of a dealership, evaluate the premises on various metrics, and build a report manually. While thorough and effective, the process is time-consuming and resource-intensive.

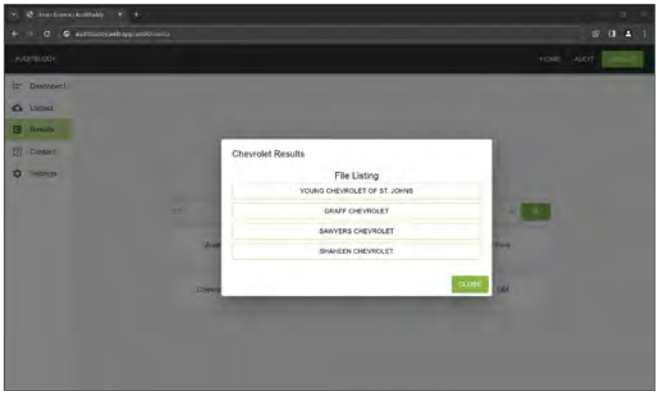
Our AuditBuddy web application significantly reduces the total audit time by utilizing artificial intelligence to analyze and evaluate footage from dealership premises.

The AuditBuddy web application interface provides a separate media file upload space for each evaluation factor. Users capture videos and photos and upload each media item to the corresponding media file. Subsequently, the footage is analyzed using our AI model and the dealership is evaluated based on the standards set by the brand.

The application produces a comprehensive report on dealership performance based on factors such as the quality of display, customer hospitality, employee satisfaction, and parking availability. Along with generating new reports, auditors can access historical reports and compare statistics across various dealerships over different time periods.

Our web application is built using ReactJS for the front end, Firebase for data storage, and Python Flask for the back end. It utilizes YOLOv3 and the Google Cloud Vision API to perform advanced computer vision tasks.





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UWM
IT Datamart Microservice for BitBucket

Headquartered in Pontiac, Michigan, UWM provides mortgage products and services to mortgage brokers all over the country and is currently the top wholesale and mortgage lender in the United States.

To support their daily operations, UWM's technical production is massive and in a constant state of change. With thousands of lines of code changing every day, production and deployment issues arise. Finding these bugs can be difficult, time-consuming, and may slow down progress.

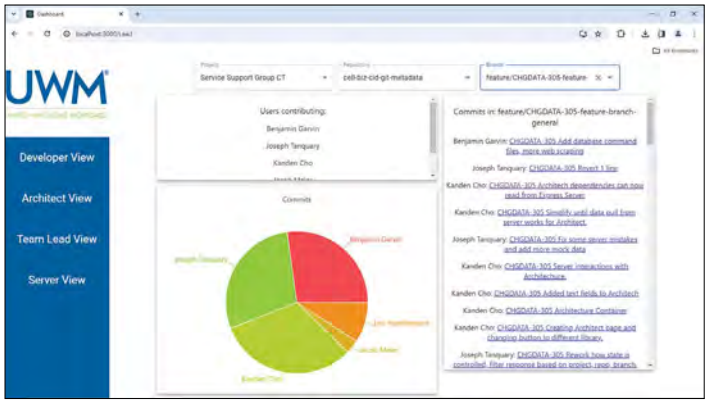
Our IT Datamart Microservice for BitBucket tool solves this problem by providing a way for managers to identify potential issues and predict where future problems may occur.

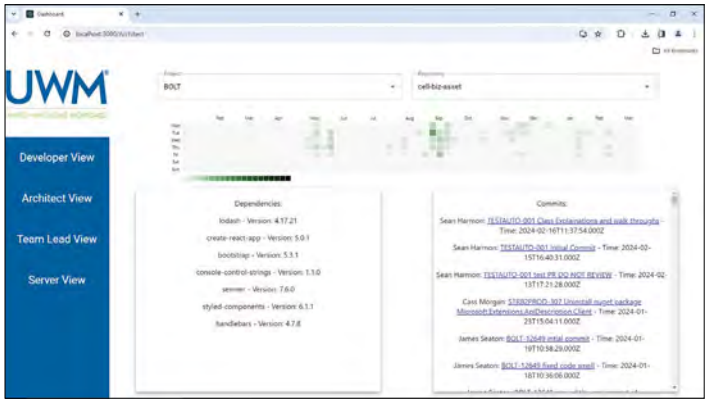
As software engineers make changes to UWM's BitBucket code repositories, our tool collects data about the changes. The data collected includes the number of commits to a branch or repository per day, the IDs of developers who contributed to a given branch, how much was contributed, when it was contributed, dependencies of the project, and more.

Once gathered, the data is then displayed on our web dashboard. The dashboard presents various diagrams for UWM employees to view. This enables managers to view information regarding thousands of code changes across the company at a glance.

Managers can then use this data to identify potential issues and predict where future problems may occur. This aids in improving code quality and preventing future bugs.

Our business logic is a microservice which is written in C#. It is hosted on a Docker container within UWM's larger server systems. In a separate container is our website written in ReactJS, which, along with the C# logic, communicates with Microsoft SQL Server to update UI elements and provide current and useful information.





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Vectra AI
Hybrid Cyberattack Simulator

Vectra AI is a leader in the cybersecurity field, harnessing the power of artificial intelligence (AI) to provide clients with state-of-the-art threat detection and real-time response across all domains of enterprise systems. With over a decade of experience, Vectra AI provides security for enterprises in 113 countries.

Today, more than 62% of all network intrusions originate from third-party vulnerabilities. Modern organizations integrate many third-party services into their technology ecosystems. However, most offer little to no visibility into attacks that span different technologies and providers. These attacks are known as hybrid attacks, and they are a critical weakness in many security systems.

It is essential that Vectra AI train their AI models to detect threats coming from any direction, including these traditional blind spots occupied by hybrid attacks. The main limitation of trying to protect against hybrid attacks, is that there is limited data available to use for training AI models.

Our Hybrid Cyberattack Simulator takes Vectra's existing Command and Control Simulator to new heights by introducing tools that generate realistic hybrid attack data. These simulated hybrid attacks produce valuable network traffic data that is displayed on a dashboard and aggregated for easy model training.

Vectra engineers use the simulated attack data to train and improve their detection systems to be able to handle these hybrid attacks that were previously underrepresented.

Our system increases the effectiveness and breadth of Vectra AI's security service, and in turn, improves the security of Vectra AI's clients.

Our server is hosted on Amazon Web Services in an EC2 instance, and our entire application set is written in Python. Our server communication with the client is achieved over multiple protocols.

VECTRA®

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Whirlpool Corporation
Personalizing the Culinary Experience

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is a global home appliance manufacturer with approximately $20 billion in annual sales, 54 manufacturing and research centers, and 61,000 employees. Whirlpool's mission is to improve satisfaction and engagement with their home appliances.

As smart appliances become more common, personalization and adaptability to users' preferences are crucial for product differentiation and user satisfaction.

While most smart appliances offer a generic approach to user profiles and recommendations, Whirlpool is at the forefront of creating personalized user experiences, setting a new standard for appliance functionality.

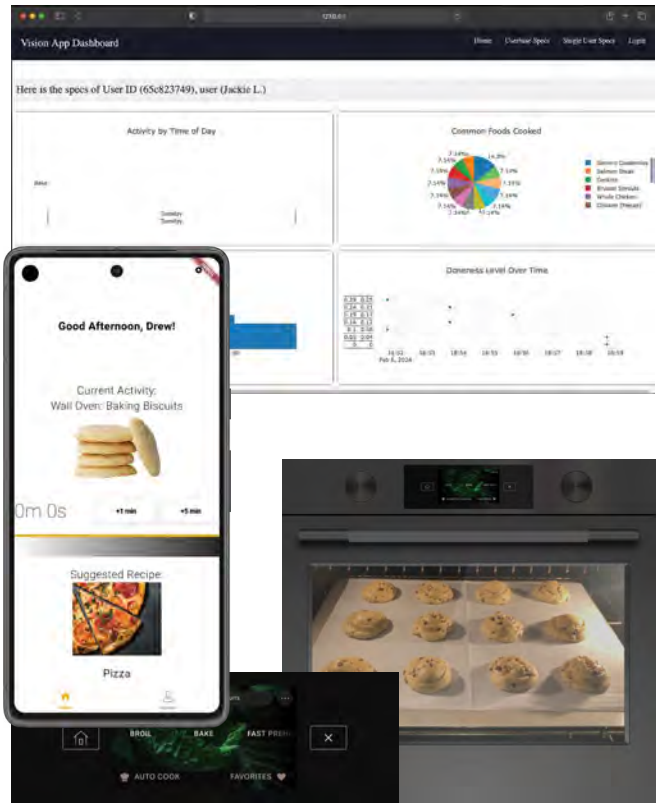
Our Personalizing the Culinary Experience application enables Whirlpool ovens to learn users' cooking habits and personalize their experience.

Our machine learning model responds to user interactions by identifying patterns in cooking settings, recipe details, and other preferences, ultimately refining user profiles over time.

This information is then used to generate tailored recipe recommendations and suggest cooking settings for the user.

Aggregated user analytics are accessible on our web dashboard, enabling Whirlpool's food scientists to enhance their services. These applications help advance Whirlpool's mission in improving user engagement by incorporating machine learning to provide customized recipe recommendations.

Our mobile and smart oven applications are built with Dart, and the dashboard is developed using JavaScript and Plotly. These applications are supported by a MongoDB server, with API calls facilitated by FastAPI. Recommendations are generated by BERT, a transformer model from Hugging Face, which we fine-tuned for our application.



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WK Kellogg Co
Next Gen Smart Factory

WK Kellogg Co, home of the world's most memorable cereal brands, is one of the largest food manufacturing companies in the nation. Located in Battle Creek, Michigan, WK Kellogg Co was created as a spinoff of Kellogg's, owning the North American cereal division.

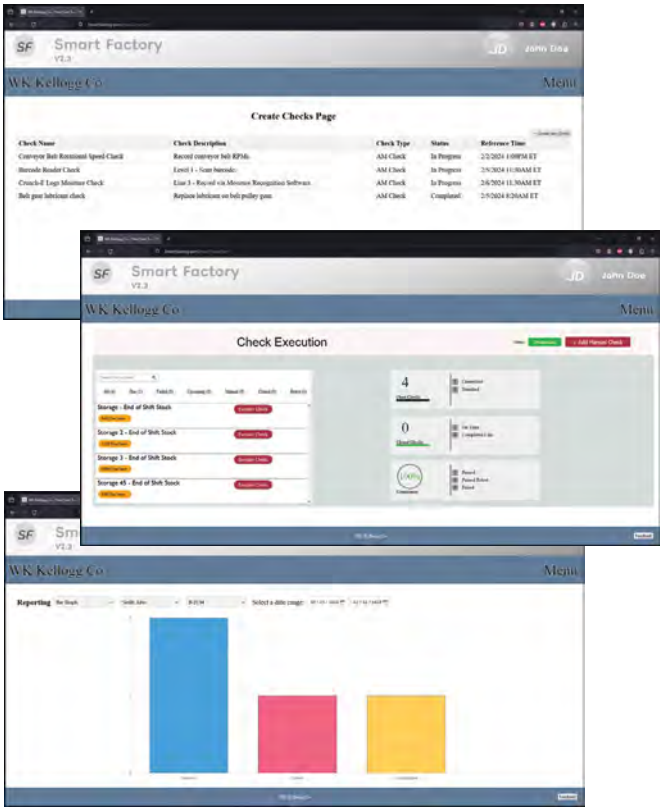
Proper factory operations are integral to cereal production. To manage factory operations, WK Kellogg Co uses a web application called Smart Factory to track factory logistics. Smart Factory keeps track of maintenance tasks for factory operators and enables management to create tasks and view visualizations of historical factory data.

However, the software that Smart Factory was created with is being retired and is not part of the new WKKC landscape. Moreover, some users of the existing software have expressed a desire for a more intuitive design for Smart Factory's next iteration.

Our Next Gen Smart Factory platform replaces the existing Smart Factory software to provide seamless and intuitive operations for administrators and factory operators alike. Moreover, Next Gen Smart Factory preserves the integral components of the previous iteration of Smart Factory while improving the user experience for administrators and operators.

Our tool enables administrators to create customizable checks for operators, track task progress, and visualize historical factory data. Operators complete checks assigned by administrators and report this via our tool. These checks are easily logged and parsed to extract relevant data for administrator review, ensuring that WKKC factories are able to continue making their famous cereals.

Next Gen Smart Factory is developed using HTML, CSS, and JavaScript for a modern, friendly, and intuitive user interface. The historical factory data is stored in a SQL Database, and Python's Flask framework to connect the front end and back end seamlessly.



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Design Day Awards

CSE 498, Collaborative Design, is the senior capstone course for students majoring in computer science. Teams of students design, develop and deliver a significant software system for corporate clients. The CSE capstone teams compete for four prestigious awards. Here are the winners from the fall of 2023.

Auto-Owners Insurance Exposition Award

CSE 498 capstone teams present their projects on Design Day in a variety of ways. Teams create and set up an exhibit where they demonstrate their software systems and answer questions from Design Day attendees including the Design Day judges.

The CSE capstone team with the best overall Design Day performance is honored with the Auto-Owners Exposition Award, which is sponsored by Auto-Owners Insurance Company of Lansing, Michigan.

Team Anthropocene Institute
Machine Learning for Optimization of Carbon Removal

Edie Haase, Nick Wang, Hemanth Yalamanchili, Jack Holscher, Ishita Kokil
Presented by Julie Wilkinson and Ross Hacker of Auto-Owners

MSU Federal Credit Union Praxis Award

One of the hallmarks of CSE 498 capstone projects is that of praxis, the process of putting theoretical knowledge into practice. Teams apply a wide variety of information technologies to produce solutions to complex problems in areas such as business, engineering, computing, and science.

The CSE capstone team that engineers the software system that is the most technically challenging is recognized with the MSU Federal Credit Union Praxis Award, which is sponsored by MSU Federal Credit Union of East Lansing, Michigan.

Team Vectra AI
Malware Command and Control Channel Simulator

Ben Hayes, Trevor Davis, Andrew Vandercar, Nixon Holley
Presented by Ben Maxim of MSUFCU

While each of the awards has a principal focus, every winning team is required to deliver a comprehensive software system, and to demonstrate outstanding communication skills by presenting, demonstrating and defending their work.

TechSmith Screencast Award

Each CSE 498 capstone team produces a video that describes and demonstrates their software product. Starting with a storyboard and a script, teams use Camtasia Studio to synthesize screen recordings, video, audio and other multimedia to produce their project videos.

And the TechSmith Screencast Award goes to... the CSE capstone team with the best project video. The award is sponsored by the creators of Camtasia Studio, TechSmith of East Lansing, Michigan.

Team TechSmith
ACE: Automated Content Editor

Gabriel Sotelo, Riley Tucker, Justin Masters, Emily Feuer, Joe Baran
Presented by Tony Lambert of TechSmith

Amazon Sigma Award

The CSE 498 experience represents the capstone of the educational career of each computer science major. An intense semester of teamwork produces impressive deliverables that include a formal technical specification, software, documentation, user manuals, a video, a team web site, and Design Day participation. The resulting sum, the capstone experience, is much greater than the parts.

The capstone team that delivers the best overall capstone experience is recognized with the Amazon Sigma Award, which is sponsored by Amazon of Seattle, Washington and Detroit, Michigan.

