Plant Nanny: The Automated Plant Growth System

GROUP 8

AJAY EMMANUEL – COMPUTE ENGINEER

CHRISTOPHER JORDAN – ELECTRICAL ENGINEER

CLAYTON SZOKE – COMPUTER ENGINEER

GABRIEL RODRIGUEZ – ELECTRICAL ENGINEER

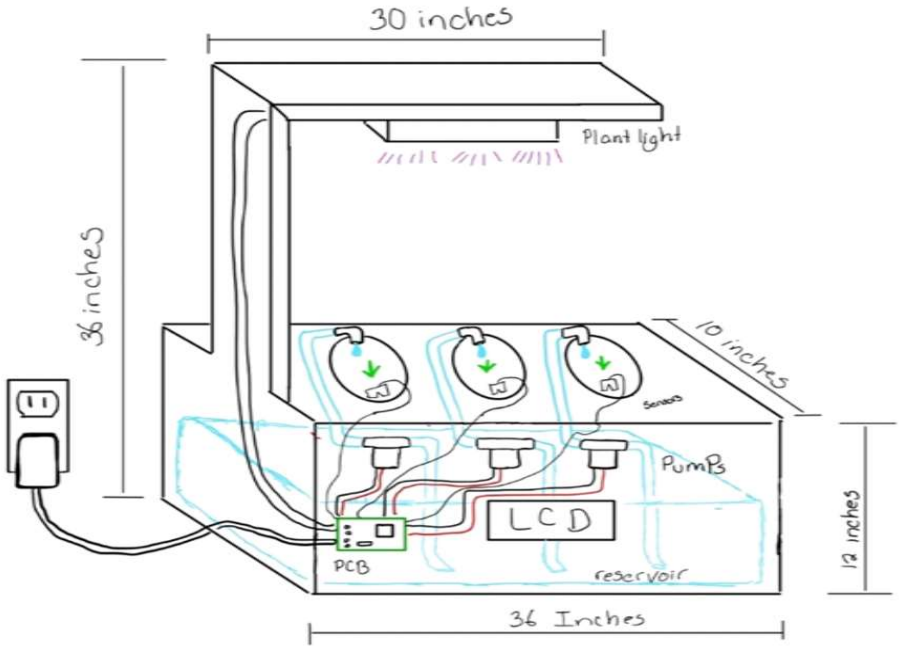
Project Motivation

There are many daily tasks that are important to us such as getting up for work or school on time, responding to people in your life, making sure you're presentable, etc. Tons of objectives to remember, and because of this the small stuff can be shrugged off from your memory. For some, watering a plant outside of your house can be forgotten for days or even weeks at a time.

Goals and Objectives

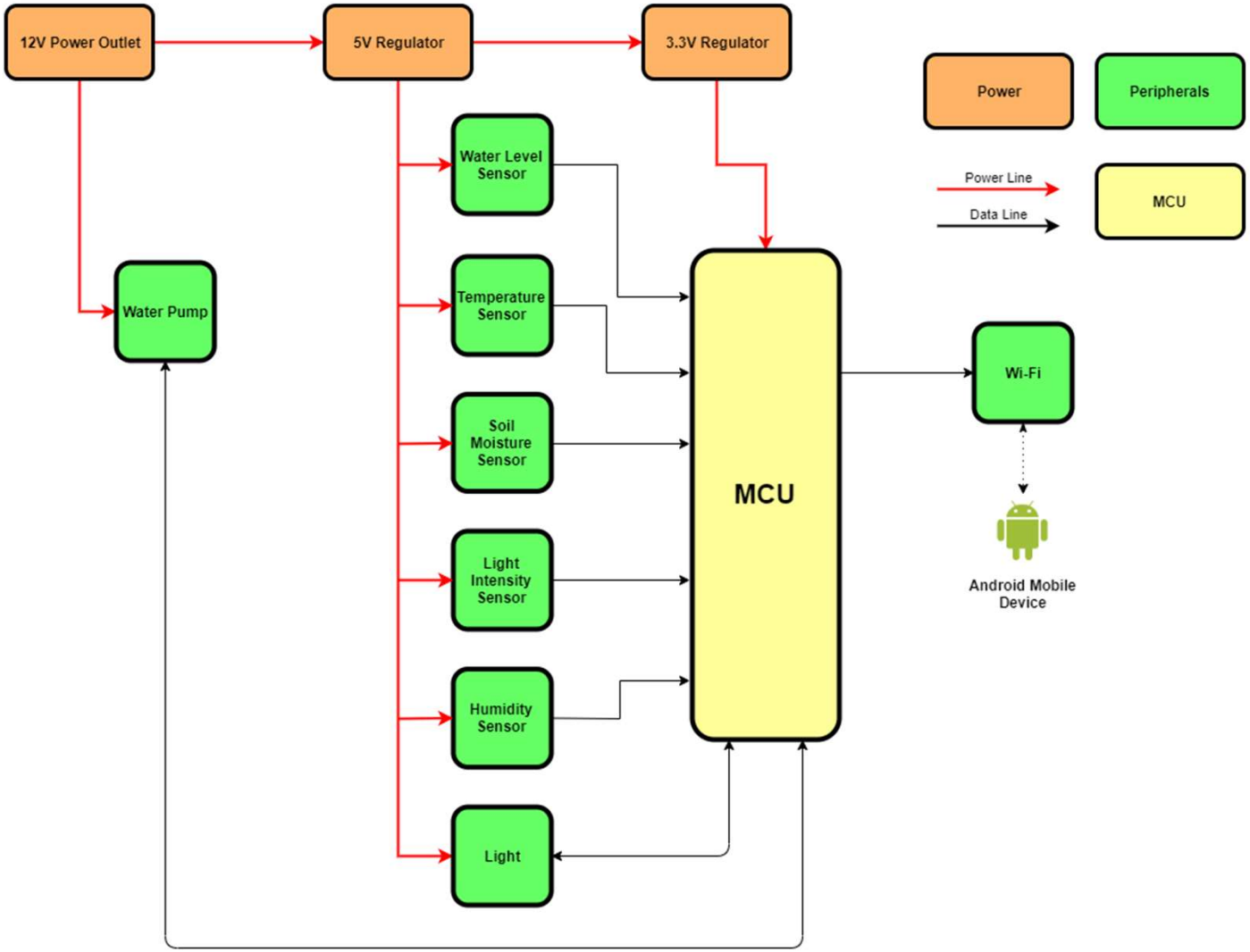
- To create a self-sufficient indoor gardening system that's capable of taking care of multiple plant types
- To keep this system simple for the user and the plant
- To design and create a cost-effective automated system
- To make tasks easier for a person with their daily chores

