HERB CHAMBER

SDP21 Team 28

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Advisor: Prof. Siqueira

University of Massachusetts Amherst BE REVOLUTIONARY™

Problem Statement

Many people are thinking about becoming more self-sufficient and growing some of their own herbs at home but are stopped at the starting point due to many requirements they need to care for the plants. Even without a green thumb, the Herb Chamber can monitor every factor that is needed to grow a garden successfully and take care of it for you, such as soil moisture, air temperature, air humidity, lighting duration and more. Herb Chamber can send you a reminder when it is time to harvest and will allow you to see your home garden from anywhere in the world. This allows you to cross the threshold without needing to do much work yourself.

System Specifications

1. Compact indoor form that fits on most tables
    a. Bed size 23” x 5.25” x 6”
    b. Compact tent enclosure 23” x 23” x 42”
2. Power supply
    a. Low cost, low power system that delivers 105W/H
3. IP65 water and dust resistance rating
4. Water system
    a. 1x 12V DC pump with ½ inch tubing
    b. 6x 12V DC solenoid controlled watering channel with ½ inch tubing
5. Light System
    a. Indoor grow light
6. Sensor System
    a. humidity/temperature module
    b. moisture sensor
7. Product app interface
    a. Connected with a wifi module allowing remote access
    b. Alarm notification when set harvest time is approaching
    c. Displays various measured parameters
    d. Adjustable nutrient/water/light given to plants
    e. Default plant directory for optimal growth

