UCF College of Engineering and Computer Science
Fall 2018
SENIOR DESIGN SHOWCASE
Friday, Nov. 30, 2018

Schedule

9 a.m. – 10 a.m.
Industry Partner Breakfast*
*HEC 113, *by invitation only*

10 a.m. – 3 p.m.
Showcase of Projects
Inside and Outside Harris Engineering Center and Engineering II

3:30 p.m. – 5 p.m.
Awards Reception
CECS alumni judges recognize the top projects in each discipline and Best In Show
Engineering II Atrium

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Projects Involving Multiple Disciplines

High-Altitude System for Microgravity Research (Florida Space Institute)
Computer Science, Mechanical Engineering
A microgravity research environment provides a more feasible, lower-cost alternative to sending research projects to outer space. This system's balloon – similar to a weather balloon – drops a teardrop-shaped container called an "aero shell" that holds large experiments inside. As the container drops, the experiments are subjected to near zero-gravity, providing valuable test data that is collected and analyzed. The container can be reeled back to the testing platform, allowing for multiple drops/ repeated testing.
– Team 1 *(ENG II, Tables 31 and 32)*
– Team 2 (Mechanical & Aerospace Engineering only) listed on Page 9 *(ENG II, Tables 37 and 38)*

Augmented Reality Physical Therapy
Computer Science, Mechanical Engineering
Involves the Microsoft HoloLens, advanced technology only available to software developers. Designed to improve patients' likelihood of doing their prescribed physical therapy exercises at home. *(ENG II Table 43)*

Florida Solar-Powered Beach Buggy Challenge by Duke Energy
Criteria is to develop an environmentally-safe, autonomous solar-powered beach buggy capable of transporting one passenger at 120 pounds at a top speed of 3 mph, with ability to detect and avoid stationary and moving obstacles, within a budget of $2,000.
– Black Team *(Computer Science, Mechanical Engineering) (HEC Outdoors Table 66)*
– Gold Team *(Computer Sci, Computer and Electrical Engineering, Mechanical Engineering) (HEC Table 67)*
– Blue Team *(Computer Science, Computer Engineering, Mechanical Engineering) (HEC Outdoors Table 68)*
– Fourth Team (Mechanical Engineering only) listed on Page 9 *(HEC Outdoors Table 65)*

Varying Optical Frequency Shifter for Harris Corporation
Electrical Engineering, Photonics
For use in phased array antenna systems to accurately adjust the phase and time delay of optical components. Sponsor requires that the delay range, delay step size, and the time between delay steps can't be met with conventional methods. Project involves a frequency shifting optical system using serrodyne phase modulation. *(HEC Indoors Table A)*

Light-Guide Solar Concentrator with Dual Axis Tracking System
Computer Engineering, Photonics
A compact, efficient, user-friendly example of an in-home energy system with a mobile app. *(HEC Table B)*

Irrigation Systems Innovation: Autonomous Irrigation Vehicle
Mechanical Engineering, Computer Engineering
Targeted for homeowners and community associations, particularly those with water-usage limits, this AIV is designed to traverse the lawn and precisely irrigate only the areas needing water. An attached flexible hose will reel the vehicle back to its starting point when the water is turned off. *(HEC Outdoors Table 74)*

Smart Photovoltaic System for Florida Solar Energy Center
Mechanical Engineering, Electrical Engineering
Solar panel with a frame designed for easy access and long-term cost efficiency. The system employs a new International Standardization Organization conceptual connector and IEEE data protocols to interface with solar arrays and distribute power to a battery attached to each panel to support power throughout various weather conditions and times of day. *(HEC Indoors Table 29)*

Computer Science

ELLE: Virtual Reality 2.0 for UCF's Game Research Lab
Reinforces vocabulary learning through action-oriented quizzes as players travel down a corridor in virtual reality. Educators publish vocabulary words on the web portal so users can actively play with an learn the words in-game. Created to understand how effective virtual reality is for learning a new language, especially in a classroom setting. Developed with a UCF language professor. *(HEC Indoors Table 8)*

