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On behalf of the entire Meijer family and the College of Engineering at Michigan State University, we welcome you to the 25th Annual Design Day. Today represents the culmination of countless hours of collaboration, diligence and creative ingenuity.

Meijer is proud to be the Executive Sponsor of this extraordinary program that showcases the talents of MSU's engineering students, who will one day help shape the communities in which we live and the businesses in which we work.

At Meijer, we applaud outside-the-box thinking because our history is rich with innovation and risk. During the Great Depression, our founders took a chance and opened a small grocery store – not unlike many other entrepreneurs. But they set themselves apart from the competition with a focus on their customers and an eye for innovation: shopping carts in 1938, automated conveyer belts in 1954, and the one-stop shopping concept in 1962 that has grown into a retail phenomenon.

As the digital landscape continues to change, so will the importance of understanding science, technology, engineering and mathematics. Meijer is pleased to support the emerging leaders within the MSU College of Engineering and are excited for all of you – family, friends and faculty – to see what we see in this impressive group.

Congratulations to everyone who helped make this year's Design Day a success, especially the students who've worked so hard.

Happy 25th Anniversary from Meijer and Go Green!

Sincerely,

Terry Ledbetter – Meijer Chief Information Officer

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Table of Contents: December 7, 2018

MICHIGAN STATE UNIVERSITY *Spring 2019*

Design Day

COLLEGE OF ENGINEERING

Mark Your Calendars!! It's time to save the date for Spring 2019 Design Day!

Join us April 26, 2019, for another energetic celebration showcasing talented engineering students

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

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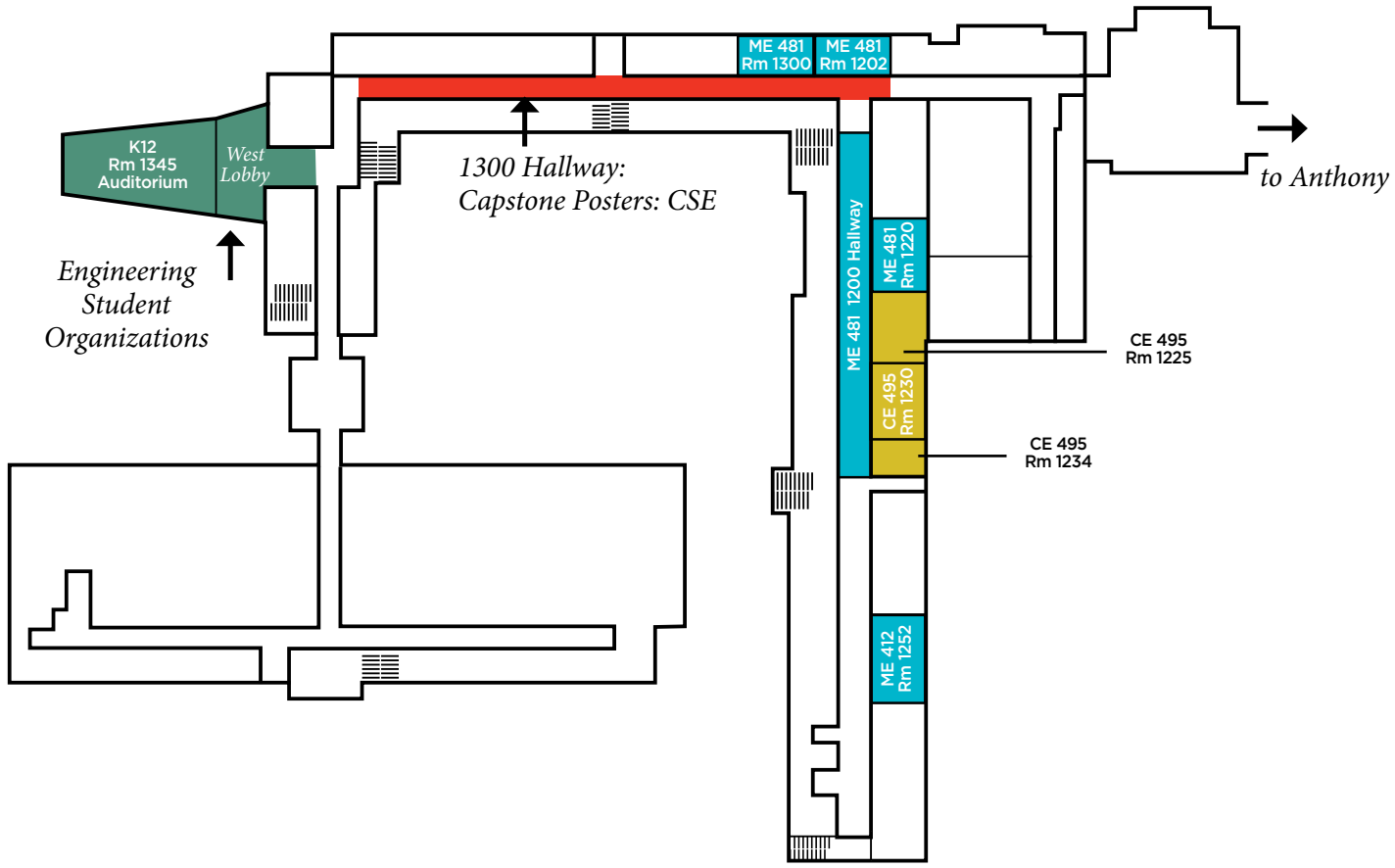
Design Day Events Schedule: Friday, December 7, 2018

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. – Noon				
EGR 100 Presentations			2nd Floor 2300 Hallway 8:30 a.m. – Noon				
ME 412 Competition		1st Floor Room 1252 8:00 a.m. - 11:30 p.m.					
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 2300 Hallway 8:00 a.m. - Noon					
CE 495 Project Presentations		1st Floor Rooms 1225, 1230, 1234 8:00 a.m. - Noon					
CSE 498 Project Presentations		3rd Floor Room 3405 7:30 a.m. - 11:50 a.m.					
ECE 480 Project Presentations			2nd Floor Rooms 2205 & 2250 8:30 a.m. - 11:25 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 Engineering Auditorium 1345 8:00 a.m. - 8:40 a.m.				
High School Awards			1st Floor Engineering Auditorium 1345 12:15 p.m. - 12:30 p.m.				
MSU Awards			1st Floor Anthony Room 1281 1:15 p.m. - 2:00 p.m.				

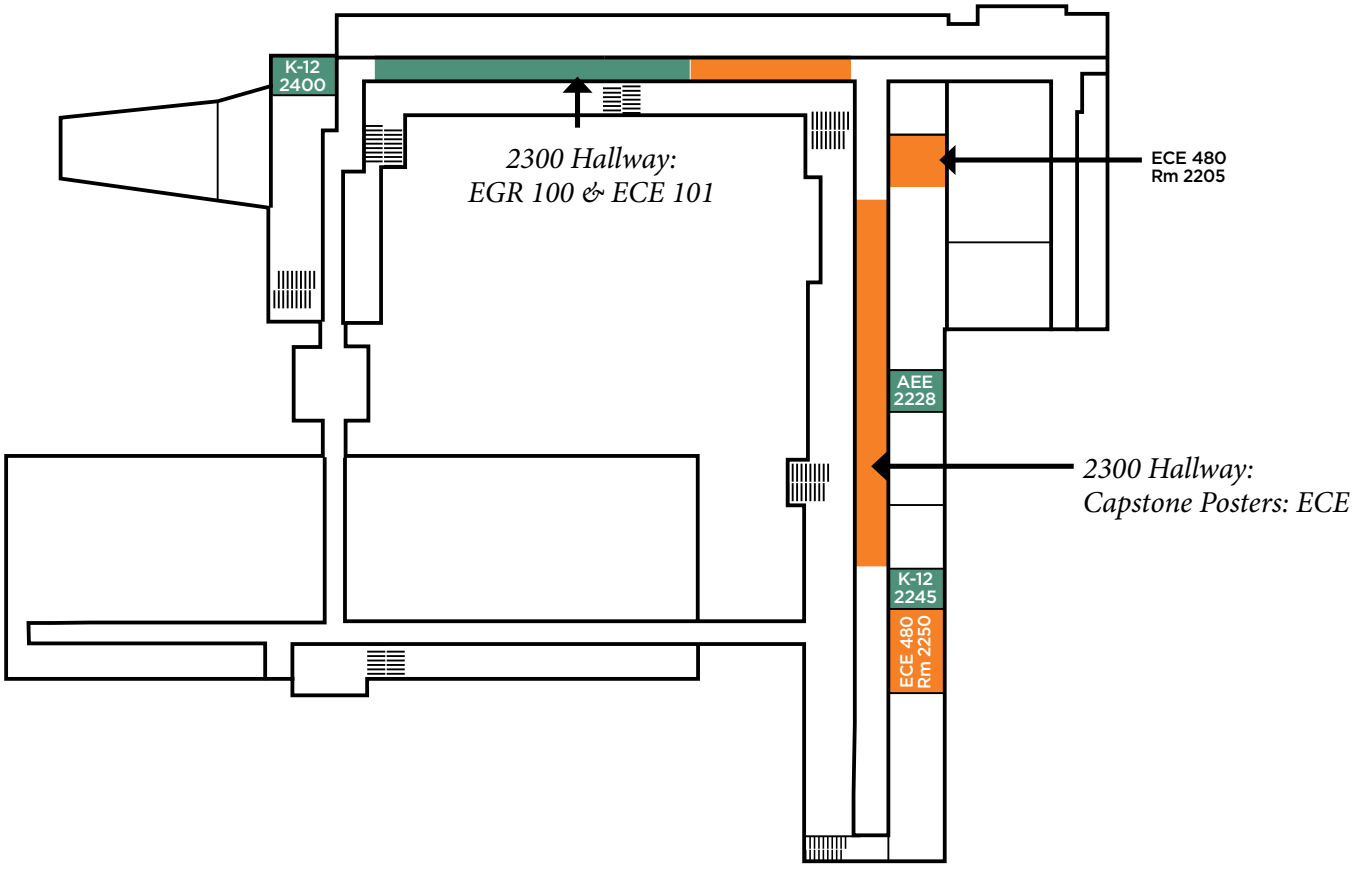
Social Media Links:
"Like" the College: https://www.facebook.com/SpartanEngineering
"Follow" the College: https://twitter.com/msu_egr_news

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

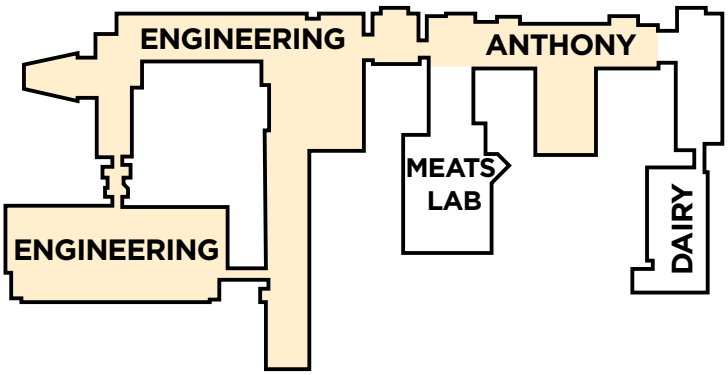


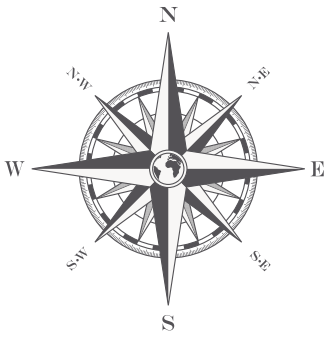
Overview

Color Legend:

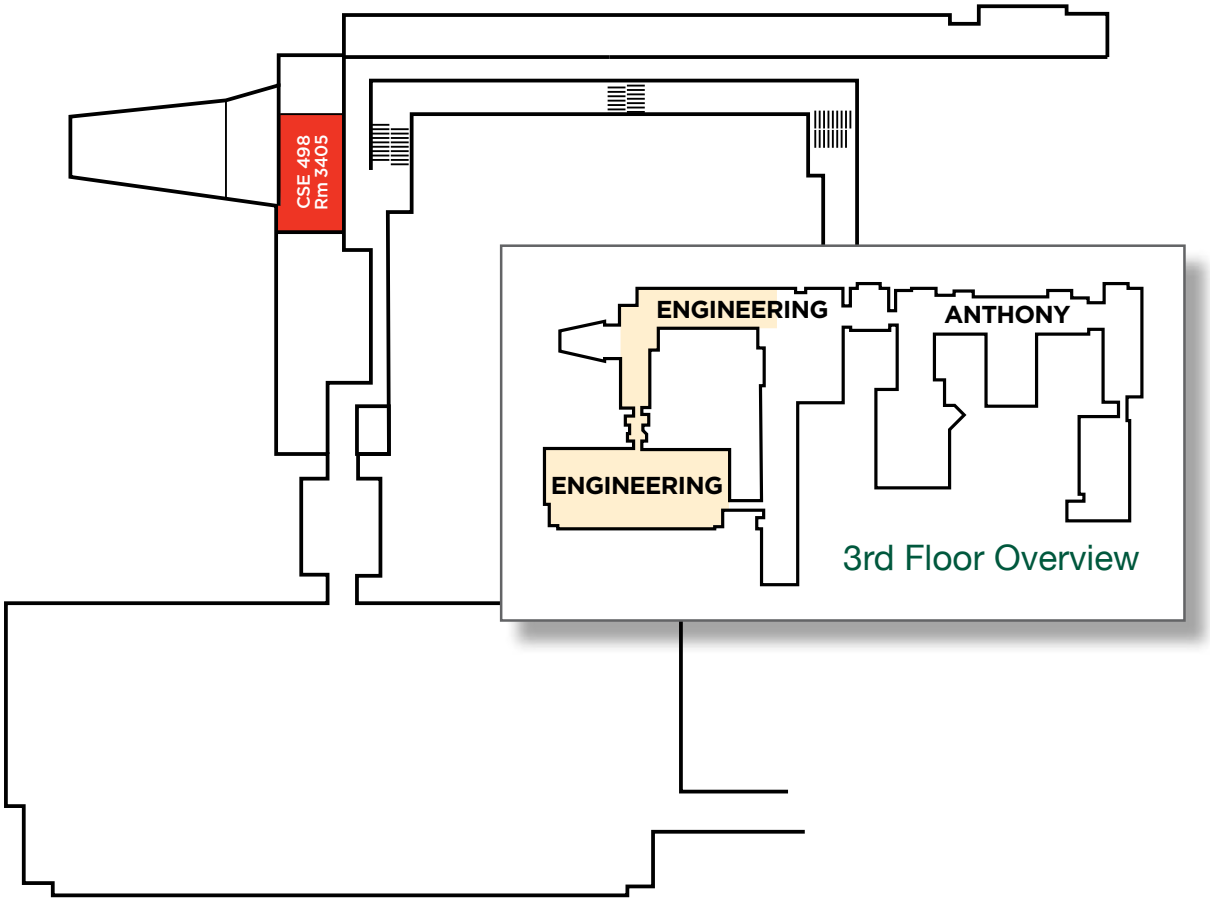
- CEE
- CSE
- ME
- ECE
- Joint/Other

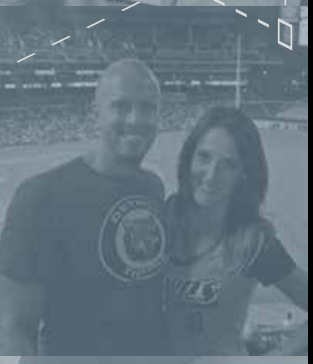
Design Day Floor Plans of the MSU Engineering Building





3rd Floor Engineering





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Let's be remarkable.

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: Battle Creek Area Math and Science Center, Brighton High School, Innovation Central High School and Women in Engineering.

	1345 Engineering Building: Engineering Auditorium: Check in for all schools	K'NEX Bridge Team Build Room 2245	VEX Robotics Room 2400	1st & 2nd Floor Voting/project viewing	Trebuchet Launch Competition Room 1345
8:00–8:15	Check in for all schools				
8:15–8:30	Welcome & voting procedures - Dr. Neeraj Buch, Associate Dean for Undergraduate Studies and Luis Donado, Assistant Director				
8:40–9:30		Women in Engineering	Battle Creek Area Math and Science Center	Innovation Central High School	Brighton High School
9:35–10:20		Battle Creek Area Math and Science Center	Innovation Central High School	Brighton High School	Women in Engineering
10:25-11:10		Innovation Central High School	Brighton High School	Women in Engineering	Battle Creek Area Math and Science Center
11:15-12:00		Brighton High School	Women in Engineering	Battle Creek Area Math and Science Center	Innovation Central High School
12:15–12:30	Awards Ceremony, 1345 Engineering Building, lunch immediately after (EVERYONE)				

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

MEMBERS OF THE ORGANIZING COMMITTEE FALL 2018

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

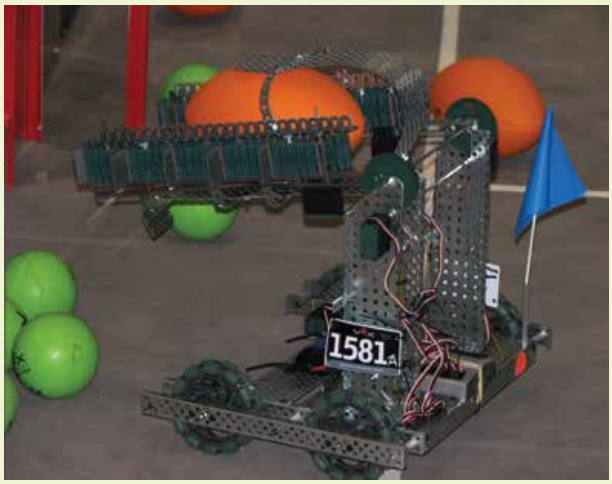
Rachel Esch
K-12 Outreach
Secretary

Danielle Farness
K-12 Outreach
Secretary

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.



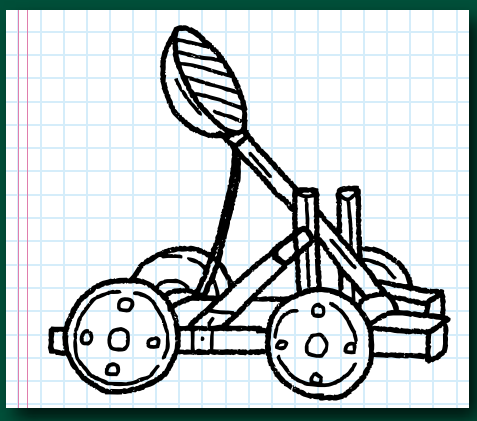
INTERDISCIPLINARY ENGINEERING BUILD

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.

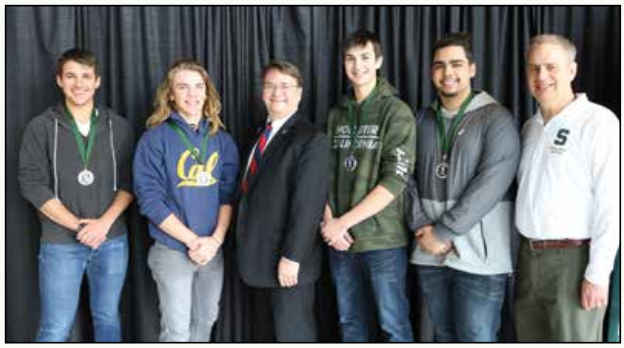
TREBUCHET LAUNCH COMPETITION

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 2018



VEX ROBOTICS PROGRAMMING AND RACE

VEX Robotics competition winners from East Lansing High School: Anakin, Aiden, Garrett, and Sam, with Dean Kempel and Mr. Robert Watson

EGR 100 DESIGN PROJECT

EGR 100 winners Jacob, Megan, Melissa, and Sean with Dean Kempel. The instructor is Dr. Jenahvive Morgan

TREBUCHET DESIGN AND COMPETITION

Trebuchet launch competition winners Jayla, Jennifer and Todd from Battle Creek Area Math and Science Center with Dean Kempel and Instructors Mr. Kant and Mr. Boss, Ph.D. candidates in Mechanical Engineering

EGR 100 DESIGN PROJECT (TIE)

Gabe, Kathleen, and Matthew, with Dean Kempel. The instructor is Dr. Jenahvive Morgan

INTERDISCIPLINARY ENGINEERING BUILD COMPETITION

Interdisciplinary engineering build competition winners from the Battle Creek Area Math and Science Center: Camilla and Eve

ECE 480 DESIGN AWARD

ECE 480 winning team members Jack, Kendi, Kyle C., Kyle G., and Sanh, taught by Dr. Lalita Udpa, were sponsored by MSU Resource Center for Persons with Disabilities

ME 371: MECHANICAL DESIGN I: BEST PROJECT AWARD

Dr. Lavagnino taught the winning team from Section 2, Team 10: Brad, Craig, Jessica and Zach, "Thrills for Pre-collegeiates: Mechanisms that Fascinate, Captivate, and Stimulate and Entice"

EGR 100 Introduction to Engineering Design

Dr. Jenahvive Morgan
Academic Teaching Specialist

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 1177 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 Park and School, and (vii) CoRe Industry-Sponsored Projects**. CoRe Industry-Sponsored Projects involved collaborations with Aptiv on autonomous vehicle sensing 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 2018 EGR 100 Project Poster Award Winners:

l-r: Sean Marek, Melissa Gordon, Dean Kempel, Megan Greer, Jacob Wright

l-r: Matthew Hagan, Dean Kempel, Kathleen Williams

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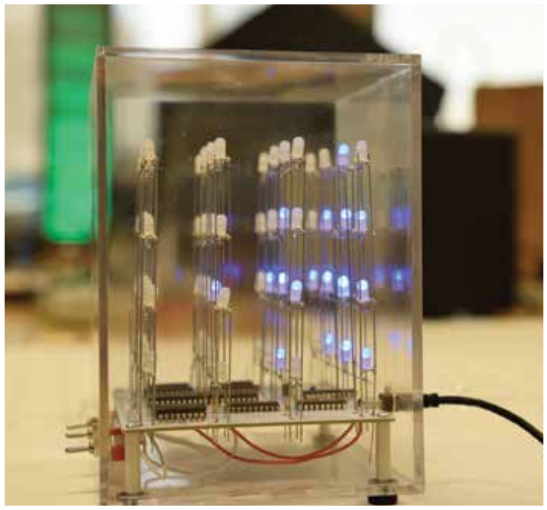

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BRANCH LOCATIONS:

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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MICHIGAN STATE UNIVERSITY FEDERAL CREDIT UNION
Building Dreams Together

The Capstone Projects

Faculty Advisors:
Professors Chatti, Haider, Hashsham, Ingle, Lajnef and Li


Chatti


Haider


Hashsham


Ingle


Lajnef


Li

Presentation Schedule – Room 1225

Time	Team	Room
9:20 a.m.	Team 5 - Spartaneers Consultancy	First Floor Room 1225 EB
10:40 a.m.	Team 3 - Sustainable Engineering Consultants	First Floor Room 1225 EB

Presentation Schedule – Room 1230

Time	Team	Room
8:00 a.m.	Team 7 - East Lansing Technical	First Floor Room 1230 EB
9:20 a.m.	Team 6 - Spartan Sustainable Solutions	First Floor Room 1230 EB
10:40 a.m.	Team 4 - Exponential Engineering	First Floor Room 1230 EB

Presentation Schedule – Room 1234

Time	Team	Room
9:20 a.m.	Team 2 - PURE Consulting Group	First Floor Room 1234 EB
10:40 a.m.	Team 1 - Elite Engineering	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

Michigan State University Water Treatment & Storage

Michigan State University has proposed a massive improvement to the campus water distribution system, with the construction of a new water treatment plant and elevated storage tank on campus. The University is currently constructing a 2 million gallon water tower to replace the function of the water reservoir on campus. The water tower must be connected to a proposed water treatment plant located immediately south of Service Drive, west of Farm Lane. The students in CE 495 provided a preliminary design for the infrastructure improvements necessary to procure this project for construction.

This design project includes an 11,500 gross square foot water treatment plant which will include water treatment processes such as chlorination and fluoridation (in addition to iron removal), which are currently done at the reservoir. The old reservoir will be taken out of service when the new water treatment plant becomes operational. Total construction costs are estimated to be $18 million, with operational opening date in Spring 2020. This project will improve water quality and reliability throughout the campus and is designed to meet future needs projected in the next 40 years.

