MICHIGAN STATE UNIVERSITY COLLEGE OF ENGINEERING **FALL 2019**

DESIGN DAY

MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY FOUNDATION

Executive Partner Sponsor

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On behalf of the entire Michigan State University community, it is my pleasure to welcome you to the College of Engineering's Design Day, now in its 26th year.

Twice each year, Design Day showcases some of the most entrepreneurial, innovative and impressive work produced by MSU students. The project exhibits, plus competitions, demonstrations and presentations to pre-college students, make this event a highlight of the undergraduate calendar.

Design Day reflects the very spirit of the practical, cutting-edge land-grant university for which Michigan State was an acknowledged prototype some 160 years ago. Beyond providing the means for states to establish agricultural colleges, the 1862 Morrill Act also specified courses in "the mechanic arts" as part of a curriculum to equip students for "the several pursuits and professions of life."

We are grateful for the sponsors who support capstone projects for our graduating seniors.

And thanks, too, to the talented and dedicated people of the College of Engineering who have inspired and guided the students represented here today.

Congratulations to all on this latest demonstration of Spartan ingenuity and engagement.

Sincerely,

Samuel L. Stanley Jr., M.D.
President, Michigan State University

Office of the President

Hannah Administration Building
426 Auditorium Road, Room 450
East Lansing, MI 48824

517-355-6560
Fax: 517-355-4670
president.msu.edu

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Welcome from the Dean

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

This year we celebrate 25 years of Design Day. The first Design Day featured 12 Mechanical Engineering Capstone teams.

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

Check out the Design Day milestones highlighted on a timeline in the center of this booklet.

We are pleased to acknowledge Meijer as our Design Day Executive Partner Sponsor and Auto-Owners Insurance as our Design Day Directing Partner Sponsor. Our Design Day Supporting Partner Sponsors include Amazon, Bosch, Ford, MSUFCU, Norfolk Southern, and TechSmith. We thank all of our sponsors for their generosity and their ongoing commitment to Design Day.

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

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

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

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

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

Dr. Leo Kempel
Dean of the College of Engineering
Professor of Electrical and Computer Engineering
Michigan State University

MSU Foundation Ad

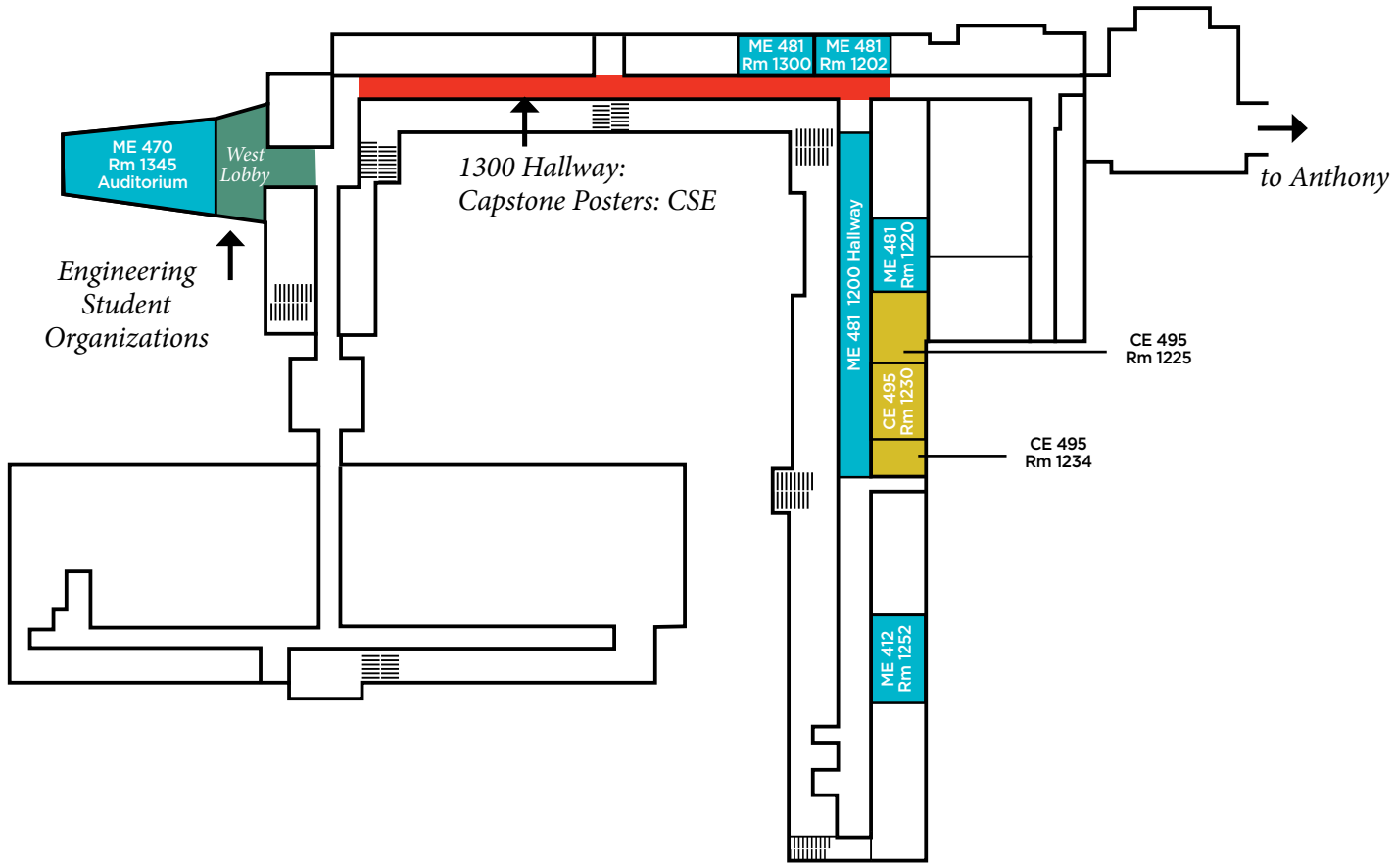
Design Day Events Schedule: Friday, December 6, 2019

EVENTS	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon	1 p.m.
Audio Enthusiasts and Engineers		2nd Floor Room 2228 8:00 a.m. – Noon					
Engineering Student Organizations		1st Floor Lobby 8:00 a.m. – Noon					
ECE 101 Presentations			2nd Floor 2300 Hallway 9:00 a.m. – 11:30 a.m.				
EGR 100 Presentations			2nd Floor 2300 Hallway 9:00 a.m. – 11:30 a.m.				
ME 412 Competition		1st Floor Room 1252 8:00 a.m. - 11:45 p.m.					
ME 470 Competition		1st Floor Room 1345 8:00 a.m. - Noon					
CAPSTONE COURSES							
CSE & ME Posters and ECE Posters		CSE & ME Posters: 1st Floor 1300/1200 Hallway 8:00 a.m. - Noon ECE Posters: 2nd Floor 2200 Hallway 8:00 a.m. - Noon					
CE 495 Project Presentations		1st Floor Rooms 1225, 1230 & 1234 8:00 a.m. - Noon					
ECE 480 Project Presentations			2nd Floor Rooms 2205 & 2243 8:30 a.m. - 11:30 a.m.				
ME 481 Project Presentations		1st Floor Rooms 1202, 1220 & 1300 8:00 a.m. - 11:30 a.m.					
OPENING, LUNCH AND AWARDS							
High School Opening			1st Floor 1279 Anthony Hall Auditorium 8:00 a.m. - 8:40 a.m.				
High School Awards			1st Floor Engineering Auditorium 1345 12:15 p.m. - 12:30 p.m. – *lunch at Brody after*				
MSU Awards			1st Floor Anthony Room 1281 1:15 p.m. - 2:00 p.m.				

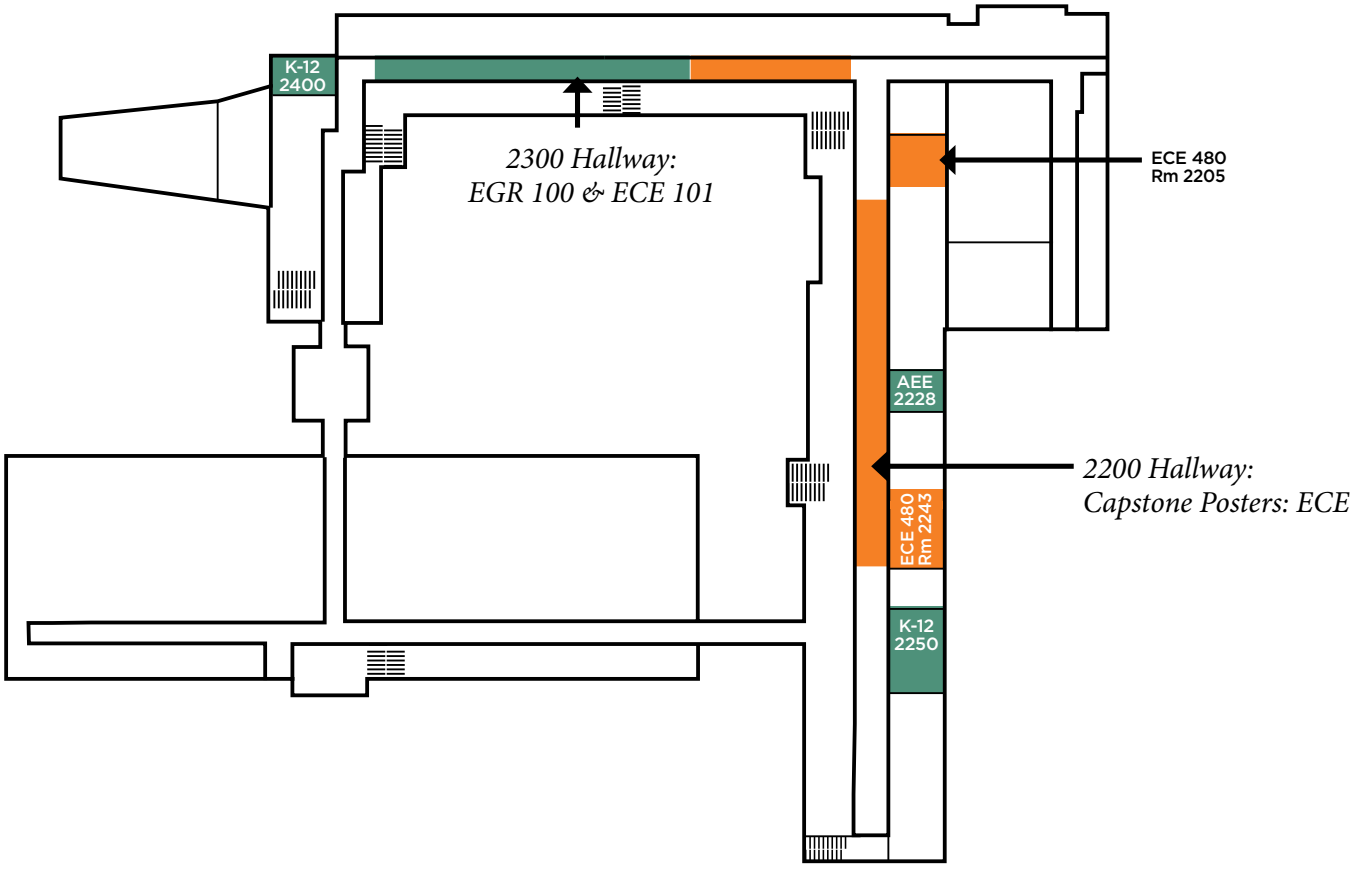
Social Media Links:
"Like" the College: https://www.facebook.com/SpartanEngineering
"Follow" the College: https://twitter.com/msu_egr_news

To stay up to date w/Careers in Engineering:
“Like” Us http://www.facebook.com/pages/The-Center-for-Spartan-Engineering/226159694117936
“Follow” Us: https://twitter.com/msuengineer

1st Floor Engineering



2nd Floor Engineering

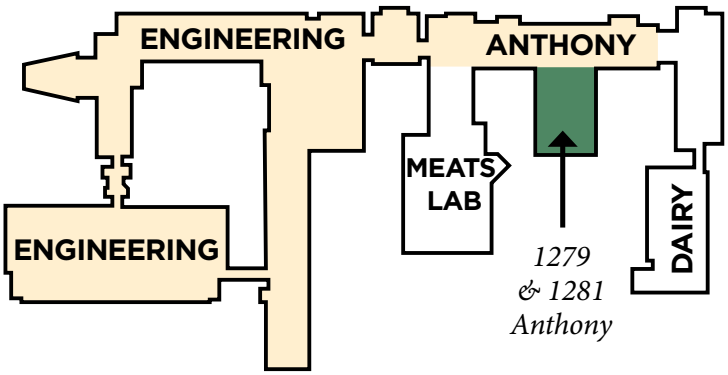


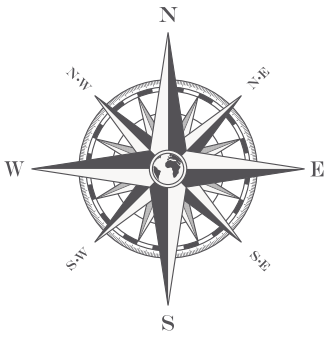
Overview

Color Legend:

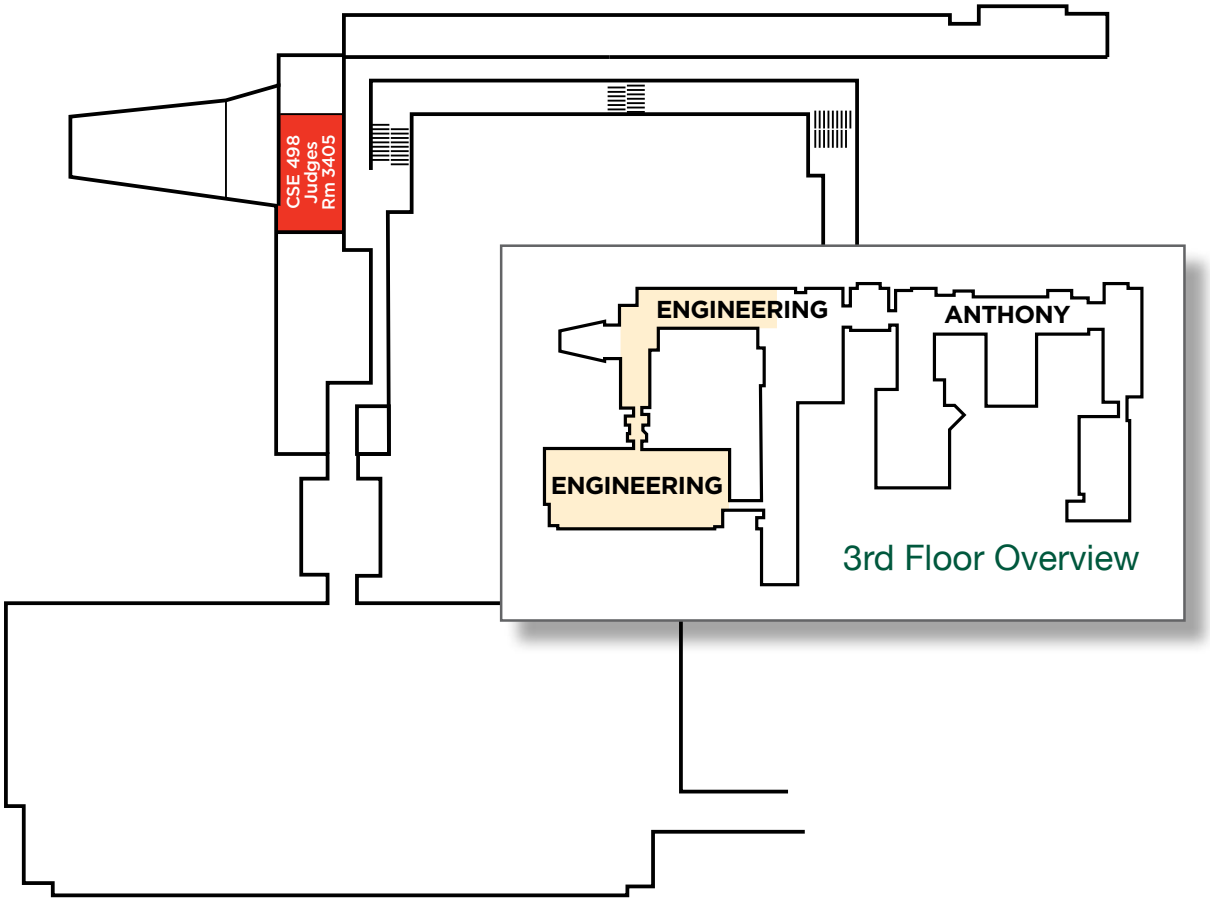
- CEE
- CSE
- ME
- ECE
- Joint/Other

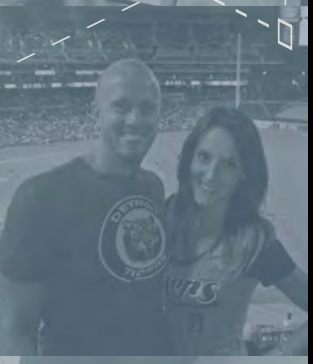
Design Day Floor Plans of the MSU Engineering Building

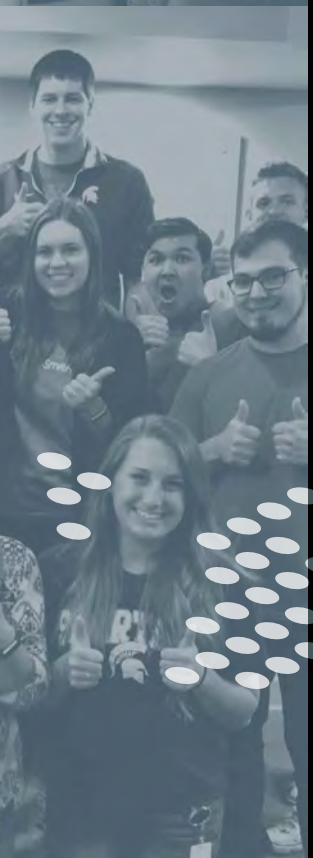




3rd Floor Engineering







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High School Innovation & Creativity Day

Precollege Student Voting: During the morning on Design Day all visiting precollege students will be viewing Engineering Projects and voting.

During this time college students will have a chance to interact with "non-engineering" students and demonstrate the underlying principles from their projects. This interaction allows the college students an opportunity to practice explaining engineering concepts to non-engineers. As the precollege students work their way through the wide variety of presentations, they will get an overview of the many different branches of engineering. Additionally, as the precollege students see both entry-level and advanced engineering applications, it allows them to see the natural progression of engineering. Lastly, this session also provides a chance for the precollege students to interact with student organizations within the College of Engineering.

The following schools and groups will be participating in this Fall's Design Day events: Brighton High School, Eaton RESA, Innovation Central High School, Jackson High School and Women in Engineering.

	1279 Anthony Hall Auditorium: Check-in for all schools	K'NEX Bridge Team Build Room 2250	VEX Robotics Room 2400	1st & 2nd Floor Voting/project viewing	Trebuchet Launch Competition 1279 Anthony Hall
8:00–8:15	Check in for all schools				
8:15–8:30	Welcome & voting procedures – Drew Kim, Assistant to Dean, and Luis Donado, Assistant Director				
8:40–9:30		Brighton High School	ICHS/Eaton RESA	Jackson HS	WIE
9:35–10:20		ICHS/Eaton RESA	Jackson HS	WIE	Brighton High School
10:25-11:10		Jackson HS	WIE	Brighton High School	ICHS/Eaton RESA
11:15-12:00		WIE	Brighton High School	ICHS/Eaton RESA	Jackson HS
12:15–12:30	Awards Ceremony (Everyone) 1345 Engineering Building, lunch at Brody immediately after the awards ceremony				

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

MEMBERS OF THE ORGANIZING COMMITTEE FOR HIGH SCHOOL INNOVATION & CREATVITY DAY: FALL 2019

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

Dean Buggia
Instructor and Technology Teacher, Okemos High School

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

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.

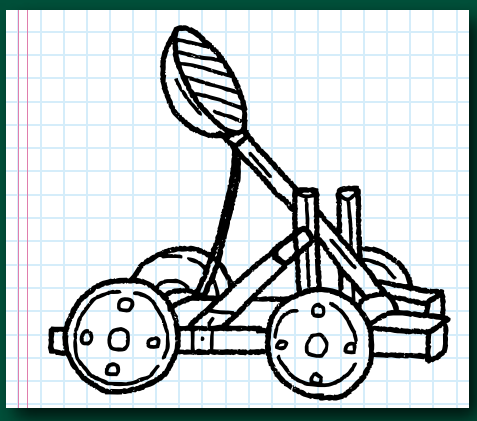
INTERDISCIPLINARY ENGINEERING BUILD

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.

TREBUCHET LAUNCH COMPETITION

The trebuchet activity at Design Day provides students with an opportunity to manipulate some of the parameters associated with launching a small projectile at a specific target. Using basic conservation of mechanical energy concepts from physics, student groups load a small, pre-made trebuchet with potential energy and release the device, transforming the stored energy into kinetic energy to throw the projectile. Students have control over the length of the throwing cord, the placement of the counterweights, and the pivot point on the throwing arm. The event is scored based on proximity to the target point.



High School Innovation and Creativity Day

K12 Awards Spring 2019

EGR 100, 3-D PRINTING, GROUP 1

Dr. Morgan taught EGR 100. Winning Group 1 was Cayla Coury, Emme Darkowski, Madison McMahan, and Madeline Stump, with Tim Hinds, the director of CoRe program

EGR 100, 3-D PRINTING, GROUP 2

EGR 100 Winning Group 2 was Olivia Bianchini, Avery Kohler, and R, with Dr. Morgan and Tim Hinds

ECE 480 DESIGN AWARD

Winning ECE 480 group members Zoinul Choudhury, Tejas Bharath, Josh Richter, Weston Shellhorn, Jiaran Ye, and Jake Aprilliano, with Dr. John Albrecht

MIDDLE SCHOOL BRIDGE BUILDING COMPETITION

Dean Buggia, Okemos HS Engineering and Technology teacher, with the Plainwell Middle School Bridge Building competition winners Logan Tungate, Luke Johnson, and Richard Ritzema

TREBUCHET DESIGN AND TOSS COMPETITION

Winners of the Trebuchet Design and Toss Competition from Scranton Middle School, Brighton: Liam Kinney, Dylan White, and Quinn Johnson

VEX ROBOTICS COMPETITON

Winners of the Vex Robotics Competition from Scranton Middle School, Brighton: Josh Hamilton, Tanner Perkins, and Aiden Babas

EGR 100 Introduction to Engineering Design

Dr. Jenahvive Morgan
Course Instructor

Course Project

EGR 100, Introduction to Engineering Design, is a college-level course required of all incoming first-year engineering students. It is an integral part of the CoRe (Cornerstone and Residential) Experience. The course introduces students to the engineering profession and the engineering design process through team-based, interdisciplinary design projects and assignments. There are 1034 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from seven project types: **(i) Solar Car Competition, (ii) Cell Phone App Inventor, (iii) Design of a Heat Exchanger, (iv) 3D Printing, (v) Arduino Programming, (vi) Costa Rica Design of a School Site and Educational Facility, and (vii) CoRe Industry-Sponsored Projects.** CoRe Industry-Sponsored Projects involved collaborations with ArcelorMittal on an optimal basic oxygen furnace steelmaking scrap mix design. Teams from each of the project types will display their prototypes at Design Day along with posters detailing their design concepts. Pre-college students will recognize the most outstanding projects with awards.

http://www.egr.msu.edu/core/

Spring 2019 EGR 100 Project Poster Award Winners:

l-r: Jenahvive Morgan, Madison Mcmahan, Cayla Coury, Emme Darkowski, Tim Hinds

l-r: Jenahvive Morgan, Rhett Pimentel, Avery Kohler, Olivia Bianchini, Michael Porcaro, Tim Hinds

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BRANCH LOCATIONS:

East Lansing	3777 West Road
	4825 E. Mt. Hope Road
	523 E. Grand River Avenue
	MSU Union, 49 Abbot Road Room 108
Lansing	104 S. Washington Square
	200 E. Jolly Road
	653 Migaldi Lane
	Sparrow Professional Building Suite 300
Haslett	16861 Marsh Road
Okemos	1775 Central Park Drive
	2300 Jolly Road
Mason	1133 S. Cedar Street
Charlotte	180 High Street
Auburn Hills	3265 Five Points Drive
Rochester	102 Oakland Center
Clarkston	8055 Ortonville Road
Ortonville	4 South Street
Grand Rapids	86 Monroe Center Street NW
Berkley	1833 Coolidge Hwy *(Coming December 2018)*

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The Capstone Projects

Mr. Anthony Ingle
Teaching Specialist

Faculty Advisors: Teaching Specialist Carlson
Professors Dargazany, Haider and Hashsham


Carlson


Dargazany


Haider


Hashsham

Presentation Schedule – Room 1225

Time	Team	Room
9:20 a.m.	Team 7 – Spartan Engineering Services	First Floor Room 1225 EB
10:40 a.m.	Team 6 – Mid-Michigan Associates	First Floor Room 1225 EB

Presentation Schedule – Room 1230

Time	Team	Room
8:00 a.m.	Team 5 – Capital City Consultants	First Floor Room 1230 EB
9:20 a.m.	Team 4 – Ingle SES	First Floor Room 1230 EB
10:40 a.m.	Team 3 – SBA Engineering	First Floor Room 1230 EB

Presentation Schedule – Room 1234

Time	Team	Room
9:20 a.m.	Team 2 – Civil Solutions	First Floor Room 1234 EB
10:40 a.m.	Team 1 – Capital City Contractors	First Floor Room 1234 EB

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, transportation, and structural 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

A GRAND NEW CROSSING

A community organized project has proposed a new pedestrian bridge crossing the Grand River in downtown Lansing. The bridge will link downtown with the Lansing River Trail and provide improved access to the Impression 5 Science Museum and RE Olds Transportation Museum. In addition, the city of Lansing will develop a pocket park and outdoor classroom on the east bank of the Grand River. This project demonstrates continued enhancement of pedestrian and non-motorized infrastructure leveraging the riverfront as a natural asset to the community. Figure 1 depicts the planned project vicinity as described.

The preliminary engineering design must identify infrastructure improvements necessary to procure this project for construction. In conjunction with this project, part of the Lansing Board of Water and Light water treatment plant is being evaluated for potential redevelopment into a craft brewery. The students evaluate the production capacity with regards to water use and wastewater production.

