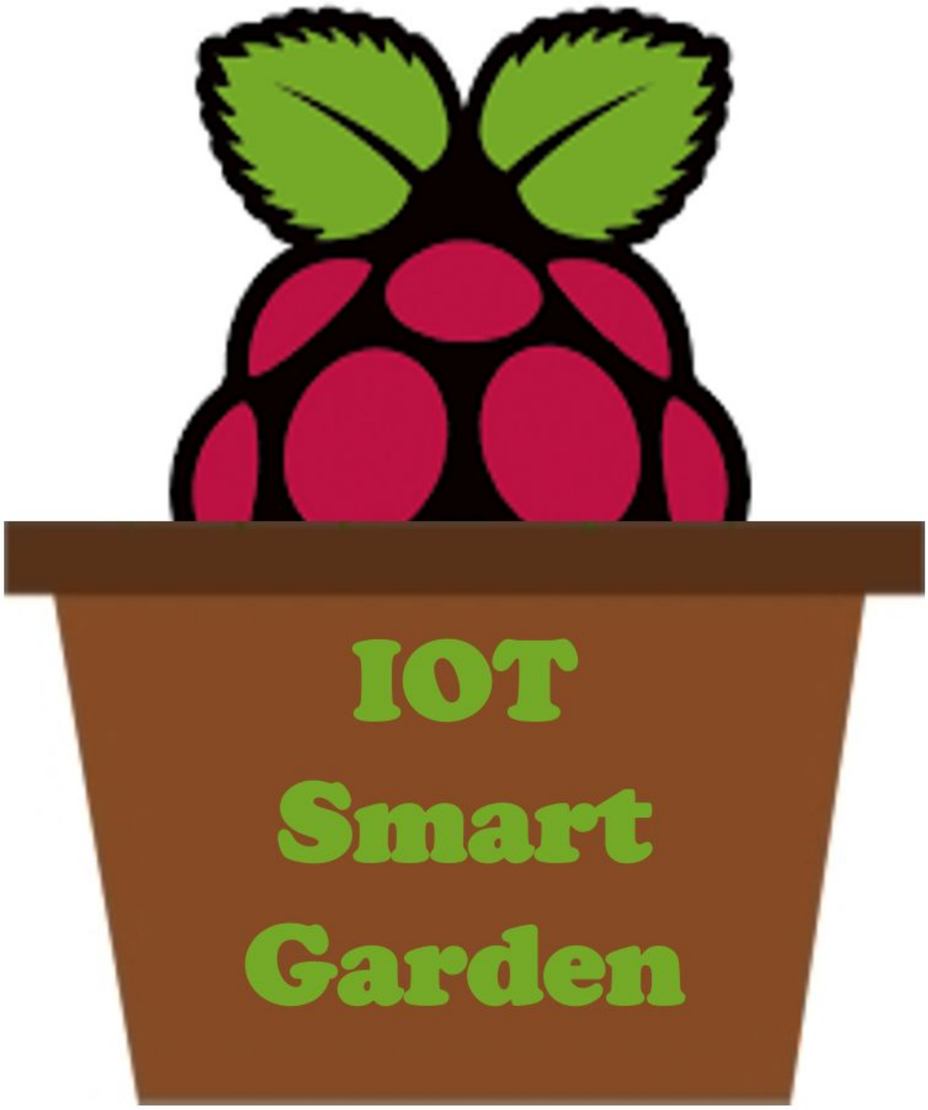
**CA400 Final Year Project**

**IOT Smart Garden**

**User Manual**

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## 1. Prerequisites

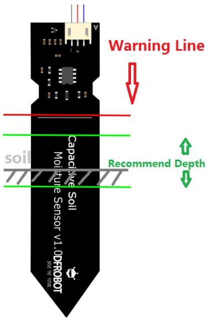
A Networked raspberry pi

Components:

1 • DHT11 temp/humidity
2 • Capacitive Soil Moisture Sensor v1.2
1 • ds18b20 waterproof thermometer
1 • water level sensor
3 • 5v relays
3 • 5v water pumps
2 • power supplies
1 • raspberry pi
1 • breadboard with jumper cables

