



ECE UTDESIGN EXPO – FALL 21

Friday, December 10th 2021

ORAL PRESENTATION AGENDA: TRACK 1

Room: SPN 2.220

10:00 am – 10:15 am Welcome: Dr. Lawrence Overzet
10:15 am – 11:27 am UTDesign: Oral Presentations
11:27 am – 12:45 pm Lunch Break
12:45 pm – 2:45 pm Poster Presentations

| Time | Team | Project | Faculty Mentor | Corporate Mentor |
|-------|------|---|----------------|------------------------------------|
| 10:15 | 1277 | Smart Mirror (UTDesign II) | Marco Tacca | |
| 10:21 | 1281 | Internet-of-Things Inventory Control Shelves for HEB Stores (UTDesign II) | Marco Tacca | Karl Kevilus |
| 10:27 | 1282 | CloudPlug (UTDesign II) | Marco Tacca | Gert Grammel and Andrea Fumagalli |
| 10:33 | 1283 | Electrical Engineer Workbench (UTDesign II) | Neal Skinner | |
| 10:39 | 1360 | RF Signal Identification using Machine Learning Model (UTDesign I) | Marco Tacca | Tin Maung |
| 10:45 | 1362 | Toyota Motors: Cybersecurity Test Automation Platform (TAP) Feature Development (UTDesign I) | Marco Tacca | Bernard Moore and Nicholas Borgers |
| 10:51 | 1364 | ATEC International Parking Lot Museum (UTDesign I) | Neal Skinner | Dale MacDonald |
| 10:57 | 1365 | Optimizing Signboard Trailers (UTDesign I) | Ian Di Franco | Jose Avendano |
| 11:03 | 1366 | Drive Signal Control for RF Amplifier (UTDesign I) | Marco Tacca | Matthew Poulton |
| 11:09 | 1367 | High Efficiency 2GHz RF Power Amplifier (UTDesign I) | Marco Tacca | Richard Wilson |
| 11:15 | 1368 | Python RF Analysis Tools (UTDesign I) | Marco Tacca | Mark Greene |
| 11:21 | 1369 | RF Bias T with High-Speed Pulse Current Measurement Capabilities (UTDesign I) | Marco Tacca | Richard Hilton |

11:27 am – 12:45 pm Lunch Break
12:45 pm – 2:45 pm Poster Presentations

ABSTRACT LIST

- 1277 Title: Smart Mirror (UTDesign II)
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.

- 1281 Title: Internet-of-Things Inventory Control Shelves for HEB Stores (UTDesign II)
Team Members: Thor Westergaard (EE), Trey Lakatos (EE), Samiha Sharif (EE), Sangeetha Tatineni (CE), Cristobal Muniz (EE), Karthikeyan Lakshmana Doss (EE), Ashutosh Anand (CE), Jeongwon Seo (CS), Nicolas Chevrie (CS), Skylar Sonneveld-Bixler (CS), Ahmed Ilaiwi (CS), Hubert Cheng (CS), Nicole Rodrigues (CS)

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. 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. By the end of the Fall 2021 semester, we will have a 2'x3' mat that uses 864 pressure sensors to create a pressure map of the shelf. Machine vision can then be used to identify the items and where they are applying pressure. We then use the pressure to calculate the weight of the items in that area.

- 1282 Title: CloudPlug (UTDesign II)
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 specific logic in software and swapping modules by remote configuration rather than physical replacement.

- 1283 Title: Electrical Engineer Workbench (UTDesign II)
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 three fundamental functions, as well as a programmable digital gate array, 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 an 18 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 \$600 in parts to ensure convenience and affordability.

- 1360 Title: RF Signal Identification using Machine Learning Model (UTDesign I)
Team Members: Eric Kleckner (EE), Chasen Whorton (CS), Lathe Abusaid (CS), Ansel Krauss (CS), Brooks Roberts (CS), Gjorgji Vitanov (EE), Camden Boren (CE)

Abstract: Given recent advancements in fields like machine learning and wireless communication, many ideas that were previously considered purely theoretical now have immediate practical utility. One application borne from these developments is radio frequency identification, a method of identifying a signals modulation scheme from just looking at a time domain sample of the signal. Our group is focusing on training a machine learning model to identify a range of signal modulations, right now we are focusing on OOK, ASK, BPSK, and QPSK and PSK modulation schemes, but we have plans to develop our model further to recognize a larger range of signals. The system, which is currently under development, will be able to capture an RF signal from the air using a Software Defined Radio unit, classify the signal using our trained model, and inform the user of the signal's modulation type. This framework can provide the basis for further improvement in signal/device identification, as well as aid in future research around radio frequency and machine learning.