Fig. 1:
Aerial view of project site

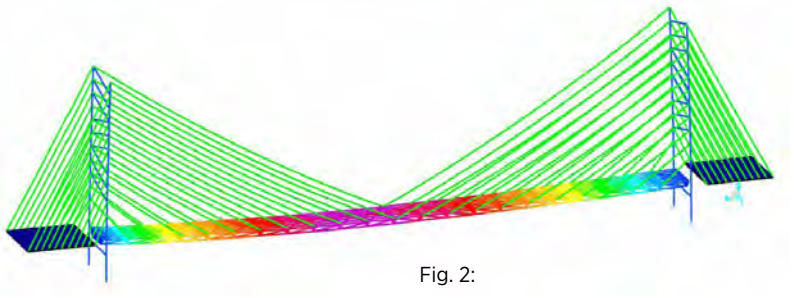


Fig. 2:
Cable stayed bridge 3D model

Fig. 3:
Example crossing along Okemos Road

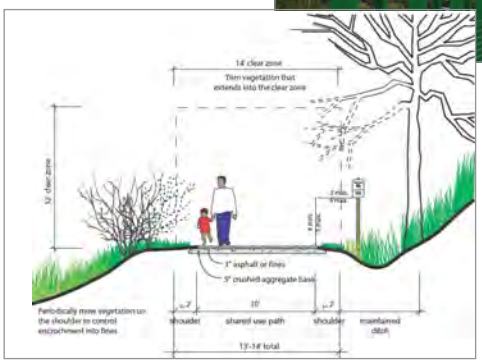
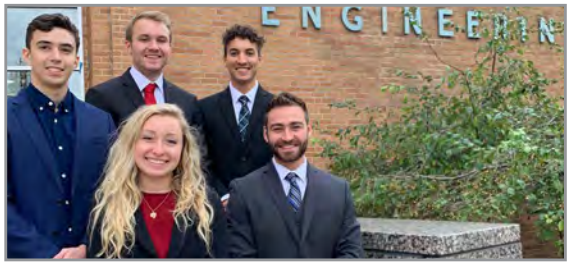


Fig. 4:
Pathway cross-section per AASHTO

Team 1: Capital City Contractors

Left to Right: Madelyn Hanton (H), Brady Veine (T), Masoud Alraqibah (P), Molly Ehasz (PM), Mitchell Murrell (E), Anne Heidelberg (P), Yin Liu (S)

Team 2: Civil Solutions



Back Row, Left to Right: Sergio Amaya (S), Andrew Banitt (E), Jerzy Kolanowski (P) **Front Row, Left to Right:** Amber Stanek (T), Shane Lampe (PM)

Team 3: SBA Engineering

Left to Right: Kristina Crimmins (H), Steven Andooparambil (P), Paige McClintock (PM), Jeffery Lorencen (E), Natasha Sonck (T), Rece Shankleton (S)

Team 4: Ingle SES

Left to Right: Danielle Marrone (E), Thomas Thibault (PM), Luke Daoust (P), William Schubert (H), Matthew Motz (T), Alexander Go (S)

Team 5: Capital City Consultants

Left to Right: Matthew Hadar (S), Eli Saffell (E), Peter Baker (H), Harry Julien (PM), Allison Hartman (T), Ashley Astor (P)

Team 6: Mid-Michigan Associates

Left to Right: Joao Almeida (E), Jack Puscas (P), Ana Butler-Telleria (E), Andrew Ellsworth (S), Isheanesu Chiswanda (S), Ethan Frakes (PM), Garrik Slawski (H), Garrett Preston (T)

Team 7: Spartan Engineering Services

Back Row, Left to Right: Ben Schafer (S), Colton Morrow (PM), Justice Bennett (T), Eric Metz (P) **Front Row, Left to Right:** Cait Campbell (E), Lilli Celovski (H)

Key to primary roles and responsibilities of each team member:

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

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Michele Buckler, P.E.
Detroit Diesel

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

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

Greg Losch, P.E.
Michigan Department of Transportation

Leanne Panduren, P.E.
Rowe Professional Services

Robert Rayl, P.E.
RS Engineering LLC

Charles Rolfe, P.E.
OHM Advisors

Scott Stowitts, P.E.
Barton Mallow

Dan Thome, P.E.
Nicholson

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

Brad Wieferich, P.E.
Michigan Department of Transportation

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.

Juan Alcantar
Michigan Department of Transportation

David Bluhm
Fleis & Vandenbrink

Rick Chelotti
Bergman Associates

Dan Christian
Tetra Tech MPS

Brian Davies
Hubbell, Roth & Clark

Tyler Dawson
NTH Consultants

Nathan Fettes
Michigan Department of Transportation

Andrew Granskog
U.S. Department of Agriculture

Matt Hill
WPS

Matt Junak
HNTB

Brandon Onan
Michigan Department of Environment, Great Lakes and Energy

Priyank Patel
Michigan Department of Environment, Great Lakes and Energy

Mario Quagliata
Bergman Associates

Lauren Roller
HED Development

Emily Schlanderer
Fishbeck, Thompson, Carr & Huber

Paul Stokes
City of East Lansing

Michael Thelen
Consumers Energy

Anthony Thomas
Soil & Materials Engineers

Phil Vogelsang
AECOM

Jon Ward
Rowe Professional Services

Emily Warners
Consumers Energy

Design Day Awards Spring 2019

Rolla C. Carpenter Senior Design Award

The Rolla C. Carpenter Senior Design Award ($600 and medals) 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 in 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, Thompson, Carr & Huber, Inc. (FTC&H) and Barr Engineering Co.

Rolla C. Carpenter Senior Design Award Winners, Spring 2019

Team 3: G.S. LAND Associates

Left to right: Liam Dwyer, Neil Guest, Abrar Aldhamen, Michael Ridley, Sydney Garner, Garet Rice, Alexandra Fischer, Daniel Hong

Computer Science and Engineering

Capstone Course Sponsors

We thank the following companies for their generous support of the computer science capstone course.

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Sunnyvale, California

technology services group
Chicago, Illinois

TechSmith
Okemos, Michigan

Union Pacific
Omaha, Nebraska & Okemos, Michigan

UNITED
Chicago, Illinois

URBAN SCIENCE
Detroit, Michigan

Vectorform
Royal Oak, Michigan

Volkswagen
Auburn Hills, Michigan

yello
Chicago, Illinois

The Capstone Projects

8:00 a.m. — Noon | Engineering Building | 1300 Hallway | First Floor

Dr. Wayne Dyksen
Professor of Computer Science and Engineering

Ryan Johnson

James Mariani

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 Accenture, Amazon, AppDynamics, Aptiv, Auto-Owners Insurance, Bosch, Dow, Evolutio, Ford, General Motors, Google, Harvard Law School, Herman Miller, Learning A-Z, Meijer, Michael Sadler Foundation, Michigan State University, Microsoft, Mozilla, MSU Federal Credit Union, Principal Financial Group, Proofpoint, Quicken Loans, Spectrum Health, Surge Solutions, Technology Services Group, TechSmith, Union Pacific, United Airlines, Urban Science, Vectorform, Volkswagen and Yello.

Accenture
Email Classification Using Machine Learning

Accenture is a Fortune Global 500 company that solves their clients' toughest challenges by providing services in strategy, consulting, digital, technology and operations. Accenture's iDefense provides contextual, timely and actionable security intelligence to the largest governments and organizations in the world, enabling them to make smarter decisions to defend against new and evolving threats.

Spam emails are a growing issue for many companies. According to SpamHaus, 14.5 billion spam emails are sent globally every day, accounting for nearly 45% of all emails sent. Spam emails can range from mild annoyance to exceedingly dangerous, possibly containing potent computer viruses and malware.

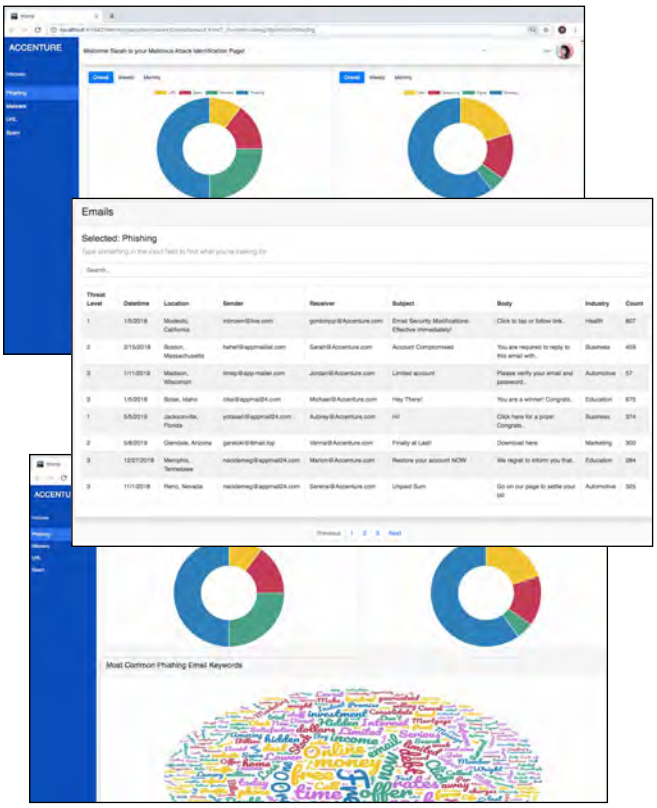
Due to the increased sophistication of spam emails, it is becoming more and more challenging for companies and employees to determine the legitimacy of their email messages. Any mistake by an employee can lead to a serious security breach.

Our Email Classification application utilizes machine learning and natural language processing algorithms to automatically classify and categorize incoming emails based solely on their content, thereby quickly and easily identifying spam emails.

Without the threat of malicious spam emails, employees and companies can more safely and securely manage their emails without worrying about potential security threats.

Administrators and security analysts from Accenture's client companies also have access to our web dashboard which enables them to easily view metrics and statistics of their email systems.

Our Email Classification Using Machine Learning system is hosted on a virtual machine running CentOS. Our web app is built using Flask and Bootstrap. Our data is stored in a Mongo database.



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Amazon
SPARTI: Selling Partner Application Ready to Integrate

Founded in 1994 as an online bookstore, Amazon is the largest online retailer in the world. Amazon has seen tremendous growth and success, making history by becoming the second U.S. company to be valued at $1 trillion. A key factor in Amazon's rise to the top is their e-commerce platform, which accounted for nearly 50% of all online retail purchases last year.

Today, more than half of the items sold on Amazon are managed and listed by third-party sellers. Amazon third-party sellers utilize the Amazon Seller Central portal to manually manage their listings and inventories on Amazon's platform. While the Seller Central site works well for small businesses, manual management becomes close to impossible for large and growing businesses.

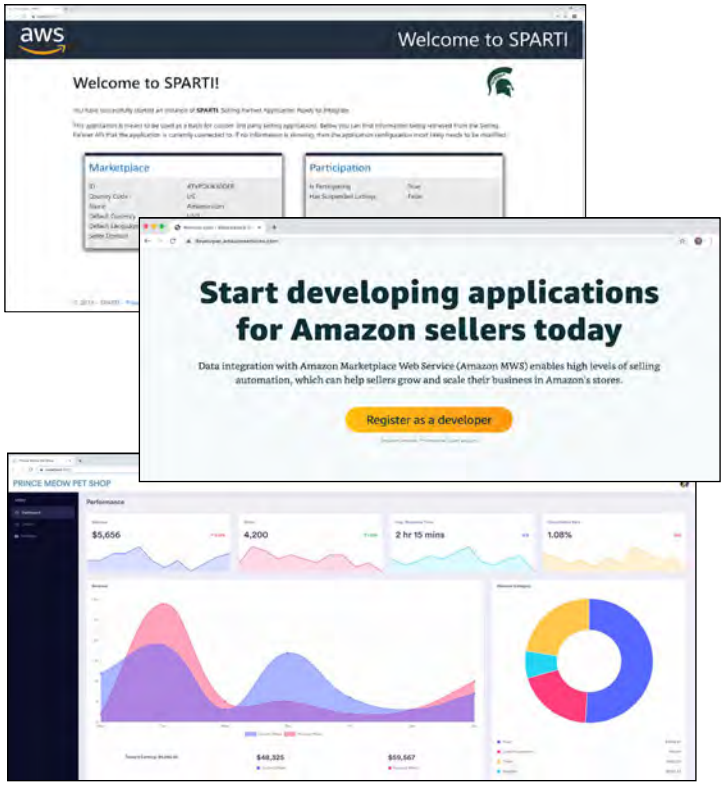
Third-party sellers often create custom selling management applications. However, the process of creating these custom applications is often too difficult or overly time-consuming.

Our SPARTI application (Selling Partner Application Ready to Integrate) enables Amazon's third-party sellers to quickly and easily create custom selling management applications.

SPARTI provides users with a template application capable of fully connecting with Amazon's seller services. To deploy their custom site, a third-party seller merely needs to update the given template code with their own information.

Turnkey integration with Amazon Web Services (AWS) is also supported within SPARTI, giving third-party sellers the ability to automatically deploy and host their applications in the cloud.

Within the course of a day, a third-party seller is able to utilize the SPARTI project to build a containerized .NET application hosted on AWS ECS Fargate. The infrastructure for the application is instantiated by AWS CloudFormation.



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AppDynamics
BizIQ Flow Map Using Sequential Analytics Data

Acquired by Cisco for 3.7 billion dollars, AppDynamics offers Application Performance Management (APM) solutions to their customers. These APM solutions monitor customers' application stacks and give them flawless experiences.

Currently, customers have access to linear flow map representations of individual applications. However, customers cannot represent business transactions that branch in multiple directions and across multiple application stacks.

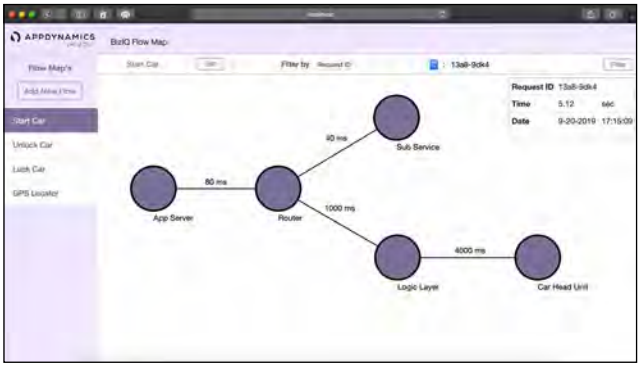
BizIQ Flow Map Using Sequential Analytics Data augments AppDynamics' current offerings by allowing customers to represent multi-branch and multi-application business transactions. It enables users to create custom flow maps representing the various transactions and save the flow for viewing and editing purposes.

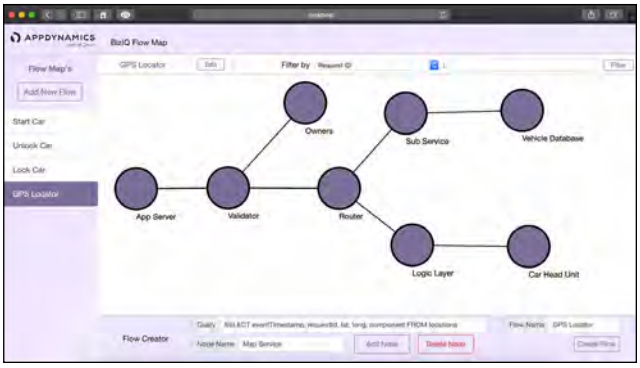
Flows are easily analyzed. The user sees the average time it takes for a particular business transaction to occur and the flow can be filtered to show specific instances.

Consider the manager of a car manufacturer. The manager is assessing the time it takes for a customer to unlock their car door using an app on their cell phone. When a user unlocks their car with the mobile app, events are collected and sent to a central interface.

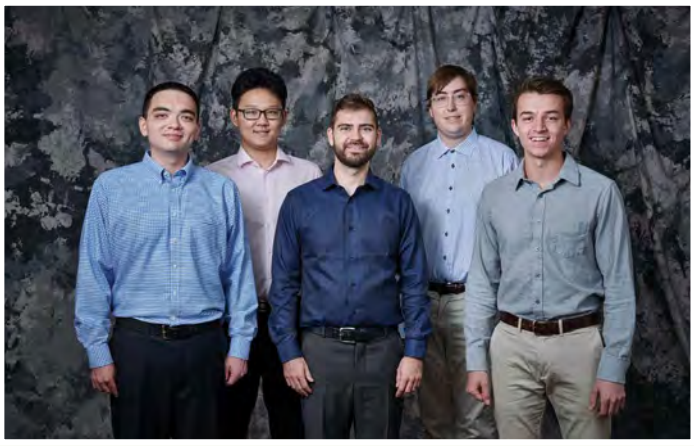
These various events are connected to create a flow map. If there is an issue with the amount of time elapsed after the user unlocks their car, the manager sees this in the flow map. For example, if verification usually takes one second and the flow shows it took five seconds, a potential problem may be impacting this user. The flow map generated by BizIQ Flow Map Using Sequential Analytics Data alerts the manager to this potential problem.

BizIQ Flow Map Using Sequential Analytics Data is created using Node.js and utilizes the AppDynamics Analytics API to acquire data. The visuals of the project are created using d3.js, React and CSS.





APPDYNAMICS



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Auto-Owners Insurance
"Danger Diner" VR Training

Auto-Owners Insurance is a Fortune 500 company that provides home, life, automobile, and business insurance to over 3 million policy holders. With over 47,000 independent agents, Auto-Owners has been serving the community since 1916.

Auto-Owners insures businesses throughout the Midwest. Therefore, recognizing good and bad safety practices is an essential skill for their insurers.

The best way to learn the principles of good or bad business practice is real-world experience. However, this can be prohibitively expensive and time-consuming.

Our "Danger Diner" VR Training is a competitive virtual reality game designed to teach Auto-Owners insurers to identify good and bad safety practices. Insurers learn in an immersive and interactive way providing them with a realistic experience.

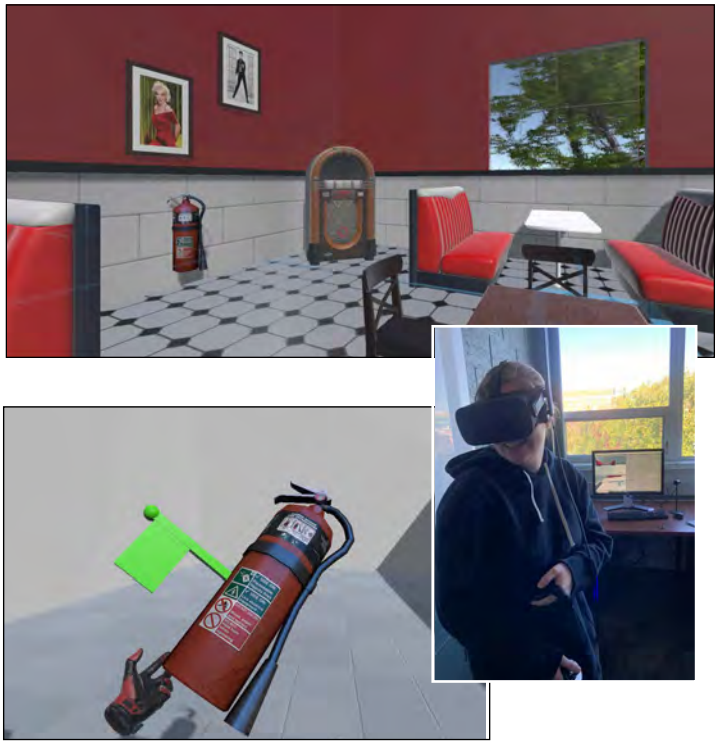
Using an Oculus Rift headset, Touch controllers and sensors, insurers explore a virtual restaurant. A player is tasked with identifying potential safety and hazard items throughout the scene. Players are educated about business safety with a simulation of a realistic, everyday restaurant.

Each round features a unique selection of items. All item locations are randomly generated, ensuring that no two game sessions are the same.

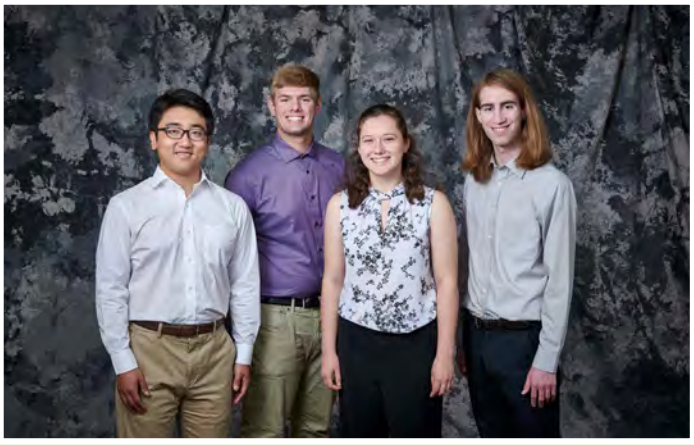
To give our game a competitive feel, the scores are recorded and displayed on a leaderboard.

"Danger Diner" helps new insurers get hands-on training with no setup or expense and can also be played with large groups for training seminars and meetings.

"Danger Diner" is built using the Unity Game Engine. The game is played using an Oculus Rift headset, Oculus Touch controllers, Oculus sensors, and the SteamVR application.



Auto-Owners INSURANCE
LIFE • HOME • CAR • BUSINESS



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Bosch
Integration and Testing Suite for ADAS Radar Sensors

Founded in 1886 by Robert Bosch, Bosch is an engineering and electronics company with products sold in 150 countries worldwide. In addition to its industrial and building lines of products, Bosch is the world's leading supplier of automotive components.

Bosch develops sophisticated radar software for use in driver assistance systems. These radars are used to detect and identify obstacles and hazards on the road. Based on the output of the software, cars can notify drivers of hazards, and even automatically brake to avoid a collision.

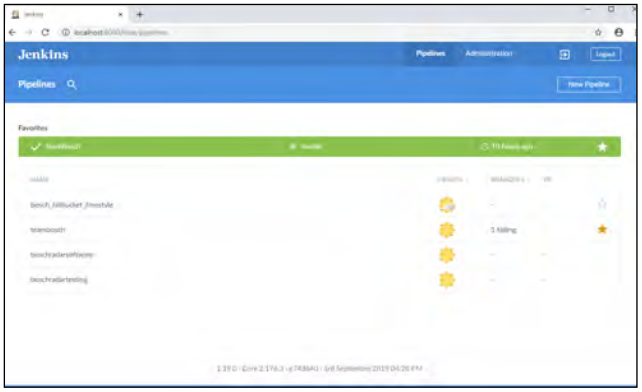
Every configuration of radar and hardware requires a unique software system. Consequently, each configuration also needs a unique testing and deployment system. The testing and deployment of Bosch's radar software is currently done manually, requiring significant investment of time and money.

Our Integration and Testing Suite for ADAS Radar Sensors automates the testing and deployment of Bosch's radar software. Whenever an engineer updates their code, the resulting software undergoes extensive automatic testing. This testing verifies that any updated software does not compromise the radars or their functionality.

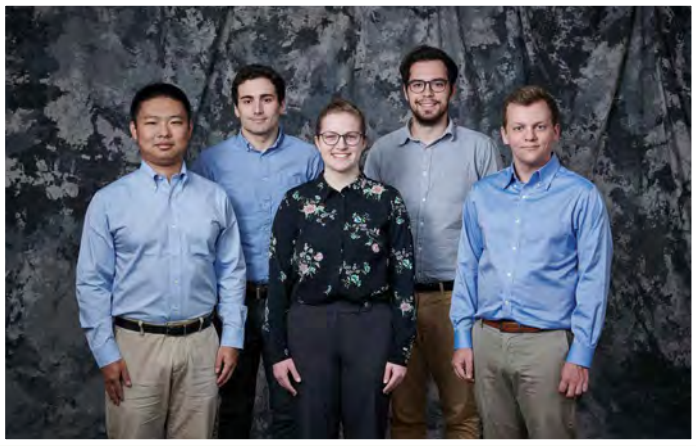
Automatic deployment and testing enable Bosch's developers to quickly identify malfunctioning software, patch any software bugs, and avoid introducing any new errors.

Our Integration and Testing Suite frees engineers to focus on implementing new features without the concern of errors, instead of manually running tests.

Automated flashing and testing use Jenkins. Flashing is communicated using CANape and CANalyzer. This provides functionality so that when a Bosch engineer changes the software in Bitbucket, a Jenkins job then starts and tests the software.



BOSCH
Invented for life



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The Dow Chemical Company
3D Product Showcase Application

With over a century of experience, Michigan-based Dow is a global leader in the innovation, creation, and distribution of specialty chemicals, advanced materials and plastics.

As a materials science company, Dow uses augmented reality applications to assist with marketing. Augmented reality is a technology that places a virtual object in the user's view of the real world (see image to the right). At trade shows, these augmented reality applications demonstrate the value of Dow's materials by providing interactive 3D models of their clients' products.

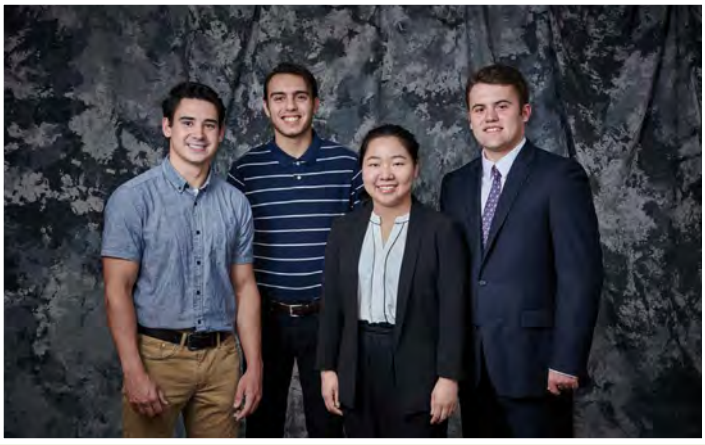
For each product, a new application must be created, or an old application must be manually updated. Dow's product catalog is continually expanding, requiring a significant time commitment on the part of Dow engineers.

Our 3D Product Showcase Application provides a standard platform for augmented reality experience creation. Customers can now use one application to view any of Dow's clients' products.

Viewing the world through a smartphone's camera and screen, Dow customers can view and interact with 3D product models as if they exist in the space around them. Users can place a product on any visible surface, allowing for easy customization and visualization through tapping interactive regions around the model.

Utilizing our platform, Dow engineers and sales teams can easily and quickly develop new augmented reality experiences. Dow customers can now navigate one application for all Dow products, as opposed to learning a new application for each product.