Fig. 1: Exisiting Arial Photo

Fig. 2: Proposed Treatment and Storage Site Plan

Fig. 3: Rendering of Treatment Plant

Fig. 3: Tank Logo Detail

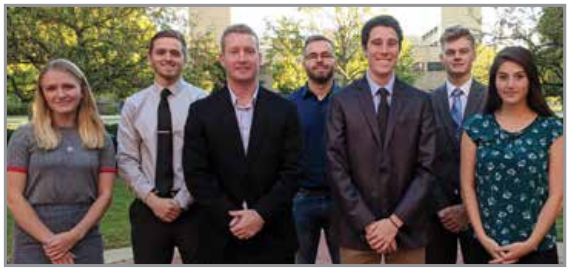
Team 1: Elite Engineering

Left to Right: Jeremy Swiatek (G), Mitchell Murray (S), Kate Richardson (H), George Kariagi (T), Julia McClafferty (PM), Logan Williams (E), Ben Moizio (P)

Team 2: PURE Consulting Group

Left to Right: Kevin Heffernan (G), Yuheng Luo (S), Emily Sullivan (PM), Evan Pohlmann (T), Kayla Ghiata (E), Shane McVeigh (H), Coty Southworth (P)

Team 3: Sustainable Engineering Consultants



Left to Right: Ana Kusmortceva (S), Colin Dumond (PM), Jordan Most (T), Jon Mahut (E), David Ravitz (H), Nolan Denslow (P), Jade Taylor-Diaz (G)

Team 4: Exponential Engineering

Left to Right: Bradford Shelle (P), Anyssa Schember (E), Diego Acevedoquintanilla (H), Stephen Subu (PM), Anastasia Matta (T), Nick Borkowski (S)

Team 5: Spartaneers Consultancy

Left to Right: Xianzhao Jiang (H), Kartik Sewani (G), Saeed Almarri (T), Farish Jazlan (PM), Elise Walker (E), Jazz Hao (P), Chen Cheng (S)

Team 6: Spartan Sustainable Solutions

Back row, left to right: Alex Iliev (S), Nadean Shovels (T), Nolan O'Brien (P) **Front row, left to right:** Stacey Hannula (E), Madison Gropp (PM), Zachary Purtill (H)

Team 7: East Lansing Technical

Back row, left to right: Andrew Sjogren (PM), Adam Marshall (E), Kellen Boyd (H) **Front row, left to right:** Sahira Melo (P), Briana Wendland (S), William Zatezalo (T)

Key to primary roles and responsibilities of each team member:

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

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

David Baar, P.E.
Fishbeck, Thompson, Carr & Huber

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

Leah Tapp, P.E.
HNTB

Dan Thome, P.E.
Nicholson

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

Brad Wieferich
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.

Sam Baushke
Barr Engineering Co.

Erik Carlson
Michigan Department of Transportation

Rick Chelotti
Bergmann Associates

Dan Christian
Terra Tech MPS

Jim Corsiglia
HED Development

Brian Davies
Hubbell, Roth & Clark

Tyler Dawson
NTH Consultants

Nathan Fettes
Michigan Department of Transportation

Andrew Gerlach
Consumers Energy

Matt Hill
WPS

Cindy Irving
Lansing Board of Water & Light

Matt Junak
HNTB

Peter Margules
NTH Consultants

Mario Quagliata
Bergmann Associates

Emily Schlanderer
Fishbeck, Thompson, Carr & Huber

Todd Sneathen
Hubbell, Roth & Clark

Michael Thelen
Consumers Energy

Anthony Thomas
Soil & Materials Engineers

Geneva Vanlerberg
Lansing Board of Water & Light

Phil Vogelsang
AECOM

Jon Ward
Rowe Professional Services

Design Day Awards Spring 2018

Rolla C. Carpenter Senior Design Award

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

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

The faculty and students of the Department of Civil and Environmental Engineering gratefully acknowledge the generous contributions from Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) and Barr Engineering Co.

Rolla C. Carpenter Senior Design Award Winners, Spring 2018

Team 8 – Miller & Associates

Left to right: Stan Miller, Elaina Medvedik, Jimmy Milligan, Alissa Yanochko, JT Covington, Kira Fillar, Matt Beatty

Congratulations on 25 years of design!

Opportunities for students and new graduates

Amazon.jobs

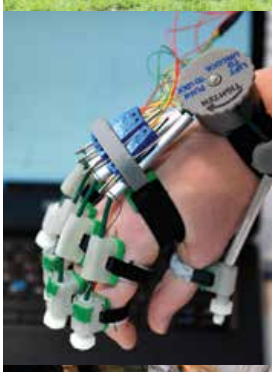
At Amazon, our evolution has been driven by the spirit of innovation that is part of our DNA. As a new college graduate or intern, you can have multiple opportunities to innovate and solve real-world, complex technical and business problems as you join us on our journey.

We strive to hire the brightest minds from universities around the globe, and have various career opportunities available for undergraduates and advanced degree students with diverse academic backgrounds.

The work environment here is fast-paced and continually evolving, and every Amazonian is passionate about ownership and delivering results for the company. If you want to work in an environment that will challenge you to relentlessly improve the Amazon experience for our customers, where each day is different from the next, and your learning never truly ends, take a look at Amazon's many university and graduate opportunities.

amazon Detroit



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25
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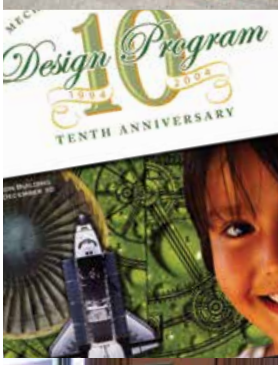
College of Engineering
MICHIGAN STATE UNIVERSITY







Computer Science and Engineering

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The Capstone Projects

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Ryan Johnson

James Mariani

TEACHING ASSISTANTS

Presentation Schedule – Engineering Building, Room 3405

Time	Team	Project Title
7:30 a.m.	Amazon	AVAST: Amazon Video And Shopping Technology
7:43 a.m.	Aptiv	Autonomous Vehicle Fleet Connectivity App
7:56 a.m.	Auto-Owners	Jeffrey: Virtual Insurance Claim Advisor
8:09 a.m.	Dow	IT Assistant
8:22 a.m.	Ford	Ford Customer App Review Dashboard
8:35 a.m.	Herman Miller	FIBRE: Fabric Identification Based Recommendation Engine
8:48 a.m.	Meijer	Shrink Reduction Using Blockchain
9:01 a.m.	Michigan State University	Navigating MSU's Campus Using Augmented Reality
9:14 a.m.	Microsoft	ITPro Company Portal
9:27 a.m.	Mozilla	Asynchronize All the (Localization) Things!
9:40 a.m.	MSUFCU	Transaction Anomaly Detection
9:53 a.m.	Proofpoint	Improved Detonation of Evasive Malware
10:06 a.m.	Quicken Loans	Walter, You Gotta Go
10:19 a.m.	Spectrum Health	Spectrum Health Virtual Reality Experience
10:32 a.m.	TechSmith	TechSmith Video Review and Slack Integration
10:45 a.m.	Union Pacific	Augmented Reality Mechanic Training
10:58 a.m.	United Airlines	Toolkit Content Verification System
11:11 a.m.	Urban Science	VIN-Verse
11:24 a.m.	Volkswagen	VW Car-Net® Demo App
11:37 a.m.	Whirlpool	IRAV: Image Recognition, Annotation and Validation

CSE 498 Collaborative Design

CSE498, Collaborative Design, provides the educational capstone for all students majoring in computer science. Teams of students build software systems for corporate clients.

During the capstone experience, students

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

Our clients are local, regional, and national including Accenture, Amazon, Aptiv, Auto-Owners Insurance, Chrysler, Dow, Ford, GE, General Motors, Google, Herman Miller, Meijer, Michigan State University, Microsoft, Mozilla, MSU Federal Credit Union, Proofpoint, Quicken Loans, Spectrum Health, Symantec, TechSmith, Union Pacific, United Airlines, Urban Science, Volkswagen, Whirlpool and Yello.

Amazon
AVAST: Amazon Video And Shopping Technology

Founded in 1994 as an online bookstore, Amazon is the largest online retailer in the world. In addition to retail, Amazon offers services in cloud infrastructure through Amazon Web Services, and audio and video streaming through Amazon Music and Prime Video.

According to a recent study, 80% of internet usage will be people watching online videos by the year 2020. This presents a significant opportunity for all online retailers.

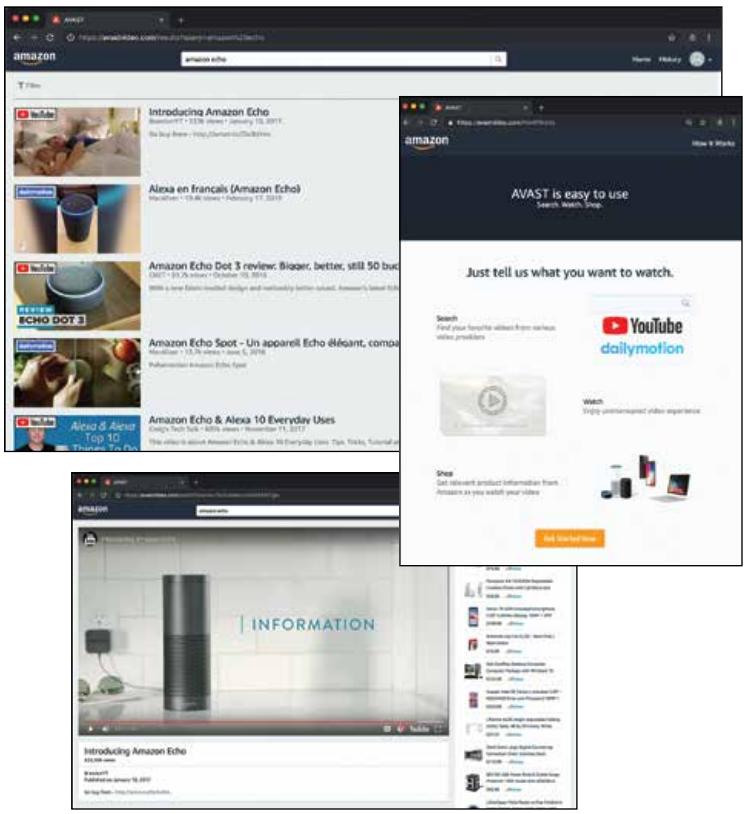
Our AVAST (Amazon Video And Shopping Technology) platform leverages the growth in online video streaming by providing users with an easy way to purchase products of interest that they see in the videos they are watching.

Using AVAST, an Amazon customer can stream videos from content providers such as YouTube and their favorite TV networks.

While a user is watching a video, AVAST analyzes it to find items of potential interest to the viewer. As the video plays, related Amazon products are displayed alongside the video as illustrated in the examples at the right.

For each item, AVAST displays a product description, pictures and ratings. A viewer can easily purchase any product simply by clicking on the conveniently provided link to Amazon.

The frontend of AVAST (Amazon Video And Shopping Technology) is built using Angular 6, while the backend is implemented using PHP Laravel. In addition, several Amazon Web Services are used including Rekognition to analyze videos, and EC2 to host the AVAST website.



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Aptiv
Autonomous Vehicle Fleet Connectivity App

Aptiv is a global technology company that is transforming mobility with its portfolio of safe, green, and connected solutions for its customers.

As a leader in autonomous vehicle development, Aptiv maintains an extensive test fleet of autonomous vehicles, which must be managed and monitored.

Our Autonomous Vehicle Fleet Connectivity App provides connectivity to Aptiv's autonomous test fleet, which operates across the US, Europe and Asia, and includes various vehicles with software for every level of autonomy.

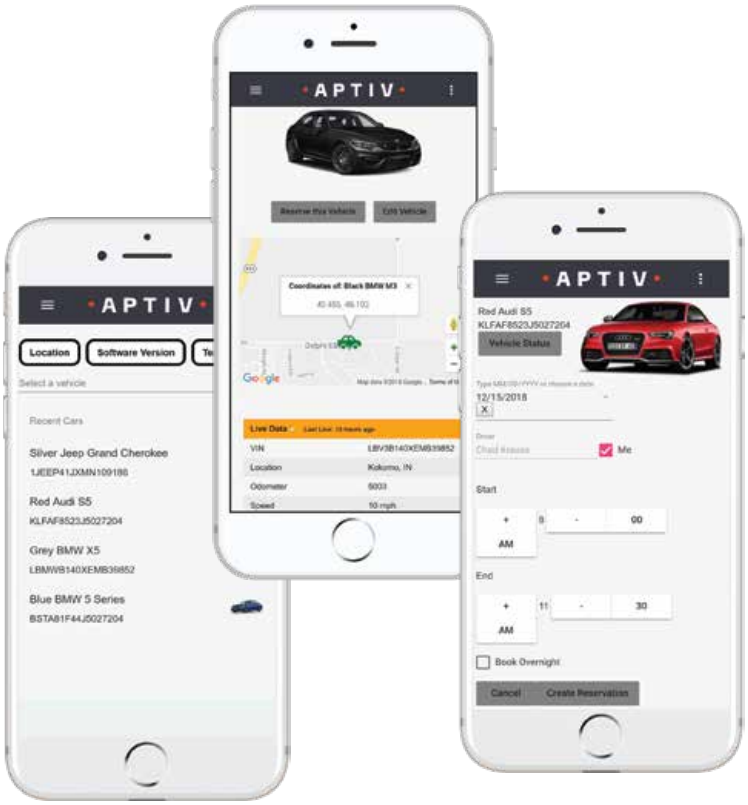
Among other features, our system provides scheduling of test vehicles. After logging in, Aptiv engineers see a calendar view of the entire fleet from which they can select a particular day to obtain a list of available vehicles.

Once a vehicle is selected, our app displays a complete set of information about it including its past usage, reservations and diagnostic information.

In addition to checking availability of vehicles based on dates, our app provides for advanced search to narrow the scope based on things like type of vehicle, location of vehicle and level of autonomy.

The "My Reservations" tab shows a user's upcoming vehicle reservations as well as enabling them to make and cancel reservations.

Our Autonomous Vehicle Fleet Connectivity App is written using the Angular web framework, obtaining information from Aptiv's native servers. Communications are implemented using Microsoft Azure Services.



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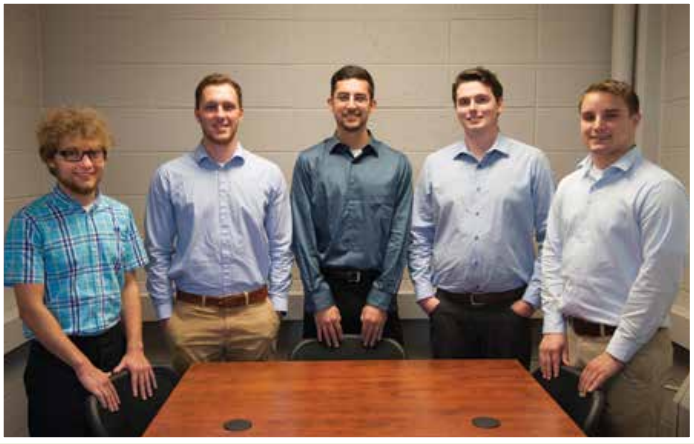

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Auto-Owners Insurance
Jeffrey: Virtual Insurance Claim Advisor

Auto-Owners Insurance is a Fortune 500 company that provides automotive, home, life and commercial insurance. Headquartered in Lansing, Michigan, Auto-Owners is represented by over 44,000 licensed insurance agents across 26 states, and provides insurance to nearly 3 million policyholders.

Every day, hundreds of insurance claims are filed with Auto-Owners through its independent agents. This process can be tedious for both policyholders and agents.

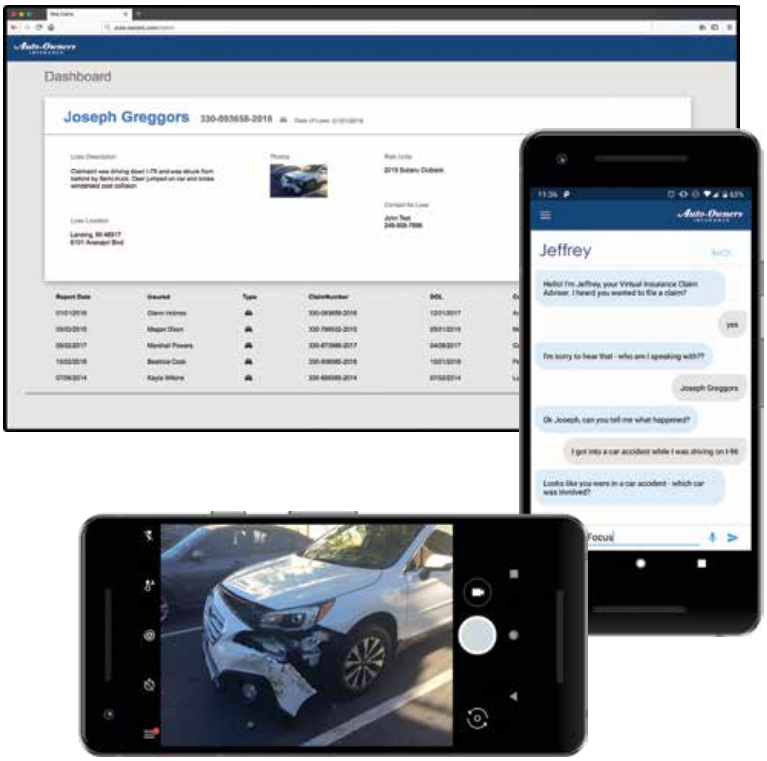
Our Jeffrey Virtual Insurance Claim Advisor system is a virtual claim assistant that automates the entire claim reporting process. Our mobile app, shown at the right, enables both agents and policyholders to file a claim easily and efficiently.

Jeffrey engages in a dialogue with policyholders and agents to gather information required to file their claim through natural conversation. If necessary, Jeffrey prompts users to take photos, record videos or attach documents relevant to a claim.

After completing a dialogue with a user, Jeffrey automatically gathers the appropriate claim information and submits it to Auto-Owners.

Our companion web app enables agents and Auto-Owners associates to find and review claim information that is submitted through the mobile application.

Our Jeffrey Virtual Insurance Claim Advisor system features natural language processing, which is implemented using Google's Dialogflow. A custom REST API, written in Kotlin, handles interactions between the applications and our MySQL database. Our web application is built using the React JavaScript framework.



Auto-Owners INSURANCE
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Dow Chemical Company
IT Assistant

With over a century of experience, Dow Chemical Company is changing the world through innovation by providing advancements like more drinkable water, more clean and affordable energy, and increasing food production.

Dow employs over 70,000 people worldwide, including some 30,000 of which are contractors. For many of them, information technology (IT) is central to their work. Providing IT support is crucial, but to do so for so many people in so many locations is a challenge.

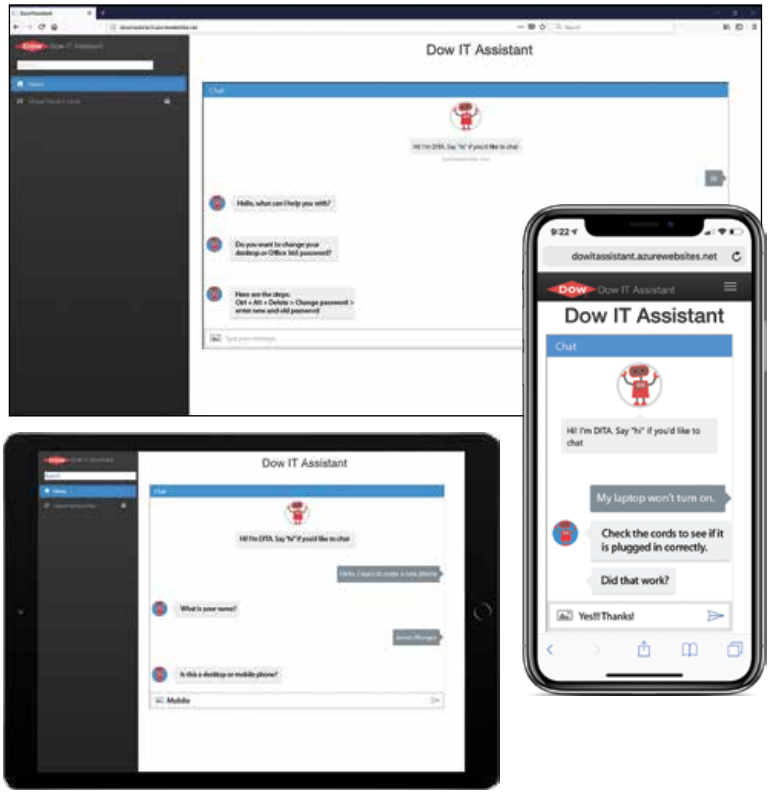
Our IT Assistant is a chatbot that brings all of Dow's IT knowledge to one place, providing a one-stop shop for resolving IT issues.

Our chatbot leverages natural language processing to engage with a Dow employee in a natural and intuitive way, handling both text and voice input.

When a user describes their IT problem, IT Assistant either provides a solution by searching Dow's vast knowledge base of issues and solutions or it asks the user for more information.

IT Assistant is a responsive web app so it can be used with any web browser on a desktop or on any mobile device. And, since it's web-based, it provides IT support at any time, from anywhere.

Our IT Assistant uses a variety of Microsoft Azure Cloud Services including LUIS and Voice Services. Our chatbot leverages Dow's extensive IT knowledge base of issues and solutions. Hosted on Azure, IT Assistant is implemented using React.js and C#.



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Ford Motor Company
Ford Customer App Review Dashboard

Founded in 1903, Ford Motor Company is the second-largest automaker in the U.S. and fifth-largest in the world, employing 202,000 people worldwide and selling 6.6 million vehicles in 2017.

Currently, Ford offers several mobile apps for connected vehicles, allowing users to take advantage of features such as remote start, parking search, media streaming and more.

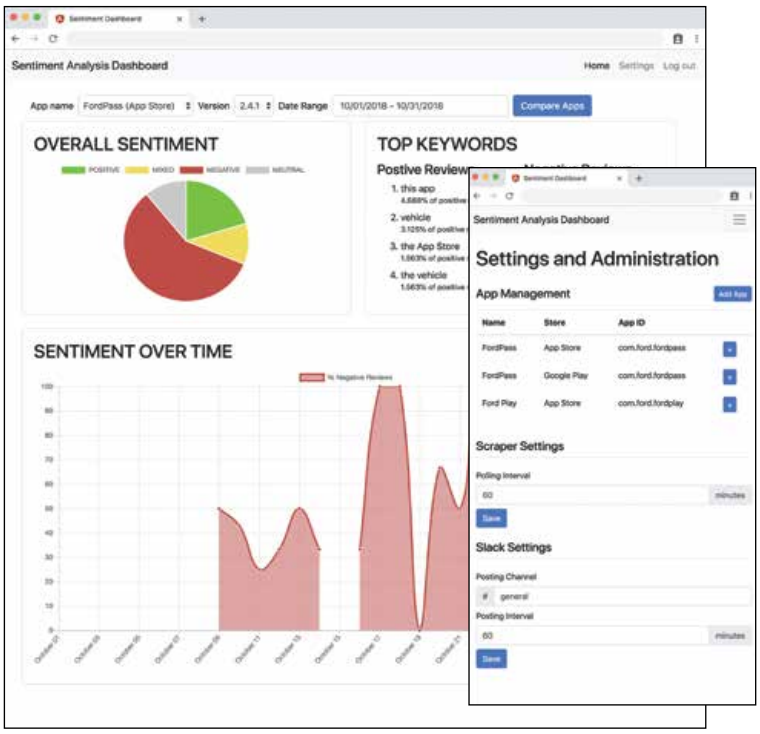
With their passion for customer satisfaction, Ford associates continually monitor user feedback for their apps to ensure that they meet the needs of their customers.

