IoT based water quality assistant for Irrigation

Capstone Mentor Evaluation 2

and 3

Submitted by:

CPG 101

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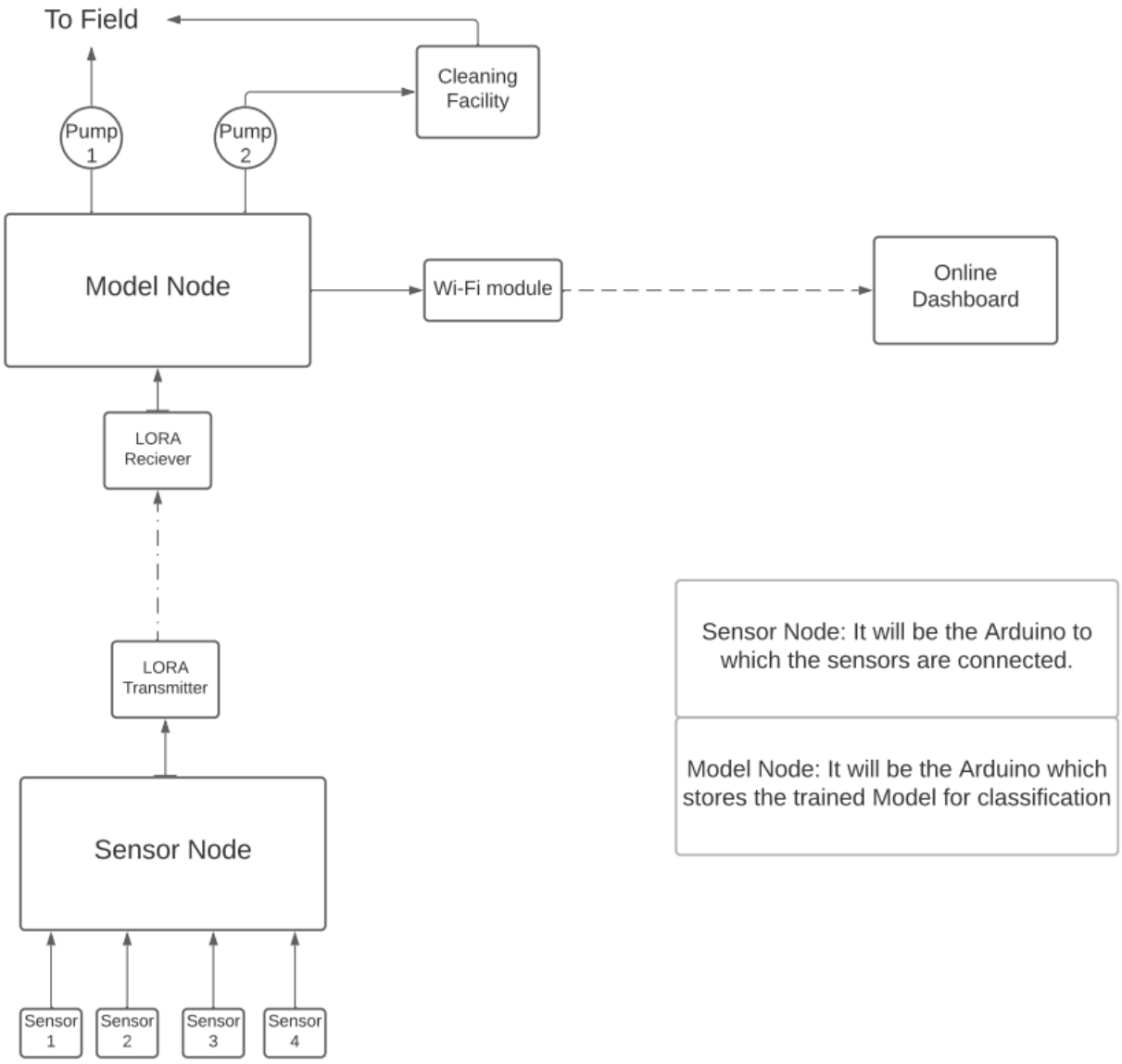
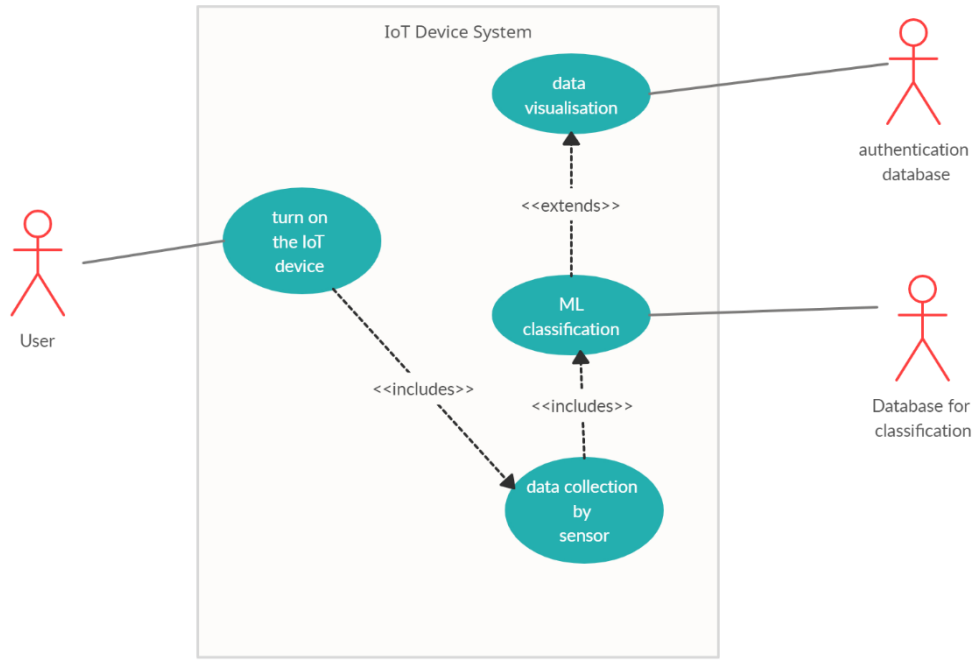
1. Product Perspective