The 3D Product Showcase Application stores product information and models in an SQL database in the Microsoft Azure cloud. The front end is implemented in C# using the Unity Game Engine and the AR Foundation framework for augmented reality. Our application supports both iOS and Android devices.



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Evolutio
ERP Air Force: Drone Elephant Recognition and Tracking

Evolutio is a group of technology professionals convinced that business problems have significantly simpler solutions than the market is led to believe. These solutions span across the globe, including the non-profit Elephants, Rhinos, and People (ERP), a group founded to preserve and protect Southern Africa's wild elephants and rhinos.

As part of their initiative to preserve and protect elephants, ERP uses drones, or Unmanned Aerial Vehicles (UAVs), to monitor elephants on Dinokeng Reserve in South Africa.

Drone operation, however, is costly and time-consuming. Elephants are seldom captured in drone footage and, when present, are difficult to spot. Video data collected from drone flights require manually analyzing hours of uninformative footage to find the few video frames that contain footage of elephants.

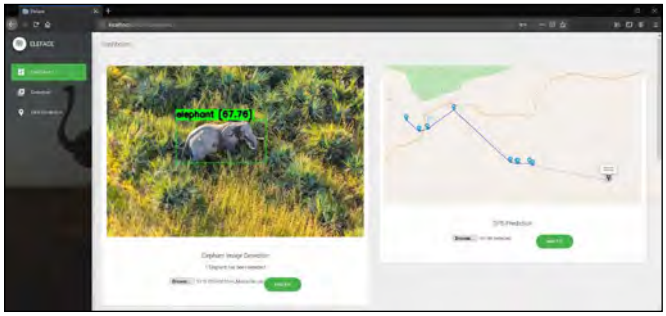
Our Drone Elephant Recognition and Tracking application serves two main functions: elephant recognition and predictive elephant tracking.

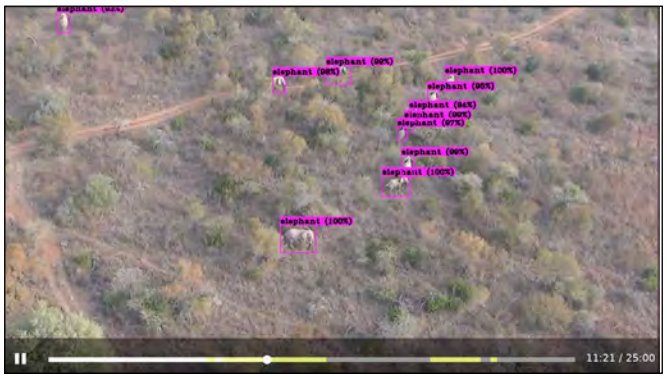
Elephant recognition specifies where and when in the hours of drone footage elephants are present (shown on the right). Our automatic elephant recognition removes the need to manually analyze video footage, saving ERP hundreds of man hours.

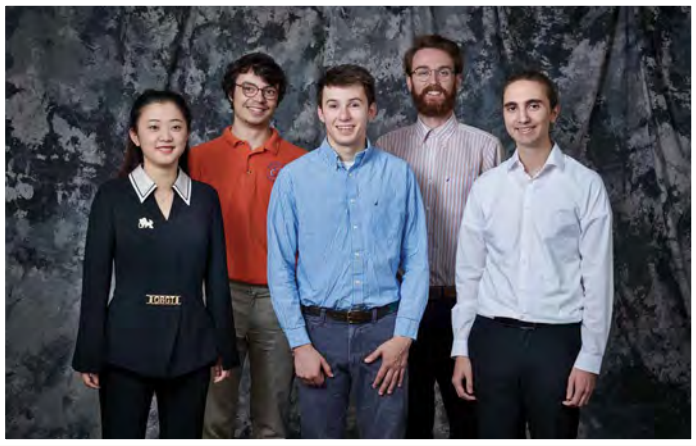
Elephant predictive tracking predicts potential future elephant locations. Predictive tracking allows pilots to create flight paths that maximize the chance of flying over elephants, allows rangers to be deployed to the correct location for checkups or, in the case of an active poacher situation, to confront the poacher.

ERP personnel use our web dashboard to view video footage, as well as the results of our Elephant Recognition and Tracking.

The web dashboard is built with VueJS interfacing with a Python Flask RESTful API. Detection of elephants uses a YOLOv3 model. A Recurrent Neural Network uses GPS collars to predict elephant movement.







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Ford Motor Company
Ford Mobility Product Metrics

Ford Motor Company is an international automotive manufacturer based in Dearborn, Michigan. Ford employs nearly 200,000 people worldwide and is currently ranked among the top ten automobile companies in the world.

The car buying experience is becoming more and more digital as consumers are buying cars online in record numbers, spending about 60% of their time online. Ford embraces this reality and offers customers top-class online shopping experiences.

To keep their websites running smoothly, Ford's employees need to closely monitor the health of their websites to ensure excellent customer service, which can be time-consuming.

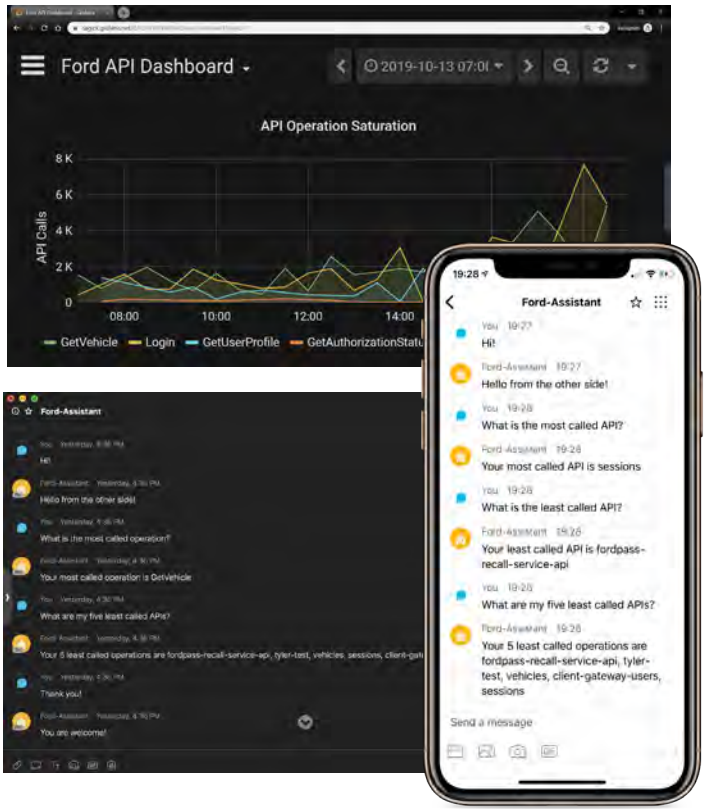
Our Ford Mobility Product Metrics platform includes intuitive, mobile, and easy-to-use chatbots, as well as a web metrics dashboard.

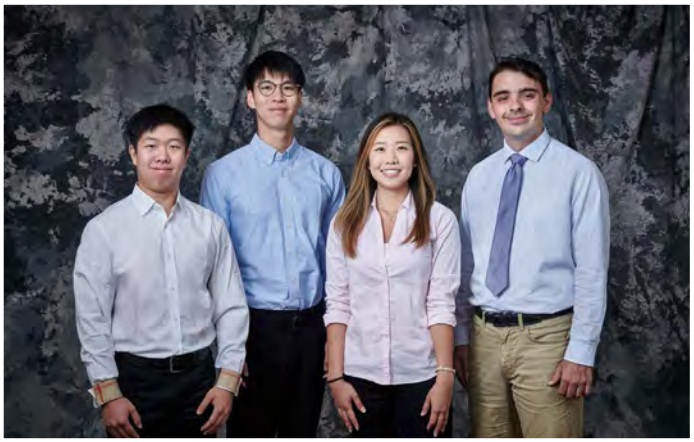
Ford's employees can ask our chatbots for information on a variety of topics, including Ford's software products, as well as website user metrics. Employees can also schedule regular report generation using our chatbots to stay up to date on the health and overall performance of Ford's websites.

Our chatbots give Ford's employees the ability to easily and quickly analyze the performance of Ford's websites and software. For a more comprehensive view, employees can use our web dashboard.

When a customer visits any of Ford's websites, their behavior is monitored and stored. Our web dashboard allows Ford's employees to view and analyze user behavior to monitor the success and health of Ford's websites and software.

Our Node.js chatbots serve Slack and Webex Teams applications. The data is collected from Ford's Azure Log Analytics API and a MySQL database. The dashboard is created with Grafana.





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General Motors
Profiling Manufacturing Plant Computer Network Traffic

General Motors is one of the world's foremost designers and manufacturers of cars and trucks, which are sold in more than 125 countries. Headquartered in Detroit, GM operates almost 400 facilities on six continents.

The Internet of Things is an up-and-coming computer networking and data collection paradigm that utilizes many individual computers all working together towards a single goal.

GM's manufacturing plants use the Internet of Things to increase efficiency and reduce errors in their manufacturing processes.

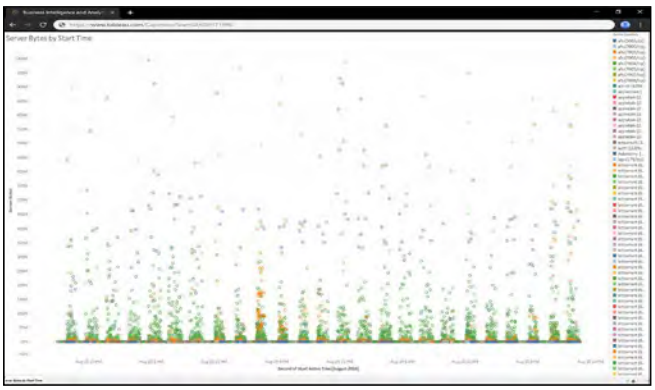
To protect their Internet of Things network, GM employs extensive real-time monitoring to alert them of any security threats or network malfunctions. As the Internet of Things network grows, the overhead of real-time monitoring increases, necessitating maximum efficiency.

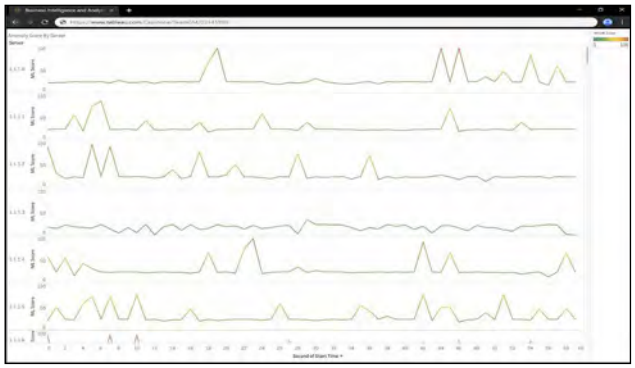
Our tools for Profiling Manufacturing Plant Computer Network Traffic utilize machine learning techniques to efficiently identify potential network anomalies in GM's manufacturing plants. Users can view the data and results of our monitoring in a web dashboard.

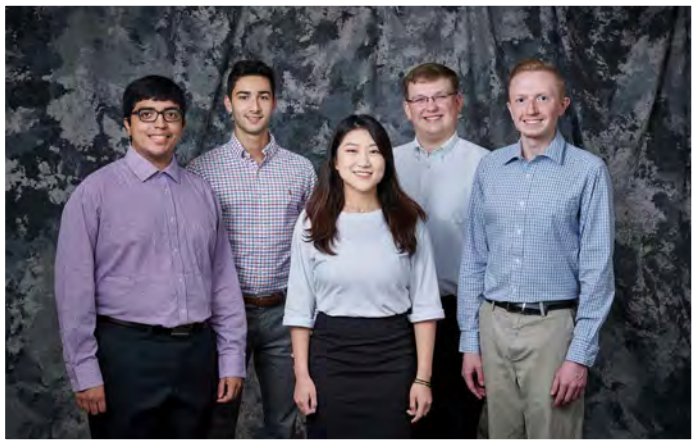
GM's security analysts use our web dashboard to monitor and visualize the performance of the Internet of Things network. Any detected anomalies are ranked with a severity score, allowing the security analysts to solve the highest priority threats as soon as possible.

Our tools allow GM's Internet of Things network to grow without sacrificing security or introducing expensive overhead.

Network flow data is stored in a MySQL database and our machine learning models are implemented in Python. These models are trained with network logs collected from multiple GM manufacturing plants. Users can interact with the system via a Tableau dashboard.







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Harvard Law School
"StackLife" Library Search and Display Tool

Founded in 1837, Harvard Law School is the oldest law school operating in the United States. Consistently ranked as one of the top universities in the world, an average of 560 students enroll in Harvard's prestigious law program each year.

The media presence surrounding Islamic news, policy, and debate makes easily accessing the millions of surviving Islamic/Sharia documents more important than ever.

Harvard Law School wants to consolidate the world's information on Islamic law and history with the hope of facilitating universal access.

Harvard Library currently has cataloged records from multiple data sources. Some of this data is inaccurate or misplaced, causing the information to be difficult, even impossible, to access.

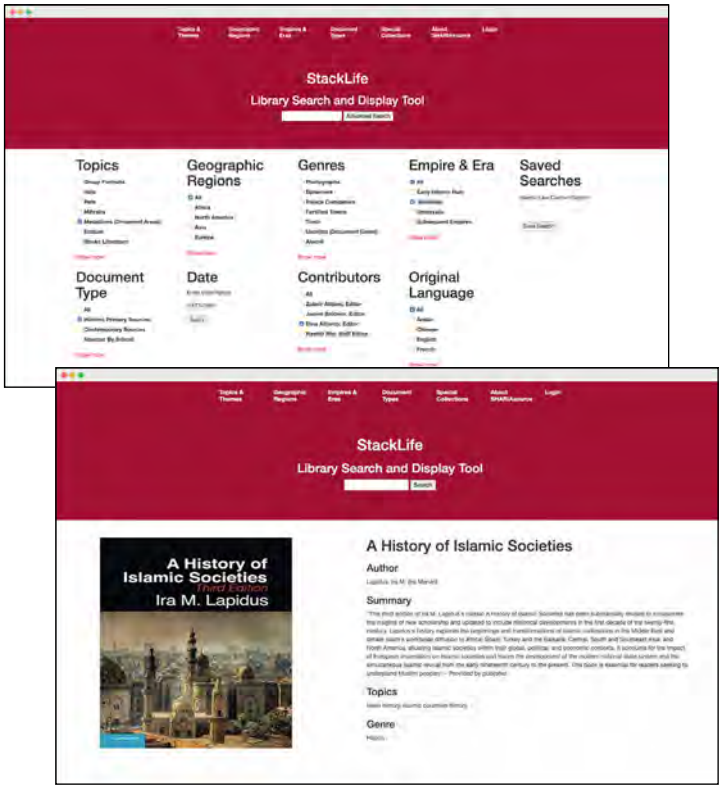
Our "StackLife" Library Search and Display Tool consolidates the data from Harvard Library and stores it in one, easily accessible location.

Consolidating data not only allows for easier access, but also helps to remove inconsistencies and inaccuracies that may exist between multiple data sets.

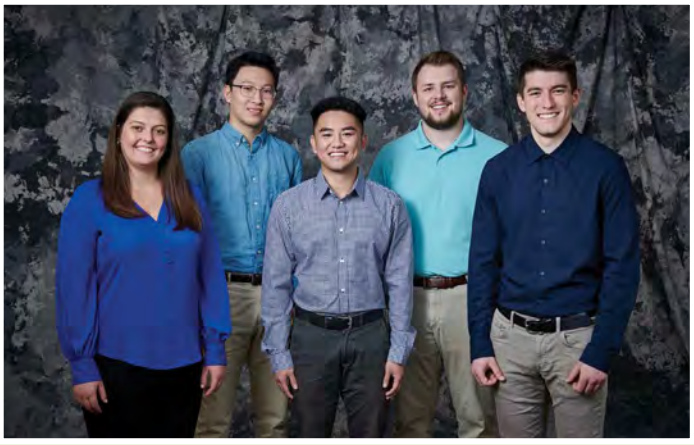
Researchers use our website to customize searches to locate sources as well as save their searches, allowing seamless repeated querying.

As more users search for sources, our specialized search algorithm continuously improves the research experience, placing more relevant resources first.

Our application is built using Bootstrap and Python Flask and is contained within Docker. We are using Amazon Web Services to create a relational database server with MySQL 8.0.



HARVARD
LAW SCHOOL



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Herman Miller
Computer Vision for Furniture Manufacturing

Headquartered in Zeeland, Michigan, Herman Miller is one of the world's largest producers of high-end office furnishings. The company's ergonomic office chairs are used in modern workspaces around the globe.

Herman Miller provides a wide array of customization and configuration options for each piece of furniture, including an extensive catalog of over 30,000 fabrics.

Every individual piece of fabric used in a product undergoes extensive human verification to ensure the correct fabric is used and no defects are present. Some fabrics, however, are very similar, with differences scarcely visible to the human eye.

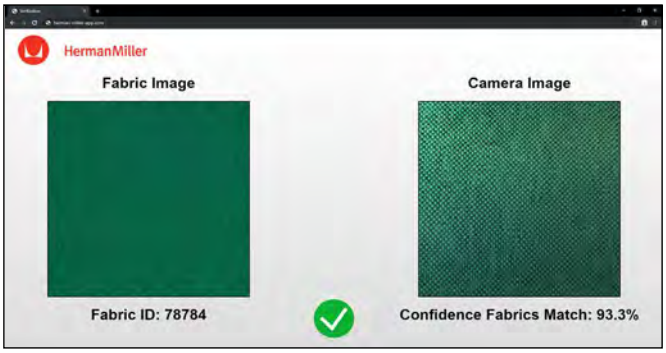
Our Computer Vision for Furniture Manufacturing system utilizes machine learning to verify fabric color and pattern on each piece of furniture that passes through the assembly line.

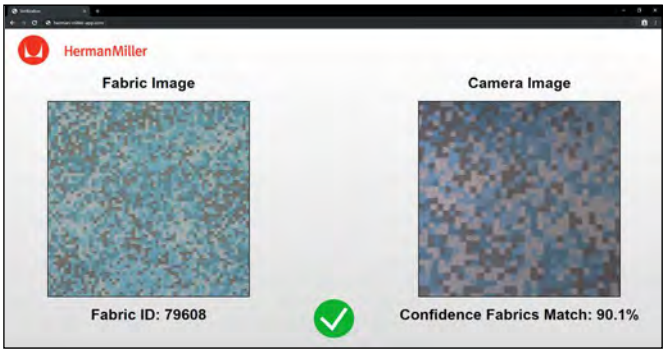
First, Herman Miller's entire fabric catalog is analyzed to enable our system to know what fabrics are available.

When a panel passes through the assembly line, a barcode is scanned, processed, and an image of the furniture is taken and sent to our system. This barcode indicates what fabric should be present. If there is an error, the fabric and the barcode will not match.

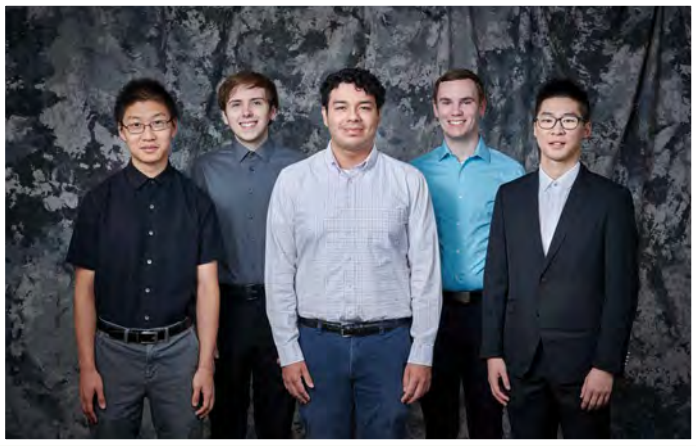
The verification results are displayed for Herman Miller operators on our web dashboard. If an error is detected, the operator can rectify the problem before the product is shipped. Our system removes human errors that might occur from similar looking fabrics.

The Computer Vision for Furniture Manufacturing system uses Tensorflow and SageMaker to handle color and pattern verification. Flask, which is hosted on Amazon Web Services, provides a web interface to display verification results. A Raspberry Pi, barcode scanner, camera, and a light system are used to take consistent photographs on the assembly line and upload them to Amazon Web Services for analysis and verification.





HermanMiller



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Learning A-Z
Robot Builder Word Guessing Game

Founded in 2002, Learning A-Z is an education technology company dedicated to expanding literacy through an extensive collection of thoughtfully designed tools and resources. With nearly 8 million active students, Learning A-Z seeks to provide students with the 21st century skills they need to excel in the classroom and beyond.

Learning A-Z currently offers an extensive suite of educational resources. Students use Learning A-Z's software for a multitude of subjects and lessons and therefore are familiar with the content and style. When a new resource is added, students waste less time learning the software and more time learning the material.

Our Robot Builder Word Guessing Game provides a personalized vocabulary learning experience for students. The game is designed with Learning A-Z's style and content, allowing students to focus on learning vocabulary.

When a game is started, a word is chosen at random and an outline of the robot shape appears.

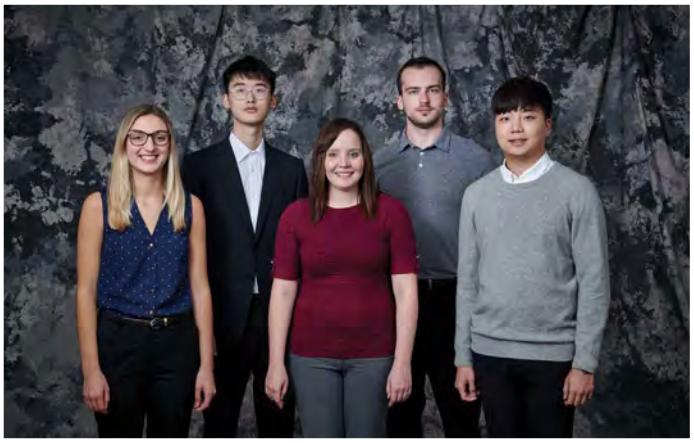
If the student chooses a correct letter, it appears in the word and a robot part is displayed (see image to the right). If the student completes the word, they are awarded a number of stars, which is the common currency for the Learning A-Z software.

Upon completing the word, students are given the option of entering a bonus round where they choose the definition of the word that was presented.

Based on previous results, words are chosen to best match the skill level of each individual player. If a student struggles with a particular word or set of words, our system exposes them to more words of the same difficulty.

Our Robot Builder Word Guessing Game is developed using Angular for the front end and Swift for iOS platforms. It communicates with our MySQL database using PHP.

Learning A–Z



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Meijer
Creating Picking and Fulfillment Efficiency

Meijer, one of the country's largest supercenter chains, provides high quality groceries and merchandise to several states across the Midwest United States. Meijer has over 240 stores, 77,000 team members and is continuously improving today's shopping experience with cutting-edge technology like curbside pickup and online grocery ordering.

Third-party shopping services enable customers to order groceries online. A professional shopper then does the shopping for them and delivers the groceries directly to the customer's home.

The satisfaction of both the customer and the professional shopper is directly related to the speed of the overall delivery. If the professional shopper does not know the layout of a store, or chooses a non-optimal path, the order picking duration will increase.

Our Creating Picking and Fulfillment Efficiency system calculates the optimal path through Meijer supercenters to increase the efficiency of professional shoppers. Faster delivery leaves the customer satisfied, and allows the professional shopper to fulfill more orders, thereby increasing their profits.

Customers place orders online, which are then accepted by professional shoppers. The shoppers fulfill these orders by picking up the items a customer has ordered. Our application, running on Android and iOS devices, uses a sophisticated pathfinding algorithm to determine the optimal route to each item on the shopping list.

Our pathfinding algorithm is generalizable and can be used in any Meijer store. Also, our algorithm takes into consideration factors such as frozen and perishable items that need to be picked up at the end of the shopping trip.

The Android and iOS apps are written in C# and XAML using cross-platform interfaces created with Xamarin.Forms. These apps make requests to a SQL server database hosted in a Microsoft Azure Cloud environment via a .NET Framework API.

meijer®

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Michael Sadler Foundation
GameChang3rs Learning Management System

The mission of the Michael Sadler Foundation is to inspire and empower students in building their personal legacies. The foundation uses six pillars of character as stepping stones for this growth, and does so with the GameChang3rs Program.

GameChang3rs is a program to give students tools that will help them develop strong character, make good choices, and become socially and emotionally engaged. GameChang3rs student ambassadors are volunteer high school students who teach and mentor elementary school students.

As the foundation expands, organizing and analyzing the accrued data becomes challenging and complex. Current data analysis and organization exists in Excel spreadsheets and paper.

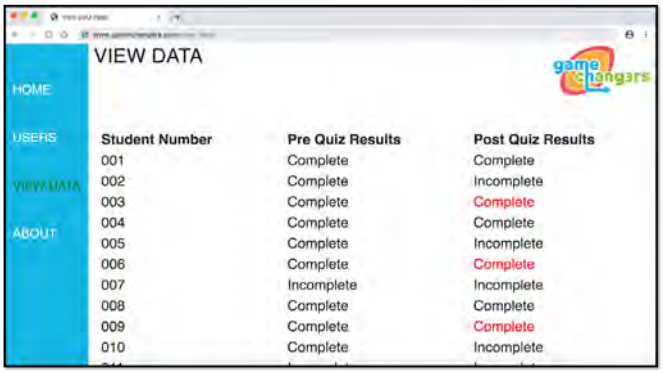
Our GameChang3rs Learning Management System helps to automate and digitize this process. Our web application allows administrators to manage staff and training material, as well as collect student metrics on the effectiveness of different lessons and initiatives.

Used by administrators, student ambassadors, and foundation sponsors, our application is a hub for all foundation materials, including lessons, quizzes and presentations.

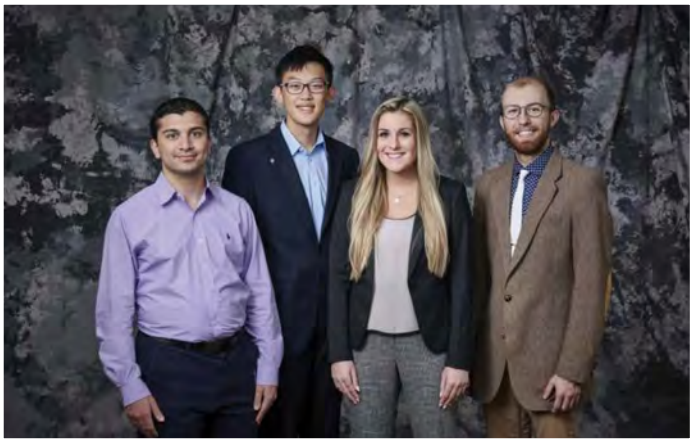
Google applications, which are used for presentations, videos, and quizzes, are fully embedded in our site, ensuring that GameChang3rs members can access all of their data and materials in one convenient application.

