Smart Drip Irrigation System

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Project Manager: Dr. Steven Pei
Faculty Advisor: Dr. Leonard Trombetta
Sponsors: IEEE EDS, BioNica, and Universidad Nacional Agraria (UNA)
Date: April 1st , 2021

Problem

Approximately 35% of the Nicaraguan population lives in poverty

Agriculture provides employment for rural population

Farmers cannot afford expensive equipment

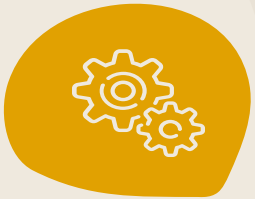
Farming as main source of food

Agriculture serves as a primary export

Purpose

Cost Effective System

Maintain a low-cost, fast return-on-investment product



Improve Current Design

Adapt design to function for multiple crops

Coordinate Relief

Project coordination with BioNica and Universidad Nacional Agraria (UNA)

User Analysis

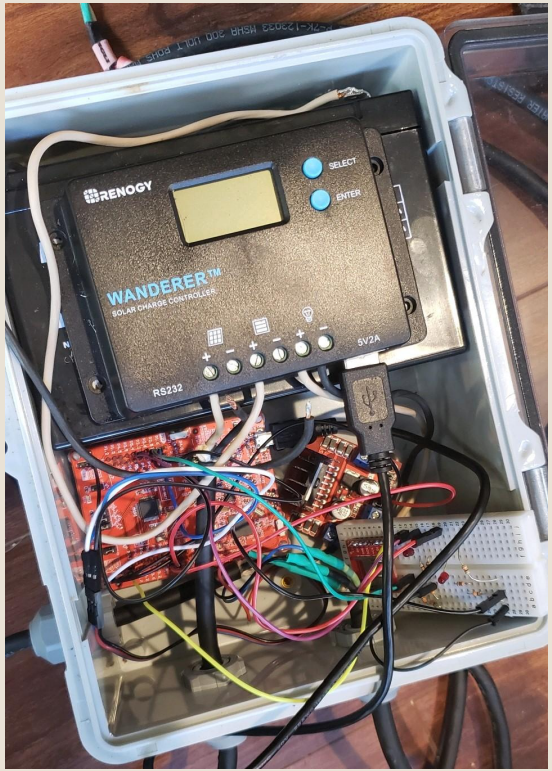
Low-income

Technical inexperience

Full-time farmers

Main target is Nicaraguan farmers

Improvements from Previous Group



Old Project

Previous Group	Our Group
Single Crop Design	Polycrop Design
One Moisture Sensor	Six Moisture Sensors
Loose Wiring	Printed Circuit Board
Used LEDs to Communicate	Using LCD Screen to Communicate
Three Solar Panels	4 Solar Panels
IP65 Container	IP67 Container
Normal User Manual	Video User Manual

Deliverables: Specs and Features

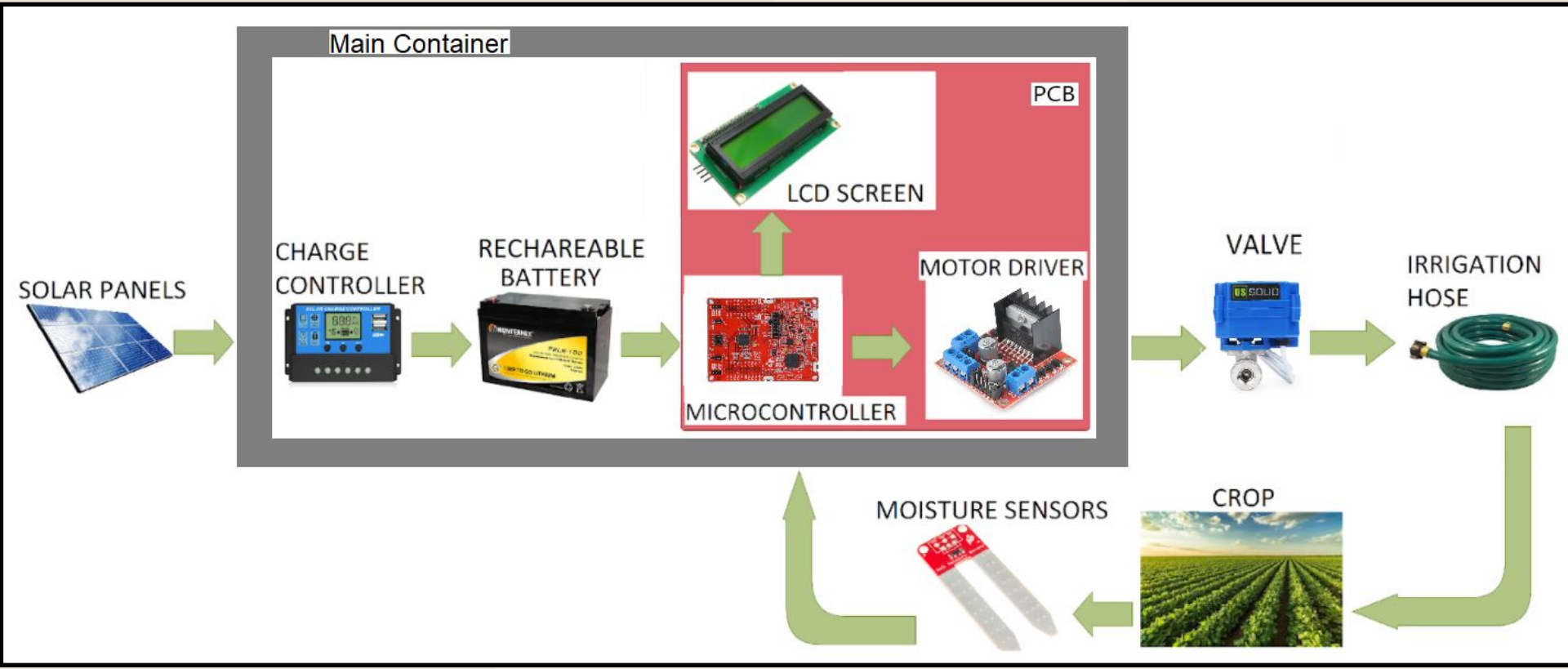
Key Specs:

- Operates on 12 [V] DC
- Heatproof, Water Resistant, Dustproof
- Ability to irrigate 9 [m] x 16 [m]
- Valve opened at a period of two hours
- Battery powered with capacity of 7 [Ah]

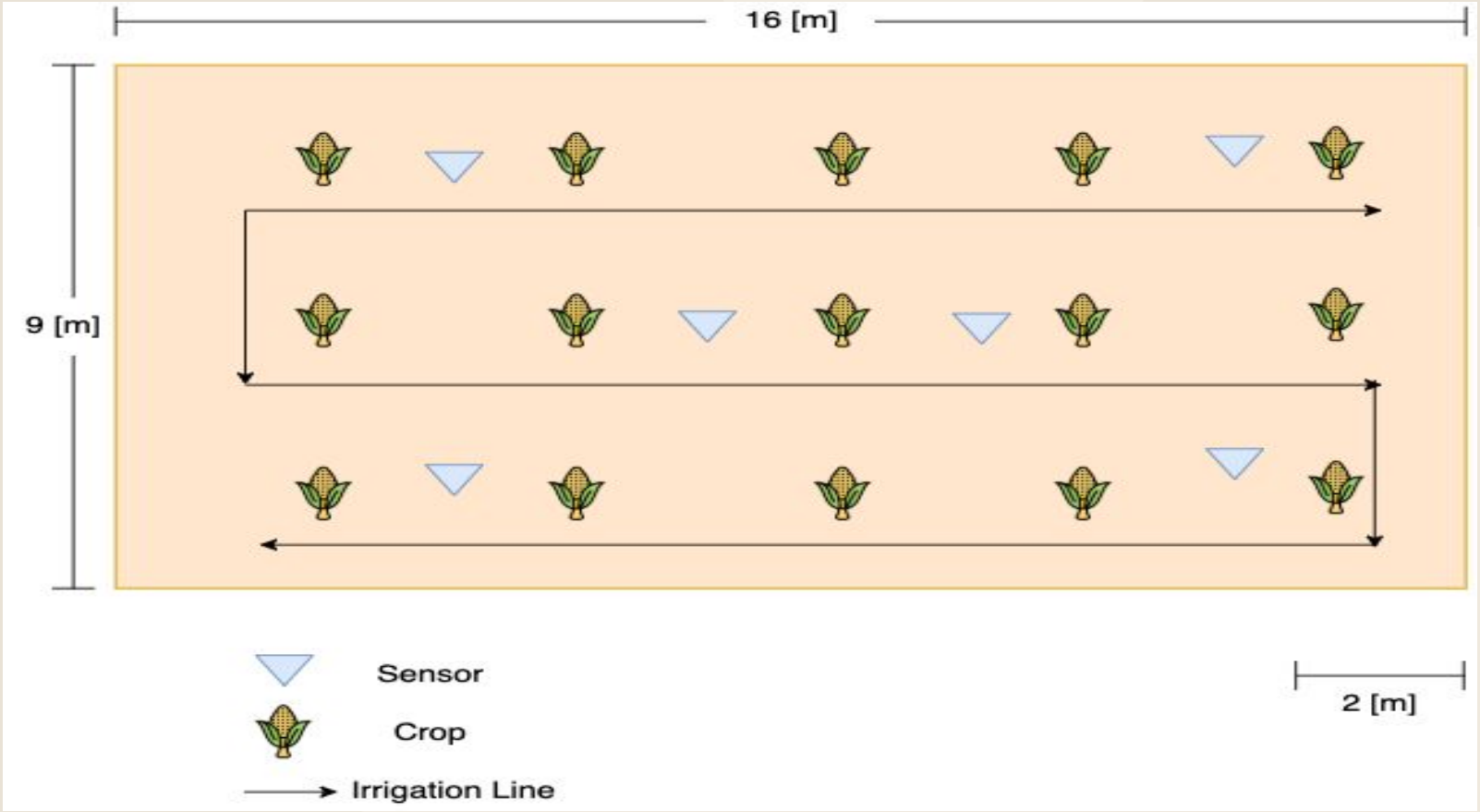
Features:

- Visual interface to show system info
- Powered by Solar Panels
- Autonomous Operation

Overview Diagram



Overview Diagram



Patents - Diego

- S. . Bermudez Rodriguez, H. F. . Hamann, L. Klein, and F. J. . Marianno, “Automated Irrigation Control System,” 10 , 241 , 488 B2, 26-Mar-2019.
  - Light sensitive sensor
  - Schedule based on weather

Patents-Josh

- Richard W. Parod, C. H. M. (n.d.). “Solar Powered Irrigation Machine”. *Patent No. 8517289B2. 9-28-2007*
  - Mobile irrigation across a field via a motor
  - Solar tracking
- *Our Approach:*
  - *No solar tracking, strictly for power*
  - *Valve operated instead of motor operated*

Patents - Victor

- Paul, M. F. (2020). “WATERTIGHT ELECTRICAL COMPARTMENT FOR USE IN IRRIGATION DEVICES AND METHODS OF USE,” 10,965,109, 30-Mar-2021.
  - Patent of building a water-tight electrical compartment
  - Includes claims for methods used to monitor soil and how the system manages irrigation

Patents - Vedant

- D. Lankford, “Crop-specific Automated Irrigation and Nutrient Management,” 10,512,226 B2, 24-Dec-2019.
  - Irrigation based on user input
  - Watering frequency

Standards - Diego

- IEEE Standard for Sensor Performance Parameter Definitions
  - Parameter for moisture and humidity control
  - Minimum and limit operations
  - Used for I/O systems

Standards-Josh

- IPC J-STD-001, “Requirements for Soldered Electrical and Electronic Assemblies.”
  - Covers the soldering process
  - Plated hole soldering
  - Electrostatic Discharge (ESD)
  - Important for our project since we are soldering through a PCB

Standards - Victor

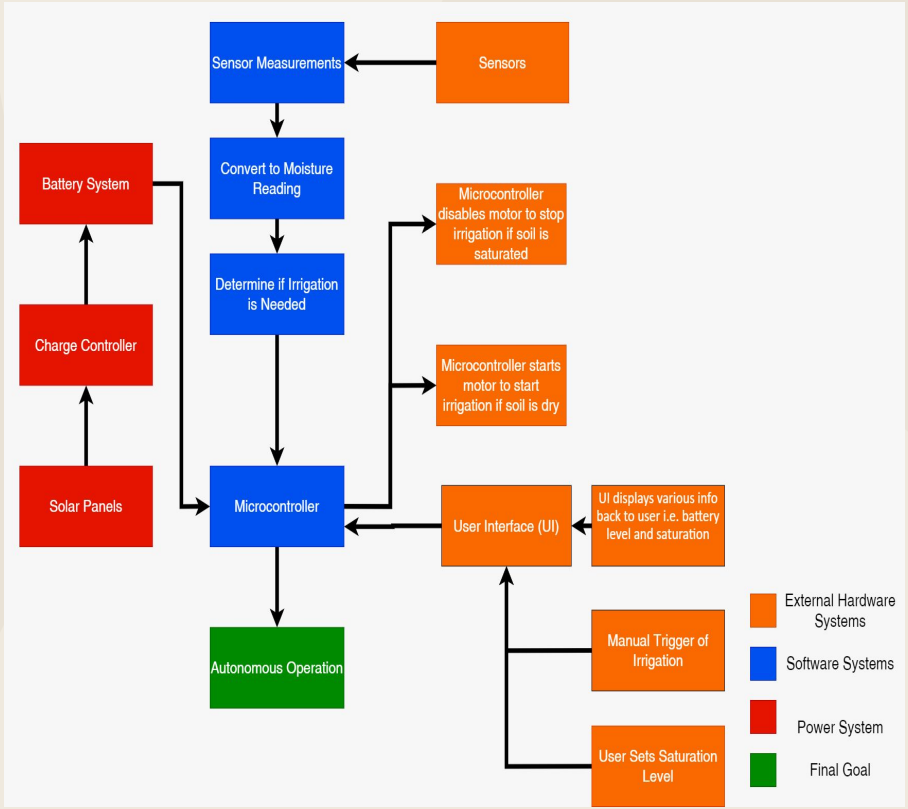
- Recommended C Style and Coding Guidelines
  - Written Texas Instruments in 2013
  - Gives info on file naming, variable naming, comments, ect.
  - If we were hired by Texas Instruments, our code would not meet their industry standards

Standards - Vedant

- IPC-2152 —Standard for PCB Trace Width
  - Net Width of PCB Connections based of range of currents
  - recommended to provide a 0.010” width for low current analog and digital signals
  - Printed circuit board traces that carry more than 0.3 A should be wider
  - Most 3D CAD Softwares takes this into consideration automatically

Goals

- Provide an automated system that irrigates several types of plants
- Keep system's price per unit as low as possible
- Extend the system's lifetime as long as possible

