MICHIGAN STATE
UNIVERSITY

MICHIGAN STATE UNIVERSITY

Design Day

Spring 2013

COLLEGE OF ENGINEERING

Dear Students, Family Members, Company Representatives, Alumni, Faculty & Staff:

On behalf of Auto-Owners Insurance, and in partnership with Michigan State University, it gives us great pleasure to welcome you to the beautiful MSU campus and specifically to the MSU College of Engineering Design Day. We are pleased and honored to partner with Michigan State University in this program, which showcases the talents and abilities of many gifted students.

It has been said the future belongs to the youth. If this is the case, (which we believe to be true) by the creativity, imagination, and initiative displayed by the participating students in this year's Design Day Program, you have to admit the future looks very bright indeed. A tremendous array of skills and abilities will be displayed this year, which further substantiates our continued support of this program. We congratulate each participant along with those who have provided support, guidance and instruction to them.

As a recruiter of talent for the ongoing needs of our Company, we could not be more pleased with programs like Design Day, or the constant exposure to creative thinking that is provided through the daily coursework at Michigan State University. We hire many graduates from numerous disciplines at MSU, and find them to be dedicated, hard working individuals who quickly become solid members of our team. We could not be more proud. Auto-Owners Insurance has called Michigan home since our beginning in 1916. We consider ourselves, along with Michigan State University, one of the great success stories in this state. This year we were rated "Highest in Customer Satisfaction with the Auto Insurance Claims Experience, Five Years in a Row" by J.D. Power and Associates. It is because of our outstanding associates that we are able to receive such great recognition and continue to grow.

We wish you a truly pleasant, exciting and stimulating day here on the MSU campus. May you be thrilled by the talent of the participants as well as the deep heritage of this campus. We at Auto-Owners Insurance join in congratulating all the participants, proud parents, and sponsors who took the initiative to support this program. Our best wishes to all for a wonderful day!

Sincerely,

Jeff Harrold, Chairman & CEO

"Highest in Customer Satisfaction with the Auto Insurance Claims Experience, Five Years in a Row."

- J.D. Power and Associates

Auto-Owners Insurance

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

Auto-Owners Insurance ranks highest among auto insurance providers in the J.D. Power and Associates 2008-2012 Auto Claims Studies℠. 2012 study based on 12,508 total responses, ranking 26 insurance providers. Excludes those with claims only for glass/windshield, theft/stolen, roadside assistance or bodily injury claims. Proprietary results based on experiences and perceptions of consumers surveyed November 2011-September 2012. Your experiences may vary. Visit jdpower.com.

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Welcome from the Dean

As Dean of the College of Engineering, on behalf of the entire faculty, we 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 recognize Auto-Owners Insurance as our Design Day Executive Partner Sponsor for the eighth consecutive semester and GE as our Design Day Directing Partner Sponsor for the third consecutive spring semester. Our Design Day Supporting Partner Sponsors include Bosch, General Motors, the MSU Federal Credit Union, RECSOLU, Spectrum Health, Union Pacific, and Urban Science. We thank all of our sponsors for their generosity and their ongoing commitment to Design Day.

As you explore the exhibits throughout the Engineering Building, 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

Acting Dean of the College of Engineering

Professor

Michigan State University

1st Floor

Map including 3rd floor finalized this weekend

2nd Floor

Anthony

Design Day Floor Plans of the MSU Engineering Building

Map including 3rd floor finalized this weekend

3rd
Floor

Design Day Events Schedule
Friday, April 26, 2013

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 2200 Hallway/Rm 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 1200 Hallway 9:00 a.m. - Noon				
ME 412 Competition			1st Floor Room 1225 8:20 a.m. - 12:20 p.m.				
ME 471 Competition		1st Floor Room 1345 8:00 a.m. - 12:30 p.m.					
ME 478 Presentations		1st Floor 1200 Hallway 8:00 a.m. - Noon					
CAPSTONE COURSES							
All Capstone Posters for most projects, including BE485/487, ChE 434 and MSE 466		1st Floor 1300/1200 Hallway 8:00 a.m. - Noon					
AES 495 Project Presentations		1st Floor 1100 Hallway/Room 1145 8:00 a.m. - Noon					
CE 495 Project Presentations		3rd Floor 3405 A & B 8:00 a.m. - Noon					
CSE 498 Project Presentations		1st Floor, Anthony, Room 1310 7:30 a.m. - Noon					
ECE 480 Project Presentations		2nd Floor, Room 2250 7:50 a.m. - 12:15 p.m.					
ME 481 Project Presentations			1st Floor, 1200 Hallway/Rooms 1208 & 1220 8:30 a.m. - Noon				
LUNCH AND AWARDS							
High School Opening			1st Floor Anthony 1281 8:45 a.m. - Noon				
High School Lunch			1st Floor Anthony 1279 Noon - 12:15 p.m.				
MSU Lunch			1st Floor, Lobby 12:15 p.m. – 1:00 p.m.				
MSU Awards			1st Floor Anthony 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

Acknowledgements:

Thank you Dr. Satish Udpa, Executive Vice President of Administration Services (formerly Dean of Engineering), for your support in the growth of this great program. We wish you well in your new role.

A special thank you to the following people for making this Design Day event a success...

Roy Bailiff, Department of Mechanical Engineering

Denise Barnsted, Engineering Deans Office

Jill Bielawski, Department of Mechanical Engineering

Stephen Blosser, Resource Center for Persons W/Disabilities (RCPD)

Dean Buggia, K-12 Interdisciplinary Build Instructor

Linda Clifford, Department of Electrical and Computer Engineering

Kelly Climer, Department of Computer Science and Engineering

Judy Cordes, Women in Engineering Coordinator

Cathy Davison, Department of Computer Science and Engineering

Ethan Fahy, K-12 Design Day Voting Coordinator

Bernadette Friedrich, Center for Spartan Engineering

Craig Gunn, Department of Mechanical Engineering

Debbie Kruch, Department of Computer Science and Engineering

Brian LaFleur, K-12 Design Day Student Coordinator

Garth Motschenbacher, Director, Center for Spartan Engineering

Mary Mroz, Department of Civil Engineering

Greg Mulder, Department of Electrical and Computer Engineering

Kora Nixon, Student, Applied Engineering Science

Career Peers, Center for Spartan Engineering

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Meredith Schmidt, Department of Computer Science and Engineering

Laura Taylor, Department of Civil Engineering

Norma Teague, Department of Computer Science and Engineering

Francie Todd, Communications Manager

Teresa VanderSloot, Advisor, Department of Computer Science and Engineering

Dr. Tom Wolf, College of Engineering Associate Dean

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

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

MOTOROLA

	Room 1281 Anthony Welcome all Schools	C.E./M.E. Team Build Room 2243	VEX Robotics Room 2400	1st & 2nd Floor Voting/ project viewing*
8:45–9:00	All Schools 1 thru 6			
9:05–9:55		Schools 1 & 2	Schools 5 & 6	Schools 3 & 4
10:00–10:55		Schools 3 & 4	Schools 1 & 2	Schools 5 & 6
11:00-11:55		Schools 5 & 6	Schools 3 & 4	Schools 1 & 2
12:00–12:10	All students in Room 1279 Anthony for the awards ceremony. Lunch will immediately follow.			

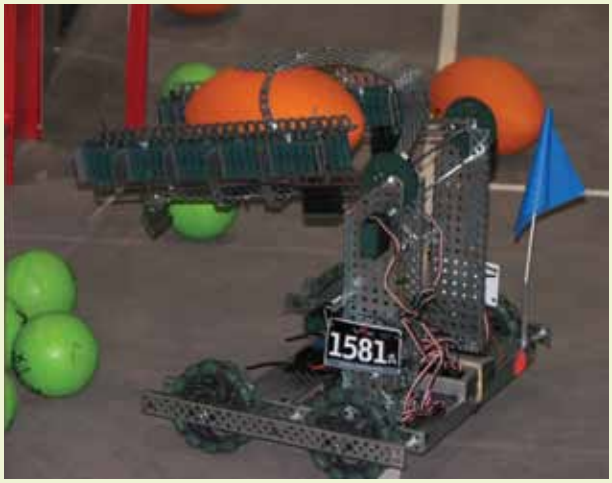
Participating High Schools: Cass Tech, Detroit International Academy of Young Women, East Lansing, MLK, Okemos, Western International

**Schools voting on BE485, CSE 498, ECE 480, EGR100, and ME 371,*

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

VEX ROBOTICS

Our team of experts has designed a lab experience to give precollege students an introduction to robots. Students will work in small groups and have a hands-on approach learning to control the VEX robot. They will write programs using Robot C language, and they will program the robot to be a 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

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

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

Jamie Lynn Marks
MSU Engineering
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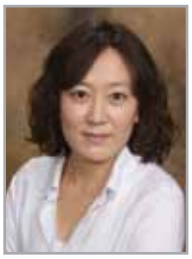
Russ Pline
Okemos High School and MSU Engineering
Recruitment and K-12 Outreach Design Day Coordinator



Jung Sung
Education and Technology Consultant

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

EGR 100 Introduction to Engineering Design

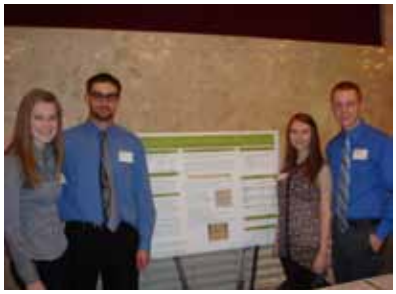
Mr. Timothy Hinds
Academic Director

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. Over 500 students are enrolled in EGR 100 this semester.

For the final course project, the student teams selected from four project types: (i) solar water heater design, (ii) Lego® Mindstorms® competition, (iii) MSU Resource Center for Persons with Disabilities (RCPD) design and (iv) Residential Initiative on the Study of the Environment (RISE) project. For the first choice, the student teams were to design, build and test a solar water heater that would successfully increase the temperature of a given volume of water in a fixed time. The second choice required the students to build and program an autonomous robot that competes simultaneously against other robots to gather high-scoring, colored balls. For the third project type, teams worked with RCPD clients to design and build working prototypes to assist the clients in daily activities. The final project type had teams work with RISE to design prototypes to help increase crop production through heating their hoop house in cold weather. 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.

Fall 2012 EGR 100 Project Poster Award Winners:

l-r:Hailey Dann, Joe Asciutto, Lauren Strange, James Weaver



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

Careers of the future: Green technology at Bosch

Make your personal contribution to the green technology of the future.

Bosch is an innovator of resource-efficient and eco-friendly technologies, including green dishwashers, green solar cells, and green heating systems. Roughly half of our research and development budget is spent on future technologies specifically designed to reduce pollution and minimize the use of resources. In 2012, we again received the Energy Star Sustained Excellence Award from the United States Environmental Protection Agency (EPA). Many of our home appliances actually exceed Energy Star qualifications and are among the most energy efficient in the world, including our dishwashers that can turn two gallons of water into the cleaning power of 1,300. Our solar energy division produces highly efficient solar cells and modules. And our Bosch Thermotechnology Geothermal Heat Pump is the most efficient complete geothermal line in the industry. This is just the beginning.

Apply now. Discover the diverse range of green opportunities at Bosch.

www.careers.bosch.us

Applied Engineering Sciences

Capstone Course Sponsors

We gratefully acknowledge Eaton, Chrysler, and Consumers Power for their financial support of the 2013 AES Capstone Program. We also gratefully acknowledge the corporate scholarship from Eaton to support students in the AES Technical Sales Concentration.

Capstone Project Sponsors and Award Sponsor

Bath Township

BioPlastics Polymer & Composites

Consumers Energy

Chrysler

MSU Office of Sustainability

Habitat for Humanity

Peckham industries

Schafer Flooring

XG Sciences

Dr. Phil Fioravante, alumni of our program, is the 2013 sponsor of awards for AES Capstone projects. Winners are determined based on both final written project reports and on oral presentations at Design Day. We thank Mr. Fioravante for his generous support of the AES awards event.

Applied Engineering Sciences

Dr. Jon Sticklen
Director of Applied Engineering Sciences

Kevin Gibbons MBA (2013)
Supply Chain Management
The Eli Broad Graduate School of Management

Luke Balcerzak MBA (2013)
Supply Chain Management
The Eli Broad Graduate School of Management

Presentation Schedule – 1st Floor, 1100 Hallway / Room 1145

	Time	Team Sponsor	Project Title
Non-Profits	8:00 a.m.	Bath Township	Revamping the Main Intersection Bath Township
	8:25 a.m.	Habitat for Humanity	Logistics Shipping Solution for E-Paint
MSU Internal	8:50 a.m.	MSU Office of Sustainability	MSU Sustainable Purchasing Policy
MSU Spinoff Companies	9:15 a.m.	BioPlastic Polymers & Composites	More Profitable Utilization of Soybeans
	9:40 a.m.	XG Sciences	Applications of Graphene Nanoplatelets in CDI
	10:00 a.m.	Break	
Corporate	10:15 a.m.	Consumers Energy	Procurement Sustainability
	10:40 a.m.	Chrylser	Parts Receiving Process Improvement
	11:05 a.m.	Peckham	Manufacturing Process Improvement
	11:30 a.m.	Schafer Flooring	Developing Lean Systems Processes

AES 410 Capstone Course Senior Capstone Project

The AES capstone is the culmination of the entire program. The course covers content new to the students on professional ethics, project management methods, and concepts of six sigma methods. But the strong thrust of the program is the capstone project itself. The capstone project is…

- A project from industry or non-profit companies typically focused at the confluence of modern business operations and engineering or technical issues
- Attacked by a group of 4 - 5 capstone students
- Is intense, demands substantial time, and - most of all - is a transition for AES seniors from the world of the classroom and the world in which their careers will be built

Bath Township
Revamping the Main Intersection

The purpose of our project is to help Bath Township rebrand itself by giving them the tools needed to initiate and sustain new business development.

Bath Township is a small community but growing fast. Since the 2006 census, the population has increased by 54% to the 2010 total of 11,558 residents. To help accommodate the growing number of citizens, the township leadership has taken it upon themselves to invest time and money into the common conveniences that the township has to offer.

Our team will help in this process by addressing four main areas: understanding business site requirements, increasing availability of statistical data, cultivation of a sense of community and the creation of relationships with local entrepreneurs.

Specifically, our group has focused our efforts on the revamping of the intersection of Webster and Clark. This area serves as the main intersection of Bath Township and will serve as a starting point for future development.

For reference, Bath Township is located approximately 15 miles northeast of Lansing, Michigan. Downtown Bath is approximately two miles north of I-69, making it fast and easy to access the freeway for work and shopping.

Michigan State University
Team Members (left to right)

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Eric Hull
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Bath Township
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Matt Wendling
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Brian Kessey
Bath Township, MI

Habitat For Humanity
Logistics Shipping Solution for E-Paint

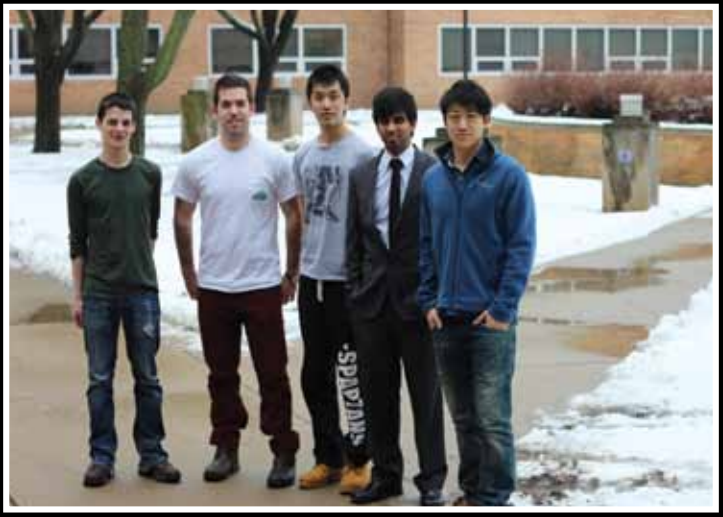
Habitat For Humanity is looking to increase their supply of remanufactured paint, as well as use their ReStores as drop off locations. ReStores are located throughout the state of Michigan. These ReStores sell gently used building materials, furniture, accessories, home improvement goods, and appliances. Remanufactured paint is one of the largest draws of these ReStores.

The paint is currently collected via donation drives and are then remanufactured by Mr. Jim Cosby at E-Paint (pictured right) in Battle Creek Michigan. E-Paint is the only producer of remanufactured paint in the area and their only customer is Habitat For Humanity

Currently E-Paint has no formal logistics plan or supply chain in place. This is currently preventing paint to be transported to the ReStore locations in order to meet their demand for remanufactured paints.

Objectives

- Increase sales of E-Paint in Habitat ReStores
- Optimize transportation routes
- Increase truck capacity utilization
- Create collection points for donated paint



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Habitat for Humanity
Project Sponsors

Andy Andersen
West Branch, Michigan

Jim Cosby
Battle Creek, Michigan

MSU Office of Sustainability
MSU Sustainable Purchasing Policy

Michigan State University has been known to be one of the most self sustaining universities when it comes to energy use, such as water and electrical. The misunderstanding is where the school buys everyday products such as paper and electrical items used in labs and classrooms.

The best way to help make sure how sustainable our products are is to create a sustainable purchasing policy. This is our main goal as a group.

A sustainable purchasing policy means buying products that are energy efficient, reduce waste, and reduce cost over time. Having a sustainable purchasing policy also means buying locally. This can in turn form bonds with local companies. Even further down the line help the local economy. Finally, hopefully, forcing these companies to make more sustainable products and services.

The plan on obtaining a policy for MSU is to look at other schools that already have a sustainable purchasing policy. Some examples are Rutgers and Arizona State University, who are some of the first to establish a policy.

After researching how other schools policies work and how great the positives are, we will try to adopt some of their policies as well as modify and create some of our own.
The final goal we plan to achieve is to reduce the schools overall ecological footprint when it comes to the purchases it makes.

be green spartan

Michigan State University
Team Members (left to right)

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MSU Office of Sustainability
Project Sponsors

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East Lansing, MI

Kim Kokenakes
East Lansing, MI

BioPlastic Polymers & Composites
More Profitable Utilization of Soybeans

BioPlastic Polymers and Composites is a technology catalyst for innovative development of non-petroleum-based plastics and polymer composites. Headed by CEO Prof. Ramani Narayan (ChE Professor, MSU), the company is a technology catalyst for developing and commercializing technologies in the bioplastics and byproducts space. A major goal of BioPlastic Polymers and Composites is to bring technology partnerships to investment grade; i.e. to de-risk the technology.

Zeeland Biobased Products LLC is a joint venture between Bio Plastics & Polymers and Zeeland Farm Services. The goal of this venture is to create and commercialize a portfolio of value added industrial products from the underutilized portions of soybeans and other plants.

Zeeland Farm Services is a privately owned soybean refinery plant that processes about 31,000 bushels of soybeans per day to produce two main products, soybean meal and oil. Zeeland Farm Services soybeans come mostly from Michigan farmers, with 90% of Michigan grown soybeans processed here and over 2,500 farmers serviced.

The goal of our project is to investigate the possibilities of using the meal created from Zeeland Farm Services' soybean refinery to create value added products. Currently, Zeeland Farm Services sells the meal as feed for animals, which has a low price per pound. After the product analysis is done, we will perform extensive and comprehensive analysis of the market to determine the likelihood that our product suggestions will succeed and that there our actual customers in the Michigan area that will buy the products. The ultimate goal is to increase the revenue and profitability of Zeeland Farm Services as well as increase the impact of soybean production on the economy of Michigan.

BIOPLASTIC
POLYMERS & COMPOSITES

Michigan State University
Team Members (left to right)

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Kun Li
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BioPlastic Polymers & Composites
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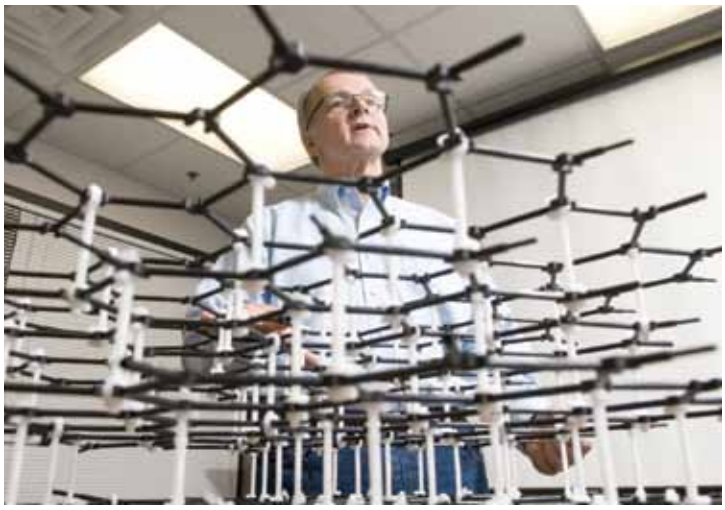
Dr.Elodie Hablot
Lansing, MI

XG Sciences
Applications of Graphene Nanoplatelets in CDI

XG Sciences Inc. is a privately owned company, founded in 2006, based out of Lansing, MI. The pilot production facility produces large amounts of material, termed xGnP Graphene Nanoplatelets, using a unique manufacturing process that was pioneered by our team sponsor, Dr. Larry Drzal, at Michigan State University. These exceptionally thin xGnP Graphene Nanoplatelets act as barriers and excellent electrical and thermal conductors. By 2010, XG Sciences achieved their first goal and released their first line of nanoplatelets called Grade H as a commercial product. Today, the company has a global presence in Korea, Japan, Taiwan, China, and Europe.

By conducting market analysis and implementing business strategies, Team XG Sciences will provide a comprehensive overview analyzing the affects of nanoplatelets on the water purification market. Our team will research current methods of desalinization, identify opportunities and weaknesses in the market, and isolate the parameters necessary to making xGnP Graphene Nanoplatelets into a viable business.

Through the research process, our team is able to complete a market and business analysis as well as have an impact on the severe water crisis throughout the world. XG Sciences is on the cutting edge of technology with the aspirations of producing a nanoplatelet that is just as successful as our everyday copper and plastic. Our hope is to help XG Sciences accomplish this goal in order to eventually help others around the globe.



XG sciences

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XG Sciences
Project Sponsors

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Consumers Energy
Procurement Sustainability

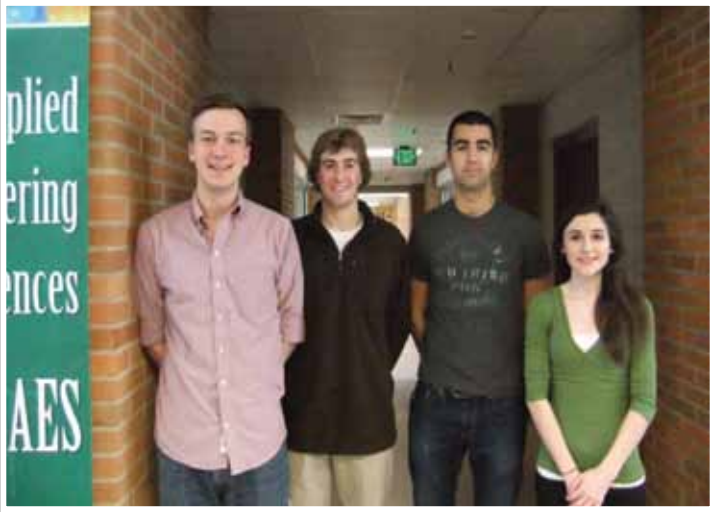
Consumers Energy provides electric and gas energy to more than six million of Michigan's residents. They have over 3,500 suppliers providing a wide range of products and services to assist Consumers in providing top quality for its customers.