System Block Diagram

Power Unit: 12V, 5A

Control Unit: Arduino

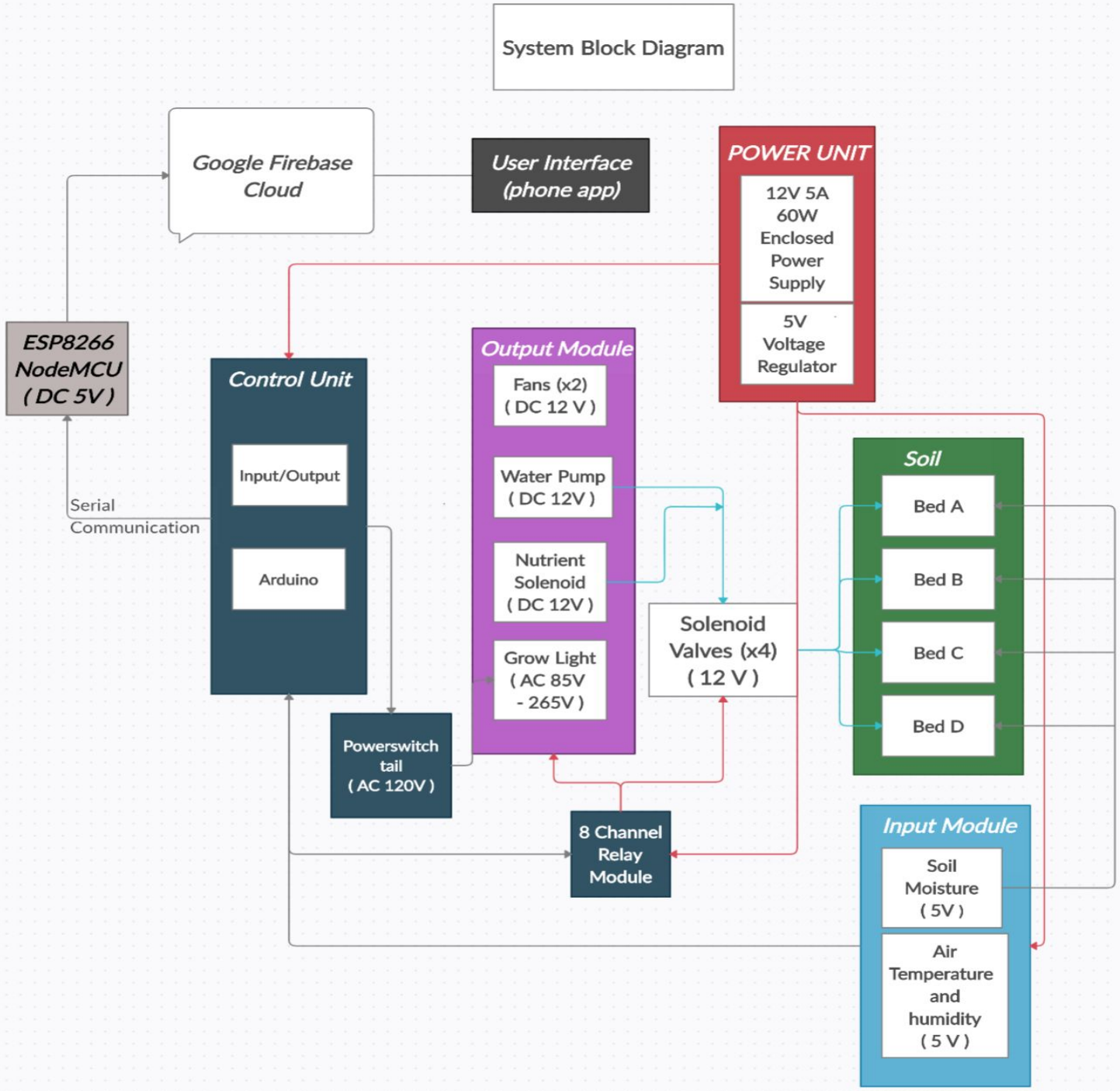
Cloud Unit: ESP8266

Sensors:

Capacitive Soil Moisture

DHT11 Air Temperature and Humidity

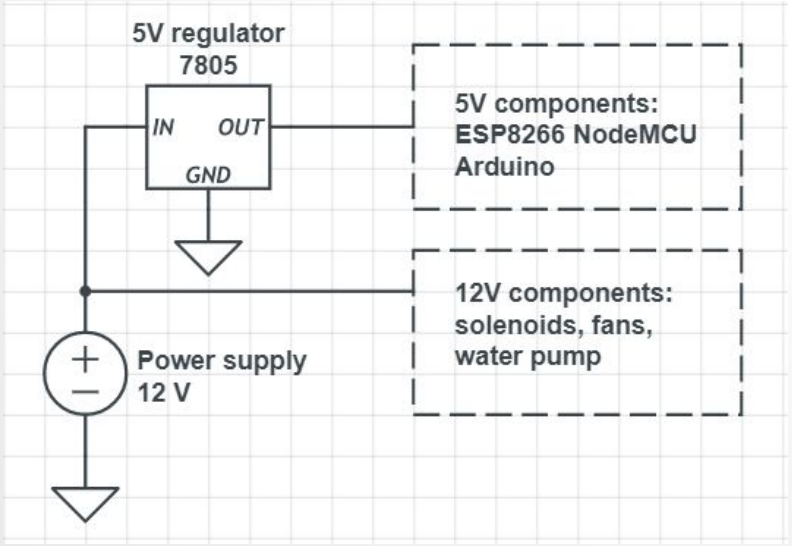
Relay Unit: Controlling fans, light, and solenoids



Nam's Part: Power Unit and Serial Communication

Power Unit:

- Calculated the overall DC power usage of the system (not counting the AC light source) to be under 50W/H
- Decided to use a 12V, 60W power supply
- Split the power source to 12V and 5V using a voltage
- regulator
- Schematic:



Nam's Part: Power Unit and Serial Communication

5V DC Relay is not reliable in term of safety for switching AC powered units.

Solution: A power tail switch functions similarly to a relay, but is mainly used for controlling AC devices.

Specification:

5V input

Switching 120VAC

How to wire:

Power -> +in

Signal -> -in

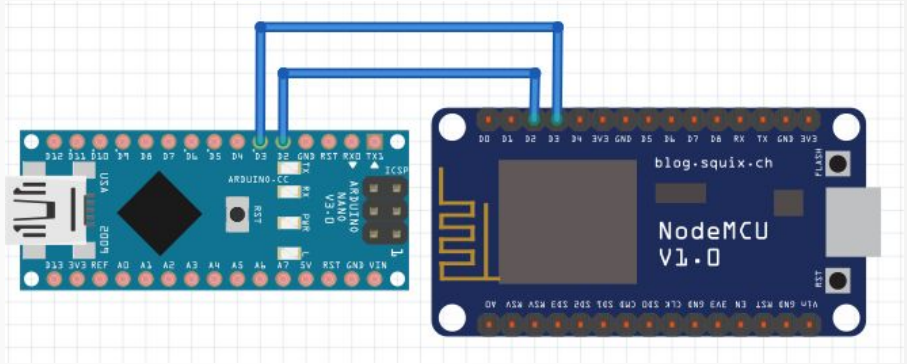
Gnd -> Ground

Nam's Part: Power Unit and Serial Communication

Serial Communication between

Arduino and

ESP8266 NodeMCU:



- Connected pin 5 and 6 of the arduino to D5 and D6 of NodeMCU to establish serial connection (RX/TX)
- Arduino can proceed to send any data after establishing a common baud rate between the 2 devices

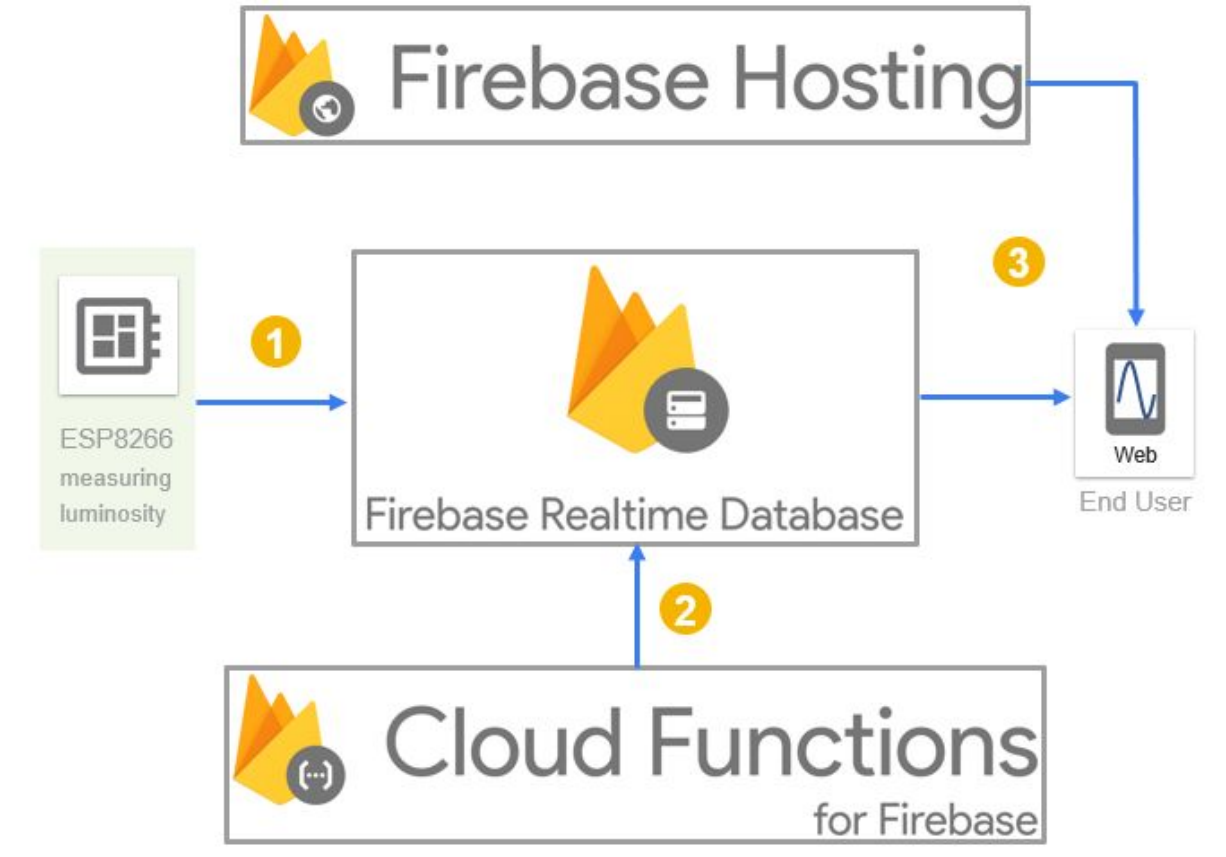
Duoc's Part: Host Server Communication

Create Cloud Host Server

- Google Firebase
- Link authorisation key and project URL with code
- Testing real time data collection with Sensor subsystem

