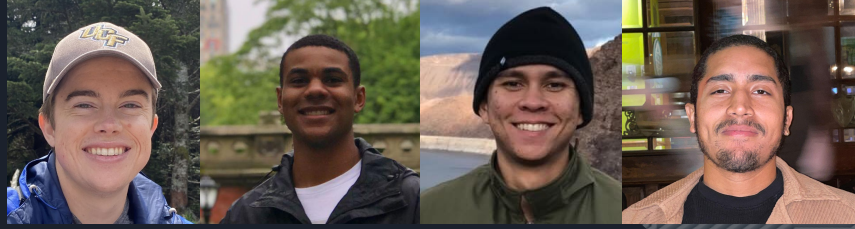


Modular Hydroponics

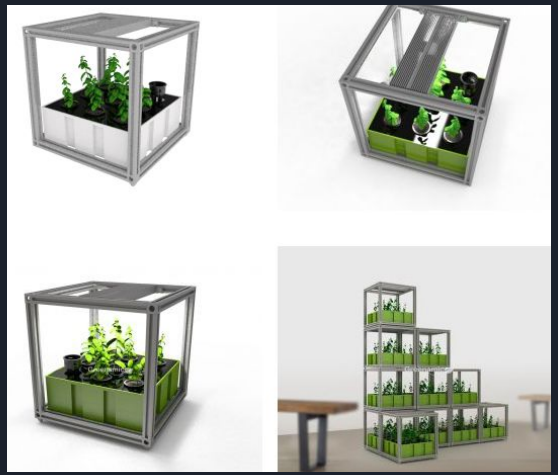
Group 7
Adam Loree
Brandon Mitchell
Don Ellington
Jonathan Rodriguez

Overview

- Description - (Don)
- Motivation - (Don)
- Block Diagrams and Task Distribution - (Adam Don Jon)
- Project Goals and Objectives - (Adam)
- Specifications (Brandon)
- Overall Design - (Brandon)
- Hardware Design (Brandon)
- PCB Schematic - (Jon)
- Processor and Firmware - (Adam)
- Mobile Application - (Don)
- Website Application - (Don)
- Budget - (Jon)
- Progress - (Don)

Description

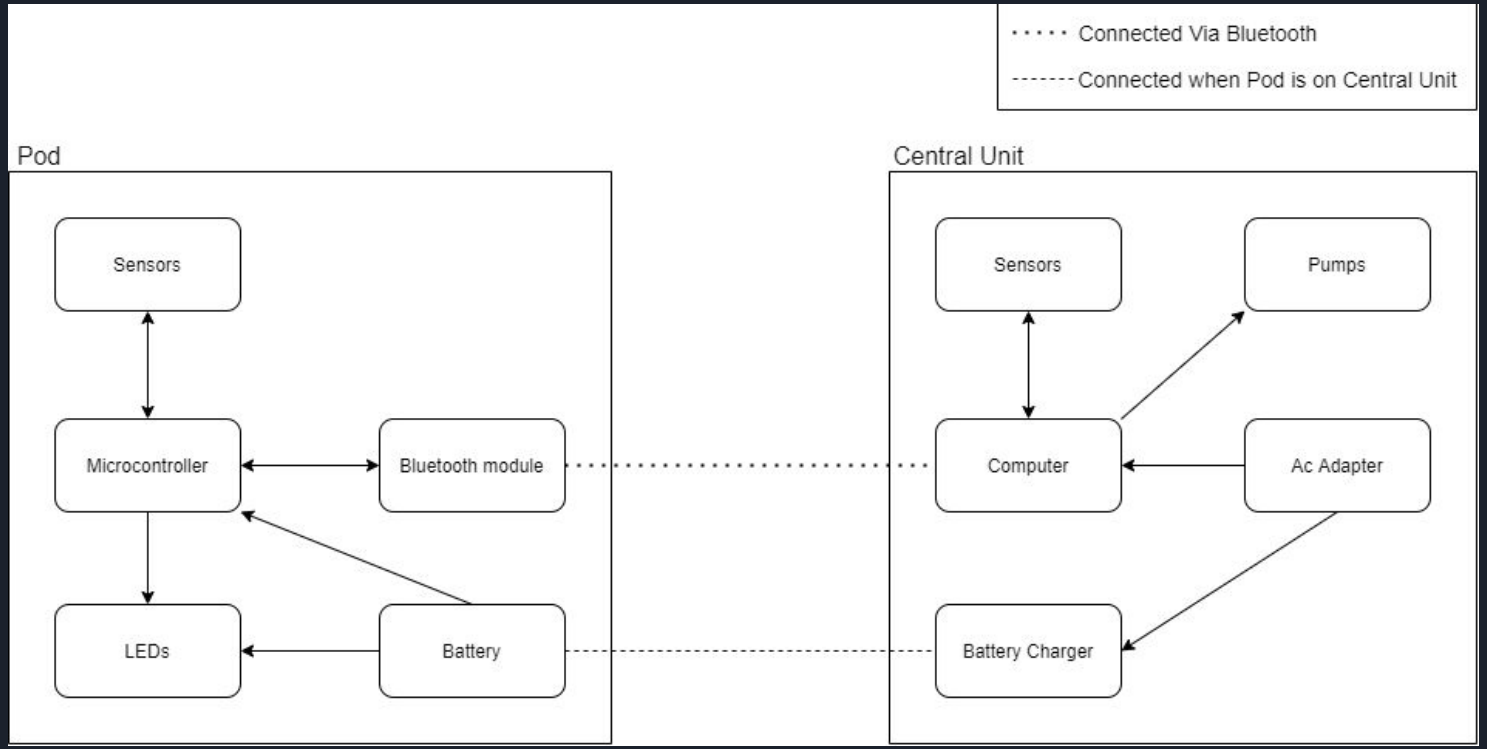
A modular hydroponics system that allows the user to access information about their plant's recent health status through seamless software applications.