Portable Education with Augmented Reality
An educational mobile app to determine if AR is an effective supplement to a class curriculum and student learning in grades K-8. While there are many mobile AR applications, few are structured for education, particularly in physical sciences such as astronomy, anatomy, biology and physics. *(HEC Indoors Table 1)*

Macro Meals: Helps Plan Meals When Dieting
This system recommends recipes based on caloric consumption, likes and nutritional needs. The user builds a profile including their height, weight and gender. The app calculates daily caloric needs. Machine learning will recommend recipes based on user preferences. *(HEC Indoors Table 2)*

Attacking Fingerprinting Authentication with Adversarial Machine Learning
This project aims to prove that neural networks are flawed that can lead to dangerous vulnerability in fingerprint authentication systems holding sensitive data: they can be fooled by small changes to images not discernable to the human eye. This team created a proof-of-concept by attacking their own neural network that classifies fingerprints to different users by using another neural network to slightly modify the image until the classifier authenticates the wrong user. *(HEC Table 3)*

AI-Based Legal Chatbot for Community Legal Services of Mid-Florida
The nonprofit legal aid organization receives tens of thousands of calls each year, with only 30 attorneys on staff. Wait times for an attorney can be up to several hours. This AI system increases the efficiency of the intake process using various technologies. Uses a remote database system, a web hosting server and front-end support to interface with the prospective user. The AI system will learn from an open source set of legal questions and answers that have already been provided. *(HEC Indoors Table 4)*

Deloitte Resume Scanner
This system makes it easier for recruiters to analyze possible candidates in a more efficient manner. Scans resumes into forms using text recognition and a web application that hosts the data. *(HEC Indoors Table 16)*

Mobile Classroom Attendance for UCF
An alternative to sign-in sheets, this system provides a fast and easy way to track class attendance. First, students download the system's mobile app. Then, at the beginning of each class, the teacher opens the Webcourses portal and clicks the attendance tab to display QR codes on the screen. When the screen is projected at the front of the room, students use their apps to scan QR codes. Once the system validates that a student has scanned two consecutive valid QR codes, their attendance will be confirmed. *(HEC Indoors Table 6)*

Scribe: Web Interface for NASA
NASA launch control uses many audio channels with many people speaking on them. People who monitor the streams must listen to different streams simultaneously. The Scribe project uses speech-to-text AI called "Audrey" to display the text from the voice channels in a neatly organized way on the listener's computer. *(HEC Indoors Table 7)*

Computer Science

Case Management System for Colleen Quinn Investigations
Designed to assist in managing records of many cases at the same time. Allows the user to input case information so that it can be easily organized with less duplication. Most investigation and mitigation firms do not have software to manage their data, so this system provides a unique solution for a specialized business. *(HEC Indoors Table 9)*

"SporSight" – Soccer Video Analytics
Simplifies the analysis that soccer coaches perform by tracking and detecting players on the field using video footage of a soccer game. The product stitches multiple videos together to create a single panoramic video of the soccer field. Afterwards, using Convolutional Neural Networks, the system detects each player on the field to track their movement throughout the video. Each player is given a unique ID which allows the coach to easily reference a player. The coach may also use GPS coordinates for players to allow for position analysis. Similar products exist but none are automated or are specific to soccer.
– Blue Team *(HEC Indoors Table 11)*
– Red Team *(HEC Indoors Table 12)*

Database-Backed Mentoring System for UCF iSTEM Program
In UCF's stem-retention programs such as EXCEL and GEMS, upper-classmen mentors give first-year students guidance and support during their transition to college. This project is a database-backed mentoring system and a mobile and web application that provides the lead mentor with constant feedback from mentees on their mentoring experience. System also tracks mentor/mentee attendance. This system automates the current manual documentation process. *(HEC Indoors Table 17)*

