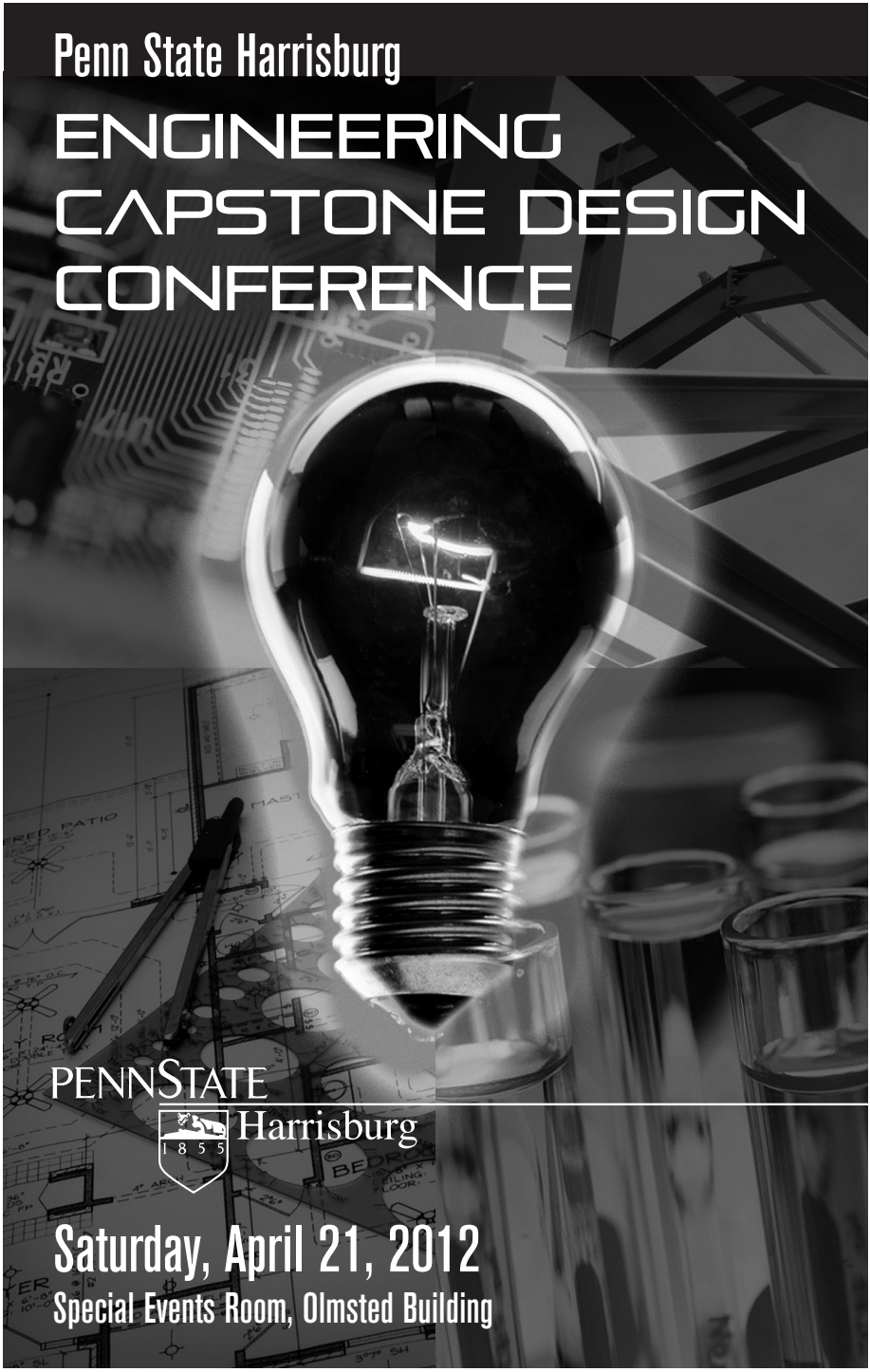
Penn State Harrisburg

ENGINEERING CAPSTONE DESIGN CONFERENCE



PENNSTATE Harrisburg 1855

Saturday, April 21, 2012

Special Events Room, Olmsted Building

ENGINEERING CAPSTONE DESIGN CONFERENCE

SCHEDULE OF EVENTS

8:00 a.m.	**Breakfast**
8:30 a.m.	**Featured Speaker:** Dennis Butler, Patent Attorney, Panitch, Schwarze, Belisario and Nadel LLP in Philadelphia
9:00 a.m.	**Presentations Begin** **Special Events Room, Olmsted Building**
9:30 a.m.	**C-211, Olmsted Building** 10:45 a.m. – 20 Minute Break 11:05 a.m.-12:40 p.m.
	E-253, Olmsted Building 10:45 a.m. – 20 Minute Break 11:05 a.m.-12:40 p.m.
	E-261, Olmsted Building 10:45 a.m. – 20 Minute Break 11:05 a.m. -12:20 p.m.
	E-265, Olmsted Building 10:45 a.m. – 20 Minute Break 11:05 -11:50 a.m.

After presentations, attendees may view projects in the mechanical engineering lab (Engineering Technology Laboratory Building) and the electrical engineering lab (Room 213, Olmsted Building)

FEATURED SPEAKER

Dennis Butler

Patent Attorney, Panitch, Schwarze, Belisario and Nadel LLP in Philadelphia.

Butler graduated from Penn State Harrisburg in 1993 with a bachelor's degree in Mechanical Engineering Technology; he went on to get a master's degree in Engineering Mechanics from University Park. After many years with Boeing and Synthse, he earned a law degree from Temple University. He specializes in intellectual property and technology law. He and his wife Haley established an award in Mechanical Engineering for technology internships.

SPECIAL EVENTS ROOM, OLMSTED BUILDING

9:00 a.m.

Project: **Vehicle Fire Suppression System**
Group Members: **Kevin Dalbey, Bryson Sheaffer, and Theresa Bowie**
Project Advisor: **Dr. Abu-Mahfouz and Dr. Jula**
Description: A prototype vehicle fire suppression system (VFSS) is to be used within the small vehicle racing community. This system would prevent driver-related burning as well as damage to the vehicle beyond what is normally associated with a fire accident. The system will trigger via hard-wired switches in the cabin