



MICHIGAN STATE UNIVERSITY *Fall 2017*

Design Day

COLLEGE OF ENGINEERING



MICHIGAN STATE
UNIVERSITY

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STATE
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FEDERAL CREDIT UNION
Executive Partner Sponsor



Welcome to MSU College of Engineering Design Day!

On behalf of Michigan State University Federal Credit Union (MSUFCU) in partnership with the College of Engineering, and Michigan State University, we would like to welcome you to MSU's campus and this extraordinary program.

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

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

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

Sincerely,

April M. Clobes
President/CEO, Michigan State University Federal Credit Union

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Building Dreams *Together*

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MICHIGAN STATE UNIVERSITY *Spring 2018*

Design Day

COLLEGE OF ENGINEERING

**Mark Your Calendars!! It's time to save
the date for Spring 2018 Design Day!**

**Join us April 27, 2018, 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!

We wish you an enjoyable event as you experience our students and their amazing talents through presentations, competitions, demonstrations and posters.

We are pleased to acknowledge MSU Federal Credit Union 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, Dow, Ford, General Motors, Humana, the MSU Alumni Association, Norfolk Southern, Symantec, 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.

Another exciting part of Design Day is the Dart Foundation Day of Engineering Innovation and Creativity, which involves some 175 high school students. On Design Day, these future engineers explore design principles with hands-on projects requiring the application of their creativity and ingenuity.

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.

A handwritten signature in black ink, appearing to read 'Leo Kempel', with a long, sweeping horizontal line extending to the right.

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 8, 2017

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 2200 Hallway 8:30 a.m. – Noon				
ME 371 Demonstrations			1st Floor Rooms 1225, 1230 & 1234 8:30 a.m. - Noon				
ME 412 Competition		1st Floor Room 1252 8:00 a.m. - 12:20 p.m.					
ME 471 Competition			1st Floor Room 1345 8:30 a.m. - 11:40 a.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 2200 Hallway 8:00 a.m. - Noon					
CE 495 Project Presentations		3rd Floor Rooms 3400 & 3540 8:00 a.m. - Noon					
CSE 498 Project Presentations		3rd Floor Room 3405 7:30 a.m. - 12:10 p.m.					
ECE 480 Project Presentations			2nd Floor Rooms 2205 & 2250 8:30 a.m. - 11:00 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 Anthony, Room 1279 8:00 a.m. – 8:40 a.m.				
High School Awards			1st Floor Anthony, Room 1279 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>

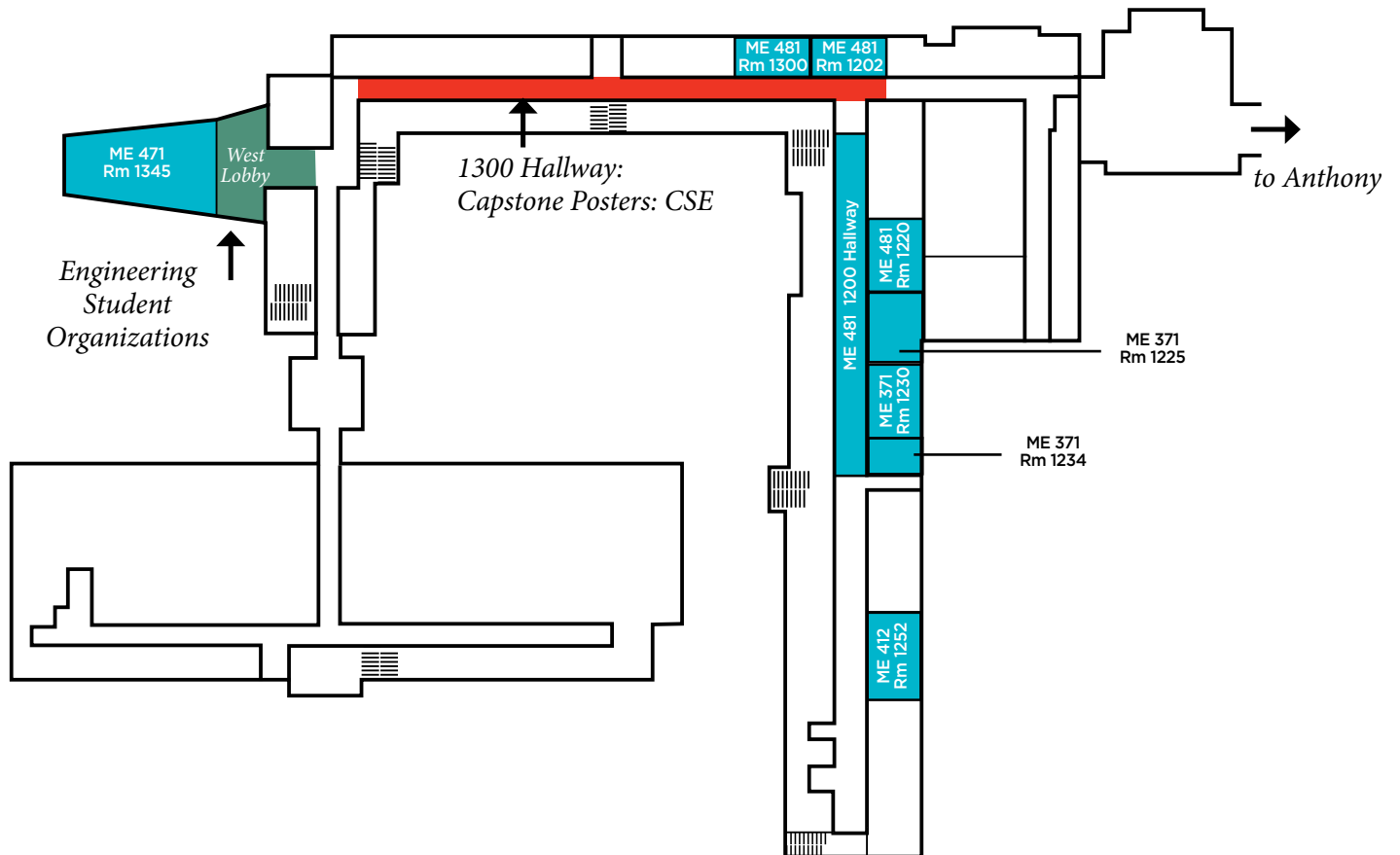
"Follow" the College: https://twitter.com/msu_egr_news

To stay up to date w/Careers in Engineering:

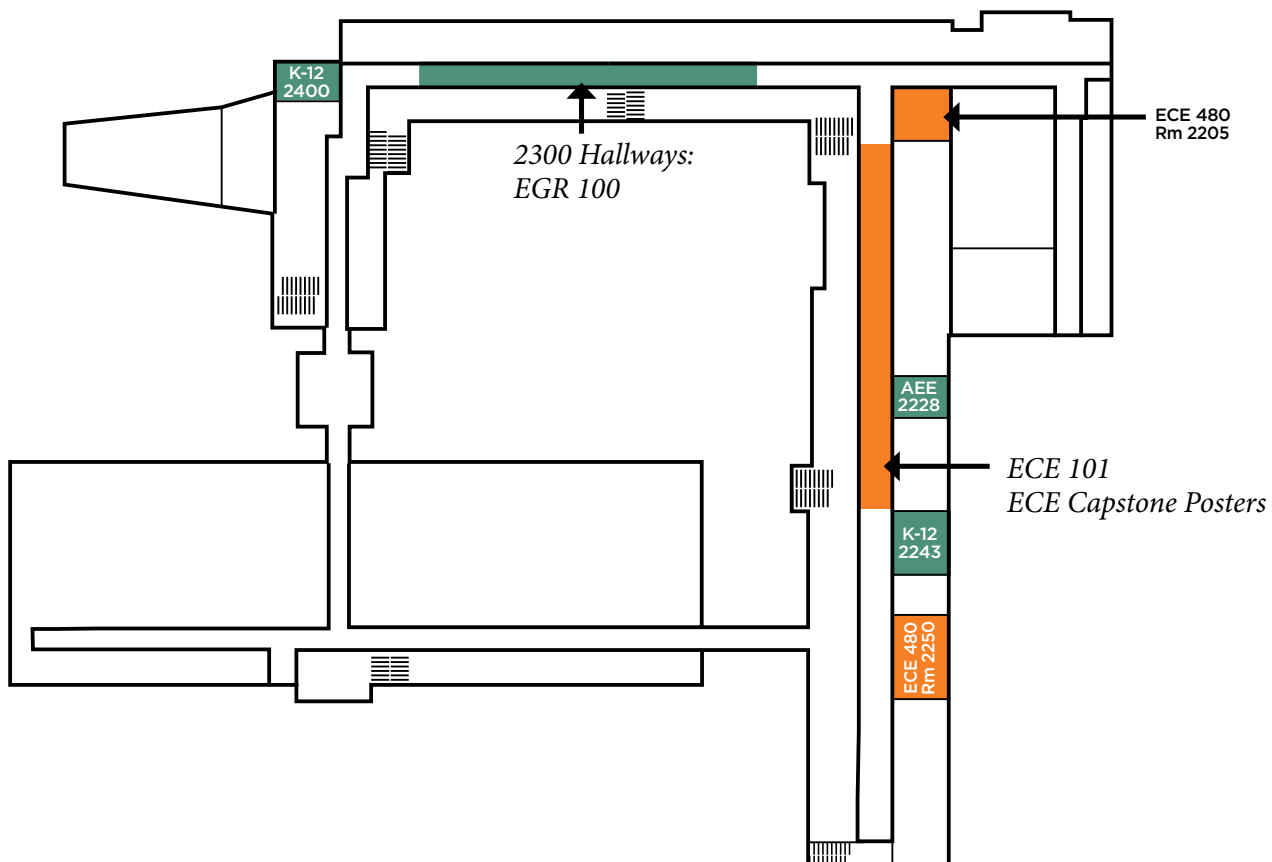
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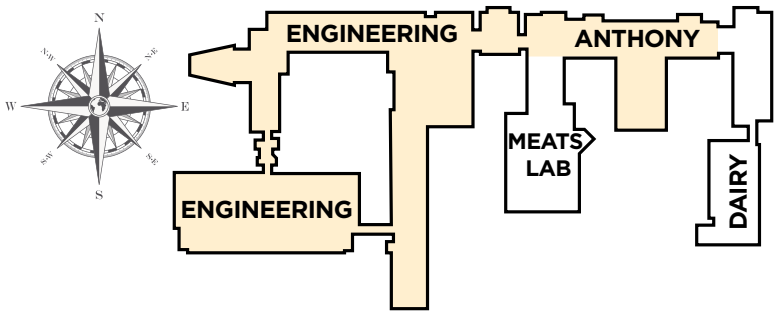
1st Floor Engineering



2nd Floor Engineering

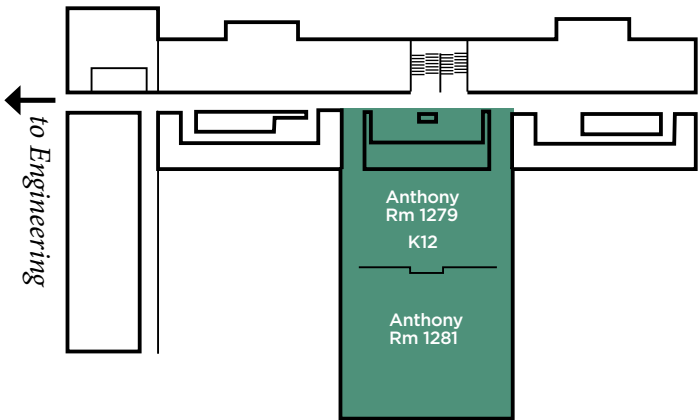


Overview



Design Day
Floor Plans
of the MSU
Engineering
Building

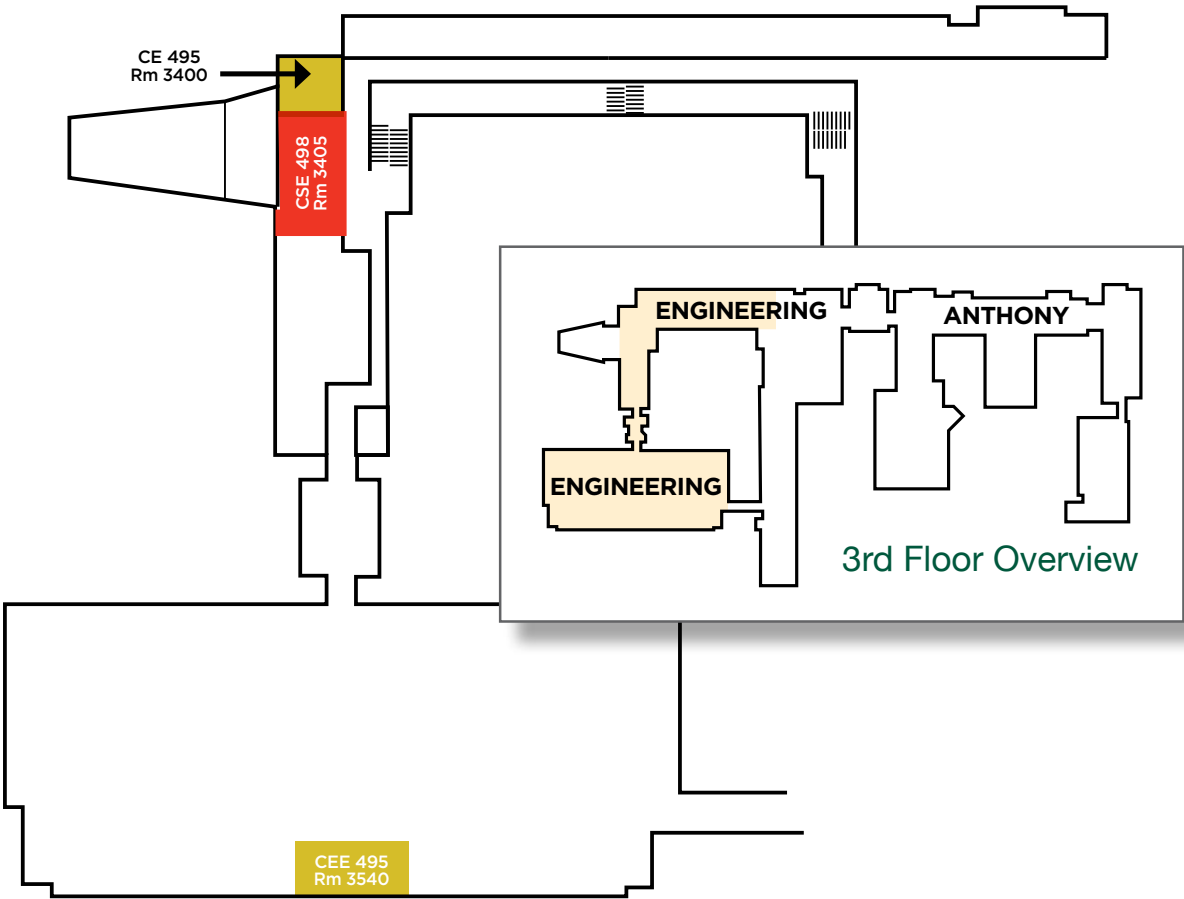
1st Floor Anthony



Color Legend:

CEE	CSE
ME	ECE
Joint/Other	

3rd Floor Engineering





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Founded in 1987, TechSmith pioneered the revolutionary idea of capturing screen content for better communication. Today, TechSmith is the world's #1 source for visual communication software with our flagship products Snagit and Camtasia.

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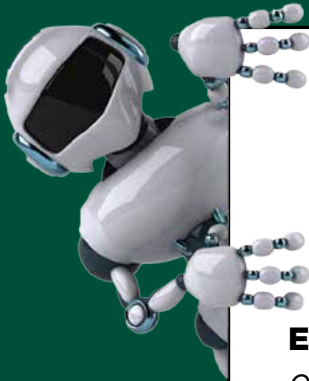


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Let's be remarkable.



Build a **Better** future as a

Spartan Engineer

Explore Engineering Before You Even Enter College.

Our pre-college engineering programs will show you how to bring your intellect and creativity together to have fun, solve problems, and discover your career interests.

RESIDENTIAL CAMPS~

High School Engineering Institute (HSEI)

When: Session 1: June 24-28; Session 2: July 8-12;
Session 3: July 15-19; Session 4: July 22-26

Who: Co-ed, open to students entering grades 10-12 in Fall 2018, as well as incoming freshmen.

Introduction to Radar for Student Engineers

When: July 8-13

Who: Co-ed, open to students entering grades 11 & 12 in Fall 2018, as well as incoming freshmen.

Making a Game of It:

Programming in Python to create video games and more!

When: June 17-22

Who: Co-ed, open to students entering grades 11 & 12 in Fall 2018, as well as incoming freshmen.

COMMUTER CAMPS~

Spartan Engineering for Teens

When: June 18-22, Afternoons; Commuter

Who: Co-ed, open to students entering grades 8 & 9 in Fall 2018

Spartaneering LEGO® Robotics Plus

When: Session 1: June 18-22; Session 2: June 25-29;
Session 3: July 16-20

Who: Co-ed, open to students entering grades 4-8 in Fall 2018

Use your smart-phone or tablet to check out these and other pre-college programs. Or, go to:
www.egr.msu.edu/future-engineer/programs
to learn more and register.



Dart Day of Innovation and Creativity *for 7th-12th Grade Students*



Our Future Lies in Some Very Precious Hands...

At the Dart Foundation, we are committed to developing scientifically literate students in Michigan. We're proud to sponsor the MSU College of Engineering Design Day for pre-collegiate students.

Funded by the Dart Foundation



MICHIGAN STATE UNIVERSITY | College of Engineering

High School Innovation and 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 will be participating in this Fall's Design Day events: Jackson High School, Kalamazoo Area Math & Science, Marlette High School, Women in Engineering.

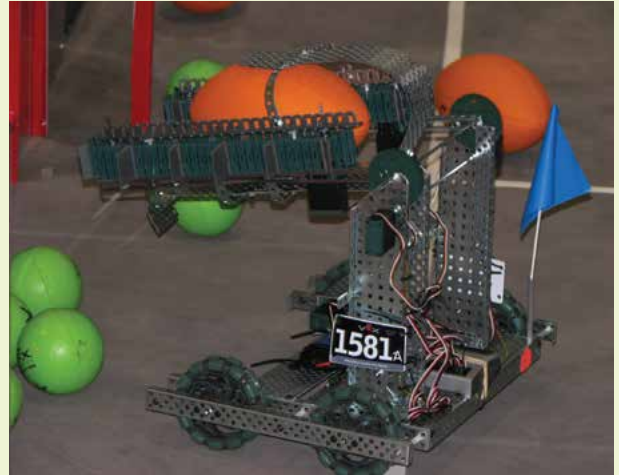


	Room 1279 Anthony Hall Check in for all schools	K'NEX Bridge Team Build Room 2243	VEX Robotics Room 2400	1st & 2nd Floor Voting/project viewing	Trebuchet Launch Competition Anthony Hall 1279
8:00–8:15	Check in for all schools				
8:15–8:30	Welcome & voting procedures - Drew Kim, Dr. Buch and Luis Donado				
8:40–9:30		Women in Engineering	Kalamazoo Area Math & Science A	Kalamazoo Area Math & Science B	Marlette/Jackson HS
9:35–10:20		Kalamazoo Area Math & Science A	Kalamazoo Area Math & Science B	Marlette/Jackson HS	Women in Engineering
10:25–11:10		Kalamazoo Area Math & Science B	Marlette/Jackson HS	Women in Engineering	Kalamazoo Area Math & Science A
11:15–12:00		Marlette/Jackson HS	Women in Engineering	Kalamazoo Area Math & Science A	Kalamazoo Area Math & Science B
12:15–12:30	Awards Ceremony, 1279 Anthony Hall, lunch immediately after (EVERYONE)				

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

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.



MEMBERS OF THE ORGANIZING COMMITTEE FALL 2017



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



Dean Buggia
Instructor and
Technology
Teacher, Okemos
High School



Rigoberto Burgueno
Civil Engineering
Faculty



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



Rachel Esch
K-12 Outreach
Secretary



John Plough
AP Physics Teacher
East Lansing
High School



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

K12 Awards Spring 2017



BRIDGE BUILDING AND DEFLECTION TESTING

The East Lansing High School team with a winning Bridge Build was instructed by Mr. Dean Buggia.



VEX ROBOTICS PROGRAMMING AND RACE

Mr. Bob Watson once again taught VEX Robotics. The winning team is from Eaton RESA. Congrats!



TREBUCHET DESIGN AND COMPETITION

The trebuchet toss was designed and taught by Mr. John Plough, East Lansing High School AP Physics teacher. The winning group is from Eaton RESA.



ECE 480 DESIGN AWARD

The ECE 480 team, led by Profs. John Albrecht and Lalita Udpa, won the Kids' Choice Award with their "3D Sensing Platform."



ME 371 BEST PROJECT AWARD

Prof. Michael Lavagnino's winning ME 371 team was selected by visiting high school students.

EGR 100 DESIGN PROJECT

Two EGR 100 teams tied for the EGR 100 Design Project Award.



EGR 100 DESIGN PROJECT (TIE)

The winning EGR 100 team was taught by Prof. Jenahvive Morgan.



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 1097 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from four project types: (i) Solar Car Competition, (ii) Cell Phone App Inventor, (iii) Robotics Competition, and (vi) CoRe industry-sponsored projects. CoRe industry-sponsored projects involved collaborations with ArcelorMittal on an annealing furnace gas sampling system, Delphi on 48-volt mild hybrid architecture, and Tenneco on the design of a pothole reporter. 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 2017 EGR 100 Project Poster Award Winners:



l-r: Pat Walton, Tim Hinds, Dylan Wolschleger, Craig DeClerck, Kevin Chung, Savi Singh, Jenahvive Morgan, Dean Kempel



l-r: Pat Walton, Tim Hinds, Braxton Kalfs, Connor Quigg, Jenahvive Morgan, Dean Kempel



PROBLEM *Solved.*

On Design Day you'll showcase all of the skill, logic and knowledge that you've amassed as a Spartan to solve a real-world problem. And you'll look good because MSU has prepared you well for this day.

You never know what problems you'll encounter after you leave East Lansing. But no matter what you face, the MSU Alumni Association is here to help you stay connected to the resources and people that keep Spartan Nation strong.

**JOIN OUR NETWORK OF
PROBLEM SOLVERS TODAY.**

ALUMNI.MSU.EDU



The Capstone Projects

Faculty Advisors:

Professors Burgueno, Haider, Hashsham, Ingle and Li



Burgueno



Haider



Hashsham



Ingle



Li

Presentation Schedule – Room 3400

Time	Team	Room
8:00 a.m.	Team 1 – Vindicator Consulting	Third Floor Room 3400 EB
9:20 a.m.	Team 2 – MacDonald Engineering	Third Floor Room 3400 EB
10:40 a.m.	Team 3 – Great Lakes State Engineering	Third Floor Room 3400 EB

Presentation Schedule – Room 3540

Time	Team	Room
8:00 a.m.	Team 4 – Global Core Engineering	Third Floor Room 3540 EB
9:20 a.m.	Team 5 – Pelfrey Pathway Consultants	Third Floor Room 3540 EB
10:40 a.m.	Team 6 – Almost Done Engineers	Third Floor Room 3540 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 To Lake Lansing Trail Connector

Meridian Township has proposed a pathway linking Michigan State University to Lake Lansing. Ultimately this project would require about 5 miles of new pathways along a corridor that connects the MSU campus to commercial and employment destinations such as the Meridian Mall, Meijer, as well as other township and county park facilities. The first phase of this project consists of approximately 1.1 miles of pathway running mostly north along the Red Cedar River between Hagadorn Road and Park Lake Road. This phase of the project will include a new pedestrian bridge crossing the Red Cedar River, as well as two separate boardwalk locations.

The preliminary engineering design must identify infrastructure improvements necessary to procure this project for construction. At the west end of the project, the trail will connect to Hagadorn Road at Shaw Lane at an existing pedestrian crossing to the MSU Campus. The trail crosses the Red Cedar River just east of Hagadorn Road from the MSU Community Music School. From that point, the trail will be positioned north of the river banks along various residential (apartments), commercial, and industrial parcels. Initial plans call for approximately 1,200 feet of boardwalk at specified locations due to the topography and access constraints. The project is coupled with potential expansion of the operations at a local brewery near the midpoint of the trail. Ellison Brewery was evaluated for expansion of their production capacity with regards to their water use and wastewater production. These two projects were considered as occurring simultaneously with coordination mutual to the benefit of the public.