With the end goal of rapid expansion, our Learning Management System is designed to be fully scalable to include more ambassadors, schools, and even organizations in the future.

The Gamechang3rs Learning Management System front end is built using JavaScript, HTML and Bootstrap. The back end uses PHP and is hosted on Amazon Web Services through AWS Elastic Beanstalk.



MICHAEL SADLER FOUNDATION™
Empowering Today's Game Changers to Become Tomorrow's Leaders™



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Michigan State University ITS
Spotlight: Discovering Clubs and Student Organizations

The nation's pioneer land-grant university, Michigan State University (MSU) is one of the top research universities in the world. In addition to nationally ranked and recognized academic programs, there are over 900 registered student clubs.

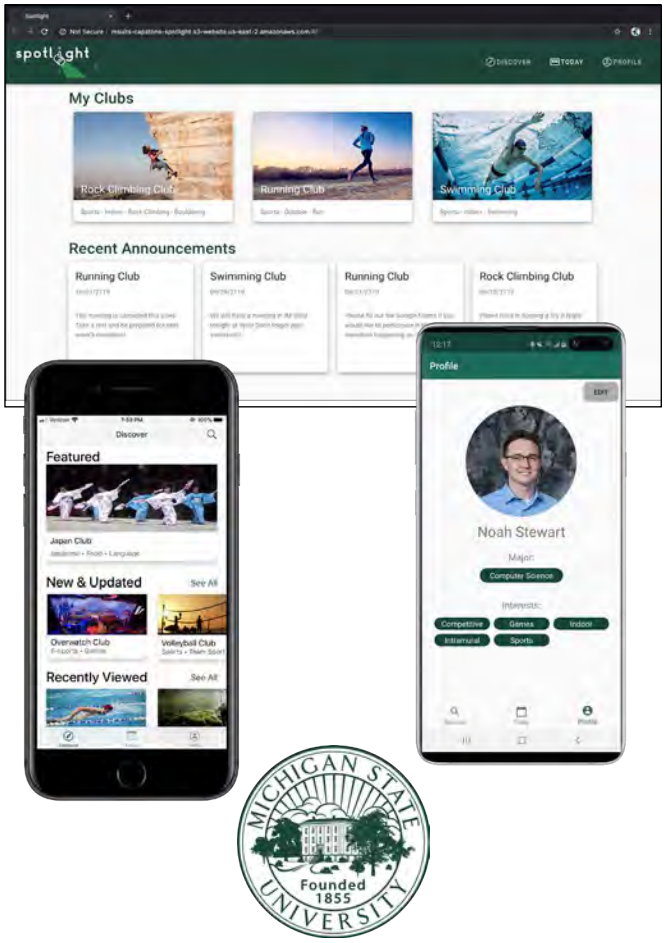
Among the 50,000 students on campus, around 9,000 are first-year students. Many join clubs to find friends and de-stress from school activities, but identifying interesting clubs is a challenge. Research has shown that students who take part in campus activities are happier, healthier and have better grades. This is why MSU ITS, MSU's primary IT division, is committed to helping students find clubs with Spotlight. Spotlight is a mobile app and website that suggests clubs and events to students. Unlike mass emails and fliers, Spotlight is tailored to the students' specific interests, allowing them to pinpoint clubs they want to join.

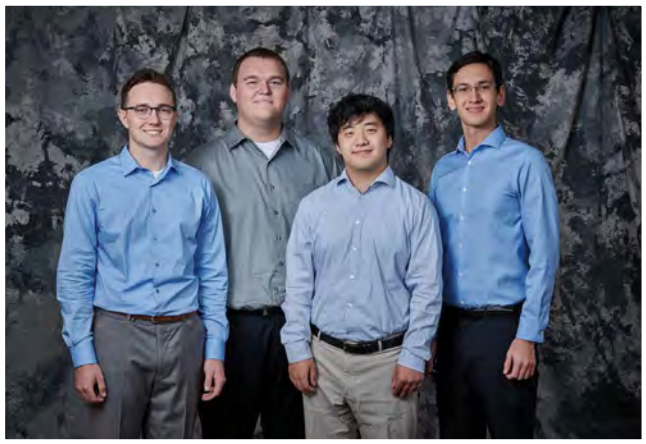
Students using Spotlight input their general interests upon first using our application. Spotlight then provides students with club and event recommendations based on these interests, as well as shared interests with similar students.

When searching for events, students have many options. If proximity is important, a map view of campus shows nearby events for students to attend and provides directions to get there safely.

If a student has a busy schedule, time of day might be more important than location. Spotlight allows users to filter events by meeting time in addition to location, member count and other characteristics on the Discover Page (shown on the right).

Spotlight's personalized home view (shown on the right) provides an updated feed of announcements and information from joined clubs. Spotlight is developed with Swift for iOS, Kotlin for Android and Vue.js for Web. The AWS Lambda API is written in Node.js and uses MySQL as the underlying database.





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Microsoft
ITPro Company Portal

Microsoft is a longtime leader in the technology industry, providing enterprises with a comprehensive suite of software solutions created to drive productivity.

As the world evolves technologically, more and more people are using their personal mobile devices to perform company work, both inside and outside of the office. This allows for more flexibility and productivity for employees, and lowers the hardware costs for companies.

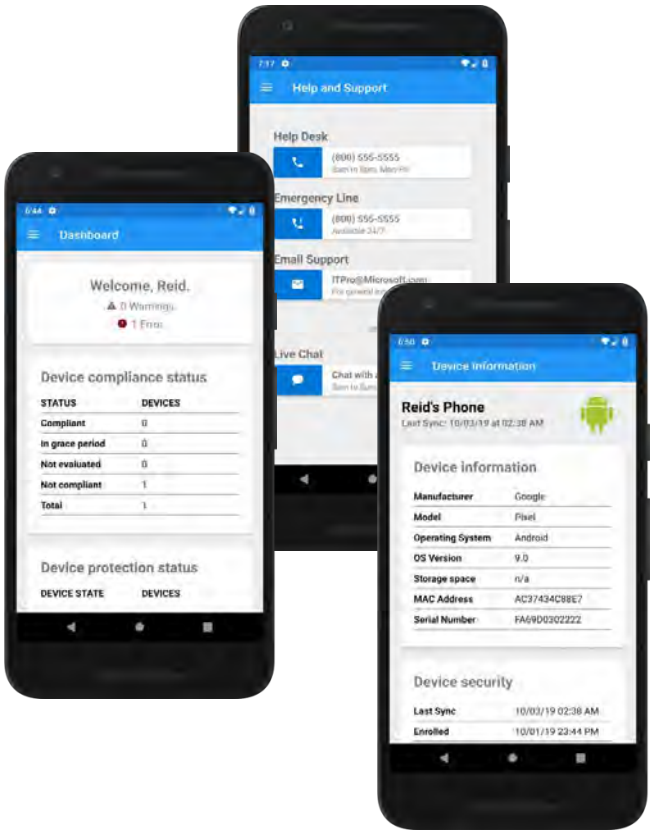
However, as more personal devices connect to corporate networks, it becomes important to keep corporate information safe from unwanted access and malicious attacks.

Our ITPro Company Portal is a system that enables information technology (IT) administrators to ensure that all company employees' personal mobile devices are both secure and reliable.

Prior to using one's personal mobile device for work, the user downloads the ITPro app, which allows an IT professional to check that it is indeed secure and reliable. ITPro does so with very limited access, which maintains an employee's personal privacy and complete control over their device's non-work information. Our application comes with a variety of features for the user such as status updates on the system, policy creation, and user control.

Using ITPro, IT administrators can be confident that all mobile devices company-wide are compliant with corporate security and reliability policies. And, since ITPro itself is a mobile cross-platform app that supports Google Android, Apple iOS, and Microsoft Windows devices, administrators can do so using any device, from anywhere in the world, at any time.

Our ITPro Company Portal app is written in C# using the Xamarin framework within Microsoft Visual Studio. It communicates with Intune via the Microsoft Graph API.



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Mozilla Corporation
Splitting the Atom. Again.

Mozilla is a global, nonprofit organization dedicated to improving the World Wide Web. Mozilla places a strong focus on open-source projects that prioritize the privacy and security of its users. Mozilla's most popular project, Firefox, is the second most used desktop browser, serving over 250 million users worldwide.

Recently discovered security vulnerabilities, "Spectre" and "Meltdown," have reiterated the need for computers to maintain the security and privacy of their users. To this end, Mozilla has started to convert Firefox to a new system, called Fission.

Currently the Firefox browser runs each webpage in a single process, which can be thought of as a physical container. Each webpage consists of multiple parts. If these parts all reside in the same container, then they can interact with each other's parts, thereby enabling potential security vulnerabilities.

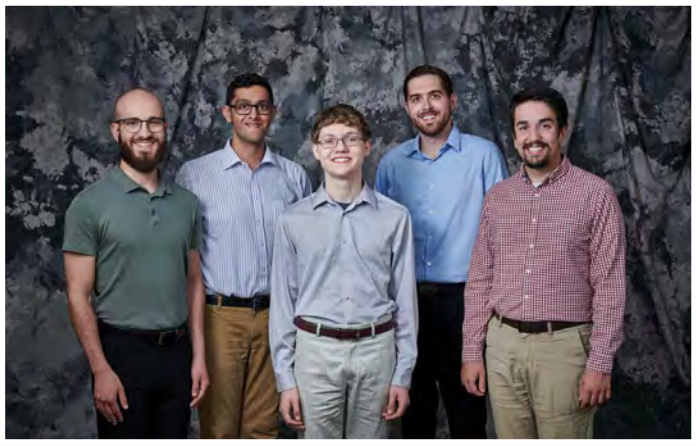
Fission is a new paradigm developed by Mozilla to split webpages in Firefox into multiple processes, or containers, to protect the user from potentially malicious web pages or advertisements. Using Fission, a malicious web page can no longer access private information because it no longer resides in the same container as anything else.

To implement Fission, Firefox's underlying infrastructure must be reworked. Firefox is massive, containing over 5 million lines of code, so converting the entire browser to Fission is not trivial.

Our "Splitting the Atom. Again." project updates various parts of the Firefox browser, such as picture-in-picture video, pop-up blocking, and page thumbnail creation, to use Fission. From a Firefox user's perspective, this transition is unnoticeable, but it is essential to ensure a secure browsing experience.

These advancements are implemented using JavaScript, with Mercurial used for version control and Phabricator used for code reviews.

Firefox Browser



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MSU Federal Credit Union
Building Hopes and Dreams Together

Founded in 1937, Michigan State University Federal Credit Union offers financial services to members of the Michigan State University and Oakland University communities. With 280,000 members and over $4.5 billion in assets, MSUFCU is the largest university-based credit union in the world.

As the age of digitization progresses, banking has become increasingly automated and impersonal. Now, more than ever, it is imperative for businesses to provide a more personal, engaging experience for consumers.

Our Hopes and Dreams system is a hyper-personalized banking platform aimed at understanding members' financial needs and life goals to ultimately provide a better, more personal user experience.

As a user first logs into the Hopes and Dreams application, they are prompted to complete a short quiz. This quiz helps our system understand each user's spending needs and goals on a more personal level.

With a deeper understanding of our users, Hopes and Dreams provides personalized offers and spending tips, tailored to each specific user. An example tip from our system might be: "to afford your dream trip to Europe, you should spend less money at Starbucks."

Our offers and tips are generated based on a user's quiz responses, as well as demographic spending data related to a user's income, age, and spending habits.

Users can also set their own spending goals and keep track of their progress through any of their iOS or Alexa devices.

Hopes and Dreams is available on Amazon Alexa, and mobile devices running iOS. The CRM is available on all web browsers. The iOS app is built using Swift, and the website is primarily HTML, CSS and PHP. All applications call an API running Python Flask.

MICHIGAN STATE UNIVERSITY
FEDERAL CREDIT UNION

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Proofpoint
Detecting State-Sponsored Cyber Security Threat Actors

Headquartered in Sunnyvale, California, Proofpoint is an innovative cyber security company offering protection to a wide range of Fortune 100 corporations as well as public institutions such as Michigan State University.

For those with sensitive data, the threat of cyberattacks is constant. Companies, and those who protect them, find themselves locked in an endless battle with rapidly advancing, malicious, and highly coordinated foreign threats.

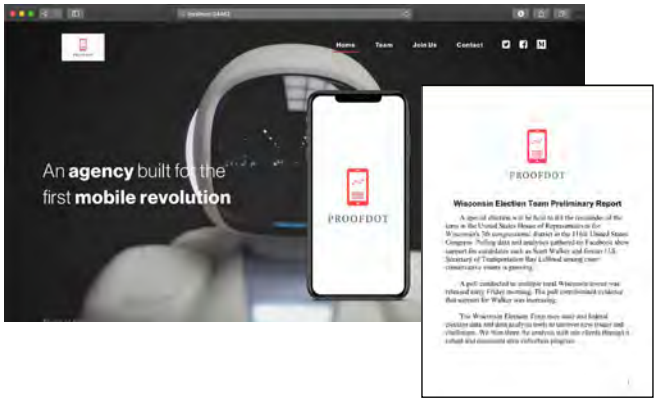
Our Detecting State-Sponsored Cyber Security Threat Actors platform is designed to swiftly analyze and study these state-sponsored threats to better understand their attack patterns and to thwart future attacks.

To gain adequate data from threats in a controlled environment, the cyber security industry often turns to a mechanism known as a honeypot. Honeypots appear to contain information an attacker would find valuable, but in reality is effectively worthless. Upon accessing the honeypot, the attacker's actions are monitored, and their methods analyzed.

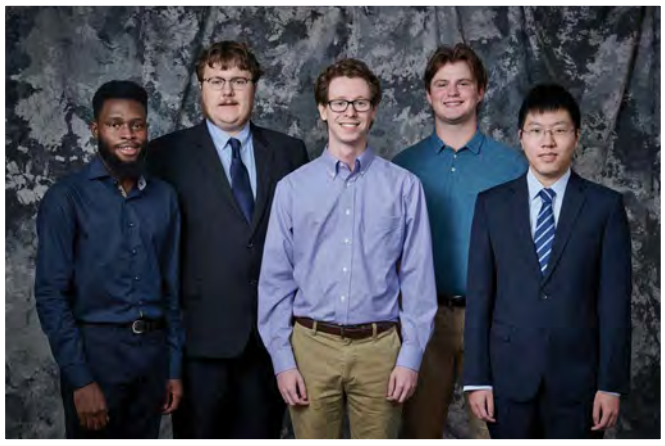
Our Detecting State-Sponsored Cyber Security Threat Actors system simplifies the process outlined above. It enables researchers to quickly generate honeypots, depicted as the bottom website and paper to the right, place them in high-traffic areas, and stream obtained data back to an intuitive dashboard.

The web dashboard enables security researchers to investigate individual attacks and the efficacy of each lure, allowing them to package related attacks in a controlled environment, and to design more effective lures.

The web dashboard consists of a React front end with a Python Flask and PostgreSQL back end. HTTrack is implemented to quickly develop lure websites, GPT-2 generates believable documents, and Suricata continuously monitors traffic and accumulates data.



proofpoint™



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Technology Services Group
Document Management Using Google Cloud Platform

Founded in 1996 in Chicago, Technology Services Group (TSG) focuses on helping companies manage and store their data. TSG has many clients across a wide range of industries and is a leading provider of content management solutions.

Clients of TSG include car insurance companies, whose claim agents take multiple phone calls and receive documents and images regarding new incidents. Claim agents spend copious amounts of time re-listening to phone calls and manually checking images to retrieve information regarding a specific incident.

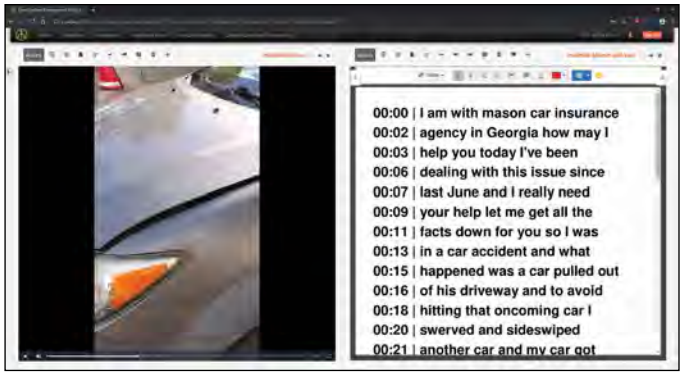
Our Document Management Using Google Cloud Platform system integrates the power of Google Cloud Platform (GCP) with TSG's existing software, OpenContent Management Suite (OCMS).

Our system offers the ability to transcribe and analyze audio and image files and perform searches based on the output of the analysis.

When a media file is opened in OCMS, the option to transcribe the audio becomes available through an action button. A new file is generated containing the transcription of the audio and is linked back to the original media. A claim agent is able to search the transcription by keywords or scroll manually to find the information.

Additionally, claim agents are able to search by image content. For example, if a claim agent searches the words "car crash," all images containing a crashed car are displayed in the results. This saves time since each image does not need to be opened to determine its content.

Our Document Management Using Google Cloud Platform system utilizes Angular, Apache Solr, Apache Tomcat, HTML, Java, JavaScript, and GCP Services: Cloud Bigtable, Cloud Storage, Speech API, and Vision API.



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TechSmith
Smart Automatic Video Creation

TechSmith provides software that empowers people to communicate more effectively by easily creating visual content such as images and video. Their flagship products, Snagit and Camtasia, are used by more than 30 million people worldwide.

Creating videos is a difficult, lengthy, and potentially expensive process. Many content creators are looking for an efficient way to automate the video creation pipeline.

Our Smart Automatic Video Creation platform automatically generates high quality, unique videos based on a single text input.

In particular, our system takes any script or article as input and automatically creates video content composed of relevant images, videos/animations, sounds, and text annotations.

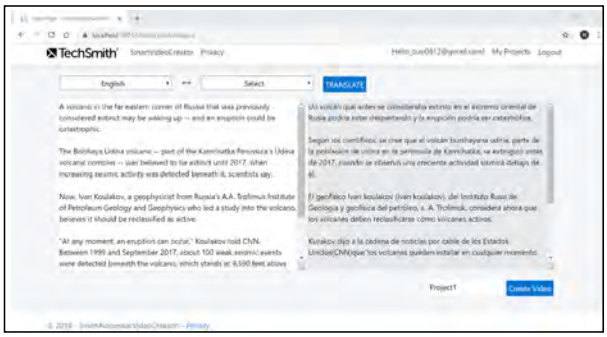
Users start by accessing our web application where they are given the option to upload or paste a script or article. After the text is submitted, natural language processing algorithms are used to generate a concise summary of the article. This summary is used as subtitles for the video (shown to the right). At this point, users can also choose to translate their summary to any language, allowing content to reach a broader audience.

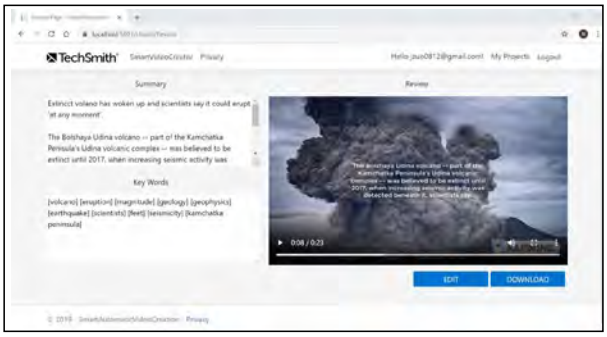
The summary is analyzed to find keywords and ideas. These are used to find suitable visual content. Images and videos are found using the TechSmith Assets API, and Bing's image search.

After the visual components of the video are selected, the text is again analyzed for sentiment. The sentiment of the text is then used to find audio that fits the mood of the text.

Once the assets are all collected, our system stitches together all images, videos, music, and text and automatically generates a video for the user based on their initial input text.

The front end of our web application is made using JavaScript and the back end is written using C# and .NET core framework. The web application and SQL database are both hosted on Microsoft Azure. FFmpeg is used to render and complete the final video.





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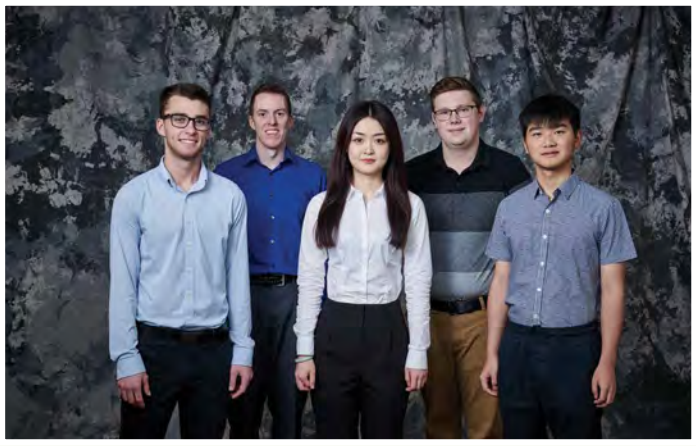

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Union Pacific
Railroad Physics Data Visualization

Union Pacific was founded in 1862 and is now the leading railroad transportation company in America. With over 32,000 miles of track in 23 states, 8,600 locomotives, and 43,000 employees, Union Pacific plays an important part in the transportation of goods in the nation.

Derailments cost transportation companies millions of dollars every year due to missed deliveries, additional employee time, and equipment repairs. Union Pacific uses simulations to analyze such incidents and diagnose causes. These simulations record data such as speed and buff/draft forces, and this information is output as a raw data file.

Our Railroad Physics Data Visualization platform provides a web-based user interface that converts a simulation's raw data files into clean, readable, and intuitive graphical output. These interactive graphs aid in the analysis of derailment simulations.

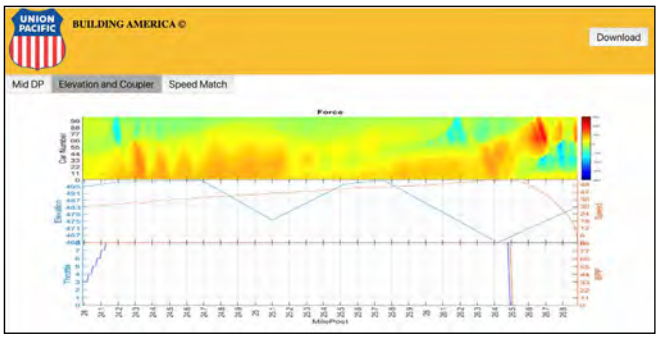
After a successful simulation, the raw data file is uploaded to our system via a web dashboard page. A user can then access the web dashboard to analyze a file.

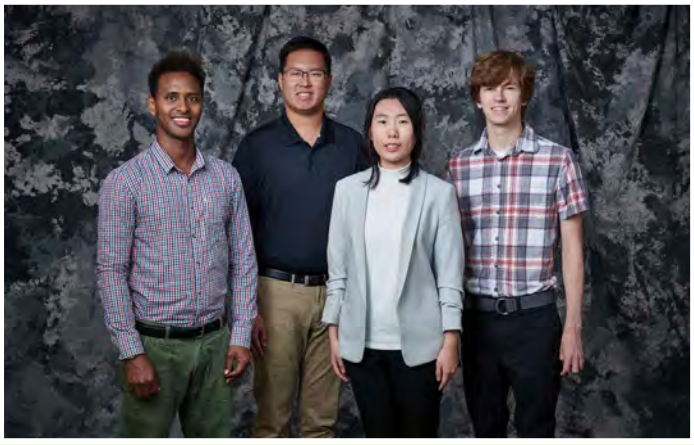
Graphical output from our Railroad Physics Data Visualization platform can be viewed on our web UI (shown on the right) or downloaded as a generated Excel file.

In addition to static graphs and charts, our platform produces animated graphs that visualize train elevation, as well as the forces between train cars over time.

Using our system, Union Pacific employees can more quickly and accurately determine the cause of derailments and accidents, saving Union Pacific valuable time and money.

Our Railroad Physics Data Visualization project has a front end web UI that uses the Angular framework and is written in TypeScript and CSS. Our back end is written in Java, runs in a Tomcat environment, and communicates with an Oracle MySQL database.





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United Airlines
Training Scheduling and Optimization System II

United Airlines is the world's second largest airline company, operating 4,600 flights a day to 357 destinations. To maintain its fleet of 1,300 aircraft and ensure successful flights, it is crucial to have properly trained personnel. United's Technical Operations division has 45 instructors who teach around 700 classes yearly to over 7,000 employees.

Our Training Scheduling and Optimization System II provides a web app to facilitate United's maintenance training schedulers to schedule instructors, students, and courses across the country.

When the scheduler wants to schedule a course, they must take into account a number of factors, including instructor availability, venue availability, instructor travel distance, and instructor qualifications.

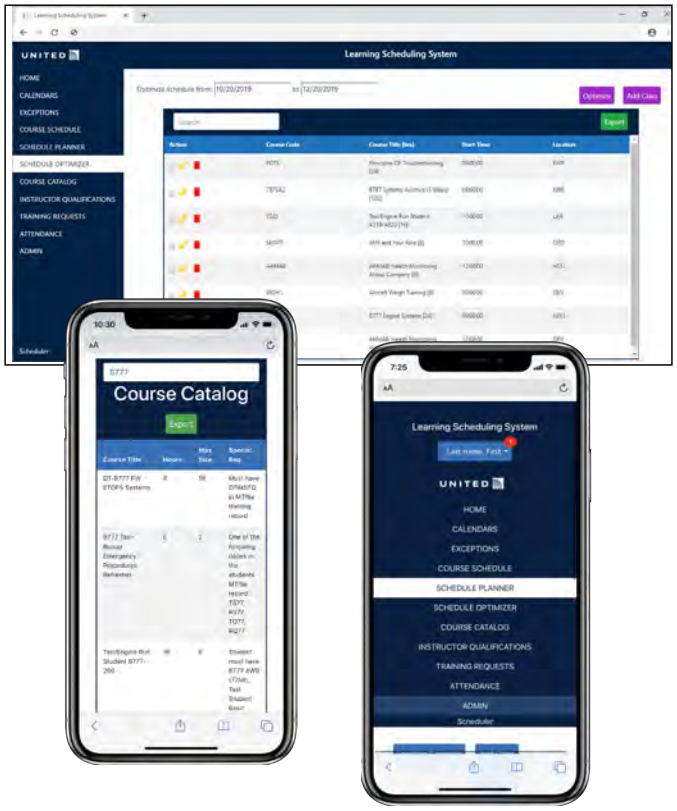
Using our mobile compatible website, users can schedule classes manually, or through our automated schedule optimizer. Manual scheduling can be used effectively for a few classes in a short time frame. However, when dealing with a large number of classes and taking into account all relevant factors, manual scheduling is an arduous task.