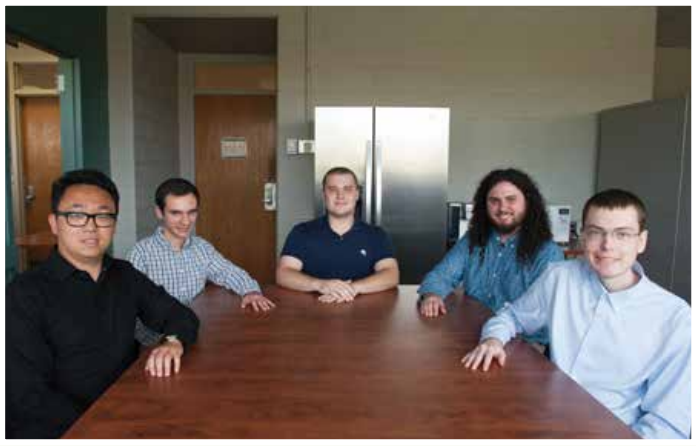
Our Customer App Review Dashboard streamlines this process by providing a convenient and automated system to analyze, summarize and display data from many app reviews all at a single glance.

Reviews are gathered from multiple app stores and analyzed using Natural Language Processing (NLP) to determine whether the sentiment of each review is positive, negative or neutral. Our web app visualizes the results of this analysis, enabling Ford associates to see the distribution of positive versus negative reviews at a glance.

Updates to our review analysis are sent through the Slack messaging service, which gives a real-time feed of user feedback. Ford associates use our companion web app to adjust dashboard settings.

Our Customer App Review Dashboard's frontend is written in Angular 6. Our RESTful API is written in Java using Spring Cloud Function. Our NLP is implemented using Amazon Comprehend. The backend processing is serverless, performed using AWS Lambda.





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Herman Miller

FIBRE: Fabric Identification Based Recommendation Engine

Herman Miller, a 100-year-old-plus company, is an industry leader in office and home furniture, which are sold and used in countries all over the world.

Herman Miller furniture is highly customizable, with thousands of combinations for each piece including choices for the color and pattern of the fabric. In addition, customers can not only choose from a catalog of Herman Miller fabrics, they can also request a fabric of their own, making an order even more complex.

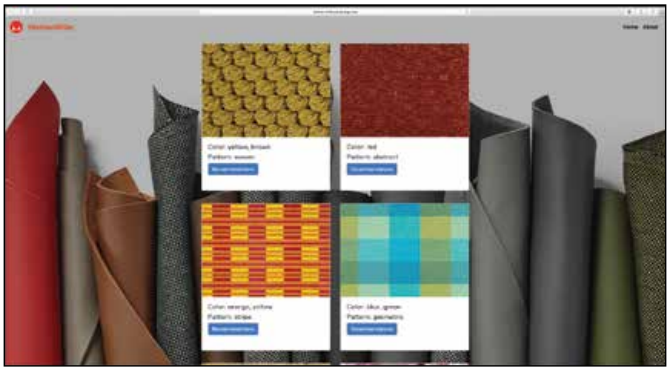
When a custom fabric is requested, the process of manually searching for a similar fabric in Herman Miller's existing catalog of fabrics is tedious, error prone and very time-consuming.

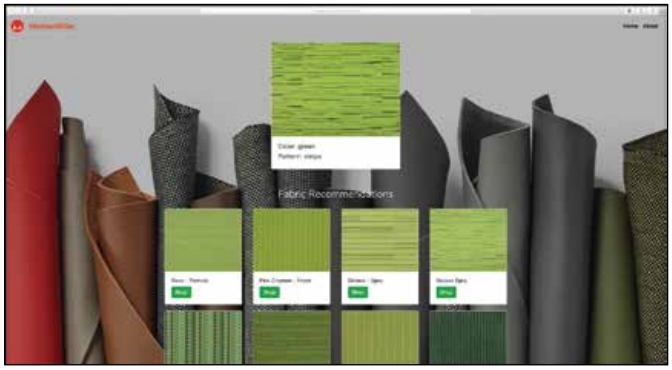
Our Fabric Identification Based Recommendation Engine, FIBRE, leverages computer vision and machine learning to classify fabrics, automatically detecting color and pattern.

FIBRE is first applied to Herman Miller's existing extensive catalog of fabrics, to tag images with standard, quantifiable measures of both color and pattern.

When a request for a custom fabric is submitted, our system analyzes it, generates its measures of color and pattern, searches the extensive Herman Miller catalog of fabrics, and finds fabrics that most closely match. The four most similar fabrics are displayed for review by a Herman Miller associate or customer, thereby reducing the number of fabrics to consider from thousands to just four.

Our FIBRE utilizes scikit-learn for color detection, and SageMaker and TensorFlow for pattern detection. Flask provides the client side interface to the backend, which is hosted on Amazon Web Services.





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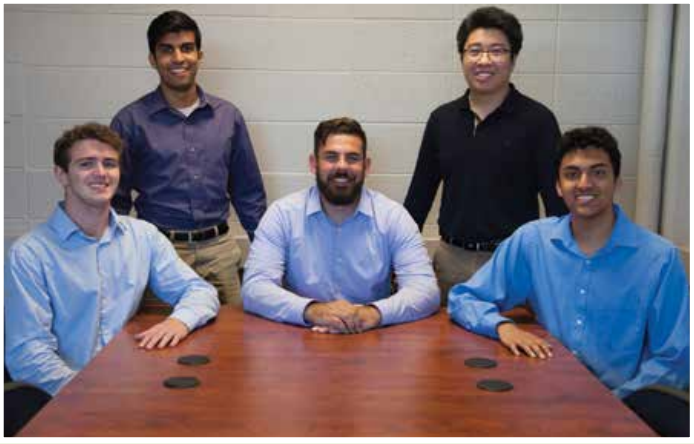

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Meijer
Shrink Reduction Using Blockchain

Founded in 1934, Meijer is the pioneer of the modern supercenter with 242 stores located throughout the Midwest.

As a large retailer, Meijer ships and tracks thousands of products from supplier to store shelf. Timely and safe arrival of products is key for customer satisfaction and business efficiency.

All retailers experience product loss, often from theft or from product expiration for things like produce and dairy products. This product loss is known as "shrink."

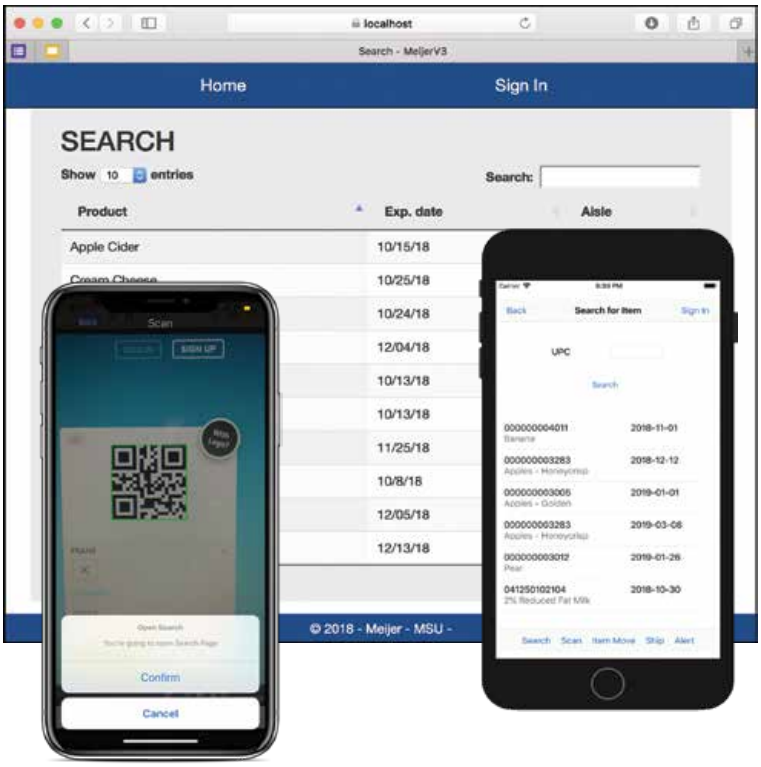
Our Shrink Reduction Using Blockchain system reduces shrink resulting from product expiration by tracking products along the entire supply chain from supplier to store.

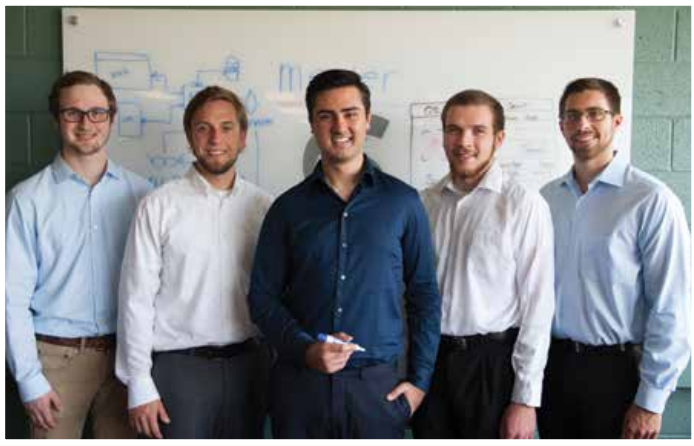
Meijer team members use our web app to record a product's expiration date when it is received from a supplier. Team members update product information by scanning QR codes each time a product arrives at a new location, which is updated in our blockchain database.

Meijer team members use our shrink reduction alerts to decide which products should be put on the shelf based on their expiration dates. As a result, more products are sold before their expiration dates, thereby reducing shrink.

Our companion web app shows loss statistics on specific products such as product location and estimated cost, which is used to prevent future loss.

Our Shrink Reduction Using Blockchain system uses the Microsoft Azure Framework with Ethereum Private blockchain technology. Our iOS app is built using XCode. Our web app uses HTML, CSS, JavaScript and ASP.NET.





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Michigan State University
Navigating MSU's Campus Using Augmented Reality

Founded in 1855, Michigan State University is the nation's pioneer land-grant university. Today, MSU is one of the largest universities in the US with over 50,000 students and holds many distinctions, including being one of the top 70 universities in the world.

Each year, thousands of people come to MSU for the first time, including some 8,000 freshmen. MSU's campus is comprised of hundreds of buildings spread across its large 5,200-acre sprawling campus. Navigating this large campus is a challenge for all newcomers who often rely on paper maps and hard-to-find signs.

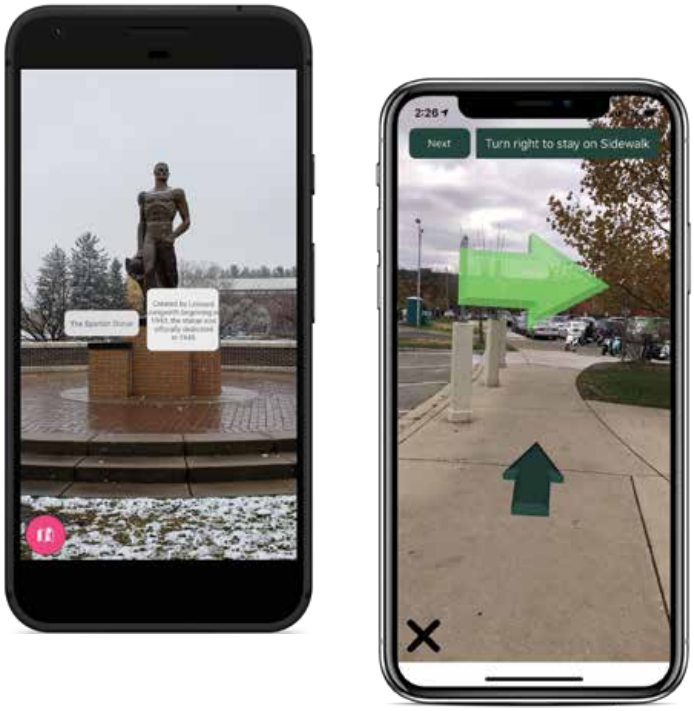
Our Navigating MSU's Campus Using Augmented Reality app leverages augmented reality (AR) to guide people around MSU's large campus with ease.

Our app, shown at the right, identifies and labels buildings and landmarks simply by using the camera of any supported mobile device. Some landmarks, such as the Spartan Statue and the Rock, have clickable names where a user can learn fun facts about them.

A user can easily navigate MSU's campus with a 3D AR experience called wayfinding, which gives directions to any destination on campus.

After selecting a destination, directional arrows, as seen at the right, are overlaid on a user's mobile device showing the way to go. Users simply follow the arrows to find their way to their chosen destination.

Our Navigating MSU's Campus Using Augmented Reality app supports both Google Android and Apple iOS, which use ARCore and ARKit SDKs respectively. Our app obtains building information and wayfinding directions from MSU's ArcGIS API.



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Microsoft
ITPro Company Portal

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

More and more, people are using their personal mobile devices to do company work, both inside and outside of the office. This enhances work flexibility and productivity, and also lowers company hardware costs.

However, this new work paradigm presents significant security and reliability risks since personal devices are now connecting to corporate networks and often storing confidential corporate data.

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.

Before using their personal mobile device for work, an employee installs a simple 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.

With 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
Asynchronize All the (Localization) Things!

Since its establishment in 1998, Mozilla's mission has been to build a better, more open and accessible internet. As a part of this mission, Mozilla's Firefox web browser supports 99 languages worldwide.

Currently, non-English users must download a separate version of Firefox or perform a series of complex configuration steps and then restart the browser to use their preferred language. Such customization of software is referred to as "localization."

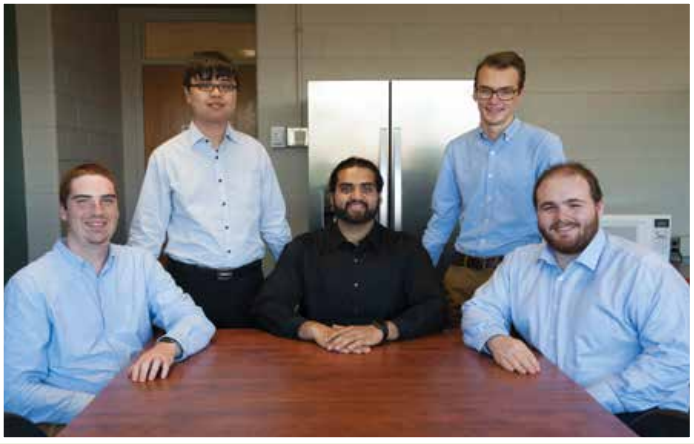
Mozilla's new framework, called Fluent, addresses these issues and improves the localization experience for users, translators and developers. Fluent allows users to change their locale on the fly, and helps localizers and developers by simplifying the work required to convert phrases from English to other languages.

Firefox contains many pages, which enable users to localize Firefox for things like menus and error messages. For each page, the English phrases are now consolidated into new Fluent files, and the Firefox frontend code is updated. These phrases take several forms, from static content to dynamic expressions where the phrasing varies depending on language and context.

To save work for volunteer localizers, our new Python scripts are used to migrate phrases from old files to new Fluent files in every language that is currently supported.

After thoroughly testing our system, our localization patches are now integrated into the Firefox codebase for distribution to hundreds of millions of users worldwide.

Our Asynchronize All the (Localization) Things project is implemented using Fluent, JavaScript, Python, XHTML, XML and XUL.



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MSU Federal Credit Union
Transaction Anomaly Detection

Founded in 1937, Michigan State University Federal Credit Union offers financial services to students, faculty and staff of Michigan State University. With over $4.1 billion in assets and 265,000 members, MSUFCU is the largest university-based credit union in the world.

In the past year, U.S. consumers experienced over $8 billion in losses due to payment card fraud. MSUFCU protects its members from fraud by monitoring almost 40 million transactions of its members annually.

Our Transaction Anomaly Detection system leverages the MSUFCU's existing software platforms to notify its members of unusual account activity.

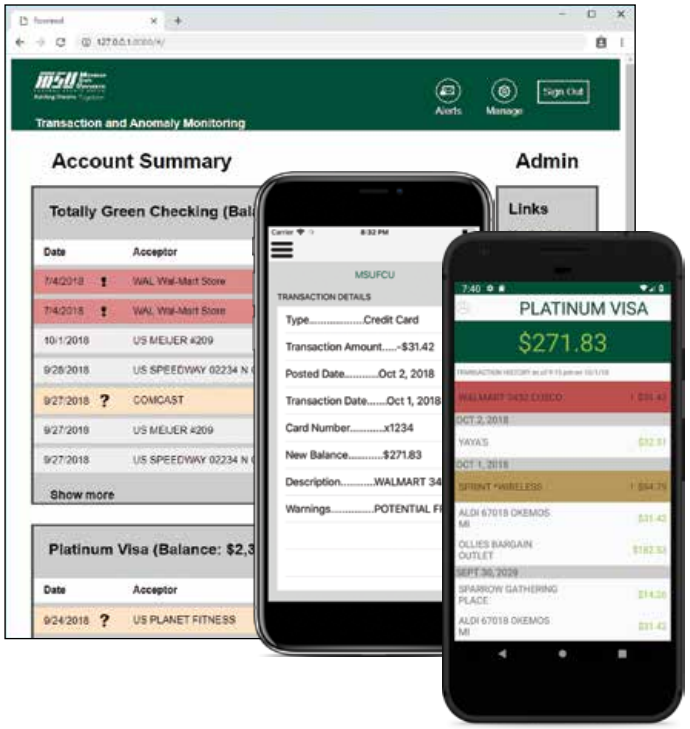
When anomalous transactions are detected, our system sends push notifications to MSUFCU members and flags the transactions on our companion web app used by MSUFCU associates.

Our system identifies irregularities ranging in severity from a peculiar increase in a monthly cable bill to a suspected account takeover.

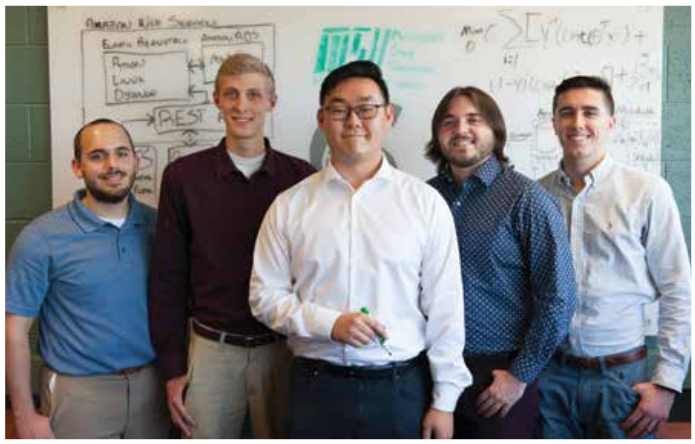
In addition to detecting suspicious account activity, our system harnesses a member's transaction data to provide them with insights into their spending habits.

Within the MSUFCU member web portal, transactions flagged as suspicious can be expanded for more information. Spending habits are summarized by personally tailored reports, which categorize purchases and visualize patterns.

Our Transaction Anomaly Detection iOS, Android and web apps connect to a Django server via a RESTful API. Anomalies are detected using a machine learning TensorFlow module and other scientific Python packages.



MICHIGAN STATE UNIVERSITY
FEDERAL CREDIT UNION
Building Dreams Together



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Proofpoint
Improved Detonation of Evasive Malware

Headquartered in Sunnyvale, California, Proofpoint provides cybersecurity to many organizations, including Fortune 100 companies and educational institutions such as Michigan State University.

Analyzing malware is challenging. Viruses, spyware, ransomware and other malicious programs come in many complex forms. To protect its customers, Proofpoint uses tools called sandboxes, which are restricted computing environments where potentially harmful malware can be tested and analyzed safely.

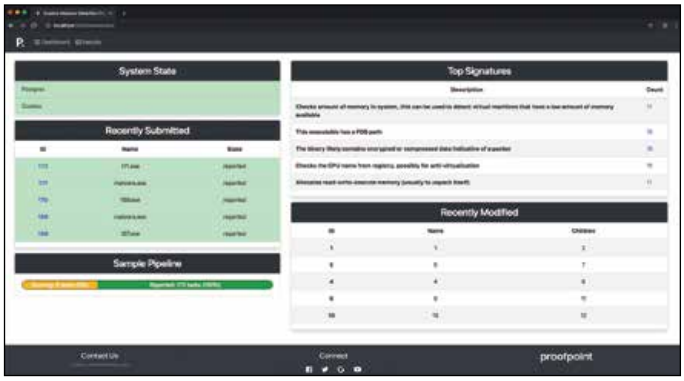
Unfortunately, a new class of malware called "evasive malware" is rapidly emerging, thereby presenting a new, more dangerous class of cybersecurity threats.

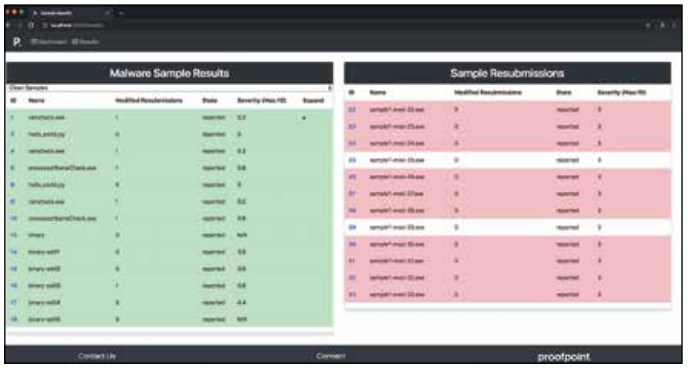
Evasive malware has the ability to detect the presence of the sandbox environment. After doing so, it changes what it does, thereby evading analysis.

Our Improved Detonation of Evasive Malware system modifies evasive malware to block its ability to detect the sandbox environment, which causes it to execute. When the evasive malware does execute, its behavior is analyzed to determine precisely what it does so that Proofpoint can design countermeasures to protect against it.

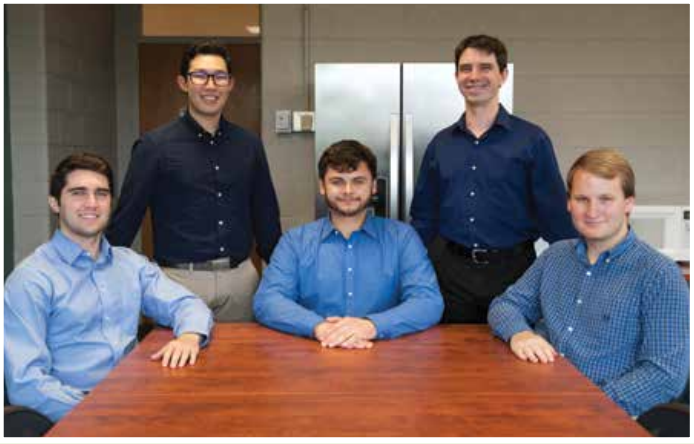
Our web app, shown at the right, displays the results of processed malware. Users can check the status of the malware samples being tested as well as see the top evasive techniques being used. Both harmless and harmful evasive results are presented.

Our Improved Detonation of Evasive Malware system is implemented in Python, using the Cuckoo sandboxing framework and Suricata network monitor. Our web app is implemented using Python and Flask with the interface framed in Bootstrap and jQuery.





proofpoint™



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Quicken Loans
Walter, You Gotta Go

Quicken Loans is the largest online mortgage lender in the US, the nation's largest FHA lender, and the premier Veteran Affairs lender. Legacy software systems can be tedious and inefficient to use, sometimes requiring employees to spend valuable time manually inputting data from documents. Unfortunately, replacing legacy software systems with modern ones is complex and costly.

Our Walter, You Gotta Go system provides a modern software system that accomplishes the same task as the legacy system without replacing it.

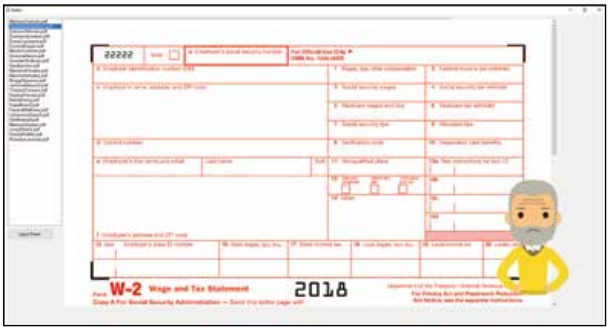
Our system leverages Robotic Process Automation (RPA) to create a specialized program called a "virtual worker," which watches how a user processes documents in the legacy software and then learns how to replicate it.

Having learned the process, the virtual worker then automates the data-entry process by extracting information from documents and submitting the data to the legacy system directly, saving time and reducing errors.