Team Moii.AI
Small Object Detection Using CCTV Cameras

Khushi Vora, Ian S. Valdovinos Granados, Nathan Srivastava, Hong Zhuang, Angela Majestic
Presented by E.J. Dyksen of Amazon

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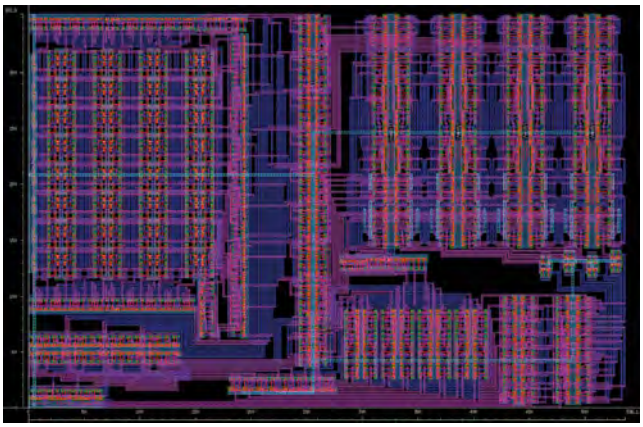
ECE 410
VLSI Design

Instructor: Prof. Steve Zajac
TA Staff: Abdelrahman Abdelkader, Zainub Laji, Avirup Roy, Jason Shell

Design and Characterization of a CMOS 8-bit Microprocessor Data Path

Students in ECE 410 were challenged to design the schematic and physical layout of an 8-bit microprocessor data path, including an Arithmetic Logic Unit (ALU), a barrel shifter, and a register file, using CMOS circuitry and Cadence VLSI design tools. The resulting microprocessor datapath projects will be judged on their ability to satisfy several competing goals, including speed, minimization of area, number of operations and difficulty of the operation set.



Spring 2023 Winning Design

Intel Outstanding Project Award

The Intel Outstanding Project Award ($600) will be awarded to the team that produces the best overall project, as judged by a panel of experts from industry and academia. The faculty and students of Electrical and Computer Engineering are very grateful to Intel for the generous sponsorship of this award.

Team 1
Prerana Gunda
Samuel Rabick
Rachel White

Team 2
Alexander Bejin
Noah Deback
Ben Schuchardt

Team 3
Jake Cabana
Justin Littleton
Sebastian Spaenle

Team 4
Adishvar Jeyaranjan
Benjamin Leising
William Nimtz

Team 5
Ethan Grant
Kihong Kim
Doriana Vuljaj

Team 6
Ian Ashley
Krish Chiwhane
Scott Risdon

Team 7
Jaden Hanold
Zoltan Kovacs
Peyton Nagher
Remy Van Wert

Team 8
Brandon Curtis
Bryan Malak
Mateusz Moczulski

Team 9
Aryan Gondkar
Benjamin Griffith
Randy Hirmiz

Team 10
Adrinil Dennis
Erik Firehammer
Frank Wei

Spring 2023 Intel Outstanding Project Award Winners:
Kyle Neid, Keaton Mulcahy, Maximus Sese

The Capstone Projects

Dr. Yiming Deng
Associate Professor of Electrical and Computer Engineering

Dr. Jian Ren
Professor of Electrical and Computer Engineering

Project Facilitators: Premjeet Chahal, Robert McGough, Daniel Morris, Jeffrey Nanzer Panagiotis Traganitis


Chahal


McGough


Morris


Nanzer


Traganitis

Presentation Schedule – Engineering Building, Room 2245

Time	Team Sponsor	Project Title
8:00 a.m.	MSU College of Music	Feel the Music
8:30 a.m.	Fraunhofer USA	The Design and Fabrication of an Inkjet Printer for Selective Diamond Growth
9:00 a.m.	Wyatt's Creative Works, LLC.	Isn't it LIFEly?
9:30 a.m.	Break	
10:00 a.m.	Valtech Mobility-Detroit, Safety Team	Pedestrian Crossing Awareness Service
10:30 a.m.	Texas Instruments	System for Slope Measurement with Radar

ECE 480 Senior Design

ECE 480 is required of all electrical engineering or computer engineering majors at MSU. It prepares students for the workplace, or for graduate school, including:

- Putting into practice the technical skills learned in the classroom, on industrially sponsored team projects, under faculty guidance, doing open-ended design, giving them experience in teamwork, project management, product life cycle management, intellectual property, accommodation issues and entrepreneurship;
- Polishing their communication skills - individual and team - on proposals, reports, resumes, evaluations, posters, web pages, and oral presentations; and
- Requiring each student to complete four individual hardware/software laboratory assignments.

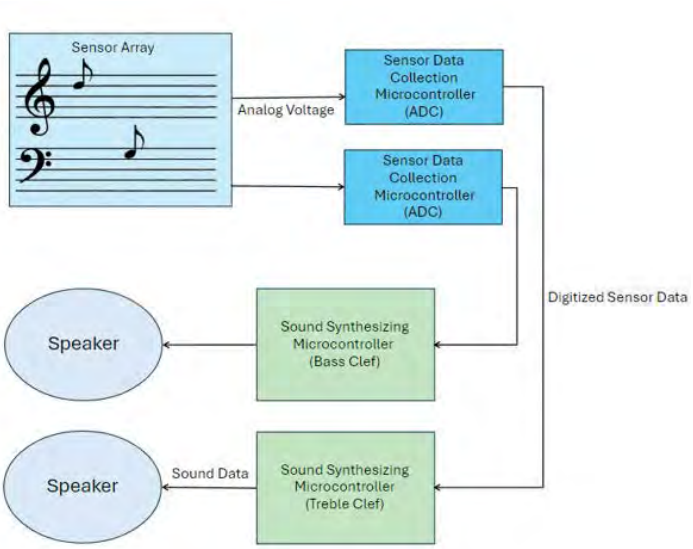
MSU College of Music
Feel the Music

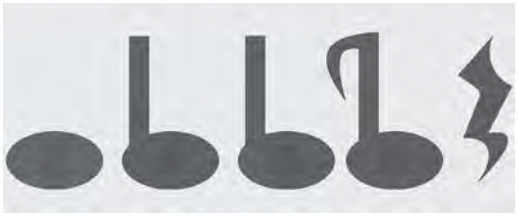
When thinking of music in a general sense, most people think of bars with notes arranged on them to produce a melody. Though to a visually impaired individual, how would you go about describing what can be viewed? Braille notation provides a text description of what can be seen but what if there was a step further? What if there was a way to visualize music through touch?

The goal of this project is to create a 3D tactile approach to written music that overcomes limitations in Braille notation. The board is designed so that a visually impaired individual can interact with music as it was written by a composer. The board contains 3D notes that can be placed on the recessed staff lines to allow the individual to set up several measures at once. These measures play simultaneous staffs of notes with the proper duration and pitch.

The top of the board has embedded metal plates that will react to the magnets embedded in the notes. These 3D notes can then be arranged on the top and bottom staffs on the board. Notes available to be placed on the board include eighth, quarter, half, and whole notes as well as a quarter rest (see the bottom right image).

To detect the note placement and duration, Hall effect sensors are placed just under the surface of the board near the metal plates. These Hall effect sensors change their output voltage if the magnet from a note or rest interacts with the sensor. From here, the voltages are passed through a signal processing system (see the top right image) that will ultimately end with the melody output through two separate speakers.





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MICHIGAN STATE UNIVERSITY

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Dr. Daniel Morris

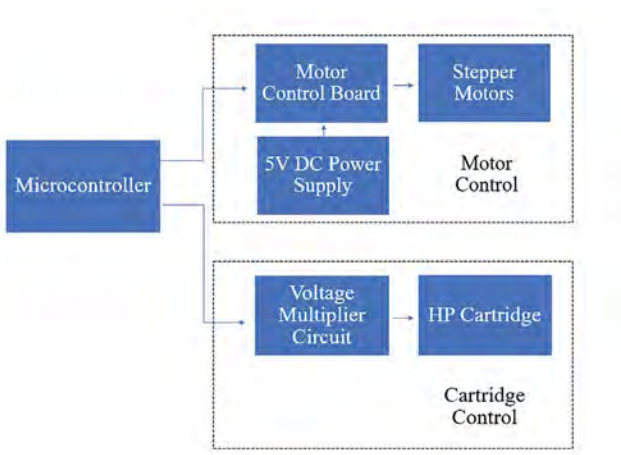
Fraunhofer USA

The Design and Fabrication of an Inkjet Printer for Selective Diamond Growth

Fraunhofer USA is a 501(c)(3) not-for-profit research and development organization that bridges the gap of academic research with industrial scaleup. In collaboration with Michigan State University is the Center Midwest Diamonds and Coatings Division, focused on diamond technologies, thin films, chemical measurements, water treatment and additive manufacturing.

One of Fraunhofer's focuses is increasing the efficiency of diamond chip manufacturing. Currently, it consists of growing an entire silicon wafer with a diamond thin film and processing it. During the diamond patterning, the diamond needs to be removed, presenting a waste of resources, and requiring costly manufacturing equipment. Another issue is that when the diamond grows, there is internal strain causing bowing of the wafer and making it difficult to process. To overcome this, we are striving to develop a selective seeding system through using an inkjet printing device to print a diamond seeding solution directly onto the silicon wafer only where it is needed. This will take an entire step out of the original diamond development approach, which will save Fraunhofer time in the development process.

The printer can move in both the x- and y-axis directions to create the patterns and designs specified by the user. The z-direction is also implemented to enable wafers with varying thicknesses. Additionally, the user is able to interact with the printer to change the height of the nozzle. This will ensure the nozzle does not contact the wafer. If the nozzle does touch the wafer, it could create defect sites in the development process, disrupting the clean fabrication. The goal of this project is to have full control of all three axes, with an accuracy down to 30 micrometers to enhance the chip's functionality and ensure it develops properly.



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Wyatt's Creative Works, LLC.

Isn't it LIFEly?

Wyatt's Creative Works, a startup based in Grand Blanc, Michigan, is thrilled to reveal its latest venture into the digital realm with the development of a mobile application designed to improve personal and business organization. Leveraging the business's expertise in content creation, ranging from publishing books to crafting innovative applications, we are tasked with creating a mobile application that seamlessly integrates into the daily lives of users, enhancing their ability to manage day-to-day tasks with ease and efficiency.

Our application ensures that all users' organizational needs are covered by providing a variety of templates for notetaking and information tracking tailored to users' diverse needs, such as managing bills and expenses to organizing grocery lists, setting agendas, and planning travel. Additionally, our application features a user-friendly toolbar equipped with drawing tools, allowing for the addition of personalized notes to any template. This customization aspect ensures that each user's experience is unique, making their organizational tools truly their own.

To develop a mobile app for iOS and Android within our timeframe, we chose the open-source cross-development platform Flutter. Flutter utilizes the programming language Dart, which allows us to deploy mirror apps to both iOS and Android devices without needing to write in their native languages.

Data storage and authentication are handled via the backend-as-a-service product Google Firebase. Firebase integrates seamlessly with Flutter allowing for a streamlined development process and rapid prototyping, with minimal cost to the client.

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Wyatt's Creative Works
Project Sponsor

Marquonda Wyatt
Grand Blanc, Michigan

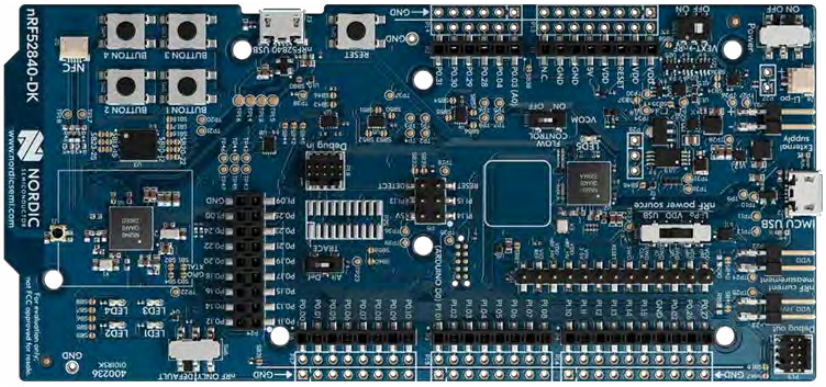
Project Facilitator

Dr. Panagiotis Traganitis

Valtech Mobility – Detroit, Safety Team
Pedestrian Crossing Awareness Service

Valtech Mobility, established in 2018 through a collaboration between Volkswagen Group and Valtech GmbH, focuses on enhancing vehicle intelligence. Their new project aims to leverage technology to enhance pedestrian safety, particularly for individuals using smartphones.

Our mission is to contribute to the creation of intelligent solutions for the future of driving. We closely collaborate with Valtech to ensure that our products are not only useful but also continually improving. Imagine this scenario: individuals often remain engrossed in their phones while waiting at crosswalks. To facilitate their safe crossing, we are enhancing a smartphone app called the Smart Crosswalk Assistant. This app functions as a helpful companion, notifying users when it is safe to cross. Using the phone, the app recognizes when someone is waiting to cross, checks the traffic signals, and sends a notification to the user, indicating that it is safe to proceed. This way, even if people are engrossed in their phones, they won't overlook the signal to cross the road. In this manner, the application serves as a benefit not only to pedestrians navigating crosswalks but also to drivers, minimizing instances of pedestrians crossing when it is not safe, thereby improving traffic flow.



valtech_

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Valtech Mobility – Detroit, Safety Team
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Project Facilitator

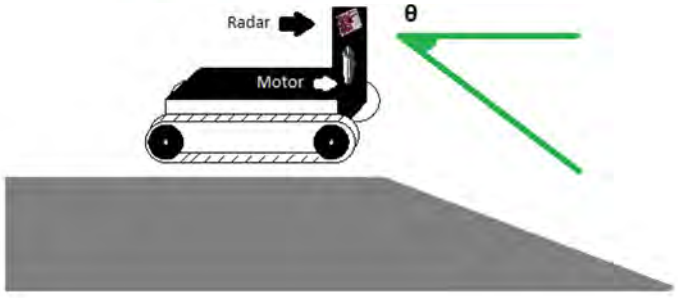
Dr. Jeffrey Nanzer

Texas Instruments
System for Slope Measurement with Radar

Texas Instruments (TI) has been a leader in solving sensing challenges with radar for both industrial and automotive applications. TI began working on its mm Wave radar in 2009. This project achieved its initial goal of bringing affordable sensing to automobiles. The mm Wave is equipped with a high-resolution radar and uses a lower power architecture with the ability to endure strenuous environmental conditions.

Our team sought to solve a fundamental problem using a IWR6843 radar. How do we prevent a robot from falling off a cliff or sliding down an inclined plane? Sensors such as cameras and lidar can be negatively impacted by adverse weather conditions like dense fog, smoke or rain. Radars operating at 60GHz have a larger wavelength and therefore can be more reliable in these weather conditions. Radars operate by transmitting radio waves that will reflect off a surface and then be received by the radar.

We worked to design and build a radar-based system using the IWR6834 and DCA1000 to accurately measure the slope of an inclined plane ahead. The design includes a structure to be able to modify the slope of the inclined plane ahead, a radar and a screen to display the measured slope. The design utilizes only one radar to measure a range of angles. It is mobilized by a servo to adjust its angle and find the optimal position for slope measurement. An algorithm was developed to convert the data into a slope estimate. This system can extend ahead of the robot and successfully measure the slope so a robot can avoid sliding down the slope. Our radar system provides a solution that TI can use for applications that require ground travel.



