LIMA: Lovely Irrigation Monitoring App

Daniel Albers, Sam Jackson, Seth Lightfoot, Sierra Lucht, & Landon Woerdeman
Advisor: Dr. Govindarasu Manimaran & Client: Dr. Ajay Nair

Motivation:

Farmers need to accurately monitor their crops
- High prices and difficulty using the technology

Objectives:

Save on irrigation costs
- Improve environment by reducing water
- Ensure healthier crop

Create easy to use technology
- Mobile access
- Accurately measure soil moisture

Design Requirements:

Non-Functional
- Easy to understand and use
- Near to real time data response

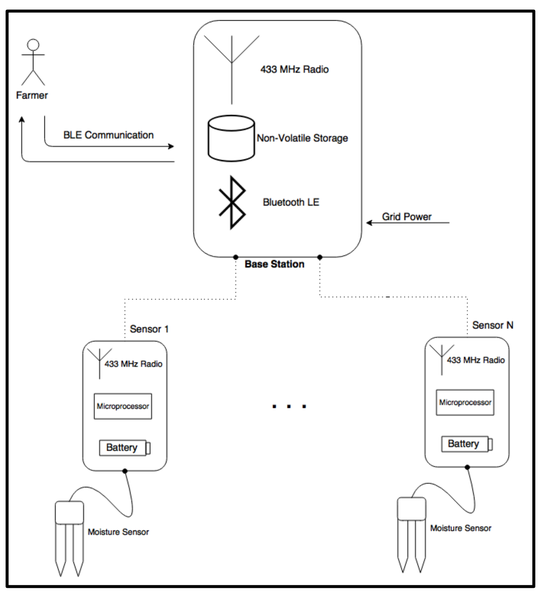
Functional
- Probe buried 18-24 inches in soil
- Sensor data accessible on smartphone
- Operable under growing weather conditions
- Adequate battery life

Use Cases:

Use Case 1
- Remote soil monitoring
  - Soil monitors send their data to the base station
  - Base station connects to the phone when in range

Use Case 2
- Fully automated irrigation
  - Automatically turns on the irrigation system if the sensor indicates an area is dry

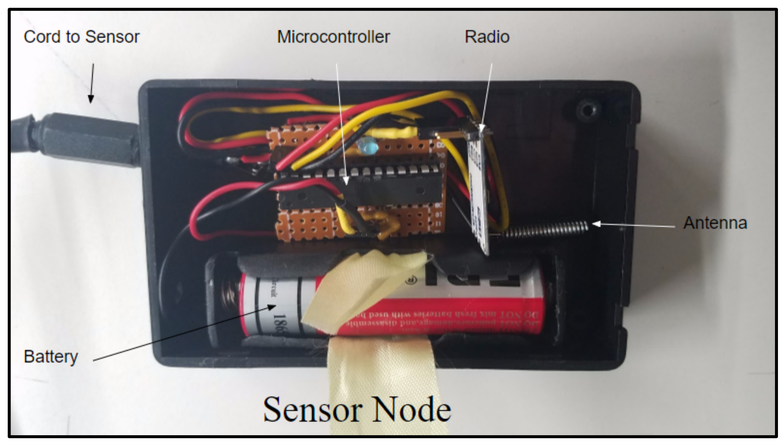
Design Approach:



- Soil moisture sensor is buried in the dirt
- Sensors relay information with a Bluetooth microcontroller
- Base Station signals sensors to relay data
- Microcontrollers relay information to the Base Station with 433Mhz radio
- Base station transmits the data to the smartphone application via Bluetooth