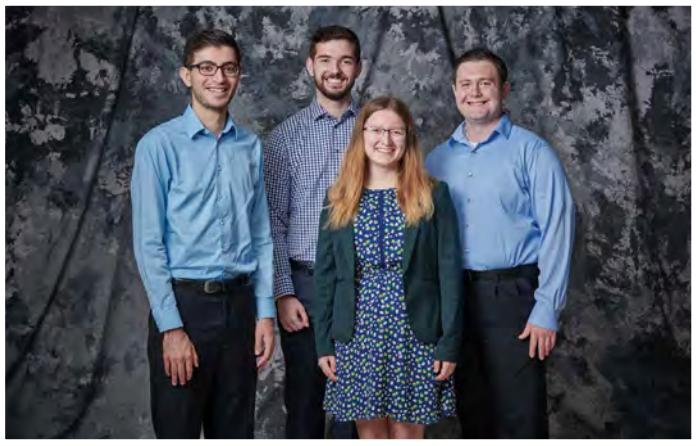
Our schedule optimization feature allows a scheduler to input a given time frame, a set of classes, and a set of locations. The optimizer then recommends an optimal schedule, including instructor and classroom assignments.

The optimized schedule minimizes the distance traveled by instructors and takes into account instructor qualifications and room availabilities.

An optimized schedule saves United Airlines significant time, money, and resources.

Our Training Scheduling and Optimization System II web app is built with ASP.NET Core, Angular 8, Node.js, an Entity Framework, and an Azure SQL database. The web app is hosted as an app service on Azure Cloud Platform.





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Urban Science
AutoHook Creative Tool

Headquartered in Detroit, Urban Science is internationally renowned for providing data-driven, science-based solutions to problems in the automotive, health, and retail industries. AutoHook is a subsidiary of Urban Science and assists automotive dealers and OEMs in increasing walk-in customer traffic.

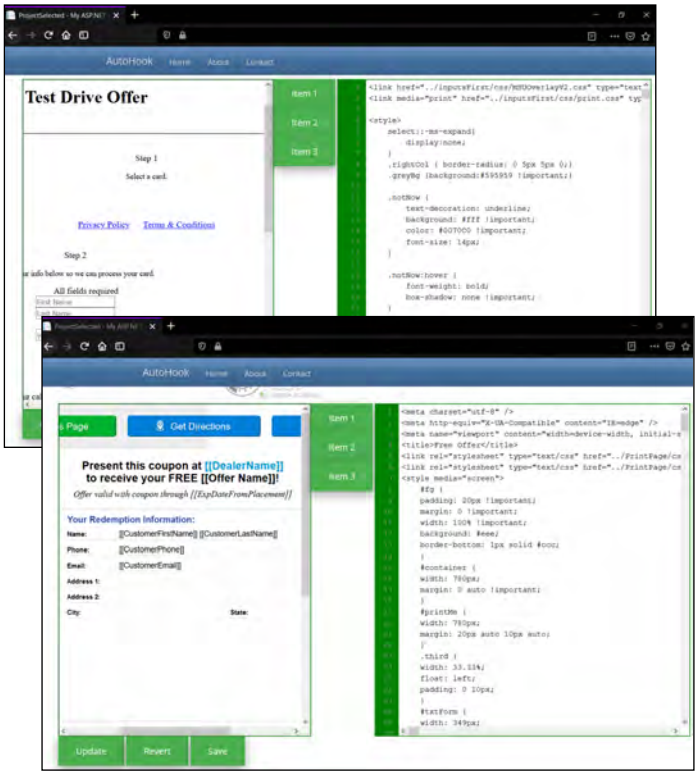
AutoHook provides custom, incentive-driven forms and web pages to dealers and OEMs to help increase vehicle sales. Each online form needs to be created to fit a specific dealer or OEM. Currently, AutoHook's system for updating and creating new forms is effective, but also time-consuming. To view an updated form, the developer has to redeploy the web page after every change. To create a new form, a developer must start from scratch, even if the form is like one already developed.

Our AutoHook Creative Tool application is a file management system and an in-browser form editor used by AutoHook to simplify and expedite the updating and creation of online forms.

With our intuitive web interface, AutoHook employees can update existing online forms using our in-browser form editor (shown on the right). If a designer wants to make a small change, they can update the code in-browser, and a representation of how the change affects the form is shown. This removes the need for designers and developers to redeploy their forms after every minor change.

Our AutoHook Creative Tool file management system allows existing online forms to be imported into any new project, thus providing an already polished starting point.

AutoHook Creative Tool is an ASP.net web application that is hosted on Microsoft Azure, using bootstrap styling for its front-end components and C# for its back-end functionality. The OEM form data is updated and loaded from an SQL database that is hosted on Microsoft Azure.



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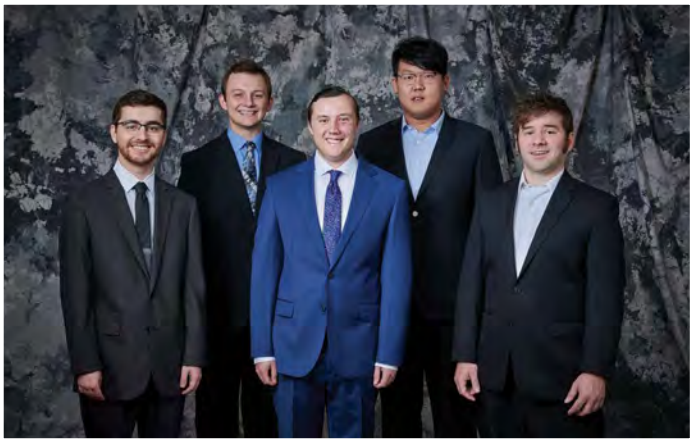

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Vectorform
Rumble

Founded in 1999, Vectorform creates digital products and experiences for the world's leading brands, with a focus on immersive technologies, mobile experiences, Internet of Things, smart homes, connected vehicles, and wearable technologies.

Life in modern society can be very busy, and it can be easy to forget that a load of laundry was started.

Our Rumble system keeps people aware of the wash status of their machines by integrating their washing machine into the Internet of Things and providing updates based on sensor readings from their washing machine.

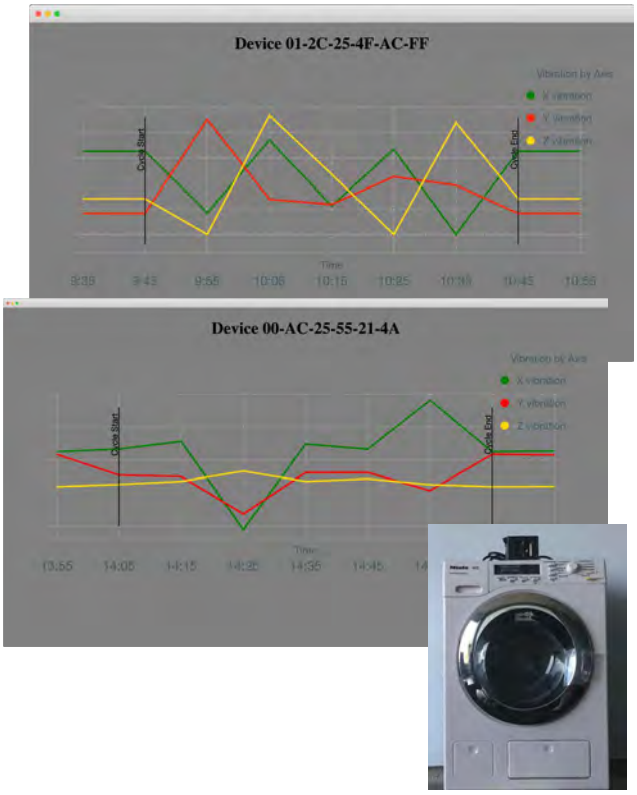
Accelerometer sensors are devices that measure acceleration caused by movement. These sensors are attached to washing machines, and the vibrations of a wash cycle indicate the current status of a washing machine.

Using deep learning techniques, our Rumble sensors predict when a wash cycle is running, and when a wash cycle has ended. Once a cycle has been predicted to be over, the user will be notified via our web application.

Our deep learning solution to wash cycle prediction is generalizable, allowing the user to place their accelerometer sensors anywhere and in any orientation on their washing machines. The overarching goal of Rumble is to predict different cycles of a wash, and also to predict if a washing machine is malfunctioning.

To the right, you can see our Rumble sensor mounted on a miniature model washer. Our solution works for any appliance that moves and vibrates while operating, allowing our work to be duplicated across many devices.

The Rumble sensor uses Adafruit ESP32 as the main microcontroller, our neural net is implemented in C++. Readings from the Rumble are pushed to the server via MQTT, and stored in a MySQL database. The web app is implemented using HTML, CSS and the React.js extension Victory React for data visualization.



Vectorform

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Volkswagen Group of America
VW Car-Net Smart Hub Web App

Volkswagen Group of America is the North American operation headquarters and subsidiary of the Volkswagen Group, which is comprised of 16 brands and produces a variety of cars, motorcycles and commercial vehicles.

In 2013, Volkswagen introduced VW Car-Net, a connected service system that offers convenience and ease-of-access to Volkswagen owners through a variety of features and tools. Drivers currently interact with Car-Net through a mobile app. To reduce driver distraction resulting from drivers using their phones, the Car-Net team is building web apps that are available in the car's screen called the Human Machine Interface (HMI).

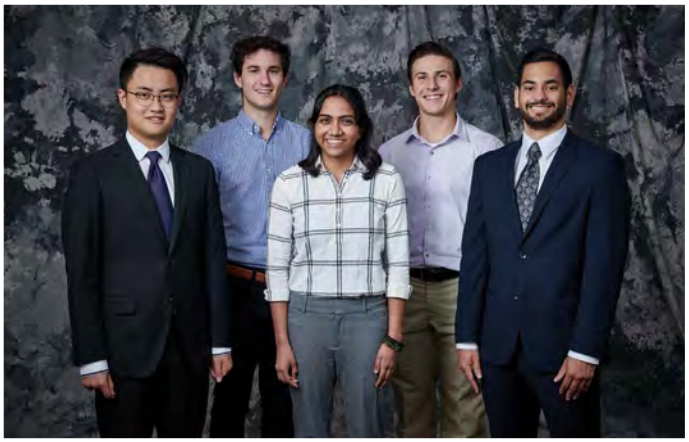
Working with the garage door and smart home company, Chamberlain, our VW Car-Net Smart Hub Web App enables users to automate interactions with Chamberlain products without any user input.

Using our web app, a driver encompasses their house with a so-called geo-fence, which is simply a geographic area that triggers an action when the border of the geographic area is crossed. Once set, the garage door automatically opens when the vehicle crosses this border when approaching the house, and automatically closes when the vehicle crosses the geo-fenced border when leaving the house.

In addition, our app also supports other Chamberlain smart home devices such as lights, gates and door locks.

Our app enables control of all smart devices, regardless of location, from the VW HMI screen. Drivers also receive notifications relating to their smart devices directly in their car.

VW Car-Net Smart Hub Web App utilizes the Google Maps and Chamberlain APIs to enable customer ease with setting up and activating the boundary alerts. Our web app is written in TypeScript, HTML and CSS using the web development framework Angular.



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Yello
Intelligent and Adaptive Data Mapping

Yello is a Chicago-based company that provides software for talent acquisition. Their products help recruitment teams hire the right talent at the right time.

Collecting applicant data at recruiting events is a valuable tool for every company during the hiring process. A problem arises when submitted data is not standardized.

If a recruiter feels they have had a great conversation with an applicant from Michigan State University and wants to schedule an interview, they will search the applicant data for "Michigan State University." However, if the applicant listed their university as "MSU" or "Mich. State," the recruiter might not be able to find the applicant's information.

Our Intelligent and Adaptive Data Mapping application mitigates the issues related to non-standard input through use of Yello's wealth of collected university data.

As an applicant is entering their data, our application suggests to the user the standardized input based on historical data. For example, "MSU" is the abbreviation of 15 different universities. As a user inputs their information, any non-standard input is mapped to a list of accepted standardized inputs for the user to select.

Standardized input suggestions are available for applicant input fields including degree type, academic major and college.

Ensuring standardized inputs enables recruiters to make informed decisions about a candidate with the most accurate information.

Our Intelligent and Adaptive Data Mapping web app is built with the JavaScript library React. Our back end utilizes Django REST framework and Python to best match user input based on current data. This data exists in our NoSQL database, which is hosted through Firebase.

yello

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Dustin Hansen
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Design Day Spring 2019

Penultimate All-Hands Meeting

Design Day Judges

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. The winners are selected on Design Day by a panel of distinguished judges.

Auto-Owners Insurance Exposition Award

Auto-Owners INSURANCE
LIFE • HOME • CAR • BUSINESS

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. Each team plays their project videos and answers questions for a panel of 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 Herman Miller
Office Navigation Using Augmented Reality

Aaron Eshleman, John Riley, Zhenru Wang, Matt Rhodes, Stefan Zhang
Presented by Scott Lake

MSU Federal Credit Union Praxis Award

MICHIGAN STATE UNIVERSITY FEDERAL CREDIT UNION
Building Dreams Together

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 Ford
Greenfield Labs SHARED Locker System

Rob Sulaka, Brett Dziedzic, Wei Dai, Ning Han, Seth Killian
Presented by Ben Maxim

Design Day Judges

Amadou Anne
United Airlines

E.J. Dyksen
Michigan State University

Adam Haas
Ford Motor Company

Michael Taylor
Google

Mark Buikema
Herman Miller

Mark Eldred
Meijer

Wendy Hamilton
TechSmith

Kabe VanderBaan
Place Technology

Chris Cook
Priority Health

Rich Enbody
Michigan State University

Elizabeth Klee
Urban Science

Frank Weith
Volkswagen

Ashlee DeLine
Humana

Garrett Gaw
Amazon

Ben Maxim
MSU Federal Credit Union

Karen Wrobel
Fiat Chrysler

Bob Dyksen
Evolutio

Dave Giordano
Technology Services Group

Marty Strickler
Rose Packing Company

TechSmith Screencast Award

TechSmith®

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 Okemos, Michigan.

Team Humana
Technology Peripheral Inventory Predictor

Katie Sydlik-Badgerow, Gabe Apaza, Siru Chen, Brendan Vande Kieft, Linda Duong
Presented by Wendy Hamilton

Urban Science Sigma Award

URBAN SCIENCE

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 Urban Science Sigma Award, which is sponsored by Urban Science of Detroit, Michigan.

Team Michigan State University ITS
Group Project Organization and Scheduling

Cyndy Ishida, Jack Wydra, Sarah Abumansoor, Jacob Dasuqi, Kristin Calder, Jacob Bickel
Presented by Elizabeth Klee, Bill Bye and Jim Anderson

Introduction to Electrical and Computer Engineering

Dr. Dean M. Aslam
Professor of Electrical and Computer Engineering

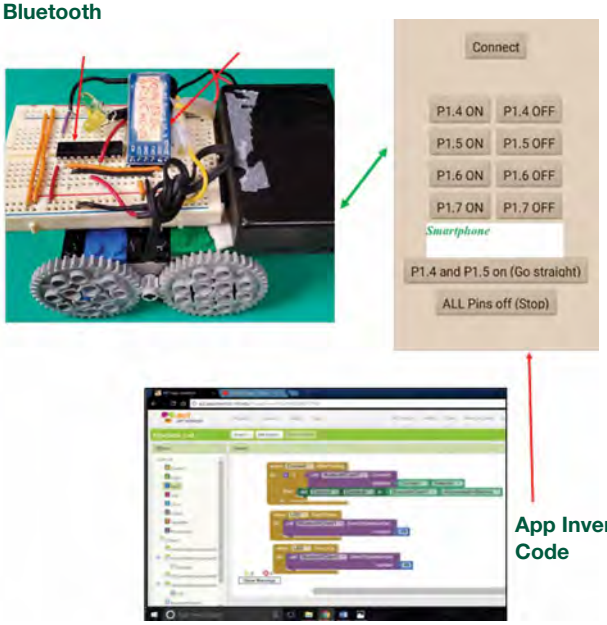
Problem statement

ECE 101 is an elective course introducing freshman students to Electrical and Computer Engineering through a series of unique/innovative hands-on flipped laboratory experiments linked to Smartphones, App development and creative research/teaching approaches. The experiments include (a) MATLAB Mobile, (b) App Inventor, (c) Ohm's Law Simulation and Testing, (d) Smart Bracelets for Health Monitoring, (e) Smartphone Digital Microscope, (f) Smartphone Controlled LED/Motor using Bluetooth Module and Microcontroller, and (g) Microcontroller Programming using a Smartphone-based IDE (Integrated Development Environment).

Graduate Student Assistant: Anna Citko

Team Members	Project Title
Team #1: Nadine Kavadias Feiyang Zhang Haxiang Zhang	Smartphone Game
Team #2: Jadon Dester Kamic Jok Evan Miller	Bluetooth Controlled Car
Team #3: Matthew Jelcin Carter Kochanski Omar Lopez	GPS App
Team #4: Luke Batchelor Evan Buikema Paul Williamson	Using an Ultrasonic Sensor and Nano Arduino to Pick Up Objects
Team #5: Deante Davis Naveen Kumanan	Car Locator App

Microcontroller, Bluetooth



App Inventor Code

The Capstone Projects

Dr. John Albrecht
Associate Professor of Electrical and Computer Engineering

Dr. Mi Zhang
Assistant Professor of Electrical and Computer Engineering

Dr. Lalita Udpa
Professor of Electrical and Computer Engineering

Faculty Advisors: Aslam, Biswas, Chakrapani, McGough, Mitra, Mukkamala, Srivastava, and Udpa


Aslam


Biswas


Chakrapani


McGough


Mitra


Mukkamala


Srivastava


Udpa

Presentation Schedule – Engineering Building, Room 2205

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Solar Racing Team	BEV Level 2 On-Board Charging Module
8:25 a.m.	MSU FRIB	Wide Bandwidth Differential Oscilloscope Probe
8:50 a.m.	MSU FRIB	Broadband GHz Microstrip Matching Network for Beam Diagnostic Test Stand
9:15 a.m.	The City of St. Johns, Michigan	Detection of Buried Lead Water Pipes
9:40 a.m.	MSU RCPD/MSU Bikes	Intelligent Defense System (IDS)
10:05 a.m.	Orphans International Helpline/MSU RCPD	Power Management System
10:30 a.m.	MSU ECE Smart MicroSystems Lab	Automated Winch System for Underwater Sampling
10:55 a.m.	MSU ECE Smart MicroSystems Lab	Snake Robot for Inspection of Small Diameter Pipelines (Joint Project with ME 481)

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; and
- Requiring each student to complete four individual hardware/software laboratory assignments.

MSU Solar Racing Team
BEV Level 2 On-Board Charging Module

The Michigan State University Solar Racing Team is a student-led organization that designs and builds full-sized solar electric vehicles. Beginning in Fall of 2017, the team started designing a two-person solar car to compete in the cruiser class of the 2020 American Solar Challenge. A previous version of the vehicle went to competition this past summer as a practice run before the main competition. To prepare the car for the long-awaited American Solar Challenge, all multi-occupant style vehicles must be equipped with an On-Board Charging Module (OBCM) to allow the vehicle to charge its battery at US level 2 electric charging stations.

Our team was tasked with developing an effective architecture and working prototype OBCM that will allow charging of the battery pack on the team's current car, Aurora. The module takes 240 AC voltage from a level 2 BEV (Battery-Electric Vehicle) charging station and converts it to the proper charging voltage and current to charge our pack. This feedback charging loop was designed using the Constant Current - Constant Voltage (CC-CV) method, intended for lithium ion batteries. Reliability, shock-resistance, optimal thermal cooling and power efficiency were key benchmarks for the design. The success of this design will provide a path for continued development of the OBCM, eventually leading to the fabrication of a reliable and upgradable system for future generations of the Solar Racing Team.

Architecture of a BLDC Motor Controller

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Shubham Shedge
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Evan Charles
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Jacob Randall
Novi, Michigan

MSU Solar Racing Team
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East Lansing, Michigan

Project Facilitator

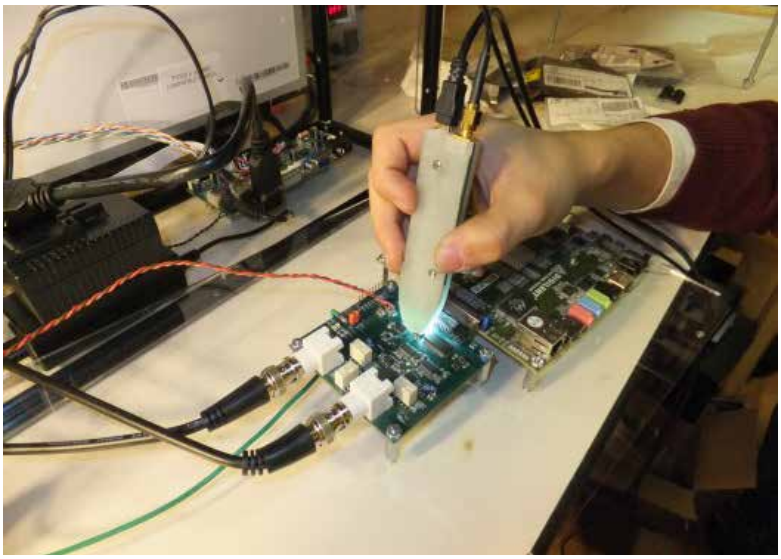
Dr. Joydeep Mitra

MSU Facility for Rare Isotope Beams (FRIB)
Wide Bandwidth Differential Oscilloscope Probe

The Wide Bandwidth Differential Oscilloscope Probe is a project for electrical and computer engineering students that focuses on designing, building and characterizing a differential probe for an oscilloscope. Single-ended probes are more common, but they typically pick up a high ratio of signal-to-noise, while differential probes that can be used for measuring high-frequency signals give a better ratio and more precise measurement. Normally the cost of a commercial differential probe is more than $2000; we are planning to achieve it for under $500.

Our sponsors set some objectives that we need to achieve to get the required circuit behavior.

We will develop a buffer stage to meet the high input impedance, a differential amplifier IC to meet wide bandwidth of 1 GHz and differential measurement, and a high pass filter to block frequencies below 1 KHz. Also, for the purpose of minimizing noises in signals measurements, a battery will be used instead of a power supply. A network analyzer will be used to test and characterize the device.



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Lansing, Michigan

FRIB
Project Sponsor

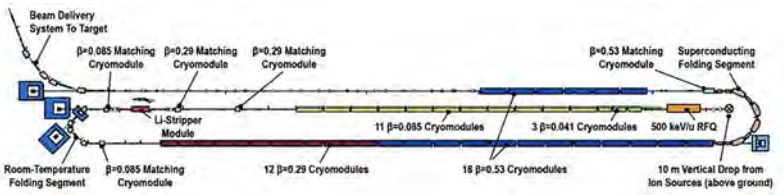
Project Facilitator

Dr. Ramakrishna Mukkamala

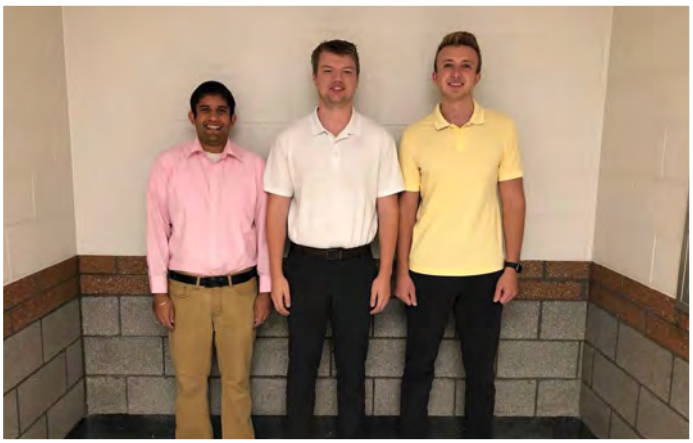
MSU Facility for Rare Isotope Beams (FRIB)
Broadband GHz Microstrip Matching Network for Beam Diagnostic Test Stand

The Facility for Rare Isotope Beams (FRIB), funded by the DOE-SC, Michigan State University, and the state of Michigan, will assist scientists in making discoveries in nuclear physics. These discoveries will help scientists understand the properties of rare isotopes that are short-lived and not typically found on Earth. With a greater understanding of the properties of these rare isotopes, scientists will be able to apply this knowledge to applications in nuclear energy, society, medicine, homeland security, and industry.

Our team has been asked to work with FRIB at Michigan State University to design a microstrip matching network for the facility's beam diagnostic test stand. The purpose of the facility's test stand is to replicate the velocity and electromagnetic fields of a non-relativistic beam. The test stand needs to calibrate beam diagnostic devices for non-relativistic effects. The microstrip matching network that our team will be designing must be broadband to replicate the beam and match the helix impedance.



FRIB



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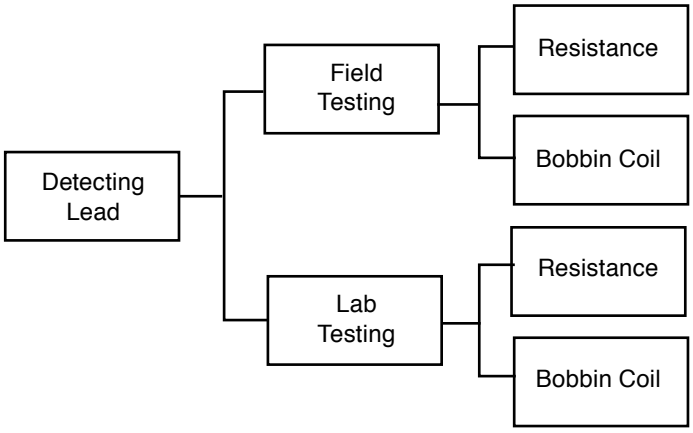
Project Facilitator

Dr. Dean Aslam

The City of St. Johns, Michigan
Detection of Buried Lead Water Pipes

Following the recent lead contamination problems in Flint, the City of St. Johns aims to locate and remove all water service lines that contain lead and can possibly cause harm right now or in the near future. Due to insufficient record-keeping in the past, the materials of many service lines are unknown.

