UNT COLLEGE OF ENGINEERING
EST. 1890

UNT College of
ENGINEERING

Senior Design Day 2018

UNT COLLEGE OF ENGINEERING
EST. 1890

Department of ELECTRICAL ENGINEERING

Senior Design Day 2018

UNT® COLLEGE OF ENGINEERING
EST. 1890

PLC Test Station

Team Members:

- Ahmed Al Afreed
- Kevin Dempsey
- Billy Matthew
- Mark Matthews

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Tao Yang

Abstract:

The purpose of this project is to design and build a programmable logic controller test station for the use of the Electrical Engineering department at The University of North Texas. This project will be left for future classes to learn from, use, and potentially build onto. Our immediate market resides with the UNT EE department; however, this piece of equipment could potentially benefit other departments that reside within Discovery Park. This project will include research regarding a SCADAPak PLC and the software it uses as well as some Allen Bradley components.
Proficiency in wiring, troubleshooting components, and overall circuit functionality design will be obtained in the completion of this project. The main cabinet will be temperature control, while the secondary feature will show a mixing station.

UNT COLLEGE OF ENGINEERING
EST. 1890

BE-Wind Turbine Data Logging System

Team Members:

- Hussam Alanazi
- Faisal Basmer
- Christopher Berdan
- Nga Nuyen

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Miguel Acevedo

Abstract:

BE-Wind has asked the UNT Electrical Engineering department to design a system to evaluate their EOW2 wind turbine. The system to be designed must be able to measure the angular velocity of both turbine blades, the local wind speed effecting the turbine, and the voltage and current produced by the turbine. These variables must all be collected and correlated in order to analyze the power produced by the turbine at different wind speeds. The purpose is to provide accurate power and performance curves of the wind turbine. A data logger system will be designed and used to gather all the variables and time stamp the information in a format that can show performance over time. This will allow BE-Wind to apply the data to their power conversion systems in order to improve performance. The final design will be an off-grid system involving an anemometer, photo-optic sensors, a current sensor utilizing the Hall-effect, and a DC voltage transformer.

UNT COLLEGE OF ENGINEERING
EST. 1890

Smart Irrigation System

Team Members:

- Hussain Aldawsari
- Nawaf Alraddadi
- Fawaz Alsagheer

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Parthasarathy Guturu

Abstract:

Our senior project is basically to design and develop a smart irrigation system employing WSN (XBee) concept and using WiFi-module. The design of our system is based on a microcontroller (Arduino) that is used to process the reading values obtained from the soil moisture sensor and sent by XBee (RX) to the other XBee (RX). As a result, it will either irrigate the plants by turning the water pump on or off according to the received set of data. The purpose of using WiFi-module is to enable us monitoring the system wirelessly from anywhere.

UNT COLLEGE OF ENGINEERING
EST. 1890

Wireless Charging System

Team Members:

- Hussen Aldhelep
- Hassan Alghazwi
- Hassan Alkhodar

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Parthasarathy Guturu

Abstract:

With cell phones turning into a fundamental piece of life, charging the batteries of these cell phones might be a problem. Each phone's manufacture produces different types of phones and batteries. Eventually, all these batteries needed to be charged. Therefore, the main objective of this current proposal is to make charging cell phones much easier. On the other hand, there are some disadvantages for this project such as: Slower charging, more expensive, and Inefficiency. However, the main reason of this project is to help people to charge their phones without plugging in the USB cable in their phones. Thus, in this project, we are going to build a wireless cellphone charger and test it with using some of the lessons that we have learned in engineering classes. The Pspice software will be also used to simulate the circuit. After we build the circuit on a breadboard, we will transfer the working circuit to a PCB. The components we are using in this project are: HF-Transformer, 2 Inductor Coils, Rectifier, Capacitors, Transistors, HF-diodes, and Voltage regulator. Converting the volte from 230V AC to 12 V DC is going to be done by using high frequency transformer. The full bridge rectifier that would wirelessly receive the AC signal and then turn it back into DC power to charge the cellphone. We are transferring current and we need to limit it because there's a fixed amount of current that batteries can handle. Transistors are goingto be used for this job. The voltage regulator is an essential component to control and stabilize the output voltage of the rectifier in the receiver. The rectifier is one of the main components of the receiver. It useshigh-frequency power to generate DC power.

