ECE UTDESIGN EXPO – SPRING 2021

Friday, May 7, 2021

TRACK 1 AGENDA

9:45 am – 10:00 am **Welcome: Dr. Lawrence Overzet: Spring 2021 EXPO main meeting**
10:00 am – 11:12 am **ECE UTDesign EXPO: Oral Presentations: Track 1 Spring 2021 EXPO**
12:00 pm – 2:00 pm **ECE UTDesign EXPO: Poster Presentations (Links to MS Teams in a separate document)**

Time	Team	Project Title	Faculty Mentor	Corporate Mentor
10:00	1153	**Advancing Speech Technology for Apollo Mission Audio (UTDesign II)**	John Hansen	
10:06	1129	**Micropac MODLink Ethernet-Optical Media Converter (UTDesign II)**	Neal Skinner	Tom Cruz
10:12	1130	**Hoboloco Foot Controlled Game Controller (UTDesign II)**	Neal Skinner	Rick Tett
10:18	1131	**Redesigning the Arrowhead M90 Trailer (UTDesign II)**	Ian DiFranco	Jose Avendano
10:24	1132	**Raytheon Unmanned Aerial System Innovative Showcase (UTDesign II)**	Marco Tacca	Alfonso Lopez
10:30	1133	**Not Your Common Sensor: Drone Detection and Tracking System (NYCS) (UTDesign II)**	Marco Tacca	Sharon Miller, Anthony Cappiello, Marco Maldonado
10:36	1134	**Visible Light Communication (VLC) System (UTDesign II)**	Marco Tacca	Andrea Fumagalli
10:42	1135	**Acoustic 3-D Sound Lab (UTDesign II)**	John Hansen	
10:48	1275	**Microsecond Temperature Measurement During Photonic Curing (UTDesign I)**	Marco Tacca	Julia Hsu
10:54	1276	**Savior Smart First Aid Kit (UTDesign I)**	Marco Tacca	
11:00	1278	**Health Detection System (HEDS) (UTDesign I)**	Marco Tacca	
11:06	1279	**A Study Hat-empowering Solution to Sleep Deprivation (UTDesign I)**	Marco Tacca	

ABSTRACT LIST

1153 Title: Advancing Speech Technology for Apollo Mission Audio

Team Members: Rafael Espino (CE), Tae Yoon Kim (EE), Kristopher Ables (CE), Aryan Barghi (CE)

Abstract: Our main goal was to establish a knowledge-based speech detecting solution which achieves consistent performance in terms of equal error rate (EER) and Decision Cost Function (DCF). Speech Activity Detection (SAD) is the first processing step in any speech technology used to diarize massive audio materials such as the UTD Fearless Steps Apollo corpus (19k hours of data). The success of various speech technologies depends on effective performance of SAD since detecting the presence/absence of speech vs. noise impacts all potential follow-on tasks such as Automatic Speech Recognition (ASR) or Speaker Identification (SID). Our solution is expected to be employed in the UTD-CRSS solution to process and release over 150,000 hours of the entire NASA Apollo missions as a resource for the international community. Thus, our team's solution will have a significant impact on the community. The solution was built upon supervised machine learning method called bDNN, which is well-suited for audio data with high noise. To improve performance of the neural network, hyperparameter tuning and alternative front-end speech feature extraction methods were explored. The performance of the solution was measured on previously recovered NASA Apollo-11/13 data by UTD-CRSS using Equal Error Rate (EER) and Decision Cost Function (DCF), accuracy metrics based upon speech-vs-silence. An investigation was also conducted to document the original NASA SoundScriber, a historical recorder used to record audio logs of mission communications during NASA missions. This effort also detailed the re-design of the playback system by UTD CRSS to support 30-channel digital audio recovery on the original tapes. Documenting both hardware and system allows for an effective understanding of sources of potential noise and interference in the analog audio tracks. Highlights of the team's work was presented in a published abstract and oral presentation at the NASA Human Performance Investigators' Conference (Feb. 1-4, 2021).

1129 Title: Micropac MODLink Ethernet-Optical Media Converter

Team Members: Lane Bolan (EE), Andrew Ridge (EE), Matteo Sarmiento (EE), Christopher Pierce (EE), Johnathan Schneider (CE/CS), Don Kelly (EE)

Abstract: Ethernet-Optical media conversion is often used for transmitting within server farms over distances unsupported by, and through regions where electromagnetic and radio interference may introduce noise to, copper twisted pair wiring. The conversion is performed because fiber optic supports transmission over longer distances and is immune to electromagnetic and radio interference. Fiber also weighs significantly less than copper. This means that a more robust specialized ethernet-optical media converter design could be well-suited for use in high electromagnetic and radio interference generating equipment in outer space.

In an effort to explore the design requirements and capabilities of a media converter suited for outer space, this project uses an FPGA board to implement an ethernet-optical media converter that uses similar protocols and interfaces to what would be used in a media converter built for the target environment and equipment. The project's critical design is programmed into the on-board FPGA to process signals received by or intended for transmission by the on-board ethernet-phy and SFP connector. An off-the-shelf SFP module with fiber optic loopback adapter is inserted into the SFP connector. The fiber optic loopback adapter returns SFP module transmissions to the SFP module receiver to demonstrate the media converters ability to convert signals from ethernet to optical and optical to ethernet. The signals are generated and checked by a PC connected to the board via ethernet.

1130 Title: Hoboloco Foot Controlled Game Controller

Team Members: Sarvesh Kodiswaran Ramiya (CE), Murali Krishna Velineni (CE), Adwaith Moothezhath Rajesh (CE), Shubham Patil (EE), Pranav Chopada (CE), Amaey Bellary (EE)

Abstract: HoboLoco is a startup that develops Human Input Devices (HID) intended to improve movement and control for virtual reality, video games, and telerobotics. These devices use standard protocols such as keyboard, mouse, and gamepad to provide compatibility with most existing applications and games. HoboLoco has prototyped a variety of designs. These prototypes use off-the-shelf Arduino-type processor boards mounted on breadboards. In order to manufacture devices for sale, HoboLoco needs a custom printed circuit board (PCB) and a connector-based wiring scheme.

The main goal of this project is to design, build, and test a custom, optimized controller PCB with connectors and a suitable system on a chip (SoC). Our team will research a selection of SoC products that would meet the requirements. These requirements include support for BLE, and WiFi, availability of HID libraries, memory, performance, and cost. Once the PCB design has been completed and a mockup has been tested, a few will be manufactured. The team will demonstrate the capabilities of the finished PCB including emulation of HID keyboard, mouse, and gamepad over wifi when connected to a PC. The team will also prepare a simple demo showing how the controller can be programmed from a web server connected to the PCB. The PCB controller will enable HoboLoco to proceed toward manufacturing and selling a variety of products.

1131 Title: Redesigning the Arrowhead M90 Trailer

Team Members: Erin Butler (EE), Ryan Foley (EE), Seshen Fraser (CE), Jeonghwan Kim (EE), Pegah Merdasi (EE), Bryan Untalan (CE)

Abstract: Our goal is to analyze the current design to find opportunities for new technology to improve competitiveness, reduce weight, and reduce cost. The team collaborated with the mechanical team to redesign the Hill & Smith Arrowhead trailer. The team is composed of three parts: controller, solar panel, and battery & LED. On the controller side of things, the team designed and implemented a DC-DC converter, logic controller with LED driver, solar tracking controller and mobile app. The mobile app, especially, is one of the improvements of competitiveness proving that the new trailer can communicate via wireless. The LED lamp and battery section goals are to improve the total power efficiency from the LED lamps in order to decrease the total battery capacity, therefore aiding in the reduction of total cost. For the solar panel and LED parts, the team used more efficient components with lower cost. Also, the team adopted the solar tracking system enabling us to reduce the size of the solar panel, which allows to reduce the weight and entire cost.

1132 Title: Raytheon Unmanned Aerial System Innovative Showcase

Team Members: Arjun Bakhshi (CE), Mira Jambusaria (CE), Salek Khan (EE), Bishesh Manandhar (CE), Ryoma Takahashi (EE), Alisa Thomas (EE), Keerthana Yogananthan (CE)

Abstract: The EE/CE Team, sponsored by Raytheon Intelligence and Space, designed and built a drone that autonomously completes a variety of challenges such as precision landing and obstacle avoidance on a football field. This system is delivered on a mixed Raspberry Pi 4B / Coral Edge TPU platform enabling real-time data processing and ML inference on the drone platform. We are working with another team at UT Dallas consisting of CS students who are developing the software package, while we (the EE/CE) team will be developing the hardware platform, flight system, and hardware/software integration. This project took two semesters (Fall 2020 and Spring 2021), and at the end of the Spring 2021 semester, our drone will compete against other autonomous drones built by UT Arlington and UT El Paso. Over this past academic year, our team successfully reached our goals of completing research, modeling our parts in CAD, 3D printing our final drone design, integrating all hardware/software components on the drone, and writing and testing Python scripts for autonomous flight for all three of the competition's challenges. We will be participating in Raytheon's UAS Showcase on May 1st, 2021.

1133 Title: Not Your Common Sensor: Drone Detection and Tracking System (NYCS)
Team Members: Luke Adams (EE), Jemetric Freeman (CE), Kruti Modekurty (CE), Matthew Moss (EE), Zachary Post (EE), Aaron Schuette (CE)

Abstract: Two million drones are currently registered in the United States and according to the FAA the number is expected to double by 2021. It is only a matter of time before a rogue drone encroaches on the user's territory. The low-cost passive drone detection and tracking system uses only acoustic and radio frequency data to monitor quadcopters. A software defined radio scans the 2.4GHz band for energy changes. When a change is detected the acoustic sensors are activated. A machine learning algorithm then decides if the detected noise is a drone. If the sound is confirmed as a drone, a direction of arrival is calculated from two sensors. The intersection of the direction of arrivals is then calculated, tracked, and displayed on the central computer.

1134 Title: Visible Light Communication (VLC) System
Team Members: Ian Bird (CE), John Bunyard (EE), Mariana Huerta (EE), Gelareh Nobakht (CE), Bryan Ray (EE), Kimberly Klein (CE)

Abstract: As 5G technology rapidly takes over today's world, Visible Light Communication has the potential to offer high-speed data rates, security, and ample bandwidth with the blink of an LED. It opens a whole new spectrum of frequencies and alleviates the already saturated RF spectrum. The purpose of our project is to successfully prototype a VLC transmitter (TX) and receiver (RX) that will transmit a signal wirelessly using light from LEDs. We aim to transmit and receive data at a frequency of up to 200 MHz through free space with our VLC system. For transmission, our team has chosen to use a crystal oscillator to send the very high frequency through our pre-emphasis stage, which boosts the signal output for the LED. For receiving, we have opted to use a photodiode to capture the signal and send it through a transimpedance amplifier to increase the voltage and a high-pass filter to reconstruct the signal. Building from the research and design we did in Fall 2020, we have built and tested our transmitter and receiver prototypes to verify their behavior in the lab.

1135 Title: Acoustic 3-D Sound Lab
Team Members: Jason Dang (CE), Samuel Hoopingarner (CE), Nicholas Ngo (CE), Matthew Roan (CE), Samuel Roberts (EE), Steven Paisley (CE)

Abstract: Communication is essential for people to learn, interact, and develop/maintain relationships. Communication disorders, either speech/language/hearing, can have a lasting impact on a person's ability to achieve happiness and contribute to society. This means it is vital to detect communication disorders early. Additionally, it is crucial to advance technological and scientific solutions to maintaining communication skills as individuals experience age related reductions in hearing. To aid in these endeavors, our team has worked on revamping a collaborative, between Jonsson School and BBS/Callier Center, research lab focused on spatial audio testing. This lab, located in the Callier Center, houses a 24-speaker array that will aid in evaluating subjects, which include children and adults, for various speech/language/hearing research studies. The entire apparatus consists of: (a) a visual reinforcement system, (b) a multi-channel 24-speaker audio control system, and (c) a corresponding sound booth patch panel and integrated experimental computer-support system. Implementation and integration of these systems together allows researchers to conduct experiments which include playback of specific test sounds from individual speakers within the array (i.e., assess bi-lateral hearing

and localization abilities), utilization of monitors to provide visual stimuli (i.e., provide visual and/or audio stimuli from controlled directions), connection of equipment for use inside the booth by subjects, querying of feedback by means of an in-room response button, and usage of a front-display screen for subject data support. The goal of this project was to establish an effective lab infrastructure that can support a diverse range of hearing and speech based human subject testing needs from faculty and researchers at the Jonsson School and BBS/Callier Center. This includes establishing a workflow that is well-defined and easy-to-use while enabling efficient execution of various types of speech/language/hearing tests. Current development will allow the equipment and systems to be presently usable but primed for further progress and additional refinement.

1275 Title: Microsecond Temperature Measurement During Photonic Curing
Team Members: Connor Gray (EE), James Ferrell (EE), William Varner (CE), Gabriel Formenti (CE), Jessica Grayson (EE), Hizkias Mekonnen (EE)

Abstract: Traditional thermal annealing techniques for use in material fabrication take anywhere from tens of minutes to hours. In order to move towards roll-to-roll manufacturing, processing samples one after another as fast as possible, high-intensity light pulses may be used as a replacement for more traditional forms of heat, like ovens or furnaces. This technique is known as photonic curing, which uses a xenon lamp in a confined space to heat and process samples in as little as one millisecond. The purpose of our project is to determine the actual surface temperature of samples as they anneal during the photonic curing process. Measurements need to be taken at a sub-microsecond time resolution, and over a temperature range of 25-600°C.
Our team researched both optical and electrical approaches to measure the surface temperature of the samples. For the optical approach, research indicated that a pyrometer would be a feasible option. A pyrometer is a type of non-contact thermometer which measures an object's thermal radiation to determine temperature. For the electrical approach, we found that a pure metal thin-film thermistor deposited onto the sample would be able to accurately measure temperature changes at a sub-microsecond time resolution. The resistance of a pure metal thin-film thermistor increases as the temperature of the sample increases. Using this resistance value allows for the temperature of an object to be calculated at a given temperature.
Throughout the research process, our team determined that the optical approach, using the pyrometer, would be more applicable to a variety of samples. The main issues with this method is the cost and the bevy of unique problems that we would need to accommodate for. As for the electrical approach, using the pure metal thin-film thermistor, this method is well within the time and temperature constraints of the project, but will not work on every type of sample. For the purposes of our project, our team will be focusing on the electrical approach, as the pyrometer for the optical approach is too costly and would take a significant portion of our limited timeframe to complete the project.
To simulate a conventional photonic curing machine, our team will be constructing a prototype photonic curing set up with a commercially available flash-lamp and a black box built of heat resistant material. This prototype rig will enable our team to quickly iterate upon our designs and allow for the detection potential issues.

1276 Title: Savior Smart First Aid Kit
Team Members: Rachel Richardson (EE), Raghav Balasubramaniam (CE), Sangho Lee (EE), Mohammad Hamim (CE), Chintan Vora (CE), Timothy Brown (EE)

Abstract: In 2019, private industry employers reported that 2.8 million non-fatal injuries and illnesses occurred in the workplace. Shock, stress, or lack of first aid knowledge can lead to improper or no treatment of injuries acquired on the job, potentially resulting in life-threatening consequences. Various on-site medical emergency

response packages, such as the automated external defibrillator (AED), guide the user through the treatment steps for someone experiencing cardiac arrest. Incorporating a comprehensive response package like the AED has been shown to reduce the "fight, flight, or freeze" response that occurs during medical emergencies. The same approach can greatly benefit different types of injuries treatable with a smart first aid kit. Functionalities of the kit include symptom assessment, injury identification, and injury treatment. The kit connects users to first responders by calling 911 in the event of an emergency. It communicates through two microcontrollers alongside a GUI presented on a display screen and provides audio cues to help the user tend to a variety of medical injuries such as cuts, burns, fractures, etc. Vitals such as temperature, heart rate, and blood oxygen saturation level are measured via sensors interfaced through one of the microcontrollers. Anonymous incident reports are logged in a database for future use by the company. Additionally, after a treatment plan is complete, a screen prompts the user to rate their experience and provide feedback so that the kit can be optimized to its highest potential.

1278 Title: Health Detection System (HEDS)
Team Members: Ellington Shephard (CE), Yusuf Abdallah (CE), Arvind Narayanan (CE),Tarnparit Kaur (EE), Omar Abdel (CE)

Abstract: Although the public consensus is that we are nearing the end of the COVID-19 pandemic, even as daily vaccination numbers increase and statewide restrictions are eased, COVID-19 still remains a prevalent threat to the public's health. The Health Detection System (HEDS) has been designed with several useful features to aid in combating the spread of the coronavirus, flu, and any other general illnesses. The HEDS system is meant to be utilized in schools, stores, public buildings and most commercial businesses. The main components of HEDS are its infrared temperature scanner, distance sensor, mask detection unit and electromagnetic locking mechanism. The combination of these modules along with IOT cloud computing allows the HEDS device to monitor building capacity, record all health screenings, and regulate building entry. If someone approaches the HEDS device with a temperature of 100 degrees Fahrenheit or greater, business management is notified, and the said individual is restricted from entry. If the current capacity count exceeds a predetermined value, further entry will be ceased, and business management will be notified. This aids facilitators in ensuring compliance with both fire code, and local/state COVID-19 building capacity ordinances and restrictions. Additionally, tracked metrics can be utilized for businesses to monitor hourly traffic and adjust their services accordingly. The overall goal of our system is to help businesses maintain safe social distancing practices and to minimize possible risks to public health.

1279 Title: A Study Hat-empowering Solution to Sleep Deprivation
Team Members: James Travis Pitts (EE), Caleb Perez (CE), Zhe An Qian (CE), Charles Kumets (CE), Nicholas Zahabizadeh (EE), Nha Nguyen (EE)

Abstract: At present time, extended periods of wakefulness is a widespread, common phenomenon . Many factors, both environmentally and psychologically, play an active part in detrimentally influencing individuals to lose out on length or quality of sleep. Mental fatigue is a prolonged habit unwarranted, but resultant of society and an individual's life habits to adapt to it. Changing daily life routines to establish a healthier mental cycle is often times difficult to achieve short term due to many constraints including tied to sustaining the individual's livelihood and their ability to make end meet in order to survive. Various occupation throughout society require prolonged needs for active attention and focus, such as drivers, emergency medical workers, and students. Individuals seeking academic tutelage and learning make up a large majority of those experiencing a congested lifestyle wrought with mental fatigue. This often times cannot be helped given most students' immaturity towards aspects of efficient time management. Therefore, a device that is able to enable its user to push through a tiring workload is oftentimes needed as a temporary remedy. This device being fitted in the form of a wearable contraption on top of an individual's frontal region extending to the crown of the

head will efficiently allow delicately setup sensors within the device to monitor the user's biometrics and facial contours in order to track the extensive drowsiness that may be occurring. Once the device has confirmed a prolonged fit of inactiveness due to fatigue, it will physically alert the user to awaken.

ECE UTDESIGN EXPO – SPRING 2021

Friday, May 7, 2021

TRACK 3 AGENDA

9:45 am – 10:00 am **Welcome: Dr. Lawrence Overzet: Spring 2021 EXPO main meeting**
10:00 am – 11:06 am **ECE UTDesign EXPO: Oral Presentations: Track 3 Spring 2021 EXPO**
12:00 pm – 2:00 pm **ECE UTDesign EXPO: Poster Presentations (Links to MS Teams in a separate document)**

Time	Team	Project Title	Faculty Mentor	Corporate Mentor
10:00	1144	**Firefighter Data Collection Device (UTDesign II)**	Marco Tacca	Eric Hamke
10:06	1145	**Deepcut: A Robot that Raps (UTDesign II)**	Neal Skinner	
10:12	1146	**Automatic Billing Shopping Trolley (UTDesign II)**	Neal Skinner	
10:18	1147	**Multifunction Helmet System with HUD (UTDesign II)**	Neal Skinner	
10:24	1148	**The Smart Garden Sensor System (UTDesign II)**	Marco Tacca	
10:30	1149	**CompuStart: Hardware-Software Integration Through a Modular Computer System (UTDesign II)**	Marco Tacca	
10:36	1150	**Grill Buddy (UTDesign II)**	Marco Tacca	
10:42	1151	**TempIRature (UTDesign II)**	Marco Tacca	
10:48	1283	**Electrical Engineer Workbench (UTDesign I)**	Neal Skinner	
10:54	1284	**Smart Mail Crate (UTDesign I)**	Marco Tacca	
11:00	1277	**Smart Mirror (UTDesign I)**	Marco Tacca	

ABSTRACT LIST

1144 Title: Firefighter Data Collection Device
Team Members: Georpi Ikamba (CE), Fahad Fayyaz (CE), Nicola Overa (EE)

Abstract: Many firefighters lose their lives on the line of work due to poor communication among them. With an increasing need to improve firefighters' safety and security across the United States, there is a growing need to incorporate new technologies in the development of electronic devices to enhance the monitoring of firefighting personnel's health conditions while on the field. This assignment is part of a larger project between UTD and UNM to propose a solution. The overall project consists of developing electronic devices that will form a Local Area Network. Firefighters will use it to share data about their conditions and environmental hazards wirelessly to a base station. The data is processed, analyzed, and monitored to assure each firefighting personnel's safety and security in real-time. Our work focuses on developing a firefighter node device, a relay node device, and the nodal network connecting them with the base station. The relay node consists of a Beagle Bone Black development board encased on a high-impact and fire resistance enclosure. The firefighter node comprises a Beagle Bone Black development board and a Nordic nRF52DK covered with the same type of enclosure. However, we will use an Arduino board for practicality during testing as a substitute for the Nordic nRF52DK board, which will serve as a simulator to generate the data initially supposed to be coming from the Nordic nRF52DK board that the UNM team is developing.

1145 Title: Deepcut: A Robot that Raps
Team Members: Jarrod Luckenbaugh (EE), Heriberto Felipe (EE), Shah Misbahul Huda (EE), Delia Victoria Trejo (CE), Hamza Aamer Bhatti (CE), Luz Martinez-Lucas (EE)

Abstract: Multimedia signal processing and music generation are both subfields of engineering that may benefit due to advances in speech technology. We present a system that is capable of the synthesis of music with a rapped vocal style performed on a custom built robot. This consists of 2 main subsystems: 1) A synthesizer capable of end-to-end generation of rapped vocals given only a string of text and the choice of several ”flow” parameters that dictate the vocal articulation over the provided lyrics. This consists of an initial text-to-speech synthesis, followed by a novel speech-to-rap transformation. 2) A robotic performance module that generates movements using these vocals and mixes them with a selected hip-hop backing track. The system will generate vocals/performance data on the fly to be communicated to the robot wirelessly via a local wireless socket. The robot will have two moving arms, an LCD based face, and an onboard speaker system, all connected by a Raspberry Pi 4B single board computer. Team members will present the final system and the results of perceptual studies on the generated performance.

1146 Title: Automatic Billing Shopping Trolley
Team Members: Prachi Patel (EE), Kishan Patel (EE), Devanshi Patel (EE), Kriti Sarker (CE), Zachary Maeshima (CE), Zareen Subah (CE)

Abstract: Based off research, 73% of shoppers within supermarkets have claimed that they would prefer retail self-service technologies instead of engaging with store associates. Similarly, another study shows that 83% of customers value a quick and easy checkout the most. The objective of our project is targeted towards making the overall shopping experience faster and efficient for customers. There are pre-existing cart technologies such as the Dash Cart by Amazon; however, they are available on a smaller scale and are not as affordable. Our automatic billing shopping trolley provides users with the option of choosing an automatic billing shopping

trolley and thus, eliminating the time spent waiting in line for checkout and allowing them to both shop and pay through the cart. The system will utilize a regular shopping cart with an embedded barcode scanning system that allows users to add/remove items from their cart with prices of the individual items and total bill listed displayed on an LCD screen. Weight sensors using Raspberry Pi on the cart track the items' total weight to provide authentication to the purchase process and finally, a simulated credit card system allows the customer to pay effortlessly7erterterertertthrough the cart itself and sends the receipt to the customer's email.

1147 Title: Multifunction Helmet System with HUD
Team Members: Luis Montes de Oca (EE), Severo Vasquez (CE), Daniel Quintero (EE), Kumel Waliany (EE), Nam Nguyen (EE), Omar Elsaadany (CE)

Abstract: In a foreign environment, navigational information and communication is key, especially when potential lives are at stake, which is what led to the development of a wearable helmet device that aims to assist users with their occupational tasks. This device will not only provide the user with useful information about their environment, but also contain a variety of features that can improve overall performance in the field, even within hazardous work environments. For example, the team tracking feature will allow the user to identify the location of other users as well as send their own for other users to see. To achieve this, the system will consist of an inertial measurement unit sending a collection of sensor and GPS data to the core Raspberry Pi, which will in turn relay that information to the user through a visual interface. Simultaneously, the Raspberry Pi will broadcast/collect this information to/from any other device in the system that is within range, providing an overall view of the team.
We also recognize that feedback of this data must be presented to the user in a timely and effective manner in order to reduce the amount of response time between actions. This is why we have integrated an AR headset onto the wearable helmet device, which will provide an AR visual interface that the user can use in order to quickly identify the location of other users in a 3D space while still maintaining their own vision.

1148 Title: The Smart Garden Sensor System
Team Members: Ikemefule Ekwueme (EE), Milan Gulati (CE), Helen Lee (EE), Justin Lu (EE), Sophia Malony (CE), Jonathan Washington (CE)

Abstract: Over the past decade, the number of gardeners across the country has grown by over 200%. As this sustainable and satisfying hobby has become more popular in urban areas, small gardens have become a common sight across the country. The Smart Garden Sensor is designed to provide convenience for home gardeners by offering an easy-to-use system that works directly from their garden and an online dashboard for visibility into current growing conditions. Our solar-powered solution provides convenience to the user by monitoring the plants' environment through multiple sensors and displaying the results to the user through an online interface. The system also includes methods on adjusting the plants' environment such as the amount of sunlight and water present in the soil.

1149 Title: CompuStart: Hardware-Software IntegrationThrough a Modular Computer System
Team Members: Nicolas Rodriguez (EE), Deanna Rodriguez (EE), Kento Maeda (CE), Valentin Rodriguez (EE), Michael Ly (EE), Hija Tovi (EE)

Abstract: To educate users on the design process of a computer, the functional capabilities, and the connection between hardware and software, our team has created a modular computer system that incorporates older technologies that will demonstrate the fundamentals of computer building. Coming equipped with various modules and instructions on how they were created, users will be able to recreate the system and add upon

it with their gained knowledge. This objective of this project was to present a niche educational tool to the public. There are already tools that give an understanding of basics or others that show the higher-level design. This system will work to demonstrate both and the connection between them.

1150 Title: Grill Buddy
Team Members: Huy Nguyen (CE), Jeongho Park (EE), Joel Allen Carabeo (EE), Romi Goldberg (CE), Theo Esemuze (CE), Zachary Sanford (EE)

Abstract: There are many food thermometers on the market, but most of them require you to be standing with the food and nervously watching so as not to over or undercook it. The goal of our project is to alleviate the anxiety of cooking meats and other various foods to the correct temperature. In order to do this we will use a wired temperature probe that you can leave inside whatever you are cooking and walk away while it cooks. An app that will be available on Android will notify you when your food is ready based on a pre-specified meat and/or recipe that the user will input. We would also like to integrate the information for all the steps in between like flipping the meat over or when to change the temperature of the grill to get that pull off the bone feel. With heavy focus on software development we want to have one of the most comprehensive apps on the market, allowing anyone from a professional chef to a novice griller to be able to use our product in their grilling for the perfect outcome every time.

1151 Title: TempIRature
Team Members: Muhammad Mubeen (CE), Apratim Kaustubh (EE), Prajwal Paul (CE), Michael Elandary (EE), Jacob Thampan (EE), Mohammad Mubashir (CE)

Abstract: With COVID-19 affecting billions of lives all across the globe, active safety measures like checking temperature frequently is crucial. The availability of mobile devices should unlock a new and convenient way for people to regularly check their temperature. Existing contactless thermometers and devices measure temperature from a safe distance but do not connect to a personal mobile device for real-time temperature sensing. The main purpose of our team was to design and create a contactless thermometer that can interface with a web application. Additionally, the device's accuracy is on-par with competing contactless thermometers. We wanted the device to be rechargeable as this is environmentally friendly and helps users save money in the long run. Our device consists of a microcontroller, IR temperature sensor, a battery with a battery management board and can connect to any device with WiFi capabilities. The microcontroller connects to a mobile client to show the temperature results in real-time which can be done within Wi-Fi range. Using this simple method, people can feel confident about their health by allowing for quick temperature checks anytime, anywhere.

1283 Title: Electrical Engineer Workbench
Team Members: Christian Duffee (EE), Tsega Fetene (EE), Anita Luo (CE), Teresa Nguyen (EE), Nicholas Roth (CE), Nour Shoukri (EE)

Abstract: Electrical Engineers commonly use three basic tools for the testing and debugging of electric circuits: a power supply, function generator, and oscilloscope. Traditionally these have been separate large and expensive pieces of equipment, however efforts have been made recently to condense these into a single cheaper device. Many of these projects lack adequate voltage and frequency ranges for professional use.
This device will offer these four fundamental functions in the form factor of a textbook. It will consist of a dual power supply with a 36 V range, a dual function generator with a 36 V and 15 MHz range, a bank of high speed programmable logic gates, and a dual oscilloscope with a 15 MHz range. All functions will be controlled via a cross-platform GUI on an external device connected via USB, to which data can be easily exported. A large

amount of breadboard area will be available to allow circuits to be constructed on the device itself, which will be protected by a removable cover that will permit safe transportation inside a backpack. The device will be powered via a single wall plug and will consist of less than $500 in parts to ensure convenience and affordability.

1284 Title: Smart Mail Crate

Team Members: Bryan Pham (CE), Louis Avila (EE), Ennis Brown (CE), Nguyen Tran (EE), Saja Zahra (CE), Michael Osa-Okoro (EE), Imran Hussain (EE)

Abstract: One creation that has made everyone's life a little easier is at home delivery services. One thing we haven't yet achieved is a smart at home delivery service that doesn't require any human to human interaction, only human to computer interaction. The smart crate reports a new method of delivery to provide customers and businesses with higher level security. This takes deliveries to a more extensive level, ensuring that packages will arrive and be stored in a safe place when they are not available for pickup. This development will use a high quality camera for live view, multiple sensors and notification alerts to deter porch pirates, and a tracking number scanner to allow delivery drivers to gain access to the box. This will all be powered from a Raspberry Pi Zero W, a lightweight yet efficient microcomputer that allows us to program all the functions of the crate without having to worry about excessive heat and power draw from the device. Users can remotely access the Pi to update the tracking number so that the delivery driver can gain access to the crate via barcode.

1277 Title: Smart Mirror

Team Members: Cosmo Ha (EE), Mackenzie Fitzgerald (EE), Sahil Verasia (EE), Jonathan German (CE), Esau Sanchez (EE)

Abstract: Recently we have seen a surge in smart devices such as smart phones, smart boards, and smart mirrors. We want to create a more innovative smart mirror that will allow the user to have more control and more accessories. The key will be showing our ingenuity and skill in this project by utilizing code in unison to create one smart mirror that accomplishes everything you would want a mirror in 2021 to have.
We will be using new and old features of smart mirrors which include voice command, IR frame, facial recognition, different profiles for users, LED lights, and different applications. We will accomplish these various tasks using Raspberry Pi 4 code to sync different accessories such as a microphone for voice control and camera for facial recognition. These accessories and customizations will come together to create one functioning smart mirror that accomplishes these various tasks cohesively.

ECE UTDESIGN EXPO – SPRING 2021

Friday, May 7, 2021

TRACK 2 AGENDA

9:45 am – 10:00 am **Welcome: Dr. Lawrence Overzet: Spring 2021 EXPO main meeting**
10:00 am – 11:06 am **ECE UTDesign EXPO: Oral Presentations: Track 2 Spring 2021 EXPO**
12:00 pm – 2:00 pm **ECE UTDesign EXPO: Poster Presentations (Links to MS Teams in a separate document)**

Time	Team	Project Title	Faculty Mentor	Corporate Mentor
10:00	1136	**Bluetooth Handset for Microsoft Teams (UTDesign II)**	Marco Tacca	
10:06	1137	**Vehicle Keyless Entry Signal Attack Simulator (UTDesign II)**	Ian DiFranco	Mark Fairchild
10:12	1138	**Intelligent Occupancy Management Using Air Quality Measurements (UTDesign II)**	Marco Tacca	Riyaz Muhammad
10:18	1139	**Natal Cheq: The Veterinary Birthing Monitor (UTDesign II)**	Marco Tacca	Sharon Caswell
10:24	1140	**TI-Innovator Hub Backpack DAQ Tool (UTDesign II)**	Neal Skinner	Mark Easley
10:30	1141	**Implementing Digital Pre-Distortion for Power Amplifiers Using Software-Defined Radio (UTDesign II)**	Marco Tacca	Richard Wilson
10:36	1142	**Doherty PA Tuning (UTDesign II)**	Marco Tacca	Richard Wilson
10:42	1043	**Integration of System Controller for Devices data Analytics Storage (UTDesign II)**	Marco Tacca	Matthew Poulton
10:48	1274	**Totally Autonomous navigating Kodi (TANK) (UTDesign I)**	Neal Skinner	Karl Kevilus
10:54	1281	**Internet-of-Things Inventory Control Shelves for HEB Stores (UTDesign I)**	Marco Tacca	Karl Kevilus
11:00	1282	**CloudPlug (UTDesign I)**	Marco Tacca	Gert Grammel

ABSTRACT LIST

1136 Title: Bluetooth Handset for Microsoft Teams
Team Members: Kashif Brown (EE), Joshua Dastague (EE), Joanna Martin (EE), Sean-Micheal McGuire (EE), Nithin Kumar Santha Kumar (EE), Robert Woods (CE)

Abstract: With the Coronavirus pandemic pushing most work and school online, the need for online communication platforms, like Microsoft Teams, has greatly increased. With this has also come a desire for more headphones that people can use while at work or in class. Our goal is to create a cordless telephone-like Bluetooth device that interfaces with Microsoft Teams.
The user will have the ability to accept and hang up calls and mute and control the volume straight from the device without having to touch their computer. Professors at UTD can use this device to interact with students and colleagues virtually. The Bluetooth phone will be designed to interface cleanly and minimally with MS Teams without the need for configuration and will function like a regular landline phone, but with the Bluetooth interface.

1137 Title: Vehicle Keyless Entry Signal Attack Simulator
Team Members: Joel Johnson (EE), Aaron Brown (EE), Noor “Emen” Cloyd (EE), Zeyad Elhabbab (CE), Orlando Garcia (EE), Kevin Stack (EE)

Abstract: Automotive security has been repeatedly targeted by hackers in a multitude of ways. The methodology and techniques continuously evolve in sophistication and complexity. Keyless entry systems have become a standard feature in the automotive industry, allowing owners to remotely open and start their cars using either passive keyless entry systems [PKE] or remote keyless entry systems [RKE]. To deter unauthorized opening and starting of the vehicle by car thieves, car manufacturers often employ encryption and rolling code techniques to provide security. This project aims to develop hardware for the testing of various car makes and models for their susceptibility to relay, replay, and immobilizer attacks.

1138 Title: Intelligent Occupancy Management Using Air Quality Measurements
Team Members: MD Fiaz Islam Bhuiyan (CE), Maxine Cabrasawan (EE), Bobby Counts (EE), Benjamin Dattilo (EE), Chandler Linseisen (EE), and Pranav Mathews (EE)

Abstract: Murata Manufacturing Co. has tasked the UTDesign Team, Team WAQ, with creating a low-maintenance system that successfully predicts occupancy in a building through non-intrusive sensing technology. Data gathered by the system must be transmitted wirelessly to a central hub for processing and prediction. Team WAQ's engineering team will focus on the physical sensor network while the computer science team will concurrently design the prediction algorithm.
The design is split into three parts: sensor modules, LoRa gateway, and cloud server. Sensor modules are equipped with sensors that send recorded data to the gateway. The gateway then forwards this information to the cloud, where the prediction algorithm uses it to predict occupancy. Each sensor module consists of a custom PCB header mounted on top of a LoRa development board that is housed in a 3D-printed casing. Powered by a battery, a single unit can run for up to two years without needing maintenance. Every module in a network connects to a central gateway through a wireless LoRa network, seamlessly transmitting data to the cloud. Future work will focus on creating a single custom board that combines the functionality of the header and dev board.
The occupancy prediction system allows for pre-emptive regulation of building systems such as HVAC, leading to savings in both money and energy for companies. Additionally, occupancy management has been crucial in the past year during the COVID-19 pandemic. Implementation of this system would be integral in remaining

vigilant over proper air quality in highly interior spaces. As a non-intrusive monitoring solution, the Intelligent Occupancy System is an enabling technology that will lead to more effective building management and safer interior environments.

1139 Title: Natal Cheq: The Veterinary Birthing Monitor
Team Members: Michaela Perez (CE), Andrew Gallegos (EE), Matthew Cruz (EE), Gaurav Mohile (EE), Matthew Hinson (EE), Cheng Yang (EE)

Abstract: For this project we are tasked with making a system to detect when an animal is about to give birth. Because the products currently on the market can be unreliable and invasive, our goal is to predict parturition more accurately by utilizing a non-invasive, three-input configuration, sensing temperature, contractions, and device orientation. Fastened to the abdomen of the animal, the device will use a highly accurate temperature sensor to measure ambient temperature drops and an IR sensor to detect muscle contractions. In combination with data from an accelerometer and gyroscope, filtered and amplified information will be sent from a microcontroller to a Raspberry Pi 4 over a BLE protocol to be uploaded to a database. The data collected will be analyzed by an algorithm to continuously track the health condition of the animal. The mobile devices of veterinarians, breeders and owners may then get alerts and display data from the database once user-specified thresholds have been reached.

1140 Title: TI-Innovator Hub Backpack DAQ Tool
Team Members: Bradford Manning (EE), Danfeng Wei (EE), Hong Kim (EE), Jacob Earley (EE), Jacob Noonan (EE), Sunho Kim (CE)

Abstract: The COVID-19 pandemic increased the demand for tools that engineering students can use to learn remotely ("backpack tools"). As a result, Texas Instruments (TI) is looking to utilize an existing product from their technology portfolio that can be adapted for academic use and offer capabilities to assist with Data Acquisition (DAQ) in classwork and labs. Our design is an affordable and portable alternative to bench-top electronic test and measurement equipment that would normally only be found in an in-person lab setting. This design also provides a compelling, low-cost alternative to popular portable equipment used today.
The TI-Innovator™ Hub is a project kit that extends the functionality of TI graphing calculators to make coding and engineering design accessible to students in the classroom. The intended use is for students to program with TI graphing calculators and explore STEM concepts, learn basic coding and design, and use those skills to program and build working solutions. It is classroom-ready hardware and has an ideal form factor for a backpack DAQ tool.
We were tasked by Texas Instruments to create an inexpensive, highly portable suite of electronics T&M equipment including an oscilloscope, function generator, voltmeter, digital logic analyzer, and DC power supply using the TI-Innovator™ Hub in a unique application use-case beyond its original design.
We created software and firmware and designed hardware modules that enabled us to develop the previously mentioned suite of DAQ tools that interface with the TI-Innovator™ Hub. We used Texas Instruments' Code Composer Studio and GUI Composer in order to create the firmware and software that will be utilized to run our DAQ tools as well as the GUI. We also used the TI LaunchPad development kit to prototype the designs in hardware and recreate the results on the TI-Innovator™ Hub.

1141 Title: Implementing Digital Pre-Distortion for Power Amplifiers Using Software-Defined Radio
Team Members: Evan Sun (EE), Susana Lainez Garcia (EE/CE), Aaron Pan (EE), Kenneth Matthews (EE), Amy Abraham (EE/CE), Alexander Polednik (EE)

Abstract: In order to reduce operating costs, network operators use high efficiency RF power amplifiers when deploying cellular networks. The tradeoff of these efficient amplifiers is that they exhibit non-linear power

input to power output characteristics. This translates to unwanted intermodulation distortions (IMDs) in sideband frequencies that violate spectral emission standards. Digital pre-distortion is a common, cost-effective technique to compensate for the non-linearities associated with the power amplifier. By preemptively distorting the desired input in a manner complementary to the distortions generated by the power amplifier, the output can be linearized at a typically non-linear operating point. This leads to a more linear power amplifier, without requiring any direct modifications to the power amplifier itself. In this project, we present a static DPD solution implemented using a commercial, off-the-shelf software-defined radio. We record a distorted test sample for calculating a set of generalized memory polynomial coefficients and use these coefficients as an input to a predistortion algorithm. Furthermore, we will present our progress regarding the implementation of this predistortion algorithm in the native FPGA of the SDR. In addition, a 5W RF power amplifier has been designed using Qorvo's QPD0005 RF GaN transistor.

1142 Title: Doherty PA Tuning
Team Members: Victor Omoto, Anthony Vu, Kevin Mashayekhi, Cheema Zoraver, Ethan Markle, Claude Dubois

Abstract: The purpose of the RF Power Amplifier is the amplification of an RF signal to the expected level at an antenna port. Linear amplification is required to maximize data throughput and to enable the receiver to accurately demodulate the transmitted signal. As the power amplifier is the highest power consumption component in the radio, efficiency is key to minimize the radio running costs. In addition, a high-efficiency amplifier can be implemented in a smaller, lighter form factor due to the reduced heat sinking required. A combination of low complexity, high efficiency, and wide signal bandwidth capability makes the Doherty configuration the optimal solution for BTS applications. The tuning process for a Doherty PA can be complex and time-consuming since any amplitude and phase changes typically involve PCB trace or component changes. The solution presented by the team will allow engineers to quickly evaluate the performance of the Doherty under multiple conditions to find the optimal design of input split.
Our team, sponsored by Qorvo, designed a method for optimizing the performance of a Doherty amplifier through the tuning of the amplitude and phase of the RF input signal. The team is designing a system whereby the user can change the input amplitude and phase to properly tune the Doherty amplifier. In doing so, it will become faster to tune and evaluate the Doherty amplifier's performance.
We decided to use a LimeSDR as the implementation for signal generation, with Lime Suite and Python as our coding tools. Input parameters will be adjusted in the software to obtain optimal results in power and efficiency. We will then capture the output signal of the Doherty amplifier with the same SDR and compare it to the input given. The visualization of the data will be handled through Python GUI. We are working on two solutions for visualization, one that handles the data directly from the trace file and one that uses data that has been input into an Excel document.

1143 Title: Integration of System Controller for Devices data Analytics Storage
Team Members: Andrew Krueger (EE), Hermilio Javier (EE), Muntasir Khaleque (EE), Matherws Joel Prince (EE), Connor Boykin (EE)

Abstract: Mobile data traffic per month is expected to increase from 14 exabytes in 2017 to 110 exabytes in 2023. In order to keep up with the mobile data demand, designs involving radio frequency (RF) GaN/GaAs devices are used to meet the demand of the mobile data network. For our project we are focusing specifically on a GaN RF power amplifier provided by Qorvo and how to maintain its optimal operation. The optimal operation will be a bias point that balances efficiency and linearity for our use case. There are two device characteristics that we will be focusing on, temperature drift and cycle drift. The device will be tested and measured for long periods of time and through many temperature cycles in order to characterize the device

during operation. Then we will create a compensation algorithm based off lab data in order to maintain the optimal operation point even when device drift occurs. This allows the device to stay in operation for longer periods without frequent maintenance.

1274 Title: Totally Autonomous navigating Kodi (TANK)
Team Members: Rishab Nair (CE), Orobosa Ogbemudia (EE), James Tran (EE), George Yu (CS), Maziar Mirrokni (CS), Nick Dobmeier (CS), Marshall Morton (CS), Sam Ali (CS), Johnathan Schneider (CS)

Abstract: The purpose of this project is to make HEB's TANK autonomous, making it easy to transport groceries to customer vehicles, homes, and any other area convenient for their customers. The TANK is a robot equipped with motorized treads designed to carry grocery items from point A to point B in any terrain. Our team's solution involves implementing microcontrollers, GPS modules, cameras, computer vision, machine learning, and other sensors which can help the TANK move, and operate autonomously. We also plan to implement a Graphical User Interface (GUI), which will allow for user-friendly operator control of the TANK. Navigational aids on the TANK and the Google Maps API will be utilized to allow the TANK to easily navigate pedestrian walkways, making autonomous neighborhood level deliveries possible. With this autonomous TANK, HEB can potentially save on delivery costs, slim down the store-to-consumer delivery process, and provide greater convenience options for their customers.

1281 Title: Internet-of-Things Inventory Control Shelves for HEB Stores
Team Members: Thor Westergaard (EE), Trey Lakatos (EE), Samiha Sharif (EE), Sangeetha Tatineni (CE), Cristobal Muniz (EE), Karthikeyan Lakshmana Doss (EE), Ashutosh Anand (CE)

Abstract: Grocery stores can face a significant loss of profit due to unstocked shelves. With numerous shelves and an even larger variety of products, it is difficult for grocery store employees to manually keep up with which shelves need restocking throughout the day. This is where our team comes in to research and develop a prototype shelf that will ensure the correct products are stocked on shelves using a variety of Internet-of-Things (IoT) sensors. We have spent the Spring 2021 semester researching existing smart shelf technologies and conducting a literature review to survey any new methods we could use. We have concluded that we will use a combination of pressure mat technology, Raspberry Pi's, camera modules and machine vision to determine the count and identity of products on any given shelf, and notify employees when product counts are below a set threshold. Since our research found a centralized system to be the cost-efficient option, data acquired from our Raspberry Pi's will be sent to a central server for processing. By the end of this semester, we will have a detailed hardware design diagram, and a preliminary plan of action for the incoming CS team that will be developing the software for our prototype in the Fall 2021 semester.

1282 Title: CloudPlug
Team Members: Brandon Bearden (EE), Jason Kim (EE), Connor DeCamp (CE), Nguyen Nguyen (EE), Elizabeth Estrada (EE), Donghyun Seo (EE), Eduardo Hervert (EE)

Abstract: SFP+ modules can transmit data at high speeds using many different types of cables. There are hundreds of different SFP+ modules from different vendors, and, theoretically, most of them should follow a standard. On each module is an EEPROM chip that stores vendor and diagnostic information which is used by a host to identify the device. However, not every module works with every host system. This leads to customers asking system vendors to support different SFP+ modules, which leads to dozens of software variants, test cases, and combinations per host-system. The issue is that each qualification test requires a person to physically insert and remove the module. This limits testing to a small number of switches featuring the SFP+

modules under test. Thus, qualification testing requires physical access to a limited resource which is time consuming.

The main goal of this project is to design and build a proof-of-concept device, known as the CloudPlug, to qualify the control aspect of programmable pluggable interfaces. In other words, the CloudPlug should be able to mimic specific SFP+ modules and be accepted as genuine by the network switch. In order to do this, a docking station is needed to read and save the internal memory of vendor SFP+ modules. The docking station also allows users to monitor critical parameters of SFP+ modules in order to create stress-cases to program into the CloudPlug, which the CloudPlug can feed to the network switch it's inserted into. The docking station is controllable through ethernet/IP and the CloudPlug is wirelessly controllable, both through a control software designed by the team. CloudPlugs would allow scaling testing resources by replicating vendor logic in software and swapping modules by remote configuration rather than physical replacement.