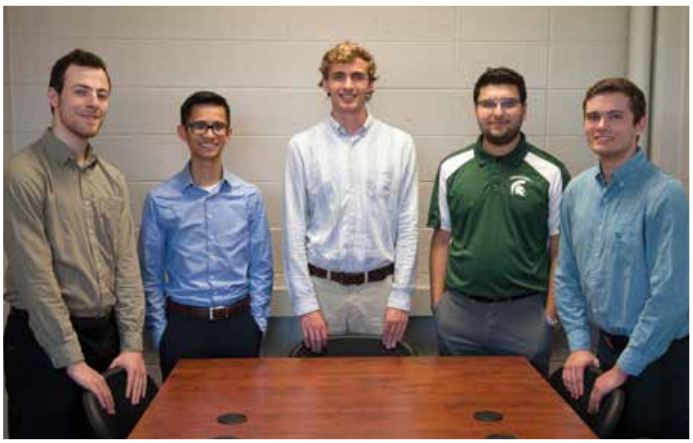
In addition to our virtual worker, our system includes a web app used to view and edit previously entered data. This web app provides all of the functionality of the legacy system as well as some additional features, all with a modern user experience.

In the spirit of Quicken Loans, each part of our system is anthropomorphized with its own persona. Walter is the tired legacy system that is replaced by Lindsey who is the new cutting-edge princess of the mortgage world.

Our virtual worker is implemented with an RPA tool using UiPath to extract data. Our web app is written with the Angular 6 framework and Quicken Loans' Spark Design Systems. Our backend is powered with a GraphQL API connected to a Microsoft SQL Server database.



Quicken Loans
Engineered to Amaze



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Spectrum Health
Spectrum Health Virtual Reality Experience

Based in Grand Rapids, Michigan, Spectrum Health is a not-for-profit integrated health-care system including 12 hospitals, 8 urgent care facilities and 48 lab centers, making them the largest employer in West Michigan.

For patients and their families, a trip to a hospital or other medical facility is often confusing and stressful. Strange devices, some rather large and others rather intimidating, seem to be everywhere.

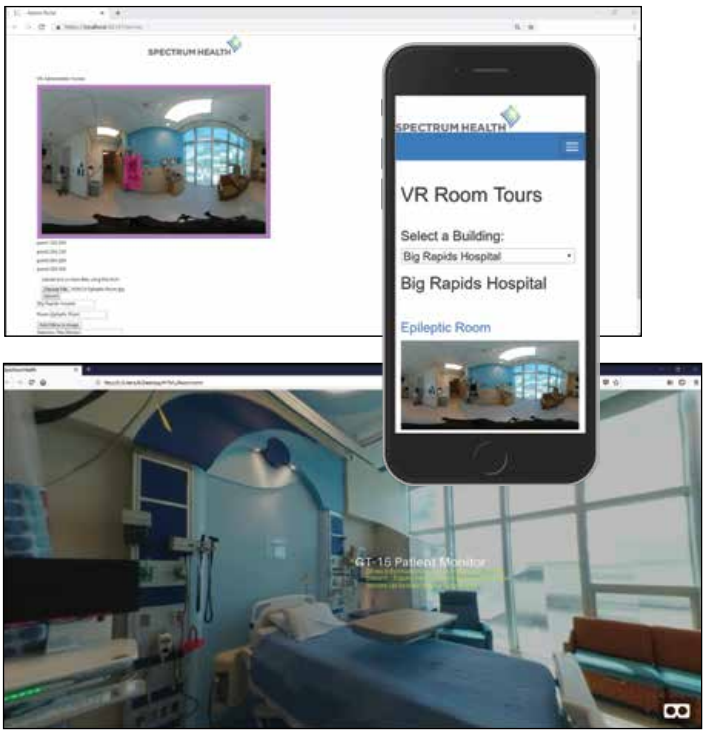
Our Spectrum Health Virtual Reality Experience app gives patients and their families the ability to explore Spectrum Health's many facilities virtually, from the convenience and comfort of home.

Patients enjoy an interactive experience with a full 360° view. As they look around, items in the room are identified and explained. From operating rooms to treatment rooms to patient rooms, users learn what's what before ever entering a Spectrum Health facility, thereby reducing confusion and stress.

Our Spectrum Health Virtual Reality Experience app runs within any desktop or mobile web browser. In addition, our app supports various virtual reality devices such as an Oculus Rift or a Google Cardboard to provide a completely immersive experience.

Spectrum Health employees use our companion administrative web portal to add new rooms, which includes uploading 360° images and annotating points of interest within a room.

Our Virtual Reality Experience app is written in HTML and JavaScript. A-Frame is used for 360° image browser support. ASP.NET Core and MSSQL provide server integration.



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TechSmith
TechSmith Video Review and Slack Integration

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.

TechSmith Video Review is a web-based system that enables video authors to obtain feedback on their videos before publishing them.

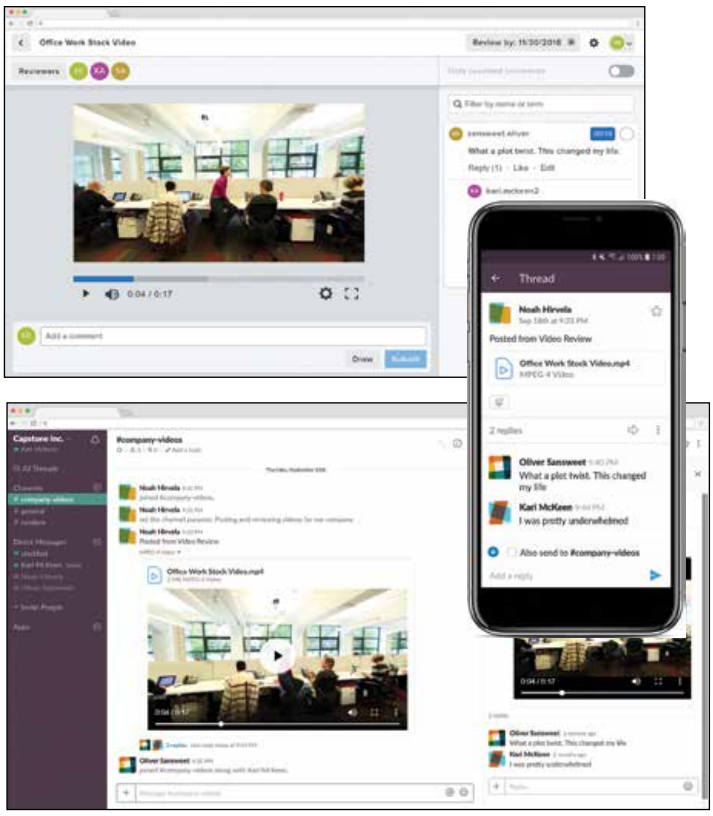
Our TechSmith Video Review and Slack Integration project extends the functionality of Video Review by connecting video authors with video reviews using team messaging systems.

In particular, our system integrates the popular messaging system Slack into Video Review. Users post and review videos, all from within their desired Slack channel. Reviewers post reviews of their own and comment on other users' reviews. Video authors read reviews and respond to reviewers interactively using Slack.

Reviews can be created from directly within Slack or synchronized from a preexisting review created from within TechSmith's Video Review.

Once a review is posted on Slack, all reviews and replies are updated both within Slack and within Video Review. This enables users to create and modify reviews on the platform of their choice while having consistent information.

Our TechSmith Video Review and Slack Integration system is implemented using two proxy servers, one for Slack's API and one serving a REST API that communicates with Video Review. Both servers are written in C#, contained in Docker, and documented using Swagger.



TechSmith®

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Union Pacific
Augmented Reality Mechanic Training

Headquartered in Omaha, Nebraska, Union Pacific is a leading railroad company with some 42,000 employees, 8,600 locomotives and 64,000 freight cars riding on 32,000 miles of track covering the western two-thirds of the U.S. To maintain this massive infrastructure, Union Pacific must train teams of mechanics to repair and operate complex machinery. This equipment is often large, unwieldy and expensive, making it challenging to provide training that is both safe and cost-effective.

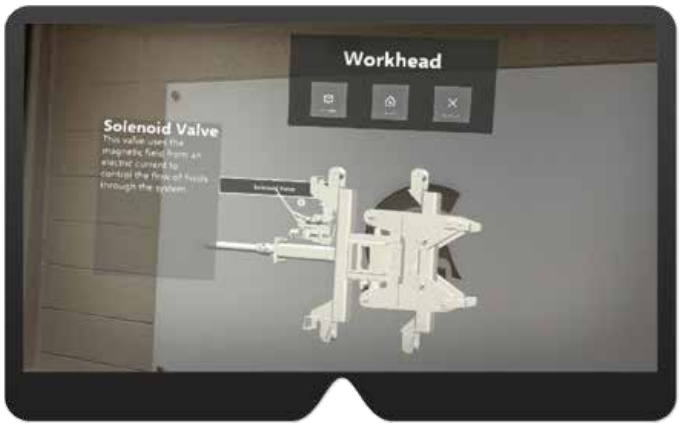
Our Augmented Reality Mechanic Training systems provide an immersive and intuitive virtual training experience using the Microsoft HoloLens and Android. Our system is separated into two educational modules: Learn About Machinery and Build a Train.

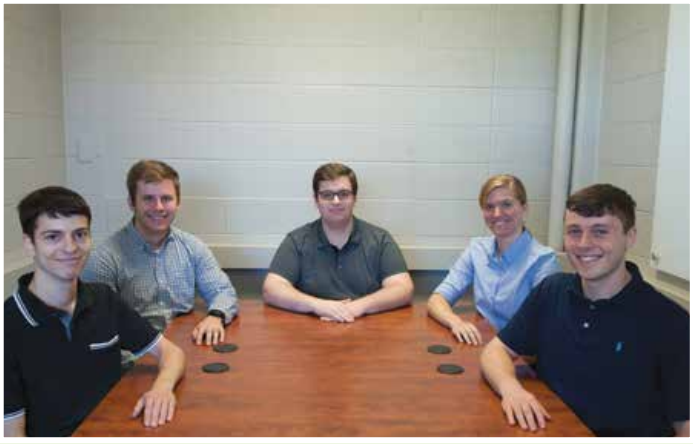
Learn About Machinery displays holographic images of equipment for mechanics to study as a replacement for actual, physical machinery. As shown in the lower example at the right, trainees can rotate and interact with these holograms, accessing detailed maintenance information.

Build a Train provides real-time instructions on how to assemble a train, verifying that each step is completed correctly along the way. Labels projected above each train car provide guidance to the trainee as seen at the right.

Our Learn About Machinery and Build a Train systems demonstrate proof that augmented reality environments such as ours provide safe and cost-effective training.

Our Augmented Reality Mechanic Training systems are written in C# using the Unity game engine. They use Vuforia for object recognition and the PiXYZ plugin to process CAD models.





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United Airlines
Toolkit Content Verification System

United Airlines is one of the world's largest airlines, serving over 148 million customers a year to 357 destinations in 48 countries with 4,600 daily departures.

For any airline, aircraft grounded due to mechanical issues may cause cancelled flights, loss of revenue, and dissatisfied customers. United operates the third largest fleet in the world with some 757 planes.

In order to maintain their fleet, United uses over 200,000 tools stored at various airports. Many of these tools are bundled into kits designed for very specific tasks like changing out the engine on a Boeing 787.

When a toolkit arrives at a United destination, it is crucial that the kit be complete so that technicians can address the issue and return the aircraft to service safely.

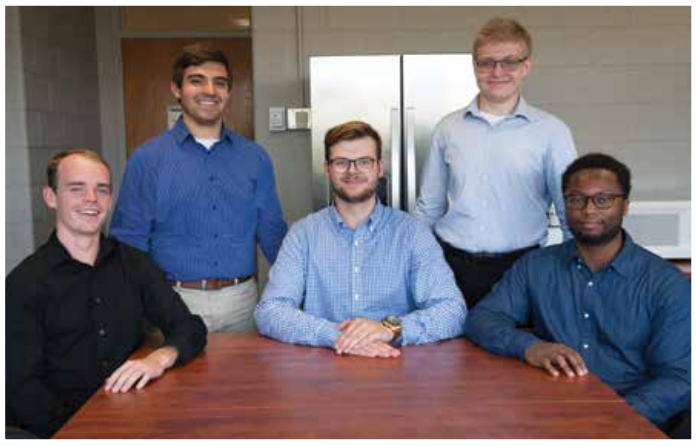
Our Toolkit Content Verification System ensures that toolkits are complete before they are checked out for use and before they are checked back in for storage. The system also logs every transaction for each toolkit.

To verify the completeness of a toolkit, a United technician simply uses their Apple iPhone or iPad to capture a photo of an opened kit as shown at the right.

Once a photo is captured and sent to our server, computer vision algorithms determine which tools are present and which are missing. On screen, our app then informs the technician whether or not the kit is complete.

Senior technicians use our companion web app to add new toolkits to the system and to track histories of kits.

Our Tooling Kit Content Verification System iOS app is written in Swift, with computer vision processing using the OpenCV library. Our web app uses the Django framework.



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Urban Science
VIN-Verse

Headquartered in Detroit, Urban Science is internationally renowned for providing data-driven, science-based solutions to problems in the automotive, health and retail industries.

The history of a vehicle is important to owners, sellers and buyers alike. Keeping an accurate and accessible record of a vehicle is a challenge, which often results in a disorganized group of documents stored in a vehicle's built-in filing cabinet, its glove box.

Based on a vehicle's unique Vehicle Identification Number (VIN), our VIN-Verse system leverages Urban Science's existing data to provide a comprehensive history of a vehicle, including maintenance, both past and upcoming, repairs, recalls, and accidents.

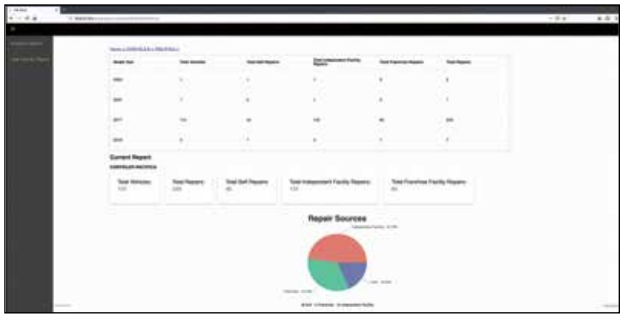
VIN-Verse enables a vehicle's owner to manage who can view their vehicle's history. Repair facilities give better service when they are able to review a vehicle's complete history. Potential buyers are more likely to purchase if they know the complete facts about a vehicle.

To augment Urban Science's existing vehicle data, VIN-Verse includes a verified self-reporting system with which vehicle owners can enter their own repairs, thereby making the history complete.

For vehicle manufacturers, VIN-Verse provides a dashboard that visualizes trends in the service history of the vehicles that they make and sell.

As a responsive web app, VIN-Verse is accessible using any web browser on desktops or mobile devices.

The frontend of our VIN-Verse system is built with ASP.NET/C# and Angular 6. The backend is implemented using Microsoft SQL Server 2016.



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Volkswagen Group of America
VW Car-Net® Demo App

Volkswagen Group of America is the North American operation headquarters and subsidiary of the Volkswagen Group. Volkswagen sold 10.5 million vehicles globally in 2017, the most of any manufacturer.

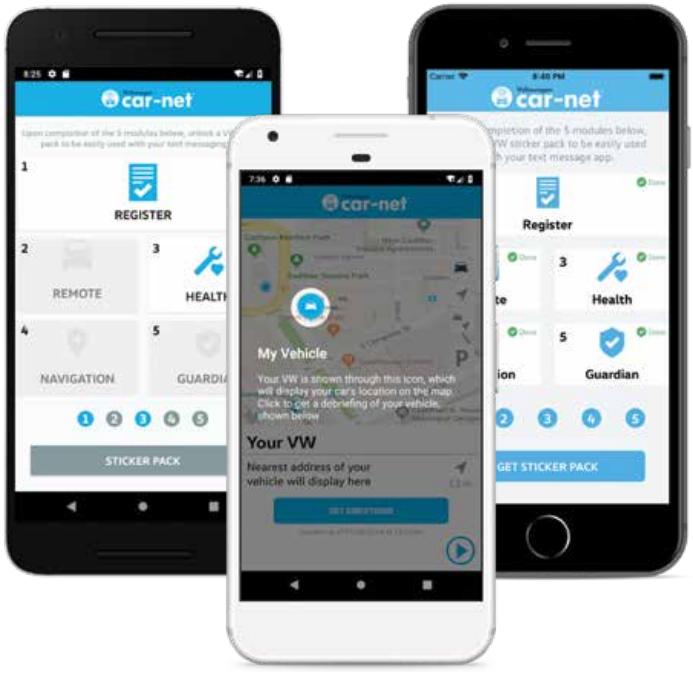
In 2013, Volkswagen introduced VW Car-Net, a Connected and Mobility Services system that offers convenience and ease of access to Volkswagen owners through a variety of features and tools. With technology evolving quickly, VW is preparing to launch an updated version of VW Car-Net with new features and technologies starting with model year 2020 vehicles. As a result, it is important that dealers and customers be made aware of the benefits of this new version of VW Car-Net.

Our VW Car-Net Demo App provides a platform where users are introduced to and familiarized with VW Car-Net while at the dealership. Our app guides users through several tutorial modules. Each module explains the functionality of a VW Car-Net feature, acquainting users with the advantages of their connected car services while simultaneously engaging with the VW brand.

Our app consists of five tutorial modules that explore VW Car-Net features including Registration, Remote Services, Vehicle Health Reports, Navigation and Guardian Services.

To encourage the greatest number of potential VW customers to learn about VW Car-Net, our app supports both Google Android and Apple iOS mobile devices.

Our VW Car-Net Demo App is written in Kotlin for Android and Swift for iOS. Firebase Analytics is integrated into each app to gather usage statistics.



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Whirlpool
IRAV: Image Recognition, Annotation and Validation

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is the world's leading major home appliance company with approximately $21 billion in annual sales and 92,000 employees.

Whirlpool is reducing the daily challenge of getting meals on the table by providing their customers with a seamless kitchen experience. To this end, they recently acquired Yummly, the premier digital food platform.

Yummly gives personalized recipe recommendations based in part on the ingredients that a user already has on hand. Yummly determines these ingredients by applying computer vision to images captured with mobile devices.

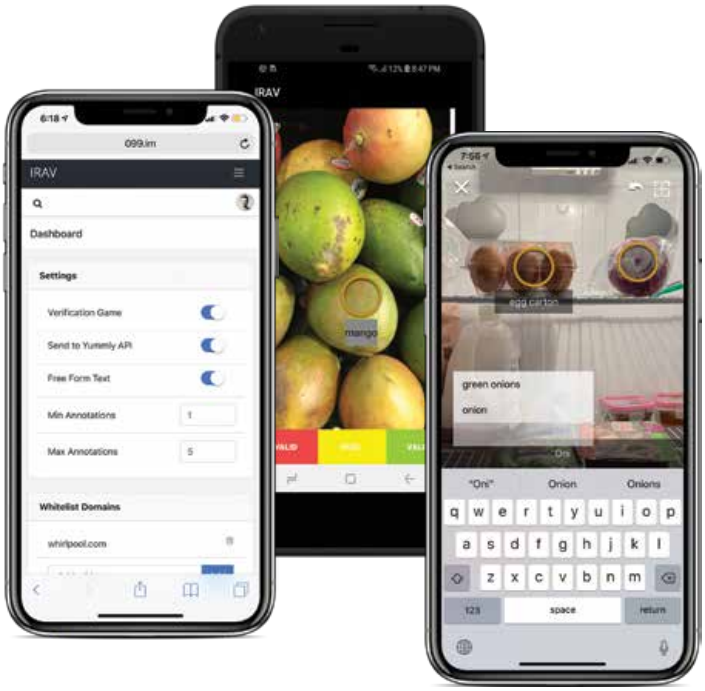
In order to recognize ingredients accurately, Yummly compares captured images to a large set of existing images in which ingredients are already annotated with labels and validated for accuracy.

Our Image Recognition, Annotation and Validation (IRAV) mobile application leverages crowdsourcing of Whirlpool employees, utilizing users' captured images and validating them, effectively contributing to the many comparison images required by Yummly.

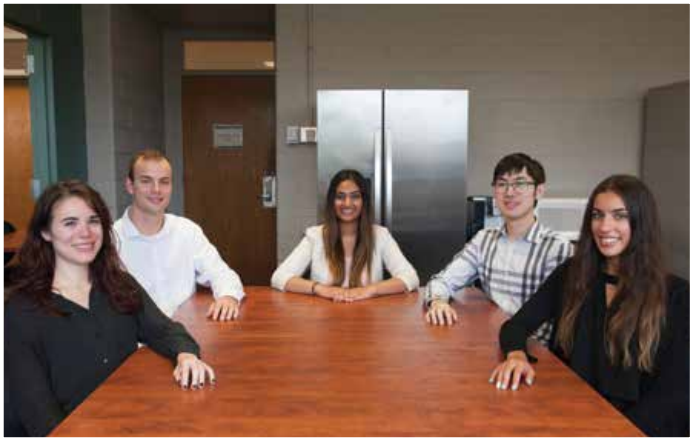
IRAV users take pictures of ingredient items, annotate them, and submit them. However, before Yummly accepts an image, the annotations must be validated by other users.

An image is considered to be acceptable only after it is validated by enough IRAV users. Only then is it added to Yummly's set of comparison images.

Our Image Recognition, Annotation and Validation application is written in Swift using Xcode for iOS, and Java using Android Studio for Android. Google Firebase is used for the backend.



Whirlpool CORPORATION



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Design Day Awards

CSE 498, Collaborative Design, is the senior capstone course for students majoring in computer science. Teams of students design, develop and deliver a significant software system for corporate clients. The CSE capstone teams compete for four prestigious awards. 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 Phoenix Group
Customer Service System with Chatbot

Aman Goshu, James Finch, Sarah Fillwock, Dan Shumaker, Fatema Alsaleh
Presented by Ross Hacker and Scott Lake

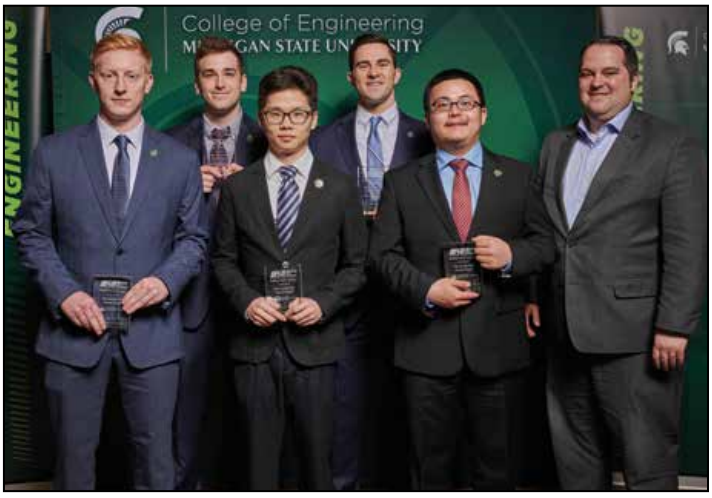
MSU Federal Credit Union Praxis Award

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 Amazon
AMPED: Amazon Marketplace Podcast Earnings Detection



Zach Whitener, Cam Korzecke, Chess Luo, Dillon Stock, Hansheng Zhao
Presented by Ben Maxim

Design Day Judges

Chris Brush
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Adam Haas
General Motors

Mike Lovejoy
Sandia National Laboratories

Marty Strickler
Rose Packing Company

Mark Buikema
Herman Miller

Wendy Hamilton
TechSmith

John Marx
Amazon

Dave Washburn
MSU Foundation

Bob Dyksen
The Phoenix Group

Fred Killeen
General Motors

Ben Maxim
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Elizabeth Klee
Urban Science

Rob McCurdy
Michigan State University

Rich Enbody
Michigan State University

Keith Landau
Ribbon Communications

David Mysona
Blackstone Technology Group

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 Quicken Loans
Fundamenta: Trust in New Home Construction

Riley Annis, Jaiwant Bhushan, Vishal Adusumilli, Turner Anderson, Erin O'Hara
Presented by Wendy Hamilton and David Norris

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 Herman Miller
Adjust: Augmented Reality Chair Adjustment Assistant

Kyle Kinsey, Han Huang, Jacob Weber, Kevin Gaban, Mike Bremiller
Presented by Elizabeth Klee, Nik Steel and Andrea Michaud

SOME MILESTONES DURING 25 YEARS OF

DESIGN DAY

1994
First "Design Day" is held in the Communications Arts Building; 12 Mechanical Engineering teams present their "Environmentally Friendly Designs;" ME Design II teams present their projects; awards are given

1996
Design Day moves to the MSU Union

1998
First humanitarian project – Zack's Bike – is presented

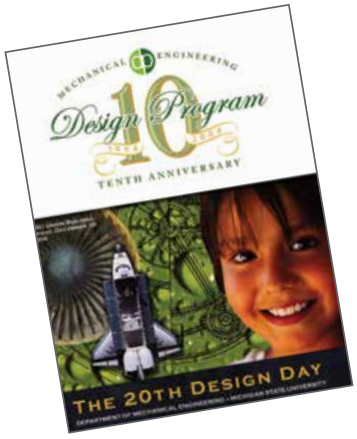
2002
Chemical Engineering teams display posters; two Materials Science teams present projects

1994-1998 | **1999-2003** | **2004-2008**

1995
Design Day is held in Brody Hall; 20 Mechanical Engineering teams are supported by 5 corporate sponsors

1997
K-12 students are invited to attend

2004
10th Anniversary of Design Day is celebrated

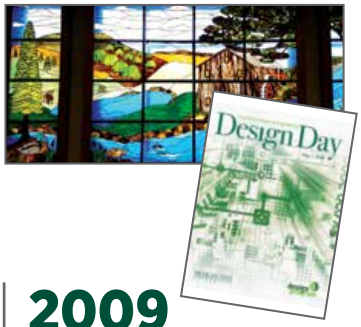


2005
Dart Foundation begins sponsoring K-12 activities

1997
Most current capstone students are born in this year

1999
Google celebrates its first birthday!

from 1994-2019



aes Applied Engineering Sciences

2006
Electrical & Computer Engineering joins; name is changed to College of Engineering Design Day

2009
Biosystems & Agricultural Engineering joins Design Day with poster presentations; Auto-Owners Insurance becomes the first Executive Partner Sponsor

2010
With the addition of Applied Engineering Sciences, all academic programs in the College now participate in Design Day

2014
Design Day celebrates its 20th year; its 5th with all academic programs participating

2018/19
Design Day celebrates its 25th anniversary!