Fig. 1: Aerial view of project site

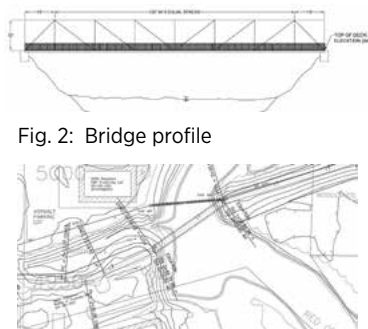


Fig. 2: Bridge profile

Fig. 3: Bridge contour site plan

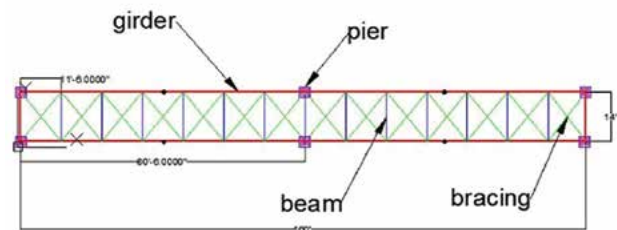


Fig. 4: Bridge Plan View



Fig. 5: Example crossing along Okemos Road

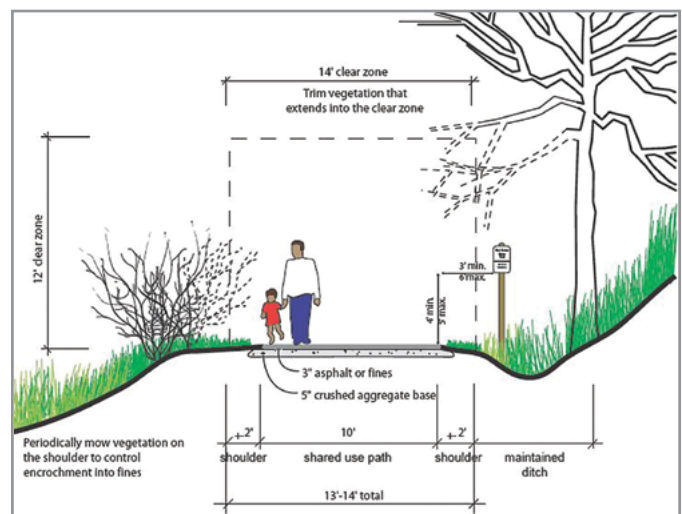


Fig. 6: Pathway cross-section per AASHTO

TEAM 1: VINDICATOR CONSULTING



Left to Right: Quan Yuan (T), Kyle Seewald (S), Gabriel Talon (P), Michael Walukas (PM), Dean Apostoleris (H), Danyelle Hotchkiss (E)

TEAM 2: MACDONALD ENGINEERING



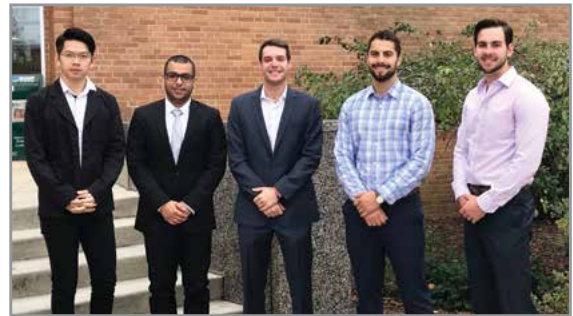
Left to Right: Yukang Tang (P), Jacob Belfer (S), William Beattie (H), Ryan Daniels (T), Marc Rasmussen (E), Anna MacDonald (PM)

TEAM 3: GREAT LAKES STATE ENGINEERING



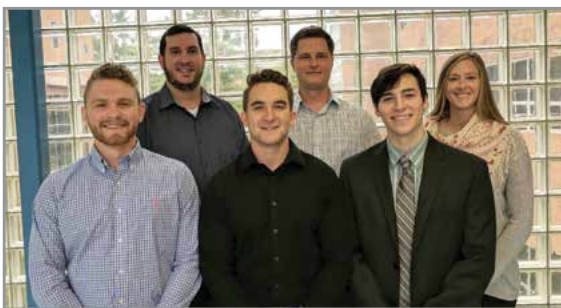
Left to Right: Daqiu Chen (S), Soly Fakhoury (T), David Jackson (E), Jordan Neeland (P), Hans Mendiola (PM), Brandon Williams (H)

TEAM 4: GLOBAL CORE ENGINEERING



Left to Right: Deqing Wang (H), Saeed Alkhunaizi (P), Jack Flory (T), Max Drenth (S), Trevor Muska (PM)

TEAM 5: PELFREY PATHWAY CONSULTANTS



Left to Right: Evan Pelfrey (PM), Stryder Croswhite (E), Michael Gold (S), Logan Bowling (P), George Anganis (T), Mary Leverentz (H)

TEAM 6: ALMOST DONE ENGINEERS



Left to Right: Kevin Puninske (T), Kyle Lash (P), Blessing Tayisepi (H), Patrick Schwyn (PM), Zhouhang Deng (S)

Key to primary roles and responsibilities of each team member:

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

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Michele Buckler, P.E.
Detroit Diesel

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

Iman Harsini Ph.D.
Michigan State University

Cheryl A. Kehres-Dietrich, CGWP
Soil & Materials
Engineers, Inc.

Mike Lanotte, Ph.D.
Michigan State University

Greg Losch, P.E.
Michigan Department of
Transportation

Ryan D. Musch, P.E.
Fishbeck, Thompson,
Carr & Huber

Leanne Panduren, P.E.
Rowe Professional Services

Robert D. Rayl, P.E.
RS Engineering, LLC

Scott Stowitts, P.E.
Barton Malow

Leah Tapp, P.E.
HNTB

Michael Thelen, P.E.
Consumers Energy

Daniel Thome, P.E.
Nicholson Construction
Company

Roy D. Townsend, P.E.
Washtenaw County Road
Commission

Mark VanPortfleet, P.E.
Michigan Department of
Transportation

Matt Wendling, P.E.
OHM Advisors

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.

Jill Bauer, P.E.
Rowe Professional Services

Sam Baushke, P.E.
Barr Engineering Co.

Daniel Christian, P.E.
Tetra Tech MPS

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

Tyler Dawson, P.E.
NTH Consultants

Matt Hill, P.E.
WSP

Matt Junak, P.E.
HTNB

Mario Quagliata, P.E.
Bergmann Associates

Anthony Thomas P.E.
Soil & Materials Engineers, Inc.

Geneva Vanlerberg, P.E.
Lansing Board of Water & Light

Phillip Vogelsang, P.E.
AECOM

Emily Warners, P.E.
Consumers Energy

Design Day Awards Spring 2017

Rolla C. Carpenter Senior Design Award

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

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



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

Rolla C. Carpenter Senior Design Award Winners, Spring 2017

Team 6: Capital City Consulting

Left to right: Khalid Alajaji, Kelli O'Brien, David Fennell, Bon Fitzgerald, Megan Grohnke, Steven Turzewski, Tom Sheldon. Presented by Anthony Ingle, Course Instructor





Opportunities for students and new graduates

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 the best universities globally, 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.



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"Being made for more means always pressing onward. It's a concept that reflects GM's constant pursuit of fresh ideas and groundbreaking solutions. The automotive industry is quickly evolving and we're determined to be at the forefront of change, leveraging our creativity to define the new era of mobility."



CAREERS.GM.COM

The policy of General Motors is to extend opportunities to qualified applicants and employees on an equal basis regardless of an individual's age, race, color, sex, religion, national origin, disability, sexual orientation, gender identity expression or veteran status.

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Indianapolis Indiana



Grand Rapids, Michigan



Mountain View, California



Okemos, Michigan



Lansing, Michigan



Omaha, Nebraska & Okemos, Michigan



Detroit, Michigan



Chicago, Illinois



The Capstone Projects

Dr. Wayne Dyksen
Professor of Computer Science and Engineering



Jonny Dowdall **James Mariani**
TEACHING ASSISTANTS



Presentation Schedule – Engineering Building, Room 3405

Time	Team	Project Title
7:30 a.m.	Amazon	Faia: Fashion Artificial Intelligence Assistant
7:44 a.m.	Auto-Owners	House of Hazards
7:58 a.m.	Avata	Security Analytics Suite: Configuration Setup Tool
8:12 a.m.	Ford	Ford Smart Parking
8:26 a.m.	GM	Automated Workplace Safety System
8:40 a.m.	Humana	MyHumanaBot
8:54 a.m.	Meijer	Meijer Fresh-ipes
9:08 a.m.	Michigan State University	SEA: Spartan Experience App
9:22 a.m.	Microsoft	Enhanced Company Portal with Graph
9:36 a.m.	Mozilla	Taking Firefox Screenshots Testing Suite to 11
9:50 a.m.	MSUFCU	Digital Banking with Chatbots
10:04 a.m.	Phoenix Group	OPEN v2.0: Smart Order Picking
10:18 a.m.	Rook	Cloud Security Event Processing and Alerting Platform
10:32 a.m.	Spectrum Health	Spectrum Health Symptom Checker
10:46 a.m.	Symantec	Secure Application Layer API Proxy
11:00 a.m.	TechSmith	TechSmith Director
11:14 a.m.	TWO MEN AND A TRUCK	Online Moving Estimator
11:28 a.m.	Union Pacific	RailBuilder: The Great Race to Promontory
11:42 a.m.	Urban Science	VDA: Virtual Dealership Adviser
11:56 a.m.	Yello	Automatic Resume Verification

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 Amazon, Auto-Owners Insurance, Avata Intelligence, Boeing, Bosch, Chrysler, Electronic Arts, Ford, GE, General Motors, Google, Humana, Meijer, Michigan State University, Microsoft, Mozilla, MSU Federal Credit Union, The Phoenix Group, Quicken Loans, Spectrum Health, Rook Security, Symantec, TechSmith, TWO MEN AND A TRUCK®, Union Pacific, Urban Science, Whirlpool and Yello.

Amazon

Faia: Fashion Artificial Intelligence Assistant

Amazon is the largest online retailer in the world, selling a wide variety of products and services including a complete line of clothing and apparel.

Today, nearly 25% of millennials buy most of their clothing and apparel online. Paid subscription services provide personal fashion assistants who select and send clothing to their customers based on the customers' style preferences.

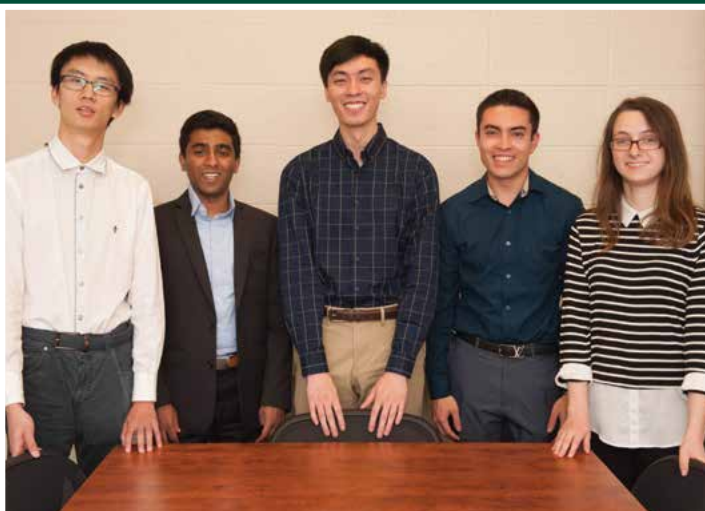
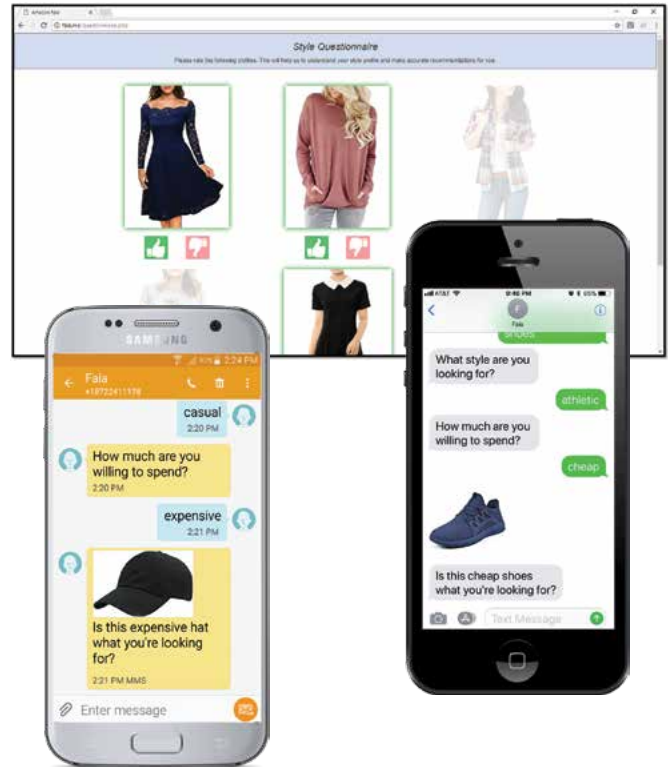
Our Fashion Artificial Intelligence Assistant, Faia, competes directly with this trending market by providing the same service for free through texting.

For example, an Amazon customer might text Faia "Find me a shirt I'd like." She responds by texting choices of shirts that complement that customer's personal fashion style. Faia also texts shirts that are bought by others with similar tastes.

As customers text with Faia, they tell her what they like and dislike. Over time, using artificial intelligence, Faia learns more and more about each customer's personal style preferences so she can provide better and better recommendations for clothing and apparel.

Customers text with Faia for an easy and complete shopping experience from getting recommendations to rating clothing to adding things to their Amazon shopping cart.

Our Fashion Artificial Intelligence Assistant web signup page is written using PHP and hosted on EC2. Faia is built using Amazon Lex and is powered by Python AWS Lambda functions.



Michigan State University

Team Members (left to right)

Zizhen Wang
Suzhou, Jiangsu, China

Nikhil Ramu
Troy, Michigan

David He
Chicago, Illinois

Dominic Zottolo
Macomb, Michigan

Danielle Schugars
Muskegon, Michigan

Amazon

Project Sponsors

Peter Faricy
Seattle, Washington

Garret Gaw
Detroit, Michigan

Tom McDonald
Detroit, Michigan

Rob Streeter
Detroit, Michigan

Auto-Owners Insurance House of Hazards

With over 100 years of experience, Auto-Owners Insurance is a Fortune 500 company with more than 6,200 independent insurance agencies in 26 states and a written premium of almost \$6 billion.

Auto-Owners insures homes throughout the Midwest. So, understanding and teaching home safety is an important aspect of their mission.

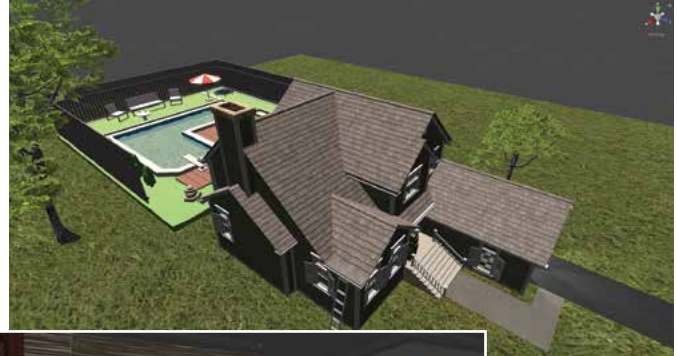
Our House of Hazards is a competitive virtual reality game that is designed to teach Auto-Owners' associates about just that, home safety. Associates learn in an enjoyable, immersive and interactive way while getting a realistic experience.

Using an Oculus Rift Headset, Touch controllers and sensors, a player explores a virtual furnished home. A player is tasked with identifying potential hazards to the occupants and to the property itself. Players are educated about home safety with a simulation of a realistic everyday home.

Our game features three difficulty levels. In the easiest level, hazards are easy to find and numerous. In harder levels, hazards are harder to find, and identifying harmless items as hazardous results in the loss of points.

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

Our House of Hazards game is played on a Microsoft Windows PC with the Oculus Rift Headset, Touch controllers and sensors. The Oculus Rift hardware communicates the input to our game, which is implemented using the Unity game engine.



Auto-Owners
INSURANCE

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Michigan State University

Team Members (left to right)

Frederick Lee
Rochester, Michigan

Matthew Drazin
West Bloomfield, Michigan

Kenneth Stewart
Ann Arbor, Michigan

Kevin Nickolai
Waterford, Michigan

Brian Wong
South Lyon, Michigan

Auto-Owners

Project Sponsors

Ross Hacker
Lansing, Michigan

Scott Lake
Lansing, Michigan

Jim Schumacher
Lansing, Michigan

Avata Intelligence

Security Analytics Suite: Configuration Setup Tool

Founded in 2013, Avata Intelligence leads the security industry in artificial intelligence (AI) and advanced analytics solutions including AVA, an intuitive AI application, which is used in a variety of sectors including public safety and defense.

For example, AVA can be used to analyze past crime records to predict when and where future crimes are likely to occur. With this knowledge, law enforcement can patrol exactly when and where crimes are most likely to occur, thereby increasing safety and security.

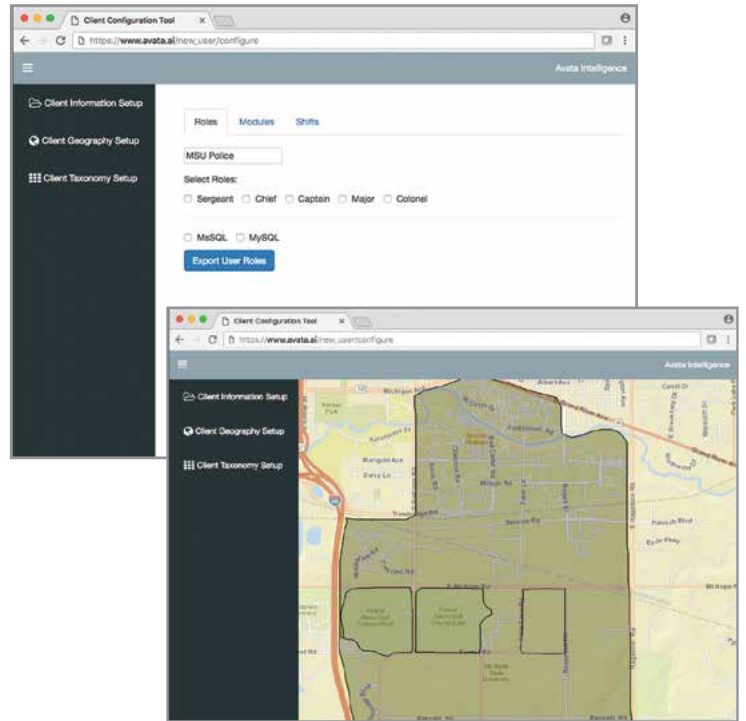
Our Configuration Setup Tool is a web app used by Avata engineers to aid in the onboarding process of new clients, specifically targeting police and law enforcement agencies.

Previously, in order to onboard a new client, an Avata engineer would obtain information about them by manually reading through PDF files and printouts and then writing computer scripts to enter this information into a database.

Our Configuration Setup Tool provides an intuitive user interface to streamline the new-client onboarding process. Our app automatically generates the appropriate MySQL or MsSQL script needed by an engineer to add a new client into the Avata client database.

By automating the onboarding process, Avata is reducing their time and cost spent on customer acquisition.

The front-end of our Configuration Setup Tool is written in ReactJS using ArcGIS, a JavaScript API. The back-end is implemented in Java with Spring Boot.



Michigan State University

Team Members (left to right)

Zack Lumley
Farmington Hills, Michigan

Ashley Gagnon
Fraser, Michigan

Chantz Johnson
White Lake, Michigan

Meenakshi Sundararaju
Novi, Michigan

Sean Edwards
Watkins Glen, New York

Avata

Project Sponsors

Ripple Goyal
Venice, California

Manish Jain
Venice, California

James Pita
Venice, California

Ford Motor Company

Ford Smart Parking

Ford Motor Company is a Fortune 500 automotive company headquartered in Dearborn, Michigan, employing 201,000 employees worldwide and selling 6.65 million vehicles in 2016.

Often times while driving around crowded places you do not know where there is open parking. You waste time and gas looking for parking spaces, which leads to arriving late to meetings and unpleasant moods.

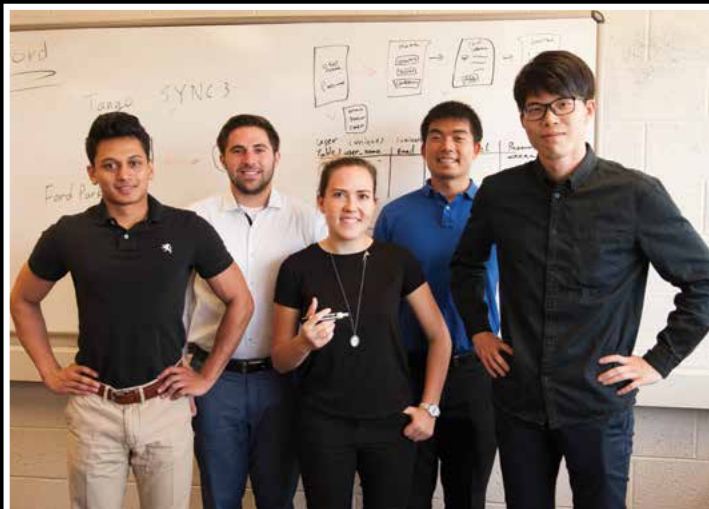
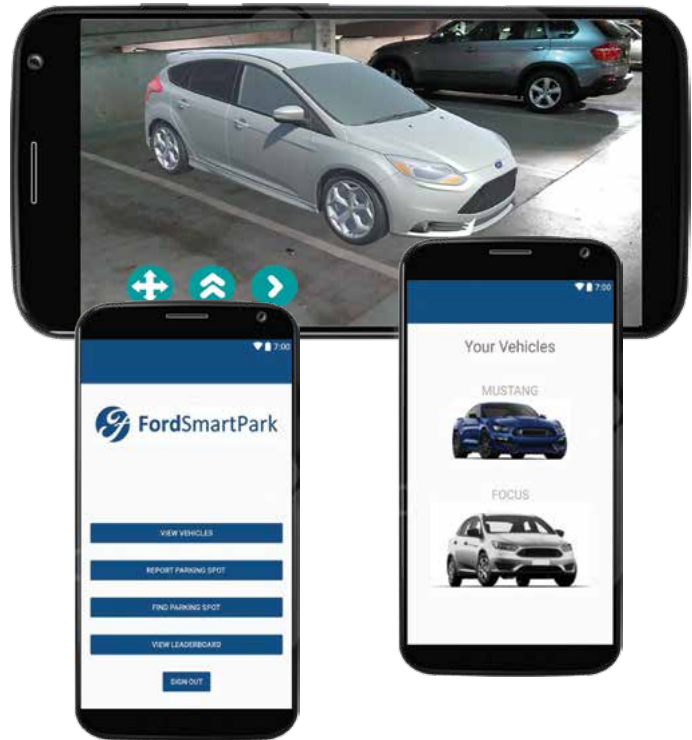
Our Ford Smart Parking app allows pedestrians to report open spots and it then enables drivers to find those spots. This helps drivers save time and gas when parking in crowded places whether on college campuses or at work.

When a pedestrian sees an open spot, they open the app to login and fill out a short survey to report the spot. Drivers can login and press a button which shows them the nearest parking space available.

Our Ford Smart Parking app is mirrored on Ford's SYNC onboard vehicle system so that a driver of a Ford vehicle can find a parking space using their car's touch screen.

In addition to finding a place to park, users can place virtual Ford vehicles into their home garage to see if they will fit.

Our Ford Smart Parking app, written in Java, runs on Android devices. Parking spots are stored in a Fire-base database. Virtual vehicles are displayed using the Google Tango and Android APIs.



Michigan State University

Team Members (left to right)

Rahul Patel
Livonia, Michigan

Douglas Kantor
Suffern, New York

Helena Narowski
Ann Arbor, Michigan

Eric Wu
Farmington Hills, Michigan

Chengzhu Jin
Qingdao, Shandong, China

Ford

Project Sponsors

Adam Haas
Dearborn, Michigan

Clifford Harding
Dearborn, Michigan

Dave Sexton
Dearborn, Michigan

Michael Volk
Dearborn, Michigan

General Motors

Automated Workplace Safety System

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

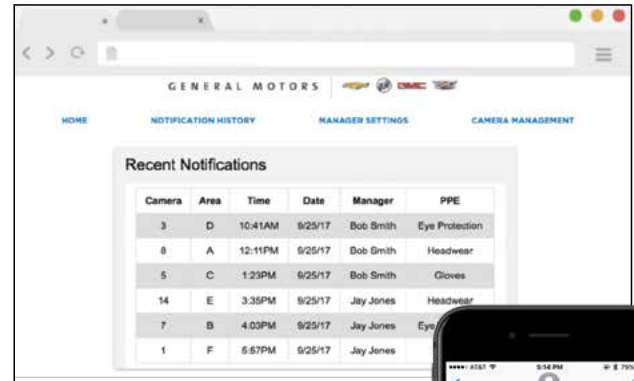
Among GM's facilities are its many factories that build and assemble cars and trucks. In order to ensure the safety and well-being of those who work in these factories, GM provides a variety of personal protective equipment (PPE) including helmets, goggles and vests.

Our Automated Workplace Safety System determines if workers are missing any of their PPE by analyzing the video from cameras stationed at factory entrances. Our system uses object detection models to identify the workers and their PPE as they pass by.

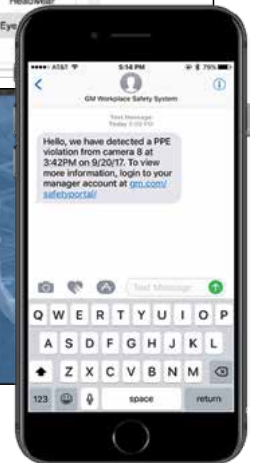
If a worker is determined to be missing any of their PPE, a text message is sent to their safety manager, and a violation incident is recorded in a database.

Safety managers use our companion web app to display statistics and graphs of the PPE violation incidents, which can be sorted by camera, time or PPE. In addition, managers use our web app to indicate shift changes, and to add and remove cameras.

Our Workplace Safety System utilizes an NVIDIA Jetson to run the object detection models. Camera configuration with NVIDIA's Jetson is written in Python. Our web app, written in HTML, CSS, PHP and JavaScript, is connected to a MYSQL database. Twilio is used to send SMS text messages.



Camera	Area	Time	Date	Manager	PPE
3	D	10:41AM	9/25/17	Bob Smith	Eye Protection
8	A	12:11PM	9/25/17	Bob Smith	Headwear
5	C	1:23PM	9/25/17	Bob Smith	Gloves
14	E	3:35PM	9/25/17	Jay Jones	Headwear
7	B	4:03PM	9/25/17	Jay Jones	Eye
1	F	5:57PM	9/25/17	Jay Jones	



Michigan State University

Team Members (left to right)

Michael Peng
Troy, Michigan

Marc Bellemare
Plymouth, Michigan

Steven Levesque
Holland, Michigan

Ike Uchendu
Southfield, Michigan

Guannan Hong
Dalian, Liaoning, China

GM

Project Sponsors

Mike Adelson
Warren, Michigan

Chelsea Jacobs
Warren, Michigan

Fred Killeen
Warren, Michigan

Dan Rudman
Warren, Michigan

Christian Stier
Warren, Michigan

Humana

MyHumanaBot

Humana promotes health and wellness by offering many innovative products and services to a diverse customer base. Humana takes pride in providing personalized plans for each of its members.

