MICHIGAN STATE UNIVERSITY COLLEGE OF ENGINEERING **FALL 2025**

DESIGN DAY

MICHIGAN STATE UNIVERSITY

amazon

Executive Patron Sponsor

amazon

Welcome to MSU Design Day!

We at Amazon are honored to continue our long-standing partnership with the College of Engineering and Michigan State University in supporting the extraordinary innovation, collaboration, and leadership displayed by MSU students during Design Day.

At Amazon, we use **Leadership Principles** every day to guide our decision making, problem solving, and discussing new ideas. We see these same leadership principles throughout the projects from Design Day. Teams demonstrate **Customer Obsession** as they are working backwards from the customer to solve what is really needed. Students work hard to **Invent and Simplify** on behalf of customers, trying new and different experiments before finding the best simplified solution.

I know first-hand as a MSU CSE 498 and Design Day graduate that these skills will help propel them into the workforce where they will go on to be future engineers, leaders, innovators, entrepreneurs, and outstanding co-workers.

Congratulations and best of luck to all the students, faculty and staff who helped make this year's Design Day a success for MSU and all its partners. We at Amazon are proud to be included and sponsor the **Amazon Sigma Award**, recognizing the CSE capstone team that delivers the best overall design experience. We look forward to working with these Spartans in the future and can't wait to see what you'll invent next.

Sincerely,

Derek Gebhard
Director, Selling Partner Services

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Welcome from the Dean

As Interim 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 68 capstone teams and 650 seniors from all 10 of the College's academic programs.

We are pleased to acknowledge Amazon as our Design Day Executive Patron Sponsor and MSU Federal Credit Union as our Design Day Directing Patron Sponsor. Our Design Day Supporting Patron Sponsors include Anthropocene Institute, Auto-Owners Insurance, Delta Dental, Meijer, TechSmith, and Urban Science. 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 and Anthony Hall, 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.

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. Be sure to stop by and see how they innovate, communicate, and perform at the highest levels in an increasingly global and demanding world.

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 p.m. when we will honor all of our talented Spartans, the best of the best.

Dr. Ioannis "John" Papapolymerou
Interim Dean of the College of Engineering
MSU Research Foundation
Professor of Electrical and Computer Engineering
Michigan State University

Join our team.

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Design Day Events Schedule:
Friday, December 5, 2025

EVENTS	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon	1 p.m.
Engineering Student Organizations		1st Floor Lobby 8:00 a.m. – Noon					
ME 412 Competition		1st Floor Room 1252 8:00 a.m. - 11:30 a.m.					
ME 470 Competition		1st Floor Room 1345 8:00 a.m. - 11:45 a.m.					

CAPSTONE COURSES							
CSE Posters		3rd Floor 3200/3300 Hallway 8:00 a.m. - Noon					
ECE Posters		2nd Floor 2300 Hallway 8:00 a.m. - Noon					
ME Posters		1st Floor 1200/1300 Hallway 8:00 a.m. - Noon					
CE 495 Project Presentations		3rd Floor Rooms 3400 & 3540 8:00 a.m. - Noon					
ECE 480 Project Presentations		2nd Floor Room 2320 7:40 a.m. - 12:20 p.m.					
ME 481 Project Presentations		1st Floor Rooms 1202, 1220 & 1300 8:00 a.m. - 11:30					

OPENING AND AWARDS							
High School Opening			1st Floor Anthony Hall Auditorium Room 1279 8:00 a.m. - 8:30 a.m.				
High School Awards				1st Floor Engineering Auditorium 1345 12:15 p.m. - 12:30 p.m.			
MSU Awards					1st Floor Anthony Room 1281 1:15 p.m. - 2:00 p.m.		

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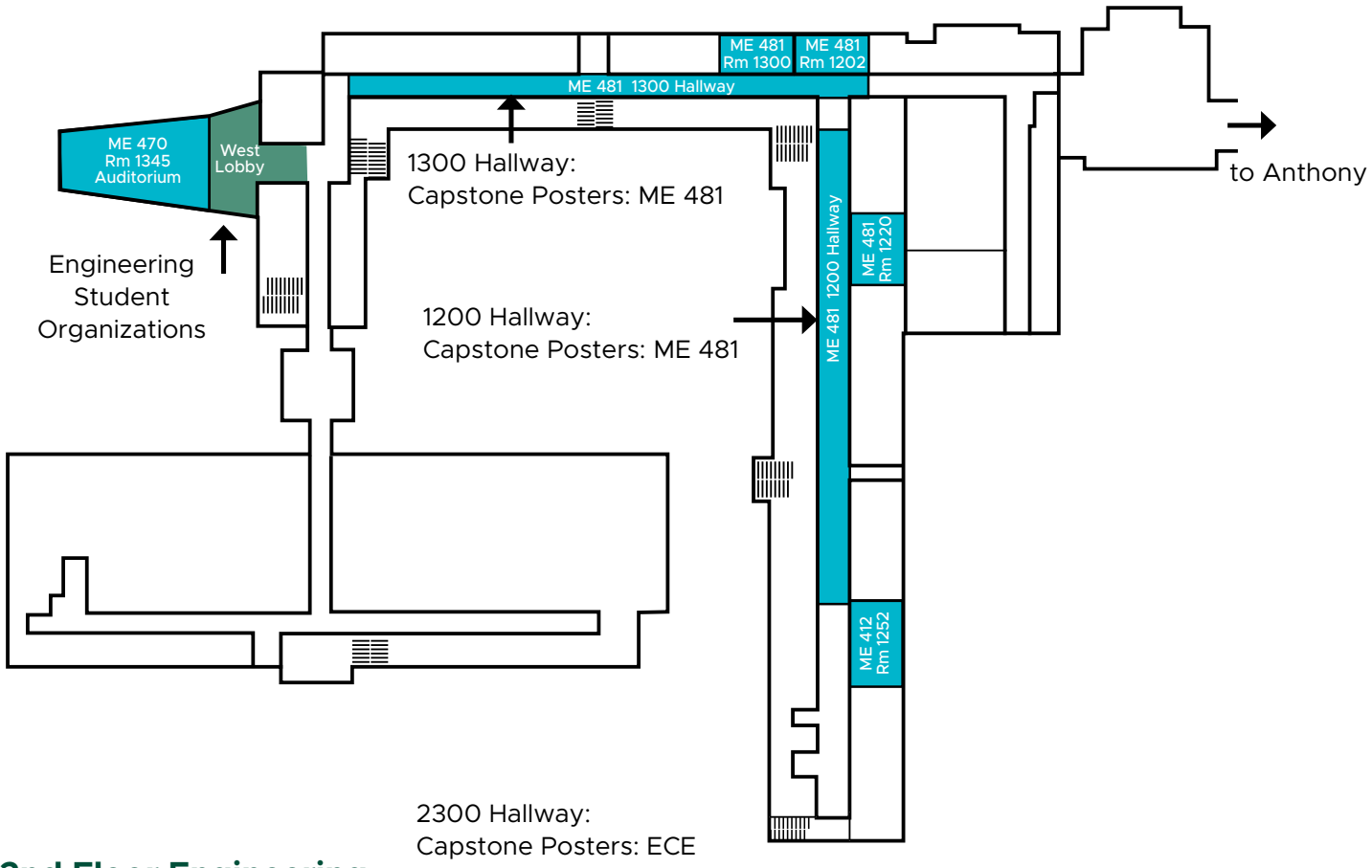
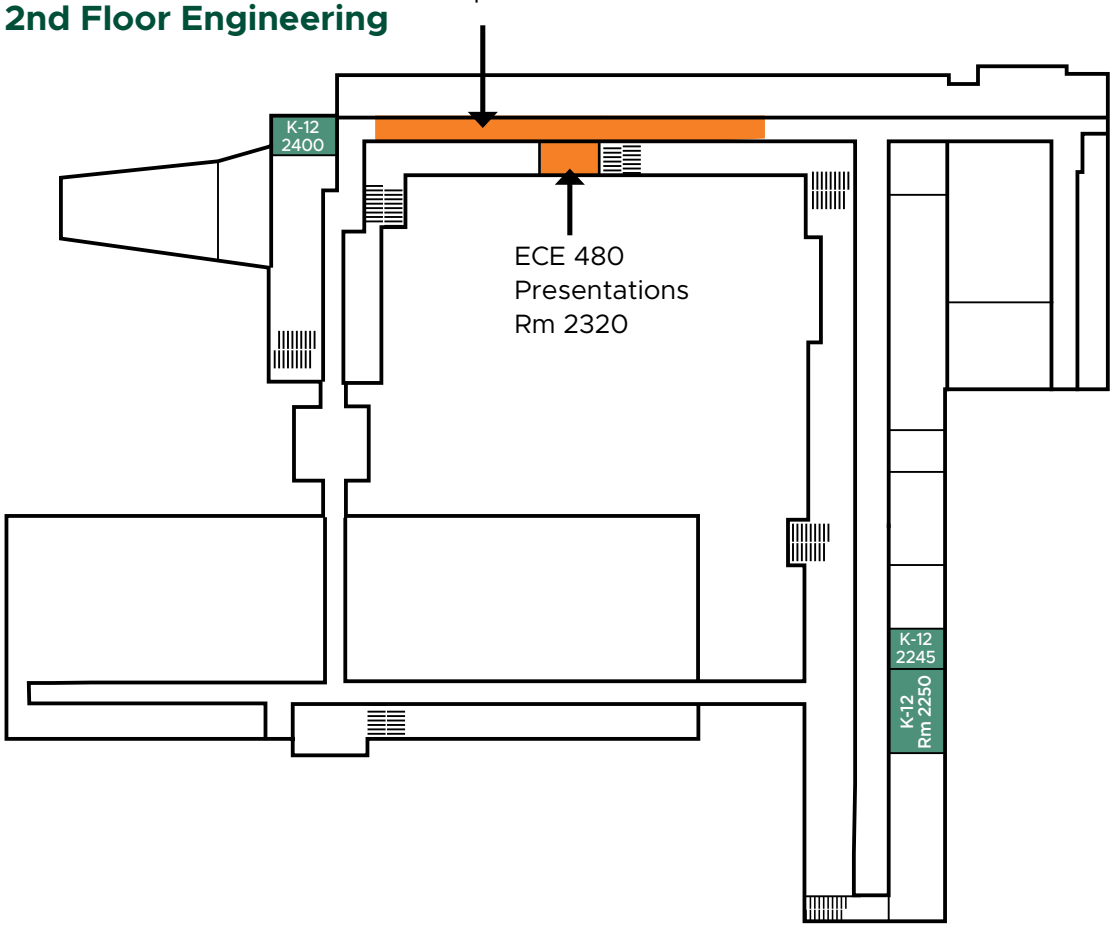
To stay up to date w/Careers in Engineering:

instagram.com/msuengineers/

1st Floor Engineering



2nd Floor Engineering

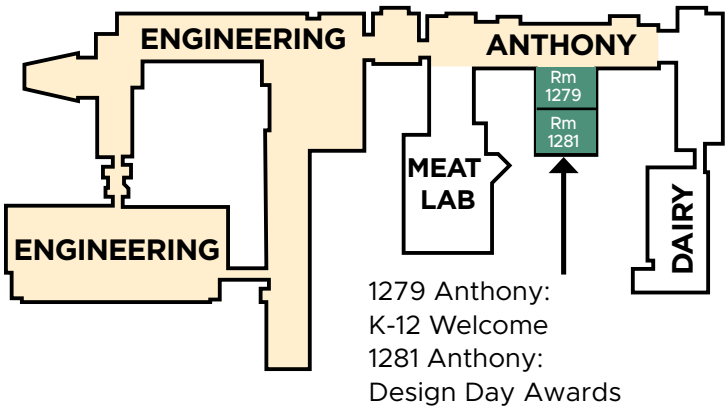


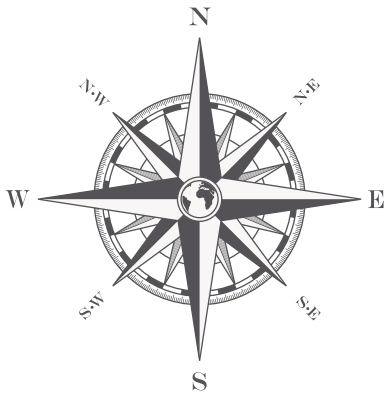
Design Day Floor Plans of the MSU Engineering Building

Overview

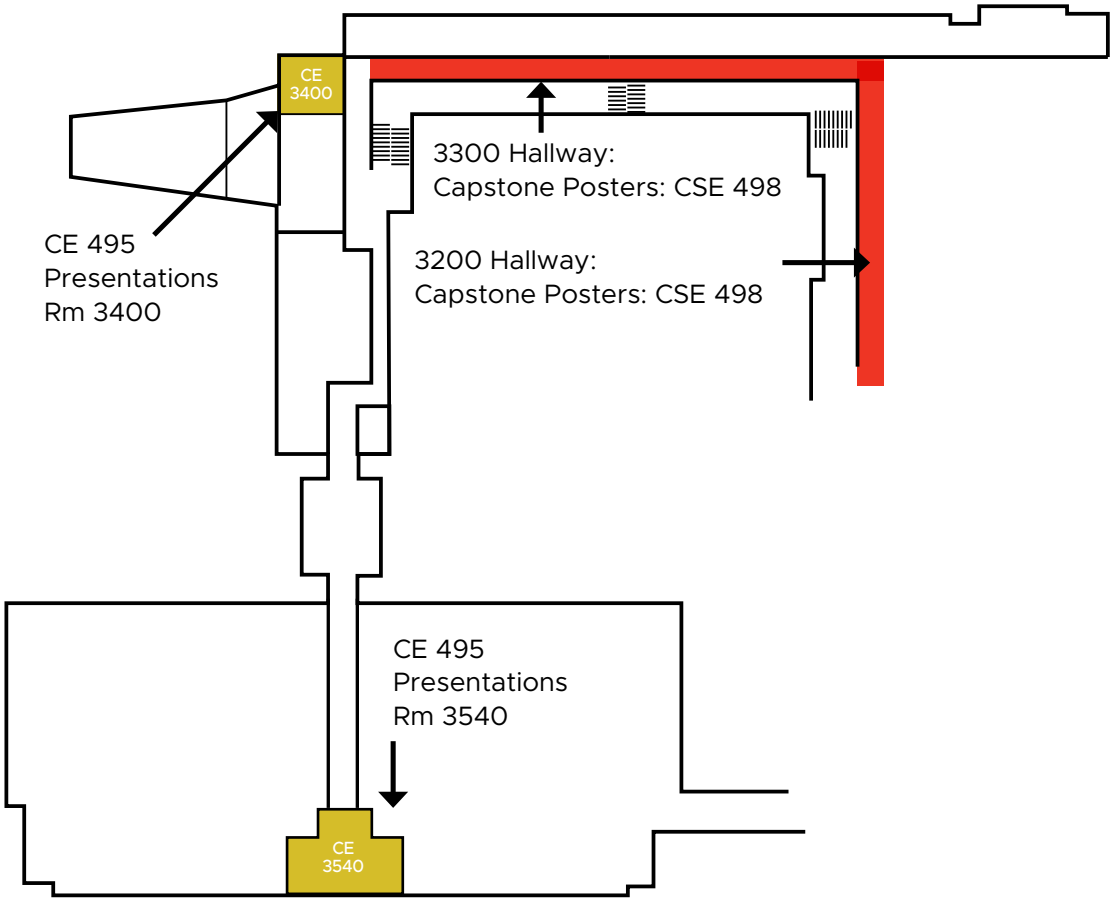
Color Legend:

- CE
- CSE
- ME
- ECE
- Joint/Other





3rd Floor Engineering



High School Innovation & Creativity Day

The following schools and groups will be participating in this Fall's Design Day events: Detroit Area Pre-College Engineering Program (DAPCEP), East Lansing High School (ELHS), Innovation Central High School (ICHS), and Oakland Schools Technical Center (OSTC).

Magna International is one of the world's largest suppliers in the automotive space and a proud sponsor of MSU's Design Day High School Innovation & Creativity Day.

MAGNA

	1279 Anthony Hall Auditorium	K'NEX Bridge Room 2245	VEX Robotics Room 2400	1st & 2nd Floor Project Viewing	LED Labyrinth Competition Room 2250
8:00–8:15	Check in for all schools				
8:15–8:30	Welcome and Voting procedures – Drew Kim, Assistant to Dean, and Luis Donado, Assistant Director				
8:40–9:30		OSTC	DAPCEP	ICHS	ELHS
9:35–10:20		DAPCEP	ICHS	ELHS	OSTC
10:25-11:10		ICHS	ELHS	OSTC	DAPCEP
11:15-12:00		ELHS	OSTC	DAPCEP	ICHS
12:15–12:30	Awards Ceremony, 1345 Engineering Building				

egr.msu.edu/future-engineer **LIKE US: facebook.com/futurespartanengineers**

MEMBERS OF THE ORGANIZING COMMITTEE FOR HIGH SCHOOL INNOVATION & CREATIVITY DAY FALL 2025

Drew Kim
MSU Engineering Assistant to the Dean Recruitment, Scholarships, and K-12 Outreach

Sabrina Auden
K-12 Outreach Coordinator

Dean Buggia
Instructor and Technology Teacher, Okemos High School

Luis Donado
Assistant Director of MSU Engineering Recruitment and K-12 Outreach

Pahoua Nguyen
Logistics Coordinator/ Office Manager

Geralynn Phelps
Assistant Director for Broadening Participation K-12

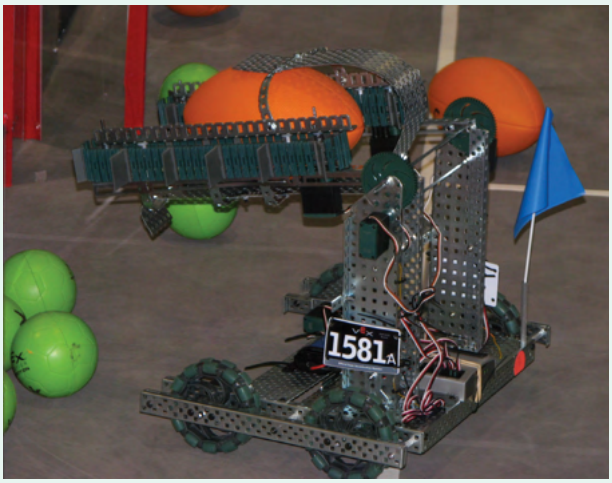
Bige Unluturk
Assistant Professor, Electrical and Computer Engineering

Teresa Vandersloot
Director for Broadening Participation K-12

Bob Watson
MSU Engineering K-12 Outreach LEGO and VEX Robotics Coordinator

VEX ROBOTICS

Our team of experts has designed a lab experience to give precollege students an introduction to robots. Students will work in small groups and have a hands-on approach learning to control the VEX robot. They will write programs using Robot C language, and they will program the robot to be controlled by a remote control. Application and discovery of how programming works will be similar to lessons presented in science and math classes. Each team will discover how to adjust their programs based upon the program inputs and actual output (robot performance). During each phase, new challenges will be introduced to engage the students. This will reinforce new ideas and concepts while exposing students to the newly emerging capabilities of student-controlled robotics programs.



INTERDISCIPLINARY ENGINEERING BUILD

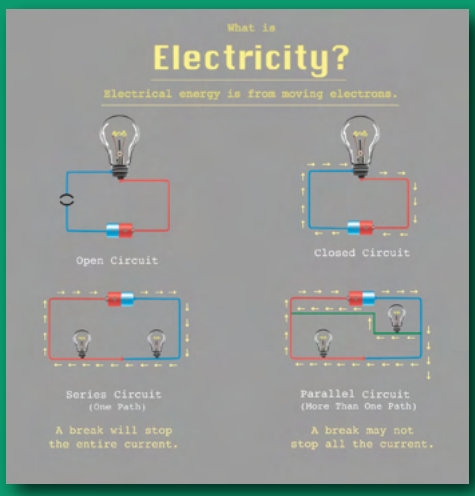
In this build you and your team will be integrating practices from multiple fields of engineering to build and evaluate a support system. Support systems can range from simple beams to intricate bridges composed of gussets, trusses, cables, etc. These types of systems are used throughout Civil, Mechanical and Structural Engineering works. This session will start with a brief introduction to the forces and stresses that act on support systems. Additionally, you will see how digital sensors can read and convey data about these stresses to a computer. We will also look at the computer code that takes this raw data and converts it into a format that can easily be interpreted.

During the build portion of this session, you and your team will be given the design constraints for the structure. Utilizing the information learned at the start of the session and the limited materials provided, your team will need to design and then construct a model to be tested. Your finished structure will be placed on one of our test beds for evaluation. With the help of MSU Engineering students, the results will be collected by a sonic ranging sensor. These data points will be interpreted by the computer program and your team will be evaluated on percent deflection of your support. Throughout this session you will need to listen, learn and utilize your team to be successful. Good Luck.

LED LABYRINTH COMPETITION

The circuit activity at Design Day provides students with an opportunity to manipulate the path of the electrical current in a circuit by switches. Using basic principles of circuits and parallel/series connection concepts, student groups will turn on and off switches to direct current in a premade electrical circuit with LEDs indicating each active branch.

Since an LED allows the current to pass through in only one direction, students should identify the different paths they create by activating different branches, which might be connected in series or in parallel. The event will be scored by how many LEDs can be turned on without breaking the closed circuit.



HEALTH, WEALTH, CLIMATE, & SECURITY

Anthropocene Institute

anthropoceneinstitute.com

The Capstone Projects

Dr. Anthony Ingle
Teaching Specialist

Faculty Advisors: Professors Cetin, Engle, Haider, Hashsham, Ingle, Kumar, Li


Cetin


Engle


Haider


Hashsham


Ingle


Kumar


Li

Presentation Schedule Room 3400

Time	Team	Room 3400
8:00 a.m.	Team 1 - Grand River Consulting	Third Floor Room 3400
9:20 a.m.	Team 2 - Red Cedar Civil and Environmental	Third Floor Room 3400
10:40 a.m.	Team 3 - Beaumont Builders	Third Floor Room 3400

Presentation Schedule Room 3540

Time	Team	Room 3540
8:00 a.m.	Team 4 - Gruff Engineering Company	Third Floor Room 3540
9:20 a.m.	Team 5 - Hard Iron Constructors	Third Floor Room 3540
10:40 a.m.	Team 6 - Spartan Steel	Third Floor Room 3540

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

MSU Spartan Gateway District

The Spartan Gateway District is a potential development at Michigan State University that could reshape a key entrance to campus northeast of the intersection of Harrison Road and Trowbridge Road. This project follows a conceptual plan that is subject to change as the project evolves. Covering about 14 acres, the project is designed to serve as both a welcoming point for visitors and a new center of activity for students, faculty, and the surrounding community. By combining athletics, housing, hospitality, and retail spaces, the development addresses longstanding campus needs while creating opportunities for stronger connections with Lansing and East Lansing.

At the heart of the initially planned project site is a 6,000-seat Olympic Sports Arena that can host MSU volleyball, gymnastics, and wrestling, as well as concerts, tournaments, and community events. Alongside the arena, the first phase will include a hotel and structured parking, with later phases expanding to add housing, office space, and retail uses. Together, these facilities will enhance student life, draw alumni and visitors, and strengthen the university's role as a host for regional and statewide events. The student teams created independent preliminary designs that are based on realistic site-specific constraints without intentionally replicating any plans for the evolving actual development.

Fig 1. Conceptual site plan 3D model looking southeast

Fig 2. Central street view festivities looking east

Fig 3. View from hotel towards arena

Team 1: Grand River Consulting

Left to right: Zach Bearden (S), Colin Pearson (T), Ambrose Moore (G), Rico Iglesias (H), Max Nordlund (P), Ryan Kleimola (PM), and Michael Memering (E)

Team 2: Red Cedar Civil and Environmental

Left to Right: Tim Braford (G), Grace Millbauer (H), Kayleigh Barricklow (PM), Josh Rayl (T), Amelia Cooper (S), Brandon Bardhollari (P), Michael Memering (E)

Team 3: Beaumont Builders

Left to Right: Luke Henry (G), Brigid Horgan (H), Jimena Carmona (PM), Brianna Anderson (T), A'Nya Morrison (E), Alex Robb (P)

Team 4: Gruff Engineering Company

Left to right: Ghassan Awali (S), Noah Kadlec (T), Drew Rogers (PM), Drew Keohane (G), A'Nya Morrison (E), Logan McCall (P), Robert Page (H)

Team 5: Hard Iron Constructors

Left to Right: Cooper Hill (S), Nicholas Buettner (T), Alex Prince (G), Joe Godi, (PM), Wesley Fitzsimmons (E), Lauren Dee, (H), Nathan Bremer (P)

Team 6: Spartan Steel

Left to Right: Josh Broaden (S), Max Meyers (T), Khirakorn Sarasin (H), Chris DeSalvo (G), Evan Shaw (PM), Wesley Fitzsimmons (E), Samy Kankote (P)

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.
Clark Dietz, Inc.

Chuck Rolfe, P.E.
OHM Advisors

Kristen Schuster, P.E.
Michigan Department of Transportation

Alex Sherman, 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.

Sam Baushke, P.E.
Michigan Dept. of EGLE

Leigh Burgess, P.E.
Clark Dietz Inc.

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

Reid Cooksey, P.E.
Stonefield Engineering

Ihab Darwish, P.E.
Benesch

Jordan Doddie, P.E.
HNTB

Jason Early, P.E.
HNTB

Brian Gombos, P.E.
Wade Trim

Michael Kaminski, P.E.
Wade Trim

Fritz Klingler, P.E.
FK Engineering Associates

Chris Mattson, P.E.
Spicer Group

Hailey Savola, P.E.
ROWE Professional Services

Michael Thelen, P.E.
Schnabel Engineering Inc.

Design Day Awards Spring 2025

Rolla C. Carpenter Senior Design Award

The Rolla C. Carpenter Senior Design Award ($700 and medallion) 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, Spring 2025

Team 2: Sustainability Synergy

Left to right: Sarah Scott, Julianna Thompson, Alaina Dorset, Garrett Johnson, Lily Blastic, Katie Jarrad, Alison Delor

Computer Science and Engineering

Capstone Course Sponsors

We thank the following companies for their generous support.

Detroit, Michigan

Detroit, Michigan & Seattle, Washington

Palo Alto, California

Lansing, Michigan

Grand Rapids, Michigan

Okemos, Michigan

Detroit, Michigan

Detroit, Michigan

Detroit, Michigan

Menomonee Falls, Wisconsin

Troy, Michigan

Holland, Michigan

Troy, Michigan & Aurora, Ontario, Canada

Irving, Texas

Grand Rapids, Michigan

East Lansing, Michigan

East Lansing, Michigan

Columbus, Ohio

Detroit, Michigan

Kalamazoo, Michigan

East Lansing, Michigan

Louisville, Colorado & Omaha, Nebraska

Detroit, Michigan

Pontiac, Michigan

San Jose, California

Benton Harbor, Michigan

The Capstone Projects

Dr. Wayne Dyksen
Professor of Computer Science and Engineering

Dr. James Mariani
Professor of Instruction

Griffin Klevering

Jared Singh Sekhon

Luke Sperling

Graduate Teaching Assistants

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, Corewell Health, Delta Dental, General Motors, Google, HAP, Henry Ford Innovations, Kohl's, Launch, Magna, McKesson, Meijer, Microsoft, Mozilla, MSU Federal Credit Union, NetJets, Stryker, TechSmith, Union Pacific, United Airlines, Urban Science, UWM, Vectra AI, Volkswagen, Whirlpool, and WK Kellogg Co.

Ally Financial
Data Consistency and Reconciliation Tool

Ally Financial is an industry leader in financial services headquartered in Detroit, Michigan. As one of the largest online-only banks, Ally Financial provides their approximately 11 million members with a full suite of banking and financial services powered by ever-advancing modern technology.

Focusing on the rapid growth in data-driven decision-making, Ally Financial's experts analyze various types of data across multiple sources for critical processes. The analysis process requires effective management of varied and abundant data to ensure consistency and accuracy which is time-consuming and may cause overlooked discrepancies if done manually.

Our Data Consistency and Reconciliation Tool streamlines the process by analyzing and validating multiple data sources. The tool automatically detects anomalies and generates reports highlighting issues.

When using our web-based application, users are first presented with a dashboard showcasing a summarized overview of data sources and consistency checking displayed through various charts and tables. On the data ingestion page, users upload data sources in various formats to be analyzed. The tool applies predefined validation rules for consistency checking, and any mismatches present are analyzed between two different data sources for reconciliation, logging discrepancies to provide an inconsistency history.

Our tool cuts down on the complexity and time cost associated with analyzing and reconciling multiple types of data, giving Ally Financial's experts more time for other endeavors.

The user interface is developed using React. Data is stored and processed in Snowflake, a cloud-based data warehouse platform. Flask, a Python web framework, is used to transfer data between the front end and database.

