Construction of a Wireless Sensor Network for Use in Precision Agriculture

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Abstract

Precision agriculture uses technology to collect, transmit, and process data to help improve farm management decision making. (Anisi, 2015) Access to updated information on a crop's status will allow for more effective use of resources.

Objective

This project will design and build a wireless sensor node that can monitor, collect, and transmit data between nodes. This design will include an enclosure that can survive the environment.

Introduction

Nodes will be collecting data from four sensors: temperature, humidity, pressure, and light. The node will be placed in the field constantly transmitting data for other nodes to read. This will create a wireless sensor network. This system will need a consistent power source to keep it operational. For this purpose a 1200 mAh li-ion battery and solar panel are used.

Housing

The prototype of the housing will be made of cardboard and clear tape . A portion of the lid will be made with tape so as not to interfere with the light sensor. Holes will be drilled in the bottom of the container to allow air circulation for the pressure, temperature and moisture sensors. The holes are drilled on the bottom so water does not leak in from the top. The actual enclosure will be made out of plastic and glass.

Materials and Methods

Before beginning formal work on constructing the sensor system, several class periods were utilized in the beginning of the semester to learn how the Arduino board, its programming language, and its IDE worked. During this time, example tutorial codes for an Arduino Uno were downloaded and tinkered with. Once comfortable with the basic operation of the Arduino, we transitioned to working with a Feather M0 board for the sensor system.

In order to collect data from the sensors, example codes were merged from the Adafruit BME280 Triple Sensor/Temperature Humidity Pressure Sensor (Figure 1) and the Adafruit TSL2591 High Dynamic Range Digital Light Sensor (Figure 2). Data from the sensors will be collected and transmitted by an Adafruit Feather M0 with RFM95 LoRa Radio - 900Mhz.

Figure 1. BME280 Triple Sensor

Figure 2. TSL2591 Light Sensor

The sensor and Feather radio codes were merged into a final working code for the Feather to transmit and receive data.
A 2.5W 5V/500mAh Solar Panel will be charging the 1200 mAh lithium-ion Battery.