To ensure that current and prospective members understand their options, Humana communicates the value of their plans through intuitive, easy-to-use customer service tools.

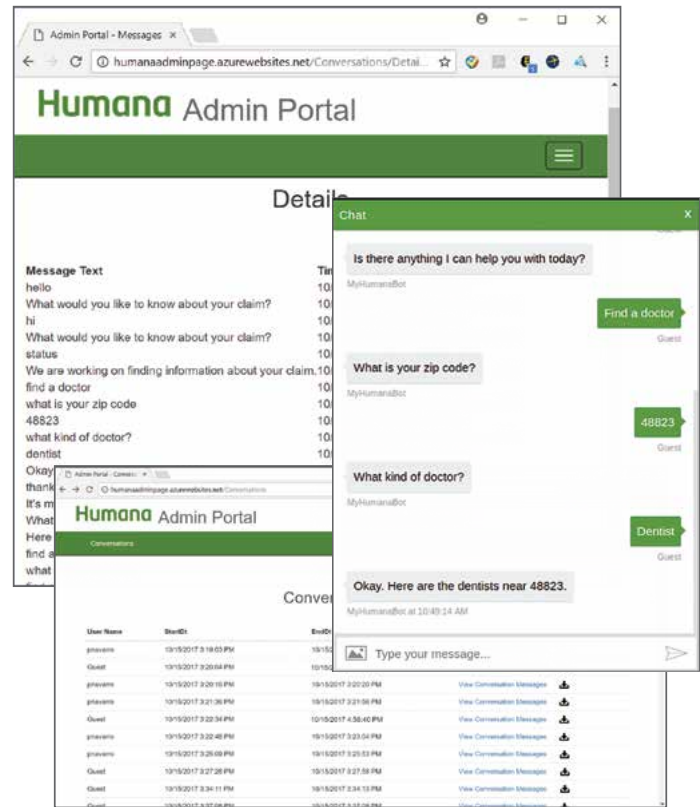
One of these tools is our MyHumanaBot, which provides a natural, in-person conversational experience. Users ask MyHumanaBot questions just as they might ask a Humana customer service agent. MyHumanaBot responds with accurate answers, quickly and efficiently.

For example, after logging into the Humana web portal, members can ask specific questions about their account such as “What are my current health insurance plans?” or “What’s the status of my most recent claim?”

Users can ask more general questions such as “Can you help me find a doctor?” to which MyHumanaBot may respond “Sure, what kind of doctor are you looking for?”

Conversations are saved and viewed using our companion administrative web portal, which is used by Humana associates for continuous improvement of MyHumanaBot.

Our MyHumanaBot uses Microsoft’s Bot Framework written in C# along with Dialogflow for natural language processing. All components are hosted on Microsoft Azure.



Humana



Michigan State University Team Members (left to right)

Anthony Dionise
Lansing, Michigan

Madeline Levinson
Midland, Michigan

Jason Thompson
Dayton, Ohio

Yi Shi
Beijing, China

Tynan Ford
Williamston, Michigan

Humana Project Sponsors

Ashlee DeLine
Louisville, Kentucky

Mick Horton II
Louisville, Kentucky

Erin Wycoff
Louisville, Kentucky

Meijer

Meijer Fresh-ipes

Committed to providing customers with new and innovative shopping experiences, Meijer is one of the largest supercenter chains with 237 stores located throughout the Midwest.

Our Meijer Fresh-ipes app streamlines meal planning, shopping and meal preparation for Meijer customers.

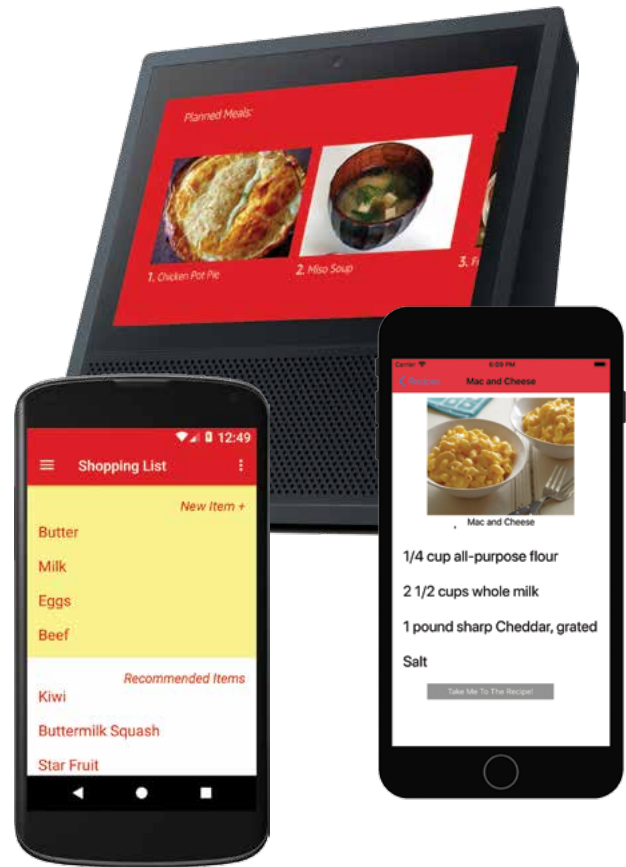
As items are purchased, Fresh-ipes adds them to a customer's virtual pantry that tracks their availability as ingredients for recipes. Stock of pantry items is adjusted automatically when used in recipes or manually by the customer.

Fresh-ipes offers intelligent recipe recommendations based on ingredients that are available in a customer's virtual pantry. Customers add recipes to their planned meals or favorite recipes. When preparing meals, customers view recipe directions on their mobile device or Amazon Echo Show.

Fresh-ipes provides customers with purchase recommendations based on planned meals and low ingredient stock in their virtual pantry. Customers add items to their shopping list manually and from items recommended by our app. Additionally, Fresh-ipes offers the options for curbside pickup or delivery.

Our Fresh-ipes app encourages customers to shop at Meijer by making meal planning and shopping easier and simpler.

Android, iOS and Amazon Echo Show apps make requests to the .NET Core Web API and SQL Server database hosted in a Microsoft Azure Cloud environment. These requests integrate with the Yummly API to provide recipe recommendations.



Michigan State University

Team Members (left to right)

Charles Heil
Novi, Michigan

Daniel Radler
Midland, Michigan

Olivia Miller
Birmingham, Michigan

Justin Pearson
Eaton Rapids, Michigan

James Murray
Dearborn Heights, Michigan

Meijer

Project Sponsors

Bill Baer
Grand Rapids, Michigan

Jim Becher
Grand Rapids, Michigan

Von Franklin
Grand Rapids, Michigan

Chris Laske
Grand Rapids, Michigan

Terry Ledbetter
Grand Rapids, Michigan

Murali Rajagopalan
Grand Rapids, Michigan

Michigan State University

SEA: Spartan Experience App

The nation's pioneer land-grant university, Michigan State University (MSU) is one of the top research universities in the world. With over 50,000 students, MSU is home to nationally ranked and recognized academic, residential college and service-learning programs.

Our Spartan Experience App (SEA) is a mobile app that provides useful information for both students and visitors to enhance their MSU experience.

Looking for a bite to eat? SEA shows categorized menus within each dining hall, including dietary restrictions.

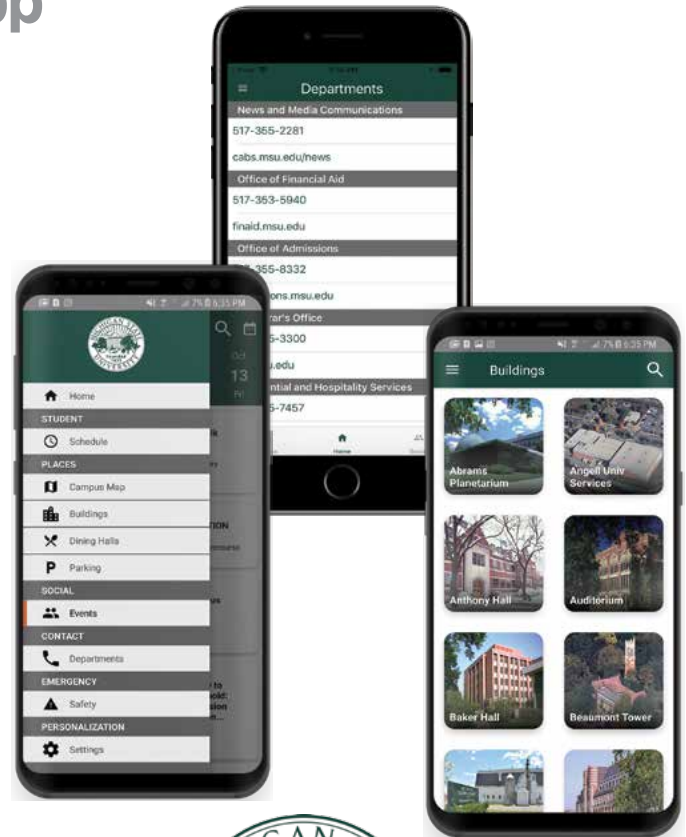
Not sure where your first class is? Use our app to search for building locations and get directions.

Visiting and not sure where to park? SEA gives parking locations as well as navigation to get to them.

Wondering when the next football game is? Our app notifies users of current and upcoming events and keeps them connected with a live Twitter feed.

SEA's personalized home view provides relevant and contextual information based on the user's location and time of day. Users see nearby dining halls and are alerted to upcoming events. A countdown timer helps students avoid being late to their next class.

Our SEA: Spartan Experience App is developed with Swift for iOS platforms and Java for Android platforms. The AWS Lambda API is written in Python and uses PostgreSQL as the underlying database.



Michigan State University Team Members (left to right)

Scott Swarthout
Farmington Hills, Michigan

Ryan Johnson
Brighton, Michigan

Nayana Kodur
Okemos, Michigan

Patrick Pale
Troy, Michigan

Roy Perryman
Roscommon, Michigan

Michigan State University Project Sponsors

E.J. Dyksen
East Lansing, Michigan

Rob McCurdy
East Lansing, Michigan

Tyler Olsen
East Lansing, Michigan

Spencer Ottarson
East Lansing, Michigan

Microsoft

Enhanced Company Portal with Graph

Headquartered in Redmond, Washington, Microsoft is a long-time technology leader and innovator. For decades, they have provided enterprises with a comprehensive body of technological solutions created to drive productivity.

More and more, people are using their personal mobile devices to do work that was once done only in the office. This not only enhances work flexibility and productivity, but it also lowers company hardware costs. However, accessing sensitive company data on a personal device poses a potential significant security risk.

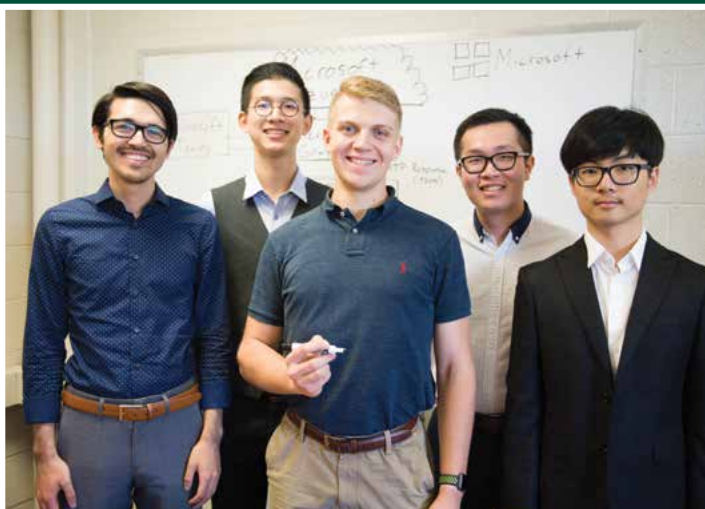
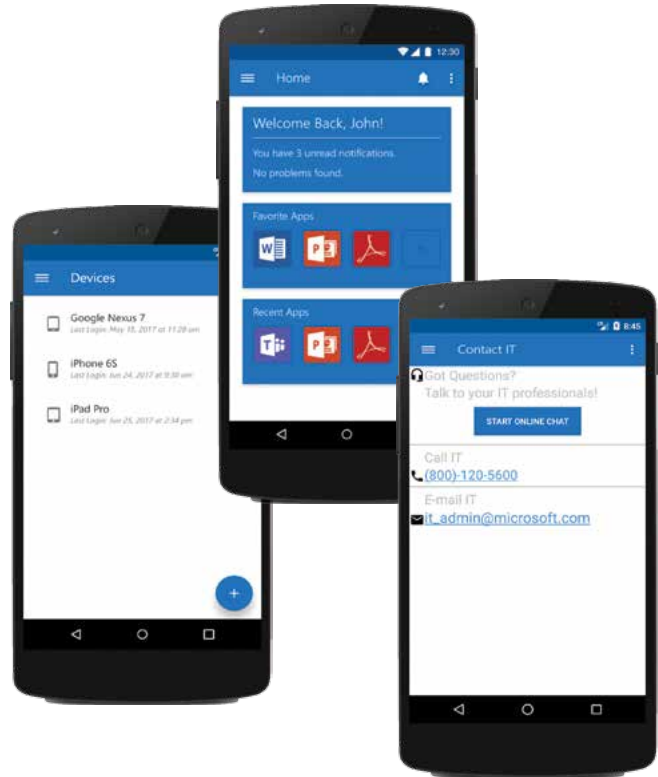
Our Enhanced Company Portal with Graph is an Android app that enables employees to access company resources safely and securely using their personal mobile devices.

Our app uses Microsoft Graph to provide users with a single endpoint for information and resources across all Microsoft programs, applications and platforms within their organization.

After using our app to enroll their personal devices, employees can access valuable company resources, data and applications directly on their personal devices. In addition, users can contact their company's IT department directly from within our app to open and resolve service tickets quickly and efficiently.

To provide for safety and security, once a user's mobile devices are enrolled, their enterprise IT team can ensure that employee devices are compliant with the company's security policies.

Our application is written in Java using Android Studio.



Michigan State University

Team Members (left to right)

Jordan Green
Holt, Michigan

Junda Yin
Guangzhou, China

Matthew Pasco
Clarkston, Michigan

Mike Xiao
Wuhan, Hubei, China

Yumo Wang
Qingdao, Shandong, China

Microsoft

Project Sponsors

Wyatt Berlinic
Boston, Massachusetts

Scott Sawyer
Boston, Massachusetts

Kurt Seippel
Boston, Massachusetts

Scott Wadsworth
Redmond, Washington

Mozilla Corporation

Taking Firefox Screenshots Testing Suite to 11

Mozilla is a global, nonprofit organization dedicated to improving the World Wide Web. Mozilla's international community of developers creates open source software such as Firefox, which is one of the most widely used browsers today.

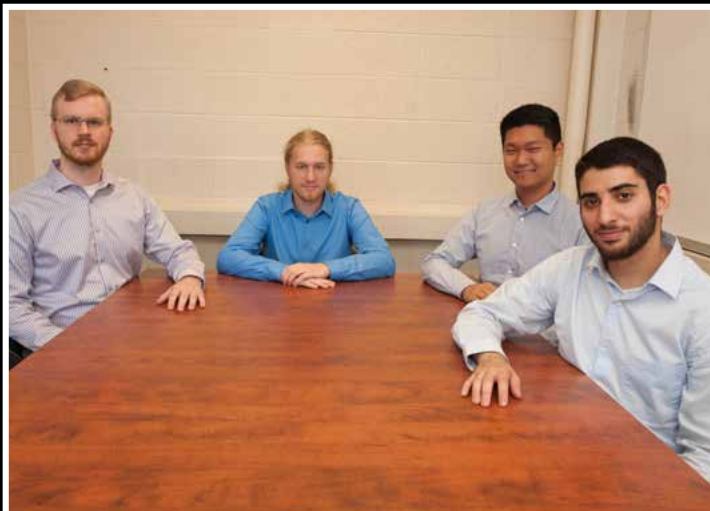
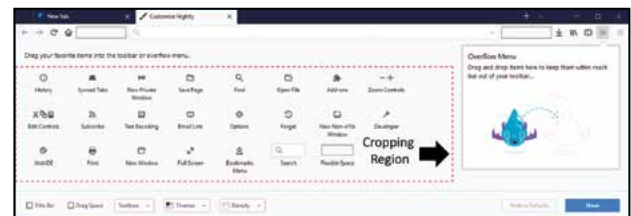
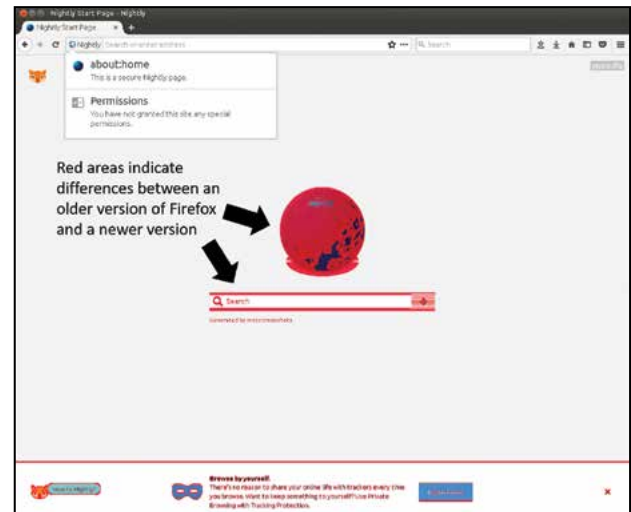
Firefox requires automated quality assurance during development to provide an excellent and consistent user experience. Occasionally, developers may inadvertently change the user interface.

Mozilla's Firefox Screenshots Testing Suite detects inadvertent changes and alerts developers by taking a screenshot of a development version of Firefox, comparing it to a known "good" screenshot, and highlighting any differences.

Our improvements to the Firefox Screenshots Testing Suite make it more reliable and efficient. The tool now automatically crops screenshots to relevant areas, reducing false positives. Additionally, the tool takes a more varied sample of the Firefox user interface. Finally, better communication now exists between the screenshot testing suite and other quality assurance tools.

Our combined improvements make the Firefox Screenshots Testing Suite a more important piece of Firefox's overall quality assurance process.

Our improvements to the Firefox Screenshots Testing Suite are written in JavaScript and use Mozilla's Mochitest and XPCShell frameworks to run tests. The tool includes a legacy Firefox extension which manipulates the user interface and takes screenshots.



Michigan State University Team Members (left to right)

Michael Williams
Pittsburgh, Pennsylvania

Robin Miller
Laingsburg, Michigan

Christopher Cho
Troy, Michigan

Rand Mustafa
Grand Rapids, Michigan

Mozilla Project Sponsors

Mike Conley
Toronto, Ontario, Canada

Jared Wein
Burton, Michigan

MSU Federal Credit Union Digital Banking with Chatbots

Founded in 1937, Michigan State University Federal Credit Union offers financial services to members of the Michigan State University and Oakland University communities. With 250,000 members and over \$3.7 billion in assets, MSUFCU is the largest university-based credit union in the world.

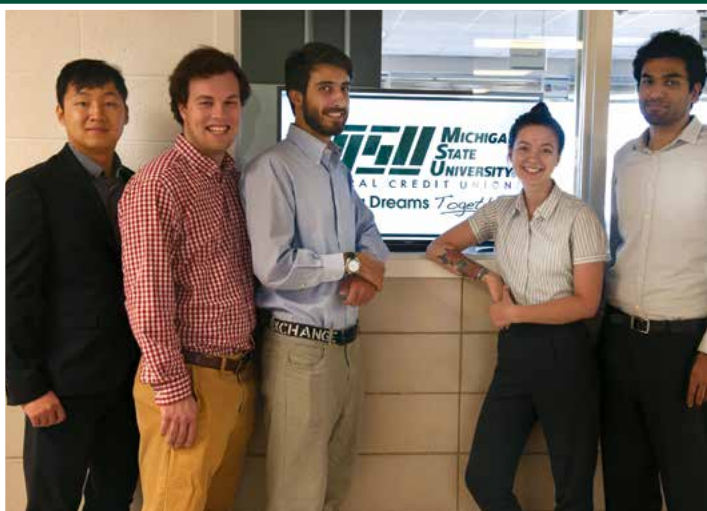
Currently, Credit Union members can speak to a customer service representative over the phone or through live chat on the MSUFCU website. Members can also log on to the Credit Union's website or mobile phone apps to view their accounts.

Our Digital Banking with Chatbots system enhances this customer support by allowing members to complete common tasks 24 hours a day with no wait time. The system also increases accessibility by expanding to three new platforms: Facebook Messenger, Google Assistant and Amazon Alexa.

The chatbot system allows for natural conversation. Members can check account balances, transfer funds, reset passwords and perform other tasks just as easily as they would speak to a teller at an MSUFCU branch.

These chatbot conversations can be initiated through the existing web chat, on Facebook, and even through voice controls with Google Assistant and Amazon Alexa. If a member needs more help, the chatbot connects them to a live representative.

The natural language processing (NLP) services are Dialogflow and Amazon Lex. Each communication platform connects to the NLP service and to a SQLite database through a custom API. The API, fulfillment application and web application are written in Node.js.



Michigan State University

Team Members (left to right)

Chuanyn Xiao
Chongqing, China

Josh Benner
Grand Rapids, Michigan

Gustavo Fernandes
Sao Paulo, Brazil

Cori Tymoszek
Cheboygan, Michigan

Syed Naqvi
Muscat, Oman

MSUFCU

Project Sponsors

Samantha Amburgey
East Lansing, Michigan

April Clobes
East Lansing, Michigan

Ben Maxim
East Lansing, Michigan

The Phoenix Group

OPEN v2.0: Smart Order Picking

The Phoenix Group (TPG), founded in 2001, is the largest independent Point of Sale (POS) distributor in the industry. Leveraging distribution agreements with every major manufacturer, TPG supplies banks and independent sales organizations with POS equipment and services.

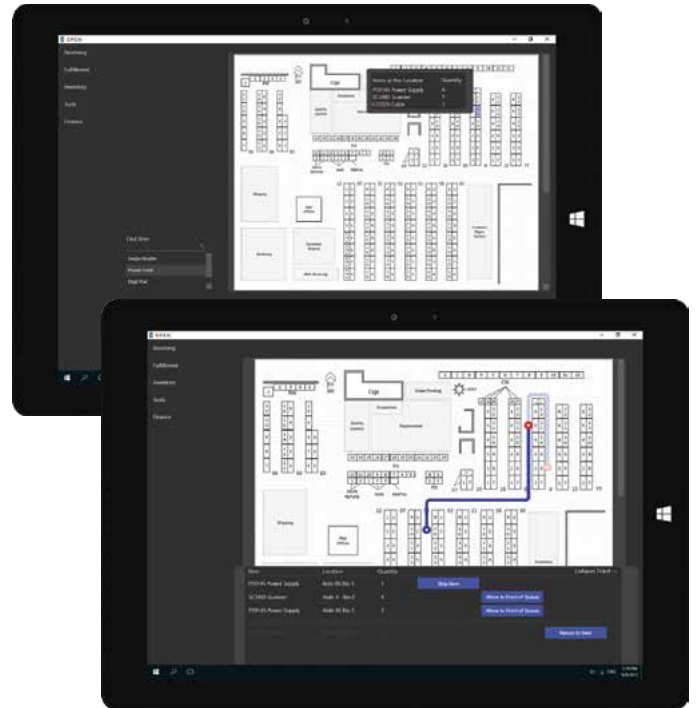
TPG POS systems are custom-configured for each of its many customers. TPG technicians traverse through their large warehouse to pick up the parts and pieces needed to build each customized POS device. Maximizing warehouse order-picking efficiency is a high priority to meet increasing order volumes.

Our OPEN v2.0: Smart Order Picking app adds intelligent interactive order-picking features to TPG's proprietary logistics app OPEN. Our new features guide order pickers along the fastest route to fulfill an order and track inventory in real time.

Our app displays a warehouse map, which indicates the current location of the tablet, the items that must be picked for an order, and the fastest route to retrieve them all. Inventory is updated immediately when an item is picked so that warehouse stock is continuously up to date.

Our OPEN v2.0: Smart Order Picking features increase the speed that orders can be fulfilled and decrease the frequency of error throughout the process.

OPEN v2.0 is a Windows Presentation Foundation (WPF) application written in C#. It communicates with a backend API written in Node.js. An array of Bluetooth Low Energy Beacons broadcasts signals, which are used to determine location within the warehouse.



Michigan State University Team Members (left to right)

Charlie Deneau
Onsted, Michigan

Evan Brazen
Romeo, Michigan

Bryce Corey
Holt, Michigan

Austin Rix
Lowell, Michigan

Austin Littley
Coldwater, Michigan

Phoenix Group Project Sponsors

Bob Dyksen
O'Fallon, Missouri

Scott Rutledge
O'Fallon, Missouri

Rook Security

Cloud Security Event Processing and Alerting Platform

Rook Security is a managed threat response force that is dedicated to providing global IT security solutions that anticipate, manage and eliminate threats.

