You are invited to attend the sixty-second Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., **Tuesday, April 17, 2018** at the College of Engineering and Applied Sciences on the Parkview Campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry. The conference is free and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the College Circle in front of the building and then park in lot P-2 (See map).

**Parking** is available in the ramps behind the College of Engineering and Applied Sciences (See: Lots P3 and P4). There is no charge for parking for those attending the Conference.

**Presentations begin on the hour and half hour.** Please do not enter a room after a presentation has begun.

**Session locations, times, and page number for project descriptions:**

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A lunch break is scheduled from 12 p.m. to 1 p.m. There is a café available on site.

For more information about the conference, call Tamara Bergman at (269) 276-3248.

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THANK YOU

The College of Engineering and Applied Sciences is grateful to these sponsors that have provided or cooperated in Senior Engineering Design Projects being presented in April 2018. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

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The City of Bay City
The Green Glove Dryer
United States, Gypsum Corporation Otsego Paper
WMU- College of Engineering
WMU-Department of Computer Science
WMU-Department of Statistics
WMU Foundry Casting
WMU-Lee Honors College
Wrightman & Associates
INCREASE OF PULP PRODUCTION FOR SOUTHERN MILL
by: Taylor Baranski, Eric Baudouin, Collin Conrad, Christine Dowdy, and Tyler Rheinhardt
Sponsor: None
Faculty Advisor: Said Abubakr, Ph.D.
8:30 a.m. – 8:55 a.m.

A pulp mill in the southern U.S. produces fully bleached Kraft pulp from pine wood. It is desired to increase production of unbleached pulp to fully utilize site capacity. This project required assessment of the current production rate in order to implement modifications of existing equipment to achieve maximum increase of pulp production. Investigation and material analysis of the system digesters, heat exchangers, and chemical usage and recovery operations were performed to determine the most effective solution. Capital investment and return on investment were obtained to reflect the recommended expenses and increase to pulp production.

ASH REMOVAL AND REPURPOSING
by: Alexis Blakley, Matthew Klimasz, and Ryan Melbow
Sponsors: United States, Gypsum Corporation Otsego Paper
          Eric Bock, Henry Krell, and Tom Oldham
Faculty Advisor: Dania Alsaid, Ph.D.
9:00 a.m. – 9:25 a.m.

Paper mill sludge is a major economic and environmental problem for the paper industry. Sludge, specifically produced in the liner pulp production process, consists of a high percentage of ash which affects the quality of the sludge and reduces its usefulness. A process was designed to separate the ash so that it can be used for beneficial purposes.
REDUCING BIOLOGICAL OXYGEN DEMAND IN PAPER MILL PROCESS WATER
by: Travis Garlock, Matthew Muhs, and Joseph Taylor
Sponsor: Graphic Packaging International
Ana Perez
Faculty Advisor: Richard Edwards
9:30 a.m. – 9:55 a.m.

Biological oxygen demand (BOD) is a measure that largely contributes to increasing effluent costs for recycled paperboard mills. Research was conducted on methods to reduce biological oxygen demand in mill process water. The proposed methods should reduce BOD levels without affecting the quality of product or performance of the paper machines. These methods will treat effluent wastewater delivered to the municipal treatment facility with the potential to significantly reduce costs incurred by the mill from elevated BOD.

SIMULATION MODELING OF THE CHARACTERISTICS OF GREEN SOLVENTS
by: Meghan Jackson, Jinq Jia Lim, Bethany Neybert, and Jeremy Williams
Sponsor: Kalsec, Inc.
John White
Faculty Advisor: Dania Alsaid, Ph.D.
10:00 a.m. – 10:25 a.m.

In recent years, there has been a push for food manufacturers to use green solvents in their extracting processes. The ability to predict the solubility behavior of bioactives in the selected green solvents is of foremost importance. Both group contribution theory and molecular thermodynamics were incorporated to estimate Hansen solubility parameters. Computer modeling software was used along with these parameters to develop a simulation that predicts this behavior. Extraction parameters were determined to optimize the extract quality, concentration, and yield of the desired bioactive component(s) using this model.

OPTIMIZING WATER USAGE IN A COOLING SYSTEM
by: Suhyb Albetairi, Abdulelah Aljameel, Alexander Maurer, and Ricardo Sanchez
Sponsor: Kalsec Inc.
Jason Buero, Stephen Kuhnert, and David Gordon
Faculty Advisor: Dania Alsaid, Ph.D.
10:30 a.m. – 10:55 a.m.

Well water is used in the cooling of various processes at Kalsec Inc. Due to continued growth and process additions, over a period of time, the well has reached its maximum capacity before system pressure loss. This loss has caused scheduling issues in the production lines. While this poses an economical concern, there is also a sustainability and environmental concern to reaching the well’s capacity. The main focus was to reduce well water usage to increase facility capacity and reduce its environmental impact.
IMPLEMENTATION OF A SOLVENT TANK FARM VAPOR RECOVERY SYSTEM
by: Aqeal Al Ramel, Paul Brown, and Garrett Parzynski
Sponsor: None
Faculty Advisor: Dania Alsaid, Ph.D.
11:00 a.m. – 11:25 a.m.

Controlling solvent usage and loss is important in extraction companies. These solvents are separated and stored in tank farms. The continuous addition and removal of solvents to tank farm systems result in solvent losses. Reducing transfer losses in the tanks, a solution was proposed to collect the vapor lost during transfer. Different solvent recovery methods were compared in efficiency and cost. A detailed economic analysis was completed to assess the viability of implementing the proposed system.

SUBSTANTIATE PERCENT YIELD WITHIN PERSONAL CARE MANUFACTURING PLANT
by: Devin Dunn, Fatimah Ghallab, Mikelyn Hokenmaier, and Brian Peterson
Sponsor: Amway
Bret Nordland, Nancy Beard, and Bruce Neely
Faculty Advisor: Richard Edwards
11:30 a.m. – 11:55 a.m.

The Personal Care Manufacturing Plant produces a variety of products with each designated to a specific production line. Finished product travels from the mix vessel to the individual package using multiple transfer systems varying in size and length. Throughout the process, scrap rates vary for different equipment types and capabilities based on the products’ properties. Engineering studies were conducted at various areas on a single production line to identify opportunities for improvement. Actual yields were determined to compute and verify scrap loss at each area. The team will report on the analysis techniques that were used to establish the optimal system changes.

OPTIMIZATION OF A GAS PROCESSING PLANT
by: Fatimah Al Abudulaziz, Taibah Albeloushi, and Marcus Kong
Sponsor: None
Faculty Advisors: Dania Alsaid, Ph.D. and Richard Edwards
1:00 p.m. – 1:25 p.m.

Natural gas is gathered from wells and transported by a pipeline to a turbo-expander type gas processing plant. The plant utilizes two main distillation columns: A demethanizer column and a deethanizer column. This project optimized the gas processing plant to recover ethane. Changes to the process were made to maximize product streams value as well as to minimize energy consumption. Final recommendations were based on a comprehensive economic analysis of the whole proposed changes.
OPTIMIZING FROSTED MINI-WHEATS’ FINISHED FOOD COOLING PROCESS
by: Jean Richard Jn Baptiste, Jessica Graves, Brady Hostetler, and Abdullah Sulais
Sponsor: Kellogg Company
Terry Andren, Joseph Cwiakala, and Nicole Remily
Faculty Advisor: Richard Edwards
1:30 p.m. – 1:55 p.m.

Analyzing energy intensive processes in industry is crucial for improving sustainability, lowering costs, and increasing profit margins on products. Material and energy balances were performed to identify process losses in the cooling of Frosted Mini-Wheats. Existing cooling technology was compared to alternate technology available on the market, and a cost analysis was performed to compare all options explored. Recommendations were made to the system to potentially reduce the line’s energy usage and downtime, with the objective of creating a more sustainable and efficient process.

TOASTER PASTRY ICING PREPARATION AND APPLICATION OPTIMIZATION
by: Beatrice Pei Wen Chai, Cornellius Marcello, Rebecca Martus, and Robert Repke
Sponsor: Kellogg Company
Nicole Remily, Greg Stevens, and Joey Carroll
Faculty Advisor: Richard Edwards
2:00 p.m. – 2:25 p.m.

The Kellogg Company is interested in optimizing the way the icing for a baked good is prepared and applied during production. The current method has not been significantly changed since the item was first introduced over 50 years ago. A new process was developed to make a more efficient preparation and application of the icing operation. New equipment was identified based on established methods in the food industry. The new equipment and process were verified after the mass and energy balances were calculated. A capital and operating cost analysis was performed to determine if the introduction of the new process would be a worthwhile investment.