Sketch Draft Design

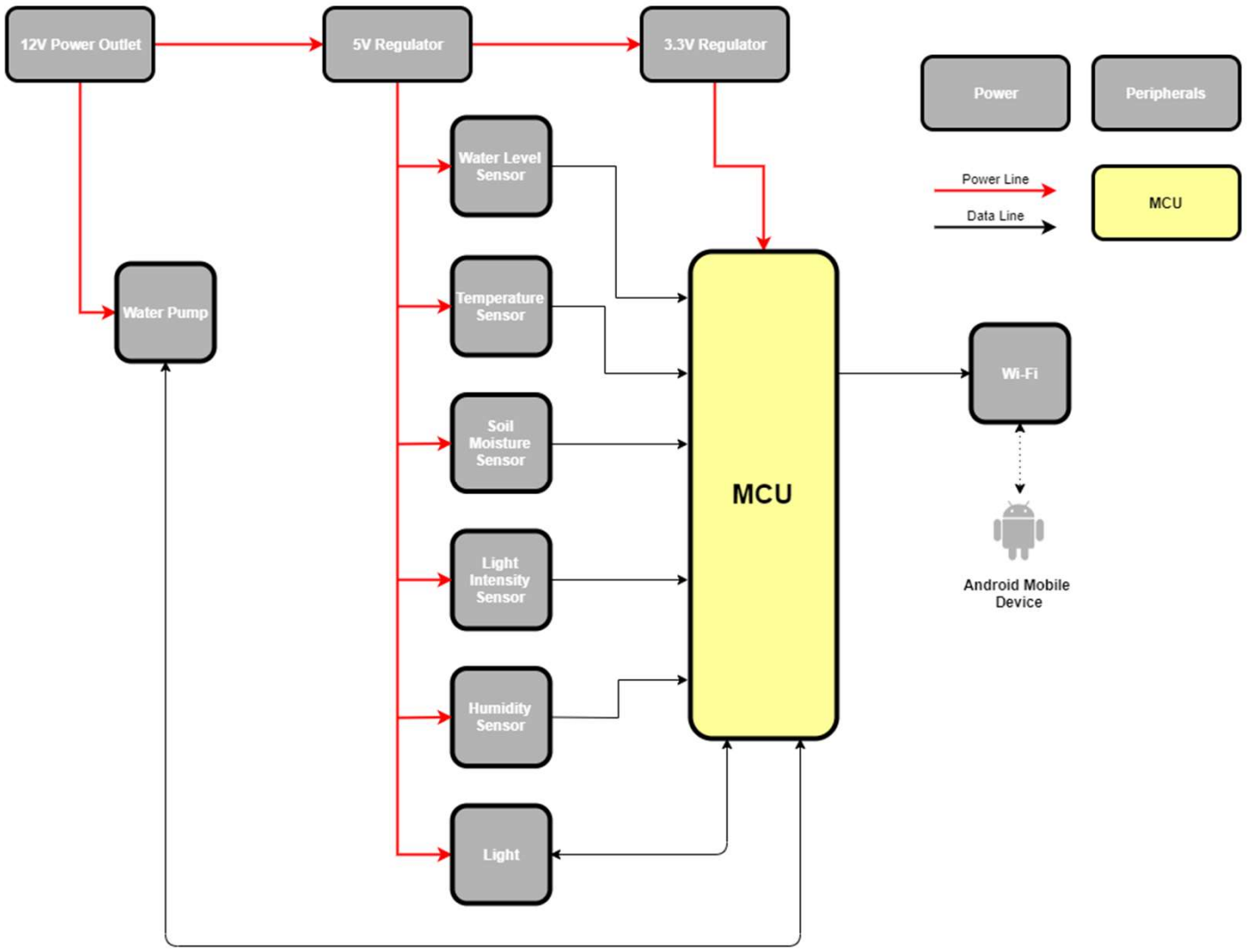


Requirements

Main Requirements
System shall be able to water the plant both manually through the application and automatically from the moisture sensor readings
System shall be able to detect the water level of the reservoir and when it needs to be refilled
System shall be able to turn on/off the plant light by application or timer
System shall be able to display temperature, humidity, moisture, light intensity, and water levels through the application and the LCD display
System shall be controlled through a WIFI connection.



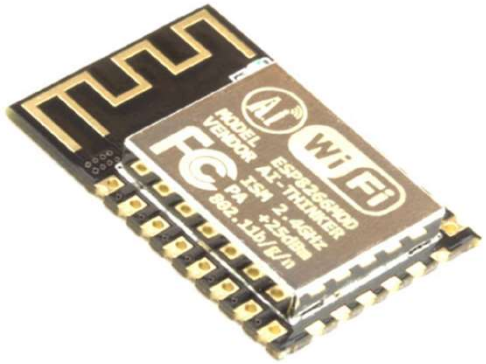
Block Diagram


12V Power Outlet
5V Regulator
3.3V Regulator
Water Pump
Water Level Sensor
Temperature Sensor
Soil Moisture Sensor
Light Intensity Sensor
Humidity Sensor
Light
MCU
Wi-Fi
Android Mobile Device
Power
Peripherals
Power Line
Data Line
MCU

MCU

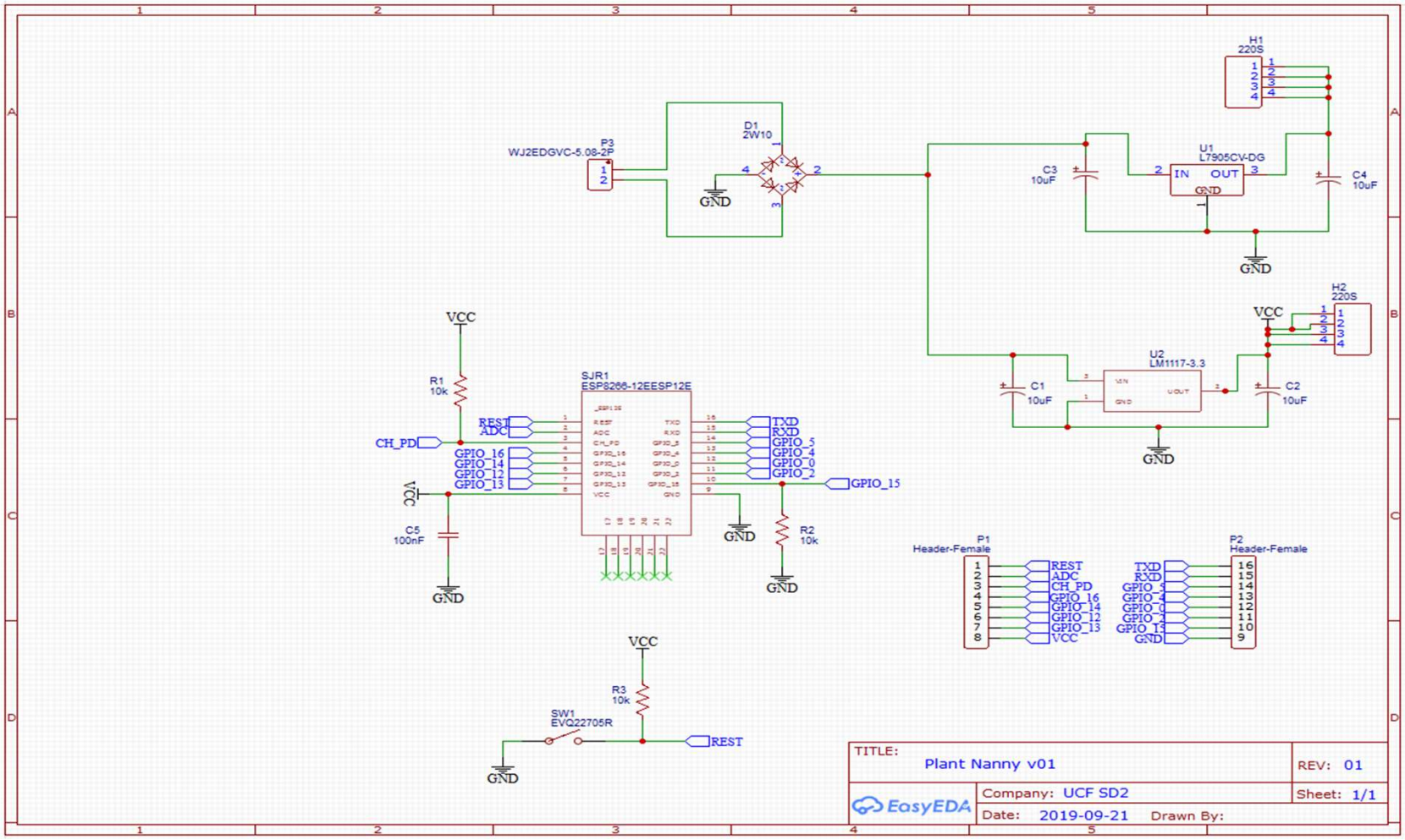
ESP12e

- Community
- GPIO pins(11)
- WIFI capabilities
- Functions as a standalone application
- Maximum current allowed to draw per pin: 15mA
- Operating voltage and current :3.3V, 80mA