UNT® COLLEGE OF ENGINEERING
EST. 1890

Neural Recording System

Team Members:

- Abdulrahman Alraimi
- Joshua Maddux
- Kelechi Ubani

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Ifana Mahbub

Abstract:

A neural recoding system is composed of several micro devices that allow the user to record neural signals emanating from the human body with the help of wires, process the signals received, then store this decoded data from processed signals for further study. While the neural recording system is helpful, constructing an efficient system can be difficult.

For this senior design project, we want to develop an energy efficient wireless neural signal processing system for neural prosthetic applications. We will focus on three main objectives. First, we want to make this system wireless. This will allow us to transmit data from our analog to digital microcontroller to our signal processing system to prevent any risk of using wires. Second, as mentioned before, we will create an energy efficient system with the addition of the wireless aspect. This wireless aspect will allow us to control the transmitter and receiver through sleep-wake functionality to converse energy while maintaining a low power consumption for our micro devices. Lastly, we will develop an algorithm for spike detection and sorting. Spike detection and sorting is achieved through applications of signal processing by grouping neural spikes based on shape and characteristic using MATLAB.

We can accomplish these objectives in four useful steps. The first step in this algorithm is to perform a band-pass filter. The second step is to establish a threshold for the amplitude peaks for detecting which neural signals are worth processing. This is because some peaks may present itself as too small, in which we can simply ignore those. Then, we move onto our third step to identify and extract the characteristics and features of the neural spikes. These features and characteristics can be the actual shape, size, or frequency. We want to eliminate any random repeated variations.

Lastly, we group the spikes based on their features and characteristicsthrough clustering. Clustering can be achieved through machine learning which will use automatic spike sorting to maximize the algorithm's potential. Once sorted, we can use our computer device for analyzing the final results.

UNT COLLEGE OF ENGINEERING
EST. 1890

Frequency Modulated Continuous Wave Radar System

Team Members:

- Natchanon Boonumpaichaiyakul
- Guy Kouaho
- Noppassorn Sribenrat

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Kamesh Namuduri

Abstract:

Since new technologies have been developed from time to time, more limitations in using technology are overcome. Frequency Modulated Continuous Wave (FMCW) RADAR (Radio Detection and Ranging) has become in use to develop a better device comparing to simple continuous wave radar. This project will develop a low cost and compact device using FMCW RADAR as a remote sensor. This radar system can be used for automotive security and protections applications. The radar must be able to detect and differentiate between moving and static object in the direction of radar. It also can determine speed of the target. MATLAB and DSP (Digital Signal Processing) manipulation will be used in data analysis. Doppler Effect is applied to estimate the distance and velocity. The transmitter of an FMCW radar system sends a linear signal with high frequency and large bandwidth. When the transmitted signal hits target, the target modulates the signal which is reflected toward the receivers. Time delay and a frequency shift (Doppler frequency) of reflected signal depend on the target distance(R) and relative speed.

UNT COLLEGE OF ENGINEERING
EST. 1890

Climate Monitoring Module by Circuit Breakers

NECTAR AGRICULTURE

Team Members:

- Daniel Campagnola
- Seth Markovich
- Eric Mercado
- Peyton Strain

External Sponsors/Mentors:

- Nectar Agriculture

Internal Sponsors/Mentors:

- Dr. Xinrong Li

Abstract:

In the changing world we live in there is a higher demand for effective growing methods. This include food production and nutrition diversity. Nectar Agriculture is developing an environmentally controlled enclosed growing pod with several drawers to grow practically any produce in the same location. Our team is working with Nectar Agriculture to develop a sensor array capable of monitoring the climate of the individual growing drawer inside the pod facility. The climate module is a standalone device with the intent to be integrated into the individual growing drawers of the growing pod Nectar Agriculture is developing.