DISTILLATION OPTIMIZATION IN THE PHARMACEUTICAL INDUSTRY
by: Osamah Alghamdi, Clayton Carter, Jacob Cipich, and Daniel VanZweden
Sponsor: Pfizer Inc.
Nicholas Muller, Zachary Wolf, and Eric Smith
Faculty Advisor: Dania Alsaid, Ph.D.
2:30 p.m. – 2:55 p.m.

Distillations are commonly used throughout industry to perform separations by phase change, producing a liquid phase and vapor distillate. However, the process of distilling can be slow and energy intensive, providing a limitation in the production process. Possible improvements to current distillation systems were considered on the basis of thermal efficiency, material throughput (cycle time), and material tolerance. Consideration was given to ensure maintenance is straightforward and relatively quick, as fouling, contamination and tank utilization were concerns. Economic viability of the improvements was completed to determine the project benefit. The optimized design offers increased efficiency for production lines.
DESIGN OF WASTE WATER TREATMENT PLANT AERATION SYSTEM
Sponsor: None
Faculty Advisor: Richard Edwards
3:00 p.m. – 3:25 p.m.

Maintaining sufficient levels of dissolved oxygen in bio-sludge waste water treatment is critical for the success of the microorganisms in the process. The current process of aerating waste water basins involved in the secondary treatment of activated sludge utilizes equipment and techniques that are labor intensive, energy inefficient, and require frequent part replacement. New technologies in oxygen delivery were investigated to find a system capable of meeting the same oxygen demand with less energy input. Greater system life expectancy was also established to significantly reduce the cost of aeration processes at a waste water treatment plant.

DESIGN AND EVALUATION OF A LARGE-SCALE BIOSENSOR MANUFACTURING PROCESS
by: Logan Hughey, and Alexander Maldonado
Sponsor: None
Faculty Advisor: Brian Young, Ph.D.
3:30 p.m. – 3:55 p.m.

In vitro diagnostics play a critical role in disease prognosis and monitoring. Advancement in the design and manufacture of immunoassays – a subset of in vitro diagnostics- will extend the reach of medical technology to allow in-field testing with point-of-use biosensors that respond to specific antigens. A process and facility for monoclonal antibody production and subsequent biosensor manufacturing was designed for the fabrication of a novel immunoassay platform. The production facility was economically evaluated to determine construction, operation, and product costs. This design also provides a framework which could facilitate the laboratory-to-industry translation of current biosensor research.
IMPROVING SECONDARY FIBERS THROUGH ENZYME MODIFICATION
by: Thomas Anderson  
Sponsor: None  
Faculty Advisor: Kecheng Li, Ph.D.  
9:00 a.m. – 9:25 a.m.

The recycled paper industry spends a large percentage of its money attempting to strike the right balance between drainage rate and internal bonding strength to make a quality sheet while managing costs in the drying stage. A series of enzyme treatments were done on recycled pulp, following which various internal bonding tests were conducted to determine the overall impact of the enzymes on the fibers. These tests can be administered to determine if a specific enzyme will have a positive impact on the environmental renewability, strength properties, and end cost to the mill.

KUBELKA-MUNK STUDY OF CALCium CARBONATE AND CLAY PIGMENTS IN CONJUNCTION WITH NATURAL AND SYNTHETIC BINDERS
by: Evan Ericson  
Sponsor: WMU-Pilot Plant  
Matthew Stoops  
Faculty Advisor: Matthew Stoops  
9:30 a.m. – 9:55 a.m.

The Kubelka-Munk theory was used to determine a coating formulation that is low cost, recyclable, and environmentally friendly with comparable Kubelka-Munk values. The Kubelka-Munk theory is often used to predict optical properties of a coating applied to a paper substrate. Kubelka-Munk is the ratio of absorption coefficient to the scattering coefficient of light, known as the theory of reflectance. A coating formulation consists largely of pigments and binders. When compared, different pigments such as Calcium Carbonate and Kaolin Clay, gave a credible overview as to which formulation had the best Kubelka-Munk value. Additionally, this lab compared how natural and synthetic binders affected the Kubelka-Munk values to find the recyclability of a coating formulation.
THE ENHANCEMENT OF AKD SIZING UTILIZING CATIONIC STARCH
by: Garrett Fisher
Sponsor: None
Faculty Advisor: Qiang Yang, Ph.D.
10:00 a.m. – 10:25 a.m.

The usage of alkyl ketene dimer (AKD) for many years within the paper industry has revealed problems associated with its’ use including: poor retention mechanisms, high rate of hydrolysis, backwater contamination, inability to obtain curing temperatures in dryers, and size reversion. The similarity of starch’s chemical structure to that of cellulose within the paper web created a high affinity between the two compounds. Thus, sizing retention/efficiency may be improved by varying levels of cationic wet end starch mixed with AKD prior to sheet addition. Using Minitab DOE and TAPPI standards; a high efficiency retention system was developed within the lab.

MOISTURE SENSOR ON SBS BOARD COATED WITH GLUCOMANNAN BARRIER COATING
by: Darah Fitch, and Ruoxi Ma
Sponsor: None
Faculty advisor: Alexandra Pekarovicova, Ph.D.
10:30 a.m. – 10:55 a.m.

The need for functional biodegradable coatings in the paper industry is expanding in efforts to become more sustainable. For these coatings to become standard, a way of testing for their moisture control properties is crucial to ensure their performance. Using a dispersion casting method, a biodegradable coating was formed using Glucomannan and was applied to SBS board. A moisture sensor was then screen printed on the Glucomannan coating using silver based conductive ink in order to test performance. This sensor will be important in determining the time for moisture to penetrate coated board and the rate of transmission following breakthrough.

INVESTIGATE SUSTAINABLE ALTERNATIVES TO PETROCHEMICAL BASED MOISTURE BARRIER COATINGS
by: Alex Fleck
Sponsor: None
Faculty Advisor: Matthew Stoops
11:00 a.m. – 11:25 a.m.

Current moisture vapor barrier coatings employ polyethylene as the functional film former due to its superb water resistance and low production cost. However, polyethylene possesses a very poor biodegradation rate which contributes to the accumulation of over 25 tons of mixed plastics in landfills annually. This experiment sought to investigate water-based biopolymers to achieve a “green” barrier coating. Cross linked starch (via oxidized sucrose) and a prevulcanized natural rubber latex and modified lignin blend are the primary specimens for investigation. The properties used to quantify the barrier films were water vapor transmission rate (WVTR), water absorbency, contact angle, permeability, and blocking potential.
NATURAL POLYMER BARRIER COATINGS FOR OIL AND GREASE RESISTANCE
by: Andrew Kathan
Sponsor: None
Faculty Advisor: Matthew Stoops
11:30 a.m. – 11:55 a.m.

Many barrier coating formulations currently used for oil and grease resistance development in the paper industry have issues with sustainability, biodegradability, or have health concerns associated with them. This project aims to test polymers, namely starch, as barrier coatings to develop oil and grease resistance for food grade packaging sheets and draw conclusions on their feasibility for use in the paper industry. Two modified starches identified through research were cooked and applied at varying coat weights to handsheets of varying porosities. These handsheets were extensively tested and compared to conventional food grade packaging for analysis.

OBSERVING ZINC OXIDE’S IMPACT ON LIGHTFASTNESS FOR INKJET COATED PAPERS
by: Jonathan Mayoros
Sponsor: None
Faculty Advisor: Matthew Stoops
1:00 p.m. – 1:25 p.m.

Ultraviolet absorbers are used in photographic papers to prevent the paper’s color and brightness from degrading by absorbing ultraviolet light. Titanium dioxide is the most common ultraviolet absorber, yet it is one of the most expensive additives for coating paper. Zinc oxide is similar to titanium dioxide, however zinc oxide can absorb a wider range of ultraviolet light and is cheaper. Zinc oxide was used to replace various amounts of titanium dioxide in a coating in order to reduce the cost of manufacturing inkjet coated papers and to evaluate if zinc oxide will absorb more ultraviolet light than titanium dioxide.

RECYCLING OF SILVER FROM PRINTED ELECTRONICS
by: Ryan Melbow
Sponsor: None
Faculty Advisor: Sasha Pekarovicova, Ph.D.
1:30 p.m. – 1:55 p.m.

Printed electronics have the potential to become a multimillion dollar industry. One of the hurdles of the industry is the high material cost of the silver inks used for the circuit boards. To make this industry economically viable, a method to recycle these precious metals from inks was developed. This study explored the possibility of using enzymes followed by electrolytic floatation to extract silver from the printed circuit boards.
The cellulose insulation process relies heavily on newsprint as its main resource, but the supply of this resource is running very low. Research to find new materials that can be used was done. Wool fibers and container boards were chosen to be tested. In the lab the runnability of these materials were tested to see if there will be enough absorbance in the material to absorb insulation chemicals necessary for the product. The new isolated material was then tested compared to the insulation mixture that uses newsprint as its main material.

