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ELECTRICAL AND COMPUTER ENGINEERING

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1801
SPONSOR: Sikorsky
ADVISOR: Ashwin Dani

Group members front left: Xinkang Chen, Malcom Lopez, Hahyeong Kim, Krishnan Sureshkumar

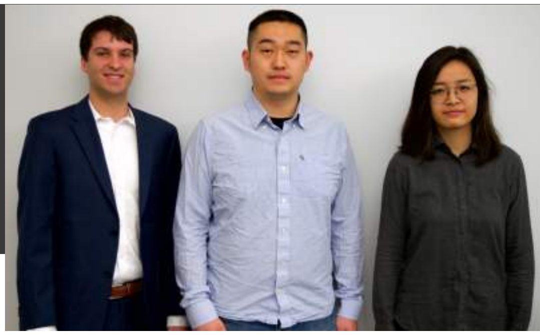
Autonomous Firefighting Drone

SIKORSKY
A LOCKHEED MARTIN COMPANY

Aside from military and transportation purposes, helicopters are used for fire aviation to deliver a payload of fire retardant. However, helicopters operated by pilots run the risk of becoming distracted, incapable of operating the drone/vehicle, or being unable to avoid an incoming obstacle. Therefore, situations like these might cause helicopters to become damaged and lead to casualties without accomplishing the objective to extinguish the fire. In order to eliminate these obstacles and increase the efficiency of fighting fire, we can integrate autonomous features of both obstacle avoidance and fire-fighting capabilities into the helicopter.

Over the recent years, the usage of drones has increased greatly both for military and commercial use. We plan on modifying a commercially available drone with an autonomous obstacle avoidance system and firefighting system to be used as a small-scale version of a helicopter for future use.

A commercially available drone will be integrated with sensors and a water propulsion system to transform the drone into an autonomous firefighting vehicle. There will be two main types of sensors used in this project. The first set is mainly used for obstacle detection and avoidance while the second type of sensor will be used for flame detection. The goal of the drone is to be able to move, avoiding any obstacles along the way. Once it has detected a flame, the drone will reposition itself so that it can deploy the water propellant system to extinguish the flame. The development of this system will serve as a test case which can then be integrated into larger scale systems at the decision of the project sponsor Sikorsky Aircraft.

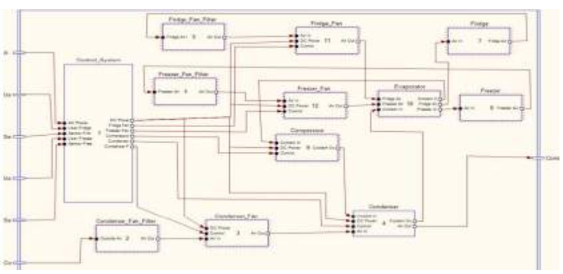


Left to Right: Noah Jordan, Minglei Cai, Yi Shu.

TEAM: 1802
SPONSOR: Qualtech Systems Inc.
ADVISOR: Shengli Zhou

Power Systems Diagnostic Model

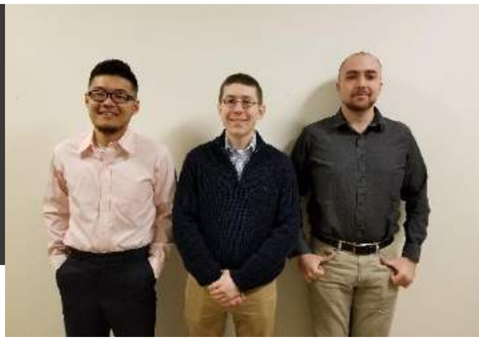
QSI
QUALTECH SYSTEMS INC.



Systems simulation for design and analysis is an import part of modern engineering. Currently there are several software packages that allow engineers to simulate complex systems, and test them under different conditions. One such software package is the TEAMS Design Suite from Qualtech Systems Inc (QSI). QSI is a Connecticut-based company founded by University of Connecticut alumni and faculty around the creation of TEAMS. Like Simulink, TEAMS is used for systems analysis, however it provides users with a detailed view of system faults and failure modes. The TEAMS (Testability, Engineering and Maintenance System) Software Suite is a set of system-modeling tools focused on automating system fault testing and detection. TEAMS software is utilized by test engineers to model possible failure modes of a system, allowing them to monitor individual components based on the system's outputs. The overall goal of this project is to translate system fault to test relationship from Simulink to TEAMS.

In order to accomplish this goal our project focuses on creating a method to test a Simulink model's output response given certain internal component failures. With data explaining how a component failure changes a system's output, a diagnosis can be made on the relative health of the system. This can be done through designing tests for a system's outputs. Ideally, failure of any combination of tests will allow us to identify specific components which operating in a state of failure. This fault to test relationship can then be expressed in a proprietary XML (eXtensible Markup Language) format which can be loaded directly to the TEAMS suite.

Our prototype software is being designed around a NASA testbed model built in Simulink. The Advanced Diagnostic and Prognostic Testbed or Virtual ADAPT model "...is functionally representative of an electrical power system (EPS) on an exploration vehicle…" Our team, as well as the sponsor, believe that the Virtual ADAPT model offers enough complexity to create a more generic solution once a prototype is completed. The Virtual ADAPT model also offers an avenue to inject component faults through a user interface. This allows us to automate component fault injection in MATLAB, and run simulations on the model for relatively large input data sets. Once the prototype process is completed, we hope to apply it to other Simulink models.



From Left to Right: Yuansong Liu, Daniel Dabkowski, John Brousseau

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1803
SPONSOR: Lenze Americas
ADVISOR: Dr. Ali Bazzi

3 Level Inverter, 1700 Volt Switching

Inverters are electrical devices which convert Direct Current signals to Alternating Current. Lenze manufactures inverters in variable frequency drives (VFDs) for a market in the US and Canada which uses 600 Volts RMS systems. These inverters once used transistors rated for 1400 Volts, but these are no longer available. Our task is to use two 1200 Volt transistors in series to share the voltage, in order to achieve the proper voltage rating. These two transistors are to be controlled using only one control signal, to allow Lenze to use previous two-level inverter switching algorithms with the new design. This allows the benefit of a robust design without using expensive and slow 1700 Volt transistors, and prevents the need to design a new three-level switching algorithm.

The main challenge with this task is the importance of timing the two transistors to switch simultaneously. If one transistor in a pair turns on or off slightly before the other transistor, this causes the entire voltage blocking stress to fall on one transistor. If this happens repeatedly, overheating and component failure will occur.

Two solutions are proposed. One method involves using an external capacitor between the gate and ground of the top transistor in a pair. This method enables two transistors to be switched with only one input signal, and prevents overvoltage conditions due to uneven transistor switching. Another major advantage is the simplicity of the circuit, as it only requires seven passive components per transistor pair. The second solution is logic-based and uses external logic gates to generate sequenced switching signals for each transistor to prevent overvoltage conditions. The advantage of this method that it can be implemented within the microcontroller in the VFD. Both approaches have the benefit of simplicity and robustness, and may be implemented together to provide two levels of protection from transistor overvoltage.

The inverter circuit is to be proven to work in simulations at 850 Volt DC input, powering a 3 horsepower motor. The PCB inverter circuit will work at in input voltage of 240 Volts, power a 3 horsepower motor, and interface with a provided Lenze VFD. The circuit will also be testing at higher input voltages, to ensure feasibility at the voltage conditions the variable frequency drives are used in the market.

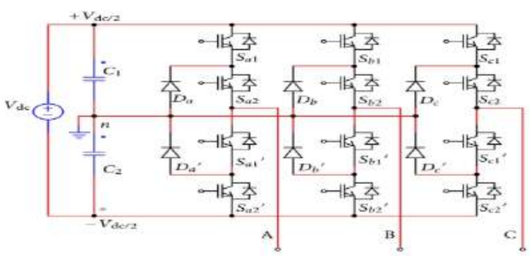


Figure 1. Three Level Inverter Layout

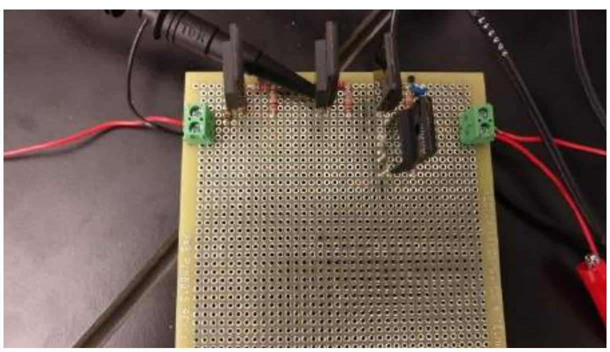


Figure 2. One Phase Leg Prototype

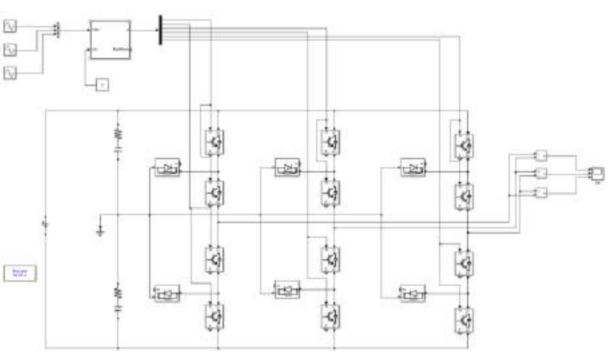


Figure 3. Three Level Inverter With Two Level Controls Simulation

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1804

SPONSOR: The MITRE Corporation

ADVISOR: Dr. Peter Willett

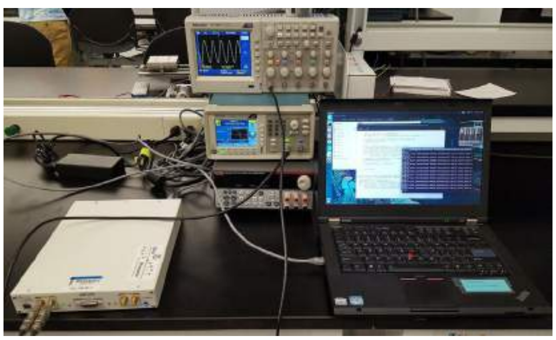
Implementation of Underwater Communication System and Channel Model

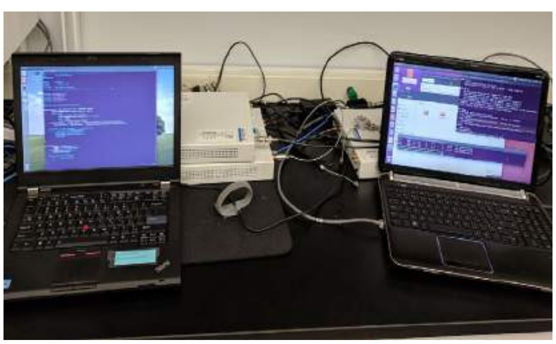
From left to right, Aaron DeMaio EE, Nicholas Gorbenko EE, Michael Stratton EE/CSE

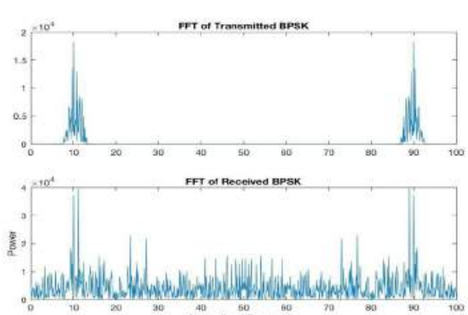
This project involves the implementation and testing of an underwater acoustic communication emulator using software defined radios (SDRs). The goal of this project is to model an underwater environment for use during communication system testing. This project has many unique challenges due to the greatly increased stresses that an underwater environment places on the integrity of a signal. In addition, an underwater environment introduces different challenges that are not present in radio communication systems that exist above water. These challenges have given rise to using acoustic communication techniques as opposed to radio communication when attempting to communicate underwater.