2009-2013 | **2014-2019**

2007
Computer Science & Engineering joins Design Day with 6 teams

2008
Engineering 100 and Civil Engineering begin participating

2013
Design Day outgrows the MSU Union and moves to the Engineering Building

2007
Apple introduces the iPhone to the world

2010
The world's tallest building opens in Dubai at 2716 ft

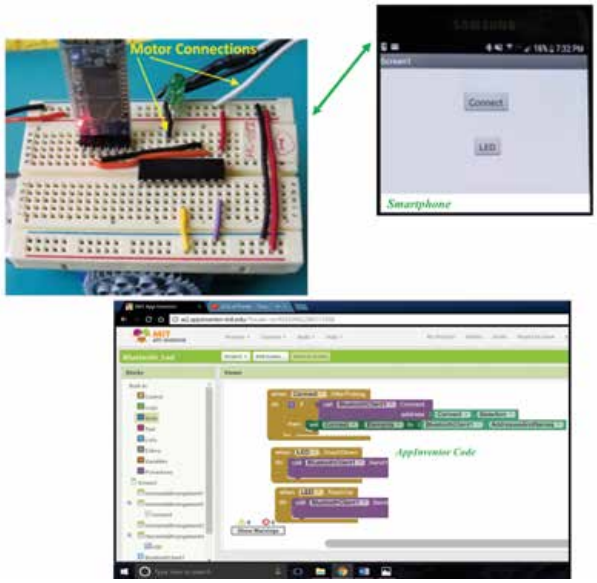
Introduction to Electrical and Computer Engineering

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 Smartphone and new research/teaching approaches. The experiments include (a) Brainwaves Using Mindwave Mobile and Smartphone, (b) MATLAB Mobile, (c) App Inventor, (d) Smart Bracelets for Health Monitoring, (e) Smartphone Digital Microscope, (f) Smartphone Controlled LED/Motor Using Bluetooth Module, and (g) Microcontroller Programming using a Smartphone-based IDE (Integrated Development Environment).

Microcontroller, Bluetooth



Graduate Student Assistant: Avni Sharma

Team Members	Project Title
Team #1: Cody Bridges Nick Krause Aylasia Steen	Remote Control Robot Car
Team #2: Baraa Aljanadi Jeffrey Chau Jan Mendiola Lucas Takamoribraganca	Robot Car with Catapult
Team #3: Austin Lowien Steven Tuttle Yuchen Wang	Motion Control Robot
Team #4: Andrew Mackoul Yilong Xie	Creating an App that uses SMS to Control Another Phone

The Capstone Projects

Dr. John Albrecht
Associate Professor of Electrical and Computer Engineering

Dr. Dean Aslam
Professor of Electrical and Computer Engineering

Faculty Advisors: Baryshev, Mitra, Mukkamala, Radha, Tan, Ulusoy


Baryshev


Mitra


Mukkamala


Radha


Tan


Ulusoy

Presentation Schedule – Engineering Building, Room 2205

Time	Team Sponsor	Project Title
8:30 a.m.	MSU Solar Racing Team	Brushless DC Motor Controller
8:55 a.m.	MSU D-CYPHER Lab	Robotic Crop Weeder
9:20 a.m.	FRIB	Development and Characterization of LNA Stage for Beam Current Measurement
9:45 a.m.	NASA/ASU	Neutral Flux Detector
10:10 a.m.	CANVAS SOAR	Ride Quality Monitor
10:35 a.m.	MSU NDE Lab	Measuring Relative Viscosity of Automotive Engine Oil Using Ulstrasonics
11:00 a.m.	Aptiv	Advanced Study of Antenna Coverage for Implementing Next Gen V2X Technology in Commercial Vehicles

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:

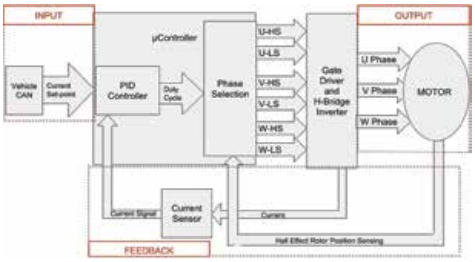
- Putting into practice the technical skills learned in the classroom, on industrially sponsored team projects, under faculty guidance, doing open-ended design, giving them experience in teamwork, project management, product life cycle management, intellectual property, accommodation issues and entrepreneurship;
- 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.

Michigan State University Solar Racing Team
Brushless DC Motor Controller

The Michigan State University Solar Racing Team is a student led organization focused on the design and construction of solar powered electric vehicles. The team participates in annual competitions against universities from across North America in a circuit track format, as well as a biannual long distance road race, which, this past summer, traveled from Omaha, Nebraska to Bend, Oregon.

The current solar vehicle is one-wheel drive, requiring only a single motor controller. The team is looking to advance to a two-wheel drive system in the next vehicle, requiring two motor controllers. The motor controller in use is a **Tritium Wavesculptor 22**, at a retail price of $4,500, making the desired two-wheel drive upgrade costly.

Our team was tasked with designing a motor controller to replace the **Tritium Wavesculptor 22** for a fraction of the cost, saving the Solar Racing Team a significant amount of money and creating a base of knowledge for future development. This controller will have a power rating of 7.5kW with passive thermal management, utilize hall effect rotor position sensing, and be compatible with the existing vehicle CAN. Additionally, our team would like to provide a design that is easily reparable and upgradable for future generations of the Solar Racing Team.



Architecture of a BLDC Motor Controller

MICHIGAN STATE
SOLAR RACING TEAM

Michigan State University
Team Members (left to right)

Ryan VanZalen
Grand Rapids, Michigan

Ben Farmer
Plano, Texas

Greg Stark
Armada, Michigan

Sydney Borowiak
Gaylord, Michigan

Neal Malackowski
Schoolcraft, Michigan

Joey Lucas
Brighton, Michigan

MSU Solar Racing Team
Project Sponsor

Project Facilitator

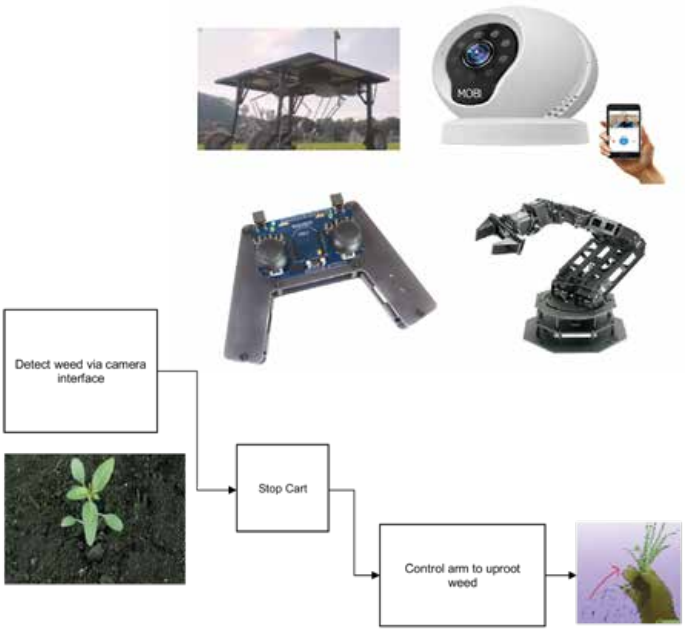
Dr. Joydeep Mitra
East Lansing, Michigan

MSU D-Cypher Lab
Robotic Crop Weeder

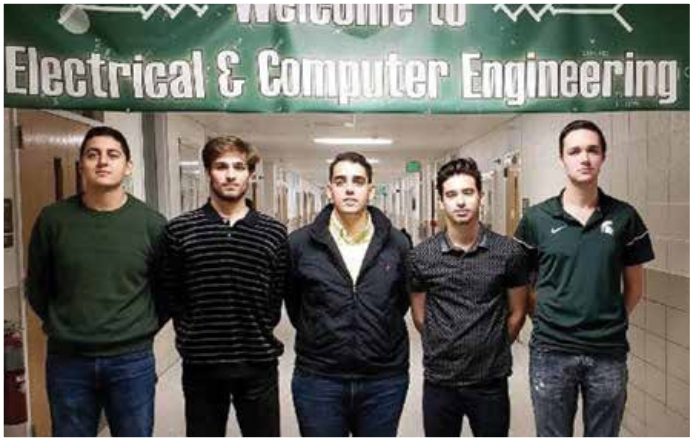
Farmers are the backbone of great nations, supplying food for the masses seamlessly. Specifically, corn is a staple that is heavily relied on by consumers, especially in the United States, where there are 96 million acres of land preserved for its specific cultivation, establishing the US as the largest producer of the crop.

In the modern world, agricultural developers are not often considered when it comes to technological innovation, regardless of the magnitude of their problems. Citizens wake up in the morning expecting sustenance conveniently, without ever considering the labor that is required to produce such products. In the case of corn farming, particularly in the early stages of its development (within the first 6 weeks to 8 weeks of growth) it is heavily susceptible to invasive weeds stealing nutrients and resulting in a lower yield by a factor of 1% to 15%.

Our team has been tasked with finding an ergonomic solution for the removal of weeds within the most vulnerable period of a corn plant's adolescence. Utilizing the PhantomX Reactor, a remotely controllable robotic arm, and a vision system, the design must be capable of locating, gripping, delivering force, and fully removing weeds from the soil near the base of corn. The prototype must also be maneuverable, maintain a minimum of 30 minutes of battery life, and not interfere with the production process, while also having the possibility for upgrades (such as full autonomy, weed pattern detection, and a motorized cart) once the design is passed off. Through this proposed design, farmers can expect higher yields at a lesser cost, with the potential of this design branching out to other crop varieties.



College of Engineering
MICHIGAN STATE UNIVERSITY



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Omar ElAhdan
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MSU D-CYPHER Lab
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East Lansing, Michigan

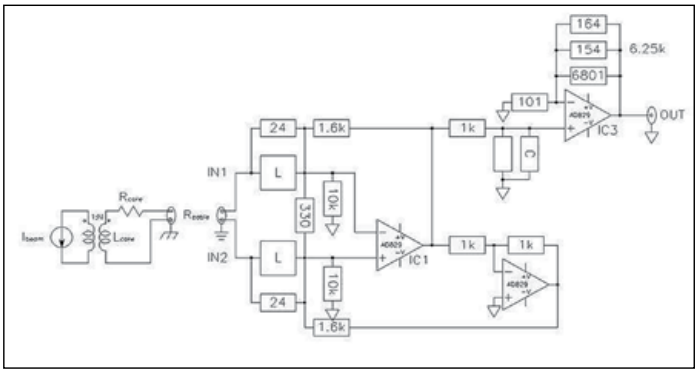
Project Facilitator

Dr. Xiaobo Tan
East Lansing, Michigan

Facility for Rare Isotope Beams (FRIB)
Development & Characterization of LNA Stage for Beam Current Measurement

The Facility for Rare Isotope Beams (FRIB) currently uses a commercial beam monitor system which they would like to optimize for lower noise density during measurements. The goal is to reduce the noise in the output around the 1Hz-100Hz range.

In order to accomplish this, our team will modify the amplifier and feedback circuit, as well as utilize an Arduino for digital noise reduction. These will serve as a proof-of-concept to the customer and will be further developed with the idea of a Field Programmable Gate Array (FPGA) in mind.



FRIB

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Nick Gierak
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Tyler Ruark
Cedar Springs, Michigan

Facility for Rare Isotope Beams
Project Sponsor

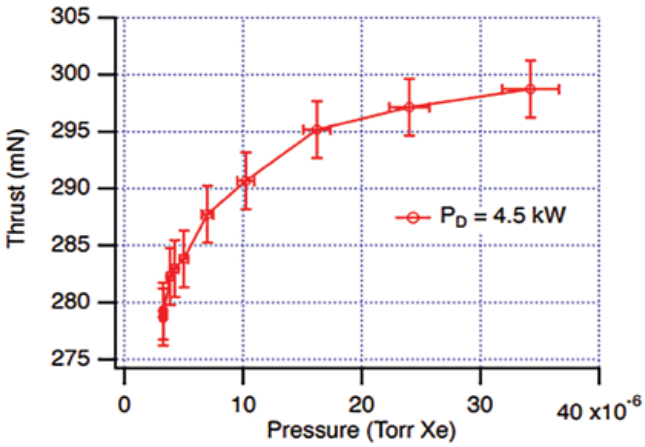
Steve Lidia
East Lansing, Michigan

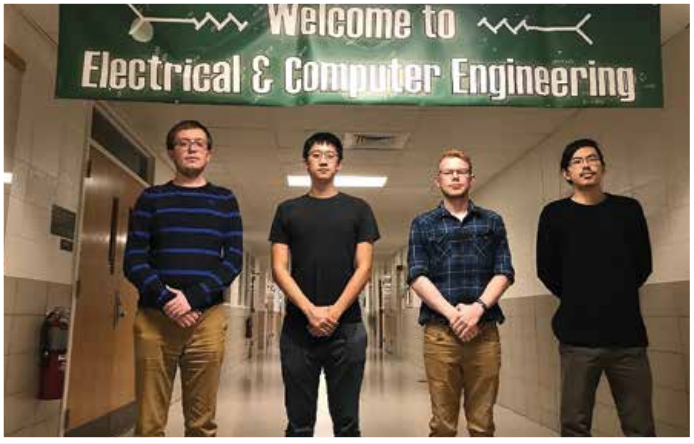
NASA/Arizona State University
Neutral Flux Detector

Psyche is the name of an asteroid made of mostly nickel-iron metal currently orbiting the sun; the asteroid is located between Mars and Jupiter. Psyche is also the name of the NASA mission to send an unmanned spacecraft to orbit the asteroid, which is scheduled to launch in 2022.

The Psyche spacecraft utilizes hall-effect thrusters for high efficiency, low thrust propulsion. There is an observable increase of background pressure in NASA facilities during testing of the hall-effect thrusters. This background pressure causes an increase in efficiency of the thruster, destroying the integrity and accuracy of any tests conducted. Some theories proposed to explain this phenomenon include ion re-ingestion and molecule re-ionization.

Our team is tasked with providing a sensor capable of measuring the flux of neutrals present within testing facilities. The purpose of the sensor is to provide NASA researchers with data to help extrapolate theories to explain the cause of increased background pressure.





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NASA/Arizona State University
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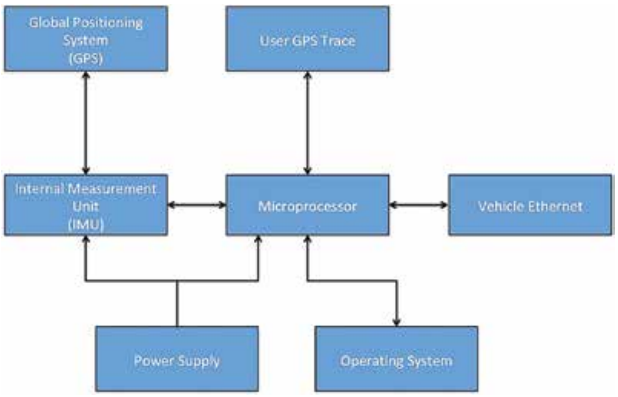
CANVAS SOAR – AutoDrive Challenge
Ride Quality Monitor

SOAR is a student-organized research organization focused on building a highly autonomous Chevrolet Bolt capable of traversing an urban scenario as part of the three-year SAE/GM AutoDrive Challenge Competition. The AutoDrive Challenge consists of both static and dynamic competitions focusing on a range of topics including societal impacts, engineering robustness and driving ability of the vehicle.

In preparation for the AutoDrive Challenge, our team is tasked with creating a ride quality monitoring device to aid in autonomous vehicle development. During the AutoDrive Challenge, the team is scored based on the ability of the vehicle to provide a quality ride. Ride quality is a measure of driving smoothness and how well the vehicle stays within designated lanes, trajectories, and speed limits.

The goal of this project is to develop a portable device capable of tracking vehicle dynamics during testing, while also tracking the location of the vehicle with respect to a predefined vehicle path. The team aims to provide an interface for this test data so ride quality can be quickly assessed. The team is also tasked with providing a composite score based on the AutoDrive Challenge scoring metrics.



SOAR

Student Organized Autonomy Research Club

A CANVAS organization

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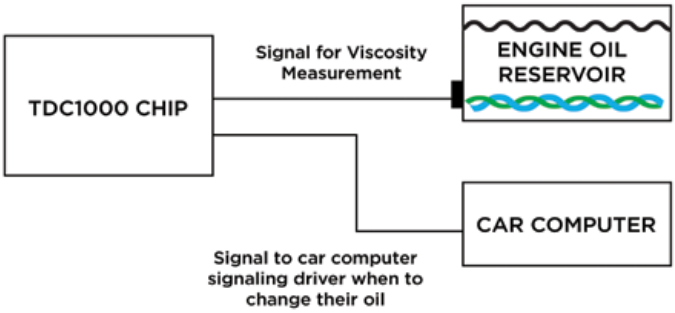
MSU Nondestructive Evaluation Lab (NDE)

Measuring Relative Viscosity of Automotive Engine Oil Using Ultrasonics

There is much debate by mechanics in the automotive world as to how often one's engine oil should be changed in their automobile. Some say it depends on the size of the vehicle, mileage, driving habits, and other variables. Instead of guessing when one should change their oil, if the viscosity of the oil is measured in real-time or using a waveguide, then the oil condition can be assessed directly. This measurement can also be simplified by using a relative viscosity measurement tool which will compare the viscosity of used oil with fresh oil.

In an attempt to clarify when one should change their oil and to reduce wasted oil, our team was tasked with designing a setup that utilizes ultrasonics via the TDC1000 chip in order to measure engine oil viscosity in real time. Eventually this tool, which can be installed in the automobile, will tell the driver when to change their oil based on oil quality instead of mileage.



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MSU NDE Lab
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Sunil Chakrapani
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East Lansing, Michigan

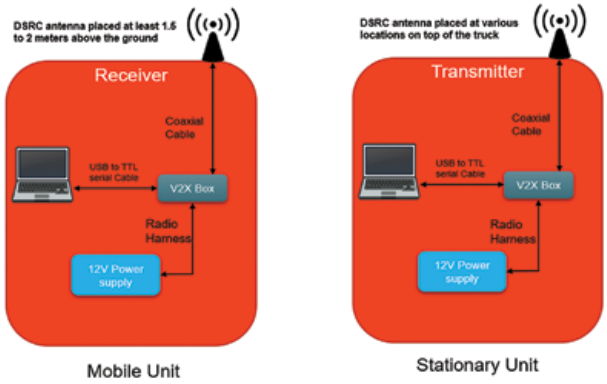
Aptiv: Advanced Study of Antenna Coverage for Implementing Next Gen V2X Technology in Commercial Vehicles

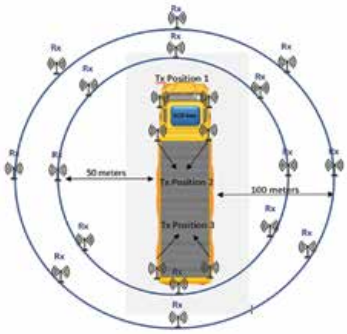
Aptiv is a global technology company that develops safer, greener and more connected solutions enabling the future of mobility. Aptiv's vision is to develop and implement the next generation of active safety, autonomous vehicles and smart cities by using its hardware and software capabilities.

As a part of Aptiv's vision of a more connected future, our team was tasked with the testing and implementation of V2X technology which includes vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. These communications are enabled via wireless links using Dedicated Short-Range Communication (DSRC) protocol.

The project involved using Aptiv-developed V2X Gen2 hardware modules to perform extensive research on the DSRC RF signal coverage around a 26-foot truck and real-time 360-degree signal measurements as well as several distance measuring techniques. This measurement procedure is part of special use-case in commercial vehicles known as Cooperative Adaptive Cruise Control or "Platooning," which promises increased fuel efficiency management for heavy truck fleets.

After performing the required testing, our team is responsible for data analysis on antenna coverage of the DSRC signal around the truck.





APTIV

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Chet Smith
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Zhi Zhou
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Linh Pham
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Chris Ruppel
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Project Facilitator

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East Lansing, Michigan

The Capstone Projects

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Dr. Dean Aslam
Professor of Electrical and Computer Engineering

Faculty Advisors: Biswas, Li, Mahapatra, Mason, Morris, Mukkamala, Salem


Biswas


Li


Mahapatra


Mason


Morris


Mukkamala


Salem

Presentation Schedule – Engineering Building, Room 2250 (11:00 a.m. in Room 1202)

Time	Team Sponsor	Project Title
8:30 a.m.	MSU CSANN Lab	Deep Neural Networks for Image/Data/Video Recognition and Classification
8:55 a.m.	MSU ECE Department	Mobile Robot Companion for Selfies
9:20 a.m.	MSU ECE Department	Smart LED Lighting
9:45 a.m.	MSU Bikes Service Center/ RCPD	Bicycle Collision and Blind-spot Detector
10:10 a.m.	MSU ECE Department	Underwater Wireless Communication Sensor for Temperature
10:35 a.m.	Instrumented Sensor Technology	Wireless Accelerometer
11:00 a.m.	MSU Recycling (Note: This presentation takes place in room 1202 on the first floor)	Tracking and Monitoring Trash Bins A joint project with Mechanical Engineering

ECE 480 Senior Design

We gratefully acknowledge the support of this semester's project sponsors: Aptiv, CANVAS SOAR, CSANN Lab, FRIB, Instrumented Sensor Technology, MSU Bike Service Center, MSU D-CYPHER Lab, MSU College of Engineering, MSU Recycling, MSU Solar Racing Team, NDE Lab and NASA/Arizona State University.

The ECE project facilitators who supervised ECE 480 teams this semester are: Sergey Baryshev, Subir Biswas, Tongtong Li, Steve Lidia, Nihar, Mahapatra, Andrew Mason, Joydeep Mitra, Daniel Morris, Ramakrishna Mukkamala, Hayder Radha, Fathi Salem, Xiaobo Tan, and Ahmet Ulusoy.