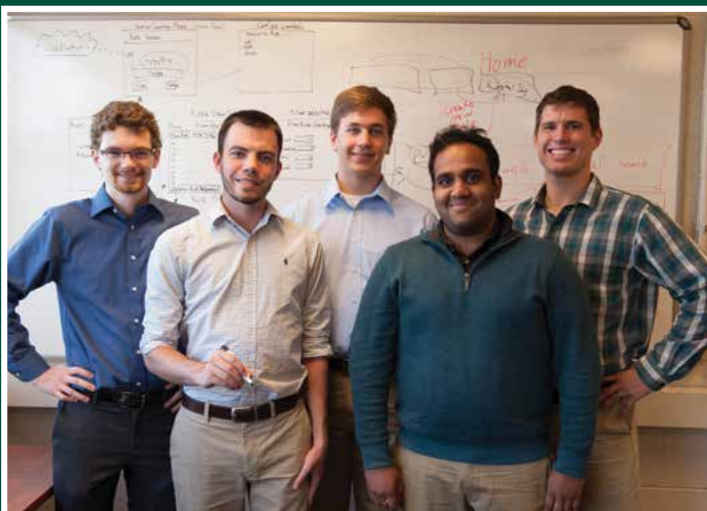
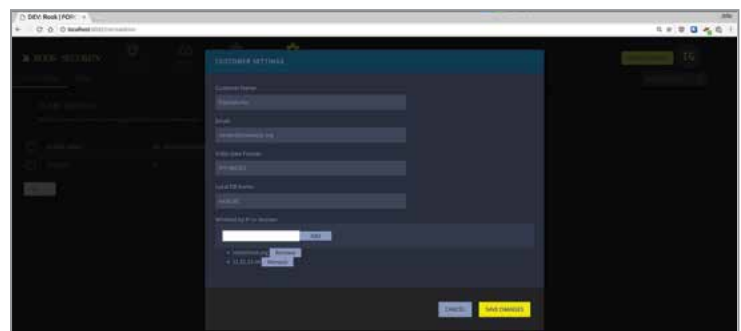
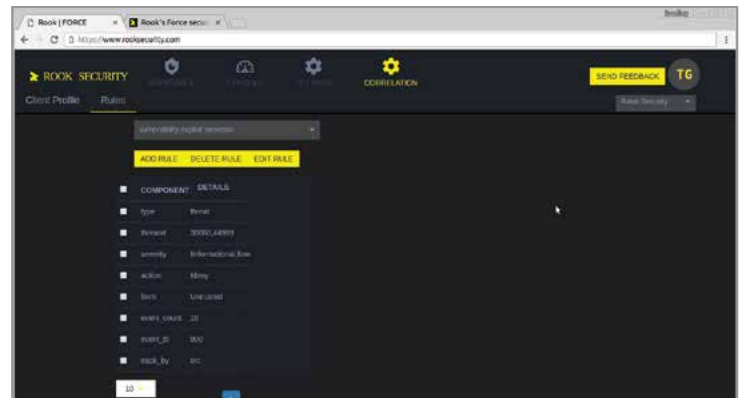
Our Cloud Security Event Processing and Alerting Platform analyzes log information from a client's computer network looking for security-related events. Rook receives millions of these events that must be parsed and correlated into discrete incidents.

Our system provides a web interface that enables Rook engineers to edit existing correlation rules and to examine how these new rules perform, making it easier and more efficient to onboard new clients.

In addition, our system leverages Amazon Web Services (AWS) to create a reliable serverless architecture. Manageable from Rook's Force web platform, our AWS system scales easily and quickly with on-demand computing to accommodate a growing base of clients and sudden surges of incoming network events.

Our Cloud Security Event Processing and Alerting Platform is identical in functionality to Rook's previous version thereby keeping all of the same protections and making for a seamless transition for Rook's analysts and customers alike.

The analytical Lambda functions are written in Python. The backend RESTful API leverages the Django framework with the frontend written in JavaScript using React/Redux libraries. The platform takes advantage of multiple Amazon Web Services including Athena, S3 and EC2.



Michigan State University

Team Members (left to right)

Jake Fenton
Kalamazoo, Michigan

Brian Jones
South Lyon, Michigan

Alexander Fall
Grand Rapids, Michigan

Kaushik Sridasyam
Troy, Michigan

Bradley Baker
Carleton, Michigan

Rook

Project Sponsors

Mat Gangwer
Indianapolis, Indiana

Michael Taylor
Indianapolis, Indiana

J.J. Thompson
Indianapolis, Indiana

Spectrum Health

Spectrum Health Symptom Checker

Spectrum Health is an integrated, not-for-profit health system based in Grand Rapids, Michigan that provides high quality healthcare through 12 hospitals and more than 140 service sites in West Michigan. Priority Health, its award-winning health plan, serves over 788,000 members across the U.S. and ensures that patients can affordably access quality care.

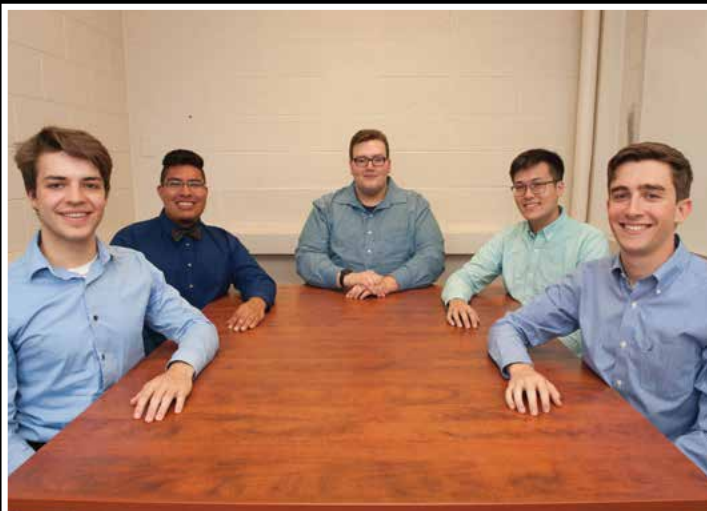
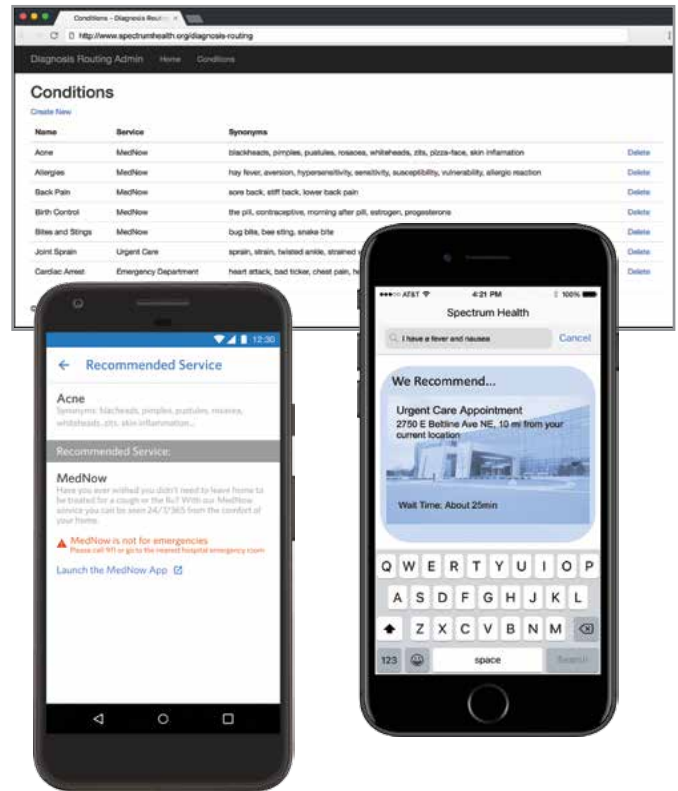
To increase accessibility of various cloud services, such as bill payments and appointment scheduling, Spectrum Health provides an app for Android and iOS users.

Our Symptom Checker is a feature within the application that recommends a healthcare service to patients based on the symptoms they are experiencing.

After a patient submits how they are feeling, they are presented a list of conditions commonly associated with their symptoms. After choosing which condition they feel fits them the best, the patient is given the option to schedule an appointment using MedNow, visit an Urgent Care center, or seek emergency care at a Spectrum Health Emergency Room.

Our other features added to the Spectrum Health mobile app include the ability for users to pay medical bills through Spectrum Health's secure Pay My Bill service, get in touch with providers through a Contact Us page, and view job opportunities through the Careers portal.

Our Symptom Checker and other features are written in Swift 4 for iOS devices and Java for Android devices. C# and ASP.NET Core 2.0 are used to implement our natural language processing RESTful API.



Michigan State University Team Members (left to right)

Silas Brumwell
Grand Blanc, Michigan

Jose Hernandez
Fresno, California

Morgan Muyskens
Ludington, Michigan

Joshua Miles
South Lyon, Michigan

Christopher McGrath
Clarkston, Michigan

Spectrum Health Project Sponsors

Adam Bakker
Grand Rapids, Michigan

Jane Gietzen
Grand Rapids, Michigan

Markus Neuhoﬀ
Grand Rapids, Michigan

Patrick O'Hare
Grand Rapids, Michigan

Vincenzo Pavano
Grand Rapids, Michigan

Mark Welscott
Grand Rapids, Michigan

Symantec

Secure Application Layer API Proxy

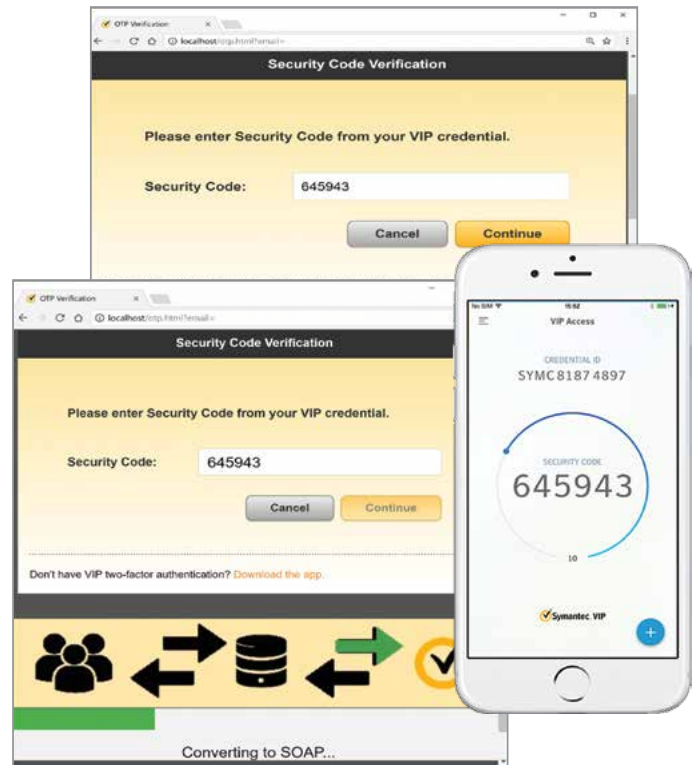
Symantec Corporation is a global leader in the cybersecurity industry, unifying cloud and on-premises security to protect users, information, messaging and the web.

As companies move their critical data from behind their own firewalls to running in the cloud, they must add additional layers of security to protect their data. One layer added is that of Symantec's VIP, which is a popular multi-factor authentication tool used during the login process.

When a company purchases VIP, they are given access to a web interface that enables the company to integrate and secure their services. To access the VIP web interface, software developers currently must form web requests—that is, messages sent over the internet—using a traditional web messaging protocol called Simple Object Access Protocol (SOAP).

Our Secure Application Layer API Proxy simplifies access to the existing SOAP web interface by introducing a more modern one. We leverage a more efficient, flexible and easier to use protocol called Representational State Transfer (REST). Our proxy accepts REST-style web requests and converts them to a SOAP format for VIP. Once the proxy receives a SOAP response back from Symantec's already existing systems, it sends that response back to the user in a REST format. Most importantly, our service preserves the superior level of security that VIP guarantees its customers throughout this process.

Our Secure Application Layer API Proxy is written in C# using the .NET framework and uses signed JSON Web Tokens (JWT) for secure communication between the proxy and end user.



Michigan State University

Team Members (left to right)

Steven Kneiser
Grosse Pointe Farms, Michigan

Yili Luo
ChengDu, Sichuan, China

Jacob Carl
Rochester Hills, Michigan

Lauren Allswede
East Lansing, Michigan

TJ Kelly
Jackson, Michigan

Symantec

Project Sponsors

Shantanu Gattani
Mountain View, California

Renault Ross
Mountain View, California

TechSmith

TechSmith Director

TechSmith helps people easily create visual content such as images and video, to communicate more effectively. Our products, including Snagit and Camtasia, are used by more than 30 million users worldwide, and growing.

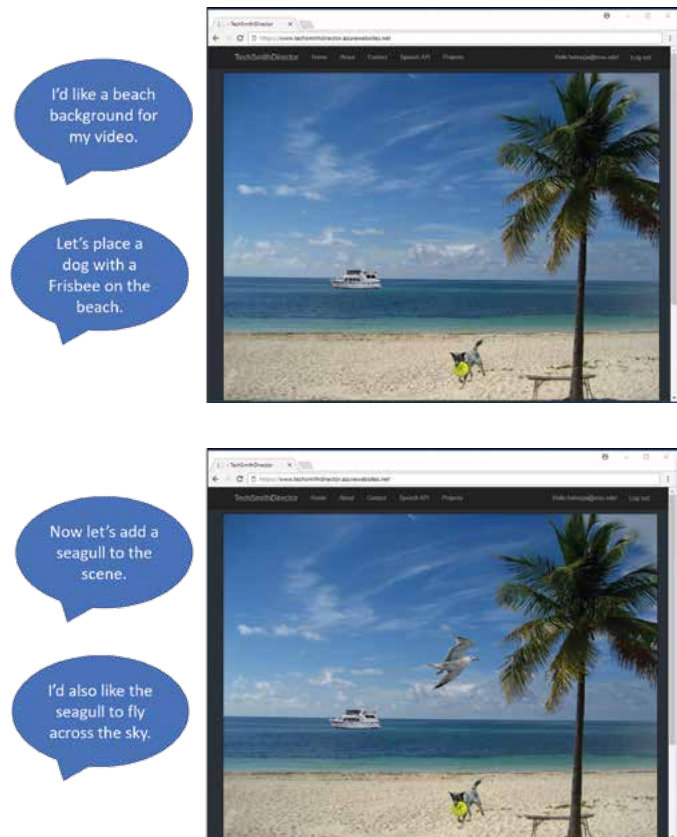
Due to the complexity of many video editing platforms, video creation is difficult for the average person. There are often countless menus, buttons and settings that require time and experience to learn and understand.

Our TechSmith Director strips the need for a complicated interface by interpreting the user's spoken commands to create a video. Users dictate commands to Director and let the software handle the tedious work. The user further edits their video project using simple drag and drop functionality.

For example, a user may create a video by saying things like "I'd like a beach background for my video" followed by "Let's place a dog with a frisbee on the beach." Animations may be added simply by saying "I'd like the dog to walk across the beach." Users also search for audio clips in the same way.

Video projects are saved so users may view and edit them later. Multiple projects are stored and managed through a single user interface.

TechSmith Director is written in C# using ASP.NET Core, HTML and JavaScript. The site is hosted on Microsoft Azure and data is stored on a SQL server. Voice commands are processed using Microsoft Cognitive Services.



Michigan State University Team Members (left to right)

Joe Freedman
Commerce Township, Michigan

Pranay Kandru
Novi, Michigan

Kevin Ahn
Bloomfield Hills, Michigan

Jacob Heisey
Holt, Michigan

Jared Ballance
Grand Blanc, Michigan

TechSmith Project Sponsors

Ryan Eash
Okemos, Michigan

Wendy Hamilton
Okemos, Michigan

Tony Lambert
Okemos, Michigan

Dan Latterner
Okemos, Michigan

Dave Noris
Okemos, Michigan

Ben Rhodes
Okemos, Michigan

Paul Stanos
Okemos, Michigan

TWO MEN AND A TRUCK®

Online Moving Estimator

TWO MEN AND A TRUCK is the fastest-growing franchised moving company in the country with more than 400 locations in 42 states and 4 countries.

While TWO MEN AND A TRUCK customers can request to receive a moving estimate online, if the customer's home is over 2,000 square feet, an in-home consultation may be required, which takes time both for TWO MEN AND A TRUCK and its customers.

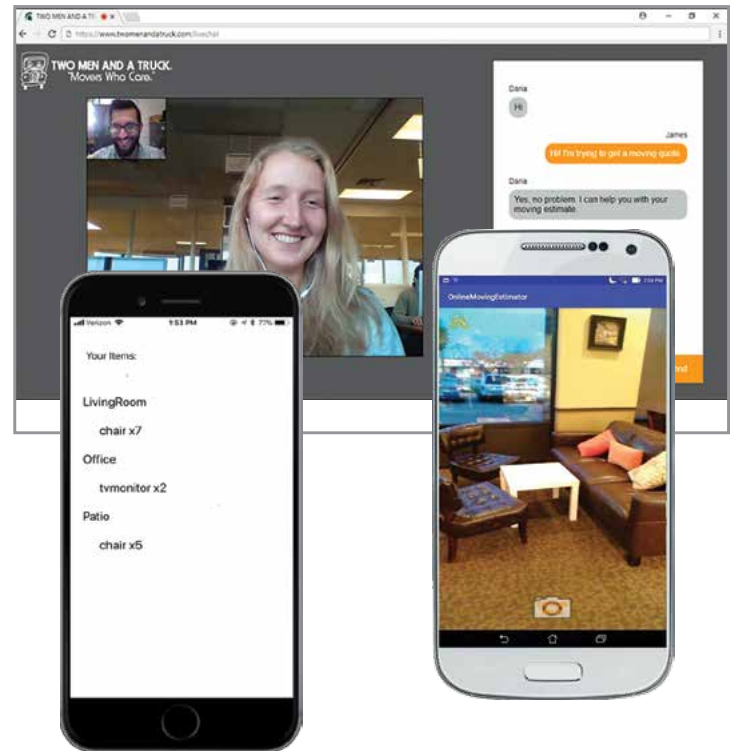
Our three new features for TWO MEN AND A TRUCK's Online Moving Estimator make the estimation process faster and more convenient for both parties.

First, our online video chat service enables a customer to connect with a TWO MEN AND A TRUCK agent who completes the estimate remotely through video conferencing.

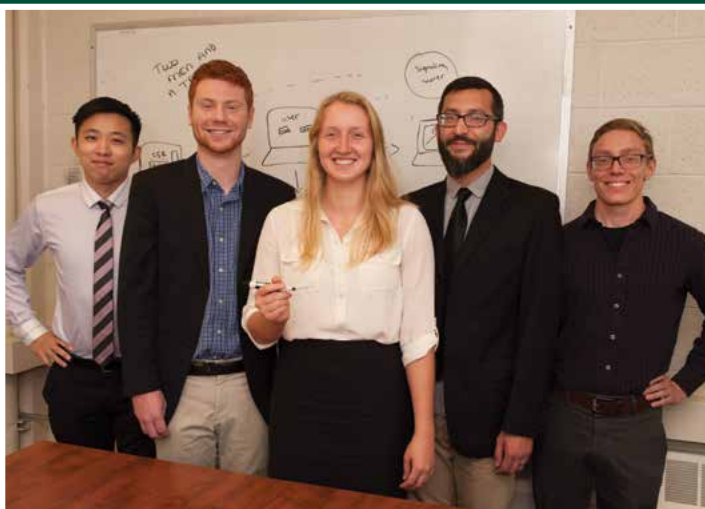
Secondly, our web app allows TWO MEN AND A TRUCK to select from a queue of waiting customers or schedule a video conference consultation at a later time.

Finally, our mobile apps remove the need for an agent to be involved and allow a customer to complete an estimate on their own time by using image recognition. Customers take pictures throughout their house or apartment, confirm objects in each image, and then submit a final list to obtain their estimate.

Our web app for Online Moving Estimator is written in CSS, HTML and JavaScript. The video conferencing uses WebRTC. YOLO provides the object recognition library. The backend uses ASP.NET/C# with a MySQL database. Our mobile apps are written in Swift 4 for iOS devices and Java for Android devices.



**TWO MEN
AND A
TRUCK®**



Michigan State University

Team Members (left to right)

Liyang Ye
Hangzhou, Zhejiang, China

Clayton Wilson
Canton, Michigan

Daria Tarasova
Holt, Michigan

Bradley Williams
Midland, Michigan

Kevin Dittman
South Lyon, Michigan

TWO MEN AND A TRUCK

Project Sponsors

Jake Gaitan
Lansing, Michigan

Corey Lasley
Lansing, Michigan

Jon Nobis
Lansing, Michigan

Mark Roberts
Lansing, Michigan

Ashley Skaggs
Lansing, Michigan

Caleb Williams
Lansing, Michigan

Union Pacific

RailBuilder: The Great Race to Promontory

Headquartered in Omaha, Nebraska, Union Pacific is a leading transportation company with over 8,500 locomotives running on 32,100 miles of track across 23 states.

Union Pacific provides a variety of training software for its crews. For their simulation training to be effective, it must include realistic three-dimensional (3D) environments with appropriate topography, soils, water and vegetation.

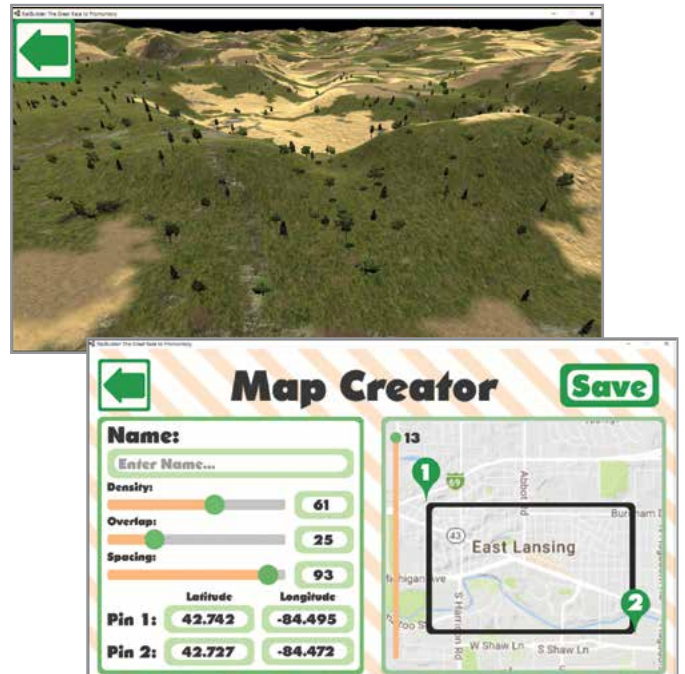
Our application, RailBuilder: The Great Race to Promontory, enables users to generate accurate 3D terrain maps of the United States easily and quickly. Our companion railroad game showcases our terrain building capabilities.

Players easily create, name and save maps of any part of the continental US using our Map Creator editor. The resulting 3D maps include all of the appropriate topography, soils, water and vegetation depending on the area selected.

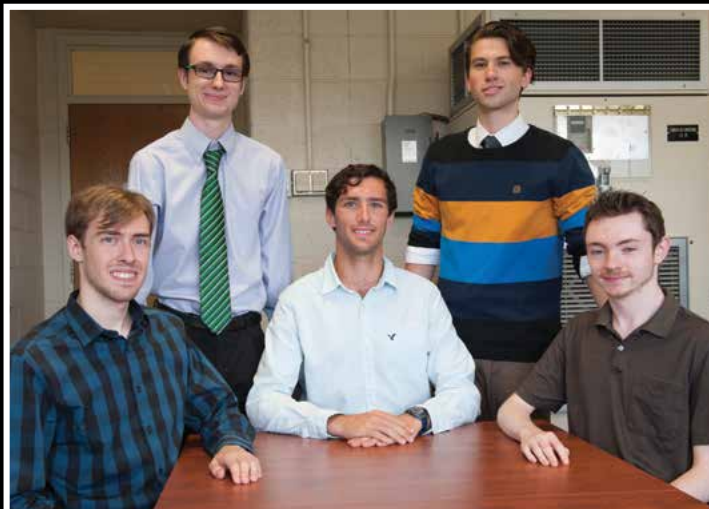
Once a map is created, our game places two rail stations on the map. A player must then connect the stations by building a railroad between them. RailBuilder is easy for anyone to learn how to play and provides a challenge for even the most experienced veterans.

RailBuilder is a standalone app that runs on any Windows computer. All maps are saved locally so each player enjoys a unique experience.

RailBuilder is written in C# using the Unity3D game engine. Our backend uses integration from Google Maps and the United States Geological Survey.



BUILDING AMERICA®



Michigan State University

Team Members (left to right)

Trever Daniels
Clarkston, Michigan

Declan McClintock
Versailles, Kentucky

Jacob Young
Eden Prairie, Minnesota

Kyle Bush
Grand Rapids, Michigan

Zachary Brenz
Shelby Township, Michigan

Union Pacific

Project Sponsors

Seenu Chundru
Louisville, Colorado

Chris Cornish
Okemos, Michigan

Tim Court
Okemos, Michigan

Jeff Girbach
Okemos, Michigan

Rick Holmes
Omaha, Nebraska

Henk Plaggemars
Okemos, Michigan

Urban Science

VDA: Virtual Dealership Adviser

Urban Science is an internationally renowned solutions company with a passion for solving data-driven problems. Headquartered in Detroit, Urban Science specializes in providing science-based solutions for the automotive, health and retail industries.

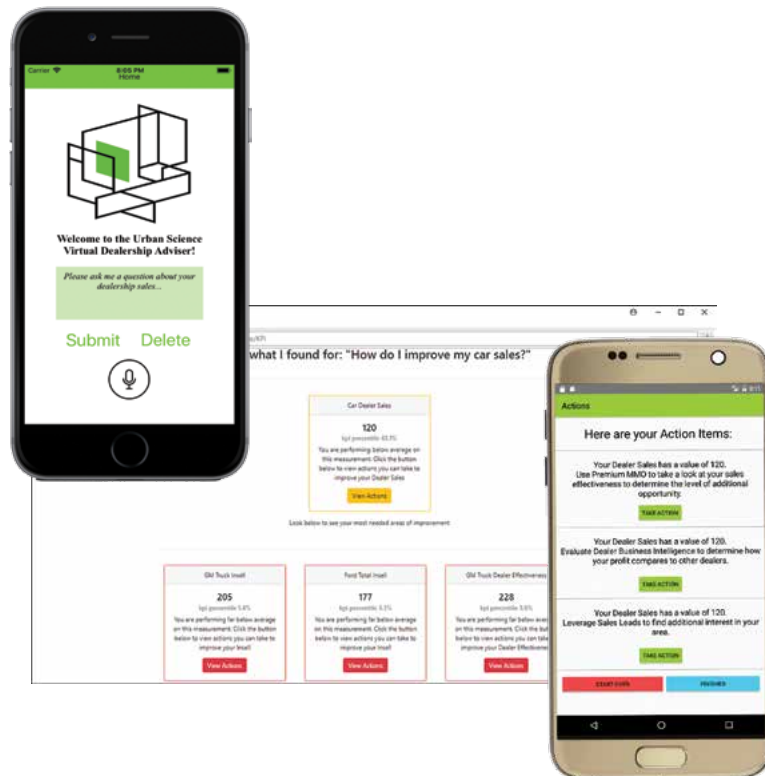
Within the automotive industry, Urban Science provides deep-data insights that dealerships use to improve their business. These dealerships frequently encounter the challenge of facing numerous metrics to analyze, making it difficult to determine which areas of their business need the greatest improvement.