This project is a continuation of a project from the previous few years which also explored the use of SDRs in modeling an underwater environment. By using SDRs we are able to easily modulate an inputted signal and add channel effects we have modeled to simulate an underwater environment. The SDRs allow for this to be done quickly and easily.

The hardware setup of our channel emulator consists of three SDRs connected to separate laptops which emulate the channel effects, modulate and demodulate the signal, and finally export it and display the original signal sent. This platform also uses several attenuators and hydrophones. All of the signal processing can be done using easily found, open-source software.





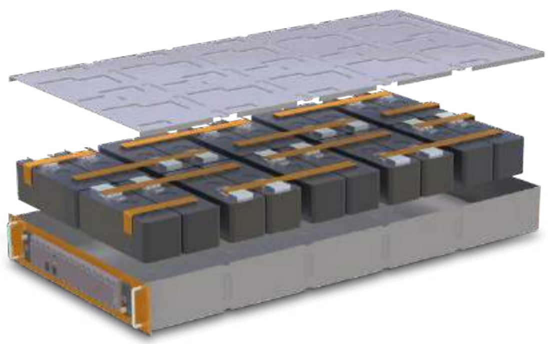


ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1805
SPONSOR: Cadenza Innovation
ADVISOR: Dr. Sung-Yeul Park

Shawn Battey, Johnathon Serio, Timothy Burroughs

Design of a Rack-Based Li-Ion Battery Module for Grid Storage Application

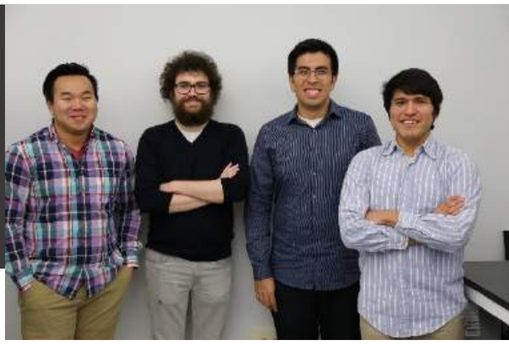


Photos courtesy of Cadenza Innovation

In recent years there has been an increase in need for electrical grid storage support in areas such as grid stabilization, peak shaving, and sustainable energy backup solutions. To address this rising need, a multidisciplinary team of UConn electrical, mechanical, and manufacturing and management engineering students were tasked by Cadenza Innovation to develop an economic, safe, and energy-dense rack-based grid storage Li-Ion battery module. UConn ECE was responsible for engineering and testing the electrical aspects of the module, including the Supercell configuration to meet the voltage range of the inverter, busbar sizing for the appropriate ampacity, the voltage and temperature measurement cable harness, the battery management system (BMS) communication network, and the inter-module power cabling.

Working within Cadenza Innovation's requirements and with their patented Supercell design, Team 1805 implemented an electrical configuration that would maximize energy density and safety. Aluminum busbars are laser-welded onto the Supercell terminals to establish a secure connection for current flow. The cross-sectional area of the busbars was sized for the worst-case discharge rate, while keeping the physical footprint and temperature rise to a minimum. The module was developed with an attention to modularity, serviceability, and safety. As a part of this effort, removable power distribution cables were selected to link modules together. These cables were sized for the appropriate ampacity and temperature rise, in a similar manner to the busbars. A Cadenza-supplied BMS will later be connected to the module and used to monitor the state of health and the state of charge of the Supercells. Sensor and communication networks were designed to enable the master BMS to collect voltage and temperature measurements from the slave BMS dedicated to each module.

The final module design is one that achieves electrical, thermal, and mechanical conditions, and can be replicated and connected with other modules based on the desired voltage range requirements.



From left to right: Dat Le, Jacob Hastings, Oskar Vasquez, James Quintanilla
D

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1806
SPONSOR: Microsemi Corporation
ADVISOR: Helena Silva
D

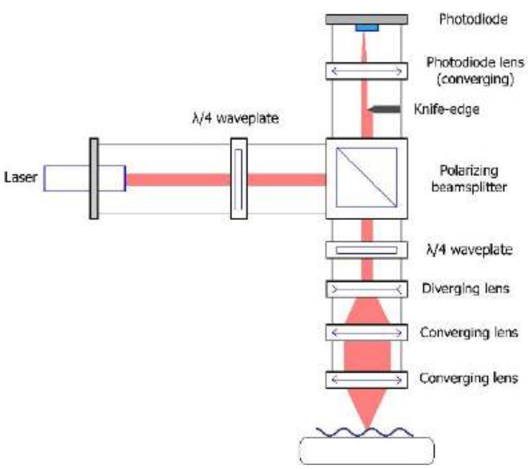
Surface Acoustic Wave (SAW) Laser ProbeD

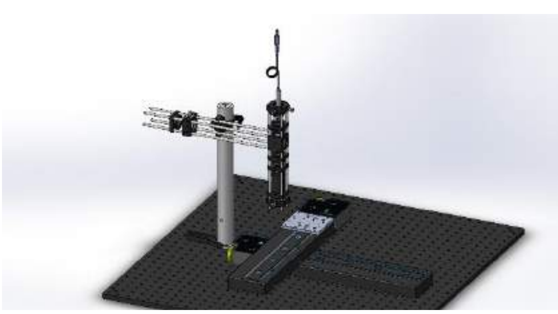
Microsemi
Power Matters.™

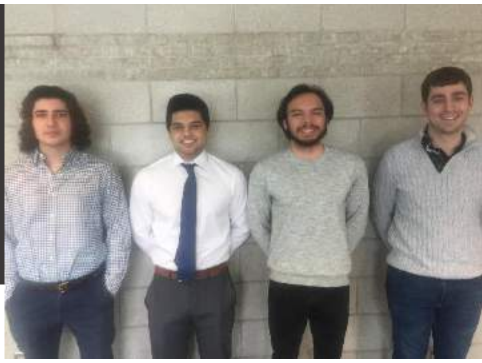
Surface acoustic waves (SAWs) are sound waves which propagate across the surface of a solid in a manner similar to how water waves travel across the surface of the ocean. SAWs can be induced in piezoelectric materials by applying an AC voltage to a transducer fixed to the surface of the material. This method of inducing SAW propagation is used in a class of electromechanical components called SAW devices which are found most commonly in RF filters, delay lines, and oscillators.

Our group was tasked with designing and assembling a scanning probe system capable of mapping the amplitude and phase of a SAW on the surface of a given SAW device. Our probe system is based on a SAW characterization method sometimes referred to as the knife-edge measurement technique. In the knife-edge method, a laser beam is directed at the undulating surface of the SAW device. When the beam strikes the surface, it is reflected at some angle determined by the characteristics of the SAW at the point of reflection. This angle of reflection changes in accordance with the oscillations of the SAW; the reflected beam is “angle modulated” by the oscillations of the SAW. If half of the reflected beam is initially blocked with a knife-edge (such as a razor blade or even a sufficiently opaque piece of paper), a photodiode positioned behind the knife-edge can register the change in the brightness of the beam as the beam sweeps across the knife-edge due to the changing reflection angle caused by the SAW oscillations. Therefore, a certain recorded beam brightness is related to where the SAW is in its period of oscillation.

In order to create a surface map of the SAW, we scan the active surface of the SAW device using an XY positioning stage. As we scan across the surface, we measure the pointwise amplitude and phase of the signal from the photodiode detector circuit using a lock-in amplifier. From these measurements, we are able to solve for the mechanical amplitude and phase of the SAW at each sample point on the surface.







From left to right: Robert Lancia, Waleed Tellawi, Aidan Devin, Richard Fleisch

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1807

SPONSOR: Kaman Fuzing & Precision Products

ADVISOR: Rajeev Bansal

Energy Harvesting for Small Munitions in Tactical/Battlefield EnvironmentsD

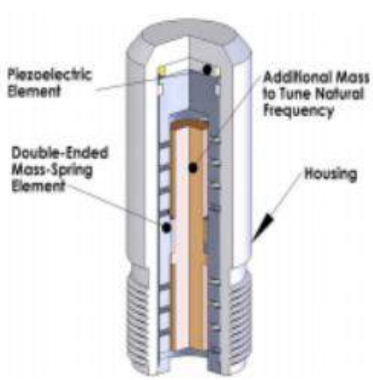
KAMAN
Fuzing & Precision Products

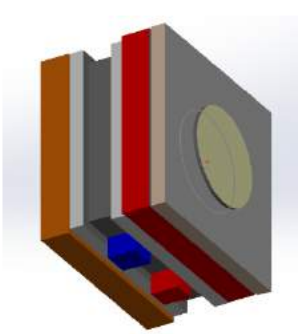
Kaman Fuzing & Precision Products is a faction of Kaman Aerospace, which is an American aerospace company located in Connecticut. Kaman Fuzing & Precision products focuses on developing state of the art electronic devices and systems for extreme environments for both commercial and military applications. While best known for their fuzing technology, Kaman also researches into new system technologies for various military applications. Among their many projects, Kaman has tasked us with designing an energy harvesting subsystem that derives its power from the launch of a projectile.

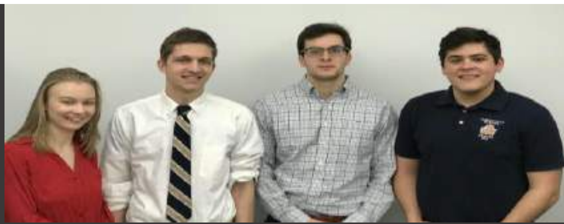
The project objective is to design an energy harvesting device that can power on-board electronics using outside forces. Since, the final design will be in live munition, limitations are present in size, weight, shelf life, force resistance, operating temperatures, and energy requirements. Due to the restraints set by military regarding munitions, our device must not have any stored energy, so simply using a battery to power the device is not viable.

Initial research identified piezoelectric and thermoelectric energy harvesting as the most promising designs for further development and testing. Both approaches use the initial forces of the launch and would produce usable electrical energy in a relatively short period of time. A piezoelectric (PZT) based implementation uses the piezoelectric effect that is present in certain materials that generates an electric charge when put under mechanical stress. Our design will utilize the propulsion forces that are present in a projectile launch to set in motion a mass-spring system to cause an alternating mechanical stress on the PZT material and generate an AC voltage.

The thermoelectric design would utilize the thermoelectric effect where an applied difference in temperature over a thermocouple produces a voltage difference. In our design, the initial propulsion forces of the launch would strike a primer to ignite a flammable compound. The corresponding exothermic reaction would then be used to produce a temperature difference.







