MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY

Design Day

COLLEGE OF ENGINEERING

Fall 2015

TechSmith®

Executive Partner Sponsor

Welcome from TechSmith

Welcome to the MSU College of Engineering Design Day!

In partnership with Michigan State University's College of Engineering, TechSmith welcomes you to the 17th biannual MSU College of Engineering Day. We are both excited and honored to celebrate the achievements of the brilliant engineers that make up this great college.

TechSmith is proud to partner with MSU's College of Engineering because in order for us to succeed we will always need engineers that are prepared to lead, create, and innovate. Today serves as a great opportunity for us all to witness the talent of MSU engineers and the hard work they have accomplished throughout the semester.

Design Day not only gives students that ability to showcase their semester projects, but also serves as a way to demonstrate their knowledge, ingenuity, and teamwork skills. Throughout the semester, we observed students facing real-world challenges and developing innovative solutions. We have great confidence that the students of the College of Engineering will change the world for the better.

Congratulations to all Design Day participants! We are proud of all your accomplishments and look forward to witnessing your future successes.

Sincerely,

Dean Craven

Dean Craven
Chief Technology Officer, TechSmith Corporation

TechSmith®

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Continued on next page

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Design Day Events Schedule: Friday, December 11, 2015

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 2200 Hallway 9:00 a.m. – Noon				
EGR 100 Presentations			2nd Floor 2300/2200 Hallway 9:00 a.m. – Noon				
ME 371 Demonstrations			1st Floor Rooms 1230 & 1234 9:00 a.m. - Noon				
ME 412 Competition		1st Floor Room 1252 8:00 a.m. - 11:30 a.m.					
ME 471 Competition		1st Floor Room 1345 8:00 a.m. - 12:16 p.m.					
ME 491 Demonstrations			1st Floor 1200 Hallway 9:00 a.m. - Noon				
CAPSTONE COURSES							
All Capstone Posters for most projects		1st Floor 1300 Hallway 8:00 a.m. - Noon					
CE 495 Project Presentations			1st Floor Room 1538 & 3rd Floor Room 3540 9:00 a.m. - Noon				
CSE 498 Project Presentations		3rd Floor Room 3405 7:30 a.m. - Noon					
ECE 480 Project Presentations		2nd Floor Room 2250 8:00 a.m. - 11:40 a.m.					
ME 481 Project Presentations			1st Floor 1200 Hallway/Rooms 1202, 1208 & 1220 from 8:30 a.m. - Noon				
OPENING, LUNCH AND AWARDS							
High School Opening			1st Floor Anthony, Room 1279 8:00 a.m. - 8:40 a.m.				
High School Award			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:
"Like" Us http://www.facebook.com/pages/The-Center-for-Spartan-Engineering/226159694117936
"Follow" Us: https://twitter.com/msuengineer

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 TechSmith 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, ArcelorMittal, Boeing, Bosch, General Motors, Marathon, the MSU Alumni Association, the MSU Federal Credit Union, Norfolk Southern and Salesforce.org. 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 for 7th-12th Grade Students, which involves some 200 local junior high and high school students. On Design Day, these future engineers explore design principles with hands-on projects requiring the application of their creativity and ingenuity.

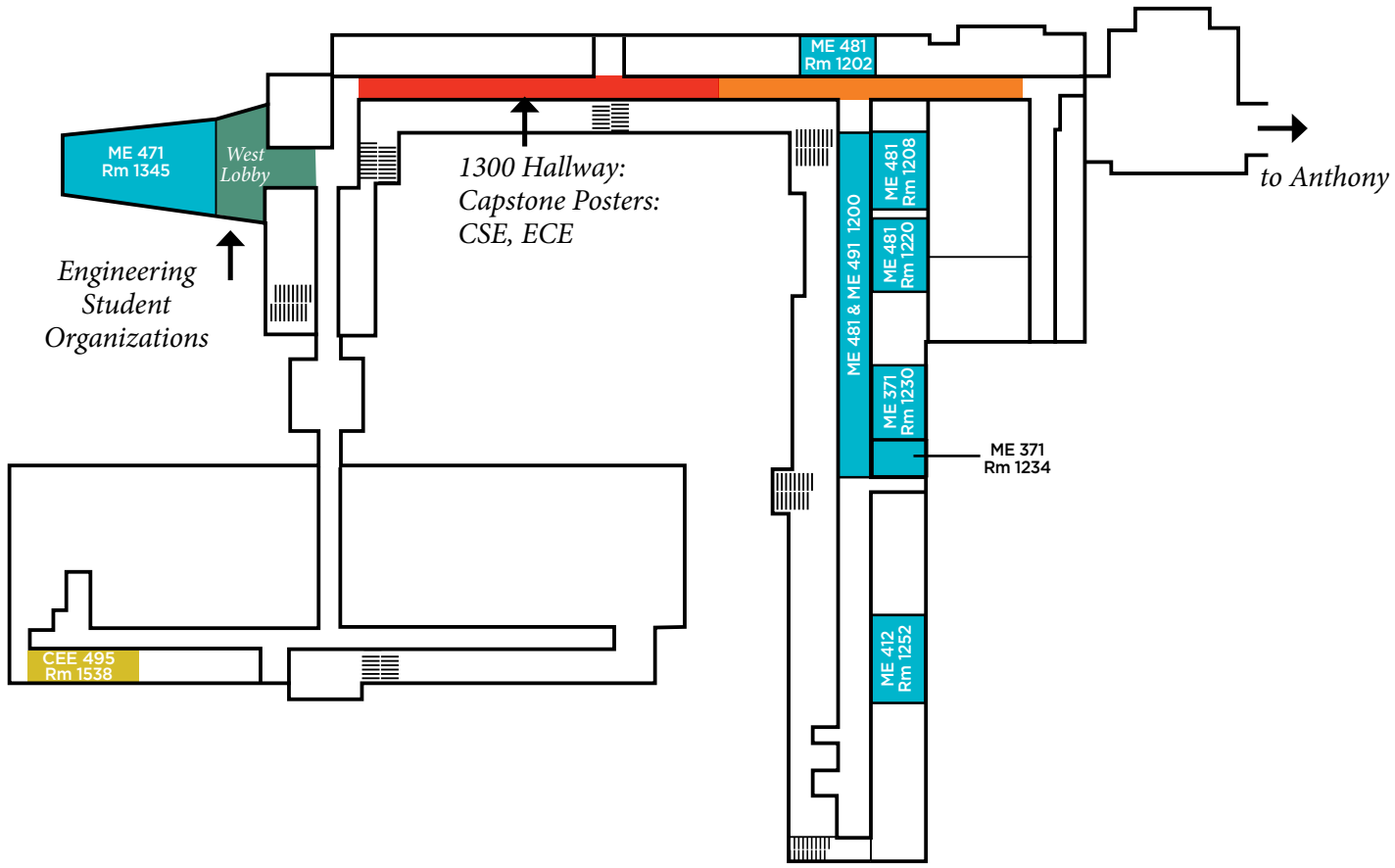
The headliners of Design Day are our graduating seniors as they present their design projects through exhibits, posters and presentations. Their projects represent the capstone of their educational career. You will see that our graduating MSU engineers are ready to lead, create and innovate.

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.

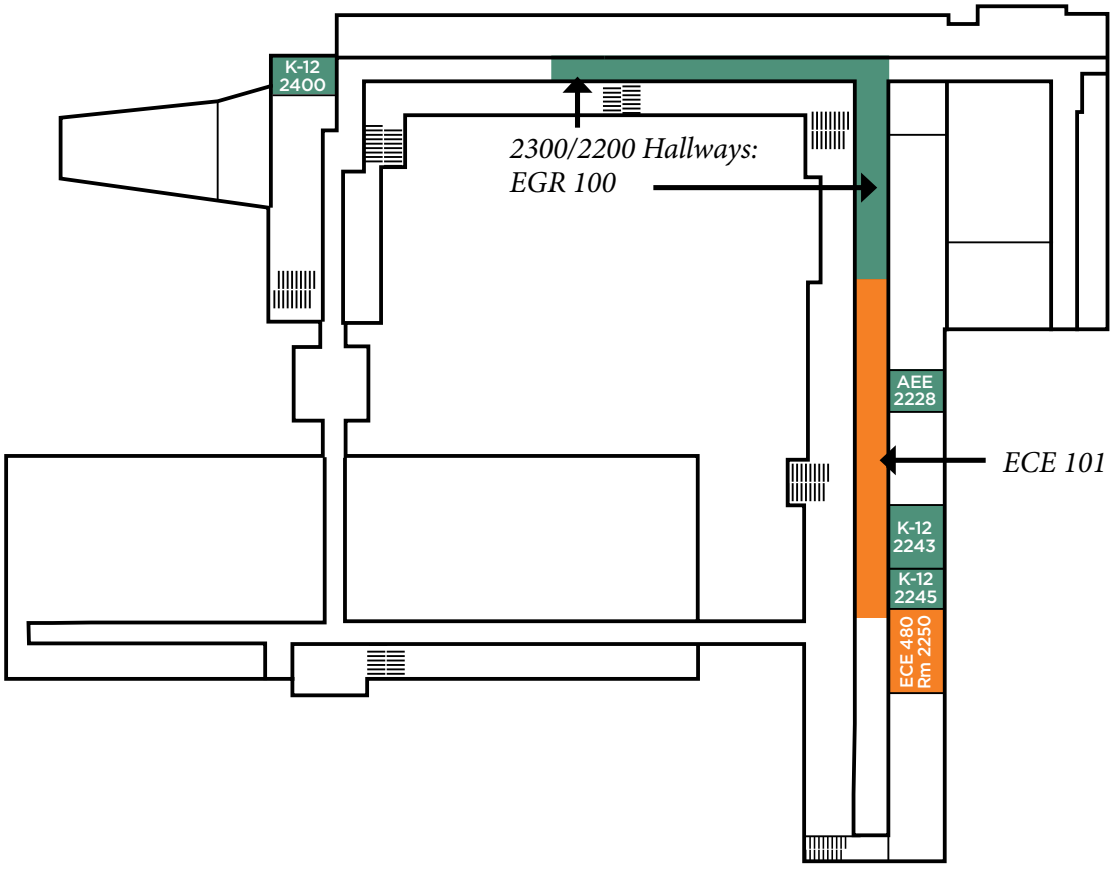
Please join us for the Design Day Awards Ceremony in Anthony Hall Room 1281 at 1:15 pm when we will honor all of our talented Spartans, the best of the best.

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

1st Floor Engineering

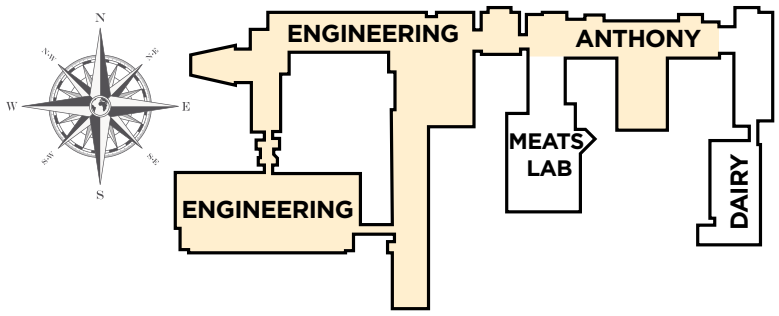


2nd Floor Engineering

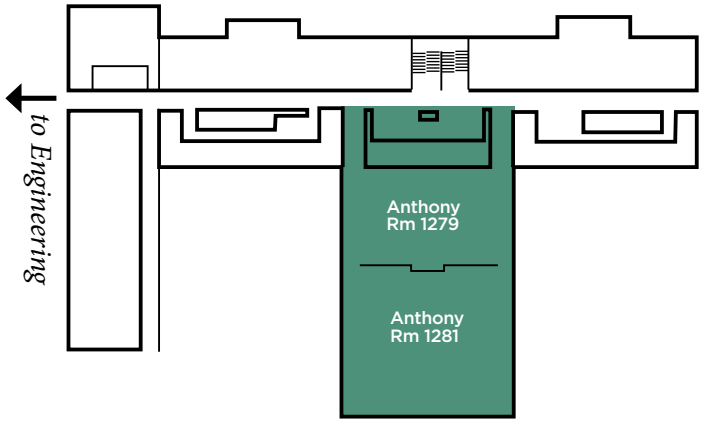


Design Day Floor Plans of the MSU Engineering Building

Overview



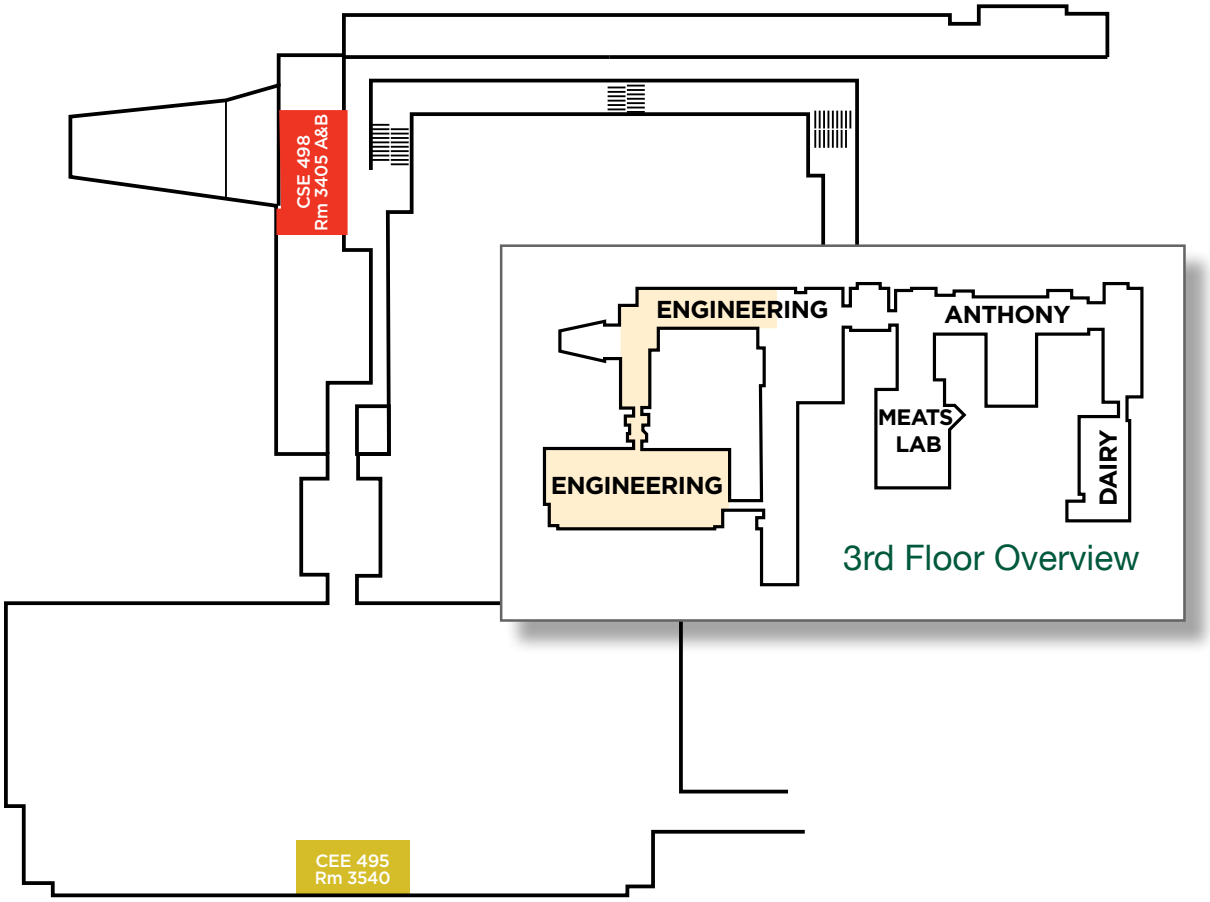
1st Floor Anthony



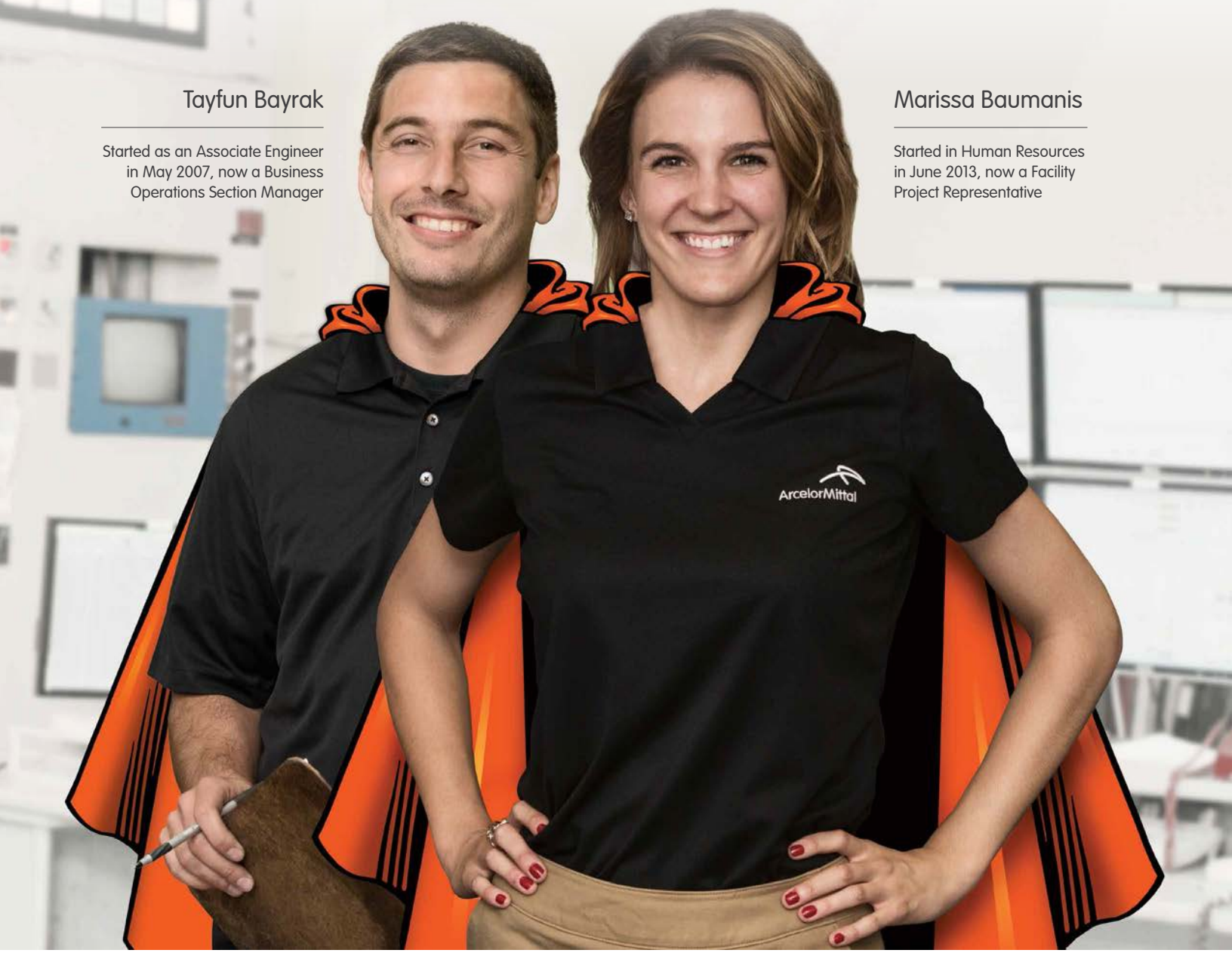
Color Legend:

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

3rd Floor Engineering



Superheroes of steel.



