



## Fall 2015 Senior Design Showcase

Thursday, Dec.3, 2015, 8 a.m. to 2 p.m., Engineering I and II Atrium  
63 Projects by 283 Graduating Seniors

### **Mechanical and Aerospace Engineering**

29 Teams, 139 Students

#### **1) High Pressure Shock Tube**

Simulates conditions that exist in rocket chambers. There are few shock tubes in the U.S. that can reach pressure of 4400 psi. Used for testing new rocket fuels, biofuels and more.

#### **2) Sustainable Sorption**

A refrigeration system that passively converts waste heat without the use of a mechanical compressor. A more efficient, smaller system than what's currently available.

#### **3) K9 Assist Unit**

A do-it-yourself kit with instructions to help owners of dogs with hip dysplasia custom-fit an assistive device for their dog. Kit employs inexpensive off-the-shelf parts. Final product will be much more inexpensive than assistive devices on the market now.

#### **4) Wave Power Generation System**

"Watts on Water" – A device for recreational boaters that's small enough to fit on a boat. It captures the energy from ocean waves. The energy can help keep boaters' cell phones charged or power music. Can be used on house boats or long-term trips.

#### **5) Hypersonic Aerospace Materials Testing Rig**

A new facility that can allow for measuring the mechanics of materials as they are placed in extreme temperatures (above 1832 degrees Fahrenheit/ 1000 degrees C).

#### **6) Helical Power System – Vertical Axis Wind Turbine**

Uses wind to generate power that will be stored in a battery. Turbine can be used on top of homes and commercial buildings.

#### **7) Furnace Design for Material Synthesis/Testing**

A design for a furnace to make graphene, a material with useful electrical and mechanical properties. Since graphene is only one atom thick, making graphene is difficult.

#### **8) Platform for Combined Extreme Environments – Phase II**

Machine capable of testing thin metal samples under a combination of compression/ tension loading, temperature cycling and vibration. There has never been a device that can test all of these loading types at the same time. Data will be used by the U.S. Air Force for use in fuselage panels of jets that operate above the speed of sound.

### **9) Active Noise Cancellation System**

This project tests the concept of active noise cancellation as applied to a wall through the use of sensors and actuators. This system would be useful for those living in areas with constant noise sources like traffic or heavy machinery. This project aims to expand on current concept and do so inexpensively.

### **10) Motorized Solar Augmented Power Scooter**

Project goal is to create a more sustainable battery runtime of a mobility scooter using solar cells. Designed for recreational setting, such as an amusement park. Solar panel is attached to a scooter. Users use a switch to lift the panel to the top to get maximum scooter performance. Scooter's battery will be charged throughout the day.

### **11) Long Term Creep-Fatigue Testing Rig, Phase II**

First of its kind in creep-fatigue material testing. Phase I was structural foundation of the rig (former senior design team). Phase II has created controls for the cyclic temperature loading and fatigue loading. Another feature is specimen alignment to ensure accuracy of testing.

### **12) Lockzit**

Device that locks objects (a purse, laptop, etc.) to deter thieves. It uses multiple forms of alerts including a buzzer, lights and a message sent to user's cell phone. Device communicates with cell phone and sends/receives GPS coordinates.

### **13) Harris Cold Plate Testing Rig – Joint project with Electrical & Computer Engineering's Project #13 below.**

Measures the temperature of a conductive heated plate at many points, and also measures the airflow and pressure drop across the plate as air is passed over it. Device measures these properties under steady state and pulsating air flow to identify problems. Tool made exclusively for Harris Corporation.

### **14) Soap Bracelet**

A bracelet the size of a wristwatch that delivers a cleaning product to the hands throughout the day. Currently no marketable product similar to this design.

### **15) Fused Layer ABS Hybrid Rocket Fuel Grain**

The core shape of a fuel "grain" (the component in which fuel is burned) greatly influences fuel performance. This project explores the benefits of 3D-printed fuel grains. 3D printing allows for more complex grain geometries or shapes than standard cored, slotted or star grains, and can offer more precise tailoring of the thrust curve.