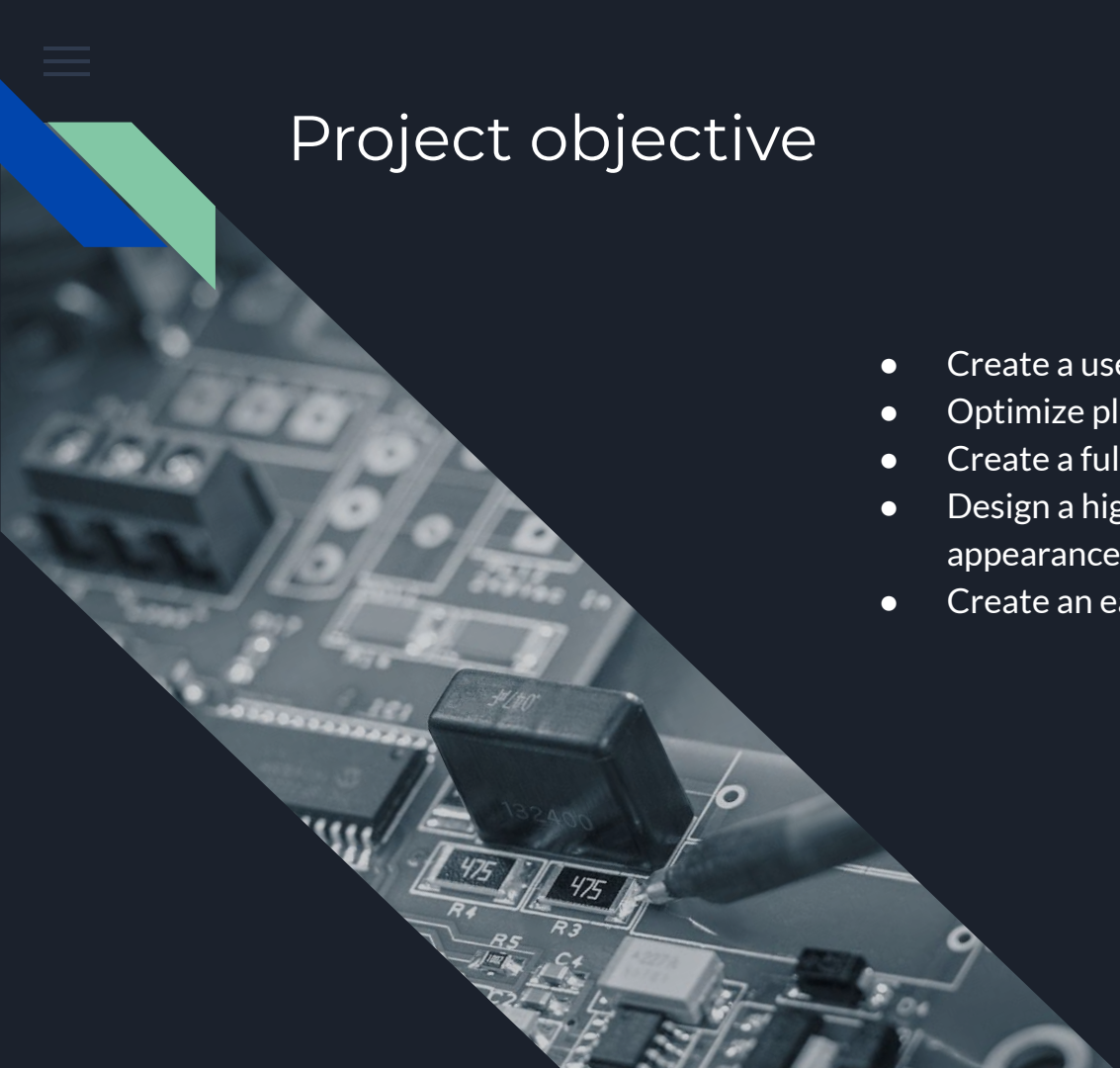
Motivation

- Improve upon current hydroponics designs
- Increase flexibility and water efficiency of farming
- Increase supply and variety of food in diets
- Accessibility across entire world
- Scalability
- Portability

Block Diagram

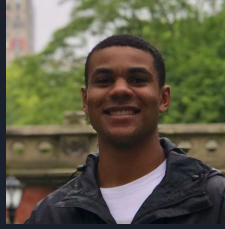


Project objective



- Create a user friendly hydroponics experience
- Optimize plant growth
- Create a fully automated system
- Design a high performing unit with an aesthetic appearance
- Create an easy to use, modular design

Specifications



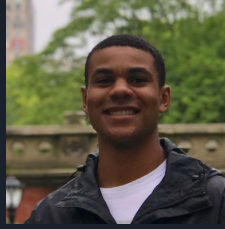
Market Specifications

- System must be of reasonable weight (<50lbs per component)
- Display necessary data in a nice interface
- Effectively communicate with all wireless components
- Able to be controlled remotely
- Must not leak

Engineering Specifications

- Self-Regulate pH to 0.01
- Self-Regulate nutrients to 1.0
- Completely refill Pod in 3 mins
- Provide user specified hours of supplemental light
- Reservoir Capacity 5 Gallons
- 120 AC Power converted to 12, 5, 3.3V DC
- 1Mbps Bluetooth communication

Overall Design

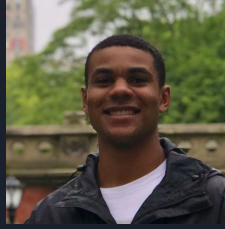


Central Unit

- Communicates with both the user and the plant pod via bluetooth/wifi
- Powered by the user's home
- Contains enough water for 2 full pod refills
- Contains all necessary nutrients/pH balancing liquids