Tayfun Bayrak

Started as an Associate Engineer in May 2007, now a Business Operations Section Manager

Marissa Baumanis

Started in Human Resources in June 2013, now a Facility Project Representative

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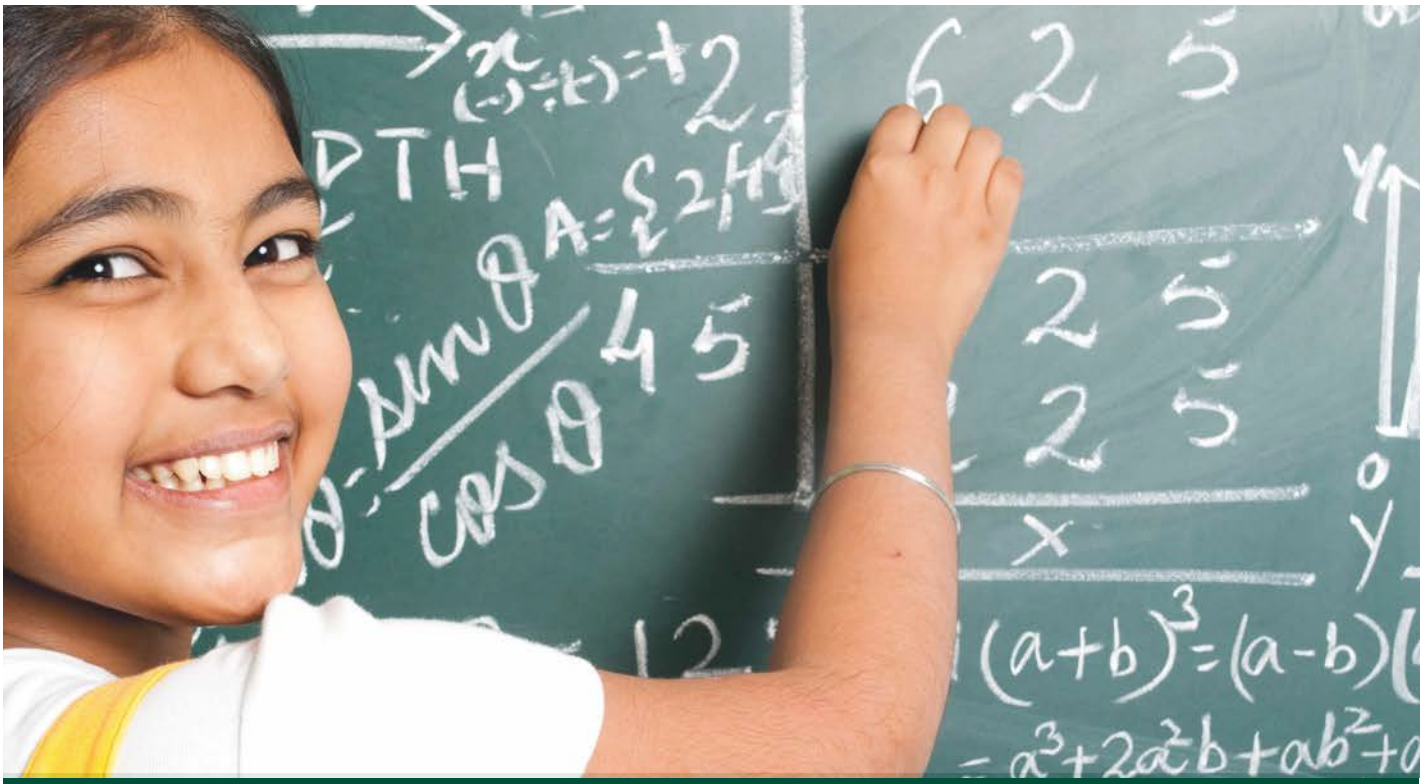
Dart Day of Innovation and Creativity

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

DART FOUNDATION SM

MICHIGAN STATE UNIVERSITY | College of Engineering

The Dart Foundation

Middle and 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.

DART FOUNDATION

Office for Inclusion and Intercultural Initiatives

NSF

	Room 1279 Anthony Check in	C.E./M.E. Team Build Room 2245	VEX Robotics Room 2400	1st & 2nd Floor Voting/ project viewing	Center for Highway Pavement Preservation Room 2243
8:00–8:40	All Schools 1 thru 8				
8:40–9:30		Schools 1 & 2	Schools 5 & 6	Schools 3 & 4	Schools 7 & 8
9:30–10:20		Schools 7 & 8	Schools 1 & 2	Schools 5 & 6	Schools 3 & 4
10:20-11:10		Schools 3 & 4	Schools 7 & 8	Schools 1 & 2	Schools 5 & 6
11:10-12:00		Schools 5 & 6	Schools 3 & 4	Schools 7 & 8	Schools 1 & 2
12:15–12:30	All students in Room 1279 Anthony for the awards ceremony. Lunch will immediately follow.				

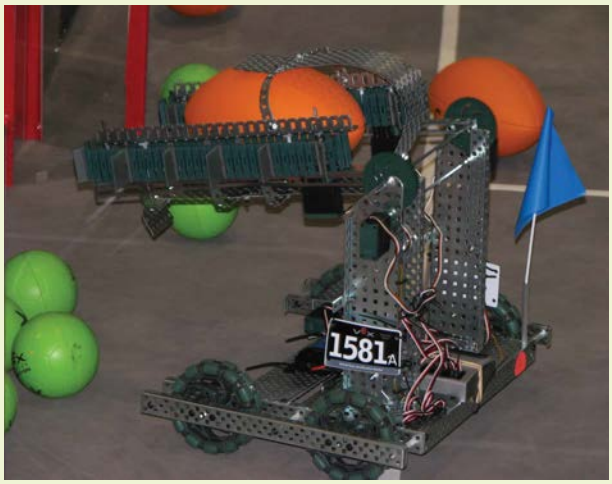
http://www.egr.msu.edu/future-engineer/ **LIKE US: https://www.facebook.com/futurespartanengineers**

UNIVERSITY TRANSPORTATION CENTER FOR HIGHWAY PAVEMENT PRESERVATION (CHPP)

The need to protect the massive national highway infrastructure investment is recognized by Congress and clearly cited in the "Moving Ahead for Progress in the 21st Century Act" or the "MAP–21." The establishment of CHPP is consistent with the U.S. Secretary of Transportation's strategic goal of "State of Good Repair." The mission of CHPP is aimed at providing a new platform for accelerating innovation in highway pavement preservation. The center will assist in meeting the increasing demand for highway pavement preservation research and will further the goal of increasing the reliability and performance of the nation's highways. Encouraging the best and brightest future engineers pursuing degrees and careers in transportation-related engineering disciplines should be a big priority. This CHPP session will center on showcasing innovative, creative, and fun challenges, as well as opportunities for participating high school students and teachers.

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 2015

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

Dean Buggia
Instructor and Technology Teacher, Okemos High School

Luis Donadoto
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

Imen Zaabar
UTC Faculty and Outreach Team

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

MSU Federal Credit Union is proud to support the Michigan State University College of Engineering Design Day!

From purchasing a new computer to an upgraded apartment or your first car, it's our mission to help you achieve your financial dreams. Our free financial tools will help prepare you for every stage in life, bringing you one step closer to achieving those goals.

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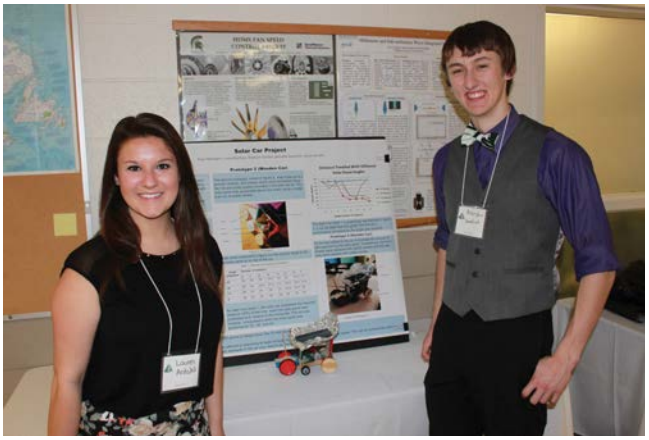
EGR 100
Introduction to Engineering Design

Mr. Timothy Hinds
Academic Director

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 1042 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from six project types: (i) Solar Car Competition, (ii) Cell Phone App Inventor, (iii) Engineers Without Borders (EWB) Projects, (iv) MSU Resource Center for Persons with Disabilities (RCPD) Adaptive Designs, (v) MSU Adaptive Sports and Recreation Club Designs, and (vi) CoRe industry-sponsored projects. The EWB design projects were Solar Water Heater Design, Water Purification System and Rainwater Collection System Design. Two RCPD projects were offered including an E-Bike Cargo/ Passenger Carrier and a Hand Cycle Pedal Adaptor offered jointly with the Adaptive Sports and Recreation Club. Adaptive Sports and Recreation Club projects also included a Throwing Chair Stabilizer and Athletic Wheelchair Toe Guard. CoRe industry-sponsored projects were collaborations with ArcelorMittal on Overhead Crane Safety Zone Alert and a Furnace Exhaust Gas Sampling System. 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.



Solar Car Competition team

Spring 2015 EGR 100 Project Poster Award Winners:

l-r: Pat Walton, Megan Krampe, Elaine Johnston, Dean Kempel, Sam Morris, Timothy Hinds

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

Ford Community Corps

Resource Center for Persons with Disabilities

Union Pacific

GE

Consumers Energy — Count on Us

MSU Adaptive Sports and Recreation Club

Michigan State University - Engineers Without Borders

ArcelorMittal

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The Capstone Projects

Faculty Advisors:
Professors Baladi, Haider, Ingle, Kodur, Li, and Masten


Baladi


Haider


Ingle


Kodur


Li


Masten

Presentation Schedule – Room 1538

Time	Team	Room
8:00 a.m.	Team 1 – Entourage Engineering	First Floor Room 1538 EB
9:20 a.m.	Team 4 – 360 Engineering Consultants	First Floor Room 1538 EB

Presentation Schedule – Room 3540

Time	Team	Room
8:00 a.m.	Team 2 – Chase & Company Consulting	Third Floor Room 3540 EB
9:20 a.m.	Team 3 – Riparian Professional Services	Third Floor Room 3540 EB
10:40 a.m.	Team 5 – The Brady Bunch	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, geotechnical, 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 Shaw Lane Power Plant Renovation

Michigan State University is in the process of implementing components of its campus master plan. As a part of the 2020 Vision: Campus Master Plan Report, a new academic building was envisioned at the location of the now decomissioned Shaw Lane Power Plant. A recent update to the campus master plan suggested the option to renovate the existing building and add a substantial expansion to the building footprint. In conjunction with this project, the segment of Shaw Lane between Chestnut Rd and Red Cedar Rd will be reconstructed. Both the street reconstruction and the academic building expansion must be congruent with the overall campus master plan.

The project emphasizes implementation of green infrastructure. Green infrastructure refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or harvest stormwater at its source. The projects were prepared for submission in the Demonstration Project category of the EPA Campus RainWorks Challenge. The EPA competition requires proof-of-concept level designs that examine how green infrastructure could be integrated into an on campus site to meet multiple environmental, educational, and economic objectives.

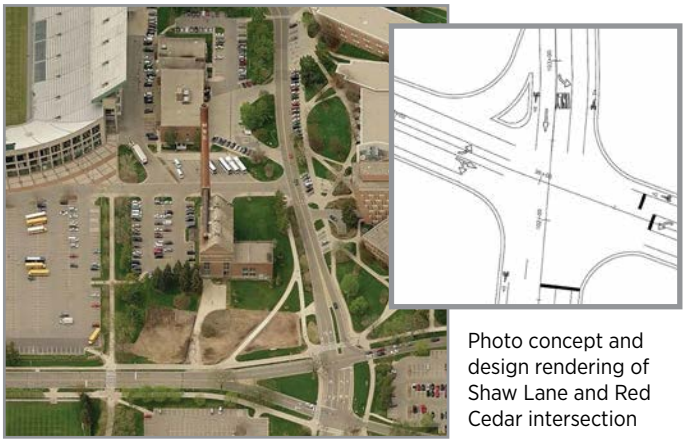
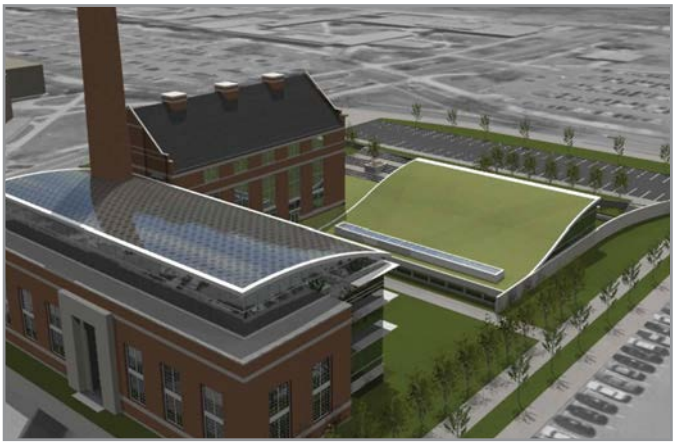
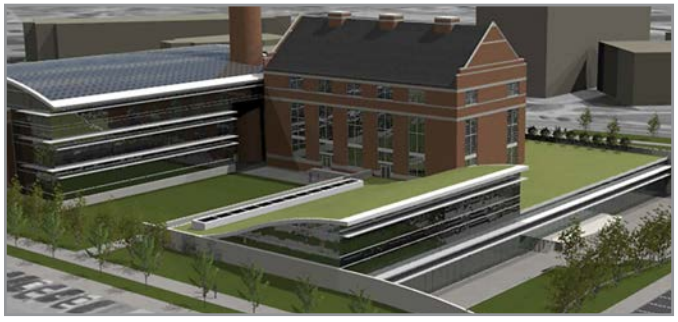


Photo concept and design rendering of Shaw Lane and Red Cedar intersection





Integrated Architecture

Shaw Lane project for 2020 Vision Campus Master Plan. Concept rendering courtesy of Integrated Architecture, Grand Rapids, MI.

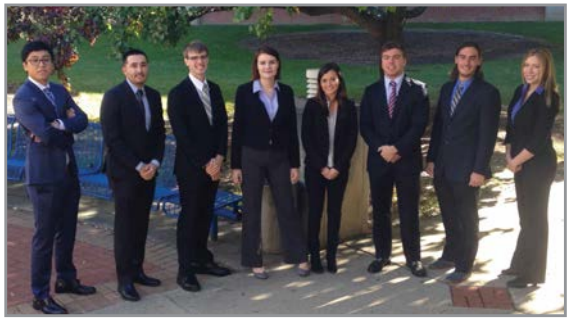
TEAM 1: ENTOURAGE ENGINEERING

Left to Right: Chris Rothhaar (S), Alex Zuker (P), Alex Wangeman (WR), Tom Bonney (PM), Kaleb Sondgerath (T), Steven McConnell (E), Tony Brehmer (G)

TEAM 2: CHASE & COMPANY CONSULTING

Left to Right: Yuchen Zhang (G), Muhammad Alabduljabbar: (P), Kailyn Gerzich (WR), Dennis Chase (PM), Kathryn Capeneka (E), Joe Eberle (S), Layton Korson (T)

TEAM 3: RIPARIAN PROFESSIONAL SERVICES



Left to Right: Guida Chen (G), Jose Ramirez (P), Timothy Honick (T), Rachel Wandmacher (PM), Sophia Borroni-Bird (WR), Jesus Sanchez (G), Joshua Garvin (E), Samantha VanVlerah (S)

TEAM 4: 360 ENGINEERING CONSULTANTS

Left to Right: Jad Elkhazeim (S), Oliver Cameron (S), Armaan Sakhrani (P), Laura Peterson (WR), David Hayden (PM), Eric Kamps (G), Jon Nichols (T), Josh Moore (E)

TEAM 5: THE BRADY BUNCH

Left to Right: Benjamin Thoune (G), Nicholas Mcdonald (P), Brian Hebden (S), Sarah Remington (E), John Brady (PM), Nicholas Wojno (T), Robert Atkinson (WR)

Key: E = Environmental, G = Geotechnical, H = Hydrology, P = Pavements, PM = Project Manager S = Structures, T = Transportation and WR = Water Resources

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Michael J. Buckler, P.E.
Fishbeck, Thompson, Carr & Huber

Iman Harsin
Michigan State University

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

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

Leanne Panduren, P.E.
Rowe Professional Services

Mark Quimby
Soil & Materials Engineers, Inc.

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

Charles Rolfe, P.E.
OHM Advisors

Michael Thelen, P.E.
Consumers Energy

Daniel Thome, P.E.
Nicholson Construction Company

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

Kelby Wallace, P.E.
Michigan Department of Transportation

PROFESSIONAL EVALUATORS

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

Tom Boom, P.E.
Bar Engineering Co.

Rick Chelotti, P.E.
Bergman Associates

Daniel Christian, P.E.
Tetra Tech MPS

Tyler Dawson, P.E.
NTH Consultants

Lauren Fedak
Harley Ellis Devereaux

Matt Junak, P.E.
HTNB

Peter Margules, P.E.
NTH Consultants

George McKenzie, P.E.
Consumers Energy

Todd Sneathen, P.E.
Hubbell, Roth & Clark

Michael Thelen, P.E.
Consumers Energy

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

Phillip Vogelsang, P.E.
URS Corporation

Emily Warners, P.E.
Consumers Energy

Lauren Warren, P.E.
Parsons Brinckerhoff

Design Day Awards Spring 2015

Rolla C. Carpenter Senior Design Award

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

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

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

Rolla C. Carpenter Senior Design Award Winners, Spring 2015 (Tie)

Back Row Left to Right: Blake Junak, Alex Casabuena and Evan Forgacs
Front Row Left to Right: Dr. Tom Wolff, Brian Merk, Morgan Hoxie, Trevor Painter andAlexander Novikov

Rolla C. Carpenter Senior Design Award Winners, Spring 2015 (Tie)

Back Row Left to Right: Joseph Kolpasky, Daniel Krokker and Daniel Domino
Front Row Left to Right: Dr. Tom Wolff, Dylan Simmer, Anna Strong, Ryan Austin and Tyler Hesse

Computer Science and Engineering

Capstone Course Sponsors

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

Amazon
Seattle, Washington & Detroit, Michigan

Auto-Owners Insurance
Lansing, Michigan

Ford Motor Company
Dearborn, Michigan

General Motors
Detroit, Michigan

Meijer
Grand Rapids, Michigan

MSU Federal Credit Union
East Lansing, Michigan

Quicken Loans
Detroit, Michigan

Spectrum Health
Grand Rapids, Michigan

Symantec
Mountain View, California

TechSmith
Okemos, Michigan

Urban Science
Detroit, Michigan

Whirlpool Corporation
Benton Harbor, Michigan

The Capstone Projects

Dr. Wayne Dyksen
Professor of Computer Science and Engineering

Angie Sun
Teaching Assistant

Presentation Schedule – Engineering Building, Room 3405

Time	Team	Project
7:30 a.m.	Amazon	Seller Forums Echo Companion
7:50 a.m.	Auto-Owners	HR Recruiting System
8:10 a.m.	Ford	Connected Vehicle Protocol Test Harness
8:30 a.m.	GM	Global Service Desk Mobile App
8:50 a.m.	Meijer	In-Store Price Compare
9:10 a.m.	MSUFCU	Online Dollar Dog Store
9:30 a.m.	Break	
9:45 a.m.	Quicken Loans	Enterprise Roadmap Tool
10:05 a.m.	Spectrum Health	Patient Service Delivery Planning
10:25 a.m.	Symantec	Integrated Silent Authentication via Symantec VIP
10:45 a.m.	TechSmith	Intelligent Real World Text Recognition
11:05 a.m.	Urban Science	Visualizing Brand Loyalty
11:25 a.m.	Whirlpool	Whirlpool Indoor Maps

CSE 498 Collaborative Design

CSE 498, Collaborative Design, provides the educational capstone experience for all students majoring in computer science. The course objectives include the following:

- Designing, developing, and delivering a comprehensive software system to a client;
- Learning to work effectively in a team environment;
- Developing written and oral communication skills;
- Becoming proficient with software development tools and environments;
- Learning about system building and system administration; and
- Considering issues of professionalism and ethics.

Project sponsors are local, regional, and national, and have included Amazon, Auto-Owners Insurance, Boeing, Bosch, Chrysler, Dow, Electronic Arts, Ford, GE Aviation, General Motors, Google, IBM, Meijer, Microsoft, Motorola Mobility, Mozilla, MSU Federal Credit Union, Quicken Loans, Spectrum Health System, TechSmith, Toro, Union Pacific Railroad, Urban Science and Whirlpool.

The Capstone Experience Lab Sponsored By

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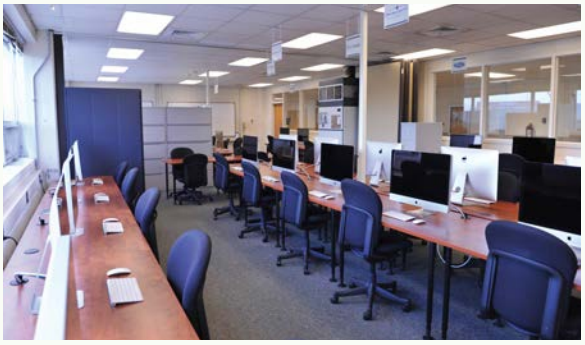
We thank Urban Science for their generous support of the Capstone Experience Lab.



Amazon
Seller Forums Echo Companion

Amazon, one of the world's largest online retailers, sells hundreds of millions of different products. Of these online sales, many are fulfilled by third-party sellers.

Amazon's Seller Forums is a web resource for third-party sellers to post questions about selling on Amazon. Our *Seller Forums Echo Companion* provides these sellers with a hands-free way to interact with the Seller Forums.

The Amazon Echo is a tower speaker providing voice assistance through the cloud-based Alexa intelligent assistant. Amazon sellers use our Echo Companion to ask Alexa about the questions and answers posted in the forums.

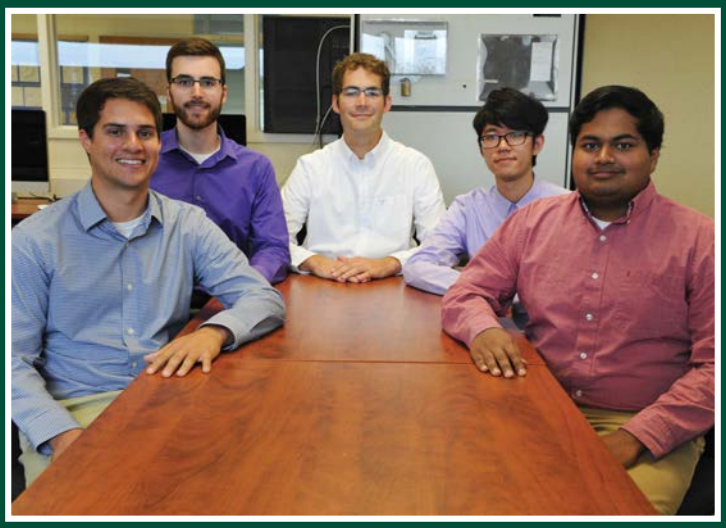
For example, a seller asks "Alexa, are there any replies to my question about shipping?" Alexa answers "There are three new replies to your question." The seller then responds "Read the most helpful reply to me."