In recent years there has been a substantial push for positive sustainability in manufacturing industries. Within the paper industry, mills have been incorporating more broke/recycle in the furnish, using more environmentally safe chemicals and utilizing different sources of raw materials to achieve positive sustainability. Utilizing kenaf as a potential softwood substitute (either as a blended ratio or complete substitute) in the Kraft pulping process will help promote positive sustainability due to the extremely short cultivation turnover rate of ready-to-use fibers. The study is designed to see compare kenaf fibers to a control softwood fiber source pulped under the same parameters. The study will consist of three separate cooks, changing the maximum cooking temperature and time of the cook, analyzing the cooking liquors before and after the cook, and calculate the screened and unscreened yields, along with reject percentage. The experiment will be performed in the Pulping Laboratory at Western Michigan University, utilizing the lab digester and chemicals necessary to conduct this study.

Linerboard is the outermost layer in cardboard packaging, and currently many petroleum-derived chemicals are applied to it to add strength, water, oxygen, or grease resistance. In an effort to create a more sustainable oxygen barrier and strength coating, hemicellulose that was extracted from corn cobs was used and made more effective by crosslinking with citric acid. The coating adds an oxygen barrier and physical strength to the linerboard while staying completely compostable or recyclable, which is often impossible when petrochemical-derived barriers are used. Results were determined from TAPPI standards tests and analyzed for statistical significance.
KALAMAZOO RIVER’S EDGE ROUNDABOUT DESIGN
by: Matthew Amstutz, Zachariah Culbert, and Maxwell Murray
Sponsor: Wrightman & Associates
    Alan Smaka and Frank Renaldi
Faculty Advisors: Decker Hains, Ph.D. and Valerian Kwigizile, Ph.D.
9:00 a.m. – 9:25 a.m.

The intersection of Gull Road at Harrison Street and Ransom Street in City of Kalamazoo (COK) posed transportation and environmental challenges due to unique geometries, ununiformed traffic volumes and patterns, and rehabilitation of critical wastewater/water/storm water infrastructure. The project entailed engineering disciplines involving evaluating the best transportation (conventional intersection design, signalization, different roundabout configurations) and utility routing alternatives, developing cost estimates and life-cycles analysis of the proposed alternatives and their varying material selections/operation and maintenance costs, modeling of the transportation configurations, and ultimately the design and development of construction drawings in accordance with AASHTO standards.

STATE STREET RECONSTRUCTION
by: Gabriel Ferreras, and Marco Sanchez
Sponsor: Fleis & VandenBrink Engineering
    Jeffrey Wingard, P.E.
Faculty Advisor: Decker Hains, Ph.D.
9:30 a.m. – 9:55 a.m.

State Street Reconstruction Project is located in the City of Hillsdale. The project consisted in the repaving of a section in State Street and solving the standing water dilemma in Wolcott Street. The solution to the problem was provided by designing and constructing a storm sewer with a detention basin and repaving the section of State Street. Now, along with the sewer, the section of State Street includes a concrete curb and gutter and a sidewalk. This helped create communication between downtown Hillsdale and the county’s park. Now, State Street is ready for its high vehicular volume with the addition of a pedestrian sidewalk.
The possibility that MDEQ may require sewers to be separated in the future in the City of Bay City provided the opportunity to conduct a cost study for such a project. Quantities were taken for sanitary sewer, water main-including lead service lead replacement, drive approaches, curb and gutter, and roadway reconstruction. Sidewalk replacement was included as an option. Material and cross section alternatives were investigated and Complete Streets design based on the City’s Non-Motorized Plan was followed. Three options were provided for millage costs based on 20, 30 and 40-year bond periods for the City’s consideration.

The Hart-Montague bike trail ran 22 miles between the City of Hart and the City of Montague. However, it was in dire need of addition due to the high traffic volumes. The trail has been extended to reach the south end of the Village of Pentwater. Many options were presented for the path of the trail between the Village of Pentwater and the existing trail head, which were evaluated. By adding to the trail, the Village of Pentwater will gain economic benefit from the additional tourism.
TICKET MANAGEMENT PORTAL
by: Parker Loomis, Brennan Muir, and Brandon Seager
Sponsor: Midwest Realty Group, LLC.
           Rick DeKam, CCIM
Faculty Advisor: John Kapenga, Ph.D.
9:00 a.m. – 9:25 a.m.

The Ticket Management Portal allows the management and employees to seamlessly and quickly track issues submitted by customers, as well as internal projects. Tenants can log in with unique credentials and submit a ticket for their property. Any problems they require, from repairs to maintenance, can be handled through the portal. Tickets are then received by management and delegated to employees to handle. Within the ticket, employees can add comments, upload documents, and even track time spent on each ticket. Time spent from ticket creation to closure is greatly reduced and better managed.

CANINE VISUAL ACUITY TESTING APPARATUS
by: Alex Ewert, Brandon Grothe, Samuel Lewis, and Chandler Miller
Sponsor: AcuiSee LLC
           Dillon Burton
Faculty Advisor: John Kapenga, Ph.D.
9:30 a.m. – 9:55 a.m.

Canine cognitive and vision research is an area lacking in innovation as current methods are mostly performed by hand. With modern technology, testing procedures can be automated and devoid of human elements. With the use of microcomputers and touchscreens, an apparatus has been created that automates vision testing for small to midsize canines. This will be in combination with a backend database that will store and provide research information to research teams. This apparatus and software combination will help an area lacking in modern automation.
HABITAT FOR HUMANITY RAMP DESIGNER
by: Bishop and Cade Gillem
Sponsor: Battle Creek Area Habitat for Humanity
Justin Byrd
Faculty Advisor: John Kapenga, Ph.D.
10:00 a.m. – 10:25 a.m.

People with physical disabilities often have trouble entering and leaving their homes. An open source software was created in order to expedite the processes of design, obtaining building permits, and construction of complex multi-level ramps. The Java-based software receives measurements input by a user and uses this information to generate a properly annotated diagram. Parameters include the maximum height of the ramp, the shape of the ramp, and the length of each section. The software is designed to be user-friendly and may be used on-site, without an internet connection, on a Windows-based tablet or laptop.

WMU LEE HONORS COLLEGE MOBILE APPLICATION
by: Benjamin Campbell, Peter Shutt, and James Ward
Sponsor: WMU Lee Honors College
Katie Fox
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. – 10:55 a.m.

Members of WMU’s Lee Honors College do not have an efficient way to obtain the college’s information from their smartphone. A mobile application has been developed with the React Native framework for both iOS and Android platforms. The app will include a newsfeed filled with the latest college information. It will also contain building hours, events, contacts and announcements. The mobile application will now be used by members of the Lee Honors College to view college information in an effective manner from their smartphone.

INFRASTRUCTURE AS CODE: HOST MANAGEMENT THROUGH SOFTWARE
by: Justen Pacsai, Jonathan Pennington, and Steven Steffey
Sponsor: WMU Department of Computer Science
Colin MacCreery
Faculty Advisor: John Kapenga, Ph.D.
11:00 a.m. – 11:25 a.m.

Efficient management of software applications and configurations over a large number of hosts is a commonly sought-after goal for system administrators. The software utility Ansible is used in the development of a framework for software deployment and host configuration. The framework enables a system administrator to quickly deploy a number of essential services and to accomplish numerous tasks across multiple hosts with ease.
WRANGLR FOR NHANES
by: Jacob Darling, Apolinar Ortega, and Antonio Ruiz
Sponsor: WMU Department of Statistics
    Joseph McKean, Ph.D.
Faculty Advisor: John Kapenga, Ph.D.
11:30 a.m. – 11:55 a.m.

Plenty of research relies on the vast collection of studies provided by the National Health and Nutrition Examination Survey (NHANES). Wrangling the data to get the desired data frames for analysis can easily get complicated and become a time-consuming process. An interface in the form of a web application has been developed, which allows users from any platform to access the NHANES data sets. The application was developed using the R scripting language and utilizes the RShiny library for creating web applications. The new solution provides a simple method for accessing the desired data.

CAMPUS TOURS
by: Nick Pawlawski and Ken Rivard
Sponsor: WMU CEAS
    Scot Conant
Faculty Advisor: John Kapenga, Ph.D.
1:00 p.m. – 1:25 p.m.

A: Campus Tours is a website for the college of engineering and applied sciences. The campus offers daily tours for prospective and returning students. The campus tours software allows these students to register for a tour. The software also provides the college with a way to manage the tours while providing the college with analytics about the tours that take place. The software is being built with the web framework Laravel and uses standard development methodologies used by professionals today.