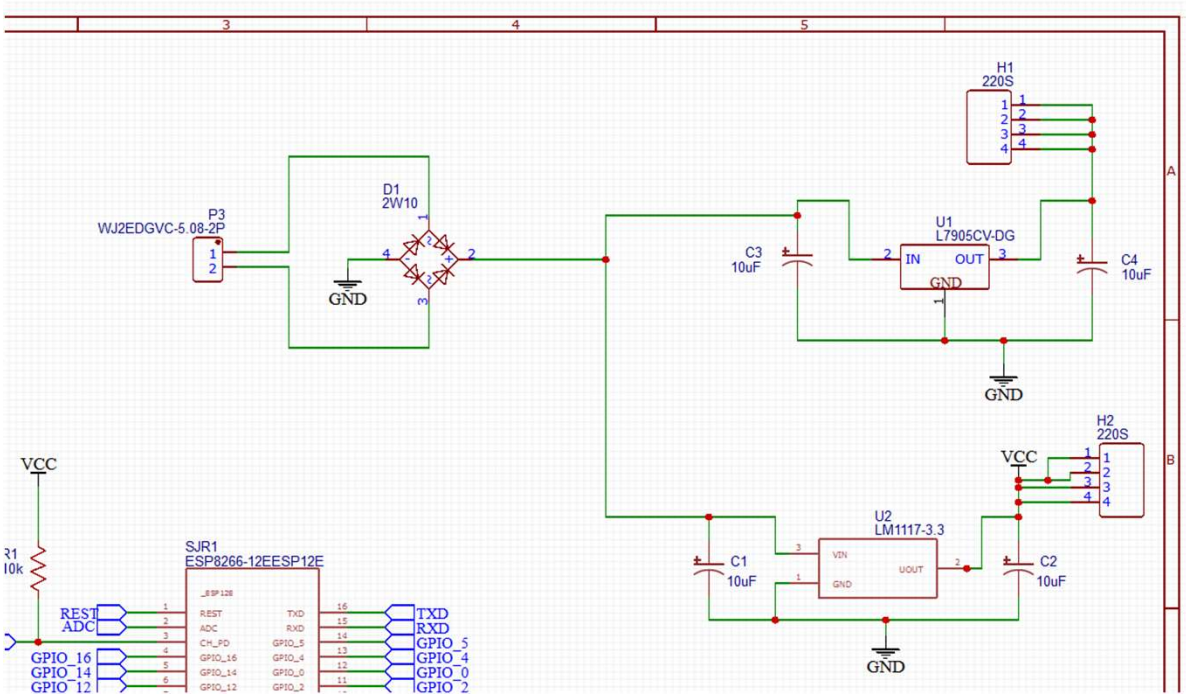


Schematic & PCB Design

- Use of EasyEDA Program:
- Freeware
- Very simple/beginner friendly
- Schematic not yet finalized, but mostly complete
- Practicing PCB Design