Our Echo Companion is based on Alexa "skills," which are comprised of language constructs called intents for which Alexa listens and performs subsequent actions. Alexa uses its natural language processing in combination with the Seller Forums database to accomplish a seller's desired task.

Alexa's actions include many common Amazon Seller Forums tasks such as posting questions, reading questions, editing account settings and receiving notifications.

Our *Seller Forums Echo Companion* is coded in Java. AWS Lambda, an Amazon cloud service, stores and runs the Java. A MySQL database hosted by Amazon Web Services contains the content of the Seller Forums.

amazon



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Auto-Owners Insurance
HR Recruiting System

Auto-Owners Insurance is a Fortune 500 company working with more than 6,200 independent agencies in 26 states. Founded in 1916, Auto-Owners continuously improves their products and services for their policyholders.

Auto-Owners is committed to recruiting and hiring the very best candidates to be associates at Auto-Owners. Our *HR Recruiting System* streamlines the entire process from recruiting to applying to hiring.

Applicants create accounts and complete job applications easily. They can upload their resumes and pull data from their LinkedIn profiles.

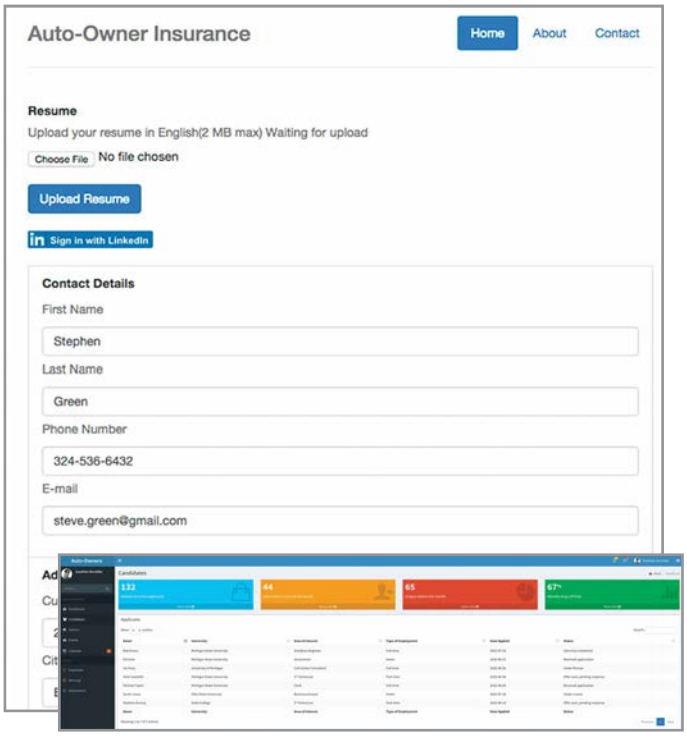
To measure the user-friendliness of the system, Google Analytics tracks the number of applicants who complete the entire application process.

Recruiters assign themselves to specific applicants, rank applicants based on interviews, and update the status of each application.

Recruiters can request video, phone, and in-person interviews. They can send acceptance, rejection, and hold letters.

Recruiters use our system to log recruiting events and record relevant information such as expenses, number of recruits in attendance, and contact information. Paper copies of resumes collected at events are scanned and stored in the system.

Our *HR Recruiting System* is written in HTML, CSS, AngularJS, and NodeJS. Our system is supported on the backend by a SQL database.



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The No Problem People®

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Ford Motor Company
Connected Vehicle Protocol Test Harness

Ford Motor Company designs and manufactures Ford and Lincoln vehicles across six continents and employs more than 220,000 employees in 90 plants worldwide.

Many Ford vehicles that roll off the assembly lines have complex infotainment systems. The performance demands on these systems varies with the customers' desires such as streaming audio and video directly to their car or truck.

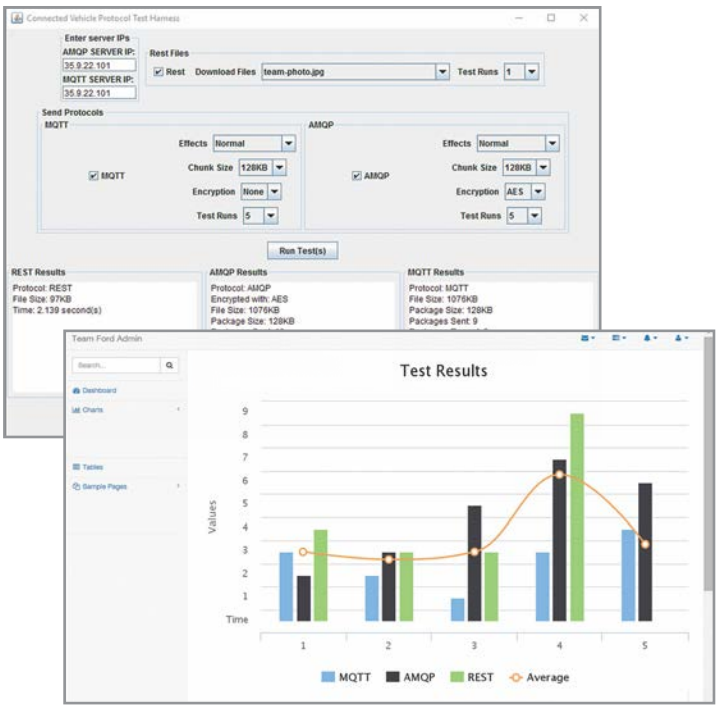
Infotainment systems send and receive a wide array of messages around the vehicle which include things like media files and system updates. As these messages are transmitted, they must arrive at their destination quickly and accurately.

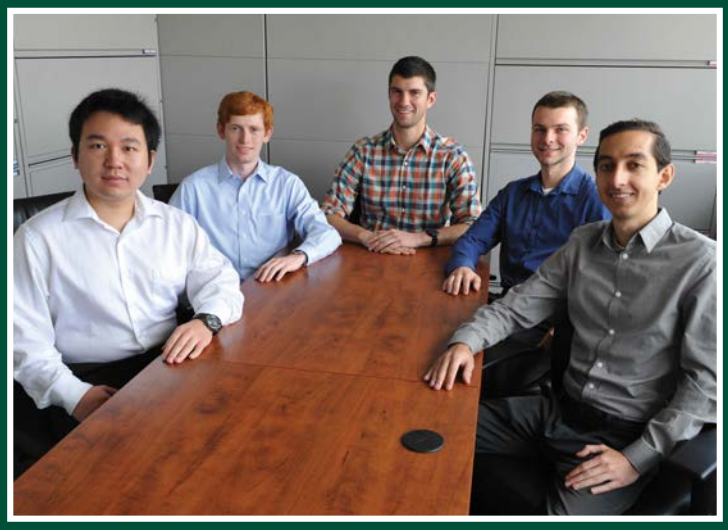
Ford engineers use our *Connected Vehicle Protocol Test Harness* to evaluate the performance of a variety of messaging protocols. Engineers use the results of these evaluations to choose the best protocols for their designs.

Our test harness transmits various encrypted file types from the Ford Discovery Box, which simulates a vehicle, to a server. The test harness monitors and measures these transmissions, and collects data about a protocol's performance.

Ford engineers visualize the test results with graphs and tables using our companion web application, which enables them to compare and analyze various messaging protocols to determine the optimal performance.

Our *Connected Vehicle Protocol Test Harness* is written in Java and uses RabbitMQ as a message broker. The web app uses HTML/CSS and JavaScript with PHP and SQL to store data.





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General Motors
Global Service Desk Mobile App

General Motors is one of the world's foremost designers and manufacturers of cars and trucks sold in more than 120 countries. Headquartered in Detroit, Michigan, GM's 218,000-plus employees work in 396 facilities spanning six continents.

GM's Global Service Desk (GSD) helps GM employees solve their information technology (IT) problems. Our *Global Service Desk (GSD) Mobile App* provides GM employees with access to the GSD from anywhere at any time.

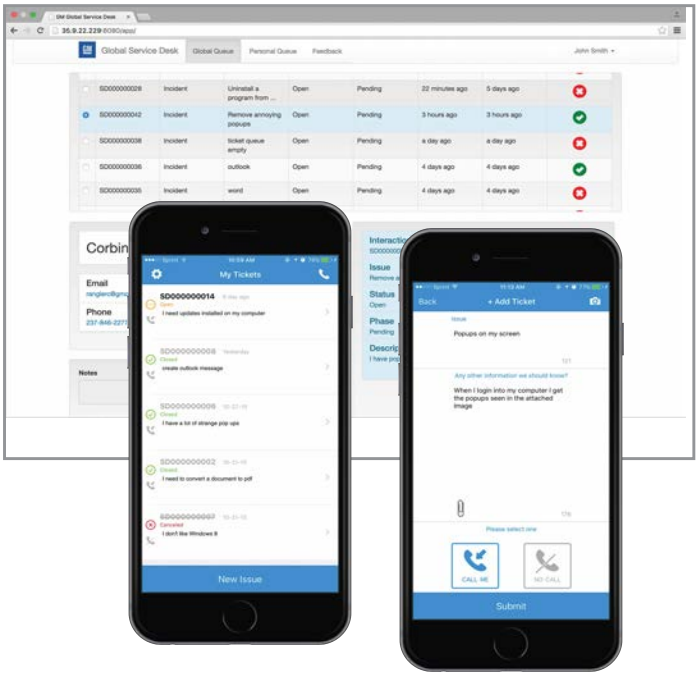
When needing IT assistance, GM employees use GSD Mobile. After describing their problem, users are presented with possible fixes so they can solve their problem immediately themselves, without calling the GSD. If not resolved, users submit a help ticket, which they can track easily.

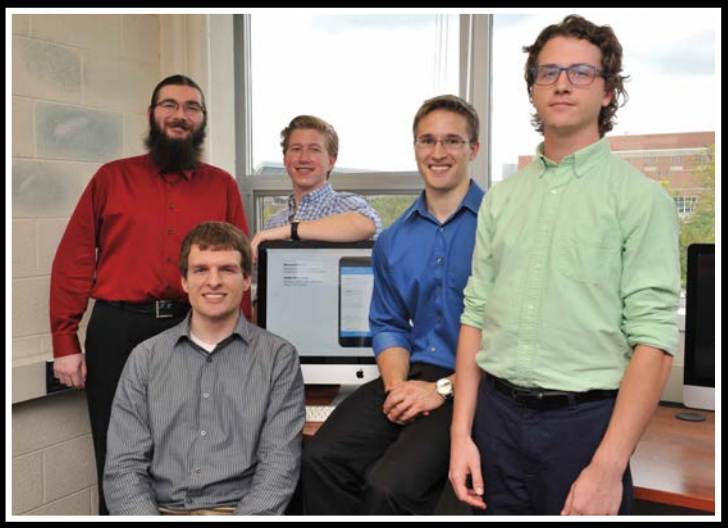
A GSD agent determines the best time to call an employee needing IT help by looking at the employee's calendar, which our team integrated into GM's IT Service Manager system.

As an agent makes changes to a help ticket, push notifications are sent to the *GSD Mobile App* to keep the GM employee up to date. Agents may also send preset messages requesting more information about an employee's problem.

Using our system, GSD agents process help tickets faster and more efficiently, alleviating phone congestion for other GM employees with more serious IT issues.

Our *GSD Mobile App* and web front end are written in Swift 2 and JavaScript, respectively. Both interface with an Apache2 web server that synchronizes with a MySQL database via PHP.





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Meijer
In-Store Price Compare

Meijer is one of the country's largest supercenter chains, providing high quality food and merchandise in six states across the Midwest. With their headquarters located in Grand Rapids, Michigan, Meijer has over 200 stores, 60,000 team members and serves millions of customers each year.

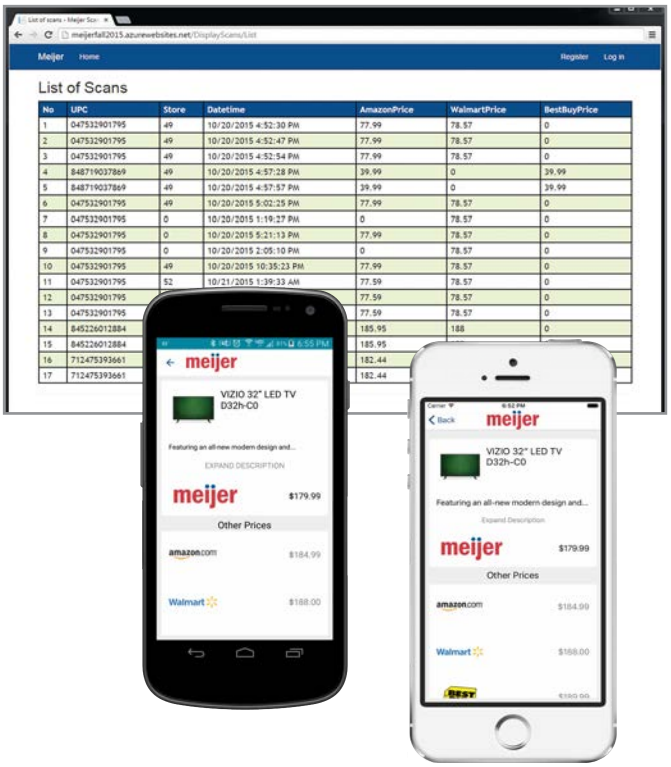
Our *In-Store Price Compare* mobile app gives Meijer customers an easy way to compare prices as well as giving Meijer insight into the marketplace.

Customers scan an item's barcode using their iPhone, iPad or Android device. Our app shows the Meijer price along with the prices of Meijer's competitors. If the Meijer price is not the lowest, a special one-time coupon may be offered to encourage the customer to make the purchase at Meijer.

Every time a Meijer customer scans a product for pricing, relevant data about the product and prices are uploaded into a Meijer database. Our companion web app visualizes this data with charts and graphs.

Meijer sourcing managers use the web app to analyze the strengths and weaknesses of their in-store pricing as well as consumer buying patterns. As a result, Meijer customers get the best products at the lowest prices.

Our *In-Store Price Compare* iOS and Android apps are written in C# using cross platform interfaces created with Xamarin.Forms. The web platform runs on the ASP.NET framework and is written using HTML5, D3.js and Bootstrap. Both the SQL database and web platform are hosted on Microsoft Azure.



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MSU Federal Credit Union
Online Dollar Dog Store

Michigan State University Federal Credit Union (MSUFCU) is the largest university-based credit union in the world, serving Michigan State University, Oakland University and their surrounding communities.

The MSUFCU Dollar Dog program encourages good banking habits in young MSUFCU members. When children ages 5-12 make deposits, they earn Dollar Dog coins, which they can exchange at a Dollar Dog Store for prizes such as backpacks, coloring books, bouncy balls, and stuffed animals.

Currently, there are Dollar Dog Stores in thirteen MSUFCU branches so it's difficult for kids who do not live near one of these branches to use Dollar Dog coins to buy prizes.

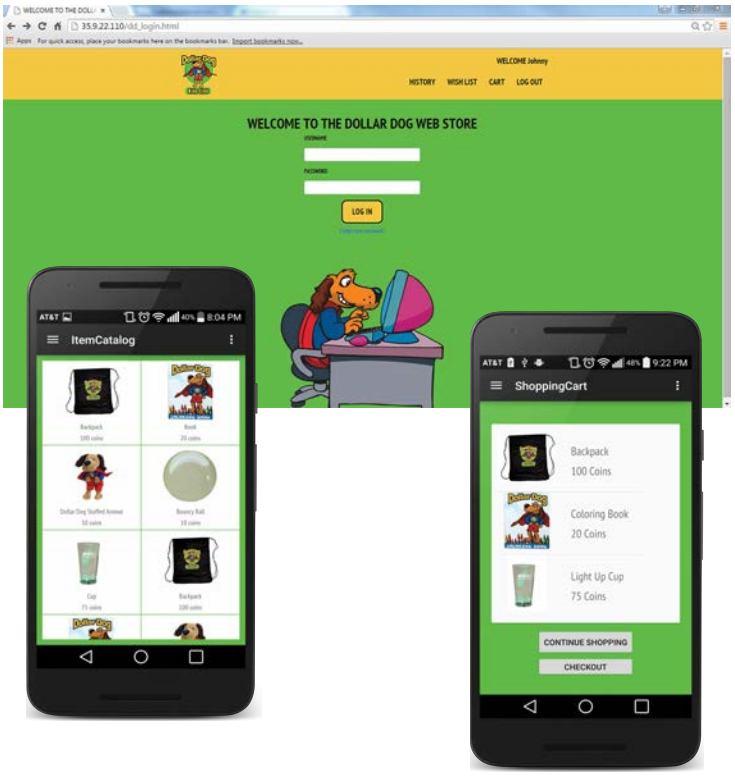
With our *Online Dollar Dog Store*, MSUFCU kids can shop online using Dollar Dog coins to buy prizes, which are shipped directly to their homes.

After logging in with their MSUFCU userid and password, kids can add prizes to a cart for purchase with Dollar Dog coins or they can add them to a wish list for a future purchase.

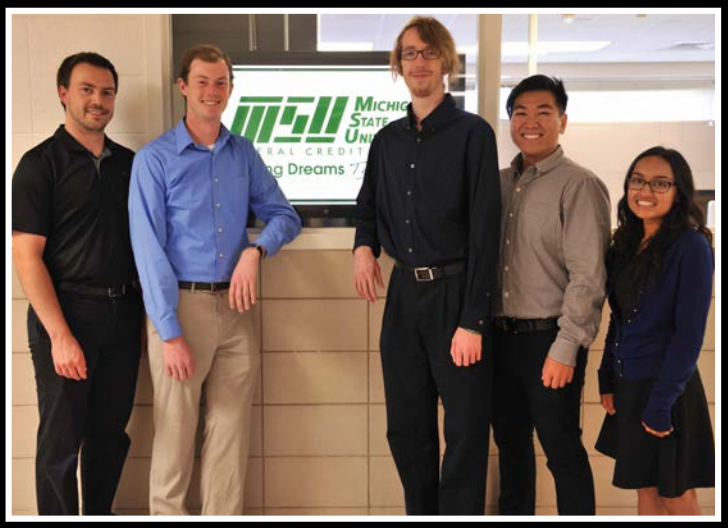
Our *Online Dollar Dog Store* works on desktop and mobile web browsers including iPhones, iPads and Android devices.

MSUFCU administrators use our companion web app to edit the store catalog and adjust user coin balances.

Our *Online Dollar Dog Store* native mobile apps are written in Java and Swift. The responsive web app uses CSS, HTML, JavaScript, and Bootstrap. All three platforms connect to a MySQL database via a PDO connection through an API running PHP.



MICHIGAN STATE UNIVERSITY
FEDERAL CREDIT UNION
Building Dreams Together



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Quicken Loans
Enterprise Roadmap Tool

Quicken Loans, based in Detroit, is the largest online mortgage lender in the US. With almost 30 years of experience, their customers include over 2 million families.

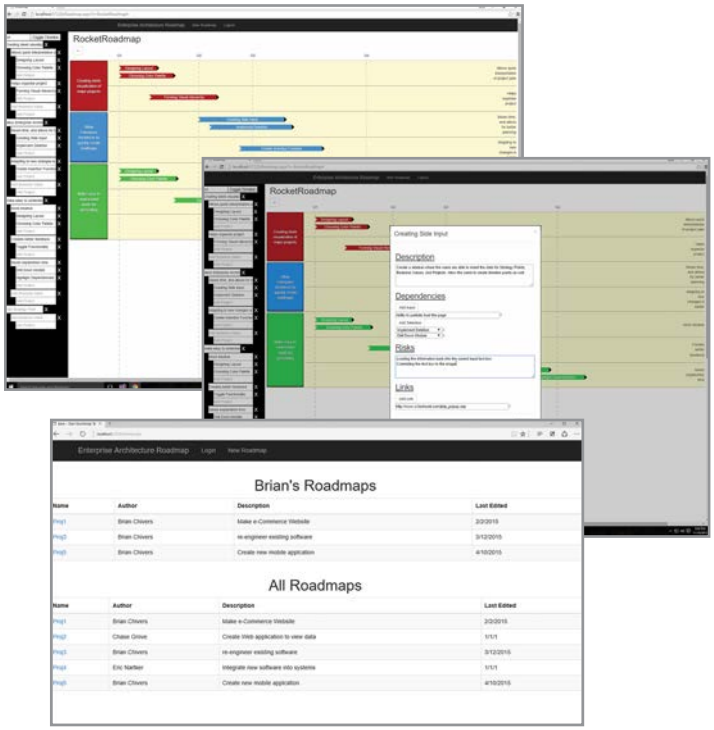
Quicken Loans designs and develops its own enterprise software systems, which often requires significant amounts of time and money. In order for senior level executives to make sound business decisions about investing in the development of these new systems, executives must understand what's being proposed and why.