UCF Crime Watch Mobile App
Allows users to report various traffic incidences (violations, road hazards, etc) in real time using only sound-based input to an Alexa device which interfaces with the app to submit a report. The reports are gathered and displayed so that a visual representation of the user-generated data can be shown to officials to provide insight on where incidences are most prevalent, to help guide solutions in high-problem areas. *(HEC Indoors Table 13)*

Quantacrime: Predicting Crime Rates Across American Cities
A web-based crime prediction application that uses machine learning to take a city's crime statistics from more than a decade of data to predict crime rates in that city's future. Provides an innovative solution to explain crime data to help users make informed choices. The predictive aspect is what sets this program apart from most crime data programs. *(HEC Indoors Table 14)*

Electrical and Computer Engineering

TankBot: Autonomous Turret Mounted Sentry
Performs dangerous military or security jobs typically performed by humans. TankBot's physical and computational agility allows it to make quick decisions and act on them similar to how a human would react. Multiple modes include search and destroy, patrolling a predetermined area, follow a target, and sleep. Employs camera and computer vision technology. *(HEC Indoors Table 15)*

MITTS: Touch and Temperature Feedback in Virtual Experiences
With MITTS the user can "feel" objects in the virtual environment with a glove and custom software designed for the glove that provides touch and temperature feedback. This project offers a lower-cost alternative to products currently available. *(HEC Indoors Table 10)*

Plan Bee: Commercial Beehive Health-Tracking Solution
Designed as a general-purpose asset tracking solution customized for the client, Pollination USA. A cost-effective device capable of gathering data from a series of connected sensors and broadcasting the data to the cloud for analysis. This project monitors the health and outputs of remote commercial beehives. Design includes GPS locator, load cells, thermistor, humidity sensor, accelerometers and vibration sensors. Weatherproofed hardware allows for placement on the beehives. *(HEC Indoors Table 5)*

Water Smart: Lawn Watering System with Motion Detection
Solves lawn over- or under-watering. Entire system, a zone or an individual head can be turned off in rainy conditions. Motion detection sensors signal the watering to stop to prevent passerby from getting soaked. Powered with batteries that are rechargeable by embedded solar panels. *(HEC Indoors Table 18)*

Smart Mirror
Provides a useful yet minimal way to start the day with features such as weather, timers, and a calendar. Users can also check e-mail. Employs an intuitive gesture and touch interface. Swipe left to open an app dock with a variety of apps. When an app is selected and opened, it consumes the center portion of the mirror. Swipe right to close the app dock and return to the mirror's default state. *(HEC Indoors Table 19)*

RF ChatterBox: Low-Cost Spectrum Analyzer
System displays measured data from different frequencies along an area. A device measures the data and updates in real time in a website. The computer display shows real-time data power measurements taken from the devices in specific locations on campus, and a heat map of the data measured. *(HEC Indoors Table 20)*

Interactive Chess Trainer
Designed to optimally teach new participants how to play chess, and also acts as a competitive opponent for more experienced chess players. Uses LED lights to show available, illegal and recommended moves to help new players. This board can also give more difficult scenarios for experienced players to practice weaknesses. *(HEC Indoors Table 21)*

Solar-Powered Smart Lock
Solar-powered lock grants users access to home by choosing the means of access such as RFID, passcode, fingerprint or a phone app. Easy to program by the user but difficult to hack into. No physical key is needed. *(HEC Outdoors Table 75)*

Electrical and Computer Engineering

Medi-ID Smart Watch
With a goal to provide a second pair of eyes to maximize patient safety, this smart watch provides a wireless way to verify that a patient is located where they should be, and that the patient is identified correctly. Also sends a wireless distress signal in case of a fall or other emergency. The Smart Watch communicates with the wireless networks in the hospital to pinpoint patient's location. It also verifies patient's identity, allergens, conditions and other necessary patient information. *(HEC Indoors Table 22)*

Backup Buddy Universal Camera for Vehicles
A backup camera to install on any vehicle that lacks the safety feature. Design includes a mountable assembly and a smartphone app to see the video feed. Video is sent using WiFi. Distance measuring sensors provide exact distance to obstacles, which is displayed in the app. Also provides audible warnings to the driver in the event of an obstacle. Most aftermarket backup camera systems require a long wire from the back of the car to an external monitor installed on the dashboard. This system eliminates the clutter. *(HEC Indoors Table 23)*