### **16) Muscle Sensor-Controlled Wheelchair (Electro-Mechanical Interface System)**

Ideal for wheelchair users who have limited hand mobility, this system employs the user's remaining functioning muscles (face, neck, shoulders) to control their wheelchair. A 3D-printed electro-mechanical interface system moves the wheelchair control joystick based on signals transmitted from muscle sensors worn on the user's head or face. There is nothing like this on the market. The closest product is a "sip and puff" controller which uses air pressure to send signals to a device. This product is open-sourced, low-cost (under \$250) and all parts are found in the marketplace. Project led by Limbitless Solutions, a UCF-based nonprofit known for making 3D-printed bionic limbs for children.

### **17) Universal HVAC Project**

A retrofitted HVAC system for a current ride at an Orlando theme park. The ride's current system is from 1991. This system uses the latest HVAC technology and brings the ride up to the standards of the American Society of Heating, Refrigeration and Air Conditioning Engineers. The increased energy efficiency is expected to deliver a positive Return On Investment in two years.

### **18) Sub-Surface Hydrokinetics**

Hydropower is a renewable and clean energy source. This is a water turbine that uses the rough underwater currents at sea to generate electrical power. Project features a unique arrangement of six blades, and a unique body design that acts as another blade to further catch flow and create rotation. Project catches the flow of water in any direction to generate power. Design could be employed by energy companies for underwater turbine farms.

### **19) Kinetic Energy Recovery System**

Conventional braking methods on road vehicles typically waste the vehicle's kinetic energy by converting it into wasted heat. This project, targeted to karts, transfers braking energy to the flywheel using a chain-driven clutching system. No one has applied a flywheel to a kart before. System can be easily installed.

*Projects 20 & 21 are listed under Electrical & Computer Engineering below.*

### **22) Tesla Turbine**

A turbine design that provides an alternative to energy conversion, allowing for the use of renewable resources such as water and air. Powered by a fluid that travels through a chamber of disks with minimal spacing between disks. Creates a "boundary layer effect" that causes the disks to spin. A shaft attached to the disks also spin, producing torque that could be transferred to harness energy.

### **23) Electrolysis and Combustion of H<sub>2</sub>O**

Low-thrust rocket motor system intended to provide propulsion for interplanetary travel or to delay orbital decay in satellites. System uses electrolysis to convert liquid water into gaseous hydrogen and oxygen which, when introduced to a spark inside a combustion chamber, ignites to provide small amounts of thrust. System would allow the amount of traditional rocket fuel necessary at launch to be reduced and replaced by water, which is cheaper and safer than current solid or liquid propellants.

*Projects 24 thru 28 are listed under Electrical & Computer Engineering below.*

### **29) Solar Assisted Unmanned Aerial Vehicle**

A single engine, fixed wing airplane assisted by the power generated from solar cells. Increases flight time of the UAV in an environmentally-friendly way.

*Projects 30 thru 33 are listed under Electrical & Computer Engineering below.*

*Projects 34 thru 39 are listed under Computer Science below.*

### **40) Multi-Parabola Sun Tracker**

Water heater that concentrates solar rays with multi-parabolic dishes to a single receiving point containing a coolant. Energy is transferred to a heat exchanger holding water. Sun tracking software is used to calculate sun's position in the sky based on time of day, and the geo-position latitude of the customer. Dishes follow along the path of the sun throughout the day.

### **41) Foot Pedal-Powered Kayak: Aquatic Human Powered Propulsion System**

A foot-powered (pedal) propeller system that can mount to an existing kayak (no need to modify kayak body). The hands-free system (no paddle required) benefits anglers, photographers, etc. Current solutions require a custom kayak body. This universal mounting system attaches to the kayak through simple straps and mounts. Pedal system to snaps into place. Linear pedals and a cable-based system spins a submerged propeller drivetrain. The downshaft of the drive system is pinned to allow for shallow water operation, and the system itself can be rapidly mounted and retracted with retaining pins and ball detents.