Currently, Consumers is in the midst of incorporating sustainability into all levels of the company. To this end, the supply chain department at Consumers wants to develop a comprehensive procurement sustainability policy. To accomplish this, Consumers' suppliers need to be studied, graded and monitored for compliance to various environmental standards. This is where our work comes in. Our goal is to develop a policy for Consumers that grades its suppliers and then applies that grade to a tiered supplier recognition system.

To develop this policy, it will entail assessing Consumers' current supply base based on sustainability programs and certifications already in place, investigating industry alliances and competitors green programs, and establishing best practices for sustainability across multiple industries.

Once this has been done, recommendations will be given for monitoring and tracking key sustainability metrics and the amount of staff and cost it will take to implement this program.

This project will help Consumers support a clean environment, build upon their sustainable energy policy, support a solid economy, and continue to stress the importance of sustainability to Consumers' target market.



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Jack Weirich
Jackson, MI

Cheryl Ragland
Jackson, MI

Chrysler – Prototype Build Engineering
Parts Receiving Process Improvement

Chrysler Group LLC, in strategic alliance with Fiat S.p.A., is a world-class automobile manufacturing company, providing a total of seven different brands across a worldwide distribution network. Founded in 1925 by Walter P. Chrysler, the company has grown to offer some of the world's most identifiable vehicles, including the Chrysler 300 and Town & Country, Jeep Wrangler and Grand Cherokee SRT, Ram 1500, and the all-new Dodge Dart. With its headquarters in Auburn Hills, Mich., Chrysler employs over 71,000 professionals, and was able to produce 2.2 million vehicles worldwide, yielding a net revenue of $65.8 Billion in 2012.

On a daily basis, Chrysler receives and handles an immense amount of inventory from numerous suppliers for use in their Prototype Build Engineering Department. This process affects many different functional areas, and it is essential that information associated with inventory shipments be accounted for immediately into their ERP systems. Chrysler's current process requires employees to "manually receive" about half of these shipments annually, due to improper labeling issues on the behalf of their suppliers. Our goal is to improve the efficiency and data collection associated with Chrysler's receiving process. Achieving this goal will require us to develop barcode labels capable of meeting the informational needs of all affected functional areas, as well as provide detailed labeling instructions for suppliers. Furthermore, we will research modern barcode scanning technology and suggest our findings to the Prototype Build Engineering team.

CHRYSLER

Michigan State University
Team Members (left to right)

Adam Altier
Sterling Heights, MI

Chelsea Davis
Troy, MI

Aaron Day
Marysville, MI

Abigail Henry
Lansing, MI

Eric Vincent
Haslett, MI

Project Mentor
Lucas Balcerzak
East Lansing, MI

Chrysler Prototype Build Engineering
Project Sponsors

Scott Bittinger
Auburn Hills, MI

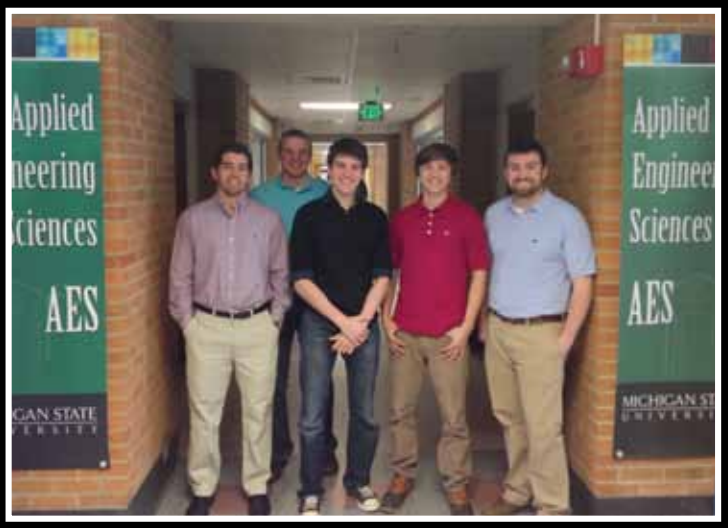
Himanshu, Khandelwal
Auburn Hills, MI

Peckham Incorporated
Manufacturing Process Improvement

Peckham Incorporated is a unique business and human services agency whose mission is to provide a wide range of opportunities to maximize human potential. The agency's headquarters in Lansing, Michigan is consulting a team of AES student to help optimize one of their fabric handling processes.

After receiving rolls of material for a dedicated supplier, Peckham Inc uses a series of spreaders to unroll each type of fabric in preparation for a cutting and sewing process. However, each supplied roll of fabric has a varying degree of width both between multiple rolls and between the endpoint of the same roll. This variance causes problems in the production process when workers forcibly stretched the fabric to conform to the operating standards set by the plant. While placed in the spreader, the stretched material reverts back to its original shape. Consequently, the layers of fabric become skewed and are improperly cut. These defective sections are then sewn together and shipped to another production facility where they go undetected until they are needed.

To assist Peckham, our team wants to better accommodate for the great variance in the supplied fabric. Through process optimization, we hope to assist Peckham in reducing the amount of defective fabric sections the line produces. This reduction of defective sections would ideally cut processing cost and thus improve Peckham's bottom line.



Michigan State University
Team Members (left to right)

Nate De Bruin
Houston, Texas

Ryan Bosma
Hastings, Michigan

Gordon Gibbons
Troy, Michigan

Jay Zaleski
Birmingham, Michigan

Nick Wasko
Farmington Hills, Michigan

Project Mentor
Lucas Balcerzak
St. Paul, MN

Peckham
Project Sponsors

Larry Stevens
Lansing, MI

Schafer Hardwood Flooring Co.
Developing Lean Systems Processes

Schafer Hardwood Flooring Co. in Tecumseh, MI provided the opportunity to use the core of the Applied Engineering Science curriculum in a practical, real-world situation. While completing this project we were not only able to use the knowledge we had gained to help serve Schafer Hardwood Flooring but also the surrounding community.

The main goal while working at Schafer was to help them introduce lean practices into both their overall business model and throughout their supply chain. The project focused on trying to root out the inefficiencies in both the ordering and scheduling processes. These inefficiencies were seen as the main barrier holding the company back from realizing its outstanding growth potentialn order to do so, both the order and schedule process needed to be both significantly simplified as well as standardized; thus making the processes as a whole much leaner. This in turn should lead the reduction of lead time as well as an increase in the speed and accuracy of quotes and orders. Lastly the goal was to make this whole process sustainable so that it will benefit Schafer both now and well into the future.

To achieve these goals a new automated customer order form and scheduling system was put in place. The entire Schafer team was trained on the processes and ample time and effort was put into making the transition as smooth as possible.

Michigan State University
Team Members (left to right)

Nicole Halbeisen
Lowell, MI

Mike Sadler
Grand Rapids, MI

Thomas Gartner
Midland, MI

Project Mentor
Luke Balcerzak
St. Paul, MN

Schafer Hardwood Flooring
Project Sponsors

Scott Schafer
Tecumseh, MI

Jim Manley
East Lansing, MI

Dr. Ajit Srivastava, PE
Professor / Chair

Dr. Dana Kirk, PE
Specialist

Dr. Luke Reese
Assoc. Professor

About the Program

The Biosystems Engineering (BE) undergraduate programs prepares graduates who will integrate and apply principles of engineering and biology to a wide variety of globally important problems. To achieve that purpose, the primary objectives of the BE program are to prepare graduates to:

- Identify and solve problems at the interface of biology and engineering, using modern engineering techniques and the systems approach, and
- Analyze, design, and control components, systems, and processes that involve critical biological components.

Additionally, the Biosystems Engineering Program is designed to help graduates succeed in diverse careers by developing a professional foundation that includes vision, adaptability, creativity, a practical mindset, effective communication skills for technical and non-technical audiences, the ability to work in diverse, cross-disciplinary teams, and a commitment to sustainability, continuing professional growth, and ethical conduct.

BE 485 / BE 487 Program

Every year, teams of Biosystems Engineering students, enrolled in the two-semester biosystems design capstone experience, BE 485/487, develop, evaluate, and select design alternatives in order to solve real-world problems. The projects are diverse, but each reflects systems thinking by integrating interconnected issues impacting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. The project designs are then presented to engineering faculty and a review panel of licensed professional engineers for evaluation. A BE 485/487 capstone design team prepares and presents a design solution to industry, faculty, general community and peers that:

- Requires engineering design
- Combines biology and engineering
- Solves a real problem
- Uses a holistic approach

Project Sponsors / Faculty Advisors

- Aquaculture Research Corporation, - Mr. Steven Srivastava
- Biomedical Laboratory Diagnostics - Dr. John A. Gerlach
- MSU Extension - Dr. Wendy Powers
- JBT FoodTech - Mr. Scott Millsap & Mr. Bob Stacy
- Ocean Spray® - Dr. Ferhan Ozadali
- Tetra Tech - Ms. Valerie Novaes
- DQY Agriculture Co. Ltd., China
- Chestnut Growers, Inc.
- Heat Transfer International - Mr. Dave Prouty
- ConAgra Foods - Ms. Cassaundra Edwards
- Dr. Dana Kirk
- Dr. Vangie Alocilja
- Dr. Yan Liu & Dr. Jeff Li
- Dr. Brad Marks
- Dr. Kirk Dolan
- Dr. Pouyan Nejadhashemi
- Dr. Wei Liao
- Dr. Dan Guyer
- Dr. Chris Saffron
- Dr. Shiny Matthews & Dr. Ajit Srivastava

INDUSTRY ADVISORY BOARD & PROJECT EVALUATORS

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the Biosystems Engineering program. Its function is to improve continuously the quality of the program by keeping it current and relevant. Board members serve as external evaluators for BE 485/487 projects. Thank you to the 2012/2013 board members.

Michelle F. Crook, PE
MDA, Environmental Stewardship Division
Engineering Specialist

Chad Ducey, PE
Werks Management, LLC
Project Manager

Cassaundra Edwards
ConAgra Foods
R & D Manager

Bryce Feighner, PE
MDEQ
Chief, Office of Environmental Assistance

Gene Ford
Nestle Nutrition
R&D Ctr. Principal Scientist

Andrew Granskog, PE
Rural Development USDA
State Engineer

Jeffrey Mathews, PhD
PepsiCo
Principal Engineer

Juanita McCann, PE
USDA-NRCS, St. Johns
Engineer

Scott Millsap
JBT Food Tech
Freezer Operations Mgr.

Valerie M. Novaes
Tetra Tech
Project Engineer, Water Resources Dept.

Mitch Miller
General Mills - Yoplait Plant
Processing System Engineer

Dave Prouty
Heat Transfer International (HTI)President

Steve Richey
Kellogg Company
Director, Morning Foods Process Engineering

Steve Steffes, PE
Perrigo Company
Vice President, New York Operations

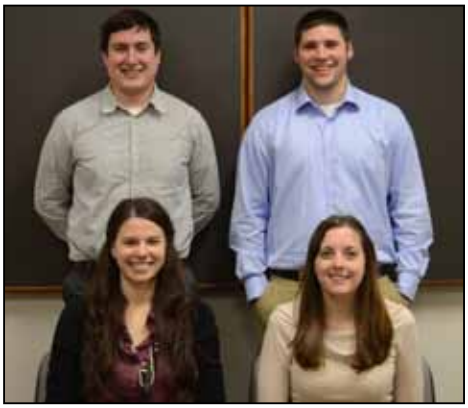
Larry D. Stephens, PE
Stephens Consulting Services, P.C.
President

Muluken Tilahun
Kraft Foods
Assoc. Principal Engineer

Redesign of ProMix Batter Mixer Cooling Mechanisms

Regulations from the FDA require a batter mix added to food to be at 50°F or below in order to comply with food safety. JBT Foodtech is setting a more stringent temperature reduction to 45°F.

The objective of this project is to redesign the batter coolant system on the ProMix continuous batter mixer in order to reduce the temperature of the mix 10°F in 20 minutes and then maintain a temperature between 40 and 45°F in order to ensure compliance with FDA/USDA regulations.

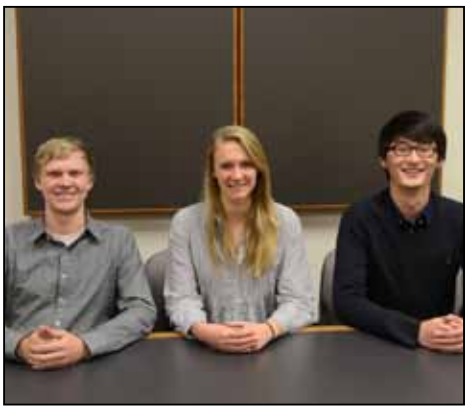


(B to F, L to R) Michael O'Meara, Lucas Poquette, Adrienne Bunce & Stacey Stark

Emission Mitigation From Confined Animal Feeding Operations (CAFO) Using Wet Scrubbers And An Algae Culture

Animal feeding operations emit large quantities of ammonia gas and particulate matter. These emissions affect the health of workers and residents in the surrounding area. Without emission mitigation animal feeding operations will not be able to continue to expand with growing demand for meat and dairy products.

To design an integrated wet scrubber system which will shower ventilation exhaust air and absorb the ammonia and particulate matter. The effluent water will be used in an algal cultivation greenhouse system to recycle the water, while developing value-added products from the algae, such as fertilizer.



(L to R) Benjamin Thomas, Elyse Kutsche & Yingkui Zhong

Torrefaction Process Improvement

Typical torrefaction product yields are approximately 70%; however, HTI experiences a low product yield of 30% for their torrefaction process. Large particle size distribution and large variance in the shape of wood chips make it difficult to ensure complete biomass torrefaction.

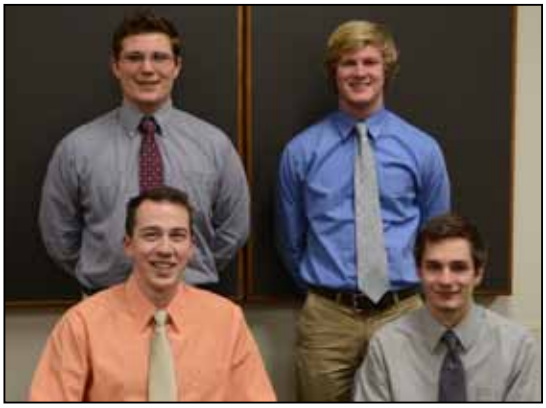
Green Coal Inc. will design a method to increase the product yield of HTI's torrefaction process while consistently and completely torrefying biomass of varying size and shape.

(L to R) Kristen Henn, Jamie Yeung, Kaitlin Ward & Jinsha Li

Chestnut Chip Dehydration System Design

Chestnut chips are a value-added product that can be used as an ingredient, eaten as a snack, or milled into flour. In order to realize the market potential of chestnut chips, chip drying techniques must be investigated and optimized to make the production of chestnut chips economical.

By determining the theoretical drying parameters, investigating alternative systems, and performing economic analyses, the optimal dehydration system for chestnut chips can be determined. A tool must be developed that determines the optimal dehydration system parameters.



(B to F; L to R) Kyle McLachlan, James Burns, Ethan Nussdorfer & Jacob StLouis

Water Quality Best Management Practices Design for a City of Lansing Re-Development Project

Urban landscapes have a high percentage of impervious areas increasing stormwater runoff times and peak flow conditions. Using best management practices from the Michigan Low Impact Development (LID) Manual, runoff can be managed to reduce the quantity and improve the quality of the stormwater.

To design an efficient stormwater runoff treatment system for the redevelopment of a parking lot in downtown Lansing in compliance with Michigan LID techniques.

(L to R) Joshua Wolter, Matthew Herman & Maureen Berryman

Integration of Aquaculture, Anaerobic Digestion, and Hydroponic Systems

Currently, aquaculture is expensive and has a long payback period after an initial capital investment. Incorporating aquaculture with anaerobic digestion and hydroponics adds an additional source of revenue to the system along with the reduction of operational costs through the combustion of gas produced from an anaerobic digester.

Optimize an anaerobic digestion system using fish carcass and wastewater from an existing aquaculture facility, with the products from the anaerobic digester used as fertilizer and an energy source to maximize yield in a hydroponic system.

(L to R) Derek Hladki, Kristin Sanburn & Nathan Jandernoa

Biosystems BE 485/487

Hydroponic Processing Optimization for Mung Bean Sprouts

Mung beans are grown hydroponically from seed to sprout in 5.5 days where they are used in La Choy products by ConAgra. The process has not been modified in over four decades and observable losses in yield and sprout quality are evident.

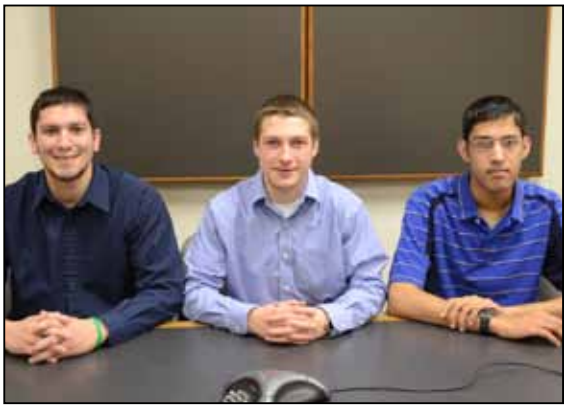
The goal of this project is to increase profit by optimizing the hydroponic system and reducing a 3% loss of quantity due to hard bean germination and a 10% loss due to water shortages. Multiple production processes are being investigated including pH imbalance which causes browning, lowering the quality of their product.

(B to F, L to R) Kelsey Downey, Ander Rochefort, Sarah Steudle & Maddie Saylor

Dried Blood Spots Optimization for DNA Extraction

The Dried Blood Spot (DBS) technique is an effective way to screen for diseases and genetic disorders for patients who do not have much blood to give, access to veins to draw blood such as infants and the elderly, and also for those who live in low resource areas.

Improvement of the method can make blood testing more efficient and much more cost effective. The project goal is to increase the yield of DNA that can be extracted from a DBS sample in the most cost effective and time-efficient manner.

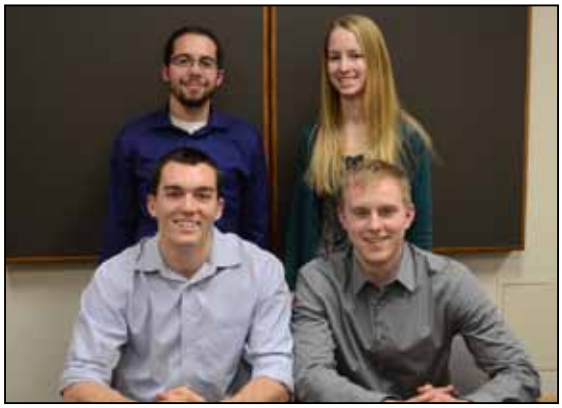


(L to R) Kayvon Parvizi, Steven Archer & Kunal Choubey

Optimization and Modeling of a Plastic Bottle Rinser

The bottle rinser is the last step in decontamination before the product is hot-filled into the containers. When the bottle rinser operates optimally, the risk of public safety or fiscal loss due to microbial or foreign material contamination is significantly reduced.

Design a process to reduce microbial contamination and reduce foreign materials in the packaging bottles before the bottles reach the hot-fill beverage lines at the Ocean Spray® juice factory.

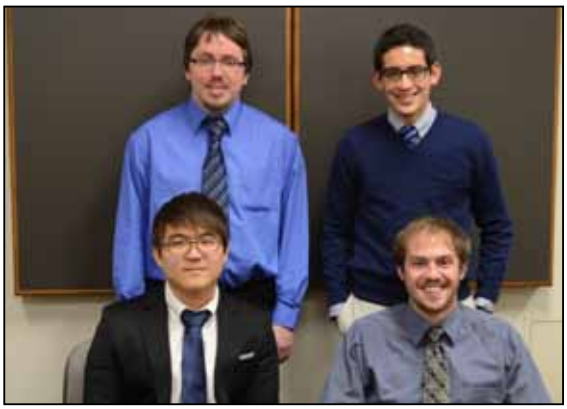


(B to F, L to R) Paul Zeltzer, Jena Laur, Tyler White & Matthew Crowder

Electrocoagulation-Flotation Treatment System for Anaerobic Digestion Effluent

Conventional chemical and physical treatments of agricultural, municipal and industrial residual waste streams do not provide an efficient solution with a small footprint and limited chemical utilization. This presents the need for a cost-effective, high strength water treatment and reclamation system.

The goal of this project is to investigate the effectiveness of coupling dissolved air flotation and electrocoagulation-flotation technologies in treating liquid AD effluent to improve upon the efficiency of the processes when utilized independently and to recover nutrients.



(B to F, L to R) Robert McGuire, Ryan Gardner, Younsuk Dong & Luke DeSmet

The Capstone Projects

Faculty Advisors: Professors Baladi, Chatti, Hashsham, Kodur, Maleck, Masten, and Wallace


Baladi


Chatti


Hashsham


Kodur


Maleck


Masten


Wallace

Presentation Schedule – Room 3405 A & B

Time	Team	Room
8:00 a.m.	Team One	Third Floor Room 3405 A
8:00 a.m.	Team Two	Third Floor Room 3405 B
9:20 a.m.	Team Three	Third Floor Room 3405 A
9:20 a.m.	Team Four	Third Floor Room 3405 B
10:40 a.m.	Team Five	Third Floor Room 3405 A
10:40 a.m.	Team Six	Third Floor Room 3405 B

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 work place 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

PROFESSIONAL SEMINAR SPEAKERS

Michael Gee, Assoc. AIA
Giffels, LLC /IBI Group

Daniel G. Fredendall, PE
OHM Advisors

Taryn E. Juidici, PE, LEED AP
OHM Advisors

Polly Kent
Michigan Department of Transportation

William B. Kussro PE, SE, LEED AP
Giffels, LLC /IBI Group

Carl J. Otte, PE
Fishbeck, Thompson, Carr & Huber, Inc.

Robert D. Rayl, PE
RS Engineering, LLC

Scott K. Stowitts, PE
Walbridge

Leah Tapp, PE, AVS
HNTB Corporation

Steven J. Vandette, PE
City of Troy

Christian G. Youngs, PE
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.

Len Becker, PE
HNTB

Rick Chelotti, PE
Bergman Associates

Daniel Christian, PE
Tetra Tech MPS

David Conklin
Fishbeck, Thompson, Carr & Huber

Angie Cosman
Ingham County Drain Commissioner

Tim Greenleaf
Barr Engineering Co.

Andrew Hermiz, EIT
Harley Ellis Devereaux

Matt Junak, PE
HNTB

Stu Kogge, PWS
JF New

Thomas Larder, PE
Process Results, Inc.

John LeFevre, PE
MSU Physical Plant

Peter Margules, PE
NTH Consultants

George McKenzie, PE
Consumers Energy

Stephanie O'Donnell, EIT
MSU

Todd Sneathen, PE
Director of Public Works

Michael J. Thelen, PE
Soil & Materials Engineers, Inc.

Anthony Thomas, PE
Soil & Materials Engineers, Inc.