Organization and Collection of Data

- Collect various data from sensor
- Format data in presentable form

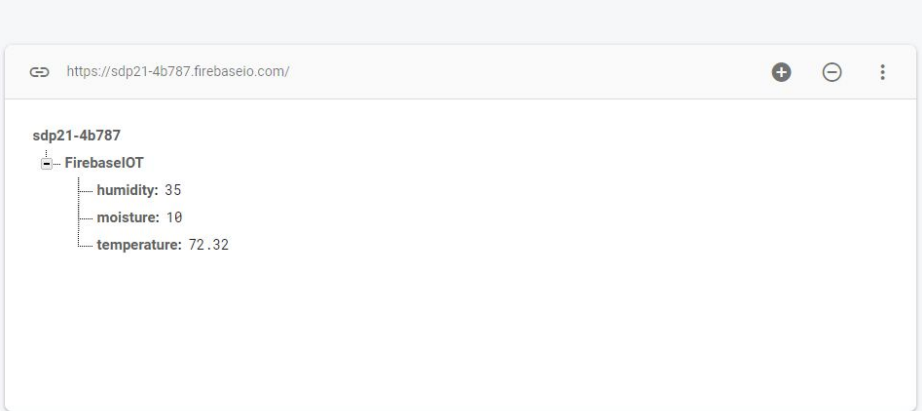


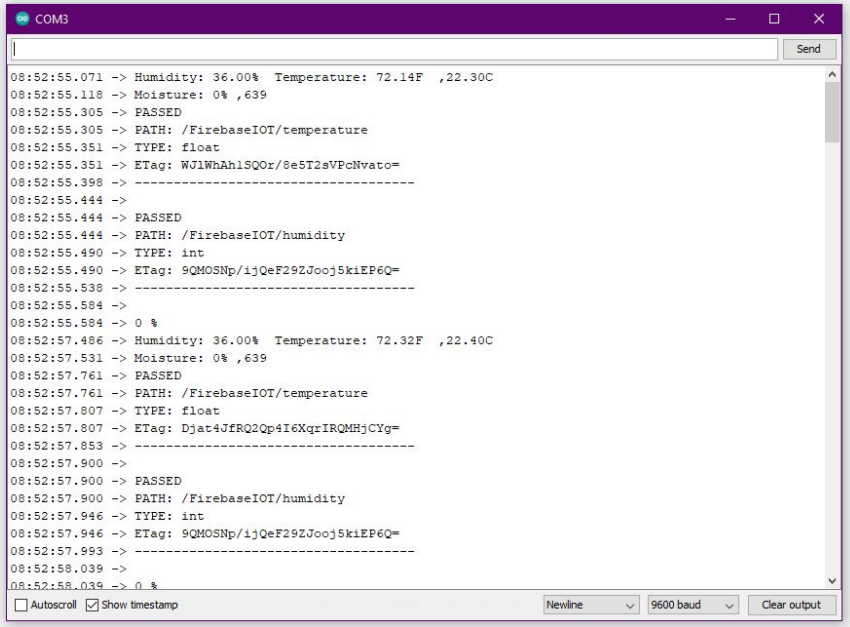
Data collection:

- 580-720 for soil moisture in contact with air
- 310-350 for moisture with direct contact with water
- formatting that data to easily understandable percentages with air contact as 0% and water contact 100%
- moisture from fresh soil ranges around 25%
- temperature and humidity are in stand US metrics