- 1362 Title: Toyota Motors: Cybersecurity Test Automation Platform (TAP) Feature Development (UTDesign I)
Team Members: Alexander Schittko (CS), Levon Gevorgyan (CS), Alexander Le (CS), Michelle Abiodun-Oladipupo (CS), Bikrant Mishra (CS), Srividya Seetharam (CE), Jeremiah Mathew (CE), Sehar Malik (CE)

Abstract: The PASTAnet team, a group of senior computer science and computer engineering students, will be working with Toyota Motor North America and The University of Texas at Dallas to implement new features on the Toyota's Portable Automotive Security Testbed with Adaptability (PASTA) system so that the system will be highly scalable and can continue to be improved upon. After implementation, the team will analyze performance of the modified PASTA system with an unmodified PASTA and report on the findings and final recommendations.

1364 Title: ATEC International Parking Lot Museum (UTDesign I)

Team Members: Jade Rodriguez (CE), Feriha Ahmad (EE), Audrey Mabbun (EE), Maria Morales (EE), Gabriel Braun (CE), Henry Shao (CE)

Abstract: Parking lots dominate the landscape of today's society, especially in urban and suburban areas, with an estimated two billion individual parking spaces in the United States alone. These lots serve community centers such as schools and offices, shopping centers, and event centers. As such, parking lots have become cultural centers of their own. Serving as access and gathering points, they are exposed to a unique community perspective which allows them to be used as a medium for content sharing and data collection. An electronic parking spot sign post consisting of sensors, cameras, and single-board computers will be developed to collect data on local activity and atmospheric conditions. This data will be used to create and present a variety of interactive experiences to nearby users connected to the system via integrated displays and the users' personal devices.

1365 Title: Optimizing Signboard Trailers (UTDesign I)

Team Members: Tahsin Mamun (EE), Julie Smith (CE), Kevin Nguyen (CE), Kyu Min Lee (EE), Suryoun Lee (EE), Joshua Shen (CE)

Abstract: Roadwork can take from days to months to complete and requires an external indicator to direct and control the traffic around it. A popular choice is to utilize a signboard trailer that can be programmed with the information needed to direct the traffic. These trailers must last the entire duration of road work without any external energy being provided. There are three systems in the trailer that are responsible for the total amount of energy: the signboard system, the solar system, and the battery system. The signboard is the main component of the trailer that will relay the information to passing drivers and is the main consumer of energy. The solar system utilizes a solar panel to recharge the batteries to eliminate an external power source. The battery system will take the extra solar energy and store it to be used when there is minimal to no solar energy being harvested for the signboard. The system under development seeks to extend the life of the trailer by increasing the solar panel output, increasing storage and longevity of the battery, and optimizing the signboard.

1366 Title: Drive Signal Control for RF Amplifier (UTDesign I)

Team Members: Michael Kessler (EE), Matan Levy (EE), Vivek Krishna (EE), Carl Boutin (EE), Mabsur Quraishi (EE), Josh Hernandez (CE)

Abstract: Many design considerations must be taken when choosing an RF amplifier for a system. Parameters such as efficiency, peak-to-average ratio, and saturated power are some examples of the key aspects of an RF amplifier. However, each of these parameters can change drastically depending on the frequency, amplitude,

and phase of the input signal. There is also no perfect configuration, as increasing one parameter may reduce another. Tradeoffs must be considered when selecting the optimal amplifier for a system, but this can be difficult due to the complexity of the measurements. The system that is under development includes an RF amplitude and phase control circuit which modulates the input of a parallel combined RF amplifier. An interface is being developed in Python to perform analysis and display the signal. The interface will show the signal in multiple 3D viewpoints and have many tools to easily investigate the signal.

1367 Title: High Efficiency 2GHz RF Power Amplifier (UTDesign I)

Team Members: Hansvi Patel (EE), Drew Coley (EE), Dhruv Goel (EE), Alexandra Danhof (EE), Luke Sherlock (CE), and Jacob Reyna (CE)

Abstract: RF power amplification has been an important part of technology for many years, with modern MOSFET-based solutions dating back to the 1960's. Historically, power efficiency was of less concern as these solid-state amplifiers were already more efficient than their vacuum tube-powered predecessors, and their uses were limited to devices that did little more than communicate basic speech. As transistor and similar technologies progressed, RF power amplification became necessary in smaller and more complex devices, causing the demand for power efficiency to increase. Modern mobile devices, such as cell phones, tablets, and mobile hotspot routers have many power draining components, from their processors to memory chips and displays, all working alongside the RF amplifier-enabled 5G/LTE modem. To meet this demand, new transistors are constantly being designed to enable smaller and more power-efficient amplifiers. One such transistor is the Qorvo QPD0005, which uses 5 watts. The task of this project is to design an RF power amplifier optimized for 2GHz operation. Although this product will not go directly into a commercial product, the significance of a high efficiency operation is paramount in all RF applications. The system being developed can be used as a starting point for future RF designs utilizing the QPD0005 or similar transistors.