LOCAL BUSINESS WEB DEVELOPMENT
by: Rawan Alfaraj and John Harvey
Sponsor: None
Faculty Advisor: Samantha Parker
1:30 p.m. – 1:55 p.m.

Local businesses with no online presence are very common, especially small and older ones who operate mostly on paper. A web application used for hosting information and operational management was developed using Ruby on Rails. A PostgreSQL database management system allows customers to access account information through a user dashboard and manage purchases. Both customers and staff will benefit from this web application due to its ease of access and readily available information.
The International Education Faculty Development Fund (IEFDF) is a grant which allows faculty to travel internationally at a reduced cost. Current administration of the fund is cumbersome; most of it handled manually and takes days or weeks of staff hours to facilitate each cycle. To reduce this problem, a website was developed which allows faculty to apply for grant online and streamlines the grant approval process. The site utilizes the Central Authentication Service so the faculty can login without creating new accounts. The completed site organizes an otherwise unwieldy process and saves a significant amount of unnecessary labor.
AUTONOMOUS BRAKING SYSTEM FOR REMOTE CONTROL CARS
by: Jacob Killman, Nicholas Pappas, and Jaren Pashak
Sponsor: WMU ECE Department
Faculty Advisor: Steven Durbin, Ph.D.
9:00 a.m. – 9:25 a.m.

Autonomous braking systems are being manufactured and installed in numerous brands of vehicles all over the world. These braking systems allow the operator to have full control of the vehicle while adding the safety feature of automatically stopping before hitting an unexpected object. The project converted a pair of remote control cars to add an autonomous braking system to each. This enables students, or guests of Floyd Hall, to race against each other in a safe manner, especially during open house events.

REAL-TIME NEURON MEMBRANE VOLTAGE CONTROLLER
by: Lucas Essenburg, Robert Saltzman, and Joshua White
Sponsor: Neurobiology Engineering Laboratory
Faculty Advisor: Damon Miller, Ph.D.
9:30 a.m. – 9:55 a.m.

The WMU Neurobiology Engineering Laboratory explores efficient stimulation of biological neurons using control theory. Previous experimental work utilizes a WPI DUO-773 electrometer to evoke and measure neuron membrane voltage responses. Stimulation current waveforms are pre-computed in MATLAB®, generated by a USB-6211 data acquisition device, and sent to the DUO-773 using a computer-based LabView® application. The computer is also used for data logging. Applications of this technique to medical devices require real-time performance. Thus, a self-contained device capable of estimating and applying an optimal stimulation current to a biological neuron and measuring the neuron response in real-time was developed.
MUSIC KEYBOARD BASED ON FLEXIBLE HYBRID ELECTRONICS
by: Jesse Echtinaw, Tony Hanson, and Kyle Mann
Sponsor: Massood Atashbar, Ph.D.
Faculty Advisor: Massood Atashbar, Ph.D.
10:00 a.m. – 10:25 a.m.

Flexible Hybrid Electronics (FHE) is an emerging technology and has high potential in consumer electronic applications. A musical keyboard is a bulky instrument. FHE can be implemented to vastly improve portability of the musical keyboard. The flexible keyboard allows the user to play a full octave of notes, and adjust volume output while minimizing size. The core of this flexible keyboard is an array of capacitive sensors located within each key.

SCALED DOWN IMPULSE GENERATOR
by: Andrew Covell, Esther Mawi, and Jeremy Smith
Sponsor: WMU ECE Dept.
Pablo Gomez, Ph.D.
Faculty Advisor: Pablo Gomez, Ph.D.
10:30 a.m. – 10:55 a.m.

The impulse test is a crucial test to assess the dielectric performance of different power system components. This test uses an impulse generator to produce a high voltage, with a fast rising pulse, to emulate the impact of a lightning or switching condition on the power device. The scaled-down impulse generator that has been constructed shows a safe demonstration of the impulse test in order to study wave propagation along power devices.

OPTIMIZED KNN IMPLEMENTATION ON A FPGA CLUSTER
by: Andrew Farran, Grant Fettig, and Daniel McKee
Sponsor: Lina Sawalha, Ph.D.
Faculty Advisor: Lina Sawalha, Ph.D.
11:00 a.m. – 11:25 a.m.

With machine learning being used over a large span of industries and studies, there is a need to further optimize its use. One instance of machine learning is the K-Nearest Neighbor algorithm. The algorithm’s performance was accelerated by implementing a Verilog architecture design on a Zynq™ Board (ZYBO). Further optimization was achieved by parallelizing the algorithm to work on a cluster of Field Programmable Gate Arrays (FPGA). Multiple FPGAs communicating via Ethernet reduces execution time by leveraging parallel operations without a drastic increase in energy consumption. This is compared to other hardware solutions such as Graphical Processing Units (GPU).
WiTricity is based on coupled electromagnetic resonant coils for efficient power transfer without wires. Since its conception, it has been successfully applied in a wide range of industrial, commercial and residential devices. A very significant application is related to improving the experience and quality of life of medical patients. WiTricity technology enables efficient recharging of essential medical devices such as pacemakers, defibrillators or ventricular assist devices implanted deeply within the body cavity, several centimeters from the skin. This eliminates the risks associated with the use of charging drive lines or surgical procedures to replace batteries. In the project, an electric charger based on WiTricity technology was designed and built specifically for medical applications.

MEDICAL DEVICE HAND SWITCH TESTER
by: Hussain Alzayer, Thomas Harker, and Ryan Maniwczak
Sponsor: Stryker Instruments
Faculty Advisor: Dean Johnson, Ph.D.
1:00 p.m. – 1:25 p.m.

Current designs for hand switch testers (HST) are purely analog, require daily calibration checks, and an operator to make a judgment if the switch passes or fails. A new HST has been designed to be used by Stryker Corp. in their surgical instrument plant to verify the functionality of hand switches. The new HST is computer automated and provides documented results of tests such as pass or fail results. Switches need to be tested before they can be sent to hospitals for use. It’s important that the results of testing the switches can be trusted.

DESIGN AND CONTROL OF A NANOGRID
by: Abdulilah Alaknah, Firas Alotaiby, and Mohammed Boshlibi
Sponsor: Rick Meyer, Ph.D.
Faculty Advisor: Pablo Gomez, Ph.D.
1:30 p.m. – 1:55 p.m.

The purpose of this project is to design a desktop size DC nanogrid that includes renewable energy from a photovoltaic panel, an energy storage system and fossil fuel-sourced energy provided by rectified wall power. The nanogrid is monitored and controlled by an Arduino microprocessor that is programmed to manage the operation of the nanogrid between island mode and grid mode depending on the generation, storage and load conditions in order to ensure the continuity of power to the load. The completed design serves to showcase the operation of a microgrid at a lower scale for educational purposes related to class demonstrations, lab projects, or research purposes.
ROCKING, SENSING, SOOTHING
by: Paige Coffeen, Nicholas Neppach, and Jordan Wagner
Sponsor: Ikhlas Abdel-Qader, Ph.D.
Faculty Advisor: Bradley Bazuin, Ph.D.
2:00 p.m. – 2:25 p.m.

A device has been designed that can monitor, detect, and soothe autistic children during sensory overload. The device is comprised of a vest containing a microcontroller and a 9-axis IMU (inertial measurement unit) to detect repetitive motions. These motions can be trained to the vest so that a detected pattern triggers output vibration in strategic locations on the body. This stimulates the nervous system to calm the child. A smartphone application has been developed that interfaces with the vest for caretaker monitoring, notification, and control. The device provides a tool for caretakers to help soothe autistic children with no emotional outlet in stressful social situations.

SUGAR CONTENT AND TEMP SENSOR FOR HOME-BREWING
by: Izat Dahger, David Gipe, and Brandon Robbins
Sponsor: Blichmann Engineering
  John Blichmann
Faculty Advisor: Janos Grantner, Ph.D.
2:30 p.m. – 2:55 p.m.

Since the late 4th century the process of measuring the alcohol content in beer has remain unchanged. A device called a “Hydrometer” is floated in the solution, and the sugar consumption (i.e. alcohol) can be calculated. Using ultrasonic and temperature sensors, a submersible device was developed that monitors the changing density of the beer during fermentation. The device uses this data to calculate the Specific Gravity, and transmit it via Bluetooth to a phone or PC. The user then uses this information to calculate alcohol content. This device is the first of its kind, and can modernize the brewing process.

UAVs FOR ELECTRIC UTILITY INSPECTIONS
by: Sarah Gill, Nathan Richardson, and Kyle Schittenhelm
Sponsor: Consumers Energy
  Nathan Washburn
Faculty Advisor: Ralph Tanner, Ph.D.
3:00 p.m. – 3:25 p.m.