and on the exterior of the vehicle, a remote trigger system, and an autonomous sensor. These overlapping fail-safe systems will give the vehicle's driver the opportunity to turn his focus to extrication during an accident rather than being concerned with locating an extinguisher and manually putting the fire out. In addition the inclusion of an autonomous sensor that will trigger the system based on preset parameters can ensure any fire in the engine bay or fuel cell can be extinguished in its early stages, saving emergency response personnel from having to battle fully-developed fires after the accident.

C-211, OLMSTED BUILDING

9:30 a.m.

Project: **Fluid Flow Channel**
Group Members: **Eric Dotson and Stefan Eshleman**
Project Advisor: **Dr. Abu-Mahfouz**
Description: The objective of this project is to develop a water channel laboratory teaching tool. The purpose is to enable the demonstration and testing of fluid dynamic concepts, such as internal flow, drag and left, open channel flow, laminar and turbulent flow characteristics, volumetric flow rate measurements and calculations, and the investigation of pressure-velocity relationships.

9:55 a.m.

Project: **Micro Hydro Laboratory Unit**
Group Members: **Jacob Elston, Ryan Sutkowski, Stuart Johnson, Mark Bruening, and Joseph Dellario.**
Project Advisor: **Dr. Abu-Mahfouz**
Description: A modular hydro generator is to be developed for the purpose of education and research. To this time, a modular device is not known to exist as a readily available and purchasable product. The hydro generator will be used to show the effect of a change in head, velocity and flow rate upon each of the three most common turbine designs. The three turbines which will be utilized in the modular design of the hydro generator are the Francis, the Pelton, and the Kaplan. A reduction of cost in manufacturing may occur from the use of modular parts. The possibility of mass production could be realized if the design is feasible and a high market demand for such a renewable energy resource exists.

10:20 a.m.