Michigan State University
Team Members (left to right)

Jordan Tansingco
Troy, Michigan

Linh Nguyen
Haiphong, Vietnam

Abishek Pemmada
South Lyon, Michigan

Venkata Chinmayee Mannava
Troy, Michigan

Tinku Sharma
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Julia Sznitka
Sterling Heights, Michigan

Ally
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Charlotte, North Carolina

Dan Lemont
Detroit, Michigan

Jesse Podell
New York, New York

John Stoutenger
Charlotte, North Carolina

Theresa Weaver
Detroit, Michigan

Amazon
Seller Agent Management Platform

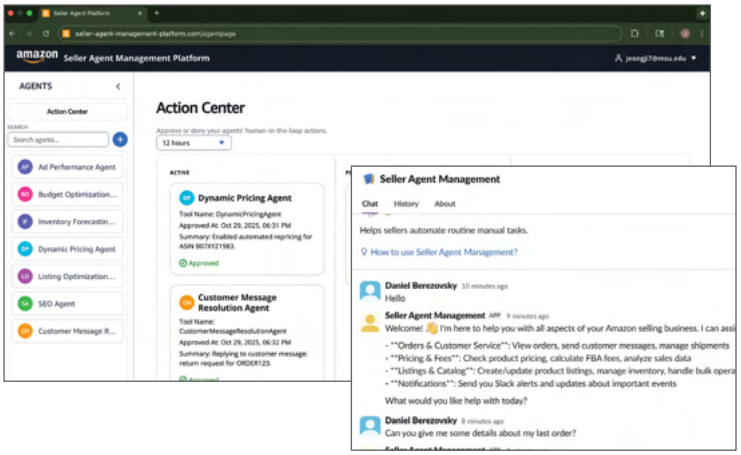
Amazon, headquartered in Seattle, Washington, is a global leader in technology and an e-commerce powerhouse. Originally founded by Jeff Bezos in 1994 as a book marketplace, Amazon has since expanded to be one of the most influential and well-known online selling platforms throughout the global market.

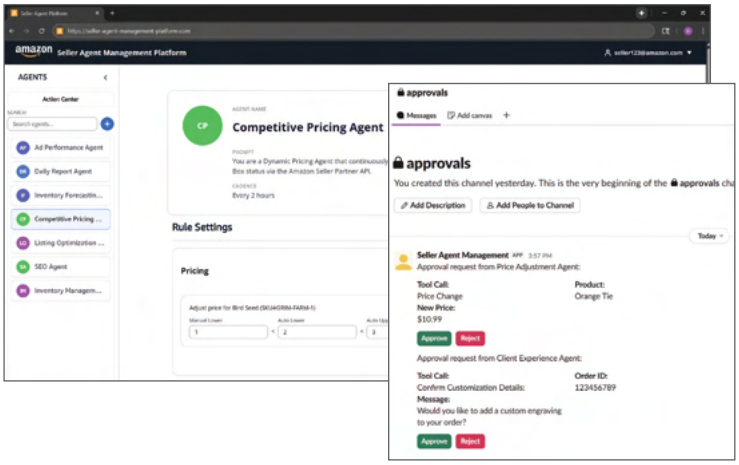
To maximize sales, sellers on Amazon are responsible for performing many tasks. These include responding to customer inquiries, adjusting prices based on competitors, remembering when to stock new inventory, processing returns, and much more. Currently, these tasks are performed manually, requiring sellers to either take time out of their day or hire extra employees to accomplish these tasks.

Our solution, the Seller Agent Management Platform, addresses these challenges by enabling sellers to create customizable agents to automate tasks set by the seller. By offloading tasks, such as price adjustments or inventory stocking, to our advanced AI agents, sellers can save time while maintaining the same quality Amazon buyers have come to expect.

Users create agents through our web application, where they provide the agent with rules and settings on how to operate through our easy-to-use interface. Some of these settings include having the agent react to real-time events, assigning a task by providing a prompt, and specifying which capabilities the agent can or can't have, as well as which actions need human approval before use. Sellers communicate with agents and approve agent actions using Slack, a messaging platform.

Our platform leverages AWS technologies such as Bedrock for LLM inference and Bedrock AgentCore for running the agents and accessing tools. The web application front end is built with NextJS, while the back end uses FastAPI, Amazon API Gateway, and Amazon Elastic Container Service.





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Ethan Tunney
Novi, Michigan

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Daniel Berezovsky
West Bloomfield, Michigan

Ziad Bakki
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Tyler Nguyen
Sterling Heights, Michigan

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Project Sponsors

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Landon Grim
Detroit, Michigan

Hatim Kagalwala
Seattle, Washington

John Marx
Detroit, Michigan

Chris Osborn
Detroit, Michigan

Anthropocene Institute
Modeling Michigan's Energy Future

Founded by Carl Page, The Anthropocene Institute bridges investors, policymakers and institutions with the goal of combating the global climate emergency. The Anthropocene Institute has risen to the forefront of both green technology and education through promoting clean and sustainable energy.

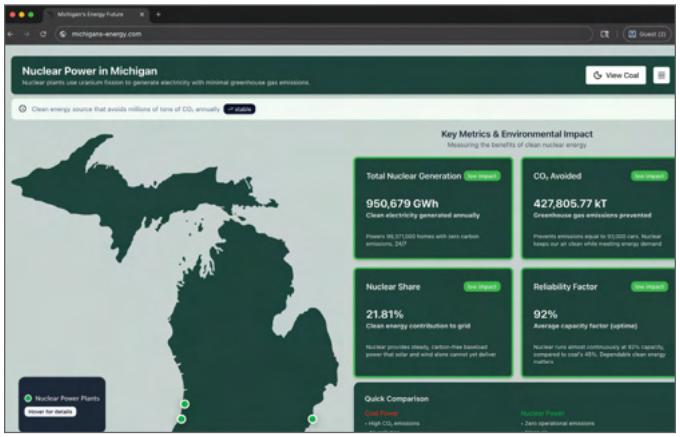
Investment in renewable energy is a crucial first step in reversing the damage done to the environment. However, not all solutions are equal. Nuclear power provides a highly efficient, scalable and reliable way to replace current non-renewable power hegemony. Nuclear power does all this while being incredibly safe, having caused not a single death within the last decade. Despite this, public opinion remains skeptical.

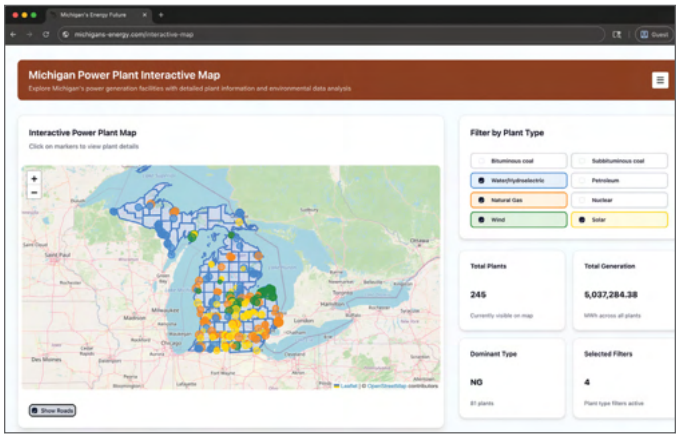
Our Modeling Michigan's Energy Future website contains an interactive map where users view the different power plants within the state of Michigan. Users interact with the plants and change the source of the power they generate before observing the estimated effects of their changes in real time.

The Modeling Michigan's Energy Future website also provides the user with current statistics relating to Michigan's actual electricity usage, generation, and prices. Users view projections of Michigan's power supply and grid pollution where all fossil fuel plants have been transitioned to nuclear plants.

Our website helps spread awareness of nuclear energy through a public-facing, engaging and educational platform. It encourages the public to challenge their preconceived notions regarding wind and solar being safer and more cost-effective. Most importantly, it cements nuclear power as the most feasible clean energy source.

The front end is built using Next.js with React, while the back end utilizes Flask with Python. PostgreSQL provides data storage with pandas handling data processing. Interactive mapping is done through leaflet and charting uses Recharts and Shadcn.





Anthropocene Institute

Michigan State University
Team Members (left to right)

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North Muskegon, Michigan

Raama Katragadda
Novi, Michigan

Tommy Maceri
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Navya Bhardwaj
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Ishraj Yadav
Gurgaon, Haryana, India

Quinn Fransen
Midland, Michigan

Anthropocene Institute
Project Sponsors

Frank Ling
Tokyo, Japan

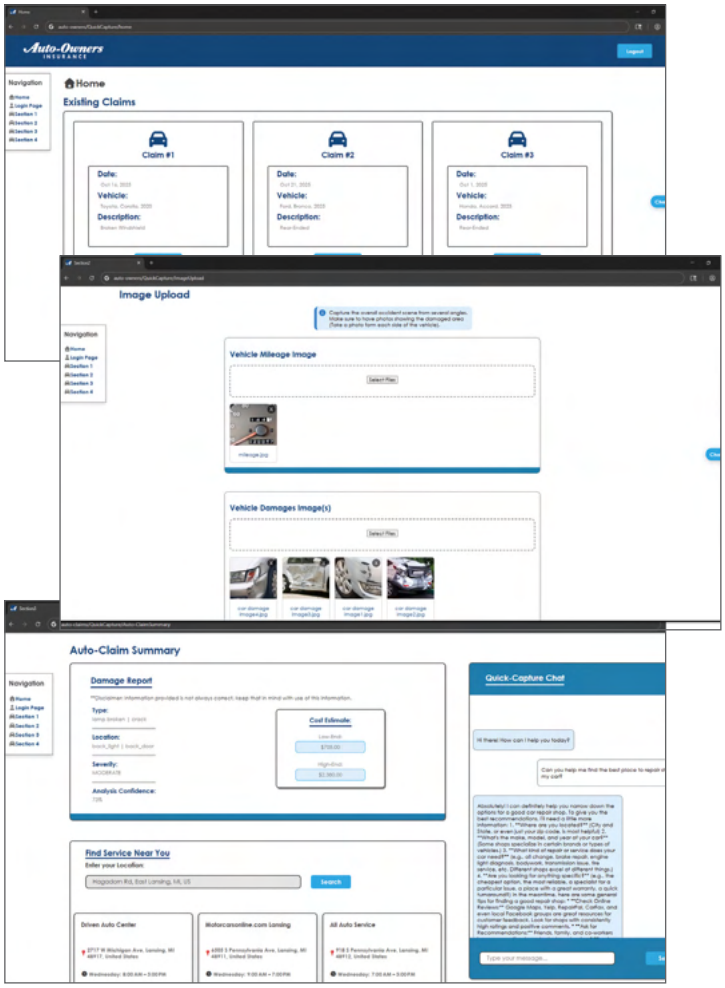
Guido Núñez-Mujica
San Francisco, California

Carl Page
Palo Alto, California

Jesús Alejandro Pineda
Bogotá, Colombia

Auto-Owners Insurance

AO Quick Capture



Auto-Owners Insurance is a Fortune 500 company that provides automotive, home, life, and commercial insurance to nearly 3 million policyholders in 26 states. Headquartered in Lansing, Michigan, the company is recognized for exceptional financial strength and customer service.

Insurance claims take time to process, which creates inefficiencies and additional stress for people after a crash. AO Quick Capture speeds up the experience with a simple, step-by-step flow. It helps policyholders obtain an estimate, repair options, and documentation about the damage in minutes.

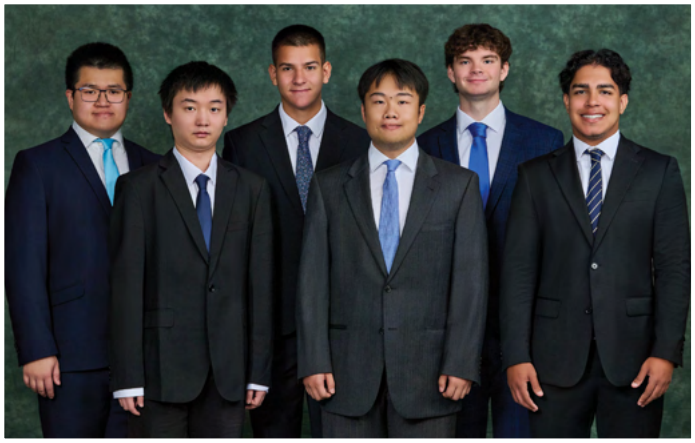
Policyholders sign in, choose a policy and vehicle, confirm details, and upload photos of the damage. Our software analyzes the images, produces an instant repair estimate, and recommends next steps. It suggests nearby repair shops and assembles a shareable PDF report for adjusters and shops. An easy-to-use built-in chat assistant answers questions about coverage, documents, and next steps clearly and concisely.

AO Quick Capture's estimates reflect the visible damage in the photos and highlight items that may require an in-person inspection. The shop suggestions factor in distance and availability while reports summarize the estimate, link the selected shops, and capture photos set for later review. Policyholders can download the report immediately or access it later.

Our system reduces back-and-forth, sets expectations, and helps people make informed choices the same day as the accident. It saves time and stress for policyholders in an already tough situation.

The front end uses Angular 18 with HTML, TypeScript, and SASS. The back end uses Spring Boot (Java) with Microsoft SQL Server. Image analysis runs in Python with PyTorch, YOLOv11, and Gemini, while Google Maps supplies shop recommendations. The system is containerized using Docker.

Auto-Owners INSURANCE



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Corewell Health

An AI Tool for Enhancing Medical Education

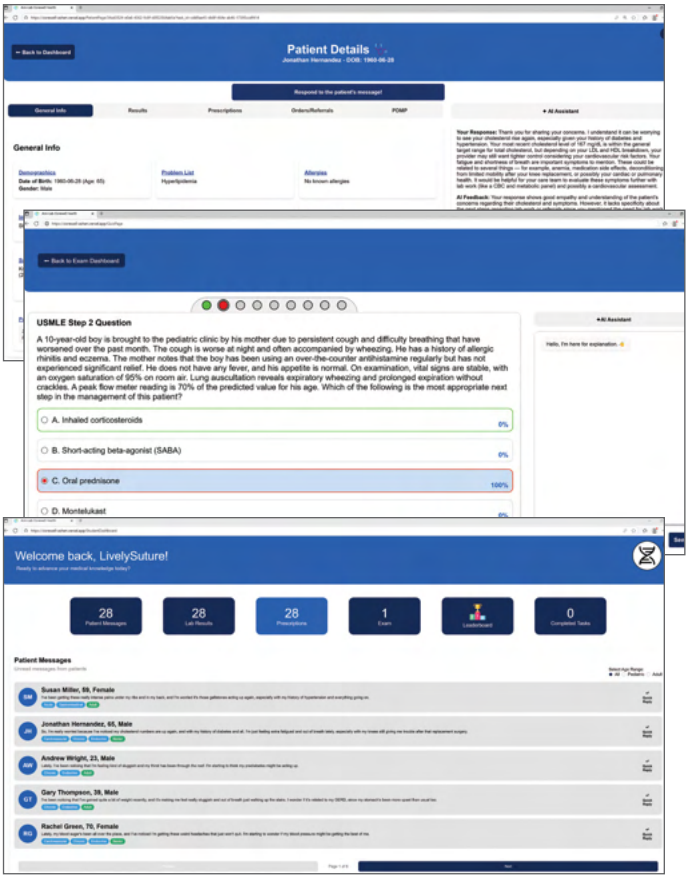
Corewell Health, originally formed in a groundbreaking 2022 merger between Spectrum Health and Beaumont Health, is Michigan's largest nonprofit health system. They currently operate 21 hospitals and 300 outpatient facilities while partnering with universities statewide to train future medical professionals.

Electronic health records (EHRs) and secure patient messaging are now fundamental components of modern healthcare. They enable physicians to quickly review test results, update charts, and communicate with patients. However, most medical school curricula do not provide structured training in how to use these crucial software systems. To close this gap, Corewell Health is expanding its simulated EHR platform, preparing students for the digital systems they rely on during residency and beyond.

Our AI Tool for Enhancing Medical Education integrates into Corewell Health's family medicine curriculum. The system generates diverse, realistic AI-generated patient cases built from national health datasets. Students interact with both adult and pediatric patients, order tests, and prescribe medications. An integrated order entry system mirrors existing EHRs, while AI-generated feedback highlights errors and reinforces correct reasoning. This process enables medical students to practice responding to patients in a realistic setting.

The platform also features an exam preparation page with AI-generated United States Medical Licensing Exam Step 2 questions, helping students strengthen diagnostic thinking and become more confident with exam formats. This ensures they are not only better prepared for testing but also more equipped to face the responsibilities of residency.

Our front-end software is written with ReactJS, and our back end is written in Golang. We use Flask and OpenAI's API for the LLM microservice, and our data is stored in a Supabase database.



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Delta Dental of Michigan, Ohio & Indiana
AI Rule Metadata Generator

Delta Dental of Michigan is a dental insurance provider primarily serving the Tri-State area of Michigan, Indiana and Ohio. Through their business affiliates, they provide their services beyond the Tri-State area to millions of commercial clients, businesses, individuals, and government programs.

To service their millions of clients, Delta Dental hosts a database of business rules that contain business and dental-specific information. These rules are the building blocks of an insurance policy but often become unruly in their size and complexity. It is then difficult for Subject Matter Experts to obtain an organized and concise summary of these rules.

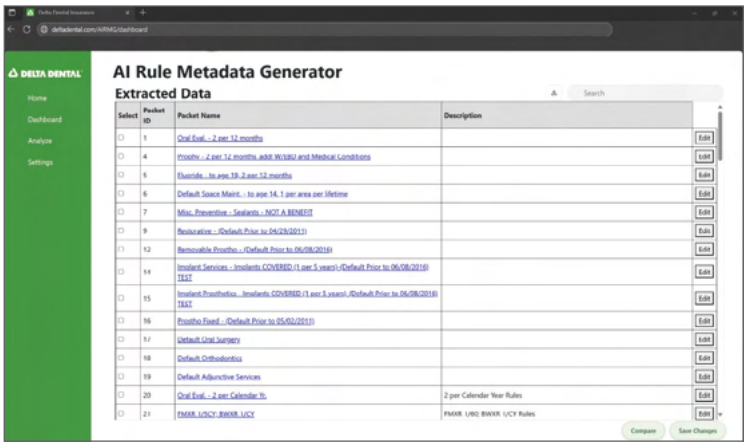
Our AI Rule Metadata Generator mitigates common issues that Subject Matter Experts often face by employing a state-of-the-art large language model that summarizes and builds robust metadata on these business rules.

The application is accessible through an easy-to-use web interface. The user navigates to the business rule of their interest – either through a manual lookup or by using our search feature – chooses up to four business rules, then clicks our "Generate" button.

The chosen business rules run through the large language model, and a concise overview of the available and generated metadata is presented to the user in the web application. The user can edit anything they want and then download the generated metadata to use in their work.

Our tool streamlines the claims process by generating in-depth metadata for business rules. This helps Subject Matter Experts efficiently find and understand complex business information for a quicker and more accurate analysis.

The front end of our web application is built on Angular with a back end built on FastAPI, a PostgreSQL database, with an OpenAI large language model accessed through Azure Services.



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Delta Dental of Michigan, Ohio & Indiana
Insurance Quoting Assistant

Delta Dental provides dental insurance coverage to more than 83 million Americans. They are the largest dental insurance provider in the United States, saving their customers more than $4.3 billion in just the past few years.

Creating over 80 million insurance quotes annually, Delta Dental tasks their underwriters with the creation of these quotes for prospective clients. Underwriters identify the manual and tedious data entry of client-supplied information to be the biggest pain point of this process. Due to the chaotic nature of this data and a wide range of possible formats, efficiency can be an elusive goal.

Our Insurance Quoting Assistant solves this by analyzing and parsing a wide variety of client-supplied files and automatically creating proposals, thereby streamlining the underwriting process.

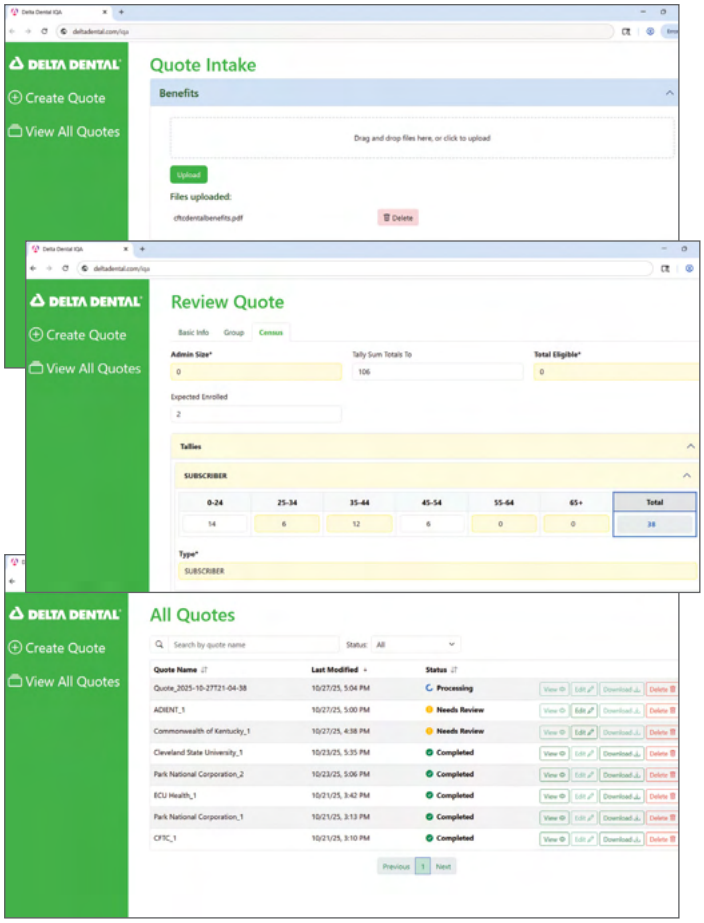
The web application lets an underwriter upload a wide variety of files and to review automatically generated sections of the quote through an intuitive and easy-to-use UI. Once the underwriter reviews and makes the necessary additions, the web application generates a proposal document for the client.

If changes are requested, seamless version tracking and editing capabilities aid the underwriter in accommodating, while the search feature enables efficient retrieval of these different versions.

Our application streamlines the underwriting process by enabling underwriters to gather and review information to generate quotes at an unprecedented rate.

Even using a very conservative estimate, the tool saves around 200 hours of work time a year and likely more for some of the more difficult quotes.

The front end of our web application is built with Angular and Bootstrap. Python FastAPI serves as the AI microservice. MongoDB provides the database. The Java Quarkus back end connects all these components together.



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General Motors

Habitat Identification Using Drone Imaging

General Motors (GM) is a global company that has grown to become one of the largest and most recognizable automotive brands in the world. Founded in 1908 by William C. Durant, GM has established itself as a powerhouse within the industry, and has since expanded into various fields, such as Auto Loan Finances, Defense, and Software.

GM has a longstanding history of protecting natural resources, minimizing environmental impact, and preserving the biodiversity across its operations worldwide. The company is now exploring new ways to efficiently identify and monitor species at its sites.

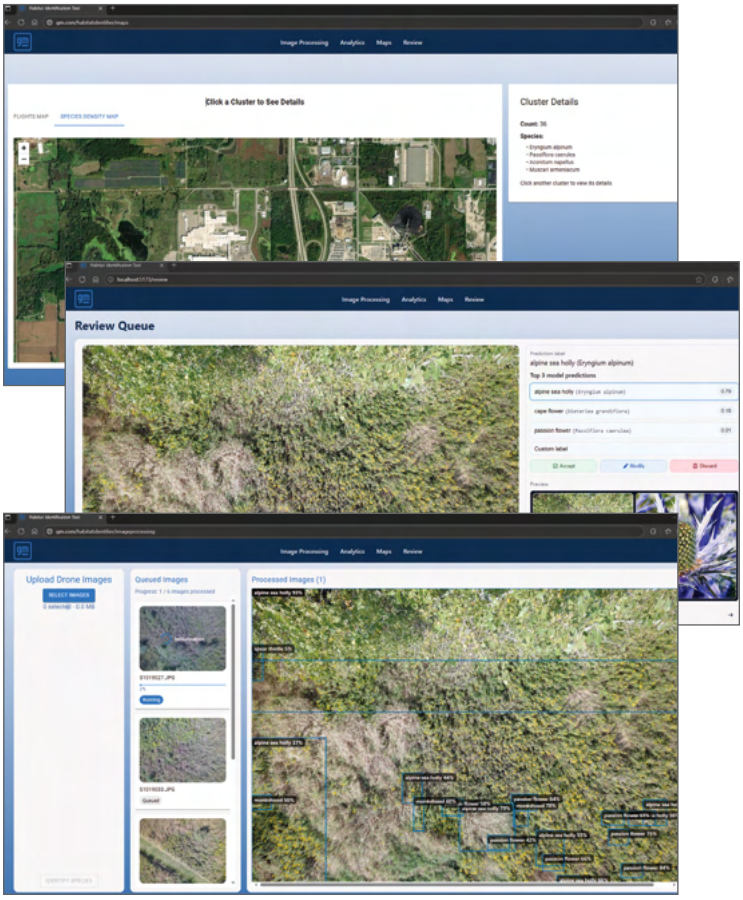
Our Habitat Identification Using Drone Imaging tool makes it easier to map and log plant species more efficiently through an intuitive web application.

When a user provides drone imagery of a habitat, the images are processed by a machine learning model that detects and classifies different plant species. The results of the model are stored in a database and displayed through an easy-to-read and interactive UI.

The application also supports continuous model learning by enabling users to confirm or correct the model's outputs. This means the model not only improves over time but also learns to classify unknown plant species through user feedback.

Our application efficiently reads drone imagery and identifies the different plant species present within the habitat. It provides the experts at GM a tool for tracking plant species abundance and diversity over time.

Our Habitat Identification Using Drone Imaging tool is built as a web application using a React together with TypeScript front end. The back end is built on Flask with Python. The machine learning model is developed using Segment Anything Model in combination with the ViT to detect and segment plant species. PostgreSQL is used to store the data from the drone footage and model.



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HAP

Mastering AI Prompts: HAP Prompt Yielder (HAPpy)

Health Alliance Plan is a health insurer based in Detroit, Michigan that provides coverage for both individuals and businesses of all sizes. HAP serves over 430,000 members across the state of Michigan. By sponsoring innovative projects, HAP supports the development of tools that make technology more accessible.

Artificial intelligence is a technology sector that is rapidly evolving and is becoming an essential tool in the workplace. However, many users struggle to write effective prompts. Without clear guidance, they risk vague or low-quality results from artificial intelligence systems.

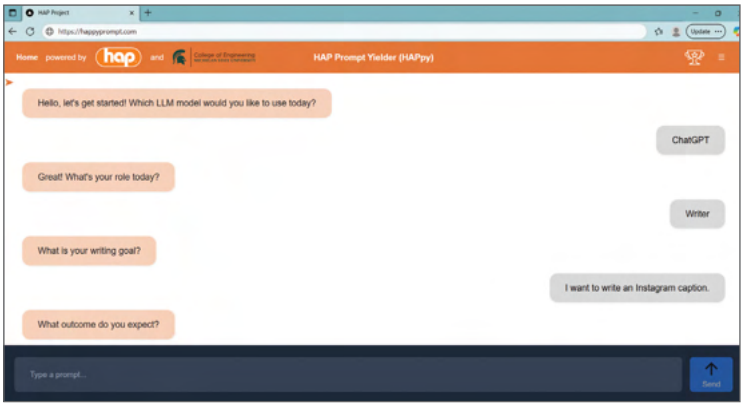
HAP seeks way to improve users' prompt engineering skills by creating technology that is accessible to anyone.

Our HAP Prompt Yielder (HAPpy) software is an automatic prompt generation tool usable by anyone. By breaking down the components of a strong prompt, our system helps users craft better instructions for large language models like ChatGPT, Claude, Gemini Pro, and more.

The system provides a live, prompt quality scorecard which contains three different categories on how a prompt is evaluated. Based on the user's role, they can interact with the system in a chat-like manner and receive a final prompt. From there, the user is redirected to a page recommending top large language models. Their outputs are displayed and easily viewable for comparison. Users can give feedback to improve the scoring model, making the tool smarter over time.

Our software speeds up prompt generation, improving productivity and saving time, resulting in happy users.

HAPpy is built with a React and Next.js front end hosted on Vercel, a Python FastAPI back end deployed on Render with a database layer, and Supabase managing PostgreSQL storage for data and user feedback.



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Henry Ford Innovations

Electronic Laboratory User's Guide (eLUG) 2.0

Based in Detroit, Michigan, Henry Ford Health is a leading health system and academic institution that has brought clinical innovation and research to healthcare since its beginnings in 1915. With over 50,000 team members, 13 hospitals and 6,000 research projects per year, Henry Ford Health is dedicated to making breakthrough discoveries to innovate healthcare and improve outcomes for all patients.