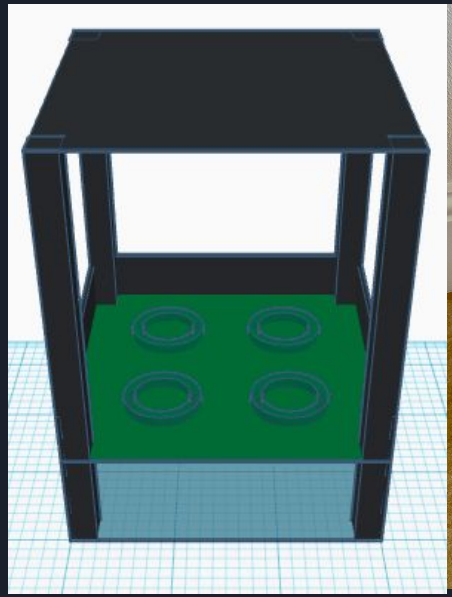
Garden Pod

- Completely modular growing environment
- Transported to/from central unit for regulation/refilling
- Communicates with central unit via bluetooth (up to 9m/30ft)

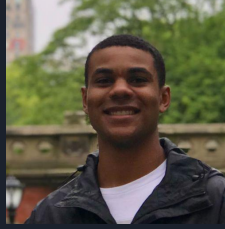


Hardware Design (Garden Pod)

- Height: 14”
- Width: 11”
- Length 11”
- Water Reservoir Volume: 484 in^3 (2.095 gallons)
- Plant Growth Volume: 1210 in^3
- ⅛” Acrylic sealed with 100% silicone

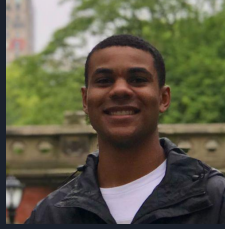


Hardware Design (Central Unit)

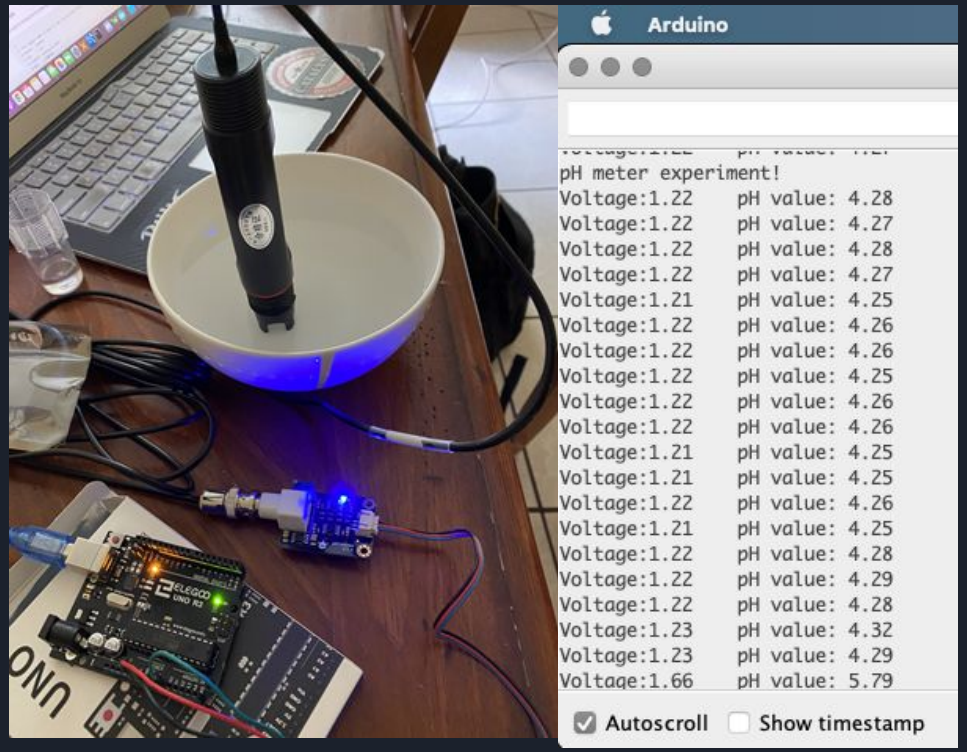


- Water Reservoir Volume: 1848 in^3 (8 gallons)
- 18 Gallon Main Container with smaller containers for each section
- Electronics placed in smaller waterproof containers for safety

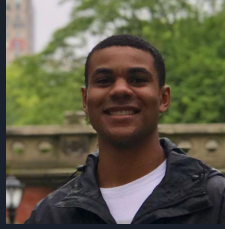
Hardware Design (Sensors)



- pH Sensor
- Ambient Light Sensor
- Water Level Sensors
- Water Quality Sensor (TDS)
- Temperature/Humidity Sensors



Hardware Design (Garden Pod Battery)

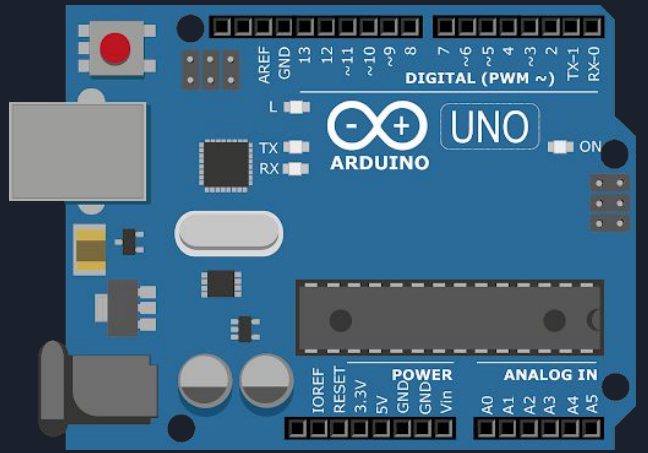


- DC 12V Lithium Ion 18650
- Rechargeable
- 6800mAh
- Automatic protection system: battery overcharge, over discharge, over current and external short circuit effective protection.
- Suitable for long discharge times

Pod Arduino

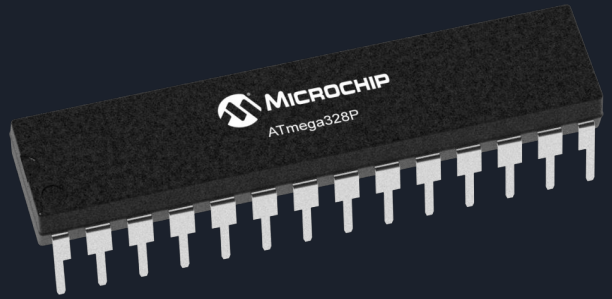
The arduino is a microcontroller that hosts the ATmega328P microcontroller.