TEXAS INSTRUMENTS

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The Capstone Projects

Dr. Yiming Deng
Associate Professor of Electrical and Computer Engineering

Dr. Jian Ren
Professor of Electrical and Computer Engineering

Project Facilitators: Virginia Ayers, Shaunak Bopardikar, Mauro Ettore, Matthew Hodek, Oleksii Karpenko, Woongkul (Matt) Lee


Ayers


Bopardikar


Ettore


Hodek


Karpenko


Lee

Presentation Schedule – Engineering Building, Room 2250

Time	Team Sponsor	Project Title
8:00 a.m.	MSU NDE Laboratory and NSF	Aerial Drone for Next Generation NDE
8:30 a.m.	MSU NDE Laboratory	Robotic Arm Object Reconstruction for NDE
9:00 a.m.	MSU Solar Racing Team	MSU Solar Car Battery Management System
9:30 a.m.	Break	
10:00 a.m.	MSU Solar Racing Team	Solar Car Steering Wheel Serial Communication
10:30 a.m.	MSU D-CYPHER Lab	Design of Hardware-in-the-Loop Fire Simulator
11:00 a.m.	MSU Department of Electrical and Computer Engineering	24W DC-DC Converter

ECE 480 Senior Design

We gratefully acknowledge the support of this semester's project sponsors: Fraunhofer USA, MSU College of Engineering, MSU College of Music, MSU D-CYPHER Laboratory, MSU Department of Electrical and Computer Engineering, MSU Nondestructive Evaluation Laboratory, MSU Solar Racing Team, Texas Instruments, Valtech Mobility-Detroit, Safety Team, and Wyatt's Creative Works.

The ECE Project Facilitators who supervised ECE 480 teams this semester are: Virginia Ayres, Shaunak Bopardikar, Prem Chahal, Mauro Ettorre, Matthew Hodek, Oleksii Karpenko, Woongkul (Matt) Lee, Robert McGough, Daniel Morris, Jeffrey Nanzer, and Panagiotis Traganitis.

MSU Nondestructive Evaluation (NDE) Laboratory
Aerial Drone for Next Generation NDE

Nondestructive evaluation (NDE) is a field that involves detailed quantitative inspections of objects without permanently changing or damaging the structure(s) and/or object(s) of interest. NDE ensures the safety and proper functionality of critical infrastructures in the construction, energy, automotive, and aerospace industries.

The MSU NDE Laboratory focuses on designing and developing innovative sensors and monitoring systems to assess the structural integrity of various parts and components. The evaluation of parts includes internal and external flaw detection, flaw thickness measurements, and the analysis of the part or components' material composition.

This project involves implementing a workflow for a manually controlled Autel Evo II Pro v3 aerial drone that will be mounted with a magnetic flux leakage (MFL) sensor developed by the MSU NDE Lab and a purchased Raspberry Pi.

The workflow consists of multiple stages, starting with reconstructing a computerized 3D model from 2D images of the area/structure of interest. The 2D images will be obtained from the drone and its sensors. This is done using the open-source Meshroom software.

The data acquisition stage involves acquiring infrared imaging of the complete target structure and taking MFL readings in regions where damage is suspected. The data processing stage entails overlaying infrared imaging on top of the 3D reconstruction using the CloudCompare software.

Lastly, the evaluation of the structure will be done through statistical analysis, comparing the infrared measurements and the MFL sensor measurements. The combination of this acquired data will suggest the presence of defects, their location, and will provide accurate and detailed measurements for the suspected defects.

Department of Electrical and Computer Engineering
MICHIGAN STATE UNIVERSITY

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Conner Grant
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MSU Non-Destructive Evaluation (NDE) Laboratory
Project Sponsors
MSU Department of Electrical and Computer Engineering
East Lansing, Michigan

MSU Nondestructive Evaluation (NDE) Laboratory
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National Science Foundation (NSF)
Alexandria, Virginia

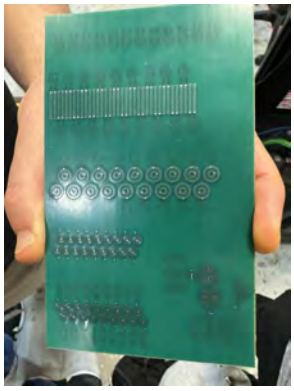
Project Facilitator
Dr. Shaunak Bopardikar

MSU Nondestructive Evaluation (NDE) Laboratory
Robotic Arm Object Reconstruction for NDE

The MSU Nondestructive Evaluation (NDE) Laboratory focuses on developing sensors and systems for monitoring and evaluating structural integrity of parts and components. This includes collecting data on internal or external flaws, determining the precise dimensions of components, and determining material structure and composition. Currently, one of the NDE Laboratory's primary methods of evaluation is a robotic arm with a laser distance sensor as an end effector. The goal of this system is for any component to be able to be scanned and evaluated by the robot in the testing area. Current drawbacks with this system include limited data from the laser sensor which cannot be reliably used to help improve the robot's scanning path, inaccuracies in the robot's programmed vs. actual movements due to its age, and stereo camera 3D imaging not providing consistent or accurate enough data for the precision evaluations NDE Laboratory wants.

Our team has been tasked with improving upon the NDE system's functionality by integrating a new suite of sensors into the current system. This will include an Eddy current sensor, inclinometer sensor, and the required support modules to run these sensors such as a Raspberry Pi and DAQs. The Eddy current sensor in the form of a printed circuit board (PCB) will assist in conducting more precise NDE analysis and provide mapping data that can be used to improve the robot's scanning path. The inclinometer will be implemented to generate precise positional and angular data of the robot's end effector in order to solve the robot's accuracy issues adhering to its scanning path while working in conjunction with an L-GAGE Laser sensor from the previous design team.

Our goal this semester is to deliver a working NDE analysis package that satisfies or exceeds the expected improvements to the current system's pathing and scanning capabilities without compromising any of its other functionality.



Eddy Current Probes

Fanuc Robotic Arm End Effector Mount

Nondestructive Evaluation Laboratory

Fanuc Robotic Arm and Stereo Camera

Department of Electrical and Computer Engineering
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MSU Non-Destructive Evaluation (NDE) Laboratory
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Project Facilitator

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MSU Solar Racing Team

MSU Solar Car Battery Management System

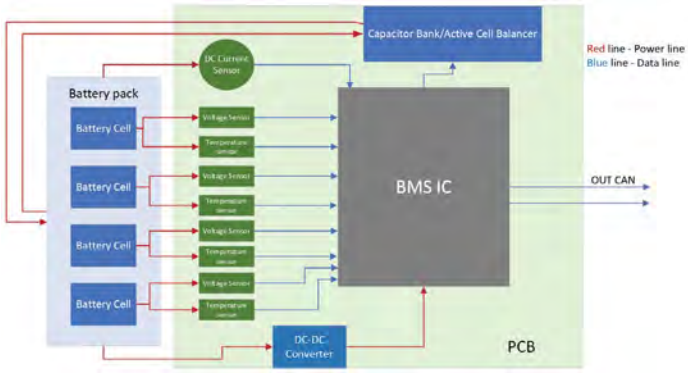
The goal of the MSU Solar Racing Team (SRT) is to design a car that not only runs on solar power, but races long distances. This requires careful balancing of the on-board batteries to allow the car to travel fast while using as little power as possible.

A Battery Management System (BMS) can aid in the regulating of charging and discharging. Additionally, the SRT requests live voltage and temperature measurements of each battery module, as well as the current of the overall system.

These measurements of voltage, temperature, and current are used to monitor the health of the batteries. The use of these values over time can prolong their lifespan.

The picture to the right is a representation of the proposed circuit design, with power lines in red, and data lines in blue. Each battery will have a dedicated voltage and temperature sensor, and one current sensor is placed in series. All of these sensors report to the main Integrated Circuit (IC). The IC then controls a capacitor bank, instructing it how to charge and discharge.

Electric vehicles available for purchase require thousands of battery modules and in turn, require sophisticated management. As the automotive industry moves away from fossil fuels and towards alternative energy, new and innovative techniques must be developed to manage electric energy.



MSU SOLAR RACING TEAM

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(left to right)

Brendan Somers
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MSU Solar Racing Team
Project Sponsor

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Project Facilitator

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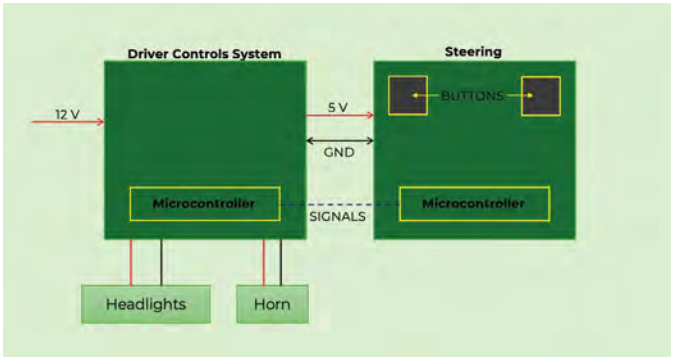
MSU Solar Racing Team

Solar Car Steering Wheel Serial Communication

The MSU Solar Racing Team is a student-led organization that focuses on designing, building, and racing a solar-powered vehicle. The team is comprised of students from many different majors, with the two biggest sub-teams being the Electrical and Mechanical Teams. Students from the Electrical Team mostly contribute by creating the printable circuit boards (PCBs) for different functions of the car and by using software to code these PCBs. Within the Electrical Team, there is the Driver Controls group which focuses on the design and integration of the Driver Controls Systems (DCS) board as well as the Steering board that serves as part of the human-machine-interface between the driver and the DCS.

Currently, the DCS board and the Steering board are connected electrically using parallel wires for each signal. As a result, there is an overwhelming number of wires being used. With the DCS board mounted inside the dash and the Steering board mounted onto the steering wheel, this makes the system more complex and adds weight once it has been integrated into the final design of the car.

To address this issue, a microcontroller can be installed onto the Steering board and serial communication can be used to send the analog signals as digital signals to the DCS board microcontroller. The new microcontroller would also replace the current Arduino Teensy 4.1. It would have low power consumption and be a low-cost option that could end up being implemented onto other boards by the team after this project is completed. The DCS microcontroller would essentially serve the same purpose as it already does, which includes controlling the inputs and outputs that make various functions of the vehicle work. These functions would include, but not be limited to, headlights, turn signals, hazards, cruise control, and horn.



MSU SOLAR RACING TEAM

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MSU Solar Racing Team
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Project Facilitator

Dr. Matthew Hodek

MSU D-CYPHER Lab

Design of Hardware-in-the-Loop Fire Simulator

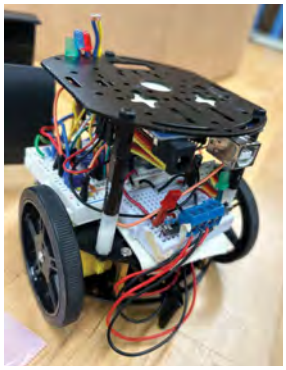
Fire management is a serious contemporary issue. Whether it is a wildfire sparked by lightning or a housefire caused by faulty wiring, it is a tragedy for those involved and a municipal responsibility to extinguish, as swiftly and as effectively as possible.

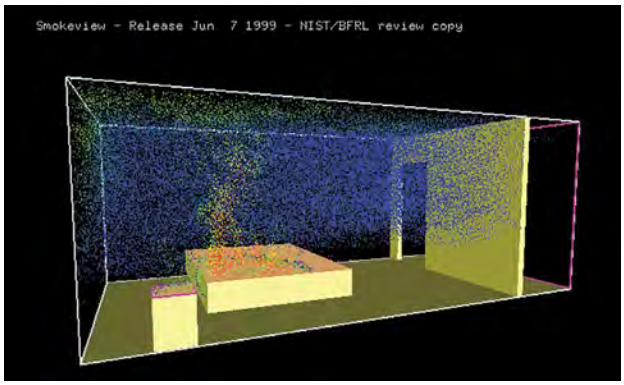
The National Institute of Science and Technology (NIST) has created a Fire Dynamics Simulator (FDS) to model and simulate the fluid dynamics of fire and its mitigation, as well as Smokeview (SMK) to visualize these simulations. These are outstanding tools for analyzing the nature of fires and how they can be suppressed. As is, however, these tools cannot interface with real, physical robots to act out the firefighting case studies.

This is where hardware-in-the loop (HIL) comes in. HIL is a known testing method that sends signals from a controller to hardware to simulate and test software, thus making sure the controller is sending the correct signals. National Instruments describes HIL as a technique to "trick" the controller into thinking it is sending signals to a fully assembled system, even though it is only being sent to a small, simple piece of the assembled system.

By adding real-time simple robots to receive signals from the FDS simulation, our team and the D-CYPHER Lab are creating an HIL system that allows for realistic testing of different algorithms for suppressing fires. Being able to investigate simulated firefighting strategies is valuable as is it costly, ineffective, and often unfeasible to start real fires to do so otherwise.

Our team is bringing this important project to its next operational level. The goal of our project is to develop an HIL system that can interface a full team, or "swarm" of robots with the NIST FDS simulation software. Developed software will monitor physical positions of multiple robots and relate them to positions within the FDS simulation, then activate application of simulated fire retardant. Strategies to extinguish intense, multiple, or moving fires can now be explored.





Department of Electrical and Computer Engineering
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Dr. Virginia Ayres

MSU Department of Electrical and Computer Engineering
24W DC-DC Converter

Michigan State University is home to one of the top engineering programs in the state, providing a quality education to over six thousand undergraduate students every year. MSU relies on various laboratory-based learning experiences to maintain this level of academic quality, and so that students are able to see the conceptual knowledge they learn in their lectures applied in practice.

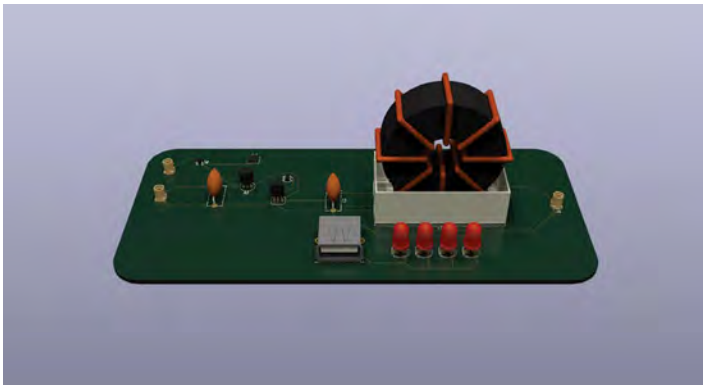
To better facilitate student learning and maintain the high academic standards here at MSU, the Department of Electrical and Computer Engineering is looking to construct a DC-DC converter to be used in various power systems labs for demonstrating and teaching buck and boost operation.

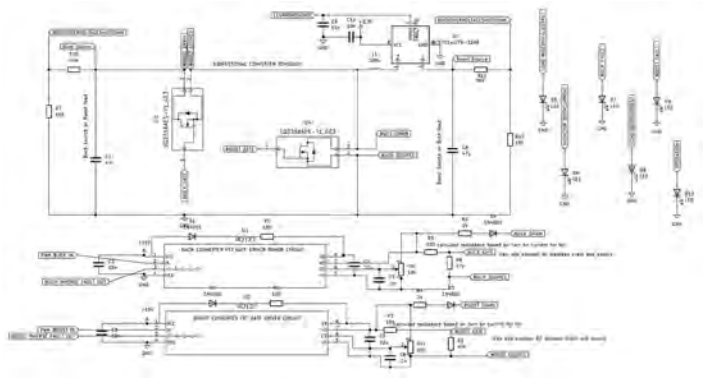
As always, safety is the first priority, especially in a laboratory setting, so the converter will have redundant overcurrent and overvoltage protections, as well as a misconfiguration shutdown, since it is highly likely for things to be assembled incorrectly.

With student learning being the main goal of the project, component accessibility is a high priority; all components will be clearly visible and labeled such that students can easily identify and interact with them. Additionally, certain signals, such as input/output voltages, input/output currents, and inductor current, will be made easily available for display on an oscilloscope.

The physical implementation of the circuit will consist of a PCB enclosed in a 3D-printed case. Physical knobs and buttons will be used to provide user inputs alongside a software interface, which can override the physical controls when connected.