1368 Title: Python RF Analysis Tools (UTDesign I)

Team Members: Kristi Doleh (EE), Jacob Jones (CE), Charles Gustof (EE), Preston Glenn (CE), Eslam Elsayed (EE), Dubem Okonma (EE)

Abstract: The primary objective of the project is to design a software tool that performs Doherty Analysis on an incoming set of RF data; this process includes the capturing of electrical behaviors and evaluation of parameters for optimized input/output power, gain, drain efficiency, and more. All program processes are conducted solely through the Python programming language. The method of analysis in which the data is assessed is contingent upon the user's provided input for what parameter and value they would like to evaluate for. The project can best be represented by the following steps: a provided MDF file is parsed and read into a Pandas DataFrame; user input provides the desired operation in which the program will perform; the original data set is sliced at the optimum data points based on the users desired optimization value returning a new, derived data set containing only the optimum data points; computational analysis is then performed to output the proper optimized point(s) within the set of data as a whole. The process depicted above outlines, to the best of our knowledge, a comprehensive approach to optimizing a given set of data based on a specified parameter description.

1369 Title: RF Bias T with High-Speed Pulse Current Measurement Capabilities (UTDesign I)

Team Members: Alex Nguyen (CE) Sri Jahnavi Gadiraju (CE) Nathan Puckett (EE) Nitish Ghosh (EE) Rahul Varkey (CE) Zabir Rahman(EE)

Abstract: For the characterization of devices such as transistors in the RF and microwave frequency range, often a RF bias T is used. A bias T is a 3-port circuit that provides an RF, DC, and RF+DC path. This configuration allows RF and DC signals to be combined for biasing or alternatively, to separate RF and DC signals. The project's aim is to build a RF Bias T that operates from 1 GHz to 4 GHz with minimal insertion loss. Furthermore, as current measurements are required for device characterization, the system should implement a means of current measurement to capture high speed current pulses through the DC path of the bias T and display to a GUI.

The final circuit was designed to operate at a higher bandwidth from 100MHz-8GHz. The circuit was analyzed and simulated on AWR microwave office using manufacturer component models and microstrip transmission lines. The circuit was designed in Cadence and the PCB was designed in Allegro. For current measurement a system was designed involving a shunt resistor, a current sense amplifier, and a high speed ADC on a STMicroelectronics microcontroller. This system allows a small voltage drop across a shunt to be readable by an ADC and sent to the computer for processing through USB. A GUI was developed in MATLAB software to read in data in real time and display current across time with minimal delay.

An order for the PCB was sent to a PCB manufacturer to fabricate the design which will be validated and measured in the spring semester. The ADC and GUI has been tested at a 12bit resolution and 100kps in real time. Further improvements in speed and accuracy can be made in the spring. The final step will be to integrate and test the RF bias T with current measurement in a complete system.

ECE UTDESIGN EXPO – FALL 21

Friday, December 10th 2021

ORAL PRESENTATION AGENDA: TRACK 2

Room: SPN 1.121

10:00 am – 10:15 am Welcome: Dr. Lawrence Overzet
 10:00 am – 11:06 am UTDesign: Oral Presentations
 11:15 am – 12:45 pm Lunch Break
 12:45 pm – 2:45 pm Poster Presentations

| Time | Team | Project | Faculty Mentor | Corporate Mentor |
|-------|------|--|----------------|---|
| 10:15 | 1284 | Smart Mail Crate (UTDesign II) | Marco Tacca | |
| 10:21 | 1302 | Automated Irrigation System (UTDesign II) | Marco Tacca | |
| 10:27 | 1303 | ThirdEye Personal Safety Device (UTDesign II) | Marco Tacca | Oren Eliezer and Shailesh Nirgudkar |
| 10:33 | 1304 | Signal Digitization and Processing for a Biomedical Diagnostic Device (UTDesign II) | Marco Tacca | Zhenping Qin, Oren Eliezer, Marco Tacca, Dinesh Bhatia, Dennis Robbins, Abdullah Bayram |
| 10:39 | 1370 | Raytheon AUX Showcase (UTDesign I) | Marco Tacca | Christine Nezda and Alfonso Lopez |
| 10:45 | 1371 | Vehicle Signal Amplification Relay Attack (SARA) Simulator (UTDesign I) | Ian Di Franco | Mark Fairchild |
| 10:51 | 1372 | Cellular Connectivity for TI MCU Based End-node or Gateway (UTDesign I) | Ian Di Franco | Mark Easley |
| 10:57 | 1373 | Dynamometer Test Bench Upgrade (UTDesign I) | Neal Skinner | James Lockeridge and Murugavel Raju |
| 11:03 | 1375 | Autonomous Power Delivery Robot (UTDesign I) | Marco Tacca | |
| 11:09 | 1376 | Smart White Cane (UTDesign I) | Marco Tacca | |

11:15 am – 12:45 pm Lunch Break
 12:45 pm – 2:45 pm Poster Presentations

ABSTRACT LIST

- 1284 Title: Smart Mail Crate (UTDesign II)
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. We have seen lockers in apartments or in stores like Whole Foods, but that requires home owners to leave their home in order to retrieve their packages. This is also mainly provided through companies like Amazon, not US postal services or UPS/FedEx. 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 update the tracking number in a database so that the delivery driver can gain access to the crate via the correct barcode.