#### **42) Motorcycle Lift**

Assists in safely loading and transporting motorcycles. This project is a safer alternative to existing "do-it-yourself" ramps. The most common method for transporting motorcycles is a trailer. Showcased is an 8-foot lift affixed into a trailer that can lift up to 1,500 pounds. It's easy to use and store.

#### **43) Solar-Powered Vending Machine**

To be used in places that typically don't have vending services, like hiking trails and campsites. It dispenses items such as cooled water, first aid kits, non-perishable food, contained in a rugged, weatherproof structure. Also provides GPS data to the user for the purpose of locating themselves if lost. Solar vending machines exist currently but they are more novelty instead of a necessity.

#### **44) 3D Printed Quadcopter**

The printer used for this project allows for printing a wide range of materials. This will showcase the ability to print fully functional electromechanical devices.

#### **45) Reverse Osmosis Water-Filtration Solutions**

Allows any fresh water source to become drinking water, safely and sustained for up to 3 months. The device filters out particles to U.S. Food and Drug Administration standards. Using reverse osmosis (creating a high concentration of particles in liquids). A semi-permeable membrane removes the particles. A pump forces water across the membrane. System can support a family of 5 for up to 3 months while only using human power for input. Could help disaster victims.

#### **46) "JAMM Pole": Affixed Anchor for Kayak**

Attached to the rear of the kayak and connected to a pulley system that allows the user to pull a lever with one hand to lower the anchor into the lake or river bottom to stop the vessel from moving. This provides a low-cost alternative to what's currently on the market.

### **Electrical and Computer Engineering**

19 Teams, 69 Students

*Projects 1 thru 12 are listed under Mechanical & Aerospace Engineering above.*

#### **13) Harris Cold Plate Testing Rig** – Joint project with Mechanical and Aerospace Engineering's Project #13 above.

Measures the temperature of a conductive heated plate at many points, and also measures the airflow and pressure drop across the plate as air is passed over it. Device measures these properties under steady state and pulsating air flow to identify problems. Tool made exclusively for Harris Corporation.

*Projects 14 thru 19 are listed under Mechanical & Aerospace Engineering above.*

#### **20) SAE Paddle Shift System**

Current Formula SAE vehicle has a manual shifter. The system is slow and hard to use. This project allows the driver to keep both hands on the steering wheel instead of having to remove hand from steering wheel, hold the clutch and move the lever. Project performs upshifts and downshifts. System also allows to shift into neutral from first gear using a special button mounted on the steering wheel. System also includes GPS and data-logging capabilities to use for after-race analysis. System could be adapted for other applications (motorcycles, or assisting people with mobility impairments).

### **21) LIDAR System**

LIDAR systems are typically used in autonomous motion problems such as the Google car. This project is a stopwatch-like component that sheds thousands of dollars off of the price of typical LIDAR system components. This is a discrete sensor that can be used in future senior design projects, that rotates continually 360 degrees taking distance measurements at a fixed rate, thousands of times per second.

*Projects 22 & 23 are listed under Mechanical & Aerospace Engineering above.*

### **24) "HitSmart" Sensor Kit for Boxing Gloves**

Targeted to athletes interested in improving their boxing abilities. Provides insight into strength of their punches, rate of their attacks, and calories burned. This is a smart boxing, training and analytics system. These are not "smart gloves," which is not a new concept. This is a separate sensor kit that can be added to any existing gloves.

### **25) Modular Home Monitoring System**

Incorporates a wide variety of sensors for use around a home, including carbon monoxide, smoke and humidity sensors. Includes a video camera. Allows for remote 24/7 monitoring with text alerts in the event of dangerous situations.

### **26) SERES: Smart Emergency Response System**

Wireless sensor system that detects a hazard and sends out that information to building occupants. After the sensor is triggered, LED modules will light up and display a path to the exit. System is low-power and can easily have new sensors added to it.