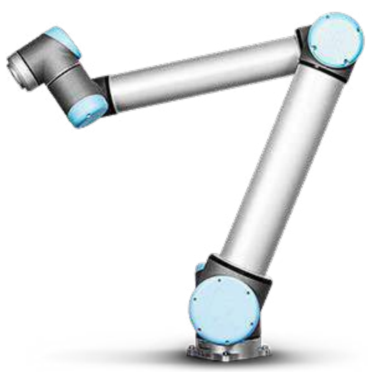
ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1808
SPONSOR: Kaman
ADVISOR: Ashwin Dani

Brittany Bohn, Timothy Jorsz, Thomas Bacon, Ivan Paz

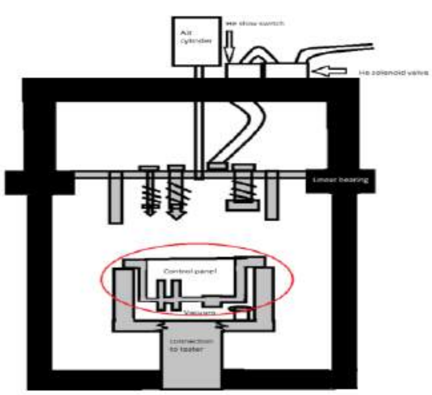
KAMAN
Fuzing & Precision Products

Automated Leak Test



Kaman Fuzing and Precision Products is one of the largest ordnance-based manufacturers in the United States. To keep up with increased demand and to improve efficiency, Kaman is attempting to automate an outdated manufacturing process. One of the products that the Middletown Facility produces is the JPF (Joint Programmable Fuze). Kaman's goal is to automate a building process of the JPF system by utilizing a helium leak test to verify the integrity of welding completed earlier in the assembly.

To do this, our team needed to integrate the current equipment (helium mass spectrometer) with a more modern robotic arm produced by Universal Robots (UR5). This approach involved the use of a PLC (Programmable Logic Controller) to remotely start and read data from the mass spectrometer. The PLC was also used to interface with the sensors placed throughout the system, and remotely signal to the UR5 robotic arm. The UR5 Robotic arm is in charge of moving the testing piece from a starting point to the mass spectrometer, then after the test is complete move the part to the area designated for a successful test or the area designated for a failed test.



Our project is a joint project with the Mechanical Engineering department. We had to work with two Mechanical Engineers, Ronnie Fierro and Nate Baker, and interface our design with their design in order to make the fully automated cell. Their part of the project consisted of building an apparatus that creates a vacuum seal so the leak test can be done properly. The design of the new apparatus includes safety features to ensure safety of the test operators.

In conclusion, we thank Kaman, the ECE and ME departments for this invaluable experience. We learned a lot working throughout this project and will be able to use the skills we learned in future endeavors.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1809

SPONSOR: United Illuminating (UI)

ADVISOR: Professor Peng Zhang

D

*From left to right: Christopher Gutierrez, Marissa Simonelli, and Martial Sawasawa.*D

Utility Grid Enhancement for Deep Integration of Distributed Photovoltaic Power GenerationD

D

United Illuminating (UI) is an electric utility company based out of Orange, Connecticut with a service area covering predominately Southwestern Connecticut. Recently, UI has seen an increase in Photovoltaic (PV) installations within their area. Historically, power has flowed from the transmission network down to the load. PV panels installed at residential and commercial areas have resulted in power flow in the reversed direction – from the load back onto the distribution network. It is of great importance for UI to determine if these installations will result in any adverse impacts to the system as a whole. The Connecticut Public Utilities Regulatory Authority has defined such adverse impacts to be when the distribution meter's voltage falls outside of the +3% to -5% range. D

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Historically, UI has been concerned with under-voltage falling below -5%. However now, with the installation of PV panels, the focus has been shifted to keeping meters below the +3% threshold when PV sites are at maximum generation. Currently, UI's System Impact Studies use the nameplate capacity of PV panels when testing for adverse impacts. The nameplate capacity is defined as the maximum rated output of the generator. Using this value is a conservative estimate of the true outputted power from PV in order to help maintain grid reliability and stability. However, UI would like a better understanding of PV generations impacts on their distribution system. D

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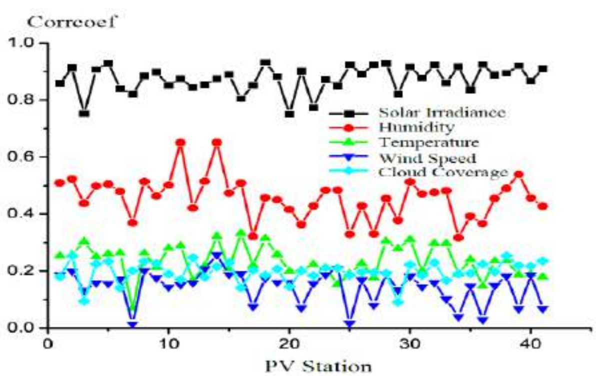
UI's goal with this project is to better represent the amount of PV power being outputted onto the grid; in other words, the purpose of this project is to give UI a sound methodology for predicting PV extreme output within its territory and provide a glimpse into the true impact of PV within Connecticut.

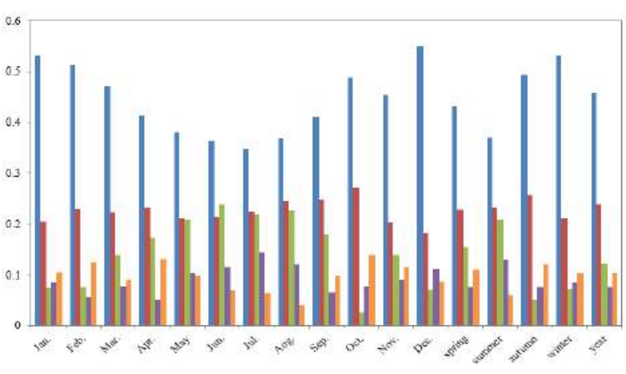
Our team designs a powerful tool for PV power forecasting which will be critical for the real-time integration of PVs in the power grid. To obtain high-fidelity extreme PV power injections, a three-level big data analytics is developed using high resolution meteorological and in situ sensor data:

(1) a K-means-clustering-based zone partitioning method,

(2) an extreme value theory (EVT) and

(3) a regional frequency analysis (FRA) method for provably correct forecast of extreme PV output.





ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1810
SPONSOR: Pratt & Whitney
ADVISORS: Dr. Helena SilvaD

D

ECE Team: Shahzeb Makhdoom, John Rockett, Matthew Doll

Low Cycle Fatigue Spin Rig

Pratt & Whitney is a subsidiary of United Technologies with a focus on aerospace. Disks used in engines must be tested before implementation. Current methods of testing stress in spinning disks are expensive and test rigs are extremely large in size. Our team consisting of electrical, computer and mechanical engineers is responsible for designing a table-top spin rig to characterize materials used in gas turbine engines on a small scale. We will be analyzing the behavior of a material which will undergo uniaxial stress conditions. Test rigs are important to help us understand and prevent disk failures inside an engine.

The test specimen used in our rig is a disk designed by the team. The disk was designed to have a 1:1 hoop to radial stress ratio in which we must achieve a 110% yield stress to exhibit low cycle fatigue. The rig required a containment unit for the spinning disk which must withstand a critical failure of the disk splitting apart. Our sponsor has asked us to characterize Titanium 6Al-4V and INCONEL 718. However due to limitations in motor capabilities as well safety we used aluminum for our test rig but recorded the required changes to be made in order to use the previous materials.

A motor and drive were chosen which has the capability of spinning the specimen to a speed which will cause the required 110% yield stress and back down to 5% yield stress in under one minute. We designed and implemented a control system that will monitor the health of the rig as well as provide a safety mechanism for emergency shutoff due to rig failure from the motor or the disk. This control system would also automate the one minute cycle used to spin the disk up to its highest speed in back for a repeated number of cycles.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1811
SPONSOR: Seconn Fabrication LLC
ADVISOR: Dr. Shengli Zhou

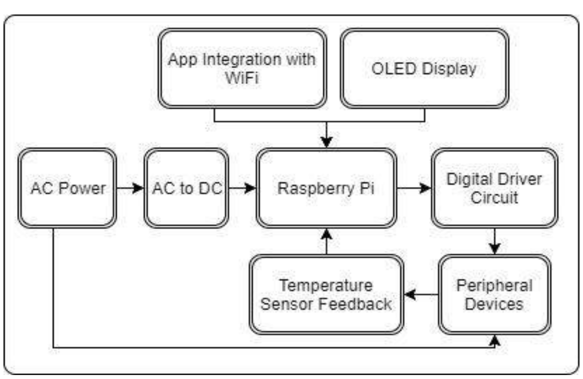
Trevor Svec, Adam Burns, Jason DeJesus

Designing a Microcontroller System Integrated with a Mobile Application for a Pellet Smoker

Microcontrollers are used to automate and control complex electronic devices, in order to help them perform complex functions. Pellet smokers are one such device that use microcontrollers to control aspects of smoking such as maintaining constant temperature and smoke in the cook chamber of the smoker. The microcontroller currently controlling the consumer line of Myron Mixon Pellet Smokers has limited functionality and low temperature accuracy. The new microcontroller will control the same number of peripheral devices with the same functionality, with additional functionalities such as real-time tracking of temperature data, wireless connectivity capabilities, and improved temperature feedback loops for improved efficiency. Peripherals include elements commonly found in pellet smokers such as a heating element to ignite pellets, a fan to control airflow, and an auger to feed pellets.

To complement the wireless capabilities of our controller, we will be developing a mobile application for Android that will allow for complete control of the smoker via direct WiFi connection. We will also be adding a visual display to improve user experience and facilitate interaction between user and smoker.

A Raspberry Pi 3 Model B will act as the primary controller for the entire system, which will be powered by a 5v signal converted from AC to DC. A driver circuit will act as a module that connects the digital output from the Raspberry Pi to control the AC power to peripheral devices. The driving circuit will use similar components to those found in the existing microcontroller, and will be based upon a TRIAC, a three terminal semiconductor device used for controlling alternating current. The Raspberry Pi will also act as a WiFi access point allowing a smartphone (specifically an Android device) to connect and directly control the pellet smoker wirelessly. This can be done by modifying the internal libraries of the pi and using a USB range extender. The mobile application will be developed alongside our controller and along with allowing users to control the smoker, will provide the user with data relating to temperature of the cook chamber and temperature of the meat.