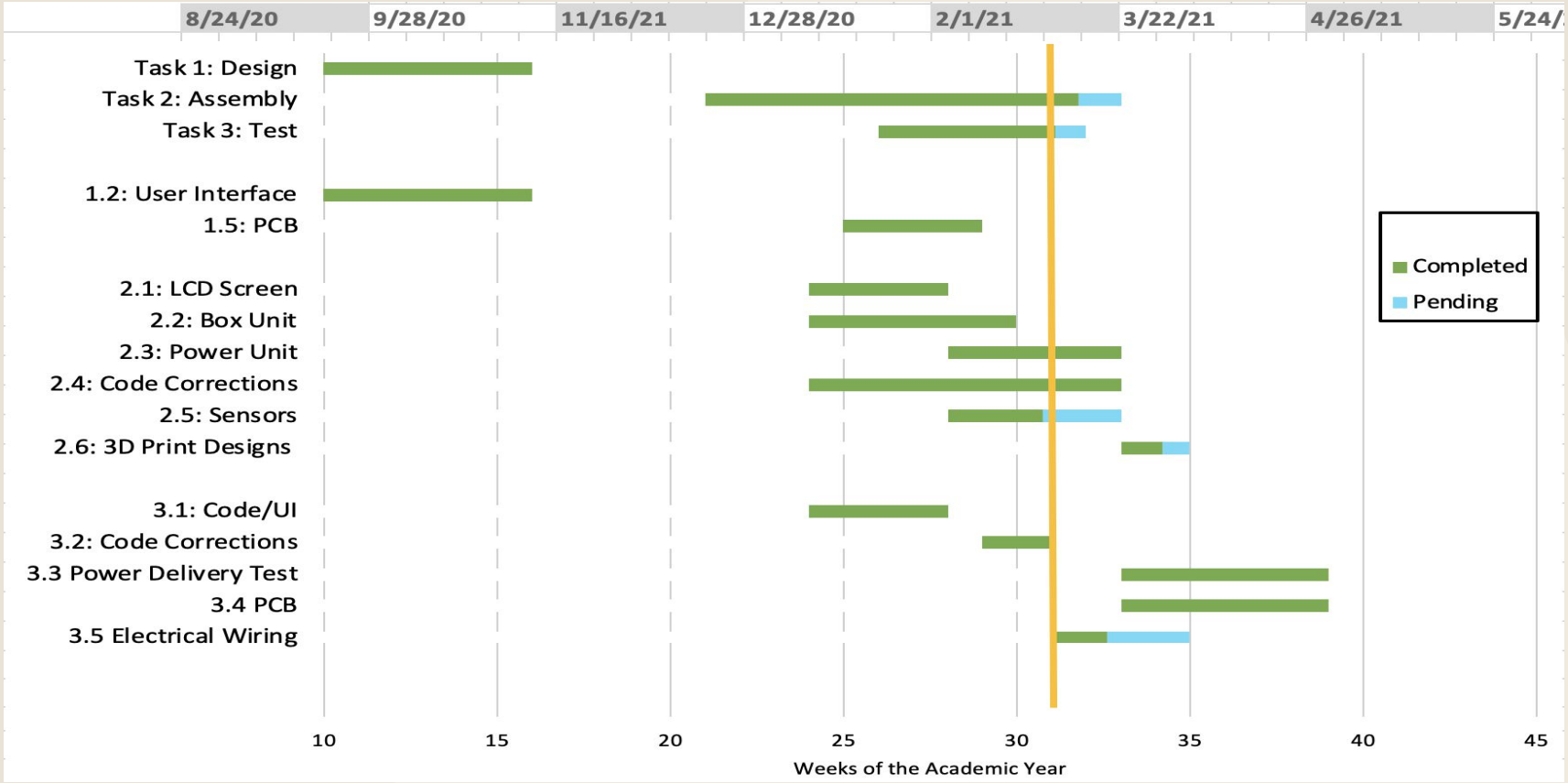


Constraints

- Unable to establish contact with Universidad Nacional Agraria
  - No field team has been established
  - Delay in setting up system

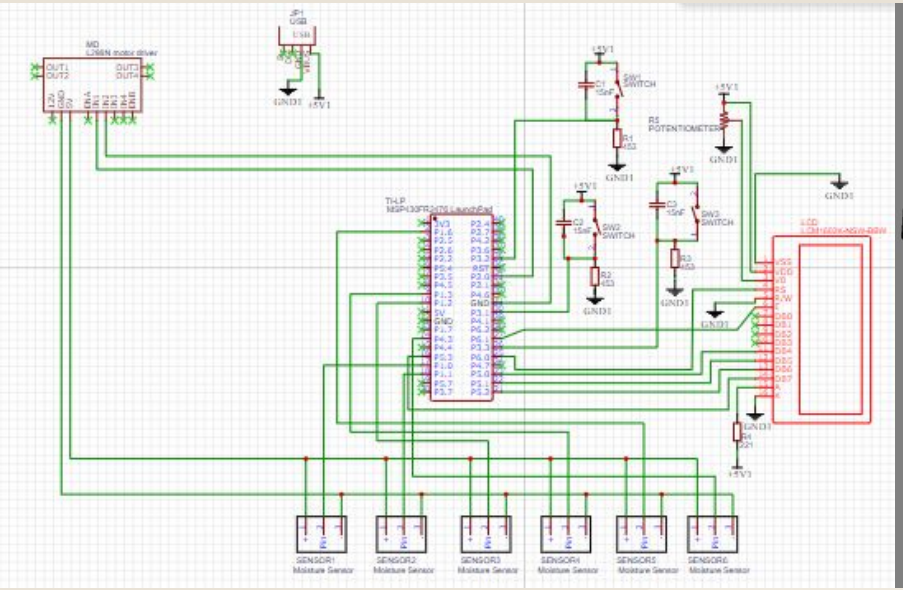
- No Data
  - Previous team’s equipment not installed
  - No information on performance