Civil & Environmental Engineering Civil Design Award

The Civil & Environmental Engineering Senior Design Award ($700 and plaques) is presented to the best team as judged by the faculty and a panel of practicing engineers.

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.

These companies currently make this award possible. FTC&H is a professional civil engineering, environmental consulting, architectural/engineering, and construction management firm with clients in Michiganand throughout the nation. Barr Engineering is a professional engineering company providing engineering, environmental, and information technology services to clients across the nation and around the world.

Award Sponsors

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Michigan State University
Student Apartment Complex Designs

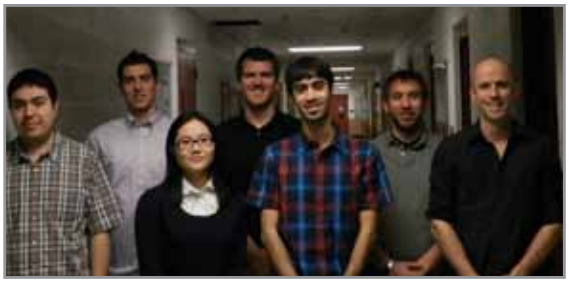
Student-teams developed preliminary designs for elements of a 144-unit student apartment complex located east of campus near the Red Cedar River. Two configurations were considered: One would employ three buildings, each with a paved, uncovered, interior courtyard that is used for parking; building height is limited to three stories above ground in order that wood frame construction can be employed. The second alternative would provide the same number of housing units in a more compact configuration that placed some parking within each building's footprint; these buildings required at least four stories above ground which necessitates steel and/or concrete structures. Teams provided a design for key structural elements of the buildings and their foundations; for road and intersection geometry, as well as; the pavement design; for an enhanced pedestrian and bike pathway connecting the development with Grand River and the MSU campus; for a constructed wetland to treat storm water; and for improvements to the existing mitigation-wetland.

Team 1: l-r: Michael Klein (Hydrology), Joel Siegel (Pavements), Jacob Heinz (Structural), Renee Lynde (Environmental), Kevin Janes (Group Leader), Qianqian Pan (Geotechnical), Timothy Koch (Transportation)

Team 2: l-r: Scott Mcgehee (Structures), Conrad MacBeth (Transportation), Jordan Streby (Hydrology), Austin Rose (Pavements). Front Row 1-r: Katelyn Burns (Environmental), Eric Herbert (Project Manager), Elizabeth Mroz (Geotechnical)

Team 3: l-r: eam 3: l-r: Joseph Gorman (Transportation), Brent Kraft (Geo-Tech), Sean Scully (Pavements), Chloe Grabowski (Environmental), Jordan Sikkema (Structures), Ziwei Zhong (Hydraulics), and Karen Wood (Project Manager)

Team 4: l-r: Chad Homuth (Transportation), Hisham Nasr (Structures), Brennan Graham (Environmental), Danielle Walley (Project Manager) Front row (l-r): Jason Comfort (Pavements), Jonathan Stransky (Geotechnical), Emily Movsesian (Hydrology)



Team 5: l-r: Juan Alcantar (Geotech), Mike Hagen (Pavements), Yuanji Li (Environmental), Christopher Kowalski (Structures), Husain Albanai (Transportation), Jacob Kleinhenz (Hydrology), Matt Owens (Project Manager)

Team 6: l-r: Charles Singer (Transportation), Nick Nelson (Geotech), Nathan Pitters (Structures), Daniel Elhosni (Environmental) Front row (l-r): Jacob Armour (Pavements), Rachel Jackson (Project Manager), Paul Larios (Hydrology)

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FREE ATMs There are over 100 surcharge-free MSUFCU ATMs in the Greater Lansing area and over 30,000 surcharge-free CO-OP Network ATMs located nationwide where you can access your MSUFCU account, make transfers, and more.

Extended Hours MSUFCU makes it easy to get in touch with us by offering extended hours online and over the phone. Speak with a member service specialist Monday-Friday from 7:00 a.m. to 9:00 p.m. and Saturdays from 9:00 a.m. to 3:00 p.m. Or, contact us online via Instant Chat Monday-Friday from 8:00 a.m. to 7:00 p.m. and Saturdays from 9:00 a.m. to 3:00 p.m.

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Process Design and Optimization II

Professor Martin Hawley
Professor and Chairperson of Chemical Engineering and Materials Science

Chun Liu
Graduate Assistant
Chemical Engineering and Materials Science

Course Description

ChE 434 is a logical extension of the first semester of chemical engineering senior design. The abilities developed over a wide range of chemical engineering courses are now applied to a problem extending over a somewhat longer period of time; requiring more initiative, enterprise, care and a greater measure of individual responsibility. For the 44th successive year, we have worked the American Institute of Chemical Engineering (AIChE) Student Contest Problem. We use these industry-designed problems for three reasons: 1) they are well-rounded problems, 2) they tell our students and our faculty something about the kind of abilities that industrial companies would like graduating chemical engineers to have, and 3) there is the advantage of seeing how well our students compare with graduates of other universities in a national competition of this quality.

For Design Day, 6 Teams and 2 Individuals were chosen to present their design via a poster presentation. From this final group, two teams of two, and two individuals will be chosen to compete in the national AIChE competition in the fall. Since 1968, about half of the students whose reports rated first or second at MSU also finished among the top six nationally.

Last Year's Winners!

One student who presented at last Spring's Design Day received top honors in the 2012 AIChE National Student Design Competition. Cristopher Beuerle was able to travel to Pittsburgh in October 2012 to present their solutions at the AIChE National Meeting.

AIChE®

Michigan State University

Compare two bio-mass reactor systems

Comparison of Bio-mass to Bio-oils Reactor Systems: Direct Conversion vs. Companion Coal Gasification

The objective of this year's AIChE Design Problem was to compare the economics of two bio-mass to bio-oil reactor systems. The first system is done by direct bio-mass pyrolysis, and the second system is done by "marrying" bio-mass to bio-oil to coal gasification.

The students were required to determine the capital equivalent of a yearly cash flow or the equivalent of a capital investment. Use a 5 year payout for converting capital investment to equivalent year cash flows. They need to calculate the final price of the product for each system, with well designed process flow and safety as well as environmental considerations.

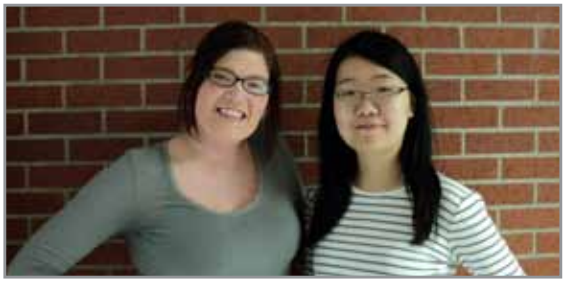
Brian LaFleur and James Szymanski

Dan Victory and Lucie Salyer

Jake Hoppert and Evan Muller

Kevin Alward

Logan Ryan Matthews



Mackenzie Jones and Yunhua Ding

Matthew Aben and Donald J. Malinowski

Nicole Shriner and Kourtney Alspach

Senior Design Capstone in Materials Science and Engineering

Professor Martin Crimp
Professor of Chemical Engineering and Materials Science

Course Description

MSE466 is a senior level course for Materials Science & Engineering majors providing students with a team-based capstone design experience. A major aspect of this course is to have students apply their course-learned background knowledge and skills in materials science and other disciplines to real-life design problems. A failure analysis investigation (FAI) fits this context. Failures are a major motivating factor for promoting more innovative designs or design changes. A failure analysis investigation provides a unique platform to design and to solve real-world engineering problems via systematic engineering approach. By focusing on a specific design failure, the student teams learn how to confront an open-ended problem that requires them to develop a strategic design plan and to execute the methodology for assessing how and why the failure occurred. The analysis is conducted using established investigative procedures and constraints for conducting failure analysis investigation. This semester, there are four 3-4 member teams working on four real engineering failures.

Successfully completed team projects culminate in a comprehensive written final report and a strategic redesign plan to improve the design and mitigate future failures. The teams will give poster presentations that summarize their findings. For 2013, four teams are conducting an FAI on following project titles:

Analysis of the Failure of an HV Segment

This failure analysis was conducted to determine the technical causes of failure of a fractured HV segment. The HV segment is used as a height adjuster in the seat assembly of many automotive vehicles. In addition, during an automotive accident, the HV segment acts as a safety device, preventing the driver and passenger seats from moving in a way that would injure the occupants of the vehicle. During quality testing of the HV segment, it fractured at a lower load than the industry standards require. The purpose of this failure analysis is to determine the failure mode and causes of the failure of the HV segment. By collecting background information and photographs, performing visual examinations, and implementing non-destructive and destructive testing techniques, the causes of the failure of the HV segment were determined.

Team 'Merica: Amanda Heydel, Scott Bandkau, Shaohua Zhao

Team Espana: Jarret, Sara, Cade

Clevis D-ring Failure Investigation

A Clevis D-ring made out of steel failed when the component was put under load of around 3330 pounds. The failure in this case, fortunately, did not result in any major economic or personal losses. These D-rings are used in many other aspects in the world such as tie downs on trucks and they are used for lifting. In our report we will include background data about the failed component and what was happening when the component failed. For that we are doing various testing techniques, both nondestructive (such as SEM, macrophotography, replica testing, and computerized stress analysis) and destructive (cleaning with acids, stress analysis), that will help us to find the cause of failure.

Team Won: Nicklas Kulczycki, Carissa Shalosky, Eugene Simon, Jacob Sloan

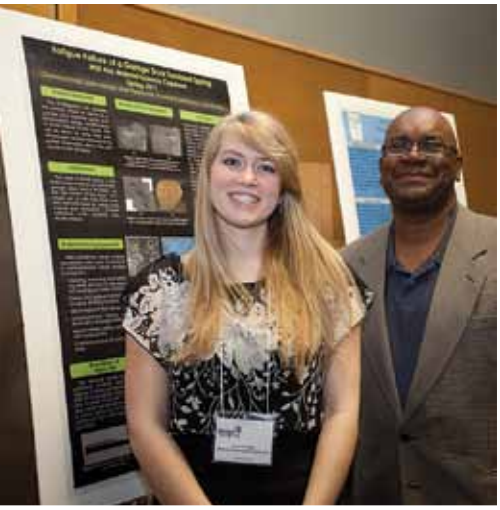
Fracture Analysis of the Failed Lower Link of a Motorcycle

The lower link for a Yamaha YZ–R1 motorcycle failed during a rider's routine, leisurely cruise. Potential loss of life was averted as the rider was able to halt the motorcycle and safely dismount. The lower link was removed and brought before a team of senior materials engineering students (Team Won) to investigate and analyze the circumstances of the failure. After due deliberation, the group selected from a variety of nondestructive testing methods and devised an appropriate plan to evaluate the failed lower link, in hopes of discovering the cause of failure and applying the knowledge gained toward prevention of any future incidents under equivalent circumstances.

Team Triple Threat: Olivia Kinney, Michael Kirin, Julie Motz

Failure Analysis of an Air Cooled Turbine Blade

The purpose of this project was to analyze an air cooled turbine blade of a Co-based alloy with an aluminide coating that failed under normal use. X-40 cobalt-based alloy exhibits excellent corrosion and oxidation resistance, and is therefore commonly used in jet engine turbines. The failure of this component was discovered when a jet engine began to malfunction, and a thorough inspection of the unit was completed. A failure such as this is potentially fatal and must be addressed to ensure the safe design of future turbine blades. Through non-destructive and destructive testing and analysis the group will determine the modes of failure and construct a preventative maintenance or design plan.



Computer Science and Engineering

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MSU Federal Credit Union
East Lansing, Michigan

Spectrum Health Systems
Grand Rapids, Michigan

TechSmith
Okemos, Michigan

Urban Science
Detroit, Michigan

Whirlpool
Benton Harbor, Michigan

The Capstone Projects

Dr. Wayne Dyksen
Professor of Computer Science and Engineering

Presentation Schedule – Anthony Hall, Room 1310

Time	Team	Project Title
7:30 a.m.	Auto-Owners	Event Planning Web App
7:50 a.m.	Boeing	Paper Airplane Building Game Simulator
8:10 a.m.	Dow	Personalized Intranet Portal
8:30 a.m.	EA	Streaming Android Emulator for EA Games
8:50 a.m.	GM	My Conference Room
9:10 a.m.	Meijer	IT Metrics Repository
9:30 a.m.	Break	
9:45 a.m.	Mozilla	Multi-Touch Gestures for Firefox
10:05 a.m.	MSUFCU	Mobile Information App for Staff
10:25 a.m.	Spectrum Health	SLA Management and Metric Reporting System
10:45 a.m.	TechSmith	American Sign Language Learning App
11:05 a.m.	Urban Science	Dealership Consultant Mobile App
11:25 a.m.	Whirlpool	Guided Cooking and Recipe App

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 Auto-Owners Insurance, Boeing, Chrysler, Dow, Electronic Arts, Ford, GE Aviation, General Motors, Google, IBM, Meijer, Microsoft, Motorola Mobility, Mozilla, MSU Federal Credit Union, Quicken Loans, Spectrum Health Systems, TechSmith, Toro, the Union Pacific Railroad, Urban Science and Whirlpool.

The Capstone Experience Lab Sponsored By

URBAN SCIENCE

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

Auto-Owners Insurance
Event Planning Web App

Auto-Owners Insurance is a Fortune 500 company with written premiums of over $5 billion. For over 95 years, Auto-Owners has been dedicated to the independent agency system. Auto-Owners is recognized for exceptional financial strength and stability among the nation's largest insurers.

Auto-Owners provides its associates and independent agents with many opportunities to socialize at events outside of the work environment. Our Event Planning Web App is a mobile ready web app that allows associates and independent agents to register for these events.

Auto-Owners administrative users can schedule events, edit events, send invitations, send reminders and view lists of registered attendees.

Our Event Planning Web Application includes built-in events for performing arts, golf outings, baseball games and football tailgates. Administrators are also able to create new types of events as needed.

Auto-Owners associates and independent agents use our Event Planning Web App to register for invited events or search and register for open events.

Our app is designed to accommodate various screen sizes including mobile screens so it works well on most mobile phones and tablets.

Our Event Planning Web Application is written in Java and JQuery Mobile, with the data hosted on an IBM DB2 database.

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

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The Boeing Company
Paper Airplane Building Game Simulator

Boeing is the world's leading aerospace company and the largest manufacturer of commercial jetliners and military aircraft.

Our Paper Airplane Building Game Simulator is a game in which a player's goal is to organize a factory of humans and robots to assemble one or more paper airplanes.

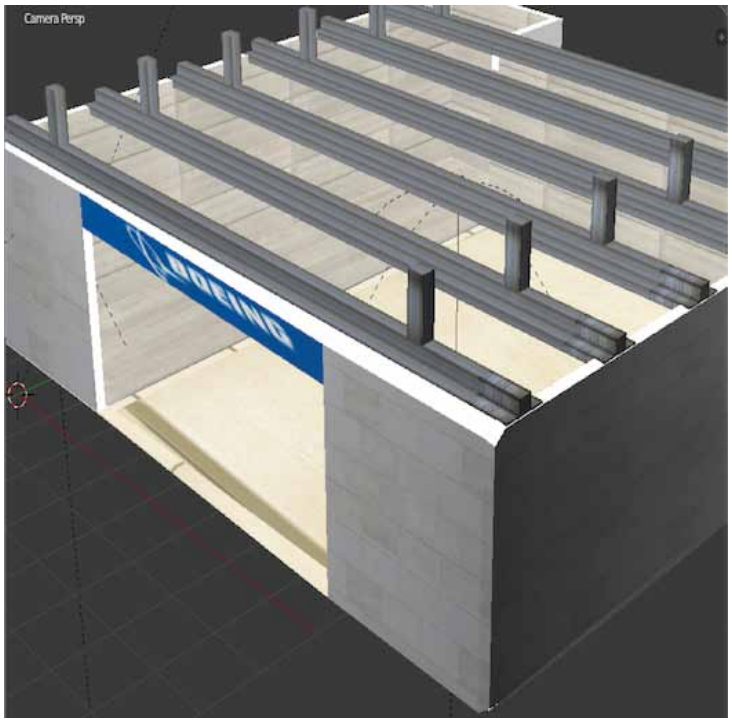
The game begins with a default layout of humans and robots along with a budget and a time limit. A player can manipulate the position of humans and robots before the simulation takes place while robots may be purchased from the Game Shop.

Pressing the play button begins the simulation. The different game objects then proceed to carry out their different functions. Once the paper pieces are taped together, they form a large sheet of paper, which is folded into a paper airplane.

During the simulation the overall safety on the factory floor is taken into account. Safety concerns such as collisions between the factory workers are highlighted and warnings are issued.

A player can pause the simulation and edit the setup including purchasing more robots if they have enough funds.

A player can advance if the paper airplanes are constructed within the time limit, budget and safety violations threshold. Our Paper Airplane Building Game Simulator is compatible with Ubuntu 12.04 and runs above the Gazebo Robotics Simulator, uses Ogre3D renderer and Bullet Physics.



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The Dow Chemical Company
Personalized Intranet Portal

The Dow Chemical company connects chemistry and innovation with the principles of sustainability to help address many of the world's most challenging problems such as the need for clean water, renewable energy generation and conservation, and increasing agricultural productivity.

Our Personalized Intranet Portal keeps Dow's 50,000 employees in over 160 countries connected with each other via this internal web communication portal.

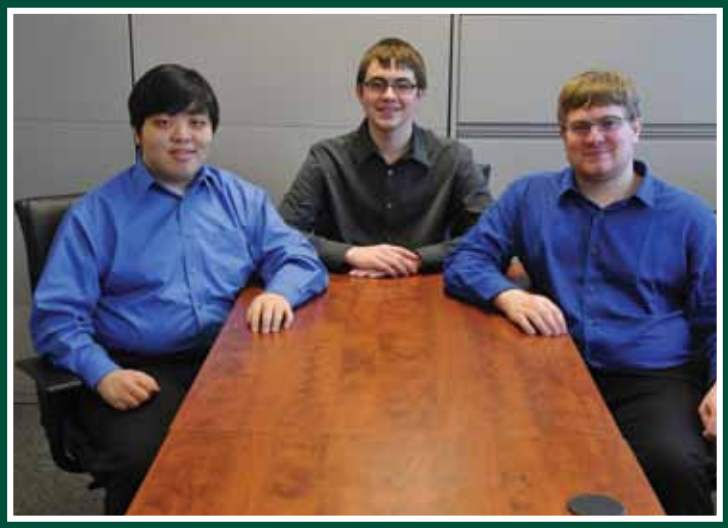
We leverage modern technologies to replace Dow's existing older portal. In order to provide an easy transition for users, the overall look and feel of our new portal remains mostly consistent with the legacy version.

Our Personalized Intranet Portal is designed around the taxonomy of Dow's business structure and common functions. Hence, portal navigation is based on this taxonomy.

We support many of the features of the legacy portal. For example, administrators are able to use a survey tool to create and distribute surveys. After users complete surveys, results are displayed as charts in the portal.

In addition, Dow employees are able to publish content such as memos and technical reports on the website within their branch of the company. This provides Dow with the ability to manage their web content easily.

The Intranet Portal is built using Microsoft SharePoint 2013 Enterprise, HTML, CSS and Microsoft SQL Server 2012.



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Electronic Arts
Streaming Android Emulator for EA Games

Electronic Arts (EA) is a leading interactive entertainment software company that develops, publishes and distributes interactive software for internet-connected consoles, personal computers, mobile phones, tablets and social networks.

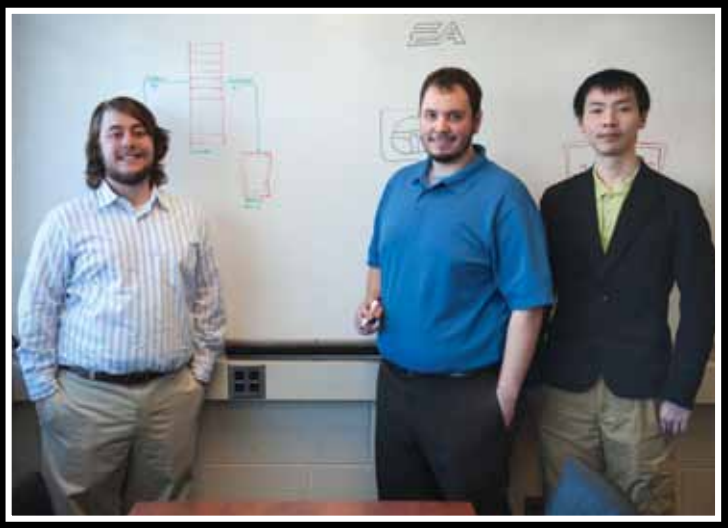
With mobile development on the rise, EA must find ways for users to run mobile games simply on non-mobile devices.

Our Streaming Android Emulator for EA Games enables Android-based games to be run on any computer with a capable web browser such as Chrome or Firefox. A wide variety of games can be streamed from EA over the internet and played without installing any additional software.

After players select a game to play from an EA game server, game video streams to their local PC. Players control the game running on their PC using an Android device, which supports multiple sets of controls schemes including options such as touch, multi-touch, swipes and accelerometers.

Since the Android-based game controller is implemented as a web app, users can run and control games immediately without installing any additional software on their Android device. The layout and functionality of the game controller is customized depending on the game being played.

Our Streaming Android Emulator for EA Games system uses a slightly modified version of the Android SDK emulator. HTML5, PHP and JavaScript are used to implement the game controller interface.



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General Motors
My Conference Room

In today's fast-paced, ever changing world, businesses must be agile to stay ahead of the competition. Among other things, such agility requires the ability to hold impromptu meetings.

My Conference Room is a mobile app that enables GM employee groups to identify and book open conference rooms for "spur-of-the-moment" meetings.

Conference room availability is determined easily and quickly with a smartphone by scanning QR (quick response) codes located outside of each conference room.

Based on the QR code, users are automatically directed to a mobile website that shows the room number in a color-coded box that indicates the availability of the room.

If a room is available, users can book the room immediately by pressing the "Book Now!" button.

If a room is booked, users can search for nearby available rooms based on the desired duration of their impromptu meeting and the capacity of the room.

My Conference Room displays a variety of information including the room capacity, the next booked appointment and various amenities associated with the room such as Wi-Fi, SmartBoards, video conferencing and outdoor views.

C# and ASP.net are the underlying code for the mobile website. Conference room schedules are hosted on Microsoft Exchange Server 2013.

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Meijer
IT Metrics Repository

Meijer is a regional supercenter providing quality food and merchandise in five states throughout the Midwest. Headquartered in Grand Rapids, Michigan, Meijer has nearly 200 stores and over 60,000 employees.

In order to provide the best service possible for their customers, Meijer collects large amounts of data used to measure performance. These data measurements, or metrics, are used by comparing data to desired goals or to other metrics.

One important area to monitor is that of Information Technology (IT). Providing low cost, available and reliable IT computer applications and infrastructure are keys to remaining a leading company in the competitive supercenter business.

Our IT Metrics Repository provides Meijer's IT group with an easy and flexible means of creating, storing, viewing and updating IT metrics. Users can create, edit and populate new metrics along with corresponding goals. New metrics can be based on existing metrics.

Metrics are viewed via user generated reports, which present graphs and tables of the metrics over a user selected time range. Each metric's performance is compared to its goal.