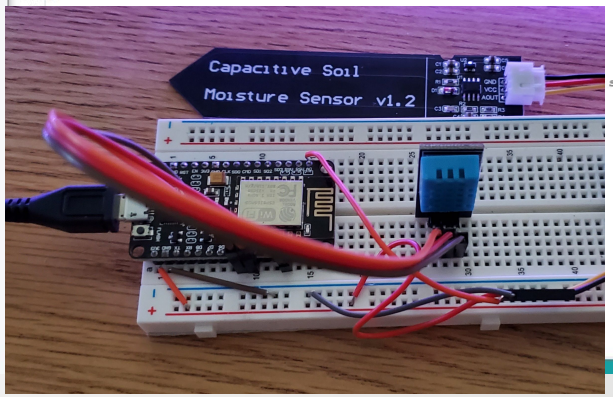
Host Authorization Code

- snippet of code to connect to cloud
- https://github.com/ncube3/HerbChamber





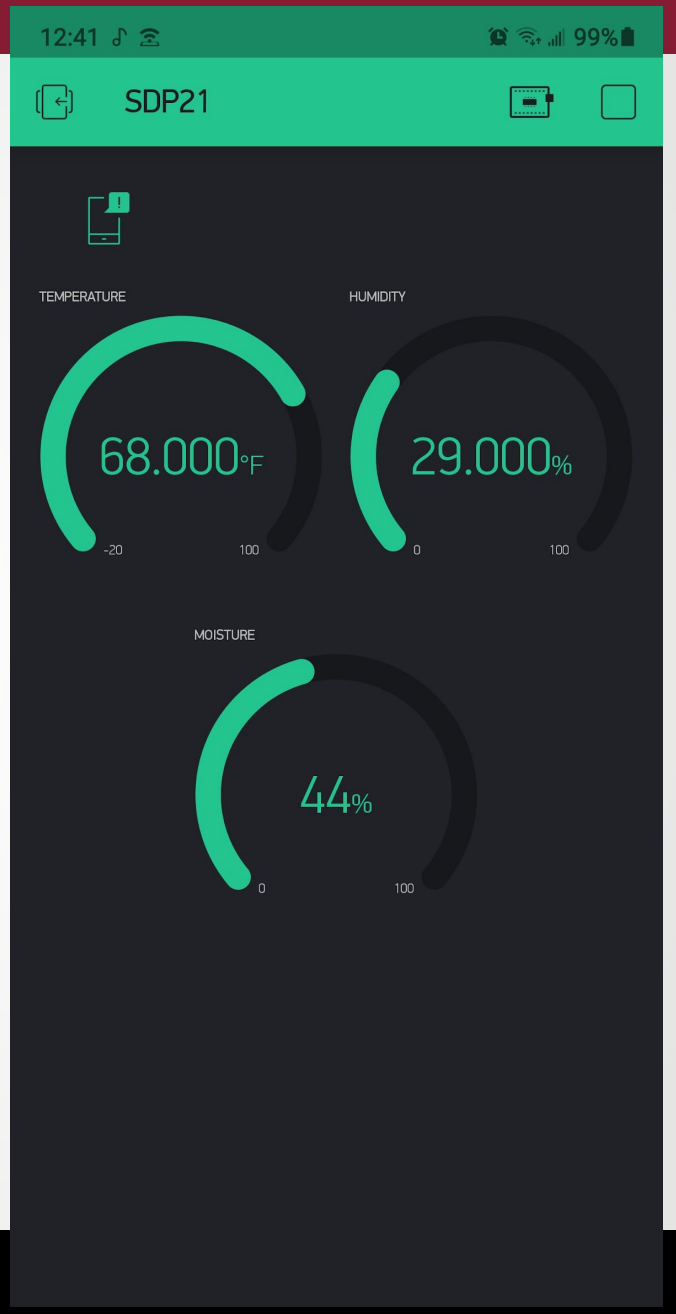

```
#define FIREBASE_HOST "sdp21-4b787.firebaseio.com/" //Without http:// or https:// schemes
#define FIREBASE_AUTH "Vw8Z1F4gKtPxfs4i0K7EWKMSVJpP6yvZFVWCwR21"
#define WIFI_SSID "Galaxy10"
#define WIFI_PASSWORD "00000000"
#define DHTPIN 4    // Connect Data pin of DHT to D2
#define DHTTYPE DHT11

DHT dht(DHTPIN, DHTTYPE);
FirebaseData firebaseData; //Define FirebaseESP8266 data object
FirebaseJson json;

const int AirValue = 640;   //you need to replace this value with Value_1
const int WaterValue = 360;  //you need to replace this value with Value_2
const int SensorPin = A0;
int soilMoistureValue = 0;
int soilmoisturepercent = 0;

void setup() {

  Serial.begin(9600);

  dht.begin();

  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("Connecting to Wi-Fi");
  while (WiFi.status() != WL_CONNECTED)
  {
    Serial.print(".");
    delay(300);
  }
  Serial.println();
  Serial.print("Connected with IP: ");
  Serial.println(WiFi.localIP());
  Serial.println();

  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
  Firebase.reconnectWiFi(true);

}
```