Purpose:
The purpose of this device is to hold our microcontroller and provide simple pinouts and to also provide voltage regulation.



Pod Microcontroller

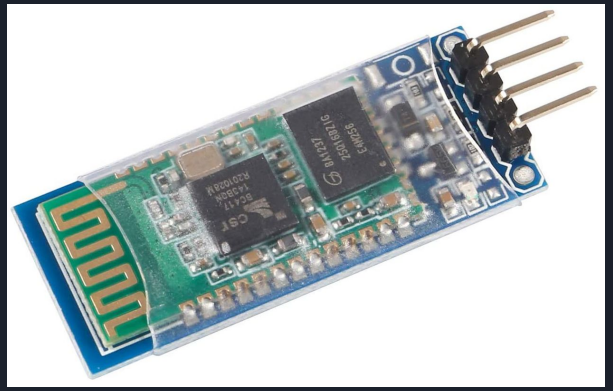
The microcontroller used in the pod is the ATmega328P chip. This chip is commonly found in arduino devices.



Purpose:
The purpose of this chip starts with taking inputs from sensors then the chip uses these inputs to change the amount of light in the module. The chip sends the inputs from other sensors to the main processor in the base via bluetooth.

Pod Bluetooth

The bluetooth chip is connected to the microcontroller in the pod. We used a HC-06 RS232 4 Pin Wireless Bluetooth Serial Transceiver. This chip supports bi-directional serial communication.

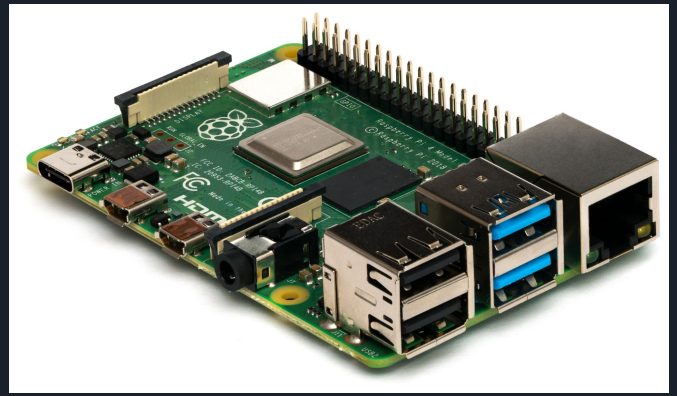


Purpose:
The purpose of the bluetooth module is to send and receive data to and from the processor located in the base via a serial connection.

Base Processor

The raspberry pi is essentially a tiny computer.

Purpose:
There will be many purposes to this processor. The raspberry pi will get information via bluetooth from each of the pods. The processor will then process this information and display it to the website and application. The pi will also control the ph balancing and nutrient levels for the base. Finally the pi will direct the filling and emptying of the pod when connected to the base.



Base Processor Bluetooth module

The usb bluetooth module provides the most compatibility and the easiest use for the raspberry pi.

Purpose:
The purpose of this module is to transmit data to and from the pod via bluetooth.

PCB Design: Features

Garden Pod PCB:

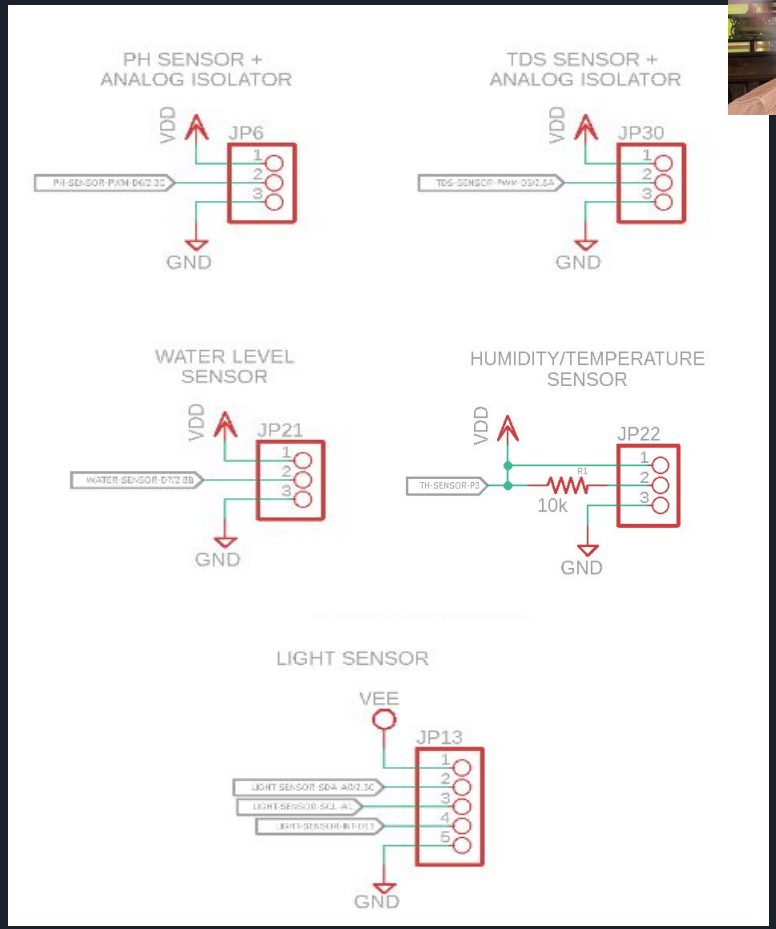
- Ph Sensor
- Light Sensor
- Water Level Sensor
- Temperature/Humidity Sensor
- Axial fan
- UV LED Strip
- Bluetooth module