Our *Enterprise Roadmap Tool* provides visualizations of Quicken Loans' enterprise software systems including projects being proposed and developed. Executives view an intuitive project roadmap rather than reading a complex document.

Enterprise architects use our system to build project roadmaps and their main components: the strategic purpose, the business value, and the tasks that need to be accomplished to achieve the purpose and business value.

A roadmap presents a high-level overall view of a project, color-coding tasks and business values to show dependencies. As executives drill down into the details, popups provide more information such as a task's description, its dependencies on other tasks, risks involved, and links to outside relevant information.

Our *Enterprise Roadmap Tool* is written in JavaScript and C# using the .NET framework. The database is implemented using Microsoft SQL Server 2012.



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Spectrum Health
Patient Service Delivery Planning

Spectrum Health, located in Grand Rapids, Michigan, provides high quality, high value healthcare through its seven hospitals, more than 140 service sites, and Priority Health, a health plan with nearly 500,000 members.

Our *Patient Service Delivery Planning* system increases customer satisfaction for patients while at the same time improving efficiency for Spectrum Health. It consists of two distinct parts, a mobile app and a web app, which share a common backend.

Our mobile app enhances the experience for patients by finding the nearest Spectrum Health urgent care center with the shortest wait time.

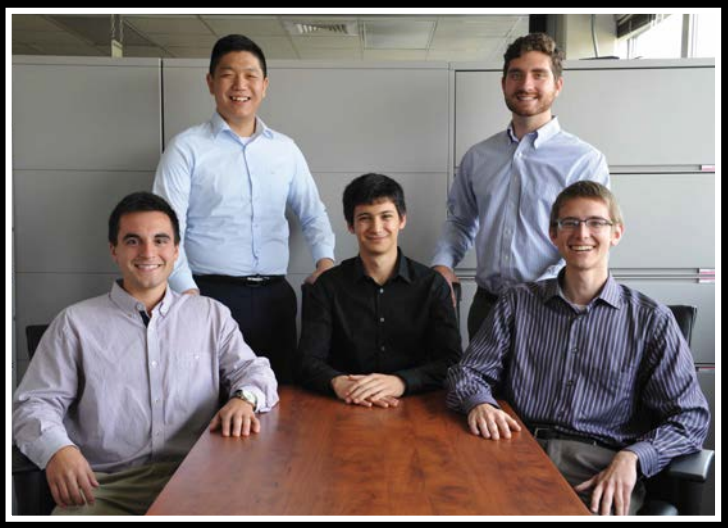
In addition, patients can see predicted future wait times so that they can plan for future visits on days and at times when wait times are normally shorter.

Our companion web app provides Spectrum Health with graphs and analytics of both past and predicted patient arrivals. Spectrum Health leverages this data to staff their facilities, optimize business hours, and predict average treatment time.

Both the mobile app and the web app use complex statistical software that predicts patient wait and treatment times. The design of this predictive model is completely modular so that it can be easily updated, enhanced, or even completely replaced.

Our *Patient Service Delivery Planning* system is written in C#, JavaScript, and R using AngularJS, D3.js, and MongoDB.

SPECTRUM HEALTH



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Symantec

Integrated Silent Authentication via Symantec VIP

Based in Silicon Valley, Symantec Corporation is a security technology company that offers software products and services related to computer and information protection.

While passwords are the most common method to authenticate users, using passwords alone is not secure. Security is increased by adding a second factor such as a unique secret PIN generated dynamically on a user's mobile phone.

Symantec provides a two-factor authentication (2FA) product with their "Validation and ID Protection" or VIP service.

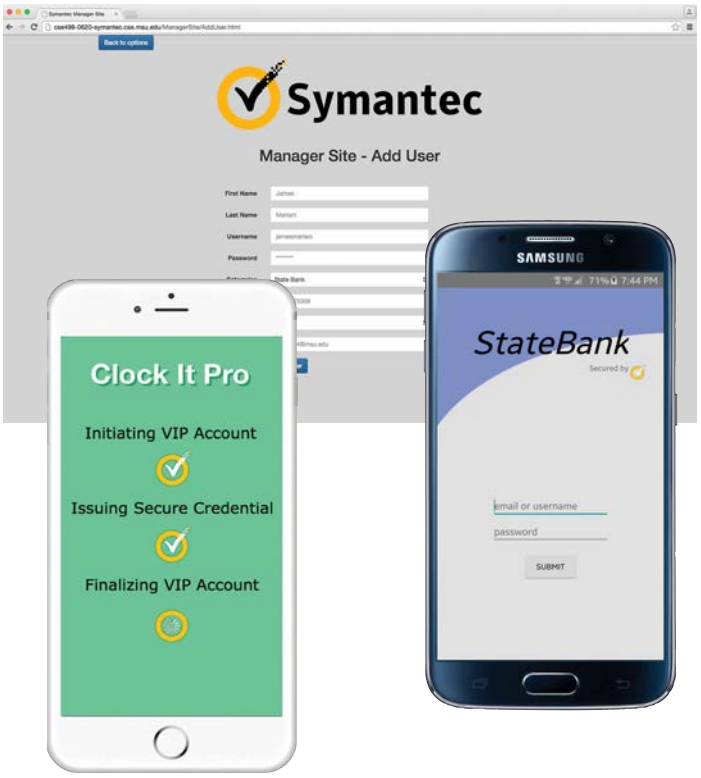
Typical 2FA on a mobile device is cumbersome. A user must enter a userid and password in one app, generate a secret PIN with a second app, copy the PIN from the second app, and finally paste the PIN into the original first app.

Our *Integrated Silent Authentication* via Symantec VIP architecture integrates the second authentication factor into an app so that it's done silently and automatically for the user.

Our system consists of multiple sample apps including "Clock It Pro" and "StateBank." Users need only enter their userid and password, which demonstrates the user friendliness of the VIP service by making 2FA transparent to the user.

Our sample apps with corresponding documentation are used by Symantec customers to design and develop their own apps.

Our Android and iPhone apps are written in Java and Swift, respectively. Communication with Symantec servers is accomplished through the Symantec VIP SDK as well as our own Java Enterprise Edition server. Our data is stored in a MySQL database.



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TechSmith
Intelligent Real World Text Recognition

TechSmith is a leading developer of screen capture, video capture, and editing software including the very popular Snagit, Camtasia, TechSmith Relay and Morae, which are used by companies and educational institutions around the world.

Our *Intelligent Real-World Text Recognition* app uses a device's camera to find text in the real world, recognize what it is, and then perform a task depending on the format of the text.

For example, if our app recognizes text as a phone number, it offers to call it or save it. If it sees an email address, it can send an email. If our app recognizes a street address, it gives the address to Microsoft's Bing Maps.

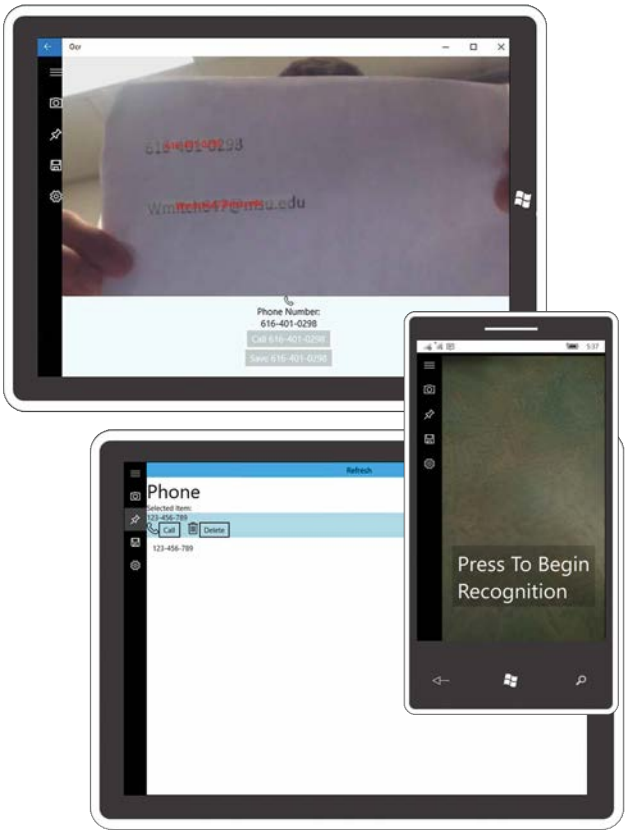
A useful feature of our app is its ability to read text out loud for the visually impaired or someone learning to read.

Our app is a Universal Windows 10 application, which means that it runs on any Windows 10 platform including phones, tablets, laptops and Raspberry Pi devices.

Users can save recognized text to the cloud and access it from any Windows 10 device.

Our app meets accessibility standards so that it is usable by those with disabilities. It enhances productivity for all users.

Our *Intelligent Real-World Text Recognition* app is written in C# and XAML. Microsoft Azure cloud services and an SQL database store the recognized text. Microsoft's Optical Character Recognition Engine converts camera frames to text, which is then recognized using regular expressions.



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Urban Science
Visualizing Brand Loyalty

Urban Science is a business-solutions company focused on supporting the sales and marketing needs of automotive companies. They leverage a scientific methodology to help their client partners sell more vehicles, improve profitability, and increase customer loyalty.

At each client partner, marketing managers track customer loyalty through a variety of metrics. By looking at "repurchase loyalty scores," managers determine the amount of customers repurchasing the same vehicle brands. Low scores prompt consideration of new marketing schemes.

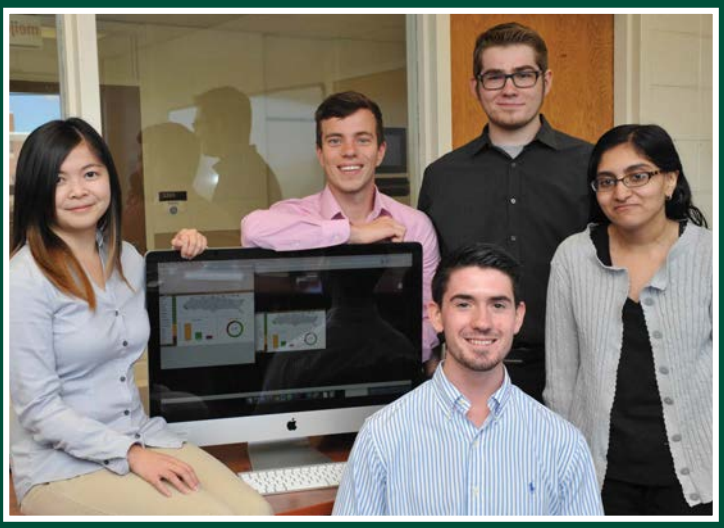
Our *Visualizing Brand Loyalty* app consolidates loyalty data in expressive visualizations that enable loyalty managers at client partners to quickly assess market performance.

Using a multi-diagram interface, loyalty managers select a market of interest for a specific manufacturer's brand or model. Markets are colored red or green depending on the loyalty of customers, which allows loyalty managers to identify which markets are struggling and what former customers are buying instead of their vehicles.

Loyalty trends over time illustrate new customer (conquest) data and former customer (defection) data. Monthly push notifications alert loyalty managers of newly acquired market data.

Visualizing Brand Loyalty is an application written for Apple and Android tablets. It is built on the Ionic framework using AngularJS and the D3 visualization library. PHP connects the application to a Microsoft SQL Server database.

URBAN SCIENCE



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Whirlpool Corporation
Whirlpool Indoor Maps

Headquartered in Benton Harbor, Michigan, Whirlpool is the world's leading global manufacturer of home appliances, employing over 100,000 people across 170 countries.

Whirlpool's facilities include many buildings with hundreds of conference rooms and thousands of cubicles. So, finding a specific conference room or cubicle in an unfamiliar building can be quite a challenge. In addition, determining room availability for meetings is often difficult and time-consuming.

Our *Whirlpool Indoor Maps* (WIM) app provides interactive maps of Whirlpool buildings. Using our simple and intuitive design, employees can access and explore maps of any building at any Whirlpool location with their mobile phone.

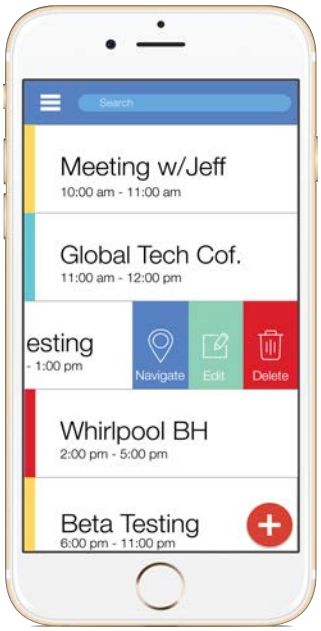
WIM enhances the everyday work life of Whirlpool employees in a unique way by displaying up-to-the-minute Google Calendar information.

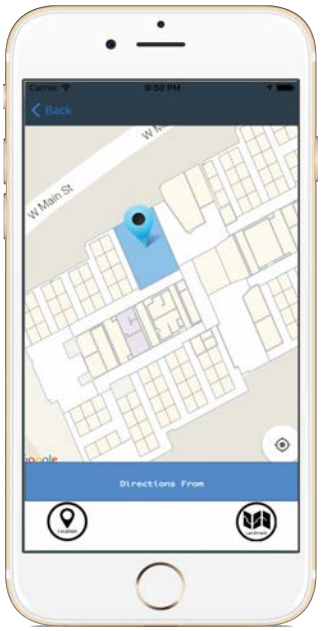
Our app combines Google Calendar with maps to provide a streamlined service so employees can find and book available meeting rooms with visual map feedback.

To ensure simplicity, meetings for the day are readily available for viewing, editing and deleting.

Our mobile maps, combined with reservation and navigation functions, provide a comprehensive tool that increases the productivity of Whirlpool employees worldwide.

Our *Whirlpool Indoor Maps* app runs on both iPhones and Android phones. The iPhone app is written in Swift, while the Android app uses Java. Both utilize Google's API services.





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Design Day Awards

CSE 498, Collaborative Design, is the senior capstone course for students majoring in computer science. Teams of students design, develop, and deliver a significant software system for corporate clients. The CSE capstone teams compete for four prestigious awards. The winners are selected on Design Day by a panel of distinguished judges.

Auto-Owners Exposition Award

Auto-Owners Insurance
Life Home Car Business
The "No Problem" People®

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 Whirlpool
Launder: Laundry Room Tablet

Sam Bentzel, Evan Swinehart, Angie Sun, Alex Kambeitz
Presented by Scott Lake

General Motors Praxis Award

GM

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 General Motors Praxis Award, which is sponsored by General Motors of Detroit, Michigan.

Team Ford
Electric Vehicle Charging Station App

Ryan Switzer, Justin Grothe, Kevin Karabon, Brian Jurgess
Presented by Mike Adelson and Fred Killeen

Spring 2015

Design Day Judges

Samantha Amburgey
MSU Federal Credit Union

Barb Dawson
Michigan State University

E. J. Dyksen
Mutually Human

Rich Enbody
Michigan State University

Adam Haas
Ford Motor Company

Louise Hemond-Wilson
IBM

Fred Killeen
General Motors

David Mysona
Blackstone Technology Group

Matt Packowski
General Mills

Marty Strickler
Rose Packing Company

Dave Washburn
MSU Foundation

Mark Welscott
Spectrum Health

Karen Wrobel
Chrysler

TechSmith Screencast Award

TechSmith®

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

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

Team GM
Employee Companion Mobile Application

Jacob Ray, Yutaka Iwasaki, Ryan Boyce, Nate Seifert, Derrick Dunville
Presented by Dewey Hou

Urban Science Sigma Award

URBAN SCIENCE

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

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

Team Amazon
SIFT: Seller-Forums Information Filtering Tool

Ben Taylor, Max Goovaerts, Carl Johnson, Johnny Zheng, Luke Pritchett
Presented by Kathy Krauskopf and Matt Bejin

TechSmith®

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TechSmith is based in Okemos, Michigan just outside of the state capital, but our software can be found all around the world. We LOVE our employees and are always looking for ways to reward outstanding performance. We offer you a **unique and growing** company culture where you can enjoy your work and advance your career. If this sounds like a place you would like to work, go to **www.techsmith.com/careers** to apply today!

amazon

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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.

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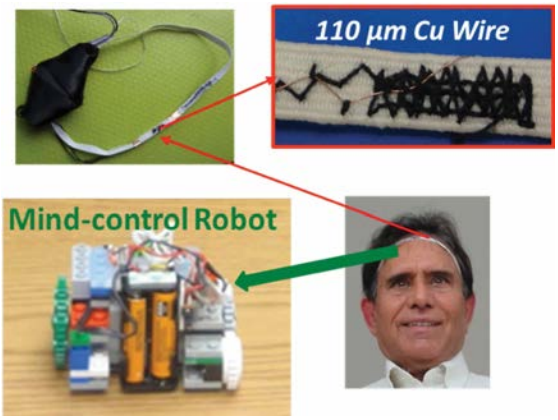
www.amazon.jobs

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 laboratory experiments linked to new research and teaching areas. These experiments relate to (a) computer switches, (b) mind-control robots, (c) program LEGO robot using C-code (MSP430 microcontrollers) and NXT controllers, (d) pH measurement using NXT sensors, (e) maple-seed robotic fliers (MRF) with on board electronics, (f) location of bio-molecules using RFID, (g) renewable energy resources using windmill and solar cells, and (h) nanotechnology study using a LEGO gear-train.



This semester's projects include:

Teams	Project Title
Team #1: Amin Asraf, Zach Daniels, Jovani Pacheco, Shayne Palmer	NXT robot sensor, sorting pH levels using the pH sensor
Team #2: Bailey DeLuca, Savannah Detzler, Steven Grosz, Kyle Heethouse	NXT robot sensor, sorting colors using the color/light sensor
Team #3: Brian Amburn, Brandon Nhica, Elizalde Vasquez	Energy collection by windmill
Team #4: Guanlin Cheng, Rob Gabridge, Josh Meyer	3d printer enabled modeling of MRF

LAB INSTRUCTOR: Sean Evans

The Capstone Projects

Dr. Timothy Grotjohn
Professor of Electrical and Computer Engineering

Dr. Lalita Udpa
Professor of Electrical and Computer Engineering

Presentation Schedule – Room 2250 Engineering Building, Second Floor

Time	Team Sponsor	Project Title
8:05 a.m.	Dr. Satish Udpa	RFID Luggage Tagging and Tracking
8:25 a.m.	Fraunhofer USA	Monitoring of Diamond Polishing Process
8:45 a.m.	Great Lakes Controls & Engineering	Incoming Power Grid Monitoring
9:05 a.m.	St. Mary Star of the Sea	Historic Building Video Monitoring
9:25 a.m.	ArcelorMittal	Cone of Safety around Crane Hook
9:45 a.m.	Break	
10:00 a.m.	TRIFECTA	Classroom Noise Monitor
10:20 a.m.	Michigan State University	Early Warning Sensing for Solar Panels
10:40 a.m.	MSU ECE Department	agBOT Challenge
11:00 a.m.	MSU Resource Center for Persons with Disabilities	E-Bike Motor and Controller
11:20 a.m.	Whirlpool	Wireless Sensor Unit for Dryers

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, Fraunhofer USA, Great Lakes Controls & Engineering, Michigan State University, MSU College of Engineering, MSU ECE Department, MSU Resource Center for Persons with Disabilities, St. Mary Star of the Sea, TRIFECTA, and Whirlpool. Thank you to each of these team sponsors.

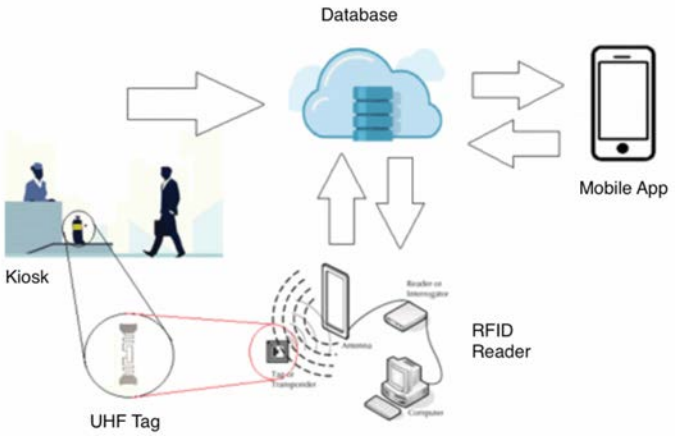
Dr. Satish Udpa
RFID Luggage Tagging and Tracking

The current luggage tracking system, centered around barcode reading, is prone to failure as evidenced by the 15% failed scan percentage. These failed scans result in significant damages to airlines both in reputation and in monetary deficits in the form of customer compensation and manual labor costs. The Sponsor for Design Team 1, Dr. Satish Udpa, has proposed a new system for scanning, revolving around the use of Radio Frequency Identification (RFID) technologies.

RFID is becoming increasingly popular in a variety of fields including access security, commercial shipping, and anti-theft systems. Because of the recent increase in RFID usage, production has increased to the point where the cost associated with the components has decreased to practical levels, making more industries interested in integrating these technologies into existing systems.