MSU CSANN LAB
Deep Neural Networks for Image/Data/ Video Recognition and Classification

Integration of sensors with quick decision on-the-fly leads to many appealing applications in new generation embedded devices and systems. Example applications are in image/video recognition, identification, tagging, navigations, etc. Simply, such devices would assist the user with instant essential information from staggering images and/or data. Successful and streamlined designs of deep neural networks have demonstrated appealing capabilities, in particular, image recognition and classification.

Powerful capabilities can be tailored for the available processing resources or onto embedded low-power co-processing Field Programmable Gate Arrays (FPGAs). This would provide local capabilities for the smart device/phones – off the cloud – with added benefits of speedups and device security.

The final project will include demos of the accuracy performance in recognition and classification of the device-captured images and/or sounds. Our team's project outcomes will be judged on their ability to satisfy several competing performance metrics: classification and accuracy performance, execution speed and added power consumption expense.

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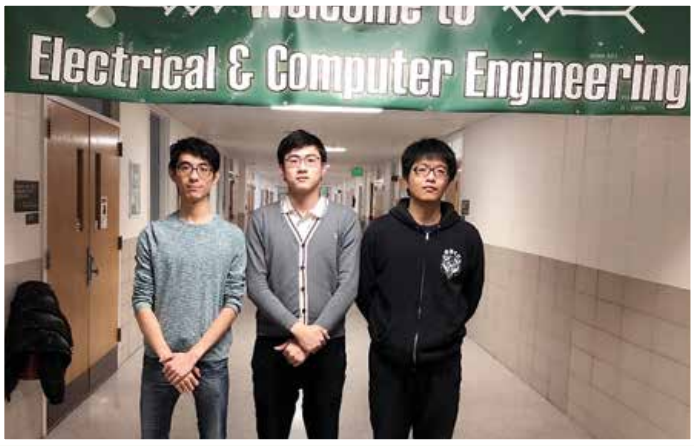

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Beijing, Beijing, China

Shuotao Wang
Shaoxing, Zhejiang, China

Yu Han
Wuhan, Hubei, China

MSU CSANN Lab
Project Sponsor

Project Facilitator

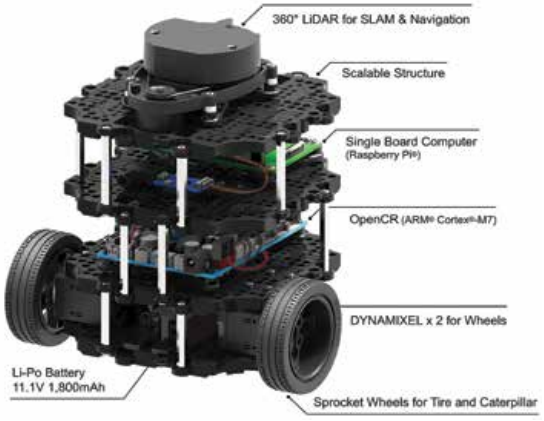
Dr. Fathi Salem
East Lansing, Michigan

MSU Electrical Engineering Department
Mobile Robot Companion for Selfies

Demographic reports indicate that the population of older adults is growing significantly around the world and, in particular, in developed nations. Consequently, there are a noticeable number of demands for certain services such as health-care systems and assistive medical robots and devices. With emerging technology, robots are going to eventually fulfill the role of our companions, and provide important services for us, including care for the elderly and disabled.

Our team was tasked with designing a way to integrate a mobilized robot companion that follows a person throughout everyday activities while capturing photos and videos whenever requested to do so. The goal of the project is to utilize a robot with integrating sensors and a Raspberry Pi with an enhanced camera and LIDAR, which utilizes light and radar to detect movements while avoiding certain obstacles.

The Turtlebot3 provides the necessary specifications and components to assist us with accomplishing this project. With its open source capabilities, the team can integrate a ROS (Robot Operating System) to simplify the task of creating complex and robust robot behavior across a wide variety of robotic platforms.



College of Engineering
MICHIGAN STATE UNIVERSITY

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Yulin Mao
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MSU Electrical Engineering Department
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Project Facilitator

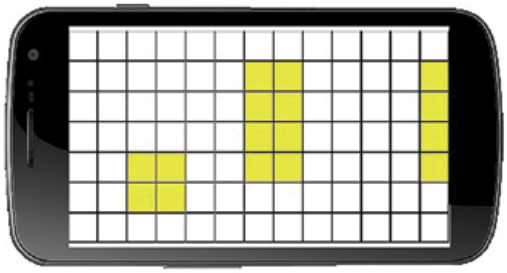
Dr. Daniel Morris
East Lansing, Michigan

MSU Electrical Engineering Department
Smart LED Lighting

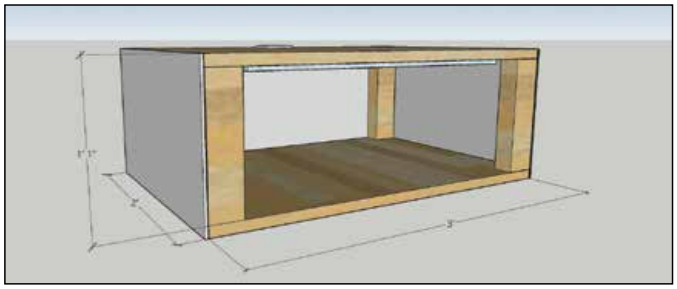
Residential lighting accounts for about 10% of all residential electric energy consumption in the US, or about 130 billion kWh per year. With modern LED lighting, it is possible to control this consumption by intelligently eliminating the illumination of areas not in use. This is currently done by sensing when a room is in use and turning off illumination when nobody is occupying the room.

Our team was tasked with a duel-phase project. Phase one is to design an illumination system that only lights a portion of a room. The system must be controlled using a touchpad to move the illuminated spot and have the ability to control the size of the illuminated region.

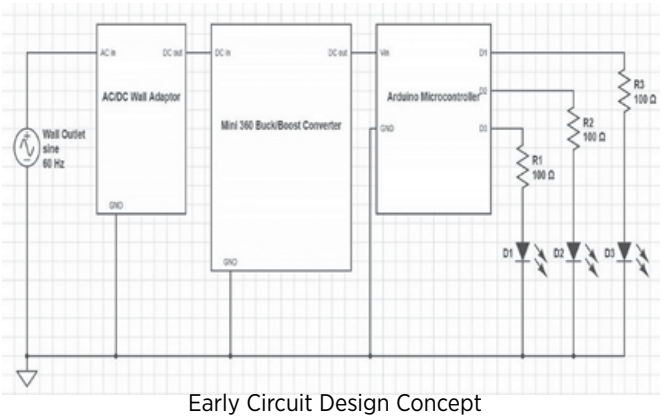
Phase two is then to add a system of sensors that must locate a person within the room and move the illuminated spot to that person. As the person moves, the illumination spot will broaden and move in front of them.



Prototype App Concept

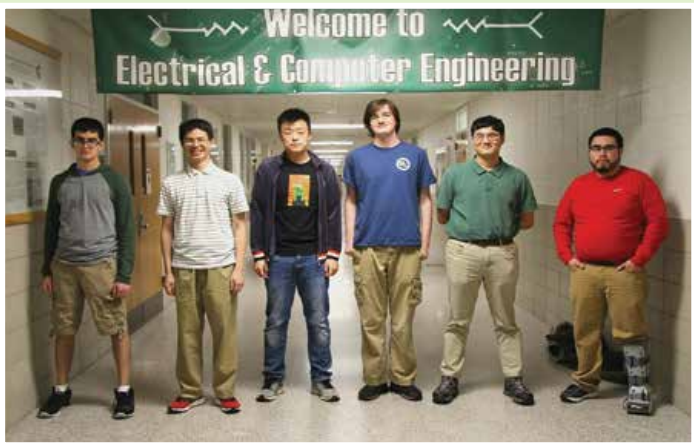


Early Testing Facility Concept



Early Circuit Design Concept

College of Engineering
MICHIGAN STATE UNIVERSITY



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Joseph Chi
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Jiaju Shi
Shijiazhuang, China

Carl Geiger
Webberville, Michigan

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MSU Electrical Engineering Department
Project Sponsor

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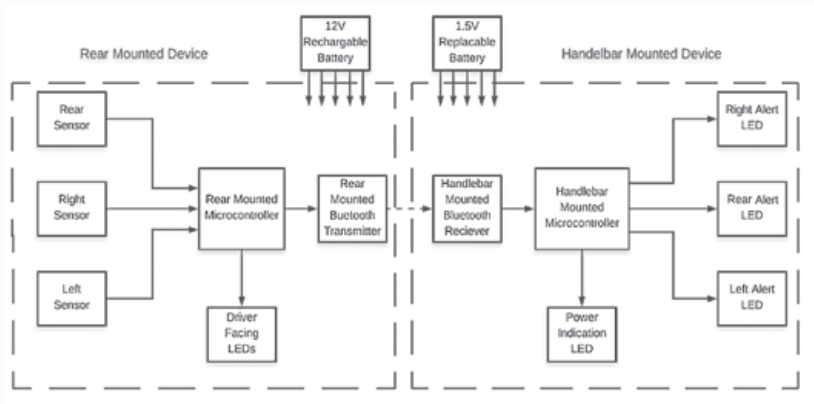
East Lansing, Michigan

MSU Bikes Service Center/RCPD
Bicycle Collision and Blind-spot Detector

In 2015 in the United States over 1,000 bicyclists died, and there were almost 467,000 bicycle-related injuries. Of these collisions, 43% were the fault of the cyclist.

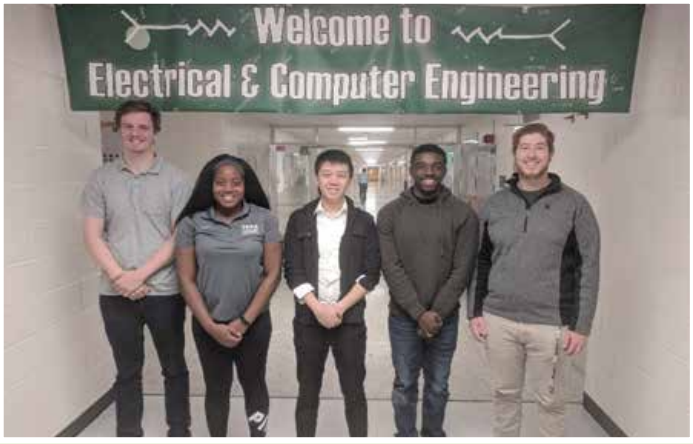
Our team was given the task of designing a device to help reduce that 43%. The goal of the project is to alert the cyclist to when collisions are imminent and when there is a vehicle in the cyclist's blind-spots.

Utilizing microcontrollers and radar technology, we plan to have a pair of devices to detect and alert the cyclist: one rear-mounted device, and one handlebar-mounted device, used concurrently to detect vehicle position, direction and speed. This data will be implemented into our software to alert cyclists to the possibility of collisions.



Resource Center for Persons with Disabilities

Bikes
MICHIGAN STATE UNIVERSITY



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MSU Research Center for Persons with Disabilities
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MSU ECE Department
Underwater Wireless Communication Sensor for Temperature

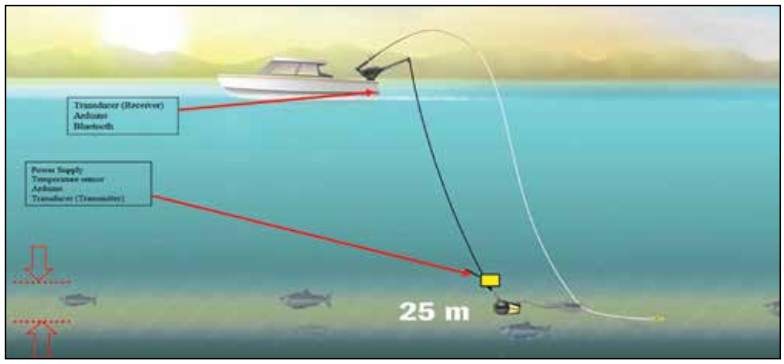
The goal of the project is for a temperature sensor to be able to wirelessly communicate through the water to a receiver that displays the temperature digitally. A system will be created to lessen the burden of changing out wired components on a downrigger.

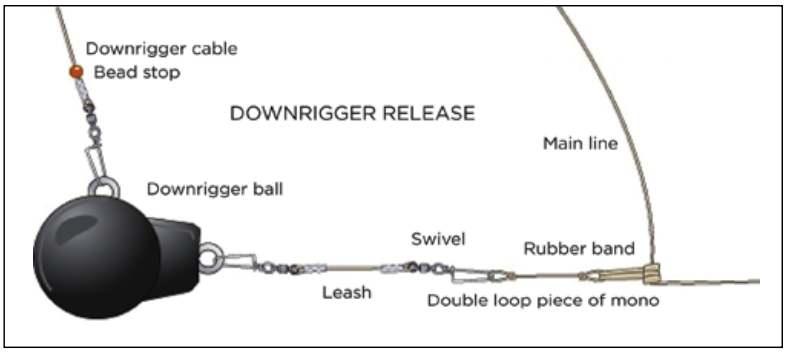
The sensor system will be attached to the downrigger weight and covered in epoxy in order to be waterproof. The problem involved is sending the signal. This is difficult because the water will be conductive, so high-frequency signals cannot be sent.

Our solution is to use Sonar or ELF waves to send the information to the receiver attached to the bottom of the boat. This will, in turn, have a display attached to indicate the temperature onboard.

The sensor system will be composed of the temperature sensor (a thermocouple, an RTD sensor or a generic temperature sensor) and a device to transmit the signal (either a Sonar signal with the temperature information encoded on it or an ELF wave).

The second system will be a receiver which will decode the information and display it. This will be composed of a receiver/transducer, an Arduino or a Raspberry Pi.





College of Engineering
MICHIGAN STATE UNIVERSITY

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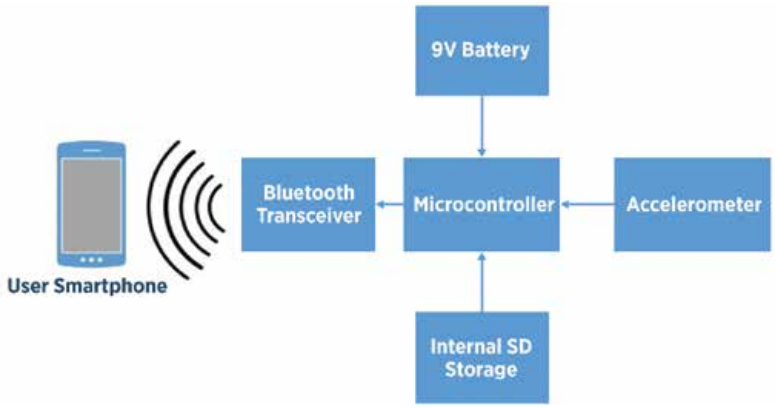
Dr. Subir Biswas
East Lansing, Michigan

Instrumented Sensor Technology, Inc.
Wireless Accelerometer

Instrumented Sensor Technology, Inc. offers a data recording device called the SnapShock-PLUS accelerometer that records peak acceleration, including impact, vibration, and shock, over the X,Y and Z axis. The current product requires a wired connection to remove the data from the device and onto a PC.

Our team has been tasked with recreating the acceleration recorder to measure peak g-levels but with the ability to wirelessly transmit its data to a smartphone application. This smartphone application will also be created by our team to allow the user to program recording parameters for the device to follow and to display the data from the recorder on the smartphone.

The device will utilize a Bluetooth transceiver to transfer the data from the accelerometer to the smartphone. All data will be internally stored to prevent data loss. The entire device will be powered by a 9V battery.



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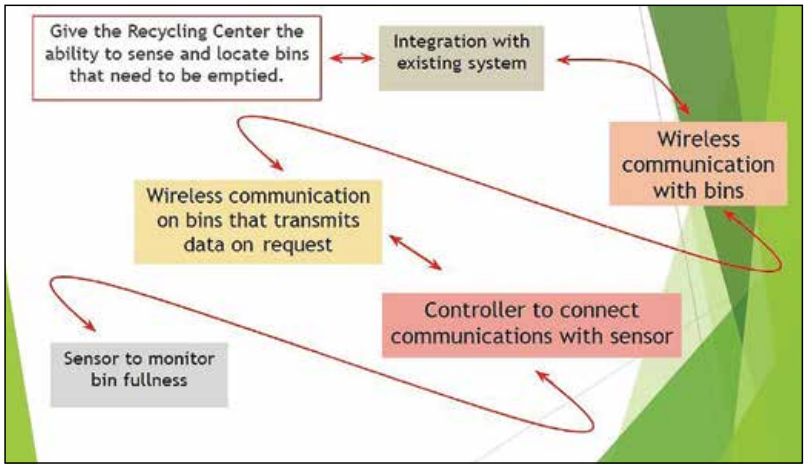
MSU Recycling
Tracking and Monitoring Trash Bins

There are over 200 green MSU recycling bins permanently scattered around campus and up to 400 additional bins are put in place during events. Currently, bins are monitored manually to determine whether they need to be emptied. Due to the uncertainly, this is an inefficient way to map trash collection routes.

MSU Recycling desires a method to determine the fullness of a bin in order to maximize route efficiency while minimizing their operating costs. The goal is to create an environment where bins are emptied before they become unpleasant for the general public.

Our team was tasked to create a system that will sense the fullness of the bin, communicate its current state to MSU Recycling and integrate the collected data into the existing system. Therefore, MSU Recycling will have the ability to create trash collection routes that will reflect only those bins that need to be emptied.



Surplus Store and Recycling
managing waste as a resource

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Kyle Keough
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MSU Recycling
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Project Facilitator

Dr. Andrew Mason
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Design Day Awards Spring 2018

Electrical & Computer Engineering Winners, Spring 2018

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.

Team MSU Solar Racing Team "Solar Array Maximum Power Point Tracker"

Left to right: Chris Hawkey, Alan Alen, Sean Murray, Gurveer Deol, Jack Whinham, Corey Beyer

Team CANVAS/AutoDrive Challenge "Lane Following and Obstacle Avoidance" and "Autonomous Vehicle Safety & Integrity Monitor (SIM)"

Left to Right:
Manoj Agarwal, Jason Merlo, Kyle Lammers, Boyuan Sun, Anton Schlegel, DJ Seeds, Ryan Ashbaugh
Not Pictured: Steven Yik

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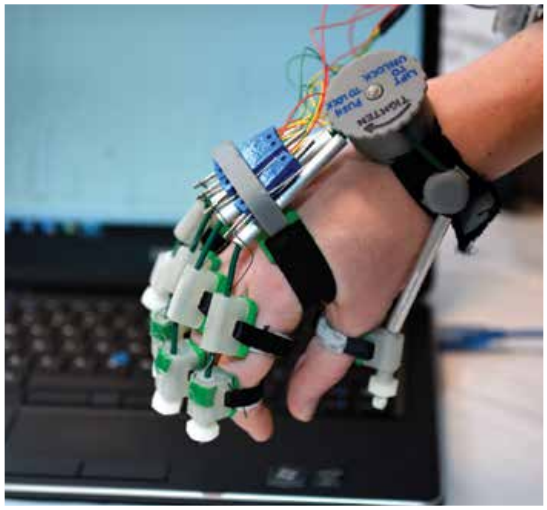


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00:30:00
MECHANICAL ENG

ME 412 Heat Transfer Laboratory

Yuping Wang
Academic Specialist
Department of Mechanical Engineering

Heat Exchanger Study

Heat exchangers are common. They are found in homes, cars, factories; and they take on a variety of designs and sizes from simple tubular to compact plates to many innovative structures. For this project, students are expected to understand heat exchanger operations and applications through two parts of work. For the major part, each team will build a simple heat exchanger based on their own design and then evaluate its performance through lab testing and thermal analysis. The objective of the design is to maximize the temperature drop of the hot fluid stream. For the second part, each team will choose a specific heat exchanger application of their interest and conduct a review of its design and performance, as well as its existing experimental/computational works. On the testing day, each team will have 15 minutes to set up, demonstrate, and disconnect their device. Both hot and cold water supplies are available with instrumentation provided for flow rate and temperature measurements. Each team will also prepare a power-point slideshow or video clip for the audience to explain the design decisions, fabrication, and thermal analysis of their heat exchanger.

Competition Schedule

Time	Station	Team members
8:00	A	Mohammed Alneyadi, Kory Iott, Suhas Kodali, Travis Wahl
	B	Michael Bertrand, Qianhui Dong, Caitlynn Dubie, John Vetter, Yi Zhou
8:15	A	Stuart Gadigian, Vinnie Herrman, David Mccriston, Philipp Waeltermann
	B	Matt Forsyth, Jennifer Kozlowski, Sebastian Mendez, Taylor Stensen
8:30	A	Amanda Boone, Shane Brady, Brent Diamond, Jared Rogers, Ruiwei Sui
	B	Ryan Ahee, Ryan Britain, Sydney Clark, Dallas Creech
8:45	A	Steven Atkin, Jill Hubbard, Katie Miller, Nicole Stanley
	B	Gabe Lefere, Michael Logan, David Mackens, Matthew Weber
9:00	A	Katie Frayer, Michael Houser, Xiaoke Wang, Simone Young
	B	Tony Anason, Andrew Capaldi, Robert Wei, Chenxi Yin
9:15	A	Zachary Cook, Alexander Johnson, Sarah Lohman, Levi Zimmerman
	B	Ben Beckas, Val Gueorguiev, Ivan Iovtchev, Diamant Topllari
9:30	A	Drew Dunker, Anindow Saha, Gabriel Sarnacki, Antonio Ulisse
	B	Zach Bowling, Robert Cortese, Tecumseh Hakenjos, Edward Kennedy
9:45	A	Abdulrahman Alqarni, Samantha Jones-Jackson, Elizabeth Pollack, Austen Shiau
	B	Alayna Farrell, CJ Johnson, Jason Kim, Nuno Marriott
10:00	A	Madison Duncan, Colin Horton, Holly Iglewski, Andrew Webb
	B	Mackenzie Martin, Josephine Muscato, Kevin Schuett, Brian Valentine
10:15	A	Evan Finses, Ethan Jacobs, Patrick Kelly, Matt Sarver, Zac Zettle
	B	Nathaniel Jenkins, Alex Kerns, Andrew Lamkin, Shane Luksch
10:30	A	Mitch Agrwal, Madeline Oesch, Reed Potter, Drew Roth
	B	Max Ralya, Vincent Rogers, Shariq Shariqameer, Paul Zhuang
10:45	A	Brianna Forsthoefel, Tom Karbon, Sammie Pfeiffer, Nicole Shaffer
	B	Brad Chapman, Jessica Derkacz, Nate Lewis, Ginnie Olszewski
11:00	A	Shiyu Liu, Josh Miller, Matt Rimanelli, Michael Zielinsky
	B	Justin Barg, James Breen, Jennifer Ju, Brant Toback
11:15	A	Luke Crompton, Marcus Li, Oscar Scheier, Xiaohang Wei

The Capstone Projects

Dr. William Resh
Professor of Mechanical Engineering
Mechanical Engineering Capstone
Course Coordinator

Faculty Advisors: Bénard, Engeda, Lillehoj, Mukherjee, Segalman, Wichman


Bénard


Engeda


Lillehoj


Mukherjee


Segalman


Wichman

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:00 a.m.	Consumers Energy	Guidelines to Relocating Natural Gas Mains
8:30 a.m.	MSU Spartan Marching Band	Redesign Equipment Trailer
9:00 a.m.	Ingersoll Rand – Trane	Lifting Lug Redesign
9:30 a.m.	NSCL	Design of a Clover Detector Support Frame
10:00 a.m.	Ingersoll Rand – Trane	Airflow Measurement System
10:30 a.m.	Hitachi	Tabletop Wind Tunnel
11:00 a.m.	MSU Recycling (Note: This is a Joint Project with ECE)	Automated Waste Detection

Mechanical Engineering Design Program

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, BorgWarner, Consumers Energy, Eaton Corporation, EPA, Ford, Fraunhofer USA, General Motors, Heartwood School/Ingham ISD, Hitachi Automotive Systems, Ingersoll Rand - Trane, Kautex Textron, Marathon Petroleum Corporation, Michigan AgrAbility, MSU Adaptive Sports and Recreation Club, MSU Recycling, MSU Spartan Marching Band, NASA/Arizona State University, National Superconducting Cyclotron Laboratory, and Whirlpool Corporation .