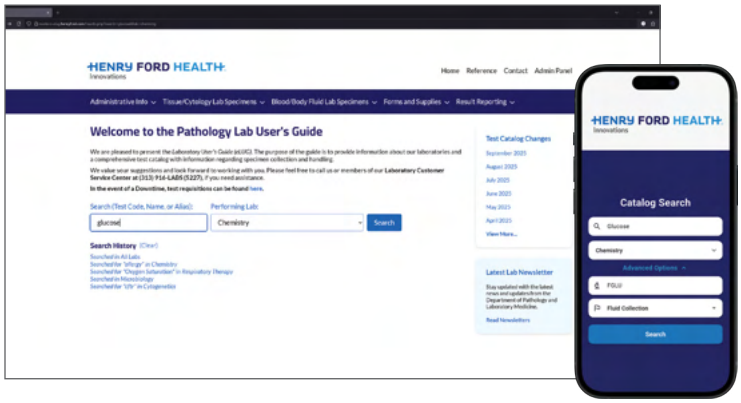
For Henry Ford Health's Department of Pathology, clearly defined and accessible testing procedures are critical. The software they use to achieve this is their Electronic Laboratory User's Guide (eLUG). The eLUG features a lab testing catalog with information on collection instructions and specimen submission requirements for specific tests.

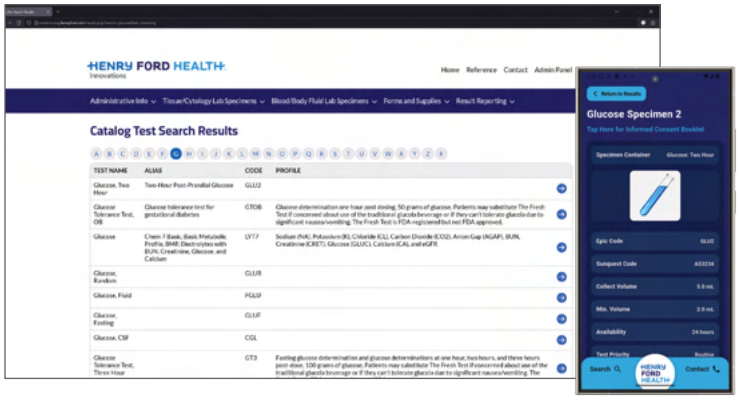
The eLUG's existing web application has not had a major overhaul since 2003, necessitating a modern design for both improved usability and maintainability.

Our new eLUG 2.0 software provides clinicians and staff with improved usability through a completely redesigned user interface and a cross-platform mobile application. The improved maintainability comes from a new database structure with increased integration.

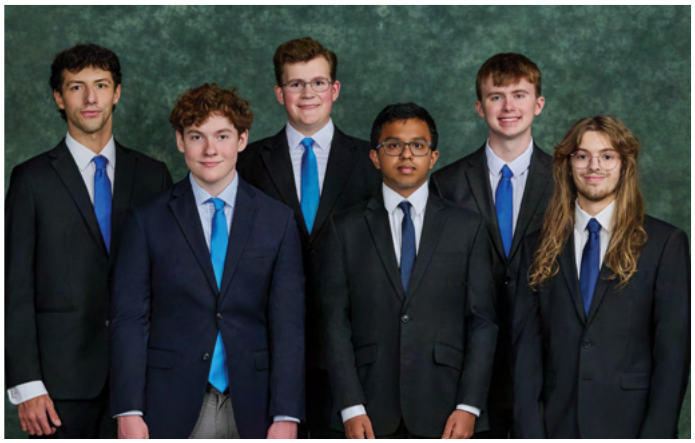
Security is vital for healthcare systems. To secure the applications, the eLUG 2.0 boasts a management utility that uses multiple layers of permissions to restrict access to certain data. This requires that users be internally authenticated to perform specific tasks, keeping Henry Ford data private and secure.

Our web application is built using a Windows Server technology stack. The front end consists of dynamic HTML pages, CSS and JavaScript. The back end uses Microsoft IIS and PHP, connected to a Microsoft SQL Server database. The mobile app uses the same back end, but with Flutter as the front end.





HENRY FORD HEALTH
Innovations



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Kohl's
Kohl's Cash Hero

Kohl's is a Fortune 500 company that provides for families across America at over 1,100 stores in 49 states, as well as at Kohls.com and through the Kohl's App.

Kohl's proudly serves over 60 million customers and is always looking for ways to improve. In pursuit of this, Kohl's searches for various strategies to engage new and long-time customers alike. Younger consumers respond well to systems that encourage daily streaks and intuitive user interfaces.

Our Kohl's Cash Hero encourages shoppers to use the Kohl's website while also providing a new way to discover the Kohl's catalog.

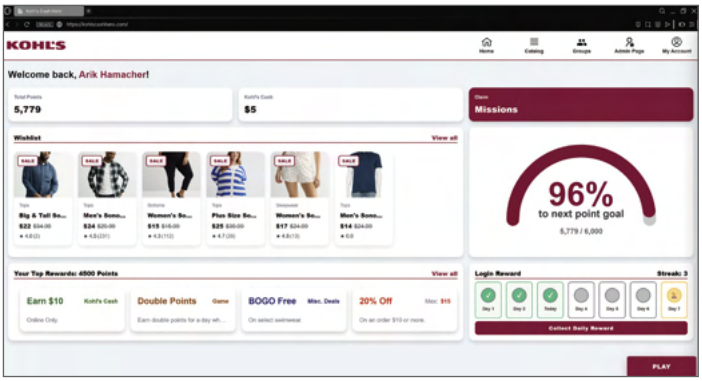
Instead of the shopper walking through a store or scrolling through Kohls.com, our system brings the product to the shopper. Shoppers are shown a series of products that our system predicts will interest them. With a simple swipe, a user can signal interest in eye-catching items as well as add them to a wish list. Our web app automatically learns user preference and taste, recommending more appropriate wares.

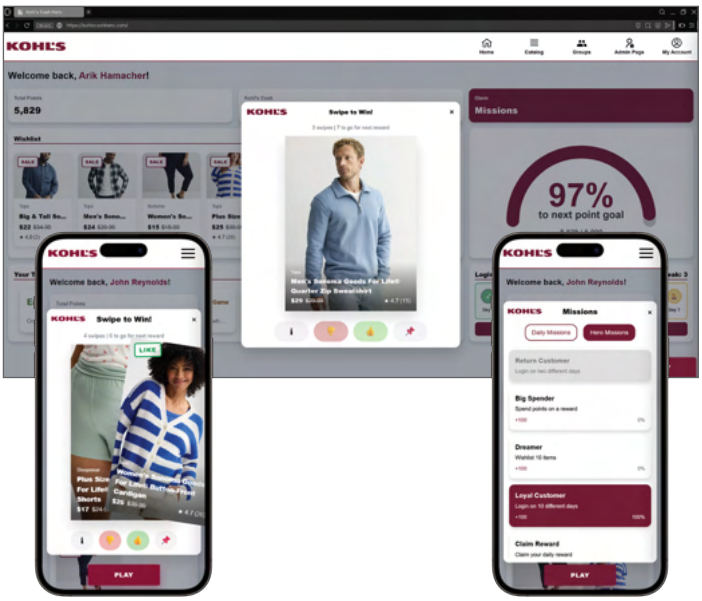
Our system rewards players each day that they swipe with guaranteed in-game points, which shoppers can use to redeem coupons. Consecutive days of use starts a streak for bonus points.

The information our system provides to Kohl's also helps them better serve customers by revealing trends and consumer tastes using insight not provided by sales data alone.

Our software increases customer retention and encourages them to shop at Kohl's, improving customer loyalty and increasing revenue.

The system uses React on the front end and Spring Boot on the back end. Axios handles communication between the two, and product information comes from a Microsoft SQL database hosted by Azure.





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Launch by NTT DATA
My VR Language Tutor

Launch is a technology solutions company and division of NTT Data, a top 10 global IT provider. Launch provides dynamic, long-lasting digital solutions for companies, such as Epic Games and Ford, who look to deliver scalable and competitive products at high speeds.

Many language learners struggle to learn a new language through rote memorization and rigid conversational templates. Limited experience leads many to feel unprepared when they have the opportunity for a real-life conversation.

My VR Language Tutor is a virtual reality application that provides users with an immersive language-learning experience powered by artificial intelligence, bridging the gap between learning a language and putting it into practice.

Our software includes vibrant environments populated with objects, signs and characters that simulate real-life language use cases. Users explore at their leisure, conversing with the characters and interacting with the environment.

Users build vocabulary by identifying objects and receiving feedback. To improve pronunciation, users read signs aloud and receive a grade based on their performance. Speakers improve natural conversation skills by chatting with characters about topics relevant to the environment.

To cater to learners of all skill levels, multiple levels of proficiency are supported. Additionally, hints and assistance can be toggled.

Our software is built for the Meta Quest 3 headset utilizing the Unity 6 game engine. The back-end services utilize C# and Python with an AWS hosted FastAPI system. The Microsoft Azure AI Foundry and an OpenAI integration are utilized for natural language processing tasks including translation, transcription, speech synthesis and language generation.

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Ludus
Web-Based FGL Ticket Emulator & Interpreter

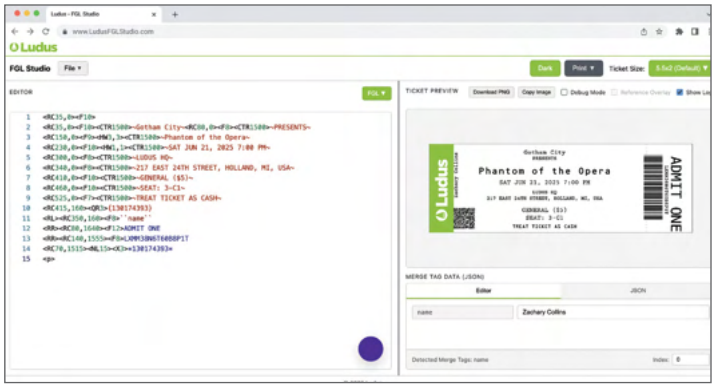
Founded in 2016 by a student and theater director duo, Ludus is a company made for thespians, by thespians. Ludus is a software-as-a-service (SaaS) company based in Holland, Michigan which has grown to support more than 4,500 organizations in creating incredible experiences for venues across America, providing solutions in ticketing, marketing, fundraising, volunteer management and much more.

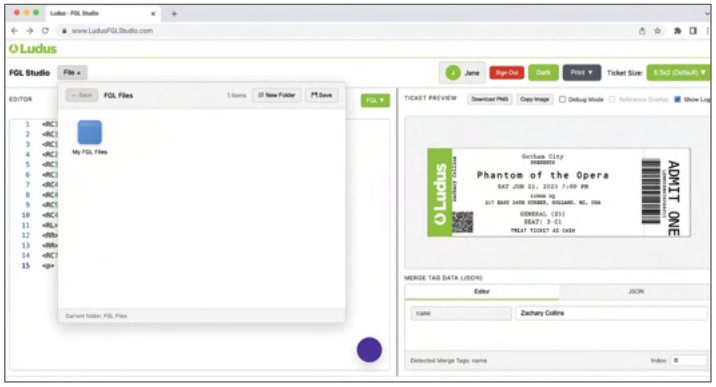
The primary solution Ludus provides is digital ticketing. However, Ludus also prints physical tickets for their clients who desire a more analog ticketing experience. Physical ticket printing is carried out through the industry standard BOCA printers, which do not ship tools for ticket creation. Instead, designers configure tickets in FGL code, a highly technical language that is over 15 years old, and with matching development software. Ludus' vision is to bring FGL into the modern web-based world.

Our Web-Based FGL Ticket Emulator & Interpreter ushers users into that bright future, through easing the creation and design of tickets, with the ability to preview designs prior to printing, which was never possible before. It provides a clean interface familiar to users of other technical languages, including features such as syntax highlighting, automatic text prediction, error checking, validation and, most importantly, instant ticket printing.

The emulator also supports real-time previews of the ticket as it is being edited as well as access to the whole corpus of FGL features. These include 13 different fonts, barcodes and various layout adjustments. With access to all these features, ticket design time is reduced from hours to minutes.

The application runs as a web app built with React, separated into a parsing package which validates the FGL code alongside a high-performance rendering package written in TypeScript using low-level HTML5 canvas API calls for precise, fast output.





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Magna

ML/AI Pipeline for Condition-Based Maintenance

Magna is one of the world's largest automotive suppliers, recognized for their scale, reliability, and innovations across the entire automotive industry. They are committed to maintaining the highest standards of operational excellence and industrial leadership.

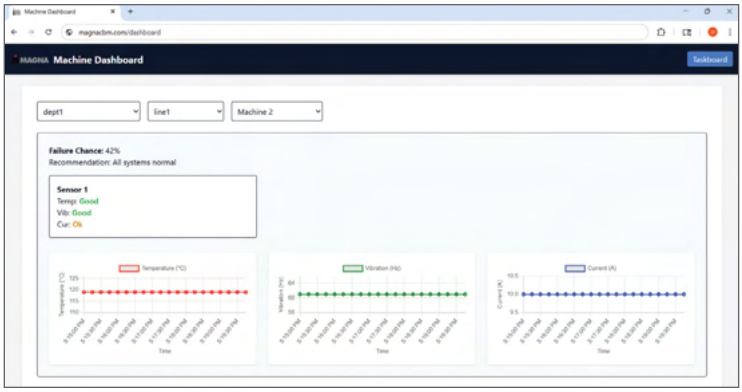
Unplanned equipment downtime is a major challenge in manufacturing, leading to financial losses and reduced productivity. Traditional maintenance—reactive or fixed-schedule—often prove inefficient. A better solution is predictive maintenance, which anticipates failures before they happen, saving costs, optimizing production, and extending equipment life.

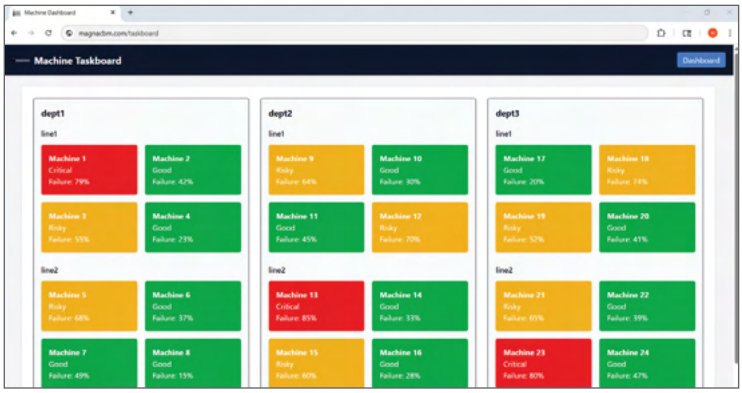
Our ML/AI Pipeline for Condition-Based Maintenance provides a complete system that monitors equipment health in real time and predicts future failures. Our software uses machine learning to collect and analyze sensor data from industrial machinery. The system identifies subtle changes in a machine's performance, leading technicians to address issues proactively.

Our system presents live sensor readings, historical trends, and predictive alerts through an intuitive dashboard. Each machine equipped with sensors has a dedicated page displaying all attached sensors and their current data readings. The interface also highlights any readings that are abnormal or potentially concerning for quick identification and response.

For each machine, the system displays the projected probability of failure within the next 30 days to help maintenance operators determine when maintenance should be performed.

The front end of our condition-based maintenance system is built with React, while the back end uses Next.js and stores data in a PostgreSQL database. The ML/AI pipeline is implemented in Python using ROS 2, with sensor data transmitted via the MQTT protocol.





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Magna
LLM 3D Model Interpretation & Decomposition

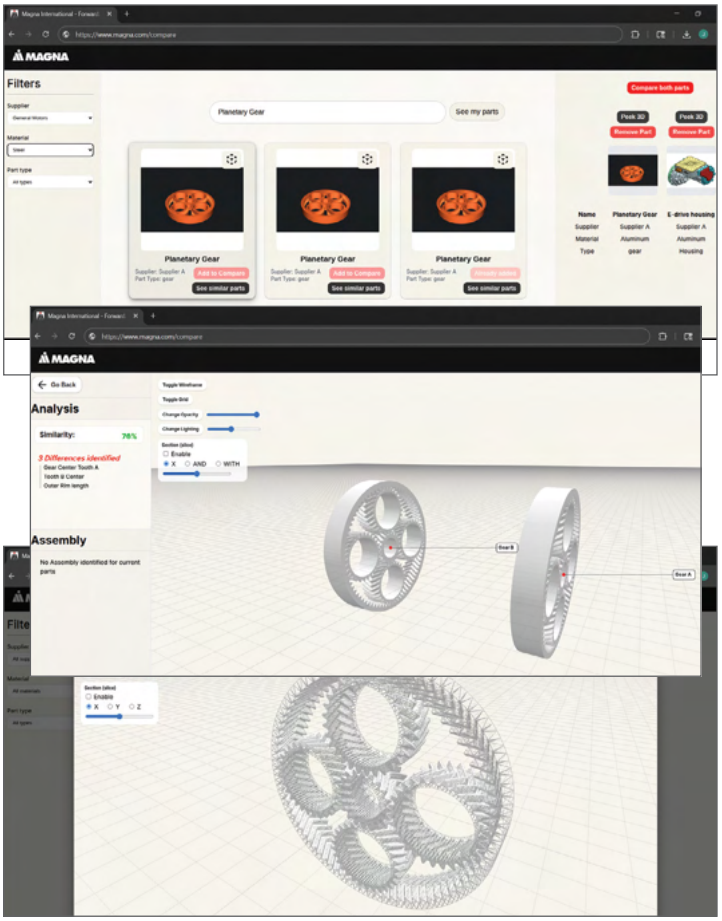
Magna is the leading supplier in the automotive industry, with operations in more than 28 countries and over 100,000 employees. They design and manufacture advanced systems found in nearly every major automotive brand. Magna's vision is to continue advancing mobility for everyone and everything.

Magna relies heavily on a wide array of component models. These components exist in many variants across different suppliers. Engineers must view, examine and compare the models to further develop their products. This task is slow and difficult to complete, especially as the scale of models increases.

Our LLM 3D Model Interpretation & Decomposition tool eliminates the slow and tedious process of analyzing these component models. The system automatically interprets 3D models, decomposes them into meaningful sections, and generates clear descriptions of each part and its structure. Variants are placed side by side in an interactive three-dimensional viewer where key differences and similarities are highlighted in real time.

Engineers can also query for specific parts using a natural language query through plain text, removing the need to filter and search through thousands of models, turning hours of work into mere seconds. Users can find any part based on any criteria such as material, supplier, or even a specific functionality of the part. Our system streamlines the automotive component comparison process, saving time and money.

Our LLM 3D Model Interpretation & Decomposition tool is developed as a Python-based pipeline with Open3D geometry processing, vector storage through Neo4j, and an AI-powered FastAPI back end. The results appear in a responsive web application with visualization powered through Three.js, for detailed analysis.



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Magna
VR Human-AI Multimodal Interaction

Magna International is a leading global automotive part supplier. By utilizing its 158,000 employees, throughout 342 manufacturing operations, across 27 countries, they foster innovation and push the boundaries of sustainable auto production.

Computer-aided design (CAD) is the industry standard for creating 2D and 3D models. Due to the rising level of proficiency required for production-level CAD, modeling is typically restricted to highly experienced users.

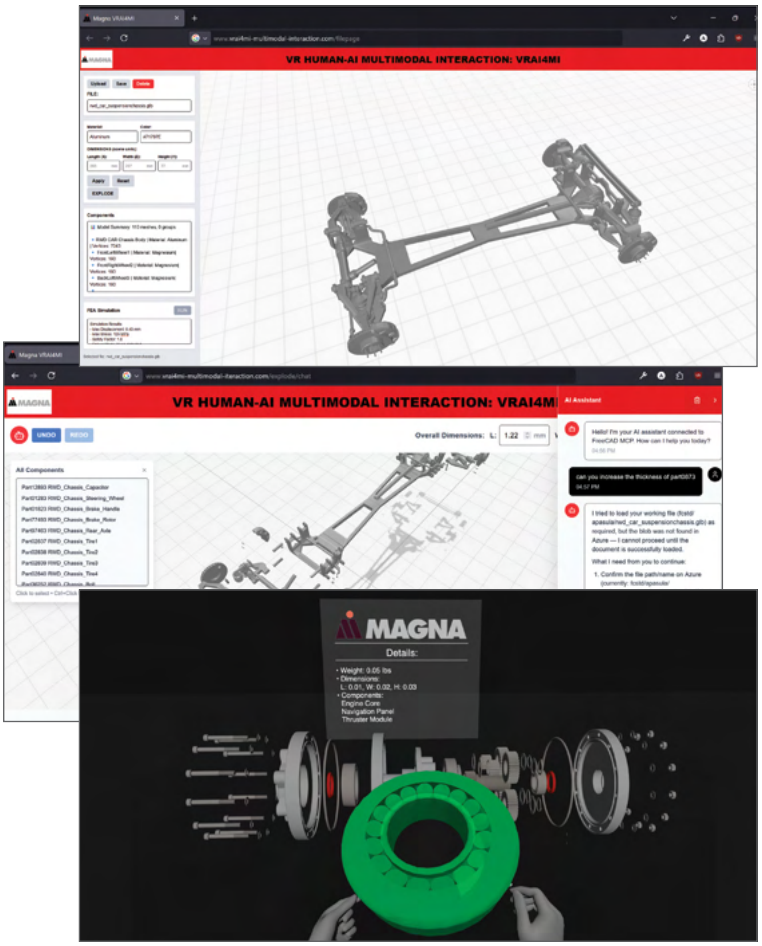
Our VR Human-AI Multimodal Interaction application empowers less experienced users by enabling advanced CAD operations through human-AI interaction. This vastly simplifies the design process and minimizes the CAD expertise required for advanced modeling.

Users utilize speech commands paired with interconnected AI models to invoke both specific and general object manipulation. Existing models can be quickly edited with a single sentence to meet new specifications. This bypasses the elaborate manual design process, enables engineers of varying design experience, and reduces production time.

Engineers and designers interact with their models in a 3D environment using virtual reality. Simple hand gestures and voice commands are used to manipulate and edit the model.

Our application bridges the gap between advanced and intermediate CAD designers by applying cutting-edge agentic technologies, saving time spent designing CAD models.

The front end of our VR Human-AI Multimodal Interaction is built using CSS, HTML and Next.js, while the back end is implemented using Typescript, Python and Node.js. They interact with one another through artificial intelligence reliant services such as OpenAI, FreeCAD MCP and Azure Blob storage.



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McKesson

Intelligent Network Security for High-Risk Traffic

McKesson is a Fortune 10 healthcare company that distributes pharmaceutical supplies and provides patient care across the world. By integrating technology services into healthcare, McKesson emphasizes the importance of patient outcomes.

To protect sensitive data and prevent interferences in crucial operations, healthcare industries rely on secure cybersecurity initiatives. Organizations rely on firewalls to prevent malicious actors from gaining access to their network. A firewall rule is a directive for a firewall which controls the network's traffic. Detecting vulnerabilities in firewall rules is essential to maintaining a secure digital environment.

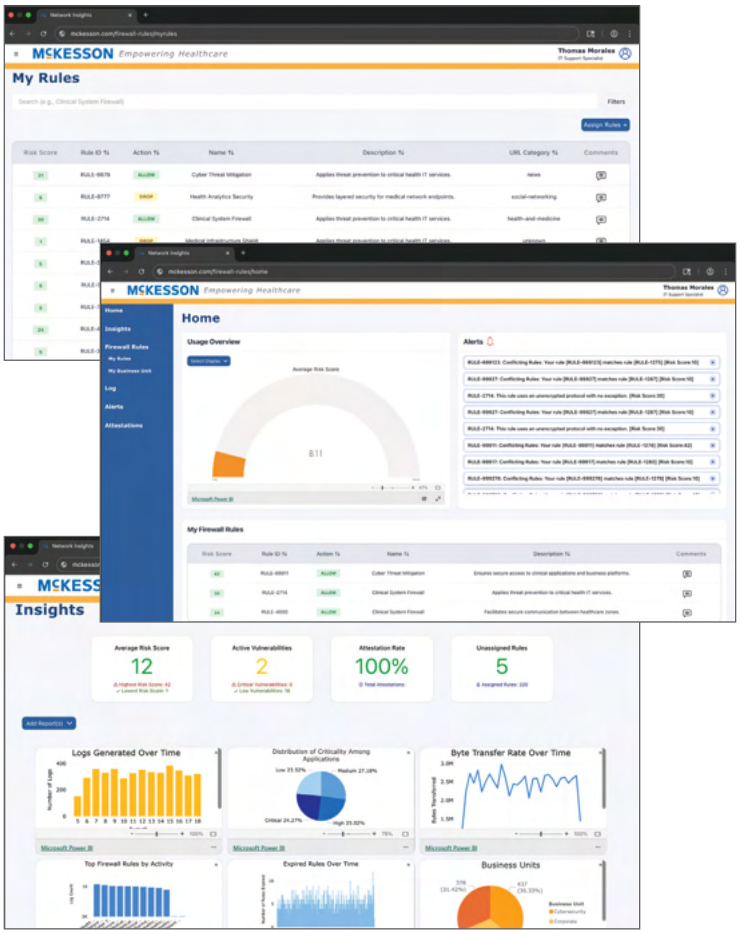
Our Intelligent Network Security for High-Risk Traffic system provides an interactive and convenient way for McKesson employees to view and mitigate firewall rule risks and threats.

Our intuitive web interface enables business and technology owners to manage firewall rules that relate to their applications. This authorizes managers to assign rules to their subordinates, making sure they are monitored in case of threats, while also regulating their own rules.

The system relies on a risk engine which analyzes attributes of firewall rules to determine their vulnerabilities. When suspicious behavior or anomalies are detected with our risk engine, alerts and attestations are sent out to the rule's owner, prompting them to act against these threats.

The webpage includes a dashboard that monitors rule usage and risk trends over time. The data is stored in a secure database which is integrated with the webpage through visualized graphs and charts that are easy to read.

The application is constructed using Python and Flask as the back end and PostgreSQL as the database to analyze firewall rules. The front end is built with React and Power BI.



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Meijer
Environmental Awareness with BeBot

Meijer is a prominent supercenter chain in the Midwest, headquartered in Grand Rapids, Michigan. They have over 270 locations across six states and have partnered with the Great Lakes Cleanup Program, an environmental non-profit, to increase sustainability and give back to the community.

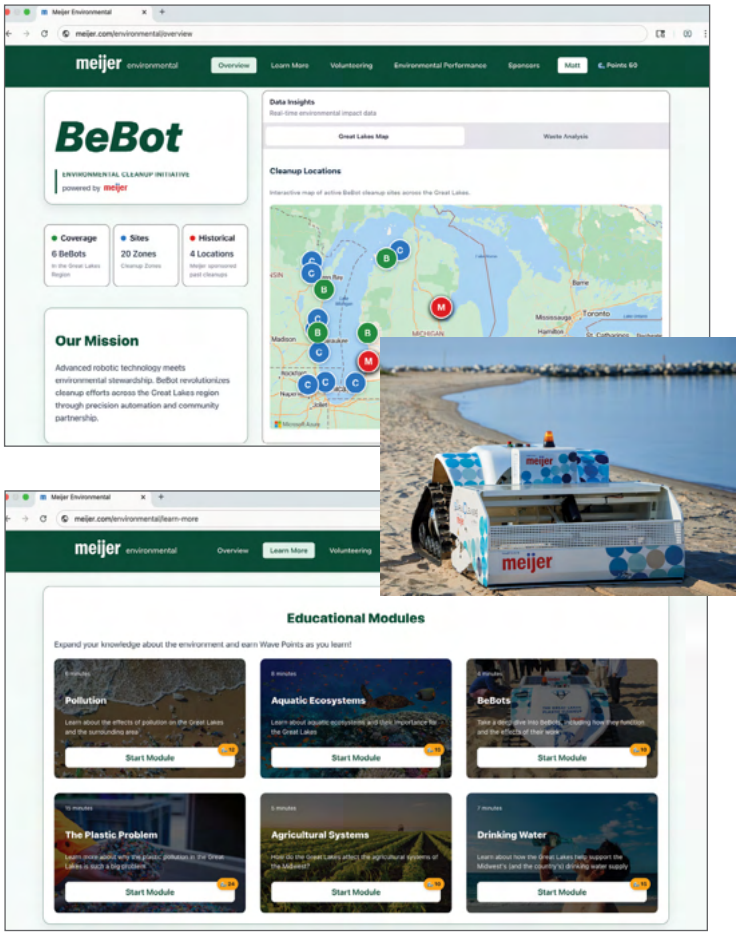
Over the past several years, Meijer's sustainability efforts have intensified and expanded to Michigan's beloved beaches. Meijer has purchased and named BeBots, beach cleaning robots that sift through sand for waste collection, which have been carrying out cleanups around the Great Lakes since early 2025.

Environmental Awareness with BeBot is a web-based application that builds community engagement with Meijer's sustainability efforts. The core features include real-time graphs and other easily digestible data visualizations that inform users about how Meijer's BeBots are helping the environment. Integrated educational modules about a range of topics provide a solid foundation of why cleanup initiatives are so important and what Meijer is doing to contribute.

The site also features a gamified point system. Completing educational modules awards users with points, called Wave Points. A signup portal acts as a hub for individuals and organizations to volunteer for cleanup events across the Midwest, also awarding Wave Points. A sponsor portal enables organizations to support Meijer in its environmental mission.

Our Environmental Awareness with BeBot fosters public engagement and raises awareness of Meijer's green-initiatives.