The goal of this project is to design, build, and test a 24W DC-DC converter, with a user adjustable switching frequency, that is capable of being operated in both buck and boost mode, and can accept a 12V input, with a maximum output of 24V.





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Rochester, Michigan

MSU Department of Electrical and Computer Engineering
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Matthew Meier
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Project Facilitator

Dr. Woongkul Lee

ECE Fall 2023 Awards

First Place Award

Team MSU Resource Center for Persons with Disabilities
"Alert System for Visually Impaired to Detect Electric Scooters"

Left to right: Ayush Chinmay, Kattie Romero-Otero, Shayna Wilson, Vigneshwer Ramamoorthi

Second Place Award

Team FRIB (MSU Facility for Rare Isotope Beams)
"Camera-based Rotational Speed Detection System"

Left to right: Josh Warminski, Easton Currie, Kevin Ladley, Kevin Cawley, Andrew Reilman

Third Place Award

Team MSU Department of Electrical and Computer Engineering
"Sound-Activated Interactive Robot System"

Left to right: Haoyan Hu, David Evans, Daniel Evans, Luke Biddle, Shane Morrison

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The Culture

Established & Empowering

As part of the Renaissance Health Service Corporation family of companies, Roosevelt Innovations offers the support of an enterprise with the nimbleness of a start-up. We empower individuals to embrace an entrepreneurial mindset in their role and their career. Everyone's efforts shape the direction and impact the success of the company.

The Work

Challenging, Growth-centric Atmosphere

Employees and interns have opportunities to work with customers and business resources to identify problems and propose unique solutions. Not only is innovation encouraged but is one of our seven core values. The success of the company depends on the successes of each individual. Together, we make Roosevelt Innovations better every day.

Your Career

Investing in Development

At the heart of Roosevelt Innovation's success are our people. We offer established career paths that lead transparently from entry-level to senior leadership. Our leaders of tomorrow are the people we hire today.

ME 412 Heat Transfer Laboratory

Yuping Wang
Academic Specialist
Department of Mechanical Engineering

Radiant Floor Heating Study

Radiant heat has been adopted for floor heating in more and more homes and non-residential buildings nowadays, especially in cold climates. In addition to the warmth and comfort it supplies, a radiant floor can be energy efficient too. For this project, students are expected to understand and perform an analysis for radiant floors. Each student team is to design, build, analyze, and test a simple hydronic radiant heating system to heat up a plywood surface, simulating how a radiant floor works. The objective of the design is for the surface to reach a certain temperature while being heated evenly as well. Hot water will be supplied as the heat source. A second part of the project is for each team to conduct a review on the various space heating systems. On testing day, each team will have 15 minutes to set up, demonstrate/test, and disassemble their device. In addition, they will also prepare a PowerPoint slide show or video clip for the audience to explain their design decisions, fabrication, operations, and thermal analysis of their device.

Competition Schedule

Time	Station	Team Members
8:00	A	Noah Iung, Emilia Jakuc, Maya McRae, Lauren Osiwala, Rachel Schenck
	B	Ian Calandrino, Justin Gauthier, Ethan Labelle, Luke Muller, Evan Rushbrook
8:15	A	Jon Hilton, Dylan Jones, Miles Peters, Anissa Sant, Kevin Schultz
	B	Bradley Haskin, Mason Koudelka, Brandon Roux, Cade Smith, Ozan Wood
8:30	A	Evan Hampel, Olivia Lyle, Alex Miciuda, Noah Roux
	B	Ethan Avery, Steven Coscino, Bennett Guensche, Amanda Jeffers, Sara Purdue
8:45	A	Ethan Azeez, Miles Grimes, Lucas Henricks, Max Hortop, Ryan Prost
	B	Jack Darrow, Daniel Erfani Zachi Yazd, Harshil Jain, Jordan Robinson, Poom Wichitrakanlikit
9:00	A	Rafael Abage, Alayna Celestini, Tyler Doral, Jeremy Kloss, Keegan Sclabassi
	B	Bryant Hixson, Gabe Johnson, Garrett Puehler, Elizabeth Sharkevich
9:15	A	Angelo Bartolome, Sean Blanchard, Megan Fazio, Zach Hetfield, David Kurylo
	B	Rawad Fakhreddine, Cameron Hesano, Aliza Opolka, Fadi Saab, Simon Sajan
9:30	A	Mason Dalrymple, Logan Jacobson, Patrick Ryan, William Schugars, Qifan Weng
	B	Austin Crawford, Sammy Dickow, Mark Kemp, Arjun Patel, Ronak Patel
9:45	A	Panzer Che, Tanaka Chonyera, Eric Joseph, Renee Kinsler, Eric Luo
	B	Pahul Kahlon, Braeden Keener, Kate Nolan, Aditya Tarle, Hoahua Zhang
10:00	A	Connor Casey, Ben Delduca, Andrew Ferguson, Colin Graf, Jacob Kunka
	B	Karem Algarash, Ari Bozann, Ali Lewis, Ryan Qualley, Katelyn Szafranski
10:15	A	Ahmed Abboushi, Gabriel Birchmeier, Ryan Cyrowski, Joe Hamouda, Elan Krakoff
	B	Colin Boulard, Aidan Dobbie, Jonathon Fudala, Manav Shah
10:30	A	Shahab Khorasanizadeh, Maggie Le, Hunter Reif, Michael Taylor, John Young
	B	Matthew Celini, Zach Doerr, Ben Lemke, Christian Takla
10:45	A	Keya Baxi, Nicole Burcon, Gina Sapiano, Brenden Shelby, Tanner Zidzik
	B	Qasem Alobaydan, Deniz Farmaka, Abdallah Hamad, Fallou Mbengue
11:00	A	Carter Beck, Noah Benson, Atharva Burande, Enido Shyti
	B	Drew Darin, Nicholas Malcolm, Sara Moscone, Justin Schmitz, Ethan Wise
11:15	A	Ben Arkles, Isaiah DeVougas, David Mueller, Tyra Treadway, Selena Vidojevski
	B	Ben Hric, Alessio Laura, Kyle Pahl, Jon Paul, Jacob Stabler

ME 470 Mechanical Design & Manufacturing II

Michael Lavagnino
Academic Specialist
Department of Mechanical Engineering

Cornhole Bag Launching Mechanism

The goal in this project is to design, build, and test a cornhole bag launching mechanism that will launch a 12-ounce cornhole bag over 15 feet onto a cornhole board. The mechanism may utilize either hand power or a motor and will incorporate a linkage system with the option of gears and cam-follower systems. The system performance will be assessed by both minimizing the design mass and the ability of the mechanism to score points by launching four bags on the board. Students will utilize materials and manufacturing capabilities from the Manufacturing Teaching Laboratory as well as premade components.

Competition Schedule

Time	Team	Station	Team Members
8:00	1	A	Dalton Dobyns, Chad Fowler, Kenneth Gordon, Tori Morgan, Gerrid Rutledge
	1	B	Zachary Colo, Chris Definis, Alessio Laura, Saransh Mehta
8:15	2	A	Mohammed Al Abri, Parker Bentley, Liam Cooney, Nelson Ladomer, Jared Throne
	2	B	Jacob Greca, Max Hortop, Ben Hric, Andre Johnson
8:30	3	A	Stephan Freitag, Ben Kruk, Gavin LaHousse, Ihsan Murtadho, Jeremy Wall
	3	B	Hussain Ashkanani, Joey Harwood, Malachi Locke, Reeddhiman Rhythm
8:45	4	A	Dominic Bednar, Max Doty, Nathan Downie, Ian Ladd, Uma Pentakota
	4	B	Ryan Bilsky, Monica Roberts, Simon Sajan, Rachel Schenck
9:00	5	A	Ethan Bentley, Haley Dyer, Rawad Fakhreddine, Mitchell Fitzsimons, Cade Smith
	5	B	David Benkes-Toth, Eric Joseph, Payson Kotel, Ethan Newman
9:15	6	A	Sydney Agius, Alex Goolsby, Brenna Marsin, Joshua Riley, David Stegehuis
	6	B	John Burroughs, Lucy Kiloustian, Logan Nicks, Jacob Rubino
9:30	7	A	Julio Dam Ferdinez, Aaron Dawson, Berk Demirci, Ryan Lux, Fadi Saab
	7	B	Hannah Crist, Jon Hilton, Lauren Spott, Cameron Tsivitse
9:45	8	A	Rishabh Ainapurapu, Gunnar Carroll, Ryan Gioffreda, Easton Knott, Logan Trierweiler
	8	B	Blake Bur, Brian Cheladyn, Max Godin, Jacob Rhue
10:00	9	A	Owen Heilman, Stephen Moussiaux, Brock Strebeck, Paddy Toole
	9	B	Mustafa Alobaidi, Therese Gordon, David Kurylo, Emma Luzbetak
10:15	10	A	Jack Bajcz, Danny Choroszucha, Shivam Pandey, Miko Parkinson, Ava Shumaker, Deyuan Wang
	10	B	Sydney Bush, Ryan Harth, Michael Maser, Tanner Zidzik
10:30	11	B	Anthony Demaio, Chase Montour, Yash Patil, William Schugars
	12	B	Lizzie Kooistra, Maya McRae, Elizabeth Milne, Aida Soltanian
10:45	13	B	Jack Darrow, Connor Mackenzie, Luke Naughton, Kaden Swierkos, Kieran Velasquez

ME 478
Product Development

Haseung Chung
Associate Professor of Mechanical Engineering

Design and Demonstrate a Transportation System

The objective is to develop a system which can transport a 157g rectangular piece straight and fast.

The requirements of the system are:

1. The system must travel at least 10m.
2. There is no restriction in design and size, but the possible potential energy must be prepared on-site only by the motor (pre-prepared energy source such as compressed air or gas cannot be used).
3. Each team can purchase any necessary components for their system within a given budget (maximum $200) other than two motors which can be provided in the class if needed.

Evaluation criteria:

1. The designed transportation system must travel in a straight line up to 10m. The deviation can be evaluated by the value (e.g. angle or distance) from the straight line in the end point.
2. The amount of time the system takes to travel 10m will be recorded and reflected in the grade.
3. Each team can have three chances and the evaluation will be based on the best trial.

If necessary, the electric motors can be controlled by MyRio, which will be provided. Starting from an individual project and progressing into a team project, each team must produce the transportation system through a series of design and manufacturing tasks. Each student needs to contribute individually as well as collaboratively to accomplish a series of tasks. CAD/CAM packages, CNC machining, rapid prototyping, and testing, etc. will be used to produce the system. Finally, teams will demonstrate their system on Design Day. The details of the designed system will be presented before Design Day.

Teams and Team Members

Group 1
Mustafa Alobaidi
Ethan Avery
Steven Coscino
Ryan Prost

Group 2
Matthew Celini
Bennett Guensche
Austin Pier
Garrett Puehler

Group 3
Ben Arkles
Sara Moscone
Luke Muller
Jon Paul

Group 4
Ian Calandrino
Olivia Lyle
Elizabeth Sharkevich

Group 5
Jacob Kunka
Michael Maser
Justin Schmitz,
Cameron Tsivitse

Group 6
Rishabh Ainapurapu
Jacob Rhue
Christian Takla,
Qifan Weng

Group 7
Ben Lemke
Kyle Pahl
Miko Parkinson
Logan Trierweiler

Group 8
Gunnar Carroll
Jacob Greca
Ali Lewis
Kate Nolan

Group 9
Jonathon Fudala
Ian Ladd
Jackson Rayer

ME 497
Biomechanical Design

Dr. Tamara Reid Bush
Professor and Associate Dean for Inclusion and Diversity

MKT 420
Biomechanical Design

Dr. Hang Nguyen
Associate Professor of Marketing Business College

Biomechanical Design and New-Product Development

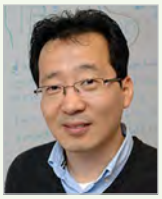
The Biomechanical Design and New-Product Development course (ME 497/MKT 420) provides students with a unique opportunity to develop and market a real, new product that incorporates biomechanical function. Students work in inter-disciplinary teams of *engineers and marketers* and experience the entire process of new product development, from need identification, concept generation and testing, to product development, design analysis and launch. This course further strengthens students' knowledge and real-world exposure by working with Spartan Innovations. This year General Motors provided $100 per team for prototyping costs and the Mechanical Engineering Department Endowment sponsored an in-class competition providing awards to the top three product ideas.

Team	Team Members	Product Name and Description
01	Luke Aman, Alexa Garavaglia, Ella Germack, Taylor Page, Ben Van Hove, Trent Warren	**Sit Assist: Squat Easy, Move Freely** - The sit assist is a stationary single-leg seat assistance device with incorporated seat hinges to assist the initial squat. It securely fastens onto the weaker leg, aiding in the motion of sitting down and standing up while distributing some weight-bearing load onto the device.
02	Sean Blanchard, Joe Castiglia, Charlie Meilinger, Sam Stefanek, Gavin Watthayu, Ethan Wise	**Adapt-a-Grip:** Attachment to assist those with hand/wrist disabilities to be able to participate in racket sports such as tennis, badminton, pickleball, etc.
03	Blake Bur, Mason Dalrymple, Haley Heykoop, Lucy Kiloustian, Jacob Rubino, Michael Stakits	**Crush It:** Pop can and garbage compactor that can be easily set up and stored in the household.
04	Emilia Breuning, Sydney Bush, Daniel Erfani Zachi Yazd, Ryan Harth, Jordyn Porter, Emma White	**One Trip Wonder:** A shopping cart with an adjustable height that loads right into the trunk of the car with minimal effort from the user.
05	Therese Gordon, David Kurylo, Emma Luzbetak, Hailee Maynard, Cy Ramsay	**Safe Stride**: Revolutionary walker that allows a normal gait while providing constant support and moving with you step by step.
06	Reagan Ferschweiler, Braeden Keener, Paige Miller, Logan Nicks, Maya Patel	**AdaptStride:** Transformable crutch-to-walker medical assistance device.
07	Gabriel Birchmeier, Alex Johnson, Jimmy King, Adolfo Lopez, Luke Naughton, Kenny Yue	**Handi-Cane:** An object retrieval cane with elevator motion.
08	Patterson Conley, Ryan Gioffreda, Julian Ly, Aisyah Mahira, Tori Morgan, Connor Whitaker	**Absolutely Trashed:** An easy lift device for a trash bin so that the trash bag and contents do not get stuck at the bottom of the bin.
09	Emilia Jakuc, Maggie Le, Tessi Lila, Maya McRae, Abby Pankey, Serena Prince	**The Boxer (Box Crusher):** Don't be crushed by an unwanted labor – let the Boxer handle it!
10	Andre Johnson, Ethan Smith, Grace Thompson, Emerson Voss, Zachary Wyrick	**Chairbrella:** An attachment to connect an umbrella to a wheelchair and assist users in opening and closing it using a lever and scissor jack.
11	Daniel Carrillo-Solis, Deniz Farmaka, Abdallah Hamad, Fallou Mbengue, Anna Winkler, Allison Zaluski	**FlexiStep Recovery Platform:** A platform that helps people with knee injuries to give more mobility when getting off the bed independently and prevent any further risks of injuries for a better recovery process.