Consumers Energy
Guidelines to Relocating Natural Gas Mains

Project sponsor Kate Barrera graduated from Michigan State University in December 2013 with a degree in Chemical Engineering and began work at Consumers Energy in January 2014. She is currently the System Engineer for Consumers Energy's Howell and Livonia service territories.

Consumers Energy owns over 27,000 miles of underground pipelines used to transport and deliver natural gas to its customers. When groups such as MDOT or the City of East Lansing perform construction on public right-of-ways for purposes such as installing new sewers or rebuilding roads, they provide their construction plans to Consumers Energy. Consumers Energy then has to determine whether the construction work has the potential to interfere with their underground pipelines. If there is a conflict, then Consumers Energy must relocate the pipes at the company's own cost. Sometimes there is an obvious conflict and pipes are promptly relocated. Other times, construction will occur over the pipelines, but there is no direct conflict. However, there is still the risk that various construction loadings from above will interfere with the pipes. For this capstone project, specific guidelines were written to help with Consumers Energy's decision-making process in regards to relocating pipes due to various historical, environmental, and geographical factors. Concepts considered in these guidelines include the age and size of the pipe, the magnitude and type of construction loadings from above, the impact of corrosion on the pipes, as well as the properties and composition of the soil containing the pipes.

Consumers Energy
Count on Us

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Patrick Kelly
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Mike Zielinsky
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Jun Jiang
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Consumers Energy
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MSU Spartan Marching Band
Redesign Equipment Trailer

The Spartan Marching Band (SMB) is a musical ensemble that performs at Michigan State football games. The SMB was a group of 10 students when it was founded in 1870 and has grown to include over 300 members. They are best known for the Series march to stadium, the kick-step, and "spinning the 'S'" during their pregame shows. They use silver instruments and special performance drums on game days. This equipment is transported around the country when the band performs at away football games, including Big Ten championships and bowl games.

Our team was asked to redesign the interior of the SMB's trailer (pictured right) to use space more efficiently and reduce the time it takes to load and unload equipment. Before the project began, the trailer contained two major shelving units that held the majority of the instruments, but instruments had to be strapped individually in order to keep them from getting damaged during transportation. Miscellaneous equipment was kept in carts that were time-consuming to roll on and off the trailer. Our team focused on designing a system that would have people working on loading many things simultaneously to improve overall efficiency and allow the band to spend less time loading and unloading when traveling. We redesigned the shelving units so that instruments can fit more compactly and be loaded the same way every time. A side door has also been added to allow two points of access for loading and unloading.

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MSU Spartan Marching Band
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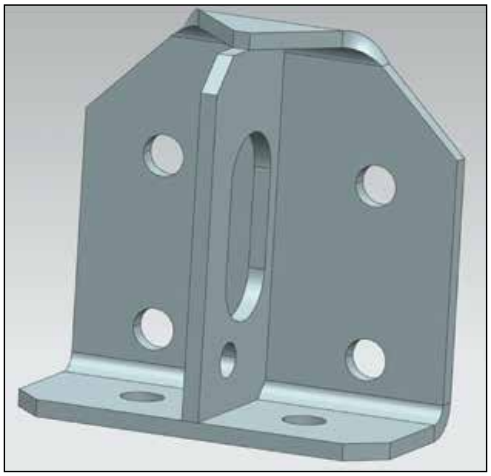
Ingersoll Rand - Trane
Lifting Lug Redesign

Trane, a subsidiary of Ingersoll Rand, provides residential and commercial comfort, connectivity, and energy efficiency solutions in the form of heating, ventilation, air conditioning (HVAC), and air quality systems. To ensure ease of transportation and installation, Trane builds these systems in modular sections and installs them onsite for the customer. Four lifting lugs are bolted onto each module in order to lift them off the ground into their desired locations. These lugs are typically left attached to the installed modules creating a manufacturing need of over 16,000 lugs each year.

Our design team has redesigned these lugs in order to reduce the benchmarked cost of $16 per unit. To achieve this, the team optimized the geometry and dimensions of the lug, while ensuring the required weight rating and factor of safety were upheld. Finite element analysis (FEA) was conducted utilizing both ANSYS and Altair Inspire software to test each iteration until an optimal design was found. These less expensive, optimized lugs allow Trane to save cost on every module's installation and funnel more resources towards providing greater innovation and value to its customers.



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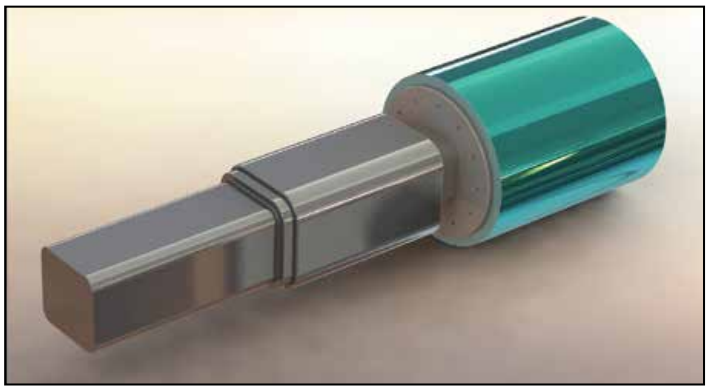
National Superconducting Cyclotron Laboratory
Design of a Clover Detector Support Frame

The National Superconducting Cyclotron Laboratory (NSCL), located at Michigan State University, is one of the world's leading nuclear science research facilities. The scientific mission of the facility is the study of rare isotopes to learn how atomic nuclei are put together, how the elements are formed in the cosmos, whether we understand the fundamental forces at play in the universe today, and how to harness the developments at the laboratory for societal benefit. Rare isotopes are produced using the K500 and K1200 coupled cyclotrons and are provided to researchers from around the world at a variety of experimental end stations. The Facility for Rare Isotope Beams (FRIB) is a next-generation rare isotope facility slated for completion in 2022, which will be the only facility of its type in North America.

Our team was asked to design and detail a frame for an array of high purity germanium (HPGe) Clover detectors, for the decay spectroscopy program at the NSCL and eventually FRIB. The rhombicuboctahedron frame consists of eight triangular and eighteen square faces in a spherical configuration, allowing the detectors to be arranged around a target center symmetrically and with a high packing efficiency. This setup provides significant challenges in mounting and positioning the clover detectors to be adjustable in relation to the center point. Since the arrangement of the detectors varies with setup, the frame has to be flexible, while at the same time minimizing the mass of material near the detectors and maintaining structural integrity. The success of this project will improve the detection efficiency of the measurements allowing studies on more exotic nuclides than are currently possible.



Clover HPGe detector

NSCL

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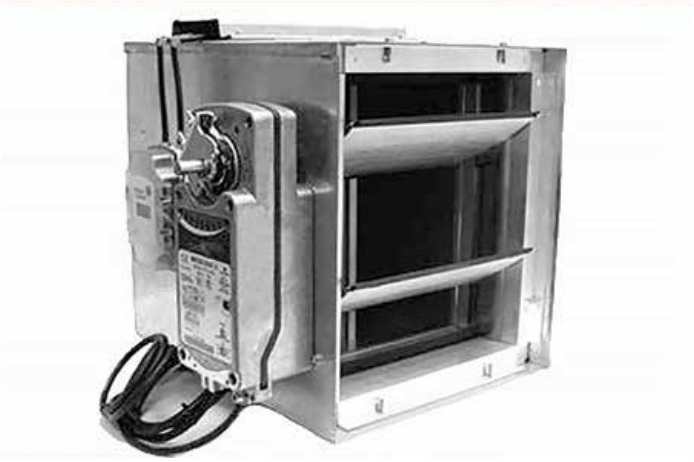
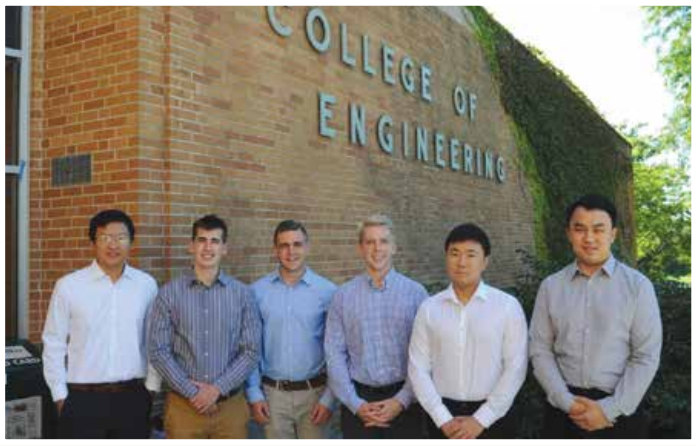
Ingersoll Rand - Trane
Airflow Measurement System

At Trane, it's all about air! As a global a leader in air conditioning systems, solutions and services, controlling the comfort and cost of airflow in residential, commercial, and educational buildings is the primary objective. Trane offers a wide variety of efficient heating, ventilation, and air conditioning systems while integrating cutting edge environmental and efficiency technology across all of its products. Focusing on efficiency while incorporating cost-effective solutions into its systems has allowed Trane to excel in the marketplace. As an evolving company, finding new ways to monitor efficiency and reduce cost ranks is its utmost priority.

Our team has designed and fabricated a cost-efficient and ergonomically-sound airflow monitoring station that has been optimized to be mounted on a rectangular damper. The airflow station is used to measure the outdoor airflow for large-scale HVAC systems and was designed to satisfy the requirements dictated by ASHRAE 62, which is the worldwide standard used to calculate outside air requirements in commercial buildings. The team used a VCM control system in conjunction with static pressure inputs to measure the air velocity and accurately represent it as airflow out of the system. This newly designed damper allows Trane to continue to improve efficiency among their HVAC systems.





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Hitachi Automotive Systems
Tabletop Wind Tunnel

Hitachi Automotive Systems is a Tier 1 supplier of world-class products to the global automotive market. Hitachi Automotive manufactures and markets engine management, electric powertrain, drive control, and car information systems for major automotive original equipment manufacturers (OEM) worldwide. Hitachi Automotive is currently developing control units for the automotive industry. These prototypes must have the ability to reject thermal energy from electronics to the ambient environment. Several factors affect the environment where the control units are located, and it would be beneficial to replicate these environments for performance testing of these prototypes.

Our team has been asked to design and document a durable, viable, and moderate cost tabletop wind tunnel that allows for the validation of prototype phase control unit designs. The validation of these controllers involves studying their ability to reject thermal energy from electronics to the ambient environment under the influence of several factors such as variable flow rates and heat conditions due to their under-the-hood application. The wind tunnel must therefore have the ability to output a wide range of volume flow rates and temperature differentials while maintaining the ability to avoid turbulent flow. The success of this device will allow Hitachi Automotive to perform a cost-efficient and thorough study of the performance of their control unit designs before full production.

HITACHI
Inspire the Next
Hitachi Automotive Systems

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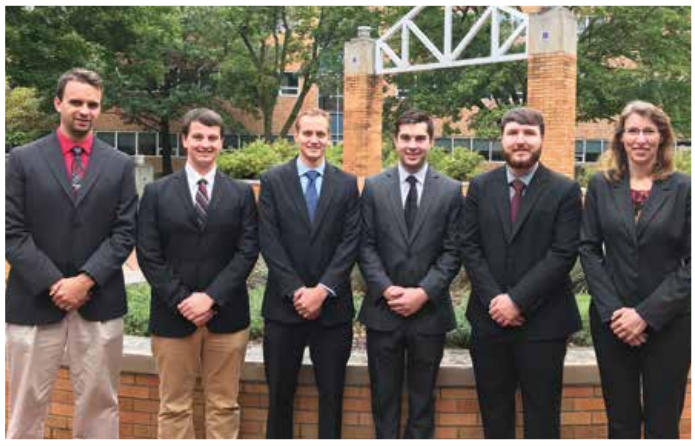
MSU Recycling
Automated Waste Detection

As the premier land-grant university in the country, it is no surprise that Michigan State University chose to take a proactive role in sustainability. In 1988, after students at MSU petitioned the Board of Trustees to focus on recycling, an administrative task force was formed to develop a comprehensive plan for waste reduction on campus. This initial task force eventually led to the creation of MSU Recycling, whose mission is "To manage MSU's waste as a resource through an integrated system of reuse, recycling, collaboration, and education."

Managing the waste of MSU's campus is no small feat. MSU maintains 200 outdoor waste bins in regular service, and this number swells to 800 bins during the football season. Checking the status of the 200 bins is labor intensive and is performed twice a week by a 2-person service crew driving a route to each bin. Manual inspections show that 70% of the bins are less than 50% full and do not need emptying. These unnecessary stops result in increased labor costs, materials' costs, and carbon emissions for MSU.

In collaboration with the ECE 480 team, our team developed an automated monitoring system to increase the efficiency of this waste management process. The result is a durable and weatherproof packaged sensor system that can be easily integrated into existing bins. The sensors detect the bin level and communicate with MSU Recycling's existing software. This solution allows MSU Recycling to monitor bins remotely and plan waste collection routes accordingly.

Surplus Store and Recycling
managing waste as a resource



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Nathan Hadobas
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Mechanical Engineering Capstone
Course Coordinator

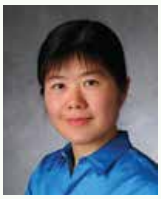
Faculty Advisors: Baek, Diaz, Feeny, Xiao


Baek


Brereton


Diaz


Feeny


Xiao

Presentation Schedule – Engineering Building, Room 1220 (9:45 a.m in Room 2205)

Time	Team Sponsor	Project Title
8:00 a.m.	ArcelorMittal	Steel Coil Transfer Car
8:30 a.m.	BorgWarner	Active P0 FEAD Tensioning System
9:00 a.m.	Fraunhofer	Cyclic Impact Tester for PVD Thin Film Coating Evaluation
9:30 a.m.	Eaton	Torque Limiter Test Fixture
9:45 a.m.	NASA/ASU (Note: This Presentation takes place in Room 2205)	Neutral Flux Probe (Joint Project with ECE. See Page XX of this booklet)
10:00 a.m.	General Motors	Active Force Feedback Device
10:30 a.m.	Michigan AgrAbility	Beehive Lifter Axle

Mechanical Engineering Design Program

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

The ME faculty who supervised ME 481 design teams this semester are: Seungik Baek, André Bénard, Giles Brereton, Tammy Reid Bush, Alejandro Diaz, Abraham Engeda, Brian Feeny, Farhad Jaberi, Peter Lillehoj, Norbert Mueller, Ranjan Mukherjee, Ahmed Naguib, Daniel Segalman, Elisa Toulson, Indrek Wichman, and Sharon Xiao.

ArcelorMittal
Steel Coil Transfer Car

ArcelorMittal, a multinational steel manufacturing corporation headquartered in Luxembourg, is the world's largest steel producer and mining company, producing 98.1 million tons of crude steel as of 2014. The company is a leading supplier in major North American markets including automotive, construction, appliance, and machinery. In the United States, ArcelorMittal employs more than 18,000 people at 27 operations. More than 95% of the company's raw steel production is from flat operations, which are primarily integrated facilities. All products are available in standard carbon grades as well as high strength, low alloy grades for more demanding applications.

Our team focused on designing and developing an automated guided vehicle (AGV) that carries a 50,000-pound steel coil from the loading docks to the shipping hall. The AGV also eliminated the need for a full-time forklift operator and allowed for the transportation of more than one steel coil at a time. Various safety features were considered since the AGV does not have operators. The weight capacities of the wheels and the floor introduced important design constraints. The design included mechanisms for holding the coil in place on the AGV in order to initiate the movement of the AGV and a track for the AGV so that there is a path for the AGV to follow.

ArcelorMittal

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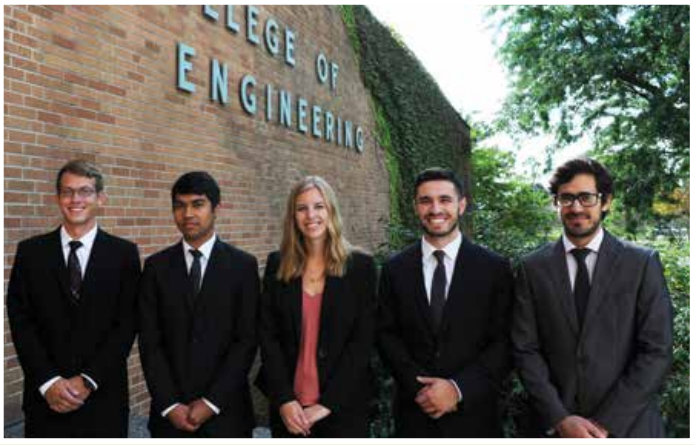
BorgWarner
Active P0 FEAD Tensioning System

BorgWarner is an international Tier I automotive supplier headquartered in Auburn Hills, Michigan. This metro-Detroit based company has over 29,000 employees worldwide and posted roughly $9.8 billion in sales in 2017. By focusing on innovative and consistently reliable products, BorgWarner has earned their spot as a go-to supplier for innovative powertrain technologies. These technologies range in products suitable for light vehicles, off-highway, aftermarket, and medium to heavy vehicles. BorgWarner is looking towards the future by increasing their portfolio of mild hybrid technologies in order to be ahead of the curve when it comes to supplying environmentally friendly automotive components.

The purpose of this project is to add to BorgWarner's product portfolio by initiating the design of an active belt tensioner for a P0 mild hybrid vehicle. The team began the project by performing a deep dive into competitive devices by analyzing active tensioner patents and researching competitor product portfolios. By performing this research, the team gained a baseline understanding of the obtainable fuel economy benefits as well as performance and efficiency gains for the proposed active tensioner design. With this knowledge, the team used the computer aided engineering software GT-SUITE to perform a benefits analysis and layout optimization of a P0 mild hybrid front-end accessory drive system with an active tensioner.

BorgWarner



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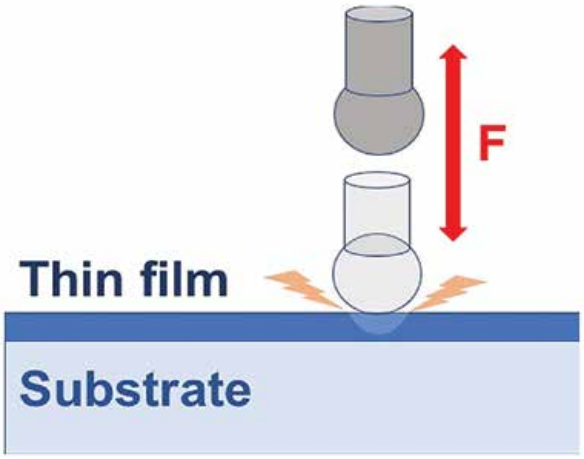
Fraunhofer, USA
Cyclic Impact Tester for PVD Thin Film Coating Evaluation

Fraunhofer USA, Inc. operates as a not-for-profit organization with the mission of advancing applied research. This mission is made manifest by Fraunhofer USA's continual efforts to nurture new technologies and methods for implementation in the industrial sector. Fraunhofer USA's work serves the global industrial market by introducing new and viable solutions, such as thin film coatings. The German based company operates one of its facilities on the Michigan State University campus and collaborates with university faculty.

Our team has been asked to design and build a device to provide impact testing on the Fraunhofer USA's thin film coating samples. The device will need to meet the requirements imposed by the company. Such requirements include highly adjustable impulse, frequency, and angle of impact. Thin, hard coatings are susceptible to damage during impact events, where the hard coating may crack or chip. Fraunhofer USA was interested in simulating the impacts seen by their coatings in an industrial application. Our device will assist them in exploring surface degradation morphologies during operation. Fraunhofer USA's coating staff will be able to research the impact loads and cycle quantities that best represent the damage produced for various use cases. The gathered data will allow the company to benchmark its coatings and further develop their impact resistance.



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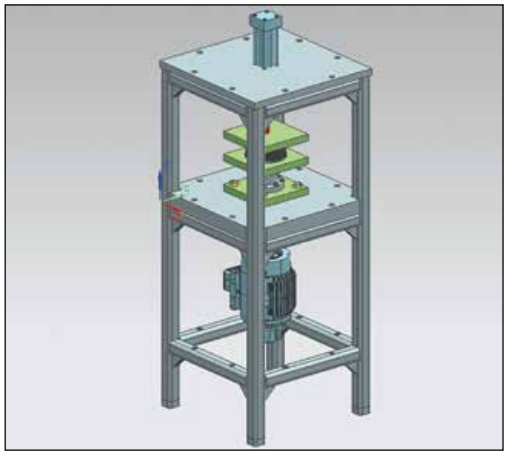
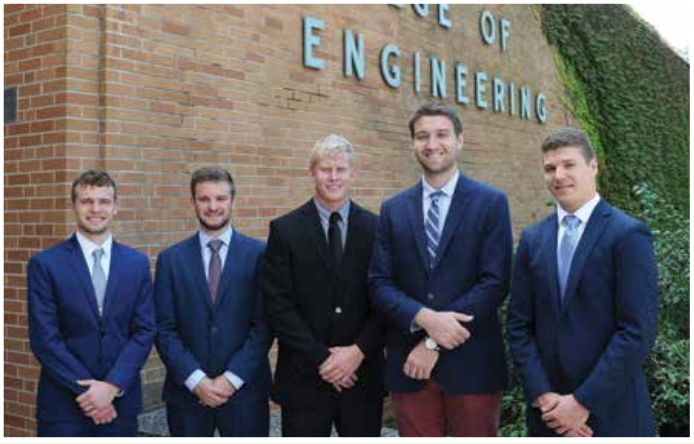
Eaton Corporation
Torque Limiter Test Fixture

Eaton Corporation is a power management company that provides energy-efficient solutions to help its worldwide customers manage electrical, hydraulic, and mechanical power more efficiently, safely, and sustainably. The location in Grand Rapids, Michigan is one of the sites that encompasses Eaton's Aerospace group. It specializes in manufacturing controllers and smart actuation systems for military and commercial jet customers. Eaton's technology of linear and rotational actuators utilizes single or multi-plate skewed roller friction subassembly as part of torque and force limiting devices. This technology safely prevents output forces and torques from causing catastrophic damage to the actuator or aircraft structure by prohibiting unwarranted motion from occurring.

The goal of this project is based on working from a previous 2015 MSU capstone team. Our objective is to manufacture the testing fixture and develop a guideline for Eaton's torque limiting bearing. This will result in the ability of Eaton to provide lower cost and lower weight design solutions to its customers. To successfully conduct baseline testing of existing torque limiting components, the team procured and manufactured the torque limiter test fixture using and validating the previous capstone design. Once fabricated, the testing fixture will be used to test torque limiting bearings and collect a survey of data for lubrication, material, and geometric parameters. After collecting the design data and comparing it with the baseline model, the team and Eaton determined the optimal design parameters for the torque limiting skewed roller bearing.





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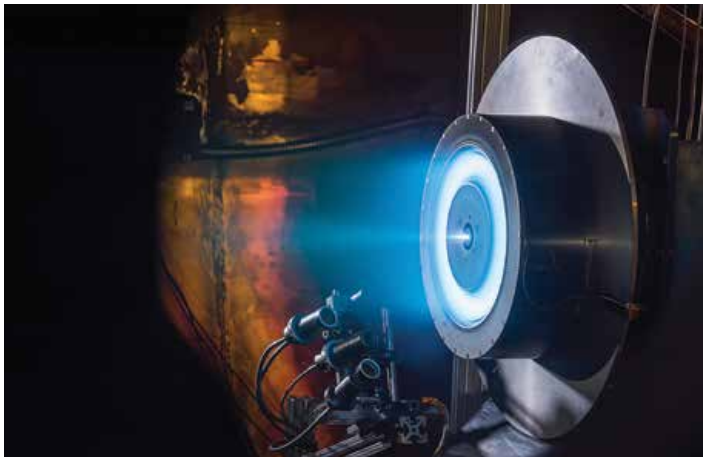
NASA/Arizona State University
Neutral Flux Probe

Psyche is the name of a metal-rich asteroid orbiting the sun between Mars and Jupiter. It is also the name of the NASA mission, led by Arizona State University, to visit this asteroid. The spacecraft will launch in 2022 and will utilize solar-electric Hall Effect Thrusters (HETs) in order to reach the asteroid in 2026. A HET is a type of ion thruster that accelerates propellant with electrons in an electric field, then neutralizes these ions as they exit the thruster. These HETs are tested in large vacuum facilities to simulate the conditions in space, which are those of near-vacuum pressure and very low temperature, as the HETs are very sensitive to small changes in pressure. However, a problem arises when residual propellant from these thrusters remains in the vacuum chamber and has a deleterious effect on those same thrusters. The residual propellant leads to a decrease in the efficiency in the thrusters.