2. Use Cases



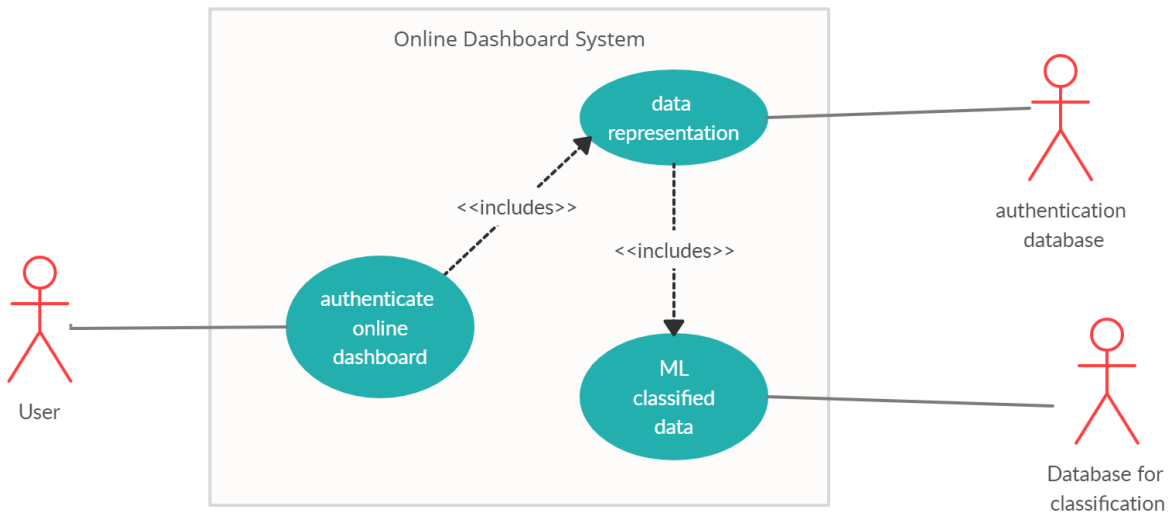
Use Case Diagram 1

1. Setting up the Device

Precondition	None
Use Case	Setting up the Device
Actors	User
Purpose	Set up the device to check water quality
Overview	The user has to place the sensors into the water and turn on the Arduino.
Type	Primary
Task Sequence	**Successful Scenario:** 1. (AA) User places the sensors into the incoming stream of water. 2. (AA) User turns on the microprocessors. 3. (SR) The microprocessor LED's begin blinking to indicate that transmission of data is taking place. **Alternate Scenario:** 2. (AA) User does not require wireless transmission and only sets up one microprocessor
Post Condition	1. User will be able to use the system further.

2. Classification

Precondition	1. System is in place 2. Data is being collected for analysis by system
Use Case	Classification
Actors	None
Purpose	To classify the incoming water as suitable or unsuitable
Overview	The data collected by sensors will be analysed with the help of a Machine Learning model uploaded directly onto the Microcontroller.
Type	Primary
Task Sequence	**Successful Scenario:** 1. (SA) System transmits sensor data to microcontroller 2. (SR) System uses ML models to analyse data 3.(SR) System classifies water quality as suitable 4. (SR)System turns on pump 1 and pumps the water to fields **Alternate Scenario:** 3.(SR) System classifies water quality as unsuitable 4.(SR)System turns on pump 2 to send the water to treatment facility
Post Condition	Depending on the classification water is either sent to fields or to a treatment facility



Use Case Diagram 2

3. Setting up online dashboard

Precondition	1. Microprocessor must be collecting data
Use Case	Setting up online dashboard
Actors	User
Purpose	The online dashboard will help the user to access past data in order to analyse the long term effects of the system as well as make any improvements onto it
Overview	The wifi module will be set up either on one of the microprocessors depending on the user configuration.
Type	Primary
Task Sequence	**Successful Scenario:** 1. (SA) System LED are blinking to indicate transmission of data 2. (AA) User connects Wi-Fi module with the internet by providing the Name and password. 3. (SR) System blinks the Wi-Fi LED to indicate connection with the internet and dashboard **Alternate Scenario:** 2.(AA) The user refuses to connect the Wi-Fi module with the internet 3.(SR)The system does not connect to the dashboard to internet and the Wi-Fi LED does not blink
Post Condition	1. Data will be transmitted to the online dashboard

4. Display

Precondition	1.Sensor data has been analysed and water quality has been classified
Use Case	Display
Actors	None
Purpose	To display analysed data about water quality through graphs on an online dashboard for the user to see
Overview	After the sensor data is collected and analysed the system displays the data in graphical form on an online dashboard which a user can access after authentication
Type	Primary
Task Sequence	**Succesful Scenario:** 1. (AA)The user logs in to the online dashboard after authentication 2. (SA) System displays the analysed data on the online dashboard

	3.(AA) User views the data and can analyse and make decisions based on the data **Alternate Scenario:** 1. The user forgets the password and has to reset it 3.(AA) User wishes to end the session and can log out
Post Condition	1. Sensor data about the water is displayed

Typical Course of Events/Successful Scenario/Normal Scenario

1. (AA) The user starts the IoT device
2. (SR) The field component will collect the temperature, pH value, turbidity, SAR value and flow of water
3. (SR) The LORA module transmits the data to microcontroller receiver
4. (SR) The ML models analyse the data and determine whether water is fit for irrigation or not
5. (SR)The microcontroller diverts the flow of water based on the result obtained
6. (SR) The system uploads data online on a dashboard
7. (AA) The user creates an account on the online dashboard and logs in
8. (AA) The user accesses the data for his own use

Alternative Flow Of Events

1. The user has change of mind and does not turn on the device
7. The user opts out of creating an account on the online dashboard