Solar-Powered High-Tech Beach Umbrella
This product delivers the ease and comfort of staying indoors to the outdoor environment. This beach umbrella has all the necessary conveniences, such as a charging station, a cooler, a speaker for amplifying music, weather updates, and a security system. *(HEC Outdoors Table 72)*

Smart Garden Controller
Makes the task of supervising and watering a garden easier and more intuitive. System waters plants autonomously, collects weather data such as wind speed, humidity, and soil moisture levels. *(HEC Outdoors 73)*

T.I.N.J.A.C.: Autonomous Shopping Cart
Helps users who need an extra set of hands – ideal for senior citizens who use walkers or anyone who already has their hands full in a store. This cart uses infrared sensors to avoid obstacles, and sonar sensors to measure how fast the user is walking behind the cart. This smart cart takes the user to the item they want to purchase. *(HEC Indoors Table 24)*

SmartLock System with Keyless Entry and Mobile App
A passive keyless entry system similar to those used on vehicles, and WiFi integration to be used with a mobile app. Many similar products on the market are expensive or have buggy features or poor implementation. This project is a study into how smart lock designs can be streamlined to make a lower-cost, secure and reliable product to expand the market of Internet of Things devices. *(HEC Indoors Table 26)*

Park Shark: Improved Parking Garage Monitoring
The UCF parking availability app sometimes gives inaccurate information to users. UCF's system uses sensors at the front of the garage to track total number of cars entering and exiting. This project tracks each spot inside the garage directly by employing two sensors, a computer vision module and an ultrasonic sensor to detect cars in the garage. *(HEC Indoors Table 25)*

FKAD: In-Home Delivery System
This safe and reliable in-home delivery alternative acts as a third party between vendors and customers. It involves a unit installed at the house's entrance. Employees will have access to the house via fingerprint technology. The process is recorded and uploaded to an app where customer/homeowner will have access and ability to view videos on demand. While this project is focused on shopping items, the system could be applied to home services, such as cleaning services or dog walkers. *(HEC Indoors Table 27)*

Industrial Engineering and Management Systems

Florida Hospital: Controlling Temperature Boundaries of Patient Meals
The team seeks to improve the cycle time of an order to keep hot foods hot and cold foods cold for hospital's Nutritional Dept. The team explored how a server receives an order, builds a tray, and travels to the patient. The team has recommended improvements by exploring all the system's inputs and outputs. *(ENG II, Table 47)*

Process Improvement of Coca-Cola Blending Operations
The plant produces different products that are manufactured on lines that fill multiple sized packages. Products must be blended, pasteurized and delivered to the aseptic tank in a manner that provides a supply of material to the filter with no gaps in supply. Currently the facility experiences gaps in supply which cause manufacturing lines to go idle waiting on supple from blending. There is high variability in completing blends by flavor, associate, crew and time. Currently the impact from product unavailability from blending due to unconstrained line efficiency is 2% or 2,377,000 cases. This team was tasked with improving efficiency. *(ENG II, Table 48)*

Parrish Healthcare Center Patient Experience
This project aims to reduce the wait time at the Center, improve the flow of processes throughout the patient experience, and make the experience more interactive. This team conducted a time study on the system, and then sought methods of improvement. This is an in-depth review of the Parrish Healthcare patient experience and offers a faster, more efficient, and more satisfying patient experience. *(ENG II, Table 49)*

Non-Carbonated Beverage Blending Optimization for Coca-Cola
Focuses on the pre-weighing and staging components for prior to the blending process to reduce the overall blend time and minutes lost due to corrections. This project affects the manufacturing plant's employees and its customers in Auburndale, Fl. The current process needs standardization to the blending line and organization in inventory management. Efficiency solution could be applied to other blending lines. *(ENG II, Table 50)*