Inspections of electrical distribution lines are necessary to prevent unwanted and costly power outages to customers, locate safety hazards, find damages to equipment, and conform to the law. Though necessary, the current process for power distribution line inspections is slow and labor intensive. An unmanned aerial vehicle and light detection and ranging camera were used to automate the inspection process, cutting down on the labor costs. By better automating the inspection process, inspections can be completed faster, thus improving the reliability of electric distribution assets.
SOLAR CELL MANUFACTURING DESIGN PROCESS
by: Dylan Gritzmaker, Evan Luoma, and Joshua Mead
Sponsor: Steven Durbin, Ph.D.
Faculty Advisor: Steven Durbin, Ph.D.
3:30 p.m. – 3:55 p.m.

Design and fabrication of silicon solar cells using spin-on doping technique and screen printing was performed to produce functioning solar cells on campus. A one-dimensional solar cell simulation code (ADEPT) was used to design the structure, and process modeling was performed using SUPREM.

SOLID STATE LIGHTING CONVERSION
by: Dipesh Jha, Jumana Turkistani, and Albert Wright
Sponsor: None
Faculty Advisor: Steven Durbin, Ph.D.
4:00 p.m. – 4:25 p.m.

Floyd Hall has outdated fluorescent lighting devices in the classroom, which fail often and do not dim properly. A mock-up was designed to replicate a standard classroom environment of Floyd Hall with improvements to correct this issue. The new lighting system was modified and updated from Compact Fluorescent Lights to more cost-efficient light emitting diodes. The lighting zones were reconfigured for easier user layout and improved light viewing capabilities. New controls and increased functionality were added for better color temperature ranges and dimability to meet standard classroom settings.
STANDARDIZING THE RECEIVING PROCESS AT STRYKER
by: Ben Holewinski, Audi Matvekas, and Brandon Weber
Sponsor: Stryker Instruments
    Shelby Rhein
Faculty Advisor: Larry Mallak, Ph.D.
8:30 a.m. – 8:55 a.m.

A local manufacturer of medical instruments sought new ideas for standardizing and making their returns receiving process more efficient. Hospitals and other medical facilities need their repaired units delivered on time. With that in mind, the overall goal was to reduce the total time it takes units returned for repair to travel throughout this process. Analysis of the current process and use of time studies, interviews, identifying bottleneck areas, and 5-S methodology led to proposed solutions. These included a new process flow chart and a redesigned floor plan of the returns receiving process. These proposed solutions will lead to the returns receiving process operating at a reduced total cycle time.

COST OF SUPPLIER QUALITY DASHBOARD
by: Kendry Bautista Mosquera, William Bonam, David Gushee, and Michael O’Dell
Sponsor: BENTELER Automotive
    Jim Hall
Faculty Advisor: David Lyth, Ph.D.
9:00 a.m. – 9:25 a.m.

Poor product quality in a manufacturing environment leads to higher production costs. A local automotive supplier of metal frame and chassis components has a system to track the cost associated with poor supplier quality. This system produces a database that stores information of bad quality parts in relation to their suppliers, defects, and other associated costs. To allow upper management to make use of these data, a dashboard was developed that integrates costs, quality, and parts supplied. This dashboard also allows quality engineers and purchasing to rank suppliers. Use of these tools will allow the company to track supplier-related costs with respect to supplier ratings and possibly renegotiate supplier prices.
FRUIT FLY TRAP DESIGN
by: Austin Bieri, Blake Holzgen, Connor Morency, and Dan Trelenberg
Sponsor: Karen Smoots
Faculty Advisor: Jorge Rodriguez, Ph.D.
9:30 a.m. – 9:55 a.m.

The infestation of fruit flies is a common household problem in the summer and fall months. An effective trap was designed to capture and exterminate fruit flies in an eco-friendly fashion. The design process was followed throughout the entire project. Testing was conducted to determine the most effective design for the model. The final design was created in a 3D CAD software, yielding a 3D printed prototype. This design includes an injection molded body with a removable top, and can be cleaned and re-used. This fruit fly trap can effectively eliminate the common household fruit fly problem.

GOING GREEN AT GREEN DOOR DISTILLING COMPANY
by: Sai Myint, and Silas Wolff
Sponsor: Green Door Distilling Company
Faculty Advisor: Betsy Aller, Ph.D.
10:00 a.m. – 10:25 a.m.

Water usage and conservation is of concern to all industries, and particularly to beverage producers. A local distillery uses water as a cooling element but does not currently reuse or reduce its water use. Research on typical and creative methods of distilling processes and measurements of the current processes that use water led to the selection of the appropriate design to reduce the water use. Measurement of current water usage was performed using a volumetric flow analysis. Cost analysis tools were used to distinguish options of equipment, process upgrades, and system limitations. The implemented design will provide a sustainable and cost-effective alternative to current methods and allow the distillery future production growth.

AUTOMATION AND MEASUREMENT STUDY OF A WHITE LIGHT SCANNER
by: Lucas Baffi, Austin Lovins, and Christopher Moore
Sponsor: None
Faculty Advisor: Mitchel Keil, Ph.D.
10:30 a.m. – 10:55 a.m.

The automation of 3D white light scanning technologies has increased the consistency of on-the-line checks, and has also decreased cycle times in the inspection room. Coupling the automated white light scanner with an automated turntable has increased the consistency and repeatability of 3D scanning. The measurement capability of the automated white light scanner and turntable was compared to that of manual scanning by inspecting multiple simple geometric shapes with known dimensions. The resultant measurement capability for both automated and manual scanners has shown an increase in repeatability of automated scanning. This comparison of automated white light scanners to manual scanners will assist future students’ research, as well as help companies make educated equipment purchases.
AUTOMATED DIE CASTING IN A BOX
by: Kevin Bors, Jack Gibson, and Yadira Reyes
Sponsor: North American Die Casting Association
    Steve Wiegerink
Faculty Advisor: Sam Ramrattan, Ph.D.
11:00 a.m. – 11:25 a.m.

Metal casting is a major industry that is underrepresented in the STEM field. To address this, a scaled down press was designed to demonstrate the die casting process on a small scale. To allow the machine to automatically cycle parts, a melt system was designed, fabricated, and installed to continuously supply molten metal. The die casting in a box machine was automated by integrating a PLC and shot monitoring system along with guards and a part handling system to safely automate castings. The completed machine allows for a portable demonstration of an automated die casting process to students and faculty in the STEM field.

HYDRAULIC MONOWHEEL
by: Corey Smith and Cameron Tschupp
Sponsor: National Fluid Power Association
Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriguez, Ph.D.
11:30 a.m. – 11:55 a.m.

With the ongoing demand for greener energy, hybrid power sources are increasingly sought after. A nationwide engineering challenge was presented to create a human-powered vehicle with a hydraulic system. A concept for this vehicle was created in Solidworks, a 3D solid modelling program, and the hydraulic circuitry was tested using Automation Studio. An original vehicle was fabricated, assembled, and tested in house; and it participated in the competition. The vehicle represents hydraulic principles that can be applied to consumer vehicles to aid in the next generation of green energy.

LITTLE FREE LIBRARIES
by: Geoff Burns, Brian Fulkerson, Andre Ly, Jack Ruggless, and Ozella Wooley
Sponsor: David Middleton, MFS, and Betsy Aller, Ph.D.
Faculty Advisors: David Middleton, MFS, and Betsy Aller, Ph.D.
1:00 p.m. – 1:25 p.m.

Since 2009, the Little Free Libraries organization has been spreading knowledge in communities worldwide. Their “take a book, leave a book” mantra empowers neighborhoods by offering a free source of literature that changes with each new user. Little Free Libraries were designed and built for two Kalamazoo homes. The designs drew inspiration from the aesthetics of the neighborhoods in which they will reside. One is a craftsman style library for placement in the West Main historic district and is a model suitable for purchase as a kit. The second is influenced by mid-century architecture. It is a DIY or short run production requiring basic carpentry skills with the addition of exterior seating. Both installations were designed using Solidworks and Creo CAD systems. Our goal is to not only provide interesting and useful products, but aid in the enrichment of our city as well.
Western Michigan University’s plastic sheet extrusion line needed to be made capable of producing thermoformable sheet. Four main issues were identified after a thorough evaluation of the equipment. First, the die manufacturer was consulted for methods to control the extrudate width. Second, thermolators were installed to provide thermal control of the sheet take-off system. Third, programmable logic controllers and a host of safety equipment brought the equipment into compliance with ANSI and OSHA safety guidelines. Finally, a detailed processing manual was made for students. After extensive equipment modifications, the sheet extrusion line can now safely be operated by students to recycle scrap plastic into new thermoformable sheet.
TEETH WHITENING STRIP PACKAGING LINE OPTIMIZATION  
by: Amber Johnson, Nicholas Roe, and Austin Tarhanich  
Sponsor: Ranir LLC  
David Berkemeier and Nicholas Teopas  
Faculty Advisor: David Meade, Ph.D.  
9:00 a.m. – 9:25 a.m.