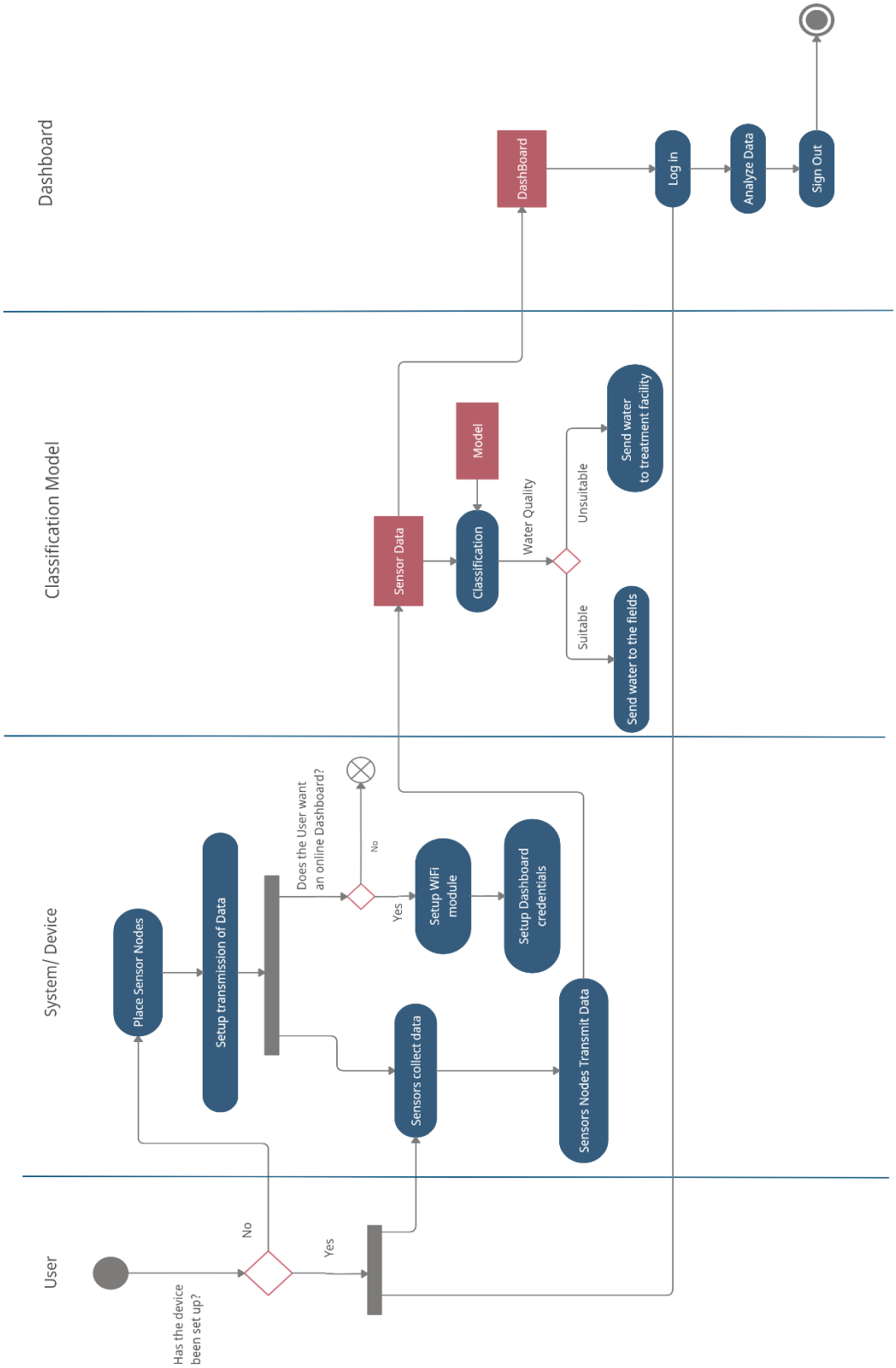
Exceptional Flow Of Events

1. The field sensor is not properly placed due to which it is unable to function properly giving a wrong reading
7. The user enters the incorrect password causing an error
8. The user is unable to access the data due to session expiration

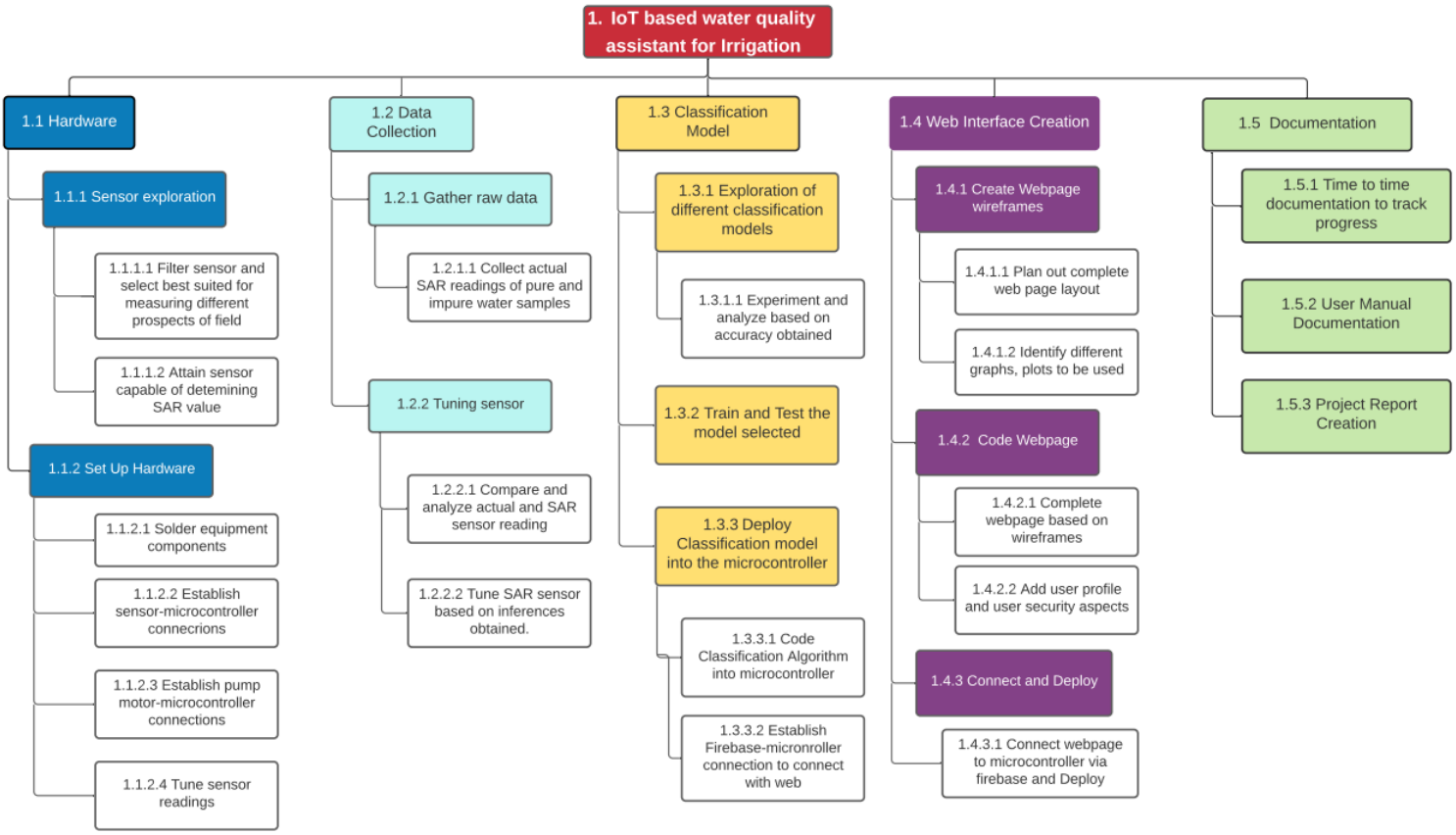
3. Tasks and Subtasks

1. Hardware
    - 1.1 Gathering of equipment
    - 1.2 Exploring different types of sensors
    - 1.3 Soldering of equipment
    - 1.4 Configuring hardware with the sensors and tuning them
2. Data collection
    - 2.1 Collection of data
    - 2.2 Analysis of data
3. Creation of Model
    - 3.1 Exploration of classification models
    - 3.2 Evaluating and choosing one classification model
    - 3.3 Training the model
    - 3.4 Uploading the model onto the Arduino.
4. Implementation of UI
    - 4.1 Creating wireframes for flow of the website
    - 4.2 Choosing which graphs to implement and show
    - 4.3 Creating the UI
    - 4.4 Establishing User profiles in the backend for authentication and login
    - 4.4 Connecting with the firebase database that stores the sensor data.