The front end of our application uses ReactJS, with a back end utilizing Java with Spring Boot, and Azure Custom Vision. The platform is hosted on Microsoft Azure. Data is managed through an Azure SQL database, and Power BI dashboards provide real-time graphics of trash cleanup efforts around the Great Lakes region.



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Remote Interface for Small-Scale Autonomous Racecars

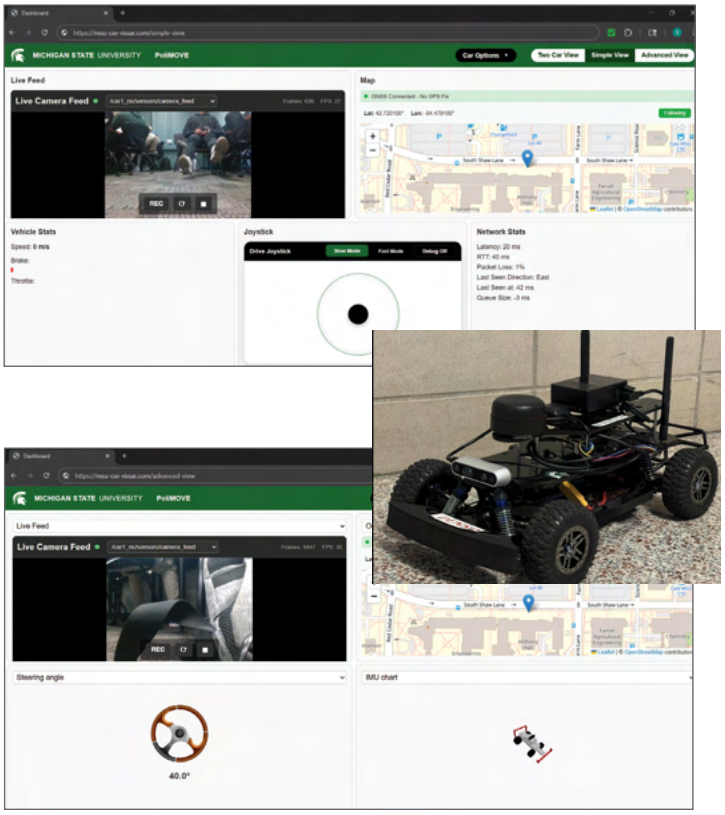
The PoliMOVE-MSU team, a collaboration between Michigan State University and Politecnico di Milano, is a fierce competitor in the Indy Autonomous Challenge. The team has won first place in the competition multiple times and has set several world records, demonstrating just how impressive and versatile their skills are.

To best navigate environments and avoid expensive crashes when racing, autonomous vehicles need to be trained and tested on real-world sensor data. To capture data accurately, the PoliMOVE-MSU team utilizes a small remote-controlled car equipped with sensors, enabling the team to gather data without putting a full-scale car at risk. Unfortunately, the team currently does not have an easy way to control and receive data from the vehicle.

The Remote Interface for Small-Scale Autonomous Racecars assists with both research and community outreach, enabling both in the same easy-to-use web application. With our software, the user can operate the remote car while seeing real-time sensor data from the car, which is continually recorded and saved for efficient use in training. Furthermore, our software creates a realistic and safe environment for children to operate the vehicle, educating them about autonomous vehicles in a hands-on environment.

Our web application has three different views the user can choose from. The simple view shows less data but enables driving the car right from the touchscreen for easy demonstrations, enabling children to operate the vehicle via a touchscreen computer or tablet. The advanced view enables customizable sensor displays, ensuring researchers can track every sensor they need. The two-car view supports driving two cars simultaneously, so multiple users can work on the same instance of the application.

The front end of our software is written in ReactJS while the back end is built with Flask and Python. Communication with the car is handled using ROS2 middleware.



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Citing Slavery Data Presentation

The Citing Slavery Project, spearheaded by Michigan State University professor Justin Simard, acknowledges and discusses the modern citation of slave cases. Modern court cases continue to cite slave cases as precedent, legitimizing slavery by fitting cases involving enslaved people into standard legal categories.

Modern legal databases are complex and difficult to navigate, requiring researchers to spend time and energy searching for the right cases. Our software renovates the current system, bringing a fresh look as well as implementing robust searching strategies used by educators, students, lawyers, and the general public.

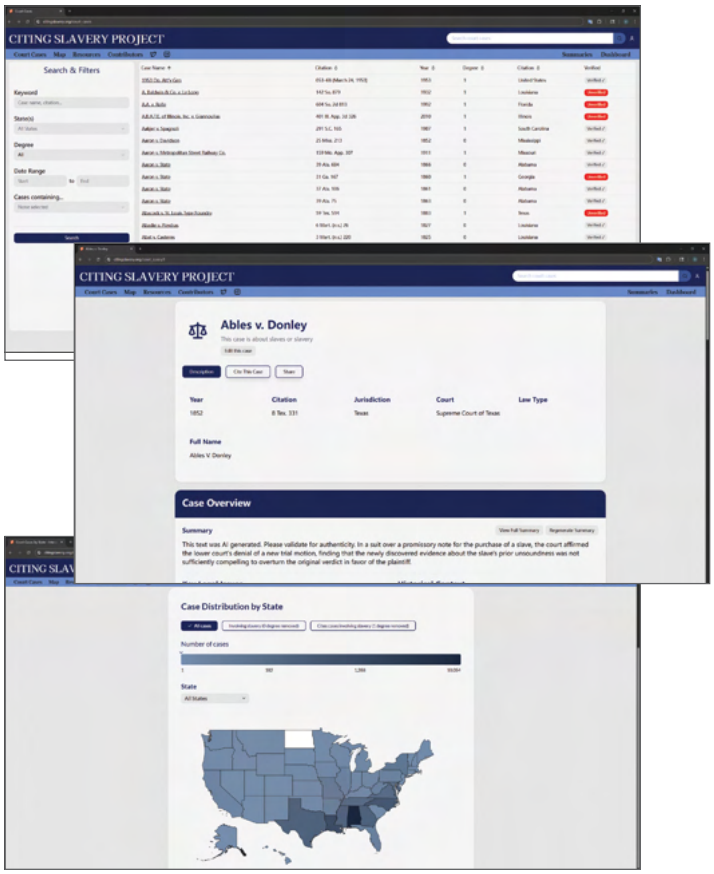
Our Citing Slavery Data Presentation website focuses on making slavery court case data accessible by offering a simple, easy-to-use website. Our site is modern and approachable to anyone, including users with disabilities.

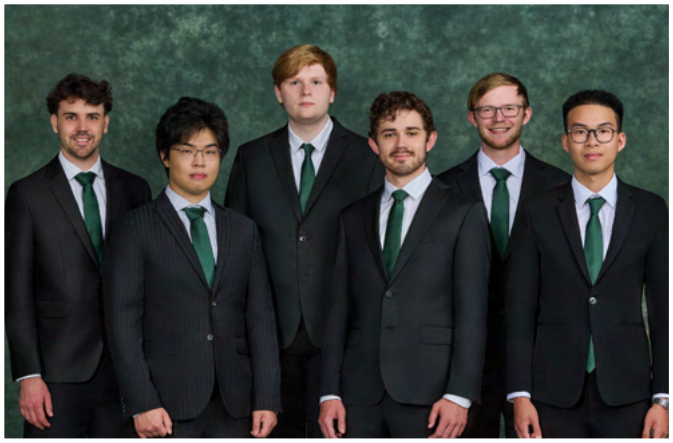
The site's key attribute is its universal search feature, located at the top of every page. Extensive filtering options are achieved via the court case table page, enabling users to organize thousands of court cases by various criteria.

A major concern of the Citing Slavery Project is the accuracy of citing cases as many historic cases contain inaccurate citations, causing associations between invalid cases. The website automatically verifies each court case, flagging all that require approval by law students or professionals. Furthermore, the project provides case summaries that exclude complex legal jargon so users can understand the importance of each case.

Our website works on any device with a web browser, including mobile devices and computers.

Our front end is written in SvelteKit, the back end is written in Ruby on Rails, and data is stored in a PostgreSQL database. Our software is hosted via Railway. The project utilizes OpenAI embeddings for semantic searching and case summaries.





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MSU Federal Credit Union
AI-Powered Financial Wellness Coach

MSU Federal Credit Union (MSUFCU) has been serving Michigan State University and the greater Lansing area since they were established in 1937. MSUFCU has a mission to help both local communities and those beyond to reach financial freedom with 35 branch locations across the Midwest and over 367,000 members.

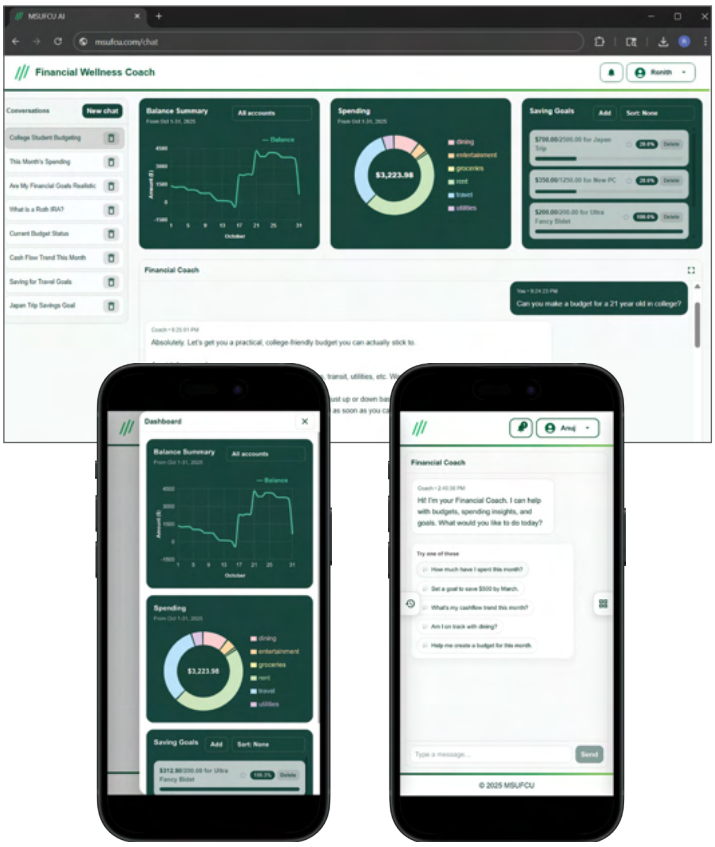
Currently, many young professionals, students, and financially vulnerable people manage money without clear guidance. Budgeting effectively feels confusing, noisy, and the next best step isn't always obvious. Members find it difficult to identify financial patterns and build confidence. As such, MSUFCU is looking to provide a seamless assistant to help members see financial patterns, set a plan, and follow it with confidence.

Our AI-Powered Financial Wellness Coach turns everyday financial activity into clear personal guidance and support. Using plain language, the coach responds to members with high quality answers and helpful information. Members simply ask questions such as, "How was my spending history this month?" and can receive spending breakdowns, set savings goals, and visualize their finances.

When members reach goal milestones with real-time tracking, the coach automatically notifies the member about the milestone and offers simple next steps to continue the momentum. Similarly, members can set budgets with the coach and receive real-time feedback that helps them stay on track with their spending.

With the AI-Powered Financial Wellness Coach, MSUFCU helps their members build the financial future they want.

Our Financial Wellness Coach utilizes a front end built with React for web and mobile, and a back end built with Python, PostgreSQL, and OpenAI API. A Model Context Protocol server is the middleware that securely connects the agent to simulated banking information.



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NetJets
Weather Monitoring and Impact Assessment

NetJets is the global leader in private aviation, operating a fleet of over 700 private jets. NetJets is at the forefront of the fractional ownership model, providing its customers with luxury flights from thousands of airports.

Weather patterns, such as thunderstorms or hail, often bring about risks on aircraft efficiency and safety. Keeping track of these constraints can be difficult for NetJets personnel to manage and plan around.

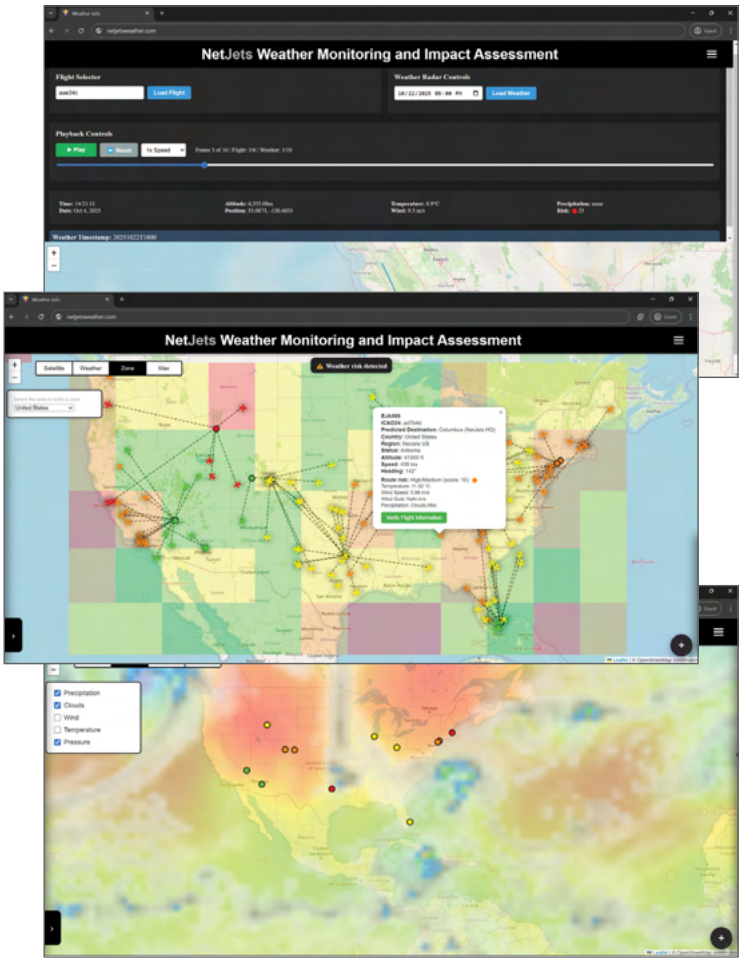
Our Weather Monitoring and Impact Assessment tool is an interactive web application that enables users to view NetJets aircrafts and weather phenomena as they are in flight. Our system enables operators to see the critical factors that may impact flight safety such as heavy rain and high wind speeds.

Our program gives users the option to view different map types depending on what they are looking for: world map view, a weather view with toggle options to see weather in real time, or a risk zone view to assess risky areas determined by weather factors.

Each plane is assessed by flight path to determine the risk it is in. If the flight path is near or within a severe weather event, the flight is colored to match the risk level of the event.

For greater analysis on impact assessment, our tool provides a historical record of previous NetJets flights. The NetJets operational team can view unprecedented weather events in the past and understand what may have caused damage to their planes. This enables NetJets personnel to determine methods that may help minimize these risks in the future.

The front end of the Weather Monitoring and Impact Assessment system is built using ReactJS, while the back end transfers data to and from DynamoDB. The program is hosted on Amazon Web Services. Flights are drawn from OpenSky and weather is drawn from OpenWeather.



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PACE of Southeast Michigan
AI Services & Vendor Navigator

PACE of Southeast Michigan is a healthcare provider that offers comprehensive, all-inclusive medical and wellness support for elderly residents. PACE provides Medicare- and Medicaid-covered services, as well as a broad range of other services that are medically necessary for a patient's health. This includes at-home healthcare, mental health services, and even transportation.

For services PACE does not provide in-house, the interdisciplinary team coordinates with a range of outsourced vendors, including hospitals, specialty clinics and medical equipment providers, aligning with the patient's needs.

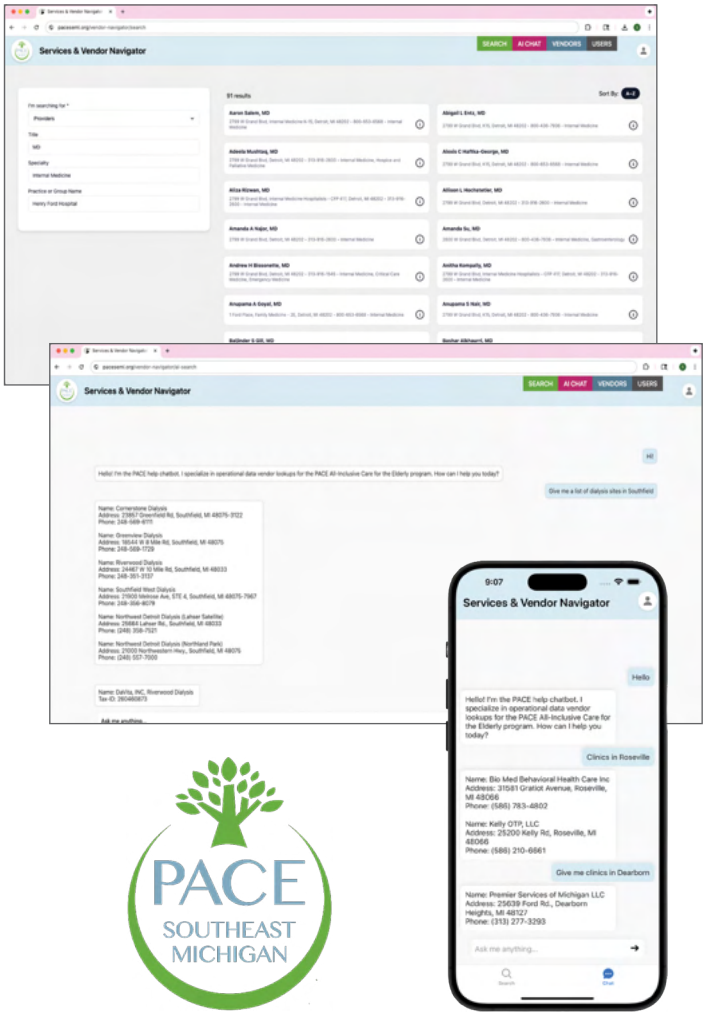
Our AI Services & Vendor Navigator helps PACE employees quickly retrieve vendor and service information through an easy-to-use web and mobile app.

Our software enables employees to ask questions in a chatbot interface and receive clear and accurate answers from a centralized database. Using this information, they can explore and compare vendors to better support PACE members' healthcare needs.

In addition to the AI chatbot, the application enables employees to directly search through the database. They can filter search results by different fields, including by vendor name, location and specialty. They can also further refine the results by distance to a PACE site to get the most relevant search results.

The application includes an additional admin page for data management, enabling administrative users to add, edit, and remove vendor data. This page helps keep vendor and contract information up to date, ensuring that elderly residents get the quality care they deserve.

The front end of our software platform utilizes React Native for mobile and web compatibility. The back end is built on Flask using Python with PostgreSQL managing the vendor database and OpenAI API powering the conversational interface.



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Stryker
Clean & Sterilized Instrumentation

Stryker is a global leader in medical technologies, offering innovative products and services to improve healthcare for patients globally, influencing over 75 countries serving over 150 million patients.

Hospitals around the world have Sterile Processing Departments (SPD) for sanitizing and packaging tools used in Operating Rooms (OR). When packaging tools in the SPD sometimes tools are broken, soiled or missing and go unnoticed. By the time those tools are found in the operating room, it costs valuable time and money to replace them.

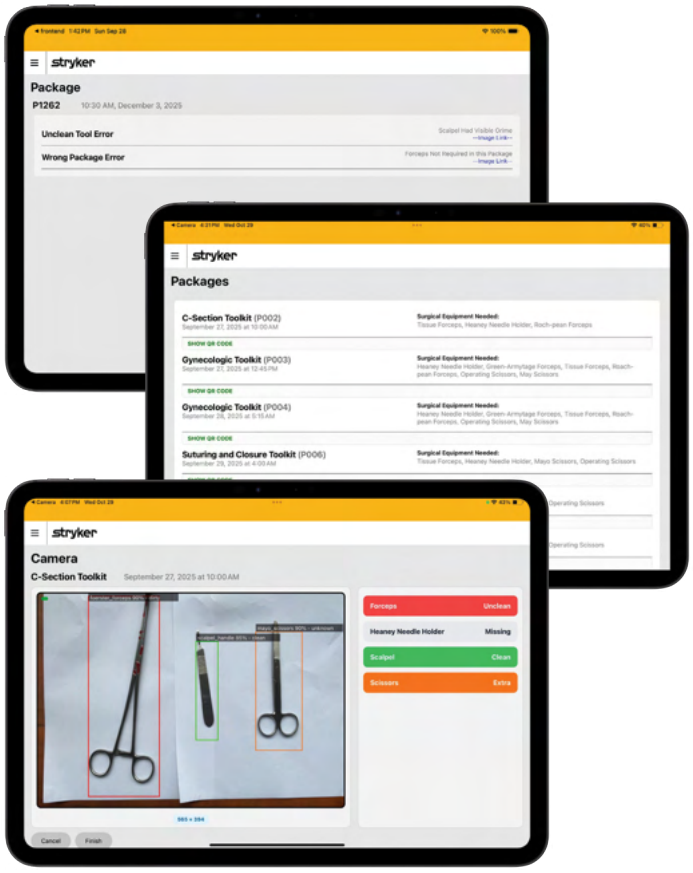
Our Clean & Sterilized Instrumentation application mitigates this issue by monitoring tool packaging within the SPD and notifying SPD technicians of any unclean tools.

On the home page, SPD technicians select what package they are fulfilling, progressing them to the camera page that utilizes the device camera to monitor the packaging of tools. The application knows what tools are required within the package and identifies tools that are broken, soiled or missing. Technicians are required to fix any issues our software finds before moving on, ensuring minimal waste of time and resources.

The OR Manager has access to all previous packages filed by SPD technicians under their management. The application tracks how many errors it finds, calculating the time and money saved by catching those errors at the SPD stage.

Our software automatically tracks tools and their usage from operation to sterilization and packaging, reducing time spent searching and improving patient safety.

Our application uses React Native, JavaScript, TypeScript, and Swift for the front end. The back end is powered by Python and FastAPI, with the AI model implemented with YOLO and PyTorch. Package and Tool data is hosted on a PostgreSQL server.



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TechSmith
Insight Weaver AI (IWAI)

TechSmith's mission enables users to communicate and share their message through media capture and editing software. Founded in 1987, TechSmith's products, notably Snagit and Camtasia, are employed by over 70 million users worldwide and all Fortune 500 companies.

Video editing can be time-consuming and difficult to learn. Many people are unfamiliar with video editing applications and lack the time to learn them. Inexperienced video editors often face the problem of transforming screen recordings, presentations, and webcam footage into professional and engaging videos.

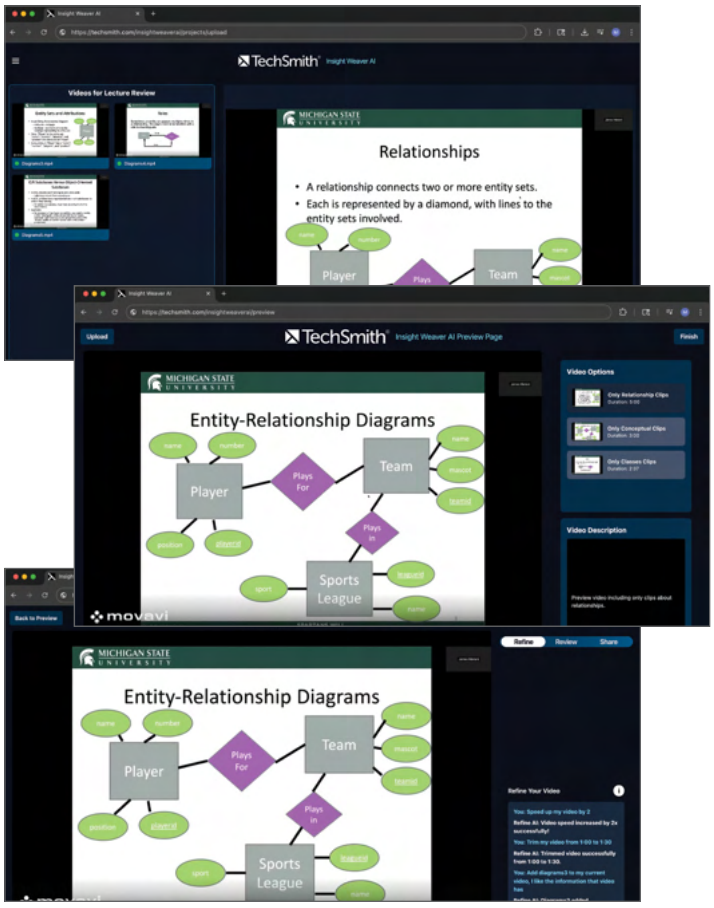
To combat this issue, our Insight Weaver AI (IWAI) web application enables users to upload their footage to be edited by our Agentic AI systems. Our software transforms the provided footage into three polished and cohesive videos to choose from, each with a distinct narrative lens.

Once videos are generated, users further refine their AI-edited video using chat and context-specific quick actions. Users also select a specific agent persona such as "film student" or "marketing director" to craft their video to their specific needs.

When videos are uploaded, IWAI's agentic AI analyzes the content, including speech transcription, sentiment analysis, and key visual elements. The AI agent selects the most important segments and intelligently combines them into three complete videos, ensuring the user will be satisfied with at least one combination.

Using our web app, video editing becomes seamless and easy for users regardless of experience. This provides an unparalleled ease of use and a magical experience for creators.

The back end of Insight Weaver AI is built using NodeJS while the front end uses ReactJS. The web application is hosted on Microsoft Azure. IWAI uses Azure AI Foundry for AI agents and video content understanding.



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Union Pacific
Cars in the Clear VR Training

Union Pacific has been building America for more than 160 years. Headquartered in Omaha, Nebraska, they manage 32,000 miles of track across 23 western states. Operating 7,000 locomotives transporting 8.3 million cars of goods a year, they play a key role in the world's supply chain.

Proper management of railcars is a time-consuming, yet safety-critical task performed by Union Pacific conductors. Inexperience leads to hazardous railyard accidents, which can easily lead to injuries. A straightforward solution is needed to train conductors on how to safely position cars in the yard.

Our virtual reality (VR) application, Cars in the Clear VR Training, creates a true-to-life simulation, simplifying the difficulties of normal training. By training in a virtual space, we provide trainees with hands-on experience before using real equipment, which reduces safety risks. Our application targets two critical skills: placing cars in the clear to stop cars from colliding, and lining switches to guide cars to their proper destination.

Cars are in the clear when they do not interfere with passage on an adjacent track. Trainees are shown the clear area of a track, then must properly position train cars clear of adjacent tracks.

Lining switches is the process of examining and flipping switches to ensure the train follows the desired path. Trainees practice identifying the type of switch and how to properly use them. The trainee then uses the switches to navigate a train to a target track.

The combination of these skills provides critical baseline knowledge for daily railyard operations, reducing accidents and improving workplace safety.

Our Cars in the Clear system is developed as a VR application that runs on a Meta Quest. Our application is written in C# and runs on the Unity game engine.

UNION PACIFIC
BUILDING AMERICA®

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Urban Science

Generating Mapping Insights Using AI

Headquartered in Detroit, Michigan, Urban Science is a global automotive consultant and technology provider that delivers data-driven solutions for original equipment manufacturers and dealerships. Since its founding in 1977, the company has utilized and leveraged data science, analytics, and software to help automotive brands optimize performance and make smarter market decisions.

As the automotive industry continues to expand and evolve, both dealerships and manufacturers face growing challenges in understanding market performance at a detailed level. Interpreting key metrics, such as sales and market share, can be especially complex when comparing results across different regions.

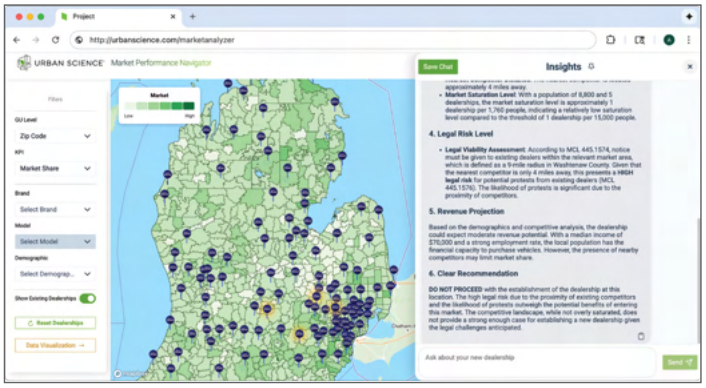
These challenges highlight the need for a tool that simplifies market insights and provides clear information on managing dealership territories.

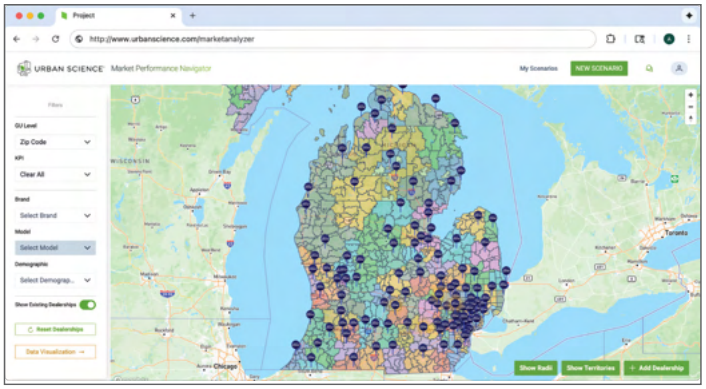
Our Generating Mapping Insights Using AI software addresses this need by providing interactive heat maps that display changes in key performance metrics and demographics. This application enables users to easily identify optimal locations for opening new dealerships or relocating existing ones.