The team's airport RFID reader is capable of scanning a single tag from up to five meters away and multiple tags over smaller distances. After scanning a tag, the reader adds the encoded information to a database from which an airline or customer can retrieve information pertaining to a specific bag. The mobile reader can identify a traveler's luggage from within a foot by comparing the scanned tag with the user's information in the database. By seamlessly reading this information from a tag, the location and status of a piece of luggage may be more easily processed and tracked.

Ultimately this technology will revolutionize automation in the commercial industry due to its passive nature, near perfect read success rate, and low costs. The team is excited to see the future of RFID technology.




Dr. Satish Udpa

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Ziye Xing
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Dr. Satish Udpa
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Dr. Satish Udpa
East Lansing, Michigan

Project Facilitator

Dr. Tongtong Li
East Lansing, Michigan

Fraunhofer Center for Coatings & Diamond Technologies

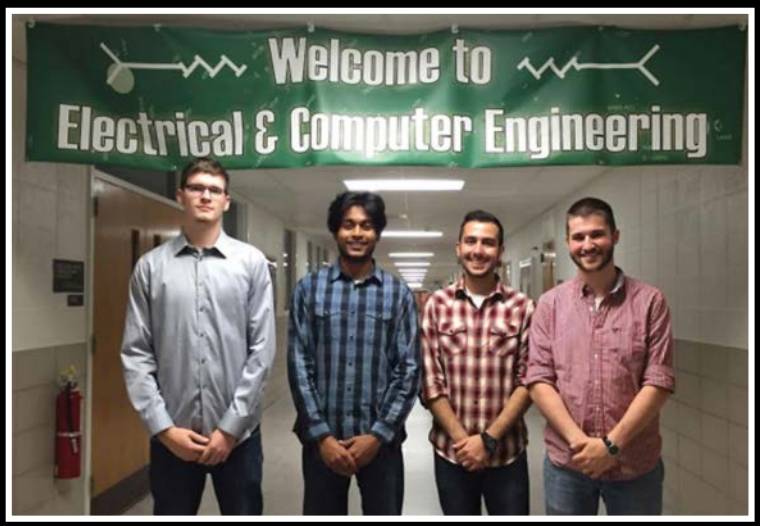
Monitoring of Diamond Polishing Process

Diamond polishing begins by gluing a diamond onto the bottom of an assembly arm which then is held against a high-speed, rotating wheel, coated with diamond powder. The diamond is held against the cast iron wheel and is polished. While the diamond scrapes against the wheel it emits a "sound." These sounds are frequencies which vary depending on the balance of the arm and wheel as well the surface and shape of the diamond. Currently, other than listening with your own ear, the diamond polishing lab has no way of indicating how smoothly the polishing is going. In order to monitor this difference in sound, a device will be created that will send real-time data to the operator so they can monitor the current polishing. This data will also facilitate future experiments.

The design relies on a two-microphone system which will collect the frequencies emitted from the wheel and the diamond. The frequencies emitted from the wheel will be filtered using a band-pass filter, and the frequencies emitted from the diamond will be filtered using a high-pass filter. Both of these frequencies will be shown on a display as well as sent to the operator's computer by microcontroller.

Additionally, to monitor the balance of the arm, an accelerometer will be used and connected to an alarm so the operator will know when the arm balance needs to be fixed.

Fraunhofer



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Anthony Garvert
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Fraunhofer USA
Project Sponsor

Aaron Hardy
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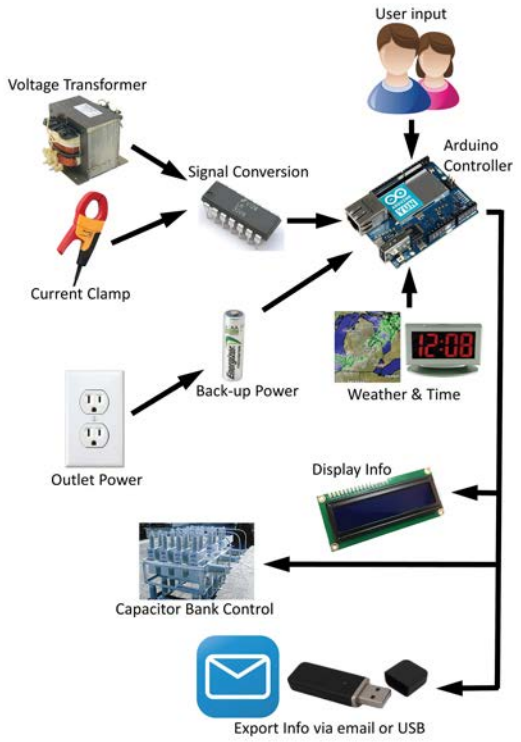
Great Lakes Controls & Engineering
Incoming Power Grid Monitoring

Great Lakes Controls & Engineering was recently contracted with the task of developing a power monitoring system that will be applied in factories that use 3 phase power. 3-phase power could possess voltage imbalance and poor power factor. Voltage imbalances damage delicate machinery which could be expensive to repair or replace. Poor power factors result in additional charges from power utilities.

Great Lakes Controls & Engineering experimented with the EXTECH 3-Phase Power Analyzer/Datalogger as a way to monitor the problem. Although the device possesses many functions for power monitoring, it lacks the ability to send notifications upon the detection of a voltage imbalance and log large amounts of data. Team 3 was tasked with developing a device which would replicate the functions of the EXTECH device and possess additional features to make up for its shortcomings.

To meet the requirements set forth by our sponsor, we designed a device that will sense an analog power signal and log the data into the device's internal memory, simultaneously comparing the logged data with the set voltage and current tolerances. If the data are above the tolerance, a notification email will be sent with a time stamp of when the event occurred. The device will be equipped with three additional features: a capacitor bank control circuit that will switch on if the detected power factor is below the set tolerance, a backup battery that will be switched on upon the loss of power, and the ability to export the logged data wirelessly.



Great Lakes Controls & Engineering

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Great Lakes Controls & Engineering
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St. Mary Star of the Sea
Historic Building Video Monitoring

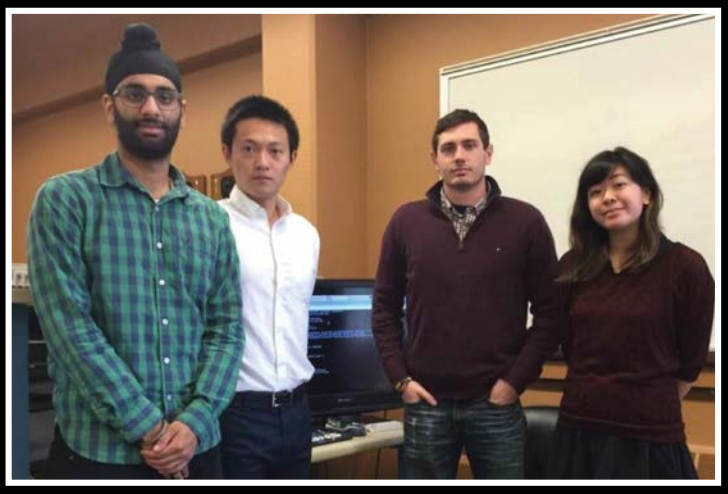
St. Mary Star of the Sea Church is a Catholic parish church built in 1926 – almost 90 years ago – in Jackson, Michigan. The church is home to countless historic treasures, including a 125-year-old Roosevelt pipe organ designed and built by the cousin of President Franklin Roosevelt. By installing a video monitoring system, this nearly century old facility will be enhanced with 21st century capabilities.

This project has the ability to positively impact the entire St. Mary community, especially the parents of young children. Currently, if children act out or start crying during the service, parents have only two options: 1) keep attending the service at the cost of their child disturbing other participants, or 2) leave the service to relocate to the church's 'crying room.' Neither option is desirable. Implementation of this system will make it possible for parents to participate remotely. A wireless camera will transmit a live video feed to a TV in the 'crying room,' so parents do not miss out on the speaker's message.

The same system can also be used to monitor the church for unwanted intrusions. The camera will be left on 24/7 to provide surveillance. Video will be recorded onto a computer to play back footage as necessary.

Pictured on the right is a basic concept of the system: video from the camera is sent to the computer, the computer outputs video for live streaming and saves video onto a hard drive, and the HDMI receiver displays feed on a monitor.

ST. MARY STAR OF THE SEA PARISH



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St. Mary Star of the Sea
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ArcelorMittal
Cone of Safety around Crane Hook

ArcelorMittal needs a reliable and robust way to measure large coils of cold-rolled steel coming off their production line. The proposed solution is to use the Axis Communications P1355-E Camera to capture live high quality video of the steel as it is being coiled at the end of ArcelorMittal's line. A dedicated computer will process the image produced by the Axis camera. This computer will be connected to the Axis camera and current system using Ethernet cables.

ArcelorMittal is the world's leading steel and mining company with presence in 60 countries and has an industrial footprint in 19 countries. ArcelorMittal is guided by a philosophy to produce safe and sustainable steel. ArcelorMittal prides itself in providing a safe work environment for its employees. To further their commitment to safety, ArcelorMittal is proud to be a sponsor of a Capstone Project at Michigan State University.

ArcelorMittal's commitment to advancing safety throughout their East Chicago, Indiana facility can be, in part, accomplished by implementing a cone of safety on remote control overhead cranes. Overhead cranes carry steel coil loads back and forth throughout the Finishing Department. The project description includes invoking a system that will create a cone around the steel coils that will sound an alarm if the crane operator enters the cone. The system will turn on at a predetermined height and the radius of the cone will change as the crane moves up and down.

The designed system will consist of two major components. One component is a sensing system to know when an operator breaches the cone. The height of the load will be sensed by a proximity sensor and activate a thermal sensor of a programmed radius that changes when the height changes. The second component is an alarm system that will sound an alarm and record alarm data when an operator is sensed by the thermal sensor's cone. The recorded alarm data will allow ArcelorMittal to effectively create procedures to better protect crane operators.

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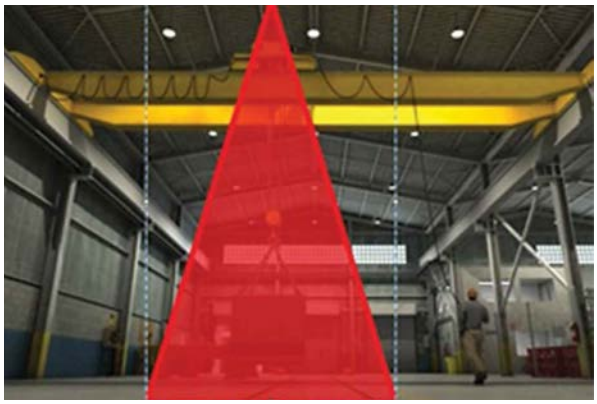
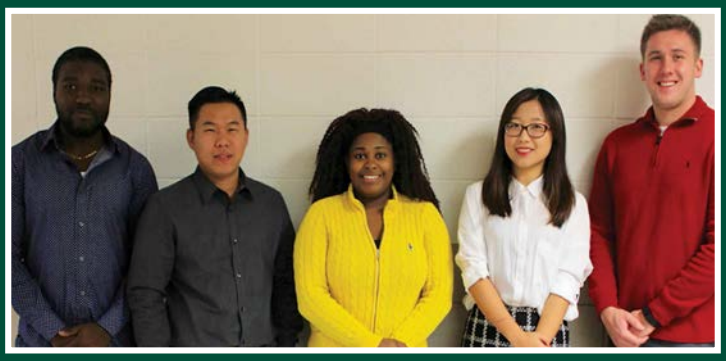


ArcelorMittal



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TRIFECTA
Classroom Noise Monitor

The Trifecta initiative is an intercollegiate effort between the Michigan State University Colleges of Engineering, Communication Arts and Sciences, and Nursing. Their goal is to advance the delivery of health services for diverse communities around the world.

Classroom noise is a frequent problem in elementary schools. Teachers need to talk louder to be heard over the children, which often results in missed work due to vocal strain and in some cases voice disorders. Research in classroom noise acoustics suggests that there should be at least a 6-decibel difference between the teacher's voice and the background noise in order for students to comprehend what the teacher is saying.

The children need to learn to lower their voices during class. The device proposed would measure the noise of the children and the noise of the teacher. Using spectral subtraction, the teacher's voice signal is removed from the background noise monitor. Then, the two dBa levels are compared and, if they are too close, a lighting system will activate. This lighting system will activate based on noise level. Using the three colors of a traffic light, the children will be informed of how loud they are being. The children will then be able to correct their own behavior, and classroom noise will decrease.

Over time, teachers will need to strain their voices less, and will miss less time at work. If implemented when students are young, this behavior modification will have a positive effect as they enter higher levels of schooling.

TRIFECTA
TECHNOLOGY AND RESEARCH INNOVATION FOR HEALTH

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TRIFECTA
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Michigan State University
Early Warning Sensing for Solar Panels

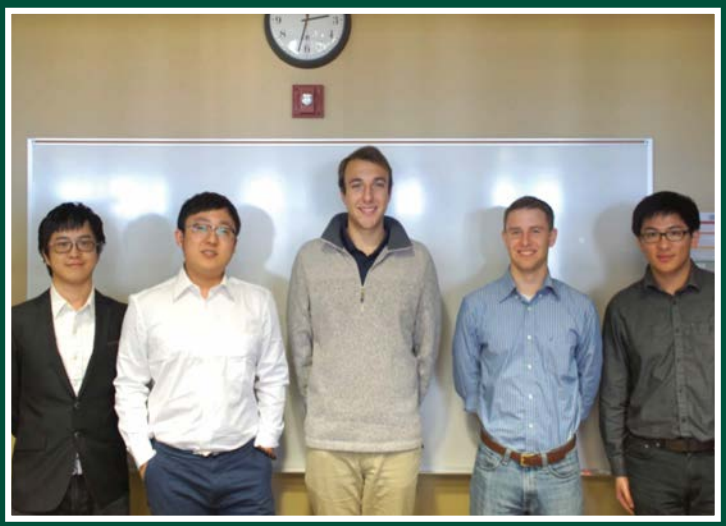
Michigan State University, in an effort to use renewable energy, is in the process of acquiring a solar panel array. The solar panels will be located in the southern section of Michigan State's campus and will cover five large parking lots via carport structures. Solar energy electricity output depends on the amount of light shining at any particular time. Since the electricity output depends upon the current weather a sudden change in cloud cover will create a reduction in the solar panel power output and create costs to import backup power go up greatly.

Our team is developing an early warning system based on remote sensors, which will enable users to anticipate changes in the output of the solar array and take appropriate action in the local profile.

By placing sensors a designated distance outside the solar panel array, a time series of the amount of light can be taken and relayed wirelessly to the control station. A software program takes the data and creates a real-time simulation of the weather around the solar panel array. Using real-time simulation, an early warning can alert users to changing weather conditions.

A sensor and microcontroller will be placed on residential homes around the area. At these locations the sensor data can be uploaded to the residential owners' Wi-Fi and to a server accessible for the software platform.

MICHIGAN STATE UNIVERSITY



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MSU Department of Electrical Engineering
agBOT Challenge

AgBOT stands for Agriculture Robot which is capable of performing farming processes like seeding and spreading fertilizer with minimum human intervention.

The agBOT Challenge is to create an agricultural robot that has the capability of planting two types of seeds and applying liquid fertilizer on top for 12 half-mile long rows. The entire process should be done autonomously.

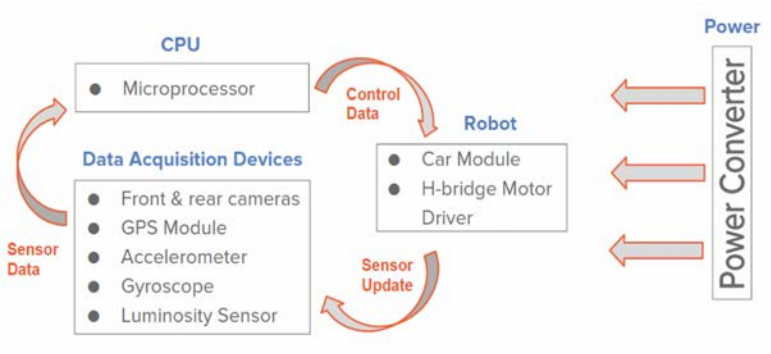
The agBOT should exchange data, such as the speed of the robot, seeding speed and the position of the robot. The agBOT also needs to have front and rear cameras that can provide live video feed.

Due to time and budget constraints, a complete agBOT could not be built. Therefore, our project was to build a scaled-down model of a real agBOT and focus mainly on the electronics of the agBOT.

The electronics includes driving in autonomous mode based on GPS, and communications which includes transferring data and live video feed.

We have used Raspberry PI with GPS and Gyroscope module to operate the car. Wi-Fi was used for communication purposes. We also have three sensors collecting passive data that do not affect any driving process.

A control loop between Raspberry PI and GPS is responsible for the autonomous driving. Moreover, there are connections for expanding passive sensor modules for future upgrades.



Original Scale	Scaled Down Model
½ mile rows	100 meters
30 inches wide row	6 inches wide rows
Full Size Truck	13-inch RC car

2016 agBOT Challenge

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Team Members (left to right)

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Yirui Wu
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Chen Hao
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MSU Department of ECE
Project Sponsor

John Albrecht
East Lansing, Michigan

MSU RCPD
E-Bike Motor and Controller

In a novel entrepreneurial enterprise, Dr. Pauliah and his sister Ms. Pauliah of the Sunrise Orphanage in Bobbili, India, are seeking a product that can be manufactured and sold to help support the orphanage and add a low-cost medical clinic to the existing facility.

Michigan State University is affiliated with the Sunrise Orphanage and its future clinic through Asian Aid USA, a Christian nonprofit organization that is committed to making a difference in the lives of children and people in poverty.

Asian Aid High School students in Jaipur, India learn electronic circuit design from Stephen Blosser, an Assistive Technology Specialist at the Resource Center for Persons with Disabilities. Mr. Blosser is an honorary ambassador volunteer with orphanages in the area and helps choose technology for the orphanage members to work with. He has designed an electric tricycle, which is in high demand in India and around the world.

Team 9 is designing a motor controller for a low-cost, high- independence, and rugged electric vehicle. Typically, they are powered through the use of a costly DC motor.

To combat this problem, ECE 480 Team 9 is using an inexpensive automotive alternator that replaces the DC motor, providing higher efficiency and increased torque at wider ranges of speed.

Resource Center for
Persons with Disabilities

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MSU RCPD
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Piotr Pasik
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Whirlpool Corporation
Wireless Sensor Unit for Dryers

Selling more than 20 billion dollars' worth of home appliances to over 170 countries, Whirlpool Corporation is an American multinational manufacturer and a Fortune 500 company. Whirlpool markets top-of-the-line products such as refrigerators, range tops, microwaves, washers and dryers. Their brand recognition and reliability is the reason why they are so common in households and public facilities. Whirlpool is always trying to innovate and improve their current products. Recently they have been looking to advance their dryer line. Throughout the semester, Team 10 has been working closely with the Whirlpool engineers to develop a new system which will be incorporated in their current dryer technology.

The goal of this project is to deliver an electronic system that is capable of sensing garment dryness attributes (temperature, moisture, humidity, etc.) from within the dryer's rotating baffle and communicating this information to the "appliance control unit" (ACU) without the use of physical wires. The cost of the total system solution should not exceed $5.00. This includes the cost of the ACU circuit, sensing circuit, and the interface between them. The system solution should last at least 10 to 12 years, but 20- and 30-year-old dryers are common.

Whirlpool CORPORATION

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Whirlpool Corporation
Project Sponsors

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Design Day Awards Spring 2015

Electrical & Computer Engineering Prism VentureWorks Prize & Winners, Spring 2015

The Prism VentureWorks Prizes ($1,500, $1,000, and $500, respectively), 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. The prizes are sponsored by Prism VentureWorks, a Boston-based venture capital firm, and Mr. William Seifert, an ECE alumnus, who is a partner in that firm. The faculty and students of Electrical and Computer Engineering are very grateful for this generous support.

Prism VentureWorks First Prize: Instrumented Sensor Technology: Lightning Strike Detector, Counter and Time Log

Left to Right:
Dr. Tom Wolff, Zongheng Pu, Matt Clary, Justin Bauer and Adam McHale
Not pictured:
Deandre Dawson

Prism VentureWorks Second Prize: Consumers Energy: Drone Monitoring of Power Lines

Left to Right:
Dr. Tom Wolff, Faisal Tameesh, Dan Pittsley, Ian Meredith, Jake Hersha, Mitch Johnson and Cody Wilson

PrismVentureWorks Third Prize: Great Lakes Controls and Engineering: Screw Machine Tool Condition Monitoring

Left to Right:
Dr. Tom Wolff, Kyle Burgess, Richard Skrbina, Caitlin Slicker, Ali ElSeddik and Chris Vogler

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#iamNS

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ME 371 Mechanical Design I

Dr. Assaad Alsahlani
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. These engineering marvels will be demonstrated and displayed with a complementary poster explaining the subtleties of each mechanism. The ME 371 teams will also be interviewed and rated by the pre-collegiate students. The most highly-rated team will be awarded the Sparty Plaque, which was designed and fabricated by students at Holt Junior High School over a decade ago.

