Wireless Moisture Sensor for Data Capture and Automatic Irrigation

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Problem Statement

The ***current*** irrigation system requires student workers to come to the farm on the weekend and is not based on the empirical water content of the soil.

- Does not reflect the water levels in the soil
- Automating the process would allow workers to help on other parts of the farm.

Constraints:

- costs below $30
- weather resistance
- interfacing with current irrigation system

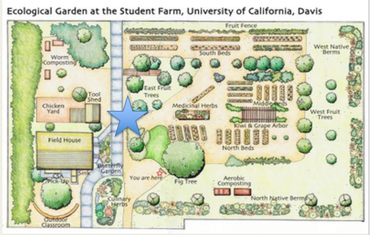


Figure 1. Ecological Garden
(Blue Star: the box with all the switches)

Design Solution

All the switches on the farm are in one box but there are many fields far away from the box. So the solution uses wirelessly communicating between the sensor node (measure soil moisture) and the control node (receive inputs and regulate solenoids) with one system controlling each pipe to each field.

Figure 2. The Solenoids Box

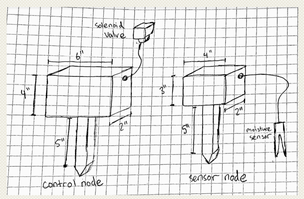


Figure 3. Prototype Design

Case Fabrication

Designed in Solidworks: ***Laser Cut,*** glued and painted

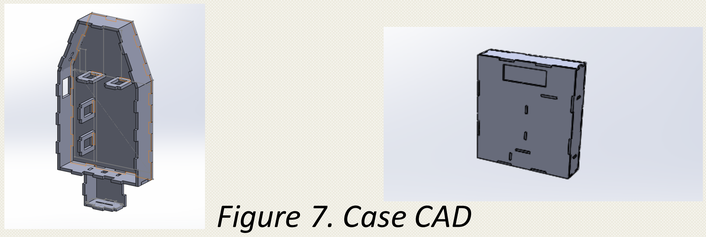


Figure 7. Case CAD
(Left: Sensor Node / Right: Control Node)

Moisture Sensor

- Records moisture values as voltages
- Adjust input using voltage follower and voltage divider
- Sends voltage value to Pi
- Report connection errors through LED

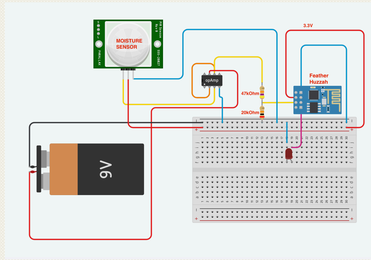


Figure 4. Sensor Circuit

Raspberry Pi with Wifi Hotspot

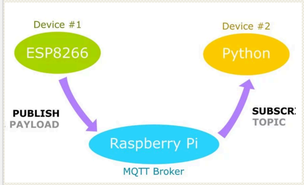


Figure 5. MQTT Protocol

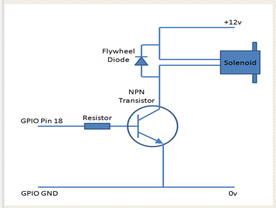
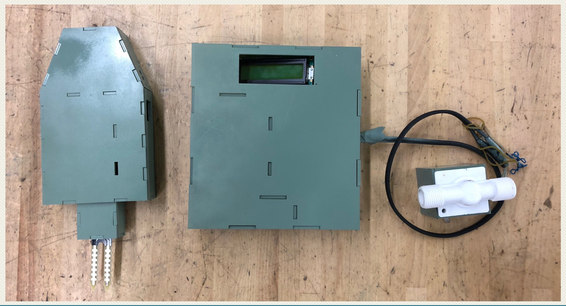


Figure 6. Solenoid Circuit

- MQTT protocol used to send messages from Hazzuh to Pi through hotspot
- Mosquitto: lightweight message broker for low power systems
- Python Script runs subscribing and voltage values comparison to the threshold values
- 2222A Transistor as a switch to turn on solenoid
- LCD screen shows the moisture level and solenoid status

Final Products



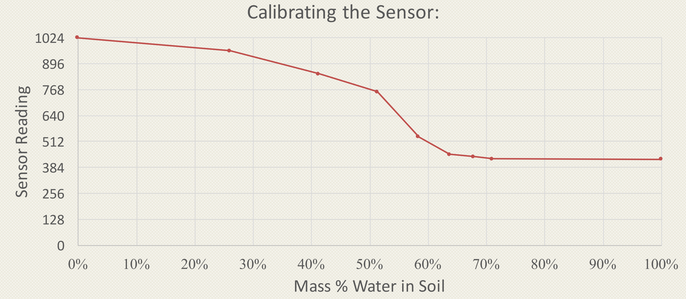
Test Data with Results

Wifi Hotspot Range Test:

- the Maximum Distance between the Raspberry Pi and the Feather Huzzah to maintain the connection
- Result: 210 Meters (enough for the farm)

Moisture Level Calibration:

- Finding the relationship between the output voltage and the moisture level in the soil.



Discussion of Results

According to our research, the output voltage between 600 to 800 is a proper range for specific plants to grow, which are the threshold values in this system. And the Wifi range is enough to cover the farm to work for all the fields.

Future Work

- Converting from DC to AC and voltage transformation to interface with current valves
- Average moisture value at one place with multiple sensors to improve the accuracy
- Switch 9V batteries for self sufficient solar panels
- Using one system with MQTT to capture the messages from all the sensors on the farm

References

- C-stem resources
- https://learn.sparkfun.com/tutorials/soil-moisture-sensor-hookup-guide
- http://www.instructables.com/id/How-to-Use-MQTT-With-the-Raspberry-Pi-and-ESP8266/
- https://pimylifeup.com/raspberry-pi-lcd-16x2/

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