The primary goals of the climate module are to operate in real time, collect the climate data from the sensors, aggregate the sensor data, send the data to an offsite server for user viewing and long-term storage, and receive commands from an offsite location. The module is being developed on a TM4C1294XL microcontroller board. This microcontroller has onboard networking capabilities making it simpler to communicate to the server. To achieve a real time operating system (RTOS) the microcontroller utilizes TI-RTOS. TI-RTOS also allows us to manage the scheduling and prevent timing conflicts in the systems operation. Environmental parameters monitored by the sensor array are barometric pressure, temperature, carbon dioxide, relative humidity, and particulate matter. Communications with the sensors is achieved through the protocols UART, PWM, and I^2C. Each drawer the climate module needs to monitor is approximately 12 ft wide, 5 ft deep, and 4 ft high. Data collected from the sensors is aggregated into a package to be sent through the onboard networking port to the offsite server. The offsite server is developed by Nectar Agricultures.

By reaching all of the primary goals our module will be the ideal component for the growing pod Nectar Agriculture is developing.

Senior Design Day 2018

UNT COLLEGE OF ENGINEERING
EST. 1890

Firefighting Emergency Response System

Team Members:

- Jesse Garza
- Connor Gillispie
- Lemuel Hadnot

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Kamesh Namuduri

Abstract:

The mission of this project is to mitigate the challenges that firefighters face everyday when putting their lives on the line to protect those in need. The challenges that firefighters face on a day to day basis are fire behavioral changes, lack of staffing, and most importantly and what we will be focusing on in this project, communication. The survival of many firefighters is dependent upon the exchange of information, which can often be affected by the building type, the environment (especially noisy environments both acoustically and electronically), and the type of communication systems that they have. Firefighters do not have the same kind of funding that the police have, and some fire departments are volunteering jobs so they will need a cost-effective solution as well as a reliable one.

In the previous semester in our Senior Design I project, we collaborated with a Senior Design II group to create a Firefighter Emergency Response System. The goal of this system is to assist firefighters in performing their duties effectively and safely in emergency situations using sensors that will be portable and will be carried on the firefighter's person that will send information wirelessly to a base station that will record data from those sensors in a central database. The sensors that we have implemented includes a GPS Sensor, a heart rate sensor, and a temperature sensor. These sensors will connect to a Raspberry Pi Zero that will read the data that will send it to the Raspberry Pi main base via WiFi. We have implemented a mesh network that will enable the Raspberry Pis to talk to one another.

For our second semester, we plan to implement a moving vehicle to the system that will be equipped with GPS trackers, in order to expedite assistance to the firefighters and help dispatchers direct those vehicles to where they are needed. We also plan to replace the mesh network, which was previously our means of communication between signals and main base, and implement a Low-Power Wide-Area Network (LORA) in order to extend the capabilities of the device to remote areas.

UNT COLLEGE OF ENGINEERING
EST. 1890

GPS Estimation for Unmanned Aerial Vehicles using Kalman Filtering and Neural Networks

Team Members:

- Dustin Howe
- Joseph Kurilla
- Michael Walton

External Sponsors/Mentors:

- N/A

Internal Sponsors/Mentors:

- Dr. Kamesh Namuduri

Abstract:

This document summarizes the proposed project to develop a GPS estimation system for unmanned autonomous vehicles (UAV). We will address problem to be solved, the proposed design, and define the deliverables

The signal from a global positioning satellite (GPS) module to the flight controller of a UAV is necessary for autonomous flight. The signal is used by the flight controller to follow predetermined flight paths and maintain position and heading. There are places such as between large buildings or indoor areas where GPS signal is degraded or denied. If the GPS signal is lost even for a few seconds, the drone will be unable to navigate. To remedy such an event, we will develop a system that estimates GPS coordinates by taking inputs from an inertial measuring unit (IMU) and calculating position change.

Because the IMU is susceptible to error from noise, we will utilize both a recurrent neural network (RNN) and a kalman filter to calculate the GPS coordinates. A RNN is a neural network that can "remember" previous data, and make predictions based off that data. The kalman filter will makes predictions for both acceleration and position using a mathematical model of the system. During an update phase, the kalman filter will use the difference between the prediction and observed information to update the error model.

The system should weigh less than 3 lbs and be mountable to a drone. It should be able to calculate the GPS coordinates within 2 meters for 10 seconds. GPS calculations should start immediately after the true GPS signal is lost. As an additional requirement of this project, a working prototype will be delivered to the TAMU Corpus Christi testing center by February, 2018.

Senior Design Day 2018