ELECTRICAL AND COMPUTER ENGINEERING

Jordan Layne, Bryan Maloney, John Friedman, Gregory Bibisi, Archit Singh, Sally Yang

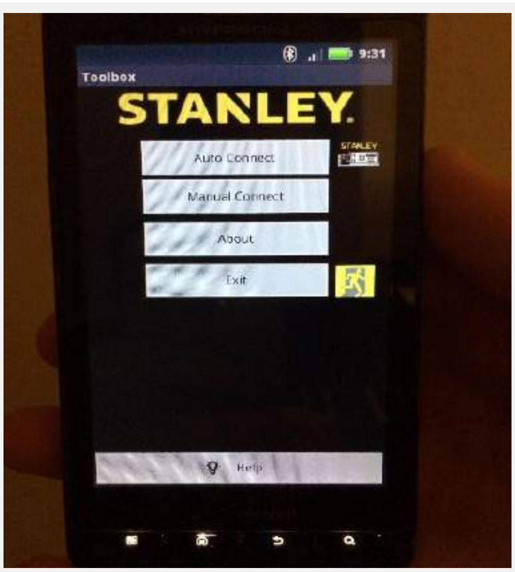
TEAM: 1812
SPONSOR: Stanley Access Technologies
ADVISOR: John Chandy
D

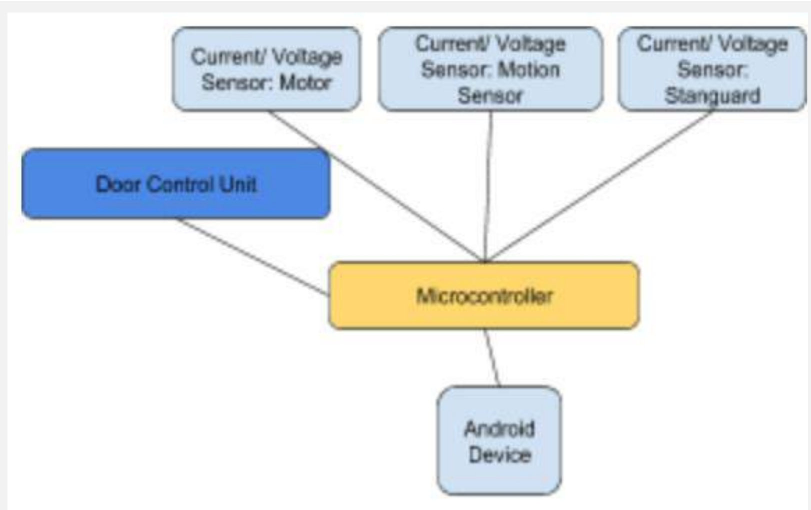
Monitoring and Correctness of BPMN Based Workflows

Stanley Access Technologies is the leading manufacturer of automatic pedestrian doors in North America. Some of their products include sliding, swinging, revolving, and folding doors. Faults may exist in a sensor, motor, or wiring, and may not be easy to troubleshoot. Technicians who attempt to fix these faults often need to work in a crowded space of the header, where the door components and wires can make that very difficult.

The purpose of our project is to develop a system to diagnose problems in the automated door systems. This system will run many tests through an Android application and give the technician using it a recommendation of what to fix and replace. Students majoring in CSE and ECE are working jointly to develop a microcontroller that will communicate directly with the android app. A solution implementing machine learning concepts will be used to diagnose any issues with the doors.

We have been given the number one selling automatic slide door in North America, the Dura-Glide slide door system, to perform our tests on, and an Android device with current testing application installed to assist us. Our system will ideally interface with the Door Control Units of the doors, which act as the central "brain" of the systems. Our system will detect readings from the DCU and the sensors connected to the various door components including the motor, motion sensors and solenoid lock. This would allow our system to monitor the signals during operation and detect anomalies while taking control of the outputs and inputs to force specific states of the system. We will be altering the current troubleshooting function within the application to make it easier for technicians to use.





ELECTRICAL AND COMPUTER ENGINEERING

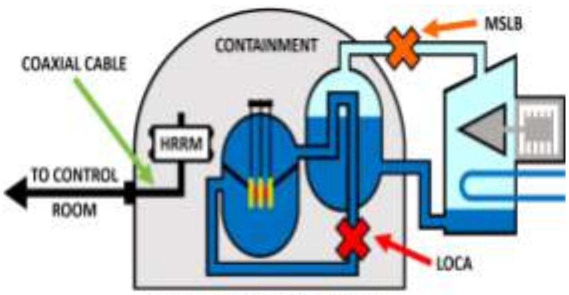
TEAM: 1813
SPONSOR: Zachry Nuclear Engineering Inc.
ADVISOR: Dr. Yang Cao

Left to right: Peter Nidever, Richard Ross, Alex Cannan

High Range Radiation Monitor Cable Study

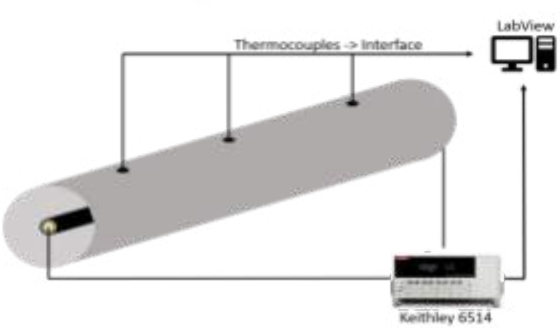
ZACHRY NUMERICAL APPLICATIONS
A DIVISION OF ZACHRY NUCLEAR ENGINEERING, INC.

High Range Radiation Monitors (HRRMs) in nuclear power plants utilize coaxial cables to transmit data from the sensor located inside the containment vessel to a recorder located outside the vessel. Operational problems have raised the concern that HRRM detector readings might be susceptible to environmental influences on the detector cable such as Thermally Induced Currents (TICs). Previously, Southern California Edison (SCE) observed unanticipated signal errors during a normal operational transient where the HRRM output signal dipped low, alarmed, and then slowly returned to normal within approximately 15 minutes. This sequence of events repeated every time a Containment Emergency Cooling Unit was started. The transient low signals were responsible for the alarms because a drop in current to 0 nA normally indicates a loss of signal in their HRRM system. It was later found out that this sequence of events makes sense in connection to the Containment Emergency Cooling Unit activation because drops in ambient temperature result in negative TICs (reduction in current through a given cable).



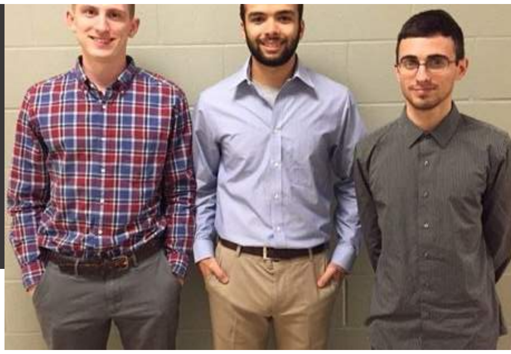
Pressurized Water Reactor

Several studies have been conducted to determine the factors that influence TICs, characterize the TIC effect with mathematical models, and develop prototypes for electronic devices that cancel out TICs in HRRM readings. These include studies performed by UConn and EPRI that dealt with bare cable analysis. The objective of this project is to expand upon the experiments performed by UConn and EPRI to study and perform CFD analysis to explore the effects that different cable-in-conduit configurations have on TICs. [1][2]



[1] High Range Radiation Monitor Cable Study: Phase I, EPRI, Palo Alto, CA: 1998. TR-110379

[2] High Range Radiation Monitor Cable Study: Phase II, EPRI, Palo Alto, CA: 2000. TR-112582



Left to Right: Richard Mullen, Alexander Valdes, Keelin Becker-Wheeler

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1814

SPONSOR: Biorasis

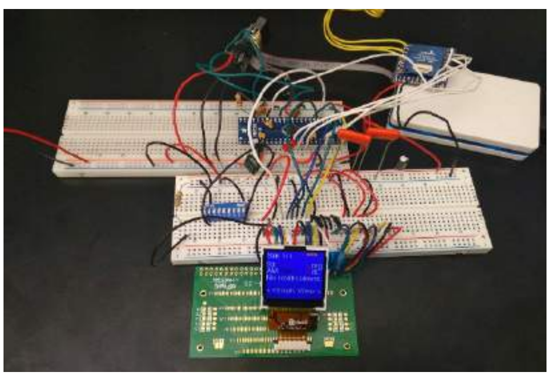
ADVISOR: John Chandy

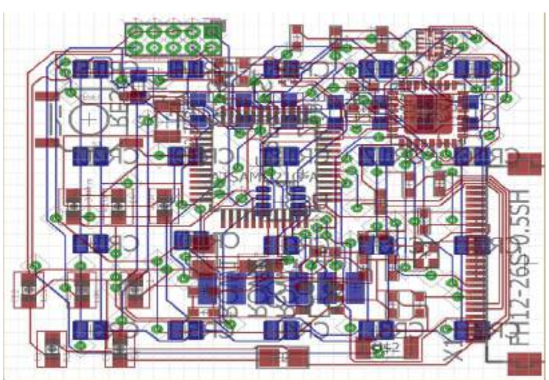
Glucose Monitoring Smartwatch

The aim of this project was to further develop a smart watch that is used to communicate with Biorasis's implantable glucose sensor. Intended for type one diabetic patients (T1D1) the watch will wirelessly power and communicate with the sensor for continuous glucose monitoring. This is more efficient than current technology (finger pricking), and will provide more data to help patients better monitor their health.

The watch can be viewed in three sections, the first is power. The implant developed by Biorasis has a solar cell, that is powered by the LEDs on the bottom of the watch. The LEDs produce light that is strong enough to activate the implantable sensor. Next the sensor has to communicate with the watch. To do so the sensor will emit an infrared light signal that is picked by the watch. Finally, the signal needs to be processed, this is done by the hardware and software that exist internally in the watch which ultimately displays information on the face of the watch.

We were tasked to change and improve many aspects of the watch, some of which include overall size, digital display, display interaction, and battery life. Originally based on the bulky Arduino platform we decided to convert to a standalone MCU design. This involved creating a PCB that is able to fit all of the necessary components that allow the watch to function. Due to the abundance of components and necessity for efficiency, most of our time has been spent designing the PCB. All of the software that controlled the watch and its functions was written in Arduino code. As we converted to a standalone MCU this code had to be ported to C code. Although requiring more time this allowed us to add some additional functionality, which would have been excluded otherwise. Another upgrade was the introduction of a new LCD screen, compared to the old option the new screen had additional real-estate and better readability. Lastly, we addressed the battery life issue, we targeted the LED's that are used to communicate between watch and implant, as they are the largest draw of power. In order to mitigate the LED power usage, we created a scanning algorithm in which the LEDs will operate in order to power the implant. Doing this we should be able to use only one third of the power previously used.





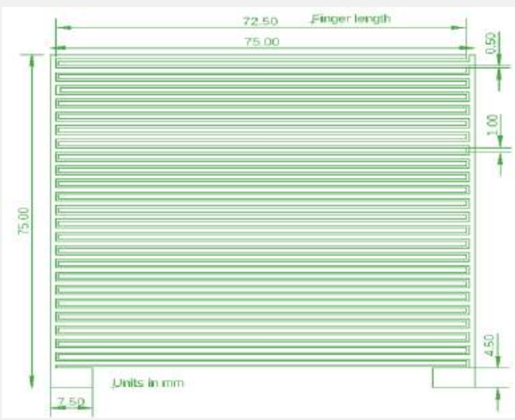
TEAM: ECE1815
SPONSOR: ASML
ADVISOR: Necmi Biyikli

D

From left to right: Gaurav Rana, Saory Chhouk, and Joanna Cropsey

EIP Redesign-High Acceleration

D



As technology advances the need for computers with higher processing power is increasing. In order to meet the demand for these chips, lithography has become extremely precise, down to the nanometer scale. ASML is at the forefront of producing very precise lithography equipment and has become a world leading supplier for many companies.