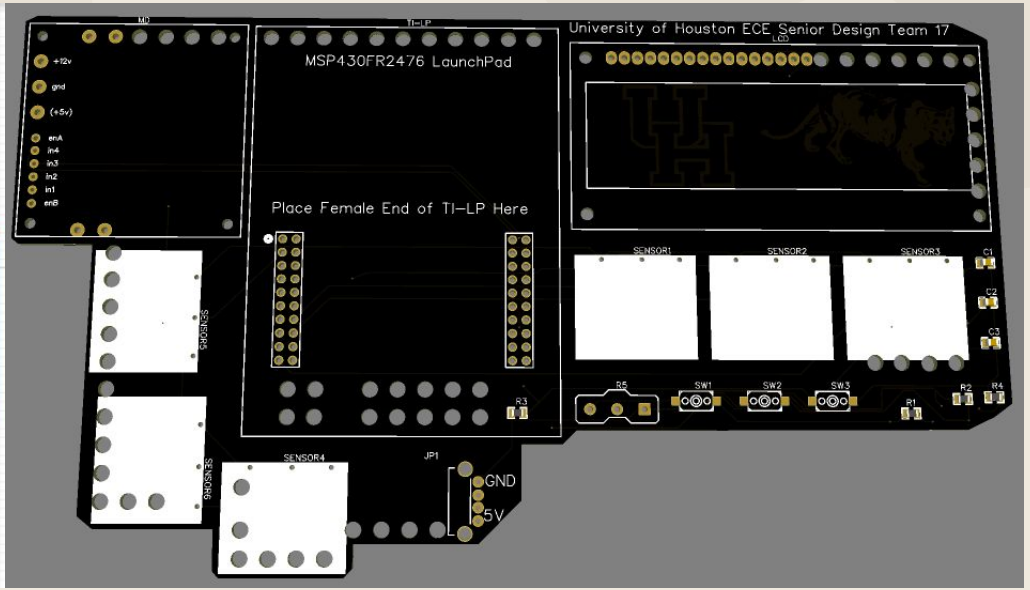
Schedule


8/24/20
9/28/20
11/16/21
12/28/20
2/1/21
3/22/21
4/26/21
5/24/
Task 1: Design
Task 2: Assembly
Task 3: Test
1.2: User Interface
1.5: PCB
2.1: LCD Screen
2.2: Box Unit
2.3: Power Unit
2.4: Code Corrections
2.5: Sensors
2.6: 3D Print Designs
3.1: Code/UI
3.2: Code Corrections
3.3 Power Delivery Test
3.4 PCB
3.5 Electrical Wiring
Completed
Pending
10
15
20
25
30
35
40
45
Weeks of the Academic Year

Task 1.5 Update: PCB

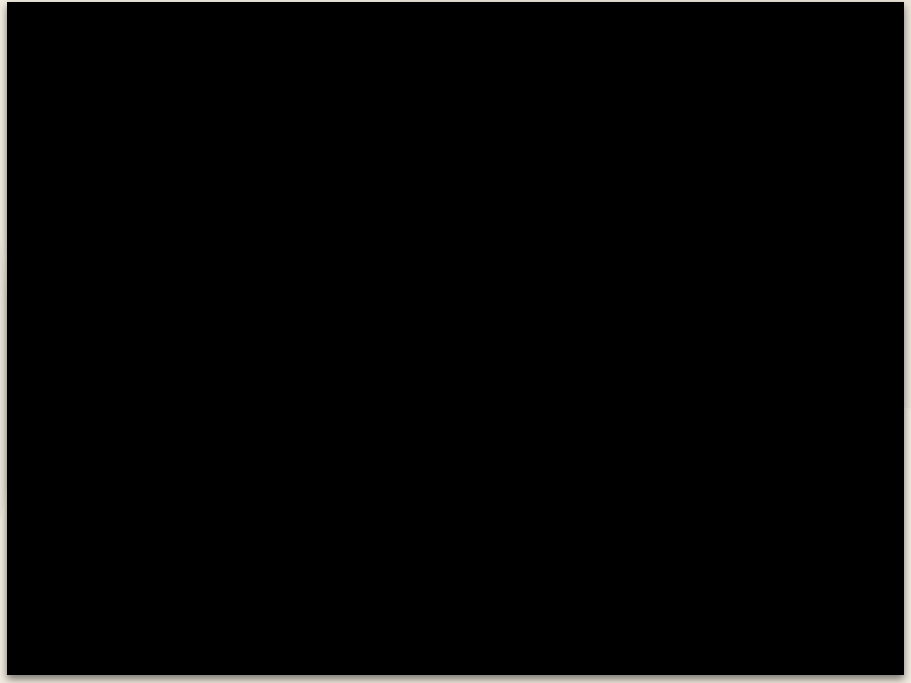
- PCB Schematic: Complete
- PCB Connections: Complete
- PCB Purchase: Complete