Overall Schematic



L7905CV

More Images

5V Regulation

Water Pumps

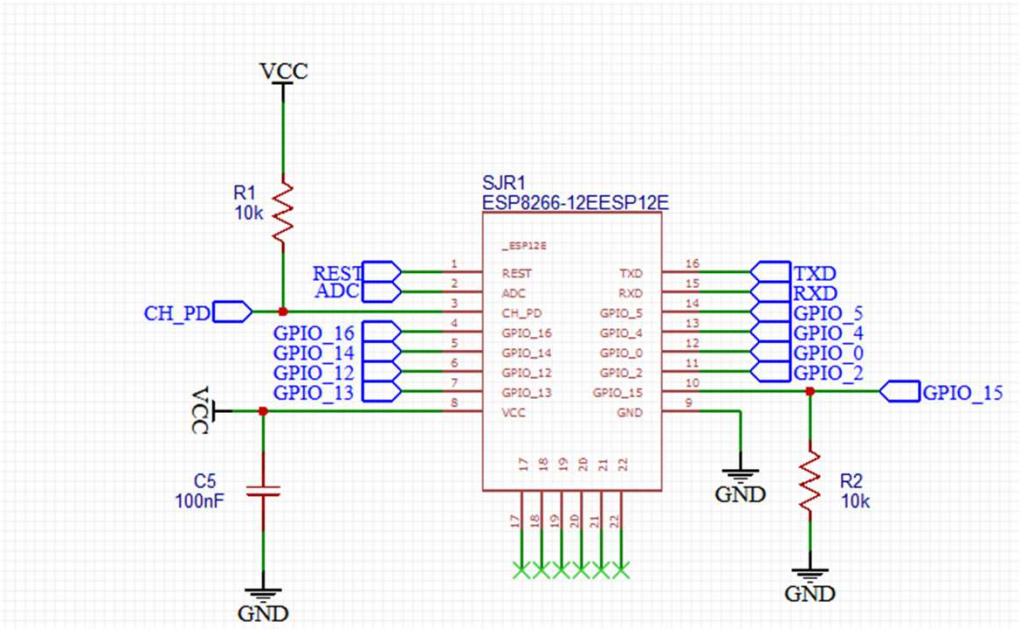
LM1117MPX-3.3

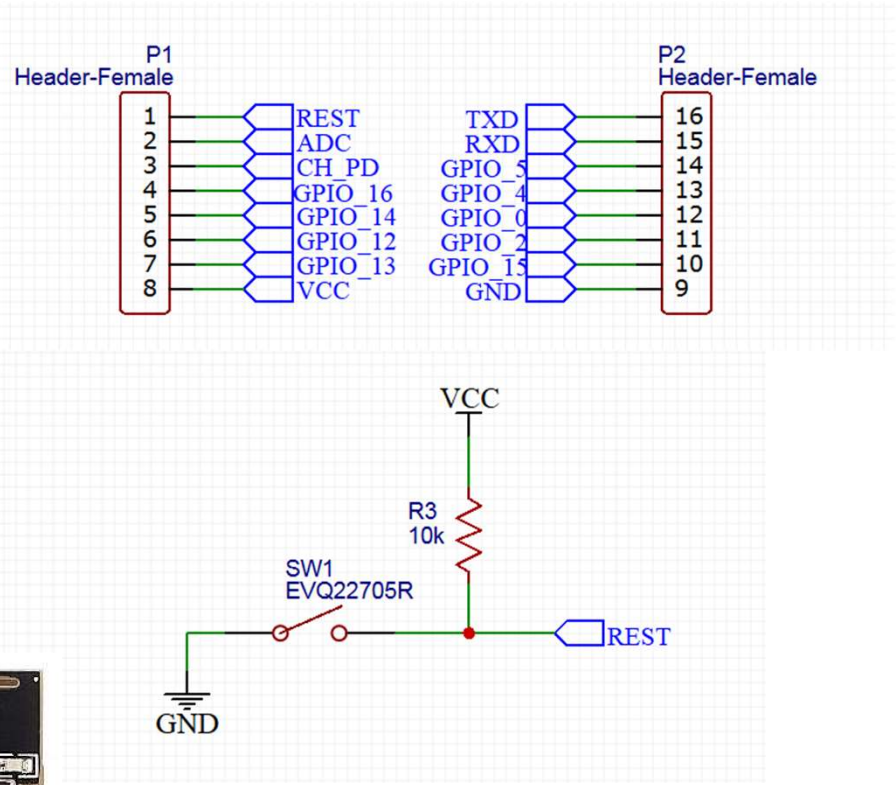
3.3V Regulation

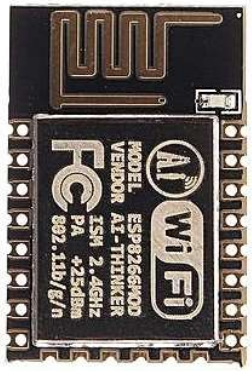
ESP8266-12E

Sensors

Voltage Regulation

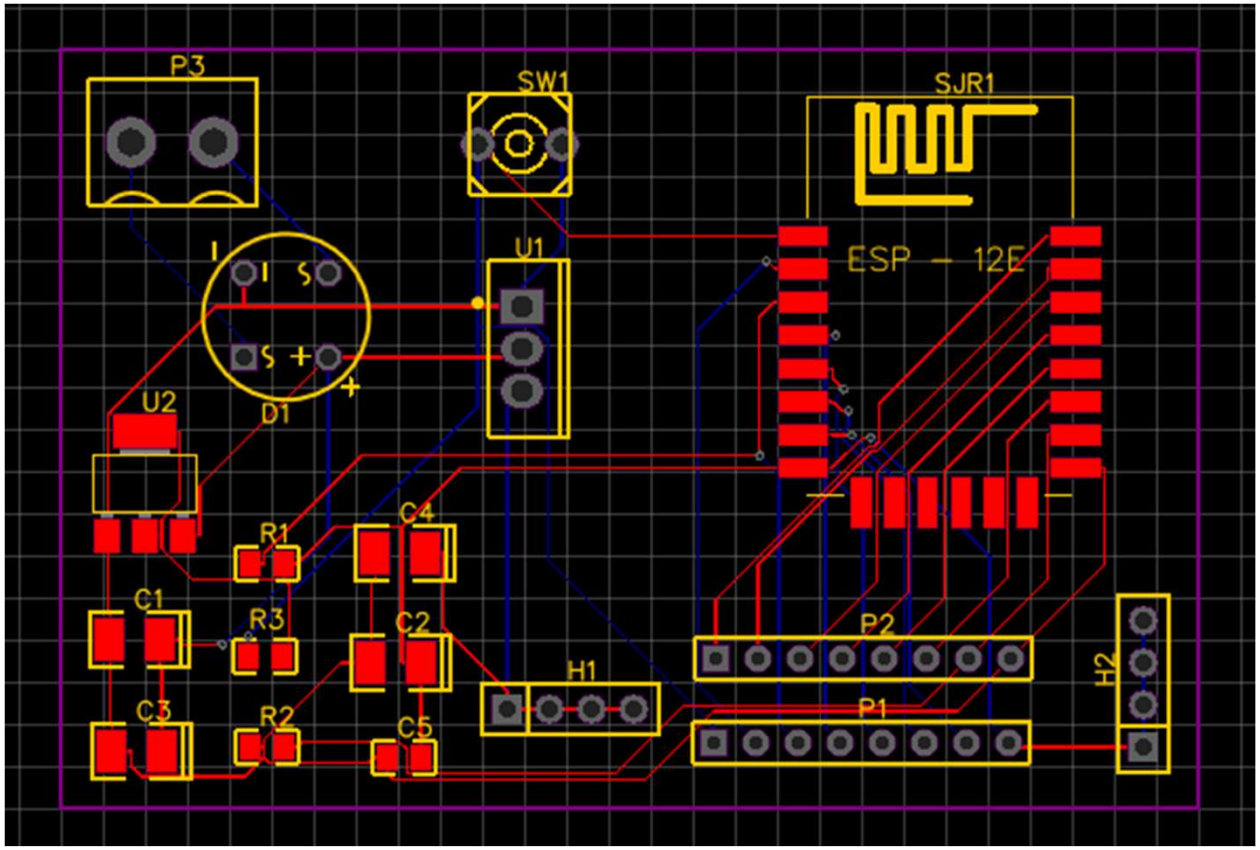

VCC
R1
10k
SJR1
ESP8266-12EESP12E
REST
ADC
CH_PD
GPIO_16
GPIO_14
GPIO_12
GPIO_13
VCC
C5
100nF
GND
TXD
RXD
GPIO_5
GPIO_4
GPIO_0
GPIO_2
GPIO_15
GND
R2
10k
GND


P1
Header-Female
1
2
3
4
5
6
7
8
REST
ADC
CH_PD
GPIO_16
GPIO_14
GPIO_12
GPIO_13
VCC
P2
Header-Female
TXD
RXD
GPIO_5
GPIO_4
GPIO_0
GPIO_2
GPIO_15
GND
16
15
14
13
12
11
10
9
VCC
R3
10k
SW1
EVQ22705R
REST
GND