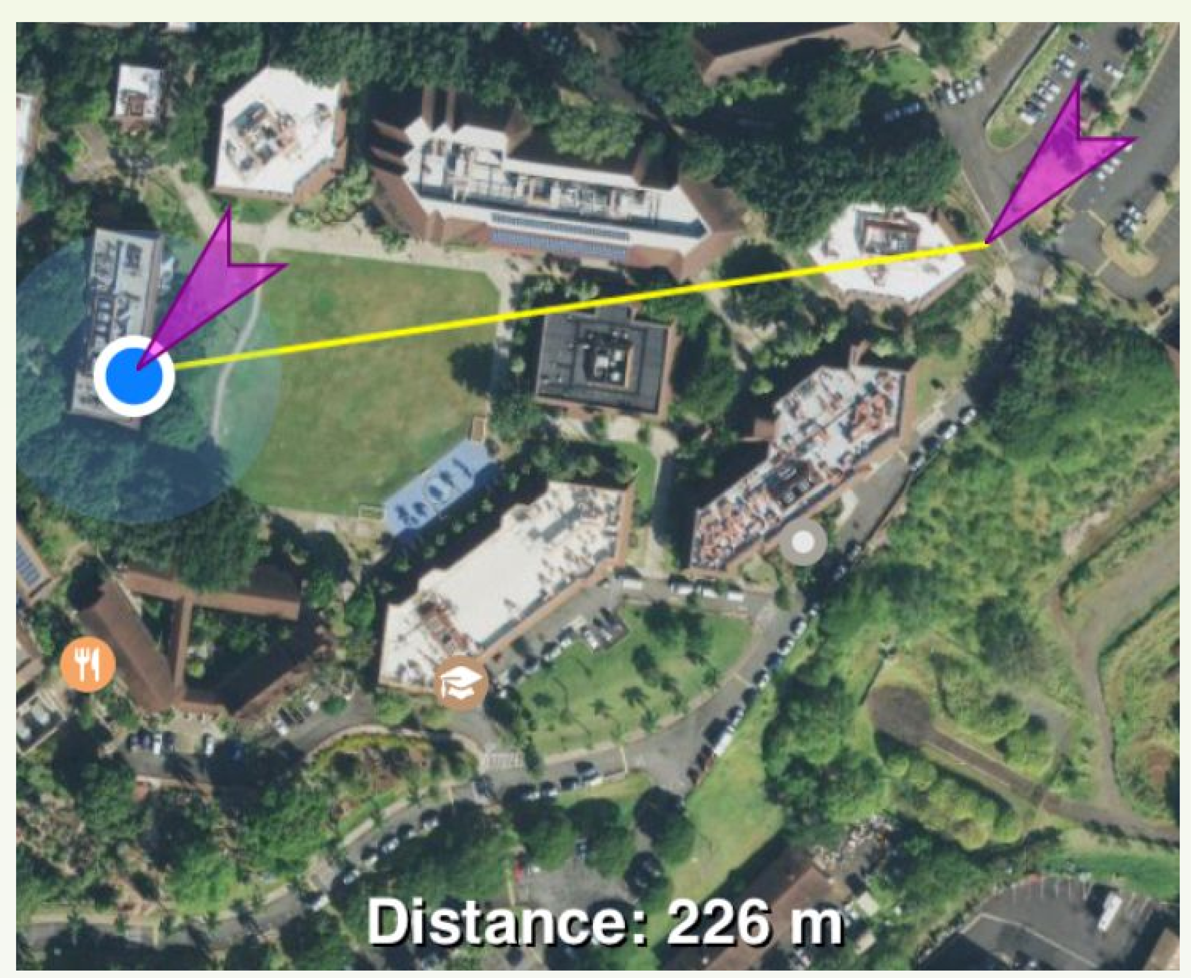

Figure 3. Map of non-line-of-sight distance.

Figure 4. Map of line-of-sight distance.

Results

Transmission range:
Non line of sight: 226 meters (Figure 3)
Line of sight: 1090 meters (Figure 4)

Conclusion

We were able to construct a basic sensor transmitter system using a Feather M0 board with a BME 280 Triple Sensor and TSL 2591 Light Sensor (Figure 5). The transmission distance between the transmitter and receiver with obstructions (non-line-of-sight) was only 226m, but increased to an impressive 1090m with clear line-of-sight

Future Work

More sensors such as a soil moisture sensor or even a video camera to directly monitor crops could be added to the transmitter system. The use of encryption to prevent unauthorized access to our devices. The addition of more sensor nodes to make the wireless sensor network larger. Larger network could allow for a cloud based database to collect and analyze data.

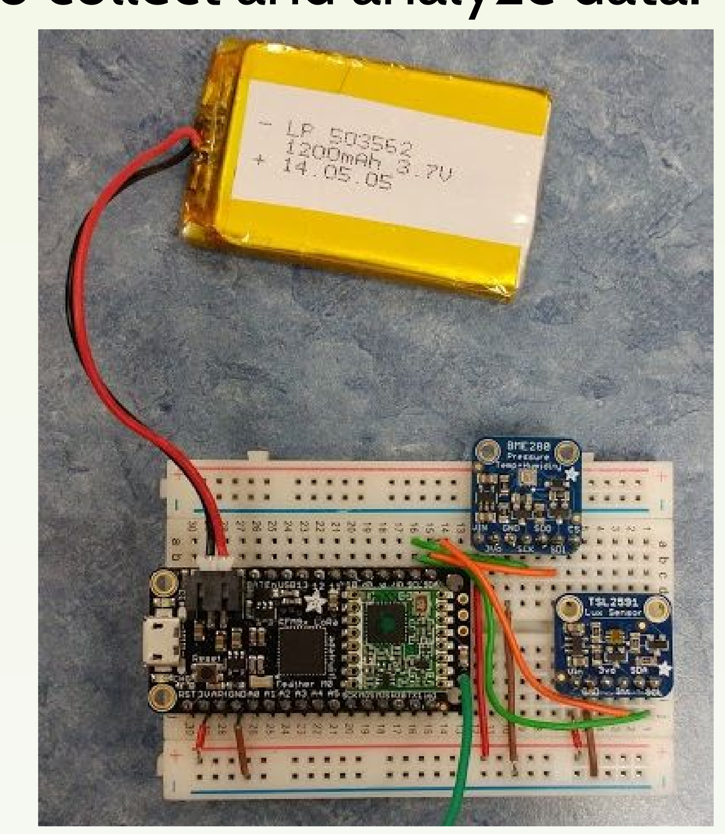

Figure 5. Completed sensor transmitter system

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