To be able to get down to the precision that many companies desire, particle contamination on the surface of the template, known as a reticle, is unacceptable. The reticle is protected by something known as an EIP, or Extreme-ultraviolet Inner Pod during transportation. ASML wishes to increase the throughput of their machines in order to greater meet the demands of the market. In order to do so, the speed of the manufacturing process must be increased and ASML needs a stronger clamping device to prevent reticle motion. The goal of this project is to provide ASML with a stronger clamping device that will protect it from movement and particle contamination while it is transported inside the EIP.

There were several ideas to create a clamping device, however the one the group settled on was an electrostatic clamp. Using the principles of electro-adhesion, the electrostatic clamp will be able to both protect the reticle from movement and be integrated into the current iteration of the EIP.

A scaled down 4x4 prototype electrostatic clamp was produced at UConn using the electrode fabrication lab. Using a modified 3D printer as a test rig the clamping device was tested for accelerations of up to 1g using a sample reticle. Based on initial observations, the clamp held the reticle in place with enough clamping force motion. This was later confirmed by testing for particle contamination on the surface of the reticle; it was found that the electrostatic clamp did a good job protecting the reticle. This final prototype device was presented to ASML as a proof of concept that the electrostatic clamp idea would work to prevent reticle motion.

Students (From Left) Kyle Mullins, Noah Lyke, Robert Townsend, Jim Lin

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1817

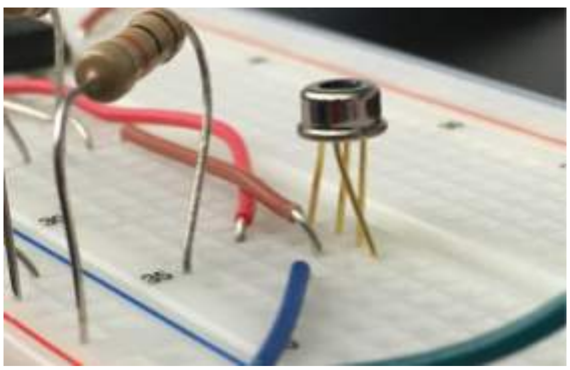
SPONSOR: Hubbell Incorporated

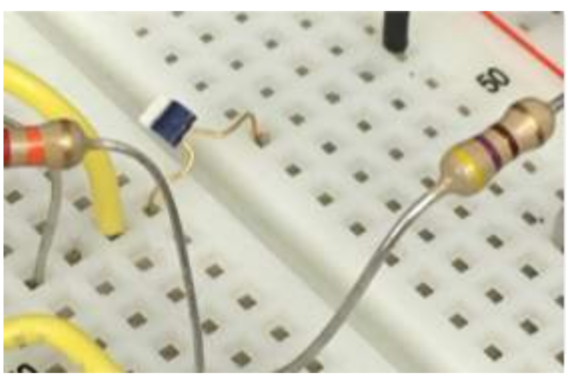
ADVISOR: Necmi Biyikli

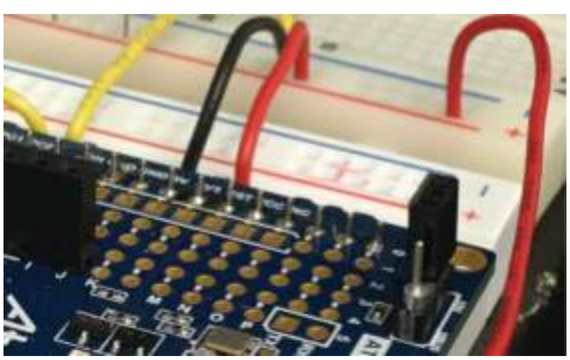
Electrical Plug, Connector, and Receptacle Temperature Sensor

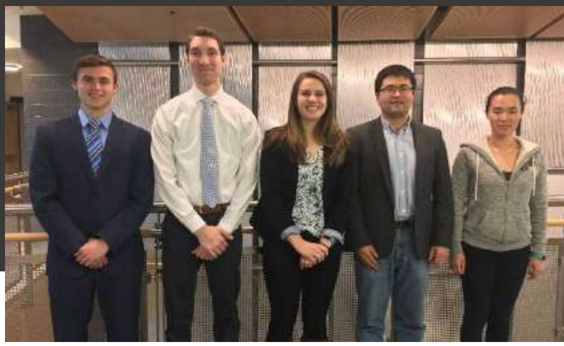
Hubbell Incorporated began its journey in the late 1800's when its founder, Harvey Hubbell, developed tooling and equipment to serve the growing demand for new assembly and manufacturing machinery during the industrial revolution. Hubbell Wiring manufactures various connectors and devices, including electrical plugs and receptacles.

Hubbell tasked the team with researching existing temperature sensing technologies and looking to utilize these technologies to design, miniaturize, and optimize a temperature sensing system. The goal is to design a miniature temperature sensing system that can monitor the temperature of multiple objects located near the sensing array. The design is to be flexible and adaptable to various environments and measurement targets. The system must be able to have a form factor that is flexible for various implementations. There must be data interpretation built into the design to take information input from multiple temperature sensors, perform any necessary computation, and output the data to the user. Overall, the project is to design and optimize a temperature sensing system with onboard data interpretation for varied implementation.









Wyatt VanFossan, Christopher Angi, Kelly Higinbotham, Peng Zhang, Yan Li (In order from left)

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1818

SPONSOR: Commercial Solar Works

ADVISOR: Peng Zhang

D

Wastewater Treatment Plant Microgrid Applications

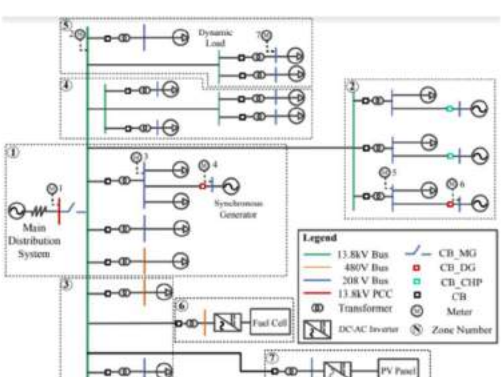
D

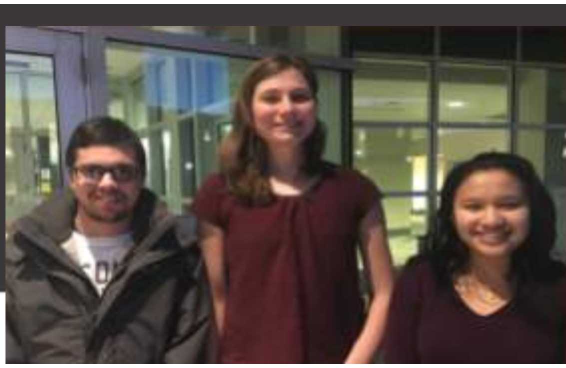
Commercial Solar Works is a company which plans to specialize in the creation of microgrids within the state of Connecticut. Specifically, they want to design a model for a microgrid that supports a wastewater treatment plant (WWTP). This plan is in response to a state initiative in Connecticut to increase the application of Microgrid technologies. The microgrid will consist of a biodigester, a generator, a photovoltaic (PV) solar array and a power storage device.

The biodigester will convert waste slurry to methane which is used as a fuel source for a generator. The size of the generator will be dependent on the critical site load and the amount of methane that is produced based on the average wastewater flow rates of the plant. A PV solar array will be sized to meet the parasitic loads of the biodigester and on-site energy usage not covered by biodigester generation. The battery storage will capture excess generated power for later use and will also provide grid reference when the site is not connected to utility power i.e. during islanding.

The goal is to create a standard design that could easily be adapted to various wastewater treatment plants, so it is important to understand how input and output of microgrid components for one plant relate to those of another plant. Wastewater treatment plants are all configured differently to handle different amounts of wastewater daily. This will affect the power output and selection of the other pieces of equipment. We will create a design that can be used to retrofit existing Wastewater Treatment Plants. Because of this, we will need to be cognizant of the existing load, site plan and slurry data for a specific site. Our design will have to be flexible enough to be easily adapted to various sites, but for the sake of this project only one site will be considered.

Our project deliverables include an updated site plan, an updated riser diagram, and an energy production model. These components serve as a proof of concept for our model. We will be collaborating with a team of three Environmental Engineering students who are responsible for designing the biodigester needed for our microgrid application.





Daniel Fernandes, Amy Robinson, Marilyn Duong

TEAM: 1819

SPONSOR: **United Technologies**

ADVISOR: Mousumi Roy (MEM), Necmi Biyikli (EE), Xu Chen (ME)

Autonomous Weight Detection System

United Technologies

Climate | Controls | Security

Team 1819 is designing a remote mass detection device in conjunction with UTC Climate, Controls & Security. UTC CCS manufactures and implements fire suppression systems across all disciplines of UTC. The suppression tanks used in many of these systems need to be inspected biannually to ensure each tank has sufficient fluid levels. If the fluid mass within a tank is reduced by 2.5%, it must be replenished. This inspection process is manual and extremely time consuming; weighing the tanks is currently done by detaching each tank from the hose, lifting it onto a scale, and comparing the value to the one previously recorded. CCS is seeking to automate this process to improve the accuracy and mitigate the costs of this inspection.

These tanks are an integral part of fire suppression systems in buildings all across the country, which are critical to the safety of everyone inside. The final product should be economical and robust to withstand harsh environmental conditions. Additionally, the system should be redundant and easily operated to ensure proper functioning.

This project seeks to develop a working prototype of a mass sensing system. A microprocessor-controlled impact device would induce vibrations on the metal tanks. From there, a sonar sensor or an audio recorder would pick up on the vibrations to send the signal to a processing unit. The processing unit would perform a frequency analysis of the signal to determine the fluid level within the tank. The result would be transmitted using a Bluetooth transceiver module to a Android application so the status of the tanks can be monitored remotely. Future work would include minimizing environmental noise interference to improve the accuracy of the system and exploring non-contact sensing methods.