Our IT Metrics Repository is a web-based application developed in Microsoft's .NET framework using C#. Microsoft SQL Server 2012 with Reporting Services is used for our database backend.

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Mozilla Corporation
Multi-Touch Gestures for Firefox

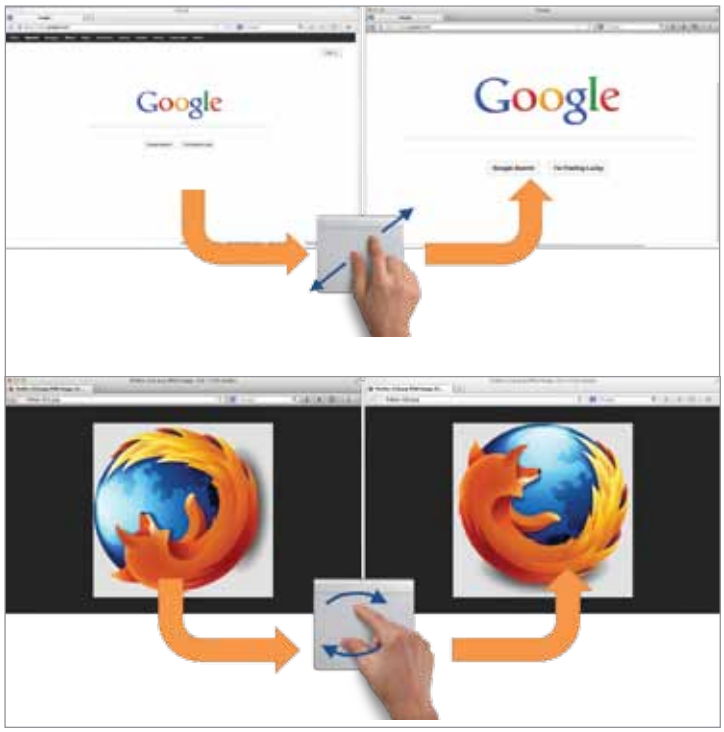
Every day, millions of users choose the Firefox browser to navigate the web. Mozilla Corporation, the creator of Firefox, is committed to providing the best web browser experience in today's market in order to retain their existing users and to attract new ones. In particular, modern users expect the same touch features found on their mobile devices to be present on their laptops and desktops as well.

Multi-Touch Gestures for Firefox, done in collaboration with Mozilla Firefox developers, provides improved gesture support for Firefox on Apple OS X and Microsoft Windows by introducing pinch and rotate gesture features, as well as double-tap on OS X. The gestures are input using a trackpad or touchscreen capable of recognizing multiple touches simultaneously, which are standard on many current laptop models and is available as an accessory for the iMac.

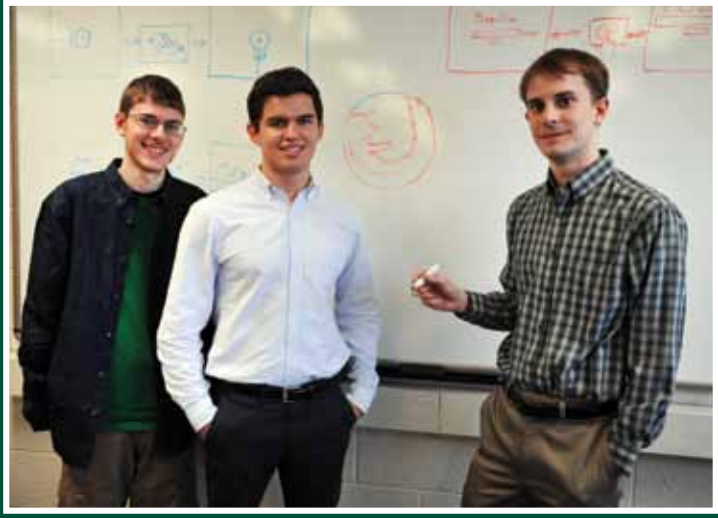
Multi-Touch Gestures for Firefox provides the ability to use the pinch or double-tap gestures to zoom in or out while surfing the web. These two gestures work on any web page.

The rotate gesture allows the user to rotate an image opened directly (known as a synthetic image document). Unlike the zooming gestures, which are featured in other web browsers, this new rotate feature is unique to Firefox.

Gesture recognition is performed by the operating system. The resulting gesture events are sent to Firefox. JavaScript is used to create XUL elements and CSS properties that display the rotated or zoomed web content.



mozilla Firefox



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MSU Federal Credit Union
Mobile Information App for Staff

With over $2.25 billion in assets and 168,000 members, Michigan State University Federal Credit Union, or MSUFCU, is the largest university-based credit union in the world.

MSUFCU strongly believes that effective communication plays a key role in the success of an organization.

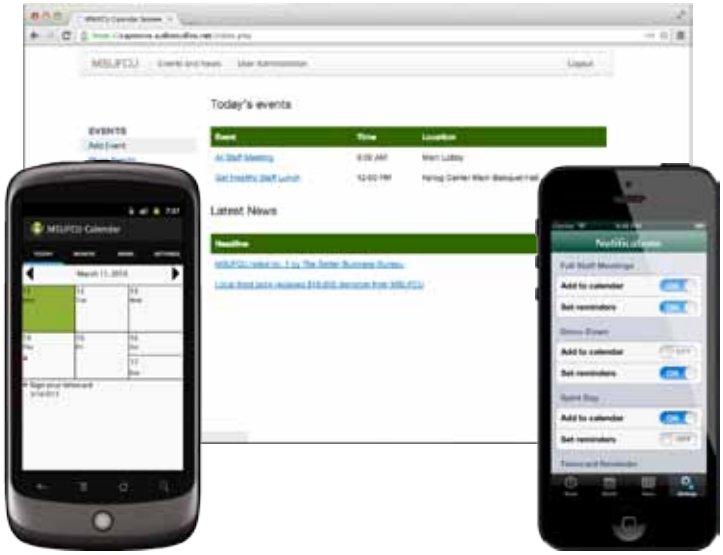
Our Mobile Information App for Staff enhances and strengthens communication within MSUFCU by providing an easy and convenient way for staff to access information regarding important events, news and announcements directly from their iPhone, iPad or Android mobile devices.

MSUFCU employees always have the latest details of upcoming staff meetings, charity events, credit union holidays and paydays right at their fingertips. Events can be integrated directly with users' mobile devices so they can receive notifications prior to the start of events.

All of the events, news and announcements to be published are edited through an online website interface, making it easy to share information and keep everyone abreast of the latest developments at MSUFCU.

Our Mobile Information App for Staff system is comprised of three distinct apps including a native iPhone app, a native Android app and a web app.

The iPhone app is written in Objective C. The Android app is written in Java. The web app is implemented in PHP, JavaScript and a MySQL database backend



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FEDERAL CREDIT UNION
Building Dreams Together

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Spectrum Health Systems
SLA Management and Metric Reporting System

Spectrum Health Systems, located in Grand Rapids, Michigan, provides high quality, high value healthcare through its nine hospitals in West Michigan, which are maintained by 19,000 employees, 1,500 physicians, and 2,600 active volunteers.

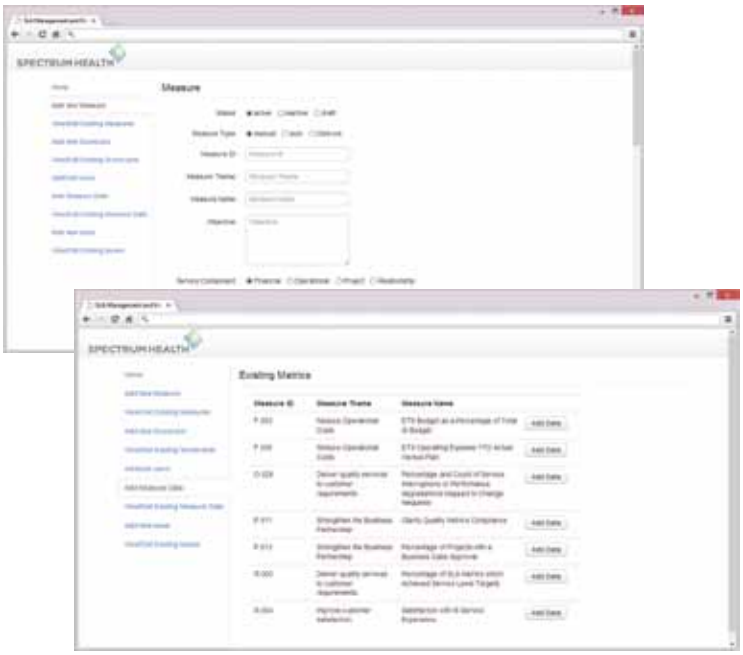
In order to manage such a large and complex organization, Spectrum Health leadership must be able to know how well they are meeting their business objectives and service-level agreements. Business metrics help leadership evaluate progress of business initiatives and assist in decision-making.

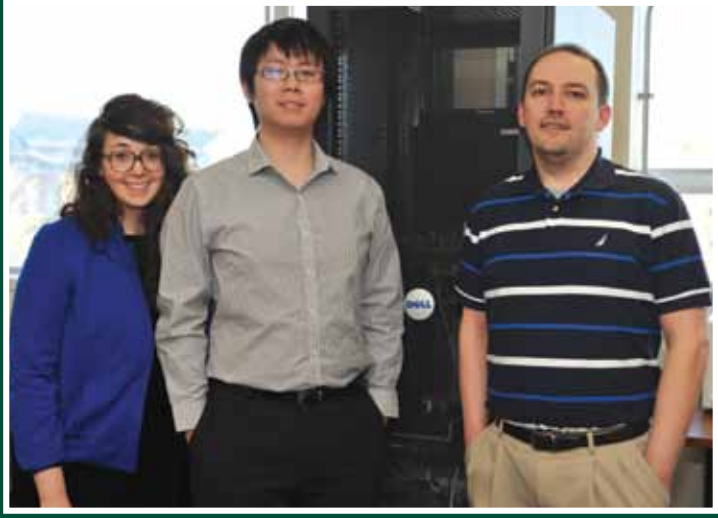
Our SLA Management and Metric Reporting System allows metric data to be managed easily and viewed by users. Leadership can quickly view data using succinct scorecards that display up to six months of metric data.

Designated users can define new metrics and scorecards. A metric creator can designate specific users to enter monthly data, choose the scorecards on which to display the metric data, and add detailed information about the metric, such as the method used to calculate the data.

Once the monthly data has been entered, leadership can review the completed scorecard. Information is presented in a color-coded format. Monthly values that hit their target are shaded green, while unsatisfactory values are shaded yellow or red, depending on the severity.

Our SLA Management and Metric Reporting System is written in HTML, CSS and jQuery. The data is stored in a MySQL server and the backend API is written in PHP.





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TechSmith
American Sign Language Learning App

Learning American Sign Language (ASL) is an interactive process between students and teachers. Feedback from teachers is needed for students to learn proper technique.

Even when traditional classroom settings are not available, the same interactions are required to effectively learn ASL.

Our American Sign Language Learning App, developed in collaboration with TechSmith, bridges this gap by allowing students and teachers of ASL to learn and teach remotely.

Teachers use the app to create lesson plans for their students either by bookmarking YouTube videos or creating videos themselves. Students review the lessons, record themselves signing and send the video to their teacher.

Teachers critique students' recorded videos by annotating the video with lines, arrows, circles, text or voice. After critiquing, teachers send the video back to their students.

There are two different options for teaching and learning. A teacher and student can share the same device in person. Or, a teacher and student can use separate devices with the video being shared between devices via a backend server.

Our American Sign Language Learning App runs on a Microsoft Surface tablet. The tablet, along with Windows RT, allows us to create a rich, interactive learning environment.

Our app is written in C# backed by a SQL database.

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Urban Science
Dealership Consultant Mobile App

Urban Science provides automobile manufacturers and dealers worldwide with software tools and analysis that enable their clients to evaluate and manage their dealer networks more effectively and more efficiently.

The Dealership Consultant Mobile App enables Urban Science consultants and field personnel to prepare for and to manage dealer visits by providing mobile access to dealer key performance indicators (KPIs) and by providing ways to track dealer visits using an iPad.

Consultants use our Dealership Consultant Mobile App in a variety of valuable ways. For example, they use it to prepare for consultations. The application identifies areas for dealer improvement based on KPIs, showing value, rank and percentile. Visually appealing graphs and charts are used to present the information to dealers in meaningful ways.

During dealer visits, consultants use our Dealership Consultant Mobile App to document the visit including agreements on areas, tasks and timeframes for improvements. These are then tracked to determine if the desired effects are achieved.

In addition, our app provides historical trends of KPIs by dealer thereby giving consultants and dealers a better understanding of the effects of changes over time and better ideas for making improvements in the future.

The application is implemented using Cordova, JavaScript, HTML5 and PHP to access data on a SQL database.

URBAN SCIENCE

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Whirlpool Corporation
Guided Cooking and Recipe App

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is a worldwide innovator in manufacturing a diverse range of household appliances and technologies.

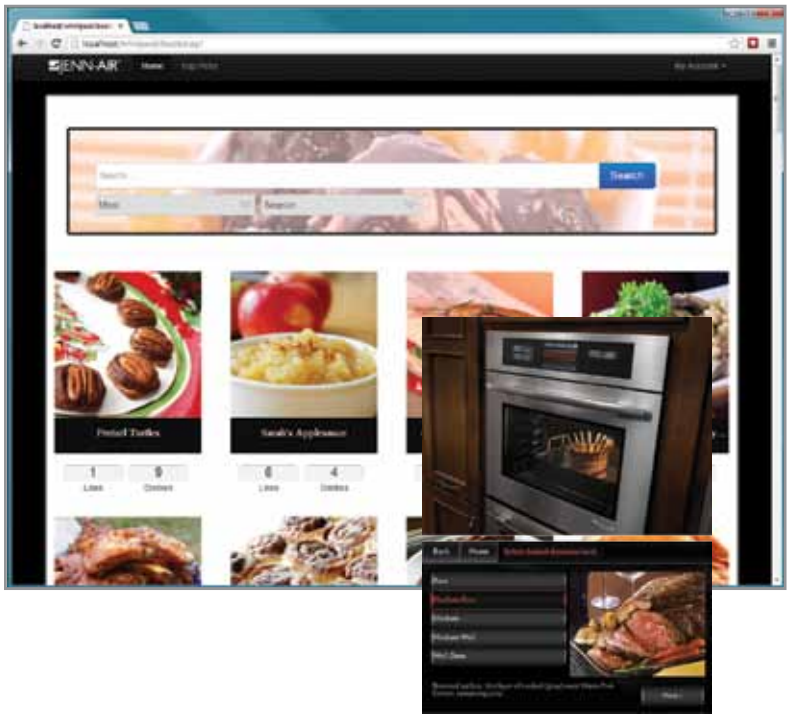
As an innovator in the field, Whirlpool now offers "Connected Appliances" that give customers new ways to interact with their appliances.

As expected, our Guided Cooking and Recipe App is a cooking and recipe guide that provides recipes including the typical lists of ingredients and preparation instructions along with cooking steps. The remarkable feature of our app is that eventually it will be able to communicate directly with a new line of Whirlpool ovens, displaying the cooking steps directly on an oven's touchscreen display.

Whirlpool customers can create their own customizable version of the guide. They can personalize existing recipes and add recipes of their own. Ingredients that a customer does not have are added to their individual shopping list by simply clicking a button.

Select Whirlpool employees are given administrator rights, which grant them the capability to add edit and remove recipes.

Our Guided Cooking and Recipe App uses a variety of technologies including PHP, MySQL, HTML5, CSS3, jQuery and JavaScript.



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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

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 Mozilla
Reader Mode for Desktop Firefox

Kevin Woodward, Michael Anderson, Matt Vorce, Chelsea Carr
Presented by Bob Buchanan and Scott Lake of Auto-Owners Insurance

Chrysler Praxis Award

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

The CSE capstone team that engineers the software system that is the most technically challenging is recognized with the Chrysler Praxis Award, which is sponsored by Chrysler LLC of Auburn Hills, Michigan.

Team Boeing
Design, Fly and Compete Sim Suite V2.0

Jake Newsted, Kevin Liening, Dan Sosnowski, Max Ellison
Presented by Karen Wrobel of Chrysler

Spring 2012

Design Day Judges

Ryan Abbott
Science Exchange

Brian Abraham
Spartan Innovations

Greg Davidson
Urban Science

Mike Drazan
Toro

Rich Enbody
Michigan State University

Adam Haas
Ford

Louise Hemond-Wilson
IBM

Fred Killeen
General Motors

Brian Loomis
Microsoft

Kevin Ohl
Michigan State University

Marty Strickler
Rose Packing Company

Karen Wrobel
Chrysler

TechSmith Screencast Award

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

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

Team Ford
MyKey Report Card

Alex Conklin, Kevin Klemmer, Andrew Crouch, Brandon D'Orazio
Presented by Dean Craven of TechSmith

Urban Science Sigma Award

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

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

Team Spectrum Health
Medication Shortages Dashboard

Ramata Koumare, Aaron Cosentino, Grayson Wright, Eric Dostie
Presented by Greg Davidson and Matt Bejin of Urban Science

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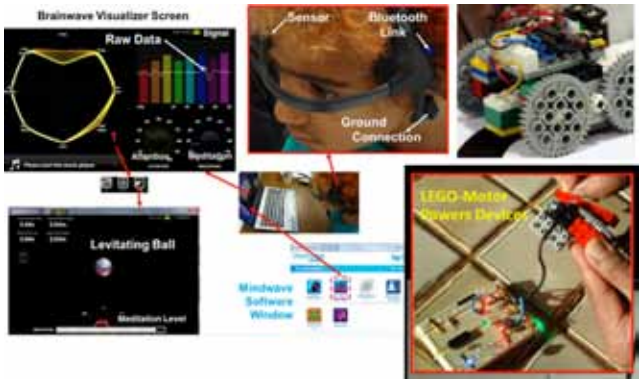
SLAP

ECE 101
Introduction to Electrical and Computer Engineering

Dean M. Aslam
Professor of Electrical and Computer Engineering

Thrills for Pre-collegiates: Mechanisms that fascinate, captivate, stimulate and entice



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) C programming of robots based on MSP430 microcontrollers and NXT LEGO controllers, (c) pH measurement using NXT sensors, (d) maple-seed robotic fliers (MRF) with on board electronics, (e) location of bio-molecules using RFID, (f) renewable energy resources using windmill and solar cells, (g) nanotechnology study using a LEGO gear-train, and (h) brainwaves and mind-controlled games using a toy EEG device.

Team Members	Project Title
Juntong Lu Ian James Mcgregor Arnold Nunez	The Exploration of Simple Electric Motors
Anthony Joseph Garvert Ian H Grosh Trevor William Sabo	Robot Mind-Control
Alexander Grein Willie James Pickett	Coin Sorter
Harsh Narendrakumar Desai Gursimran Singh	NXT robot to build a bridge between the two surfaces
Domenika Tarazhi David Alan Gilbert	Battery Recharging Windmill

The Capstone Projects

Dr. Timothy Grotjohn
Chairperson and Professor of
Dept. of Electrical and Computer Engineering

Presentation Schedule – Room 2250 Engineering Building, Second Floor

Time	Team Sponsor	Project Title
7:50 a.m.	Robert Bosch LLC	Automated Power Mode Test System
8:15 a.m.	US Agency for International Development	Low Cost Wireless Agricultural Sensors
8:40 a.m.	Texas Instruments	Electrocardiogram (ECG) Demonstration Board
9:05 a.m.	Instrumented Sensor Technology (IST)	Real Time G-Meter with Peak/Hold
9:30 a.m.	MSU Resource Center for Persons with Disabilities	Smart Voting Joystick for Accessible Voting Machines
9:55 a.m.	Break	
10:10 a.m.	MSU Resource Center for Persons with Disabilities	Haptic User Interface Phase II
10:35 a.m.	Department of ECE	Autonomous Target Tracking Robot
11:00 a.m.	Air Force Research Laboratory	Motion Capture for Runners
11:25 a.m.	Fraunhofer CCL	Diamond Optics Measurement System
11:50 a.m.	Fanson Controls & Engineering	Parts Measurement System

To view these presentations live please visit the Design Day website: http://designday.egr.msu.edu and click the *Watch Live* tab in left side menu bar.

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, legal, intellectual property, accommodation issues and entrepreneurship.
- Polishing their communication skills – individual and team – on proposals, reports, resumes, evaluations, posters, web pages, and oral presentations.
- Requiring each student to complete four individual hardware/software laboratory assignments.

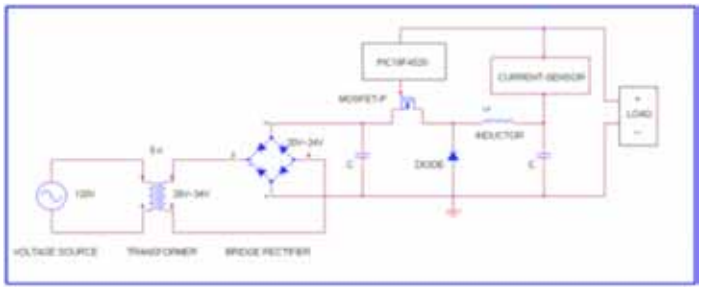
Team sponsors are local and national, including, Air Force Research Laboratory, Fanson Controls and Engineering, Fraunhofer Center for Coatings and Laser Applications (CCL), Instrumented Sensor Technology (IST), MSU Resource Center for Persons with Disabilities, Robert Bosch LLC, Texas Instruments, and US Agency for International Development. Thank you to each of these team sponsors. Also a thank you is extended to ArcelorMittal for general support of ECE 480.

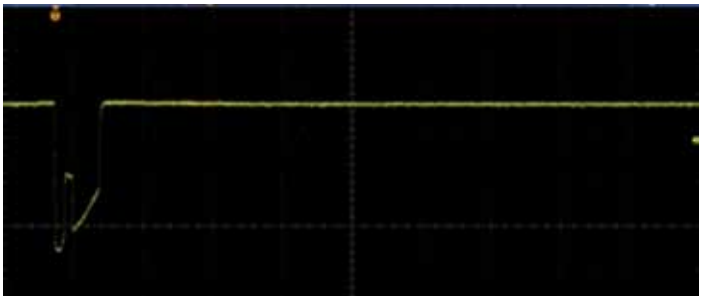
Robert Bosch L.L.C.
Automated Power Mode Test System

Robert Bosch L.L.C. must ensure safe and reliable operation of its infotainment ECUs under a variety of vehicular power modes. The transient responses included in these various power modes could cause unexpected behavior, and therefore it is imperative that the ECUs can be thoroughly tested in an easily automated way. One critical power mode is CRANK whereby the engine is usually started. The power supply our team is designing allows for simulation and testing of various CRANK profiles and their effect on the infotainment ECU in a scriptable, easily extensible, and modular fashion.