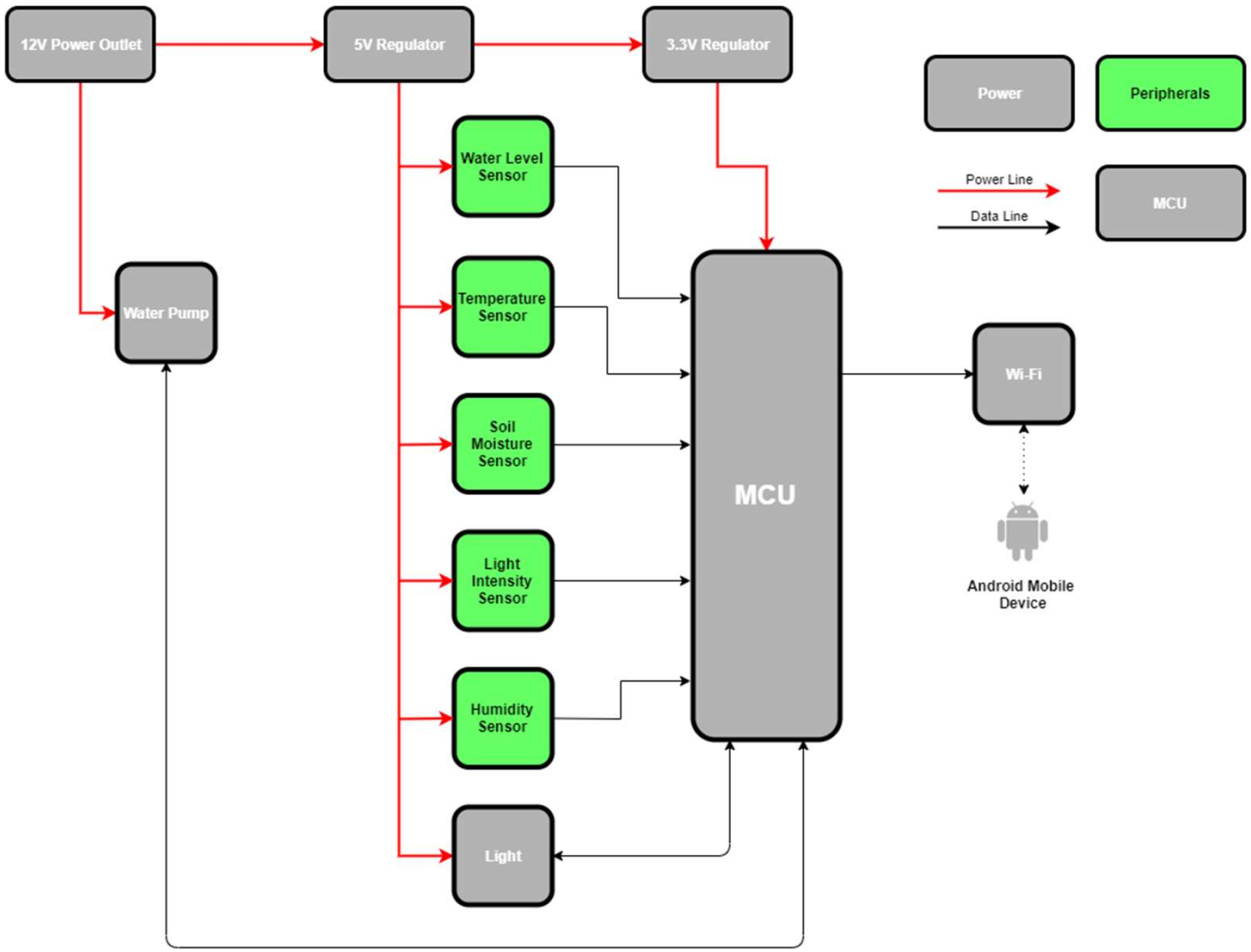

MODEL ESP8266MOD
VENDOR AI-THINKER
ISM 2.4GHz
PA +25dBm
802.11b/g/n

ESP8266-12E

P3 – Terminal Block
U1 – 5V Regulator
U2 – 3.3V Regulator
D1 – Rectifier
SW1 – Reset Switch



Sample PCB (Not Final)


12V Power Outlet
5V Regulator
3.3V Regulator
Water Level Sensor
Water Pump
Temperature Sensor
Soil Moisture Sensor
Light Intensity Sensor
Humidity Sensor
Light
MCU
Wi-Fi
Android Mobile Device
Power
Peripherals
Power Line
Data Line
MCU