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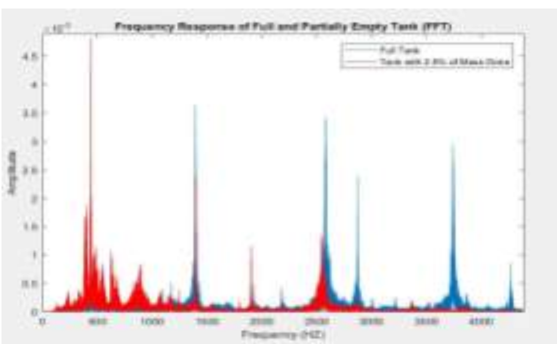
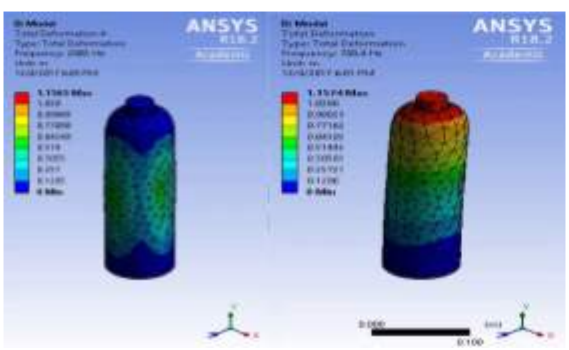




ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1820
SPONSOR: UConn CESPA
ADVISOR: Shengli Zhou

The team of superstars from left to right: Ethan Freund (EE), Benjamin Marcotte (EE), Meridith Kuperstein (CSE/EE), Derrick Chen (CompE)

Linear Motion Haptic Feedback System

To aid in his research of human interactions with novel, simulated environments, Professor Harrison at UConn's Center for the Ecological Study of Perception and Action (CESPA) has joined with senior design team 1820 to build a linear motion haptic feedback system with virtual feedback. A haptic feedback system can be defined as follows: "...of or relating to tactile sensations and the sense of touch as a method of interacting with computers and electronic devices…" A haptic feedback system provides users with touch feedback and allows users to interact with simulated environments. For example, a simple yet common example of haptic feedback technology are video game controllers. In some video games, a user will receive vibrational feedback from the game controller indicating that a collision has occurred in the video game environment. A more complex example of haptic feedback systems are flight simulators, where users receive touch feedback that simulate real life flight conditions.

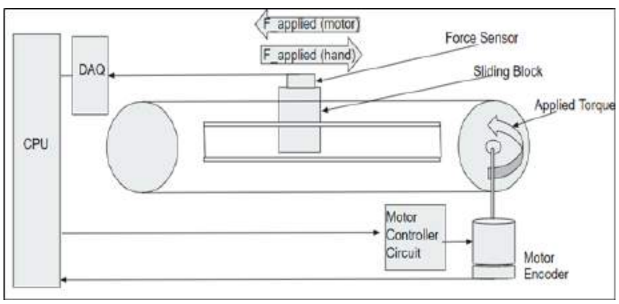


Figure 1: Layout of the Linear Motion Haptic Feedback System

Team 1820's virtual feedback system will allow users to interact with virtual objects moving linearly in a simulated environment, by moving a real block across a linear rail. The system will consist of a cart riding on a linear rail that is connected to a motor. The cart will have a block connected to it that the user will hold and move. This physical block will be able to interact with a simulated environment that has variable characteristics including variable coefficients of friction, spring forces, and 'virtual walls' that are created by varying forces exerted by a torque motor. As the block interacts with the simulated environment, the user will receive force feedback.

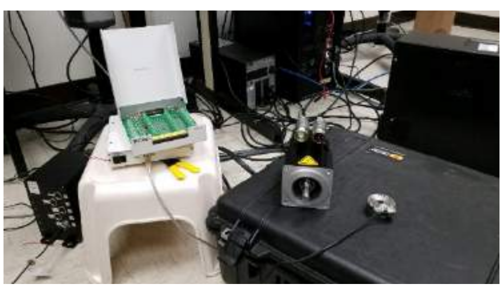


Figure 1: Data Acquisition System, Motor, and Force/Torque Sensor

While the linear motion haptic feedback system is in use, the user will be able to see a visual representation of the objects that they are moving. Furthermore, users will be able to see items in the simulated environment that they can interact with, but are not actually in the path of the carriage.

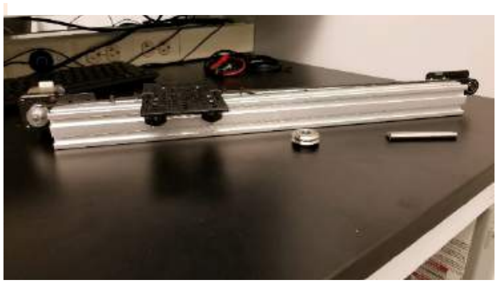
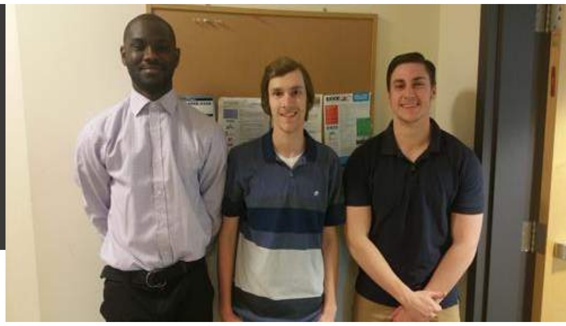


Figure 3: Prototype of rail and carriage system

The linear actuator itself will be used for Professor Harrison's research in human-object interaction. The haptic feedback system can be used as a multipurpose testbed for use in Harrison's research on how humans manipulate, transport, and perceive objects in different environments

TEAM: 1821
SPONSOR: UCONN ECE Department
ADVISORS: Ali Bazzi, Christopher Costa



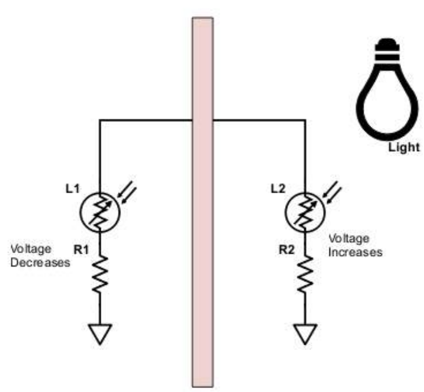
From left to right: George Oppong, James Fisher, David Pettibone

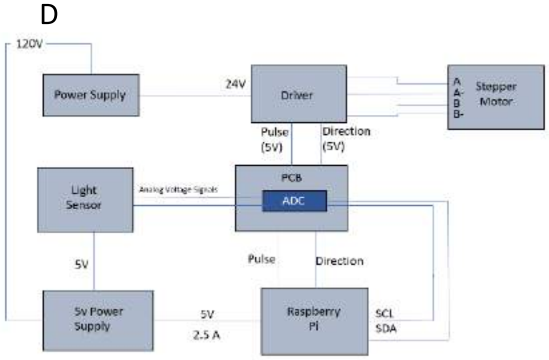
Solar Mobius

The Mobius Solaris statue was built in 1995 and designed by artist Robert Perless. Located in front of the Castleman building, this statue features a stainless-steel base connected to five polycarbonate prisms rested on a stepper motor. The stepper motor, which is connected to a driver allows the prisms to rotate 360 degrees while keeping the base itself stationary. The intention of this artwork was originally to track the sun and reflect a rainbow onto the main entrance of Castleman, but that was never achieved due to various problems. The existing electronics located in the base of the statue have only one purpose, which is to rotate the prisms at a constant rate of 360 degrees every 24 hours. The controller found in the Mobius is a simple circuit that handles the logic telling the stepper motor driver when to turn, and how many steps. The stepper motor is currently set to rotate at a rate of 2,000 steps per full revolution. The goal of this project is designing a solar tracking mechanism to acquire the position of the sun and reflect a rainbow above the main entrance of the Castleman building. This goal will be accomplished by primarily using a circuit of photoresistors and a Raspberry Pi as our microcontroller to handle the logic feeding into the driver. The other goal is to create a website specifically for the Mobius. This website would include information such as the current weather, angle of the sun, and would indicate any errors currently being read by the system.

Our proposed design for our solar tracker is to mount a light sensing circuit composed of two photoresistors separated by an opaque object onto a separate stepper motor. If the photoresistor assembly is misaligned with the sun, the opaque object will cast a shadow on one of the photoresistors. A motor will reposition the photo sensors such that neither is in a shadow, indicating the sensing assembly is aligned with the sun. The angle information provided by this mechanism will then be used to align the statue appropriately.

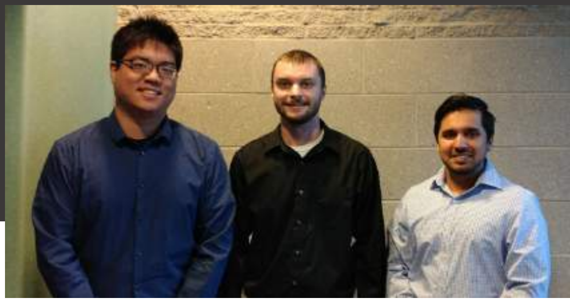
UCONN
SCHOOL OF ENGINEERING





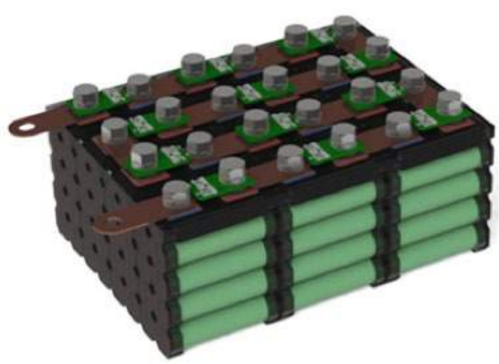
ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1822
SPONSOR: UConn Electric Motorsports
ADVISOR: Sung-Yeul Park



Sung-Lin Chen, Jason Clark, Tejinder Jutla

UCEM Battery, Management and Charging System



UConn Electric Motorsports (UCEM) is an on-campus club sponsoring four separate senior design teams, each tasked with building an integral component of a single-seat electrically powered formula-style racecar. From design to production 11 students have each brought together the best components sourced from around the world integrated into a single vehicle. North America's first electrically powered aluminum honeycomb chassis is capable of accelerating from 0-60 mph in under three seconds.

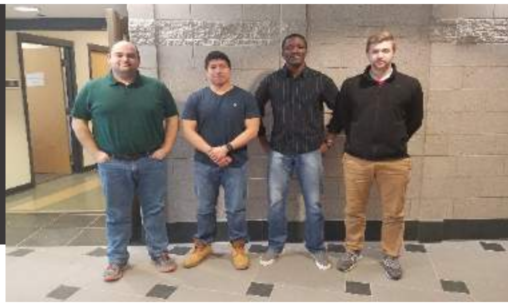
Along with meeting the club's requirements, the design also had to satisfy Formula Student Automotive Engineering (FSAE) rules. The maximum voltage allowed is 300VDC, along with a maximum power draw of 80kW. The high voltage battery pack was configured to have a maximum voltage of 260VDC. The accumulator contains 496 Samsung 18650 cells, making it a 5.2kWh (20Ah) battery pack. These cells are assembled in 62 Energus modules that also provide temperature sensors and fuse protection. With the motor team's 80kW motor, this will draw a maximum current of 360A.

The Orion BMS was chosen as the battery management system to monitor cell voltages and temperatures. It will communicate with the Elcon PFC 2500 charger to balance the cells during charging. If the battery is fully discharged to 0%, the Elcon charger will fully charge the accumulator in about 3 hours and 20 minutes. Other small components necessary to the design were chosen such as connectors, fuses, and relays based on power requirement.