Project: **Process Control Trainer**
Group Members: **Kwabena Obeng and Philip Belle**
Project Advisor: **Dr. Abu-Mahfouz**
Description: The process control simulator consists of pumps, solenoid valves, piping system, and four process tanks (such as mixing, heating and level control). Various sensors, switches, and different levels of embedded and computer-based controllers can be implemented with this system. Currently a programmable logic controller (PLC) unit is selected. Classical experiments for tank level control, including 1-tank, 2-tank, 3-tank and 4-tank systems, can be set up and monitored. In addition, mixing processes such as pH control, heating and/or cooling using a radiator or a cross flow heat exchanger can be implemented using this versatile process simulator.

10:45 a.m. – 20 Minute Break

11:05 a.m.

Project: **Design of an Autonomous Follower**
Members: **Mark Brubaker and Alex Mukam Soh**
Project Advisor: **Dr. Banerjee**

Description: The objective is to develop a small robotic vehicle with autonomous following capabilities. The robot will be robust and have the mobility to travel on small rocks and grassy fields. It is built mainly using different components from the RC vehicle industry as well as other metal and electrical sensor/components. A programmed microcontroller is used to process information from different components and control the speed of the servomotors, thereby controlling the motion and direction of the robot. Two different autonomous following systems were investigated: one using multiple infrared sensors, and another using loop antennas coupled with the fundamentals of radio frequency direction finding (RFDF) theory. A clear line of sight is needed for the robot to autonomously follow using the infrared sensors, and the later RFDF system needs a transmitter attached to the object being followed for the robot to follow autonomously. The robot also uses sonar and bump sensors to avoid obstacles in its path.

11:30 a.m.

Project: **Design of a Collapsible Quadrotor Capable of Lifting a Payload**
Members: **Chris Pierce, James Moll, Toren Hall, and Derek Colton**
Project Advisor: **Dr. Banerjee**

Description: The objective is to design and build a remote-controlled, portable, collapsible VTOL (Vertical Take Off and Landing) capable unmanned aerial vehicle (UAV) that fits into a backpack. The unit will be deployable by a small field team to perform aerial surveillance and lift/transport a payload of more than five pounds. It will be a quad-rotor design to facilitate stability and ease of operation. The frame of the helicopter will be primarily aluminum tubing with an ABS plastic central housing for the controlling electronics. To perform surveillance the UAV will be equipped with an on-board tilt and pan camera streaming live video to the controller. The unit will be equipped with a servo-controlled robot gripper to lift and transport a payload.

11:55 a.m.

Project: **Green Electrolysis Hydrogen Production System**
Members: **William Geist, Brent Goda, and Anthony Valerio**
Project Advisor: **Dr. Banerjee**

Description: Hydrogen recombination in fuel cells proves to be a green alternative to the combustion of fossil fuels. There are methods that are currently used in the production of hydrogen that are capable of high production rates, but most methods also produce some of the same harmful byproducts as combustion of fossil fuels. A greener method of producing hydrogen is with an electrolysis reaction. The goal of this project is to address many of the issues involving hydrogen production in an environmentally-conscious manner in hopes of making electrolysis hydrogen production a viable alternative to the use of fossil fuels. The three main objectives of the project are: (1) utilization of sustainable energy sources to drive the electrolysis reaction, (2) use of an electrode material which is cheaper and more readily available than platinum, and (3) use of a safe and non-polluting electrolyte mixture. The system will include components such as an energy source, an electrolysis cell, a purification system, a spark-less pump, storage tank, electrical control system and a frame.

12:20 p.m.

Project: **Moving Soccer Goalie Target**
Group members: **Robin Chakraborty and Daniel Francis**
Project Advisor: **Dr. Abu-Ayyad**

Description: The objective of our project is to improve the technology and practice methods in the game of soccer. In this day, almost every physical sport has methods of training to help improve the performance of the players. Basketball has a shoot away machine which allows players to practice shots, and football has passing machines. However, in soccer, there are not many instruments that can help improve the practice and performance of players. The purpose of our project is to build a moving target which can fit in a wide range of goals. The target will measure accuracy and force/speed of a recorded measurement. In this project, an electric motor-powered device will be attached to the cross bar of a soccer goal. The device will be made from a garage door opener, which is based on remote control. An adjustable vertical pipe will attach the rotating assembly to the target which hangs in the goal mouth.