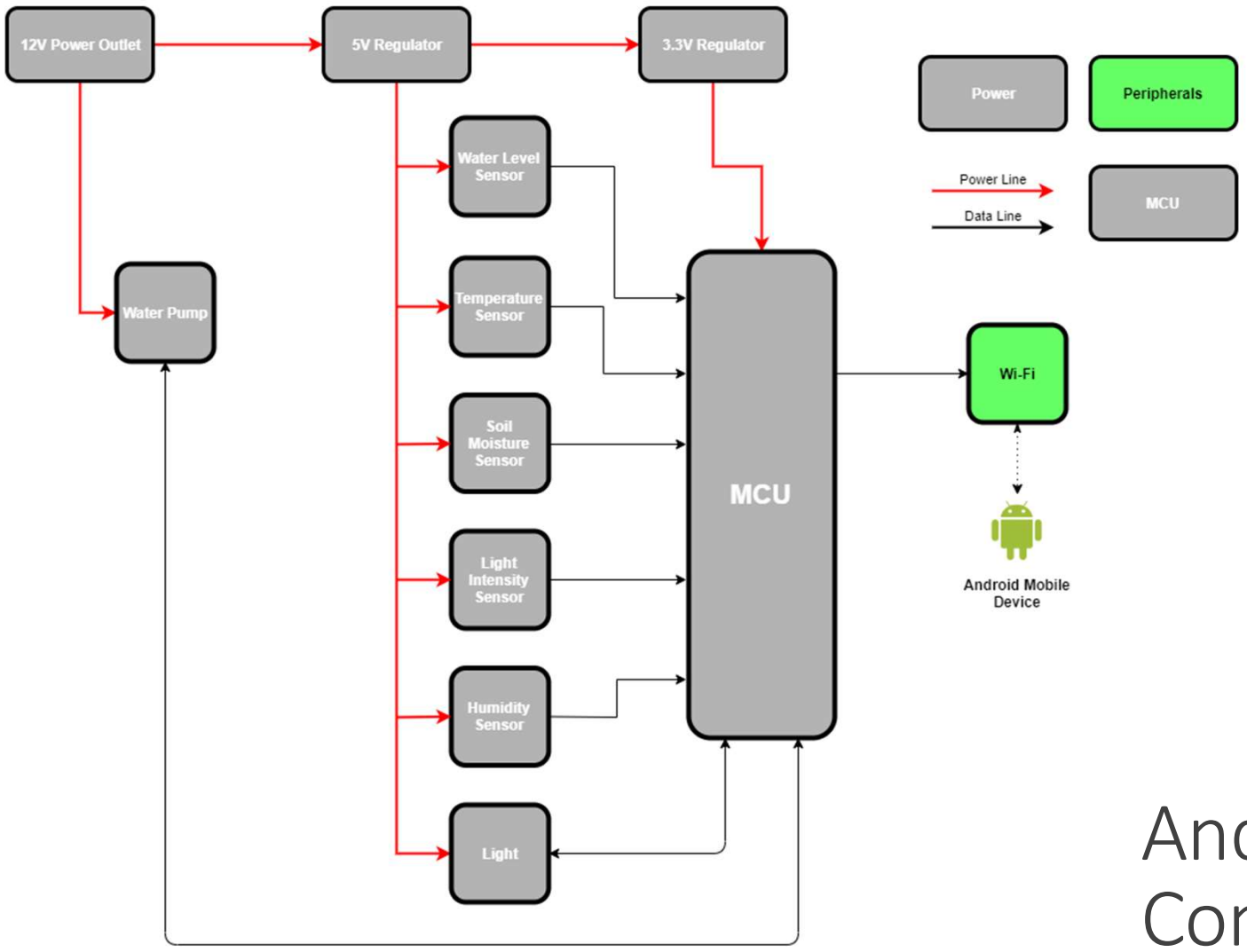
Sensors

Sensors

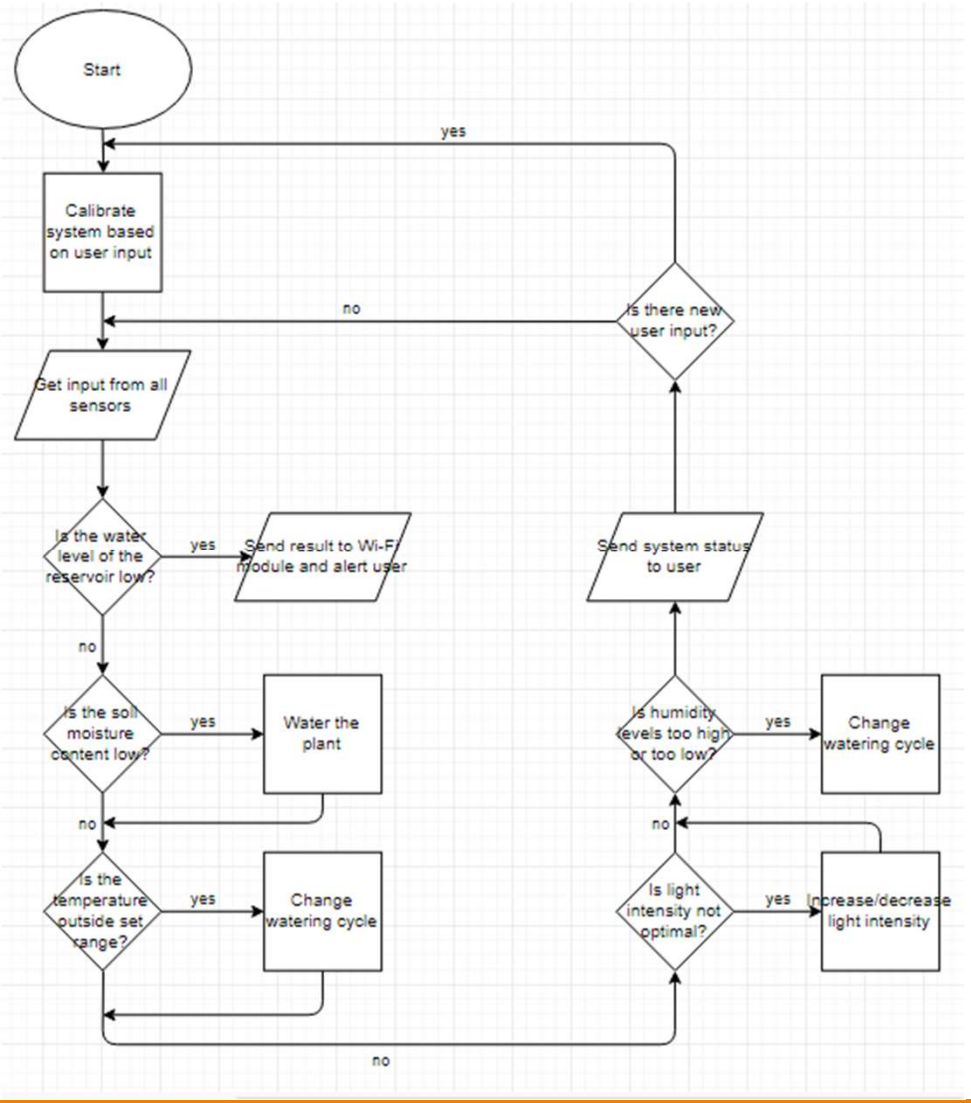
- Various sensor to track the plants environment and condition
- to be able to gather data for the system to ensure a hospitable environment with adequate resources for the plant
- array of sensors that will measure the current state of the plant and relay this data to the MCU for adjustments to the systems peripherals
- 5 different sensor types
  - Water Level
  - Soil Moisture
  - Temperature
  - Light Intensity
  - Humidity

Sensors

- These 5 are the minimum set of sensors that is needed to automate the process of plant growth
- The sensor we use are commercial products, but we found an interesting way to detect water level using only metal probes and wires
- Since sensors are one of the most important aspects of the system, we wanted to use the most cost-effective ones that will our project goals and objectives



Android Mobile Communication



MCU Software Diagram

Wireless Technology

- Wireless communication to connet the user to the device
- The user can interact with elements of the system to control plant environment

Wireless Technology

Technology	Advantage	Disadvantage
Wi-Fi	• Can be operated anywhere in the world through the internet • High speed communication • Long range	• Hard to setup
Bluetooth	• Easy to setup • Low energy consumption	• Extremely limited signal range of 10m • Cannot connect to the internet
Zigbee	• Low cost • Low power • Secure communication over encrypted network	• Limited signal range • Low transmission rate

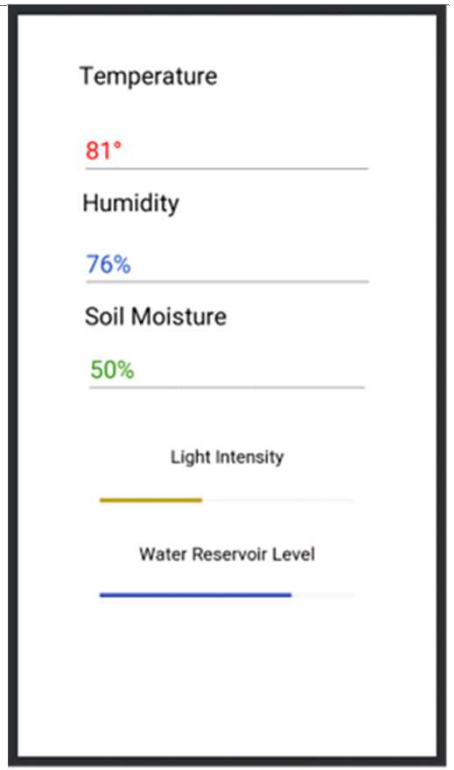
Android Application Software Design

The Question: Why have a phone application for a plant?

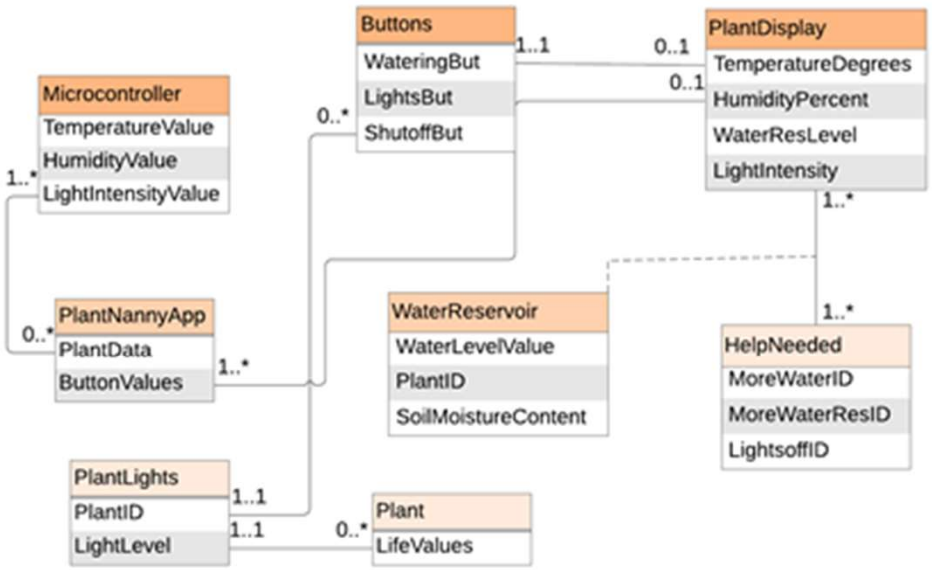
- Remote statistic viewing
- Control over the environment and power consumption
- Deeper interaction with your plants

Environmental Statistics

- Sensors transmit information to the microcontroller
  - Microcontroller sends information to your phone
- These statistics will be displayed and constantly updated
- Certain statistics will have updates when appropriate
  - Water level has increments such as 25 and 50 percent



Entity Relationship Diagram Example (UML Notation)