## 2 Hardware Setup:

Capacitive moisture sensor:




GND : GND

3v : 3V

SIG : MCP 1-3

Water Level Sensor:

GND : GND

3v : 3V

SIG : MCP 8

DHT11:


GND : GND

3v : 3V

SIG : GPIO4

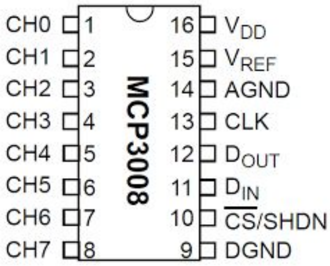
DS10B20 waterproof:

GND : GND

3v : 3V

SIG : GPIO16

MCP3008:




Functions as an analog to digital converter.

MCP -> sensors

Channels 1-3: Signal wires from moisture sensors

Channel 8 : Signal wire from Water sensor

MCP -> Pi

15, 16 : 3V

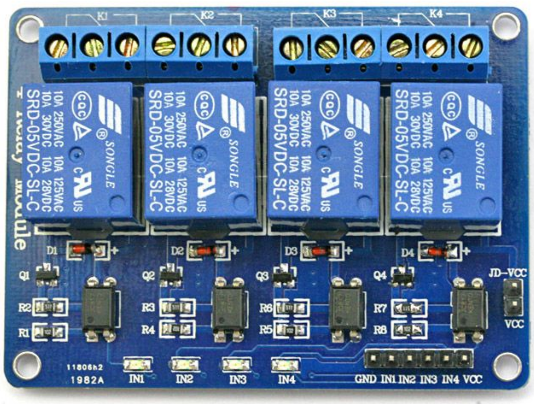
9, 14 : GND

13 : GPIO 23

12 : GPIO 21

11 : GPIO 19

10 : GPIO 24




5V four relay module:

In4 was used instead of In3 for cable management reasons

GND : GND

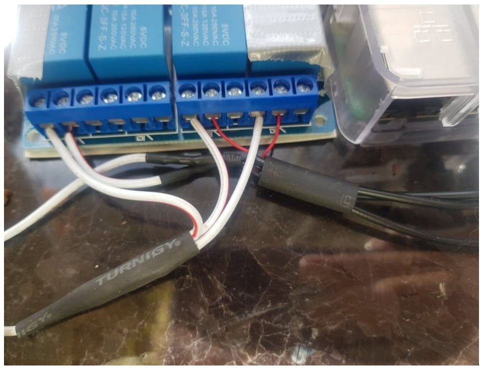
In1 : GPIO18

In2 : GPIO15

In3 : -

In4 : GPIO14

VCC : 5V

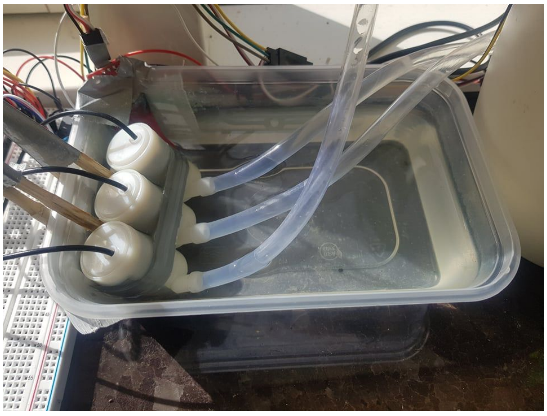
Power Supplies:  

A separate power supply is used to power the water pumps to avoid brownouts with the Pi.

A 5V Usb plug and cable Left, were spliced into 4x5Vs and 4xGNDs.