To meet increasing demands, a packaging facility can increase staff, increase machinery, or decrease line inefficiencies. Through the use of time studies, statistical analysis, ergonomics, and simulations, the packaging line was analyzed for areas of opportunity. The largest opportunities in the system were determined to be line balancing and rework frequencies. Recommendations were made in these problem areas to decrease cycle time to increase throughput to meet expanding demand.

OPTIMIZATION OF JOB & TRADESMEN SCHEDULING  
by: Brandon Cole and Steven Mohney  
Sponsor: The Austin Company  
Steve VanWorner, Brian Green, and Sam Sheets  
Faculty Advisor: Dana Hammond  
9:30 a.m. – 9:55 a.m.

Failure to properly prioritize and schedule jobs within the construction industry leads to low resource utilization and workforce imbalances. A scheduling system was developed to minimize inefficiencies by standardizing job prioritization and optimizing resource allocation. Lean principles, cost analysis, and statistics were utilized to exceed client’s expectations by effectively and efficiently completing jobs.
MATERIAL HANDLING WORK CELL OPTIMIZATION
by: Omar Bajamal, Abdulelah Bajammal, and Allison Knepple
Sponsor: FEMA Corporation
Carlee Gruizinga
Faculty Advisor: Lee Wells, Ph.D. and Dana Hammond
10:00 a.m. – 10:25 a.m.

Work space design plays a significant role in manufacturing efficiency and safety in the workplace. In this project, an optimized material handling work cell was designed to support the customer’s new washing process for hydraulic components. While this study focused on generating work cell designs, an ergonomic risk assessment of the system was also performed. Potential designs were evaluated with respect to cost, safety, and overall cell performance.

STRATEGIC EXPANSION PLAN FOR CANDLE MANUFACTURER
by: Eric Carlo, David Haruza, and Sara Rodriguez
Sponsor: Kalamazoo Candle Company
Adam McFarlin
Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.
10:30 a.m. – 10:55 a.m.

Due to the rapid growth in demand, a local candle manufacturing facility sought to improve their process to address quality defects and production inefficiencies. The current state of the candle company was analyzed and evaluated using industrial engineering tools, including product design, cost analysis, and facility planning and design. Based on this analysis, a five-year strategic plan was developed to determine capacity, future expansion milestones, and help the company meet projected growth.

PACK PROCESS IMPROVEMENT
by: Jennifer Komorowski, Anna Konstant, and Alexander Moorer
Sponsor: Pridgeon & Clay, Inc.
Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.
11:00 a.m. – 11:25 a.m.

The packing rate of a high demand exhaust shield was below the anticipated rate when the part was quoted. Therefore, the packing process was investigated using simulation, cost benefit analysis, facility planning, and ergonomic workstation design principles to develop the most cost-effective solution. This analysis resulted in recommendations to achieve higher pack rates, development of a comprehensive packaging cost model, and improvements in ergonomics of the workstation.
COMPRESSED AIR SYSTEMS EVALUATION AND IMPROVEMENT
by: Sam Goldschmeding and Lukas Swoboda
Sponsor: Parker Hannifin
Anil Verma
Faculty Advisors: Tycho Fredericks, Ph.D., Steven Butt, Ph.D., and Dana Hammond
11:30 a.m. – 11:55 a.m.

Compressed air is commonly used in manufacturing plants to power machines. Several replacement plans for an aging air compressor system were created based off financial models, statistical and logistical analysis of air flow, and equipment demands. A full layout of the air compressor room was created, and visual management standards were applied to air and water pipelines. A final recommendation for air compressor replacement was provided.
FIXED ALTITUDE AND FLIGHT TERMINATION SYSTEM
by: Kenneth Oliver-Brace Baker, Brandon Kammer, and Quentin Piaskowski
Sponsor: None
Faculty Advisor: Kristina Lemmer, Ph.D.
8:30 a.m. – 8:55 a.m.

Earth’s atmosphere has become a focal point in studying the DNA and interactions of microbial communities. Obtaining accurate microbial samples using high altitude balloons is vital for a team of biology researchers. A previous sampling system was optimized by designing a helium valve system for the balloon and ballast system using SolidWorks. Flight terminations methods were enhanced using the valve system by discharging lifting gas upon sampling completion or stop commands. The valve/ballast system provided full vertical control of the balloon by releasing either helium or sand to maintain a required sampling altitude of 5000_m over six hours.

DESIGN, BUILD AND TESTING OF A LOW FLOW RATE HOLLOW CATHODE FOR WMU AEROSPACE LABORATORY FOR PLASMA DYNAMICS
by: Thomas Kerber, Margaret Mooney, and Sarah Roiniak
Sponsor: None
Faculty Advisor: Kristina Lemmer, Ph.D.
9:00 a.m. – 9:25 a.m.

Hall effect thrusters and gridded ion engines require hollow cathodes to both ionize the propellant and neutralize the ejected plasma plume. A hollow cathode was designed and constructed to be paired with the Western Hall thruster (WHT-44) and for further research conducted at the Aerospace Laboratory for Plasma Experiments at Western Michigan University. The cathode uses materials that are capable of withstanding high temperatures and vacuum conditions required for operation. The design allows different geometric configurations to be tested on the same cathode to help determine optimum performance characteristics. Research into electric propulsion systems is crucial to the continued exploration and understanding of the universe.
DESIGN OF POWER CONVERSION AND TRANSMISSION SYSTEM FOR OSCILLATING WING UNIT (OWU)
by: Nather Alassef, Choong Beng Lim, Muhammad Maulud, Bo Ching Wong
Sponsor: Talis Equity LLC
    Brett Hungerford
Faculty Advisor: Tianshu Liu, Ph.D.
9:30 a.m. – 9:55 a.m.

Oscillating Wing Unit (OWU) for Power Generation is a non-conventional wind power generator. OWU converts the oscillation into rotation which can generate electricity stably. OWU has two wings at the tips of the model to extract torque created by the airflow with minimum speed of 1 m/s, where minimum operational speed of wind turbine is 5 m/s. The converter and gearbox are designed for converting the oscillation into electricity and varying the gears against different wind speeds respectively. These two systems implement OWU into practical usage and develop wind power potential globally.

DESIGN OF AN ELECTRIC PROPULSION THRUSTER BREAKOUT BOX SYSTEM
by: Ryan Powers, and Luke Wilkins
Sponsor: Kristina Lemmer, Ph.D.
Faculty Advisor: Kristina Lemmer, Ph.D.
10:00 a.m. – 10:25 a.m.

When performing experiments in the Aerospace Laboratory for Plasma Experiments (ALPE), creating test setups and working with electrical equipment can become dangerous and tedious. A breakout box was required that ensures the ability to troubleshoot electrical problems, decrease time needed to reconfigure equipment for an experiment, and decrease the potential for a safety hazard. The goal was to design a box that would house most of the equipment necessary to obtain current and voltage data from experiments in a safe, easy, reliable manner. A completed breakout box significantly improves the efficiency of ALPE experiments.

AGET CYCLONE PERFORMANCE OPTIMIZATION
by: Brian Erhart, George Norg Jr., and Dana Wyckoff
Sponsor: AGET Manufacturing Company
    Rob DePierre
Faculty Advisor: William Liou, Ph.D.
10:30 a.m. – 10:55 a.m.

Many processes produce significant amounts of unwanted particles which can be harmful to humans, equipment, and facilities, and can also be the cause of spontaneous combustion if not properly collected and removed. Cyclone dust collectors have not been improved upon for nearly 40 years and thus there is much room for a redesign. A customized dust collector was used to collect CFM, ESP, velocity profiles, and horsepower data. This data was then compared to an analysis performed in ANSYS Fluent, whereupon a redesign of the dust collector was conceptualized and modeled on a small scale to demonstrate a more efficient and superior design.
EMERGENCY VOR CDI FOR GENERAL AVIATION
by: Quinten Bader, Alyssa Hartsig, Ross McMahan, and Ashley Rettich
Sponsor: None
Faculty Advisor: Peter Gustafson, Ph.D.
11:00 a.m. – 11:25 a.m.