Button Functionality

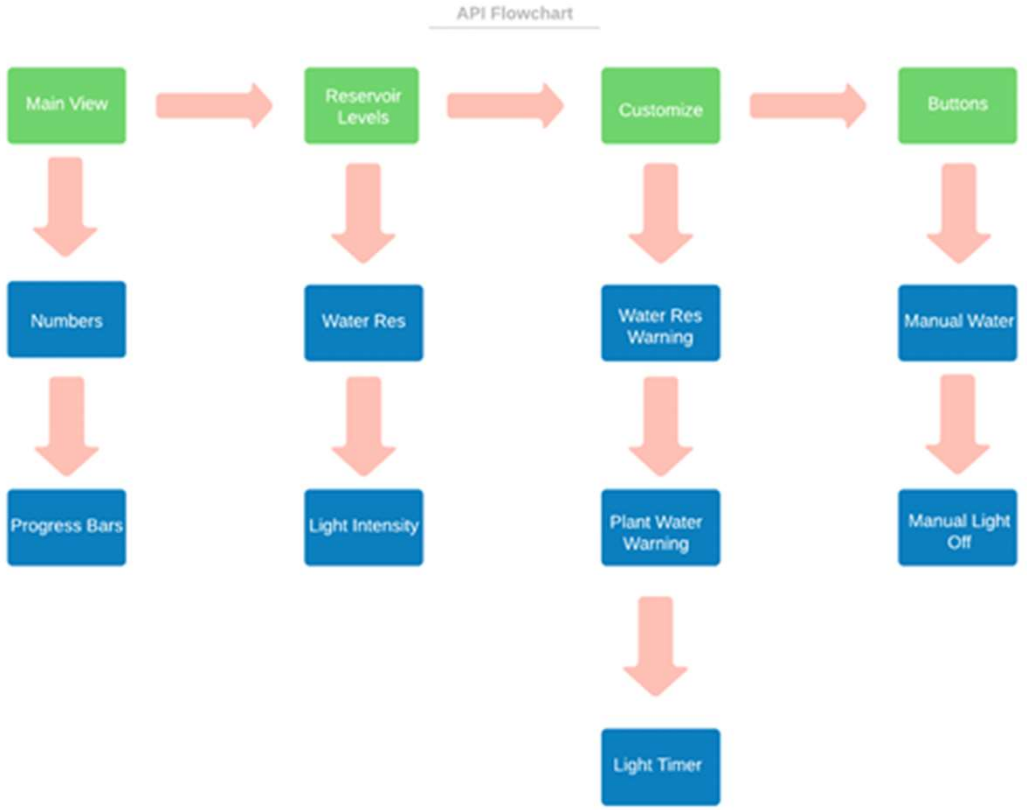
How it works:

For actions like lights turning on and off

- Button sends IP address of the microcontroller linked with a command for it to recognize
- The microcontroller receives the command and powers it off
- You receive notification that the lights are off

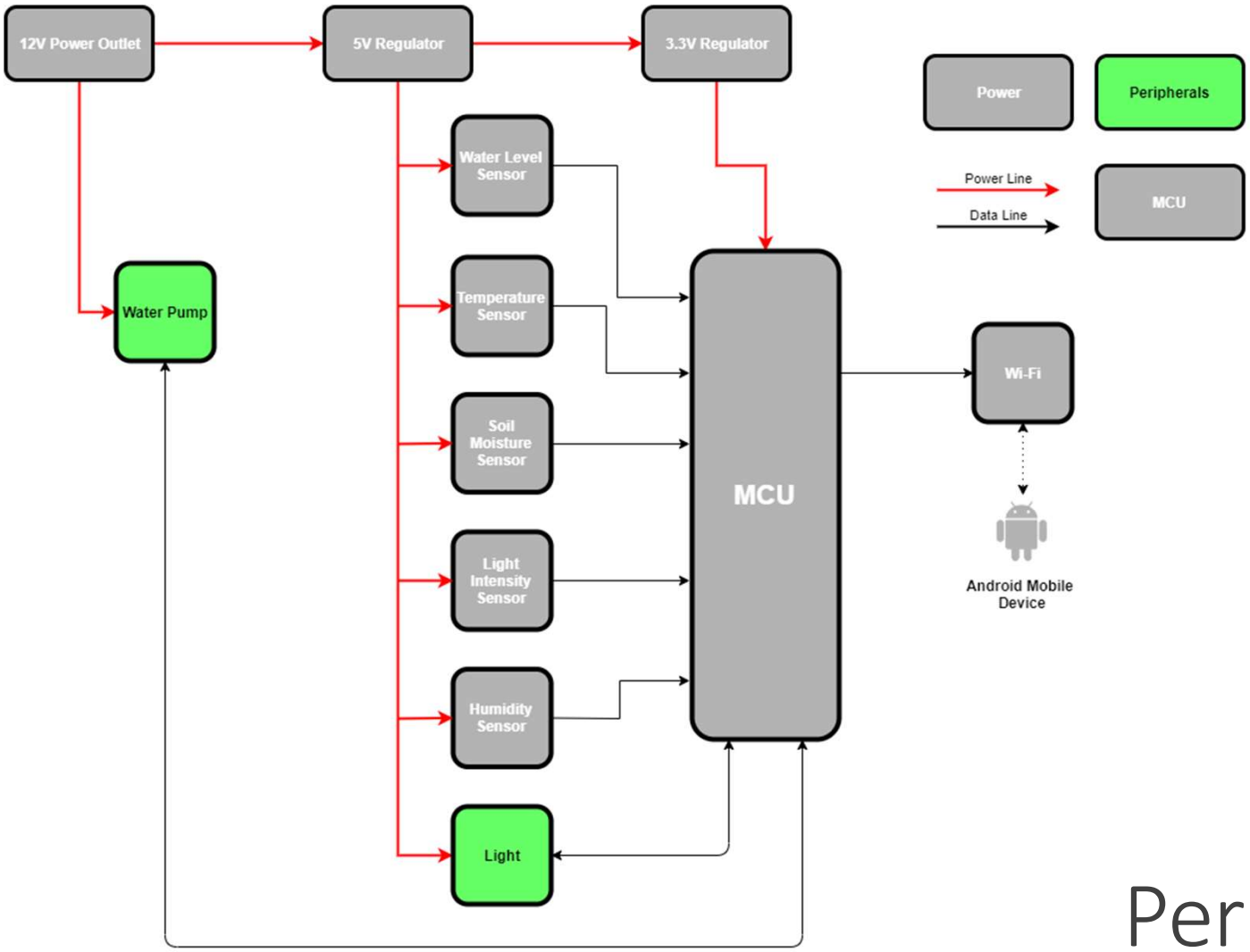
Plan of Attack

- Obtain the basics
- Small QoL features
- Control over electronics



Why Android based?