The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Seungik Baek, Andre Benard, Haseung Chung, Ricardo Mejia-Alvarez, Norbert Mueller, Galit Pelled, and Mohsen Zayernouri


Baek


Benard


Chung


Mejia-Alvarez


Mueller


Pelled


Zayernouri

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:00 a.m.	Peckham, Inc.	Loose Fabric Roll Transfer Design
8:30 a.m.	Peckham, Inc.	Laser Cutting Bed Material Handling
9:00 a.m.	Adventures in Training with a Purpose	Secure Grip Ambulation Aid
9:30 a.m.	Adventures in Training with a Purpose	Enhanced Foot Design Ambulation Aid
10:00 a.m.	MSU Broad Art Museum	Art Hanging System for Concrete Walls
10:30 a.m.	MSU Recycling Center	Debagging of Recycling
11:00 a.m.	NASA/Arizona State University	Resource Utilization
11:30 a.m.	Ford Motor Company	Vehicle Compliance Fresh Eyes Review Tool

ME 481 Mechanical Engineering Design Projects

ME 481 is a required course for mechanical engineering majors at MSU. The course provides students with a team-based capstone design experience in which they:

- Use the technical expertise, communication skills, and teaming methodologies they have learned throughout their mechanical engineering curriculum, together with their creativity, to solve real world problems
- Collaborate with practicing engineers to address problems sponsored by industry
- Develop new products or redesign existing products to reduce costs or enhance reliability and functionality
- Interact with large, medium, and small companies in the automotive, defense, aerospace, consumer products, and agricultural industries, and with US government agencies.

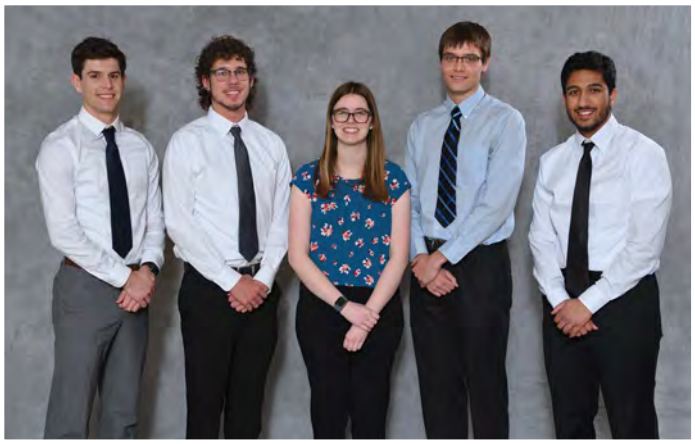
We gratefully acknowledge the participation support of this semester's project sponsors: AAM, Adventures in Training with a Purpose, Consumers Energy, Ford Motor Company, Michigan AgrAbility, MSU Adaptive Sports and Recreation Club, MSU Broad Art Museum, MSU College of Engineering, MSU Combat Robotics Team, MSU Department of Mechanical Engineering, MSU Department of Theatre, MSU Recycling Center, MSU Solar Racing Team, NASA/Arizona State University, Peckham, Inc., Pratt Engineering, and Toyota Motor North America.

Peckham, Inc.
Loose Fabric Roll Transfer Design

Peckham, Inc. is a nonprofit organization based in Michigan involved in a variety of different industries, including service, farming, and manufacturing. It is committed to providing quality products, as well as having a positive influence in its community. Peckham has numerous programs dedicated to employing those with disabilities, or that would have otherwise found difficulty finding employment. As part of its manufacturing services, Peckham provides military grade garments and equipment to the U.S. armed forces.

In order to provide high-performance clothing and gear for the military, fabric rolls are brought by trailers to Peckham's facility to be unloaded. Each trailer holds up to 700 fabric rolls and each roll is roughly 50 to 100 lbs. Historically, these rolls have had to be unloaded manually. Our team was tasked with designing a solution to facilitate unloading the rolls. The goal was to create a system that is more efficient and reduces manual labor. Multiple solutions were proposed and considered, taking into account their effectiveness, efficiency, and cost before selecting the final design. This solution was then manufactured, and it will be implemented in Peckham's facility.

PECKHAM



Michigan State University
Team Members
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Pahul Kahlon
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Peckham, Inc.
Project Sponsors

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Lansing, Michigan

Erik Johnston
Lansing, Michigan

ME Faculty Advisor

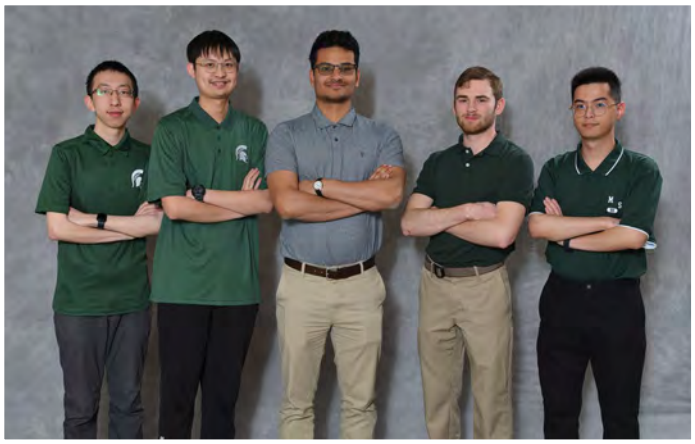
Dr. Seungik Baek

Peckham, Inc.
Laser Cutting Bed Material Handling

Peckham is a nonprofit rehabilitation organization that was founded in 1976. By providing job training and competitive employment opportunities for persons with disabilities striving for independence and self-sufficiency, their clients receive high-quality products and outstanding experiences. Peckham's Manufacturing division has long been a leading provider of high-performance clothing and gear for the military. Thousands of materials (such as fabric rolls, cut components, thread, seam tape, and accessories) are turned into high-performance garments and gear daily. Peckham strives to innovate and incorporate the latest techniques and equipment into their operations and seeks to integrate automation technology in garment packaging workstations.

Our team was focused on ergonomic and safe conditions for the operation and quick change of proper belt coverage for different working conditions. Our design was a mechanism for one operator that enables a heavy belt to be stored and pulled onto the table's surface area when single-ply cutting needs to take place, and then pulled back onto our mechanism to use the laser cutter. Our secondary design was a mount for the exhaust hose above the gantry to prevent wearing on the hose while the gantry is moving during the working process of the single-ply cutter and laser cutter.

PECKHAM



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Qifan Weng
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Dr. Haseung Chung

Adventures In Training with a Purpose
Secure Grip Ambulation Aid

Adventures in Training with a Purpose (ATP) is a nonprofit organization that aims to help those in need through purposeful physical training. ATP was established in 2015 by Jon Kolb and has continued to support vulnerable populations ever since. With the support of ATP, individuals are no longer held back by their physical limitations. Through their personalized physical training techniques, such as strength and aerobic exercises, individuals can now live a more purposeful life. ATP supports its people through various mechanisms such as Ambulation Aids that provide the greatest amount of freedom for the user while also preserving a high level of safety.

Our team was tasked with developing a secured grip design prototype for an ATP ambulation aid. The design of the grip accounted for a user who lacks the ability to grasp or squeeze a handle. To solve this issue, our design utilizes a latching mechanism to the wrist/forearm enabling the user to be secured into the crutch without having to grasp or squeeze. In addition, with our design, the latch can be released if the user falls, making it so the fall will not be obstructed by the crutch. Our secured grip design fits seamlessly into existing crutches provided by ATP, with the expectation that the combined mechanism can handle loads from 40-300 lbs.

Michigan State University
Team Members
(left to right)

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Adventures in Training with a Purpose
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Wexford, Pennsylvania

John Kolb
Wexford, Pennsylvania

ME Faculty Advisor

Dr. Ricardo Mejia-Alvarez

Adventures In Training with a Purpose

Enhanced Foot Design Ambulation Aid

Adventures In Training with a Purpose (ATP) is a nonprofit organization created with the goal of addressing health and movement challenges faced by underserved populations who lack access to paid rehabilitation services. ATP concentrates on "helping those most in need improve their quality of life through an adventure of purposeful, physical training". Many of its clients face challenges related to health conditions including traumatic brain injury, stroke, paralysis, Parkinson's disease, and various neurological disorders. Additionally, some individuals struggle with post-traumatic stress disorder resulting from combat and first responder responsibilities, along with musculoskeletal conditions.

This project was a continuation of the design work from a Fall 2023 design group to evaluate and prototype an enhanced design for a pair of wrist crutches. Our team's focus was primarily on developing a spring-loaded crutch with a specialized foot design that adds propulsion to the user's step. The goal was to maximize the stride length, speed, and safety of the user to improve rehabilitation, performance, and competitiveness.

Michigan State University
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Adventures in Training with a Purpose
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Wexford, Pennsylvania

Jon Kolb
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ME Faculty Advisor

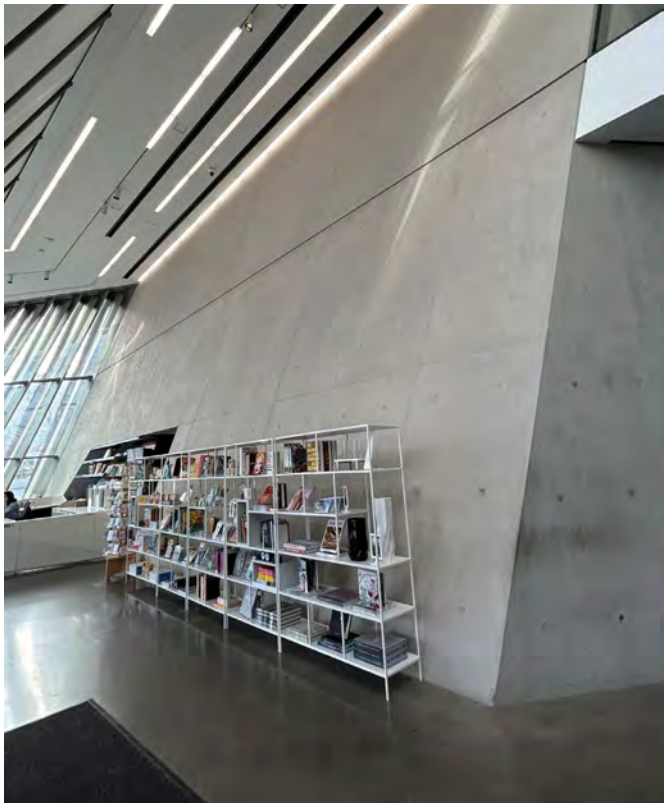
Dr. Andre Benard

MSU Broad Art Museum

Art Hanging System for Concrete Walls

Opening its doors in 2012, the MSU Broad Art Museum is a leading institution renowned for its world-class status and an extensive permanent collection comprising over 10,000 works. The museum focuses primarily on contemporary art, serving as a vibrant hub for artistic discourse from all over the world. The museum's architecture, designed by renowned architect Zaha Hadid, stands out with distinct angles and unique structural elements. This design contributes to the museum's appeal, providing a dynamic environment for art enthusiasts and the public alike.

This building features slanted concrete walls. The walls contain casting holes spaced regularly throughout the area, which have been capped with cast plugs. These holes offer an excellent opportunity to hang various items, from labels and artwork to brackets and work platforms. Our team was tasked with designing a hardware system that will enable these elements to be hung on the concrete walls. It is important to note that concrete is prone to cracking, chipping, and discoloring, so it was important for our group to ensure the safety of the structure and preserve the building's integrity. The end goal was to create a modular system of parts that could work together safely and display anything from a light painting to a heavy statue.



MSU BROAD ART MUSEUM

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Gabriel Johnson
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Evan Hampel
Clarkston, Michigan

Michael Romzek
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Noah Roux
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Bryant Hixson
Novi, Michigan

MSU Broad Art Museum
Project Sponsor

Brian Kirschensteiner
East Lansing, Michigan

ME Faculty Advisor

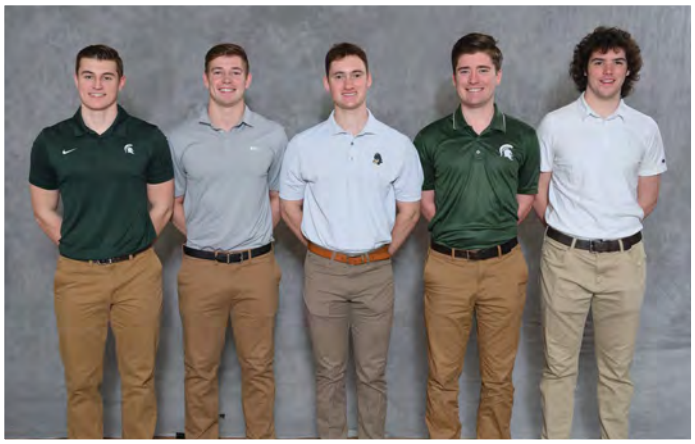
Dr. Galit Pelled

MSU Recycling Center
Debagging of Recycling

The Michigan State University Recycling Center is a comprehensive and environmentally conscious facility dedicated to promoting sustainability on campus. Operating with a commitment to waste reduction and resource conservation, the center employs state-of-the-art recycling processes to efficiently manage various materials, including paper, plastic, glass, and electronics. Through its robust operation, the center aims to minimize landfill contributions, educate the university community on responsible waste disposal practices, and contribute to a greener future. By fostering a culture of environmental stewardship, the Michigan State University Recycling Center plays a pivotal role in advancing the institution's sustainability goals, creating a campus-wide impact on waste management and promoting a more eco-friendly and responsible community.

The center collects and hand sorts over 6 million pounds of recycling annually. Some of the recycled material arrives at the facility in plastic bags. These plastic bags are received mainly from stadiums and can contain a lot of liquid and food waste. Therefore, hand-processing these bags can be a very messy process. Unfortunately, commercialized debagging machines on the market are too large for the facility. For that reason, our team decided to replicate the already existing concept but on a smaller scale to fit the means of the facility. The intended goal for the project was ultimately to eliminate the need for any debagging by hand, all while increasing the efficiency of the recycling process.

Surplus Store and Recycling
managing waste as a resource



Michigan State University
Team Members
(left to right)

Benjamin Van Hove
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Kyle Pahl
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Ryan Leinweber
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MSU Recycling Center
Project Sponsor

Julia Haidler
East Lansing, Michigan

ME Faculty Advisor

Dr. Galit Pelled

NASA/Arizona State University
Resource Utilization

The NASA Psyche Mission is an orbiter mission to the metal-rich asteroid, Psyche, which is in the asteroid belt between Mars and Jupiter. The spacecraft, launched in October 2023, and scheduled to arrive at the asteroid in mid-2029, will study the asteroid from orbit and will not land on the surface. It is possible to imagine, however, that after learning about Psyche from orbit, there may be scientists and engineers interested in proposing a future mission to explore or sample the surface. To save on mass and cost, such a mission might need to consider innovative yet feasible solutions for making use of materials found at the asteroid for the fabrication of parts, tools, or other aspects of robotic surface exploration.

Using the asteroid's known and hypothesized environmental and surface conditions, the proposed design was a method to sort and identify the various materials found on Psyche's surface. The hypothesized surface conditions provided design parameters for the mechanism's sorting features to separate the various materials found in Psyche's dust-like surface. The design includes a mechanical sorting system to account for potential materials of varying size, shape, and other defining factors. The design mechanism accounted for potential materials not previously noted or hypothesized. The design integrated light spectroscopy to further identify the materials once they have been sorted. This will allow for testing and identification of surface materials without sample collection intended to return to Earth. The surface conditions of Psyche are still unknown, so conditions including a mostly flat metallic surface, a flat metallic surface with metal and rocky debris, a rough or high-relief metallic surface and rocky terrain, and a surface with high-relief metallic crater walls were considered. The proposed design aimed at maximum scientific discovery given current knowledge

Michigan State University
Team Members
(left to right)

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Ryan Geisler
Troy, Michigan

NASA/Arizona State University
Project Sponsor

NASA Psyche Mission
Tempe, Arizona

ME Faculty Advisor

Dr. Norbert Mueller

Ford Motor Company
Vehicle Compliance Fresh Eyes Review Tool

Ford Motor Company, a family-oriented global enterprise, embodies shared ideals that resonate across continents and generations. With over 120 years of history, Ford has adeptly navigated change, emerging as a leader in the automotive industry while maintaining a steadfast commitment to service. Expanding its focus beyond traditional vehicles, Ford now prioritizes services, experiences, and software, aiming to enrich lives and enable dreams worldwide. Its mission is clear: to contribute to a world where every individual can freely pursue their aspirations unencumbered by barriers. By bridging distances and fostering connections, Ford unlocks possibilities and ignites the spirit of adventure. Ford remains dedicated to building a better world for generations to come.