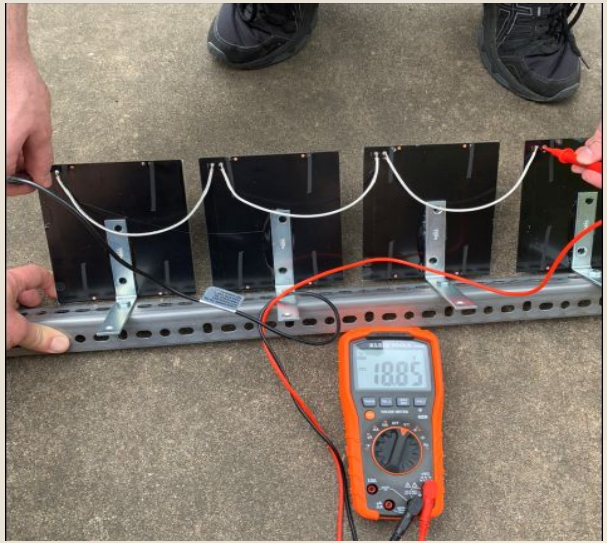
Task 2.1 User Interface Creation Update

- User interface takes in inputs to set mode
- User interface displays the current mode
- Ability to scroll up and down various options



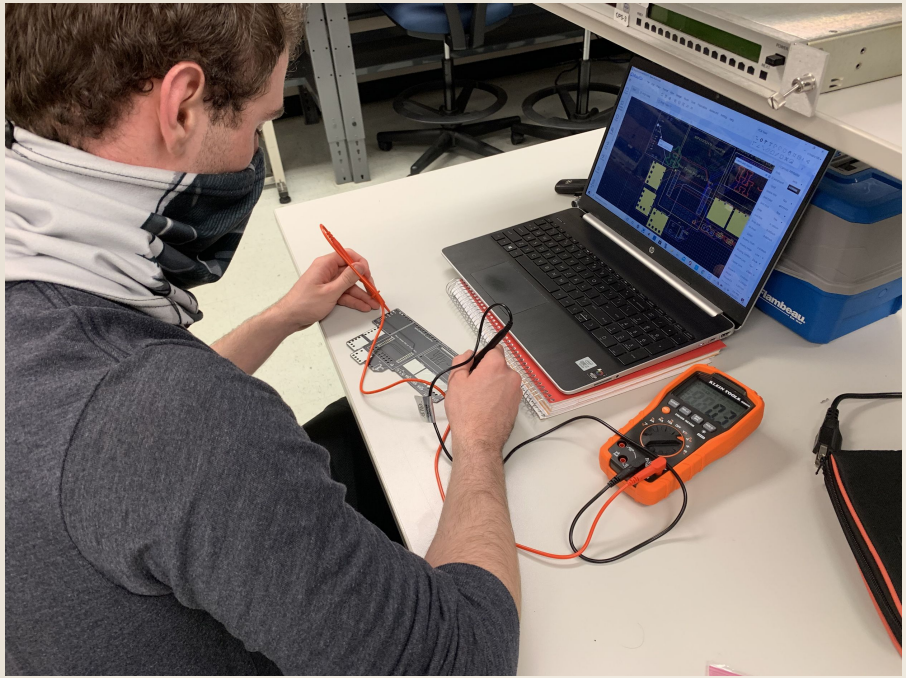
Task 3.3 Update: Power Delivery

- Power Delivery System Assembled
- Left Picture: Solar Panels on a cloudy day
- Right Picture: Battery, Charge Controller , and Solar Panels Connected Together