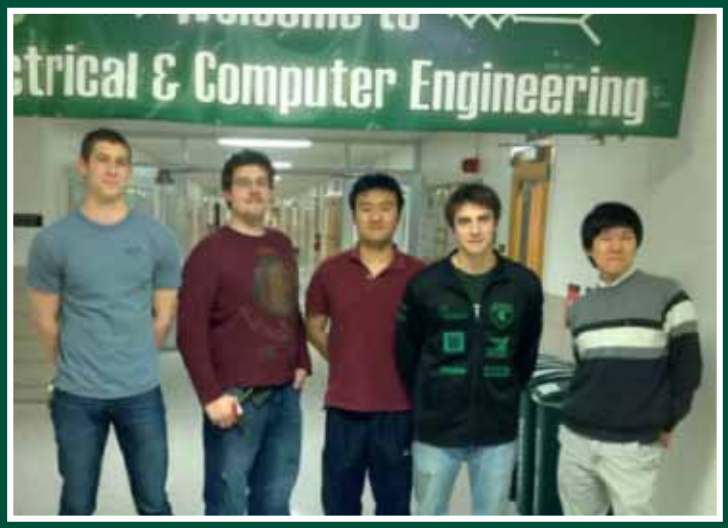
The CRANK profiles are loaded into a Microsoft C#.NET GUI application running on a Windows XP/Vista/7/8 operating system. These profiles are broken into voltage versus time metrics, and sent over USB to a PIC18F microcontroller. From within the Windows application, different profiles can be loaded and started/stopped in a scriptable fashion allowing for automated overnight testing of an infotainment ECU.

Once the voltage versus times metrics have been sent to the PIC18F microcontroller, the duty cycle required to achieve these metrics is calculated using on-chip firmware programmed in C. The microcontroller then sends pulses in the MHz range to the p-channel MOSFET pin on a Buck DC/DC regulator in order to realize these voltage versus time outputs. The Buck DC/DC is powered with DC power, which was converted from AC by an AC/DC regulator connected to a transformer. Internal traces from the device under test (DUT) are then sent back to the Windows application for analysis.





BOSCH
Invented for life



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US Agency for International Development
Low Cost Wireless Agricultural Sensors

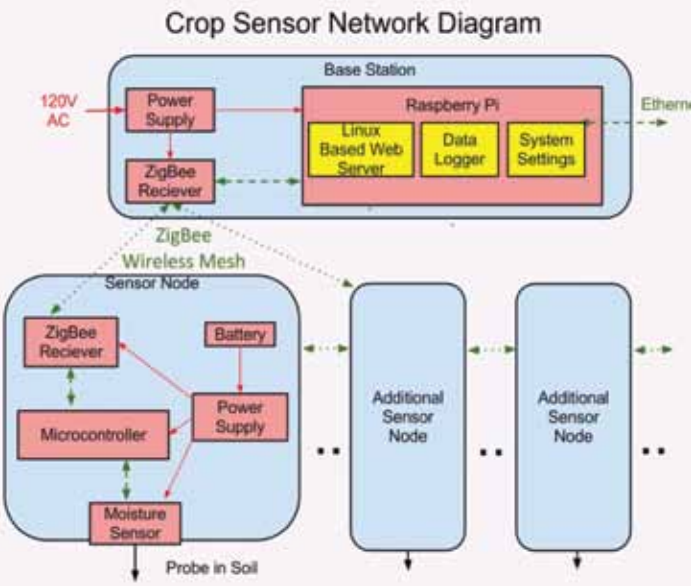
This project detects soil moisture levels across a small farm and uses a mesh communication network to relay information back to a central hub that will analyze the data and alert a user when the field needs to be watered.

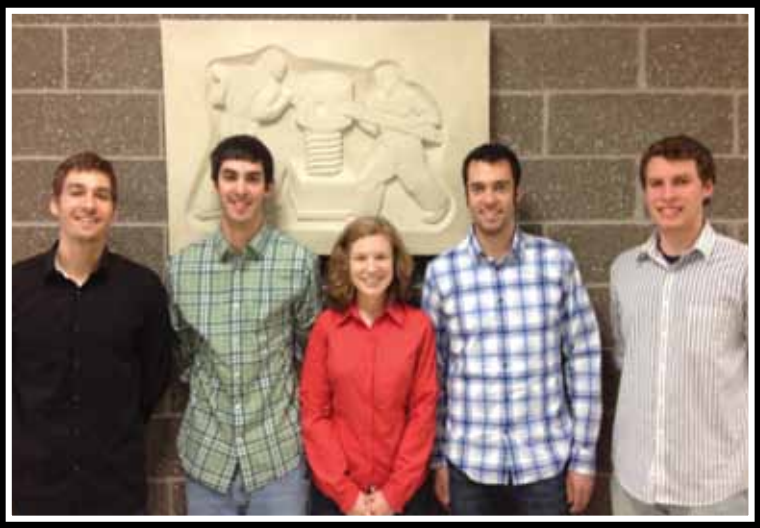
Agriculture is an important part of many developing nations economy, especially in places such as Africa where water and fertilizer can be in short supply. Using resources as efficiently as possible is critical for farmers.

Our sensors will use a Zigbee based wireless protocol to create an ad hoc network and will use a Raspberry Pi as a computing solution for the hub that collects and processes the soil data.

This network requires sensors that are low power, inexpensive and have the battery life of a growing season which is typically around three months. The network as a whole also needs to be scalable to fit the needs of various field sizes. The case that will encapsulate the circuitry connecting the sensor to the network will need to be robust to moisture, dust, wild life and theft.

Upon completion of this project our team will be traveling to Tanzania through an MSU Study Abroad experience to install our system in a small farm run by a school for the Maasai in Mto wa Mbu where they grow a mixed crop of corn an bananas.





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USAID
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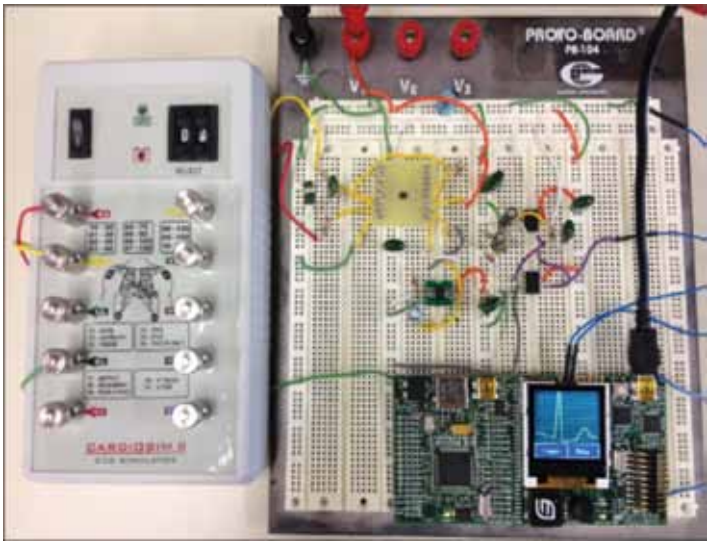
Texas Instruments
Electrocardiogram (ECG) Demonstration Board

Portable and low power electrocardiogram (ECG) systems are in high demand in today's technological markets. Many industries in the biomedical and engineering fields utilize ECG systems to diagnose heart conditions or monitor the vital signs of patients. Cardiologists, in particular, specialize in the interpretation of ECG signals. Their experience and knowledge of heart behavior allows them to correlate certain irregular signal patterns with diseases or health conditions.

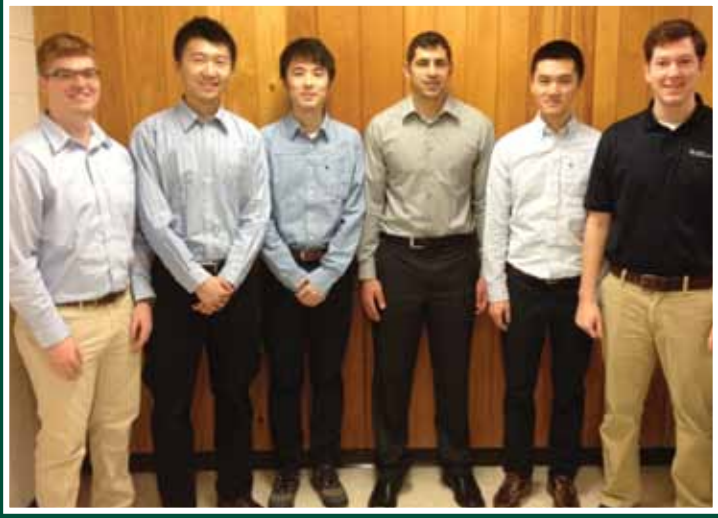
Electrocardiograms are able to sense the small electrical signals produced by the muscles in the heart. These measurements are typically measured indirectly from the skin using electrodes. Signals produced by the heart are very small and need specialized equipment to obtain accurate display. Depending on the specific use of the equipment, many ECG monitors utilize digital signal processing as well as stable and well-designed analog signal conditioning. Noise and other electrical interference make these measurements challenging.

The Precision Analog group at Texas Instruments has proposed the challenge to design the analog circuitry required to interface a portable simulator (CardioSim II) with a Stellaris Evaluation Board (Oscilloscope). Texas Instruments plans to use the board for demonstration purposes only.

After designing, simulation, fabricating, and testing the demonstration board, the team's portable solution is capable of measuring and displaying a reliable and low noise ECG signal.



Analog system linking CardioSim II with the Stellaris µC



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Texas Instruments
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Instrumented Sensor Technology (IST)
Real Time G-Meter with Peak/Hold

Have you ever wondered what kind of forces your package receives when being shipped across the country? Integrated Sensor Technology (IST) has an idea to attach a G-meter (no larger than a cell phone) to a package to measure the G-forces received by the package during transit.

IST is sponsoring this senior design team and assigned the team to design and build a portable G-meter (similar to the meter pictured on the right) that can be placed on a shipped package. The G-meter is built to last a minimum of 30 days and run on two AA batteries.

The G-meter displays data in two modes. The first mode displays the current force that is acting on the meter. The second mode displays the maximum force that the G-meter has experienced the entire time that it has been active. The second mode also displays the date and time at which the maximum force occurred. This G-meter is designed to measure G-forces between positive and negative 17g.

The G-meter is composed of three main components: an accelerometer, a microcontroller, and an LCD screen. The accelerometer is the device that actually measures the G-force. The microcontroller is the device that takes the accelerometer's measurement and formats it to display on the LCD screen. The microcontroller used in this G-meter is the TI MSP430 from Texas Instruments. This microcontroller is used because it can operate at a low power and can easily interface with an accelerometer and an LCD screen.

IST Instrumented Sensor Technology

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MSU Resource Center for Persons with Disabilities

Smart Voting Joystick for Accessible Voting Machines

Research findings prior to a single axis joystick have indicated that people with disabilities are less likely to vote than individuals who do not have disabilities (statistics show 7% of the disability population in the survey conducted are less likely in 2008 and 3% less likely in 2010). Based on the above findings, the Resource Center for Persons with Disabilities (RCPD) of Michigan State University has requested an accessible smart double axis joystick with an integral display that can be used to operate electronic voting machines at voting precincts across the United States.

Design Team 5 has been assigned with developing the double axis joystick with an integral display for a voting ballot on a computer system that will provide individuals with disabilities to successfully vote without significant discomfort and within a reasonable amount of time compared to a standard voter without such disabilities.

The developed double axis joystick has USB connectivity and has been implemented with a haptic feedback control to enhance user interactions with a standard graphical user interface (GUI) paradigm. While standard joystick devices are input-only, haptic feedback control utilizes the sense of touch in a user interface design to provide information to an end user. Another feature that has been implemented in the joystick is a detented feature, which allows our user to more efficiently remain on a selected option without being impeded by any disabilities.

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MSU RCPD
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East Lansing, MI

MSU Resource Center for Persons with Disabilities

Haptic User Interface Phase II

Jordyn Castor is like a typical college student in many ways. A sophomore Computer Science major from Rockford, Michigan, she enjoys reading, listening to music, and hanging out with family and friends. However, unlike most other students, Jordyn has been blind since birth. For the past 20 years, Jordyn has struggled with and overcame many challenges that result from being blind. As technology continues to advance and more everyday operations are handled via computers, new challenges arise for Jordyn and millions of other blind students. One of these particular challenges that our design team is addressing involves translating graphic images from a computer screen to a device that Jordyn or other blind students could interpret.

Though devices to aid visually impaired individuals with computers currently exist, they often range from $5,000-$10,000. Some read text aloud to enable the blind to navigate through windows. Others generate a raised surface of the images, from the computer screen, that users physically feel via touch. Our design is similar to this; however, there are some fundamental differences. The main goal of the project is to make an equally functional product that is more affordable compared to the devices that are on the market today.

Our solution to the design implements solenoids magnetically charging metal bars that raise and lower pins through voltage pulses. The pins latch in the raised or lowered positions depending on the polarity of the bars. Figure 1 shows an example solenoid and the magnetic field.

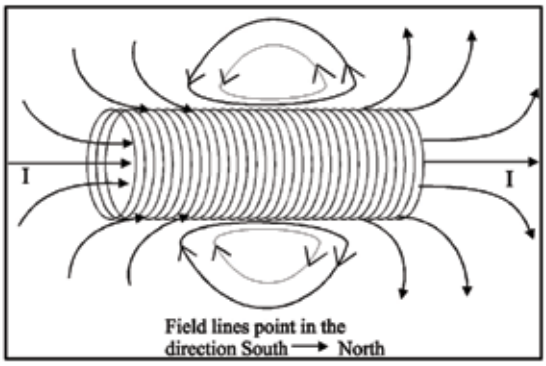

Figure 1

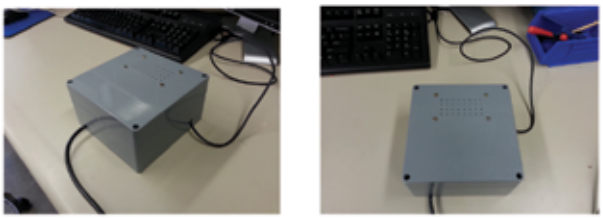

Figure 2: Phase I Final Design

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Department of ECE
Autonomous Target Tracking Robot

The purpose of this project is to design and build a robotic vehicle capable of autonomously identifying and following a marked target using a visual camera. The robot is remotely controllable for navigation to and from the target area using a commercially available Bluetooth joystick. It includes an autonomous mode where it searches a 360 degree field of view for a predefined target using the OpenCV C++ library to process the video stream from the camera. Upon successful target acquisition, the robot will close to within three feet of the target while avoiding collision. If the marked object moves the robot will be capable of autonomously following its motion. The robot is self-powered for over one hour of continuous run time. The robot is powered by a Lithium Polymer battery. It is capable of speeds around five mph and has a zero turning radius. An Arduino microcontroller is utilized to autonomously control all aspects of the robot including wheel movement, motor power, and direction. The device is capable of two-way communication with a simple portable "base station" such as a laptop, in order to accept commands and return data. This is achieved by implementing both WiFi and Bluetooth technologies. In addition to the primary collision sensors, other sensors are needed to collect additional data, such as wheel speed and target range. The chassis is structurally sound and is able to protect the electronics from minimal environmental conditions, with primary operation indoors at room temperature. Finally, an easily accessible manual shutdown switch is built into the robot that can cut power to the motors for safety purposes.

DEPARTMENT OF ECE
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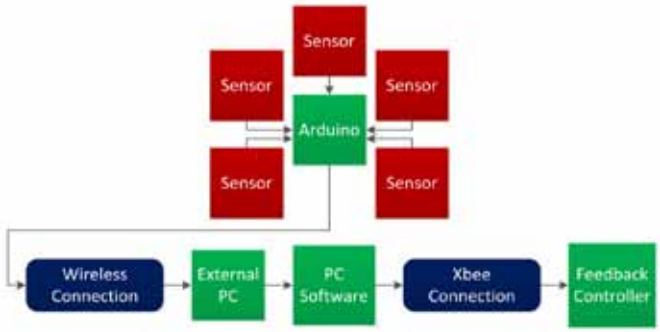
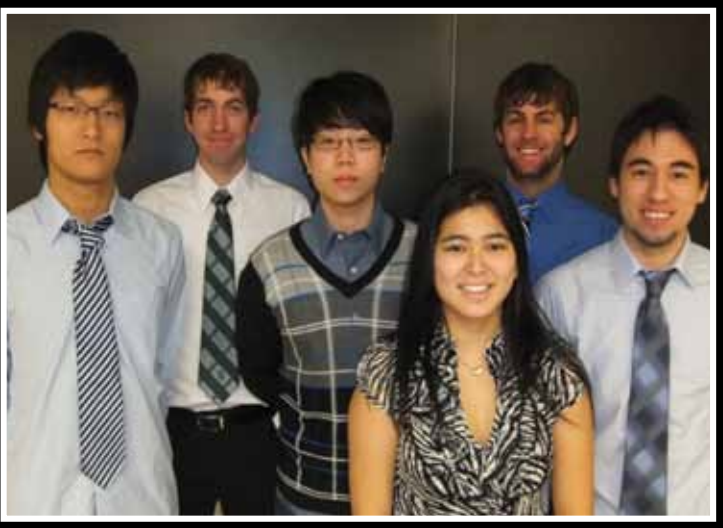
Air Force Research Laboratory
Motion Capture for Runners

The team is tasked to design and test a product to capture running motion. This product analyzes the form of a runner and compares it to an elite runner under various running conditions. Sponsored through the Air Force Research Laboratory, the team is challenged to find an innovative and low cost solution to capture and analyze motion. They hope to use this technology to further understand motion of flexible structures of aircraft and spacecraft.

The objective of this project is to design a motion capture device that can be worn by runners in order to improve running efficiency. Inertial Measurement Units (IMUs) are sensors used to capture the runner's movement. These sensors are placed within a universal body-suit to fit various body types. A body-worn microcontroller temporarily stores and performs preliminary processing of the raw data. The data is transmitted through wireless communication, processed on a PC, and compared with elite runner data. This processing is done in real-time, giving the runner immediate feedback. A body-worn indicator informs the runner on proper or improper running form.

This product is used inside on a treadmill, due to restrictions on wireless communication distances. The comparison software is utilized to process the data and perform analysis on efficiency of running form. Given accurate and real-time feedback, the runner is capable of maximizing their running technique





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MSU Technologies
Project Sponsor

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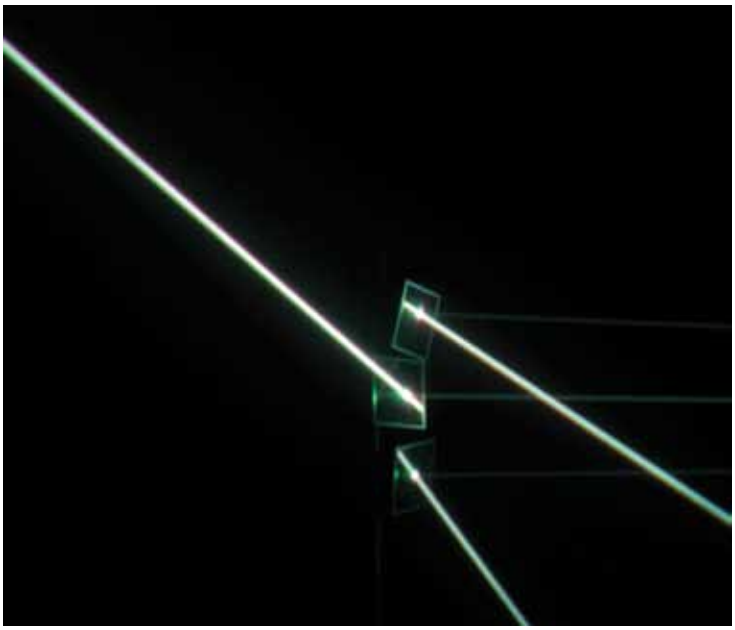
Fraunhofer CCL
Diamond Optics Measurement System

In many avenues of modern engineering, diamond is an up and coming material. Diamond is one of the hardest substances known to man, is chemically inert, and has a very wide spectral window for transmission of light. In fact, Fraunhofer CCl grows diamonds right here on campus. In order to better measure and understand the imperfections of diamond, Fraunhofer CCL commissioned for a better measurement tool. This will allow Fraunhofer CCL to make better diamonds for future engineering technologies.

Since impurities in diamonds can be extremely small compared to the sample in general, a very precise instrument is needed. The basic idea is to have a light source, or laser, check and model impurities in diamonds with the assistance of polarizers. When the light goes through a polarizer, the light wave is filtered to travel in one direction. When the light interacts with a second polarizer which is at a 90 degree angle from the first, the light wave will be canceled out completely since both directions of the light wave have been filtered. A diamond with no impurities will allow light to pass completely through it. Thus, when placed between the two polarizers, there should be no visible light measured past the second polarizer. If there is, the light that went through the diamond was refracted off some impurity or stress in the diamond causing the direction of the wave light to change and not be filtered by the second polarizer. Our measuring device will calculate the coordinates of the impurities and provide a model of the diamond with the location of the impurities.



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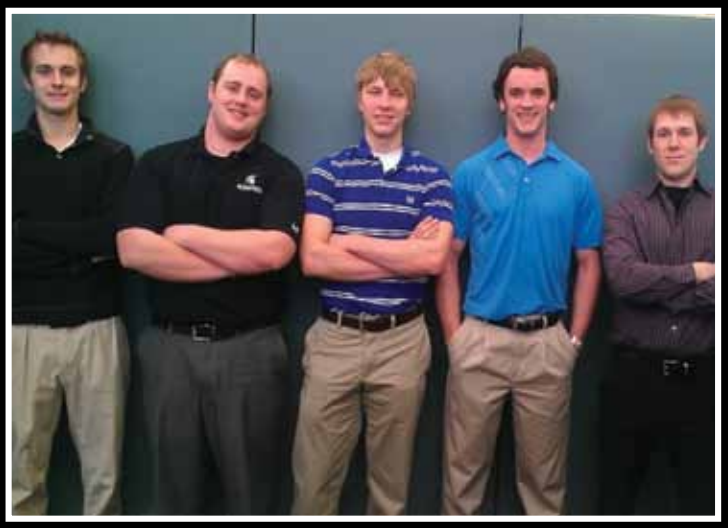
Fanson Controls & Engineering
Parts Measurement System

Fanson Controls and Engineering works closely with various manufacturing facilities to improve machine operation and control systems. Team 10 has been assigned a project from Fanson Controls and Engineering to create a parts measurement system for a transmission value (pictured on right) that is sold to various automobile manufacturers. By automating the quality control process, certain part specifications can be verified immediately after manufacturing of the part is complete. The system will increase the percentage of acceptable parts by giving immediate feedback to the operator to make manufacturing changes. Reduction of bad parts will minimize the cost of each part.

The parts measurement system implements a conveyor belt system that moves the part along a series of sensors. The part is held firmly in place with the use of a cleated conveyor belt and side railings. Sensors are mounted to the sides of the conveyor system and record measurement data as the parts pass through. The sensors measure total length, end-hole depth and diameter, and verify double broaching at the end of the part. A Programmable Logic Controller (PLC) is used to control the belt and sensor movement and to interpret analog and digital data from the sensors. If a part does not meet the required specifications, the PLC signals a solenoid to remove the part from the conveyor system. If requirements are met, the part continues to the end of the belt and falls into a bin with the other accepted parts. The system will allow for future upgrades and additions to be made by Fanson Controls and Engineering.