After relocating or adding a dealership, our system generates an AI response that interprets regional performances, enabling users to understand shifts in key metrics. It also highlights potential legal risks, such as dealer protests and state regulations, saving personnel the effort they would need to spend reading legal documents.

Our software takes the guesswork out of dealership planning, enabling users to spot opportunities, avoid risks, and make smarter decisions in a competitive market.

The application uses Angular for the front end. The back end is implemented in C# with .NET and our suite of technologies is hosted on Microsoft Azure. The data storage and LLM queries are handled through Azure OpenAI and Azure SQL.





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UWM
IT Goals Dashboard

Founded in 1986 and headquartered in Pontiac, Michigan, United Wholesale Mortgage (UWM) provides mortgage products and services to mortgage brokers nationwide. UWM is the top wholesale lender in the past ten consecutive years within the United States, serving millions of customers every year.

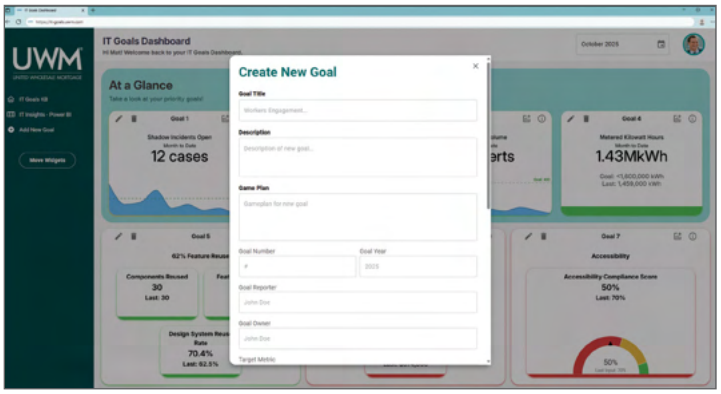
As a leader in the mortgage industry, UWM stands out in its commitment to developing and providing innovative technological solutions for brokers and borrowers. To uphold this commitment, UWM sets yearly and monthly goals for each department. IT department goals help management by tracking helpful metrics relating to employee engagement, reduced expenses, and measures of success and risk within the department.

Our IT Goals Dashboard assists department members in tracking goal progress and enables administrators to input custom data points. Our application provides team members with visual representations of goal data in the form of graphics, colors, and charts, making it easier to analyze trends at a glance and measure key data trends over time.

Our software enables users to view both current and historical data to compare performance across months and years. Admins have the flexibility to add or edit yearly goals along with their metrics. Together, these features empower employees to allocate resources more effectively and improve overall productivity.

By replacing static spreadsheets with our interactive system, the dashboard strengthens accountability, increases transparency, and promotes a more data-driven culture across the IT department.

The IT Goals Dashboard is built with a React front end and utilizes Swagger UI for API interactions. The back-end services are developed with ASP.NET Core in C# which are exposed through REST API. Finally, the data management relies on Entity Framework Core and an Azure SQL Server.



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Vectra AI
Packet Forge: AI Network Protocol Engine

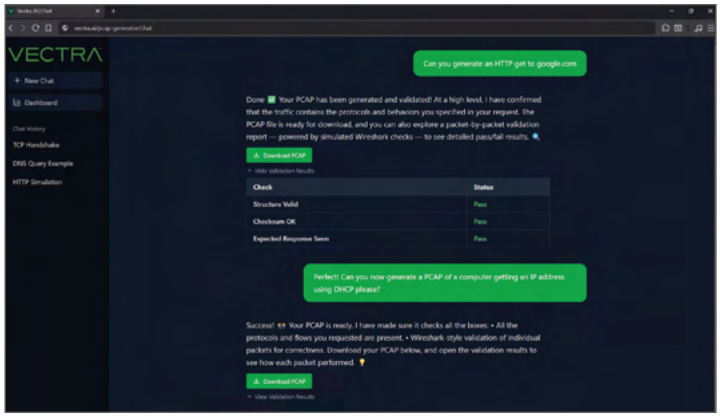
Vectra AI is a leader in the cybersecurity field, harnessing the power of artificial intelligence (AI) to provide clients with state-of-the-art cybersecurity threat detection and real-time response across all domains of enterprise systems. Backed by over a decade of experience, Vectra AI protects enterprises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

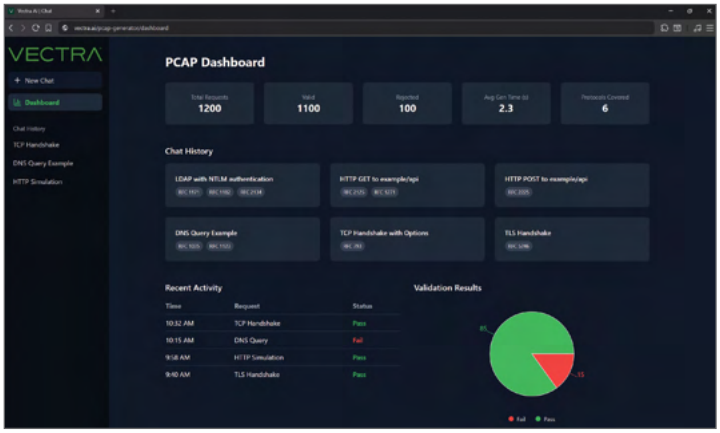
Today, the accuracy of threat detection systems depends heavily on access to high-quality, realistic computer network traffic data. Modern enterprises rely on a wide variety of protocols, but producing representative packet captures (PCAPs) for training and testing detection systems is both time-consuming and technically demanding. Engineers rely on manual creation methods, which slows down the ability to respond to new or evolving threats in a timely manner.

To address this challenge, our AI Network Protocol Engine leverages natural language processing and large language models to extract metadata from formal protocol documentation. With this structured data, the system automatically produces realistic internally consistent traffic that is industry compliant. The generated traffic covers a variety of different scenarios over multiple protocols, providing an abundant source of accurate packets for keeping threat detection up to date.

Our system expands the breadth and quality of Vectra AI's training datasets, filling gaps in protocol coverage while reducing engineering overhead. It ensures that Vectra AI's detection models remain effective against threats carried over both common and emerging protocols to strengthen client security across the globe.

The AI Network Protocol Engine UI is a local web app built with React. The back end uses ChromaDB for structured storage and OpenAI 4.1 mini as the large language model responsible for generating realistic PCAPs. All generated traffic is validated in Wireshark to ensure accuracy and internal consistency.





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Whirlpool Corporation

Intelligent Recognition and Inventory System (IRIS)

Whirlpool Corporation, headquartered in Benton Harbor, Michigan is a global home appliance manufacturer with approximately $17 billion in annual sales, 40 manufacturing and research centers, and 44,000 employees. Whirlpool's mission is to improve satisfaction and engagement with its home appliances.

Buying groceries is a common chore that consists of tedious planning. However, items get lost in the fridge from time to time. This results in food waste and repurchasing of food, which hurts the buyer's budget and creates the stress of needing to manually track groceries.

Our Intelligent Recognition and Inventory System mitigates this problem by providing an automated up-to-date inventory with the fridge's contents and a history of recent groceries that have been added or removed from the fridge.

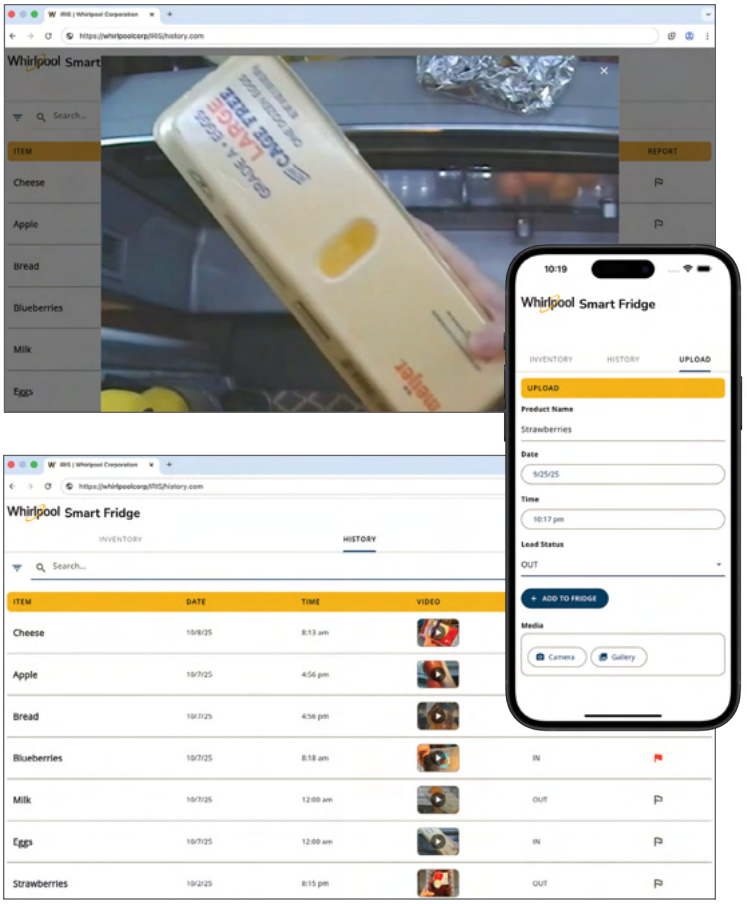
When a user opens the fridge, a camera scans and identifies the product in the user's hand. Our system determines whether the product is being placed in or removed from the fridge and updates the inventory accordingly.

Manual addition of grocery data is also supported. Any errors with the image recognition are tracked via the red flag icon in the table.

As the inventory is updated with current items in the fridge, the user sees a history of objects that were loaded or unloaded from the fridge. In addition, a video playback is accessible to the user to view the most recent groceries that have been either loaded or unloaded.

Our system reduces food waste and provides additional value to Whirlpool appliances.

The software is built with Flutter and Dart for the user interface with a Python and Firebase back end. Our software also utilizes YOLOv8 object detection model.



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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 spring of 2025.

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 Union Pacific
Training Simulator Using GPS-Indexed Video

Nico Roberts, Ravi Gangaiahanadoddi Kumar, Mohamed Ahmed
Abigail Werden, Tre Benson, Melinda Fadool
Presented by Brad Shafer 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 RPM
Automated Damage Logging for Truck Drivers

Troy Williams, Alfredo Sanchez Perez, Dheeraj Thota
Gavin Bourdon, Flower Akaliza, Hayden Rance
Presented by Ben Maxim (Right) of MSU Federal Credit Union

Spring 2025

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 McKesson
Vulnerability Scan and Detect

Ananya Chittineni, Nicholas Felarca, Brady Johnson
Chris Nguyen, John Bannon, Demetrius Wilson
Presented by Scott Schmerer and 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 NetJets
Airport Capacity and Ground Space Management

Jay Scott, Ryann Seymour, Ryan MacDonald
Ben Grycza, Kendall Korcek, Emily Telgenhoff
Presented by John Marx of Amazon

Your career in technology begins at Delta Dental of Michigan!

As one of the nation's largest dental plan administrators, Delta Dental of Michigan has technology at its core.

Opportunities in technology are diverse from planning, establishing and maintaining complex internal networks to researching, designing and building reusable software that dives deep into data.

Delta Dental has the most advanced data centers in Michigan. Interns are given front-line experience in systems and processes and work directly with technical teams.

Your work at Delta Dental will be on the leading edge of engineering and the computer and data sciences. It will also help to fulfill our mission of improving oral health care and support efforts that build healthy, smart, vibrant communities.

Our commitment to employee engagement will challenge you to grow and discover your highest potential.

Here are just a few highlights:

- Gain hands-on experience with some of the latest software and hardware technologies
- Write and deliver software that will be used by real customers
- Be part of a scaled agile team, using processes such as scrum and kanban
- Help to manage enterprise software development in the health care industry
- Use advanced public cloud technologies that are in high demand
- Identify and utilize industry best practices where security and performance are critical
- Develop skills in designing and building reusable software components by applying advanced computer science concepts
- Experience data science practices with data wrangling, analytics with potential Artificial Intelligence/Machine Learning application opportunities

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The Capstone Projects

Dr. Subir Biswas
Professor of Electrical and Computer Engineering

Project Facilitators: Omid Beik, Mauro Ettore, Shanelle N. Foster, William Harokopus, Tim Hogan, Nihar R. Mahapatra, Joydeep Mitra, Hayder Radha, Nelson Sepulveda, Li Tongtong, Lalita Udpa, Navid Yazdi


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Ettorre


Foster


Harokopus


Hogan


Mahapatra


Mitra


Radha


Sepulveda


Tongtong


Udpa


Yazdi

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, résumés, evaluations, posters, web pages, and oral presentations.

ECE 480 Electrical and Computer Engineering

Presentation Schedule – Engineering Building, Room 2320

Time	Team Sponsor	Project Title
7:40 a.m.	Kent Consulting, Inc.	A Smart Leveling Platform for Large Optics Telescopes
8:00 a.m.	Henry Ford Health	Robotic Transportation System for Pathology Samples
8:20 a.m.	MSU Animal Science Center	Mounting Behavior Detection System for Dairy Cattle
8:40 a.m.	MSU Indy Car Team	Autonomous Vehicle Stack for an F One-Tenth Car
9:00 a.m.	Nic-Nix	Personalized Nicotine Management System
9:20 a.m.	LifeExtend Global LLC and MSU RFIC Group	A Smart Helmet System with Light and Sound Therapy
9:40 a.m.	Break	
10:00 a.m.	MSU Bikes Service Center	Intelligent Alert System for Red-Light Runners
10:20 a.m.	Unluturk Laboratory For Molecular Communication	Molecular Communication Through Wind Tunnels
10:40 a.m.	MSU Non-Destructive Evaluation Laboratory	3D-Printed Flexible Sensors for Multi-Modal Sensing to Enable Digital Twins
11:00 a.m.	Texas Instruments	High-Precision Kitchen Scale System
11:20 a.m.	Texas Instruments	Smart Foam Dart Launcher System
11:40 a.m.	Texas Instruments	Arm Wrestling Evaluation Using Electromyography
12:00 p.m.	GenoPalate	Software System for Creating Automated Nutrition-aware Personalized Grocery Lists

The ECE Project Facilitators who supervised ECE 480 teams this semester are: Omid Beik, Mauro Ettore, Shanelle N. Foster, William Harokopus, Tim Hogan, Nihar R. Mahapatra, Joydeep Mitra, Hayder Radha, Nelson Sepulveda, Li Tongtong, Lalita Udpa, Navid Yazdi

We gratefully acknowledge the support of this semester's project sponsors: Genopalate, Henry Ford Health, Kent Consulting, Inc., LifeExtend Global LLC, MSU Animal Science Center, MSU Bikes Service Center, MSU Indy Car Team, MSU Non-Destructive Evaluation Laboratory, MSU RFIC Group, Nic-Nix, Texas Instruments, Unluturk Laboratory For Molecular Communication.

Kent Consulting, Inc.

A Smart Leveling Platform for Large Optics Telescopes

Kent Consulting, Inc. challenged our team to transform their existing telescope cart into a smarter, faster, and safer platform-powered mobility, automated leveling, and simplified operation. The current cart supports a 12-inch Schmidt-Cassegrain telescope and accessories weighing over 170 pounds. While it provides transport, setup still requires more than 30 minutes of manual adjustments, particularly for leveling, which is physically demanding and vulnerable to small alignment errors that reduce observing accuracy.

Our improved design focuses on automating the leveling system and preparing the foundation for future mobility and alignment enhancements. The system integrates dual Arduino controllers, one dedicated for auto-leveling subsystem and another for the wheel drive system, each powered by a shared 12V battery. Using three Triple Axis Accelerometer Sensors and one Magnetometer Sensor provides real-time feedback to measure platform tilt and magnetic north orientation. The Arduinos process this data and control linear actuators to adjust the cart's platform, maintaining level positioning within ±0.5°.

A feedback loop ensures that once level alignment is reached, actuator motion automatically stops, improving both precision and safety. Additional safety features, including limit switches and emergency cutoff circuit, protect the system from overextension and electrical overload. The design also supports future integration of motorized wheels for assisted transport and remote steering through joystick or phone control.

Powered entirely by a 12V battery, the upgraded telescope cart reduces setup time to under 15 minutes, minimizes manual effort, and ensures consistent telescope alignment. This solution represents a practical, scalable, and cost-effective step toward a fully automated telescope platform for astronomical observation.

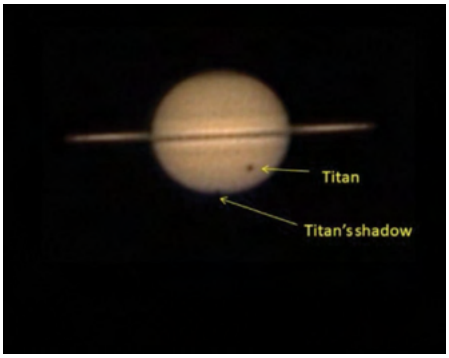
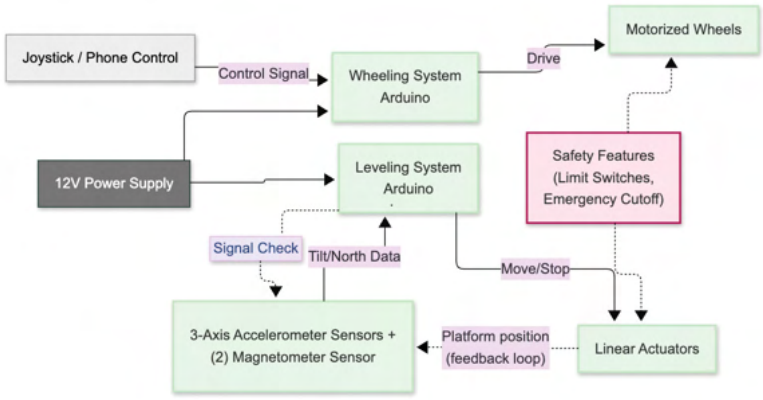


Figure: On Oct 5-6, 2025, Titan (Saturn's largest moon) crossed in front of Saturn, an event that won't happen again until 2040!



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Dr. Tim Hogan

ECE 480 | 8:00 a.m. Engineering Building, 2nd Floor | Room 2320

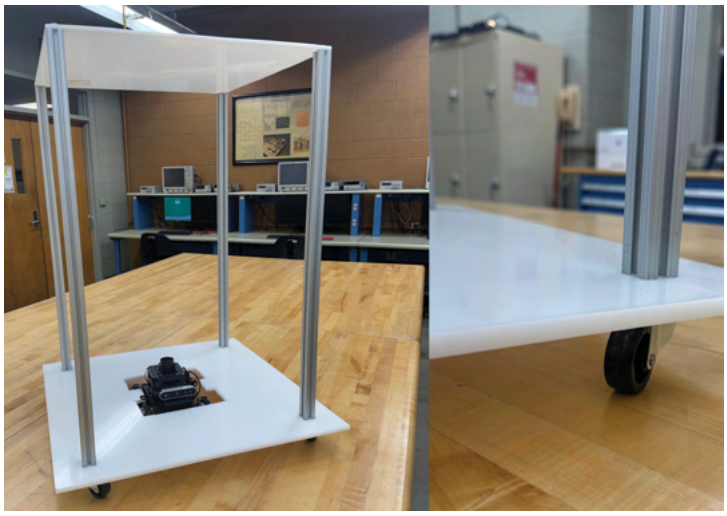
Henry Ford Health

Robotic Transportation System for Pathology Samples

Henry Ford Health is preparing for the opening of *Destination Grand*, a state-of-the-art medical complex that will integrate advanced technology and automation to improve hospital operations. One important application involves robotic transport systems designed to increase the efficiency and safety of moving pathological specimens throughout the laboratory department.

Before full implementation, Henry Ford Health is testing the capabilities of an autonomous robotic delivery system within its current facility. The current phase focuses on refining a prototype robot to meet hospital requirements through improved battery performance and wireless recharging, a durable and disinfectable frame, and reliable ROS2-based autonomous navigation. Using LiDAR mapping and waypoint control, the robot operates safely and independently along defined transport routes while maintaining clinical safety standards.

This project represents a key step in preparing Henry Ford Health for the integration of robotics into everyday hospital operations. This initiative advances the readiness of robotic systems for daily hospital use and supports Henry Ford Health's vision for a more efficient and technology-driven future at *Destination Grand*.



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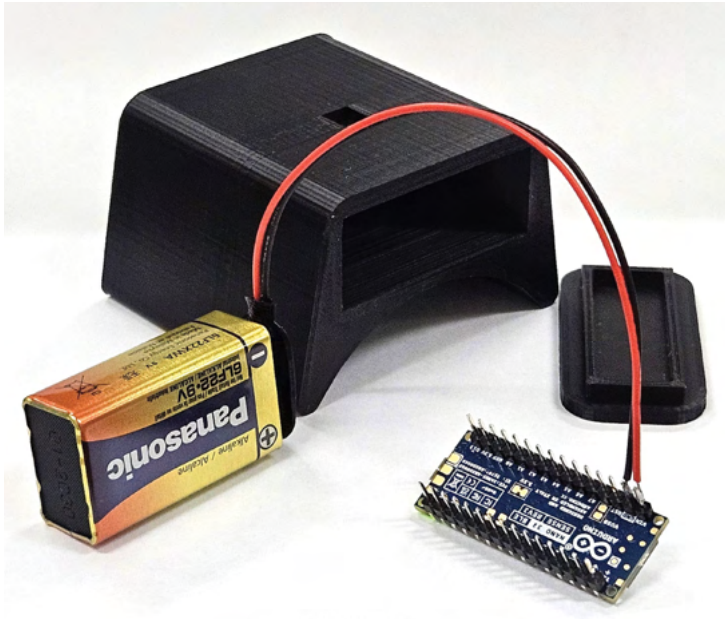
MSU Animal Science Center
Mounting Behavior Detection System for Dairy Cattle

One of the most important jobs on a dairy farm is the process of breeding cows to keep the herd population up. Most dairy farms do not keep bulls, so the process of impregnating cows is done by artificial insemination (AI). To do this, farmers must know when a particular cow is fertile. The most effective way of doing this is observing behaviors linked to estrus (heat).

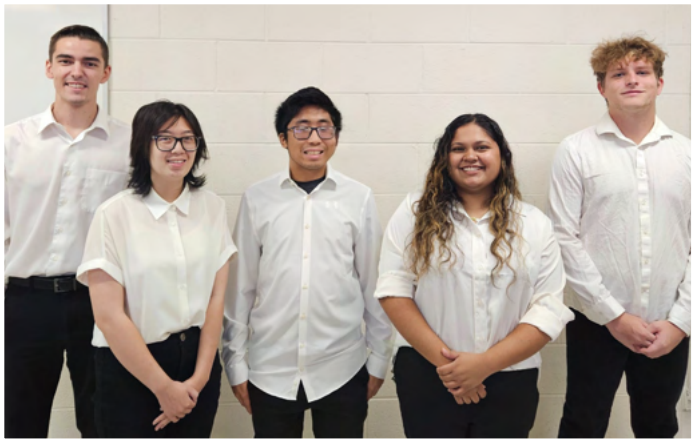
When a cow is in heat, the most common signs are the cow climbing on the back of other cows (mounting), as well as standing still and being receptive to other cows' attempts to mount them. Traditionally, the visual observation of these activities was done by herdsmen or using estrus detection aids such as tail paint or other pressure-sensitive analog devices.

Our team's project goal is to design two separate devices that can be used to detect and monitor estrus-related activity in dairy cows in order to know when the cow is most fertile and ready for artificial insemination. One device will be mounted on the tailhead region of the cow and detect when other cows are mounting. The other device will be mounted on a collar and will detect when a cow is attempting to mount another cow. These devices will differ from existing devices because of their ability to wirelessly communicate information to a nearby computer that will log the data and display it in an easy-to-read interface. The computer will then be able to alert farm managers when a specific cow is ready to be bred.

Each device will incorporate an Arduino Nano 33 BLE Sense microcontroller powered by a standard 9-volt Alkaline battery. They will communicate with a nearby data logging computer through a Bluetooth connection. The data will then be put through algorithms to detect motion and pressure patterns that indicate that the cow is mounting other cows or being mounted itself.



Animal Science
Michigan State University



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MSU Indy Car Team

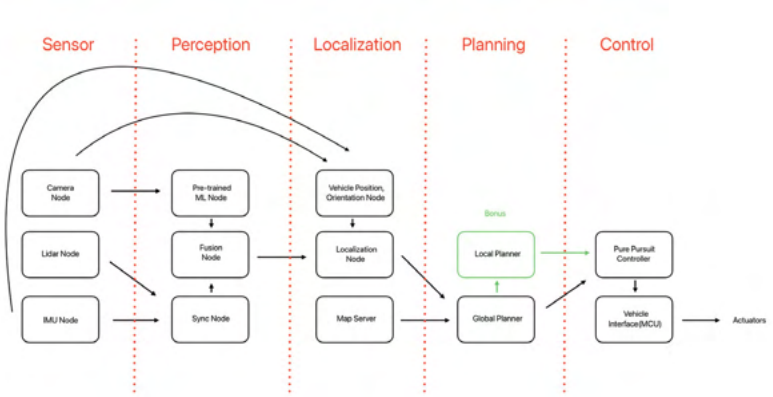
Autonomous Vehicle Stack for an F One-Tenth Car

Autonomous vehicles (AVs) are poised to transform transportation by improving safety, efficiency and accessibility. This project will focus on implementing a full autonomous software stack on an F One-Tenth scale race car to demonstrate real-time navigation, perception and control capabilities. The system will utilize an ROS2-based environment to integrate key components such as mapping, localization, obstacle detection, path planning, and trajectory tracking while providing robust data logging for analysis and validation.

The motivation for this project builds on previous work that established the hardware foundation of the F One-Tenth car platform, including sensors such as LiDAR, a depth camera, and an IMU. While a previous team focused on hardware integration, this phase of the project shifts toward software development to achieve complete autonomy. The combination of ROS2 and Gazebo provides a flexible and industry-standard framework for developing, simulating, and deploying autonomous driving algorithms in a controlled and scalable environment.

The main goal is to deliver a fully autonomous race car capable of completing a track in the fastest and most efficient way possible. The implementation follows a modular ROS2 node-based pipeline, organizing the software into three primary subsystems: perception, planning, and control. Each subsystem operates as an independent ROS2 node, enabling them to communicate through standardized topics. This modular design improves flexibility, simplifies debugging, and supports iterative development.

Ultimately, this project aims to achieve seamless autonomous navigation from perception to control, bridging the gap between simulation and real-world performance.



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Nic-Nix
Personalized Nicotine Management System

Nic-Nix and Michigan State University's Electrical and Computer Engineering Department are working together to address the rising issue of nicotine addiction among young adults through the development of a smart vape cessation device. The project combines embedded hardware, sensor technology, and data analytics to create a system that helps users gradually reduce nicotine consumption while tracking usage patterns over time.

Traditional vape devices provide no feedback or control over intake, making it difficult for users to monitor or manage their habits. Nic-Nix introduces a microcontroller-based solution that integrates sensors to measure puff count, duration, and temperature while recording data for analysis through Bluetooth connectivity. By pairing with a companion app, users can visualize their progress, receive reminders, and follow personalized tapering schedules.

The prototype utilizes an ESP32 microcontroller, MOSFET-controlled heating element, NTC thermistor, and Li-Po battery system for safe, low-power operation. The goal is to create an affordable and accessible harm-reduction device that encourages users to quit nicotine through behavioral awareness and gradual control.

NICNIX

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LifeExtend Global LLC and MSU RFIC Group

A Smart Helmet System with Light and Sound Therapy

The light and sound therapy helmet is a wearable biomedical system designed to promote relaxation, focus, and recovery through the combined use of photobiomodulation and auditory stimulation. The device integrates an array of red and near-infrared LEDs with adjustable brightness and frequency settings, delivering targeted light therapy to the scalp and upper regions of each user's brain. In parallel, binaural sound will be transmitted through integrated speakers, which we plan to implement, to influence brainwave activity and enhance the therapeutic effect.

At the core of the helmet is an STM32 microcontroller that synchronizes the light and sound output patterns while also connecting all system components. The implementation of Bluetooth connectivity will enable the user to control the therapy they receive through the various therapy modes embedded in the mobile application that we have developed, enabling fully customizable treatment sessions. The helmet's modular design enables future enhancements such as focused light therapy on specific brain regions rather than full coverage illumination. The system is designed to function wirelessly for user convenience, with safety features like automatic shutoff built in to ensure safe and reliable use.

The primary goal of this project is to create a functional product that demonstrates the feasibility of integrating optical and auditory stimulation within a single, user-friendly platform. By combining these features, the device aims to provide an accessible, noninvasive method of supporting mental wellness.