A very high frequency omnidirectional range course deviation indicator (VOR CDI) is an aircraft instrument that helps a pilot navigate the airspace. The COR CDI is the predecessor to global positioning systems (GPS), but is still widely used in general aviation aircraft. Aircraft that use VOR CDI are equipped with two indicators; only one is required to fly. The Emergency VOR CDI for General Aviation is a low-cost, user-friendly, system that can help pilots navigate to safety in the event of a single VOR CDI failure. Integrating this system with a similarly built GPS (Stratux) would provide pilots with a complete low-cost emergency navigation system.

GAS TURBINE ACTIVE DEBRIS PROTECTION
by: Dillon Duquette, and Alifiya Josh
Sponsor: None
Faculty Advisor: William Liou, Ph.D.
11:30 a.m. – 11:55 a.m.

Gas Turbine engines have historically been susceptible to damage due to intake ingestion. Current solutions implement a passive design at the intake that degrades performance. An active intake protection uses sensors for frontal area scanning and an active barrier that deploys only in the case of oncoming debris. Performance analysis is done on a Jet Fuel Starter Turbine with a dynamometer and compared with open and passive intake protection solutions.

EXHAUST WASTE HEAT RECOVERY BY THERMOELECTRIC GENERATORS
by: Matthew Frank, and Matthew Habel
Sponsor: None
Faculty Advisor: HoSung Lee, Ph.D.
1:00 p.m. – 1:25 p.m.

The current cycle of the internal combustion engine has large amounts of exhaust waste heat. The goal of this project was to design and test a thermoelectric generator system to reclaim the waste exhaust heat energy created by a gasoline engine. A thermoelectric generator array was used in tandem to an optimized set of heat exchanger fin systems. The hot side heat exchanger fin system was designed to exploit conduction and convection to maximize the heat transfer. The cold side heat exchanger fin system was integrated with an auxiliary radiator and pump to optimize the heat transfer to increase the temperature difference across the thermoelectric array resulting in an optimized power output.
DEVELOPMENT OF A VALIDATED ENGINE SIMULATOR FOR HARDWARE-IN-THE-LOOP
by: Paul Schnitzenbaumer, and Bryan Shamasko
Sponsor: DENSO North American Foundation
Faculty Advisor: Claudia Fajardo-Hansford, Ph.D. and Richard Meyer, Ph.D.
1:30 p.m. – 1:55 p.m.

A high-fidelity engine simulation was developed for a 2015 Ford 5.0L Coyote engine utilizing GT-Power software. Testing equipment was researched while complex data acquisition was programmed and setup. The model was refined and correlated with benchmark data obtained from experimentation conducted in the WMU Automotive Systems Laboratory. This high-fidelity engine simulation will be used in both research optimization studies and as a learning tool for future undergraduate programs.

CONFORMAL COOLING DESIGN
by: Ethan Richards, and Robert Vella
Sponsor: DENSO Manufacturing Michigan Inc.
Joseph Worden
Faculty Advisors: Javier Montefort, Ph.D. and Jay Shoemaker
2:00 p.m. – 2:25 p.m.

Injection molding is the most common process used to produce plastic parts. The current conventional cooling design requires a relatively long cooling cycle time before the part can be ejected. 3D metal printing allows cooling channels to be designed parallel to the plastic allowing enhanced cooling in a shorter cycle time. A comparative analysis between actual molding conditions and Moldflow FEA predictions was done, and correlation was found. Based off this analysis, conformal cooling channels were designed using 3D CAD software and warp predictions at a shorter cycle time were made through FEA.

FLAT SPRING CHECK VALVE
by: Lauren Lamie, and Wesley Young
Sponsor: FEMA Corporation
Jerry Boza
Faculty Advisor: Peter Gustafson, Ph.D.
2:30 p.m. – 2:55 p.m.

The need for pressure control in the form of Check Valves and Relief Valves are important components in the design of hydraulic systems. However, for certain applications, size and flow constraints can create the need for alternative designs. For a customer specific design, restrictions and constraints were given and it was determined that a flat spring would be best utilized. After calculating the spring constant and orifice sizes, a flat spring check valve was designed and Finite Element Analysis (FEA) conducted. The design was then prototyped and tested and conclusions were made.
DESIGN OF A TEST TO MEASURE FLOWABILITY OF GREEN FOUNDRY SAND  
by: Kyle Howland, Elly Nyambane, and Michael Shirley  
Sponsor: WMU Foundry Casting  
Sam Ramrattan, Ph.D.  
Faculty Advisor: Sam Ramrattan, Ph.D.  
3:00 p.m. – 3:25 p.m.

The America Foundry Society is seeking an appropriate technique to measure flowability of green sand used in foundries. Two identical “Ripple” test plates were designed using SolidWorks and then fabricated. Each intricate design consists of three parts with slots of different heights as the sections widen and become longer. The two Ripple plates developed are for one at the bottom of the sand specimen and the second for the top of the sand specimen. A test specimen was achieved by riddling a known mass of green sand into a plate followed by squeezing the top plate applying a known pressure. This will help to detect how well the sand specimen fills and packs. The ratio of filling and packing was used to determine a Flowability Index for green sand. Tests were performed using various green sand samples differing in sizes, shapes, and additives.

MODEL BASED ENTERPRISE SOLUTION FOR MACHINE & TOOL  
by: Christopher Alexander, Dayland Bowser, and Travis Courtney  
Sponsor: DENSO Manufacturing Michigan, Inc.  
Brian Boylan  
Faculty Advisor: Pavel Ikonomov, Ph.D.  
3:30 p.m. – 3:55 p.m.

Many design groups currently use 2D CAD drawings to share product information and specifications by creating 3D model within a modeling software, then exporting that data to a 2D space where dimensions and annotations are created, attempting to communicate the product manufacturing information. Future design practices involve defining and maintaining product manufacturing information in 3D space, i.e. Model Based Enterprise. Critical inefficiencies in the traditional 2D design standard warrant the transition to a Model Based Enterprise. Following ASME Y14.41, a design standard has been created and analyzed for a developing Model Based Enterprise.

RESEARCH AND DEVELOPMENT OF A LOW-VACUUM-MOISTURE-REMOVAL (LVMR) SYSTEM FOR A MEDICAL MATTRESS  
by: Nathan Belson, Andrew Beltramo, and DeAngelo Haggen  
Sponsor: None  
Faculty Advisor: Parviz Merati, Ph.D.  
4:00 p.m. – 4:30 p.m.

Bedsore prevention is an essential feature in the design of medical mattresses. Small pores in durable mattress clothes have imposed limited moisture vapor removal caused by lowered desirable flow rates and humidity using the current Low-Air-Loss system. A Low Vacuum Moisture Removal (LVMR) system that can endure the micro-climate of medical mattresses was designed and tested in the Fluid Dynamics Lab. Completion of tests and design of the system will aid in future investigations and the feasibility of durable clothes in medical bed production.
REDUCING AERODYNAMIC NOISE OF WIND TURBINES
by: Justin Diep, Paul McKnight, and Ravi Orlewicz
Sponsor: None
Faculty Advisor: Bade Shrestha, Ph.D.
8:30 a.m. – 8:55 a.m.

Wind turbines provide renewable, clean energy from a simple principle of winds turning its turbine blades around a rotor. Energy produced from this method is almost ideally perfect, however; one complication is the excessive aerodynamic noise produced. The noise generated can reach as far as a couple kilometers, and to mitigate the disruption, a new airfoil geometry of the wind turbine blade was designed and analyzed via SolidWorks and ANSYS Fluent software, respectively. Furthermore, a prototype of the airfoil was manufactured by using a 3D printer and subjected to testing in a wind tunnel environment to confirm our analysis.

DESIGN OF A BIOGAS SEPARATOR AS A THREE-STAGE RADIAL COMPRESSOR
by: Sterling Fulton, John Knuth, and Jacob Westhouse
Sponsor: None
Faculty Advisor: Bade Shrestha, Ph.D.
9:00 a.m. – 9:25 a.m.

Biogas is used in some countries as a fuel for cooking and other uses, but is limited in its economic value. Since biogas contains primarily methane and carbon dioxide, a need exists to separate and purify the methane component into natural gas. A design for a three-stage compressor of radial type was created and analyzed to determine its suitability to be manufactured and used in a biogas separator.
LAND, AIR, SEA, ROBER (LASR) – UNMANNED VEHICLE
by: Joshua Gudenau, Corey Lee, and Gabriel Prescinotti Vivan
Sponsor: None
Faculty Advisor: William Liou, Ph.D.
9:30 a.m. – 9:55 a.m.

The presence of drones in our daily lives has become increasingly popular in the past few years. They can be used for a variety of different missions, including search and rescue, research, educational, entertainment, commercial, and military purposes. The addition of operational capabilities to these aerial systems represents the next step in the development of drones. Through combining different propulsion and directional control systems, one single vehicle that can successfully operate in four different environments has been developed. This model will allow operations that previously required multiple vehicles to be performed using one system.