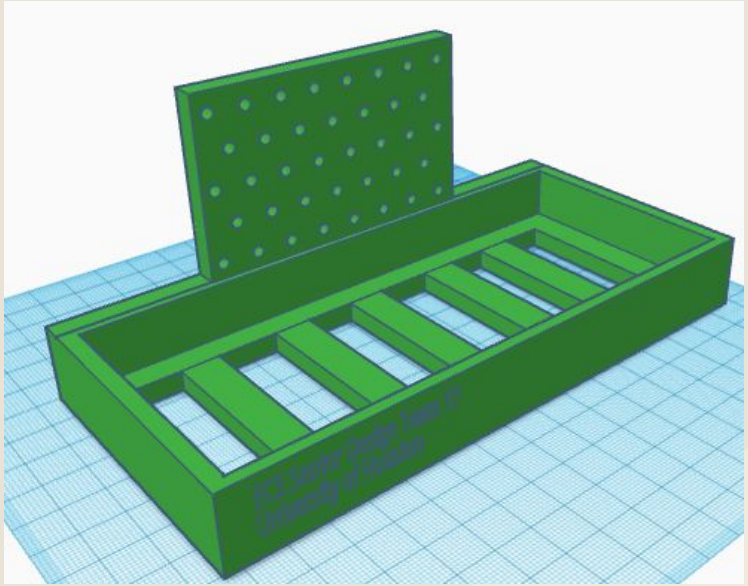
Task 3.4 Testing: PCB

- Tested Terminal Connections
- Everything is Connected Properly



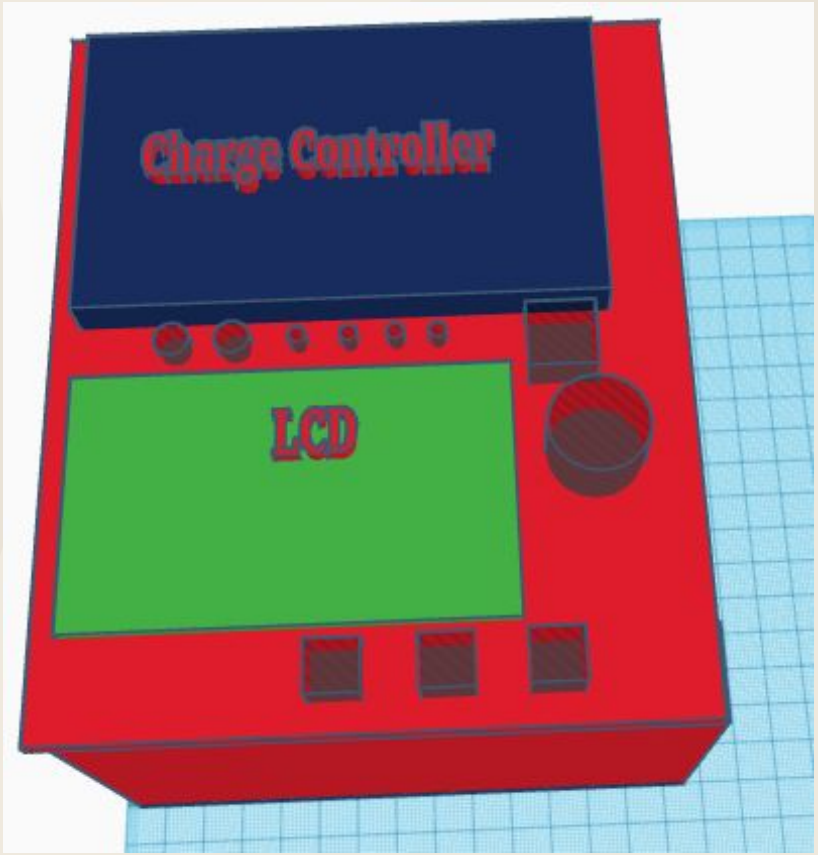
Task 2.6: Battery Platform

- 3D Designed Battery Platform
- 3D Printed Battery Platform
- Performs Correctly



Task 2: Assembly (Beginning)

- Drilled Holes for Outside Components
- Planned Layout
- Designing Shield to Hold Interactive Components



Task 2.4: Original Code Edits

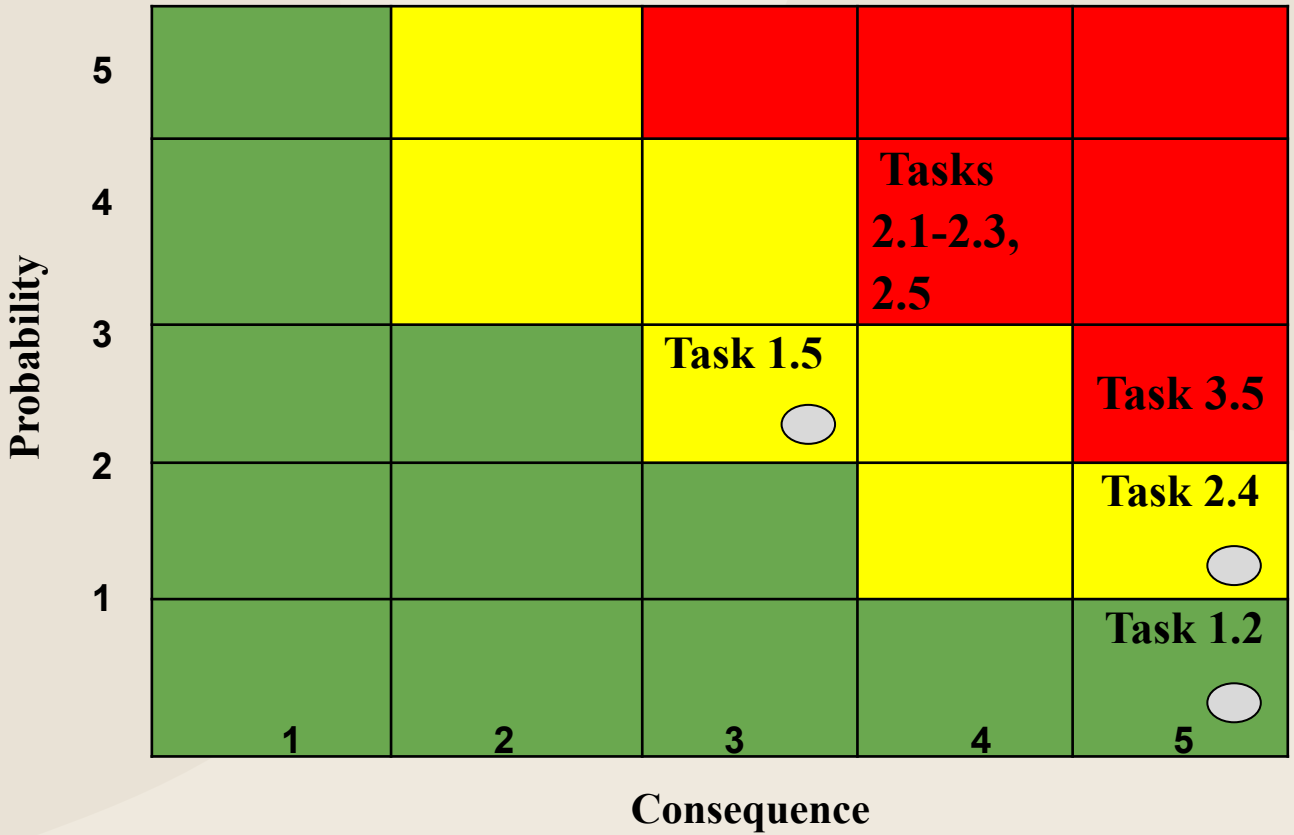
- System controls is complete
- System checks if we need to open the valve once every two hours
- Actively queue and dequeue the valve between openings
- Corrected critical code errors from previous team to achieve proper operation