Our Virtual Dealership Adviser targets these areas by allowing dealership employees to ask specific or general questions on how to improve segments of their business. For example, a user may ask: “How can I improve my SUV sales?”

Users choose between areas of improvement relevant to their question or those that offer the most room for improvement overall. Actionable solutions related to their area of improvement are then presented to the user, such as “optimize inventory mix to meet consumer demand” or “leverage sales leads to find additional interest in your area.”

Using our intuitive interface, dealership employees can find quick, data-driven solutions, allowing them to respond effectively to their market.

Our Virtual Dealership Adviser is accessible through Android, iOS and web browsers. Our databases are hosted in Amazon Web Services. Microsoft Azure is used for hosting and language processing services.



Michigan State University Team Members (left to right)

Will Renius
Goodrich, Michigan

James Grenfell
Dearborn, Michigan

Daniel Oforidankwa
Saginaw, Michigan

Eric Zhou
Troy, Michigan

Harry Singh
Saginaw, Michigan

Urban Science Project Sponsors

Linda Conley
Detroit, Michigan

Mike DeRiso
Detroit, Michigan

Elizabeth Klee
Detroit, Michigan

Luke Mercier
Detroit, Michigan

Michael Nelson
Detroit, Michigan

Yello

Automatic Resume Verification

Founded in 2008, Yello provides talent acquisition software that helps companies fill their most challenging job openings by hiring the right talent at the right time. Currently, Yello supports 20% of the Fortune 500 companies.

According to the Harvard Business Review, 80% of employee turnover is due to bad hiring decisions. In addition, it costs companies, on average, one-third of a new hire's annual salary to replace them.

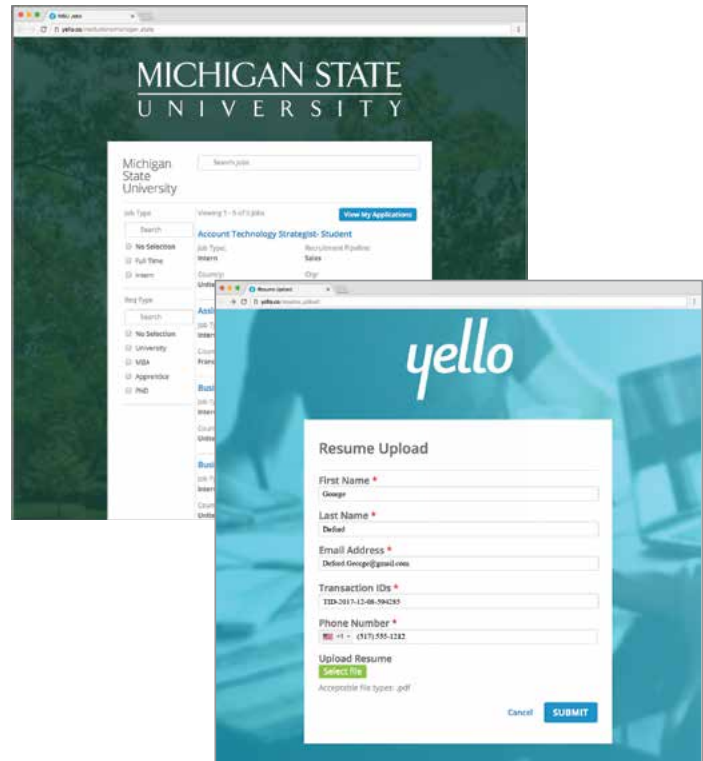
Our Automatic Resume Verification software helps Yello's client-partners identify and recruit the best candidates by automatically verifying a candidate's resume credentials.

Institutions such as universities or companies use one of our web apps to upload a prospective candidate's credentials including things like academic degrees and employment dates. Each credential uploaded is assigned a unique transaction ID which is then given to the candidate.

A candidate uses our second web app to upload their resume along with their transaction IDs. By providing the transaction IDs along with the resume, our system is able to verify the candidate's credentials automatically.

Candidate credentials are stored using a custom blockchain, which ensures scalability and security.

Our Automatic Resume Verification web apps are built with Ruby on Rails and hosted on an Amazon AWS EC2 instance. The blockchain is implemented in Python 3.6 and stored in a MySQL server.



yello



Michigan State University

Team Members (left to right)

Wan Kim
Troy, Michigan

Nathaniel Hagan
Lansing, Michigan

Giorgio Maroki
Sterling Heights, Michigan

Brandon Burt
Grand Blanc, Michigan

Ryan Nagy
Saline, Michigan

Yello

Project Sponsors

Jason Allen
Chicago, Illinois

Justin Moles
Chicago, Illinois

Steve Tiufekchiev
Chicago, Illinois

Jason Weingarten
Chicago, Illinois

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 TechSmith
Teacher's Virtual Toolbelt



Alex Crimin, Zeke Zandbergen, Yang He, Ryan Cornillie
Presented by Scott Lake

MSU Federal Credit Union Praxis Award



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

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

Team Union Pacific
Learning New Train Routes



Matthew Schleusener, Kangjie Mi, Nick Summers, Jon Wild
Presented by Liam Petraska

Spring 2017

Design Day Judges

E. J. Dyksen <i>Michigan State University</i>	Rich Enbody <i>Michigan State University</i>	Adam Haas <i>Ford Motor Company</i>	Wendy Hamilton <i>TechSmith</i>	Louise Hemond-Wilson <i>IBM</i>
Fred Killeen <i>General Motors</i>	Elizabeth Klee <i>Urban Science</i>	Terry Ledbetter <i>Meijer</i>	John Marx <i>Amazon</i>	Rob McCurdy <i>Michigan State University</i>
David Mysona <i>Blackstone Technology</i>	Marty Strickler <i>Rose Packaging Company</i>	Dave Washburn <i>MSU Foundation</i>	Mark Welscott <i>Spectrum Health</i>	Karen Wrobel <i>Chrysler</i>

TechSmith Screencast Award



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

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

Team Amazon
ACRA: Amazon Customer Review Analyzer



Jie Wan, Jason Liu, Ian Whalen, Ankit Luthra, Tess Huelskamp

Urban Science Sigma Award



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

The capstone team that delivers the best overall capstone experience is recognized with the Urban Science Sigma Award, which is sponsored by Urban Science of Detroit, Michigan.

Team Michigan State University
CATAlyst: Mapping CATA Buses in Real-Time



Charlie Ward, Cathy Dinsmoor, Tom Beaver, Jimmy Mkude, James Dodge
Presented by Elizabeth Klee and Luke Mercier



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Introduction to Electrical and Computer Engineering

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

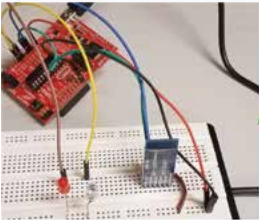
Problem statement

ECE 101 is an elective course introducing freshman students to Electrical and Computer Engineering through a series of innovative **hands-on flipped laboratory experiments** linked to new research and teaching areas. These experiments relate to (a) NXT control by smartphone, (b) App Inventor, (c) MATLAB Mobile, (d) smart bracelets, (e) digital microscope, and (f) LED Control by Bluetooth module.

Grad Student Assistant: Yunting Liu

Team Members	Project Title
Team #1: Charles Evans Grattan Rowland Alex Walsh	Desktop Projection
Team #2: Kamari Morse Zhehao Zhou	Evolution – an Android App to Demonstrate the Path of Evolution
Team #3: Anoop Khera Thomas Lynskey Michael Stein	EV3 Robot Controller
Team #4: Dillon Carrington Mitchell LeBlanc Pavan Patel	Data Download from a Maple- Seed Flier to a Smartphone
Team #5: Kaiyi Guan Dong Hae Mangolindan Han Wu	Schedule Hub App

Microcontroller and Bluetooth



Smartphone



AppInventor Code

The Capstone Projects



John Albrecht
Associate Professor of Electrical and
Computer Engineering



Dr. Lalita Udpa
Professor of Electrical and
Computer Engineering

Presentation Schedule – Room 2205 Engineering Building, Second Floor

Time	Team Sponsor	Project Title
8:30 a.m.	Union Pacific	Electricity Generation from Hot Rails
8:55 a.m.	Union Pacific	Regenerative Railcar Braking
9:20 a.m.	Continental AG	Advanced Driver Assistance Systems
9:45 a.m.	MSU College of Veterinary Medicine	Sow Identification and Data Transfer
10:10 a.m.	MSU ECE Department	Radar Micro-Doppler Classification for Autonomous Vehicles
10:35 a.m.	MSU EMRG	Autoclave System for Thin Film Lamination

Presentation Schedule – Room 2250 Engineering Building, Second Floor

Time	Team Sponsor	Project Title
8:30 a.m.	NDE Lab at MSU	Eddy Current Conductivity Meter
8:55 a.m.	MSU ECE Department	Autonomous Robot Navigation
9:20 a.m.	ArcelorMittal	Process Automation Monitor
9:45 a.m.	MSU ECE Department	Handheld Device to Detect Cracks in Aircraft
10:10 a.m.	Fraunhofer	SpartanStat: A Portable Potentiostat for the Detection of Heavy Metals

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.

Team sponsors are local and national, including ArcelorMittal, Continental AG, Fraunhofer, MSU Department of Electrical and Computer Engineering, MSU Electromagnetics Research Group, MSU College of Veterinary Medicine and Union Pacific. Thank you to each of these team sponsors.

Union Pacific Electricity Generation from Hot Rails

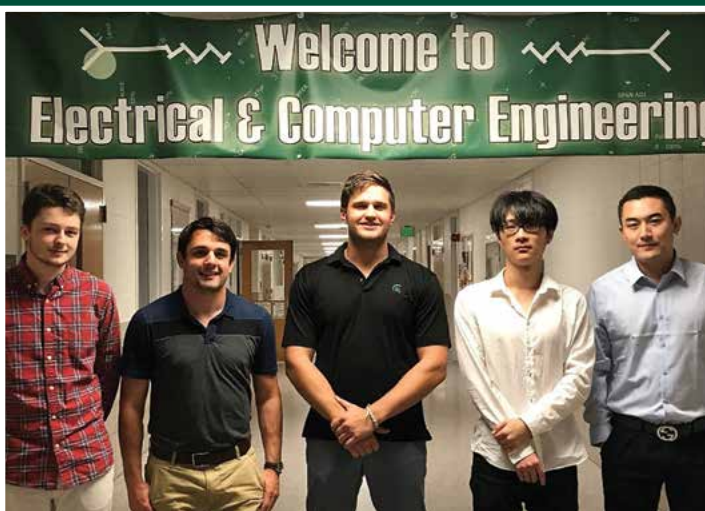
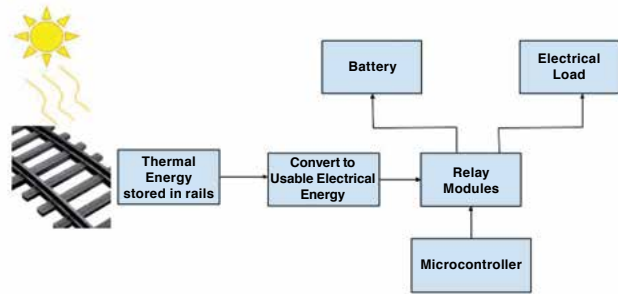
Union Pacific operates over 32,000 miles of track across North America and is a leader in transportation. They cover 23 states in the western two-thirds of the United States.

Typically, the temperature of the rails will exceed ambient temperature by 30-60 degrees, with energy stored as waste heat. Union Pacific wishes to utilize the wasted heat stored on the tracks and convert it into electrical power that can be stored for later use. With thermoelectric generation technology evolving, this wasted heat can efficiently be converted to usable energy with little cost to the company after installation.

The team was tasked with designing a way to harvest the thermal energy and convert it to usable power. The goal of the project is to utilize a Thermoelectric Generator (TEG) chip to convert enough thermal energy into DC electrical energy and be able to boost the voltage output to charge a battery load nearby. Our prototype must be capable of attaching to the side of the rail without interfering with oncoming trains.



BUILDING AMERICA®



Michigan State University

Team Members (left to right)

Jon Klapatch
Ypsilanti, Michigan

Alex Potoniec
Rochester Hills, Michigan

Sam Gasiorowski
Rochester Hills, Michigan

Yifan Zhang
Wuhan, Hubei, China

Xizhou Xiang
Chengdu, Sichuan, China

Union Pacific

Project Sponsor

Eric Gehringer
Omaha, Nebraska

Project Facilitator

Dr. Joydeep Mitra
East Lansing, Michigan

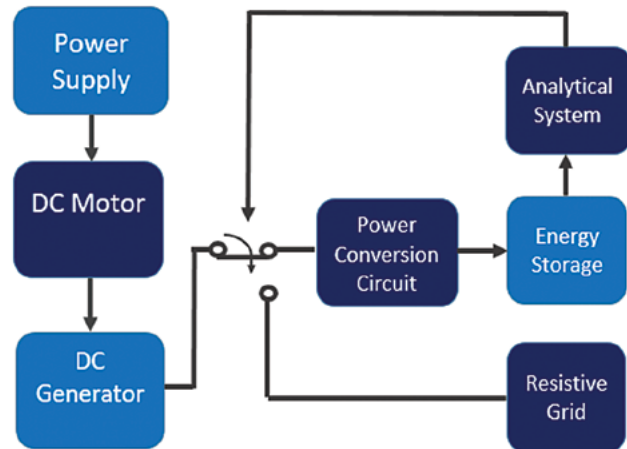
Union Pacific

Regenerative Railcar Braking

Union Pacific is the largest freight hauling railroad system in the United States with over 32,000 miles of track and over 8,500 locomotives. The company extensively uses diesel electric locomotives to haul freight cars over thousands of miles.

Union Pacific's objective is to capture the wasted energy from rheostatic braking into either super capacitors or battery banks and eventually transfer the power back onto the grid. Our team is tasked with designing a small-scale regenerative braking system to capture the power being generated from a DC generator when braking. The system will contain a small DC generator, power conversion circuit, method of storage, and data analysis software that will harness the lost energy from braking. The software will be able to demonstrate the overall efficiency of the system as well as useful quantitative measurements. The information gathered from the model can be scaled up to the size of the braking system on the EMD SD-70M to determine the potential power that can be generated from its massive traction motors. A theoretical model will be developed to show how the small-scale model can be scaled up to the locomotive.

The combination of the small-scale model and the theoretical model will provide Union Pacific with information that is useful for future implementations of regenerative braking on its locomotives. Union Pacific can potentially use the stored power as a source of revenue by transferring it onto the grid or using it to reduce demand needed from the diesel engine.



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Michigan State University Team Members (left to right)

Lucas Wolfe
Mason, Michigan

Zach Shannon
Mattawan, Michigan

Zach Bates
Lansing, Michigan

James Staley
Rockford, Michigan

Josh Clouse
Rockford, Michigan

Union Pacific Project Sponsor

Eric Gehringer
Omaha, Nebraska

Project Facilitator

Dr. Fangz Peng
East Lansing, Michigan

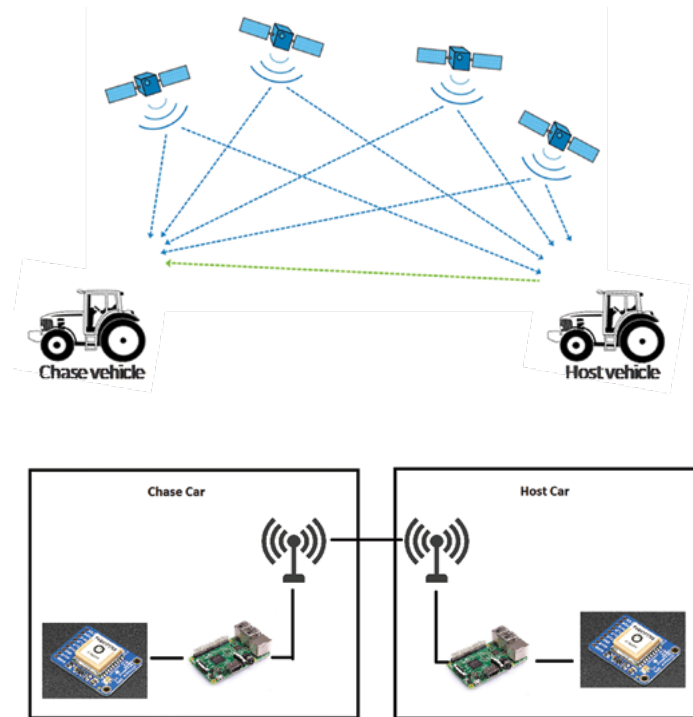
Continental AG

Advanced Driver Assistance Systems

Continental AG currently uses a Differential GPS system for testing their autonomous vehicles. This system is very expensive and has limited range due to a stationary base. They see the potential for saving hundreds of thousands of dollars by engineering a cheap and accurate DGPS system for relative positioning of autonomous vehicles testing. By using DGPS concepts, we aimed to create a relative DGPS system which would calculate the distance between two cars in real-time by sending GPS coordinates from a host vehicle to a chase vehicle.

Our team devised a system using GPS modules, XBee communication, and Raspberry Pi microprocessors to implement the relative DGPS system. The goal of this design is to calculate the distance between the vehicles within ± 10 cm accuracy with a 100 ms loop time, as well as data storage for playback on Continental's software at a later time.

A GUI interface was also implemented into the design by connecting a display in the chase car for real-time testing, debugging, and verification. Continental may also use this during the actual testing of their vehicles to verify the system is working before they start the test drive.



Michigan State University

Team Members (left to right)

Ruiming Zhao
Beijing, China

Eric Timmreck
Lansing, Michigan

Philip Dooley
Shelby Township, Michigan

Justin Hughes
Sterling Heights, Michigan

Yuanhao Xu
Sichuan, China

Xiangying Gao
Xiamen, China

Continental AG

Project Sponsor

James Critchley
Auburn Hills, Michigan

Project Facilitator

Dr. Xiaobo Tan
East Lansing, Michigan

MSU College of Veterinary Medicine

Sow Identification and Data Transfer

Michigan State's College of Veterinary Medicine is one of the top 10 veterinary schools in the nation. The school boasts top-notch facilities for its students, and the college's veterinary teaching hospital has one of the largest caseloads in the United States. This provides valuable experience for students in such areas as infectious diseases and cancer care for farm animals.

Part of the mission of the Vet-med Program is to push the boundaries of veterinary science. Every year approximately 50% of all breeding sows in America are lost to illness. There are simply too many sows for farmers to keep track of, causing many of them to succumb to illness.

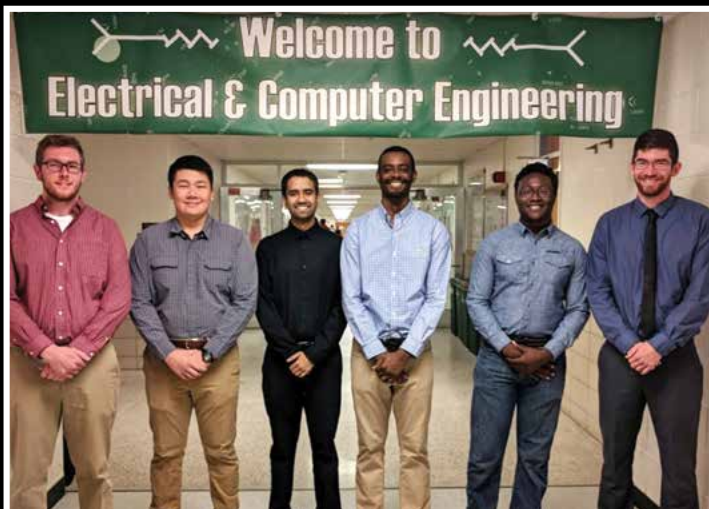
The Locomotive Identification Tracking system will monitor multiple sows as they pass through an area, identify those whose health may be a concern, and create a database of sows to help the farmer identify those that require medical attention. The designed system will use a Microsoft Kinect sensor combined with QR and RFID sensors to identify and help locate an unhealthy sow.

The Locomotive Identification Tracking system will save the farmer time and money by increasing the efficiency of the farm, improving living conditions, and decreasing mortality rates of sows.



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College of Veterinary Medicine



Michigan State University

Team Members (left to right)

Zak Driscoll
Macomb, Michigan

Ben Lindquist
Macomb, Michigan

Charles Mersereau
Dowagiac, Michigan

Parikshit Chahal
Troy, Michigan

Terlumun Nyamor
Rockford, Michigan

Joshua Friday
Detroit, Michigan

MSU College of Veterinary Medicine

Project Sponsors

Madonna Benjamin
East Lansing, Michigan

Bo Song
East Lansing, Michigan

Project Facilitator

Dr. Ahmet Ulusoy
East Lansing, Michigan

MSU Electrical and Computer Engineering Dept.

Radar Micro-Doppler Classification for Autonomous Vehicles

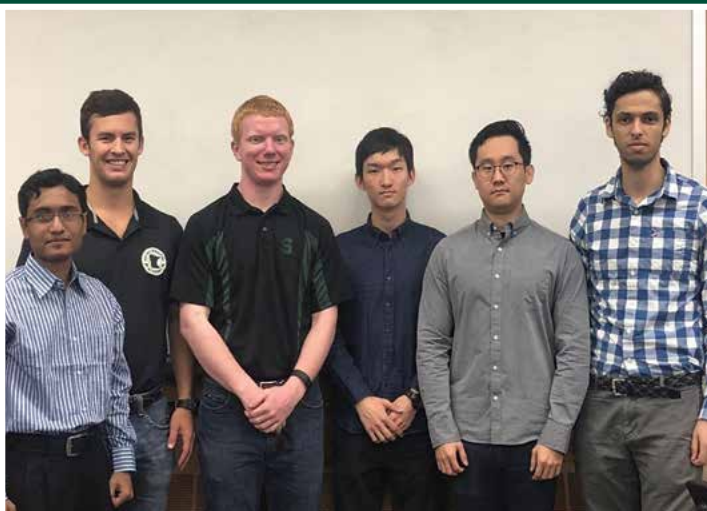
Autonomous Vehicles are becoming an ever increasing trend in the automobile industry. Several major companies have shifted their R&D teams to further advance autonomous driving technology. By 2020, many major automobile companies such as BMW, Ford, Audi and Tesla are planning to release their own fully autonomous vehicles, and it is vital for these vehicles to have the proper technology to ensure the safety of both drivers and pedestrians.

One of the most critical parts of the autonomous vehicles is sensors. The sensors must be precise and accurate in order for the system to determine if the car should stop or continue to go forward.

Our team has been tasked to design and create a device that is able to classify whether the moving object detected by the sensor through the use of radar is either a human or a vehicle. The project has been divided into two sectors, the hardware and software. The hardware system will include design of subsystems for data acquisition from the radar, noise filters, signal amplifiers and digitizer. The digitized signal will then be sent to the USB Interface for further analysis. The software developed will analyze the received signal using a Neural Network. The Neural Network algorithm will be trained and validated using a set of observational data. The trained Neural Network will be used to classify new data from the radar in real-time.



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Michigan State University

Team Members (left to right)

Alamzadeh Muhammadidban
Chittagong, Bangladesh

William Duggan
Minneapolis, Minnesota

Donovan Riley
Allen, Texas

Chengsi Liu
Beijing, China

Patrick Kim
Seoul, South Korea

Mohamed Stouka
Tripoli, Libya

MSU Department of Electrical and Computer Engineering

Project Sponsor

Jeffrey Nanzer
East Lansing, Michigan

Project Facilitator

Dr. Shanker Balasubramaniam
East Lansing, Michigan

MSU Electromagnetics Research Group

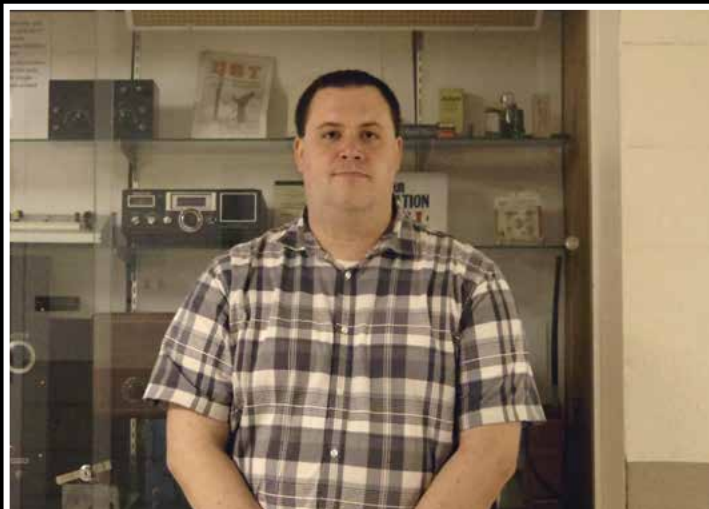
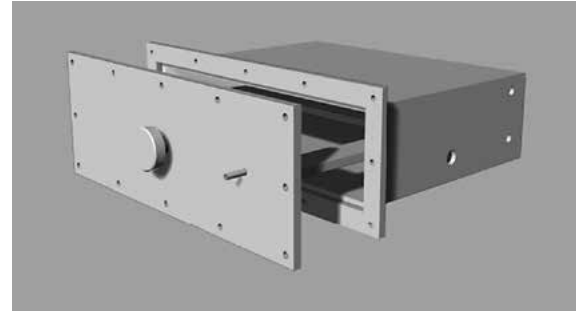
Autoclave System for Thin Film Lamination

The Electromagnetics Research Group (EMRG) is researching multilayer liquid crystal polymer (LCP) lamination techniques for use in the fabrication of high frequency (microwave and millimeter wave) flex circuits. A pressurized and temperature controlled system is required for the lamination of multilayer LCP films. The challenge is to achieve uniform lamination with good alignment tolerance and void-free. The circuit size to be fabricated can range from 1 cm² to 1 ft².