PORTABLE BIOGAS SEPARATOR-HEAT EXCHANGER 2
by: Jeremy Barr, Kyle Brady, and Tyler Huffman
Sponsor: None
Faculty Advisors: Bade Shrestha, Ph.D. and Anilkumar Kosna
10:00 a.m. – 10:25 a.m.

Creating a device that is able to separate the components of Biogas, methane and carbon dioxide, will allow underdeveloped countries easy access to cheap, renewable energy as well as create a job market for both the manufacturers and the operators such a device. A three-dimensional model of a heat exchanger contained within the device was constructed using SolidWorks. In addition, a thermal transfer simulation was created using Ansys Workbench. These models provided the necessary information to properly design a heat exchanger that met the requirements.

DEVELOPMENT OF ATTITUDE DETERMINATION AND CONTROL SYSTEM FOR THE WALI SATELLITE
by: John Maceri, and Jordan Ruterbusch
Sponsor: Jennifer Hudson, Ph.D.
Faculty Advisor: Jennifer Hudson, Ph.D.
10:30 a.m. – 10:55 a.m.

The goal of this project is to design and develop the attitude determination and control system for WALI (Western Aerospace Launch Initiative) satellite. The design presented will use magnetorquers to control the satellite’s orientation for the duration of its mission. The mission being, to perform on-orbit electric propulsion device plasma plume diagnostics. A magnetorquer consists of electromagnetic coils that produce torque by interacting with the Earth’s magnetic field. An Arduino microcontroller will be programmed to control the current passing through the magnetorquer coils. A “B-Dot” algorithm will be used to achieve initial satellite de-tumble upon orbit entry.
FORCE VERSUS DISPLACEMENT TEST STAND
by: Drew Arndt, Andrew Fritchley, and Fabian Venegas
Sponsor: Humphrey Products
    David Phaneuf
Faculty Advisor: Muralidhar Ghantasala, Ph.D.
11:00 a.m. - 11:25 a.m.

Ensuring springs, solenoids, and friction forces meet design specifications is critical in many engineering environments. A lab test with high accuracy must be performed to provide this assurance. For this reason, a force vs. displacement measurement test stand was designed around a recycled frame. The design uses a strain-gauge load cell to measure force and a magnetic linear encoder to measure displacement. It allows operators to easily gather and store data for later use. Mechanical, electrical, and controls designs were completed, and the stand was built and qualified. The test stand allows engineers to validate their designs.

SINUSOIDAL COOLING GROOVE
by: Khyzar Tirmizi, and Zachariah Williams
Sponsor: Flowserve Co.
    Erich Stuedemann
Faculty Advisor: Javier Montefort, Ph.D.
11:30 a.m. – 11:55 a.m.

A sinusoidal cooling groove is a feature that can be added to a mechanical seal to improve liquid circulation under the inboard primary seal of a dual inline seal arrangement. Models of a mechanical seal with and without a sinusoidal groove were created using Ansys engineering software. These software models were validated in experimental laboratory testing in the Kalamazoo, Flowserve R & D Labs. With the software simulation data populated in an Excel spread sheet, a calculator was created to determine the fluid temperature between the sleeve and the primary seal faces in given operating conditions. Engineers can now properly determine if a sinusoidal cooling groove will need to be added or can be left out of the final seal design.

LOW COST CONTROL SYSTEMS LAB: GANTRY CRANE
by: Adam Cruse, Brent Schneider, and Daniel Smith
Sponsor: None
Faculty Advisor: Richard Meyer, Ph.D.
1:00 p.m. – 1:25 p.m.

Premade control systems labs are expensive. To reduce costs, a gantry crane load position control lab was designed to take advantage of the 3D printing and Arduino control boards. To ensure low cost and for it to best fit any controls class, the lab was designed to be modular and use standard parts, allowing for inexpensive repairs and easy modifications. The resulting lab experiment requires the student to move the gantry and its hanging load from an initial position to a desired final load position. The lab hardware and control software allows students to demonstrate realistic position control using control method’s taught in undergraduate and graduate classes.
STRUCTURAL REINFORCEMENT OF STREAMLINE TUBING
by: Peter Grohs, Chuyle Hang, and Ben Merchant
Sponsor: SC Enterprise
    Scot Copeland
Faculty Advisors: Richard Hathaway, Ph.D. and Bade Shrestha, Ph.D.
1:30 p.m. – 1:55 p.m.

Structural integrity of suspension components is important to the safety and longevity of vehicles. Streamline tubing, an aerodynamically shaped material used for high performance vehicle suspension control arms, is prone to structural failure. The component was redesigned as a composite structure using modern materials to make a highly aerodynamic product lighter, stiffer, and stronger than a conventional all steel design. Finite element analysis was conducted and prototypes were constructed and tested. This method of maximizing component lightness and stiffness using the beneficial properties of each material contributed to a design which optimized costs while achieving set goals.

AUTOMATED UTENSIL WRAPPER
by: Austin Key, Alec Tussey, and Joshua Volk
Sponsor: SRS Pharmacy Systems
    Jim Tussey
Faculty Advisor: Richard Meyer, Ph.D.
2:00 p.m. – 2:25 p.m.

The Automated Utensil Wrapper machine wraps utensils in napkins eliminating the need for hand wrapping utensils. The Automated Utensil Wrapper provides a solution to inefficient restaurant operations by automating the process and requiring only minimal time loading the machine. Restaurant owners say that the product will be competitive if the retail price stays below $3,000 while the Automated Utensil Wrapper was designed and built for approximately $800. Using Arduino robotics to automate the machine, the Automated Utensil Wrapper is capable of fulfilling the market need while being financially viable.

POWERING STEEL CONVEYOR ROLLERS
by: Jordan Boothby, and Daniel Karsten
Sponsor: None
Faculty Advisor: Jinseok Kim, Ph.D.
2:30 p.m. – 2:55 p.m.

Moving heavy objects by hands can cause joint or muscle injuries, even if the objects are on conveyor rollers to assist motion. A model system showing this was designed to prevent human injuries during conveying heavy objects. This system was then fitted with a way to power the rollers, without changing the interaction between the rollers and the objects. This was modeled in Solidworks as well as a physical prototype, each used for testing. The data gathered from the testing was used to project power/torque requirements needed at the rollers for varying object weight.
ELECTROMAGNETIC RADIATION SHIELD FOR SPACECRAFT
by: Robert Hallenbeck, and Oseas Benjamin Hudy-Velasco
Sponsor: None
Faculty Advisor: Kristina Lemmer, Ph.D.
3:00 p.m. – 3:25 p.m.

During space travel, astronauts are exposed to dangerous ambient radiation. An electromagnetic radiation shield was built using superconducting wire, simulated with the multi-physics software COMSOL, and validated with real-world tests. As electric current passes through the superconducting wire, it induces a strong magnetic field that deflects the high-energy charged particles that comprise the most dangerous radiation in space. The radiation shield will be used to protect astronauts from harmful radiation during long duration missions outside of the Earth’s magnetic field. Radiation detectors placed behind the device recorded the amount of radiation that managed to penetrate the shield.

REINFORCED TAILGATE HINGE FOR JEEP WRANGLER
by: Sean Kade, Joseph Kalich, and Blair LaCross
Sponsor: SAGARIS GROUP INC
Alexandru Risca
Faculty Advisor: Daniel Kujawski, Ph.D.
3:30 p.m. – 3:55 p.m.

The Jeep Wrangler is a capable and popular vehicle used daily by a large number of people for off-road and on-road use. A common complaint that is noted by a large amount of Jeep Wrangler owners is the weak tailgate hinge. This hinge must support the weight of the spare tire, and often fails causing a loud rattle and an inability to utilize the tailgate. A prototype hinge was created which allows the owner to carry up to a 37” spare tire on the rear tailgate without additional modifications to the rear bumper.

CUSTOMIZABLE WHEELCHAIR BRACKET
by: Emily Gruss, Melissa Maher, and Alec Rossi
Sponsor: None
Faculty Advisor: Daniel Kujawski, Ph.D.
4:00 p.m. – 4:25 p.m.

Wheelchair accessories are a major market in the United States, including customizable features that increase the independence of wheelchair users. A universal bracket was designed to allow wheelchair users to quickly and easily change accessories depending on variable daily needs. The bracket system was designed using SolidWorks and a prototype was created to show the final look and feel of the product. Materials for the final product were selected to maintain structural stability and competitive pricing compared to existing wheelchair accessories. The final product is a practical and affordable solution to quickly and easily change accessories for any mobility-aiding chair.
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