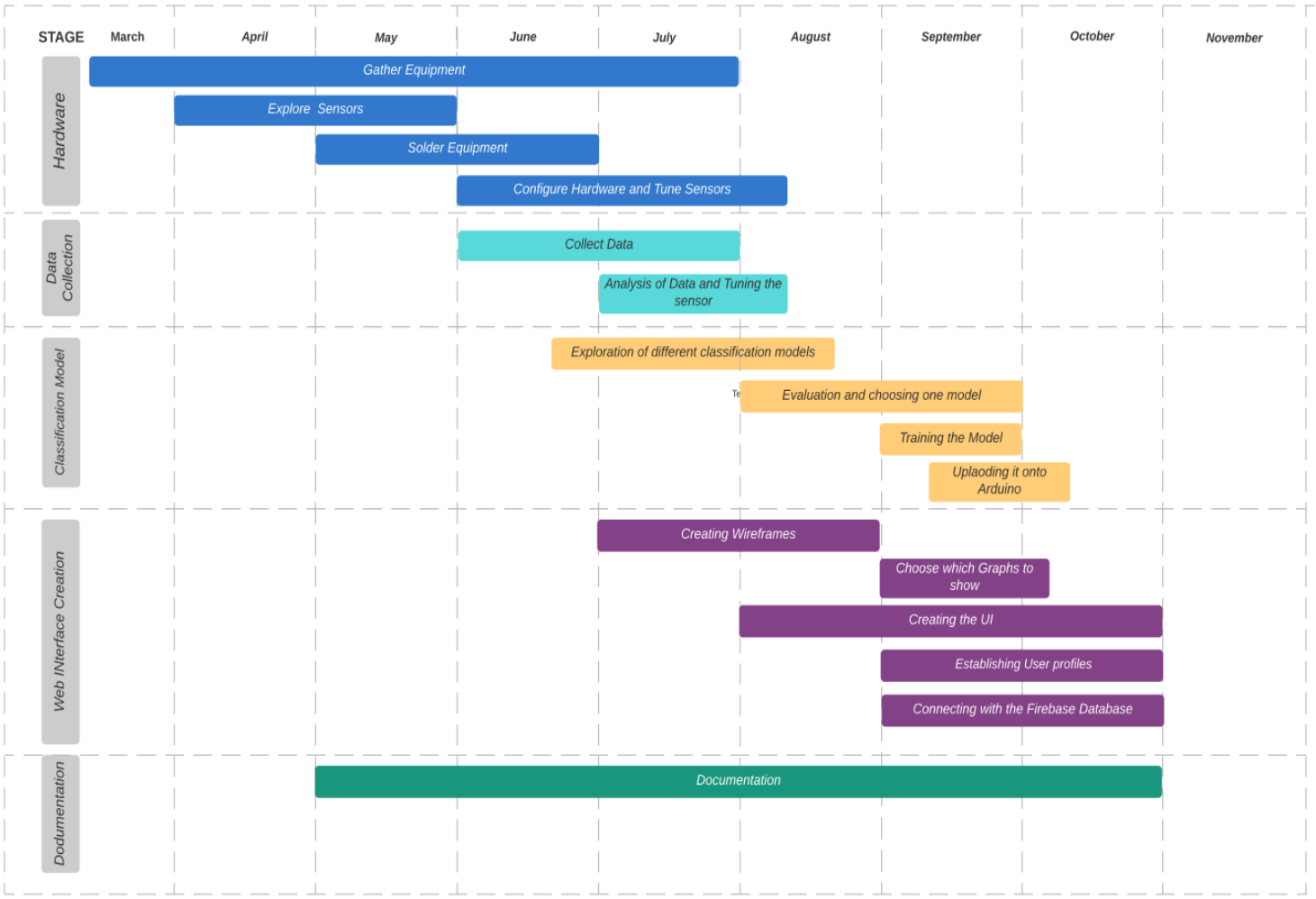
4. Activity Diagram



5. Work Breakdown Structure



6. Gantt chart



7. Functional and Non Functional Requirements

Functional

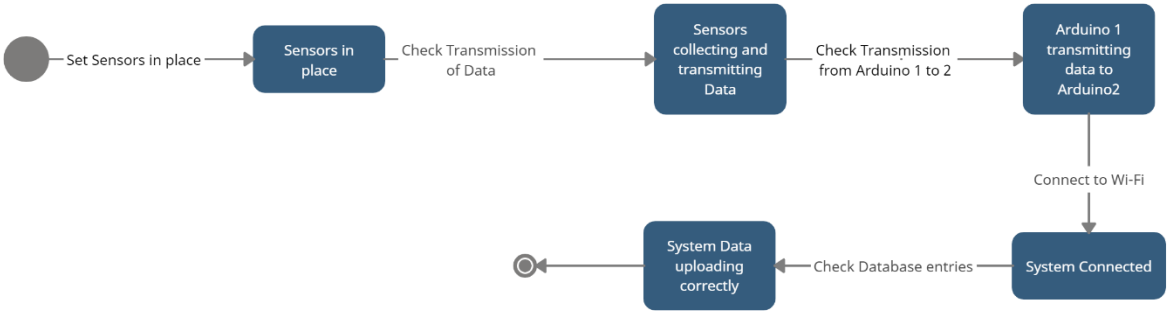
- Web interface should provide user with plots and graphs which should be easy to comprehend.
- Classification algorithm should be able to segregate water direction based on classification result obtained from the microcontroller.
- Water should be directed towards treatment plant by the pump if classified impure.
- Web portal should alert user if extreme readings are obtained from any sensor.
- Hardware setup should be integrated with web portal using shared database.
- Sensor should be able to provide data and microcontroller should be able to take classify water via underlying classification algorithm.
- Sensor should be placed at appropriate positions for them to perform optimally.
- User should have access to a water treatment plant.

Non Functional

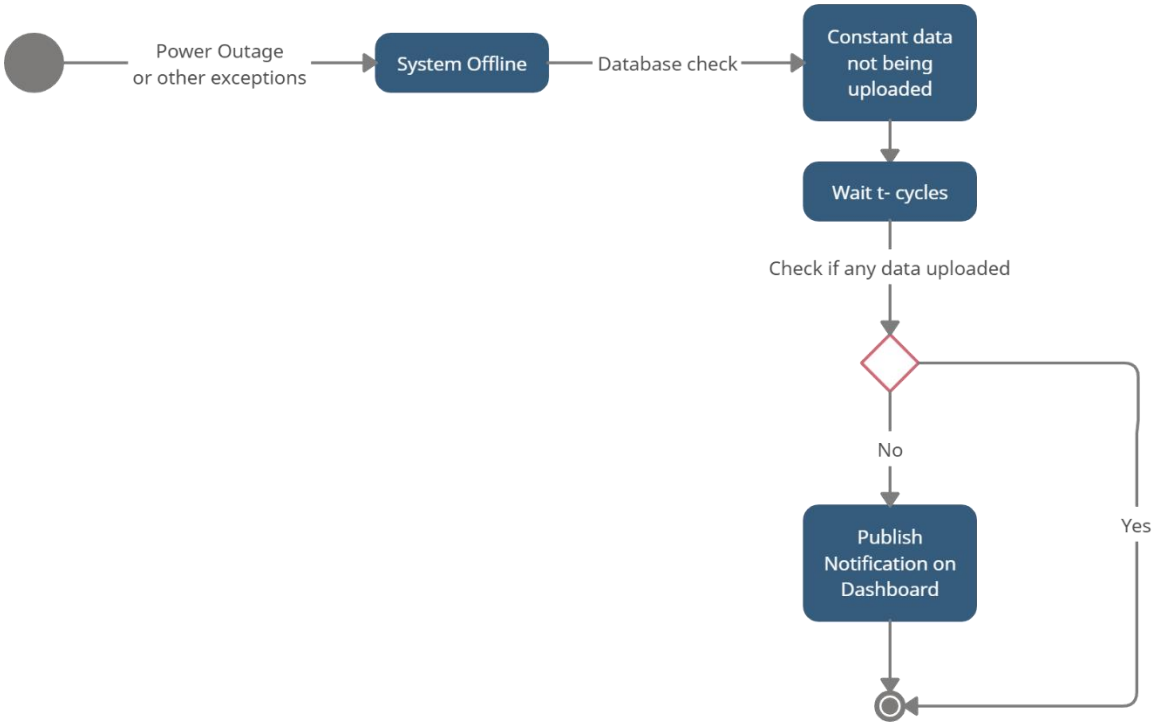
- Users must change the initially assigned login password immediately after the first successful login. Moreover, the initial should never be reused.
- Sensors and microcontroller should be kept under a protective layer to prevent damage from natural causes
- Privacy of information, the export of restricted technologies, intellectual property rights, etc. should be audited.
- User should not be allowed to tamper web portal database. Such attempt should be reported to the security administrator.