Siemens FS Human Performance Reporting and Metric Tracking/Planning & Scheduling
At Siemen's Rural Hall facility, there is a need to improve the process of project scheduling. This team sought to find scheduling software and to test it to ensure all of the client's needs are met. The software will be used by production planners. Requested features in the software include creating visibility in the system, to see the lead time, tracking and forecasting a completion date for 80 different parts with 20 or so process steps each, and the ability to track specific parts based on the client. The software will make scheduling easier and will create a more accurate timeframe. *(ENG II, Table 51)*

NASA: In-Situ Mars Fueling Plant Simulation
To improve and expand previous models of the process of in-situ chemical synthesis. System will include different rovers for locating and mining suitable Martian regolith, and for disposing spent regolith. Rovers will scour the surface in search of water-rich locations, relay locations to the next class of rovers to mine the locations, and remove spent regolith. This project aims to increase the accuracy of the chemical processing model by 25 percent, which will increase the model's validity and prevent miscalculations which could lead to massive costs or a failed mission. Demo shown in virtual-reality for realistic experience. *(ENG II, Table 52)*

Siemens AI: Assisted Robotic Assembly Modeling
This team's goal was to give a robotic assembly system a level of machine intelligence so that it can accomplish more complex tasks to assemble a pipe flange. Currently, a human operator makes decisions when tightening a series of bolts that hold the pipe flange together. Envisioned system is a two-arm configuration that can pivot around the pipe assembly and tighten two bolts at the same time. This has the potential to cut assembly time in half. This is a multidisciplinary effort. We will model the robotics system using simulation platforms such as Simio (Discrete-Event Simulation) and Gazebo (3D Simulation with a physical engine). *(ENG II, Table 53)*

Mechanical and Aerospace Engineering

Simplified Blending Operations for Coca-Cola
To improve mechanical processes and increase manufacturing efficiency for Coca-Cola's juice products. The team addressed the backlog of partially-thawed juice "slurry" (causing manufacturing delays) by effectively heating the slurry to allow for more efficient movement through the manufacturing process. The solution means plant operators will no longer have to spend costly time unfreezing pipes. *(ENG II Table 55)*

Higher-Efficiency Offloading Stage for Coca-Cola
Project's aim is increase the offloading speed in the process of transporting liquid from a tanker to a silo. The components addressed include a motor, a pump, multiple valves, a flow meter, pipe scheduling and size. This team added an air compressor to the system to increase pressure and velocity. *(ENG II Table 56)*

Fixture Design and Automation for Total Refrigeration Gaskets, Inc.
Team was tasked with improving a gasket manufacturing process called splicing by improving the versatility, efficiency and quality of the sponsor's current machine. *(ENG II Table 36)*

Improved Packaged Terminal Air Conditioner (PTAC) for Hotel Rooms
The split system PTAC design gives hotel operators another choice for in-room climate control devices. The project's goals were to decrease the footprint size of a PTAC unit, increase aesthetic appeal, and lower decibel levels to improve the hotel guest experience.
– Black Team *(ENG II Table 39)*   – Gold Team (QuadFlo) *(ENG II Table 41)*
– Blue Team *(ENG II Table 40)*   – Red Team *(HEC Indoors Table 28)*

Hybrid Rocket Motor with Throttling
Supports microgravity research platforms involving a balloon similar to a weather balloon that drops and reels in a container called an "aero shell" that collects data during free fall. Once the device reaches a certain height, a force known as drag, or wind resistance, reduces the amount of data collected. This team's solution is a small attached hybrid rocket thruster that turns on and off to overcome the drag force. *(ENG II Table 44)*

Autonomous Telescope
Tracks celestial objects such as solar systems, nebulae and star clusters, as well as celestial bodies such as asteroids, the moon and sun. Integrates a digital camera to take long-exposure photos. *(ENG II Table 42)*

