IoT4Ag Communications: LoRaWAN-based Asset Tracker and Personal Emergency Button

By Prof. Bill Eisenstadt, wre@tec.ufl.edu and in collaboration with Dr. Ian Small and Rebecca Barocco of the IFAS NSFREC Center in Quincy, FL.

General IoT4Ag LoRaWAN project goals:

This project is developing LoRaWAN communications and systems for agricultural sensors as part of the NSF IoT4Ag Research Center at UF, Penn, Purdue and U Merced. LoRaWAN has become a standard long distance communication method (up 13 km) on farms in remote locations. This project will work to create custom LoRaWAN sensor and data modules to operate with a LoRaWAN installation at the UF/IFAS NFREC IoT4Ag agricultural testbed site in Quincy, FL.

Figure 1: LoRaWAN radio and sensor module in a waterproof box.

This project builds on a prior senior design projects which developed LoRaWAN gateways and servers, and custom LoRa radio modules and codes for communication of sensor data. There will be strong collaboration with this project and sensor communications required for multiple IoT4Ag projects. Students will participate in the NSF Engineering Research Center IoT4Ag https://iot4ag.us/ and may be invited to attend (expenses paid), give a poster paper, and meet IoT4Ag students from all over the country at the annual June 2024, Iot4Ag center Summer Conference.

Specific Goals for this student Design 2 research project:

In this Design 2 research project, the student team will build a combined LoRaWAN-based Asset Tracker and Personal Emergency Button device. Existing farm areas can be large and remote and inadequately covered by WiFi, and cell modems leaving a personal security risk if someone gets injured out of wireless coverage. A LoRaWAN emergency alert device with an emergency button would provide an additional security of farmworkers and augment their cellphones. By building a mode in which the device periodically automatically broadcasts its location the device serves as an asset tracker for farm machinery, too. This device would contain a LoraWAN radio, 4th generation particle industries processor module Photon 2, a trigger button, a GPS module, a battery and charging method and a LCD screen or LEDs for user interfacing. The GPS and emergency data from the device would be broadcast to a LoRaWAN gateway and server to a geolocation map. Also, there could be an alarm system to texting interface to alert various cell phones.

The students creating the device will deploy a custom PCB board and provide working software runs the LoRaWAN radio and the Photon 2. This project builds on existing LoRaWAN radio code and server code. In addition, the students will work with the LoRaWAN server to move data to a geolocation map and to provide emergency texting. A key part of the work will be using low power programming and power supply cycling to turn the processor and RF modules on and off, conserve power and extend battery life. The power reduction work on this project will be useful for collaboration with the Wireless Power

Transfer Project IoT4Ag to see if the LoRaWAN devices can be powered wirelessly in the field. A project goal will be to collaborate with multiple NSF IoT4Ag ERC projects in progress at the University of Florida.

Last semester, the project programmed commercial gateways servers and software for LoRaWAN communications. Students will help deploy these gateways in collaboration with the other IoT4Ag researchers. Prof. Eisenstadt and students will be bringing up a commercial grade LoRaWAN gateway and server for UF and the Quincy Agricultural test field and additional gateways and servers on other test fields and in Gainesville FL.

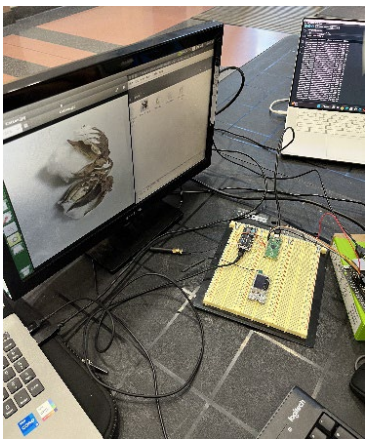

Figure 2: LoRaWAN image transfer from Jetson Nano

The project goals depending on the number of participants will be:

- Build field robust prototypes LoRaWAN-based Asset Tracker and Personal Emergency Button for field deployment with environmental sensors and LoRaWAN controlled actuators.
- Work with the Senior Design Sentinel Mini project to add the LoRaWAN radio to communicate environmental data and actuate and control the Sentinel Mini via a LoRaWAN gateway.
- Demonstrate LoRaWAN modules reporting data and actuating devices through the LoRaWAN base station in the Quincy, FL IFAS agricultural research station.
- Characterize the transmission distance, data rate and power consumption of the LoRaWAN modules
- Add wireless solar power and/or a battery power supply capable of running the LoRaWAN modules for six months. Program the LoRa sensor modules for extreme power savings to realize this.

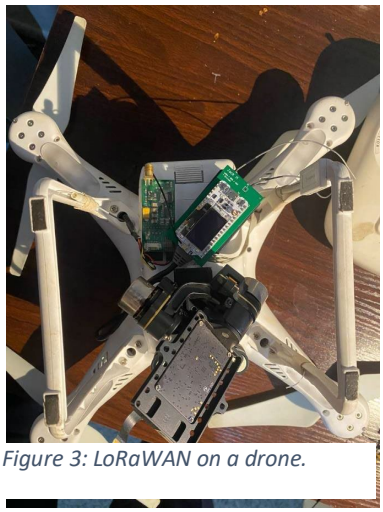

Figure 3: LoRaWAN on a drone.

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Spring 2024 EEL 4942C Senior Design Project Specifications for this Effort

This effort would be a **Design 2 research project** sponsored under the guidance of Prof. Bill Eisenstadt. Under regular senior design 2 project guidelines, this project would have some hardware complexity, and strong software complexity.

- The undergraduate student(s) on the project must build and test a low power mode LoRaWan radio sensor modules and show that they work.
- The student(s) will work with the professor, post docs and graduate students on the project.
- The undergraduate will write an undergraduate conference paper or poster paper describing the research by the end of the semester. See https://cur.aa.ufl.edu/2023-spring-undergraduate-research-symposium/. Also, https://cur.aa.ufl.edu/student-spotlight-submission/
- The undergraduate student(s) would do the assignments (PDR, FDR, weekly progress reports, etc.) of the senior design course and meet one hour a week with a sponsor professor.
- The senior design project grade evaluation for the students will be by the sponsor professor.
- There will be support for materials and equipment for the project from the professor.
- At the end of the effort, the prototype device and codes would belong to the professor.