- 1302 Title: Automated Irrigation System (UTDesign II)
Team Members: Dustin Martin, Emily Hill, Mohamed Kheddouma, Yee Yi Pang, Andrew Shoda Jr

Abstract: Irrigation systems are not fully optimized to control moisture content of target soil, which leads to over-consumption of water resources. This project's main objective is to design and implement a system that will monitor soil moisture content in order to decrease overall water consumption by disbursing water as needed based on recorded data, store and process this data, and report back to the user through a dedicated web application. The system uses wireless moisture sensors connected to a local control hub through multiple short-range, battery-powered Xbee-3 transceivers to monitor the moisture content of several zones. The hub consists of a 64 bit Arm microcontroller that runs Linux, and it will be used to host a local Nginx webserver that wirelessly connects to a dedicated Sqlite3 database. A client can then connect to the webserver through their personal device. The project aims to be useful in both residential and commercial areas, easy to install, and scalable to cover larger areas.

- 1303 Title: ThirdEye Personal Safety Device (UTDesign II)
Team Members: David Johnson, Alexis Kpochan, David Patterson, Andrew Venum, and Nicholas Wilson

Abstract: It is an unfortunate reality that today many people still experience assaults every day. Options are available to help protect people but are almost always reactive in nature. The ThirdEye Personal Safety Device is designed to provide an individual with a proactive, preventive, protection against assaults and other safety concerns. The device aims to increase user awareness and safety by sampling, analyzing, and providing real-time responses within various environments. This is implemented through a variety of sensors

(ultrasonic, infrared, and optical) directed opposite the user's field of view. The device remains in a low power state using lower powered passive infrared sensors to drive higher powered responses. Upon impulse from a low power state the device engages additional ultrasonic or microwave sensors and cameras to achieve object detection and hypothesize object intent. After creating a summary of foreign object characteristics, the device then provides auditory or visual alerts to the user and automated preventative actions in emergency situations where the device has determined the user might be incapacitated. During Phase I, the team completed the initial research and design to drive a proof-of-concept prototype, identifying the functionality and features within the device, along with selecting commercially available products able to achieve these goals. As Phase II commences, the team has completed procurement of the parts, and begun assembly and exploratory testing to verify functionality of the device components. Going through September 2021 and into October 2021, software development will be accomplished, along with the assembly design and manufacture. Throughout October, the team will complete initial integration testing, with the first system demonstration at the beginning of November 2021, followed by final testing and project completion in December 2021.

- 1304 Title: Signal Digitization and Processing for a Biomedical Diagnostic Device (UTDesign II)
Team Members: Sid Vadlamani, Saira Saleem, Ibrahim Hillway, Lashani De Alwis, Brandon Faas

Abstract: This project is important because it's not only focused towards the biomedical function of virus detection but also crucial in the field of electrical and analog engineering. This is because we are essentially replicating functionality of large, expensive oscilloscopes into a portable, cost effective data acquisition system. We will sample, digitize, and store the photodetector signal in memory. The sampling operation will be synchronized with a pulsed laser to help save memory by limiting the sampling only to the intervals where there may be a meaningful response. The digital signal collected in memory will be processed to determine what portion of them represent positive detection of the targeted biomarker. A user-interface will provide a positive or negative result to the user based on the amount of positive biomarkers detected. The guiding requirement for this system is that it has to be portable, cost effective and be able to provide a simplistic end result to the user based on signal digitization, processing and storage from the laser apparatus. Based on these requirements, utilization of an 8-Bit ADC/DAQ alongside a computer allows for seamless integration between the analog and digital components of this system through hardware and software development. In the planning and design phase, we developed a high and low-level block diagram. The diagram highlights the various components that we plan to use as well as the relationship(s) between hardware components; such as out of the box systems and ones designed by our team. Starting in August we will start ordering parts and plan to have a physical lab tour. In September we will begin building and testing first prototypes and continue into October. By November we plan to be finishing up and finalizing the project. Lastly in December we will be preparing for the design expo as well as preparing the official "hand-over" to our client team.