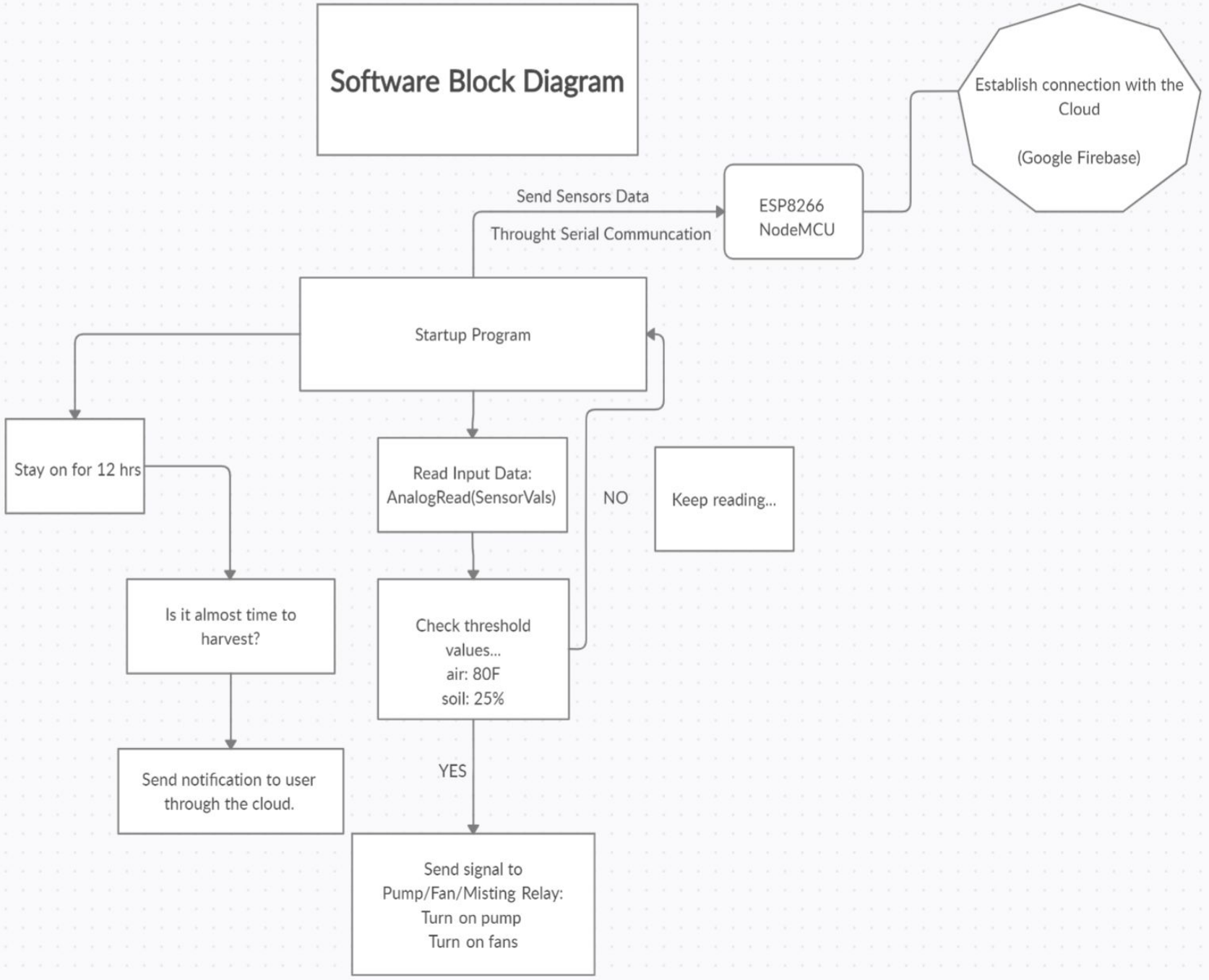
sensor)

App: Blynk

- premade, user customizable app
- Keep real time data, depends on the delay set
- set parameters that when met sends a notification
- basic app for testing purposes
- when moving forward, we will create a unique app
- current app does not allow much for customization