4x USB 5V : relay NC

4x USB GND : 4 x water pump GND

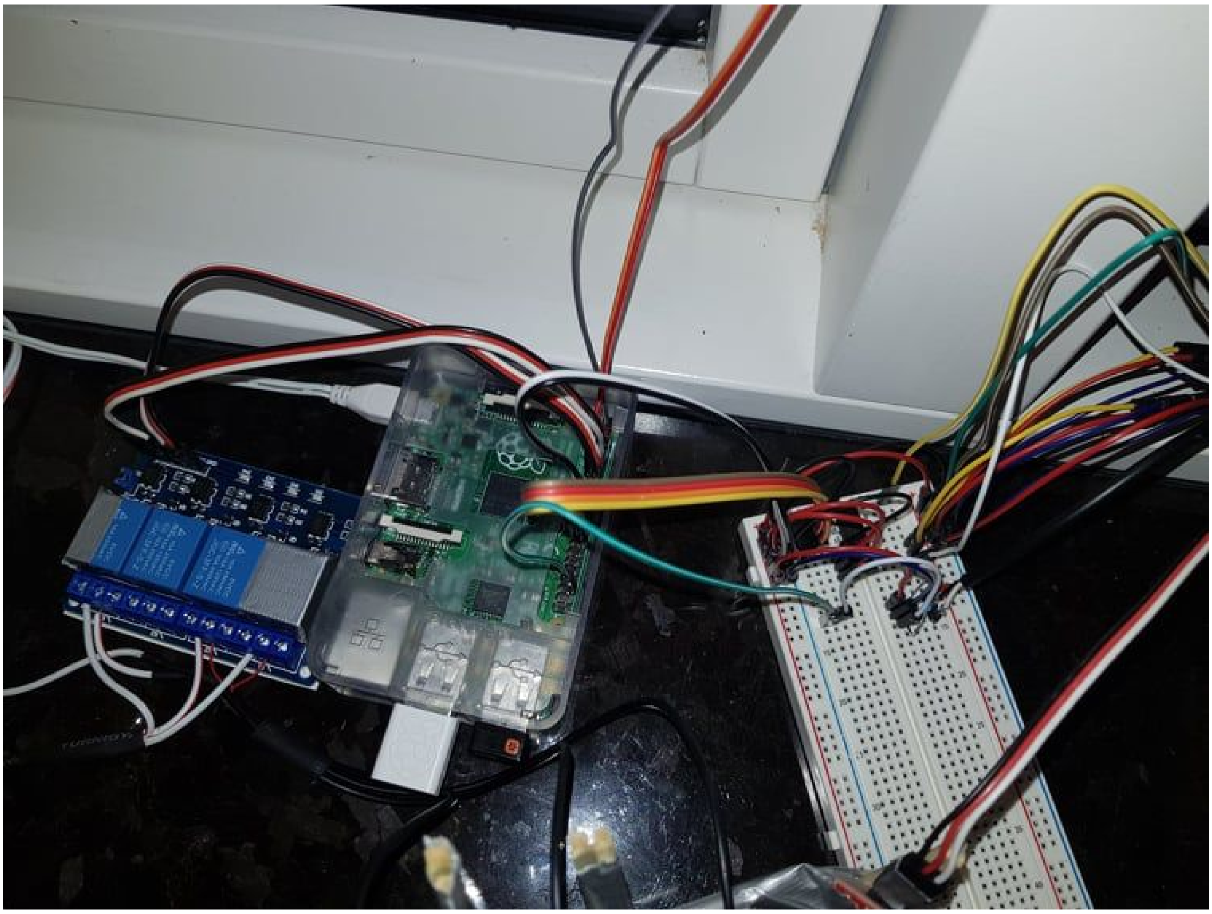


Water Pump Circuit:

GND : USB GND

5V : Relay C

-> pump1:k4 ; pump2:k2 ; pump3:k1



## 3 Software Setup

### 3.1 Database Setup

The Database provisioning is done either through the AWS RDS Console or through the AWS CLI. We chose the quicker console approach, you select AWS RDS, free tier instance and the MySQL Community Version of SQL. It is also essential to allow public access (which is secured by username and password using os.environ).

**3.2 EC2 Instance**:

Requirements:

- Flask
- Requests
- mysql.connector
- Json
- Numpy

The way the EC2 instance is similar to RDS in that we took the simpler approach by provisioning the instance through the console. To avoid charges also, select free tier and the ubuntu server option. The instance type is t2.micro.