E-253, OLMSTED BUILDING

9:30 a.m.

Project: **Solar Pond Project**
Group members: **Tyler Forsyth, Matthew Hockensmith, Brian Loughman, and Bryan Shaub**
Project Advisor: **Dr. Abu-Ayyad**

Description: The goal is to replace an expensive AC pump used to run a waterfall and filtration system in a Koi pond with an equivalent 12v DC pump and photovoltaic array which will provide power from the sun. Excess energy from the array will be stored in deep cycle batteries and will be used to power the pump during off-peak times such as night time and on cloudy days. The system installed will be used to power the pump through all non-winter months and should be easily expandable to power other home applications in the future. While the initial costs are high for solar systems, we estimate that this application will have a significantly shorter payback period (two to four years) because of how inefficiently the original pump consumed power.

9:55 a.m.

Project: **SAE Baja Car**
Group Members: **Jason Newswanger, Chris Brucker, Muhamed Jaffal, Brad Getz and Colin Minnick**
Project Advisor: **Dr. Bal**

Description: The objective of this project is to reengineer our Baja car to make it perform optimally. The car currently has many suspension issues and is completely nonfunctional. The front suspension needs to be redone with performance in mind. We will need to consider Ackerman, caster, camber, and toe angles to get the front suspension to work properly. The engine will need to be mounted, chain tensioning system designed, and the vehicle fully plumbed and wired. The engines that normally power Baja cars are 10 hp Briggs and Stratton. Our Baja car will have a Polaris 500 ATV engine that will produce 35 hp and a five-speed manual transmission. Associated with the engine swap is the reconfiguring cooling system, connecting the controls for the throttle, clutch and transmission.

10:20 a.m.

Project: **Mini Bike with Treads**
Group members: **Erik Juergensen, Andrew Mattei, Seth Matthijssen, Grant Sheaffer, and Martin Levan**
Project Advisor: **Dr. Abu-Ayyad**
Description: The group was tasked with the complete design and manufacture of a tracked vehicle to be a reflection of the team's combined education and experience. The team realized that this was the perfect capstone project, as nearly all of the fundamentals of mechanical design are embodied within a motor drive vehicle. The primary objective is to design a vehicle that will provide maximum traction across adverse terrain conditions, while using low-cost commercially-available or recycled items for a collective project budget of less than $1,000. With a broad scope of work including preliminary layouts, engineering analysis, detailed drawings, specifications, and physical construction – project management is key to ensure each team member assumes full responsibility for a successful and timely completion of the product.

10:45 a.m. – 20 Minute Break

11:05 a.m.

Project: **Auto-Assistant Clutch**
Group members: **Michael Carter, Joval Shamsoum, and Steven Georges**
Project Advisor: **Dr. Abu-Ayyad**
Description: This project involves the possibilities of handicapped drivers operating a motor vehicle far beyond their own limitations. The goal is to show how an electronically-controlled clutch system can be viewed as a permanent solution to improving the driver's quality of life. For individuals that have long-term disability or suddenly become disabled, the Auto-Assistant Clutch allows them to keep their favorite sports car, maintain their job, or generally make their dreams a reality. Such technology provides that "wind in your hair" feeling for any driver. The completion of this experiment will not only propose a solution for disabled people to operate a motor vehicle, but it will also lead to endless possibilities for the future.

11:30 a.m.

Project: **Portable Battery Charging Station**
Group Members: **Mike Sabol, Stephanie White, Taylor Newton, and Adam Sholtis**
Project Advisor: **Dr. Bal**
Description: The project is a portable battery charging station that uses both solar and wind energy to recharge batteries. The base of our project is a small trailer that can be hitched to a tractor or four-wheeler-type vehicle or transported on an actual towing trailer. On top of the trailer the telescopic wind turbine is mounted and secured. When operating, the wind turbine extends 10 feet off the ground; when in travel/storage state, the wind turbine collapses and then folds down to rest on the trailer (reducing the height to about three and a half feet off the ground). Each battery is charged by both the solar and wind energy which helps decrease charge time.

11:55 a.m.