Central Unit PCB:

- Ph Sensor
- TDS Sensor
- Water Level Sensor
- UV Sterilization Lamp
- Fountain Pump (Irrigation)
- Peristaltic Pumps (Nutrients/Ph)
- Temperature/Humidity Sensor
- Bluetooth module
- Wifi Module

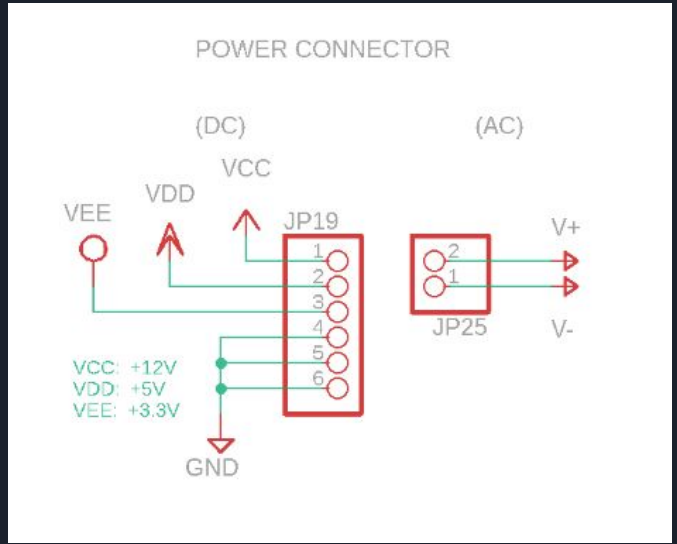
PCB Sensor Schematic

- Our design features a wide spectrum sensors for comprehensive analysis of the plant environment.
- All Sensors will be attached to the PCB via pin headers.
- Sensors that are exposed in the same body of water will be connected to analog isolator to eliminate electrical interference to provide accurate measurements.



PCB Power Source Schematic

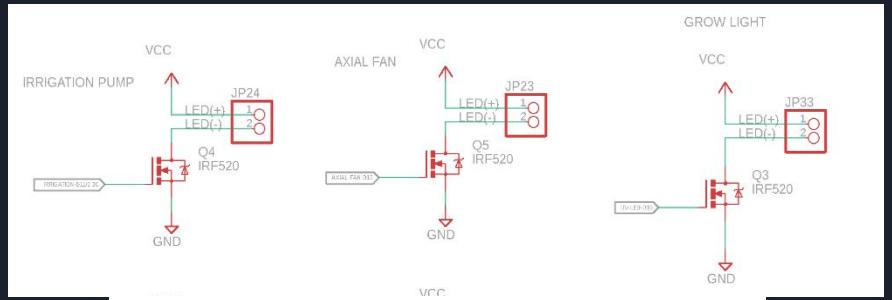
- The Central Unit will use line power which will be converted to a 12V DC voltage.
- The Garden Pod will be operated by a 12V 6800mAH rechargeable battery, which will be charged by the Central Unit.
- The MCUs will provide voltage regulation for the electronics.

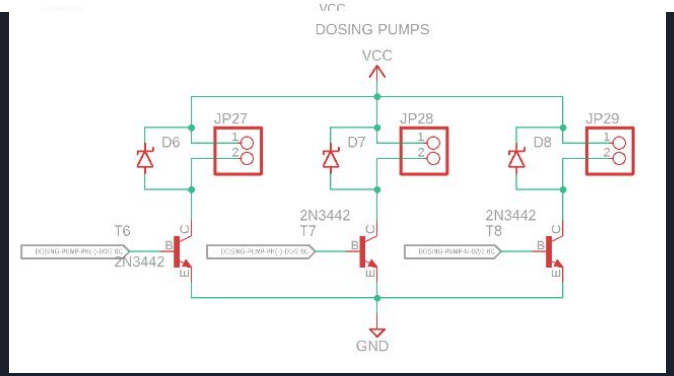


PCB Mechanical Components Schematic

The mechanical components will control the airflow, water composition, and UV exposure, and irrigate the system.

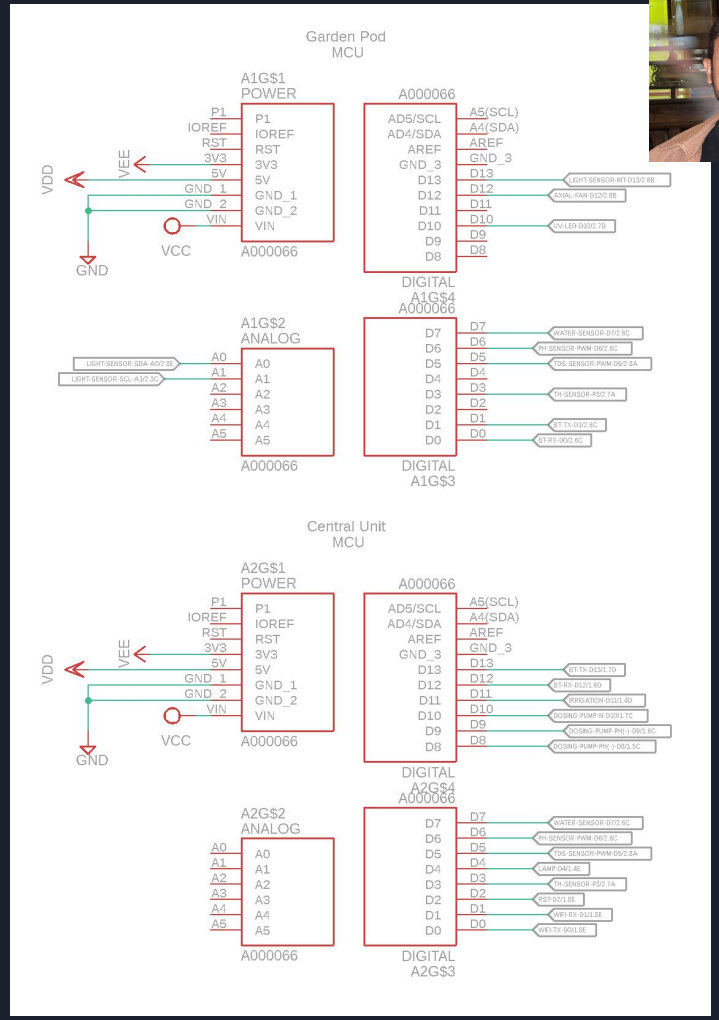
These parts will be controlled by the MCU through transistors.