Florida Solar-Powered Beach Buggy Challenge by Duke Energy
This ME team was tasked with creating a proof-of-concept method of analyzing the efficiency of solar energy as part of sponsor's challenge to develop an environmentally-safe, autonomous solar-powered beach buggy.
– ME Only *(HEC Outdoors Table 65)*   – Three Multidisciplinary teams on Page 3 *(HEC Outdoors 66, 67, 68)*

High-Altitude Platform for Microgravity Research (Florida Space Institute)
This team has advanced the work of a previous senior design team, involving encapsulating an experimental payload into a large "aeroshell" teardrop capsule that freefalls for a predetermined period of time to create a microgravity environment. The system breaks the descent and reels it back up to repeat the process. This project allows for a microgravity duration of 2 to 9 seconds.
– Team 2 (Mechanical & Aerospace Engineering only) *(ENG II, Tables 37 and 38)*
– Team 1 (Multidisciplinary) listed on Page 3 *(ENG II, Tables 31 and 32)*

Distributed Electric Propulsion Aircraft
This system concentrates and uniformly distributes airflow by using several small electric motors along the length of the wing, which increases the lift when compared to other systems. *(ENG II, Table 54)*

Mechanical and Aerospace Engineering

Micro Unmanned Aerial Vehicle
Electrically-powered UAV with at least one pusher-style propeller that will fly around a track with a 32-ounce Gatorade bottle payload. The goal is to fly as many laps as possible.
– Black Team *(HEC Outdoors Table 71)*   – Gold Team *(HEC Outdoors Table 70)*
– Green Team *(ENG II, Table 45)*   – Red Team *(ENG II, Table 46)*

Concrete 3D Printing: Cinderblocks to Build Homes
Project aims to find new, more efficient additive manufacturing techniques for constructing houses. This design works by delivering mortar slurry in a controlled and automated manner to create a structure similar to the traditional cinderblock masonry technique. *(ENG II, Table 59)*

Dynamics Demonstration Unit for UCF Mechanical and Aerospace Engineering
For UCF's MAE Department to help students who struggle with conceptualizing the physical motions associated with velocity and acceleration changes in rotational planes. This team was tasked with designing a device to help engineering students visually understand the concept of dynamics. *(ENG II, Table 58)*

Parabolic Solar Desalination System for Duke Energy
An affordable, solar-powered desalination system to produce drinking-quality water from salt or brackish water. The system uses a parabolic-focusing mirror and solar cooker tube to heat water to boiling, and then collects the resulting condensate. A solar-powered tracking system ensures the mirror maintains optimal angle with the sun.
– Black Team *(ENG II, Table 57)*
– Gold Team *(ENG II, Table 69)*

Micro Steam Turbine Generator
Steam turbine technology scaled down to home-use size. Potential applications include humanitarian relief environments and grid-independent environments. *(ENG II, Table 60)*

Solar Boat for Duke Energy
Teams were tasked with designing a solar-powered boat capable of carrying three adults as an environmentally-friendly alternative to boats with internal combustion engines. Harnesses power from the sun to an energy storage system that is used by the propulsion system. Made for leisure boaters and casual fishing hobbyists.
– Black Team *(HEC Outdoors Table 61)*
– Gold Team *(HEC Outdoors Table 62)*

Zipline Inspection Tool for United Launch Alliance
In emergency situations, spacecraft crew use a zipline cable system to escape to safety from the launch vehicle. Cables must be inspected before each launch for signs of damage that may have occurred from previous launches, corrosion from salt in the air, extreme weather conditions, and more. The current method of inspecting cables is slow and requires many hours to complete. This device records video from an array of cameras and ascends the cable slope at a constant speed. Data is logged with the device's location and stored for analysis.
– Black Team *(ENG II, Table 33)*
– Gold Team *(ENG II, Table 34)*   – Blue Team *(ENG II, Table 35)*

Solar Hydronic Heating System for Florida Homes
The full system collects and stores thermal energy from sunlight and releases the energy in the form of heat. This system has been specifically designed for 2000-square-foot Florida homes.
– Collector Team *(HEC Outdoors Table 64)*
– Storage Team *(HEC Outdoors Table 63)*