Project: **Trebuchet**
Group Members: **Carl Rudy, Ryan Grove, Transtan Stoner, and Chad Sprangler**
Project Advisor: **Dr. Bal**
Description: The objective is to launch an 8-10 pound object at least 100 feet using 500 pounds of counterweight. We first constructed a small scale trebuchet to experiment with and learn from before constructing the full-scale model. From the small-scale prototype (3ft. high at axle with arm length of 4.5ft.), we determined the best arm and sling ratio for our trebuchet. We will now build our full scale

model using the same arm and sling ratios from our small scale. Our full scale model will be 8ft high at the axle with a total arm length of 14 ft. Our small scale model threw a 1.5 lb object more than 100 feet.

12:20 p.m.

Project: **Three-Wheeled Recreational Vehicle**
Group Members: **Matt Cornwell, Josh Miller, Zach Gross, and Andy Myers**
Project Advisor: **Dr. Bal**
Description: The goal of this project was to convert an existing snowmobile into a three-wheeled vehicle for off-road use. Major design modifications include a front and rear suspension, steering, and drive train assemblies. The final product is an effective design with all-terrain capability at an affordable price.

E-261, OLMSTED BUILDING

9:30 a.m.

Project: **Aircraft Icing Sensor**
Group Members: **Greg Scarborough and Sean Kessler**
Project Advisor: **Dr. Morales**
Description: On average, there are 30 reported airframe icing incidents per year, resulting in 50 individual fatalities from airplane accidents. The current technology pilots use to warn them of airframe icing is insufficient because the average number of fatalities per year due to icing has been constant for over twenty years. Our project, the Aircraft Icing Sensor, aims to decrease the number of fatalities by providing privately-owned aircraft pilots with an onboard ice sensor and warning system. By utilizing the Zigbee wireless protocol and encrypting our data via the Advanced Encryption Standard, we will be able to provide pilots with an economical and efficient solution to this problem.

9:55 a.m.

Project: Pedicure **Tub Controller**
Group Members: **Daniel Nguyen and Kanwarvir Mundi**
Project Advisor: **Dr. Wolpert**
Description: According to the 2011 Professional Salon Industry Haircare Study from Professional Consultants & Resources, total revenues for all salon industry services (hair, skin, nails) plus salon retail grew at a robust 4.2 percent in 2011 to $72.41 billion. The Pedicure Tub Controller will add to this growth, especially in the spa salon market. Using sensors and a microcontroller to read the water temperature and water level, the controller will adjust the water going into the tub. The controller will assist salon owners and pedicure technicians by allowing them to focus on providing quality service. Furthermore, it will allow user input so a client or technician is able to set the water level and water temperature desired. This product will meet all electrical safety standards and be safe to use in a salon environment. Automating the water level and temperature control will make life easier for the technician and, thus, enhance customers' experience.

10:20 a.m.

Project: **DJ Controller**
Group Member: **Kelly Martinez**
Project Advisor: **Dr. Wolpert**
Description: DJ Controller units for disc jockeys in the club environment have become vastly popular over the past decade. Companies such as Numark, Vestax, and Native Instruments are leading the charge in developing the latest controllers to meet DJ needs. However, the latest controllers miss the mark when it comes to enabling DJ creativity. Several disc jockeys, controllerists, and audio engineers

have called for a DJ controller with functions that would allow increased DJ creative control and more useful control organization that are not implemented by commercially available models. The objective of this project is to design and build a MIDI device that will provide disc jockeys with components that allow more creativity while not sacrificing professionalism, organization, and accuracy to optimize DJ performance in a club environment. Utilizing a microcontroller board to connect a variety of components including motorized potentiometers, touch sensitive sensors, and displays to DJ software using the MIDI standard, the DJ Controller will provide disc jockeys with an ideal tool for an optimal live performance.

10:45 a.m. – 20 Minute Break

11:05 a.m.

Project: **M12 Connector Specifications**
Group Member: **Steven Blasko**
Project Advisor: **Dr. Morales and Linda Shields, TE Connectivity**
Description: The IEC standard body is attempting to develop an industrial connector that is well defined electrically so that one company's plug can be mated with another company's jack resulting in net equivalent-mated electrical performance. In order to accomplish this result, both the mated performance and the plug-only performance are being fully defined electrically in the standard so that all companies can manufacture electrically inter-mate able connector pieces. The project entails a creative way of applying a form of testing used for RJ45 connectors to the testing of M12 connectors. Circuit boards are to be designed along with the creation of templates in ADS for future use.