Teams and members: Section 1

Team 1
Kalie Collins
Stephen Covitz
John Ellbogen
Mark Johnson
Takahiro Yuasa

Team 2
Rachael Acker
Kyle Benedict
Brandon Fortman
Qiren Gao
Shangyou Zeng

Team 3
Andrew Franko
Abigail Henning
Trevor Herrinton
Daniel Lumley
Trevor Young

Team 4
Shane Frakes
Matthew Hitch
Ian May
Tyler Stricker
David York

Team5
Martin Dwornick
Jacob Krummrey
Nicholas Mikelsavage
Jacob Neubecker
Joshua Neubecker

Team 6
Michael Accettura
Saad Bahbishi
Alec Czanderna
Kathleen Noblet
Jennie Parrish

Team 7
Mhna Bawzieer
Nicholas Goguen
Yu He
Cody Lange
Alexander Starbird

Team 8
Caleb Calfa
David Meleca
Jeremy Reisig
Jordan Timm

Team 9
Shuowei Geng
Yewei Jiang
Guangchao Song
Penghao Wu
Qilin Zhu

Team 10
Alexandra Morford
Ian Mular
Lindsay Nault
Breanna Osborn
Evan Weider

Team 11
Brendan Fitzpatrick
Kyle Hawkins
Saul Makanga
Gueorgui Tzourov
Olivia Weprich

Team 12
Alex Arcaro
Troy Baertson
Tyler Draggoo
Jonathan Ristola

Teams and members: Section 2

Team 1
Faisal Bakir
Erik McGuire
John McLaughlin
Nathaniel Noel
Daniel Riggs

Team 2
Kyle Foco
Yuzhou Gu
Troy Willmer
Haonan Zhou

Team 3
Mark Hartfelder
Kyle Moeller
Michelle Samalik
Christopher Slamp
Morgan Weber

Team 4
Jared Abood
Sagar Dangal
Matthew Hart
Stephen Moye
Richard Tran

Team 5
Andrew Benson
Kevin Ellis
Tianyuan Gu
Kyle Ringwelski
Zirui Wang

Team 6
Michael Gaduski
Jesse Ouellette
Trevor Ploucha
Michael Rasmussen
James Ryan

Team 7
Mark Becker
Simbarashe Chidyagwai
William Kelly
Jack McDougall
Leah Nonis

Team 8
Joseph Brooks
Wes Dorin
Abraham Esa
Sahem Marji
Aaron Urbonya

Team 9
Sarah Egbert
Brittany Galliers
Alexander Ho
Eric Olsen
Raymond Renaud

Team 10
Alexander Caine
David Jagow
Alexander Kowal
Wesley Lanigan

Team 11
Ryan Boutet
Jake DePierre
Evan Gallagher
Kendra Martin

Team 12
Farhan Ahmed
Herbert Darrow
Matthew Gagnon
Kevin Rogers
Matthew Schomisch

Team 13
Samuel Boyea
Connor Daly
Karan Ghuman
Andrew Wandor

ME 412
Heat Transfer Laboratory

Dr. Neil Wright
Associate Professor of Mechanical Engineering

Theory and Practice of Heating of a Hot Dog

This project is concerned with the practical problem of heating a hot dog that has been skewered by an electrical resistance heater and the use of heat-transfer principles to predict how its surface temperature changes with time. Each team will skewer an MSU meat-laboratory hot dog with a welding rod of some other resistance heater of its own design. The team will then connect the heater to a DC power supply, applying as much as 20 V and 100 A to heat the hot dog. After five minutes, the surface temperature at the mid-point of the hot dog will be measured. The team which achieves the greatest surface-temperature increase and predicts that increase most accurately wins.

Competition Schedule

Time	Team #	Station	Team members
8:00	3	A	Fenykumar Patel, Ankit Sharma, Karan Takkallapally
	10	B	Benjamin Allen, Jay Gersonde, Alex Zettler
8:15	12	A	Angel Begov, John Gillis, Jacob Vymazal
	16	B	Robert Cenowa, Keegan Connolly, Joseph Senechal
8:30	17	A	Philip Lecznar, Melanie Mullett, Alan Richards
	21	B	Bradly Labaere, Trevor Laskowski, Amanda Sliney
8:45	23	A	Evan Boyers, Evan Flynn, Nathan Gill
	26	B	Alvin Chiang, Julian Diaz, Xuelai Wang
9:00	15	A	Daniel Bowers, Shane Toreki, Kevin Wilberding, Robert Wygant
	13	B	Omar Elsherif, Kevin Pugh, Patrick Vaughan
9:15	19	A	Andrew Poteracki, Andrew Stieber, Jay Thanedar
	1	B	Taylor Gilliland, Trevor McSween, Samantha Pohlen
9:30	18	A	Curtis Coscarelly, Dylan Etheridge, Kyle Medrano
	24	B	Katherine Donnay, Tyler Ellsworth, Kimberly Fortenberry
9:45	2	A	Laura Gumpper, Jennifer Jones, Renee Wirsing
	5	B	Jessica Buschman, James Hargrove, Elisabeth Warner
10:00	14	A	Alexander Hoover, George Lewis, Koreco Wilkins-Webster
	7	B	Ryan Clark, Dominique Dubay, Daniel Seiderman
10:15	25	A	Garrett Dunn, Yash Kankaria, Harsh Patel
	4	B	Nassar Alhajri, Ross Buckley, Michael Pinger
10:30	20	A	Tyler Finses, Mark Taylor, Michael Thelen
	27	B	Tyler Gallant, Graham Goble, Michael McKinley
10:45	22	A	Kane Clark, Alexander Gore, Daniel Ignatowski
	8	B	Dingyu Hu, Haocheng Sun, Hengyun Wan
11:00	11	A	Joshua Cresswell, Aimee Griffin, Basil Thurston
	9	B	Micah Appel, Ryan Kutcher, Zachary Tuller
11:15	6	A	Jun Sheng, Libin Ye, Yijia Zhang
	28	B	Ryan Glynn, Qin Liu, Jinyang Qiu

ME 471 Mechanical Design II

Dr. Ron Averill
Associate Professor of Mechanical Engineering

Dr. Patrick Kwon
Professor of Mechanical Engineering

Design of a Wheelchair Power Folding Ramp

Student teams were challenged to design, build and test a scale version of a powered folding ramp for a wheelchair. The system is to be designed and manufactured so that:

- The system mass, energy requirements and cost are minimized
- The motion of the system is smooth and controlled
- Structural components have infinite fatigue life
- The deployment and use of the system is safe
- The system is easily cleaned and maintained
- The system is easily installed and removed from the wheelchair

Teams are assessed according to the performance of their design, and their report detailing the concept development and selection process, kinematic analysis, structural analysis, failure analysis, fatigue analysis, cost analysis, integration of marketing elements, and recommendations for future improvement to the design.

Competition Schedule

Team	Times & (Stations)			Design Team
1-1	8:00 (1)	8:08 (2)	8:16 (2)	Patrick Frahm, Matthew Marchetti, Lance Roth, Michael Schwartz
2-1	8:08 (1)	8:16 (3)	8:24 (3)	Bashaier Alsinan, Chase Gunderud, Paul Miller, Renee Wirsing
1-2	8:16 (1)	8:24 (2)	8:32 (2)	Tunan Guo, Hayden May, Taylor Mullahy, Andrea Vedrody
2-2	8:24 (1)	8:32 (3)	8:40 (3)	Eric Bargiel, Alexander Gerding, Tim Mijnsbergen, Kevin Wilberding
1-3	8:32 (1)	8:40 (2)	8:48 (2)	Zachary Abbott, Bradley Trublowski, Abigail Wulf, Tingyuan Zhang
2-3	8:40 (1)	8:48 (3)	8:56 (3)	David Bernier, Nathan Fedewa, Leo McLaughlin, Michael Wicker
1-4	8:48 (1)	8:56 (2)	9:04 (2)	Joshua Dewys, Sarah Parsons, Nicholas Vukov, Ian Waugaman
2-4	8:56 (1)	9:04 (3)	9:12 (3)	Alvin Chiang, David Dudley, Vikram Mandelia, Yucheng Wang
1-5	9:04 (1)	9:12 (2)	9:20 (2)	Christine Hampton, Matthew Knudtson, Brandon Leblanc, Prateek Prasad
2-5	9:12 (1)	9:20 (3)	9:28 (3)	Brian Cobus, James Cuthbert, Matthew Maier, Haoyu Wang
1-6	9:20 (1)	9:28 (2)	9:36 (2)	Naomi Carlisle, Andrew Crechiolo, Brice Furr, Nicholas Scibilia
2-6	9:28 (1)	9:36 (3)	9:44 (3)	Bingchen Chi, Curtis Coscarelly, Haochen Li, Jason Vismara
1-7	9:36 (1)	9:44 (2)	9:52 (2)	Richard Harrington, Andrew Hildner, Mitchell O'Brien, Abhimanyu Singh
2-7	9:44 (1)	9:52 (3)	10:00 (3)	Yu Chen, Taylor Forbush, James Leung, Tim Smith
1-8	9:52 (1)	10:00 (2)	10:08 (2)	Rachel Geary, Melanie Mullett, Jessica O'Brien, Elizabeth Schaepe
2-8	10:00 (1)	10:08 (3)	10:16 (3)	Waithera Chege, Zachary Graves, Kevin Lalko, Stephen Saksa
1-9	10:08 (1)	10:16 (2)	10:24 (2)	Elizabet Gojcaj, Akiem Harshman, Ping Hsiung, Sara Knoedler
2-9	10:16 (1)	10:24 (3)	10:32 (3)	Evan Bushman, Jeffrey Hall, Andrew Kalina, Benjamin Rowley
1-10	10:24 (1)	10:32 (2)	10:40 (2)	Nick Chocko, Zackary Hickman, Rutger Kok, Shenzhou Xin
2-10	10:32 (1)	10:40 (3)	10:48 (3)	Eric Buday, Lucas Johnson, Steven Price, Gerald Rivkin
1-11	10:40 (1)	10:48 (2)	10:56 (2)	Alexandria Allman, Mark Cogo, Anthony Kobak, Jinyang Qiu
2-11	10:48 (1)	10:56 (3)	11:04 (3)	Ryan Blancke, Axel Ivers, Jacob Pusheck, Sean Raymor
1-12	10:56 (1)	10:04 (2)	11:12 (2)	Max Dunigan, Andrew Gregg, Natasha Mital, Louis Yun
2-12	11:04 (1)	11:12 (3)	11:20 (3)	Nadia Amira, Matthew Igo, Charles Pynnonen, Zachary Tuller
1-13	11:12 (1)	11:20 (2)	11:28 (2)	Daniel Cornelius, Michael Kron, Zhi Phuah
2-13	11:20 (1)	11:28 (3)	11:36 (3)	Nickolas Aguayo, Rachel Horstman, Quinn Putt, Eric Waldron
1-14	11:28 (1)	11:36 (2)	11:44 (2)	Stephanie DeJong, Reace Head, Ryan Juntunen
2-14	11:36 (1)	11:44 (3)	11:52 (3)	Blake Hatherley, Casey Palanca, Eric West
1-15	11:44 (1)	11:52 (2)	12:00 (2)	Shannon Grace, Connor Montgomery, Nicholas Youngerman
2-15	11:52 (1)	12:00 (3)	12:08 (3)	Shaoyu Han, John Neidhart, Benjamin Yancho

The Capstone Projects

Dr. Giles Brereton
Associate Professor of
Mechanical Engineering

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:30 a.m.	Kautex Textron	Improved Assembly of Fuel Tanks
9:00 a.m.	IAC	Design of a Carpet Transfer System
9:30 a.m.	Ingersoll Rand	Redesigned Street-Elbow Assembly Process
10:00 a.m.	Ingersoll Rand	Removal System for a Fan Motor
10:30 a.m.	Tenneco Inc.	Improved Catalytic Converter Assembly Process
11:00 a.m.	Meritor	Lightweight Trailer-Axle Hub
11:30 a.m.	Marathon	Hazardous-Vapor Isolation Plug for Pipelines

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:

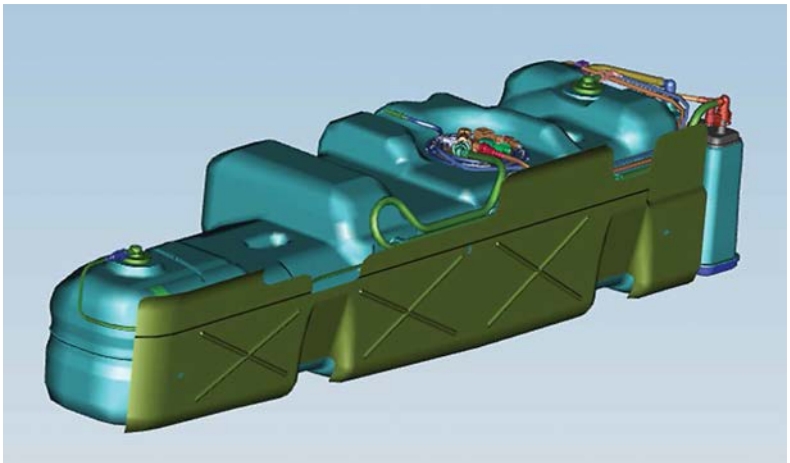
- Use the technical expertise, communication skills, and teaming methodologies they have learned throughout their mechanical engineering curriculum, together with their creativity, to solve real world problems
- Collaborate with practicing engineers to address problems sponsored by industry
- Develop 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: ArcelorMittal, Robert Bosch, Environmental Protection Agency, Fiat Chrysler, Ford Motor Company, Hitachi, IAC International, Ingersoll Rand, Kautex Textron, Marathon, Meritor, Michigan AgrAbility, Michigan Seamless Tube, Tenneco, Trickl-eez and Whirlpool Corporation; and our educational partners at Heartwood School.

Kautex Textron
Improved Assembly of Fuel Tanks

Kautex Textron, located in Providence, Rhode Island, is one of the world's 100 largest automotive suppliers. It manufactures camshafts, clear-vision, selective catalytic reduction, and fuel tank systems. Kautex has made significant advancements in fuel tank technology in recent years, revolutionizing their manufacture by constructing them from plastic materials that are lightweight, resistant to corrosion, recyclable and have many other advantages over their steel counterparts. In plastic tank systems, assembly is a two-step process in which a stud is welded or screwed into the tank and a palnut is hammered over the heat shield onto the stud. Kautex is interested in an optimized wave pad design and a method of attachment that would reduce the design lead time and the validation costs of this assembly process.

The MSU team will develop designs that reduce the need for multiple operators or machines to streamline the assembly process while meeting manufacturing constraints. An optimal design will be selected and developed in detail for implementation by Kautex Textron.



KAUTEX
A Textron Company

Michigan State University
Team Members

Alexander Hoover
Ypsilanti, Michigan

George Lewis
Marine City, Michigan

Jun Sheng
Shanghai, China

Shenquan Wang
Taiyuan, China

Libin Ye
Shanghai, China

Kautex Textron
Project Sponsors

Peter Ellwood
Troy, Michigan

William Foster
Troy, Michigan

Logan Waite
Troy, Michigan

ME Faculty Advisor

Neil Wright
East Lansing, Michigan

International Automotive Components (IAC)
Design of a Carpet Transfer System

International Automotive Components (IAC) is an automotive supplier with 32,000 employees at 100 facilities in 22 countries and is the third largest supplier of automotive interior components in the world. Components designed and manufactured by IAC include trim systems, instrument panels, flooring systems, and overhead systems. Currently at IAC plants across North America, flooring systems are made in large quantities and are often carried by employees between each stage of the manufacturing process without assistance. These carpets can be as large as 24 square feet, may weigh up to 30 pounds and are carried over distances from one to fifty feet. This practice carries a risk of employee injury and can also cause physical strain.

IAC has asked the MSU design team to develop a carpet transfer system that will reduce the physical strain on factory employees, lower the risk of physical injury, and improve workplace efficiency. The MSU team will design and manufacture a prototype transfer system for implementation and testing at IAC facilities.

IAC
International Automotive Components

Michigan State University
Team Members

Robert Cenowa
Sterling Heights, Michigan

Kathleen Landwehr
Tipp City, Ohio

Bradley Seegert
Farmington, Michigan

Joseph Senechal
Shelby Township, Michigan

Aaron Brodsky Smith
Farmington Hills, Michigan

IAC
Project Sponsor

John Tam
Southfield, Michigan

ME Faculty Advisor

Tammy Reid-Bush
East Lansing, Michigan

Ingersoll Rand
Redesigned Street-Elbow Assembly Process

Ingersoll Rand is a global industrial company that manufactures tools and air conditioning systems for consumers and businesses worldwide. The Climate Solutions Sector, which is a division of Ingersoll Rand, offers products which aim to help customers reduce energy and carbon emissions use while improving performance. During assembly of gas manifolds at Ingersoll Rand's Lynn Haven plant in Florida, one of a sequence of assembly operations is problematic. A street elbow is attached to the manifold using a torque gun, which frequently results in the street elbow being orientated incorrectly. The operator must then use a wrench to reposition it.

MSU students were asked to reduce or eliminate the need for the repositioning procedure, thus reducing or eliminating the street elbow's ergonomic score. Ingersoll Rand wants to make the manifold assembly as safe and streamlined as possible to prevent long-term injuries to personnel. The team will design a new assembly process that fulfills Ingersoll Rand's specifications. It will begin with tests of existing torque guns and ultimately result in the demonstration of new methods of assembly to improve the ergonomic score.

Michigan State University
Team Members

Tyler Gallant
Battle Creek, Michigan

Jay Gersonde
Birmingham, Michigan

Graham Goble
Okemos, Michigan

Dan Ignatowski
Sterling Heights, Michigan

Rupinder Singh
Lansing, Michigan

Ingersoll Rand
Project Sponsors

Michael Notta
Lynn Haven, Florida

Billy Smith
Panama City, Florida

ME Faculty Advisor

Tom Pence
East Lansing, Michigan

Ingersoll Rand
Removal System for a Fan Motor

Ingersoll Rand is a multinational engineering company with divisions that specialize in transportation, manufacturing, construction and agriculture. One division, Trane, specializes in heating and cooling air control. Trane manufacturers large air handling units (AHU's) for its semi-customized commercial market. These units house multiple stacked fans that can weigh up to 500 lbs. Since these fans run constantly, their maintenance is important. Their motors are heavy and removing them for maintenance or replacement can be difficult and dangerous. Trane will be launching a new AHU model and wishes to develop a reliable and consistent method of removing the AHU's fan motors safely.

The team at MSU will design and develop a safe, reliable motor-removal solution using a rail system for removal and lifting of the motors to a doorway, through which workers can handle them safely. The team will construct a prototype of the optimal design for evaluation by Trane.

Michigan State University
Team Members

Bara Aldasouqi
East Lansing, Michigan

Julian Diaz
Traverse City, Michigan

Xuelai Wang
Ningbo, China

Ingersoll Rand
Project Sponsors

Joe Fiegen
La Crosse, Wisconsin

Mike Lewis
Lexington, Kentucky

ME Faculty Advisor

Ranjan Mukherjee
East Lansing, Michigan

Tenneco Inc.

Improved Catalytic Converter Assembly Process

Tenneco Inc. is a leading manufacturer of automotive exhaust systems and catalytic converters, which have been used for emission control in vehicles since 1975. In its Grass Lake, Michigan, engineering facility, Tenneco designs converters which are manufactured at plants throughout the United States. The chemically-active component of a catalytic converter is a ceramic substrate that is wash-coated in precious metals, which undergo catalytic reaction with certain species of the exhaust gas to clean the emissions of the vehicle. The substrate is wrapped in a mat, typically made of ceramic fibers, to hold it in place within the can. While the contents of the catalytic converter are generally dictated by requirements of the customer, the process by which the contents are 'canned' is inefficient and inconsistent and offers significant opportunities for improvement.

The goal of this project is to design an improved manufacturing technique for 'canning' the substrate and mat, which may be optimized by altering the geometry or changing the mat material. The resulting catalytic converter should be constructible with greater manufacturing consistency while meeting or exceeding the quality and performance of current designs.

Michigan State University
Team Members

Evan Boyers
Jackson, Michigan

Nathan Gill
Davisburg, Michigan

Bradly LaBaere
Romeo, Michigan

Trevor Laskowski
South Lyon, Michigan

Alan Richards
Holland, Michigan

Tenneco Inc.
Project Sponsors

Nagoor Gani Mohamed
Grass Lake, Michigan

Yong Sun
Grass Lake, Michigan

ME Faculty Advisor

Patrick Kwon
East Lansing, Michigan

Meritor
Lightweight Trailer-Axle Hub

Headquartered in Troy, Michigan, Meritor is a leading global supplier of innovative products for commercial-vehicle and industrial markets. These products include axles, brake and safety systems, drivelines, suspensions, trailer components, and aftermarket parts. Meritor produces more than 50 different trailer axles for a broad range of trailer applications, all of which require a hub component as part of the wheel-end assembly. The current trailer-axle hub sold by Meritor is made of ductile iron and competes with lower quality but lighter hubs produced by other companies. Lightweight hubs are desirable to customers because less weight corresponds to lower rotational inertia. Meritor is interested in designing a new, lightweight design trailer-axle hub that meets the performance quality of Meritor's existing iron products.

The MSU design team will create an optimized design of Meritor's trailer-axle hub so that the company can introduce a more competitive product into the hub market that still meets the desired strength and durability requirements. The team will benchmark hubs from Meritor and its competitors, determine ways in which weight can be reduced and select an optimal design using optimization software.