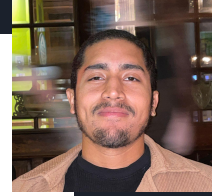




PCB MCU Schematics

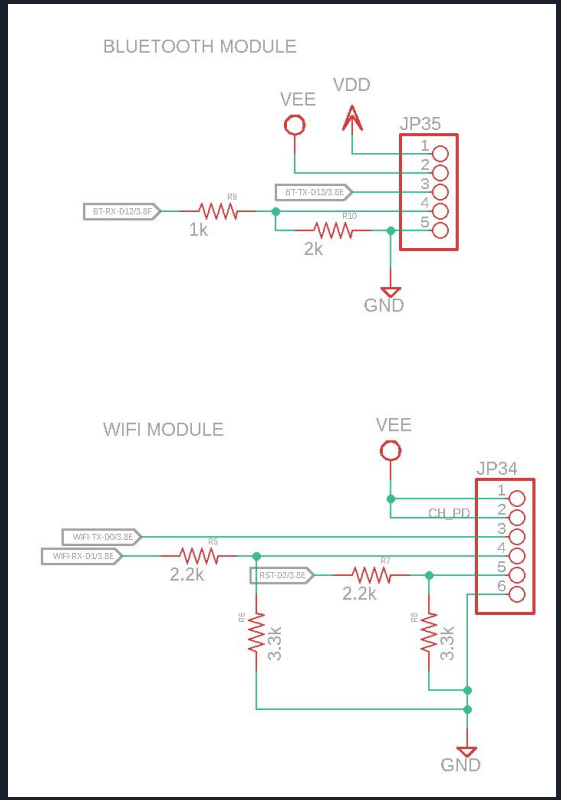
- Each unit will host its own separate MCU.
- The Garden and Central Unit will communicate wirelessly but will operate interdependently.





PCB Communication Schematic

- The Central Unit will have both Bluetooth and Wifi communication modules, while the Garden Unit will only have a Bluetooth.
- The Units will communicate with each other via Bluetooth modules
- The Central Unit will communicate with an app through a Wifi module
- Pull-up resistors will have to be implemented.

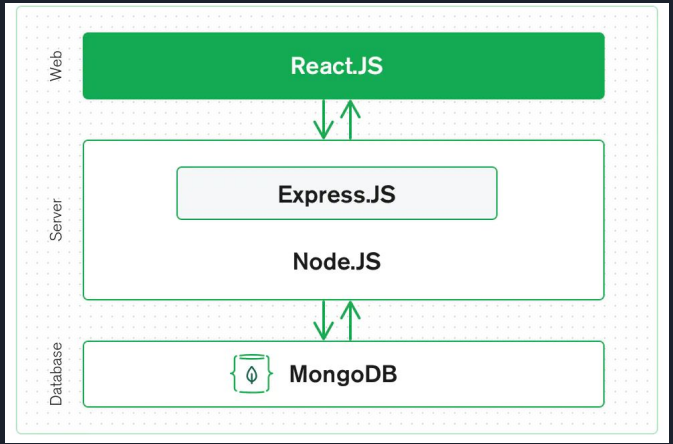


Software Applications

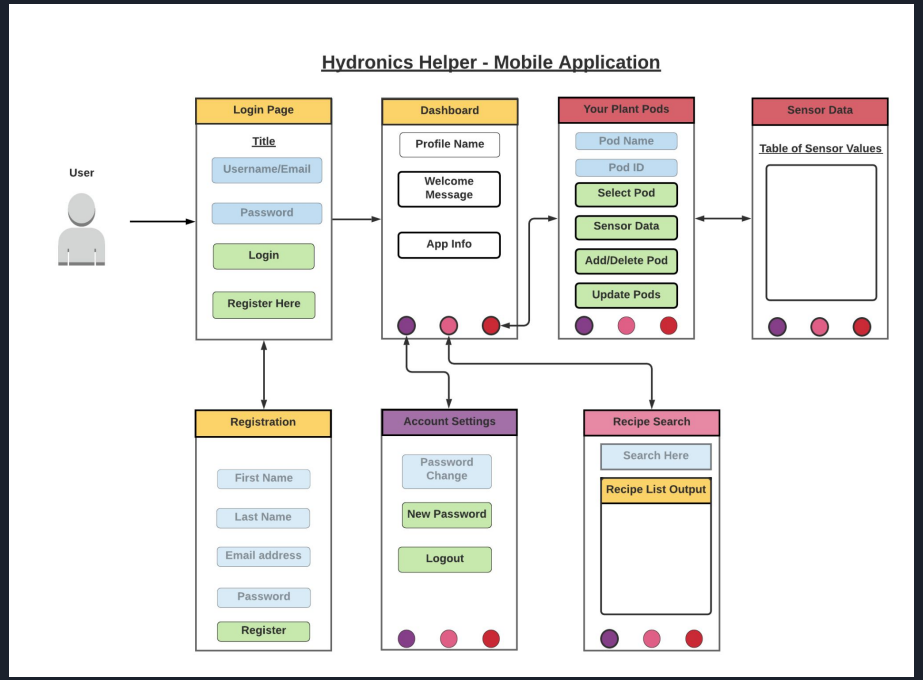
- Both
  - Allow the user to create and login to accounts
  - User Authentication
  - View plant health and sensor data history
  - Search recipes
  - Modify profile
- Website
  - Focused on complete user profile functionality
  - Additional resources and information
- Mobile App
  - Streamline functions
  - Focused on viewing data
  - Limited profile management and resources