11:30 a.m.

Project: **Wireless Building Automation Sensor Interfaces**
Group Member: **Clinton Hommel**
Project Advisor: **Professor Ebel and Garrett Schmidt, Phoenix Contact**
Description: The proposed product would allow sensor and control integration to be drastically simplified by eliminating point-to-point wiring. From a functional standpoint, this product will communicate information wirelessly to and from a generic automation controller. It will provide several digital and analog I/O connections for the control of relays and other electro-mechanical devices. Essentially, the product will be an easily-mounted, battery-operated, low cost communication link that can be installed virtually anywhere to provide real-time feedback and easy integration of the various components involved in the automation of a structure.

11:55 a.m.

Project: **Location and Display of Workers Near Heavy Equipment**
Group Members: **Zach Bahr and Ronald Scott**
Project Advisor: **Dr. Gray, Dr. Jula and Rich Van, Volvo**
Description: The project will focus on the process of paving roads, one of the most dangerous jobs in existence. One of the main components needed to complete the process is the compactor, or steam-roller. A compactor is a machine used to flatten, or compact, asphalt as it is dispersed onto the road. Depending on the size of the road crew, there are approximately 5 to 10 ground workers, working within a close perimeter of the machine. These workers are risking their lives on a daily basis working so close to the heavy vehicle. With the use of radio frequency identification (RFID) technology, each worker could be accurately identified.

This system will monitor the displacement of each worker as they enter a hazardous area, as well as notify the compactor operator of the workers location, allowing the operator ample time to respond

to the situation as necessary. Since the operator's chair on a compactor is rotational, an easy-to-read display screen will be in front of the operator at all times. The operator's display will be able to differentiate between workers who are within close range and workers in a hazardous area. Both sides of the compactor will have a detection system. All ground workers will have an RFID tag embedded in their safety vests and on their hardhats, which will be read by an antenna. The identification, of the ground workers tag that is detected will be sent back to the reader and subsequentially to the operators display, thus reducing the amount of work-related injuries and fatalities during the paving process.

E-265, OLMSTED BUILDING

9:30 a.m.

Project: **Electronic CodeBreaker**
Group Member: **Alexandra Ryder**
Project Advisor: **Professor Grotzinger**
Description: Electronic CodeBreaker is a new twist on a classic board game. Players must use strategy and problem-solving skills to see if they can outsmart the microprocessor by correctly guessing the code of four colored lights. This is a one-player game for children ages eight and above, but it's fun for adults too! CodeBreaker is similar to Mastermind, the traditional game of logic and deduction, but in a form that has never been seen before. This electronic version uses fun LED lights and buttons, and is ideal for travel since there are no longer any small parts to lose.

9:55 a.m.

Project: **Impaired Driver Lock-out System**
Group Members: **Vladimir Khodus and Christopher Kocuba**
Project Advisor: **Dr. Gray**
Description: One person dies every 40 minutes due to impaired driving. This is a major problem, and today's technology can help prevent these unnecessary deaths. Using a new approach, not only can we save lives but prevent them from ever being at risk. The Impaired Driver Project is designed to prevent impaired drivers from operating their motor vehicles, using a smartphone application, a Bluetooth transceiver, and a circuit on the vehicle's ignition line. The user's execution of the impairment test application will determine if the vehicle can be operated. Utilizing modern touchscreen phones to implement this idea will allow costs to be cut when compared to traditional breathalyzer systems. In this project, the term "impaired" is defined as "those under the influence of drugs or alcohol" but extends to "those whose motor skills are degraded by age or medical reasons."

10:20 a.m.