The project is divided into two phases. The first phase involves demonstration of functioning prototype circuits that uses films that can be laminated at lower temperature (-250 °C) and pressure (-30 psi). The second phase involves research of a high pressure (100 psi) and high temperature (-350°C) chamber not achieved by the first phase.

The goal of the research project is to display the ability of an inert pressurized, temperature controlled table-top system to fabricate circuit structures for use by the Electromagnetics Research Group.

My involvement includes both the system assembly, the integration of a microcontroller remote control system, and a programmable logic controller (PLC) interface for the temperature control and demonstration of prototype circuits. This will allow for real-time control of time, temperature and pressure for large area thin film lamination.



Michigan State University

Cameron Crump
Mason, Michigan

MSU Electromagnetic Research Group

Project Sponsor

Project Facilitator

Dr. Prem Chahal
East Lansing, Michigan

NDE Lab at Michigan State University

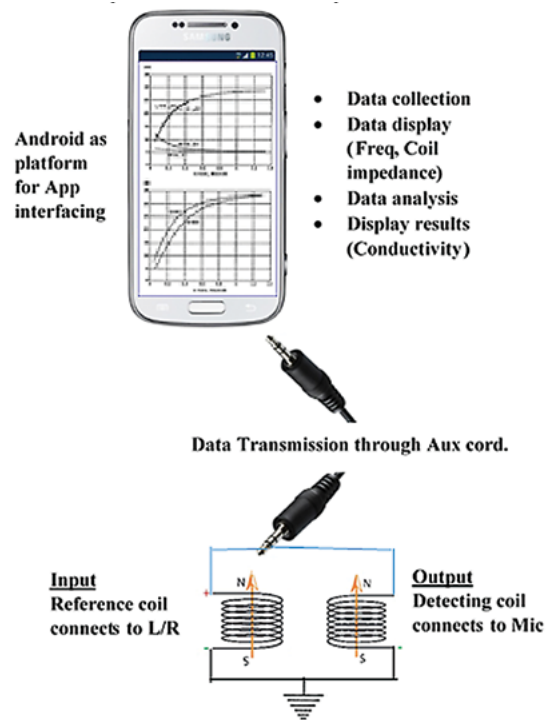
Eddy Current Conductivity Meter

Non-destructive Evaluation (NDE) is collection of sensor technologies and analysis techniques used by industry to evaluate the structural integrity of material without causing any damage. NDE is often used for quality control in manufacturing industries to find flaws before they can become a more serious problem.

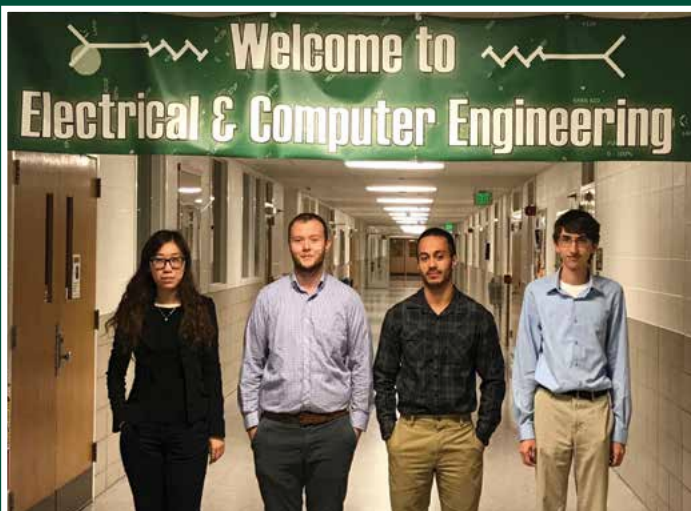
One method of NDE uses a technique with eddy currents. Eddy currents are produced by electromagnetic induction of a coil. This can be done with an alternating current. When the coil approaches a conductive material, magnetic induction will occur and eddy currents will be induced in the material. Flaws in the material change the phase and amplitude of the eddy current and can be detected by the impedance change in the coil. Through this, damages or flaws can be found.

The goal of this project is to develop an eddy current probe that can be seamlessly integrated with a smartphone for efficient and hand-held NDE inspection. The smartphone can drive our designed probe; generate, receive and process time-varying eddy current signals to measure the electromagnetic material properties of sample under test (SUT); and display the results on a user-friendly GUI.

Using an app and a smartphone provides a low-cost and simple to use alternative to Eddy Current Meters currently on the market. This approach will allow information to be shared easily among others in the industry.



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Michigan State University Team Members (left to right)

Yu Dong
Wuxi, China

Jesse Wolven
Rockford, Michigan

Alejandro Sanchez
Charlotte, Michigan

Matthew Ignatowski
Macomb, Michigan

NDE Lab at MSU Project Sponsor

Anders Rosell
East Lansing, Michigan

Project Facilitator

Dr. Yiming Deng
East Lansing, Michigan

MSU Electrical and Computer Engineering Dept.

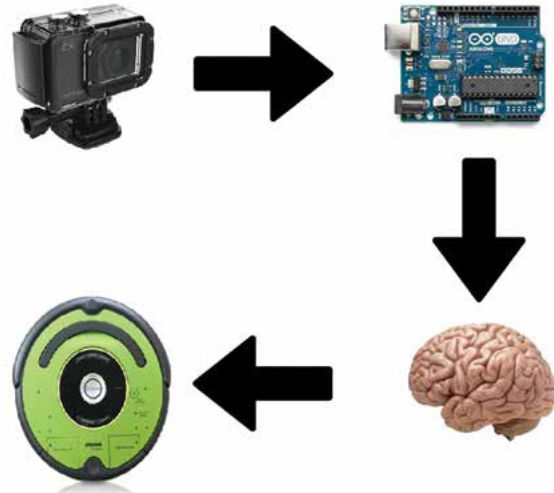
Autonomous Robot Navigation

Canvas is a program at MSU that is working towards having an integrated system that will be used by transportation vehicles to communicate with each other, their occupants, the environment, and infrastructure to make real-time decisions using the data collected from these sources.

Autonomous vehicles have been around since the 1980s, and in 1995 Carnegie Mellon Robotics Institute completed the first cross country trip in an autonomously controlled vehicle. Today, many cars have autonomous features such as being able to stay in a lane, self-parking, and automatic emergency braking.

Our Autonomous Robot Navigation system is based on having an iRobot trained to navigate through an environment by collecting data and using image processing in order for it to make real-time decisions on its own. The capabilities of the designed navigation system will be demonstrated in Michigan State Engineering Building hallways. The iRobot will travel the hallways while automatically staying on the right side of the hall and being able to make turns, if needed.

The Hardware used is an iRobot, Arduino micro-controller, Movidius neural stick, ASUS Tinker Board, 720P camera. The software used to integrate the hardware will be Python, C++, and C.



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Michigan State University Team Members (left to right)

Garik Goldwater
Sterling Heights, Michigan

Abby McQuade
Ann Arbor, Michigan

Jacob DeSantis
Clinton Township, Michigan

Sonja Berger
Fraser, Michigan

Alex Masakowski
Chesterfield, Michigan

Solomon Remmo
Buchanan, Michigan

MSU Department of Electrical and Computer Engineering Project Sponsor

Daniel Morris
East Lansing, Michigan

Project Facilitator

Dr. Virginia Ayers
East Lansing, Michigan

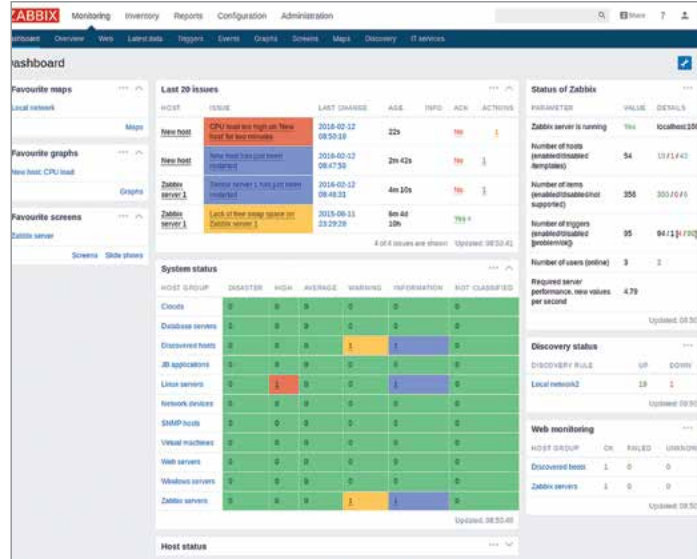
ArcelorMittal

Process Automation Monitor

ArcelorMittal is the world's largest steel producer. ArcelorMittal owns and operates 27 facilities in the United States, including mines, integrated steelmaking facilities, mini-mills and finishing operations. All ArcelorMittal facilities have process automation teams; these teams are responsible for streamlining the processes that are run and improving efficiency.

Currently, the process automations systems do not identify and report problems. Detecting these problems manually consumes time and can be detrimental to the productivity of the manufacturing units.

Our team will be implementing a process automation monitoring solution that covers all devices and services. The monitoring solution will provide a complete overview of component health, and if any problems are detected, fix them immediately. Along with identifying these issues, the system will notify the user and keep an accurate record of each case.



ArcelorMittal



Michigan State University
Team Members (left to right)

Mitchal Fejedelem
Clio, Michigan

Eric Ofori-Peprah
Owings Mills, Maryland

Chigoziem Offor
Lansing, Michigan

Ahmed Alismail
Saudi Arabia

Arnold Mutayoba
Houghton, Michigan

Sky Patel
Troy, Michigan

ArcelorMittal, USA
Project Sponsor

Carlos J. Forjan
East Chicago, Indiana

Project Facilitator

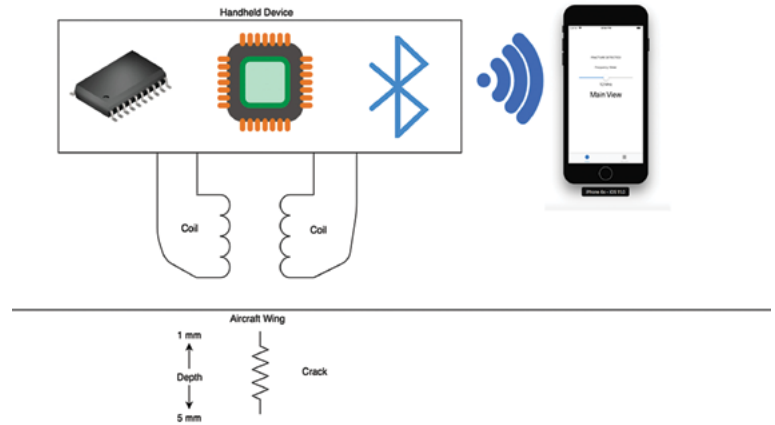
Dr. Robert McGough
East Lansing, Michigan

MSU Electrical and Computer Engineering Dept. Handheld Device to Detect Cracks in Aircraft

Nearly 700 million people boarded planes in the US in 2015. The safety inspections for material integrity developed by the aviation industry are primarily visual in nature due to the need to have speedy checks to get the plane flying as quickly as possible. This can become problematic when cracks and deformations form in the material but are not on the surface level. Engineers have developed methods for nondestructive evaluation of materials to detect these internal fractures. The primary method for detection is Eddy Current Analysis. This method is executed using bulky and expensive equipment which is not ideal for use between flights.

The purpose of this project is to develop a smaller and less expensive eddy scope that can perform the same task as the large scopes but can be used between flights to take data and improve safety.

The handheld device will vary the frequency of alternating current through a coil to produce a magnetic field, which will allow the internal circuitry to measure the impedance of the material. This analog data will be converted to digital data and transmitted over Bluetooth to a phone application where the user can control the coil frequency and be notified of detected fractures.



MICHIGAN STATE
UNIVERSITY



Michigan State University Team Members (left to right)

Nicholas Gajar
Ann Arbor, Michigan

John Bono
Lake Orion, Michigan

Peter Jones
Portage, Michigan

Ryan Sajkowski
Shelby Township, Michigan

Ryan Brozovich
Kalamazoo, Michigan

MSU Department of Electrical and Computer Engineering Project Sponsor

Satish Udpa
East Lansing, Michigan

Project Facilitator

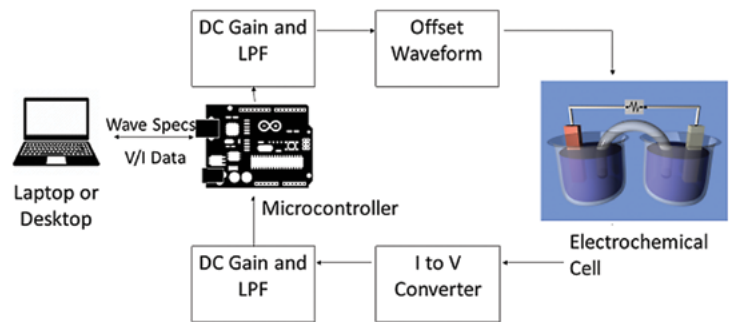
Dr. Kalyanmoy Deb
East Lansing, Michigan

Fraunhofer

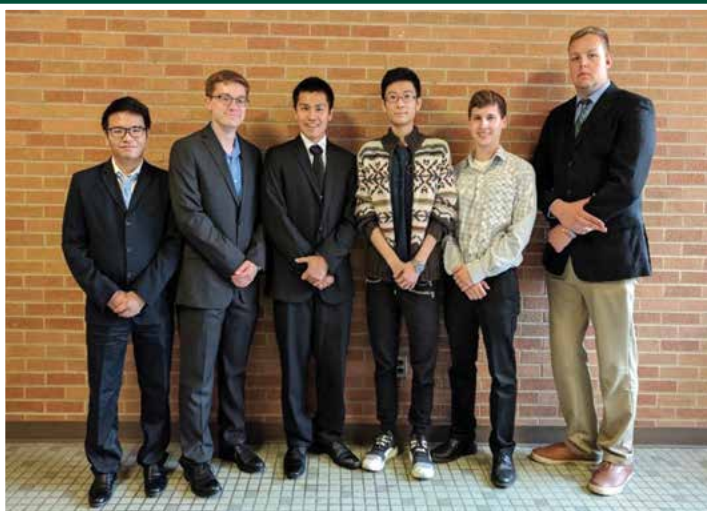
SpartanStat: A Portable Potentiostat for the Detection of Heavy Metals

It is extremely critical to accurately measure the presence of dangerous metals, and as shown by the recent Flint water crisis, they can be deadly. Currently, there are only a few ways to measure the concentration of these metals in solutions, and even fewer, if any, low-cost devices for doing so. Dr. Rusinek, at the Fraunhofer Institute, works with potentiostats, a device used to measure concentrations of various metals, but these devices are large, expensive and limited in their measurement capabilities. The main objective of this project is to create a low-cost device to replicate the capabilities of the current lab equipment. This involves building a potentiostat, using square-wave voltammetry to measure concentrations of various metals in samples.

Our device will include a microcontroller to output the square-wave pulses in addition to measuring the current during each pulse. Using this system, data will be collected and output into a computer for plotting and further analysis.



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UNIVERSITY



Michigan State University Team Members (left to right)

Xingchen Xiao
Beijing, China

Nathan Bagnall
Sterling Heights, Michigan

Haitai Ng
White Lake, Michigan

Yuzhou Wu
Chengdu, Sichuan, China

Justin Opperman
Arlington Heights, Illinois

Brandon Gevaert
Macomb, Michigan

Fraunhofer Project Sponsor

Cory Rusinek
East Lansing, Michigan

Project Facilitator

Dr. Qi Fan
East Lansing, Michigan

Design Day Awards Spring 2017

Electrical & Computer Engineering Winners, Spring 2017

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

First Place: **Team Daifuku/Jervis B. Webb Company** **“SmartCart Predictive Diagnostic Software”**

Left to Right:

Ryan Siegler, Brad Plec, Austin Brune, Kenil Patel

Not pictured: Ryan Christiansen, Yuhau Chen

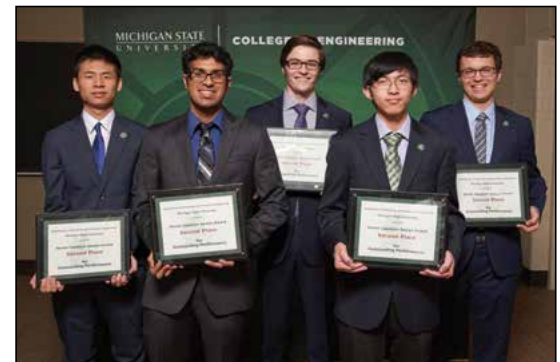


Second Place: **Team MSU EVPAS/IPF “WiMax** **Communication System”**

Left to Right:

Shaochong Wu, Prathamesh Kulkarni, Alex Zajac, Tharo Soun, William Stevers

Not pictured: Ryan Gallant



Third Place: **Team James Dyson Foundation/MSU** **“Distributed Natural Gas Detection System”**

Left to Right:

Zhaoxuan Li, Joseph Zajac, Jim Pitcher, Patrick Jalilevand, Xiohan Zhang





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uniqueness



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together



PIONEER
simplicity



RETHINK
routine

Company Fast Facts

- Founded in 1961
- 14.2 Million Medical Members
- \$54.4 Billion in Annual Revenue
- #12 Best Places to Work in IT by ComputerWorld
- 50,000 Associates
- Fortune 53 Company

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ME 371 Mechanical Design I

Michael Lavagnino
Academic Specialist
Department of Mechanical Engineering

Thrills for Pre-collegiates: Mechanisms that Fascinate, Captivate, Stimulate and Entice

Teams of students were required to design and manufacture mechanisms that would thrill an audience of pre-collegiate students. The constraints imposed upon this assignment were that each mechanism must incorporate at least one linkage, one gear set and one cam-follower combination. Each team manufactured or utilized 3D printing to create the majority of their components. These engineering marvels will be demonstrated and displayed with a complementary poster explaining the subtleties of each mechanism. The winner, chosen by the visiting students, will be awarded Dart-sponsored College of Engineering K12 Design Day competition medals.

Teams and members: Section 1

Team 1 Steven Atkin Madison Duncan Colin Horton Michael Houser	Team 2 Zachary Cook Katie Miller David O'Donnell Zak Woods	Team 3 Tom Karbon Jennifer Kozlowski Sammie Pfeiffer Ethan Vassallo	Team 4 Brian Doyle Sarah Lohman Brandon Praet Spencer Schang	Team 5 David Cohle Alexander Johnson Kevin Payne Michael Zielinsky	Team 6 Niklas Boisten Nathan Hadobas Marcus Li Michael Perrin
Team 7 Morgan Burr Caitlynn Dubie Nathan McLean Gabriel Sarnacki John Vetter	Team 8 Xingyu Cai Zhan Liu Yanze Wang Joey Xie Yi Zhou	Team 9 Tony Anason Ben Dunklee Jason Koberstein Tyler Koizumi	Team 10 Megan Luzenski Jared Rogers Jared Steen Ruiwei Sui Zach Wurtz	Team 11 Rosalie Deliz Megan Ebejer Lauren Green Mackenzie Martin	Team 12 Eric Gierc Tal Hanani Michael McCauley Bryan Warholak
Team 13 Taylor Fuhrman Jack Gilluly Max Ralya Jordan Thayer	Team 14 Connor Campbell Matt Sarver Marc Veihl	Team 15 Eli Broemer Drew Dunker Katie Frayer Jonah Kowalczyk Tyler Piotrowski	Team 16 Marc Lowenfeld Samuel Melrose Sebastian Mendez Alex Stangeland	Team 17 Xueran Gao Yaocheng Ge Hong Kee Kim	

Teams and members: Section 2

Team 1 Nick Houghton Rachael Jannette Joey Ritter Nicole Shaffer Sivajyothi Vemulapalli	Team 2 Lauren Chance Alayna Farrell Drew Roth Travis Wahl	Team 3 Ally Austin Jill Hubbard Jennifer Ju Erin Maroney Sean Powers	Team 4 Ryan Bohr Jillian Chandler Michael Logan Shane Luksch	Team 5 Nathaniel Jenkins Josh Miller Chenxi Yin Hansheng Zhang	Team 6 Sydney Clark Allison Nielsen Madeline Oesch Elizabeth Pollack
Team 7 Jenna Beauregard Ji Woo Hong Ivan Iovtchev Jun Jiang Aaron Winter	Team 8 Abdulrahman Alqarni Stephen Branch Vinnie Herrman Samantha Jones- Jackson	Team 9 Andrew Baran Suhass Kodali Anindow Saha Kevin Schuett Paul Schulman	Team 10 Ryan Ahee Amanda Boone Dallas Creech Carly Dugan	Team 11 Jacob Fiebke Ethan Jacobs Zac Zettle	Team 12 Kyle Klocko Andrew Lee Vincent Rogers Jordan Sosnoski
Team 13 Branden Goebel Tianlun Shi Gary Singh Fan Xu Gary Zakarian	Team 14 Qianhui Dong CJ Johnson Derek Roggenbuck Oscar Scheier	Team 15 Ryan Britain Zachary Brokaw Lucas Notarantonio Reed Potter Austin Zeitler	Team 16 Shane Brady Andrew Capaldi Samuel McAlvey Xiaoke Wang		



ME 412 Heat Transfer Laboratory

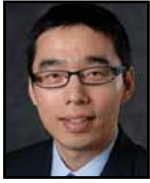
Yuping Wang
Academic Specialist
Department of Mechanical Engineering

Ranque-Hilsch Vortex Tube

A Ranque-Hilsch vortex tube is a simple, compact, light mechanical device that can be used in cooling or heating applications. For this project, each team will design, analyze, build, and test a compressed-air-powered vortex tube. The primary objective of the design is to maximize the temperature difference between the hot and cold streams coming out of the two ends of the vortex tube. A secondary objective of the project is to understand the operating principles of vortex tubes through modeling, simulating and/or reviewing existing experimental and computational works concerning flow patterns, thermal separations, and parametric studies, etc. To test each vortex tube, compressed air will be provided. There are no restrictions on the dimensions of the tube, but the compressed air will be operated at a fixed setting. Temperatures of the hot and cold outflows will be measured. Each team will have 20 minutes to set up, demonstrate and disassemble their vortex tube. In addition, they will also prepare a power-point slide show or video clips for the audience to explain their design decisions, analysis and operation of their vortex tube.

Competition Schedule

Time	Station	Team members
8:00	A	Evan Cummings, Muhammad Djafri, Christian Genord, Jacob Smyth
	B	Allison Bakka, Megan Friedrich, Logan Kincaid, Patrick Sharp
8:20	A	Megan Beisser, Kalie Collins, Cody Lysher, Bram Parkinson, Jake Wojnicki
	B	Brandon Jett, Austin Klump, Hoa Nguyen, Anuj Vyas
8:40	A	Bridget Anderson, Emily Donohue, Heather Raymor, Sarah Sonogo, Michael Williams
	B	Michael Bigelow, Angela Dobrzelewski, Darren Harnden, Krishnan Luhar, Mark VanPoppelen
9:00	A	Mojtaba Almiskeen, Stephanie Close, Syunsuke Hata, Ruichen Li
	B	Andrew Biggie, James Morey, Andy Stamm, Zirui Wang
9:20	A	Luke Boulter, Alex Clark, Do-Hyung Kim, Tyler Nicolay
	B	Anxhelo Lalaj, Ian Lindsley, Kevin McCarty, Mitchell Pollee, Amad Wahib
9:40	A	Jon Andrejczuk, Hai Nguyen, Michael Okuniewicz, Nicholas Raterman, Brendan Webberly
	B	Mitchell Holt, Jack Leckner, Austin NicholSEN, Tyler Sloan, Gino Wickman
10:00	A	Steven Collareno, Geena Duff, Trey Pfeiffer, Carly Wolf
	B	Edward Clark, Samuel Greenwald, Tyler Smith, Matt Strzalkowski
10:20	A	Jonathon Howard, Cody Kelly, Eric Lindlbauer, Christian Luedtke
	B	Reison Gjolaj, Zack Lapinski, Vincent Pahl, Kyle Raden, Matthew Rist
10:40	A	Manea Alhammadi, Omar Alhammadi, Adnan Alhuwait, Majed Almughair, Roobin Arbab
	B	Madison Case, Marissa Meaney, Jason Moll, Andrew Palucki
11:00	A	Jack Gilluly, Leah Mondro, Michael VanBemmelen, Colby Williams
	B	Zachary Engen, Yurun Gu, Yuhao He, Brian Pieciak
11:20	A	Yamen Almahmoud, Jun Jiang, Laura Nye, Hang Zhao
	B	Lance Frahm, Nor Mohdnoor, Byeong Park, Mirza Saifulbahri
11:40	A	Paul Ferraiuolo, Hunter Gvozdoch, Jeri Sutter, Ashley Wilkey
	B	Matthew Auvenshine, Matt Lawrence, Andrew Tran, Penghao Wu
12:00	A	Thomas O'Brien, Jeffrey Pattison, Michael Rasmussen, Nicholas Wojno, Jonathan Zofchak



ME 471 Mechanical Design II

Dr. Yang Guo
Assistant Professor of
Mechanical Engineering



Dr. Patrick Kwon
Professor of
Mechanical Engineering

Deployable Bridge

The goals of this project are to design, build and test a scaled-down version of a deployable bridge. The bridge system before the deployment must fit inside a box (10"L x 10"H x 15"W), which will be mounted onto the table with only four bolts. The bridge will be deployed with the input from the

motor to reach the bridge length of 30" while minimizing the deflection at the end of the bridge, the total system mass, and cost. To test the stiffness, the bridge will be loaded with 50 lbs at the end of the bridge, and the vertical deflection will be measured at the end of the bridge.