FANSON
CONTROLS & ENGINEERING



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Design Day Awards Fall 2012

Electrical & Computer Engineering Prism VentureWorks Prize & Winners, Spring 2012

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: Areclor Mittal S.A.: Load Metering and Transmission

left to right:
Timothy Grotjohn, Patrick Powers, Alexander Gollin, Kenneth Young, Cheng Zhang, Nan Xiz

Prism VentureWorks Second Prize: Air Force Research Laboratory: Equipment Rack Active Cooling System

left to right:
Timothy Grotjohn, Cherrone Cathey, Mason Pike, Calan Underwood, Michael Robell, Kilian Davis

Prism VentureWorks Third Prize: Resource center for Persons with Disabilities: Branden's Detented Joystick

left to right:
Timothy Grotjohn, Aditya Matthew, Yongjiao Yu, Scott Friedman, Nathan Hyde, Peter Ossian

ME 371
Mechanical Design I

Farhang Pourboghrat
Professor 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-collegiates. The constraints imposed upon the assignment were that each mechanism must incorporate at least one linkage, one gear set and one cam-follower combination. These engineering marvels will be displayed with a complementary poster explaining the subtleties of each mechanism, and each device will be demonstrated. Each ME 371 team will be interviewed by the pre-collegiate students who will assign them points. These points will be tallied and the winning team awarded the Sparty Plaque for creating the most thrilling mechanism. This plaque was designed and fabricated by students at Holt Junior High School over a decade ago.

Teams and members

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Jeff Hilk
Connor Koester

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Louise Dionise
Emma Drenth
Nicholas Palazzolo

Team 3
Garrett Baughman
Brandon Cameron
Todd Sabotta
Justin Sagorski

Team 4
Teddy Linabury
Alex Morita
Matthew Pingel
Ryan Thompson

Team 5
Sam Bekkers
Tom Hotari
Christina Kalouche
Alex Primeau

Team 6
Kyle Griffiths
Adam Kluz
Kyle Silcox
Yaojing Yang

Team 7
Jin Ahn
Vito Balsamo
Samrawi Gebermedhin
Casey Nicholson

Team 8
Joseph Aljajawi
Christopher Brady
Steven Hilliard
Adam Lyman

Team 9
Jason Ahlquist
Josh Hubert
John Potts
Jason Wagnitz

Team 10
Will Asherman
Scott Belonge
Luke Ferguson
Nicholas Garneau

Team 11
Moe Alsinan
Deonte Childress
Robert Jakubowski
Peter Woodbridge

Team 12
Drake DeLorme
Ryan O'Sullivan
Thomas Parshall
Jake Sparks

Team 13
Justin Fauntleroy
Cody Paupert
Stephen Tatangelo
Kyle Wright

Team 14
Abdul Rahman Bafaraj
Craig Cline
Trenton Hicks
Mohammed Itani

Team 15
Jason Gridley-Waters
Robert Hyatt
Timothy Najar
Travis Schafer

Team 16
Florian Cherdron
Travis Collings
Eddie Frankln
Joe Savage

Team 17
Megan Blaszak
Joshua Boerger
Brianna Hogan
Taekyong Lee
Brittany Watton

ME 412
Heat Transfer Laboratory

André Bénard
Associate Professor of Mechanical Engineering

Candle Powered Desalinator

Each team is to design, analyze, build and test a heat transfer device to evaporate salt water, condense the water vapor, and collect the fresh water in another container. Twelve birthday candles will be used for energy input to the device, which must begin operation at room temperature. The objective is to maximize the amount of water collected. Each team comprises no more than three students, who must complete a project report that includes an analytical model of the process, a design analysis, test data, cost information, and a comparison between the test data and the analytical model. Each team must also manufacture its device. Heat transfer devices will be judged on the basis of the amount of water produced, the mass of the device, and its cost. It must fit in a cardboard box of dimension 12" x 12" x 12". Each team will have fifteen minutes to test their device.

Competition Schedule

Time	Station	Team names	Team members		
8:20	A	The Eng. Potatoes	Evan McCune	Ming Mu	Tianyu Zhao
	B	Team B3	Benjamin Bosworth	Benjamin Dean	Elizabeth Kurcz
8:40	A	Aqua Exchangers	Rebecca Hannon	Joseph Koterba	Megan Wallace
	B	The Dream Team	Matthew Bach	Lukasz Kurczab	John McCarthy
9:00	A	Too Salty	Caitlin Bailey	Taylor Mantey	Olukemi Mejabi
	B	The Average Joes	Jonathan Bancroft	Shaun Bezinque	Evan Yoder
9:20	A	East Clintwood	Joel Cosner	C. Griffith	Michael Ryerkerk
	B	Water Boyz	Brian Farber	Kyle Hyst	Zachary Timpf
9:40	A	The Salty Sailors	Ross Otten	Scott Smith	Andrew Wheatley
	B	Salty Racers	Hasan Alali	Steven Cooper	S. Ramasami
10:00	A	The Salty Bandits	Adam Lang	April Oesterle	Eric G. Rightor
	B	Guppies	Jennifer Henige	Carly Patterson	Jason Thelen
10:20	A	Why So Salty?	Sean Crump	Thomas Hallahan	Nicholas Lannes
	B	NaClback	Steven Gerdeman	Paul Laymon	M. Marshall
10:40	A	Steam Team	Alexander Dutch	David Gaunt	Kevin Miller
	B	Salt and Peppa	C. Mushiri	Timothy Polom	Christopher Stanos
11:00	A	The Salty Tipz	Douglas Geiger	Phat Nguyen	Kyle E. Sweet
	B	Salt-en-ator	Kyle Biega	Nicholas Blancke	Steve Gorney
11:20	A	Made in…	Yueyao Hu	Yichu Jin	Matthew Wiggans
	B	Team Izzo	Kameron Kline	Brian McClure	N. Putman
11:40	A	Flaming Pyros	Bradford Fillion	Chad Houlihan	Raymond Peterson
	B	The Saltines I	Daniel Holmes	Landon Riker	Cory Snowdin
12:00	A	Blue Barracudas	Brendan Brown	Charles Ferriera	Andrew Hine

ME 471
Mechanical Design II

Ron Averill
Associate Professor of Mechanical Engineering

Students in ME 471 were challenged to design, build and test a small scale three DOF palletizing robot that collects and stacks items of cylindrical shape.

The system should be designed and manufactured so that:

- The system mass is minimized. This may in turn reduce energy usage and system cost.
- Operation of the system is smooth and accurate.
- The system can be operated by one person.
- All metallic structural components are designed to have infinite fatigue life.
- The operation of the system is safe for all personnel and intended products.
- The system is easily maintained, including cleaning and general maintenance.
- The system is easily assembled and disassembled.

The total design performance determines 50% of the final grade, and the other 50% is determined by a final written report that details the concept development and selection process, kinematic analysis, finite element structural analysis, failure analysis, fatigue analysis, cost analysis, integration of marketing elements, and recommendations for future improvement of the design.

U. S. Steel

This ME 471 design project was generously sponsored by US Steel.

Team	Time/Station		Design Team
1	8:00	1	Ante Beslic, Zakary McLennan, Margaret Moore, Nathaniel Sunderlin
2	8:12	1	Alexander Benson, Chad Houlihan, Kevin Pruess, Yunfeng Yue
1	8:12	2	Ante Beslic, Zakary McLennan, Margaret Moore, Nathaniel Sunderlin
3	8:24	1	Aerin Klump, Angela Marinich, Susan Whitenight, Todd Wolverton
1	8:24	2	Ante Beslic, Zakary McLennan, Margaret Moore, Nathaniel Sunderlin
2	8:24	3	Alexander Benson, Chad Houlihan, Kevin Pruess, Yunfeng Yue
4	8:36	1	Peter Bensel, John Casuccio, Nicholas Hansen, Stephen Sommerlot
3	8:36	2	Aerin Klump, Angela Marinich, Susan Whitenight, Todd Wolverton
2	8:36	3	Alexander Benson, Chad Houlihan, Kevin Pruess, Yunfeng Yue
5	8:48	1	David Caples, Eric Darin, Benjamin Dewys, Scott Schimp
3	8:48	2	Aerin Klump, Angela Marinich, Susan Whitenight, Todd Wolverton
4	8:48	3	Peter Bensel, John Casuccio, Nicholas Hansen, Stephen Sommerlot
6	9:00	1	Hashim Aldabbagh, Lauren Hart, Bryan Mittelstaedt, Benjamin Oberski
5	9:00	2	David Caples, Eric Darin, Benjamin Dewys, Scott Schimp
4	9:00	3	Peter Bensel, John Casuccio, Nicholas Hansen, Stephen Sommerlot
7	9:12	1	Yeldar Abitayev, William Hanley, John Jess, Cody Little
5	9:12	2	David Caples, Eric Darin, Benjamin Dewys, Scott Schimp
6	9:12	3	Hashim Aldabbagh, Lauren Hart, Bryan Mittelstaedt, Benjamin Oberski
8	9:24	1	Andrew Bloch, Harrison Cummings, Stefan Hebert, Jeffrey McCague
7	9:24	2	Yeldar Abitayev, William Hanley, John Jess, Cody Little
6	9:24	3	Hashim Aldabbagh, Lauren Hart, Bryan Mittelstaedt, Benjamin Oberski
9	9:36	1	Nassar Alhajri, Benjaman Bennetts, Ronald Dewberry, Peter Engstrom
7	9:36	2	Yeldar Abitayev, William Hanley, John Jess, Cody Little
8	9:36	3	Andrew Bloch, Harrison Cummings, Stefan Hebert, Jeffrey McCague
10	9:48	1	Stephanie Bury, Riley Chapdelaine, Grant Golasa, Rochelle Kirzhner
9	9:48	2	Nassar Alhajri, Benjaman Bennetts, Ronald Dewberry, Peter Engstrom
8	9:48	3	Andrew Bloch, Harrison Cummings, Stefan Hebert, Jeffrey McCague
11	10:00	1	Christopher Baldwin, Ann Barrett, Renee Chabon, Gustavo Gomes
9	10:00	2	Nassar Alhajri, Benjaman Bennetts, Ronald Dewberry, Peter Engstrom
10	10:00	3	Stephanie Bury, Riley Chapdelaine, Grant Golasa, Rochelle Kirzhner
12	10:12	1	Daphne Cai, Zhenyu Chen, Jonathan Erickson, Chad Floria
11	10:12	2	Christopher Baldwin, Ann Barrett, Renee Chabon, Gustavo Gomes
10	10:12	3	Stephanie Bury, Riley Chapdelaine, Grant Golasa, Rochelle Kirzhner
13	10:24	1	Brinn Cochrane, Matthew Nees, Spencer Turner, Jeffrey Vonlinsowe
11	10:24	2	Christopher Baldwin, Ann Barrett, Renee Chabon, Gustavo Gomes
12	10:24	3	Daphne Cai, Zhenyu Chen, Jonathan Erickson, Chad Floria
14	10:36	1	Zachary Averill, Katie Renaud, Yubing Su, Jonathan Wu
13	10:36	2	Brinn Cochrane, Matthew Nees, Spencer Turner, Jeffrey Vonlinsowe
12	10:36	3	Daphne Cai, Zhenyu Chen, Jonathan Erickson, Chad Floria
15	10:48	1	Megan D'Mello, Andrew Kaye, Jared Lee, Jeffrey Philippart
13	10:48	2	Brinn Cochrane, Matthew Nees, Spencer Turner, Jeffrey Vonlinsowe
14	10:48	3	Zachary Averill, Katie Renaud, Yubing Su, Jonathan Wu
16	11:00	1	Scott Bachor, Steven Cooper, William Driscoll, Scott McCarter
15	11:00	2	Megan D'Mello, Andrew Kaye, Jared Lee, Jeffrey Philippart
14	11:00	3	Zachary Averill, Katie Renaud, Yubing Su, Jonathan Wu
17	11:12	1	Daniel Dokter, Mariah Krebs, Adam Lang, Hanna Vandermoere
15	11:12	2	Megan D'Mello, Andrew Kaye, Jared Lee, Jeffrey Philippart
16	11:12	3	Scott Bachor, Steven Cooper, William Driscoll, Scott McCarter
18	11:24	1	Benjamin Cooper, Rubio Gong, Shenli Pei, Brooke Peruski
17	11:24	2	Daniel Dokter, Mariah Krebs, Adam Lang, Hanna Vandermoere
16	11:24	3	Scott Bachor, Steven Cooper, William Driscoll, Scott McCarter
17	11:36	2	Daniel Dokter, Mariah Krebs, Adam Lang, Hanna Vandermoere
18	11:36	3	Benjamin Cooper, Rubio Gong, Shenli Pei, Brooke Peruski
18	11:48	3	Benjamin Cooper, Rubio Gong, Shenli Pei, Brooke Peruski

Spend 12 minutes at Station 1, then 24 minutes at either Station 2 or 3.
Station 1: Check in, weigh the device and prepare for assembly.
Station 2/3(a): Assemble the device and prepare for test.
Station 2/3(b): One team member delivers the one-minute pitch, followed by the four-minute test.
Disassemble immediately following the post-test celebration.

Product Development

Brian Thompson
Professor of Mechanical Engineering

ME 478 Product Development and Human Health

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.'

Indeed, human health is the ultimate primary focus of this ME478 course on product development. Please note carefully the titles of the semester-long inter-disciplinary team projects dedicated to creating smoke-free clean stoves for Guatemala to enhance human pulmonary functions: treadle pumps for India to irrigate crops and enhance their yields of horticultural foods; and simplistic rope-pumps for Guatemala in order to provide drinking water for impoverished families.

This ME478 course provides a discourse on contemporary thinking about creativity, innovation and entrepreneurship in a global context. Moreover, a deeper comprehension of this triumvirate not only contributes to the public good in the USA, but also in under-developed nations where 80% of the world's population struggles to survive on an income of only U.S.$2.00 each day.

The fabric of this design-intensive ME478 curriculum is woven from a thread of ideas on societal development with a second orthogonal thread of fundamental ideas on the engineering problem-solving process relevant to every nation that shares our small planet. This warp and weft of intertwined fibers constitutes the biggest challenge confronting humanity today. Therefore students are exposed to a diverse inter-connected suite of topics that includes idea generation, psychological impediments, manufacturing, commercialization, diffusion of innovations, finance, project planning and communications.
ENJOY reviewing the innovative devices created by these teams of global citizens!

Margaret Meade (1901 – 1978) wrote, "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has."

Appropriate Technology Collaborative
Clean Cook Stoves

Every year, two million people die from indoor air pollution as a result of cookstove smoke; this equates to one death every 16 seconds! The women and children of developing nations are at the greatest risk; they spend much of their time in these harmful smoke-filled homes and are subject to danger when collecting firewood for fuel. Over three billion people, 43% of the world's population, continue to prepare meals and heat homes with traditional cookstove technologies, such as open fires.

Our team has allied with Appropriate Technology Collaborative to develop a clean, affordable, wood-burning stove for impoverished families in Guatemala. The objective of this project is to reduce the number of deaths and illnesses caused by indoor air pollution. The Guatemalans' practice of burning wood as a fuel will be unaffected by our proposed cook stove but the efficiency of combustion will be enhanced and the amount of smoke reduced.

In order to develop a clean stove, the efficiency was improved by reducing energy consumption and increasing convection. This reduction of energy consumption will not detract from the function and performance of the stove, but rather, it will result in less smoke and fewer trips to harvest wood. By utilizing abundant cheap materials and some innovative refinements, a cost-effective clean-burning stove will be offered to a deserving Latin American nation. This device should dramatically enhance the health of numerous women and children while concomitantly reducing their medical expenditures.

The Appropriate Technology Design Collaborative

Michigan State University
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Carly Patterson
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Appropriate Technology Collaborative
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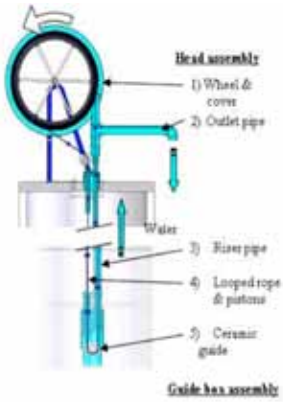
Michigan State University
Health Factors: Human Powered Rope Pump

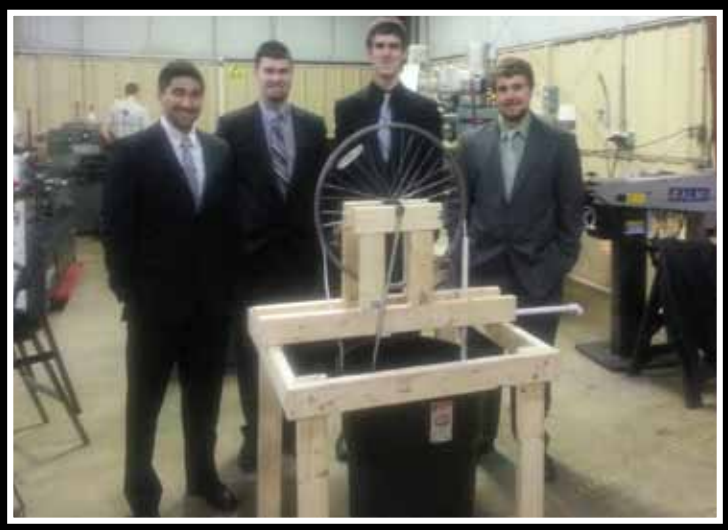
The people of rural Guatemala are in desperate need of a cost effective and reliable method to acquire clean and safe drinking water. Groundwater is the perfect solution to their problem but the water source can be at any depth from a few meters to 20 meters beneath the earth's surface. With limited technology, the harvesting of this water can be expensive and difficult. A rope pump is a simple device that can efficiently pump groundwater out of wells using materials that are readily available in the community. Frequently rope pumps are devised without engineering expertise, thereby rendering them unreliable and inefficient. Furthermore, they require a significant expenditure of human energy from a population that may be malnourished and have limited muscular strength.

An enhanced human-powered rope pump was conceived, refined and manufactured primarily for rural Guatemala, but the device also has great utility elsewhere on planet Earth. In this Latin American nation, 95 percent of the water in aquifers is potable; therefore this natural resource provides abundant safe water. With a service life of ten years and a construction cost of $150, the diffusion of this innovative pumping device will enhance the lives of thousands of people each year.

In addition, the team created a concise and comprehensive visual guide to educate rural people on the operation of rope pumps and their manufacture, installation, and maintenance. This visual guide features tables, charts and protocols for materials.



MICHIGAN STATE UNIVERSITY



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Michigan State University
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Professor Luis Flores
Institute of
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Michigan State University
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The Appropriate Technology Collaborative
Improving the Treadle Pump

The Appropriate Technology Collaborative (ATC) strives to create technologies that will improve the lives of low-income people worldwide. One of their products is a treadle pump, designed to improve the ability of farmers in rural areas to irrigate their fields during annual dry seasons. Stepping on a treadle pump as one would a StairMaster enables the device to draw water from a reservoir using a pumping mechanism and the associated irrigation of crops permits the yearly income of a farmer to increase by over 500%.

ATC has already developed a proof-of-concept treadle pump. In keeping with their ideals, ATC has offered the design to the world via the Internet. The associated manual has been downloaded over 3,500 times and is in use in India, Africa, Latin America and other parts of the world.

An analysis of ATC's current design suggested that the pump could be improved in cost, ergonomics, aesthetics, and durability. These design parameters were the subject of investigation while the treadle pump's functionality was optimized.

During the redesign of the treadle pump, the MSU team considered the attributes of those who would be operating the pump in the fields, and also those manufacturing the pump in India in order to ensure that the device could be readily produced from a wide variety of materials and standard stock items.

The Appropriate Technology Design Collaborative

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Craig Harvey
Ann Arbor, Michigan

Brennan Crispin
Ann Arbor, Michigan

The Capstone Projects

Dr. Giles Brereton
Associate Professor of Mechanical Engineering

Presentation Schedule – 1200 Hallway, First Floor, Room 1208

Time	Team Sponsor	Project Title
8:30 a.m.	Consumers Energy	Solar Heater for Educational Demonstrations
8:50 a.m.	Meritor	Design of an Air Chamber Bracket Assembly
9:10 a.m.	Meritor	Electric Shift Mechanisms for Transfer Cases
9:30 a.m.	Eaton	Composite Tube Manufacturing Process Design
9:50 a.m.	US Steel	Design of a Mold Flux Feeder for a Steel Caster
10:10 a.m.	Break	
10:30 a.m.	Ingersoll Rand	Improved Assembly of HVAC Equipment
10:50 a.m.	ArcelorMittal	Design of Improved Hot Strip Mill Slab Buggies
11:10 a.m.	Whirlpool	Basket Design for a Top-Load Washing Machine
11:30 a.m.	Whirlpool	Heat Exchanger Design for a Top-Load Washer

To view these presentations live please visit the Design Day website: http://designday.egr.msu.edu and click the *Watch Live* tab in left side menu bar.

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:

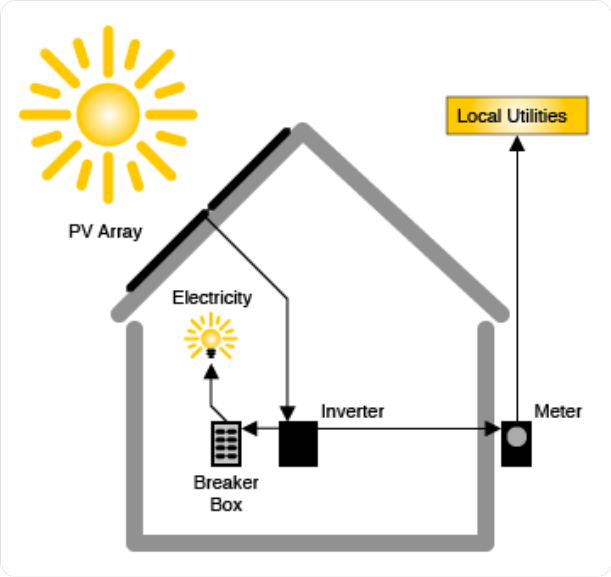
- Using the technical expertise, communication skills, and teaming methodologies they have learned throughout their mechanical engineering curriculum, along with their creativity, to solve real world problems.
- Collaborating with practicing engineers to address problems sponsored by industry.
- Developing new products or re-designing existing products to reduce costs or enhance reliability.
- Interacting with large, medium and small companies in the automotive, defense, aerospace, consumer products, interior design and material processing industries.

Project sponsors include Alcoa, ArcelorMittal Steel USA; Bosch LLC; Dow Chemical Company, Eaton Corporation; Ford Motor Company; General Electric Health Care; General Motors Foundation; Consumers Energy Foundation; Ingersoll Rand; Meritor; Stryker Medical; Union Pacific Railroad, U.S. Air Force Research Laboratory, U.S. Steel; and Whirlpool Corporation

Lansing School District and Consumers Energy
Solar Heater for Educational Demonstrations

Consumers Energy is a Michigan-based utility company that provides gas and electrical energy services throughout the state to domestic and industrial consumers. The Consumers Energy Foundation regularly sponsors projects that benefit local school districts and, in partnership with Lansing School District, is interested in developing an alternative-energy system for heating a vermicomposting bin, which can be used for instructional purposes.

Vermicomposting is a process in which worms recycle decomposed organic materials into a rich soil known as compost. Although worms can survive freezing temperatures, they cannot compost as efficiently in winter and so a heating system is required to allow them to compost year round. The team is designing and building a heater powered with photovoltaic solar panels to provide this heat transfer, and will demonstrate its composting abilities to students.