Install source files from the server/src directory

Follow the procedures mentioned in the systemFiles
Crontab: Crontab -e will open up the crontab on the instance. Copy the crontab.txt file into the crontab on the instance (using your aws authentication).
Systemd: These are the programs that are run on boot.

Make sure that they are put into '/lib/systemd/system/<name>.service'

To start the systemd files:

sudo systemctl daemon-reload
sudo systemctl start flask-app.service
watch journalctl -u flask-app.service -n 20
sudo systemctl enable flask-app.service

Restart then test with:

watch journalctl -u flask-app.service -n 20

**3.3 Raspberry Pi Setup**:
Requirements:

Flask
RPi.GPIO
Adafruit_DHT
Mysql.connector
Gpiozero
Numpy

Install source files from the pi/src directory
Follow the comprehensive guide in 'pi/systemfiles/systemdSetup.txt'. The guide will walk through the steps of setup/config and monitoring the reverse ssh tunnel and flask app.

Crontab: Crontab -e will open up the crontab on the pi. Copy the crontab.txt file into the crontab on the pi (using your aws authentication).

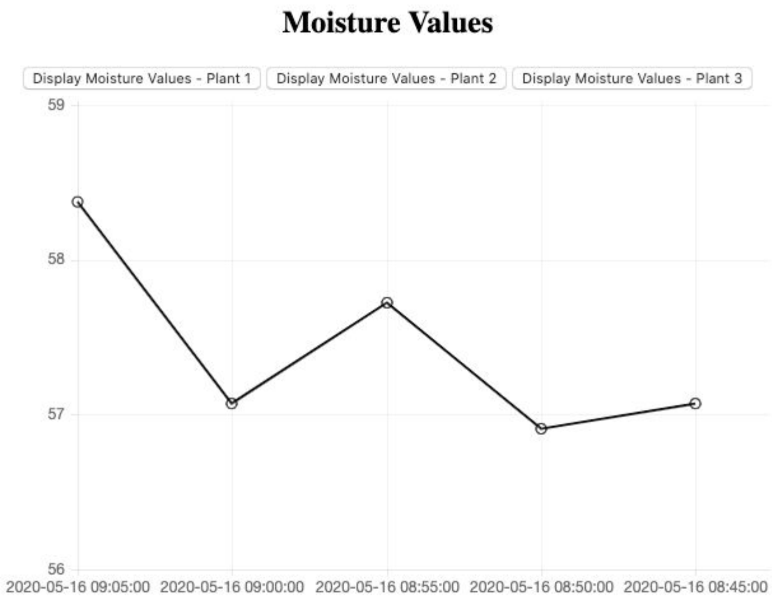
Systemd: These are the programs to be run on boot and ensure connection to the EC2 instance. Use 'systemctl status <service-name>.service' to make sure all files are running correctly.

## 4 User Interface

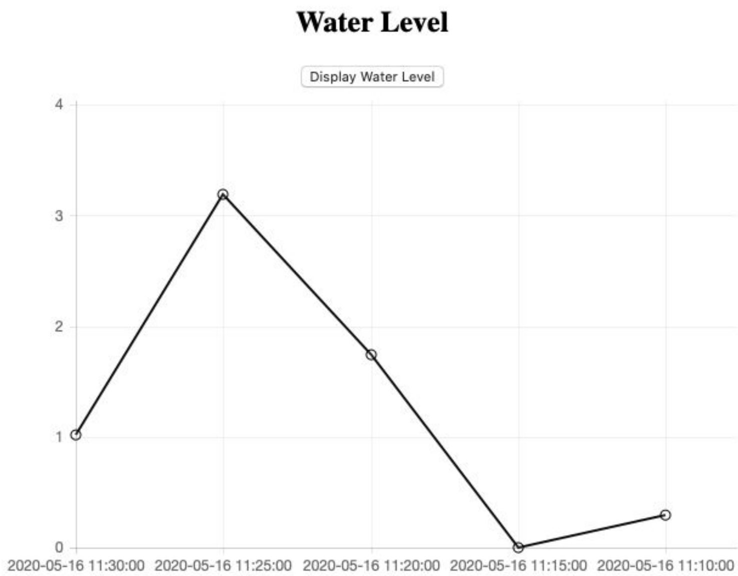
This section is comprised of the various views of the web application and describes the different functionalities associated with them.