MERITOR

Michigan State University
Team Members

Laura Gumpper
Livonia, Michigan

Ying-Hung (Michelle) Lou
Taipei, Taiwan

Hiroya Miyoshi
Mt. Pleasant, Michigan

Travis Schafer
Pewamo, Michigan

Kyle Witgen
Westphalia, Michigan

Meritor
Project Sponsors

Jacob Beasley
Troy, Michigan

Ed Eshelman
Troy, Michigan

Aaron Sinka
Troy, Michigan

ME Faculty Advisor

Sharon Xiao
East Lansing, Michigan

Marathon
Hazardous-Vapor Isolation Plug for Pipelines

As the nation's fourth-largest oil and natural-gas refiner, Marathon Petroleum Corporation operates over 8,300 miles of pipeline for transporting fuels and marketing petroleum products. Based in Findlay, Ohio, Marathon Petroleum owns a variety of storage facilities throughout the Midwest. One of these facilities, located in Woodhaven, Michigan, has seven storage reserves at which butane is stocked in caverns roughly 1,500 feet below the earth's surface. Butane is pumped between tank trucks and these caverns through thousands of feet of pipeline which require continuous maintenance. One of Marathon's maintenance projects requires the refurbishing of the well heads to the storage caverns. Marathon strives to protect workers against hazardous vapors that may escape during such operations, since safety is a top priority. Therefore, Marathon is interested in installing an isolation plug which, when placed between the production and service casings, can block all potentially hazardous or explosive gas emissions.

The Capstone team will design and model an annular, isolation plug for Marathon's pipelines. The plug must meet Marathon's functionality, reliability, and durability requirements. A final, working prototype will be delivered to the company prior to the course deadline and tested for performance at the site.

Michigan State University
Team Members

Katie Donnay
Ortonville, Michigan

Evan Flynn
Kalamazoo, Michigan

Collin Hartman
Auburn Hills, Michigan

Jennifer Jones
Northville, Michigan

Andrew Poteracki
Hartland, Michigan

Marathon Petroleum Corporation
Project Sponsors

Katelyn Erford
Findlay, Ohio

Brett Hewitt
Findlay, Ohio

Russ Tindall
Findlay, Ohio

ME Faculty Advisor

Ahmed Naguib
East Lansing, Michigan

The Capstone Projects

Dr. Giles Brereton
Associate Professor of
Mechanical Engineering

Presentation Schedule – Engineering Building, Room 1208

Time	Team Sponsor	Project Title
8:30 a.m.	Michigan AgrAbility	Redesign of a Skid-Steer Vehicle for Ease of Access
9:00 a.m.	ArcelorMittal	Exhaust Gas Sensor for an Annealing Furnace
9:30 a.m.	Robert Bosch	Waste Heat Recovery System for Vehicles
10:00 a.m.	EPA	Efficient Heating of a Dilution Tunnel
10:30 a.m.	Hitachi	Test Bench for Direct-Injection Fuel Systems
11:00 a.m.	Tenneco Inc.	Design of a Passive Exhaust Valve
11:30 a.m.	Whirlpool	Design of an Appliance Pedestal Attachment

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:30 a.m.	Trickl-eez/MSU Dept of Entomology	Advanced Orchard Spraying System
9:00 a.m.	Michigan Seamless Tube	Evaluation of Eddy Current Heating of Pipelines
9:30 a.m.	Heartwood School	Therapeutic Mechanical Pony
10:00 a.m.	Hitachi	Redesign of a Variable Timing Camshaft
10:30 a.m.	Ford Motor Company	Dynamic Friction Rig for Driveline Joints
11:00 a.m.	Ford Motor Company	Automated Assembly of Vehicle Fascia
11:30 a.m.	Fiat Chrysler	Design and Simulation of Automatic Transmissions

Mechanical Engineering Design Program

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

The ME faculty who supervised ME 481 design teams this semester are: Seungik Baek, Jongeun Choi, Alex Diaz, Brian Feeny, Farhad Jaberi, Patrick Kwon, Dahsin Liu, Al Loos, Norbert Mueller, Ranjan Mukherjee, Ahmed Naguib, Tom Pence, Tammy Reid-Bush, Steve Shaw, Rod Tabaczynski, Brian Thompson, Neil Wright, Sharon Xiao and George Zhu.

Michigan AgrAbility*
Redesign of a Skid-Steer Vehicle for Ease of Access

Easter Seals Michigan AgrAbility is a nonprofit organization that provides assistance to farmers with handicaps, injuries, or conditions due to aging. Services include creative solutions through the development of tools, equipment, and methods to improve each farmer's daily quality of life. A skid-steer, which is a vehicle designed for a variety of tasks in farming and construction, is the one such device that AgrAbility has modified to accommodate its clients' needs. Due to its versatility, a skid-steer is an essential tool for a farmer's day-to-day tasks. However, getting into skid-steers with a front-loading driver's seat requires dexterity and flexibility which many farmers with disabilities lack. Therefore, Michigan AgrAbility is interested in creative modifications that could be made to the skid-steer to help disabled farmers get into and out of their personal vehicle.

The major factors that constrain design solutions are the dimensional limitations presented by the motion of the skid-steer arm assembly and the inability to alter the vehicle's roll cage under the terms of its warranty. This team's challenge is to design, build, and test a mechanism that would allow the disabled client to get into and out of the skid-steer safely and efficiently. A prototype will be constructed and delivered for testing.

*This is a joint project of the MSU Cooperative Extension and Michigan Easter Seals, funded by the US Department of Agriculture.

Easter Seals Michigan AgrAbility

Michigan State University
Team Members

Nassar Alhajri
Alhazem, Saudi Arabia

Ross Buckley
Novi, Michigan

Kane Clark
Howell, Michigan

Kimberly Fortenberry
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ArcelorMittal
Exhaust Gas Sensor for an Annealing Furnace

ArcelorMittal is the world's leader in steel production and mining. In order to remain competitive in many steel markets, the company must operate multiple finishing-product lines. In such lines, one widely-used method of steel processing is annealing. During this process, steel coils are loaded into ovens heated by furnaces for a prescribed amount of time in order to remove stresses introduced during manufacturing processes. The furnaces vent some exhaust fumes into the processing facility, which can create a hostile work environment for employees, especially if combustion in the furnace is not ideal. While combustion gas analyzers are available for measuring furnace exhaust properties and as personal meters for individuals, the constraints on their operation require a carefully designed gas-sampling strategy to ensure workplace safety.

In order to minimize downtime and eliminate the need for expensive combustion analyzers, the Michigan State team will develop a method of collecting and cooling furnace exhaust gases. The gas cooling will be substantial enough to meet the sample temperature requirements of individual employee gas meters. The team will present a prototype design, justification and analysis to ArcelorMittal for future implementation.

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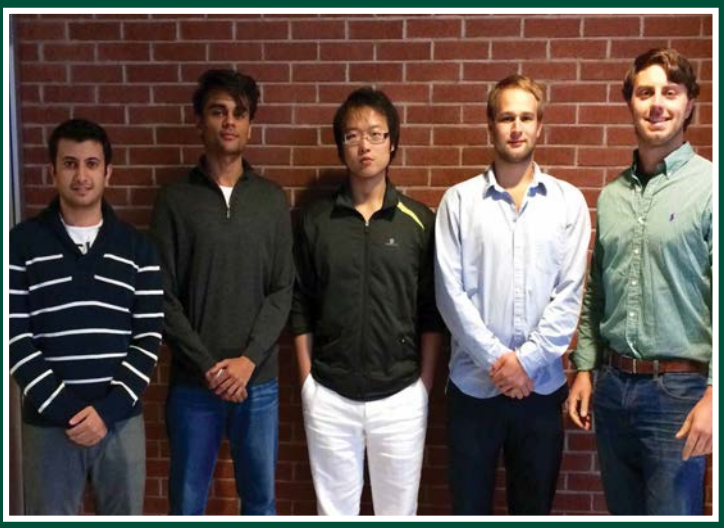
Robert Bosch
Waste Heat Recovery System for Vehicles

Robert Bosch is a pioneer in research, development and production of automotive, consumer and industrial components and systems for manufacturers worldwide. With the ongoing efforts to improve Diesel engine efficiency and environment sustainability, Bosch has developed a Waste Heat Recovery system (WHR) for heavy-duty commercial vehicles. WHR utilizes approximately 60% of invested primary energy through an Organic Rankine Cycle (ORC) in which ethanol is circulated; it converts exhaust waste heat into useful energy for powering mechanical or electrical systems in a vehicle. This system guarantees fuel savings of up to 5% and a reduced output of CO2, which will help to meet future emission limits. Currently Bosch uses a tank as one component of the ORC, which maintains ethanol at a constant pressure and volume. Determining the amount of ethanol required for the ORC is necessary for it to recover waste heat at maximum efficiency. The tank also needs to be designed with long-lasting components and materials to overcome durability and leakage problems.

The team will design and fabricate a tank which maintains the optimal amount of ethanol at constant pressure and volume for maximum efficiency. It will also specify components and materials needed for a durable, leak-free design. Structural design calculations and finite element analyses will be used to ensure the design meets the requirements of minimum weight and fabrication cost.

BOSCH
Invented for life



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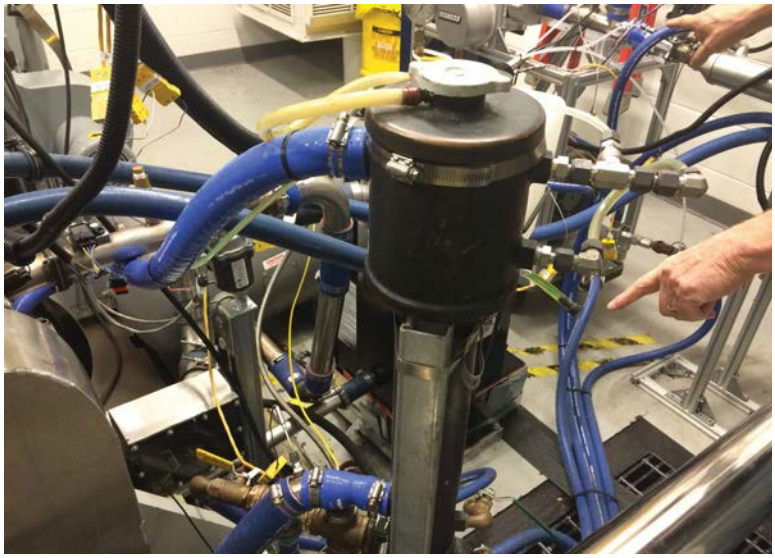
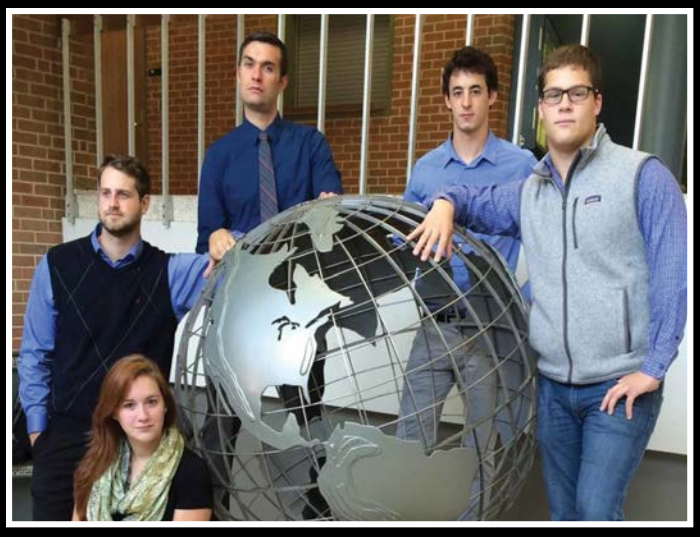
Environmental Protection Agency
Efficient Heating of a Dilution Tunnel

The Environmental Protection Agency (EPA) is a government organization that regulates and enforces laws that pertain to the cleanliness of the environment. One of the main concerns of the EPA is vehicle emissions. The EPA tests all car models sold in the U.S. to ensure they meet exhaust-gas emission standards. A common method of measuring emissions is to remove the engine from a vehicle and run it under controlled conditions on a dynamometer, collecting exhaust gas for emissions analysis. In order to accurately measure the concentrations of emissions in the exhaust, the sampled gas must be cooled prior to analysis to stop chemical reactions that would continue in uncooled high-temperature gas. The desired cooling is achieved by introducing a controlled flow of air at a specific temperature upstream from the engine exhaust, and mixing it with the exhaust gas in a dilution tunnel.

This team's objective is to design a system to heat the incoming dilution tunnel air to 47 °C +/- 5 °C as efficiently as possible. To accomplish this, the team proposes a design that utilizes as much waste heat from the engine as possible in order to minimize the requirement for additional electrical heating to reach the desired temperature. The proposed system will be tested on the EPA's dilution tunnel.





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Hitachi Automotive Systems Americas, Inc.

Test Bench for Direct-Injection Fuel Systems

Hitachi Automotive Systems is involved in the development, manufacture, and sale of automotive components and systems, and its Farmington Hills location is home to the fuel system team. A principal objective in automotive design is to maximize the fuel efficiency of vehicles in every way possible in order to meet environmental impact regulations. One method by which fuel efficiency can be increased is through the use of gasoline direct-injection fuel systems in preference to traditional port-injected systems, as they permit more precise control over the amount of fuel injected, which can reduce fuel consumption. Another method of improving fuel efficiency is by using blends of fossil and alternative fuels in optimal ratios.

The goal of this project is to design a testing bench for a gasoline direct-injection fuel system comprising six injectors. A successful design will allow the fuel system team to perform experiments that monitor the performance of an injection system using different fuel blends and to measure the fuel flow through each injector. With such tests, Hitachi may ultimately design the most efficient fuel systems for the automotive market of the future.

HITACHI
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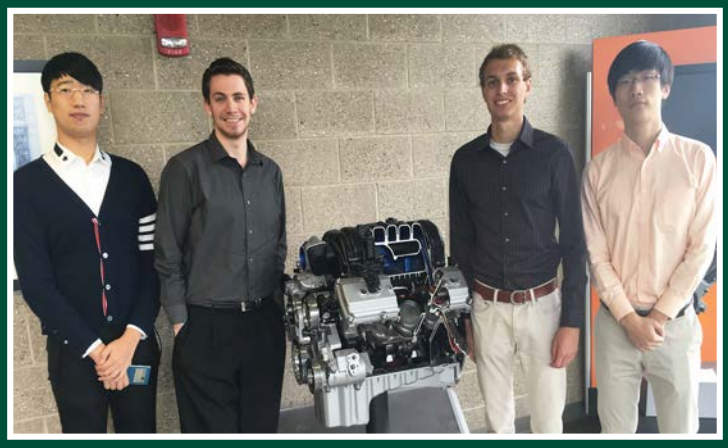

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Tenneco Inc.
Design of a Passive Exhaust Valve

Tenneco Incorporated is one of the world's leading designers, manufacturers, and distributors of clear-air and rid-performance product systems within the automotive industry. In many of the muffler systems that Tenneco designs, high pressure gas passes through a passive exhaust valve before freely entering the atmosphere. Recently, it has been observed that, if designed properly, a back-pressure can be induced in the passive exhaust valve, which can in turn, prevent approximately 2-3% of NOx emissions from reaching the atmosphere, effectively aiding in the reduction of greenhouse gas emissions. Tenneco is interested in design concepts that improve upon the functionality of the back-pressure-induced exhaust valve, which also meet decibel, temperature, lifespan, and cost regulations of the product.

The MSU team will evaluate a set of conceptual part-minimizing designs that satisfy the constraints set by Tenneco. An optimal design will be selected and then customized for a particular Tenneco muffler. A prototype of the most promising design will then be built and tested for functionality and reliability and delivered to Tenneco for further evaluation.

TENNECO

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Whirlpool
Design of an Appliance Pedestal Attachment

Whirlpool Corporation is the world's largest manufacturer of appliances. It produces models for several of the most popular brands in over 70 manufacturing facilities around the globe. One of its products is a pedestal attachment for washers and dryers that raises the appliance and provides a drawer for storage. During installation, the appliance must be laid on its back so that the pedestal can be fastened to it with screws. However, many laundry rooms are not large enough for this attachment process, in which potential customers may consider other brands. Furthermore, the appliances are not designed to be laid on their backs as they contain concrete counterweights. Whirlpool is, therefore, interested in pedestal attachments that maintain the structural and vibrational characteristics of the current design but do not require an installation process in which the appliance is laid on its back.

The MSU team will conceive and evaluate multiple designs that satisfy Whirlpool's constraints. An optimal design will be selected and a prototype will then be built and tested for preliminary functionality and reliability. This design will be delivered to Whirlpool for further evaluation and optimization.

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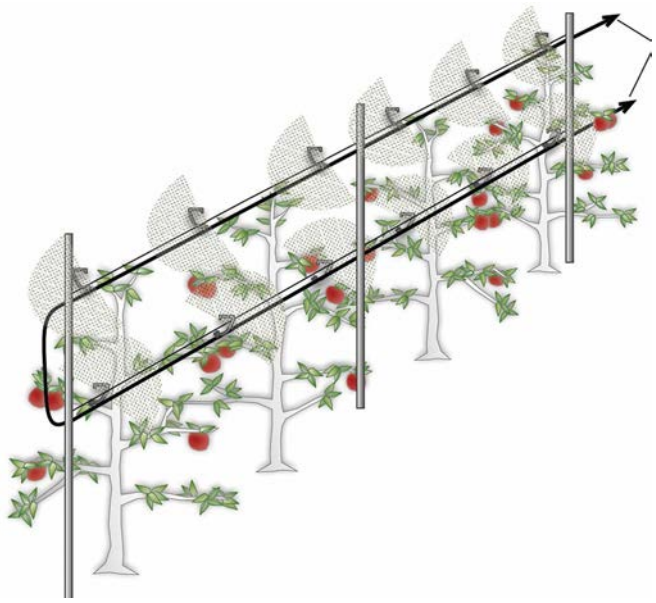
Trickl-eez/MSU Department of Entomology
Advanced Orchard Spraying System

The MSU Organic Pest Management Lab is a research lab based in the Entomology Department. It conducts research on a variety of Michigan and Great Lakes agricultural commodities. The goal of its research is to provide economically viable pest management strategies for organic farming. The lab is currently developing an optimized Solid Set Canopy Delivery System (SSCDS) for multiple applications by tree fruit producers. This delivery system is a network of lines and sprayers installed throughout an orchard that is used in place of traditional air-blast tractor-based spraying techniques. The long-term goal of the SSCDS project is to better manage expensive chemical products, improve pest and crop management and reduce labor costs. This enables tree fruit producers to remain globally competitive and environmentally responsible.

The engineering focus of this project is to optimize the existing SSCDS by reducing the waste of expensive pest management products. Our optimized design will utilize fluid analysis to create a more efficient reservoir delivery system with scalability to multi-acre orchards. A working pressure-driven prototype will be designed and built to demonstrate how the system reduces waste and decreases operating costs.



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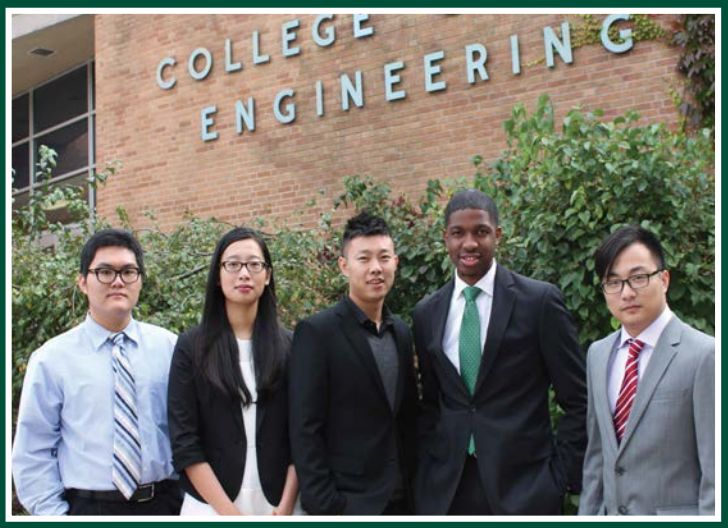
Michigan Seamless Tube
Evaluation of Eddy Current Heating of Pipelines

Since its formation in 1927, Michigan Seamless Tube has manufactured high-chrome mechanical and pressure tubing and piping for numerous industries. Michigan Seamless Tube continues to develop its cold-drawn pipe-manufacturing technology, which allows pipes to be manufactured to customers' precise specifications. Michigan Seamless Tube recently developed a tube for the oil transportation industry, manufactured using a cold-drawn technique, to serve as a heating tube for an end manufacturer's pipeline. The tubes are heated internally by electrical eddy currents imparted around their periphery, which then heats the outermost layer of oil making it less viscous. Thus skin-heating of the tube facilitates oil flow.

The objective of this project is to evaluate and compare the performance of cold-drawn tubes with hot-finished tubes, and tubes made with other manufacturing processes. An apparatus will be designed to measure the uniformity and efficiency of conduction eddy currents in each kind of tube, and to examine the effect of wall uniformity on performance. The efficiency with which oil can be heated by eddy currents is a significant economic factor in pipeline-tubing selection since oil pipelines are often over 35 miles long and are expected to last several decades.