The team has been given the task of designing and implementing a solution to differentiate materials and detect lead in water service lines. The goal is to do this in a non-destructive way, without excavating the service lines. Multiple methods, such as measuring impedance or using a bobbin coil to create a magnetic field, will be tested in order to determine the most successful solution.



City of St. Johns, Michigan
Mint Festival City

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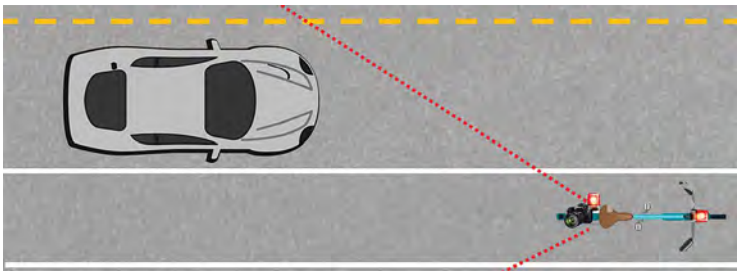
MSU RCPD/MSU Bikes
Intelligent Defense System (IDS)

In recent years, cycling has begun to be a better alternative for transportation due to the busy traffic and the air pollution in the cities. The number of distractions while driving an automobile has increased as well. As a result, every year the number of cyclist injuries and fatalities due to car collisions has increased.

Our team has been asked to help create a means of preventing cyclist injuries and fatalities due to vehicles on the road. The goal of the project is to design an affordable alert system which can detect the oncoming vehicles approaching from behind the cyclist. The team decided to use a camera to sense oncoming vehicles, alerting the cyclist and driver via a series of LEDs.

The sponsors and the team believe the low-cost, affordable intelligent defense system will prevent thousands of injuries and fatalities per year to cyclists.



Resource Center for Persons with Disabilities

BIKES

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Saim Turhangil
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Jordan Stross
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MSU RCPD / MSU Bikes
Project Sponsors

Steven Blosser
MSU RCPD

Tim Potter
MSU Bikes Service Center

Project Facilitator

Dr. Subir Biswas

Orphans International Helpline (OIH)/MSU RCPD
Power Management System

OIH (Orphans International Helpline), is a non-profit company that was created to help orphans in Haiti. It was founded in 2003, and since then they have provided shelter, medical care, clothing, food and education about Christianity for many children. Due to many natural disasters in the region, it is very difficult to maintain and control the basic needs such as electricity and water.

There is currently a hospital being built in Haiti through 100% donations, and the idea involves being self-sustainable in terms of energy. It will be powered by solar panels, wind turbines, generators, and will use lithium batteries to store the energy.

Our team has been challenged to design and build a Battery Management System, which can translate and store the power collected through different sources. Also the system needs to have the ability to detect, balance and manage the voltage of each battery and take appropriate action in different situations.

The result of this project needs to be very simple so that the people in Haiti are able to build the system themselves by following given instructions.

In order to meet the functional requirements of the project, the Battery Management System will be connected to the battery pack to charge and discharge voltage, show the battery status and different power sources to provide power to the hospital.

Resource Center for Persons with Disabilities

Orphans We Care International Helpline

Michigan State University
Team Members (left to right)

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Zeliang Ye
WenZhou, China

Fawaz Alghool
Damman, Saudi Arabia

Wentai Liu
Henan, China

Huiyu Zhao
Shanghai, China

Altair Veiga
Luanda, Angola

Hongxu Song
Daqing, China

Orphans International Helpline / RCPD
Project Sponsor

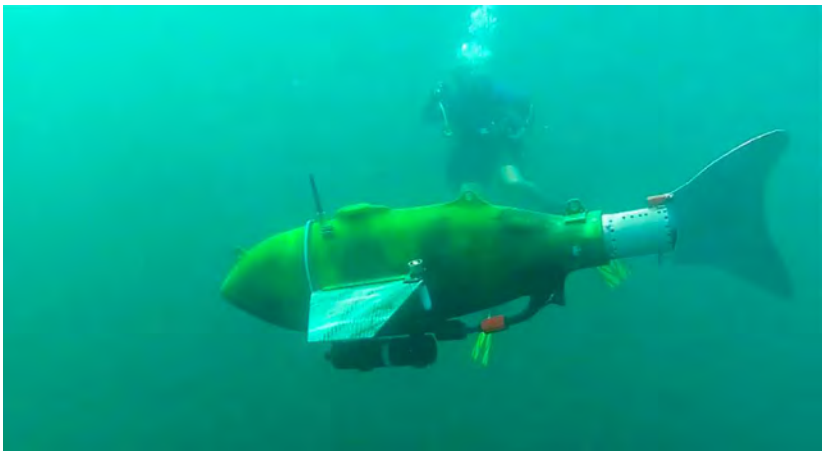
Steven Blosser
East Lansing, Michigan

Project Facilitator

Dr. Robert McGough

MSU ECE Smart MicroSystems Lab
Automated Winch System for Underwater Sampling

The Michigan State Smart MicroSystems Lab (SML) is dedicated to enabling smarter, smaller, and more integrated systems by merging advanced modeling, control, and design methodologies with novel materials and fabrication processes. The SML has authorized the Automated Winch System for Underwater Sampling project. The objective of this project is to develop a winch system that can lower sensors down to any desired underwater depth based on the feedback it receives from a pressure sensor. This work will set the foundation for the SML to eventually automate fish tracking and other underwater surveying.



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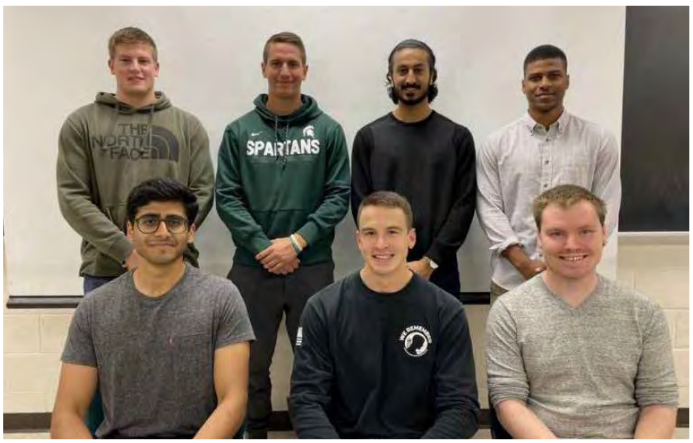

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Philip Schmitz
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Yacer Mirza
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Funakoshi Silva
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MSU ECE Smart MicroSystems Lab
Project Sponsor

Xiaobo Tan
East Lansing, Michigan

Project Facilitator

Dr. Sunil Chakrapani

MSU/ECE Smart Microsystems Lab
Snake Robot for Inspection of Small Diameter Pipelines

Pipelines are designed to last a long time so that limited maintenance work must be done on them. Over time, however, constant use can begin to wear down pipes and create deformities in them that limit the amount of fluid that can travel through them. Detecting these errors in pipelines is tough, as it is hard to pinpoint the exact location of the defects and reasoning behind their placement. This leads to large amounts of work only to find a small deformity that could take much less time to fix.

Our team has been assigned the task of creating a pipeline inspection robot that can fit within four-inch diameter pipelines. It will be able to capture images of the inside of these small pipelines while personnel assess the deformities and find solutions to fixing them. A user can control the robot with a handheld controller and can make selective turns through complicated pipe systems. The focus is to design an easy-to-use, accurate robot that will assist greatly in saving time when fixing pipelines.

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MSU ECE Smart Microsystems Laboratory
Project Sponsor

Xiaobo Tan
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Project Facilitator

Dr. Vaibhav Srivastava

The Capstone Projects

Dr. John Albrecht
Associate Professor of Electrical and Computer Engineering

Dr. Mi Zhang
Assistant Professor of Electrical and Computer Engineering

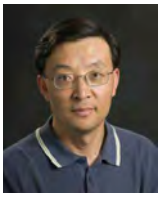
Dr. Lalita Udpa
Professor of Electrical and Computer Engineering

Faculty Advisors: Aviyente, Fathi, Morris, Ren, Strangas, and Tan

Aviyente

Fathi

Morris



Ren

Strangas

Tan

Presentation Schedule – Engineering Building, Room 2243 (11:00 a.m. in Room 1202)

Time	Team Sponsor	Project Title
8:00 a.m.	MSU ECE Robotics Lab	Robotic Crop Weeder
8:25 a.m.	MSU Offices of the Executive Vice President for Administration	Smart Hotel Cart System
8:50 a.m.	MSU Offices of the Vice President for Auxiliary Enterprises	Automation in the Dining Hall Dish Rooms
9:15 a.m.	CANVAS AutoDrive Challenge Team	Datalogging and Diagnostic System
9:40 a.m.	CANVAS AutoDrive Challenge Team	Sensor Synchronization
10:05 a.m.	MSU CSANN Lab	Deep Neural Network-based Navigation Rovers for Sound/Video Classification
10:30 a.m.	MSU NDE Lab	Motorized, Waterproof X-Y Manipulator
11:00 a.m.	ME Department (Note: This presentation takes place in room 1202)	Dynamometer for Electric Bicycle (joint Project with ME. See page 82 of this booklet)

ECE 480 Senior Design

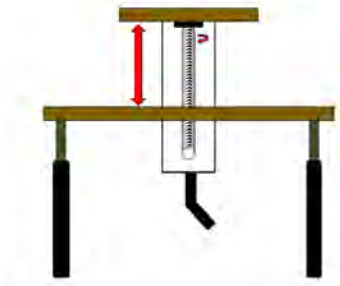
We gratefully acknowledge the support of this semester's project sponsors: CANVAS AutoDrive Challenge Team, City of St. Johns, Michigan, MSU Bikes, MSU CSANN Lab, MSU NDE Lab, MSU Offices of the Vice President for Auxiliary Enterprises, MSU Offices of the Executive Vice President for Administration, MSU ECE Robotics Lab, MSU ECE Smart MicroSystems Lab, MSU FRIB, MSU Resource Center for Persons with Disabilities, MSU Solar Racing Team, and Orphans International Helpline. Thank you to each of these team sponsors.

The ECE project facilitators who supervised ECE 480 teams this semester are: Dean Aslam, Selin Aviyente, Subir Biswas, Sunil Chakrapani, Salem Fathi, Robert McGough, Joydeep Mitra, Daniel Morris, Ramakrishna Mukkamala, Jian Ren, Vaibhav Srivastava, Elias Strangas, Xiaobo Tan, and Satish Udpa.

MSU ECE Robotics Lab
Robotic Crop Weeder

Weeds have been a problem in the agricultural industry as they negatively impact the growth of surrounding crops. These weeds occupy the crop's surroundings and steal the nutrients that are a necessity in the growth and development of these crops. The overall effect is a decline in crop production which impacts not only the farmers, but also the consumer. The current solution of controlling the spread of weeds is through manual deweeding and using chemical products. The problem with this is that it can be tedious to the laborers, and the chemical products can cause damage to both the crops and the people that consume the crops.

Recently, the agricultural industry is implementing technology and autonomy as it helps decrease the manual labor and is a cost-effective solution. This year, our team is continuing to add on to the robotic crop weeder prototype that the previous two semesters' teams have designed. The previous teams have been able to develop a robotic cart that can be manually driven, containing a robotic arm and camera, which allows the weeds to be detected and pulled. This year, our team is working with Dr. Tan to implement a z-axis manipulator to allow for more accurate deweeding as well as a torch to ensure the weeds do not come back after they have been eliminated.



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Devon Thompson
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MSU ECE Robotics Lab
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Project Facilitator

Dr. Xiaobo Tan

MSU Offices of the Executive VP For Administration
Smart Hotel Cart System

Daily housekeeping service is standard in every hotel, but many of these services have key inefficiencies relating to the flow of information. One such example is in The Kellogg Conference Center and Hotel, where data regarding late arrivals, do not disturb, and cleaning status must be collected using multiple different systems by the front desk. Once at the front desk, cleaning instructions must be printed out on paper and handed to housekeeping personnel, and changes to this information are difficult to share effectively. Additionally, the staff must knock on a door to tell if a room is occupied and have no way of logging this information or sharing it with other personnel. Our team seeks to reduce these inefficiencies at The Kellogg Center with the development of a Smart Hotel Cart System. This system will use an electronic tablet as well as an occupancy sensor to streamline the flow of housekeeping information and provide real-time updates.

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Mitchell Loe
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MSU Offices of the Executive Vice President for Administration
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Kellogg Center

Joel Heberlein
Kellogg Center

Wolfgang Bauer
REHS

Vinnie Gore
REHS

Paul Heberlein
REHS

Project Facilitator

Dr. Selin Aviyente

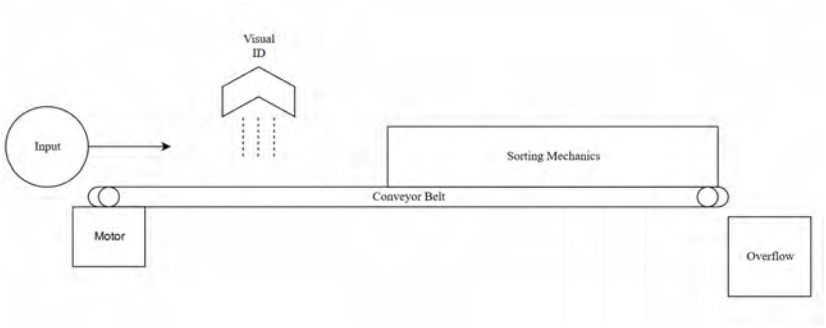
MSU Offices of Executive VP for Administration/ Office of the VP for Auxiliary Enterprise

Automation in the Dining Hall Dish Rooms

The Michigan State University dining hall dish rooms provide necessary functions to all on-campus MSU dining halls. Many of the tasks performed in the dish rooms are repetitive and time-consuming. The dish room staff have asked for help designing a process to increase productivity and speed of certain menial jobs.

Our team has been tasked with designing a system to process and sort dining hall utensils which will help increase efficiency while reducing the cost of manual labor. The focus for this system is to create a process which utilizes object recognition to detect silverware on a conveyor line, then sort the silverware into the proper storage units based on the type that was detected. The system will be designed to function in environments of high heat and humidity, while also having the capacity to operate for long periods of time.

For full functionality, the silverware must successfully pass through each phase of the above design. The key is proper visual recognition and timely removal of silverware from the belt into the appropriate bin.



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MSU Offices of the Executive Vice President for Administration / Office of the Vice President for Auxiliary Enterprise
Project Sponsor

Project Facilitator

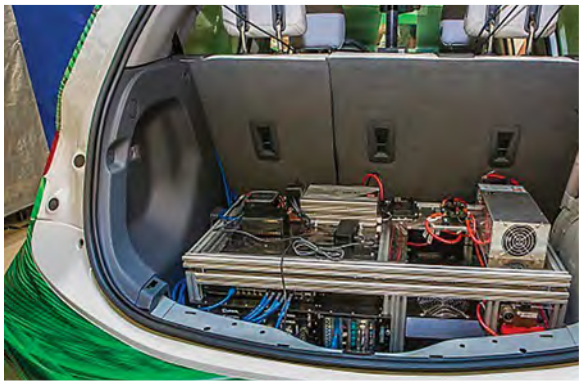
Dr. Jian Ren

CANVAS SOAR – AutoDrive Challenge
Data Logging and Diagnostic System

The AutoDrive Challenge is a collegiate level design competition created by General Motors and SAE International. As part of the competition, the MSU AutoDrive Team has been provided with a Chevrolet Bolt EV and is converting the vehicle into an SAE level 4 automated vehicle. This is an eight-university competition, and the team is currently in their third year. A key need the AutoDrive team has identified is an automated data logger and diagnosis system to give engineers insight into vehicle health and performance issues.

As a result of issues faced at the 2019 AutoDrive Competition, our team has been tasked with developing a low power, embedded computing system to log and analyze vehicle data. This data comes from the vehicle's 10-gigabit ethernet, from the in-vehicle CAN bus, and from inertial sensors around the car.

Ultimately, the system will publish frequently monitored data streams to a web server and will provide the AutoDrive Team with an effective way to diagnose future issues.



CANVAS SOAR
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Sai Katta
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Luanda, Angola

CANVAS SOAR
Project Sponsor

Project Facilitator

Dr. Daniel Morris

CANVAS SOAR – AutoDrive Challenge
Sensor Synchronization

In 2018, SAE International and GM partnered together to sponsor the AutoDrive Challenge. The goal of the challenge is to produce a Level 4 autonomous vehicle by 2020. Level 4 indicates that the vehicle is able to operate on its own, even to the point of moving through urban areas. If a driver misses a warning, the vehicle will take the safest course of action, such as pulling over at the earliest opportunity. The vehicle currently has five lidar sensors and six cameras, which are being used for basic autonomous driving.

The team has been challenged with developing a method of synchronizing each lidar sensor and camera so that they do not interfere with each other during operation. Lidars operating out of sync can cause discrepancies in scanning and can provide difficulties in interpreting the data. For example, objects could appear multiple times in an image set or scanned area.

A printed circuit board and software package will be designed to meet the required specifications from the customer. The PCB will provide power to the numerous lidars on the vehicle and take data from multiple sensors. The software package will synchronize the timing signal sent to the sensors.

CANVAS
SOAR
Student Organized Autonomy Research Club

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Mason, Michigan

Joe Friedland
Novi, Michigan

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Alpena, Michigan

Ben MacNeill
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Brandon Harris
Wyckoff, New Jersey

CANVAS SOAR
Project Sponsor

Project Facilitator

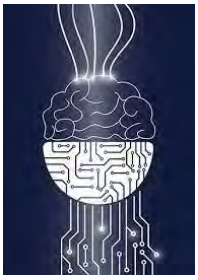
Dr. Daniel Morris

MSU CSANN Lab

Deep Neural Network-based Navigation Rovers for Sound/Video Classification

The deep neural network (DNN)-based methods are the dominant ways to solve image- and video-related classification and recognition. The DNN techniques are extensively applied in a variety of fields and subjects. Thinking and solving DNN engineering problems are becoming more and more popular. As long as big data can be collected and acquired, appropriately trained DNN modules accomplish classification fast and accurately.

Our team was tasked to implement the DNN modules on a proposed project. Two DNN modules will be applied on a human object recognition and hand gestures classification. Based on those, the picture will be taken and the background will be changed according to recognized hand gestures.



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MICHIGAN STATE UNIVERSITY

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Dachuang Zhang
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Chen Dai
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Xintong Xie
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Wei Jia Shi
Hunan, China

MSU CSANN Lab
Project Sponsor

Project Facilitator

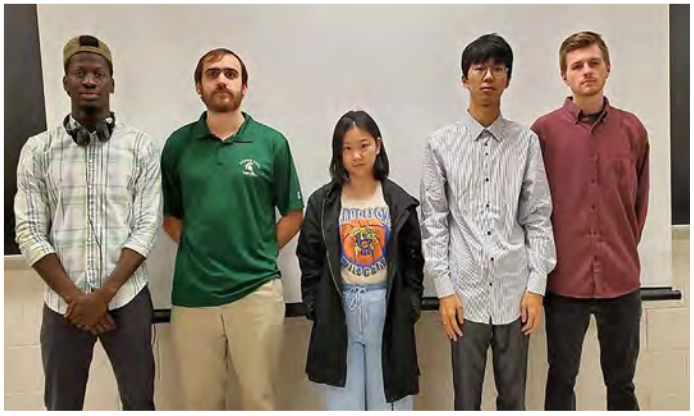
Dr. Salem Fathi

MSU Nondestructive Evaluation (NDE) Lab
Motorized, Waterproof X-Y Manipulator

The MSU Nondestructive Evaluation (NDE) lab contributes to creating sensors and systems that allow them to monitor and evaluate the structural integrity of parts and components using multiple test methods. Currently, they are using ultrasonic evaluation to conduct inspections and take measurements underwater. A manual X-Y manipulator is being used at the moment, which is time-consuming when trying to find the optimal position for ultrasonic evaluation.

Our team has been tasked with creating a motorized, waterproof X-Y manipulator in order to automate the ultrasonic evaluation process by sweeping the test area in order to scan for the best signal. The main focus of this project is to be able to motorize the X-Y manipulator while still maintaining a small footprint.

NDE Laboratory Michigan State University



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Zhiqi Hao
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Runyu Wang
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Luke Schuler
St. Charles, Illinois

MSU Nondestructive Evaluation (NDE) Lab
Project Sponsor

Sunil Chakrapani
Okemos, Michigan

Project Facilitator

Dr. Elias Strangas

Design Day Awards Spring 2019

Electrical & Computer Engineering Winners, Spring 2019

Prizes are awarded each semester to the most outstanding teams in the Electrical and Computer Engineering Senior Capstone Design Course, as judged by a panel of engineers from industry. A team with members from both ECE and another engineering major (mechanical engineering, for example) is also eligible, if the team's project is administered through ECE 480.

First Place: Team MSU Resource Center for Persons with Disabilities

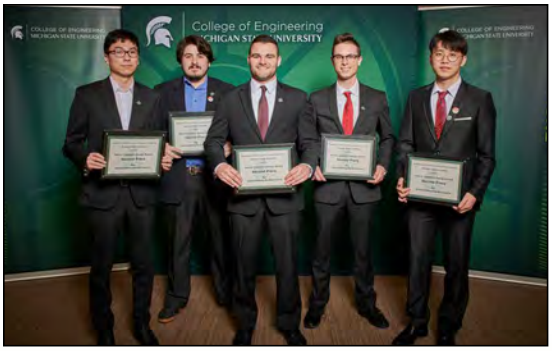
"Jungle Power Pod: A Photovoltaic Battery-Powered System for Common Portable Electronic Devices"

Left to right: Vaughn Holmes, Brendan Czarnecki, Madison Carriere, Will Briggs, Kerima Musanovic, Panashe Mayangamutse

Second Place: Team Michigan State University

"Robotic Crop Weeder"

Left to right: Ching-Ting Yeh, Eduardo Ramirez, Mike Kutzleb, Marcel Meijer, Shulin Xiang



Third Place: Team MSU Bikes Service Center/RCPD

"Intelligent Defense System: Hazard Detection and Collision Avoidance"

Left to right: Boyu Peng, Emanuel Costa, Alec Russell, Ziyu Lin, Scott Bingham, Parker Dodson

ME 412 Heat Transfer Laboratory

Yuping Wang
Academic Specialist
Department of Mechanical Engineering

Exploring Two-Phase Heat Transfer Devices

Heat transfer devices involving phase change are known to be highly effective and thus have been widely employed in various industries, such as aerospace, electronics, agriculture, manufacturing, etc. For this project, students are expected to understand two-phase heat transfer devices through two parts of work. For the major part, each team will design, build, and test a simple heat pipe to demonstrate its two-phase operation (evaporation/condensation) at low pressure. The design objective is to effectively remove heat from a liter of boiling water. For the secondary part, each team will conduct a review on heat pipes and other two-phase heat transfer devices, exploring their types, applications, performance, as well as some existing experimental/computational works about them. On the testing day, each team will have 15 minutes to set up, demonstrate, and dissemble their pipe. Liquid cooling will be provided for the testing, as well as temperature measurements. A vacuum pump will be available to lower the pressure inside the heat pipe. Each team will also prepare a power-point slideshow or video clip for the audience to explain their design decisions, analysis and operation of their device.

Competition Schedule

Time	Station	Team members
8:00	A	Eddie Kelly, Emily Money, Blade Swift, Nick Vanoost
	B	Hadi Al Naji, Jimmy Almacddissi, Alex Counseller, Zachary Wagner
8:15	A	Zach Daniels, Ryan Simon, Eric Stauffer, Jonathan Theoret
	B	Joe Brenton, Harrison Haynor, Mackenzie Meyers, Alison Reinhold
8:30	A	Jake Fosmoen, Tyler Gleason, Neil Haakenson, Danielle Rosebrook
	B	Brian Fedewa, Kevin Kinsey, Fanghan Lu, Alex Stangeland
8:45	A	Thomas Burke, Demarcus Gregory, Weiyu Li, Andrew Quang
	B	Michael Bowen, Brendan Frenczli, Muhammad Kamarudzaman, Jake Stuifbergen
9:00	A	Matthew Belknap, Carson Eby, Reed Hylka, Anthony Lafata
	B	Tyler Dubois, Derek Edwards, Ryan O'Quinn, Sterling White
9:15	A	Andrew Aziz, Allison Bell, Julia Lutz, Dillon McClintock, Morrice Morris
	B	Frank Biondo, Taylor Fuhrman, Rishi Gupta, Robert Mothersell
9:30	A	Grant Hoffman, Danny McGrail, Chase Rojeck, Wayne Wang, Yongi Yang
	B	Madison Begin, Austin Coha, Bella Henry, Michael Rettschlag
9:45	A	Cam Cabana, Sam Case, John Kalil, Conner Stevenson
	B	Tianyu Han, Jacob Sickelsteel, Zhiyao Wang, Foster Whipple
10:00	A	Mitch Cline, Lauren Lage, Garrett Weidig, Chase Wilterdink
	B	Zach Borgerson, Ethan Schrader, Dong Yang, Connor Zehr
10:15	A	Ahmed Alblooshi, Rachel Emerick, Laura Hohnstadt, Owen Ruster
	B	Chris Heilman, Ryan Heinze, Elizabeth Schester, Aaron Warstler
10:30	A	Leah Brickner, Olivia Hargrave-Thomas, Chelsey Jenkins, Hunter Moore
	B	Nick Houghton, Hyang Kim, Zach Kraut, Josh Theis
10:45	A	William Hahm, Jay Lee, Vincent Pernicano, Chizun Zou
	B	Emma Curd, Spencer Goosen, Michael Mazza, Alexander Pomaville
11:00	A	August Butzke, Patch Floyd, Trystan Melnyk, Spencer Rinke
	B	Amarildo Alijaj, Jordan Odehnal, Kurtis Potier, Warren Purvin
11:15	A	Jacob Keller, Molly McClorey, Lucas Serraiocco, Nick Stein
	B	Albert Asta, Brenden Carter, Christopher Fadanelli, Tomo Saito
11:30	A	Justin Carbary, Levi Graves, Michael Schultz, Zak Woods, Gabrielle Zapolnik
	B	Michelle Huang, Chad Winner, Derek Wittenberg, Yifan Zou

8:00 a.m. - Noon Engineering Building, Room 1345 | First Floor

ME 470 Mechanical Design & Manufacturing II

Michael Lavagnino
Academic Specialist
Department of
Mechanical Engineering

Pick and Place Race

The goal in this project is to design a machine that can ink a stamp and then stamp a piece of paper in a quick, clean, and accurate manner. The teams will utilize mechanisms such as 4-bar linkages, gear sets, and cam-follower systems. Each team manufactured or utilized 3D printing to create the majority of their components. Performance will be measured by the speed by which each device can transfer ink to paper in an accurate and clean stamping process.