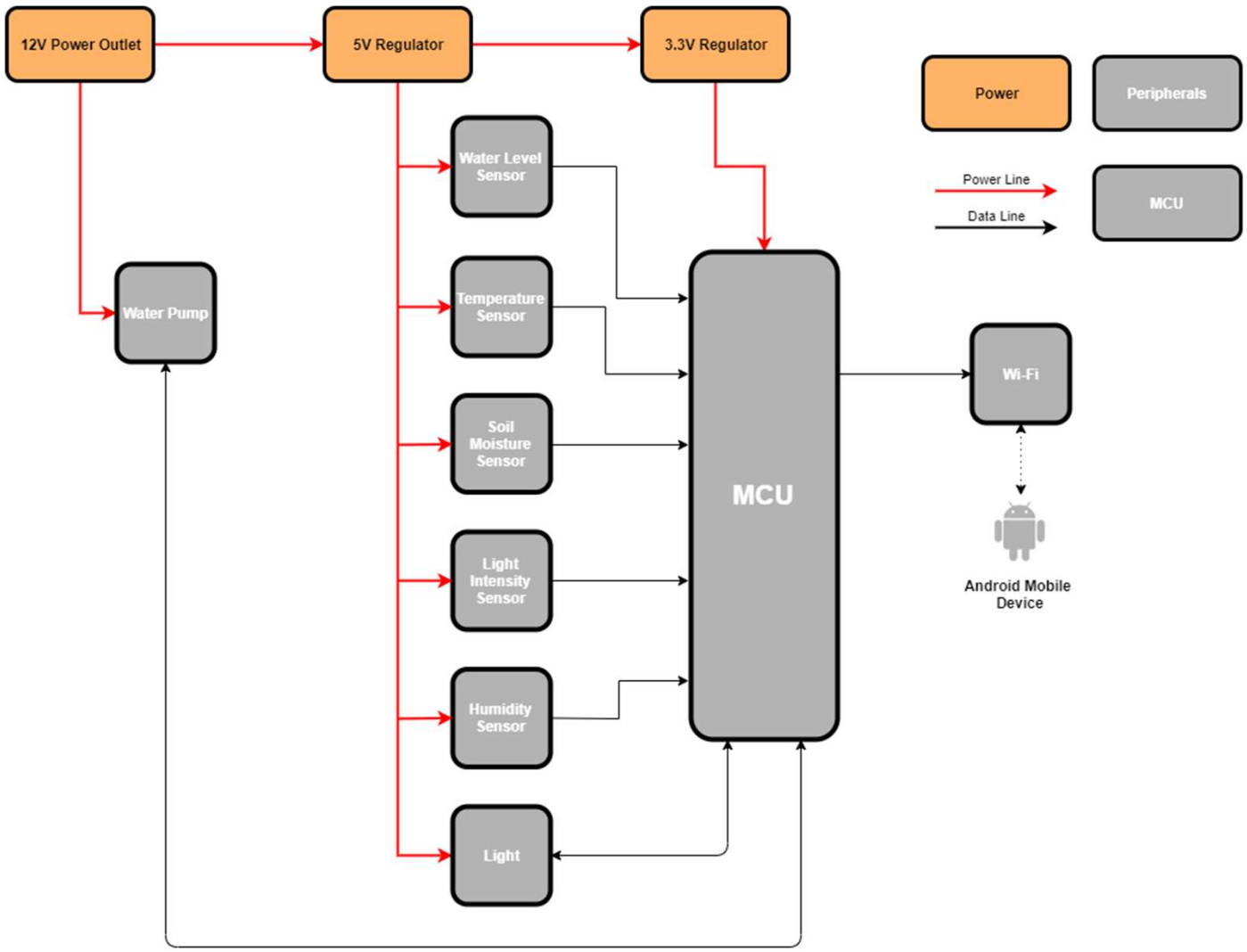
- Familiarity with Java
- Basic understanding of Android Studios
- Freeware
- Professionally used and known



Peripherals

Peripherals

- Other than the sensors we use 2 other peripherals
  - The light
  - The water pump
- They are controlled by the MCU depending on the condition of the plant
- Users can also use the mobile app to decide what the MCU should do with them


12V Power Outlet
5V Regulator
3.3V Regulator
Water Pump
Water Level Sensor
Temperature Sensor
Soil Moisture Sensor
Light Intensity Sensor
Humidity Sensor
Light
MCU
Wi-Fi
Android Mobile Device
Power
Peripherals
Power Line
Data Line
MCU

Power

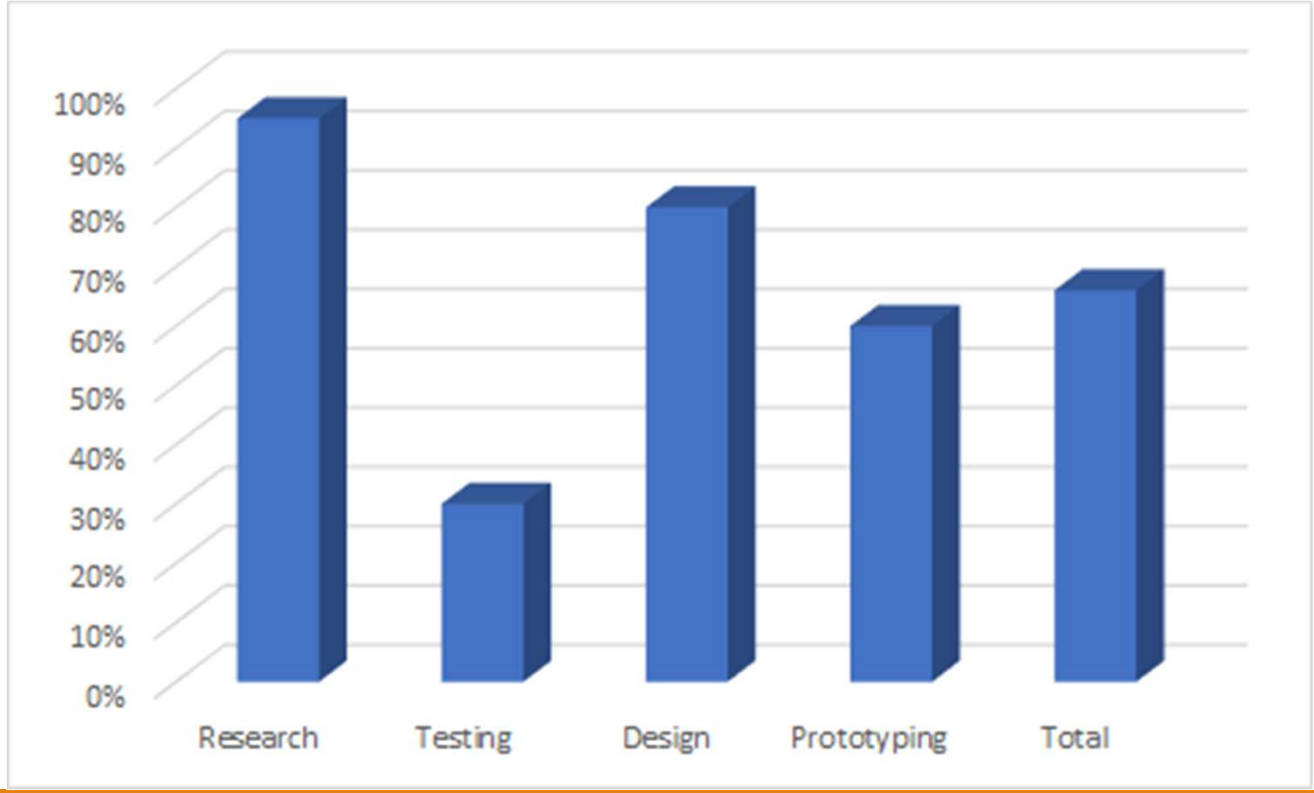
Power

- System will operate efficiently 25V @ 1.5A
- Battery/TI Web Bench /Wall Power Adapter
- Design our own AC/DC converter
  - 120VAC to 28VAC transformer
- Voltage Regulator
  - LD117V33
  - LD117V50C

Work Distribution

	Ajay Emmanuel	Christopher Jordan	Clayton Szoke	Gabriel Rodriguez
MCU Software	X			X
PCB Design		X		
Mobile App			X	
PCB Testing		X		X
Software Testing	X		X	

Progress


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Research
Testing
Design
Prototyping
Total

Difficulties

- We wanted to integrate a Ph sensor into our project but unfortunately, we could not find any such sensors that were both cheap and compatible with our chosen MCU
- Designing the PCB was a little troublesome
- There were a few minor issues setting up the wi-fi communication

Cost

Item	Manufacturer/Supllier	Cost
Sensors		
Soil moisture sensor		$6
Ultrasonic Water level sensor		$4
Humidity/temperature sensor		$10
Light intensity sensor		$5
MCU		
ESP8266		$10
Peripherals		
pump		$5
light		$20
total		**$60**