Testing Plan

What We Need to Test	Plan
Task 3.1-3.2: Code/Sensor	Attach them together and test
Task 3.4: PCB Connections ***Completed***	Online test, followed by physical test via multimeter
Task 3.3: Power Delivery ***Completed***	Connect system and test voltage
Task 3: Overall System	Test in home garden

Risk Matrix

- Task 3.5: Electrical Wiring
- Tasks 2.1 - 2.5: System Assembly
- Task 2.4: Original Code Edits
- Task 1.5: PCB Design
- Task 1.2: User Interface Creation



Low Risk – No Action

Moderate Risk – Take Action

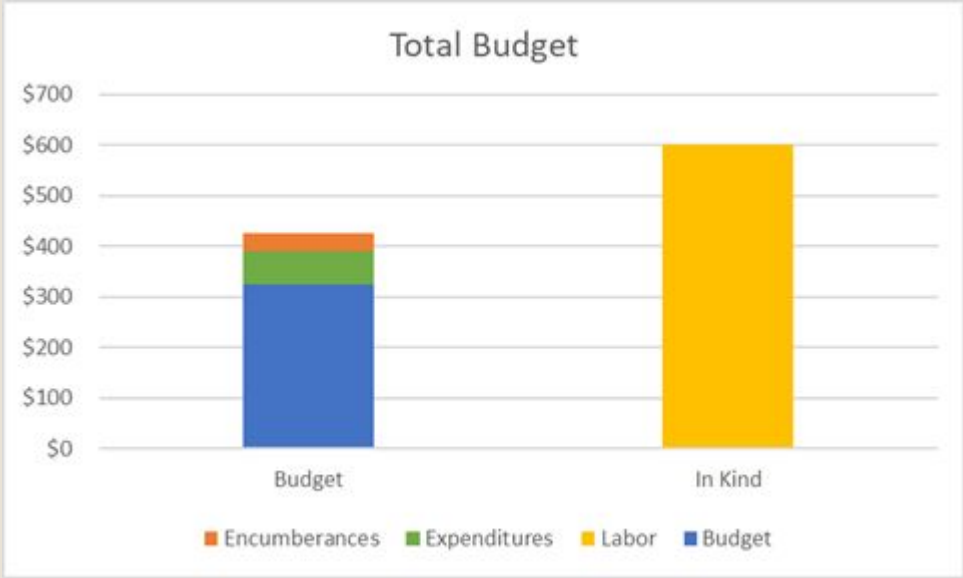
High Risk – Seek Immediate Action

Mitigation Plans

- Task 2.4: Original Code Edits
  - Would meet with advisors for assistance with the code
  - If necessary rethink the working plan for the system and plan out an alternative approach to the system.
- Task 1.5: PCB Design
  - Create connections on piece of perfboard
  - Connections will not be as robust, but will be more reliable than jumper cables
- Task 2.1-2.5: System Assembly
  - Handle components carefully
  - Store in a safe area
- Task 3.4: Electrical Wiring
  - Follow PCB Schematic
  - Backup PCB boards ordered

Budget

- Total Spent Thus Far: $389.34
- All Hardware Purchased
- Encumbrances: 3D printed materials
- Over Budget



Summary/Conclusions

Summary:

We are on schedule for creating a Polycrop Smart-Drip Irrigation System for Nicaraguan farmers

Progress Report:

Work Completed: PCB Testing, Power System, Battery Platform, Assembly Planning, and Code Edits

Next Steps: Shield, Sensor Testing, Programming, Finish Assembly, Overall System Testing

Thank you! Any questions?

Bibliography

- “Recommended C Style and Coding Guidelines.” [Online]. Available: http://software-dl.ti.com/hercules/hercules_public_sw/HerculesMCU_C_CodingGuidelines.pdf. [Accessed: 31-Mar-2021].