MICHIGAN seamless tube



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Heartwood School
Therapeutic Mechanical Pony

The children at Heartwood School in Mason, Michigan, have non-typical physical conditions associated with movement and balance. From an early age, they struggle with everyday tasks such as sitting or balancing. In order to develop the coordination and strength necessary for these skills, core muscles need to be engaged and strengthened through therapy and exercise in a durable, safe device. The faculty at Heartwood currently has few devices for this process and each has limitations. The absence of either essential support or specific muscle targeting reduces the therapist's ability to improve the child's functionality. Furthermore, existing devices do not inspire the child to participate proactively in exercises.

The MSU team will develop a therapeutic mechanical pony that will help students with physical disabilities exercise and improve their core muscle strength. Through the use of a wobble seat and adjustable components, the therapist will be able to properly engage with the student during sessions and adapt the exercise to each student's skill set. The pony will also have cosmetic features to captivate the student's imagination and reinforcing components to inspire improvement.

Heartwood School

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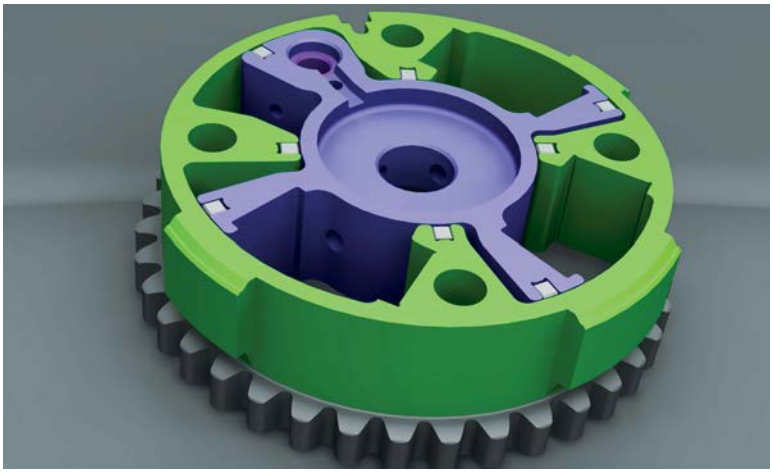
Hitachi Automotive Systems Americas, Inc.
Redesign of a Variable Timing Camshaft

Hitachi Automotive Systems manufactures and markets a broad range of electro-mechanical and electronic products for all major automotive original equipment manufacturers. The focus of this project is the Hitachi Variable Timing Camshaft (VTC). The VTC is attached to the end of the camshaft and uses rotational force driven by oil pressure to vary the valve-event timing. This assembly requires locking pins to prevent movement between the body, vane, and its other components. The positioning of these pins during assembly must satisfy tight tolerances to hold the components correctly and achieve the required initial backlash during engine start-up. However, the Hitachi's suppliers lack the ability to meet this tight tolerance specification, resulting in a high scrap rate.

The goal of this project is to investigate new assembly methods that can achieve precise component location and sufficient initial backlash without such a tight dependence on tolerances. A relaxation of component tolerances will lower the scrap rate at assembly. By reducing these operational costs, Hitachi will remain a competitive supplier to automotive companies.



HITACHI
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Ford Motor Company
Dynamic Friction Rig for Driveline Joints

Ford Motor Company is one of the largest automakers in the world with its headquarters located in Dearborn, Michigan. Ford conducts rigorous testing and modeling of all its parts to ensure the high quality of every automobile produced. However, it is currently unsatisfied with its driveline Computer-Aided Engineering (CAE) models. Ford lacks sufficient information on driveshaft. It is particularly difficult to characterize dynamic friction in driveline joints while under torque. Ford has attempted to develop a test rig for acquiring the data needed to improve understanding of dynamic friction behavior, but the range of speeds and torques of the current fixture is inadequate. Improving this aspect of data measurement and model development would help Ford enhance its ability to predict and resolve noise, vibration, and harshness problems prior to construction of prototypes, which would significantly save cost and design time.

Ford has requested that the MSU team design and construct a test rig that will be used to measure driveshaft. The rig will measure articulation torque vs. angle in real time over a significantly larger range of driveshaft torques and speeds than the current rig. These results will then be used to improve current Ford computer-aided engineering models.

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Ford Motor Company
Automated Assembly of Vehicle Fascia

Ford Motor Company is a world-renowned automotive company headquartered in Dearborn, MI. Ford has partnered with Dakkota Integrated Systems in Chicago, IL, to develop an efficient and flexible robotic cell to quickly attach rear park aid sensors to front vehicle fascias. Designed by JR Automation, this robotic cell will load the fascia onto a fixture, punch holes in its side, glue the sensor into the holes, unload the fascia to a loading nest, and then repeat the process for the next fascia in the production sequencing. This design group's task is to assess and improve this robotic process.

The MSU team will evaluate the consistency and accuracy with which the robot locates and punches each hole in the fascia. When a hole-punching process of sufficient accuracy and repeatability has been devised and implemented, the robotic cell will be tested at full capacity and then deployed by Dakkota Integrated Systems.

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Fiat Chrysler Automobiles
Design and Simulation of Automatic Transmissions

Fiat Chrysler Automobiles (FCA), located in Auburn Hills, MI, is a multinational manufacturer of automobiles and is currently the world's seventh largest. The transmissions used in many of its cars and light trucks have 250,000-mile warranties and, if the transmission fails before this mileage is reached, the company must compensate the customer. It is, therefore, useful to analyze data that portray the driving cycles and loads imposed on transmissions by the average driver in different regions of the world. These data assist engineers at FCA in designing automatic transmissions for their vehicles that perform optimally when driven in a variety of different ways. FCA's design target is for each transmission to have an average durability that exceeds 150,000 miles.

By modeling a transmission using a simulation program that incorporates a particular driving cycle, fatigue and stress analyses can be carried out at selected locations within a transmission to determine whether the 150,000-mile durability target is feasible with a given design. In cases when this design target is predicted to be unfeasible, suggestions will be made for design optimizations that would produce the most durable transmission.

FCA
FIAT CHRYSLER AUTOMOBILES

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Design Day Awards

Mechanical Engineering Design Program Awards

The Mechanical Engineering Design Program awards prizes in three technical categories and one presentational category 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. Each team's technical report is read from cover to cover to evaluate the detailed engineering analyses of each project and assess how much technical Mechanical Engineering value has been added to the project solution by each team. It is not unusual for Mechanical Engineers to include analyses that are more traditionally found in electric, civil, chemical or biomedical engineering, if the optimal project solution requires it. The quality of a team's prototype of its design solution is also an important factor, as is the clarity of its presentation of the design solution. The Edison Award is given to the team which best meets these criteria.

A second ME 481 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 Design Program also makes awards to the winners of its ME 412 and ME 471 Heat Transfer and Machine Design competitions, the rules and constraints of which vary from semester to semester.

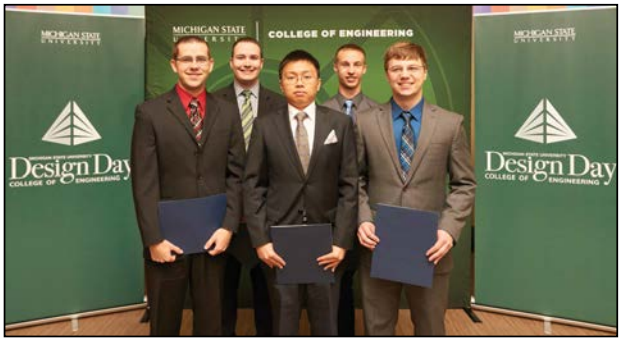
ME 481 THOMAS ALVA EDISON UNDERGRADUATE DESIGN AWARD

The Edison Undergraduate Design Award is given to the ME 481 Design Team that is judged to have produced the best technical design project. Last semester's scholars designed a fixture for measuring roller bearing friction for Eaton Aerospace. The team was supervised by Prof. Alejandro Diaz.

Left to right: Ben Carruthers, Reema Al Dhaneem, Matthew Heimonen, Emma Drenth and Kyle Sherman

ME 481 PROJECT PRESENTATION AWARD

The ME 481 Project Presentation Award for the best presentation of a design project was awarded to the team that designed and demonstrated a switch-activated basketball shooter for special-needs students at Melvin-Millett Learning Center. The team was supervised by Prof. Elisa Toulson.



Left to right: Michael Campbell, Michael Cieslik, Jinbo Chen, Seth Rohr, and Anthony LaCross

ME 471 MACHINE DESIGN AWARD: THE LEONARDO DA VINCI AWARD

The Leonardo da Vinci Award was presented to the team with the best design of a "pick and place" machine in each of the two class sections.

Section 1 Winners
Left to right: Graham Goble, Alex Taylor, Andrew Stieber, Shane Toreki and Max Bennett

Section 2 Winners
Left to right: Peter Howes, Robert Cenowa and Rupinder Singh.
Not pictured: Kathleen Landwehr and Scott Welburn

Rotational Development Programs

Success stories don't just happen. They are made.

BOSCH
Invented for life

About the programs:

Bosch offers two rotational development programs:

- Professional Development Training (PDT) Program for Bachelor's level graduates
- Junior Managers Program (JMP) for Master's level graduates

The programs consist of four rotations designed to provide cross-functional and cross-divisional opportunities. With input from executive mentors and program coordinators, rotations are custom designed based on business needs and individual career development goals. Assignments can take place in various Bosch locations across the U.S. and abroad, including in corporate offices, technical centers and manufacturing facilities.

What's in it for you?

- Gain exposure to **different roles** within your field and cross-functionally
- Build a robust professional **network** across all levels of the organization
- Gain **international** work experience
- High **visibility** and senior leadership exposure
- **Drive your own career**

What makes a good candidate?

- Relevant Bachelor's or Master's degree received within the last 36 months
- Minimum GPA: 3.0 PDT and 3.2 JMP
- Minimum one completed internship/ co-op experience, or at least six months full-time, relevant work experience related to your field of study
- Excellent verbal and written communication skills
- Demonstrated initiative and leadership abilities
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ME 491 International Humanitarian Engineering

Dr. Brian Thompson
Professor of Mechanical Engineering

W. H. Welch, MD (1850 - 1934) founder of the School of Public Health at Johns Hopkins University in Baltimore, Maryland, wrote, 'It is a well-known fact that there are no social, no industrial, no economic problems which are not related to health.'

Dr. Welch's insightful remark buttresses and sustains the vision of an international educational initiative launched over a decade ago when box ovens, heated by solar thermal energy, were developed for Tanzanian families. The subsequent International Humanitarian Engineering Program, which has featured projects in Guatemala, Honduras, India, Kenya and Peru, was born of hope and ignorance, sustained by good fortune and steadfast determination, and consummated by accomplishments that were unimaginable at the genesis.

However, upon reflection and further cogitation, the rapid growth of this program appears to be almost inevitable because authentic messy inter-disciplinary semester-long humanitarian projects motivate and accelerate undergraduate learning much more poignantly than traditional hypothetical academic classroom exercises. This profound learning is manifested by the creation of ergonomically refined pedal-pumps for irrigation; human-powered farm implements that improve harvest-yields; domestic water-purification devices; and solar-dehydration structures that reduce post-harvest losses.

The fabric of this design-intensive inter-disciplinary ME 491 course is woven from a thread of ideas on humanitarian societal development that addresses the pressing needs of the 80 percent of the world's population living on less than $2 each day, intertwined with a second orthogonal thread comprising a triumvirate of fundamental ideas on inter-disciplinary problem-solving processes, entrepreneurship, and the diffusion of innovations that's relevant to every single nation sharing our small planet. This warp and weft of interlaced fibers constitute the tapestry describing the solution strategy for solving the biggest challenge confronting humanity today: the very survival of the species.

Students enrolled in this enthralling ME 491 course are the visionaries and the bold ones. The dreamers and the doers. The explorers and the discoverers. The achievers and the magicians.

But these risk-takers must maintain paradoxical balances. They are committed to the traditional engineering practice of creating revolutionary new products that enhance the lives of the poor, yet they display personal panache; they are prepared to stand steadfastly alone, clinging tenaciously to their own personal convictions, yet they are willing to unite philosophically because of their commitment to teamwork; and they are relentlessly driven to create waves of positive change in international marketplaces, yet they are also cognizant of social, cultural and ethical responsibilities. Yes, this is indeed a complicated, convoluted conundrum!

So, at this Design Day, pause to review the spectacular innovations created by these ME 491 students. Converse with them, marvel at their dedication to serving the poor, the marginalized, and also the under-represented at the base of the socio-economic pyramid. However, please be receptive to a potential personal transformation by this emotive exchange, and consider joining these international innovators in serving the billions of men, women, and children living in abject poverty.

These ME 491 Projects were generously sponsored by Whirlpool Corporation

Whirlpool CORPORATION

Appropriate Technology Collaborative
Guatemala: Macadamia Nut Husker

In Guatemala, over half the population lives below the extreme poverty line. Additionally, Guatemalans suffer from the highest rate of chronic malnutrition in Latin America. The Appropriate Technology Collaborative, a nonprofit organization dedicated to using sustainable technologies to help low-income people, has a goal of improving this situation by building a macadamia nut husker for Guatemalan farmers. Macadamias are a rapidly growing industry, as well as a good source of several important nutrients.

After macadamia nuts are harvested, the husk must be removed within a twenty-four-hour window or mold will begin to grow. Macadamia husks also harden and become more difficult to remove after this time period. It is important not to break the shell of the nut during this process, because the nut must be dried before being cracked. Currently, many farmers sell their macadamia nuts in-husk, at a lower profit. Those with access to hand-powered huskers produce mostly B-Grade broken nuts, though husking nuts by hand is tedious and laborious.

The objective of this project is to create a device that can remove the husks of the macadamias quickly without breaking the nut, which will ensure that Guatemalan farmers will not lose any of their harvest. By improving the efficiency of this process, farmers can increase their income and improve their quality of life.

The Appropriate Technology Design Collaborative

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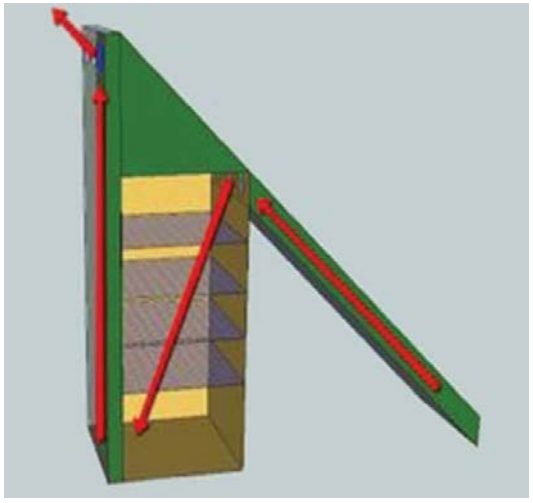
Guatemala: Solar Food Dehydrator

The citizens of Panyebar, Guatemala, lack the ability to feed their children properly. A lack of micronutrients hinders the development of these young children, leading to stunted growth, muscle and joint pain, fatigue, and many other symptoms which can hamper a child's educational and physical development. Whereas Panyebar's citizens grow the required micronutrients to feed themselves and their children, they do so only on a seasonal basis and otherwise-nutritious food rots before the next harvesting season. In Panyebar, it is the lack of proper storage techniques that causes malnutrition rather than an insufficient supply.

Monika Goforth, the director of the Panyebar Education and Nutrition Center, and the team at MSU believe that the best solution for this problem is a solar food dehydrator. A solar food dehydrator dries food so that it can be stored for much longer periods of time. This device will enable the citizens of Panyebar to have sufficient micronutrients to sustain them from harvest to harvest and may permit surplus food to be sold at local markets. Therefore, the goal of this MSU design team is to provide the citizens of Panyebar with a solar food dehydrator.

This dehydrator will provide a year-round supply of micronutrients and a new source of income. It will incorporate sufficient thermal capacity to prevent foods from molding when there is no solar radiation, and it will be manufactured with processes and materials available in Panyebar. A manual for the manufacture and operation of the food dehydrator will also be written.



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Nutri-Fresh Farm & Agri-Hub

Kenya: Processing Cassava Roots Into Flour

"We cannot solve our problems with the same thinking we used when we created them." As this quote by Albert Einstein suggests, forward thinking is required to discover solutions to current problems. Many Kenyans today face problems such as poor living conditions, inconsistent food sources, and a lack of micronutrients which result in stunted growth and malnutrition. However, a popular dish in many parts of Kenya is Ugali. Ugali is a food with a consistency similar to that of porridge. It is often made with maize. Stable food sources such as cassava (which can also be used in traditional dishes such as Ugali) are eaten by a majority of the Kenyan people, and are a major staple in many Kenyan diets.

Today in Kenya, the cassava plant plagues the majority of farmers. Cassava is a tuberous root from a tropical tree. It looks much like a sweet potato, only larger. However, the problem does not lie in the plant itself but in its short shelf life, due to postharvest physiological deterioration (PPD). After harvesting, the cassava root begins to break down within 72 hours, and the crop is soon considered unusable. The plant also contains cyanogenic glycosides which are converted into cyanide in the digestive system. These toxins must be handled properly during processing to prevent ingestion of cyanide at unsafe levels, which can result in paralysis and death.

Our team plans to develop a process and device that will allow the cassava root to be easily and quickly converted into a safe, more stable form. The goal is to lengthen the shelf life of the cassava root from 72 hours to one year by processing the root into flour. The device will be human-powered, and the process will assure the toxins within the root are brought to safe consumption levels regardless of plant variety. Because of the longer shelf life of the flour, relative to the raw cassava root, food supplies will be increased by reducing the spoilage caused by PPD. This will not only give families access to more food throughout the year but increase the annual income of small-scale farmers as more product can be sold due to decreased waste.

Nutri-Fresh Farm & Agri-Hub
Creating Agri-prenuers from Kenyan Youth & Subsistence Farmers

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Symbiosis
India: Human-Powered Machine that Collects Urban Trash

India is a land of disparities. It is the fastest growing nation in the world, yet the majority of its people lack access to clean drinking water and a basic sanitation infrastructure. To catapult India from the status of a developing nation to a developed nation, the Government of India has launched a novel program under the name of the Clean India Initiative. This initiative addresses seven basic sanitation and public health problems that are evident on a large scale in India. Implementing this scheme for a population of 1.2 billion people on seven varied fronts is no mean undertaking and this is where a team of MSU students believe they can make a difference.

One of the facets of the Clean India Initiative is public sanitation. In association with two high-ranking officials from the Government of India and the local IT Company Symbiosis, the MSU team plans to help bring about a change by designing an off-beat machine that would clean public spaces in India. This machine will be built under constraints like cost and locally available resources, with the intention of trying to spark a change in the mindset of the masses in India. The team feels that this project could be a part of the broader picture as such a project is universally applicable. If this kind of project could succeed in a byzantine land like India, it has the potential to succeed in any part of the world.

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Nutri-Fresh Farm & Agri-Hub
KENYA: Operation Irrigation Greywater Filtration Device

Kenyans suffer greatly from food insecurity; some must resort to stealing lions' prey in order to eat. To many Americans, this may seem surprising and disturbing but to some Kenyans it is a way of life. What if they could safely and consistently grow their own food? This team's project is to enable just that.

Nutri-Fresh Farm & Agri Hub is a model farm that obtains, shares, and performs practical demonstrations of the latest agribusiness innovations. They are a non-governmental organization (NGO) with which the MSU team works; its headquarters are in Thika, Kenya. Simon Wachieni is the MSU contact there who defines greywater as water that has been contaminated with household soaps and cooking oils. The team's project is to filter this water so that it is suitable for irrigation of spinach, tomatoes, kale, and strawberries. These crops are priceless to the Kenyan people and are their main defense against malnutrition.

The MSU team seeks to engineer a greywater filtration device from PVC, plastics, natural materials and other common supplies. This filtration system will filter 60-100 L/day, and each family in need will have their own. Clean filtered water will then be fed to a drip irrigation system.

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Nutri-Fresh Farm & Agri-Hub
Creating Agri-prenuers from Kenyan Youth & Subsistence Farmers

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Portable Pigeon-pea Thresher

Guatemala is a small country in Central America with a population of about 15.5 million, 54 percent of whom live on less than $2 a day. According to USAID, "over half of children under five are chronically malnourished and stunted due to lack of access to and improper utilization of nutritious foods." Currently, many organizations are analyzing the agricultural crops and techniques used by Guatemalan farmers to develop viable solutions to this nutrition problem.

Most farmers in Guatemala grow corn as their primary crop. Semilla Nueva, an NGO based in Guatemala, asserts that corn does not provide enough nutrients and protein for the local communities. Furthermore, corn can severely damage the soils and Guatemalan corn cannot compete in global commodities markets. For these reasons, Guatemala is beginning to experiment with the growth and harvesting of different kinds of crops such as pigeonpea. Pigeonpea is a crop that can reduce soil damage, combat malnutrition, and increase the profits for farming families in Guatemala. Semilla Nueva reported that two years ago it helped 30 families plant pigeonpea. Today almost 1,000 plant it. Reports have been published describing how countries like Tanzania and Mozambique have also switched to pigeonpea.

One problem with this new crop is that currently there is no low-cost method of removing the peas from their pods. The goal of this project is to create such a device to increase the number of peas harvested, thereby enhancing the health and wealth of Guatemalan communities without negatively affecting low-income farmers.

Semilla Nueva

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