Software Diagram



Current Project Expenditure

1					
2	**Team Number**	28		**Order Total:**	$304.00
3	**Team Member Contact Name**				
4	**Date**	11/17/2020			
5					
6					
7	Item Description	Link	Unit Price	Qty	Line Total
8	Relays	https://www.amazon.com/ELEGOO-Channel-Optc	$10.00	1	$10.00
9	Solenoid valves (x3)	https://www.amazon.com/Ximimark-Electric-Solen	$11.00	3	$33.00
10	Moisture sensors (x2)	https://www.amazon.com/Gikfun-Capacitive-Corro	$8.50	2	$17.00
11	Growth tent	https://www.amazon.com/VIVOSUN-Hydroponic-C	$65.00	1	$65.00
12	Growth light	https://www.amazon.com/Growing-Spectrum-Hydr	$27.00	1	$27.00
13	120mm fans	https://www.amazon.com/Antec-F12-Performance	$25.00	1	$25.00
14	Garden Soil	https://www.homedepot.com/p/Miracle-Gro-Moistu	$8.50	1	$8.50
15	Tubing 1/2"	https://www.amazon.com/pond-boss-8719800121	$9.00	2	$18.00
16	Water pumps	https://www.amazon.com/dp/B07W59D21M/ref=sy	$11.00	1	$11.00
17					
18	Humidity sensor	https://www.amazon.com/KeeYees-Temperature-H	$14.00	1	$14.00
19	Liquid Nutrients	https://www.homedepot.com/p/AeroGarden-1-Lite	$28.50	1	$28.50
20	Irrigation Fittings Kit	https://www.amazon.com/Habitech-Irrigation-Fittin	$12.00	1	$12.00
21	Fabric Grow Bags	https://www.amazon.com/VIVOSUN-5-Pack-Thick	$16.00	1	$16.00
22	DC Water Pump	https://www.amazon.com/dp/B07W59D21M/ref=sy	$19.00	1	$19.00

Future Expected Expenditure

ESP8266 - $13-26

Mini Nano/Arduino - $13-18

Heating coil - $10

PCB - $20-70

Miscellaneous - $30

ATMEGA328P - $10-15

Crystal 16MHz - $5

Current Expenses - $304

Total Expected - $405-478

Christian's Part: Light Source and Water

Parameters

- Light Source
  - Wavelengths (UV, IR, Red, Blue)
    - ranges from 390 nm to 730 nm
  - How long it should be on depends on the stage
- Water
  - V=pi(r)^2h, where h = 1 inch, r = 6 inches
  - Volume of water is 113 in^3
  - Given the water pump rate, it takes 28 seconds to water 113 in^3 precisely
  - Will be watered when the moisture sensor reads the soil is dry