7. State chart diagrams

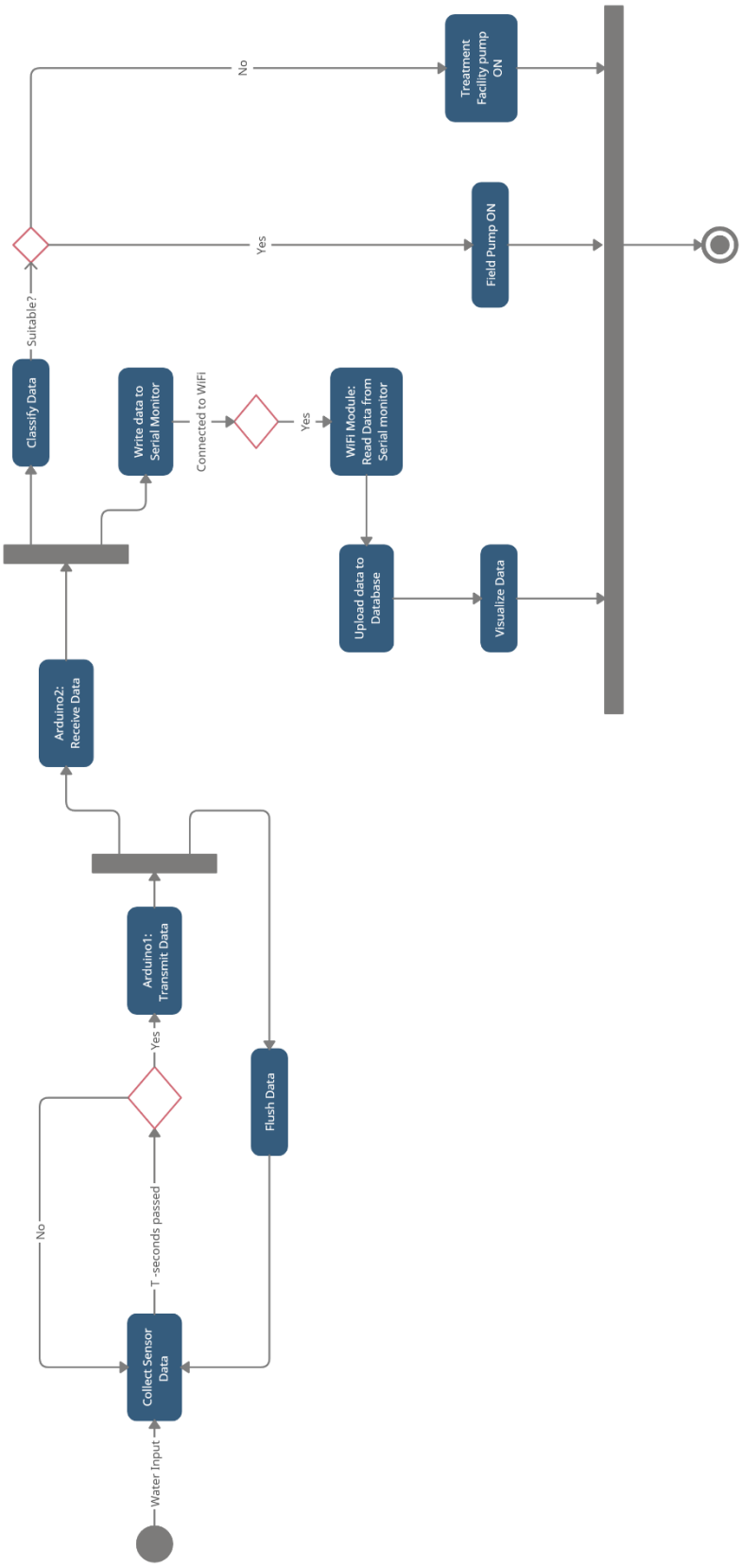
Initial Set up



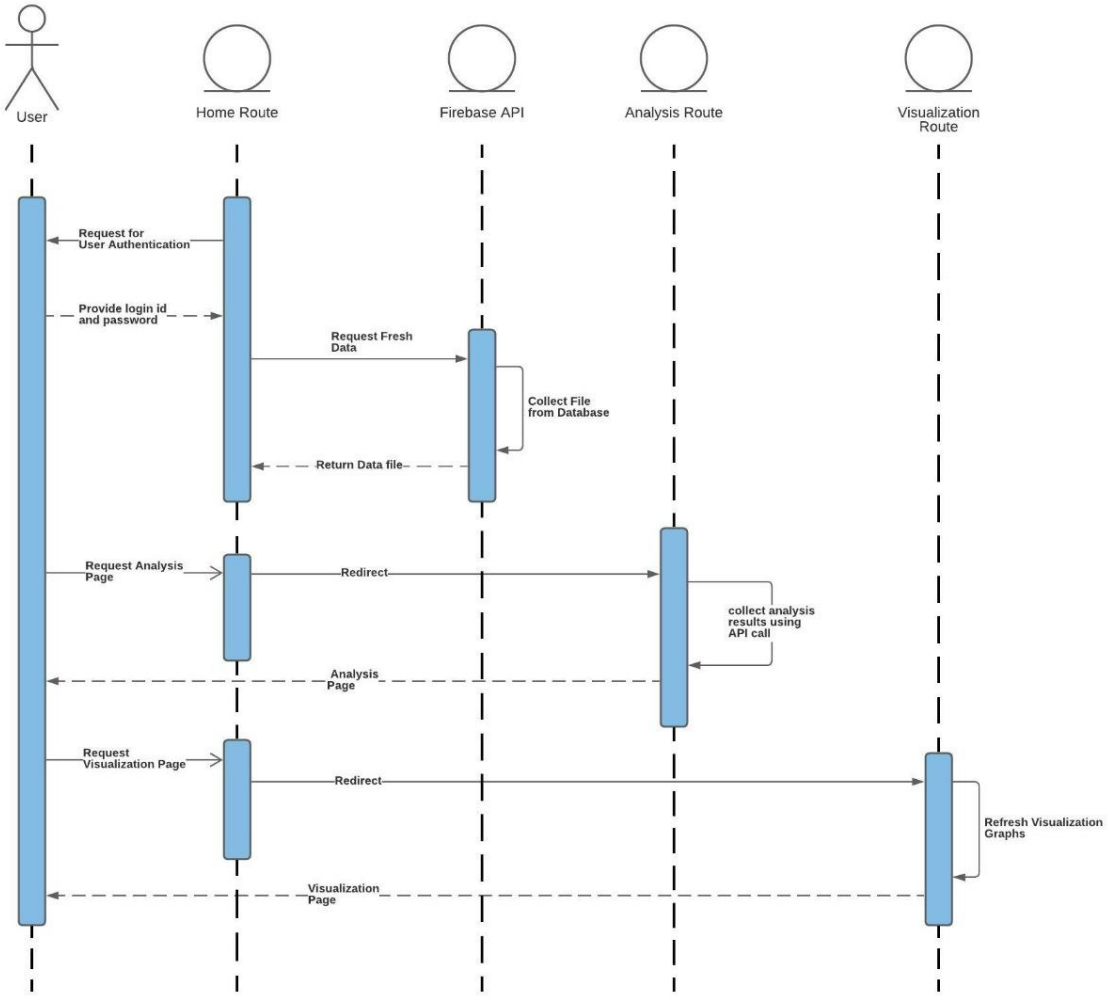
Disconnect state



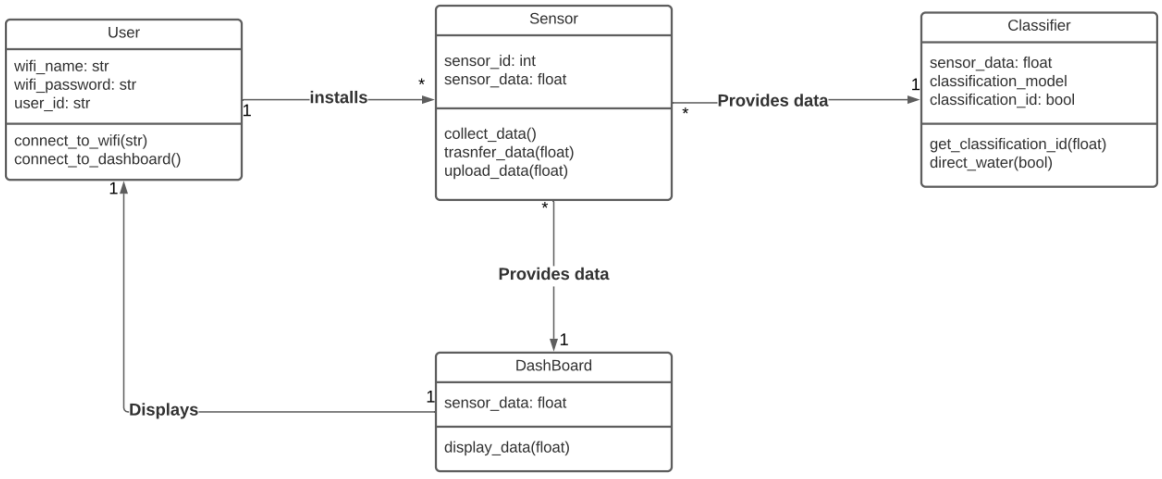
General State chart diagram



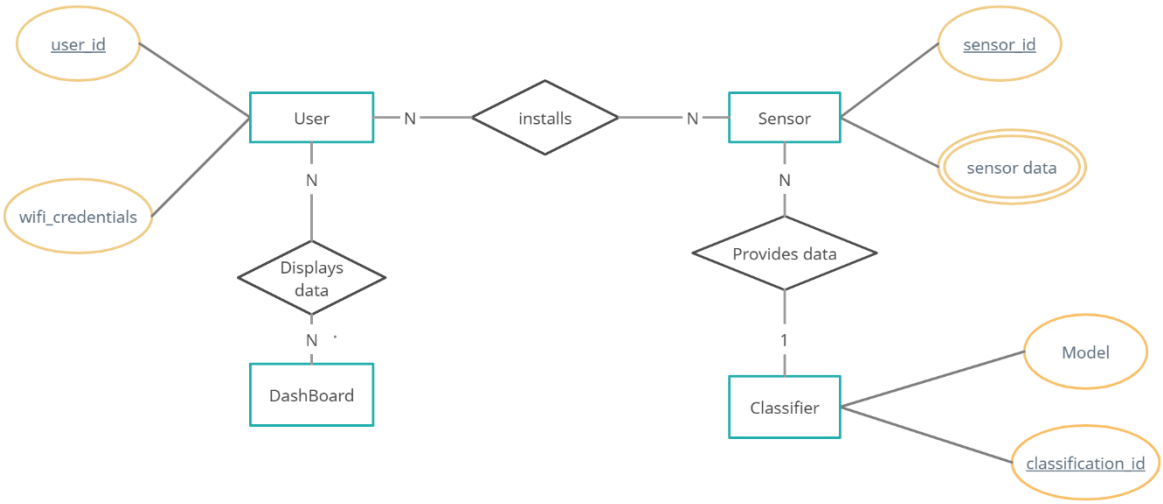
8.Sequence Diagrams