Through the application of these design approaches, the final product will showcase the potential of engineering collaboration to enhance human well-being and pave the way for future wearable technologies that merge comfort, functionality, and therapeutic effectiveness to further encourage therapy usage.

life eXtend

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Dr. Omid Beik

MSU Bikes Service Center

Intelligent Alert System for Red-Light Runners

The MSU Bikes Service Center, owned and operated by Michigan State University, has been promoting greener transportation methods on campus since 2003. As motor traffic on campus continues to increase, red-light running has become a growing concern, posing serious risks to the safety of pedestrians and bicyclists.

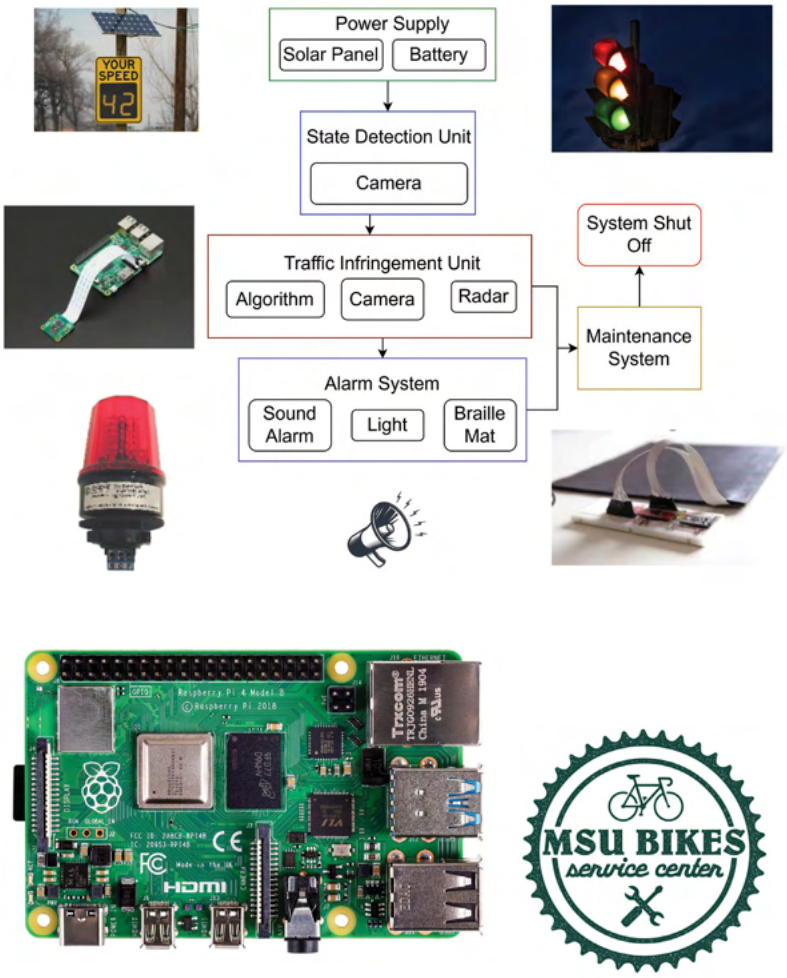
Our project consists of an image processing system paired with an alarm unit to warn pedestrians of potential red-light runners. The system is split into three major modules and powered using a rechargeable battery and a solar panel.

The first module is the State Detection Unit (SDU), which uses a camera to detect traffic light states. If the light is determined to be red or yellow, it will communicate with our Traffic Infringement Unit (TIU) to analyze the situation.

The TIU uses a camera paired with radar to determine if a car will run the red light based on a deterministic algorithm. This is designed to identify various types of vehicles, assess their braking rates, and detect potential red-light violations. This unit communicates with the alert unit (AU) to trigger the alarms.

The AU consists of a light and sound alarm to deliver clear messages to warn, but not startle, pedestrians. Additionally, to enhance accessibility for visually and hearing-impaired pedestrians, we designed a unique vibration-based alert system. It is triggered by a pressure sensor embedded in a mat placed on the walkway and will deliver a tactile Braille-style message using six carefully placed vibration points to the person's feet

Lastly, if the alert system itself encounters a fault, a dedicated maintenance light is activated, and the system automatically shuts down to prevent false signaling. It will remain offline until manually inspected and reset.



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MSU Bikes Service Center
Project Sponsor

Tim Potter
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Project Facilitator

Dr. Lalita Udpa

ECE 480 | 10:20 a.m. Engineering Building, 2nd Floor | Room 2320

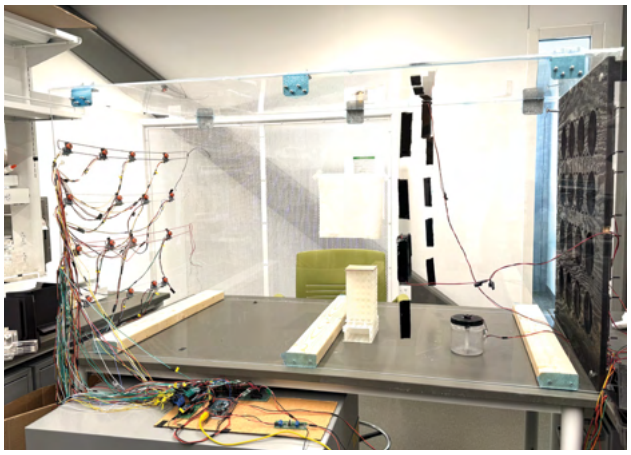
Unluturk Laboratory for Molecular Communication

Molecular Communication Through Wind Tunnels

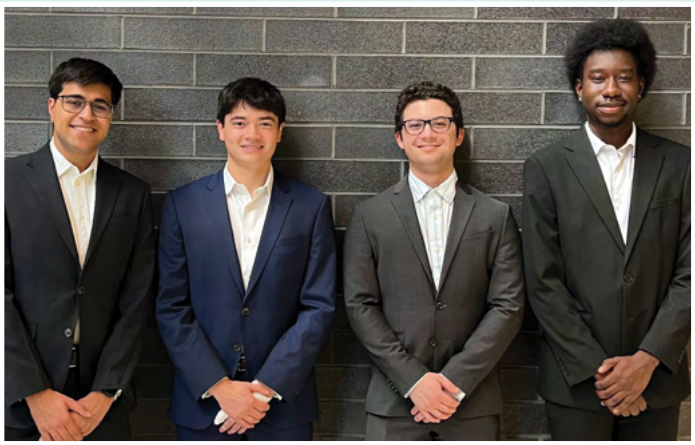
Molecular communication is an emerging bio-inspired method where molecules, rather than electromagnetic (EM) waves, serve as carriers of information. This principle, naturally occurring in cells, bacteria, and larger organisms, offers new opportunities for communication in environments where traditional wireless methods are limited or unreliable. Working with Dr. Unluturk in the Laboratory of Molecular Communication, and building on the efforts of two previous capstone teams, this project advanced the development of a controlled wind tunnel system designed to experimentally model molecular communication.

The testbed includes a 4×4 fan array for airflow control, an alcohol atomizer serving as the transmitter, two fans to simulate turbulence, and a 4×4 alcohol sensor array functioning as the receiver. Together, these components simulate a molecular communication channel that enables the study of signal propagation, diffusion behavior, and the effects of airflow on transmission performance. The setup enabled the team to visualize how molecular bursts travel through a controlled environment and to quantify how system parameters impact data reliability.

Our team is focused on testing, troubleshooting, and optimizing the existing setup to improve signal consistency and data accuracy. An automated fan control script was implemented to minimize human error, streamline experimentation, and enable extended, repeatable testing. Additional emphasis was placed on refining modulation schemes such as On-Off Keying (OOK) and Concentration Shift Keying (CSK) while recording bit error rate (BER) and data rate under varying airflow conditions. Ultimately, this project will provide insight into the feasibility and challenges of molecular communication, contributing to research in nanoscale networks and bio-inspired communication systems.



Institute for Quantitative Health Science & Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

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Michael Hichme
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Devonte Coppin
Bridgetown, Barbados

Unluturk Laboratory for Molecular Communication

Project Sponsor

Bige Unluturk
East Lansing, Michigan

Project Facilitator

Dr. Li Tongtong

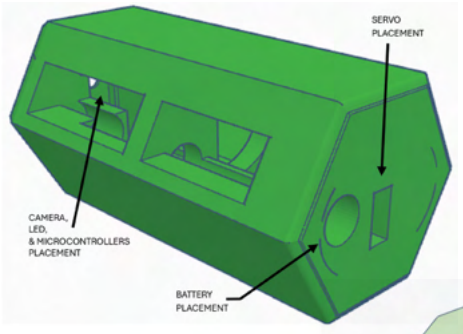
MSU Non-Destructive Evaluation Laboratory

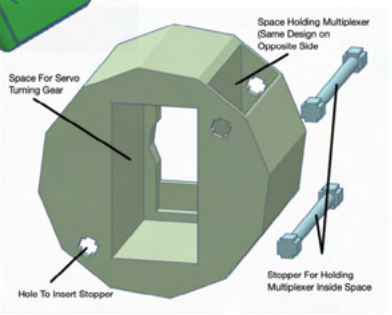
3D-Printed Flexible Sensors for Multi-Modal Sensing to Enable Digital Twins

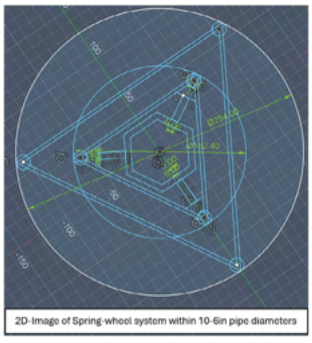
The Michigan State University Nondestructive Evaluation (NDE) Laboratory specializes in creating innovative sensors and systems that ensure the reliability and structural soundness of various materials and engineering components.

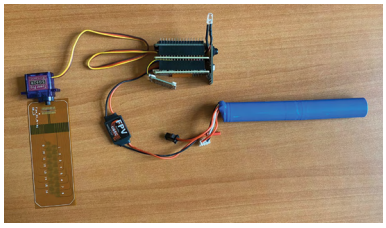
The proposed project centers on designing, fabricating, and functionalizing a 3D-printed adaptive module for implementing flexible sensor prototypes to ensure multimodal signal acquisition of data from pipelines through nondestructive evaluation sensing. Specifically, the design for the sensor module contributes to supporting optical and electromagnetic sensing for capturing both global and localized damage features inside transport pipelines. Major tasks include surveying and evaluating suitable controller components and flexible manufacturing materials for implementing flexible sensors into modules, integrating transducer elements and integrated electrodes into the sensor module, and conducting experimental testing to evaluate performance across different sensing modalities. Through manufacturing, 3D-printing technologies, systematic testing and refinement, we will develop a lightweight, customizable sensing structure that can adapt to various material surfaces and shapes, thus demonstrating the feasibility of 3D-printed flexible sensor modules as a versatile platform for possible future nondestructive evaluation applications.

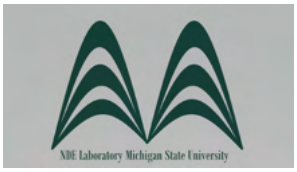
The objective of the project is to design and prototype a 3D-printed flexible sensor modal of multi-modal nondestructive evaluation sensing. The NDE Laboratory will use the data collected through our 3D-printed flexible sensor module to model and create digital twin simulations. By advancing flexible sensing technologies through additive manufacturing, the presented project contributes to the development of sustainable and intelligent inspection systems.

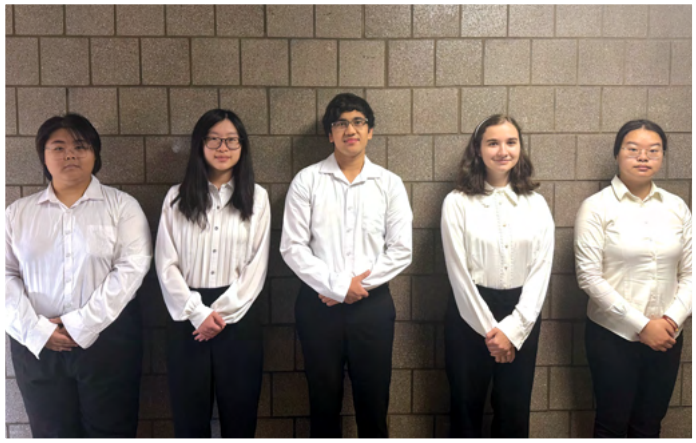





2D-Image of Spring-wheel system within 10-6in pipe diameters







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MSU Non-Destructive Evaluation Laboratory
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Project Facilitator

Dr. Yiming Deng

Texas Instruments
High-Precision Kitchen Scale System

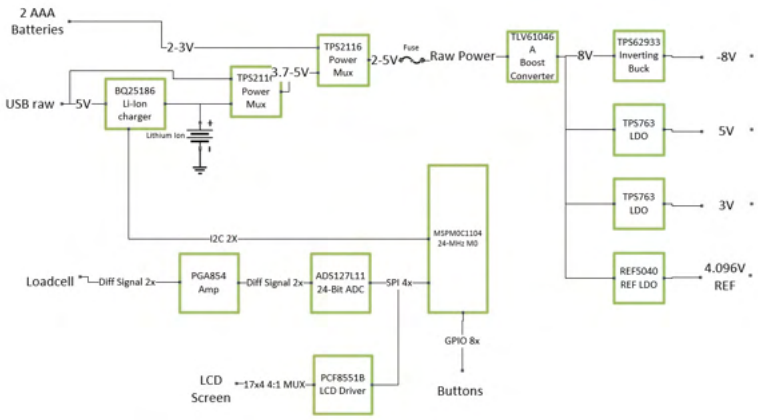
Texas Instruments is a global leader in analog and embedded semiconductor technology headquartered in Dallas, Texas. The company designs, manufactures, and tests components that enable smarter, more efficient electronic systems. Their innovations help lower the cost of electronics while improving accuracy, reliability, and power efficiency across many applications.

One area in which precision and affordability intersect is consumer measurement devices such as kitchen scales. Most low-cost scales on the market measure in 1-gram increments up to 11 pounds (roughly 5,000 g), but they often lack accuracy for smaller quantities. High-precision scales can achieve finer resolutions but typically sacrifice maximum capacity or come at a significantly higher cost.

The goal of this project is to design and build a high-precision kitchen scale that can measure up to 11 pounds with 0.1 g solution, combining the accuracy of professional grade instruments with the accessibility of consumer devices.

Our system will use a strain-gauge load cell to detect force, with signal conditioning handled by the TI PGA854 programmable gain amplifier and conversion to digital data via the ADS127L21, a 24-bit analog-digital converter (ADC). Also, a TI MSPM0C1104 microcontroller will process and display weight data on a digital interface. The software will include all the essential features such as tare functionality, unit conversion, and an intuitive user interface for reliable operation.

The design will implement a custom PCB that integrates the needed circuitry into a compact system. This project demonstrates how Texas Instruments' precision analog and embedded solutions can enable high-performance measuring systems that are accurate, affordable, and consumer friendly.



TEXAS INSTRUMENTS

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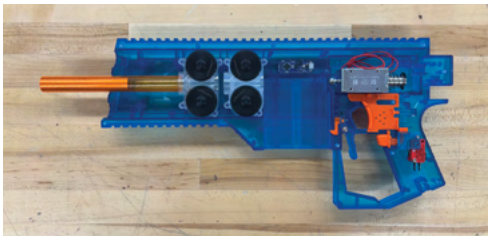
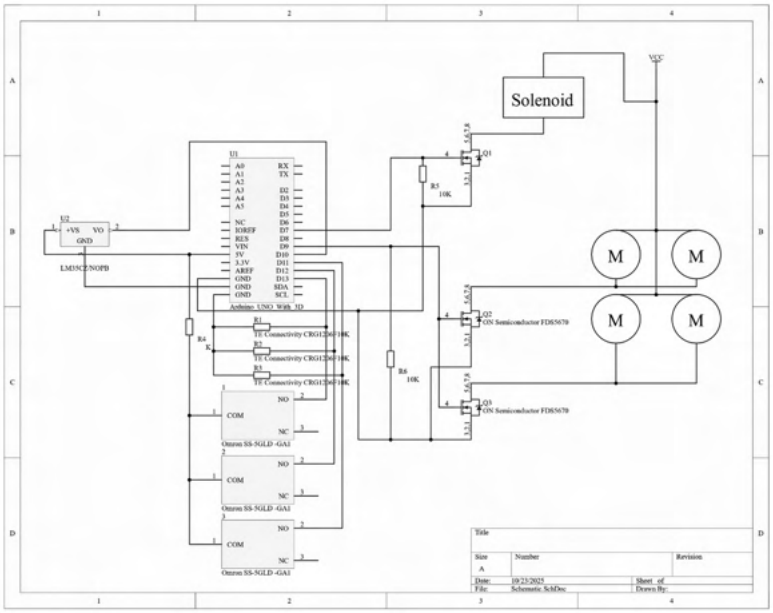
Dr. Hayder Radha

Texas Instruments
Smart Foam Dart Launcher System

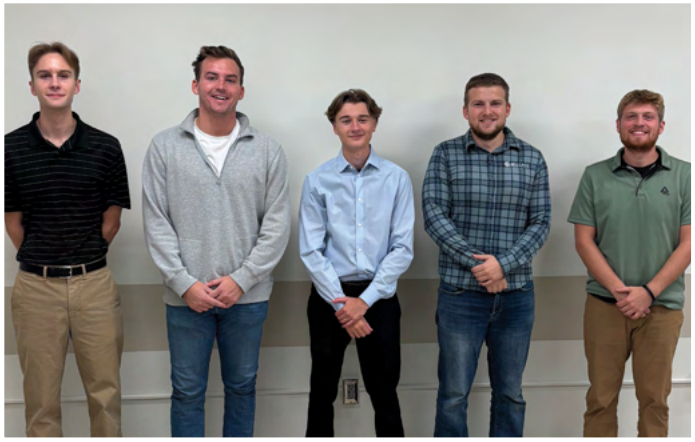
Texas Instruments, founded in 1930 and headquartered in Dallas, Texas, is a leading global semiconductor company recognized for its innovation and impact on modern electronics. The company designs, manufactures, and tests analog and embedded processing chips that power everything from industrial systems and automobiles to personal electronics. With a strong focus on engineering excellence and sustainability, Texas Instruments strives to make technology more efficient, reliable, and accessible. Their core mission is to drive down the cost of electronics and enable smarter, more connected devices through continuous advancements in integrated circuit (IC) technology.

The goal of this project is to build a brushless motor-controlled flywheel foam dart launcher. The system must be controlled using a microcontroller and powered by a LiPO battery. The system needs to have selectable launching modes: single launch, burst launch, and automatic launch. To minimize delay from launch initiation to launch, a pre-launch flywheel activation ensures the flywheels are ready to fire. The system will integrate efficient power delivery and precise motor control through a custom PCB and firmware. User interaction and mode selection will be handled through the microcontroller, providing reliable and responsive control. The launcher must be housed in a durable and secure shell that can withstand a 5' drop without damaging its functionality.





TEXAS INSTRUMENTS



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Project Facilitator

Dr. Omid Beik

ECE 480 | 11:40 a.m. Engineering Building, 2nd Floor | Room 2320

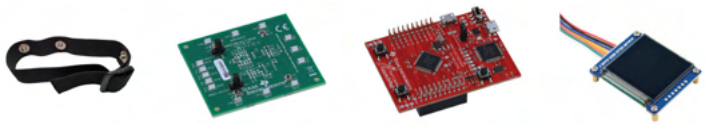
Texas Instruments

Arm Wrestling Evaluation Using Electromyography

Texas Instruments (TI) is a global semiconductor company headquartered in Dallas, Texas. TI designs and manufactures analog and embedded processing chips that power everyday electronics. Partnering with TI, our team is building a contactless arm-wrestling evaluator that uses surface electromyography (sEMG) to measure muscle activation during a short, time-boxed challenge. Instead of pushing against a device, users simply strap on a dry EMG band and flex. Making the experience clean, repeatable, and easy to demo.

The goal is to deliver a fair, engaging game that works across different people without force sensors. During a brief countdown, the system records each user's baseline noise. When both users cross a threshold, a 10-15 second round begins. Throughout the round, the device computes a running average of each player's muscle signal and shows live feedback on a compact color OLED. At the end, the higher average wins. In single-player mode, the highest average is compared in difficulty tiers (such as 20%, 50%, 90%, 99% of a reference) to challenge. In two-player mode, both channels are sampled, and the system declares the winner by higher average amplitude in the same window. This approach keeps the contest consistent and safe while keeping setup fast and simple.

Our design follows a robust signal chain: a dry EMG band feeds protected, low-noise analog amplification and filtering. A precision two-channel, simultaneous sampling converter digitizes both players at different instances to ensure fairness. A microcontroller handles countdowns, thresholds, and real-time metrics, and the user interface provides clear bars, sounds, and results using a TI-aligned color palette. The electronics are fully enclosed with strain relief and rubber feet for safety and stability. Power is provided by portable battery operation, with a wall adapter for reliability as a stretch goal. The result is an educational, TI-inspired system that turns muscle activity into an accessible, gamified competition.



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Dr. Joydeep Mitra

GenoPalate

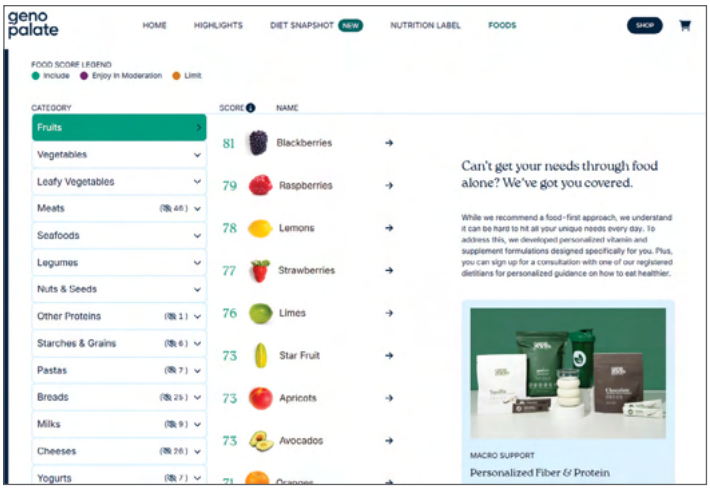
Software System for Creating Automated Nutrition-aware Personalized Grocery Lists

GenoPalate was founded in 2016 and is headquartered in Milwaukee, Wisconsin. GenoPalate is a biotechnology company that offers individualized dietary advice based on DNA analysis. Based on a person's DNA profile, its platform then suggests the best diets, supplements, and lifestyle changes. The main goal of the business is to help individuals eat and live healthier based on their individual biology by making nutrition personal and practical.

GenoPalate is a well-established mobile and web application, and as such, has extensive prior work in several areas of standard development such as app infrastructure, as well as more niche applications, such as their specific work in matching a customer's DNA to a well-fitting nutrition plan, matching each food item with a corresponding score. However, in all this work, there is a palpable shortcoming in the organization of these items, as well as other household goods, into a customizable grocery list.

The project is to implement an in-app grocery list feature that dynamically reflects food aligned with each user's genetic and dietary profile. This will help prevent the reliance on other external apps or manual tracking by keeping food recommendations and shopping lists within the app itself. The system will support dynamic updates, persistent storage, and intuitive interactions to help streamline the user's experience.

Our design will use a smart list with DNA rank integration. This method will enable our application to integrate Genopalate's DNA-based health scoring system to intelligently rank grocery items according to each user's unique nutritional profile using the already implemented database. This approach enhances user trust and engagement through tailored recommendations while maintaining a user-friendly and intuitive interface.



geno palate®
Eat For Your Genes

Michigan State University
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Esha Sura
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Dhruv Kaneria
Canton, Michigan

Nick Klemmer
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GenoPalate
Project Sponsor

Hannah Pekarek
Milwaukee, Wisconsin

Project Facilitator

Dr. Navid Yazdi

Design Day Spring 2025 Awards

First Place Award - 1

Team 2 – MSU Facility for Rare Isotope Beams
4-Wire Coupling Circuit for Ion Beam Quadrupole Moment Calibration

Left to right: Jacob Lucas, Sandhiya Suresh, Jack Dorris, Nathan Joseph, Jack Bruienne

First Place Award - 2

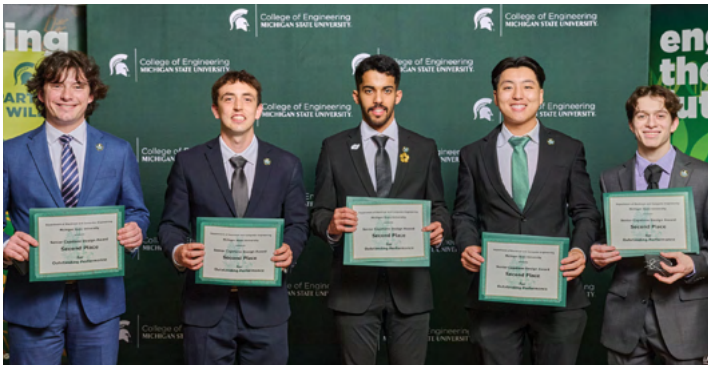
Team 10 – MSU Cyber Security Lab
Security Attacks on Machine Learning Systems

Left to right: Chris Dadisho, Owen Wurzer, Tolu Oshin, Justin Skipper, Someshwar Maji

Second Place Award - 1

Team 6 – Henry Ford Health
Pathology Robotic Transportation System (PaRTS)

Left to right: Jackie Dinh, Yi-Hung Kan, Matthew Hull, Benjamin Hackman, Pranesh Muthukumar



Second Place Award - 2

Team 11 – MSU Broadband Access Wireless Communications Lab
Hands-free Control of IoT Devices Using Mind Power Testing of Rail Tracks

Left to right: Evan Bennett, Josh Lauzon, Abdulrahman Alharbi, Daniel Qin, Matthew Frazee

ECE 410 Outstanding Project Awards

Team 5 – Shivanshu Ojha, Rose Spangler, Avery Wiklund

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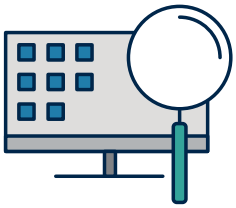

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ME 412 Heat Transfer Laboratory

Yuping Wang
Academic Specialist
Department of Mechanical Engineering

Heat Recovery Study – Hot-Air Water Boiler/Heater

Usable energy can be found and captured from the exhaust gas of engines or other industrial processes. Various heat recovery units are designed to recover the exhaust waste heat and use it to generate steam or heat water, hence improving the overall system efficiency. For this project, students are expected to understand the heat recovery process through two parts of work. First, each team is to design, build, analyze and test a water heating device with hot air as the heat source. Hot air supplied through a heat gun, simulating the hot exhaust gas, is to heat or vaporize a given amount of water. The design objective is to maximize the thermal energy delivered to the water, while cost and weight are also considered as factors in evaluation. A second part of the project is for each team to conduct a review on an existing exhaust heat recovery unit of their interest, or a general review of common types of water heater/boilers. On the testing day, each team will have 15 minutes to set up, demonstrate/test, and disassemble their device. Water supply or circulation line, and temperature measurements are available. Each team will also prepare a PowerPoint slide show to explain the design decisions, fabrication, operations and thermal analysis of their device.

Competition Schedule

Time	Station	Team Members
8:00	A	Joshua France, Brady Johnson, Ethan Koss, Leonardo Provenzola
	B	Anna Buccilli, Trayza Haido, Krithika Mahesh, Parth Singh
8:15	A	Promee Kaniz, Daniel Montes, Sai Shruthi Rajaraman
	B	Drew Christy, Abbey Michaels, Grace Reeber, Nicole Stensen
8:30	A	Nathan McDonald, Manav Oza, Aarav Thakkar, Jeremiah Wilkins
	B	Duncan Donley, Courtney Easton, William Gaal, Alessandro LoRe
8:45	A	John Hollon, Netbeti Ntini, Gregory Rivera, Manuel Vallejo, Kate Workman
	B	Luke Etheridge, M Ilham Haq, Mark Kotila, John McGivern
9:00	A	Joshua Bishel, Shaun Bontrager, Stephen Kohut, John Pekrul
	B	Colton Proctor, Jacob Walter, Charles Wejroch, Izaac Zondag
9:15	A	Ryan Knight, Danie Pawar, Ryan Pung, Sujal Soni, Jacob Waligora
	B	Alvaro Anaenugwu, Adam Laubach, Ronza Michael, Alshagri Mohammed
9:30	A	Megan Broughal, Liam Herbert, Bella Molnar, Ethan Weisblatt
	B	Lorenzo Amicucci, Nicholas Johnston, Cole Mahaffy, Kelly Montgomery, Jacob Scouler
9:45	A	Ian Doherty, Aiden Gulati, Andrew Nguyen, Enzo Ouriques Magalhaes, Jacob Veit
	B	Colson Currie, Alexander Smith, Norman Stokes, Andrew Wirth
10:00	A	Jake Jaskulka, Emma Munro, Narain Sathyaprakash, Macy Spevacek
	B	Emilio Albarenque, Alex Carter, Brandon Davies, Finn Jarvis, Brody Stack
10:15	A	Daniel Davis, Mike McGowan, Blake Nowak, Anton Samanic
	B	Josh Bergdolt, Kage Fox-Sanchez, Jacob Porath, Michael Tippy
10:30	A	Vrunda Bhagat, Connor Dunn, Owen Pirog, Srinidhi Swaminathan
	B	Joey Furuya, Dylan Hammis, Brett Kramer, Zea Labate
10:45	A	Blake Denucci, Aidan Krambeck, Cam Giang Ly, Nitin Niranjan
	B	Mihir Abhyankar, Jake Messman, Alexander Luerssen, Vinay Rao
11:00	A	Cole Cousino, Jagger Edson, Jack Hughes, Evan Misajlovski
	B	Mohammad Alqaryouti, Samuel Gamble, William Sutherlin, Ryan Zink
11:15	A	Joey Campbell, Rohan Dutt, Nathan Grooters, Derrick Lin

ME 470 Mechanical Design & Manufacturing II

Michael Lavagnino
Academic Specialist
Department of
Mechanical Engineering

Nevzat Bircan Buğdaycı
Assistant Professor
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Waste Collection Device

The goal of this project is to design, build, and test a mechanism that can lift and empty a filled waste receptacle into a bin using both a motor and hand-powered mechanical systems such as linkages, gears, or cam-followers. The device should minimize operator effort while maintaining reliable and repeatable motion. Teams will fabricate their mechanisms using available materials and equipment in the Manufacturing Teaching Laboratory. System performance will be evaluated based on (1) the total weight successfully emptied, (2) the overall weight of the mechanism, and (3) the completion time. The top-performing team across all sections will receive the da Vinci Award.