This project is to modernize Ford's compliance audit process, known as "Fresh Eyes Reviews," for production vehicles. These reviews ensure vehicles meet and maintain regulatory standards throughout production. Initially a manual process, it relied on a cumbersome spreadsheet, making it challenging to perform checks efficiently. Our team developed an understanding of the existing process, identified areas of improvement, evaluated technological solutions, and developed a user-friendly tool. This tool efficiently guides auditors through vehicle evaluations, streamlining the "Fresh Eyes Review" process.

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Team Members
(left to right)

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Mike Landry
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Dr. Mohsen Zayernouri

The Capstone Projects

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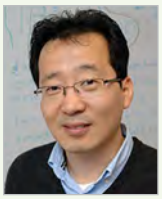
Professor of Mechanical Engineering

Faculty Advisors: Seungik Baek, Abraham Engeda, Zhaojian Li, Ricardo Mejia-Alvarez, Ranjan Mukherjee, Ahmed Naguib and Indrek Wichman


Baek


Engeda


Li


Mejia-Alvarez


Mukherjee


Naguib


Wichman

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:00 a.m.	NASA/Arizona State University	Robotic Explorer for Hypothesized Surfaces
8:30 a.m.	AAM	EDU Sub-System Sealing
9:00 a.m.	AAM	Automotive Disconnecting Differential
9:30 a.m.	AAM	Axle Assembly Test Stand
10:00 a.m.	NASA/Arizona State University	Landing System – Psyche Mission
10:30 a.m.	Consumers Energy	Gas Compressor Emissions Recovery
11:00 a.m.	MSU Department of Theatre	Scene Shop Automated Wash Station
11:30 a.m.	MSU College of Engineering	Board Storage Cart

Mechanical Engineering Design Program

Mechanical engineers make the world move and provide the energy for it to do so. One goal of the MSU Mechanical Engineering Program is to educate engineers who are prepared to lead, create, and innovate as their professional or graduate careers evolve. The Mechanical Engineering Design Program is the key element of the curriculum that supports this goal. There are five required design courses in the program which provide our students with eight hands-on team-based, 'design, test and build' projects, and numerous opportunities to practice and refine their written, oral, poster, and video presentation skills. The Design Program in Mechanical Engineering has attracted national recognition on many occasions and helps to distinguish the ME program as one of the best in the country.

The ME faculty who supervised ME 481 design teams this semester are: Rebecca Anthony, Seungik Baek, Andre Benard, Giles Brereton, Haseung Chung, Gary Cloud, Abraham Engeda, Brian Feeny, Zhaojian Li, Ricardo Mejia-Alvarez, Norbert Mueller, Ranjan Mukherjee, Ahmed Naguib, Galit Pelled, Thomas Pence, Harold Schock, Elisa Toulson, Indrek Wichman, Neil Wright, Xinran (Sharon) Xiao, Mohsen Zayernouri, and Guoming Zhu.

NASA/Arizona State University
Robotic Explorer for Hypothesized Surfaces

The NASA Psyche Mission, led by Arizona State University, is a mission to send an orbiter to the metal-rich asteroid Psyche. The asteroid, 16 Psyche, is contained within the asteroid belt between Mars and Jupiter. This orbiter, which was launched on Friday, October 13, 2023, is en route to reach the asteroid mid-2029. The key element that makes the Psyche asteroid unique is that it is not composed of rock and ice, but rather mostly metallic substances. Its surface is hypothesized to be made from large amounts of nickel, iron, and silicate materials. Because of this, Psyche has been compared to metallic cores of terrestrial planets, including that of Earth. This leads Psyche to be highly valuable in the research of planetary cores and the processes that lead to planet formation. Research of this caliber has not been conventionally possible before given the extremely harsh environment that lies deep below the crust and mantle of Earth.

While the mission described above is purely conducting orbital studies, it is likely that a trip to land on Psyche will be advantageous to further the research on the surface. Our team's project was to design a robotic explorer that is capable of adapting to the multiple hypothesized surfaces of Psyche. The surface of the asteroid has been proposed to be mostly flat and metallic with metal or rocky debris. It is also known that there is likely rough and high-relief terrain similar to formations seen in deserts and mountainous regions. Lastly, the surface of the asteroid has been reported to contain large craters. This extreme variation yields a unique problem that must be solved by an explorer that is adaptive to the environment that exists on Psyche. Given the uncertainty of the surface, many challenges were to be overcome by our design team and the systems included in our robotic explorer.

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Ethan Wise
Clarkston, Michigan

Sara Moscone
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Justin Schmitz
Fowler, Michigan

Sean Blanchard
Warren, Michigan

NASA/Arizona State University
Project Sponsor

NASA Psyche Mission
Tempe, Arizona

ME Faculty Advisor

Dr. Ranjan Mukherjee

AAM
EDU Sub-System Sealing

American Axle & Manufacturing (AAM) is a leading global Tier 1 Automotive and Mobility Supplier designing and manufacturing Driveline and Metal Forming technologies to support electric, hybrid, and internal combustion vehicles. Headquartered in Detroit Michigan, AAM has over 80 facilities in 18 countries. AAM's Driveline Division provides rear-wheel drive, all-wheel drive, and four-wheel drive systems for various engine types: IC, hybrid, and electric. AAM's Driveline product portfolio optimizes mass and increases efficiency and NVH without sacrificing performance.

The team worked to investigate various methods to improve the sealing and sealing interfaces between the oil-cooled Inverter sub-system and oil-cooled eMotor sub-systems in AAM's next generation 3-in-1 EDU to improve the robustness and reduce the overall design complexity. The team adequately sealed the Inverter sub-system from the eMotor sub-system in order to prevent damage to the system from oil ingress.

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Jonathon Fudala
South Lyon, Michigan

Aditya Swarnkar
Dubai, United Arab Emirates/
New Delhi, India

Nicole Burcon
Pinckney, Michigan

Keya Baxi
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Aditya Tarle
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AAM
Project Sponsor

Michael Zarzycki
Detroit, Michigan

ME Faculty Advisor

Dr. Seungik Baek

AAM
Automotive Disconnecting Differential

American Axle & Manufacturing (AAM) is a global leader in automotive driveline and drivetrain components. Founded in 1994, AAM provides innovative solutions to enhance vehicle performance, efficiency, and safety with a diverse portfolio, including axles, driveshafts, and power transfer units. AAM serves major automakers worldwide. Committed to excellence and technological advancement, AAM continuously invests in research and development, earning a reputation for reliability and innovation in the automotive industry.

Our team explored various methods and mechanisms aimed at disconnecting an axle shaft from the primary power or driving source. Our objective was to design a disconnecting device that could fit entirely within the packaging space of a standard open differential.

Ultimately, this change enhanced system efficiency, decreased parasitic drag from unused components, and achieved improved fuel economy with a reduction in emissions. Integrating the disconnect mechanism within the differential offered several advantages. It reduced the total axial space required for packaging compared to conventional side shaft disconnect systems, simplified assembly for the axle manufacturer, and lowered the total number of parts and part complexity.

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Andrew Ferguson
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Connor Casey
Dowagiac, Michigan

Colin Boulard
South Lyon, Michigan

Aidan Dobbie
South Lyon, Michigan

AAM
Project Sponsor

Steve Doud
Detroit, Michigan

ME Faculty Advisor

Dr. Ahmed Naguib

AAM
Axle Assembly Test Stand

American Axle & Manufacturing (AAM) is an American manufacturer of automobile driveline and drivetrain components and systems. Headquartered in Detroit, Michigan with over 80 facilities in 18 countries, AAM is a global Tier 1 Automotive and Mobility Supplier. Founded in 1994, by Richard E. Dauch, AAM has grown from five former GM plants located throughout the Midwest to a multi-billion-dollar global company that is one of the largest and most respected Tier 1 automotive suppliers in the world. AAM engineers and manufactures Driveline and Metal Forming technologies to support electric, hybrid, and combustion vehicles.

AAM's Driveline division provides rear-wheel drive (RWD), all-wheel drive (AWD), and four-wheel drive (4WD) systems. AAM's Driveline product portfolio optimizes mass and increases efficiency and noise, vibration, and hardness (NVH) without sacrificing performance. AAM boasts advanced products, processes, and systems technologies like their QUANTUM® and EcoTrac® that are smarter, lighter, more powerful, and more efficient. AAM's Metal Forming business unit represents the largest automotive forging enterprise in the world, providing engine, transmission, driveline, and safety-critical components for light, commercial, and off-highway vehicles.

The Structural Housing and Axle Tube engineering team at AAM is considering new methods for testing front and wheel axle systems. Our team was assigned the task of designing, building, and programming a scale model test stand capable of reproducing real-world driving conditions to view and measure oil flow within an axle assembly. The dynamic or "real-world" driving conditions being simulated through our programs are acceleration, braking, turning, bumps, inclines, and declines using table positioning motors. Our team's goal was to configure a system capable of recreating all these conditions in a working scale model to represent how our fully realized system would function.

Michigan State University
Team Members
(left to right)

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Nick McCarthy
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Mason Koudelka
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Harshil Jain
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Noah Iung
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AAM
Project Sponsor

Jim Borowiak
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ME Faculty Advisor

Dr. Ricardo Mejia-Alvarez

NASA/Arizona State University
Landing System - Psyche Mission

In 1852, the asteroid sometimes referred to as 16 Psyche, named for the Greek Goddess of the soul, was discovered by Italian astronomer Annibale de Gasparis. Now, the Psyche Mission led by NASA alongside Arizona State University, seeks to explore this metal-rich asteroid which orbits our Sun and resides within the asteroid belt between Mars and Jupiter. To achieve this goal, a spacecraft was launched from Kennedy Space Center on October 13, 2023 with the intent of reaching Psyche in 2029. Modern exploration of Psyche from afar has led scientists to uncover the potential for large amounts of metal to exist among rock throughout its body, producing the concept that it may be a planetesimal core, a remnant of our early solar system. The purpose of exploring Psyche is to hopefully gain a better understanding of how the core of our home planet of Earth developed.

The objective of this project was to formulate a manner by which a future mission may physically land on Psyche to conduct further exploration. This process included performing research on past NASA landing systems to not only analyze their application in this case but to invent solutions to Psyche specific situations. At this point, Psyche's actual appearance and geological makeup are unknown and will remain as such until the launched spacecraft comes closer to approaching the asteroid. Therefore, it was important to research various styles of spacecraft and landing gear in order to incorporate relevant aspects into the design, formulated to consider the most likely geological outcomes based on what is known today. Considering that nothing like Psyche has ever been examined up close, it was also important to be mindful of the many variables of touching down on a dense, irregularly shaped, low-gravity body when determining the best features to include in the proposed landing system.

Michigan State University
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Noah Benson
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NASA/Arizona State University
Project Sponsor

NASA Psyche Mission
Tempe, Arizona

ME Faculty Advisor

Dr. Ahmed Naguib

Consumers Energy
Gas Compressor Emissions Recovery

Discover the heart of Consumers Energy's vital role in Michigan's energy landscape. As a leading natural gas and electric utility, Consumers Energy powers communities across the state. The Gas Compression department, an integral part of the natural gas business unit, is tasked with managing specific locations within the state's pipeline system. Their focus is to improve pressure for warm season storage and facilitate the processing of stored gas during cold season withdrawals. Consumers maintains 41 gas compressors spanning different eras, committed to efficiency and reliability. When it comes to sustainability, Consumers Energy is continuously committed to prioritizing their carbon footprint through ongoing efforts and vigilant upkeep.

Although by design, packing systems on reciprocating gas compressor rods have leak points that release methane into the atmosphere. A goal has been set to reduce fugitive emissions from its infrastructure by 2030. Our team was tasked with resolving methane emissions from the known continuous leak points. To gain better insight, we visited the Freedom Gas Compressor station, one of the facilities where this problem was occurring. The goal was to eliminate contaminant materials, such as oil carryover and physical media, while boosting pressure to utilize methane as supplemental fuel for the compressor facility's fuel system. For our project, we developed schematics of our proposed ideas and process and instrumentation diagrams (P&IDs) that ultimately helped us when reflecting on an idea that would cut emissions from entering the atmosphere. By delivering these components, our team was able to facilitate the implementation of an effective solution to mitigate methane emissions, contributing to Consumers Energy's broader sustainability objectives.

Consumers Energy
Count on Us

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(left to right)

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Dr. Abraham Engeda

MSU Department of Theatre
Scene Shop Automated Wash Station

The Scene Shop, formally known as the Performing Arts Teaching Lab, is where all the sets needed by the Department of Theatre and College of Music opera program are created. It is a 9,370 square foot facility located on the southeastern side of campus. With 22 ft tall ceilings, the building is large enough to construct an entire scene. Updated with new technology and equipment, this new space now enables two shows to be worked on at the same time.

Our team was tasked with designing an automated wash station for the Michigan State University Scene Shop. When the Scene Shop first receives its stage components, the parts are covered in various kinds of dirt and grease, resulting in countless wasted hours spent cleaning each part before it is ready to be used in construction. The previous process for cleaning the metal was to use rags and hand wipe down each individual piece of metal. Our mechanism was designed to have an automatic feed operation that would simultaneously wash and scrub any unwanted substances off the surfaces. Our automated wash station is also able to move anywhere it is needed as it has its own tank of cleaning solution. With our automated washing station, we will save the Scene Shop both time and energy.

Department of Theatre
MICHIGAN STATE UNIVERSITY

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MSU Department of Theatre
Project Sponsor

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ME Faculty Advisor

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MSU College of Engineering
Board Storage Cart

The MSU College of Engineering organizes numerous yearly events, providing a platform for students to showcase their projects on foam boards measuring 32 inches by 40 inches. Currently, the College of Engineering manages a collection of 200 of these boards. Historically, the process of counting, transporting, and setting up these boards for each event has been challenging. Issues such as limited maneuverability, inaccessibility, and difficulty in accurately determining the quantity of boards in the storage cart have complicated the workflow. Consequently, additional efforts have been required to overcome these limitations, impacting the efficiency of event preparations.

The goal of this project was to design and create a robust and versatile storage cart tailored for the easy transportation and storage of foam boards across MSU's campus. The cart was built to overcome specific challenges, such as loading and unloading from vehicles, traversing various terrains, maneuvering into small areas such as storage rooms and elevators, and ensuring accessibility and ease of use for individuals of varying heights. Furthermore, the design emphasizes ease of repair and replacement for components subject to heavy wear, such as wheels, and incorporates ventilation features to prevent the entrapment of rodents.

College of Engineering
MICHIGAN STATE UNIVERSITY

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ME Faculty Advisor

Dr. Zhaojian Li

AMAZON DETROIT
INTERNSHIP PROGRAM

Jr. Software Dev Engineer

Are you passionate about innovation and developer experience at scale? Are you interested in working on an amazing team that is building new experiences from the ground up? Amazon is seeking excellent student programmers to work in an internship program located in Detroit.