### 4.1 Moisture Sensor Outputs

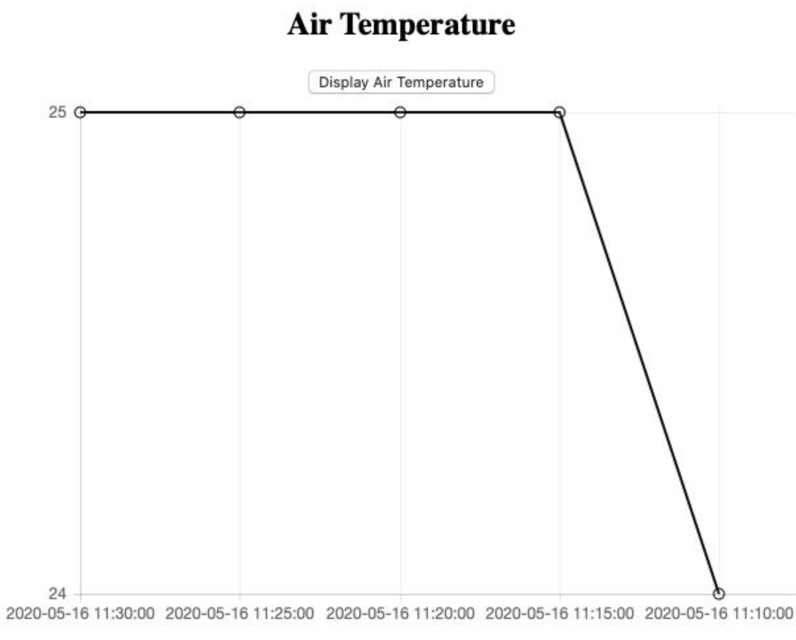
The graph below comprises the soil moisture values for each plant in our garden, the user can cycle through the different plants by clicking buttons associated with each plant. These buttons make use of the chart.js library and SQL queries to get the last 5 values detected for each plant.



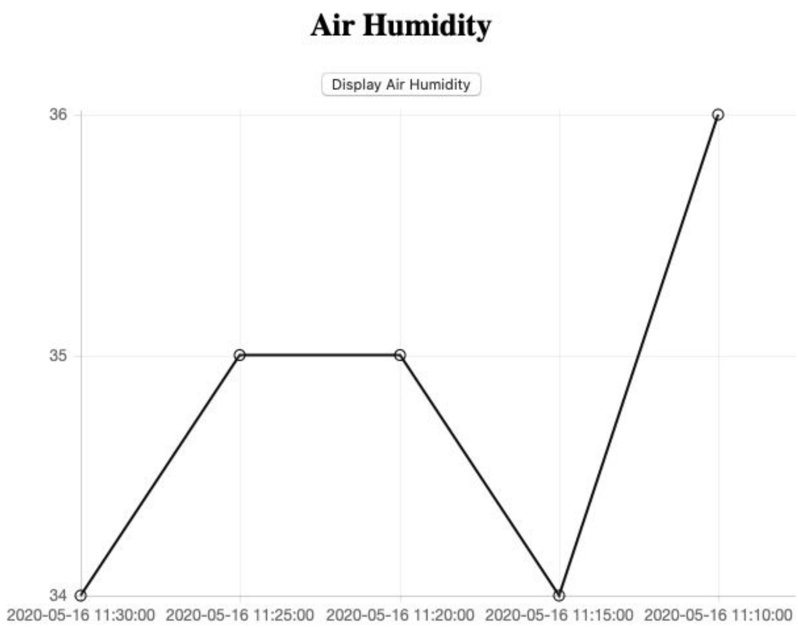
## 4.2 Water Level




## 4.3 Air Temperature



### 4.4 Air Humidity




### 4.5 Watering Modes

The IOT Smart garden system, utilises a Q-learning ML model to automatically water the plants. This function can be switched on or off with the selection buttons.
You can manually water a specified plant at any time with the water plant buttons.