ECE Senior Design Projects showcase December 10, 2020

Project 1 Portable Solar Tracking Power System

Team 2
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The portable solar tracking power system is a physical device that can be used off-grid to collect solar energy from the sun to charge an internal battery. It is a mobile system that does not require the electrical grid. The system utilizes a dual axis solar tracking to position the panels perpendicular to the sun rays so that their performance is enhanced compared to a stationary system of solar panels. The solar powered or any complicated algorithms or GPS coordinates. The system is based on a feedback control, using a tracking sensor with 4 photoresistors, providing signals to Arduino Mega controlling 2 servo motors.
The tests show that the battery (15.65 Wh) charged by the solar panels can power 10 LED bulbs of 1.5 W each for 10 hours. Using a voltage sensor and a current sensor connected to Arduino Mega, the system can monitor power in the real time.

Project 2 Anti-Theft Motion Tracking Device - ATDM

Team 4
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The ATMTD (Anti Theft Motion Tracking Device) is a device dedicated to providing security of any property of the user's choosing from potential theft, using motion tracking technology, wireless communication (through SMS text messaging and WiFi) and a mechanical buzzer, all used to alert the user. The device was successfully tested, detecting motion, activating sound alarm, and communicating with the user by SMS Messaging.

Project 3 Smart Stacking Arm

Team 5
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Smart Stacking Arm is a model of a robotic arm that can automatically stacks boxes in a determined area. The boxes are coming on a conveyor belt and four ultrasonic sensors mounted on the conveyor gate determine their height, width, and length. The dimensions of boxes are stored and used to and stacks them in a predetermined order. An additional sensor is attached underneath the gripper portion of the arm to provide feedback for its movement. Sorting boxes by their size and placing them in different locations was demonstrated.

Project 4 FPGA Noise Cancelation System

Team 9
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Advisors Dr. Marek Sosnowski

MATLAB has an active noise control (ANC) system available on their website titled “ActiveNoise Control with Simulink Real-Time”. This example project serves nicely in studying ANC systems in general. However, because this project necessitates Simulink installed on a computer to process signals and a Speedgoat Real-Time machine to convert signals between analog and digital, this ANC system is in no way meant to be deployed on real applications like office building HVAC ducts. Our project aims to make this ANC system viable for real world applications by replicating the functionality of MATLAB’s Simulink model entirely within a single portable FPGA. Creating an FPGA-based ANC system allows us to address the broader problem of noise pollution by reducing one of the most prominent contributors to indoor noise pollution: HVAC ducts. In this report, we demonstrate a prototype of our FPGA-based ANC system on noise propagating through a PVC pipe. In the future work, however, this system can be reconfigured, and cost-optimized such that it can easily be installed onto real HVAC air ducts.

Project 5 Smart Parking

Team 14
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Adviser: Professor Mohammed Feknous

According to USA Today, drivers in New York City spend an average of 107 hours per year looking for parking spots, in which 42% of respondents said they missed an appointment, 34% abandoned a trip, and 23% experienced road rage [1]. An intelligent parking spot detection system is proposed to identify available parking spots in real-time using machine learning techniques, and ultimately deliver this data to a user via a mobile application. This scaled-down prototype was designed using a Raspberry Pi 4 (main processor), two cameras, WiFi module, Google's Firebase (real-time logging database), and a mobile application. OpenCV (an open-source image processing library in Python) was used to build the vehicle detection classifier and a field-of-view partitioning script was developed to assign locations accordingly.

The proposed system successfully differentiates between vehicles (including cars, trucks, and motorcycles) and non-vehicles, and determines parking spot availability based on the vehicle's position within the frame. This information is sent to the Firebase via Wi-Fi, which then communicates with a mobile application, in which the data is finally delivered to the user, all in real-time. This system was extensively tested in NJIT's Summit St parking garage and ultimately proved successful; as a result, two cameras were utilized to comfortably monitor twelve parking spots, but can be adjusted to monitor more spots accordingly.

Project 6 Smart Dartboard

Team 16
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Cole Nelson (Electrical Engineering)
Bryan Perez (Electrical Engineering)

The Smart Dartboard is a new age spin on the timeless game of darts. Our team has successfully created a board that has the look and feel of a classic cork board, but with the technology of an electronic board. It tells you where the dart hit, logs the data, and counts the score. With these features, the codes for different dart games like 301, 501, 701, around the clock, and many more can be crated. The scoring of these game modes could potentially be displayed on a smartphone app (future development).

Project 7 High-Density Microinverter with GaN and SiC Semiconductors

Team 13
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Enrique Saladin

The goal of our project is to design and fabricate a DC-AC inverter that is smaller and more efficient than currently available ones by utilizing novel technologies such as wide bandgap (GaN and SiC) semiconductors, planar magnetics, and digital control. This inverter can take in 12VDC battery power and converting it to 120VAC pure sine wave at 1kW. Our project has potential to be adopted in automotive, industrial, and aerospace markets where performance metrics are valued over cost. Its high efficiency would also be valued in the type of microinverter systems commonly deployed in microgrid/distributed energy generation and uninterrupted power supply systems.

Project 8 Long Range IoT Development Platform

Team 17
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Long Range (LoRA) IoT Development Platform facilitates and speeds up the development of networking of LoRa devices. While adding new Internet of Things (IoT) devices may be simple in applications where a Local Area Network (LAN) connection is available, development for long range wireless applications is much more complex hence time consuming and costly. LoRa a sub GHz frequency offers the perfect solution, with its 15km range and ultra-low power consumption. The goal of this project is to combine the already wide Arduino knowledge base with LoRa's wireless protocol by abstracting all of the networking. The platform automatically sets up a Low Power Wide Area Network (LPWAN), a database to save the collected data, and an application to visualize the data. To use the platform all the user has to do is a simple call to the created Arduino library.

The platform was tested using three different sensors: touch, temperature, and GPS. The GPS sensor was used to test the working range of the platform by poling GPS coordinates from different locations. The Arduino was set to record GPS coordinates on the press of a button; the coordinates were then saved locally and transmitted to the LPWAN. The data received by the LPWAN gateway were added to a database and the failed packets were later manually added with a failed field. The data was then plotted on google maps yielding a 8.3km range in a suburb area and a 1.37km range in a city environment.

Project 9 Object recognition for the visually impaired

Team 20
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Around 1.3 billion people live with some form of vision impairment in the world. A great number of those are without any vision. Our objective was to be able to create a device that could assist a visually impaired person navigate around a room and find objects of interest. The device consists of a Raspberry Pi, a camera, earphones or a speaker, and a rechargeable battery. The completed device will be ergonomic, of cylindrical shape, for easy pointing in the direction of interest. The operating system is Raspbian based on Linux optimized for Raspberry Pi. This utilizes the tensor flow lite image recognition libraries which enables recognition of common objects and informs the user of their detection by voice.

The tests show that the system can recognize about 80 common objects, such as a chair, bed, TV, laptop and more everyday items found around the house. The device is able to recognize objects with an accuracy in the range from 71% to 89%. The device can be marketed to people with visual impairment, living at home or assisted care facilities.