We designed an accumulator container that houses all the high voltage components. Our team plans to do thermal analysis along with Computational Fluid Dynamics to determine the most efficient method for cooling. The batteries have to be tested to determine charge and discharge rate, the BMS and charger will also be tested at component level. After this is confirmed, we will integrate all components together and into the accumulator. This will now get put into the chassis of the racecar, connected to the other sub-systems.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1823
SPONSOR: UConn Electric Motorsports Club
ADVISOR: Ali Bazzi



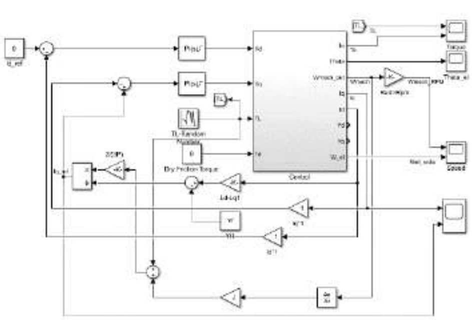
From left to right: Team Advisor Professor Bazzi, Ernesto Ortega-Hernandez, Alain Tshipamba, and Daryl Biron.

UCEM Electric Motor Control and Inverter Design

UConn Electric Motorsports (UCEM) is an on-campus club sponsoring four separate senior design teams, each tasked with building an integral component of a single-seat electrically powered formula-style racecar. From design to production 11 students have each brought together the best components sourced from around the world integrated into a single vehicle. North America's first electrically powered aluminum honeycomb chassis is capable of accelerating from 0-60 mph in under three seconds.

UCEM Electric Motor Control and Inverter Design was purposed to be the driving force of the UCEM electric vehicle. Motor selection was the first step of the system design. To select the proper motor, we had to follow competition guidelines as well as specifications given by the sponsor. Proper calculations were made to ensure all requirements were met. The next step was to simulate the response time of the motor given certain control parameters until the controller could be accurately verified.

The controller selection was made based on budget and compatibility with the motor selected. To meet safety requirements of the vehicle and for the driver, a pre-charge/discharge circuit had to be made according to the capacitance of the controller. Contact with the manufacturer allowed for the proper capacitance value to be used. The pre-charge/discharge circuit used relays and a microcontroller to send the correct signals which allowed the circuit to be made without a PCB. Testing of the system includes measurement of the pre-charge/discharge time constant, voltage, and current. Testing the system involved sending a pedal input signal and measuring the response time of the motor while keeping track of voltage and current. A load test evaluates how the system will perform when accelerating the vehicle. For the acceleration event, the system will undergo maximum torque output and therefore needed to be tested. No available testing load was available, so this feature had to be tested in the vehicle itself.



Putting the system in the car required special mounts which the mechanical engineering team designed. To pass the safety tests the vehicle had to be water proof which meant the electronics had to be properly insulated. The electronics were also secured in a way to minimize the need for long wires and any potential hardware disconnects. The motor control system had been developed and is now undergoing final tweaks before competition.

Joann Duman, Connor Garvey, Mohamed Issa

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1824
SPONSOR: UConn School of Engineering
ADVISOR: Rajeev Bansal

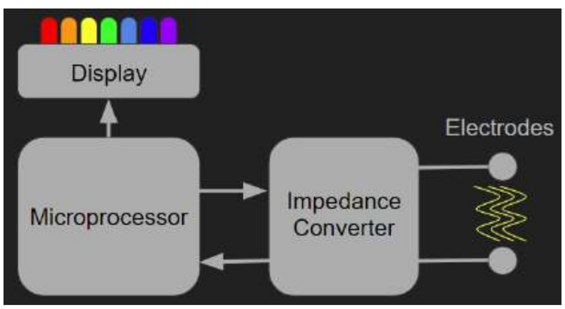
Hydralyzer: Design and Validation of Wearable Hydration Sensor

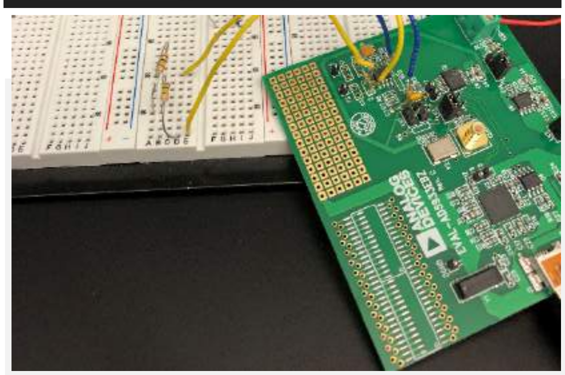
UCONN SCHOOL OF ENGINEERING

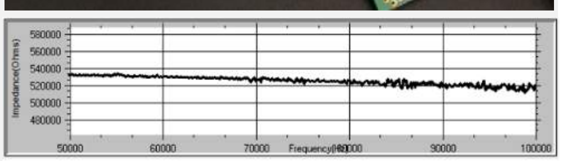
The Hydralyzer team is focused on the development of a breakthrough device in wearable technology that is capable of noninvasively monitoring the user's hydration status in real-time. This project is a continuation of a 2016-2017 multidisciplinary project sponsored by the UConn School of Engineering. The team is comprised of three Electrical Engineering students as well as two Management and Engineering for Manufacturing students. The project was originated in a School of Nursing student entrepreneurship project.

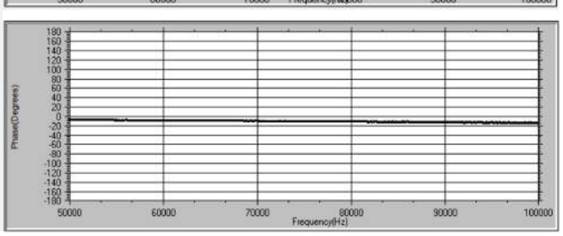
The end goal for this device is to be implemented into a smart watch product that will allow for real time monitoring of hydration status. The product has the opportunity to be marketed to a great number of customers, in both the recreational and medical fields. In recreational uses, the devices allows for monitoring of an athlete's hydration status to prevent hypo or hyperhydration during a workout. There is significant application opportunity in the medical fields, as the device can be used by patients with diseases that require acute monitoring of hydration level. Additionally, use of the device with both the elderly and infant populations allow for indication of hydration issues for groups that may not be able to communicate a need for water.

This year's team has taken a new approach to the development of this sensor, as the device developed during the previous year was found to provide inconclusive results. The method being used is known as Bioimpedance Analysis (BIA). This method measures the impedance across a small section of skin to determine the hydration status of the user. A lower impedance across the electrodes is indicative of higher hydration level. This method is validated through various tests on both fake skin analogs and human subjects. To provide a preliminary validation of the method, cardboard was used as the skin analog, and was measured in both a wet and dry state. At the completion of this validation, human tests were conducted to determine the validity of the method in a highly variable environment, with much narrower hydration range. At the completion of testing using a preliminary prototype, the device will be miniaturized and integrated into a smartwatch style device.









ELECTRICAL ENGINEERING & BIOMEDICAL ENGINEERING

TEAM ECE Team #1825 & BME Team #9
SPONSOR: University of Connecticut
ADVISOR: Dr. Shalabh Gupta (ECE) &
Dr. Krystyna Gielo-Perczak (BME)

D

From left to right:
BME Team #9: Kenny Tang, Fearass Zieneddin, Jacob Grosso, Nicole Romano, Kelsey Clemens
ECE Team #1825: Jeffrey Martin, Mohammed Serdah, Philip Syrrist

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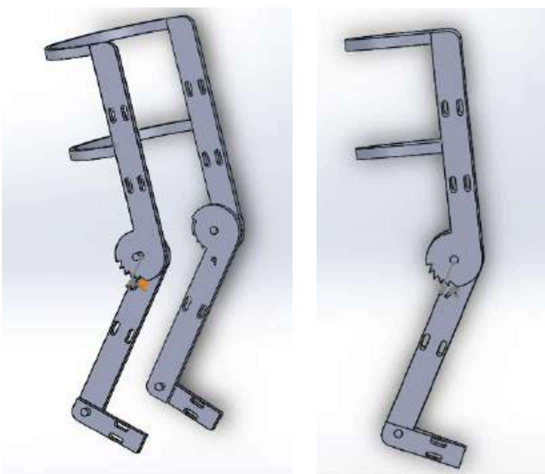
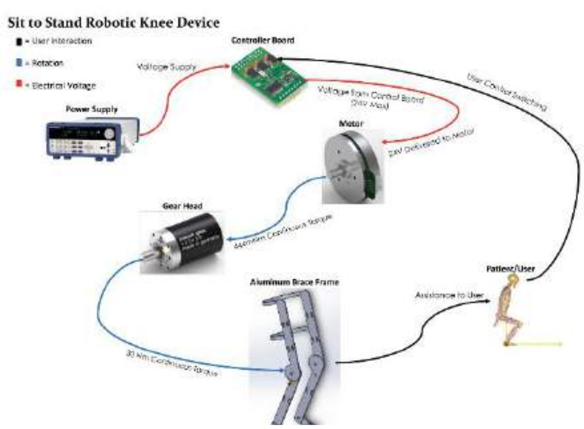
Sit to Stand Robotic Knee Device

Lower musculoskeletal injuries can range from having subtle to severe pain, and many of the times a full examination is required to determine which joint is the root cause of such pain. Injuries can be detected in any foot, ankle, knee or hip joint and this can cause complications when the patient is attempting to stand up and even walk. To begin the process in healing injuries of lower extremities, ideally a patient will begin rehabilitation, where they will be closely monitored while practicing physical activities like standing up and walking. The goal of the Sit to Stand Robotic Knee Device is to supplement the rehabilitation process and shorten the recovery time for patients with lower musculoskeletal injuries. The device will aid the patient to perform the sit to stand motion by the help of an electric motor attached to the knee area along with a built in locking mechanism to prevent falling backwards. Not only is the device manufactured with materials that are lighter and more flexible than current products on the market, but it is also minimal in size making the device more mobile.



A metal brace that runs from the base of the foot to the mid-thigh and a motor attached at the knee are combined into one design for optimal support. Using Maxon Motors' EC90 Flat motor with planetary gearbox GP52 gives the motor a peak continuous torque of 30 Nm and a peak stall torque of 45 Nm due to a reduction ratio of 353:1. At about 1.7kg and only needing 24V this motor gives our user 30% support alone. The motor is controlled with a DEC module eval board with connectors, switches, and a potentiometer to power, control direction, and adjust the speed of the motor at the user's preference.