Competition Schedule

Time	Team	Station	Team Members
8:00	1	A	Kyle Bauer, Lance Haner, David Mccriston, Matt Rimanelli, Paul Zhuang
	1	B	Mojtaba Almiskeen, Michael Bigelow, Chris Brenton, Reison Gjolak, Ryan Kruzel
8:20	2	A	Lexi Baylis, Stephanie Close, Will Hartnagel, Owen Middleton, John Schumaker
	2	B	Yamen Almahmoud, Hunter Jenuwine, Anuj Vyas, Chengming Zhang
8:40	3	A	Megan Beisser, Drew Daily, Jonathon Howard, Austin Miller, Tyler Smith
	3	B	Samantha Brown, Evan Finses, Alex Kerns, Kelly Patterson, Justin Slagter
9:00	4	A	Andrew Biggie, Sawyer Dmoch, Adri Johari, Brandon Miller, Yuexing Sun
	4	B	Justin Barg, Zach Bowling, Do-Hyung Kim, Gabe Lefere, Nathan Osullivan, Zachary Sadler
9:20	5	A	Jake Blankemeier, Aaron Feinauer, Hyeungsuk Kim, Spencer Miller, Aryka Thomson
	5	B	Shiyu Liu, Shuang Liu, Ryan Loveland, Maria Osinski, Chun-Kit Yung
9:40	6	A	Kole Brunzman, Lance Frahm, Genevieve Kobrossi, Tracey Nguyen, Joel Todd
	6	B	Madison Case, Colton Knopf, Brian Pieciak, Vince Rende, Miranda Whah
10:00	7	A	Curtis Carne, Stuart Gadigian, Matt Lawrence, Evan Paupert, Philipp Waeltermann
	7	B	Mohammed Bomoza, Lindsay Hoard, Jack Michalski, James Moran, Spencer Thompson
10:20	8	A	Robert Chaney, Jackson Garber, Evan Lile, Robert Pizzimenti, Michael Walicki
	8	B	Holly Iglewski, Kory Iott, Edward Kennedy, Jack Leckner, Quanjing Li
10:40	9	A	Alex Clark, Nathanael Ginnodo, Krishnan Luhar, Mauricio Ponsmartinez, Jonathan West
	9	B	Payton Bauman, Geena Duff, Nicholas Flannery, James Garrett, Andrew Palucki
11:00	10	A	Yibin Cheng, Grant Gooch, Brandi Mazzella, Li Ren, Henry Wikol
	10	B	Prakash Agrawal, Shwan Al-Howrami, Robert Cortese, Samuel Greenwald, Kathryn Stimetz
11:20	11	A	Peter Chew, Aaron Gordon, Danny Mccarty, Jacob Richter, Jianan Yao
	11	B	Michael Bertrand, Jacob Bullard, Andy Dong, Maria Magidsohn, James Morey

The Capstone Projects



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

Faculty Advisors: Baek, Brereton, Diaz, Liu, Toulson, Xiao



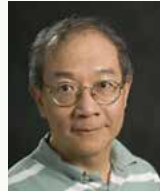
Baek



Brereton



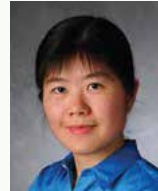
Diaz



Liu



Toulson



Xiao

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:00 a.m.	AP Lazer	Carriage Table Design Optimization
8:30 a.m.	General Motors	Baja SAE CVT Dynamometer
9:00 a.m.	DENSO	Design of Portable Ignition Test Bench
9:30 a.m.	DENSO	Pressure Chamber to Measure Ignition Energy
10:00 a.m.	Ingersoll Rand - Trane	Ganged Door Handle Redesign
10:30 a.m.	Ranir	Semi-Automated Dental Floss Assembly
11:00 a.m.	Kautex Textron	Replacing Validation Testing of Fuel Tanks with CAE

ME 481 Mechanical Engineering Design Projects

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

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

We gratefully acknowledge the support of this semester's project sponsors: AP Laser, Bosch, Consumers Energy, DENSO North America Foundation, Fraunhofer USA, General Motors LLC, Heartwood School, Hitachi Automotive Systems Americas Inc., Ingersoll Rand - Trane, James Dyson Foundation/MSU Adaptive Sports and Recreation Club, Kautex Textron, Marathon Petroleum, Meijer, Michigan AgrAbility, Peckham Inc, Ranir, Siemens Corporation, and Tenneco Automotive Operating Company Inc.

AP Lazer

Carriage Table Design Optimization

AP Lazer is a leader in laser etched engraving and has been providing both equipment and engraving solutions for customers for many years. With a patented product, AP Lazer uses CO2 coupled with the most powerful yet compact laser system on the market. With both heavy-duty and portable products, AP Lazer has the ability to engrave almost anything regardless of weight or size. AP Lazer has the ability to etch endless ranges of material including leather, stone, wood, and many metals. Although many applications involve etching of flat surfaces, AP Lazer has the ability to etch across any product regardless of orientation. This allows the etching of round objects such as mugs or balls, or etching of surfaces on an angle. You name the product; AP Lazer can do the rest.

Our team worked in collaboration with AP Lazer to update and enhance their current laser carriage across all product sizes. Updates consisted of the addition of an alignment system to assist and facilitate the process of centering the base beneath the laser. In addition to the alignment process, cosmetic enhancements such as the addition of a flexible computer mount, toolbox, and form of which the table is leveled were evaluated against potential alternatives. These updates and additions added to the efficiency and appeal of AP Lazer's product.



AP LAZER
— LEADING THE WAY



Michigan State University

Team Members (left to right)

Tanner Ellens
Grand Rapids, Michigan

Austin Nichol森
Novi, Michigan

Pronob Biswas
Sterling Heights, Michigan

Tyler Sloan
Novi, Michigan

Gino Wickamn
Milford, Michigan

AP Lazer

Project Sponsor

Tong Li
Lansing, Michigan

ME Faculty Advisor

Dashin Liu
East Lansing, Michigan

General Motors

Baja SAE CVT Dynamometer

Baja SAE is a collegiate design series where teams design, manufacture, and race off-road vehicles. These teams compete each year in SAE organized events across the country. Competitions are four-day long events requiring the team to balance cost, marketing, innovative design, and performance throughout a series of static and dynamic events. One of the major components of the powertrain on Baja SAE vehicles is the Continuously Variable Transmission (CVT), which uses a combination of flyweights, movable sheaves, and a belt to achieve an infinite number of gear ratios. Obtaining the proper ratio at the correct time is crucial for vehicle performance.

Previously, Michigan State Baja has used a Continuously Variable Transmission designed for snowmobiles but, more recently, has made the move to using a Gaged CVT on their car. With the increased tuning capabilities offered by a Gaged CVT, the team manufactured and programed a dynamometer in order to find the optimal tuning parameters for the CVT. The design team also created a math model to predict how the CVT will behave under different loading conditions in order to cut down the amount of time and different tuning conditions required for optimization. After the math model and dyno testing were completed, the design team ran vehicle testing in order to validate the results obtained from the dyno. The Michigan State Baja SAE team hopes to use the results in order to better tune its CVT and to be able to design a fully customized CVT in the future.



Michigan State University

Team Members (left to right)

Eric Martin
Shelby Township, Michigan

Tyler Smith
Lyons, Michigan

Matt Strzalkowski
Livonia, Michigan

Kyle Raden
Downers Grove, Illinois

Jacob Khodl
Grand Rapids, Michigan

General Motors

Project Sponsors

Evan Boyers
Milford, Michigan

Brad Labaere
Warren, Michigan

ME Faculty Advisor

Dahsin Liu
East Lansing, Michigan

DENSO North America Foundation

Design of a Portable Ignition Test Bench

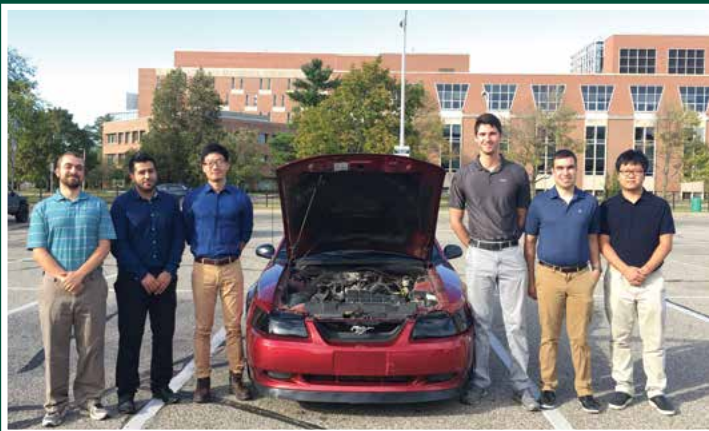
Denso is one of the largest global automotive suppliers of advanced technology, systems, and components. In the automotive field, an ignition system is an important component that contributes to engine efficiency, pollutant reduction, and robustness. Spark ignition engines are being operated at increasingly high compression ratios and at boosted and lean conditions, which require the ignition system to have higher arcing voltage and ignition energy.

Our team designed and built an ignition and flow test bench that will house ignition testing equipment and a removable ignition testing chamber. The design of the test bench requires it to be compact, portable and capable of measuring ignition energy in the ignition test chamber, while providing a flow of an inert gas from a cylinder to the ignition test chamber at a measured/controlled flow rate and supply pressure.



DENSO

Power to All



Michigan State University

Team Members (left to right)

Steven Collareno
Northville, Michigan

Mohsen Alqamber
Qatif, Saudi Arabia

Byeonggwon Park
Ulsan, South Korea

Matthew Rist
Livonia, Michigan

Evan Cummings
DeWitt, Michigan

Hang Zhao
Hubei, China

DENSO North America Foundation

Project Sponsor

Giles Brereton
East Lansing, Michigan

ME Faculty Advisor

Giles Brereton
East Lansing, Michigan

DENSO North America Foundation

Pressure Chamber to Measure Ignition Energy

The DENSO North America Foundation, founded in 2001, is a corporate foundation dedicated to helping students advance their education in engineering and technology.

The ignition system in automotive applications is an important component that contributes to engine efficiency, pollutant reduction, and overall robustness of the vehicle. With advancements in technology, spark ignition engines (a type of internal combustion engine) are being operated at increasingly high compression ratios and at boosted and lean conditions, which require the system to have a higher arcing voltage and ignition energy. As a result of the changing operating conditions, there is a need to design and manufacture a low pressure chamber to explore the dependence of ignition energy on a range of conditions.

Our team designed and manufactured a chamber able to withstand pressures up to 5 bar and temperatures up to 200°C, which has the ability to be filled with a variety of inert gases and accommodate flowing or stagnant conditions. In addition, the chamber design entails an externally adjustable electrode gap for ease of testing and is compatible with the ignition test bench. Using the manufactured design, our team was able to demonstrate that ignition energy could be measured for various pressures, temperatures, electrode gap widths, flow, and ambient inert gas conditions relevant to internal combustion engines.



DENSO



Michigan State University Team Members (left to right)

Manea Yousuf Alhammadi
Abu Dhabi, United Arab Emirates

Jeri Ann Sutter
Big Rapids, Michigan

Alexander Athens
Grosse Ile, Michigan

Jason Moll
Livonia, Michigan

Marissa Meaney
Lansing, Michigan

Paul Ferraiuolo
Perry, Michigan

DENSO North America Foundation Project Sponsor

Elisa Toulson
East Lansing, Michigan

ME Faculty Advisor

Elisa Toulson
East Lansing, Michigan

Ingersoll Rand - Trane

Ganged Door Handle Redesign

Our team has redesigned a door handle for Trane's Air Handler Units. These units hold various components such as fans, coils, filters, electrical boxes, etc. This door handle assures proper latching for compression of the gasket seal to eliminate any potential air leakage into or out of the unit. The mechanism uses custom designed cams to push the strike plate, which is critical to the functionality of the door seal. The number of cams depends on the length of the doors, meaning our handle can be used on both large and small Air Handler Units.

Trane's original design allowed for adjustability, but this required very precise alignment of the cams to the rod. Tall doors required up to six cams to latch alignments and this resulted in long assembly times. The complexity of this design also added cost to the customer. After determining there was no need for this variability, our team designed a part that is fixed. This design allows for precise orientation of the latching mechanism during the assembly process. This door handle also has an easy latch system that can incorporate a padlock if needed, creating a door that will not shut and lock behind the user. This is also very ergonomic and safe for the user. This design is safer, higher quality, and more cost-effective because of the simplicity and reduced quantity of parts.



Michigan State University

Team Members (left to right)

Melissa Oudeh
Westland, Michigan

Yurun Gu
Shanghai, China

Mark VanPoppelen
Chesterfield, Michigan

Andrew Hieber
Saline, Michigan

Megan Friedrich
Lake Orion, Michigan

Laura Nye
Saline, Michigan

Ingersoll Rand - Trane

Project Sponsor

Lee Novak
Lexington, Kentucky

ME Faculty Advisor

Xinran (Sharon) Xiao
East Lansing, Michigan

Ranir

Semi-Automated Dental Floss Assembly

Ranir, located in Grand Rapids, Michigan, is a leading company in store brand dental care. Ranir produces a wide variety of dental products including toothbrushes, dental floss, flossers, specialty-powered toothbrushes, and many other innovative dental products. At the Grand Rapids location, one of the main products manufactured is dental floss. The current assembly process involves manual loading of the bobbins into the floss container then closure of the container. This manual process has numerous issues associated with it, including being labor intensive, having inconsistent production rates and having the potential for assemblers to develop injuries from the repetitive motion. Ranir desired an innovative solution to this problem.

Our team was given the task of conceptually developing an automated solution to the dental floss assembly. The focus of the project was on the automation of the retrieval and closure of the floss container. The objective was to reduce the number of assemblers from three to one or two while increasing the production rates by 15 – 20%. Potential solutions to this problem were developed with the use of 3D models and prototypes while being analyzed to determine the optimal solution.



Michigan State University

Team Members (left to right)

Angela Dobrzelewski
Midland, Michigan

Luke Boutler
Plainwell, Michigan

Patrick Sharpe
Flushing, Michigan

Hunter Gvozdoch
Birmingham, Michigan

Darren Harnden
Avoca, Michigan

Ranir

Project Sponsor

Craig Borgman
Grand Rapids, Michigan

ME Faculty Advisor

Seungik Baek
East Lansing, Michigan

Kautex Textron

Replacing Validation Testing of Fuel Tanks with CAE

Kautex, a subsidiary of Textron, is one of the largest automotive suppliers in the world with facilities in 14 countries around the world. Kautex specializes in various systems such as blow-molded fuel systems and has used blow mold machines since 1949. The company strives to constantly improve their modern fuel systems while simultaneously reducing their environmental impact. Kautex does this through the use of High Density Polyethylene Extrusions, regrind, and ethylene vinyl alcohol to reduce atmospheric emissions. Kautex works with its various customers to constantly meet and exceed OEM specifications while striving to keep up with future technological trends.

Our team was tasked with proving the possible validity of using CAE results to eliminate the timely physical design validation testing process based on a confidence factor. The benefits this project provides to the company include reduced testing costs, in addition to reducing the time necessary to perform lengthy tests. Because testing can often take weeks or months to perform, the ability to remove the design validation trials and tests (4-8 weeks and -26 weeks, respectively), the benefits for Kautex are obvious. In addition to testing costs and time spent, this project provides the company with reduced fixture costs depending on the conclusiveness the tests express. The test that was run to accomplish this goal was the pressure vacuum test on the fuel tank with certain applications applying to various other tests. Further tests that the team performed included the pendulum hitting test, vibration test, and drop test.



Michigan State University Team Members (left to right)

Tristan Eggenberger
Okemos, Michigan

Zexi Peng
Shanghai, China

Lingfeng Wang
Zhejiang, China

Daniel Middleton
Novi, Michigan

Muhammad Djafri
Jakarta, Indonesia

Taojun Wanyan
Shanghai, China

Kautex Textron Project Sponsors

Haile Atsbha
Windsor, Ontario, Canada

Peter Ellwood
Troy, Michigan

Ujwala Thejeswini
Troy, Michigan

ME Faculty Advisor

Alejandro Diaz
East Lansing, Michigan

The Capstone Projects



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

Faculty Advisors: Benard, Engeda, Jaber, Mueller, Mukherjee, Wichman, Wright



Benard



Engeda



Jaber



Mueller



Mukherjee



Wichman



Wright

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:00 a.m.	Consumers Energy	Gas Regulation Noise Reduction
8:30 a.m.	Peckham	Mechanical Coupling for Autonomous Train
9:00 a.m.	Meijer	Automated Swapping of Bottle Collection Bins
9:30 a.m.	Ingersoll Rand - Trane	Fan Isolation and Attenuation Device
10:00 a.m.	Ingersoll Rand - Trane	Optimized Diffusion of AHU Fan Discharge
10:30 a.m.	Tenneco	Diesel Exhaust Fluid Heater and Reactor
11:00 a.m.	Siemens	Cryogenic Pipe Thermo-Mechanical Support

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: Ron Averill, Seungik Baek, Andre Benard, Giles Brereton, Tamara Reid Bush, Alejandro Diaz, Abraham Engeda, Farhad Jaber, Patrick Kwon, Dahsin Liu, Al Loos, Norbert Mueller, Ranjan Mukherjee, Ahmed Naguib, Thomas Pence, Dan Segalman, Elisa Toulson, Indrek Wichman, Neil Wright, and Sharon Xiao.

Consumers Energy

Gas Regulation Noise Reduction

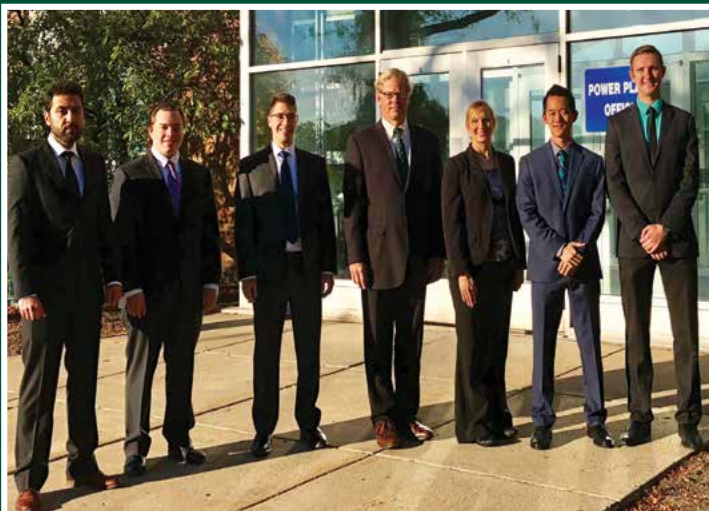
Consumers Energy provides electric and gas services to nearly seven million Michiganders, including Michigan State University community members. Consumers Energy supplies the natural gas for the T.B. Simon Power Plant that produces power for the majority of the buildings on Michigan State University's campus. When natural gas comes from Consumers Energy distribution pipelines, inlet pressures surpass 200 PSI. The Simon Power Plant requires the delivery pressures to be 35 PSI, which requires the use of gas regulators to drop the pressure to this satisfactory level. Dropping the pressure is crucial for the function of the power plant; however, this significant reduction in pressure generates high noise pollution within the pipelines. The noise level readings near the four gas regulators exceed 95 dBA, equivalent to a Boeing 737 at one nautical mile. High noise levels produce safety concerns for employees who perform maintenance on and around the equipment.

Consumers Energy requested our team to design a solution to reduce the noise level readings to be at a maximum of 85 dBA. The reduction in noise level would ensure that the Michigan Occupation Safety and Health Administration (MI-OSHA) threshold is achieved. With the reduction in noise, employees are not required to wear hearing protection, and the surrounding student housing benefits from the diminished sound pollution.



Consumers Energy

Count on Us



Michigan State University

Team Members (left to right)

Roobin Arbab

East Lansing, Michigan

Zachary Engen

Portage, Michigan

Tom Kobak

Commerce Township, Michigan

Indrek Wichman (Faculty Advisor)

Jessica Montagano (Sponsor)

Ihn Uyeb Hur

Portage, Michigan

Jacob Flight

Portage, Michigan

Consumers Energy

Project Sponsor

Jessica Montagano

Jackson, Michigan

ME Faculty Advisor

Indrek Wichman

East Lansing, Michigan

Peckham Inc.

Mechanical Coupling for Autonomous Train

Peckham Incorporated, founded in 1976, is a nonprofit organization whose headquarters are located in Lansing, Michigan. Amongst other responsibilities, this location manufactures a variety of military clothing from raw materials to finished garments. This requires the constant, manual movement of materials and fabrics throughout the facility using bins placed on dollies (pictured to the right). To increase efficiency, Peckham Inc. is transitioning to an autonomous system that allows multiple bins to be simultaneously moved throughout the plant rather than manually moving one dolly at a time, which is their current process. This system allows for a maximum of three dollies to be connected to an autonomously driven “locomotive,” which is programed to drive on a given route. Peckham Inc. requested the development of a mechanical coupling so that dollies can be easily manually attached to and detached from one another along with the “locomotive.” The facility includes a large quantity of dollies, so it was important that the mechanical coupling was a low-cost device, while still being able to handle the stresses of the system. Additionally, the team was asked to take into consideration the potential needs of the operators at any given time, so a quick and simple attach-and-release system was desired. The goal of this project was to provide a prototype, together with the design of an inexpensive, easily manufactured device so that Peckham Inc. would be able to either manufacture or contract a company to produce the devices as needed.



Michigan State University

Team Members (left to right)

Adnan Alhuwait
Abu Dhabi, United Arab Emirates

Ben Childs
Jackson, Michigan

Jonathan Zofchak
Dexter, Michigan

Zack Lapinski
Birmingham, Michigan

Omar Alhammadi
Abu Dhabi, United Arab Emirates

Peckham Inc.

Project Sponsor

Rockey Myall
Lansing, Michigan

ME Faculty Advisor

Farhad Jaber
East Lansing, Michigan

Meijer

Automated Swapping of Bottle Collection Bins

In Michigan, Meijer is required by law to collect and recycle empty bottles sold in their stores and refund the customer a 10¢ deposit per bottle. To do this, Meijer currently has multiple semi-autonomous machines at each store that can collect the empty bottles, provide customers with their refund, and drop the bottles into a collection bin underneath the machine. The machine can detect when the bin reaches its full capacity and will stop accepting bottle returns until an empty bin is swapped into the machine.

Currently, the swapping of full bins for empty bins is a manual operation that requires workers to use a hand fork truck to move the bins around. The flaw with swapping the bins manually is that they fill up at different times during the day so workers have to periodically check the machines, and they aren't always there when a machine's bin fills up. This leads to periods of time where multiple machines are down with full bins, decreasing the number of machines in service and affecting customer satisfaction.

Meijer asked our team to create an automated system that can swap the full bins with empty bins and place the full bins in the staging area before they are shipped to the recycling center. The goals of the automated system were to reduce the need for workers to swap out the bins, reduce down-time on the machines when a bin is full, make the system versatile allowing it to be integrated into existing backrooms at all current Meijer locations, and incorporate safety features for workers around the machines.



Michigan State University Team Members (left to right)

Hassan Olaiwat
Qatif, Saudi Arabia

Cody Kelly
Saint Joseph, Michigan

Eric Lindlbauer
Canton, Michigan

Pranay Chaturvedi
Novi, Michigan

Daniel Setili
Bloomfield Hills, Michigan

Meijer Project Sponsor

Craig Mathews
Walker, Michigan

ME Faculty Advisor

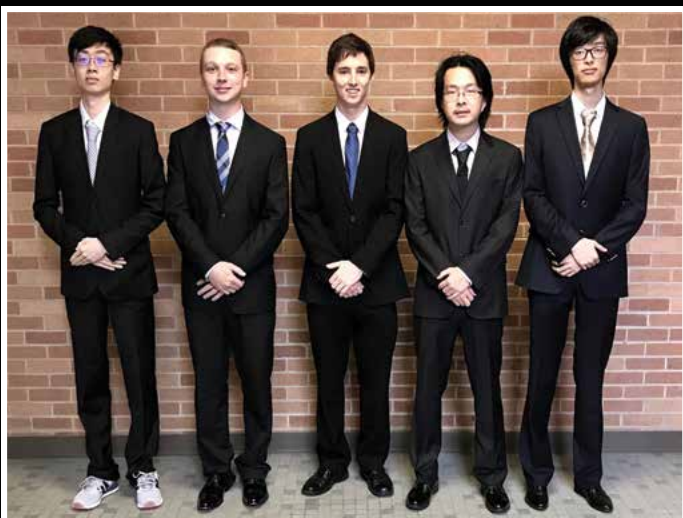
Ranjan Mukherjee
East Lansing, Michigan

Ingersoll Rand - Trane

Fan Isolation and Attenuation Device

Ingersoll Rand manufactures a wide variety of industrial machines and systems used both commercially and privately. Trane, a subsidiary of Ingersoll Rand, specializes in air conditioning units including airflow devices such as fan arrays. The quality of airflow is paramount in these systems, as turbulent flow can increase energy use and noise production levels. Trane is interested in improving upon its fan arrays through redesigning inlet geometry, aiming to reduce noise production and ensure proper isolation of failed devices. Trane currently uses gravity-assisted backdraft dampers in their fan arrays, however they believe that better solutions exist.

Our team was tasked with simulating new inlet configurations with the use of CFD software to analyze airflow velocities, deviations and flow profiles. Utilizing Ansys and its CFX solver, various geometries were tested to find solutions that offer lowest average outlet velocity, as well as low velocity deviation in that flow field. An ideal solution also closes the inlet in the event of fan failure, preventing backdraft and unwanted noise. The final design is intended to fit various square geometry fan arrays, sizing anywhere from 14" – 36" square.



Michigan State University Team Members (left to right)

Penghao Wu
Harbin, Heilongjiang

Christian Genord
Auburn Hills, Michigan

Ryan Boutet
Rochester Hills, Michigan

Xiaonan Liu
Xi'an, Shannxi

Yitian Zhu
Changshu, Jiangsu

Ingersoll Rand - Trane Project Sponsor

Dustin Meredith
Lexington, Kentucky

ME Faculty Advisor

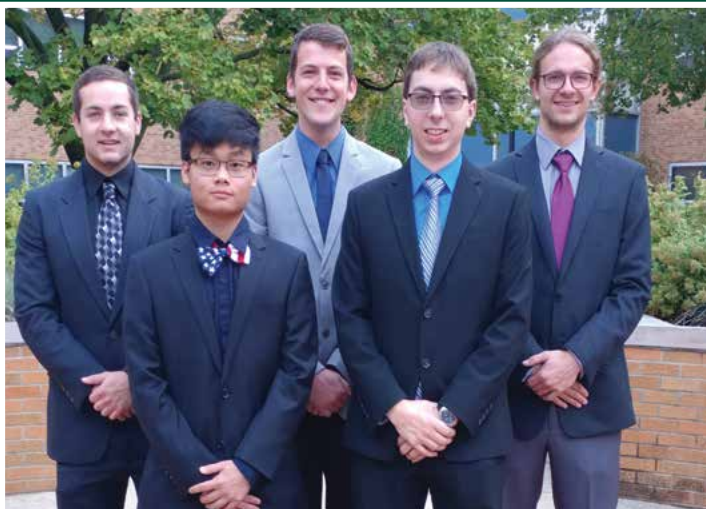
Abraham Engeda
East Lansing, Michigan

Ingersoll Rand - Trane

Optimized Diffusion of AHU Fan Discharge

Trane, a subsidiary of Ingersoll Rand, is one of the leaders in the manufacturing of Air Handling Units (AHUs). In buildings, the air handling units are responsible for moving air throughout the entire building. In addition to moving the air, the AHUs can humidify, filter, heat, or cool airflow. For the most effective performance of these devices, the air velocity is adjusted to match the requirements of the building. Air moves through the AHUs by one of two means, either a plenum fan or a housed fan. A housed fan can push air to velocities up to 3,000 ft/min directly downstream of the fan's discharge, exceeding the acceptable air velocity through some downstream components and building regulations.

Our team designed a diffuser to aid in the reduction of the air velocity out of the fan. The larger the distance between the fan and diffuser, the more material required to create the AHU and the more space it takes up. This increases the cost of the product and, thus, must be minimized. The objective was to design and test a diffuser to slow down air from a housed fan to an average face velocity of 500 ft/min while reducing the length around the current diffuser by 20%. This solution was to be implemented in as many AHU sizes and geometries as possible.



Michigan State University

Team Members (left to right)

Jeff Pattison
Plymouth, Michigan

Hoa Nguyen
Namdinh, Vietnam

Logan Kincaid
Gobles, Michigan

Austin Klump
East Lansing, Michigan

Bill Pittman
Rives Junction, Michigan

Ingersoll Rand - Trane

Project Sponsor

Joe Stewart
Lexington, Kentucky

ME Faculty Advisor

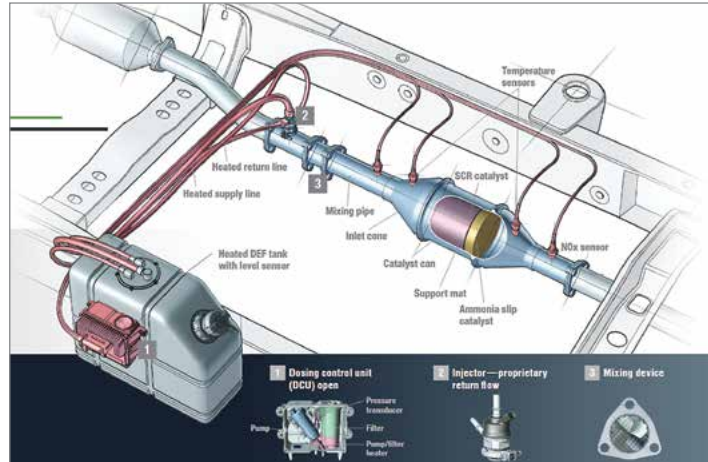
Andre Benard
East Lansing, Michigan

Tenneco Automotive Operating Company Inc.

Diesel Exhaust Fluid Heater and Reactor

Tenneco Automotive Operating Company Inc. is a global manufacturing company pioneering global ideas for cleaner air and smoother, quieter, and safer transportation. Tenneco is one of the world's leading designers, manufacturers, and distributors of Clean Air and Ride Performance products and technology solutions for diversified markets, including light vehicle, commercial truck, off-highway equipment, and the aftermarket. Emissions of NO_x from internal combustion engines contribute to the high concentration of atmospheric ozone in the modern world and are associated with health hazards. Selective Catalytic Reduction (SCR) is a leading method for reducing NO_x emissions that Tenneco is dedicated to continue developing.

As part of that mission, our team has been tasked with using a numerical computing environment to develop a model, designing a prototype utilizing CAE software, and manufacturing a prototype reactor for the heating and reaction of Diesel Exhaust Fluid (DEF), an aqueous urea solution, to generate an ammonia-rich gas mixture. Complying with guidelines provided by Tenneco, the final prototype designed by our team provided an engineering model and prototype solution that could facilitate new product development for companies in the automotive emission control industry.



Michigan State University Team Members (left to right)

Zirui Wang
Nanjing, China

Ziqing Cao
Zibo, China

Raid Alaswad
Qatif, Saudi Arabia

Oliver Xu
Shenzhen, China

Jiajun Lu
Nantong, China

Tenneco Automotive Operating Company Inc. Project Sponsors

Michael Bradford
Reading, Massachusetts

Bradley Fingland
Mason, Michigan

ME Faculty Advisor

Norbert Mueller
East Lansing, Michigan

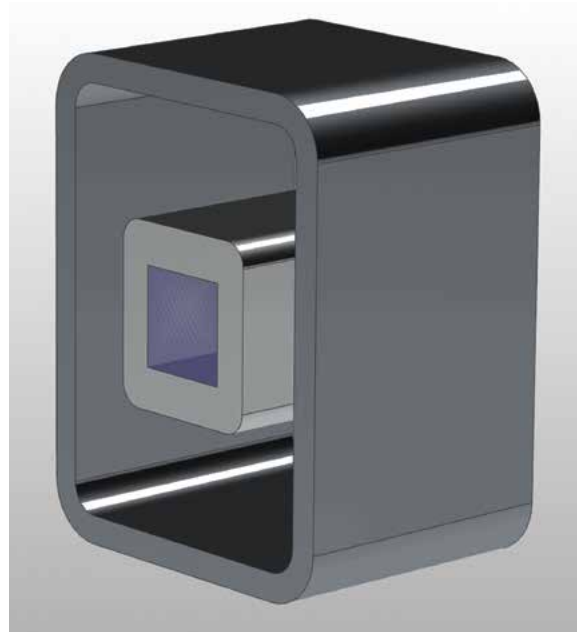
Siemens Corporation

Cryogenic Pipe Thermo-Mechanical Support

Siemens AG is a German conglomerate company headquartered in Berlin and Munich. It is the largest industrial manufacturing company in Europe with branch offices abroad.

Cryogenic pipe thermo-mechanical support will provide a significant advantage in existing markets, and enable Siemens to enter new markets with industry-leading technology. Conventional cooling methods utilize air or water; replacing this with a cryogenic cooler will result in higher cooling capacity. This will lead to more compact designs, which could result in cost savings exceeding twenty percent.

Our team focused on building a structure to support the center pipe within the confines of the exterior pipe. The center pipe carries a cryogenic fluid, which reaches temperatures as low as 30 K. This structure could only transfer a limited amount of heat into the cold center pipe from the 318 K exterior pipe. The support must also be able to endure thermal cycling and loads in excess of one million Nm-l. The team did rigorous analysis on multiple support designs, considering both the thermal and mechanical restrictions. A physical prototype for visual reference was produced after the Siemens representative decided upon a suitable option.



SIEMENS



Michigan State University

Team Members (left to right)

Jonathan Andrejczuk
Lansing, Michigan

Nicholas Raterman
Portland, Oregon

Hai Nguyen
Lansing, Michigan

Michael Okuniewicz
Rochester, Michigan

Brendan Webberly
Livonia, Michigan

Siemens Corporation

Project Sponsor

Bob Warren
Charlotte, North Carolina

ME Faculty Advisor

Neil Wright
East Lansing, Michigan

The Capstone Projects



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

Faculty Advisors: Averill, Bush, Kwon, Loos, Naguib, Pence, Segalman



Averill



Bush



Kwon



Loos



Naguib



Pence



Segalman

Presentation Schedule – Engineering Building, Room 1300

Time	Team Sponsor	Project Title
8:00 a.m.	Michigan AgrAbility	Design of a Muck Bucket Dolly
8:30 a.m.	Hitachi	Test Stand for Variable Valve Timing
9:00 a.m.	Fraunhofer	Fixture for Thin Film Application to Spheres
9:30 a.m.	James Dyson Foundation	Inclusive Sports Wheelchair
10:00 a.m.	Marathon	Tee Ball Batter Assist Device
10:30 a.m.	Heartwood School	Adaptive Sports Ball Launcher
11:00 a.m.	Bosch	Welding Apparatus for Turbo Waste Gate Lever

Mechanical Engineering Design Program Awards

The Mechanical Engineering Design Program makes three 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 will typically have built an impressive prototype which forms the basis for a very clear and effective presentation of the project background and its solution, often incorporating live or video demonstrations of its functionality.

The ME Design Program also presents the Leonardo da Vinci Machine Design Award to the winners of its ME 471 Machine Design competition. The specific design problem and criteria for this competition change from semester to semester.

Michigan AgrAbility

Design of a Muck Bucket Dolly

Michigan AgrAbility is a joint partnership between Michigan State University (MSU) Extension and Easter Seals of Michigan, which assists workers in the agricultural industry with completing tasks that are difficult as a result of age, disability or illness. Providing this service allows workers to continue in their occupation.

Many tasks around a farm involve moving and lifting heavy buckets. Specifically, horse farms require cleaning of stalls, which entails moving and lifting a bucket that can weigh as much as 60 pounds. Workers with certain physical conditions (such as back, arm or leg injuries) can find the task of moving and lifting a muck bucket to be difficult and may risk additional injuries.

In order to help solve this problem, the MSU team designed a dolly that can secure the bucket with minimal effort, transport it through rough terrain, and then lift the bucket a minimum of 45 inches where it would be high enough to slide onto a trailer or other vehicle. The design was evaluated by a potential user and a prototype built with the goal of being a device that can be produced by farmers across the state, as needed.



Michigan State University Team Members (left to right)

Kevin McCarty
St. Clair Shores, Michigan

Mitchell Pollee
Kalamazoo, Michigan

Anxhelo Lalaj
Trenton, Michigan

Amad Wahib
Hamtramck, Michigan

Michael Rasmussen
Rochester, Michigan

Matthew Walz
Grass Lake, Michigan

Michigan AgrAbility Project Sponsor

Ned Stoller
Lowell, Michigan

ME Faculty Advisor

Ron Averill
East Lansing, Michigan

Hitachi Automotive Systems Americas, Inc.

Test Stand for Variable Valve Timing

Hitachi is a global company that designs and manufactures products for the government, consumers and businesses. Some of the industries in which they create products are health care, security, digital media, industrial infrastructure, mining, logistics and automotive. One of the largest sectors of their business is in Automotive Systems. In Farmington Hills, Michigan, there is a project team at Hitachi that tests Variable Valve Timing Systems (VVT), otherwise known as Variable Camshaft Timing (VCT). These systems consist of gears and chains that are located on the front of a vehicle's engine and connect to the engine's camshaft. Hitachi performs tests on these systems by simulating how an engine will operate after production. This is done by running a customer supplied prototype engine with VVT systems in a controlled environment. Recently, the customer decided they are not going to be providing Hitachi prototype engines to test their VVTs due to the high cost.

Our team had the task of designing a test rig that mimics the bottom section of an engine block and attaches to the cylinder head, which will still be provided by the customer. The final system design is a NX 11.0 CAD model. This test rig is adaptable to multiple engine types from V8 through inline 4 with minimal modifications. The system provides oil lubrication mimicking a production engine. This will provide Hitachi with a more cost-effective solution for testing their VVTs.



Michigan State University Team Members (left to right)

Michael Accettura
Chicago, Illinois

Ashley Wilkey
St. Clair, Michigan

Leah Mondro
Clinton Twp., Michigan

Rachael Kain
South Lyon, Michigan

Colby Williams
Milan, Michigan

Hitachi Automotive Systems Americas, Inc. Project Sponsor

Andrew Turner
Farmington Hills, Michigan

ME Faculty Advisor

Thomas J. Pence
East Lansing, Michigan

Fraunhofer USA

Fixture for Thin Film Application to Spheres

Fraunhofer USA is a professional research partner that develops innovative solutions utilizing thin film coatings and diamond materials. Fraunhofer specializes in applications involving chemical and physical vapor deposition (CVD/PVD) to coat various geometries. Methods such as PVD utilize a Laser-Arc Module (LAM) that creates a modular plasma source, which is used to create a tetrahedral amorphous carbon (ta-C) thin film coating. This coating is extremely hard and has a low coefficient of friction, making it ideal for high wear applications. However, one of its limitations includes a line-of-sight application characteristic, requiring complex fixtures in order to achieve an even coating thickness of ta-C.

Currently, fixtures for the LAM can only coat certain geometries, not including spherical objects. The challenge presented to the Michigan State University team was to design, build and test a fixture that allows for spherical objects, such as ball bearings, to be coated with ta-C. To accomplish this, the fixture must allow for electrical conductivity between the work pieces and fixture to attract ionized ta-C. Additionally, the fixture must function within a chamber that experiences a high vacuum and temperature for each thin film application cycle. Design considerations for the final design included the ability to scale the design to maximize the amount of ball bearings to be coated, manufacturability of the fixture, and the ease of cleaning the ball bearings and fixture pre- and post-coating, respectively.



Michigan State University *Team Members* (left to right)

Cody Lysher
Jackson, Michigan

Allison Bakka
Pinckney, Michigan

Jason Sammut
Romeo, Michigan

Kalie Collins
Troy, Michigan

Jake Wojnicki
Hamburg, New York

Fraunhofer USA *Project Sponsors*

Lars Haubold
East Lansing, Michigan

Russell Zarras
East Lansing, Michigan

ME Faculty Advisor

Patrick Kwon
East Lansing, Michigan

James Dyson Foundation Inclusive Sports Wheelchair

The MSU Adaptive Sports Club provides opportunities for people with a diverse range of disabilities to participate in a wide array of sports. In order to accommodate the needs of its athletes, the club possesses a variety of equipment. However, one piece of equipment that it lacks is a sports wheelchair that can be used by athletes who are affected by upper body muscle asymmetry and also possess relatively complete lower body functionality. Two members of the club have these characteristics, and they have been unable to participate in many of the sports that the club plays. The club came to the team seeking a specialized wheelchair that would allow these athletes to fully and safely participate in the club's activities.

The team started with a standard sports wheelchair and integrated a device that allows the chair to be powered by the athlete's legs rather than by his or her arms. This device does not compromise the integrity of the wheelchair frame and allows the user to steer and brake easily despite his or her input limitations. The design was optimized for safety, cost, strength, and serviceability using iterative design techniques. The prototype has been tested and approved by the two athletes of interest and their input has been essential in refining the final design. This addition to the club's collection of equipment will enable it to better serve its members by allowing broader participation in its activities.



THE
JAMES
DYSON
FOUNDATION



Michigan State University

Team Members (left to right)

Richard Simon
Portland, Michigan

Kristian Rego
Detroit, Michigan

David York
Litchfield, Illinois

Ian May
Cary, Illinois

Joshua Borton
Chelsea, Michigan

ME Faculty Advisor

Tamara Reid Bush
East Lansing, Michigan

The James Dyson Foundation

Project Sponsors

Yen-Hung Chen
Ann Arbor, Michigan

Celia Cunningham
Ann Arbor, Michigan

Chai-Wei Wang
Ann Arbor, Michigan

Adaptive Sports & Recreation Club

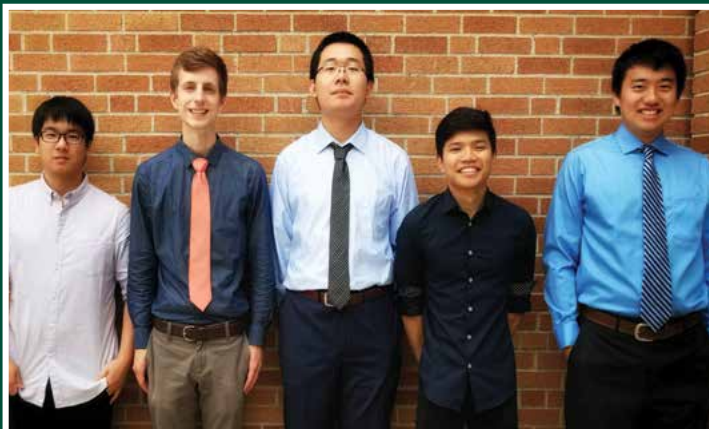
Stephen Blosser
East Lansing, Michigan

Piotr Pasik
East Lansing, Michigan

Marathon Petroleum Corporation Tee Ball Batter Assist Device

Marathon Petroleum Corporation (MPC) is a prime sponsor of the Miracle Field baseball complex in Findlay, Ohio. The facility and leagues that play there provide an opportunity for children with disabilities to participate in organized baseball. The facility lacks a device to allow children who can't swing a bat to participate. The development of a batter assist device for tee ball-level players would provide an opportunity for a much wider audience to participate in the Miracle League program. Several current MPC employees have children that are, or will be, part of the program and could benefit from the batter assist device. The impact of this project would go well beyond MPC and would be a benefit to other families in Findlay and surrounding communities.

The MSU Team worked with MPC employees and Miracle Field board members to design a device that assists tee ball-level children with disabilities. The device allows a child who is not able to hold or swing a bat to safely hit the ball from a tee. The device must be portable (easy to move into position and out of the way to accommodate batters in a game situation), durable, and activated with very simple means (e.g. push button). Ideally, the device would provide some degree of control over the trajectory of the ball to give the batter some strategic options.



Michigan State University *Team Members* (left to right)

Shiyuan Zhong
Shenzhen, China

Michael VanBemmelen
Muskegon, Michigan

Nan Chi
New Rochelle, New York

Nor Shahfiq Mohdnoor
Ipoh, Malaysia

Syunsuke Hata
Novi, Michigan

Marathon Petroleum Corporation *Project Sponsors*

Katy Erford
Findlay, Ohio

Travis Schafer
Findlay, Ohio

Russ Tindall
Findlay, Ohio

ME Faculty Advisor

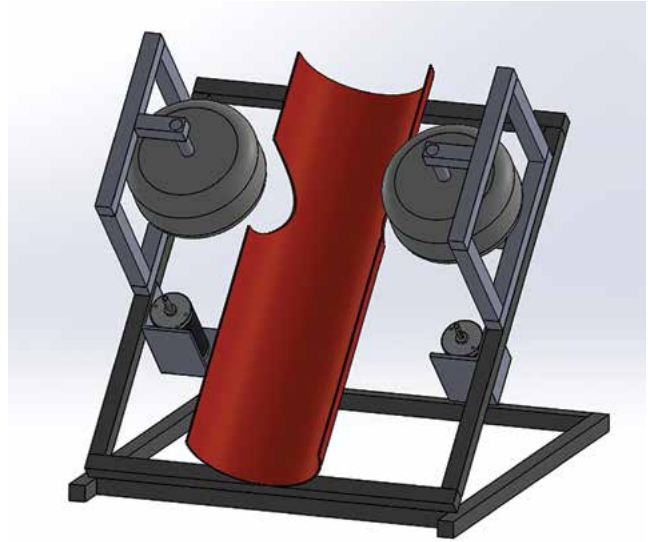
Ahmed Naguib
East Lansing, Michigan

Heartwood School

Adaptive Sports Ball Launcher

Heartwood School employs the MOVE Curriculum designed to improve the mobility and strength of children with a range of disabilities, both physical and mental. The MOVE Curriculum allows students to participate in sports activities with nondisabled peers. With an adaptive sports ball launcher, students with limited ranges of mobility are able to engage in sports such as basketball and volleyball. Heartwood School students range in age from two and a half to 26 so the ability of the sport ball launcher to adapt to different heights and disabilities was a main component of all design choices. It is an entirely enclosed and safe device because safety is Heartwood's number one priority.

By touching an assistive switch, students are able to send a signal to the launcher to effectively launch a ball. The adaptive sports ball launcher can launch a children's sized basketball or a regulation sized volleyball from the free throw line or 3-point line. To ensure the launcher would work for the wide range of students at Heartwood, the launcher was designed with easy angle and speed adjustments. Using a two-wheel system, with each wheel rotating in opposite directions, the launcher is able to be adjusted for many distances and speeds. A large battery was used to power the system in order to both remove the risk that extension cords can pose around children and increase the overall portability of the system. This sports ball launcher will aid in improvement of mobility for all students at Heartwood.



**Ingham Intermediate
School District**
Heartwood School



Michigan State University

Team Members (left to right)

Bridget Anderson
Warren, Michigan

Douglas Kubiak
Grand Rapids, Michigan

Thomas O'Brien
Livonia, Michigan

Sarah Sonogo
Troy, Michigan

Emily Donohue
Traverse City, Michigan

Heartwood School

Project Sponsors

Joanne Janicki
Mason, Michigan

Cheryl Meyer
Mason, Michigan

ME Faculty Advisor

Daniel Segalman
East Lansing, Michigan

Bosch

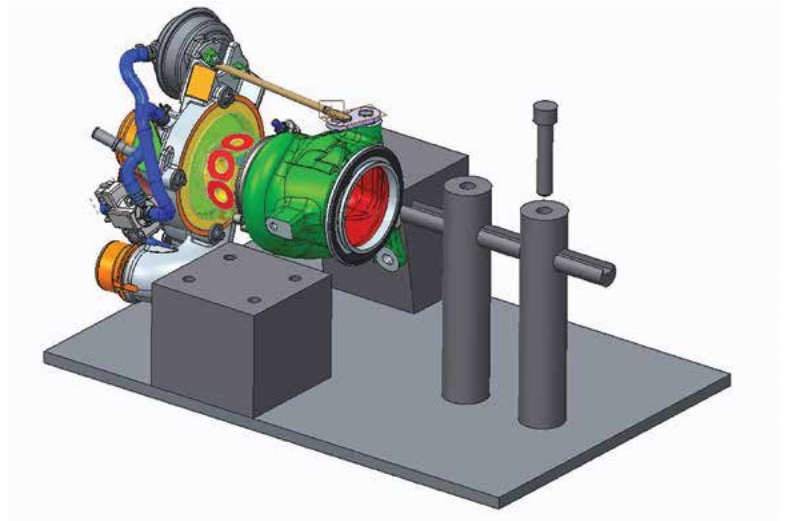
Welding Apparatus for Turbo Waste Gate Lever

For this project, our team was tasked with creating an automated welding apparatus capable of welding the waste gate on a Bosch turbo. Previously, a fixture existed to hold the turbo in place, but the apparatus was needed to control the path of the welding tool, the speed of the tool, and the power to the tool.

Bosch ordered a 3D gantry system that controls the position of a plate as well as the speed. Our team was responsible for creating a fixture to mount the welding tool onto the plate of the gantry system, allowing the path to be controlled. Next, the gantry system was mounted on the existing turbo weld fixture. Finally, the gantry system was programmed with Microsoft Excel to move the welding tool in the correct path.

The most important aspect of this weld is the repeatability. This weld must be the same for each prototype part that is used in this fixture to ensure the appropriate turbo performance. This means that the path of the weld tool must be the same every time. Because of this requirement, it is very important that the welding tool is completely locked into position and firmly connected to the gantry system.

This weld will provide Bosch value by decreasing lead-time on prototype turbos for customers. Previously, prototypes had to be sent to a Bosch location in Germany to be manufactured because the plant in North America is much smaller. The North America branch is now able to process orders more quickly and become more independent.



BOSCH
Invented for life



Michigan State University

Team Members (left to right)

Jacob Smyth
Rockford, Michigan

Mitchell Holt
Lake Orion, Michigan

Carly Wolf
West Bloomfield, Michigan

Nicholas Wojno
Rochester Hills, Michigan

Trey Pfeiffer
Otsego, Michigan

Ruichen Li
Tianjin, China

Alfred Loos (Faculty Advisor)

Bosch

Project Sponsors

Shaun Fritts
Farmington Hills, Michigan

Ajay Muthuramesh
Farmington Hills, Michigan

Aneel Singh
Farmington Hills, Michigan

ME Faculty Advisor

Alfred Loos
East Lansing, Michigan

Design Day Awards Spring 2017

SPRING 2017 ME 471 MACHINE DESIGN AWARD

Left to right: Laura Nye, Amad Wahib, Megan Friedrich,
Logan Kincaid, Byeong Park



SPRING 2017 ME 481 EDISON AWARD

Team Heartwood School “Therapeutic
Mechanical Pony”

Left to right: Kevin Glime, Brennen Burns, Jonathan
Katt, Martyna Cieslak, Matthew Marsh

SPRING 2017 ME 481 PROJECT PRESENTATION AWARD

Team Packsize “Variable Corrugate Box Stacker”

Left to right: Joseph Rombach, Martin Dwornick, Anna
Sommerfeld, Matthew Schomisch, Brian Wingate





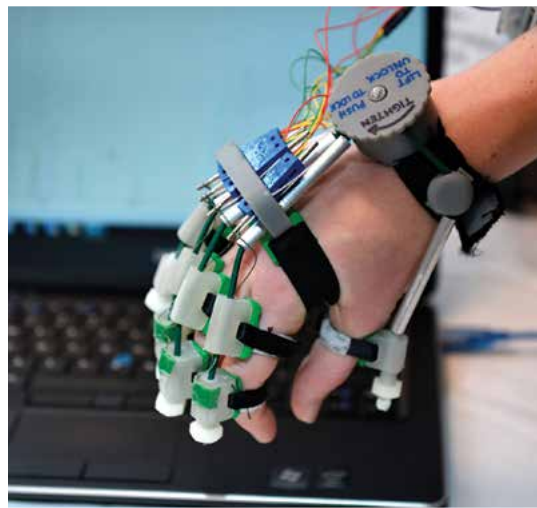
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Dr. Wayne Dyksen
Executive Director, Design Day
(517) 353-5573 dyksen@msu.edu

Jill Bielawski
Director, Design Day
(517) 353-8133 bielawsk@egr.msu.edu

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