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Lansing School District and Consumers Energy
Project Sponsor

Project Sponsor
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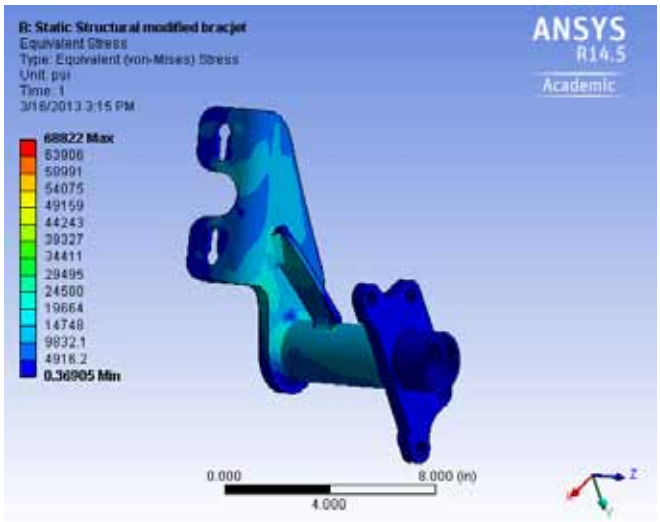
Educational Partner
Diane Graham
Lansing School District

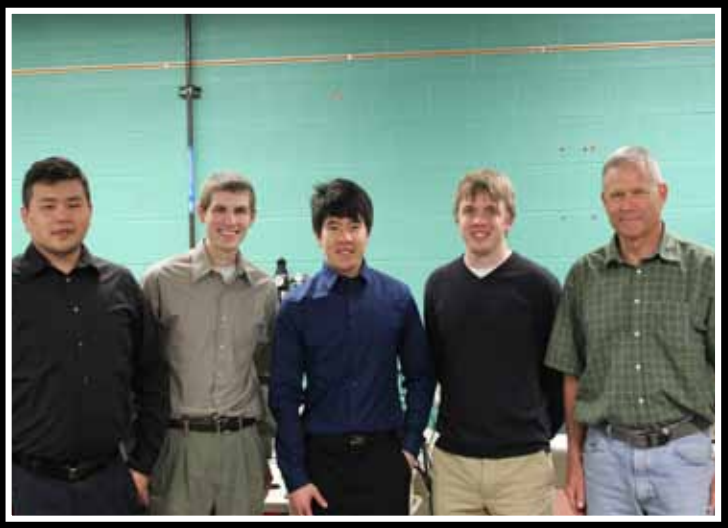
Meritor, Inc.
Design of an Air Chamber Bracket Assembly

Meritor, Inc. is a leading global supplier of a broad range of axle, brake, and suspension systems to both original equipment manufacturers and to aftermarket vendors for the transportation and industrial sectors. The brake systems on heavy-duty vehicles are driven by compressed air and one particular component–the air chamber–converts the air pressure into the force used to activate the brakes. Meritor Heavy Vehicle Braking Systems is interested in redesigning an air chamber bracket assembly that is currently in production. This redesign is intended to benefit Meritor by reducing the weight of the current assembly with minimal added cost. It also provides an opportunity to study thoroughly the current bracket design and its limitations, and to propose ways of reducing mechanical fractures in these components.

The redesigned assembly should weigh 20% less and cost no more than $5 more than the present model. The new lighter design should maintain the stiffness and bending of the current product, and must mesh correctly with the surrounding parts to perform properly within the heavy-vehicle braking system.

The design team plans to make computer-aided design models of the current bracket assembly and perform finite element analysis tests to determine which areas of the bracket can be made lighter without impairing their function. It also plans to carry out physical vibrations tests of previously fractured parts to identify points of potential weakness. The team will then build a plastic prototype of its new air chamber bracket design.





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Corey Silvis
Midland, Michigan

Tianyu Zhao
Jinan-Shandong, China

Meritor
Project Sponsor

Roy Hayford
Troy, Michigan

Meritor, Inc.
Electric Shift Mechanisms for Transfer Cases

Meritor is a global leader in providing drivetrain-mobility and braking-solution products for manufacturers and after-market suppliers of trucks, trailers and specialty vehicles in the industrial and transportation sectors. One such product is the transfer case, which takes power from an engine's transmission and drives both the front and back axles. It can power either the rear axle, as a two-wheel drive, or both the front and rear axles, as a four-wheel drive. Transfer cases can also be used to shift from high to low rotational speeds, to increase the torque provided to the axles. Meritor's current line of transfer cases uses pneumatic shifting between speed ranges. However, many medium-duty vehicles are not equipped with the compressed-air systems required for pneumatic shifting. Therefore there is a need for an electric shifting system. Meritor has designed a potential electrical shift system that comprises a motor-controlled sector cam that shifts two separate forks. One of the forks changes the drive between high, low, and neutral positions while the other switches the drive between two-wheel and four-wheel drive.

The objective of this project is to analyze and optimize Meritor's proposed electrical shift system. The team plans to create an analysis model using CAD software, with which the torque needed to move forks to each position and the stresses of each component are to be calculated. It then plans to optimize the system design to minimize the shifting torque required, and to maximize the performance life of the system through the choice of springs and shifting speeds.

Michigan State University
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Robert Caldwell
Novi, Michigan

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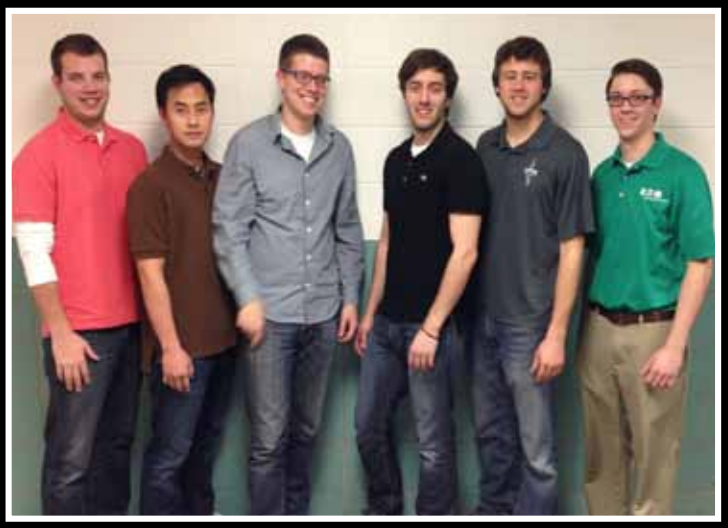
Laura Klemm
Troy, Michigan

Matt Starna
Troy, Michigan

Eaton Corporation
Composite Tube Manufacturing Process Design

Eaton Corporation is a global technology company that currently employs over 100,000 people in 150 different countries. Eaton Aerospace is one of its divisions and is an industry-leader in power management applications in the field of aerospace, specializing in fuel coupling and ducting components for all types of aircraft. It is interested in developing the next generation of high-performance, sustainable, and economical aircraft fuel systems. To accomplish this goal, Eaton proposes to manufacture ducting and hoses from lightweight and high-temperature-resistant materials such as composites.

The focus of this project is on the proposed use of composite-material piping for fluids in aircraft and the need to produce non-metallic pipes of sizes and curvatures that conform with a wide range of operating constraints. The MSU design team's goal is to design and develop an apparatus with a removable center form to produce these types of composite tubes, in a way that reduces cost and production time relative to current manufacturing methods. The design team then plans to produce a prototype of the composite forming device which, if successful, would be an integral part of Eaton's manufacturing technologies.



Michigan State University
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Kyle Sweet
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United States Steel
Project Sponsor

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Nicholas Schooley
Broomfield, Colorado

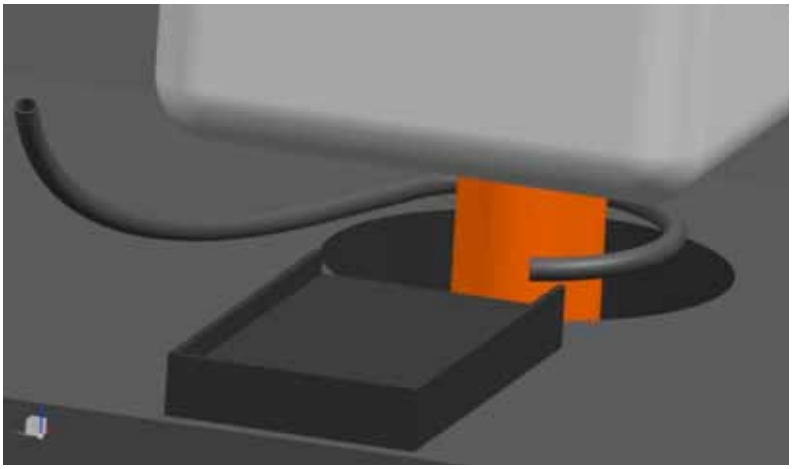
Richard Statler
Denver, Colorado

U.S. Steel Corporation
Design of a Mold Flux Feeder for a Steel Caster

United States Steel Corporation is the largest integrated steel producer headquartered in the United States, with a global capacity of 29 million tons per year. The key customers to which U.S. Steel provides its products are automobile, appliance, container, industrial machinery, construction, and oil and gas industries.

U.S. Steel wishes to design an automatic mold-flux feeder for their rounds caster located in Fairfield, AL, which produces steel in four parallel 'strands.' Mold flux is a metallic aggregate that is distributed over the surface of molten steel during processing, where it melts and spreads to: i) serve as a lubricant between the mold and the cooling shell; ii) prevent oxidation of the liquid steel to maintain its purity; and iii) serve as an insulator to facilitate uniform heat transfer throughout the cooling strand. If the mold flux is not distributed uniformly, breakouts–ruptures of the outer steel shell and releases of molten steel from within the core of the cooling bloom–occur, resulting in lost production, increased maintenance costs, a lower-quality steel product, and safety concerns.

The objective of the automatic mold-flux feeder is to evenly distribute flux and maintain it at a constant level on the top surface of the mold; it is currently distributed manually, by the shovelful. The MSU team is exploring mechanical and pressure-driven systems as possible design solutions. Computer-aided models will be used to supplement results from experimental prototypes to create an optimal design.



U. S. Steel

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U.S. Steel
Project Sponsor

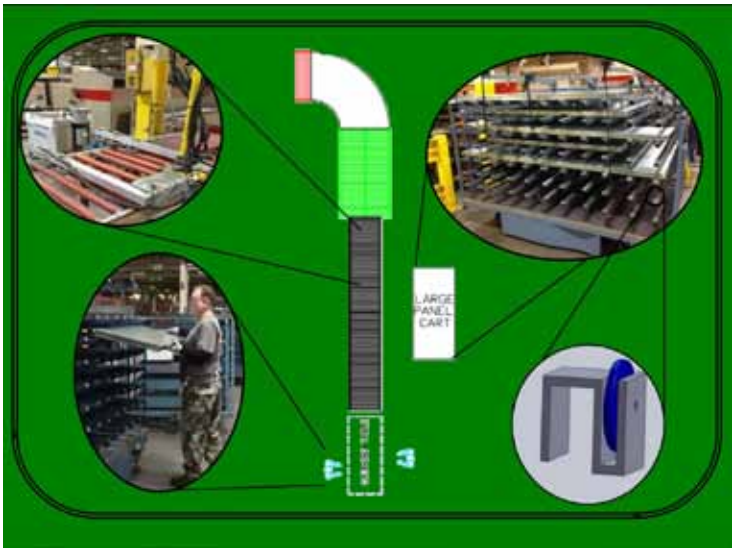
Martin Beaver
Ecorse, Michigan

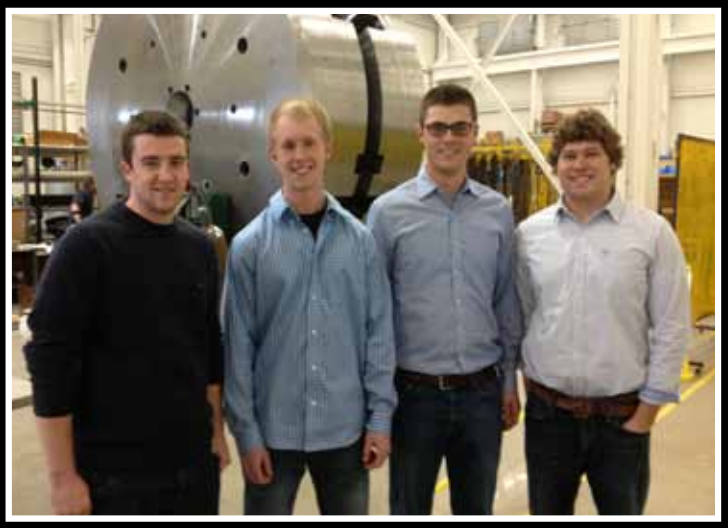
Kandi Wood
Ecorse, Michigan

Ingersoll Rand
Improved Assembly of HVAC Equipment

The Trane Division of Ingersoll Rand has long focused on innovation in heating and air conditioning systems for domestic and commercial use, and is currently one of the world's leading manufacturers. Trane caters to both residential and commercial heating, ventilation and air-conditioning (HVAC) system needs, and through its reputation for reliable, high quality products has gained 40% of the commercial systems market share. Commercial HVAC systems are custom designed to meet the customers' specifications and are constructed as HVAC hardware enclosed by laminated, foam-filled metal panels. These panels are large and heavy, and are manufactured in a range of sizes from different gauges of steel. They are currently transported manually from conveyor belts to carts during the assembly of an HVAC system. The need for employees to lift these panels, which often weigh from 50 to 100 pounds, repetitively has been identified as a potential health risk, and Trane are exploring ways of eliminating manual lifting while increasing productivity.

The MSU design team plans to carry out an ergonomic assessment of the process of transporting panels from the end of the manufacturing assembly line to the carts. The team also learned that, in the past, pneumatic suction lifts had been used to move these panels, but that facility employees had found it more productive to manually lift and sort the panels onto the carts. The goal of this team is therefore to provide a design solution for panel transportation that both reduces health risks and improves productivity.





Michigan State University
Team Members

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Ross Otten
Ada, Michigan

Nicholas Putman
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ingersoll Rand
Project Sponsor

Billy Smith
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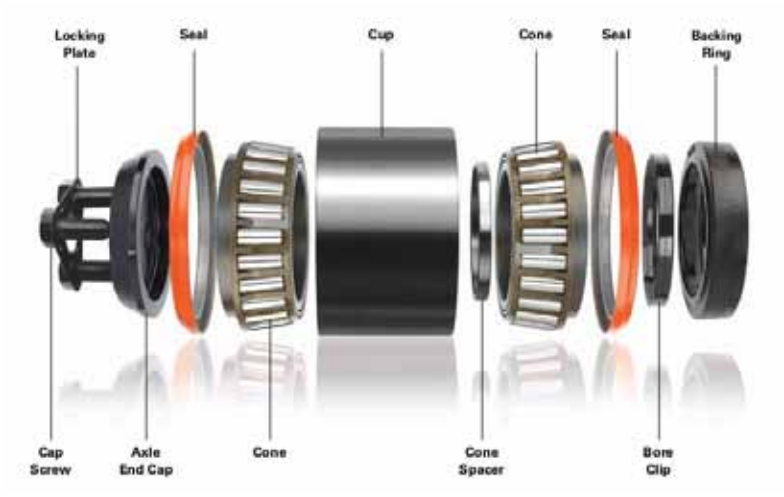
ArcelorMittal S.A.

Design of Improved Hot Strip Mill Slab Buggies

ArcelorMittal is the largest steel and mining company in the world, with its headquarters in Luxembourg, and over 260,000 employees. It operates in 60 countries and is the leading supplier of steel for all major markets including automotive, construction, household appliances and packaging. In 2011, ArcelorMittal produced 97 million tons of steel.

In the manufacturing of thin rolls of steel, transport buggies are used to move large slabs of raw steel from the warehouse to the operation/production line. These slabs are then processed into hot-rolled coils in a hot strip mill. One problem encountered in moving steel is that the weight of raw steel slabs is so great that the transport buggies fail in a number of different ways, resulting in lost production time, significant repair costs and additional maintenance. The goals of the MSU design team are to analyze the failures of buggies at ArcelorMittal's East Chicago facility and develop a solution to this problem.

The principal objectives of the project are: i) to identify the cause of the wheel bearing failures; and ii) to mitigate the crack propagations that appear on the surfaces of the transport buggies. The design team plans to use failure analysis techniques such as root cause analysis to characterize the problems of these transport buggies



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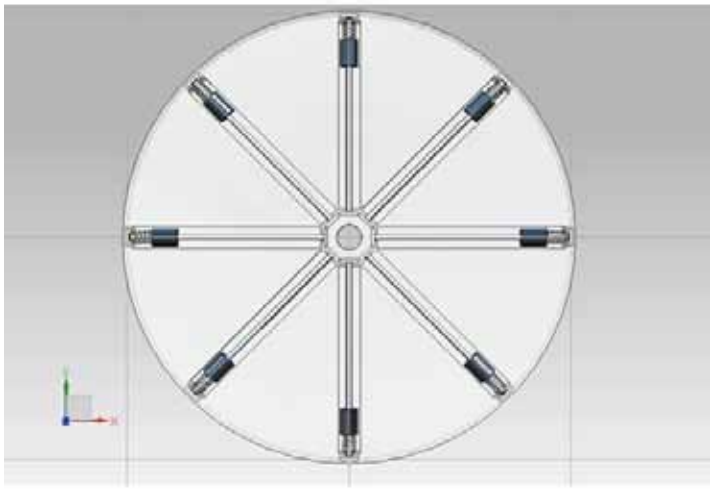
Whirlpool Corporation
Basket Design for a Top-Load Washing Machine

Whirlpool Corporation is the world's leading manufacturer and marketer of home appliances, with its headquarters in Benton Harbor, Michigan. Along with the well-known Whirlpool brand, the company has also acquired Maytag, KitchenAid, Amana and other home appliance companies and offers an extensive product line of appliances for markets throughout the world.

The washing machine engineers at Whirlpool have asked the MSU team to re-design and analyze of one of its most successful high-efficiency top-load washing machine baskets, which is currently used in the Maytag Bravos X machine. The present design features a base of conical shape that provides a rigid connection between the drive shaft of the motor and the wash-basket cylinder. The objective of this project is to design a more compact base that provides the same connection function but allows a greater volume within the basket for washing. A base with a lower profile also reduces the volume of unused water that is trapped beneath the base during wash cycles and improves washing efficiency. The proposed design must meet and/or exceed the safety requirements set forth by Whirlpool Corporation in the areas of extreme stress and fatigue loading conditions. The MSU team plans to explore various geometric designs, and expects to make extensive use of finite element analyses in finding an innovative but reliable design solution.



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Whirlpool
Project Sponsor

Basak Oguz
St. Joseph, Michigan

Whirlpool Corporation
Heat Exchanger Design for a Top-Load Washer

Whirlpool Corporation is the world's largest appliance manufacturer and has its headquarters in Benton Harbor, Michigan. Whirlpool has a large global presence and sells many products in more than 170 countries. In its efforts to improve appliance efficiency, Whirlpool is interested in reducing the energy consumption of its top-load washers.

One way of improving the efficiency of washers is by regenerative heat transfer, extracting the heat generated by the motor during the wash cycle and using it to raise the temperature of the wash water. This process reduces the requirement for hot water from the consumer's home and permits better machine performance. It may also allow more cost-effective motors to be used in large capacity washers.

To explore this energy-saving concept, the MSU team will design and analyze regenerative heat transfer systems that have the potential to improve overall washer efficiency. An optimal design will then be selected and a prototype will be built and tested for functionality and reliability, then delivered to Whirlpool for further evaluation.

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Whirlpool
Project Sponsor

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Weight of Device (lbs.)
Juice Extracted/ Orig. Apple Wt.
Aesthetics (total points /40)
4.963
.527 .079 .421 .200 .130 .562
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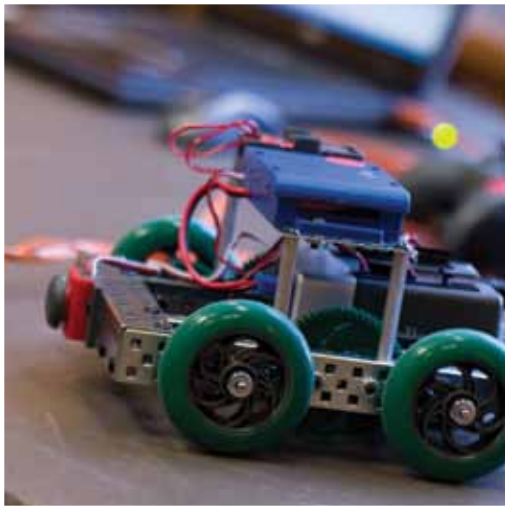



Owners Insurance
Home Car Business

The Capstone Projects

Dr. Giles Brereton
Associate Professor of
Mechanical Engineering

Presentation Schedule – 1200 Hallway, First Floor, Room 1220

Time	Team Sponsor	Project Title
8:30 a.m.	Stryker	Hospital Bed Extender Design and Optimization
8:50 a.m.	Bosch	Gas Response Test System for Exhaust Sensors
9:10 a.m.	Ford	Design of a Steering Column Gap-Hider System
9:30 a.m.	GM	Design of Active and Passive Cabin Ventilation
9:50 a.m.	GE	Design of a Mobile Breast Imaging Unit
10:10 a.m.	Break	
10:30 a.m.	AFRL	Solid State Aerial Surveillance Gimbal Design
10:50 a.m.	Dow	Fabrication of a Reverse Osmosis Filter
11:10 a.m.	Union Pacific	Improved Design of Air Hose Connections
11:30 a.m.	Alcoa	Bean Seed Dryer for Central American Farmers

To view these presentations live please visit the Design Day website: http://designday.egr.msu.edu and click the *Watch Live* tab in left side menu bar.

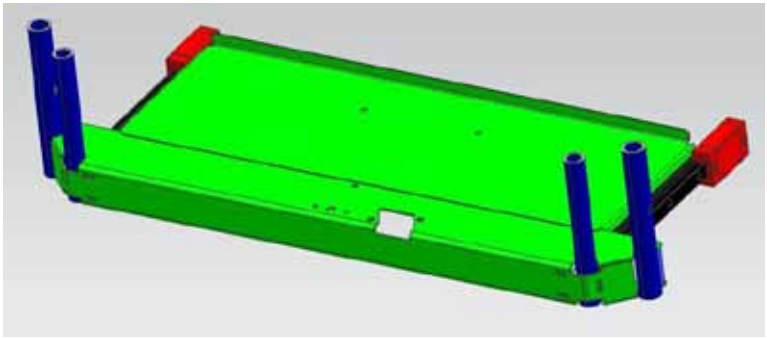
Mechanical Engineering Design Program

Mechanical engineers make the world move and provide the energy for it to do so. The 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.

Stryker Corporation
Hospital Bed Extender Design and Optimization

Stryker Corporation is a medical equipment manufacturer based in Kalamazoo which develops surgical and imaging technologies, and produces patient handling and medical emergency devices. One particular device it manufactures is a hospital bed, which must accommodate patients of different physiques while allowing medical professionals access to the patient for treatment. In contrast to conventional beds, hospital beds are carefully designed and engineered structures that are rugged but adjustable, and play a critical role in the timely recovery of patients. Hospital beds are typically manufactured in a standard size, but with a bed extension system available to accommodate tall patients.