QUALIFICATIONS

- College Student
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- Graduate date Spring 2025 or later
- Solid knowledge of JAVA or equivalent
- Networking knowledge
- Advanced programming classes completed at University

More information email us
jrdeveloperprogram@amazon.com

amazon

The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Faculty Advisors: Giles Brereton, Ahmed Naguib, Thomas Pence, Harold Schock, Neil Wright, and Guoming Zhu

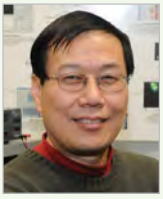

Brereton


Naguib


Pence


Schock


Wright


Zhu

Presentation Schedule – Engineering Building, Room 1300

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Solar Racing Team	Solar Car Gear Box Creation
8:30 a.m.	MSU Solar Racing Team	Solar Car Body Design
9:00 a.m.	MSU Adaptive Sports & Recreation Club	Three-Wheel Drive System for Scooter
9:30 a.m.	MSU Adaptive Sports & Recreation Club	Increasing Roller Sled Mobility: Phase III
10:00 a.m.	MSU Adaptive Sports & Recreation Club	Sled Hockey Transfer Platform
10:30 a.m.	MSU Adaptive Sports & Recreation Club	Inclusive Sports Wheelchair
11:00 a.m.	MSU Department of Mechanical Engineering	Design of a Jetfire Two-Stroke IC Engine Rotary Valve

Mechanical Engineering Design Program Awards

The Mechanical Engineering Design Program makes two project awards on Design Day. The most significant award is the Thomas Alva Edison Design Award–a medal–given to each member of the ME 481 Capstone design team that produces the most outstanding technical design project. This award considers the team's performance over the duration of the project, their presentations, the project solution, and prototype quality.

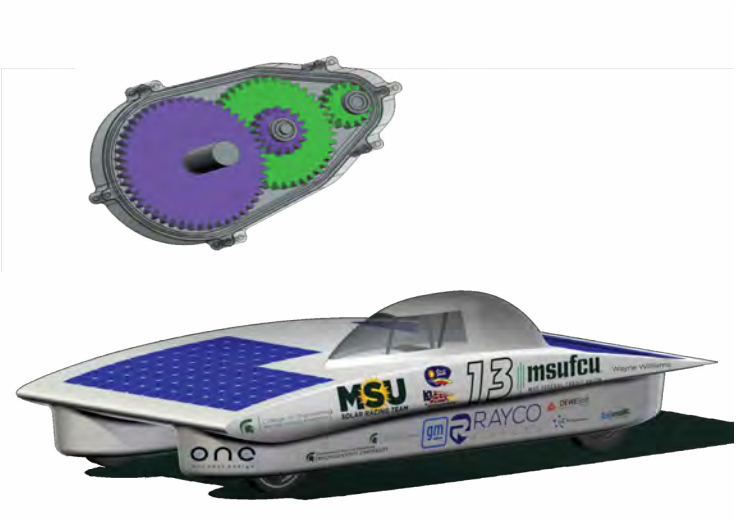
A second ME 481 Capstone award is given to the team that gives the best technical project presentation. The importance of communication of scientific and engineering ideas cannot be understated, and it is for this reason that we make the ME 481 Project Presentation Award. Award winners typically will have built an impressive prototype which forms the basis for a very clear and effective presentation of the project background and its solution, often incorporating live or video demonstrations of its functionality.

The ME Design Program also presents the Leonardo da Vinci Machine Design Award to the winners of its ME 470 Machine Design competition. The specific design problem and criteria for this competition change from semester to semester.

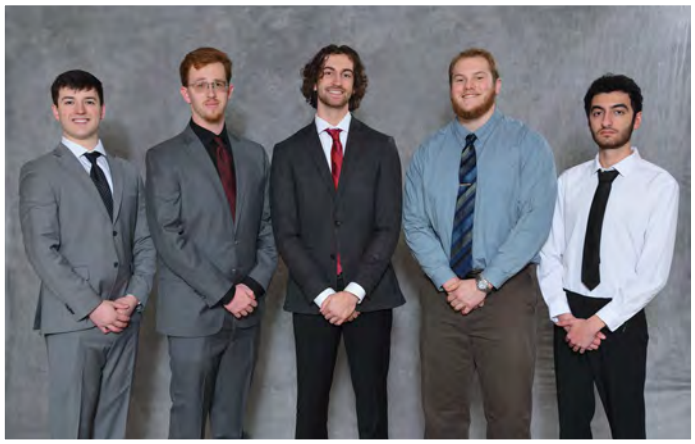
MSU Solar Racing Team
Solar Car Gear Box Creation

The Michigan State Solar Racing Team (SRT) is a student-run organization that showcases innovation and engineering excellence in renewable energy. Comprised of students from various engineering disciplines, the team dedicates itself to designing, building, and racing solar-powered vehicles. Its primary objective is to develop highly efficient and innovative solar vehicles that compete in national and international solar car challenges. These competitions, such as the Formula Sun Grand Prix and the American Solar Challenge, take place across different challenging terrains and routes, testing the limits of solar-powered transportation.

MSU SRT commissioned the development of an advanced gearbox to enhance the efficiency of its solar-powered vehicle, 'Cynisca.' Previously, a Spring 2023 Capstone team designed and modeled a gearset and housing intended for future manufacturing and testing. That future has come with a transition from concept to reality. Students designed updates to better fit MSU SRT's mechanical needs and improve the manufacturability of the drivetrain. Originally tailored for a 600-pound car, but adapted for increased weight to 950 pounds, the gearbox underwent precise adjustments. Utilizing advanced manufacturing techniques for the housing and sourcing high-quality gear contacts, we assembled each component, resulting in a mechanism designed to enhance the solar car's performance and cost efficiency.



MSU SOLAR RACING TEAM



Michigan State University
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MSU Solar Racing Team
Project Sponsors

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Rachel Schenck
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ME Faculty Advisor

Dr. Thomas Pence

MSU Solar Racing Team

Solar Car Body Design

Michigan State University's Solar Racing Team (MSU SRT) is a student-led undergraduate team that designs, manufactures, and races full-sized solar powered electric vehicles. Over the past 22 years, they have designed and built four single-occupant vehicles and one multi-occupant vehicle. Its most recent build is a cost-effective single-occupant vehicle named 'Cynisca.' The goal for this vehicle is to successfully compete in the 2024 Formula Sun Grand Prix and American Solar Challenge and perform well with consistency. This requires the car to travel over 2000 miles over the span of a few days.

The objective was to design a body that was aerodynamic, lightweight, and easy to manufacture, aiming to compare and advise on the manufacturability versus theoretical performance of carbon fiber aeroshells, monocoque body/chassis, and segmented flat paneling for future car build cycles. The body's design aims to provide a path for air around the car, effectively minimizing the formation of vortexes and high-pressure zones, thereby reducing the drag on the vehicle. By mitigating drag force, the car requires less energy to move, enabling greater efficiency. The current body for the solar car represented a significant advancement over previous iterations; however, there remained ample opportunity for enhancement. Further development was necessary to optimize material usage, refine aerodynamic performance, and streamline manufacturing processes, thereby ensuring the continued progression towards an even more efficient and competitive solar car design.

MSU SOLAR RACING TEAM

Michigan State University
Team Members
(left to right)

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Tanaka Chonyera
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MSU Solar Racing Team
Project Sponsor

Ethan Stull
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ME Faculty Advisor

Dr. Ahmed Naguib

MSU Adaptive Sports & Recreation Club
Three-Wheel Drive System for Scooter

The MSU Adaptive Sports & Recreation Club was founded in 2014 as an organization that seeks to promote the health, social, and psychological benefits of physical activity for individuals with physical disabilities. MSU Adaptive Sports aims to establish a space for athletes with physical disabilities and able-bodied volunteers to come together and create an integrated community of peers. The organization hopes to eradicate negative stereotypes about disabilities by highlighting the strengths and abilities of these individuals. The MSU Adaptive Sports & Recreation Club offers a variety of sports including tennis, basketball, and hockey. The organization hosts six events every week, with all equipment provided and everyone welcome!

The objective of this project was to develop a method for a three-wheel electric scooter to navigate through winter weather conditions. Our sponsor, Piotr Pasik, uses an electric scooter as his main means of transportation, both indoors and outdoors. The scooter would often get stuck when driving on icy and snowy sidewalks. Piotr addressed this challenge with the Mechanical Engineering Department, hoping a capstone group could find a solution to the problem. We proposed a three-wheel drive system to integrate with the current powertrain. The scooter is powered by two motors, one powering the two rear wheels, and the other powering the front wheel. The main challenge of this project was integrating the two motors so they work together. Because they are powered separately, they needed to be synced in some way. In addition, the correct power distribution and wheel speed needed to be determined and implemented.

Michigan State University
Adaptive Sports & Recreation Club
Est. 2014

Michigan State University
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Ben Lemke
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MSU Adaptive Sports & Recreation Club
Project Sponsor

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East Lansing, Michigan

ME Faculty Advisor

Dr. Guoming Zhu

MSU Adaptive Sports & Recreation Club

Increasing Roller Sled Mobility: Phase III

The goal of MSU's Adaptive Sports & Recreation Club is to increase inclusivity in extracurriculars by promoting the benefits of physical activity to individuals with physical disabilities. They seek to eliminate negative stereotypes towards disability by shifting the focus to the abilities of physically disabled individuals. Adaptive recreation options that they offer include adaptive rowing, adaptive track & field, handcycling, wheelchair basketball, wheelchair floorball, and wheelchair tennis. The Adaptive Sports & Recreation Club helps athletes make healthy choices about exercise and nutrition, meet other athletes with physical disabilities, and become part of a disability community. It improves the athlete's confidence by helping them succeed in new challenges.

While they would like to add roller sled hockey to the list of sports they offer, significant improvements to the mobility of the sleds must be made. Sled hockey utilizes sleds with blades or wheels to move on the desired terrain. With the difficulty of scheduling regular ice time at Munn for practice and games, the Adaptive Sports & Recreation Club utilizes donated roller sleds and courts at MSU's Demonstration Hall. The goal of this project is to improve the mobility of roller hockey sleds to move with ease for persons of a wide range of disabilities on the unique, higher friction terrain of Demonstration Hall. Our design incorporates mechanisms from prior semesters' design teams with the addition of our own improvements to tackle the remaining challenges and provide the best experience for both novice and experienced users.

Michigan State University
Adaptive Sports & Recreation Club
Est. 2014

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MSU Adaptive Sports & Recreation Club
Project Sponsor

Piotr Pasik
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ME Faculty Advisor

Dr. Ahmed Naguib

MSU Adaptive Sports & Recreation Club
Sled Hockey Transfer Platform

The MSU Adaptive Sports & Recreation Club, established in 2014, operates as a Registered Student Organization. It serves as a no-cost program to MSU students, employees, alumni, and the Greater Lansing community. The club's purpose is to provide an inclusive environment for athletes with physical disabilities, able-bodied volunteers, and academic project personnel. Through sports, the program fosters a community where individuals with physical disabilities and volunteers can come together. The primary objective is to challenge societal stereotypes and personal perceptions about disability while promoting both physical and personal health by ensuring consistent access to a wide range of quality wheelchairs and adaptive sports opportunities. Embracing a self-determining approach, the program prioritizes athlete autonomy, competence, and relatedness to build self-effiency in sports and physical activity, skills that can extend to other areas of life.

Our project is to enhance the Sled Hockey Transfer Platform by concentrating on refining aspects such as safety and user independence. There were some shortcomings regarding safety features in the initial design prompting our team to prioritize and implement improvements. Additionally, we recognized the significance of ensuring that the device could be utilized independently by the user. Our efforts centered around the augmentation and optimization of elements within the platform, striving to create a solution that not only prioritizes safety, but also empowers users to operate the device autonomously. Through thoughtful additions and improvements, our goal is to enhance the overall user experience and contribute to the accessibility and self-sufficiency of individuals utilizing the Sled Hockey Transfer Platform.

Michigan State University
Adaptive Sports & Recreation Club
Est. 2014

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Alayna Celestini
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MSU Adaptive Sports & Recreation Club
Project Sponsor

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Dr. Giles Brereton

MSU Adaptive Sports & Recreation Club
Inclusive Sports Wheelchair

The MSU Adaptive Sports & Recreations Club was first established in 2014 by Piotr Pasik. Its goal is to promote health, social, and psychological benefits of exercise and activity to individuals with physical disabilities. The club organizes numerous sports and events including wheelchair hockey, tennis, basketball, track, and hand-cycling. It creates a space where athletes with physical disabilities and able-bodied volunteers can work together to create a community of peers that serves to eradicate negative stereotypes by highlighting the abilities of individuals with physical disabilities. Through various grants and funding, the club can purchase sports wheelchairs, equipment, and funding for engineering projects.

The Adaptive Sports Program has worked with the College of Engineering since 2016 to develop various devices and modifications to support the organization and its athletes. With the help of College of Engineering design teams, this project is now in its tenth design phase. The goal of the project was to develop a modified wheelchair to accommodate users with limited mobility. The specific individual has muscle asymmetry that is more pronounced on his left side, preventing him from participating in a standard sports wheelchair. The task was to create a chair that can be propelled and steered using the user's right leg and arm. This specific design iteration focused on a steering system that still leaves the user's dominant hand free for sport participation and equipment. Additional desired features included increased durability of the propulsion method, reverse propulsion, and safety and comfort of the user. The project was created with a specific user in mind and prioritized his specific requirements and accommodations for a seamless participation during various sporting events.

Michigan State University
Adaptive Sports & Recreation Club
Est. 2014

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MSU Adaptive Sports & Recreation Club
Project Sponsor

Piotr Pasik
East Lansing, Michigan

ME Faculty Advisor

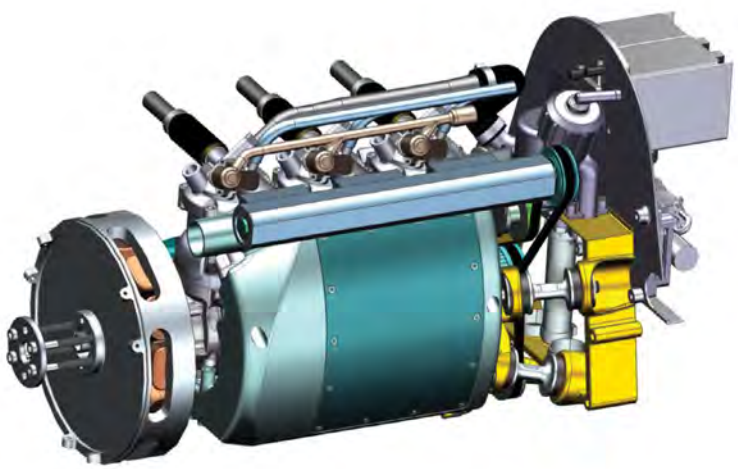
Dr. Neil Wright

MSU Department of Mechanical Engineering

Design of a Jetfire Two-Stroke IC Engine Rotary Valve

A faculty member from the MSU Department of Mechanical Engineering has pioneered a patented method to activate Turbulent Jet Ignition (TJI) using a discrete unit cartridge. This approach has been licensed to Jetfire Power, LLC for commercialization. Thanks to its revolutionary pre-chamber air control, Jetfire can initiate combustion in highly diluted stoichiometric mixtures, even under intense compression. The combustion process adheres to stoichiometry, facilitating the use of a standard 3-way catalyst for after-treatment. This combustion system accommodates both liquid and gaseous fuels. Notably, the cartridge is constructed from industry-standard components, ensuring smooth integration into an engine's cylinder head. Jetfire Power, LLC has partnered with Cobra-Aero, Hillsdale, Michigan to apply the Jetfire technology to two-stroke engines.

Our team dedicated efforts to assess various rotary valve systems previously attempted that are best suited for application to a high RPM two-stroke Jetfire engine. Rotary valves hold promise for a more streamlined and lightweight cylinder head design as they rotate at half engine speed (or one quarter), mitigating inertia forces associated with reciprocating valve mechanisms. This characteristic enables higher engine speeds and the potential for increased engine power.