9. Class Diagram

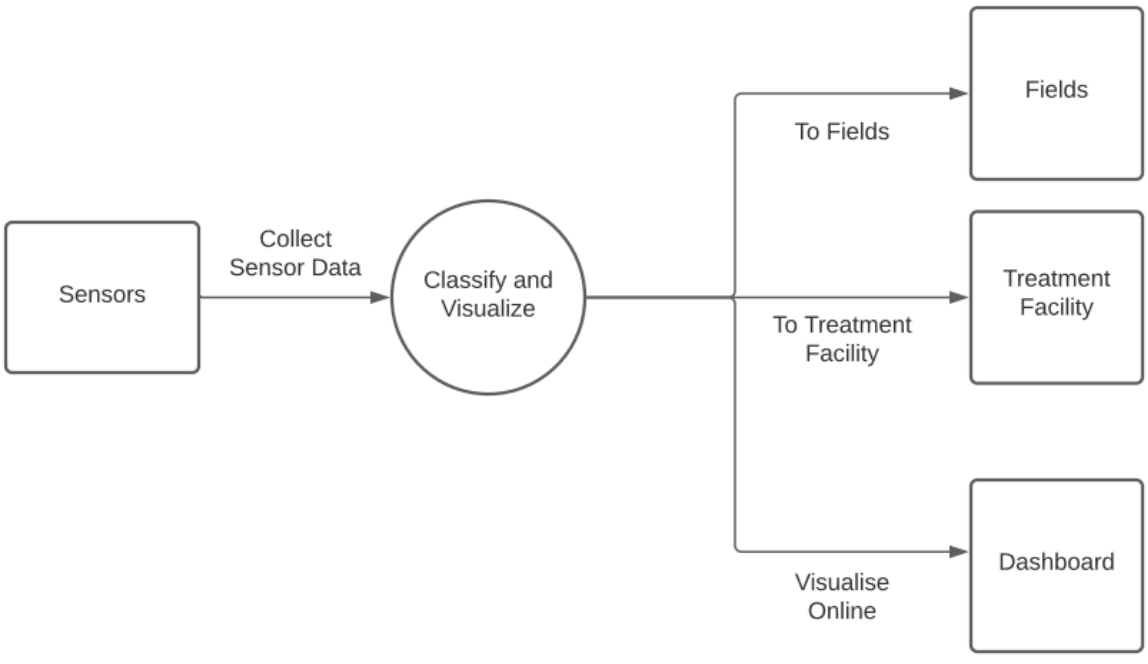


10. ER Diagram

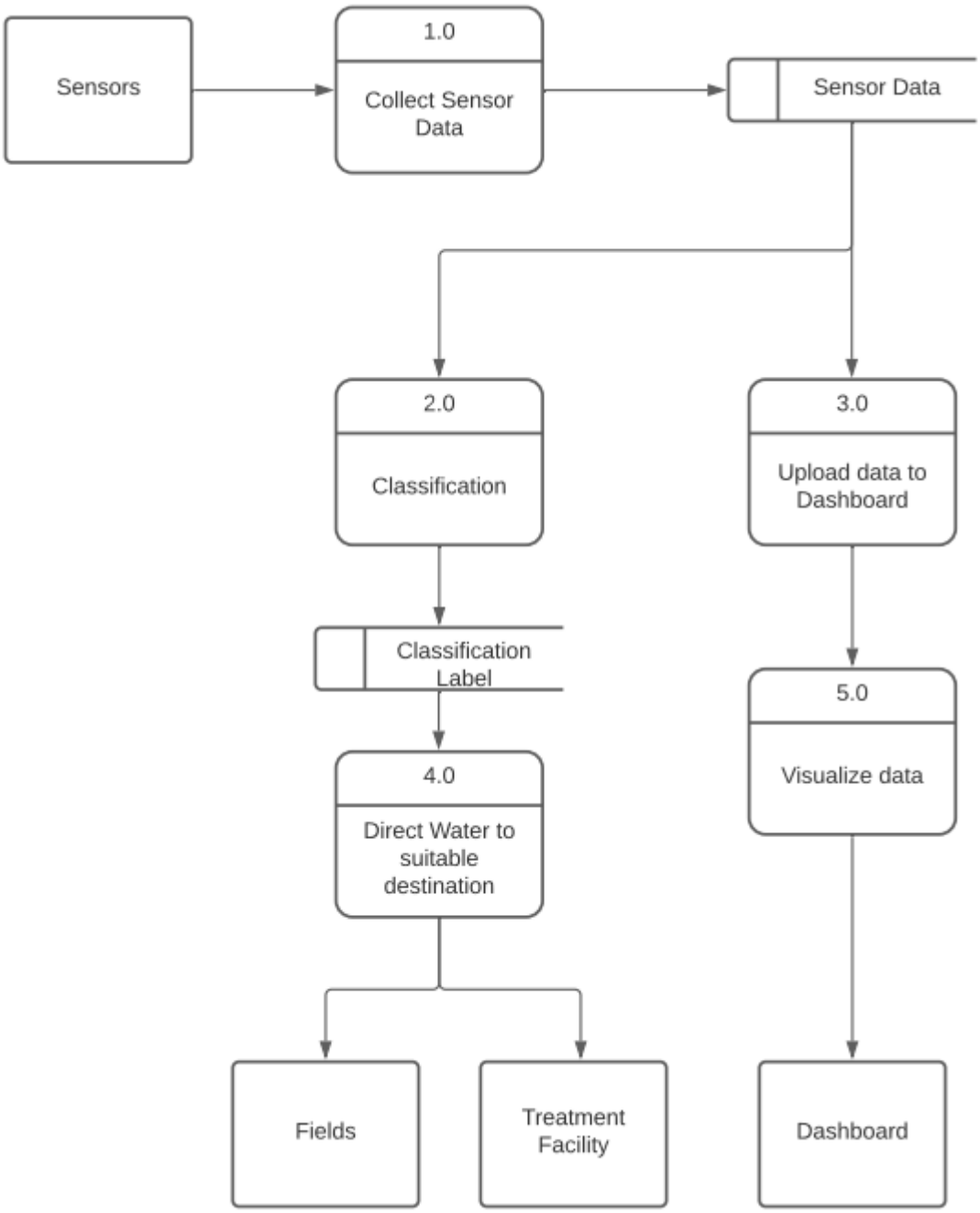


11. Data Flow Diagram

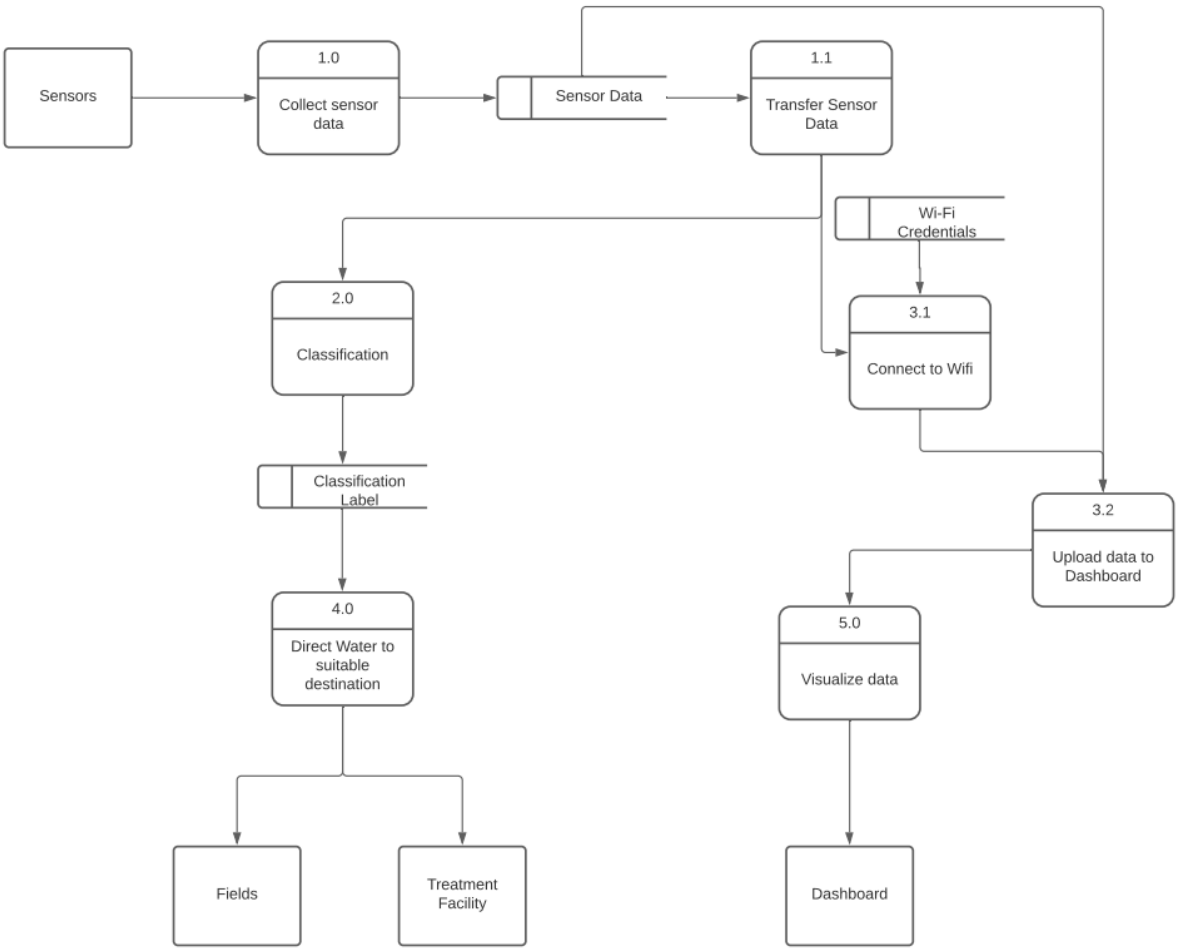
Level 0



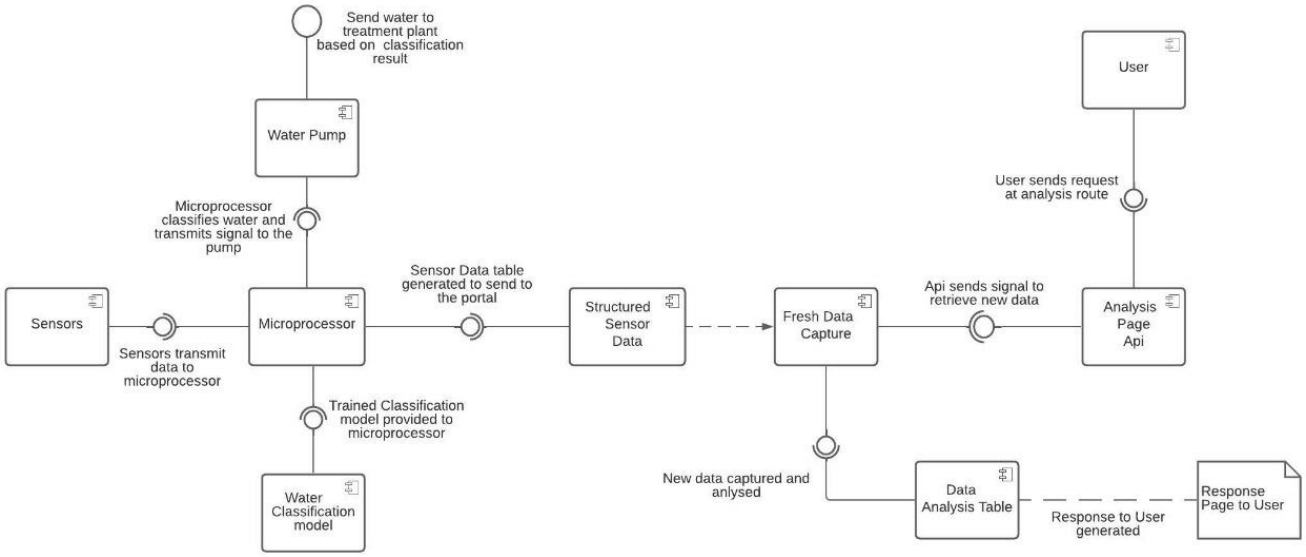
Level 1


Sensors
1.0