Competition Schedule

Time	Team	Station	Team Members
8:00	S1T01	A	Shaun Bontrager, Alaina D'Allura, Stephen Kohut, Wyatt Lamp, John Pekrul
	S2T01	B	Aanshuman Agarwal, Jagger Edson, Joey Furuya, Mark Kotila, Qipei Zhong
	S1T02	C	Joshua Bishel, Colin Brosch, Grant Chesley, Noah Sosnowski, Kyler Spike, Aidan Weitekamp
	S2T02	D	Aiden Gulati, Christian Kastelnik, Joshua Lyijynen, Eden Melamed, Kate Workman
8:25	S1T03	A	Christopher Nio, Grace Owen, Emma Powell, Natalie Stier, Nina Vozenilek
	S2T03	B	Sophia Draeger, Rohan Dutt, Narain Karthik, Kaeden Palmitier, Alex Senclair
	S1T04	C	Riley Haener, Colin Koot, Reid Scaife, Macy Spevacek, Bailey Surque
	S2T04	D	Kenneth Armor, Shane Bartlett, Jacob Jackson, Reese Kent, Jacob Scouler
8:50	S1T05	A	Tanner Auzins, Vrunda Bhagat, Blake Denuccio, Nicholas Pascual, William Selais
	S2T05	B	Ryan Fitzgerald, Luke Martin, Jake Messman, Collin Norder, Christopher Paige
	S1T06	C	Lucas Kuzner, Douglas LeMasters, Bella Molnar, Kelly Montgomery, Jacob Porath
	S2T06	D	Isabelle Christensen, Emerson Fuhrman, Samuel Gamble, Aubert Kamdem
9:15	S1T07	A	Peyton Ballard-McCrandall, Samantha Brown, William Gaal, Tristan Luick, Kaitlyn Nguyen
	S2T07	B	Ethan Gehrke, Zea Labate, Raúl Murillo Martinez, Ryan Nehls, Alexander Smith
	S1T08	C	Sidhaant Vivek Bhatt, Matthew DeBona, Benjamin Deininger, Raj Pataskar, Connor Simpson
	S2T08	D	Samuel Henn, Ethan Krahe, Emma Littell, Riley Newell, Sam Schroeder
9:40	S1T09	A	Dylan Chaudhry, Aman Goenka, Nicholas Mansch, Manav Oza, Justin Rukat
	S2T09	B	Ella Beck, Joseph Griffin, Hailey Kuplerski, Anna Suranyi, Austin Wick
	S1T10	C	Jake Coury, Andrew Hilbert, Seth Lindsey, Ryan Monaghan, Kieran Russell
	S2T10	D	Alessandro Cabrera, Sami El Hasnaoui, Wyland Hall, Debra Lawlor, Joseph Tetteh
10:05	S1T11	A	Andrew Alexander, Hamza Ayaz, Joseph Gall, Jack Hughes, Zachary Sawin
	S2T11	B	Kathryn Czewski, William Fiedler, James Patterson, Lily Reinke, Garrett Sauter
	S1T12	C	Mihir Abhyankar, Lincoln Brecheisen, Blake Burns, Ryan DePree, Chanulya Perera
	S2T12	D	Luke Bounds, Nathan McDonald, Ederick Plantegenest, William Sutherlin, Jacob Walter
10:30	S1T13	A	Joseph Lamberg, Luke Skonning, Samuel Snyder, Braden Vertalka, Qiaochu Yang
	S2T13	B	Ebenezer Adjah, Mack Bartels, M Ilham Haq, Johnathan Runge, Aditya Sil
	S1T14	C	Panashe Chiduma, Yahia Guenena, Jiwon Lim, Yuming Wang, Jeremiah Wilkins
	S2T14	D	Rigdon Freker, Tom Gilbert, Andrew Koch, Enzo Ouriques Magalhaes, Arjun Patel
10:55	S1T15	A	John Hollon, Soham Inamdar, Sai Shruthi Rajaraman, Gregory Rivera, Brandon Yip
	S2T15	B	Sofia Aultman, Gabrielle DesRoberts, Ntebeti Ntini, Caroline Roocroft, Nicole Stensen
	S1T16	C	Carson Chao, Sandhya Jagannathan, Jake Jaskulka, Colton Proctor, Kurt Rademacher
	S1T17	D	Anna Buccilli, Jillian Carosella, Braden Grabaum, William Orloff, Stephen O'Rourke
11:20	S1T18	A	Zuhaer Aranya, Joey Bastianelli, Brenden Jankowski, Savannah Nseir, Claire Osborne
	S1T19	B	Vidur Dhanapune, Joshua France, James Handrich, Liam Keane, Manuel Vallejo Munoz

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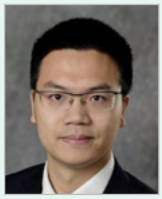
The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Faculty Advisors: Rebecca Anthony, Brian Feeny, Zhaojian Li, Hamidreza Modares, Norbert Mueller, Thomas Pence, Mike Symons


Anthony


Feeny


Li


Modares


Mueller


Pence


Symons

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:00 a.m.	Henry Ford Health System Innovations	Retractable Angiographic Suite Cable Reel System
8:30 a.m.	Arthrex, Inc.	Precision Oscillating Tip Saw System
9:00 a.m.	Takeout Takeout	Reusable Foodware Drying System
9:30 a.m.	MSU Bikes	Harnessing Wind Power to Promote Sustainable Transportation
10:00 a.m.	Gerdau	Improving the TIR Measurement Process
10:30 a.m.	American Axle and Manufacturing	Electromagnetic Coil Calibration Test Stand
11:00 a.m.	Michigan Nut & Fruit Growers Association	Sorting of Shell and Kernel Fragments of Black Walnuts

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.

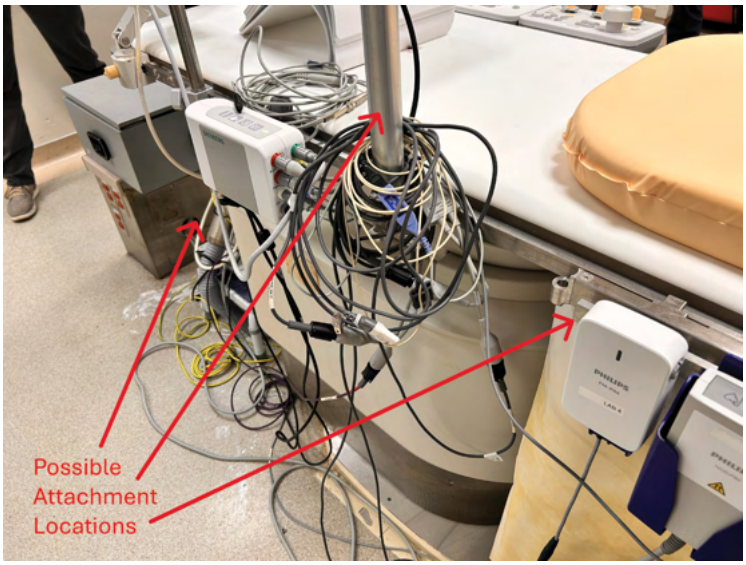
We gratefully acknowledge the participation support of this semester's project sponsors: American Axle and Manufacturing, Arthrex, Inc., Cobra-Aero, Exedy Drones, Gerdau, Henry Ford Health System Innovations, Jetfire® Power LLC, Michigan AgrAbility, Michigan Fruit & Nut Growers Association, Michigan State University Veterinary Medical Center, MSU Bikes, MSU Department of Mechanical Engineering, MSU Eli and Edythe Broad Art Museum, MSU IMPART Alliance, MSU Surplus Store and Recycling Center, and Takeout Takeout.

Henry Ford Health System Innovations

Retractable Angiographic Suite Cable Reel System

Henry Ford Health System Innovations, a division of Henry Ford Health located in Detroit, Michigan, is dedicated to developing and implementing novel healthcare technologies that improve patient care and clinical efficiency. The institute partners with industry, clinicians, and engineers to translate new ideas into practical medical solutions, fostering innovation across a range of specialties within the Henry Ford Health System. Their mission focuses on addressing unmet clinical needs through human-centered design, research, and engineering collaboration.

This project addressed a recurring issue in the angiographic suites at Henry Ford Hospital involving disorganized and tangled cables attached to patient beds. This issue is something that occurs at hospitals around the country. While our goal is to improve the cable management at Henry Ford Hospital, future development of this system could focus on a more compatible design for other hospitals. Our team developed a cable management system designed to organize five primary cables connecting from the Siemens controller to the patient. The system attached securely to the existing 3/8-inch by 1-inch bed rail and enabled smooth cable extension and retraction without tangling or creating tension on the connections. The design prioritized functionality while maintaining a lightweight, compact, and easy-to-use form. The design also prioritized infection control by maintaining an easy-to-clean structure and by keeping cables off the ground. Constructed primarily from plastic, the system improved accessibility and safety for clinical staff while ensuring it did not interfere with the operation or movement of the angiography bed.



HENRY FORD HEALTH®
Innovations

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Arthrex, Inc.
Precision Oscillating Tip Saw System

Arthrex, Inc. is a global medical device company headquartered in Naples, Florida, specializing in orthopedic surgical products and procedures. Founded in 1981 by Reinhold D. Schmieding, the company has grown to employ over 5,000 people and remains privately held. Its mission, Helping Surgeons Treat Their Patients Better®, reflects its commitment to innovation and education in orthopedics. Arthrex, Inc. is a pioneer in arthroscopy and minimally invasive surgery, having developed more than 11,000 products and procedures to support orthopedic care.

The project was to develop a Precision Oscillating Tip Saw that is driven by the Synergy Power Oscillating Saw handpiece. The Precision Oscillating Tip Saw System is intended for precise bone cutting in joint arthroplasty procedures (e.g., knee, hip, shoulder, and ankle replacements). Unlike traditional oscillating saws, the Precision Blade oscillates only at the tip, significantly reducing vibration and excursion. Its design enables surgeons to trim and shape bone with high precision, improving implant fit and reducing surgical fatigue.

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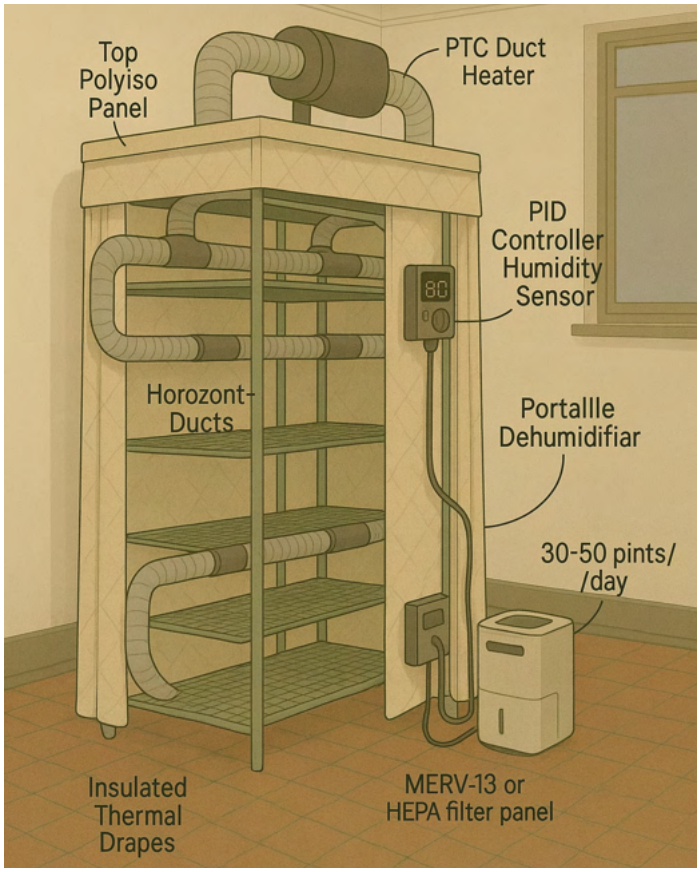
Takeout Takeout
Reusable Foodware Drying System

Takeout Takeout, a Lansing-based company founded in 2022 by Kendra Schneider, is a leader in sustainable foodware reuse operations. The company's mission is to reduce single-use packaging waste which is a growing environmental issue tied to greenhouse gas emissions from plastic production and the spread of microplastics in ecosystems. However, reusable foodware introduces a new operational challenge: it must be cleaned and dried in compliance with FDA regulations. According to FDA standards, reusable items cannot be towel-dried due to contamination risks; instead, they must be air-dried. Traditional air-drying methods, however, can take over 12 hours which is an impractical turnaround time for businesses with high-volume dish circulation.

Our team partnered with Takeout Takeout to develop a portable, FDA-compliant drying system that significantly reduces drying time. The system uses forced hot air jets to blow moisture off the containers. Blowers are implemented to continue removing moisture by recirculating the hot moist air in the system. The aluminum housing was engineered to promote condensation and drainage of humid air and can accommodate a 20" × 20" dish rack holding reusable containers of various sizes. An integrated exhaust system regulates internal pressure and ensures effective moisture removal. Through this collaboration with Takeout Takeout, we successfully created a prototype that demonstrates the feasibility of scalable dish drying for reuse-based food service operations.



TAKEOUT TAKEOUT

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Takeout Takeout
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MSU Bikes

Harnessing Wind Power to Promote Sustainable Transportation

MSU Bikes, a part of Michigan State University's Sustainability program, promotes cycling as an affordable, healthy, and environmentally responsible mode of transportation. The department operates a bicycle leasing program that aims to reduce waste by limiting the number of bikes that are abandoned on campus at the end of each semester. MSU Bikes also offers bicycle repair classes and use of a workspace where students can work on their bikes to maintain them. This approach not only diverts materials from landfills but also educates students about the life cycle of products and the value of sustainable use. By integrating creative design with sustainability outreach, MSU Bikes engages the MSU community through hands-on projects that highlight the importance of resource conservation and green mobility. It also offers students hands-on experience in creative reuse.

Our team continued development of a kinetic sculpture made out of bicycle parts to promote sustainable transportation on and off campus, an idea developed with the University's Residential and Hospitality Services unit. Originally designed by a previous ME capstone team, the sculpture symbolizes MSU's commitment to environmental stewardship, but it suffered from portability issues.

This year's project focused on redesigning and fabricating a new base to enhance structural stability, safety, and ease of transport. The improved base enables the sculpture to be mounted to a Ford Ranger pickup truck, the MSU Bikes bicycle trailer, and to be more easily moved by hand. By making the sculpture mobile, durable, and visually engaging, the project amplifies its role as a public demonstration of sustainable design, reuse, and engineering innovation at Michigan State University. Through this effort, the team hopes to inspire broader campus participation in sustainability initiatives and highlight how engineering can serve as a bridge between creativity and environmental responsibility.

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MSU Bikes

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Bill McConnell
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Dr. Hamidreza Modares

Gerdau
Improving the TIR Measurement Process

Gerdau's North American special steel division manufactures premium engineered carbon and alloy Special Bar Quality (SBQ) steel bars designed for safety-critical applications across industries such as agriculture, automotive, construction, distribution, energy, and manufacturing. Its downstream finishing facility in Jackson, Michigan focuses on precision finishing processes, delivering exacting control over diameter, roundness, straightness, length, and surface quality to meet stringent customer requirements.

Gerdau came to Michigan State University with the goal of improving the Total Indicator Reading (TIR) measurement process, which plays a crucial role in checking the steel bars' straightness before sending them to the customer. The TIR process consists of a bar being rotated in place while the TIR measurement dial analyzes the deflection of the bar. This measuring process is used in numerous parts of the facility, most commonly on the straightening and turning machines. Over the course of this project, our team worked on improving the TIR measurement system's efficiency, accuracy, and flexibility, supporting Gerdau in reducing productivity loss, ensuring more consistent measurements, and enhancing operator ergonomics. The final solution modified the existing prototype to accomplish the goals above, while custom fixtures were designed for more areas that could not fit the standard frame.

GERDAU
Shape the future

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Gerdau
Project Sponsor

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Dr. Rebecca Anthony

American Axle and Manufacturing
Electromagnetic Coil Calibration Test Stand

American Axle and Manufacturing (AAM) is a leading global Tier 1 automotive and mobility supplier. The company specializes in the design, engineering and manufacturing of driveline and metal forming technologies used in electric, hybrid, and internal combustion vehicles. AAM supports automotive, commercial, and industrial markets around the world, operating more than 75 facilities across 15 countries, with a mission to create a safer and more sustainable future. Their commitment goes beyond simply making and delivering the products. The company is dedicated to transforming the world of the automotive industry by bringing more efficient and powerful solutions. By recruiting creative associates and investing in state-of-the-art technology, the company continues to elevate and strengthen their capabilities.

The goal of this design project was to develop a test stand that measured the force over displacement of an electromagnetic actuator for the team's industrial sponsor, American Axle. An actuator is a device that converts energy to physical motion. Movement is caused by a coil within that creates a magnetic field when an electric current passes through it. These actuators are used to lock devices such as differentials, axle engage/disengage, and park locks. The actuator will be tested under load as it pushes against the spring-loaded gear within a differential. Differentials have historically been locked mechanically or hydraulicly. Switching to electromagnetic activation reduces the maintenance and complexity. A calibration system is accurate and reliable when being able to prevent component failures and ensures consistent performance across a wide range of vehicle platforms, enhancing public welfare by reducing the risk of driveline related incidents, and improving durability.

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Michigan Nut & Fruit Growers Association
Sorting of Shell and Kernel Fragments of Black Walnuts

The Michigan Nut & Fruit Growers Association (MNFGA) is a non-profit organization composed of hobbyists and enthusiasts who enjoy cultivating nuts and fruits, primarily for personal use. In addition to growing produce, MNFGA members are involved in processing the harvested nuts and fruits to preserve them. Black walnuts are particularly abundant in Michigan, and the organization has developed machines to husk and crack the nuts. However, separating the nut meats from the shells remains entirely manual, making the process slow and time-consuming.

This project focuses on developing an automated system that separates nut meats from shells by exploiting differences in hardness between the two. The goal is to improve the Spring 2025 ME 481 prototype by refining the hopper design and developing a method to organize the nuts and meats into a single line, with a gap between each piece for processing. This work supports the broader objective of creating a system in which the operator simply loads the hopper while the device performs the full separation process with minimal oversight. By enhancing these subsystems, the team aims to improve overall sorting efficiency and accuracy while maintaining the small-scale, accessible design intended for Michigan Nut & Fruit Growers Association members. Existing prototypes and nut samples will guide testing and validation as the system evolves toward a reliable, user-friendly, and replicable separation process.

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Project Sponsor

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ME Faculty Advisor

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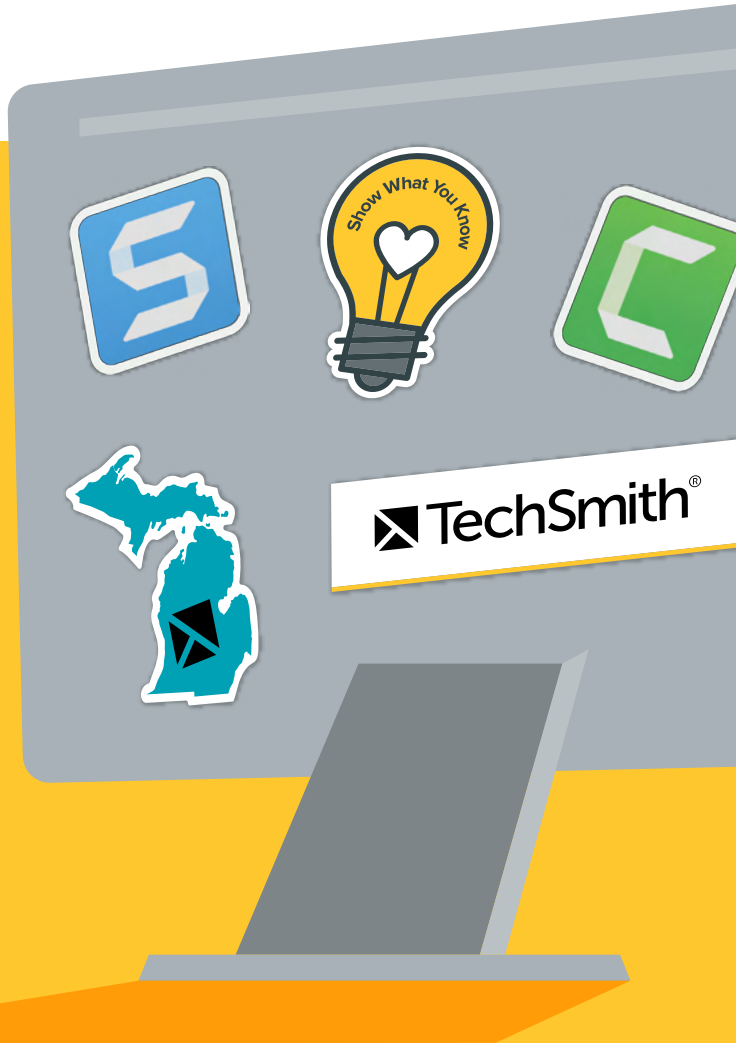

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The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Faculty Advisors: Andre Benard, Haseung Chung, Farhad Jaberi, Rajiv Ranganathan, Harold Schock, Junlin Yuan


Benard


Chung


Jaberi


Ranganathan


Schock


Yuan

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:00 a.m.	Michigan AgrAbility	Rolling Kneeler Cart Drivetrain
8:30 a.m.	Michigan AgrAbility	Assistive Device for Limited Arm Function
9:00 a.m.	Jetfire® Power LLC	Miniaturization of the Jetfire® Ignition System
9:30 a.m.	MSU Surplus Store and Recycling Center	Vermicomposting Wedge Blanket Cover
10:00 a.m.	MSU Eli and Edythe Broad Art Museum	Modular, Convertible A-Frame Art Cart
10:30 a.m.	Michigan State University Veterinary Medical Center	Underwater Treadmill Improvements

Mechanical Engineering Design Program

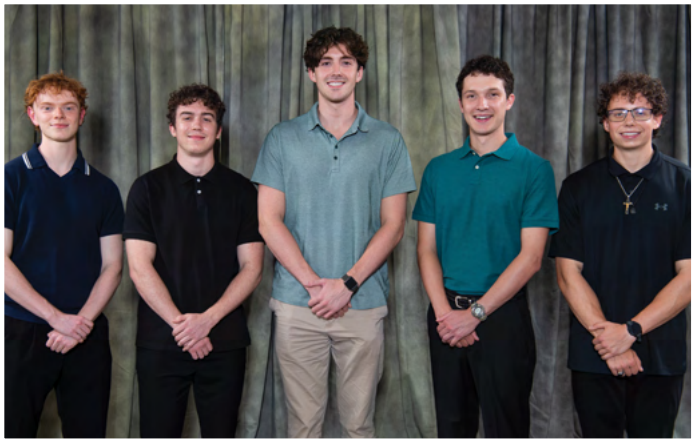
Mechanical engineers make the world move and provide the energy for it to do so. One goal of the MSU Mechanical Engineering Program is to educate engineers who are prepared to lead, create, and innovate as their professional or graduate careers evolve. The Mechanical Engineering Design Program is the 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, Andre Benard, Haseung Chung, Brian Feeny, Farhad Jaberi, Zhaojian Li, Hamidreza Modares, Norbert Mueller, Ahmed Naguib, Thomas Pence, Rajiv Ranganathan, Harold Schock, Mike Symons, Indrek Wichman, Neil Wright, Junlin Yuan

Michigan AgrAbility
Rolling Kneeler Cart Drivetrain

Michigan AgrAbility aims to enhance the quality of life for farmers or other agricultural workers with disabilities through individual consultations and other means. They are a partnership between Michigan State University Extension and Easterseals MORC and work with Michigan Rehabilitation Services to achieve their goal of enabling people with disabilities and their families to succeed in America. Furthermore, Michigan AgrAbility is a non-profit organization that puts an emphasis on easily accessible and reasonably priced parts when designing personal mechanical aids. This ensures maintenance can be provided at any time by anyone.

This project focuses on Kami who is a lavender farmer and has a disorder that causes her foot bones to break. With lavender being a relatively low growing crop, it requires strong legs and good balance to repeatedly kneel and stand up unaided while harvesting. The closest marketed devices for this scenario are Rolling Work Seats; however, these seats still require the user to bend far over, which puts strain on the lower back. The current cart is designed to provide hand and chest support to help her prune, weed, and harvest lavender. However, Kami is unable to reliably freely roll the cart, so the neutral gear was improved by switching from a pin mechanism to a dog clutch design. Doing so made it easier for the driveshaft to be put into neutral and less likely to break. Also, the previous electrical system was simplified by reducing the number of components and connections needed. This made the parts easier to maintain, replace, and assemble. Furthermore, the wheel joining mechanism was swapped from a press fit to a keyed joint. This provides better contact between the wheels and the shaft to prevent slippage, and changing the tires promoted greater traction.



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ME Faculty Advisor

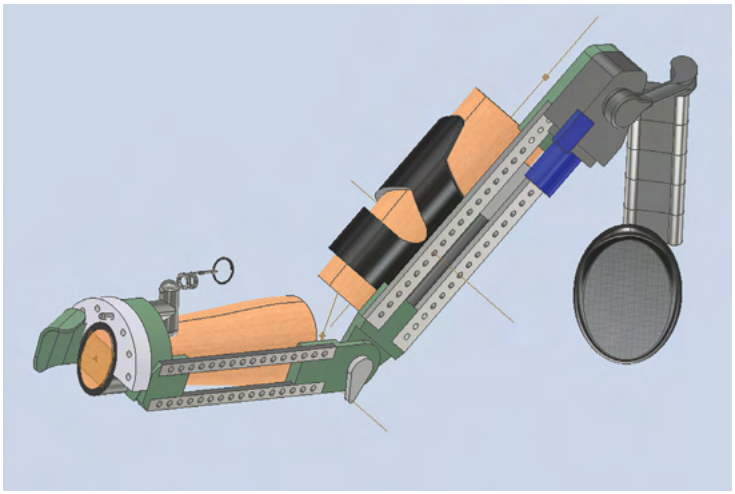
Dr. Haseung Chung

ME 481 | 8:30 a.m. Engineering Building, 1st Floor | Room 1220

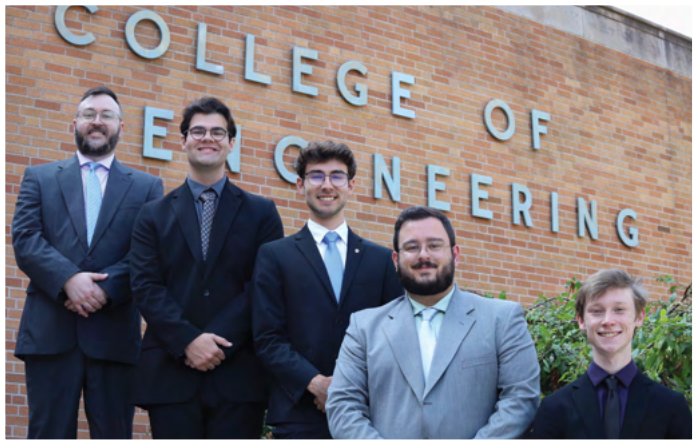
Michigan AgrAbility
Assistive Device for Limited Arm Function

Michigan AgrAbility is a program dedicated to supporting farmers and agricultural workers with disabilities or physical limitations through adaptive technologies and engineering solutions. In collaboration with Michigan State University, AgrAbility partnered with an individual client seeking to regain functional left-arm use for outdoor and educational activities. Michigan AgrAbility's mission guided our team toward creating a safe, affordable, and practical assistive device that promotes independence and accessibility for people with similar upper-limb challenges.