Time	Team	Station	Team members
8:00	1	A	Matthew Arenz, Ryan Ball, Mike Falter, Liam Kelly, Josh Peckens
	1	B	Michael Brannon, Bradley Harris, Chris McGinnis, Ben Washington, Sterling White
8:10	2	A	Naif Alzahrani, Niranjan Kulkarni, Connor Quigg, Haoran Zhang, Lucas Zheng
	2	B	Brenden Carter, Alyse Richards, Alyssa Salciccioli, Jayme Stiglich, Derek Wittenberg
8:20	3	A	Sadab Bahar, Lindsay Goodrich, Radhika Murgai, Mausam Patel, Haoyang Zhang
	3	B	Tyler Dubois, Kayla Gibbs, Justin Gilgallon, Helen Miller, Taylor Ruelle
8:30	4	A	David Abatan, Zak Kubiak, Collin Lynch, Justin Stasevich, Ben Vitek
	4	B	Jordan Bommarito, Spencer Goosen, Robert Hernandez, Grant Hoffman, Brett Howe
8:40	5	A	Devan deJong, Jack Rees, Michael Rettschlag, Jeremy St. Pierre, Lucas Walsh
	5	B	Amarildo Alijaj, Rourke Brummette, Devon Killebrew, Jake Stuifbergen, Charlie Tappan
8:50	6	A	Austin Aselage, Matt Bergdolt, Ryan Kalis, Alex Kintner, Alex Overholser
	6	B	Joseph Abbawi, Michael Bowen, Chris Heilman, Matt Rice, Michael Schultz
9:00	7	A	Brian Chan, Yash Gupta, Weiyu Li, Xiaoyu Xiong, Volkan Yildirim
	7	B	Ghali Alwajih, Adam Goodes, Jacob Morrison, Tariq Salim, Dennis Volostnykh
9:10	8	A	Christian Abbate, Minir Jakupi, Ross Kelly, Paul Sytsma, Moe Tabateh
	8	B	Nik Buchholz, Abbey Bugenske, Gregorio Gaio, Nadine Twal, Brent Weakland
9:20	9	A	Cam Cabana, Jacob Keller, Garrison Osborne, Kyle Woods, Hannah Wyatt
	9	B	Devin Cao, Hongxiang Chang, Robert Mothersell, Foster Whipple, Connor Wilson
9:30	10	A	Alex Counseller, Christopher Fadanelli, Taylor Jacobs, Nehemiah Mork, Gabrielle Zapolnik
	10	B	Tyler Gleason, Kevin Kinsey, Trystan Melnyk, Stephen Oberheim, Noah Rimatzki
9:40	11	A	Zahji Billingslea, Mia Gilreath, Owen Jarl, Ethan Schrader
	11	B	Wyatt Beachy, Brandon Chan, Todd Myers, Jin Zhang
9:50	12	A	Jimmy Almacddissi, Jake Fosmoen, Paul Han, Josh Theis, Joe Troy
	12	B	Sam Addy, Scott Anthony, Evan Drew, Nick Pak, Zijing Wu
10:00	13	A	Adam Bolyard, Austin Coha, Devon Davenport, Ryan Fantin, Joe Hegger
	13	B	Rachel Arnold, Michelle Huang, Kyle Raymo, Pankti Tank, Nic Weller
10:10	14	A	Gi Lee, Yeeun Lee, Mikayla Nitoski, Tim Ohtake, Fangao Shi
	14	B	Marcell Benkes-Toth, Neil Haakenson, Humphrey Han, Dylan Lott, Ben Merrill
10:20	15	A	Cameron Barghahn, Latif Bouda, Jeremy Coleman, Dave Kumiega, Caden Swindell
	15	B	Rachel Emerick, Tianyu Han, Karl Havens, Stephen Sutherland, Claire Trygstad
10:30	16	A	Sean Labadie, Dominic Rende, Brendan Rybicki, Aaron Warstler, Elias Zepeda-Barragan
	16	B	Jacob Bruner, Andrew Hallam, Matthew Rightor, Audrey Schroeder, Megan Weiss
10:40	17	A	Madison Begin, Paul Beiter, Mira Crain, Steven Dubey, Gabbie Wink
	17	B	Justin Carbary, Zachary Kupa, Nuno Marriott, Andrew Quang, Leah Williams
10:50	18	A	Melissa Karas, Hunter Moore, Daniel Quinn, Natalie Schlesinger, Stephen Wernette
	18	B	Harrison Haynor, Danielle Keusch, Alex Kraski, Emily Oswald, Cameron Ploss
11:00	19	A	Emma Curd, Julia Lutz, Scott Maxey, Zhiyao Wang
	20	B	Andrew Mizer, Vincent Pernicano, Alexander Pomaville, Randall Sawyer, Thomas Smither

11:15-12:00: The top teams compete in a tournament style competition to determine the fastest stamper!

The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Faculty Advisors: Averill, Grimm, Koochesfahani, Naguib, and Segalman


Averill


Grimm


Koochesfahani


Naguib


Segalman

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:00 a.m.	Michigan AgrAbility	Automatic Gate Opener
8:30 a.m.	Heartwood School/Ingham ISD	Adapt-A-Step
9:00 a.m.	Heartwood School/Ingham ISD	Bus Safe Climbing System
9:30 a.m.	MSU IPF Landscape Services	Salt Brine Development
10:00 a.m.	Swagelok	Universal Cylinder Clamp
10:30 a.m.	MSU Recycling Center	Food Waste Cart Coating
11:00 a.m.	ME Department	Dynamometer for Electric Bicycle (Joint Project with ECE 480)

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 support of this semester's project sponsors: ArcelorMittal, CANVAS SOAR– Autodrive Challenge, Consumers Energy, Flash Steelworks, Inc., Ford Motor Company, Heartwood School/Ingham ISD, Kautex Textron, Michigan AgrAbility, MSU Adaptive Sports & Recreation Club, MSU Department of Mechanical Engineering, MSU Department of Theatre, MSU IPF Landscape Services, MSU MTRAC, MSU Recycling Center, MSU Smart Microsystems Laboratory, Swagelok, and Whirlpool Corporation.

Michigan AgrAbility
Automatic Gate Opener

The vision of AgrAbility is to enhance the quality of life for farmers, ranchers, and other agricultural workers with disabilities, so that they, their families, and their communities continue to succeed in rural America. Farm gates leading to animal pens and pastures must be opened multiple times per day. Farmers with leg injuries, arthritis, or other disabilities can have significant difficulty climbing on and off a tractor several times to open gates. Often, animals may get outside the gate during this process as well, prolonging farm tasks. This could be made significantly less strenuous if farmers could instead open them from the comfort and safety of their tractor seats.

Our team focused on designing and manufacturing an automatic gate opening system that can easily be installed on a wide variety of gates that can be used by agricultural workers across Michigan and the United States. The gate opener consists of an actuator connected to the gate operated by a button-push similar to a garage door opener. The final product has strong product viability due to its low cost, component accessibility, and ease of installation relative to market competitors.

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Joe Gusumano
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Jeffrey Masten-Davies
Okemos, Michigan

Maria Daniela Martin Pereira
Lara, Venezuela

Ryan Qamar
Midland, Michigan

Michigan AgrAbility
Project Sponsor

Ned Stoller
Grand Rapids, Michigan

ME Faculty Advisor

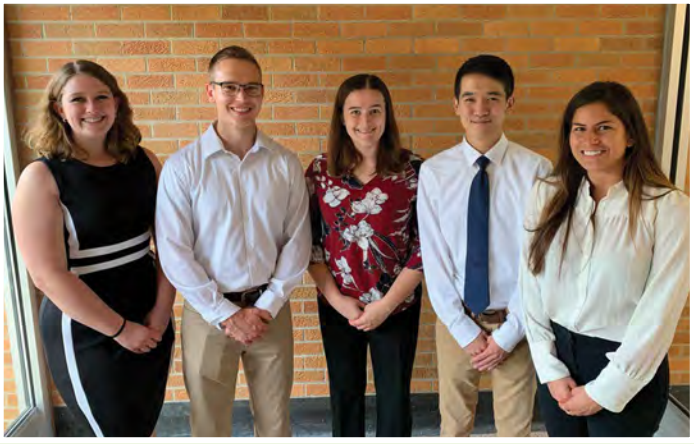
Dr. Ron Averill

Heartwood School/Ingham ISD
Adapt-A-Step

Heartwood School, located in Ingham County, serves ages 2 ½ to 26 year olds with moderate to severe cognitive impairments and severe physical impairments. Many of the younger students have not developed the ability to walk up and down the bus steps when they start school. As these students get stronger, they need to be able to practice climbing stairs several times before they can safely climb independently. This is a difficult process for the students from a cognitive and physical standpoint. Obstacles these students face are ascending the initial bus step, descending the initial bus step, and having a safe hand hold while ascending and descending the bus steps.

Our team has been asked to create a device that will help these students access these steps safely. The device utilizes an adaptable step system that will reduce the height of the first bus step to the ground. This device also incorporates a rail system that assists the students with stability when they climb up the stairs. This device must withstand a safe load, be easy to set up, and must be safe for the students to use.

Ingham Intermediate School District
A Regional Educational Service Agency



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Mason, Michigan

ME Faculty Advisor

Dr. Michele Grimm

Heartwood School/Ingham ISD
Bus Safe Climbing System

Heartwood School in Ingham County helps students with moderate to severe cognitive impairments and severe physical impairments. These impairments require the students to have close supervision at all times during mobility activities. The school's physical therapists and teaching staff are often putting themselves at risk for injury while helping to prevent students from falling when the students are navigating the bus stairs. The staff at Heartwood currently assists students from the top and bottom of the bus steps. These positions are not ideal because they require the caregivers to work in unfavorable ergonomic positions that put them at risk for injury. In addition, the current loading/unloading procedure is not ideal for the students because they are often given a large amount of assistance while being rushed up/down the steps, which takes away their ability to learn to navigate the stairs on their own to become independent in gross motor skills. The proposed bus climbing system would not replace the caregiver but would instead allow the caregiver to stand a short distance away to help the students build confidence in their motor skills while keeping both the caregiver and students safe. The staff at Heartwood envisioned a safety belt system that could be used to help support the students as they climb up and down the school bus steps and prevent falls while the hands of the caregiver are free to direct and fine tune movements. Our team designed and built a system that can provide varying levels of assistance to students while they are navigating the bus stairs. This system must catch students if they fall and must be able to support the largest students at the school. This system must also be easy to set up and be transferable between the various bus models that are utilized by Heartwood School.

Ingham Intermediate School District
A Regional Educational Service Agency

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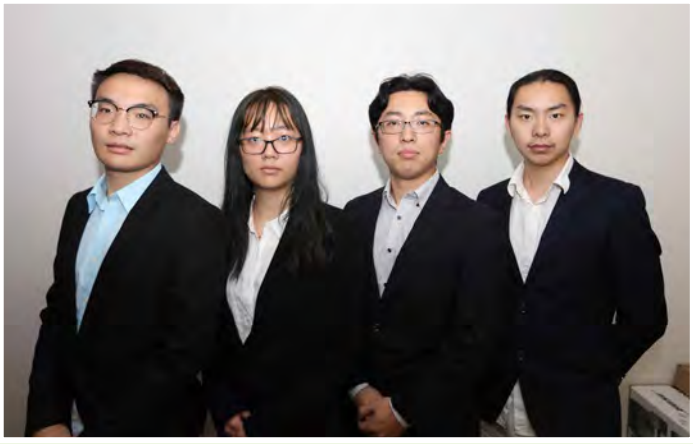
Dr. Manoochehr Koochesfahani

MSU IPF Landscape Services
Salt Brine Development

The Infrastructure Planning & Facilities Landscape Services Department (IPF) is in charge of maintaining all campus sidewalks, roads, parking lots, and parking ramps on campus. For years, Landscape Services has used a salt brine mixture made by MSU and "Liquid Snow Shovel" (a commercial solution bought from a company) as a pre-treatment for sidewalks and roadways to lower the usage of salt and keep snow and ice from adhering to the surface. However, IPF is facing several problems when dealing with lower pavement temperature and high costs for de-icing materials.

The first problem was the freezing point. When pavement temperatures get colder than 15°F, the brine mixture is less effective, causing IPF to apply more salt to campus hard surfaces. The second problem was corrosion due to the brine mixture and salt application. The main component of the brine mixture is rock salt, which deteriorates campus infrastructure and causes high maintenance cost to maintain equipment due to corrosion. A product that is available on the market called "Liquid Snow Shovel" has a lower freezing point and less corrosive effects than the brine mixture, but it caused the third problem, which was a high unit price of $2/gallon, while the brine solution made in-house costs $0.06/gallon. The project sponsor (IPF) required our team to find a new solution, which fulfilled the following requirements: freezing point less than 15°F and unit price less than $1/gallon. The success of this project would decrease the cost of winter maintenance and reduce the negative environmental impacts of salt. The project was successful.

INFRASTRUCTURE
PLANNING AND FACILITIES
MICHIGAN STATE UNIVERSITY



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MSU IPF Landscape Services
Project Sponsor

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ME Faculty Advisor

Dr. Manoochehr Koochesfahani

Swagelok
Universal Cylinder Clamp

Swagelok, a global company with headquarters in Solon, Ohio, is a well-known supplier of fluid systems components, that include fittings, valves, hoses, tubing, regulators, and cylinders. This diverse product lineup allows Swagelok to supply its customers with everything needed to establish a fluid process setup. Swagelok has over 200 sales and service centers in 70 countries. The company's mission is to push the boundaries of what is possible. They are always looking for a better way to improve customer experience through innovation and improvement of their products. It is this drive for innovation that has led Swagelok to seek improvements for their cylinder clamp mechanism. Cylinders are often mounted as part of a closed-loop sampling system that is used in facilities for operators to safely sample fluids.

Our team has designed a universal cylinder clamping solution capable of effectively mounting cylinders of various dimensions. This design supports cylinders with a base weight of up to 20 pounds and a significantly higher total weight when filled with process fluids. This design allows for ease-of-use in inserting and removing cylinders from the process area, while ensuring the safety of both the operator and the cylinder itself by providing support so that the operator does not drop the cylinder and cause harm. The clamp maintains functionality for operating temperatures of up to 300 degrees Fahrenheit.

Swagelok®

Swagelok Michigan | Toledo

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Farmington Hills, Michigan

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MSU Recycling Center
Food Waste Cart Coating

Every day food waste is produced in large quantities across the Michigan State University campus. In order to reduce the University's carbon footprint, food waste is collected in order to be composted. The cleaning process of food waste containers occurs at the MSU Recycling Center. Bins are raised individually by a mechanical lift that angles the food waste bin into a large food waste dumpster. The bin is angled so that food can fall out into the dumpster, but this is not sufficient to rid the bins of food waste. A heated power washer is used to remove any remaining food waste and simultaneously clean the bins for reuse. It typically takes at least 5 minutes to completely clean a single bin.

Our team focused on evaluating the current process to research and recommend solutions to reduce the time spent on washing food waste bins. Various non-stick coatings were tested to see if they performed well with food waste on the HDPE containers. The success and implementation of the methods suggested should have an impact on the washing time of the bins and thus lower the cost of the cleaning process.

Surplus Store and Recycling
managing waste as a resource

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MSU Recycling Center
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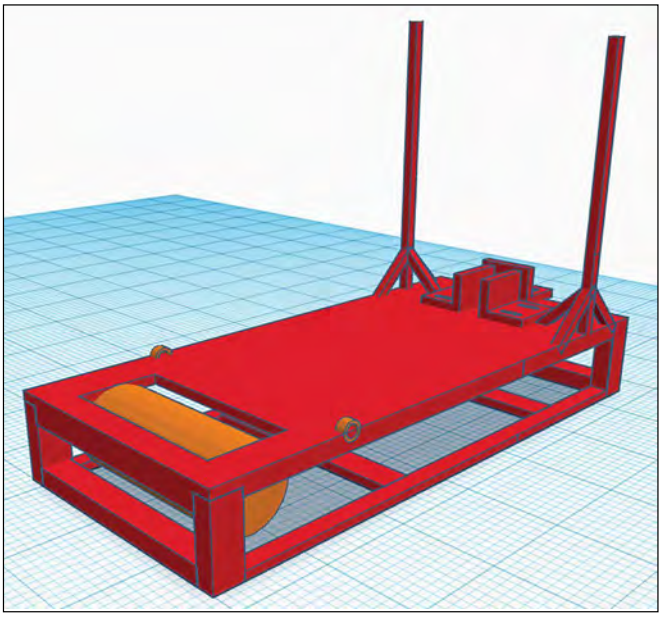
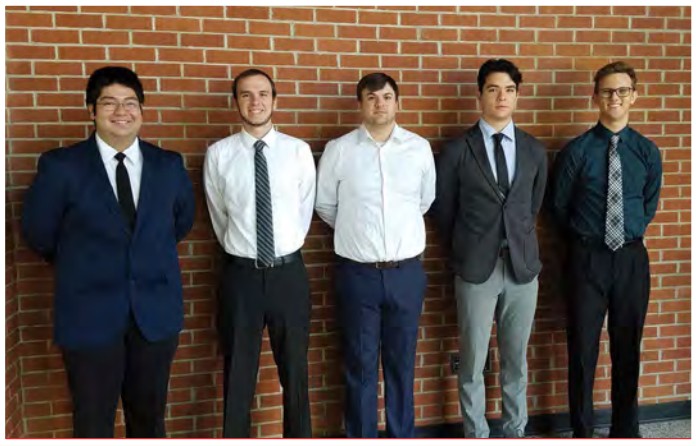
MSU Department of Mechanical Engineering
Dynamometer for Electric Bicycle

The Michigan State University Department of Mechanical Engineering works on a wide variety of research projects. One of these projects focused on an electric bicycle and the method in which it is powered. An electric bicycle has two potential power sources: a human operator and a motor. System controls and sensing strategies for the electric bicycle, as well as motor controls evaluation were required to ensure that the two power sources were able to interact smoothly over varying operating conditions.

Our team was tasked with creating a dynamometer to test the power output of the electric bicycle. The dynamometer works by attaching the power outputs of the bike to a measurement system, which is able to find the power of the bicycle. This can be through the rear wheel, as the motor of an electric bicycle and the pedaling both translate torque into the rear wheel. This is then connected to an electric motor, which can incur resistance to the wheel at varying amounts. The dynamometer was designed to operate with multiple simulated conditions (inclines and speeds) as well as varying masses of riders and electric bikes. The varying amounts of resistance can simulate these conditions. The goal of this design is to safely secure a wide range of electric bikes onto the device and for the system to operate under three power conditions: the motor alone, the rider pedaling with no motor assistance, and the rider pedaling with motor assistance.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



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ME Faculty Advisor

Dr. Daniel Segalman

The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering

Faculty Advisors: Baek, Brereton, Reid-Bush, Engeda, Jaberi, Pence, and Wright


Baek


Brereton


Reid-Bush


Engeda


Jaberi


Pence


Wright

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Adaptive Sports & Recreation Club	Sled Hockey Transfer Platform
8:30 a.m.	Michigan AgrAbility	Shop Door Hoist
9:00 a.m.	ArcelorMittal	In-Line Oil Measuring Device
9:30 a.m.	CANVAS SOAR – Autodrive Challenge	Autonomous Vehicle Sensor Integration
10:00 a.m.	MSU IPF Landscape Services	Autonomous Mowing and Snow Removal
10:30 a.m.	Whirlpool Corporation	Self-Cleaning Dryer Water Pump Test Stand
11:00 a.m.	Flash Steelworks, Inc.	Flash Processing Rotational Fixture

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 multiple 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.

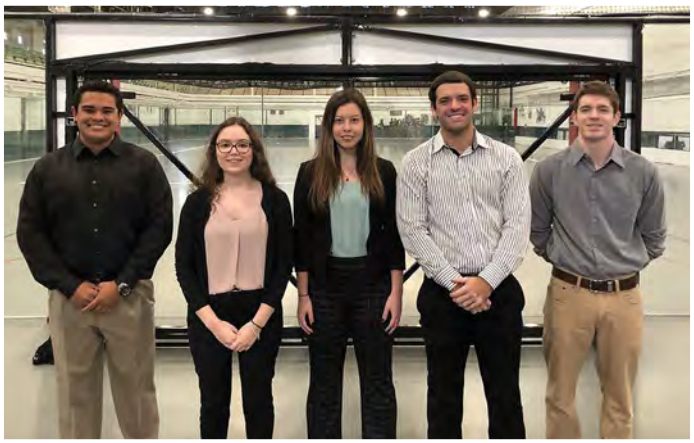
The ME faculty who supervised ME 481 design teams this semester are: Ron Averill, Seungik Baek, Andre Benard, Giles Brereton, Tamara Reid-Bush, Abraham Engeda, Michele Grimm, Farhad Jaberi, Manoochehr Koochesfahani, Peter Lillehoj, Norbert Mueller, Ahmed Naguib, Thomas Pence, Joerg Petrasch, Daniel Segalman, Elisa Toulson, Neil Wright, and Xinran Xiao.

MSU Adaptive Sports & Recreation Club
Sled Hockey Transfer Platform

The MSU Adaptive Sports & Recreation Club is a Registered Student Organization that was established in 2014 as a free program that is open to athletes with physical disabilities, able-bodied volunteers, and academic projects personnel, who are MSU students, employees, alumni, and members of the Greater Lansing community. The program seeks to create and cultivate a physically and socially acceptable space where athletes with physical disabilities and able-bodied volunteers come together to establish an integrated community of peers. The program uses sports to validate the disability experience by eradicating inaccurate societal stereotypes and invalid self-perceptions about disability, while promoting physical and personal health goals. The program adopts a self-determination approach that focuses on athlete autonomy, competence, and relatedness as key facilitators in the process of acquiring self-efficacy in the area of sports and physical activity; skills that can be transferred to other life domains.

Our team focused on designing a sled hockey transfer platform that increases player safety and independence during transfer to/from personal assistance mobility equipment (e.g., wheelchair, walker, etc.) to a roller hockey sled. The design needed to be mobile, portable, compact, and most importantly, universal, to accommodate a wide range of users presenting various levels of physical function.

Michigan State University
Adaptive Sports & Recreation Club
Est. 2014



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MSU Adaptive Sports & Recreation Club
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East Lansing, Michigan

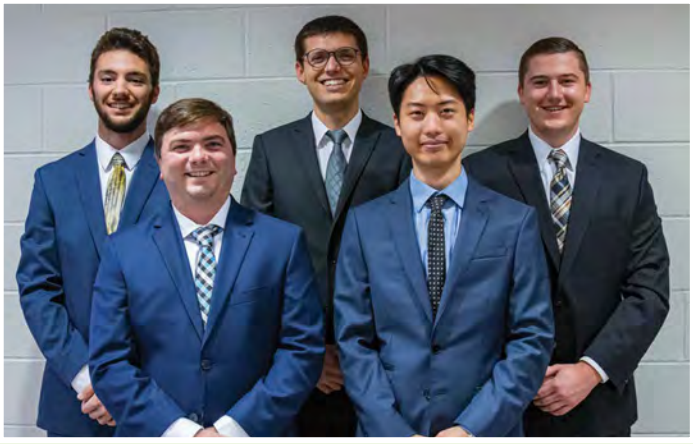
ME Faculty Advisor

Dr. Tamara Reid-Bush

Michigan AgrAbility
Shop Door Hoist

Michigan AgrAbility is an organization that aims to improve the quality of life of agricultural workers with disabilities. AgrAbility does this is by developing innovative products that provide the assistance needed to accomplish daily work.

To that end, our team was focused on designing and manufacturing an inexpensive shop door hoist that reduces the lifting weight of overhead doors for farmers with physical limitations. The door opener consists of a pulley and bracket system powered by an electric cable winch. The manufacturing cost of this solution is low, providing an excellent alternative to expensive commercial door openers.



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ArcelorMittal
In-Line Oil Measuring Device

ArcelorMittal is the world's leading integrated steel and mining company - present in 60 countries with an industrial footprint in 18 countries. Melted down iron ore pellets are cast into sheets and rolled into coils (pictured to the right) that can weigh between 50,000 and 80,000 pounds each. The steel coils are moved down a "pickle" line where oil is applied to prevent rust. Different amounts of oil are needed depending on the customer specifications. Currently, the process is monitored and controlled by a single person, causing issues with accurately identifying the amount of oil being applied on the pickle line at any given time.

Our team has been given the opportunity to create a more efficient and automated method for identifying the amount of oil being applied. We have been asked to provide a quote for an oil measuring device as well as to design an ergonomic mount for the device that will allow the device to be easily removed from the line and worked on. The successful completion and implementation of our team's design solution has a yearly cost-saving potential of >$1M.

ArcelorMittal

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ArcelorMittal
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Dr. Giles Brereton

CANVAS SOAR – AutoDrive Challenge
Autonomous Vehicle Sensor Integration

In 2017 the Society for Automotive Engineering (SAE), in partnership with General Motors, announced the AutoDrive Challenge. Eight universities were invited to compete in a three-year cycle of design, creation, and test-based competition of an autonomous vehicle. MSU was one of the eight invited schools. Each school was provided a Chevy Bolt and tasked with making it SAE Standard Level 4 Autonomous by the end of year 3. This will include navigating through urban driving scenarios and properly dealing with dynamic and static objects, as well as recognition of traffic control lights and signs. The MSU AutoDrive effort is coordinated through a student organization housed in the College of Engineering and consists of three main sub-teams: Mechanical, Software, and Electrical.

As a part of the Mechanical sub-team, we were tasked with designing weatherproof enclosures and thermal resistant mounts that are capable of resisting everyday environmental hazards such as bumps, debris, acceleration, and various weather conditions. Our sensor housing consists of one camera and one radar on each side of the car mounted between the side mirror and the front tires. It also has three radars built into the front fascia of the vehicle, and one camera centered there. The final design effectively provided dependable mounting to the vehicle with minimal vibrational impact considering the system's operations and any automotive environment. Additionally, weather resistant material was used and a cooling system was integrated for the sensors due to high ambient operating temperature conditions.