Project: **Controllable Vehicle Window Tinting**
Group Members: **Matthew Cooper and Pedro Paulino**
Project Advisor: **Dr. Gray**
Description: Controllable Vehicle Window Tinting allows a driver to adjust window transparency based on driving conditions. Automobile window tinting is a popular choice among drivers because it offers many benefits for everyone inside the automobile. However, many states regulate light transparency since it limits visibility into the vehicle from outside. Therefore, implementing the Controllable Vehicle Window Tinting project will provide protection to drivers without reducing the safety of law enforcement personnel. Also, since the state regulated transparency levels differ widely, controllable tinting allows compliance while traveling from state-to-state. Using polymer dispersed liquid crystal devices (PDLCs) technology this project will allow drivers to control the tint level on each window to a comfortable level while complying with state laws.

10:45 a.m. – 20 Minute Break

11:05 a.m.

Project: **Firefighter Finder**
Group Members: **James Farley, Kristofer Knittle, and Hisham Beshir**
Project Advisor: **Dr. Gray and Dr. Wolpert**

Description: Firefighters risk their lives every time they enter a burning building. Over 50 percent of firefighter deaths at a call-out are due to heart attack. The Firefighter Finder allows the watch command to monitor each individual's biometrics, and when tragedy strikes, pinpoint the exact location of the firefighter. Each firefighter will wear a device that uses differential inertial navigation to locate the individual and monitors heart rate, temperature and oxygen (O2). This information is transmitted to the command station via text messaging from a phone (which the firefighters already carry). The focus of this part of the project is the INS and the O2 sensing.

11:30 a.m.

Project: **Smart House**
Group Members: **Kyle Younker and Gordon Allen**
Project Advisor: **Dr. Agili**

Description: In today's world, technology is continuously growing and is used in everything we do. For the most part, technology helps make our lives easier - which is something that everyone would like to have for their homes. The Smart House System will allow control of different basic functions, appliances, and electronics from multiple mobile devices – phones or tablets – bringing simplicity, energy efficiency, convenience, and safety to the home. Since the central control devices can roam with the occupants, the system helps the disabled as well as the busy and the energy conscious. The mobility of the control devices is the innovation being introduced. The system prototype will control lighting and HVAC in a model house, but many other systems and appliances could be added.

SPONSOR A PROJECT

The purpose of the capstone design engineering project is to help bring the real-world into the classroom by providing engineering students with practical, hands-on experience.

PARTNERSHIPS WITH INDUSTRY- WIN-WIN

This program was instituted at the urging of our industry partners, who recognize the need for graduates who are well-trained in engineering fundamentals, as well as professional skills to effectively compete in today's marketplace, such as teamwork, project management, cross-functional networking, communications, and design.

For small companies, capstone design engineering project teams can be a boost to their engineering workforce. For larger companies, these teams are helping develop new ideas or improving current practices, both of which can impact a company's bottom line.

Cooperative projects are a great way for companies to get to know students when looking for new employees and also helpful in training junior-level engineers and managers by providing project management experience in a low cost, low risk, potentially high pay-off setting.

SPONSOR BENEFITS

Some of the benefits of sponsoring a Capstone Design Engineering Project are:

1. Low-risk, low-cost investment with high potential ROI (return on investment)
2. Work on "back burner" projects and help refine ideas
3. Help start-up and small companies with prototyping and development work (while fleshing out a business plan through collaboration with a team of business students)
4. Direct access to some of the best Penn State students (15-week interview)
5. Newly hired employees (i.e., Penn State students) are better trained as a result
6. Company liaison overseeing the project gains valuable project management experience
7. Increase your company's brand awareness among Penn State students and faculty
8. Entry point (and guide) into the Penn State network
9. Network with other companies through events and cross-promotions
10. Opportunity to give back to the college and influence the education and careers of many students

SPONSOR RESPONSIBILITIES

Sponsors are expected to make a tax deductible contribution of $2,500, submit a proposal explaining the scope of the project, identify an industry liaison to serve as the team's point of contact for the project, interact regularly with the student team, review reports and provide feedback, and evaluate the students' performance at the Capstone Design Conference.

ADDITIONAL DETAILS

For additional information and details on how sponsoring projects can work for your company, please contact the Penn State Harrisburg Development Office at 717-948-6316.

Penn State Harrisburg

would like to thank the following companies for their sponsorship and/or contributions to this year's capstone projects.

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