### **27) C.L.A.I.M.: Computerized Luggage and Information Messenger**

Scans bags as they are loaded onto the airport carousel and notifies passengers when their bag is available for pick up. The project scans tags placed on luggage. Scanned luggage is also displayed on nearby television monitors, in the order they were placed on the carousel. Intended for airline companies to use to improve the baggage claim experience for their customers.

### **28) Solar Blinds**

Gathers solar energy to put into a rechargeable battery for use in other home functions. Extra features are added to the blinds which use some solar energy for its own operations (LCD, motor, USB charger). Affordable and easy-to-install option to provide renewable resources to an energy-efficient home.

*Projects 29 is listed under Mechanical & Aerospace Engineering above.*

### **30) 3D Mapping Drone**

A drone using consumer grade lidar, namely the Kinect camera, to map an indoor area and give users a 3D representation of that environment. The drone can be autonomous or controlled by a user with a first-person view from the drone.

### **31) SMART CHAIR: Sensor & Mind Automated Remote Technology Power Chair**

Power wheelchair operating system that moves the chair using eye movements, depending on which direction the eye looks when user looks at a set of LED lights (positioned in front of user). Provides an alternative method to operating an electric wheelchair. Requires little to no physical muscular movements by the operator to move the chair in the desired direction. Ideal for wheelchair users with little to no arm/hand mobility. System also features a complete Android application that has a remote controlled joystick, for use by wheelchair user's assistant if present. App includes Google maps that will track where the chair is physically located and a telemetry screen that reports the frequency of the flashing LEDs, distance to the nearest obstruction, longitude, latitude, altitude of the chair and current chair speed.

### **32) The BEER Grid**

Interactive beer pong table using LEDs, fans and sensors. Project has a touch sensitive LED grid on the middle of the table with a cup display and ball cleaner system. Has Bluetooth and app for the phone.

### **33) Mini-Mixer: Automated Drink Mixer**

A kitchen-appliance sized device that automates the process between ordering a drink (order is placed via mobile app) and mixing/delivering actual drink. Historically, this has been automated before but with less-stringent constraints.

*Projects 34 thru 39 are listed under Computer Science below.*

*Projects 40 thru 46 are listed under Mechanical & Aerospace Engineering above.*

### **47) HydroCar**

A power management system for a remote-controlled car serving as proof-of-concept to optimize vehicle performance. The capability for a system to reconfigure itself to conserve energy is a feature seen in vehicle performance chips that lets the user change the vehicle's settings to move faster and conserve gasoline. This project uses software running on the car's engine control module that re-adjusts responsiveness of components such as fuel injectors to according to driver behavior. Florida Solar Energy Center will use this project to teach people about renewable energy.

### **48) Oculus Rift Quadcopter Controller**

Links virtual reality Oculus Rift with a quadcopter to give user a more immersive control experience with a glove controller. A host machine will receive video output taken from the quadcopter, which then feeds to the Oculus Rift. An embedded system is used to communicate between the glove and controller. The Oculus Rift provides a better visual than the standard viewing camera on current quadcopters.

### **49) Smart Umbrella**

Sun tracking umbrella top with solar panels to charge battery, using two motors. LED lighting will have multiple modes, including an entertainment mode. Small LCD display will show user efficiency data from solar panels. Provides USB charging for cell phones. This product is aimed toward a patio umbrella application, but will be light enough to use at the beach or any location.

### **50) BMX-RT (Bicycle Motocross Race Trainer)**

BMX race start simulation tool for riders who wish to improve their acceleration and reaction time once the gate is released. Includes monitors for acceleration, heart rate, and reaction time. Data is transferred in real-time to a mobile application. Solar powered and lower-cost than any other solution for race start practice. It also generates power from the rider pedaling, and the sun, making it a standalone system.

### **51) JUMPNAV: Parachuting Navigation System**

Primarily for aiding military paratroopers. Provides parachutists with essential information about their landing site direction and location, and information about their landing site surroundings. Uses GPS signals and sensors to accurately locate and detect location of users. Uses radio communications to transmit information to others in the network about location, meeting place, etc. Provides team location updates. Could also be used on autonomous vehicles.

### **52) Heart Racer Go Kart**

Offers a new way to make a Go Kart more entertaining. Data is retrieved from a pulse sensor and depending on what a user's heart is doing, LED lights will flash a certain color. Project also has a display that shows driver's beats-per-minute, speed and music selection. Intended to boost the adrenaline levels of Go Kart drivers for a more exciting experience.

### **53) RAVVN: Radio Ad-hoc Vehicle-to-Vehicle Network**

V2V device using a wireless mesh network, allowing vehicles to communicate sensor information such as position, speed and acceleration data to other vehicles within a certain proximity. Also processes incoming data from other vehicles and sends a warning signal to the driver in the event of a probable collision, displaying the direction and immediacy of the danger so that they may take corrective action to avoid an accident.

## **Computer Science**

6 Teams, 19 Students

*Projects 1 thru 33 are listed under Mechanical & Aerospace Engineering, and Electrical & Computer Engineering Above.*

### **34) Complete Concept Strength Application**

Provides an interface that will simplify the training prescription workflow for coaches and their athletes without location limitation. Coaches and athletes will be able to connect to each other in real time once they are registered into the application. Coaches prescribe workouts and athletes post results for a completed workout.

### **35) Argus 911**

Aims to bring emergency response into the 21st century by connecting dispatchers and first responders with the wealth of data generated by modern smart devices and facilitating rapid bi-directional communication between the general public and emergency services. Primary goal is to create a system that improves public safety by facilitating faster and better communication among public, dispatchers and first responders.

### **36) SterilEyes**

Allows professionals to get real-time feedback on donning/doffing of personal protective equipment (PPE), such as an Ebola suit. Goal is to reduce transmission of infectious diseases which can spread when health care workers put on (don) or take off (doff) their PPE. In remote locations with limited resources and tired health care providers, PPE donning/doffing mistakes can be difficult to detect.

This project crowdsources the PPE donning and doffing process so that trained observers from around the globe can help ensure the safety of healthcare providers from their own location. The service allows health care providers to video themselves as they don/doff their PPE and then get feedback from online viewers who provide multiple sets of eyes to help detect potential problems. Used to mitigate risk to health care workers, their patient/s and hospital liability for hospital-acquired infections.

### **37) PopDoxa**

Designed to encourage discussion about politics in a rational and organized manner. Consists of a website that contains a forum and a section for political polls as well as Android application with same features. The polls section will allow users to vote on polls and then slice poll results on user choices and demographics. For example, being able to take a poll about marriage equality and get results not only based on yes/no/neutral, but male votes who said yes, male votes who said no, etc.

### **38) Internet of Things (IoT) Devices Software Security Analysis**

Provides a thorough analysis of security vulnerabilities in the software associated with the Internet of Things devices. This project employs various analysis/exploitation techniques and builds on previous research of various devices to expose vulnerabilities that are potentially harmful to the user or the company.

### **39) Chemical Safety Simulation Game**

Helps train people for OSHA compliance in remembering Hazard Communication Standard. Currently, people train through reading a textbook and taking a paper/pencil test regarding the classification of chemicals and how to interpret hazard information on labels and safety data sheets. This is a simulation video game that makes the training process more fun and interactive, allowing for better information retention. Game is for anyone who may have the potential of coming in contact with hazardous chemicals in the workplace. Trains in identifying and understanding the nine Hazard Communication Standard Pictograms, knowing how to read a Safety Data Sheet and basic workplace safety and procedures.

## **Industrial Engineering & Management Systems**

10 Teams, 56 Students

*Projects 1 thru 54 are listed under Mechanical & Aerospace Engineering; Electrical & Computer Engineering; and Computer Science above.*

### **54) Florida Hospital Altamonte ED – Radiology Turnaround Times**

Identifies delays in the process of non-admitted patients who get an arm or leg X-ray. Goal is to minimize total length of stay for these patients. Project delivers a current state process map with cycle times and identifies opportunities for improvement.

### **55) Florida Hospital Orlando Emergency Department – Lean Track Utilization**

To improve patient flow out of the ED (patients who should be "fast tracked" out). Currently, many patients who are assigned the "Lean Track" use more resources (supplies and personnel), stay longer in the ED and have multiple procedures (inappropriate placement). The objective is to understand the patient assignment process, usage of, and patient flow through the Lean Track at Orlando hospital to improve the process.

### **56) United Launch Alliance VIF Optimization of the Atlas & Centaur Umbilical and Retract Systems (EGSE, MGSE and ECS)**

Objective is to optimize client's work area by improving access to parts, tools, consumables and ergonomics. Optimizing the work area will improve safety, reduce task time, de-conflict scheduled task and optimize resource use while improving employee morale.

### **57) Seminole County Public Schools Exceptional Student Support Services – Time and Efficiency Study of the ESSS Administrative Team**

The ESSS Administrative Team is housed in the Seminole County Public Schools Education Support Center. Each ESSS Cluster Administrator is assigned to a region of schools in Seminole County. Each administrator is responsible for supporting an average of 18 schools. They provide support to the Student Study Team (SST) consisting of a Staffing Resource Specialist, School Psychologist, School Local Education Agency, general education teacher and Exceptional Student Education teacher.

Problem: Is the ESSS Department using its resources in the most efficient and effective way to support schools?

This team used the lean process and tools to achieve the primary goal by identifying benefits to customers, determining value added and non-value added steps, identifying waste and developing value-added processes flows of the ESSS Administrators processes and procedures. (Time on task in SST meetings, Curriculum support, evaluations and programs improvement).

This project is actually being presented to the Seminole County School board.



### **58) Siemens Field Service – Improve Turnover**

Siemens Field Service desires improved communications between personnel shifts at an outage. The client performs a variety of repair, maintenance and upgrade work on existing fossil and steam turbine units across the country – several hundred units a year. Scope of work requires on-site team to work in two shifts (12-hour arrangement). Key information from one shift to the next is critical. This process is documented as a field procedure, but all the site conditions and situation nuances cannot be captured within one governing document. The problems result in rework, missed scope, misplaced specialty tooling or special hardware, and costs Siemens time and money.

This project developed a turnover process that creates an effective communication and documentation between the shifts, resulting in less time spent on the turnover and improves safety, quality and productivity.

### **59) Siemens Field Service – Paperless Turbine**

The goal of this project is to develop alternatives and make recommended changes that will enable the engineering and operations supervisors to spend more time on the turbine deck with the latest information and minimize the amount of printed paper required (move to a paperless system).

### **60) Boston Whaler – Second Quality Reduction**

The company has experienced significant market growth, meaning they have to ask for more products from their suppliers. Since the beginning of 2015, Boston Whaler has processed over \$500,000 worth of parts through "second quality." Second quality parts are classified as such when they are received from a supplier and they are not of the quality expectation. The goal of this project is to reduce the number of second quality parts based on individual part frequency and commodity type by 10 percent.

### **61) Screenworks USA – Improvement and Standardization of Press Set Up**

Set up time has increased to where it is now approximately 35 percent of client's production time. Each team has its own set of procedures and times vary widely. Client estimates it is losing up to 8 hours a day at an opportunity cost of \$125 per hour. The goal of this project is to reduce the average set up time from 7 minutes to 5 minutes.

### **62) SpaceX – Hyperloop Competition**

Elon Musk released a white paper on the Hyperloop, his concept of high-speed ground transportation. This is a design-and-build project of a half-scale Hyperloop pod.

### **63) Parrish Medical Center – DFSS Registration/Scheduling Throughput**

Goal is to optimize workflow, relieving staff of non-productive repetitive tasks and help cultivate an environment where staff seek to improve efficiency, and strengthen customer relationships. Project mapped the flow of the patient through scheduling and registration and improve functions of workflow based on what is observed. Overall goal is to simplify the work process to eliminate or reduce wait times, unnecessary work, re-work, fatiguing motions, long transports and complicated processes by using easier methods and standardization.