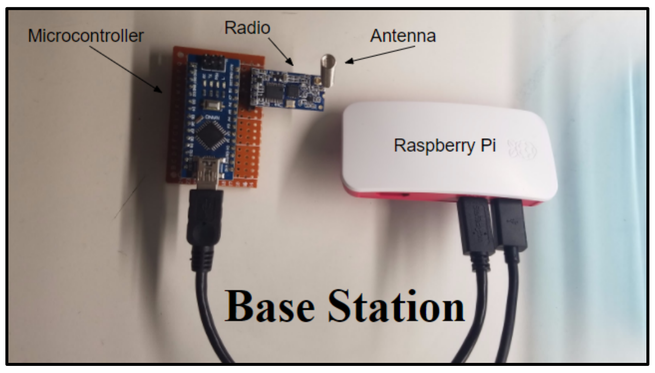
* The details between this design and the final version are detailed in the final report

Technical Details:



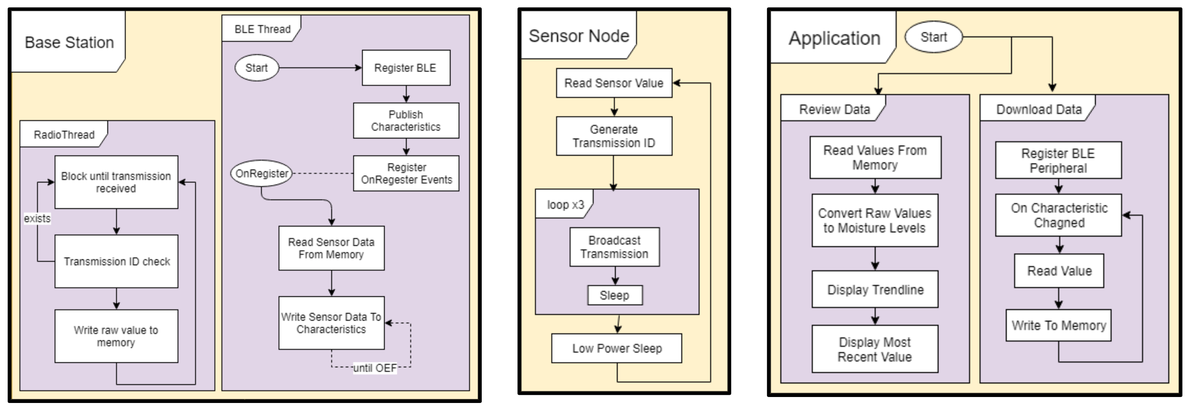
Sensor Node
- 433Mhz radio
- Bluetooth LE
- Arduino (IC)
- 10HS Sensor

Base Station
- 433Mhz radio
- Bluetooth LE
- Raspberry Pi Zero W
- CH340G NANO



Sensing Software
- Arduino
- Bleno – NodeJS
- Python

Application Software
- Flutter – cross platform
- Native BLE

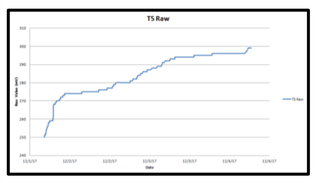


Testing:

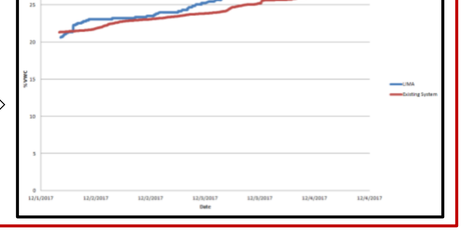
Prototype I Test
- Unreliable results
- Battery life issues

Sensor Reliability Test
- Watermark sensor vs. 10HS sensor
- 10HS much more reliable

Comparative Test
- Existing system + 10HS sensor vs. new system + 10HS sensor
- Similar results



ABS(2.589E-10 * mV^4 * -5.010E-7 * mV^3 + 3.523 E-4 * mV^2 - 9.135E-2*mV + 7.457)/2 + 20



Results:

Existing System	$1,170.00
New System	**$777.65**

- Similar sensor results to existing system
- Lower cost
  - Total system cost
  - Not limited to 5 sensors
- Mobile capabilities