CANVAS SOAR

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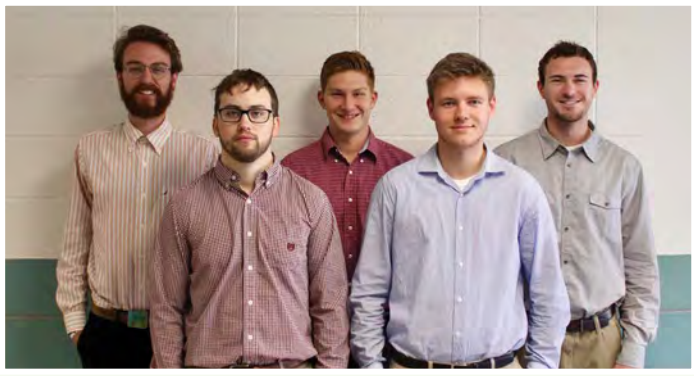
MSU IPF Landscape Services
Autonomous Mowing and Snow Removal

Michigan State University Infrastructure Planning and Facilities Landscape Services Department is responsible for many services. Of these services, lawn mowing and snow removal take up a considerable amount of time and money. Landscape Services mows 1500 acres of greenspace in the warm months and, during the winter, is responsible for maintaining 57 lane miles of roadways, 220 acres of parking lots, 113 miles of sidewalks and seven parking garages. To assist in maintaining these spaces all year round, MSU IPF purchased the first SnowBot Pro in January 2019. The autonomous vehicle from Left Hand Robotics, Inc. has the ability to perform snow removal and lawn mowing.

Our team was tasked with taking the necessary steps to ensure the safety and reliability of the SnowBot Pro on campus. With its 63-inch mowing deck, the robot mows three acres per hour. Although this is slower than human operators, it allows Landscape Services employees to spend more time on non-trivial tasks such as fertilizing. In the winter, the SnowBot Pro is equipped with a salter and broom that can clear sidewalks 14 times faster than a human. The GPS-guided robot uses radar and lidar sensors to detect nearby objects and react accordingly. Our team was challenged with creating a functional safety plan to establish success criteria that was sent to Risk Management for approval before the robot's deployment on campus. With multiple scenarios, objects, and conditions, a testing plan was created and executed to statistically evaluate the safety of the robot.

INFRASTRUCTURE
PLANNING AND FACILITIES
MICHIGAN STATE UNIVERSITY



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MSU IPF Landscape Services
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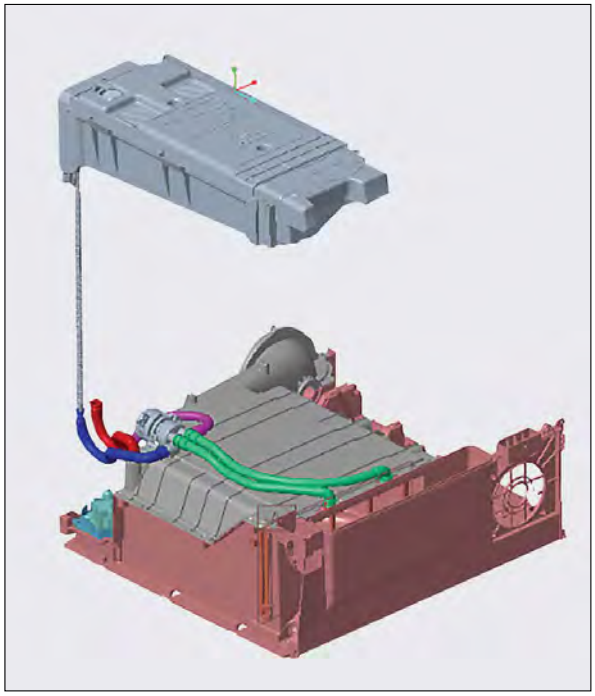
Dr. Farhad Jaberi

Whirlpool Corporation
Self-Cleaning Dryer Water Pump Test Stand

Founded in Benton Harbor, Michigan, Whirlpool Corporation has a century-long history of designing and manufacturing household appliances. Starting in 1911 with a wringer washing machine, the company has expanded its product portfolio to include dryers, dishwashers, ranges, and a myriad of other products sold under its own name, as well as under brands like Maytag, KitchenAid, and Jenn-Air.

Our project was to design and implement a testing stand for the self-cleaning filter system in a heat pump dryer. This test stand was then used to collect data to aid Whirlpool in assessing the robustness of the system's water pump to lint ingestion. Stretch goals were also set and included the optimization of critical pump components, such as the impeller, pump cover, priming holes, and bearings, in order to further increase their robustness to lint ingestion. The knowledge gained from this project is being used by Whirlpool to improve the quality of its self-cleaning filter subsystems, which will provide its customers with more positive experiences with their energy efficient appliances.



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Jonathan Theoret
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Whirlpool Corporation
Project Sponsor

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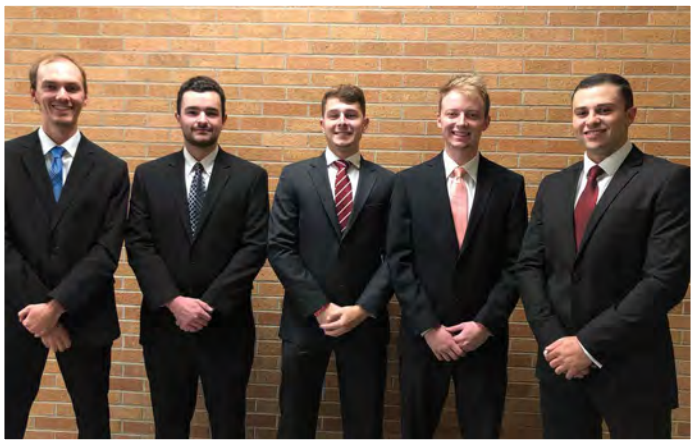
ME Faculty Advisor

Dr. Abraham Engeda

Flash Steelworks, Inc.
Flash Processing Rotational Fixture

Flash Steelworks is a R&D firm specializing in the development of advanced high strength steel. The company was founded by CTO Gary Cola and is known for its patented Flash Bainite ultra-fast heat treating process, which is proven to produce the highest performing steel on the market. Their extremely lightweight and high yielding steel is currently being applied to a select few industries: transportation, military applications, and infrastructure. Their Flash product allows engineers to design vehicle components, armor plating, and building components with steel that is stronger, thinner, lighter, more weldable, and less expensive than the competing top steel manufacturers.

Flash Steelworks presented a project that consists of designing and manufacturing a test apparatus capable of fixturing, rotating, and water-spraying a radially symmetric piece of steel. Flash Steelworks intends to use this test fixture for steel automotive rims, bowls, helmets, and other similar geometries. The prototype was designed to rotate a mass of no more than five pounds at 360 RPM. Due to safety concerns and the cost of induction heating equipment, our team took the results of this project and implemented the electric induction component on its own.



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Dr. Neil Wright

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Professor of Mechanical Engineering

Faculty Advisors: Benard, Lillehoj, Mueller, Petrasch, Toulson, and Xiao


Benard


Lillehoj


Mueller


Petrasch


Toulson


Xiao

Presentation Schedule – Engineering Building, Room 1300 (10:55 a.m. in Room 2205)

Time	Team Sponsor	Project Title
8:00 a.m.	Consumers Energy	Modular Gas Lower Explosive Limit Sensor
8:30 a.m.	Ford Motor Company	Parasitic Loss Test Data Processing
9:00 a.m.	Kautex Textron	Machine Simulation & Functionality Study
9:30 a.m.	MSU MTRAC	Non-Clogging Fungal Filter for Harvesting Microalgae
10:00 a.m.	MSU Department of Theatre	Fitting Stand
10:30 a.m.	MSU Department of Theatre	Honeycomb Deck Testing
10:55 a.m.	MSU Smart Microsystems Lab (Note: This presentation takes place in Room 2205)	Snake Robot for Inspection of Small Diameter Pipelines (Joint project with ECE. See page 63 of this booklet)

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.

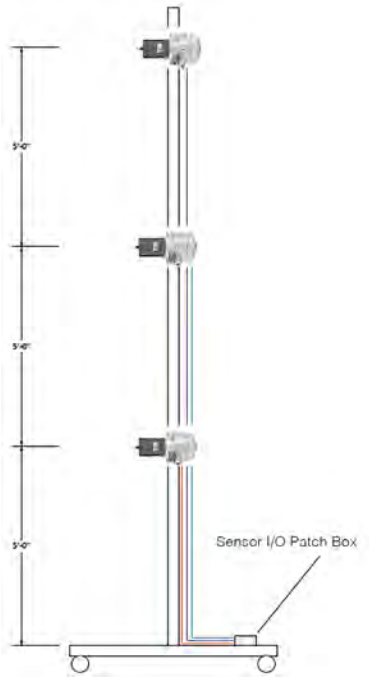
A second ME 481 Capstone award is given to the team that gives the best technical project presentation. The importance of communication of scientific and engineering ideas cannot be understated, and it is for this reason that we make the ME 481 Project Presentation Award. Award winners typically will 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.

Consumers Energy
Modular Gas Lower Explosive Limit Sensor Array

The Gas Asset Management team of Consumers Energy works to provide natural gas to 1.8 million customers throughout Michigan's Lower Peninsula. Their network includes numerous stations and nearly 30,000 miles of pipelines. Public and employee safety is the foundation of Consumers Energy, which delivers 356 billion cubic feet of gas annually. To ensure proper transport, monitoring equipment is used to test and measure gas concentrations.

While Consumers Energy can readily test gas concentrations at their stations, it does not yet have a portable solution for multi-point simultaneous testing. Our team's project was to design, build, and assemble a prototype that could provide a 15-foot tall mobile vertical support for three lower explosive limit (LEL) sensors. These LEL sensors can measure combustible concentrations by analyzing plumes of gas using infrared detection sensors. To power the sensors, we used a junction box mounted on the base of the stand that connects to a data acquisition system. Additional requirements ensured that the array could withstand wind speeds of up to 30 mph and could be assembled in 30 minutes or less. Outside of functionality, the largest concerns were sturdiness, ease of assembly, cost, and disassembled size.



Consumers Energy
Count on Us

Michigan State University
Team Members (left to right)

Trevor Dame
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Ahmed Alblooshi
Alain, United Arab Emirates

Zach Borgerson
St. Joseph, Michigan

Faris Alghool
Dammam, Kingdom Saudi Arabia

Wayne Wang (Not pictured)
Stalingrad, Russia

Consumers Energy
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Kyle Brayton
Jackson, Michigan

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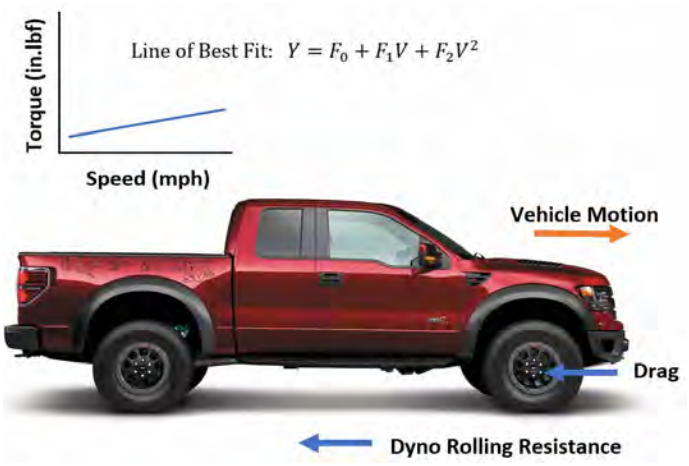
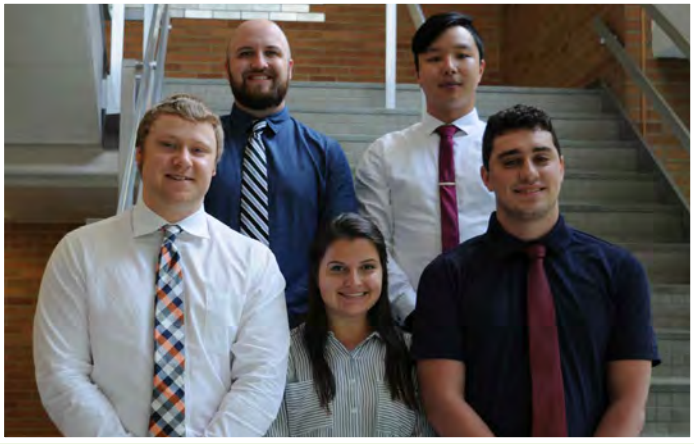
Dr. Elisa Toulson

Ford Motor Company
Parasitic Loss Test Data Processing

Ford Motor Company, with headquarters in Dearborn, Michigan, is a global leader in passenger and commercial vehicle design and production. Parasitic Loss testing is conducted at the Allen Park Test Lab, in Allen Park, Michigan. Parasitic Loss testing determines the frictional losses in the drivetrain system. The drivetrain friction is added to other vehicle losses to determine the total road load of the vehicle, which is required in order to test the vehicle on a dynamometer to prove it meets emission and fuel economy standards.

The focus of this project was to create a software program with a flexible, user-friendly interface to analyze the relationships between temperature, wheel speed, and wheel torque during a test that simulates the SAE J2263 coast-down test on a dynamometer. This program was to be flexible enough to tolerate different indices of varying torque, speed, and temperature inputs and different lengths of coast-down times. Various software already available to Ford were investigated as possibilities to achieve the project goals. After selecting a software, our team spent time learning the coding language of the software and then determined the best way to utilize the software capabilities to process the data. The developed program is capable of organizing raw data from multiple test runs into a tabular output format, providing a flexible graph of compiled data, and fitting a polynomial to the data.





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Lauren Lage
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Nate Lewis
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Mitchell Morin
Canton, Michigan

Ford Motor Company
Project Sponsor

John Cerone
Allen Park, Michigan

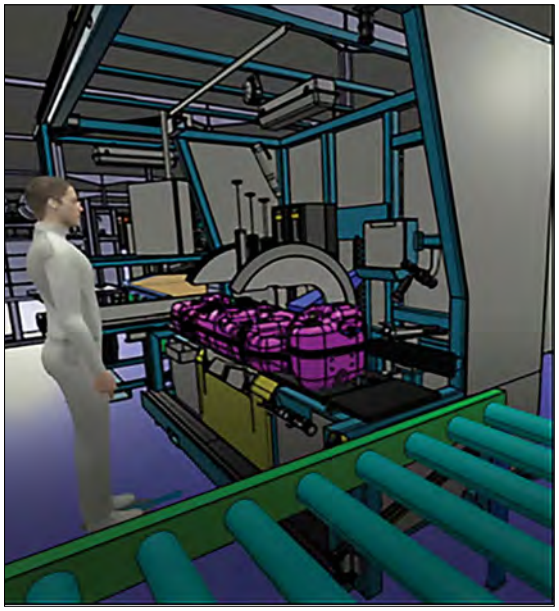
ME Faculty Advisor

Dr. Peter Lillehoj

Kautex Textron
Machine Simulation & Functionality Study

Kautex, a Textron Company, is one of the 100 largest automotive suppliers in the world in terms of sales volume. Kautex is a world-renowned company with more than 30 facilities in 14 countries. Kautex develops and produces blow-molded fuel systems, selective catalytic reduction systems, clear vision systems, engine camshafts, and plastic industrial packaging solutions.

Our team was asked to create the kinematics of the machines Kautex uses on their assembly production lines in several facilities. The CATIA 3D models, given by Kautex, are used to show static plant layouts and production flow simulations. We looked to improve these plant layouts and production flow simulations by bringing kinematic design to the existing 3D models of machines.



KAUTEX
A Textron Company

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Mohammed Alneyadi
Alain, United Arab Emirates

Brent Diamond
Brighton, Michigan

Hyang Kim
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Dong Yang
Hangzhou, China

Kautex Textron
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Alexandra Nowak
Troy, Michigan

ME Faculty Advisor

Dr. Norbert Mueller

MSU MTRAC
Non-Clogging Fungal Filter for Harvesting Microalgae

The MSU MTRAC program takes research done in a laboratory and translates that research into commercial products through licensing and startups. Dr. Du and Dr. Bonito's research with using fungi to harvest microalgae is funded by the MSU MTRAC program. Dr. Du and Dr. Bonito have found that mortierella fungi can form dense biofilms and they can grow to the size and shape of their incubation chambers. These fungi can be stacked in an apparatus that resembles a French press, and with a combination of inexpensive yet safe materials, forms a prototype fungal filter system that harvests microalgae.

Our team was asked to take the current prototype and improve the design, manufacturing process, cost, and size of the product while maintaining performance of the filter system. We focused on turning the prototype design from the French press model to a pod filter system design in order to allow for continual and practical use. This filter will be able to separate the algae from the water so that the algae can be collected. Additionally, this filter can be grown and molded to many sizes and shapes using different 3D printed molds in which the fungi can be incubated. The improved prototype will then be used and advertised to harvest microalgae on a more commercial scale.

MICHIGAN STATE UNIVERSITY INNOVATION CENTER

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Spencer Rinke
Romeo, Michigan

Tomo Saito
Battle Creek, Michigan

Chad Winner
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Fadzlan Kamarudzaman
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MSU MTRAC
Project Sponsors

Gregory Bonito
East Lansing, Michigan

Zhi-Yan Du
East Lansing, Michigan

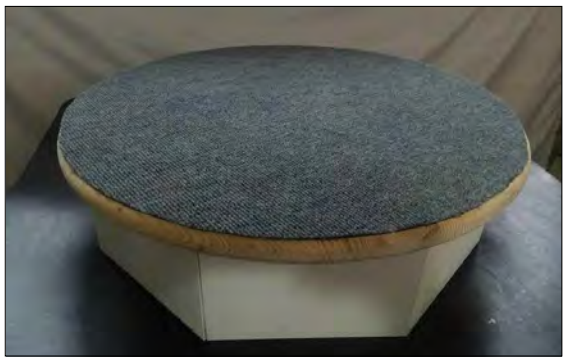
ME Faculty Advisor

Dr. Andre Benard

MSU Department of Theatre
Fitting Stand

MSU's Department of Theatre fosters a courageous, self-driven creative process to create a pathway for success. The theatre department puts on multiple plays a year and, in doing so, requires multiple hours of work from its costumer and machine shop. One of the problems that arises from the multitude of plays is the stress put on the costumer who is constantly trying to make and fit costumes for the actors. There is a constant motion to get on his or her hands and knees due to working on the bottom of the costume while trying to pin a hem or make adjustments. It is not safe to have actors stand on a chair or stool because they could fall and injure themselves.

Our team has been asked to create a device that allows the costumer to raise the actor safely while he/she works on fitting the dress to the actor. This allows the costumer to work at a more ergonomic height and reduce the strain put on their knees and back. With the 3' x 3' platform on top of the fitting stand, it is now safe to raise the actor and the risk of falling due to unstable surfaces has been reduced. An added feature of this fitting stand, is a turntable top. This rotating platform allows the costumer to stay in one location and turn the actor around when needed. This helps decrease the time it takes for the costumer to work on the costume because he/she can now stay in one location and not have to continuously move around the actor. This new fitting stand ensures a more comfortable and safer work environment for the costumer and actors.



DEPARTMENT OF THEATRE
www.theatre.msu.edu

Michigan State University
Team Members (left to right)

Levi Graves
Marshall, Michigan

Andrew Aziz
Clinton Twp., Michigan

Ryan Simon
St. Johns, Michigan

Zach Daniels
Marshall, Michigan

Danielle Rosebrook
Sterling Heights, Michigan

MSU Department of Theatre
Project Sponsors

Angela Wendelberger
East Lansing, Michigan

Mark Willoughby
East Lansing, Michigan

ME Faculty Advisor

Dr. Xinran (Sharon) Xiao

MSU Department of Theatre
Honeycomb Deck Testing

MSU's Department of Theatre performs a variety of Broadway style plays and musicals offered on the two stages at the Wharton Center. The smaller of the two stages, the Pasant stage, seats about 580 people, which offers a more intimate experience for the audience. When it is time for a new performance, the Theatre Department must lay a newly painted floor over the stage to restyle it for the next performance. Unfortunately for the Theatre Department these pieces of stage can weigh around 100 pounds, which can be difficult for some in the department to handle. To solve this problem, the MSU Theatre Department decided they would incorporate a honeycomb style design into their plywood stage. The current stage consists of two pieces of ½" plywood glued and stapled together, with the bottom half containing the honeycomb pattern. Changing the stage to this pattern reduced the weight of the stage pieces by around 30%.

Our team has been asked to create different potential load cases that this honeycomb style stage could encounter and test whether this lighter stage can handle these potential loads. We tested different static and dynamic loads. The maximum load that this stage would be expected to hold is around 1500 lbs. in addition to a large groups of performers. We were also asked to find other potential means of supporting the stage pieces. The stage is currently supported by knee walls that are layered 2 feet apart in both directions with some vertical supports.

DEPARTMENT OF THEATRE
www.theatre.msu.edu

Michigan State University
Team Members (left to right)

Maik Bittner
Cologne, Germany

Zach Wagner
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Nathaniel Jenkins
Clarkston, Michigan

Alex Stangeland
Birmingham, Michigan

Enno Breukelman
Aachen, Germany

MSU Department of Theatre
Project Sponsor

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East Lansing, Michigan

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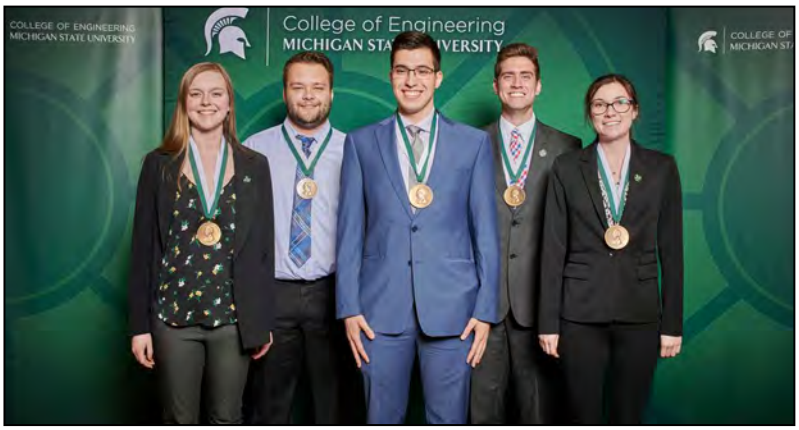
Design Day Awards Spring 2019



SPRING 2019
ME 481 EDISON AWARD

Team US Environmental Protection Agency
"PHEV Smart Charger"

Left to right: Jill Hubbard, Jake Prusakiewicz, Alex Gheorghiu, Frankie Spica, Erin Maroney

SPRING 2019
ME 481 PROJECT PRESENTATION AWARD

Team Heartwood School/Ingham ISD
"Therapeutic Mechanical Pony Enhancements"

Left to right: Jillian Chandler, Mimi Asante, Allison Nielsen, Brian Valentine, Josephine Muscato

SPRING 2019
ME 470 DA VINCI AWARD

Left to right: Zach Hoffman, Torre Crown, Jordan Odehnal, Ali Alhajji

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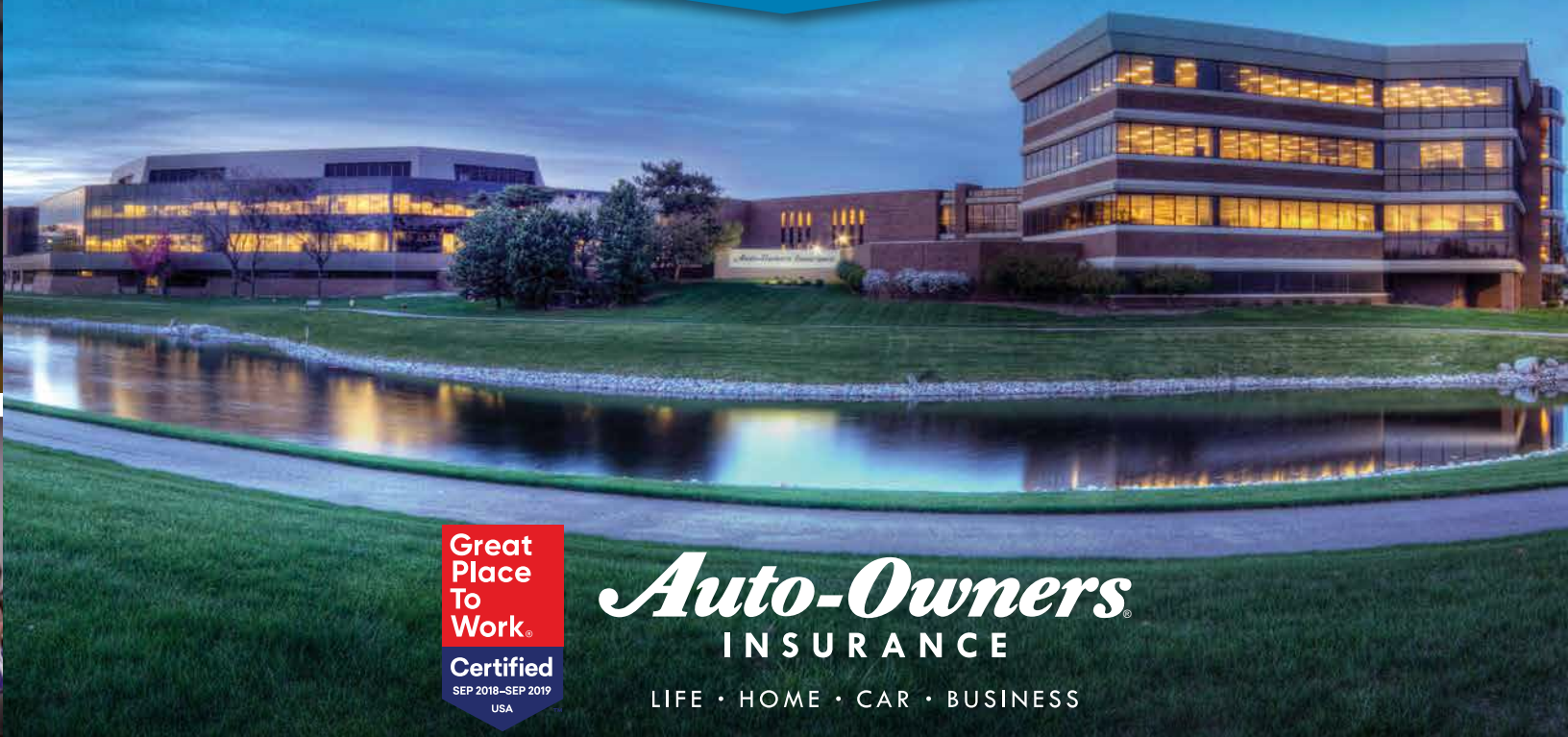

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