A99 COBRA JETFIRE 2-STROKE ENGINE

Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY

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Jordan Robinson
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Professor of Mechanical Engineering

Faculty Advisors: Rebecca Anthony, Giles Brereton, Gary Cloud, Brian Feeny, Elisa Toulson, Xinran Xiao, and Guoming Zhu


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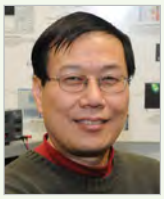
Brereton


Cloud


Feeny


Toulson


Xiao


Zhu

Presentation Schedule – Engineering Building, Room 2435

Time	Team Sponsor	Project Title
8:00 a.m.	Toyota Motor North America	Vehicle Frunk Usability and Quick Latch Design
8:30 a.m.	MSU Solar Racing Team	Solar Car Hub Motor Housing Design
9:00 a.m.	Toyota Motor North America	Automotive Engine Hood Vibration Design
9:30 a.m.	NASA/Arizona State University	Power Solutions
10:00 a.m.	Pratt Miller	FSAE Front Outboard Electric Motor Assembly
10:30 a.m.	Michigan AgrAbility	Portable Swarm Trap Lifter
11:00 a.m.	MSU Combat Robotics Team	Combat Robotics Vehicle Design and Development

Mechanical Engineering Design Program Awards

Interesting design projects that challenge the seniors in ME 481 and showcase the range of activities where mechanical engineers can work helps to make the Design Day experience special. The Design Program at MSU invites you to provide a challenging project for members of our senior class of mechanical engineers. As a sponsoring company, you introduce students to opportunities for ME students at your company; have the opportunity to create, build, and maintain relationships with students; benefit from the students' innovative design work; and bring the academic and working world together for them. Contact Jim Lang at langjame@msu.edu or 810.224.0055 to learn more about the opportunities to sponsor a design project.

Toyota Motor North America
Vehicle Frunk Usability and Quick Latch Design

Toyota Motor North America, a leading innovator in the automotive industry, has consistently demonstrated a commitment to advancing technology and sustainability in the realm of Battery Electric Vehicles (BEVs). Known for their pioneering efforts in vehicle safety, efficiency, and design, they have embarked on a mission to revolutionize the BEV market. Their latest initiative focused on enhancing the functionality and safety of BEVs, particularly in the development of a front storage area, commonly referred to as the 'Frunk.' This project aligns with their long-standing tradition of pushing boundaries in automotive engineering and design, offering a glimpse into the future of electric vehicles.

Our recently concluded project successfully redefined the front storage utility of Battery Electric Vehicles by designing innovative quick latching systems. Through intensive benchmarking and a diligent design process, we engineered several prototypes that boast high-strength hold, low-profile aesthetics, and ease of operation. Our designs adhered strictly to safety regulations, including the Pedestrian GTR head injury criterion, UN-R17: Cargo retention, and ISO-DIN75410-02: Lashing hook. We established a methodical strategy for selecting the best design, supported by comprehensive CAE simulations and a series of meticulously crafted experiments intended for Toyota's advanced evaluation labs in Ann Arbor and Saline, Michigan. The project's results are instrumental, offering Toyota a strategic direction for developing versatile Frunk accessories and demonstrating our team's adeptness in mechanics, dynamics, and materials science, all while maintaining intellectual property integrity.

Michigan State University
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(left to right)

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Deniz Farmaka
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Abdallah Hamad
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Karem Algarash
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Toyota Motor North America
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Ann Arbor, Michigan

Aaron Steinhilb
Ann Arbor, Michigan

ME Faculty Advisor

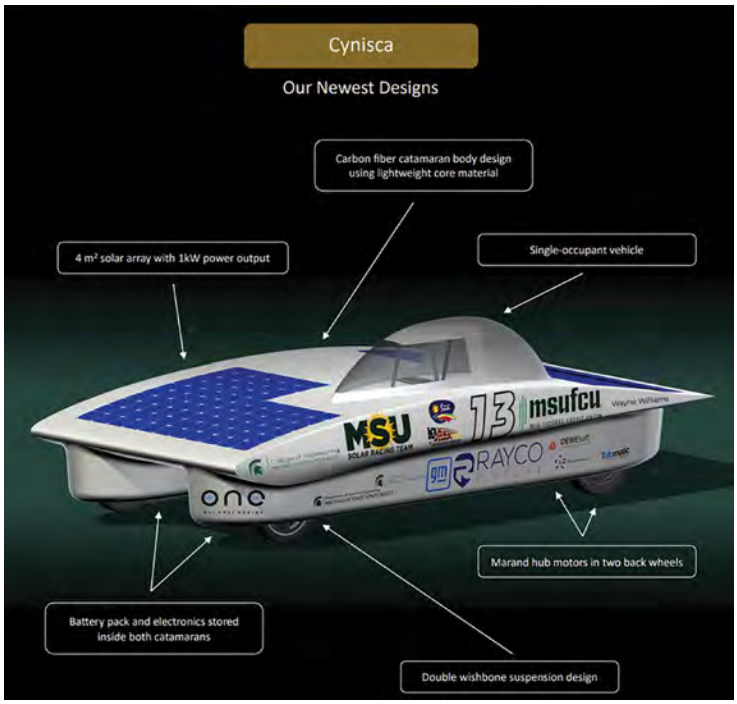
Dr. Rebecca Anthony

MSU Solar Racing Team

Solar Car Hub Motor Housing Design

The MSU Solar Racing Team (SRT) is a student-led organization that was founded 24 years ago. Since then, the team has been competitively designing and racing high-tech, solar-powered vehicles against other colleges and universities with the American Solar Challenge (ASC). The Innovators Educational Foundation (IEF) hosts the American Solar Challenge with the goal of fostering educational excellence and creative engineering. Driven by camaraderie and collaboration, the ASC advocates for the imaginative integration of technical and scientific expertise across a diverse spectrum of engaging disciplines.

The primary objective of this project was to improve upon the existing motor housing design of the current build. This involved implementing a cooling system for the housing, simplifying the current design, and optimizing the overall cost for machining and assembly. Required knowledge included NX, Ansys Finite Element Analysis, GT-POWER, and general manufacturing skills. Emphasis was placed on streamlining the manufacturing process by improving efficiency and increasing simplicity of the design. The design had to align with the professional standards set by the ASC, along with meeting the proper guidelines for consistency and safety. Additional requirements included an aesthetically pleasing final assembly that sported an MSU SRT logo.



MSU SOLAR RACING TEAM

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ME Faculty Advisor

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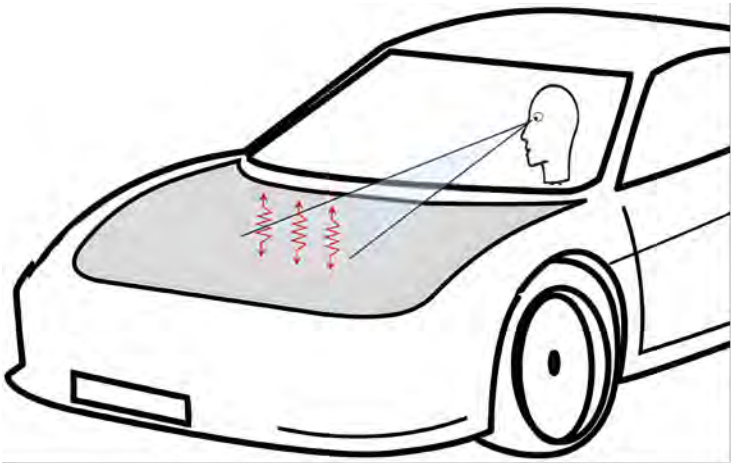
Toyota Motor North America

Automotive Engine Hood Vibration Design

The performance division within Toyota's Research and Development pillar is responsible for predicting and validating design performance to ensure products are reliable and exceed customers' expectations. Toyota is continuously looking for ways to improve the evaluation and prediction process. Automotive hood design includes a complex balancing of competing design constraints. As mass optimization and lightweighting becomes more common, hood vibration performance and prediction becomes more critical to ensure customer satisfaction.

In this project, we applied empirical analysis to sharpen Toyota's design accuracy, specifically addressing automotive hood vibration and its impact on consumer satisfaction. We rigorously collected and analyzed data on human eye perception to hood vibration in order to define acceptable performance levels. This empirical approach enabled us to pinpoint essential structural variables that contribute to vibration characteristics. With this foundation, we crafted a predictive model that correlates these structural parameters with vibration behavior. This innovative model significantly boosts Toyota's predictive precision for upcoming models, optimizing both development and validation phases. Our strategic use of empirical analysis has been crucial in refining vibrational performance prediction, and securing superior hood integrity that resonates with customer expectations.



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NASA/Arizona State University
Power Solutions

In October of 2023, NASA and Arizona State University launched humanity's first mission to a celestial body believed to be primarily composed of metal, rather than rock or ice: an asteroid by the name of 16 Psyche, orbiting the sun between Mars and Jupiter. Previous observations indicate that Psyche could contain metallic remnants of a planetesimal, a building block of planets like our own. Given current limitations on the exploration of the Earth's core, investigation of Psyche could provide key insights into the formation of the planets in our solar system.

Following the planned completion of the Psyche mission in 2029, future researchers may propose a mission to physically explore the surface of the asteroid. Such a mission would require the development of novel and cost-effective methods to generate energy using the unique properties of Psyche. Our team completed a literature review of existing power solutions used in space exploration. Synthesizing existing methods with data collected about the surface of Psyche, we proposed a system to generate energy in a manner that takes advantage of the operating conditions the device would be exposed to while exploring the asteroid's surface.

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NASA/Arizona State University
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NASA Psyche Mission
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Dr. Giles Brereton

Pratt Miller
FSAE Front Outboard Electric Motor Assembly

For 30 years, Pratt Miller has used the world's legendary racetracks as technology proving grounds to develop many race programs, including Corvette Racing, the most successful team in the history of the American Le Mans Series. Pratt Miller's world-renowned motorsports operation has evolved into the innovative, full-service product development company it is today. With over 300 employees, Pratt Miller is proudly serving a global customer base, including those in the motorsports, defense, mobility and innovation industries.

The MSU Formula Racing Team represents Michigan State University's entry into the Formula SAE collegiate design series, a competition sanctioned by the Society of Automotive Engineers. Formula SAE promotes innovation and education by challenging students to fund, design, manufacture, and race small, open-wheel racecars. Since its inception in 1981, this series has experienced tremendous participant growth, earning the title of the largest engineering competition in the world and currently hosting nine events in seven countries annually. To date, there are nearly 500 teams around the globe.

The goal of this project is to keep Michigan State University competitive by designing, manufacturing, and testing an electrical outboard motor assembly prototype that operates inside 10" OZ magnesium wheels. The process involved creating a design tailored to a specific motor that will be 3D printed to serve as a proof of concept. This approach enabled us to test the feasibility before significant financial investment is made in the motor for its implementation in the vehicle.

State RACING

PRATT MILLER

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Michigan AgrAbility
Portable Swarm Trap Lifter

Michigan AgrAbility is an organization that provides services to farmers with disabilities, illnesses, or aging conditions so they can continue participating in the work that they love. In joint partnership with MSU Extension and Easterseals Michigan, they work to research and develop farming tools, equipment, and methods to help with the challenges presented by disability. This group has a profound impact on the agriculture and farming industry by alleviating some of the concerns for farmers and their families by adapting to the physical, emotional, and financial uncertainties that often come with disabilities and chronic health problems. For this project, we worked with Gary Brown, a veteran with a back injury who works as both a beekeeper and a leader of a Heroes to Hives program at his local VFW to teach other veterans beekeeping.

Beekeepers with back, mobility, and upper extremity impairments due to spinal cord injury, amputation, stroke, or military injuries cannot climb ladders to install and remove heavy swarm traps. This problem necessitated the development of a lifting mechanism that could hoist a swarm trap box and eliminate the need for use of a ladder or heavy lifting while installing or uninstalling traps. Significant research was conducted in order to study existing and similar efforts that have been developed for the lifting and transport of swarm traps. To account for the heavy lifting constraint, a transport method was designed to facilitate moving the mechanism to and from the woods. Finally, detailed construction drawings and instructions were created in order to facilitate future fabrication of the device by beekeepers around the nation who would benefit from a disability-friendly swarm trap lifter. A prominent focus was placed on a simple and cost-effective design, as the desire was for the average beekeeper to easily source parts and manufacture this device for themselves.

AgrAbility
easterseals MICHIGAN STATE UNIVERSITY Extension

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MSU Combat Robotics Team

Combat Robotics Vehicle Design and Development

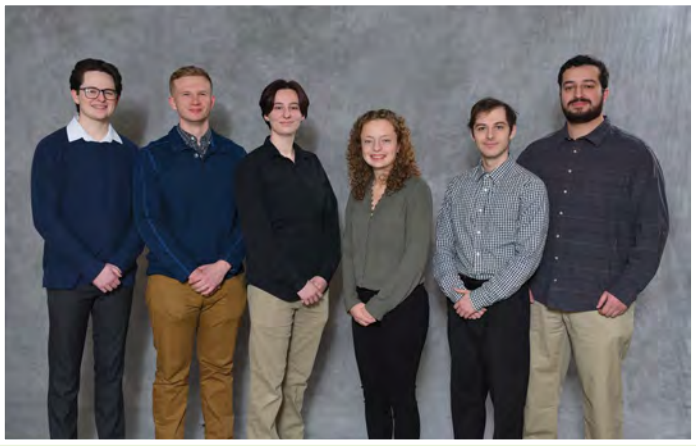
The MSU Combat Robotics team was started in the fall of 2023. The goal of this group is to create combat robots to enter into competitions. In these tournaments, robots compete in one-on-one battles to see who can inflict the most damage and remain operational.

Our team partnered with the Combat Robotics Team for this project to design, build, and compete with a combat robot. We went through all the stages of development of a combat robot with the intention of completing a robot capable of entering competitions. We designed the robot to compete in the 30-lb weight division. To do this, we had to design our robot to comply with the competition rules and safety regulations. This project included designing the robot's weapon, drive systems, chassis, weapon drive, and controls for both the drive and the weapon.

After finalizing the design, we ran simulations to identify stress concentrations and redesigned parts to maximize their strength. This included finite element analysis on the weapon, the chassis, and the weapon shaft. When the design was finalized, we were tasked with building the robot. To complete this, we first identified which parts we could manufacture in-house. We had to submit work orders for parts we could not manufacture, such as the weapon, due to the material properties and manufacturing constraints.

Once all the parts were completed and received, we assembled the combat robot and added our electronic control system. All the controllers were calibrated to run the motors at our desired speeds. This system had to be designed so the wiring would not be damaged when impacted.

Our team plans to enter our robot into our first competition after completion of this project.



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MSU Combat Robotics Team
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ME Faculty Advisor

Dr. Elisa Toulson

Design Day Awards Fall 2023

Edison Undergraduate Design Award

The Edison Undergraduate Design Award is given to the ME 481 Design Team that is judged to have produced the best technical design project.

Team: Village of Alanson (Michigan)
"Hand-Propelled Ferry to Sanctuary Island Park"

Left to right: Matthew Fular, Hunter Arnett, Celeste Salazar, Ethan Avery, Steven Coscino

ME 481 Presentation Award

The ME 481 Project Presentation Award for the best presentation of a design project.

Team: Robert Bosch LLC
"Fuel Cell Anode Recirculation Test Stand"

Left to right: Bhanu Makkapati, Alexander Arnold, Luke Schmidt, Ben Walters, Carter Stefanovski, Luke Roethemeyer

ME 470 da Vinci Award

The Leonardo da Vinci Award is presented to the team with the best machine design.

Left to right: Emilia Jakuc, Brandon Kortrum

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