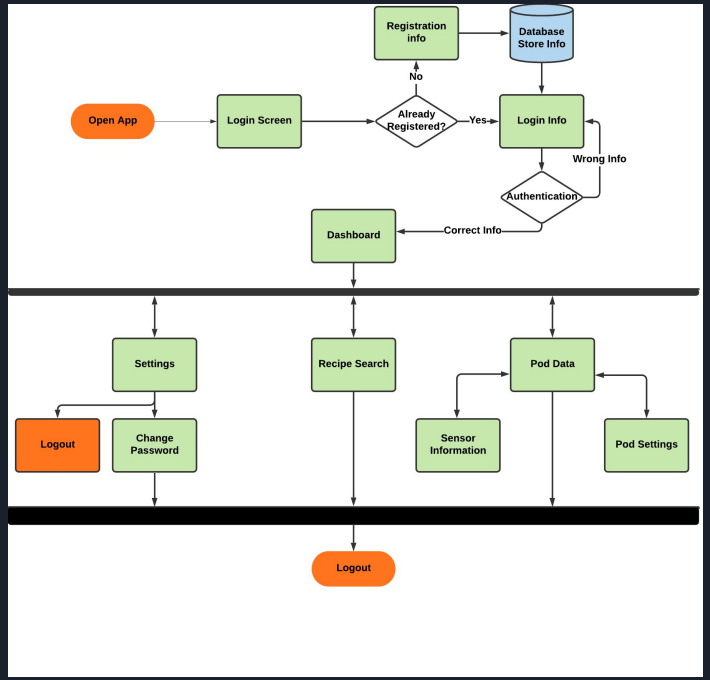
Full Stack Technology

MERN
MongoDB - document database
Express - Node.js web framework
React - a client-side JavaScript framework
React Native - mobile version of react supporting front end development
Node - the premier JavaScript web server