Our team designed an adaptive assist device that enabled the user to support and operate equipment with greater control while minimizing effort. The system provides coordinated arm motion through a lightweight and ergonomic mechanical support without requiring firearm modification. To guide development, we used motion-capture analysis, force measurements, and iterative prototyping to evaluate the user's range of motion and lifting capability. The team also researched and explored commercial solutions to similar problems, including spring-balanced arm supports, passive counterweights, and modular exoskeleton elements, which informed the final design approach. The resulting prototype demonstrates a portable and practical assistive mechanism capable of improving independence in both recreational and daily tasks that involve lifting, reaching, or carrying moderate weights.



AgrAbility
easterseals MICHIGAN STATE UNIVERSITY Extension



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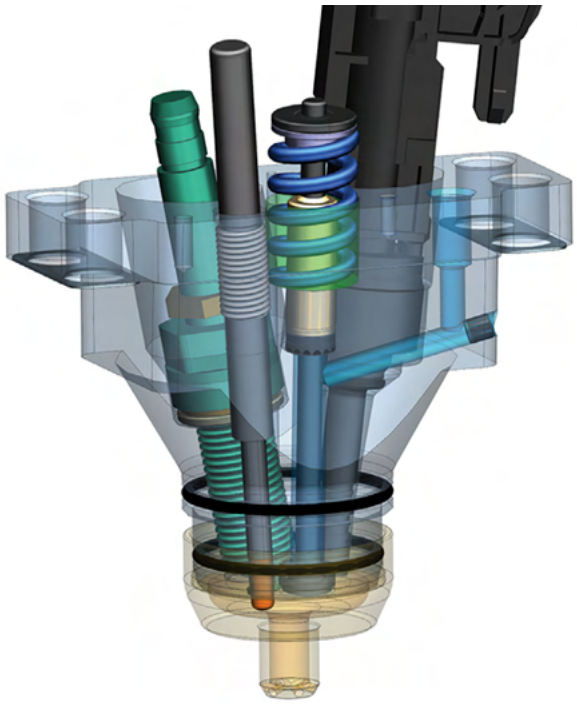
Dr. Rajiv Ranganathan

Jetfire® Power LLC

Miniaturization of the Jetfire® Ignition System

Jetfire® is an advanced ignition system developed by MSU and Jetfire® Power LLC with the aim of enhancing combustion efficiency in internal combustion engines. Experiments indicate that a Jetfire® Ignition System mounted on a 4-stroke cycle engine is able to achieve efficiencies of over 45% using conventional fuels and over 50% while operating on hydrogen. The system uses a pre-chamber ignition system that provides a rapid and complete burn, meaning improved fuel efficiency and reduced emissions. With additional miniaturization, the Jetfire® System has great potential for widespread use on a variety of engine platforms.

The current Jetfire® cartridge improves combustion efficiency by providing a combustion system that can tolerate compression ratios of greater than 15:1 while operating on 87 AKI pump gasoline. The Jetfire® system is complex to implement on existing light-duty vehicle engines due to its size. The project focuses on the design of a miniaturized Jetfire® cartridge that will mount in a 12 mm spark plug port. While previous generations utilized poppet valves operated by a camshaft, our goal is to design the cartridge implementing a rotary valve that is driven by a DC motor, controlling air delivery on the cartridge. A smaller size spark plug, and a 6 mm fuel injector are included in the new Jetfire® cartridge configuration. Jetfire® Power LLC provides CAD models of existing Jetfire® cartridges and past design prototypes ranging from Gen I to IV.



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Jetfire® Power LLC
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MSU Surplus Store and Recycling Center
Vermicomposting Wedge Blanket Cover

The MSU Surplus Store and Recycling Center manages surplus goods, recycling, and sustainable waste programs for Michigan State University. One of its most impactful initiatives is the vermicomposting program, which diverts pre-consumer food scraps from landfills. By turning organic waste into nutrient-rich compost, the program supports both sustainability goals and community enrichment.

Our project addressed the challenges faced by the vermicomposting program during the winter months. Staff previously had to manually drag large plastic sheets across compost wedges to provide insulation, which was physically demanding and time-consuming. The process also risked harming worm populations when the cover rested directly on the compost surface. The goal of our project was to design an affordable, durable, and easy-to-use system that improved worker safety, reduced labor requirements, and protected the health of the worm population to ensure continued composting success.

Surplus Store and Recycling
managing waste as a resource

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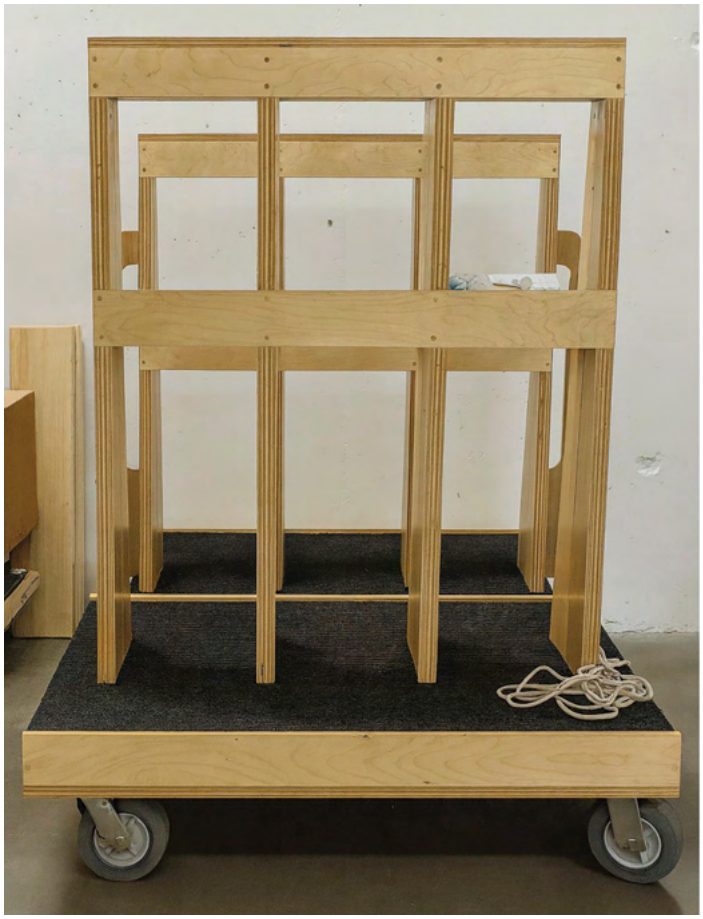
MSU Eli and Edythe Broad Art Museum
Modular, Convertible A-Frame Art Cart

The Eli and Edythe Broad Art Museum at Michigan State University is a dynamic contemporary art museum that sparks curiosity and fosters inquiry through bold exhibitions and engaging programs. Opened in 2012, the museum is housed in a striking building designed by world-renowned architect Zaha Hadid. It showcases a diverse range of artwork, highlighting both global perspectives and local voices.

Moving artwork is a regular and delicate task in a museum environment—one that must be performed with precision and care. The MSU Broad Art Museum requested a Modular Convertible A-Frame Art Cart tailored to the museum's specific needs, with a strong emphasis on flexibility, integration, and long-term usability. The final design features a clever hinged mechanism that enables the cart to transition smoothly between an A-frame position, ideal for display and artwork transport, and an L-shaped configuration for compact storage or alternate functional setups within the museum.

A key aspect of the design is its interchangeable base, which was intentionally developed to be compatible with systems created by previous MSU capstone design teams. This continuity enables seamless integration into the museum's existing workflows, while minimizing the need for new custom components. Sustainability is a core principle throughout the project; the team prioritized reducing material waste and avoiding unnecessary new parts by reusing and adapting existing systems wherever possible.

To further enhance mobility and artwork safety, the cart is equipped with custom-designed caster wheels that significantly minimizes vibration transfer to the base which is an important consideration for transporting delicate or sensitive pieces. In addition, the connector system between the cart and the base is engineered for easy disassembly and reassembly, enabling museum staff to quickly adapt or store the cart without the need for special tools.



MSU BROAD ART MUSEUM

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Michigan State University Veterinary Medical Center

Underwater Treadmill Improvements

At Michigan State University's Veterinary Medical Center, the underwater treadmill (UWTM) is a rehabilitation tool for canine patients. The physical properties of water help dogs exercise with less impact on tissue and increase resistance for strengthening. With the use of the water jet, veterinarians can either provide resistance to build muscle or assistance to support walking movements during therapy sessions. These functions make the UWTM a powerful tool in the medical center's daily operations, helping animals of all sizes recover safely and effectively. However, the current treadmill presents several challenges for both staff and patients. Moving and adjusting the jets is difficult due to its weight and size. This creates ergonomic strain for the staff. The treadmill also lacks a bumper system to help guide dogs and keep them centered on the moving belt. Some dogs stand on the side of the treadmill, causing the staff to redirect their walking path. These concerns emphasize the need for improvements that prioritize usability, reliability and long-term performance.

Our team was tasked with improving the underwater treadmill system to enhance ergonomics, safety, and overall durability. The proposed solution includes installing two fixed-position jets equipped with removable inlet hoses, enabling staff to easily adjust the system without heavy lifting or strain. A bumper system will also be developed to guide the dogs during therapy and can be removed for easy cleaning. These improvements to the treadmill will improve the quality and consistency of canine rehabilitation while reducing the physical demands placed on veterinary staff. This project supports both animal welfare and sustainable engineering practices at Michigan State University.

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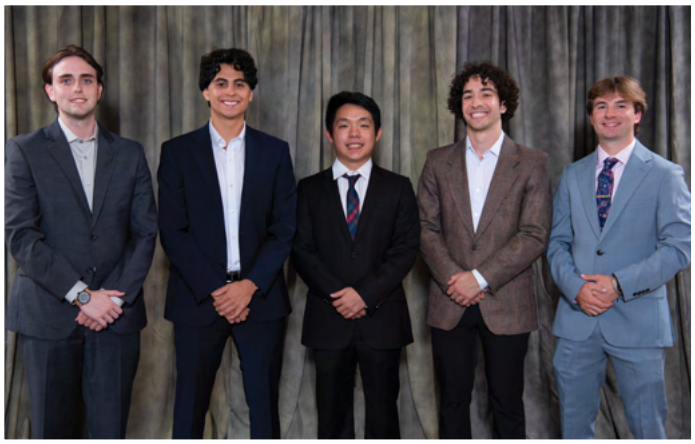

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Michigan State University | Veterinary Medical Center
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The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Faculty Advisors: Brian Feeny, Hamidreza Modares, Ahmed Naguib, Harold Schock, Indrek Wichman, Neil Wright


Feeny


Modares


Naguib


Schock


Wichman


Wright

Presentation Schedule – Engineering Building, Room 1300

Time	Team Sponsor	Project Title
8:00 a.m.	MSU IMPART Alliance	Improved Carts for Direct Care Worker Training
8:30 a.m.	MSU IMPART Alliance	Constraint System for Transport of DCW Equipment
9:00 a.m.	MSU IMPART Alliance	Revised Manikin and Bed Storage Cart for Direct Care
9:30 a.m.	Jetfire® Power LLC, Exedy Drones, Cobra-Aero	Hybrid Propulsion Heavy Lift Drone System
10:00 a.m.	MSU Department of Mechanical Engineering	Fixturing for Meteorite Machining
10:30 a.m.	MSU Department of Mechanical Engineering	Fluid Mechanics Class Demonstrator of Magnus Effect

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 IMPART Alliance

Improved Carts for Direct Care Worker Training

MSU IMPART Alliance is an organization that specializes in direct care work for older/disabled individuals and families. The direct care work provided includes long-term care systems, mental health care, and behavioral care. Workers may be helping with daily activities like getting dressed or cooking, or they may be helping with rehabilitation efforts. IMPART Alliance wants to build a workforce of Direct Care Workers that can readily support those in need. To ensure a skilled workforce, IMPART Alliance will provide training across Michigan. Training equipment is loaded onto four specialized carts built by MSU Mechanical Engineering students and transported by van to training sites.

Our project focused on improving a previous design made for IMPART Alliance. The team addressed problems that they had with the wheels and the overall durability of the cart. The updated version was designed with these improvements as well as keeping the functionality. These carts carry important medical supplies, so they must be reliable. The improvements included large wheels that can cross different terrain and rotate 360 degrees to ensure the carts can be moved and loaded for transportation with ease. Another design change included the addition of brakes to each cart for better safety measures. The base of the carts was improved to stop any deformation of the cart due to loads, as well as to strengthen the connection with the wheels. Improving these aspects enabled us to load the carts efficiently and safely while retaining the necessary mobility. By the end of our project, the team was able to create reliable carts for MSU IMPART Alliance to use to train their direct care workers.

MSU IMPART Alliance through a grant received by the Michigan Department of Health and Human Services using American Rescue Plan Act/Home and Community Based Services Project funds.

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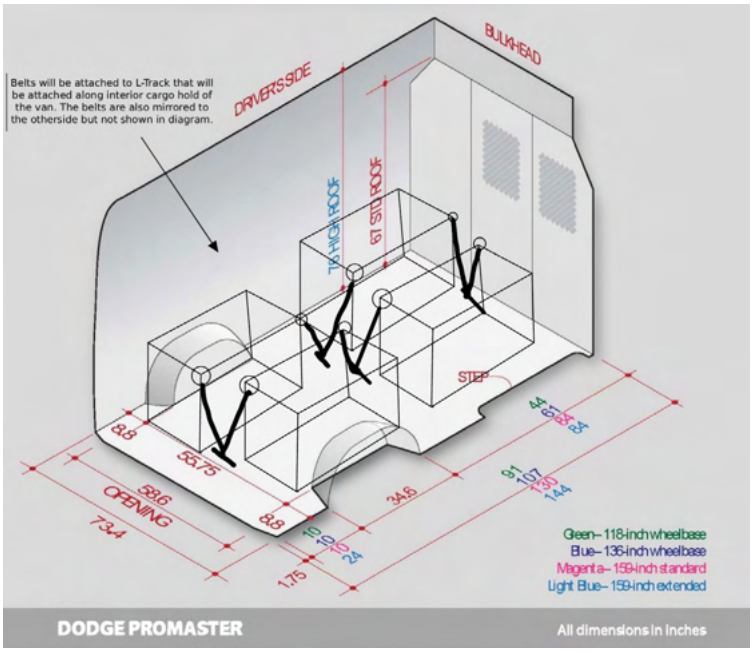
MSU IMPART Alliance

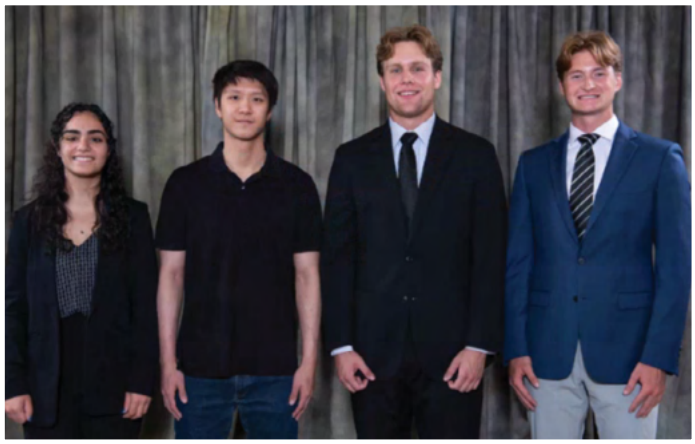
Constraint System for Transport of DCW Equipment

The MSU IMPART Alliance is dedicated to strengthening Michigan's direct care workforce. It addresses the growing shortage of trained Direct Care Workers (DCWs) who provide essential in-home support to individuals across the state who otherwise cannot access much-needed care. By building a comprehensive database of skilled workers, developing scalable training programs, and forging partnerships with statewide agencies, IMPART Alliance works to ensure access to care that is both high quality and affordable. Its mission is to enhance workforce stability, improve care outcomes, and create a coordinated and efficient system that supports both patients and their caregivers. Through education, collaboration, and innovation, IMPART Alliance aims to transform Michigan's approach to direct care.

This project was to design a cart constraint system for the transport vehicle used in DCW training for IMPART Alliance. The goal was to ensure that DCW training equipment could be safely and efficiently loaded, transported, and unloaded by a single operator with minimal mechanical knowledge and/or experience. We began by evaluating the issues identified in initial vehicle testing, focusing on the need for improved cart restraints and operator accessibility. Using these findings, we developed and implemented a cart constraint system compatible with the design of the vehicle's cargo hold, the added hydraulic lift, and the cart modifications being made by other student teams. The constraint system enables quick securing and removal of the carts and a singular wheelchair while maintaining stability during transportation. Through collaboration with IMPART Alliance and partnering teams, we created a reliable, easy-to-use solution that ensures equipment safety for the training of future DCWs of Michigan.



MSU IMPART Alliance through a grant received by the Michigan Department of Health and Human Services using American Rescue Plan Act/Home and Community Based Services Project funds.



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MSU IMPART Alliance

Revised Manikin and Bed Storage Cart for Direct Care

The IMPART Alliance initiative is an MSU-led program to train and support Michigan's in-home Direct Care Workers (DCWs). Many Michiganders and their families care for their loved ones with the help and skills of DCWs; however, there is currently an urgent shortage of well-trained DCWs. IMPART Alliance strives to bridge the gap in DCW retention and recruitment by developing training curriculum and models, establishing effective protocols and procedures, providing professional training, and collating a database of DCWs based in Michigan. As part of the IMPART Alliance's training program, its staff transport an assortment of training aids and other equipment to various locations around the state.

Training DCWs requires equipment which needs to be stored and transported efficiently. Our team's task was to improve upon a previous team's cart design that is used to transport training equipment for direct care workers; more specifically, the bed and training manikin. The new and improved cart can store all the required items, is made from sturdy materials, is easy to handle due to its weight distribution and wheels, and is small enough to fit inside the DCW cargo van, tight doorways, and hallways. The cart also has secure latches that are easy to open and has the equipment stored inside the storage compartments in such a way that makes it easy to access and then store when done. Overall, the storage cart is designed with the DCW in mind so that they can focus on doing their job effectively.

IMPART ALLIANCE
MICHIGAN STATE UNIVERSITY

MSU IMPART Alliance through a grant received by the Michigan Department of Health and Human Services using American Rescue Plan Act/Home and Community Based Services Project funds.

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Jetfire® Power LLC, Exedy Drones, Cobra-Aero

Hybrid Propulsion Heavy Lift Drone System

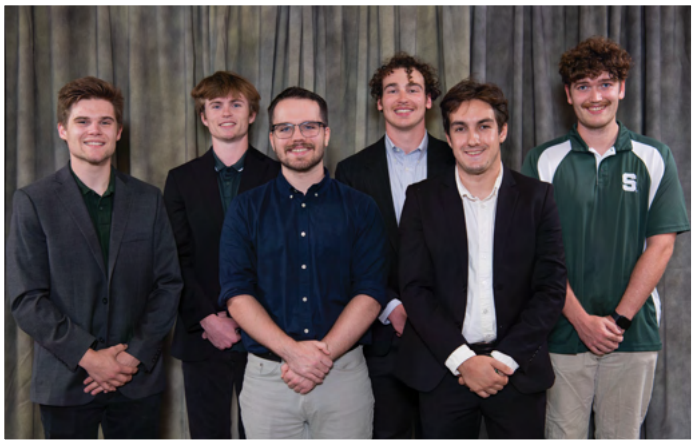
Our project for Jetfire® LLC, Exedy Corporation, and Cobra Aero is to initiate the development of a next-generation hybrid UAV system tailored for agricultural use. Jetfire® specializes in turbulent jet injector technology, Exedy provides modular drone chassis platforms, and Cobra Aero contributes expertise in combustion engine manufacturing. These industry leaders worked with our team to begin solving a critical challenge: how to deliver a high-payload, long-range drone system that meets the real-world needs of farmers. Their support provided access to proprietary hardware, technical specifications, and benchmarking data, which established the groundwork for a tool that could empower the backbone of our country with better technology.

The team began designing and testing a combustion-driven UAV capable of lifting 150 pounds for extended crop spraying missions. By integrating a Jetfire®/Cobra Aero internal combustion engine into Exedy's CT-110 chassis, we created a system focused on thrust generation, vibration damping, and hybrid control logic using PX4 flight software. Our goal is to offer farmers a more efficient, cost-effective, and sustainable alternative to electric drones, which often fall short in payload and runtime. Final deliverables include CAD models, subsystem schematics, static thrust data, and a concept drone showcased at the Kansas City Drone Show. This project marks the first step toward a robust agricultural UAV platform that can reduce labor, improve yield, and expand access to precision farming across the country.

Jetfire® Power

EXEDY DRONES

Cobra AERO



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MSU Department of Mechanical Engineering

Fixturing for Meteorite Machining

As an Assistant Professor in the Department of Mechanical Engineering at Michigan State University, Dr. Nevzat Bircan Bugdayci's research focuses on advanced manufacturing, precision machining, and fixture design for complex geometries. He specializes in developing physics-based and data-driven models for process optimization, machine dynamics, and stability prediction in both additive and subtractive manufacturing. His work bridges experimental validation with computational modeling to improve machining accuracy, vibration control, and surface integrity. Through his research group, Dr. Bugdayci aims to advance intelligent manufacturing systems that can adapt to the geometric and material variability often encountered in next-generation aerospace and space-related applications.

This project developed a modular fixturing system for securely holding irregularly shaped meteorite samples during precision machining operations. The team implemented a computer-optimized fixture design by scanning the meteorite surface using an optical scanner to identify the most stable and accessible contact planes. Using these data points, precision toe clamps were positioned at optimized locations to maximize rigidity and minimize surface damage during drilling and milling. The design was analyzed through CAD modeling and finite element simulations, then validated through prototyping and testing. The resulting fixture supports Michigan State University's ongoing research on in-space manufacturing by providing an adaptive, reproducible, and safe method for machining non-prismatic materials. In the future, this will enable probes that are sent to space with the ability to determine the material make-up of an asteroid. Then it can be concluded whether the asteroid is needed for the efforts of in-space manufacturing. This will eliminate the need for hauling materials into space on costly rocket ships.

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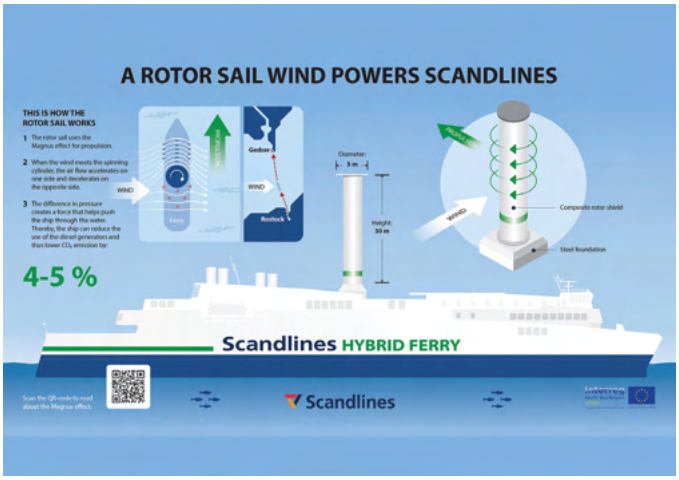
Fluid Mechanics Class Demonstrator of Magnus Effect

Dr. Ahmed Naguib is a professor in the Michigan State University Department of Mechanical Engineering whose research focuses on experimental fluid mechanics and flow control. Dr. Naguib is one of several faculty members who have supported numerous educational initiatives aimed at strengthening hands-on learning in undergraduate fluid mechanics. Our team worked with him to design and build a new experiment for the ME 333L Fluid Mechanics Laboratory, giving students the opportunity to observe and measure real-world fluid behavior.

Our team's project was to design and construct a Magnus effect demonstrator that enabled students to visualize and measure the lift force produced by a rotating cylinder in uniform water flow. The visualization is planned to take advantage of an existing hydrogen bubble setup, while the lift measurements are based on a new single-component force balance that the team is tasked with designing, constructing, and characterizing. The Magnus effect happens when a spinning cylinder changes how fluid flows around it: on the side spinning with the flow, the fluid moves faster, lowering the pressure according to Bernoulli's principle, while on the opposite side, the fluid slows, and pressure rises. This pressure difference produces lift perpendicular to the flow. This phenomenon appears in real-world applications, such as the curving motion of a baseball and in ship propulsion systems like the Scandlines hybrid ferry, which uses Flettner rotors to reduce CO_2 emissions. An image of the Scandlines ferry is featured in our project diagram to illustrate this connection. The completed demonstrator is expected to provide a clear visual representation of fluid flow around the spinning cylinder, reinforcing theoretical principles and offering students a tangible understanding of aerodynamic lift caused by rotational motion.



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MICHIGAN STATE UNIVERSITY

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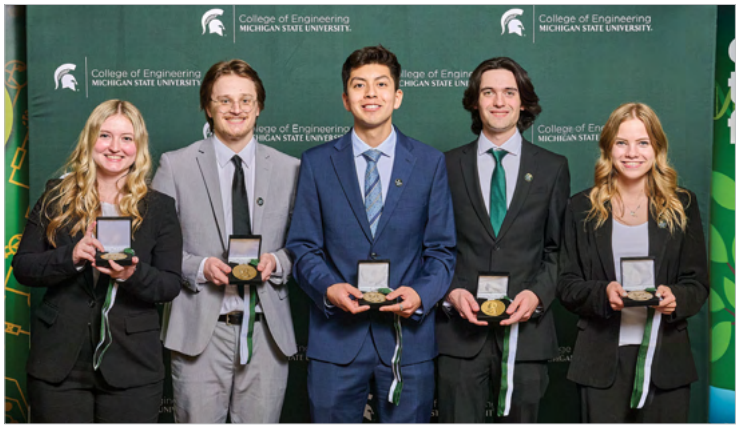
Design Day Awards Spring 2025

ME481 Edison Award for Best Capstone Design Project

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

BONWRx - Redesign Biomedical Injector

Left to right: Ashley Donbrock, Nathan Zavsza, Joshua Machuca-Gonzalez, Shawn DeFina, Hanna Stabler



ME481 Best Capstone Project Presentation Award

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

MSU Baja Racing - Design and Manufacture of Custom Brake Calipers

Left to right: Elizabeth Grant, Matthew Osborn, Justin Tyack, Robert Crouse, Sydney Agius

ME470 da Vinci Award (Best Mechanical Design)

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

Team 13 - March Madness Mechanized Mini-Basketball Launcher

Left to right: Brody Stack, Finn Jarvis, Connor Dunn, Courtney Easton

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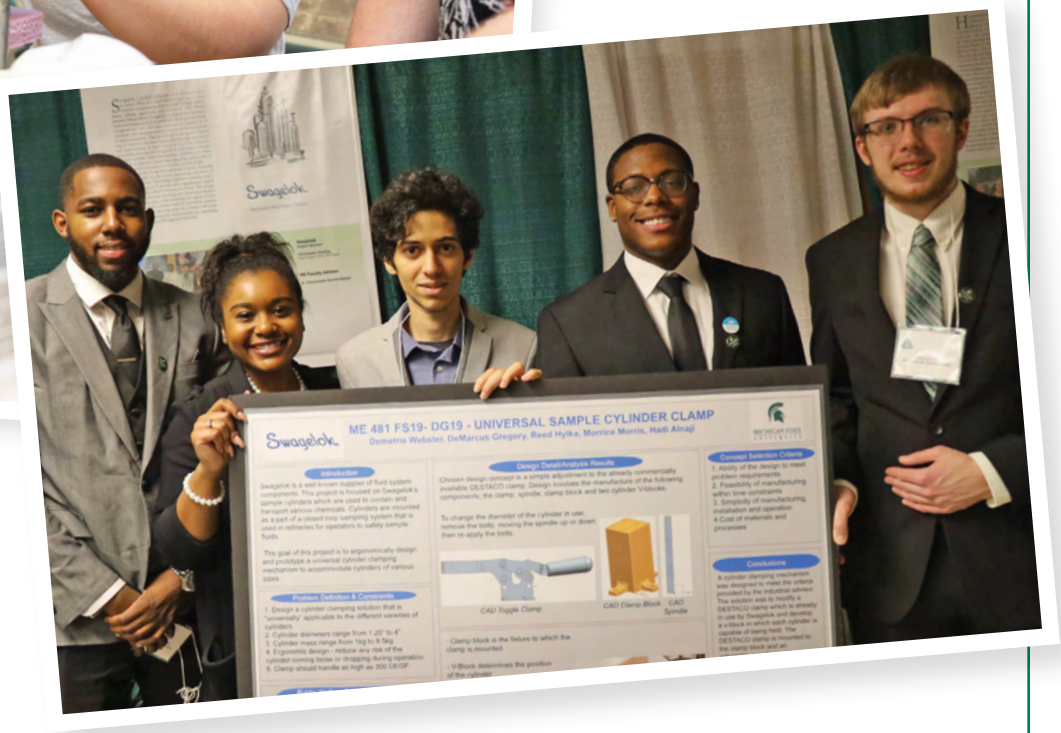
DESIGN DAY



Look for Spring Design Day projects coming in April 2026!

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