The objective of this project is to redesign an existing bed extender and optimize it for use in hospitals around the country. Problems that have been identified with the current design include: i) the awkwardness of extending the structure; and ii) the stability of the extension, which can wobble. This design exercise will focus on a mechanism for extending the bed, that can be activated with a single motion of one hand, and a more rigid structure, with a minimized overall cost and weight. The bed extender must be able to be positioned in either an extended or a retracted state, to allow for easier storage and maneuverability, and must withstand the rigors of a hospital environment. A successfully redesigned bed extender will improve the capabilities of existing beds and the recovery conditions of patients.



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Stryker
Project Sponsor

Chris Sweeney
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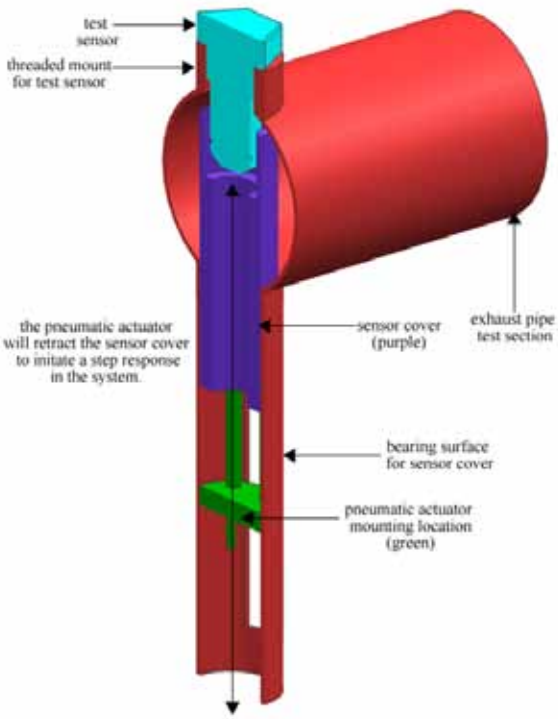
Robert Bosch, LLC

Gas Response Test System for Exhaust Sensors

Robert Bosch LLC is a leading global supplier of technology and services to a range of industries that includes automotive, industrial, consumer goods, and building technologies. It targets much of its automotive technology at increased fuel economy and reduced exhaust-gas emissions, including the design and production of oxygen and NOx sensors for engine after-treatment systems. Currently, Bosch manufactures exhaust gas sensors to monitor and control the emissions of automobile engines, each of which must be tested for accuracy and reliability. The Diesel engine group at Robert Bosch LLC is interested in a more accurate and consistent method of testing and evaluating the performance of its NOx and O2 sensors before distributing them to customers.

In its Farmington Hills facility, Bosch currently tests the performance of its emissions sensors on a test bench. However, these tests do not reproduce the conditions of the exhaust flow in an automobile and a more representative bench test is required. The goal of the MSU design team is to design a test bench for emissions sensors that creates a step response to test more accurately and consistently O2 and NOx sensors. To solve this problem, it plans to develop a mechanical system inside an exhaust pipe that will be able to quickly cover and remove the sensor, in between 100 and 200 milliseconds, without disrupting the exhaust-gas flow. Since the gas flow in this bench test contains harmful emissions, it is essential that the test system has no leaks. The final project goal is to deliver to Bosch a working prototype to test its emissions sensors.



BOSCH
Invented for life

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Robert Bosch
Project Sponsor

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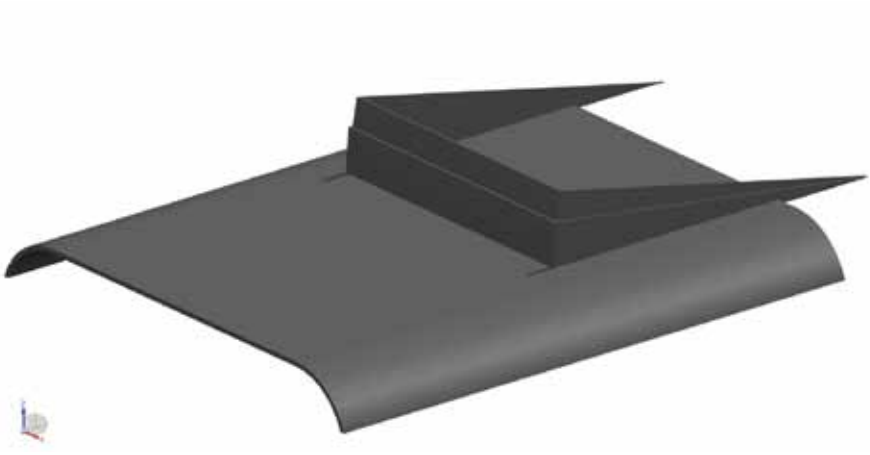
Joseph Heston
Farmington Hills, Michigan

Ford Motor Company
Design of a Steering Column Gap-Hider System

Ford Motor Company was founded 110 years ago in southeastern Michigan and is now one of the world's largest automobile manufacturers. Its products are both produced and sold globally. An important aspect of automotive design is the fit and finish of automobile interiors, which are a key factor in showroom sales and in the long-term satisfaction of the customer. Ford is especially interested in improving one component in the interior design of its current Lincoln models: the 'gap-hider' which covers the top of the steering column and connects to the dashboard. The gap-hider's function and purpose is to cover the internal components of the steering column, as well as to perform as an aesthetically pleasing interior piece.

One problem with the current gap-hider design is that it wrinkles during telescoping and tilting of the steering wheel. This wrinkling is visually unattractive and detracts from the luxury of the Lincoln brand and of the interior of the vehicle. With repeated motion of the steering column, the gap-hider material can deteriorate and lose its integrity. The MSU team is currently considering two different design approaches: implementing a new material for the gap-hider; and attaching the material to the steering column interface in a different way. Prototypes of each design solution will be tested to determine the optimal solution to this problem.



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Ford
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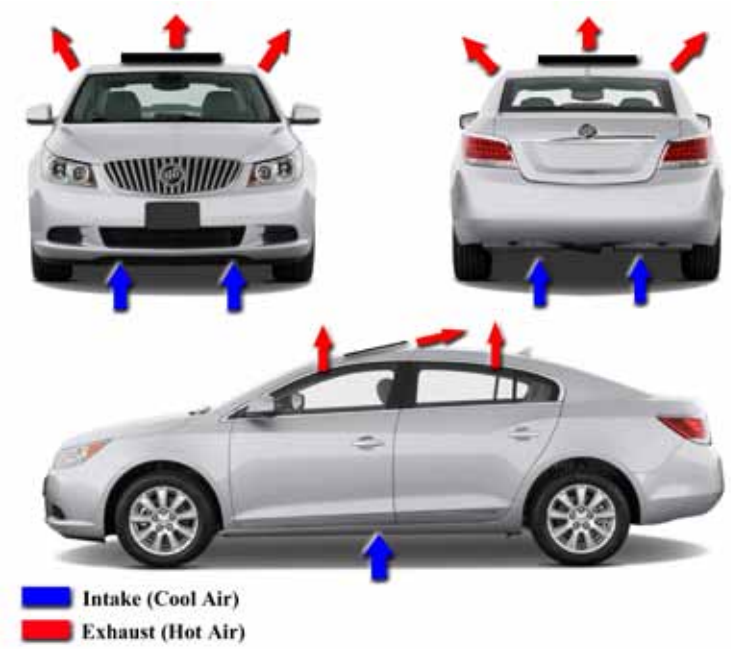
General Motors Foundation
Design of Active and Passive Cabin Ventilation

General Motors Corporation is a multinational automotive manufacturer with headquarters in Detroit, MI and is one of the largest automotive companies in the world. Its vehicles manufactured for the US market must soon be in compliance with the Environmental Protection Agency's more stringent 2017 fuel economy standards, which regulate exhaust-gas emissions of the 'greenhouse gas' carbon dioxide. General Motors is interested in exploring ways of improving fuel economy by reducing the need to use air-conditioning systems in its automobiles, which also translates to carbon dioxide 'credits.'

The objective of this project is to explore concepts for active (i.e. fan-driven) and passive cabin ventilation systems that reduce the interior temperature of the vehicle when it is parked in direct sunlight. The MSU design team plans to investigate ways in which ducts and other devices can be used to move hot air from the cabin to the vehicle's exterior by either natural or forced convection, thereby reducing the need for engine-driven air-conditioning. General Motors has provided a vehicle for the team to use to develop and demonstrate their most effective design solution.



General Motors GM FOUNDATION
moving communities toward a better tomorrow

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Project Sponsor

Kenneth Porrett
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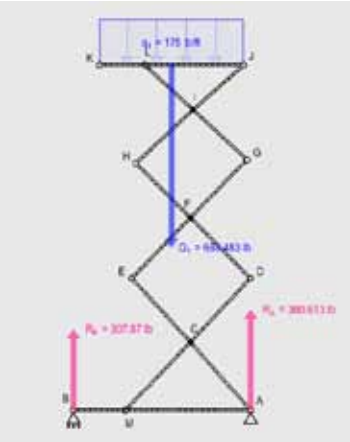
General Electric Healthcare
Design of a Mobile Breast Imaging Unit

GE Healthcare is a division of the General Electric Company, one of the world's leaders in the development and manufacturing of a wide range of electrical and mechanical engineering products. GE Healthcare currently manufactures a device known as the NM750B Molecular Breast Imaging Unit, which is used in hospitals worldwide. The unit performs functions similar to those of magnetic resonance imaging (MRI) devices used for the detection of breast cancer. However, it is a significant improvement on traditional MRI and x-ray devices as it is smaller and lighter, and reduces patient discomfort during the scan. The present unit is too large and too heavy to be transported by van or relocated manually within hospitals. The MSU design team has been assigned the task of redesigning and optimizing the NM750B for improved mobility, so that it can be easily transported by van in the field, or moved from ward to ward in a hospital so that more patients can benefit from scans.



The primary design goals of this project are to decrease the overall dimensions and weight of the unit so that it can be moved by hospital staff, without making any changes to the scanning, computing, and electrical interface equipment. The design team plans to build a prototype based on their redesign, which can be used by GE as a basis for refined redesigns and for use at trade shows and symposia.

GE Healthcare

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GE Healthcare
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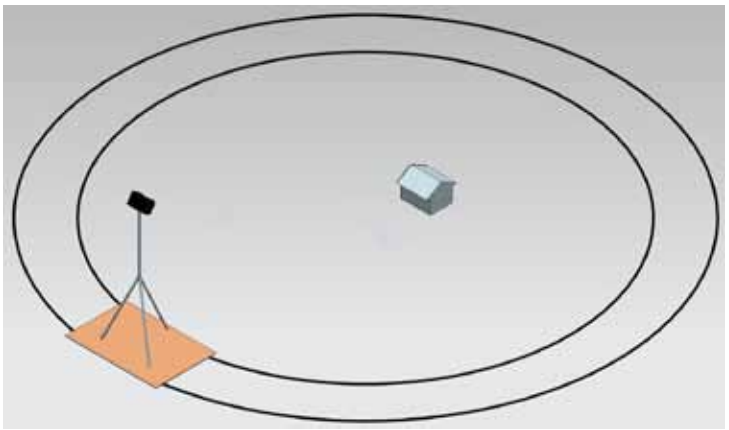
U.S. Air Force Research Laboratory
Solid State Aerial Surveillance Gimbal Design

The US Air Force uses aerial surveillance for a variety of military and humanitarian missions. However, aerial surveillance systems are limited by the way in which images are captured from airborne vehicles. Such systems typically include a camera that moves within a mount (a 'mechanical gimbal') as the vehicle flies above its target. The mount holds the camera steady so that a clear image can be produced. The gimbals are complex, heavy, and cost approximately one million dollars, so a less expensive equivalent is desirable. One alternative that has been proposed is a 'solid-state' gimbal that is static with respect to the aircraft. The long-term goal of this project is to develop an active optical targeting system that can be deployed using images produced by such a gimbal mounted in an unmanned aerial vehicle (UAV or "drone"), flying in a circular path above an active or potential battlespace.

The MSU design team's challenge is to create an image processing algorithm that allows the images produced by the 'solid state gimbal' to be used in the battlefield. The objective is to stream live images at three frames per second, while simultaneously stabilizing the images for display. The images are logged so that the user can analyze data and information regarding action at an earlier moment in time. To solve the problem, the team plans to: develop an algorithm that stabilizes a series of images; create a graphical user interface (GUI) to allow a user to interact with the images; build a test rig to demonstrate the algorithm's abilities; and secure the use of a powerful camera to create the raw image stream.



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U.S. AFRL
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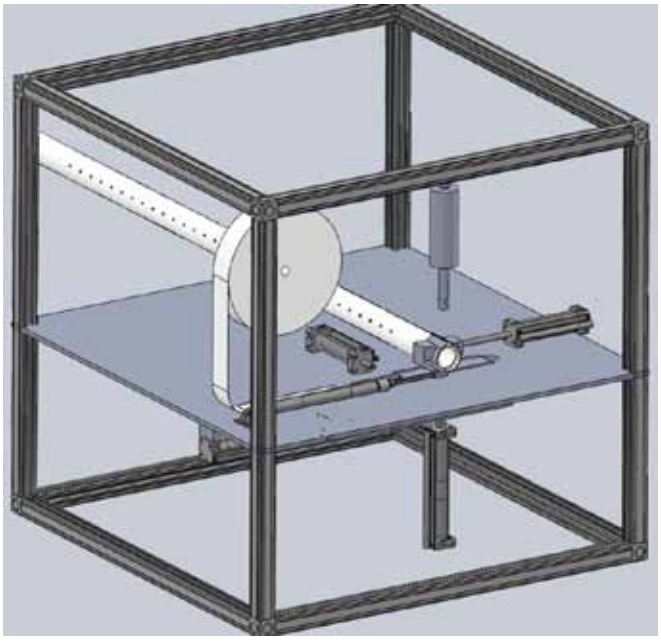
Dow Chemical Company
Fabrication of a Reverse Osmosis Filter

The FilmTec Corporation, a subsidiary of Dow Chemical's Water & Process Solutions that was acquired in 1985, has helped Dow become the global leader in the manufacturing and supply of reverse osmosis and nano-filtration products. FilmTec's current method of manufacturing reverse osmosis filters requires wrapping the filter element onto a plastic tube coated in polyurethane glue, trimming the ends of the filter to size, and securing the filter element by placing caps on the tube's ends. The trimmed portions of the filter element cannot be removed if there is glue on the tube beneath that section, so a removable protective film layer is used to keep glue from the tube ends. Currently, employees wrap a Teflon film strip around each tube end manually, and secure the film with packaging tape. This manual application method is time consuming and yields results the qualities of which vary according to the dexterity and attentiveness of the assembler.

The primary goal of this project is to design and produce a fixture that will automatically wrap, tension, and then secure the film strip around the tube in an efficient and highly repeatable manner. A secondary goal is to select a new material and attachment method if it is considered advantageous for automation of this process. A successful outcome of the project would be that a reverse osmosis filter could be assembled with Dow's employees only having to manually insert and remove the tube from the fixture.



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Dow Chemical
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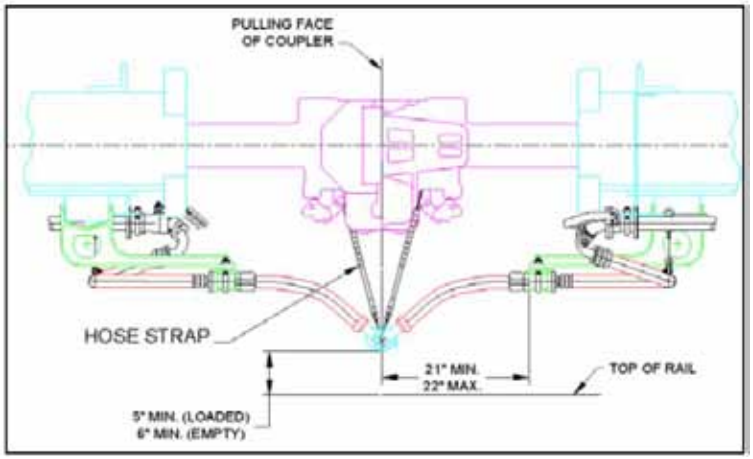
Union Pacific Corporation
Improved Design of Air Hose Connections

Union Pacific Railroad has been providing high-quality freight services since its establishment in 1862. Today, it owns the nation's largest railroad network consisting of 31,900 miles of track. As a company engaged in 'Building America,' it focuses on providing safe and high-quality service for its customers.

A current concern of Union Pacific is the accidental separation of F-type glad-hand air-hose connections, which occurs occasionally during train operations. The function of the glad-hand connection is to allow pressurization of the braking system along the length of the train. The braking system of the train is designed so that when air pressure is lost through an accidental disconnection, the emergency brakes are applied, which can cause significant train delays and possible derailments; these events result in late arrivals/deliveries and potential damage to goods. While the use of double-wide gaskets and the implementation of part-life regulations have reduced the frequency of disconnections, they remain an area of concern for Union Pacific.

The goal of this project is to further reduce or eliminate these accidental disconnections by developing: i) a more reliable glad-hand design; or ii) a stricter criterion for the maximum glad-hand lifespan. Benchmarks for this maximum lifespan criterion will be established by measuring deviations in pull-apart force of glad-hands that have undergone varying levels of degradation through use. Reaching these goals should improve the reliability of Union Pacific's services.



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Union Pacific
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Omaha, Nebraska

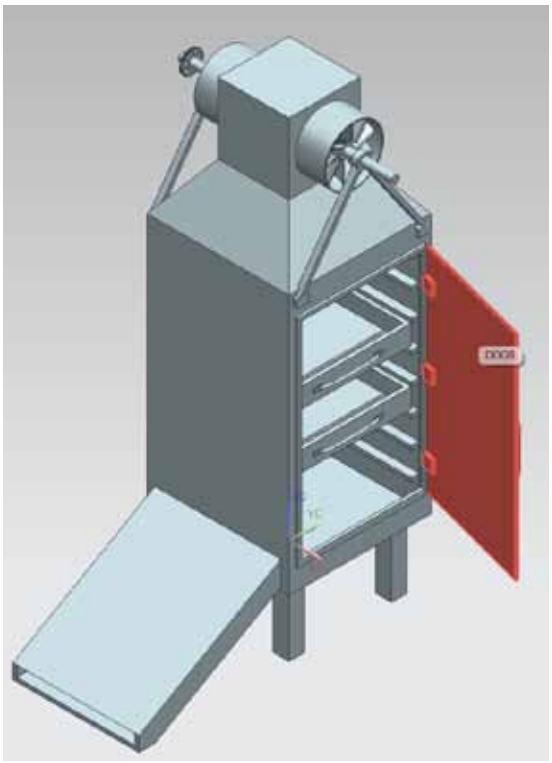
Bill Sheesley
Omaha, Nebraska

Alcoa, Inc.
Bean Seed Dryer for Central American Farmers

Alcoa Inc. is the world's leading producer of aluminum and alumina. Each year, it sponsors a design project targeted at international development; this year's project addresses the seed drying needs of Latin American farmers.

Farmers in the rural farm lands of Central and South America specialize in the cultivation of beans for subsistence and for regional commercial sale. Many of their farming and processing methods are basic and, by US standards, inefficient. A major challenge to these farmers is to dry their beans sufficiently once they have been harvested from the fields. Drying the beans serves the purposes of: prolonging their storage life; and resisting their attack by pests during storage. Current drying methods are much slower than the rate of harvesting. As a result, farmers risk losing their harvest through rain damage while drying, or through rotting if left in the fields. The objective of this project is to design a device or drying procedure that can accelerate the drying process for these farmers, and so raise the quality of their produce.

Prior to developing solutions, the MSU team has engaged the expert assistance of Dr. Luis Flores of MSU's Institute of International Agriculture, who has visited these rural farming regions and is a local expert on their farming techniques and customs. The team will use his knowledge to propose and develop a design solution for a bean seed dryer that uses technology and materials appropriate to these regions, and suited to the farmers' customs.



Michigan State University
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Muskegon, Michigan

David Gaunt
Walled Lake, Michigan

Chenaimoyo Mushiri
Harare, Zimbabwe

Timothy Polom
Sterling Heights, Michigan

Alcoa, Inc.
Project Sponsor

Jay Rateau
Knoxville, Tennessee

Design Day Awards

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 most outstanding technical design project. Last semester's winning Edison Scholars were Marcus Cannon, Karsten Harns, Zachary Hoyle, and Joel St.Cyr. They carried out a project sponsored by Williams International of Walled Lake, MI in which they designed, tested and demonstrated a complete system to reduce the noise leakage from an aircraft-engine test facility. The project was supervised by Thomas Hartley at Williams International, and by Dr. Ron Averill at MSU.

(Prof. Giles Brereton) Zachary Hoyle, Marcus Cannon; not shown: Karsten Harns, Joel StCyr

ME 481 Project Presentation Award

The ME 481 Project Presentation Award is given to the ME 481 Design Team that is judged to have given the best technical project presentation. Last semester's winning team comprised: Ryan Aenis,Zachary Albright, Sarah Haas and Andrew Stuckwisch. The team presented and demonstrated a new laser-based robotic approach to measuring the inside diameter of steel pipes, in a project sponsored by U.S. Steel. The project was supervised by Mary Beaver at U.S Steel, and by Dr. Farhang Pourboghrat at MSU.

(Prof. Giles Brereton) Sarah Haas, Ryan Aenis, Zachary Albright, Andrew Stuckwisch

ME 471 Leonardo da Vinci Award

The members of the student team winning the ME 471 competition on Design Day are given the Leonardo da Vinci Machine Design Award. The award winners are determined by the course instructor, based on the team's score in the competition.

(Prof. Ronald Averill) Benjamin Bosworth, Steven Gerdeman, Benjamin Dean, Brett Hewitt

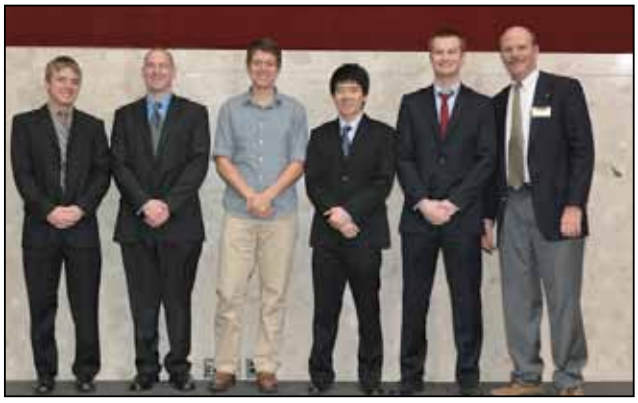
ME 412 Heat Transfer Design Award

The student team members winning the ME 412 competition at Design Day are recognized by the Heat Transfer Design Award. The award winners are determined by the course instructor based on team scoring in the competition.

(Prof. Giles Brereton) Stephen Campbell, Cameron Gibson; not shown: Samantha Hilk

ME 456 Best Mechatronic Product Design Award

The integrated design of products and processes that include mechanical and electrical components under intelligent control.



Corey Silvis, Brian Farber, Kyle Sweet, Tian Yu Zhao, Michael Trotter (Prof. Clark Radcliffe)

MICHIGAN STATE UNIVERSITY

Design Day

Fall 2013

COLLEGE OF ENGINEERING

Mark Your Calendars!! It's time to save the date for Fall 2013 Design Day!

Join us December 6, 2013, for another energetic celebration showcasing talented engineering students

Check our new website often for updates during the semester:
http://designday.egr.msu.edu/day

GO GREEN!!

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For information on sponsoring Design Day and design projects, contact

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