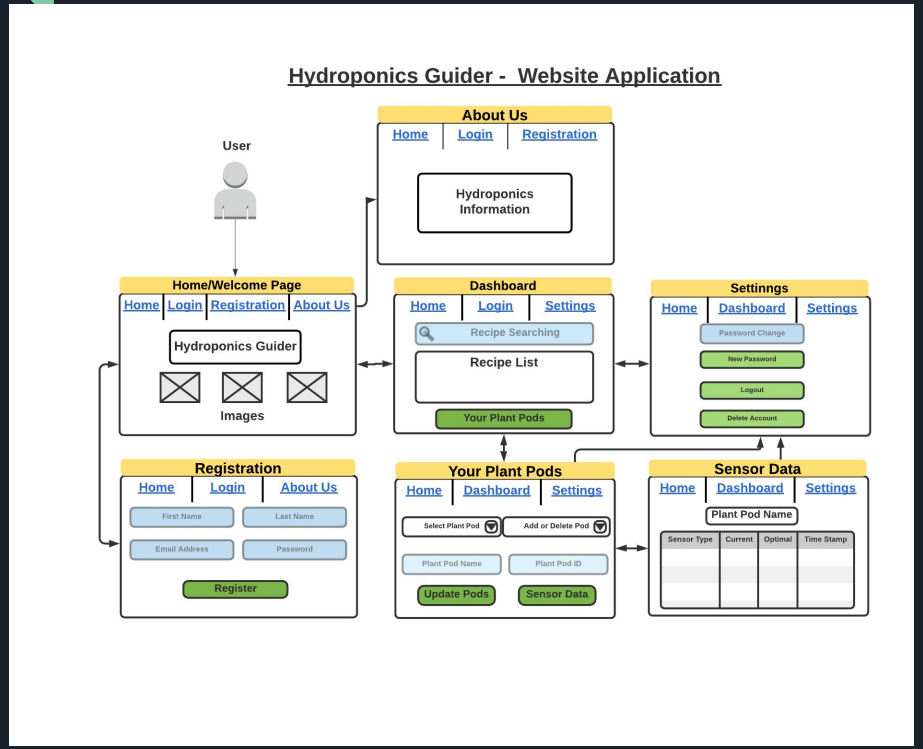


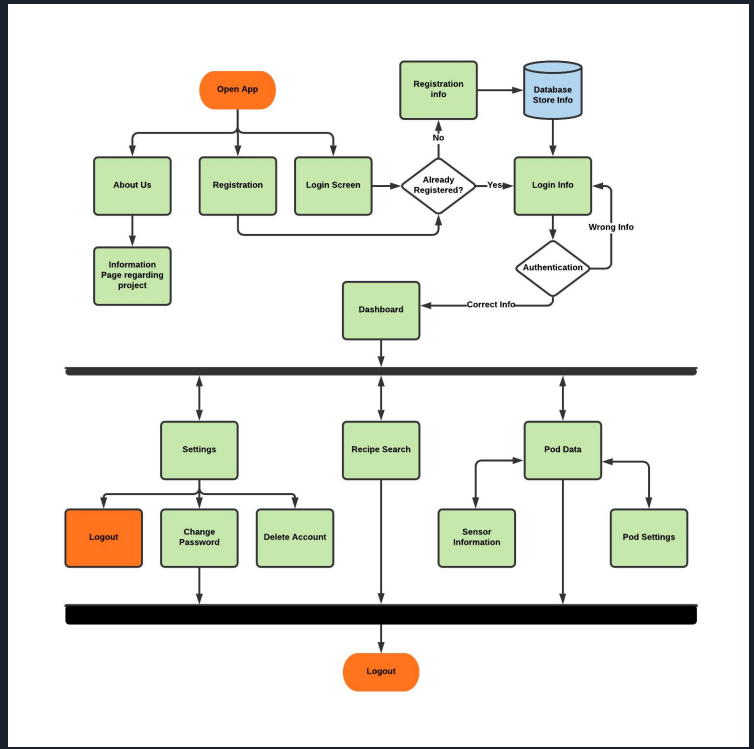
Mobile Application Design





Website Design



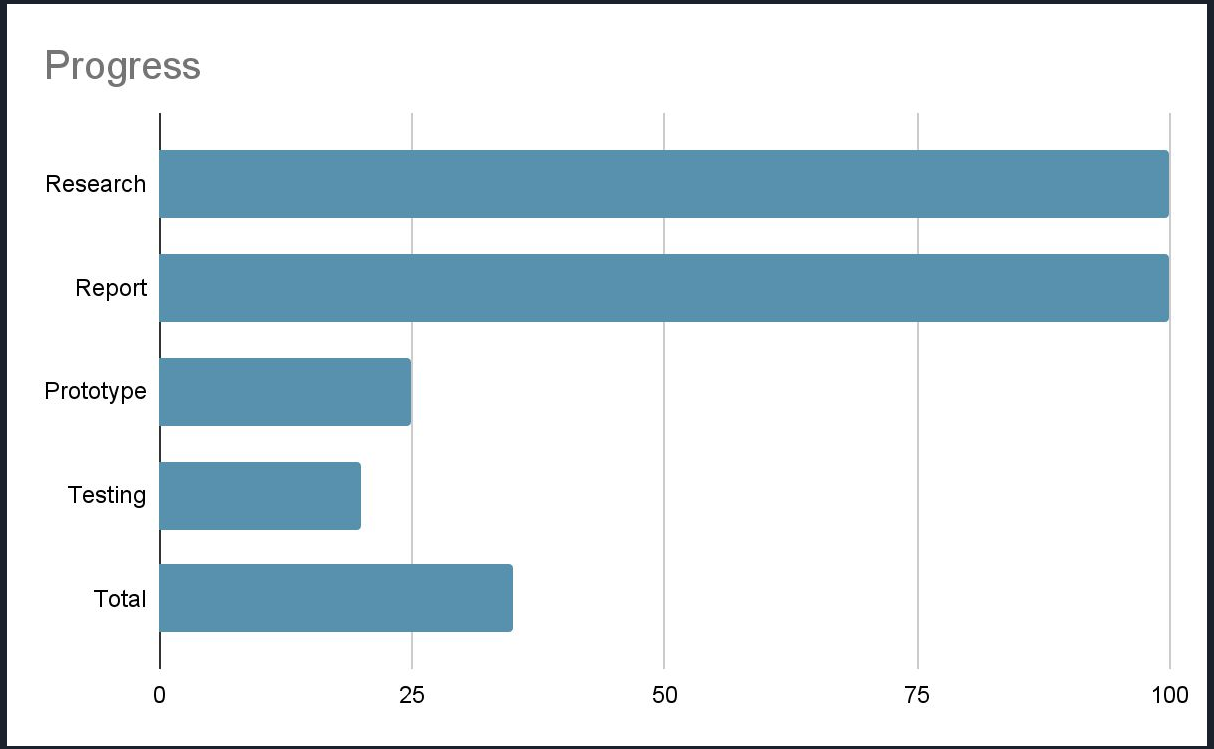


Budget

Item	Supplier	Price/Unit	Units	Total Cost
Garden Pod				
Axial Fan	Amazon	$ 12.99	1	$ 12.99
CQ Robot Light Sensor	Amazon	$ 10.99	1	$ 10.99
Gowoops Temp/Humidity Sensor	Amazon	$ 6.49	2	$ 12.98
HiLetgo IRF520 MOSFET	Amazon	$ 1.36	1	$ 1.36
CQ Robot Water Level Sensor	Amazon	$ 21.99	1	$ 21.99
UV LED Grow Light Strip (5 Meters)	Amazon	$ 19.99	1	$ 19.99
HiLetgo HC-05 Bluetooth transciever	Amazon	$ 7.99	1	$ 7.99
Ph sensor module	Amazon	$ 35.99	1	$ 35.99
ELEGOO UNO R3 Board ATmega328P	Amazon	$ 11.99	1	$ 11.99
Subtotal				$ 136.27
Central Unit				
Axial Fan	Amazon	$ 12.99	1	$ 12.99
UV Sterilization Lamp	Amazon	$ 16.98	1	$ 16.98
Gowoops Temp/Humidity Sensor	Amazon	$ 6.49	2	$ 12.98
Atlas Scientific Gravity Analog Isolator	Atlas Scientific	$ 16.99	2	$ 33.98
CQ Robot TDS Sensor	Amazon	$ 13.99	1	$ 13.99
Submersible Water Pump	Amazon	$ 10.29	1	$ 10.29
HiLetgo IRF520 MOSFET	Amazon	$ 1.36	1	$ 1.36
CQ Robot Water Level Sensor	Amazon	$ 21.99	1	$ 21.99
HiLetgo 3pcs ESP8266 WIFI Module	Amazon	$ 10.99	1	$ 10.99
Gikfun Peristaltic Pump	Amazon	$ 10.43	3	$ 31.29
HiLetgo HC-05 Bluetooth transciever	Amazon	$ 7.99	2	$ 15.98
Gravity: Analog pH Sensor	DF:Robot	$ 56.90	1	$ 56.90
ELEGOO UNO R3 Board ATmega328P	Amazon	$ 11.99	1	$ 11.99
Subtotal				$ 251.71
Total				$ 387.98

- Initial estimate was between $300 - $475. (Did not include as many parts)
- Biggest expense was the sensors
- Actual price is within the initial projected range.
- Any materials not mentioned on the table were previously owned.
- Total cost is approximately $387.98.

Project timeline



Questions?