ANSYS version 18.2 was used to select the optimal material for the device. A fatigue analysis was completed to predict the maximum equivalent stress and total deformation of the metal with the forces from the motor and the body placed upon it. Aluminum 7075 was found to be the ideal material from this simulation as the yield strength of 5.03 E8 Pa is higher than the maximum equivalent strength of 1.85 E8 Pa. Therefore this material is strong enough to maintain the structural integrity when put under significant loads but is still lightweight enough to be convenient for the patient.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1826
SPONSOR: UConn ECE Department
ADVISOR: Prof. Sung-Yeul Park

Laurne Williams, William Brown, Donald O'Boyle

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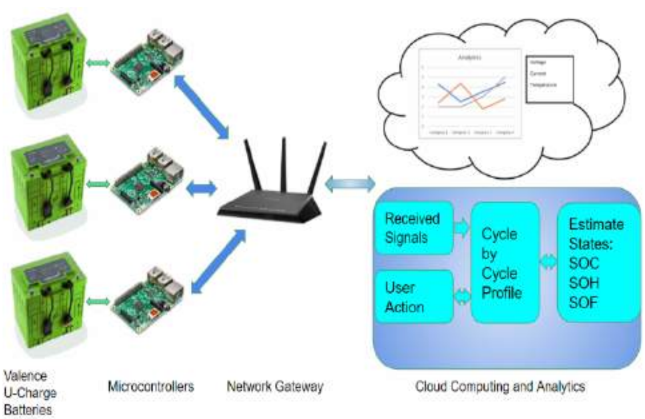
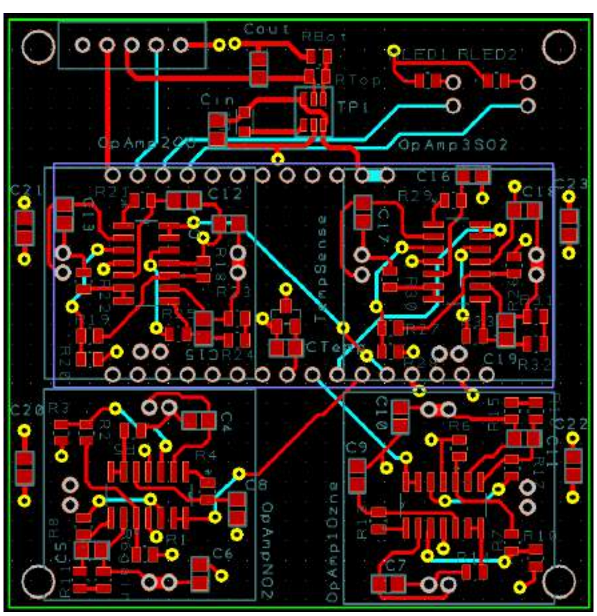
Design of a Cloud-Based Battery Management System





Our senior design project is the implementation of a cloud-based battery management system. A battery management system is a utility that provides analytics on battery charging, from direct metrics such as voltage and current, to more derived metrics like state of charge and state of health. This information is important not only to battery researchers but to systems that depend on stable battery performance. Conventionally, battery management systems depend on serial communication with the battery system, tethering the information generated by the battery (or array of batteries) to the cells themselves. Our project seeks to modernize this approach. By connecting the batteries to a localized system that reports over the internet (wirelessly or through ethernet) to a cloud database, we can aggregate battery data for analysis remotely, amplifying battery research potential and general BMS ease-of-use.

The battery management system will rely on IoT and cloud services to deliver battery analytics in real time to a web page that will be accessible remotely for the user. Doing so is an improvement on the existing system that requires the user to be in proximity to their batteries in order to monitor their charging conduct. Further, this implementation will allow for a BMS that exists at any scale, but centralizing processing power (through the Cloud) and localizing data acquisition, the system will be able to work for any quantity of users, and will passively generate a compiled database of battery infometrics from all sources, serving as a powerful resource for battery researchers.

Localized data acquisition will be handled by a wifi connected microcontroller which will use analog-to-digital converters (ADCs) to intercept BMS-outputted channels from the battery. This "node" will be responsible for a variable number of batteries, depending on the array size. The node will report to a cloud platform hosted on Amazon Web Services (AWS) which will handle data storage, identity management, and off-location computations. Likewise, a user-facing portal developed on the AWS backbone will provide endpoints for users of the system, as well as insights into larger battery charging trends.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1827 Jeffrey Santi, Leyang Shen, Ruochen Xie
SPONSOR: UCONN ECE Department
ADVISOR: Peng Zhang, Shengli Zhou, Taofeek Orekan

Leyang Shen, Jeffrey Santi, Ruochen Xie (Left to Right)

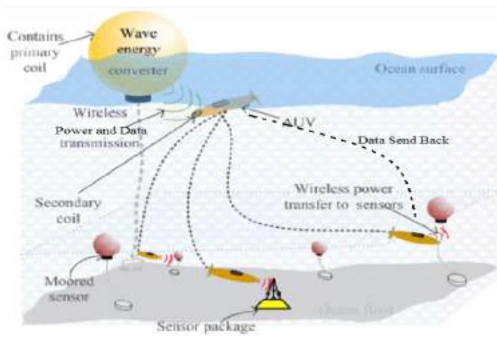
UCONN SCHOOL OF ENGINEERING

Underwater Wireless Power and Data Transfer Via Common Inductive Coupled Coils

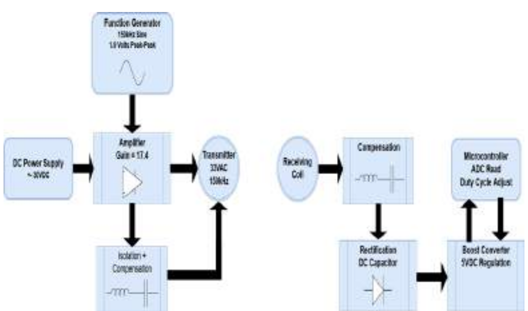
There is a popular growth in undersea industry, especially autonomous underwater vehicle(AUV). The primary need of this project is to transfer power and data for these devices wirelessly in an underwater environment. Since the devices themselves consume abundant energy and manually recharging will require additional labor; the data achieving will also be challenging considering WiFi is not available underwater.

The underwater wireless power and data transfer (UWPDT) system is divided into three main components: the transmitter, receiver and the inductively linked coil which serves as a channel between the latter two. The transmitter is responsible for developing a signal and amplifying power which is then transmitted through the coil. The receiving circuit on the right rectifies the received power and uses a control system to adjust the coupling coefficient, thereby improving the system efficiency.

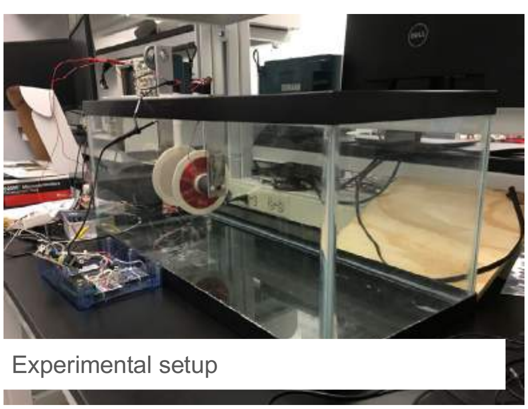
In our design, a data signal generator is added to the transmitter circuit and a data receiving system to the receiver circuit for reconstructing message sent. Once the bidirectional data and power transmission is implemented, this feature is used to develop a novel *Energy Encryption* to protect the power from unauthorized use. The goal here is to ensure that energy is transferred only to the authorized users or to the specific receivers, while saving power at the same time.



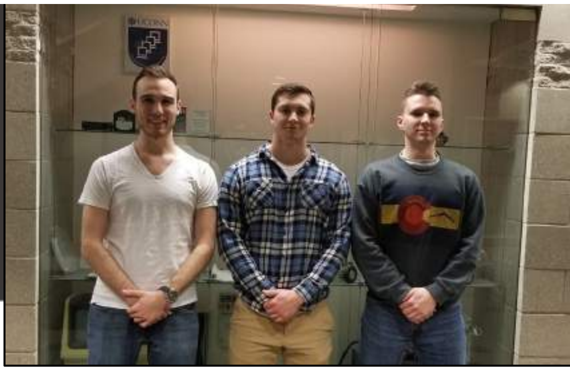
Overview of underwater wireless power and data transfer (UWPDT)



UWPDT block diagram



Experimental setup



From left to right: M. Justin Whitelaw, Daniel Trombetta, and Ryan Saltus

ELECTRICAL AND COMPUTER ENGINEERING

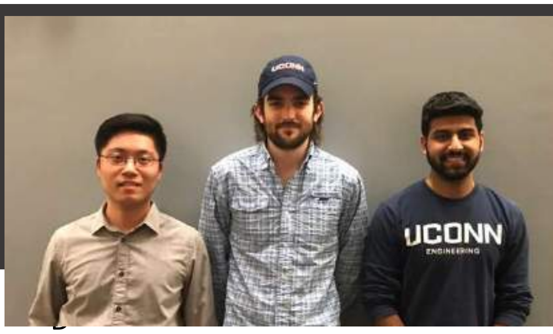
TEAM: 1828
SPONSOR: ECE Department
ADVISOR: Prof. Abhishek Dutta

Cyborg Insect

Micro Ground Vehicles (MGVs) hold many different potential applications including military reconnaissance, subterranean mapping, and search and rescue. However, due to vehicle size limitations, supplying sustainable power has been a major issue in the advancement of the technology. Recently, groups at the University of Berkeley and University of Michigan have had some successes creating insect-machine hybrids, or “insect cyborgs”. As a result of evolution, insects have inherited compact and energy efficient forms, which makes them ideal candidates for MGVs. To develop this cyborg technology further, more high level research will have to be done in this emerging field, which will in turn require the development of tools to assist researchers in running experiments and gathering data.

The goal of Team 1828’s design project is to develop a highly mobile, customizable platform with which researchers can stimulate and record data from a variety of insect hosts. This device will be locally powered, bluetooth compatible, and support a range of different output stimuli and feedback data. In addition, it also will be small enough to mount to the back of an insect and still allow a full range of motion. The ideas for the functionality of this design were founded on a great deal of background research and experimentation.

A variety of initial tests including antennal stimulation, extracellular recordings, and cyborg surgeries were performed in order to discern the necessary requirements for the research device. By using PWM signals applied to different areas, we found the roach’s movement can be manipulated to desired paths through an open loop control scheme. The inclusion of data recording abilities allows the option to close this control loop with feedback, in addition to the obvious experimental recording advantage. Because the trajectory information is very important for the development of an MGV, the addition of an accelerometer and gyroscope on the device will allow valuable position and orientation information to be logged. All data will be transferred via bluetooth between the backpack and a separate computer, where data logging and command programming will be performed. All of these considerations were made with the goal of making the backpack as flexible and efficient as possible for the potential researcher.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM: 1829
SPONSOR: ECE Department
ADVISOR: Shalabh Gupta
D

Tony Chen, David Kay, Ravi Patel

Unmanned Package Retrieval & Delivery Air Vehicle

UCONN SCHOOL OF ENGINEERING

Drone technologies have been operated by the military for the past few decades and have now made their way into the consumer market. As a result, consumers can use drones not only for entertainment purposes but also for solutions to real word problems, one being package delivery. Warehouses today are using robots that are able to maneuver themselves and place packages only in two directions, up and down, side to side, which is unproductive. To solve this problem, implementation of drones will make the process more efficient. This will allow packages to be moved and sorted in all directions, with the result being reduced time moving from point A to point B.

The goal of this project is to design a drone that can retrieve boxes, move them to a new location, and stack them. In order to accomplish this task, the drone needs some means to manipulate the desired packages. To pick up packages a mechanical end effector for the drone, designed around both the method of attachment to the drone and the package itself, will be used. Mounted centrally below the drone, the gripper could also be used as landing gear. Due to the simple nature of the items to be retrieved, such as small boxes, the design and implementation specifications are less rigid and offer flexibility with the design.

In addition to the mechanical requirements of the drone, imaging sensors are necessary for the system to see where it is going. The drone gathers height and position data from infrared, and optical flow sensors, respectively. These systems allow it to have accurate height information, as well as stable position-hold while in flight. Reliable imaging is of paramount importance as the tasks the drone is intended to carry out each require accurate positioning in all planes to complete. The sensors of the drone will be what allows it to retrieve & place objects, as well as automatically land.