- 1370 Title: Raytheon AUX Showcase (UTDesign I)
Team Members: Alexander Doudnikov (CE), Ian Falk (CE), William Greenfield (EE), Preetika Kondepudi (EE), William Mullican (CE), Sean Njenga (CE), Noah Parker (EE)

Abstract: The Raytheon AUX Showcase is an Unmanned Aircraft Systems competition involving UT Dallas CS and ECE, Raytheon Technologies, and five other Texas Universities. The objective of this competition is to research, develop, integrate, and test a drone that will autonomously compete in five challenges. Our drone design is a hexacopter that will incorporate GPS, cameras, and LIDAR to navigate obstacles and detect objects. This drone will also use a Cube Orange flight controller, Raspberry Pi 4, and ArduPilot software to integrate components and set flight plans. We plan to win this competition by delivering a drone that is reliable, accurate, and time-efficient.

- 1371 Title: Vehicle Signal Amplification Relay Attack (SARA) Simulator (UTDesign I)
Team Members: Brendan Hegg (EE), Nicholas Lesniak (CE), Habib Kalia (CE), David Wang (CE), Marie Sofijczuk (CE), Nico Ntafos (CE)

Abstract: Every day, thousands of customers worldwide buy new cars expecting that it contains the latest security features. Most modern vehicles come with a Passive Keyless Entry (PKE) System, which allows the vehicle to detect when its keyfob is nearby and automatically unlock the doors and start the engine. This new PKE system has become a very sought-after feature; however, this system has vulnerabilities that compromise the security of the vehicle. Our team has developed a device that exploits these vulnerabilities using a signal amplification relay attack (SARA) which can be used to unlock and start a car without the owner being aware. With our device, insurance and vehicle manufacturing companies can test vehicles to determine if they are at risk of a successful SARA attack. Armed with this knowledge, vehicle manufacturing companies can fix these vulnerabilities and make future vehicles more secure.

- 1372 Title: Cellular Connectivity for TI MCU Based End-node or Gateway (UTDesign I)
Team Members: Trevor Duncan (CE), Sobaha Azam (CE), Illia Volkov (EE), Swathi Deivamani (EE), Zakia Islam (EE), and Bayan Hamed (EE)

Abstract: In recent years, the growing technologies of 5G wireless connections and the IoT have created a market opening for manifold wireless applications. As the current applications using 3G bands are replaced with superior 5G connectivity, exploiting the newly freed up bandwidth efficiently has driven interest in LTE-M or LTE for Machines. This protocol allows for long-distance, energy-efficient “always on” cellular connectivity for microcontroller devices at a limited bandwidth of 1.08MHz. These characteristics make LTE-M uniquely suited for highly marketable industrial, agricultural, and commercial applications over long ranges. While many embedded system implementations already exist using Bluetooth or Wi-Fi for wireless connectivity, LTE-M implementations have not been extensively explored in industry. The team is currently designing a system which will provide Texas Instruments an edge in exploiting this emerging market. A cellular modem will be selected to provide connectivity to a TI Launchpad using an LTE-CatM1 protocol connection.

- 1373 Title: Dynamometer Test Bench Upgrade (UTDesign I)
Team Members: Abdullah Abdulhameed (CE) , Alex Goss (EE), Amin Kedwai (CE), Charles Randall (EE), Maaha Sakhia (EE), Stefan Rider (CE)

Abstract: Texas Instruments (T I) needs a dynamometer to evaluate and demonstrate stepper driver technology. The test bench applies various customizable load torque profiles with a brushless DC motor and has the option for speed control. Torque, position, and speed are measured in order to determine the stepper motor's response to different loads. To update this testbench, we will be condensing the microcontroller interface from a C2000 Microcontroller and an MSP430 Microcontroller to one C2000 Microcontroller board. We will create a new GUI using LabVIEW to control the test bench by setting the speed and torque of the brushless DC motor. Real - time data of torque, position, and speed will be displayed on the graphical user interface. We will aid in TI's redesign of the physical motor system by manufacturing NEMA 11, 17, and 34 faceplates and building a new safety shield. Our overall goal is to simplify the dynamometer and to create a more intuitive system for internal TI use.

1375 Title: Autonomous Power Delivery Robot (UTDesign I)

Members: Randy Sok (EE), Carlos Cruz (CE), Shubhdeep Aulakh (EE), Ranu Baidya (CE), Alfredo Galvan(EE), Elmer Majano (CE)

Abstract: Access to power outlets has become a noticeable issue across the UT Dallas campus in recent years. With the increase in the number of students, comes the increase in smartphone and laptop usage amongst the student body. The UT Dallas campus consists of multiple buildings which provide a limited number of power outlets to charge devices. During group study sessions, midterms and final exams, these power outlets are not always available and students in need of a power outlet have to wait until an outlet becomes available. For many students, one location may be the only convenient location to study for them to avoid having a phone or laptop with little to no power. A solution to this, that we have brainstormed as a team, is to build an Autonomous Robot that delivers power to students on campus. With sensor fusion and autonomous capabilities, the robot localizes the user's location and delivers the external power source to the user in need of a power outlet.

1376 Title: Smart White Cane (UTDesign I)

Team Members: Adriana Alva (CE/EE), Kene Chukwuma (CE), Mahmoud Elkarmalawy (EE), Moiz Khan (EE), Talha Syed (EE), Joshua Tian (CE)

Abstract: For many of the millions of individuals who are fully or gradually becoming visually impaired, the process of getting from point A to point B in a safe matter comes with additional layers of uncertainty and risk. The white cane is the most prominent and widely used mobility aid for independent visually impaired pedestrians. Being able to adapt to a new way of life should be made easily attainable, however the white cane reaches a limit of successfully helping someone navigate safely through urban and suburban areas that are host to major construction projects that lead to the closure of familiar accessible paths. Incorporating new technology into the white cane will allow for a safer and self-determined walking experience where the user has adequate information of their surroundings. Incorporating advancements in computer vision, machine learning, and low-latency communication would allow for continuous data collection and analysis with each step the user takes, all the while, the IoT system monitoring hub will check if the hazard thresholds are exceeded or warning conditions are met. The project in development will continuously scan the user's set path, record real-time measurements, and communicate with the user through audio alerts and haptic feedback.



ECE UTDESIGN EXPO – FALL 21

Friday, December 10th 2021

ORAL PRESENTATION AGENDA: TRACK 3

Room: SP2 12.216

10:00 am – 10:15 am Welcome: Dr. Lawrence Overzet
10:00 am – 11:22 am UTDesign: Oral Presentations
11:22 am – 12:45 pm Lunch Break
12:45 pm – 2:45 pm Poster Presentations

| Time | Team | Project | Faculty Mentor | Corporate Mentor |
|-------|------|---|----------------|---|
| 10:15 | 1305 | Automatic Calorie Tracker (UTDesign II) | Marco Tacca | |
| 10:21 | 1306 | Food Detection using Deep Learning (UTDesign II) | Marco Tacca | Brian Rush |
| 10:27 | 1307 | Sleep Apnea Detection Device (UTDesign II) | Dinesh Bhatia | Arun Badi |
| 10:33 | 1308 | Fast Transient Test Fixture (UTDesign II) | Marco Tacca | Casio Travesi, James Smiley, Heather Armstrong |
| 10:39 | 1377 | Smart Sign Language Glove (UTDesign I) | Neal Skinner | |
| 10:45 | 1378 | Implementing Smart Lock Technology with Machine Learning and IOT Systems (UTDesign I) | Neal Skinner | |
| 10:51 | 1379 | Smart Chicken Door (Tobor Chicken) (UTDesign I) | Neal Skinner | |
| 10:57 | 1380 | TUNe-A-Fish: An Aquarium Monitoring and Guidance System for Beginner Fish Keepers (UTDesign I) | Neal Skinner | |
| 11:03 | 1381 | Automatized Pothole Detection (Pot Solvers) (UTDesign I) | Neal Skinner | |
| 11:09 | 1382 | Bus Tracker (UTDesign I) | Neal Skinner | |
| 11:15 | 1383 | IoT Pool Monitor (UTDesign I) | Neal Skinner | |

11:22 am – 12:45 pm Lunch Break
12:45 pm – 2:45 pm Poster Presentations

ABSTRACT LIST

- 1305 Title: Automatic Calorie Tracker (UTDesign II)
Team Members: Micah Henley, Yug Singh, Aremou Salaou, Aneel Siddiqui, Syed Farooq, Sena Seong

Abstract: According to the CDC, the obesity rate in the United States has increased from 30.5% to 42.4%. Calorie counting is a major aspect when it comes to losing weight, but it can be a very daunting task. Our goal is to create a device that streamlines this process to make calorie tracking easy for anyone. Users of our device can place their food item on the scale, and through a camera using machine learning, will be told what the food is as well as how many calories it has based on the weight. Additionally, there will be a fingerprint scanner capable of allowing our system to generate a profile for each individual user making it seamless to track their calories. We have selected our components to use and will start ordering them this coming August. In the meantime, we are learning how to use Amazon web services (AWS) as that will be what we use for the machine learning aspect. By September, we will start implementing our code onto the hardware. Our goal is to complete the project by mid-November so we can test and debug by December

- 1306 Title: Food Detection using Deep Learning (UTDesign II)
Team Members: Omar Resendiz, Karthik Gopan, Mariela Ramirez, Chujie Guan, and Jordan Rider

Abstract: As technology continues to advance, the various applications of image recognition and processing continue to prove their value. Some of the important applications of image processing in the field of science and technology include computer vision, face detection, augmented reality, X-rays, and Ultrasonic scanning. This project uses a MAX78000FTHR board to detect various types of food with the use of a convolutional neural network. The final objective for this project is to create an AI neural network that can identify foods from images taken by the camera on the MAX78000 feather board. The program must run on the board itself, with the output being shown on a computer terminal. For this project we need to create and train a neural network from a data set of food images, synthesize the neural network and verify functionality, run a trained model on MAX78000FTHR board, and create documentation for the project. The neural network must be able to identify at least 10 different food types from various angles. Must be able to identify foods using the integrated camera on the MAX78000. Output results to the terminal on the host computer/or on the onboard screen that was soldered on. We have prepared our MAX78000FTHR board to use an LCD display. A neural network has been created to train off of a data set that is scaled to 128x128 and artificially expanded through image augmentation. We expect to have a finalized neural network achieved by the end of this semester, and the next semester we will be adjusting it to fit on the MAX78000. The results we expect to achieve are to create a machine learning AI using pytorch and modified MAXIM code to identify at least 10 different foods from various angles, and to have the LCD show the camera feed and label the food item shown (either what food it thinks it sees or "unknown" for things that aren't in the data set.

- 1307 Title: Sleep Apnea Detection Device (UTDesign II)
Team Members: Tanner Doidge, Adam Gruszecki, Jignesh Mangarolia, Ivan Pantoja, David Song

Abstract: Sleep Apnea is a widespread sleep disorder that can often go undiagnosed. Sleep studies used to diagnose sleep apnea can be very expensive and after a patient receives treatment, further monitoring of

their condition rarely happens. The goal of our sleep apnea detection device is to provide a cheap option for sleep apnea detection that can be used for continuous monitoring of someone's sleep over a long period of time. This device will be designed to be comfortable to wear, easy to use, and capable of sending collected data to an app on its user's mobile phone over a Bluetooth connection. The device would utilize several different sensors, including: one-channel EEG, ECG, oximeter, air-flow sensor, snore sensor, and respiratory rate sensor. These sensors are designed to satisfy the guidelines set by the American Academy of Sleep Medicine (AASM). The mobile app designed alongside the device will be capable of displaying sleep data appropriate for both the user and their clinician to understand. As of the beginning of this second semester of Senior Design, our group has finished the preliminary designs for all the hardware and purchased the necessary components to begin constructing our device. We are also in the process of developing the smart phone app and working out the details for signal transfer and processing. By the end of this second semester, we plan to have a fully functional device prototype and mobile app.

1308 Title: Fast Transient Test Fixture (UTDesign II)
Team Members: Alexander Daggett, Christian Anglemeyer, Bogdan Botnari, Jose Soberanes, Simon So

1377 Title: Smart Sign Language Glove (UTDesign I)
Team Members: Andy Bui (EE), Ninghao Shi (EE), Hamza Islam (EE), David Wang (EE), Jimmy Nguyen (CE), Yuijan (Eugene) Lin (CE)

Abstract: Sign language is the use of hand gestures to compare movements and simulate images or syllables to construct certain meanings or words based on changes in gestures. It is a hand language for people with hearing impairments or unable to speak to communicate and exchange ideas with each other. It is a "voice language". It is an important tool for people with hearing impairment and for the hearing impaired. People who have an obstacle in communicating and exchanging ideas need to learn sign language.

Our project is to create a Smart Sign Language Glove to assist those people to learn the language easily. We will build and design the glove to allow users to easily communicate with those who don't understand sign language by translating hand signs into text. We will display the text on a mobile phone app that the user can show others. We will design the glove to be lightweight and comfortable for the user to wear.

1378 Title: Implementing Smart Lock Technology with Machine Learning and IOT Systems (UTDesign I)
Team Members: Leon Khalyavin (EE), Liam Silagan (CE), Rooshi Nagar (EE), Aahil Patel (EE), Jeremiah Vo (EE), Adam Wajahat (EE)

Abstract: In today's world, the interaction between users and their technology is merging with seamless transactions. There are many benefits for smart locks, including smart home application and increased security, but can tend to be a hassle for some users. With the rise in machine learning and advanced sensors, the project intends to explore the ability to make a seamless authentication system for the home. By using new facial recognition algorithms, fingerprint recognition algorithms, and faster WiFi connectivity, it is possible to create a system for quick and reliable authentication. One of the major challenges with the project is to maintain reliability, even in the event of components breaking. This can be done with electrical/mechanical overrides and sensor information. The system is currently being developed for authentication for home applications, but then can be expanded to other authentication and/or smart home usage.

- 1379 Title: Smart Chicken Door (Tobor Chicken) (UTDesign I)
Team Members: Mudafar Hasan (CE), Satyank Nadimpalli (CE), Stiven Hajmeli (EE), Bahman Sokhansanj (EE), Omar Gabr (EE), Mehrad Nahouri (EE)

Abstract: Many farmers experience great difficulties raising chickens. One of those difficulties is a fox (or any chicken predator) can often make its way into a chicken coop and eat some, if not all of the chickens. This is a tragic loss to any farmer and our smart chicken door provides a solution to this problem. Using machine learning to perform object recognition on the animal in front of the chicken door will allow the computer to recognize if there is a chicken in front of the door and open it. Once the chicken is recognized and the door has opened, IR sensors will be at the lower end of the door to sense if there is still a chicken passing under the door and know if it should close the door or keep it open until the chicken has passed.

- 1380 Title: TUNe-A-Fish: An Aquarium Monitoring and Guidance System for Beginner Fish Keepers (UTDesign I)
Team Members: John Nguyen (EE), Long Nguyen (EE), Akash Patel (EE), MD Imtiaz Mahi (CE), Minh Tang (CE) Toan Tran (CE)

Abstract: Animal abuse and neglect are often publicized for cats and dogs, but the third most popular pet type in the United States are often overlooked. Many new fish keepers lack the knowledge and skill to properly maintain a healthy ecosystem for their new pet fish. Due to the closed system of an aquarium, water changes and testing must be routine in order to maintain the correct water parameters for a healthy environment. The need is attributed to the natural nitrogen cycle as fish are fed and create natural waste that is processed by healthy bacteria in the water. These chemical reactions produce a variety of products which, in addition to the chemicals and minerals already in the water, must be kept in the correct levels to ensure a healthy environment for the fish. Vital water parameters are often tested by fish keepers routinely, but are not always precise due to the water test strips using colored squares that are compared to a chart to gauge the water parameter levels. Modern color sensors can be used to accurately and consistently read color test strips, removing the variability of the human eye and surrounding environment. Determining the state of the aquarium also includes tracking the water temperature and level through a non-corroding temperature probe and a livestock safe ultrasonic range finder. However, new fish keepers can be overwhelmed by the data, and are lost in determining the next steps to take action to improve or remedy their aquarium, so these aquarium monitoring systems are incorporated with an application that can process the data and suggest the next course of action aiding the user and teaching them about taking care of fish and aquarium ecosystems. This system will lead to less neglected fish and more educated fish keepers bettering the quality of life for both.

- 1381 Title: Automatized Pothole Detection (Pot Solvers) (UTDesign I)
Team Members: Nirpesh Regmi (EE), Matt Harvey (CE), Juan Sanchez (EE), Siyeon Kim (CE), Silver Zuniga (EE), Shadrach Cyriac (CE)

Abstract: Potholes increase the risk of driving by providing an extra layer of obstacle for drivers. Cities all around the world face a constant battle against detecting and repairing these obstacles. This project is focused on the detection of potholes on different roadways via ultrasonic sensors and data collection. It will also enable data analysis of the detected potholes to enable workers/repairmen to better prepare, plan, and fill in our infrastructure. This project will utilize ultrasonic sensors, raspberry pi 4B, raspberry Pico devices, GPS device, and a mobile battery pack. The signals from the ultrasonic sensors will detect the change in height of the road where a pothole is and collect the approximate location of the detected hole via attached

GPS. All data can then be transmitted to a computer once the device has finished its data collection via connection to desired device.

1382 Title: Bus Tracker (UTDesign I)

Members: Jan Jan Carlo Maranca (CE), Alazar Megerssa (CE), John Yang (EE), Lorena Fuentes (EE), Anthony (Jinu) Lee (CE)

Abstract: Busses as a form of public transportation are extremely important for many individuals without reliable access to other forms of transportation, thus making the availability of their status extremely important. This status often comes in the form of bus schedules, which are unreliable at best, as busses must face the inefficiencies of modern roadways and its frequent traffic jams and delays. This leaves the passenger unable to accurately determine their arrival times, as well as requiring passengers to potentially wait long periods of time for busses to arrive, which is compounded when bus transfers are required. With the sophistication of modern satellite technology, more accurate bus scheduling can be achieved by integration of mapping technology. Using trackers equipped to each bus, they will transmit their location to a centralized database which will in turn calculate the estimated arrival time to each station within the bus route. This arrival time will then be transmitted to transceivers at each bus stop, where the estimated time for each bus circling the route will be displayed.

1382 Title: IoT Pool Monitor (UTDesign I)

Team Members: Zachary Jordan (CE), Akhil Mathew (CE), Okiemute Aganbi (EE), Mohammad Nayani (CE), Michael Kasman (CE)

Abstract: Technology today has opened us up to countless possibilities that were just a mere imagination to some not too long ago. Just as most tech today provides users with ease, the IoT Pool Monitor aims to do just that. Owning and maintaining a pool can be a little more convenient when one has a device that monitors the water and air temperature, chlorine and pH levels and reports this data on a smartphone app. The pool monitor will be mounted on the side of the pool, and will use a combination of solar and battery power. It will use an onboard microcontroller, securely enclosed in a water and dustproof enclosure, to get raw data readings from various sensors and wirelessly transmit post this data to a database which is then accessed by the user through a mobile app on their smartphone.