Our team is comprised of five mechanical engineers and three electrical engineers. The goal was to design a probe capable of measuring the flux of neutrals inside vacuum test facilities. Neutrals are the particles with no charge that exit in the plume of the thruster. The device developed utilizes tried and tested methods implemented in a unique way in order to better understand the quantity and direction that these residual particles follow as they leave the thruster.



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General Motors
Active Force Feedback Device

In the increasingly dynamic automotive industry, General Motors, an American Original Equipment Manufacturer (OEM), must lead the industry in advanced technology development to outsell competitors. In the mission of manufacturing autonomous, electric vehicles with 'by-wire' capabilities, General Motors is giving engineers the task of designing and analyzing equipment that has never been used on cars before. General Motors is a partner with Michigan State University, and once a year the company supports a design project that will significantly contribute to the company's success. The Active Force Feedback Device is this year's project.

General Motors has given our team the task of designing a prototype of a device that can actively change its force output. It will have many applications to autonomous, electric vehicles, including suspension, braking, thrust, and more systems to actively adjust force feedback between the driver, vehicle, and road. Our team designed a controls prototype in Simulink with electromechanical hardware to model the device's response to specified force input functions. The device can add or subtract force functions from its existing state to alter the feedback. The design adheres to the National Highway and Traffic Safety Administration's requirement of detecting a failed operational condition. Upon detection of a failure, the device will alter the force output to alert the driver that the vehicle must be serviced. Additionally, the team utilized CAD and CAE tools to model a 3D prototype capable of withstanding specified load cases and temperature ranges.

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Michigan AgrAbility
Beehive Lifter Axle

AgrAbility was started in 1990 as a result of the Farm Bill and has since been providing services to agricultural workers with disabilities and various backgrounds. Its vision is to enhance the quality of life for farmers, ranchers, and other agricultural workers with disabilities. It addresses various disabilities like spinal cord injuries, amputations, arthritis, back impairments, and behavioral health issues. AgrAbility prioritizes its mission to provide direct services to agricultural workers through individual consultations. Its goal is to work alongside and assist its clients in succeeding in rural areas in America.

The current project is to assist an army veteran and MSU entomology professor named Adam Ingrao. He is a local bee farmer who sustained a back injury during the line of duty. AgrAbility provided Adam with a device called the KaptarLift, which is designed to be a multi-functional dolly. It allows the user to clamp, lift, tilt, and carry beehive boxes up to a maximum load capacity of 300 pounds. The problem that Adam has with the KaptarLift is that it tends to tilt side-to-side due to its narrow wheel base when it rolls along uneven surfaces. Since Adam uses this device primarily in a field, the terrain is anything but smooth. Therefore, the challenge presented to the team was to design an improved lifter axle to prevent the device from tipping over due to the increased movement caused by uneven surfaces and the 300-pound load relative to the axis of rotation at the wheel base.

AgrAbility
easterseals MICHIGAN STATE UNIVERSITY Extension

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Mechanical Engineering Capstone
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Faculty Advisors: Jaberi, Mueller, Naguib, Reid Bush, Toulson


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Presentation Schedule – Engineering Building, Room 1300

Time	Team Sponsor	Project Title
8:00 a.m.	Heartwood School, Ingham ISD	Mobile Multi-Functional Therapy Station
8:30 a.m.	MSU Adaptive Sports & Recreation Club	Asymmetrical Arm Function Sports Wheelchair
9:00 a.m.	EPA	On-Demand Server Tower Cooling
9:30 a.m.	Whirlpool	Water Delivery for Self-Cleaning Dryer
10:00 a.m.	Ford	High Pressure Calibration Gas Cylinder Filling Station
10:30 a.m.	Kautex Textron	Enhancing Predictive Capacity in CAE Testing
11:00 a.m.	Marathon	Horizontal Directional Drilling

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.

Heartwood School, Ingham ISD
Mobile Multi-Functional Therapy Station

Heartwood School is a school in Ingham County for special needs students with moderate to severe cognitive and physical impairments. Heartwood is also a MOVE (Mobility Operations via Education/ Experience) model site. The MOVE program allows these students to learn and practice various mobility skills including sitting, standing, and walking, by making the activities fun and engaging. The school was using many different, separated pieces of equipment to develop each of the motor skills individually. Heartwood was seeking a safe, mobile, and user-friendly device that combined sensory items with mobility assistance features to create an all-in-one station to develop multiple skills.

Our team designed, built, and validated a multi-functional therapy station for the younger students. The final product is a durable, sturdy, and safe structure that promotes practice with mobility skills such as reaching, grasping, sitting, and standing. The design incorporates several activities to motivate the students to move and work on therapy goals while providing a compact unit that increases the efficiency and safety of the user. Additional features added, such as knee supports, elbow supports, and grab bars, allow students of varying ability to benefit from the therapy station with minimal assistance from a teacher or therapist. The success of this project will have a significant impact on the quality of life of these students by allowing them to learn and participate in mobility activities.

Ingham Intermediate School District
A Regional Educational Service Agency

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MSU Adaptive Sports & Recreation Club
Asymmetrical Arm Function Sports Wheelchair

The MSU Adaptive Sports & Recreation Club was founded in 2014 as a registered student organization. The goal of this organization is to create an atmosphere that provides social and physical opportunities for athletes with physical disabilities. To foster such an atmosphere, the athletes and several able-bodied volunteers meet to play a variety of sports such as floor hockey, tennis, ping-pong, and basketball. Through the use of sports, the club not only aims to improve the physical health of its athletes but hopes to eliminate societal stereotypes about disabilities as well. Since physical needs vary from athlete to athlete, some specialized adaptive sports equipment is used during activities. Even with these available, however, some athletes are still unable to reach their full potential due to equipment not being specialized enough.

Due to this lack of specialized equipment for the club, our team was asked to improve upon the design of a sports wheelchair for users with asymmetrical arm function. This wheelchair will be used by individuals with disabilities that primarily impact their fine motor skills and range of motion in their upper limbs. Design changes were implemented to allow the user to move in the direction they desire while still keeping their dominant arm free, allowing them to fully participate in whatever sport they are playing. The asymmetrical arm function sports wheelchair was designed and built with functionality, safety, and comfort in mind. With this redesigned wheelchair, the MSU Adaptive Sports & Recreation Club will be able to allow participation for a wider variety of athletes.

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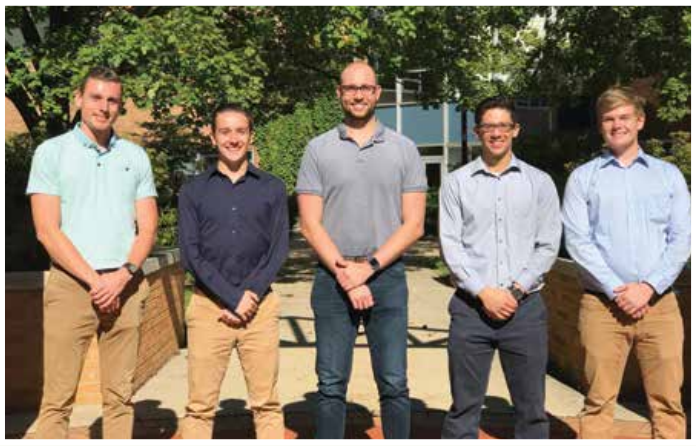
Environmental Protection Agency (EPA)
On-Demand Server Tower Cooling

The U.S. Environmental Protection Agency was established in 1970 by the federal government to carry out the mission of protecting human health and the environment. Under this agency, the Office of Transportation and Air Quality (OTAQ) was created, as well as the National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan. The Responsibilities of this state-of-the-art facility include certifying that all vehicles and engines on the road in the U.S. meet federal emissions and fuel economy standards; testing Engines for in-use compliance; analyzing fuels, fuel additives, and exhaust compounds; and researching and developing new technology to reduce vehicle emissions and increase fuel efficiency.

In the event of a disruption in electrical service to the facility, the computer servers that house the above data would be protected by a backup power system, but the room's HVAC system wouldn't. Without active temperature control under such conditions, the servers may exceed ASHRAE operating temperature guidelines, necessitating protective measures to transfer the server operations to different locations to maintain data integrity. The mission of the project is to design an on-demand cooling system for the server racks that monitor temperatures to sense an impending overheating of the servers and activate during an unscheduled power disruption. Our group has designed a low-cost prototype that will analyze the internal temperature of the server towers in real-time and activate an independently powered cooling system that is used until power and environmental control to the server area has been restored.



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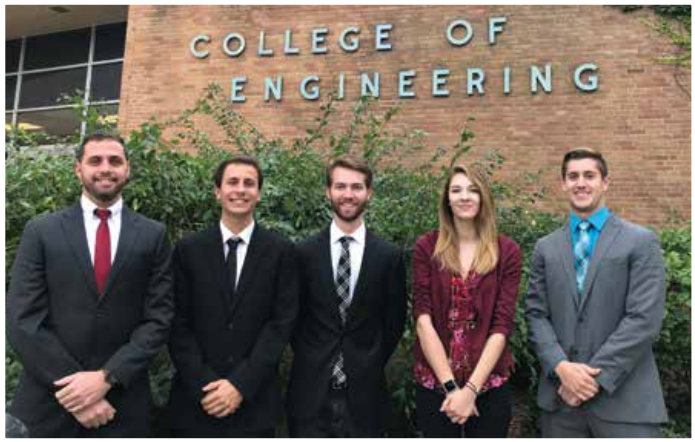
Whirlpool Corporation
Water Delivery for Self-Cleaning Dryer

Whirlpool Corporation, headquartered in St. Joseph, Michigan, designs and manufactures home, kitchen, and laundry appliances. In order to produce a continually improving line of appliances, Whirlpool has been developing technologies that create ease of maintenance for their customers. In European countries, Whirlpool sells a line of dryers utilizing a heat pump to condense moisture from the drying cycle. At the end of the cycle, a portion of the water collected is then directed through a diverter valve to clean the final lint screen in the system. When the final lint screens are not being cleaned, the water collected goes to a water collection bottle. Whirlpool has found that the diverter has a small amount of bypass water when it should be directed to the bottle.

Our team was asked to evaluate possible redesigns of a water delivery system that could be built to withstand lint debris over the product life. The goal of the new design is to eliminate the bypass while increasing cycle efficiency and maintaining design robustness. This feature gives the consumer a product with less maintenance, while being highly energy efficient.



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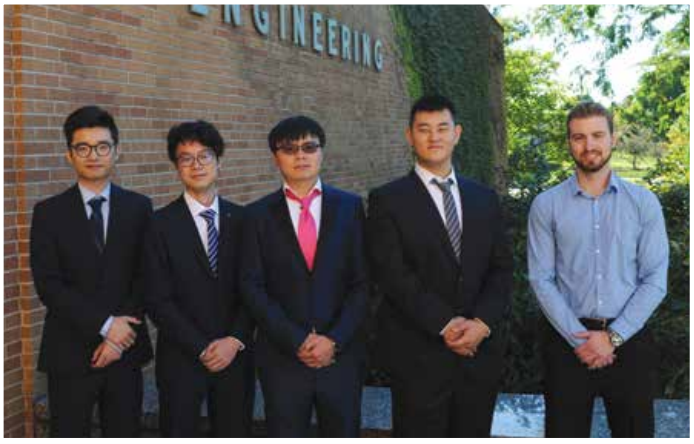
Ford Motor Company
High Pressure Calibration Gas Cylinder Filling Station

Ford Motor Company is an American multinational automaker headquartered in Dearborn, Michigan. It was founded by Henry Ford and incorporated on June 16, 1903. Ford focuses heavily on regulating automobile emissions and invests a lot of resources each year to increase the fuel economy of its automotive products. According to Ford, 99.9% of the carbon in fuel ends up as CO2, indicating that the measured amount of CO2 present is an accurate representation of fuel consumption or fuel economy. It is important that these measurements are recorded accurately in order to provide reliable results. Therefore, properly calibrated reference materials that are easily accessible are an important asset to Ford Motor Company.

Our team has been tasked with designing the gas filling station, which will be used to transfer the reference gases from large cylinders to smaller cylinders safely, quickly, and free from any contamination. After the testing and calibration processes, the newly designed filling station will be able to transfer the reference gas from a large cylinder to a smaller cylinder that can be easily transported. The success of this project is based on the ability to deliver the samples worldwide as reliable Standard Reference Materials (SRMs), enabling industry proficiency programs to maintain a strong correlation between OEMs and regulators.



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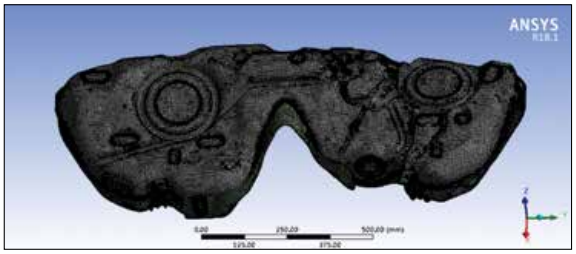
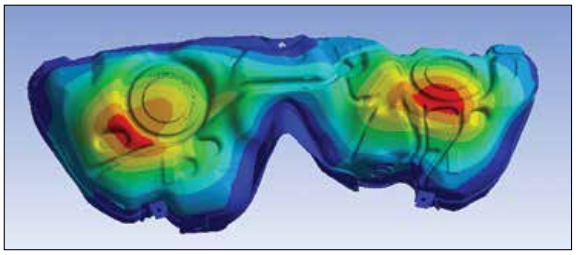
Kautex Textron
Enhancing Predictive Capacity in CAE Testing

Kautex Textron is a Tier One supplier to global OEMs. Kautex designs and manufactures fuel systems, selective catalytic reduction systems (SCR), castings, and camera/sensor cleaning systems. With 32 facilities in 14 different countries, as well as over 6000 employees, Kautex has quickly grown to become one of the 100 largest automotive suppliers in the world in terms of sales volume. While ensuring safety and reliability, Kautex has always strived to maintain the "first to market" trend with regards to its products and innovation. With this goal in mind, Kautex is continuously working to develop the most robust design and manufacturing processes.

In the automotive world of Kautex, there are currently two rounds of validation testing, Design Validation (DV) testing and Process Validation (PV) testing. The goal of this project is to justify the removal of Design Validation testing by creating accurate CAE (Computer Aided Engineering) simulations that can replicate the physical test results. This would reduce testing costs and development time for any project in the future. For this project, CAE modeling was done to simulate pressure and vacuum testing for a General Motors Camaro fuel tank.





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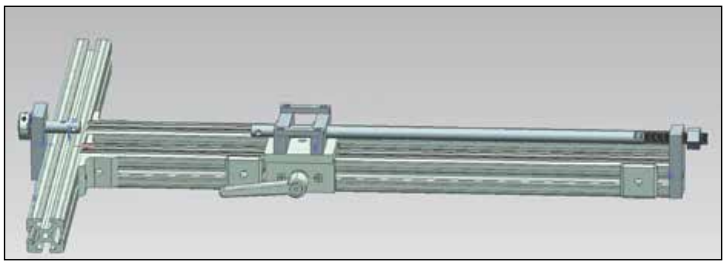
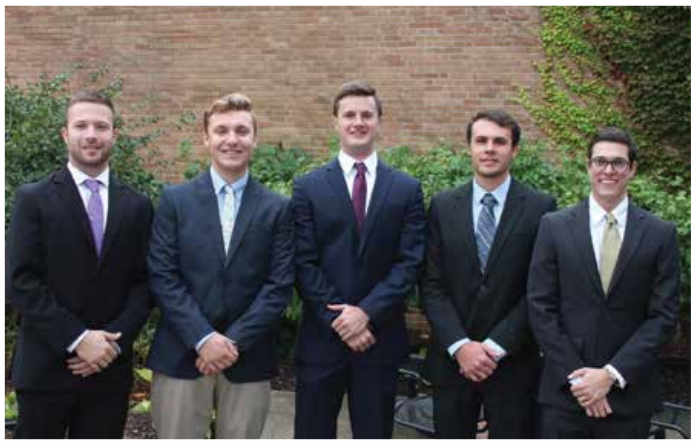
Marathon Petroleum Corporation
Horizontal Directional Drilling

Marathon Petroleum Corporation (MPLX) is a largescale, geographically-diversified, and highly-integrated refining, marketing, and midstream company. MPLX is the nation's largest refiner, with a crude oil refining capacity of more than 3 million barrels per calendar day in its 16-refinery system. In 2012 MPC formed MPLX LP, a master limited partnership involved in the transportation, storage, and distribution of crude oil and refined petroleum products through a marine fleet and approximately 10,000 miles of crude oil and light product pipelines. Headquartered in Findlay, Ohio, MPLX's assets consist of a network of crude oil and products pipelines and supporting assets in the Midwest and Gulf Coast regions of the United States.

Horizontal directional drilling (HDD) is a trenchless pipeline and utility installation method that significantly reduces surface construction impacts and is often used for river and highway crossings. During drilling operations, a wire connection is used for communication to the bottom hole assembly. This wire can become damaged during drilling operations, causing delays and increases in project cost. Our team created a more reliable wire connection to help ensure that communication between the down hole instrumentation and the surface controller is not lost. In addition, the team created a testing device and procedure to test the control design and potential prototypes. Fatigue testing was performed for both wire tension and torsion to help MPLX predict and prevent failure of the wire under operating conditions.



Tension Torsion Wire Test Device



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Design Day Awards Spring 2018

SPRING 2018
ME 481 EDISON AWARD

Team Stryker
"Stretcher Ride Characterization and Improvement Methods"

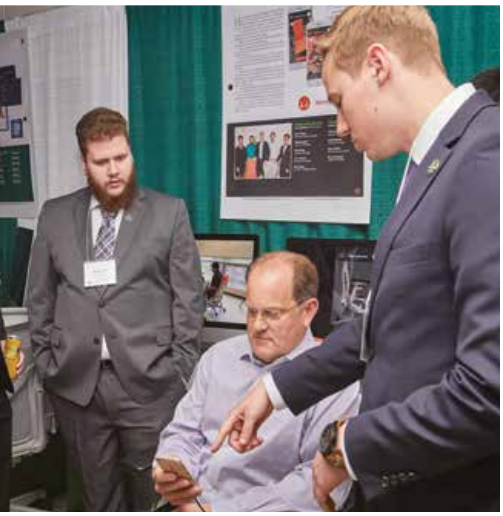
Left to right: Megan Beisser, Zachary Sadler, Jack Leckner, Kelly Patterson
Not pictured: Drew Daily

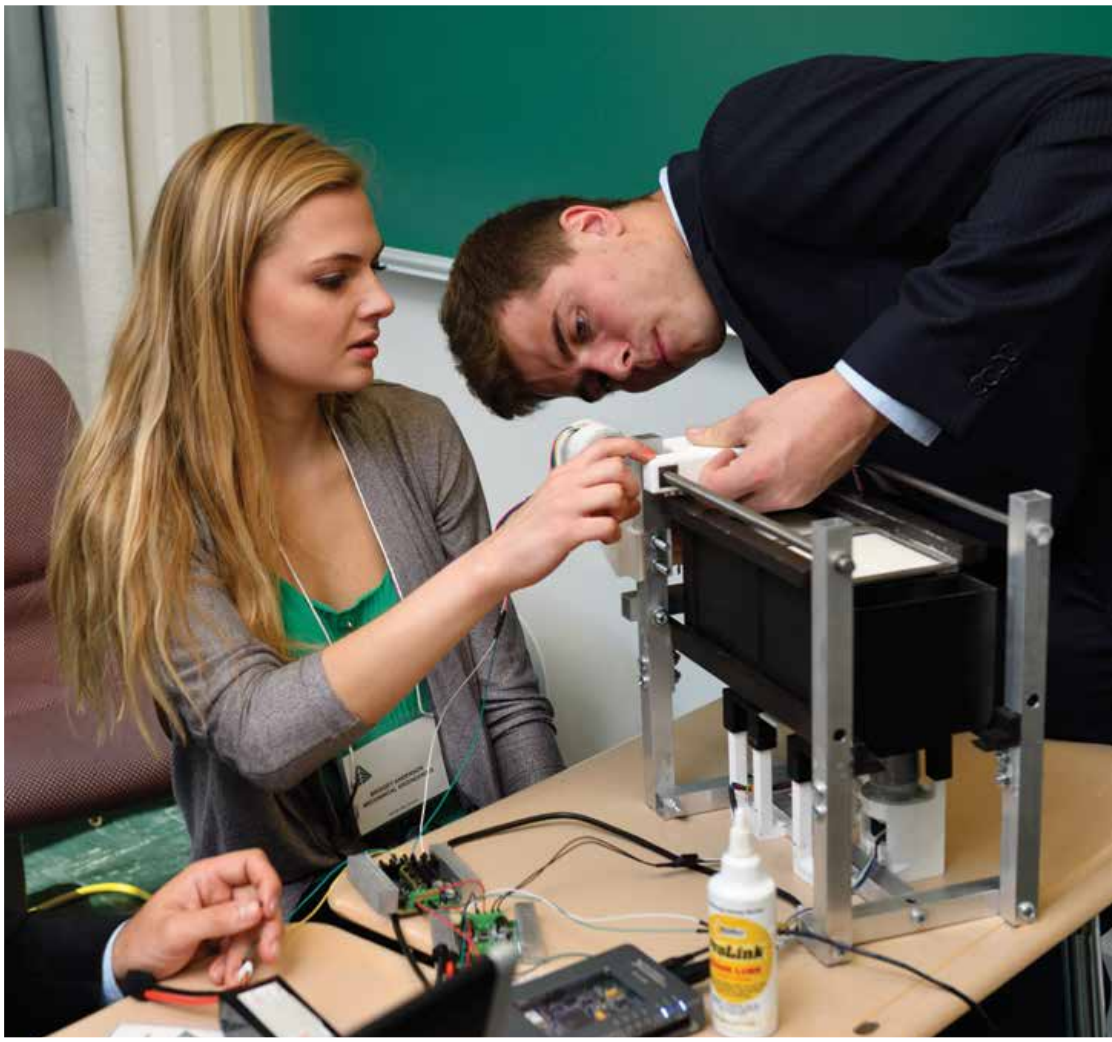
SPRING 2018
ME 481 PROJECT PRESENTATION AWARD

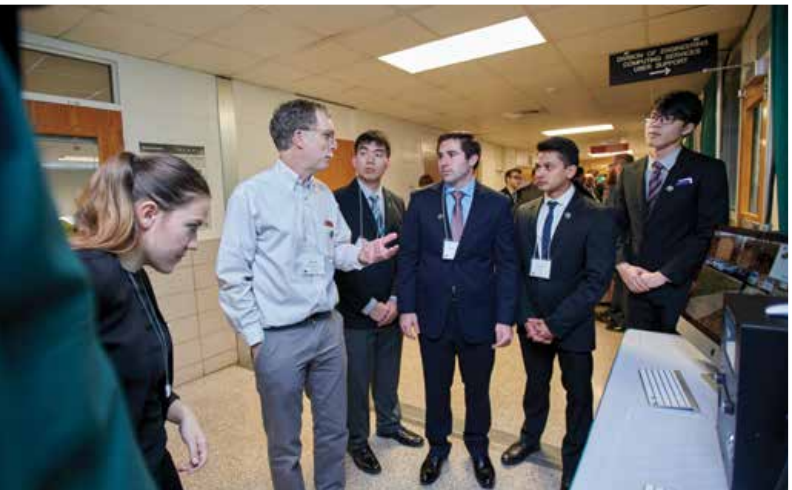
Team Pratt & Miller Engineering
"Formula SAE Active Four-Wheel Steering"

Left to right: Brandon Miller, Colton Knopf, Tyler Nicolay, Sam Greenwald, Curtis Carne


MARBLE







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