Seeding Stage
12-14 Hours on

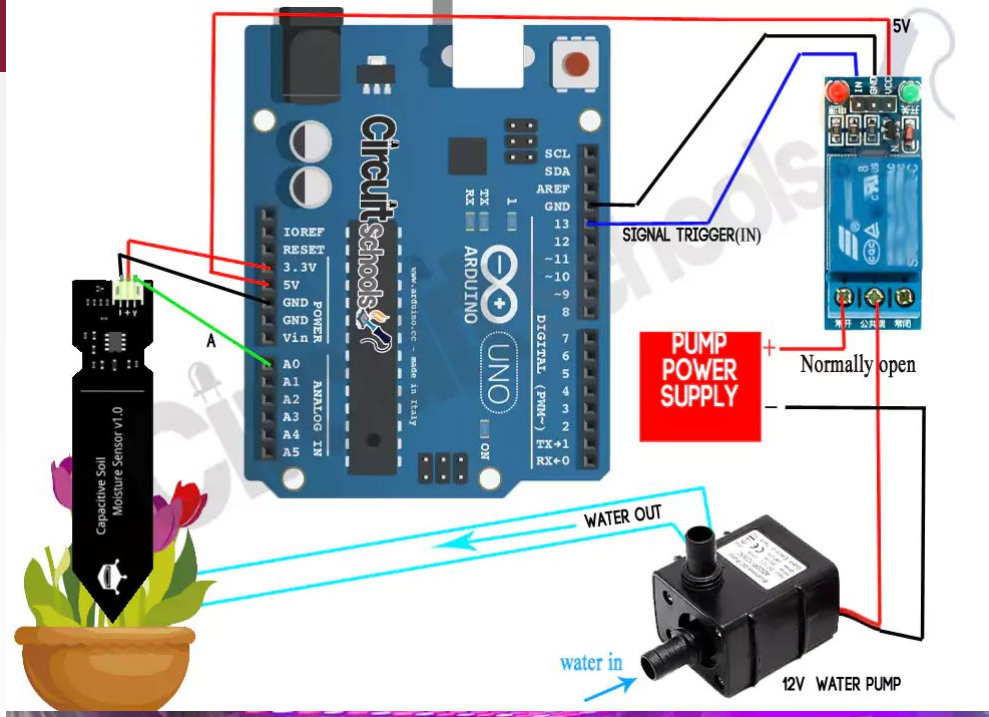
Vegetative Stage
14-16 hours on

Flower/Fruit Stage
14-18 Hours on

Christian's Part: Circuit

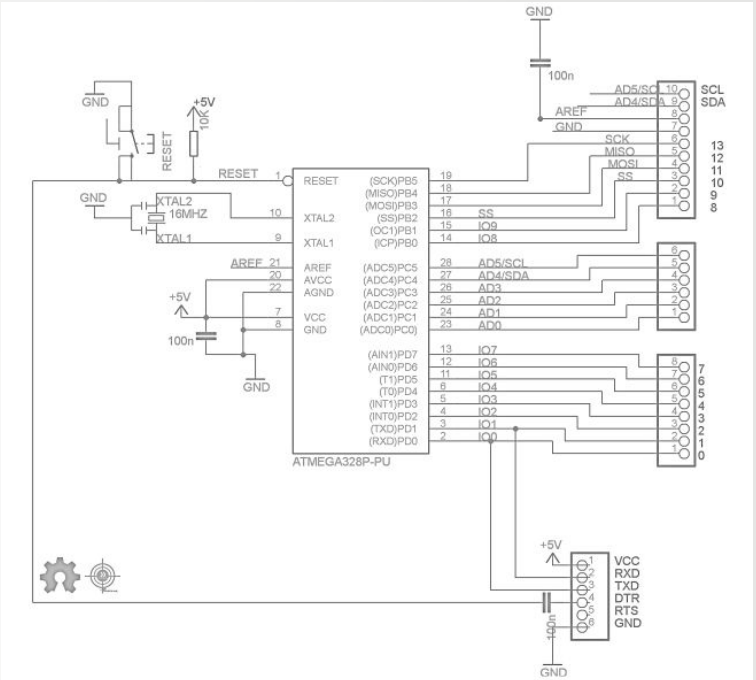
Building the Arduino Circuit

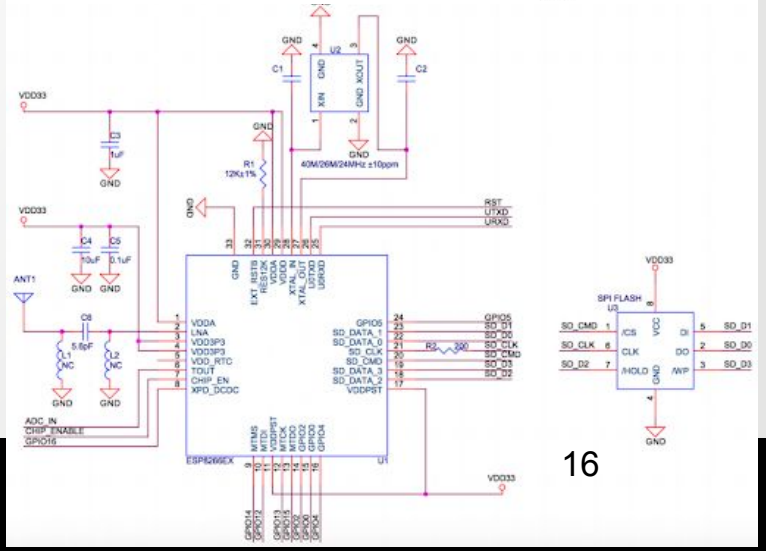
- Connected to 12 volts and 5 volt power supplies
- Connected sensors to 5 volt source, ground, and analog pins
- Wired the Relays (12 volt supply, Arduino, Fans, Solenoids)
- Attached Pump to the solenoids



Hardware Plan for FPR

- ATmega328P, ESP8266, RTC, etc
- Hardware Plan for FPR -- tell us what you plan to put on your custom PCB and list any single board computers or breakout boards that your team has requested or will request to use at FPR
-





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Project Management/Gantt Chart

Nam: Team Coordinator

Simon: Budget Lead

Duoc: Cloud Server/Application Lead

Christian: Altium Lead

MDR Deliverables

- Assembled main structure and water system 
- Communication with sensors and actuators 
- Working power subsystem for components 
- Cloud Firebase Communication with Sensor system 

DEMO

Q&A Session: