**E/CE DEPARTMENT**

**THE COLLEGE OF NEW JERSEY**

**SPRING 2020**

**ELC 496 - Senior Project**

**ONLINE**

**FINAL DESIGN REVIEW (FDR)**

**May 6th from 9:00 am to 12:20 pm**

**PRESENTATION SCHEDULE:**

**9:00 am Smart LED Fixture by Mike Shorr, Jack Rosse and Ian Templeton; Adviser: Larry Pearlstein.**

**Abstact:** In this project the team has designed a high power LED fixture that can be controlled via an Android application, which interfaces over Bluetooth low-energy (BLE). The system includes four major components: a power supply, a LED constant current-driving circuit, a Cypress PSoC 4 BLE and an Android application. The PSoC BLE prototyping kit is utilized to receive data from the Android device and control the LED circuit board to provide variable dimming and color temperature.

**Bios:** Ian Templeton is the team lead and is responsible for the Android application development. He is an electrical engineering major. Jack Rosse is responsible for the firmware development, and is an electrical engineering major. Michael Shorr is responsible for the hardware development. He is also an electrical engineering major.

**9:20 am** **Automated Pollination Information System (APIS) by Zachary Warcola, Jake Bezold, Matt Kilcher, and Adam Varone; Adviser: Dr. Pearlstein.**

**Abstract:** Honey bees are the most important and most prevalent pollinator in the world. It is estimated that about one third of the food consumed by humans relies entirely on the pollination of bees. In order to keep bee populations healthy, hundreds of thousands of beekeepers work day in and day out feeding, expanding, and relocating their hives for maximal pollination. APIS (Automated Pollination Information System) aims to help beekeepers monitor the health of their beehives without having to physically inspect each hive. APIS is a completely self-sustaining IoT device that aims to track the weight and ambient temperature/humidity of a set of four beehives. A beekeeper can access the information about individual sets of hives and view these three properties over time. These properties can then be used as a tool to diagnose the health of each set of hives. APIS utilizes a Pycom FiPy microcontroller to transmit data from various sensors via an LTE connection to a cloud database. A custom web application will extract stored data and create a dashboard, allowing the operator to view the historical hive information. The embedded system is powered via a battery with solar-powered charger, to avoid requiring the operator to change batteries, or provide an external power connection.

**Bio:** Zach Warcola is the team lead and is a senior Computer Engineering student. Matt Kilcher is a senior Computer Engineering student. Upon graduation both Zach and Matt will be starting careers as software engineers at AT&T. Adam Varone is a senior Electrical Engineering major. After graduation, he will be starting his career at Lockheed Martin as a software engineer. Jake Bezold is a senior Computer Engineering major. He plans a career in machine learning upon graduation.

**9:40 am Convolutional Neural Network Acceleration Hardware by Paul Brodhead, Kiera Cullen, Hussain Khajanchi and Ryan Mosher; Advisor: Dr. Larry Pearlstein.**

**Abstract:** Deep Convolutional Neural Networks (DCNNs) have made significant progress in approaching a wide range of problems in the general area of computer vision. However, they generally require enormous computational resources and are therefore difficult to deploy in real-time systems. To address this problem, we designed a system for accelerating the core operations required by DCNNs, by using a low-cost Field Programmable Gate Array (FPGA) platform. We designed an end-to-end accelerator platform, including a PC running Linux, an FPGA board and PC-to-FPGA communication via serial data (over USB). We designed a hardwired convolution processor using custom fixed-point multipliers, and a software handler for sending and reconstructing images. Using custom Verilog/VHDL RTL descriptions and C++ software, we aim to exploit the parallelism inherent to FPGAs for high-speed acceleration.

**Bio:** Paul Brodhead is a computer engineering major. He was the systems engineer for this project. During the summer he was as an intern at the Naval Undersea Warfare Center in Newport, RI. Kiera Cullen is an engineering management major with a specialization in electrical engineering. After graduation she plans to work in project management. Hussain Khajanchi is a electrical engineering major. After graduation he will pursue a PhD in E/CE. Ryan Mosher is a senior electrical engineering major. After graduation he will work at L3Harris Technologies.

**10:00 am Augmented Reality Smart Device by Christopher Sluke, Chris Henry and Ranen Liu; Advisor: Anthony Deese.**

**Abstract:** Augmented Reality (AR) is an area of technology that superimposes computer generated imagery onto a user’s real-world environment, and is used in a wide array of fields. However, one area of use that has been overlooked is the potential to display important information in front of a user’s eye, eliminating the need to look at a smartphone, which may prove distracting during activities such as driving. The project team has sought to address this issue by creating an AR smart device, which affixes to a pair of glasses, displaying information including the direction, speed of travel, and time. The design is lightweight, and includes a microcontroller, gyroscope, and GPS sensor. These sensors allow the device to gather the information mentioned previously.  After coding and testing each sensor, the finished device was put together, before being further streamlined to minimize the overall bulkiness when the user is wearing it. It can be attached onto most standard sized glasses to display the time, direction, and speed information onto an OLED screen.

**Bios:** Ranen Liu is a computer engineering major. After graduation, he hopes to join a company that works with business software solutions. Chris Sluke is a computer engineering major. After graduation, he will work at L3 Harris Technologies. Chris Henry is a computer engineering major. After graduation, he hopes to join a company that focuses on sustainability in engineering.

**10:20 am Teleoperation of Humanoid Robot Using Motion Sensing Technology by Garrett Hope; Advisor: Seung-yun Kim.**

**Abstract:** The goal of this project is to create an enhanced telerobotic experience, by controlling a humanoid robot with a person's motion. Telerobotics has many applications, be it medical, military, space/sea exploration, etc. In most cases, these robots are used to do things, or go places that a human cannot. This project is focused on making the human operator feel even more so like they are in the place of these robots, by controlling them with the motion of their own body. A Microsoft Kinect V2 motion sensor is used to track the human's movements, which are translated directly to a NAO robot. Each of these technologies are interfaced using their respective software development kits: Kinect for Windows 2.0 SDK PyKinect wrapper, and NAOqi SDK. Both of these are compatible with Python 2.7, which allows for low latency and high accuracy between the Kinect and NAO robot.

**Bio:** Garrett is a Computer Engineering major. After graduation he will be working as a software engineer at AT&T.

**10:30 am Smart Metering by Joel Rivera, Endale Seleshi, Daniel Puzio and Derek Lopez; Advisor: Anthony Deese.**

**Abstract:** Smart metering is a smart gas sensor that is able to record and transmit gas readings of a residential home or commercial business. The purpose of he smart meter is to eliminate the cost of labor for utility companies for routine checks that are performed physically by meter readers. The project utilizes an airflow sensor, Narrowband-IoT, Amazon Web Services, and the Android platform to produce this smart meter. Narrowband- IoT (NB-IoT) communicates gas readings to Amazon Web Services (AWS), where the data is stored in a cloud database. From here, the Android mobile application takes data from the AWS database and presents it to the user in an easily readable manner.

**Bios:** Joel Rivera is a Senior Electrical Engineering major who holds a passion for IoT and communication systems. Joel will continue his education at NJIT, while working at Tenna as a Hardware Engineer. Daniel Puzio is a Senior Electrical Engineering major. Dan has spent the last two summers at PSEG working in solar project management and substation design and controls. Previously, Dan has interned at BAE Systems. In the future, Dan plans to obtain an MBA. Derek Lopez is a Senior Computer Engineering. Last summer he interned at Prudential Financial performing cloud computing. Derek plans to obtain an MS in Internet Engineering at NJIT. Endale Seleshi is a Senior Computer Engineering major who is one of the software developers and webmaster for this project. After graduation, he wants to work in software engineering.

**10:50 am Trauma Sense by Alex Regner, Ryon Barclay, Jonathan Ortega and Julian De La Cruz; Advisor: Allen Katz.**

**Abstract:** This project is to develop headwear that is outfitted with accelerometers and a Bluetooth sensor in order to detect the forces acting on the wearer’s head. The accelerometers record the acceleration affecting the head on a three-axis coordinate plane. This information is then sent via the Bluetooth sensor to a mobile application that is also being developed. There, the data will be interpreted and displayed in a manner that will be easy to understand by a user. The intention is for the device and application to be used for potential medical incidents that may occur when playing contact sports. Medical professionals will be able to see the acceleration that affected the head and use the data shown to properly assess any possible medical issues.

**Bios:** Alex Regner is a senior Electrical Engineering student and the group’s project manager. He is also the contributor to the medical research and accelerometer design. Ryon Barclay is a senior Electrical Engineering student. He is involved with the circuit design and printed circuit board layout. Julian De La Cruz is a senior Computer Engineering major who is working on the mobile application portion of the Trauma Sense project. Jonathan Ortega is a senior Electrical Engineering student. He is in charge of the physical structure of the headband and the compatibility among the components.

**11:10 am Pre-Ictal Electroencephalographic Pattern Recognition Monitoring Device, by Joseph Bruno, Emily Driscoll, Daniel Funke and Samantha Mastriano; Advisor: Ambrose Adegbege.**

**Abstract:** According to the Center for Disease Control (CDC), approximately 3.4 million Americans suffer from some form of epilepsy. While the type and severity of seizures experienced by epilepsy patients vary over a wide range, all seizures are inherently caused by abnormal neuroelectric patterns occurring at the surface of the brain. The Portable Electroencephalographic Ictal Pattern Recognition and Monitoring Device (PEIPR MD) is a wearable device that will record, store, and process a user’s brain activity for the purpose of detecting the onset of an epileptic event. The device will be worn on the head and will apply a variety of analog and digital signal processing techniques to monitor the recorded data. It will also integrate via Bluetooth with an Android device to distribute alerts over the internet to a predefined set of individuals if a threshold event is detected (e.g. medical professionals or a user’s family). An added benefit of such a device is the *in situ* collection of EEG data. That is, even when the device does not detect a threshold event, it will collect a patient’s EEG data as they perform their normal daily routine. This type of information can help physicians develop individualized treatment plans to address the unique symptoms of a specific patient and thereby improve clinical outcomes. While a few commercial products currently exist that perform these tasks, they can be prohibitively expensive. The goal of this project is to develop a device that will deliver the same functionality at a drastically reduced cost.

**Bio:** Emily Driscoll is a senior electrical engineering major. Her interests are in Power Systems and Semiconductors. She is Vice Chair of the IEEE Student Branch. Joseph Bruno is a senior electrical engineering major. His interests lie in the field of Control Systems and Analog Circuit Design. He is IEEE Student Branch Chair.

**11:30 am Motion Detection Security System by Paul Giordano, Alex Predenkoski and Evan Rahimi; Advisor: Anthony Deese.**

**Abstract:** The objective of the group’s senior project is to create a security sensor that detects motion through an infrared sensor, and transmits this data over WiFi to a neat and organized mobile application. The group will utilize the Firebase real time database to store data as well as communicate with the app to let the user know their sensor’s activity. The motion sensor module will be created with an infrared sensor, WiFi module and an internal battery. The final product will also include a convenient mobile application that will allow the user to create an account, and better manage their personal sensor’s data. The application will be available for both IOS and Android devices, and will be coded through Xcode and Android Studio respectively. For the first semester, the goal is to have a barebones mobile application that will display the data for the sensor from the Firebase real time database. The second semester of the project will be focused on the polishing of the app, while also looking at more luxurious features such as better data encryption and insightful analysis of the user’s data. The main point of emphasis for the project is to create a system that is a commercially competitive in price, size, battery life and response time.

**Bio:** Paul Giordano is a computer engineering major and developed the iOS application and the software for the WiFi communications. Alex Predenkoski is also a computer engineering major. He developed the Android application and the hardware design of the WiFi circuitry. Evan Rahimi is an electrical engineering major. He worked on the housing, project planning and website for the project.

**11:50 am Emotion Recognition/Expression Using Nao Robot by Brian Rentsch and Trisha Dusari; Advisor: Seung-yun Kim.**

**Abstract:** In recent years, human-robot interaction (HRI) has emerged as a significant area of study in the field of robotics due to its wide range of potential uses and implications. As humanoid robots become more sophisticated in their capabilities and more common in our society, the importance of HRI will only increase. One recently developed humanoid robot, the NAO robot, has been widely accepted in the education and healthcare industries due to its pleasing physical design and extensive range of body movement. A high level of human acceptance, as achieved by the NAO robot, is an integral part of effective HRI. As such, this project aims to further improve the ability for humans and robots to interact meaningfully by developing speech-activated robotic facial features, which may be incorporated onto a NAO robot to achieve an even greater level of human acceptance. NAOs are highly equipped for expressing realistic body language, but lack the functionality to express meaningful facial emotions; through this project, we have addressed this shortcoming by creating a physical device which can be attached to a NAO robot to add physical, motorized eyebrows and lips to the robot that enable it to express a significant range of facial emotions in reaction to human speech.

**Bio:** Brian Rentsch is a senior computer engineering student graduating in Spring 2020. He performs undergraduate research in image processing using deep convolutional neural networks, as well as long-range communication using LoRaWAN and NB-IoT protocols for asset tracking. He interned at AT&T, and hopes to pursue a career in software development. Trisha Dusari is computer engineering major. She has a keen interest in software development and product design and has interned at Guardian Life Insurance Co where she worked on designing APIs for their future state architecture. She plans to pursue a career in product development after graduation at Infosys.

**12:00 noon ISO 9000:2015 Certification Quality Engineering Processes by Kristen Munafo; Adviser Anthony Deese.**

**Abstract:** The ISO 9000 certification is a highly coveted quality registration. The criteria include a worldwide based collection of guidelines for quality assurance and quality management. The goal of this project was to obtain the ISO 9001:2015 quality management and quality assurance certification for a company by preforming the functions of a Quality Team Leader. There are some twenty elements that go into the certification, and starting with top management’s commitment. The Quality Team Leader trains personnel, prepares a quality policy manual and operating procedures, holds internal audits, selects a registrar and completes registration process.

**Bio:** Kristen Munafo is a senior Engineering Science student with a specialization in Management and a preference for Electrical Engineering. She plans to pursue a career in project management and an MBA.

**12:10 pm Applying DSP Techniques to Monitor RF Signals by Lucas Andrade; Adviser: Joseph Jesson.**

**Abstract:** The combination of digital processing and analog RF has always made up communication systems. The objective of this project is to develop a low cost weather station capable of receiving and processing a satellite signal to demonstrate a comprehensive understanding in signal processing techniques used in software defined radio. To achieve this, the system model requires a Quadrifilar Helix antenna, a low noise amplifier, a receiver and a PC sound card. The data output from the sound card is recorded as an audio file. This file is decoded using DSP processing techniques by digital satellite streaming RF reception, sampled and demodulated using a Matlab programming environment.

**Bio:** Lucas Andrade is a senior Computer Engineering major. After graduation he plans to pursue a PhD in Cybersecurity.