Collect Sensor Data
Sensor Data
2.0
Classification
3.0
Upload data to Dashboard
Classification Label
5.0
Visualize data
4.0
Direct Water to suitable destination
Fields
Treatment Facility
Dashboard

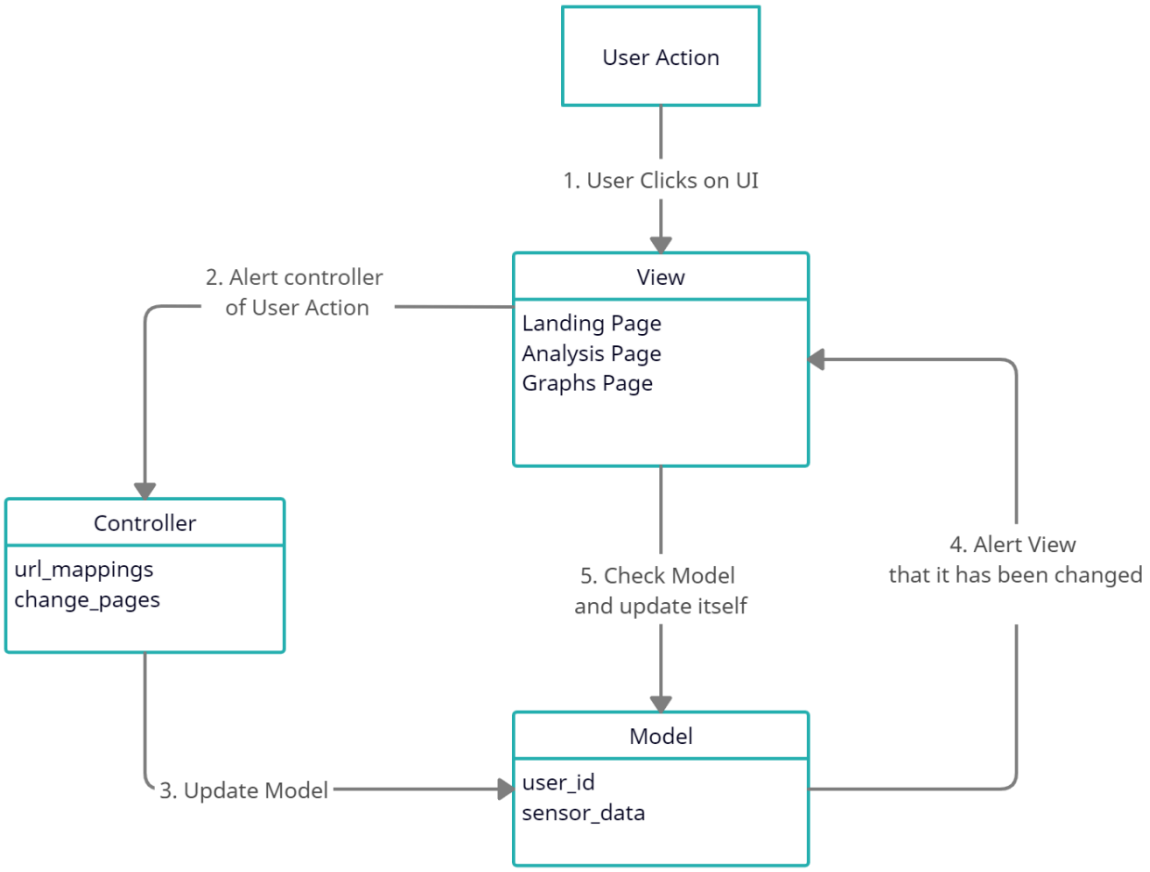
Level 2


Sensors
1.0
Collect sensor data
Sensor Data
1.1
Transfer Sensor Data
Wi-Fi Credentials
2.0
Classification
3.1
Connect to Wifi
Classification Label
3.2
Upload data to Dashboard
4.0
Direct Water to suitable destination
5.0
Visualize data
Fields
Treatment Facility
Dashboard

12. Component Diagram

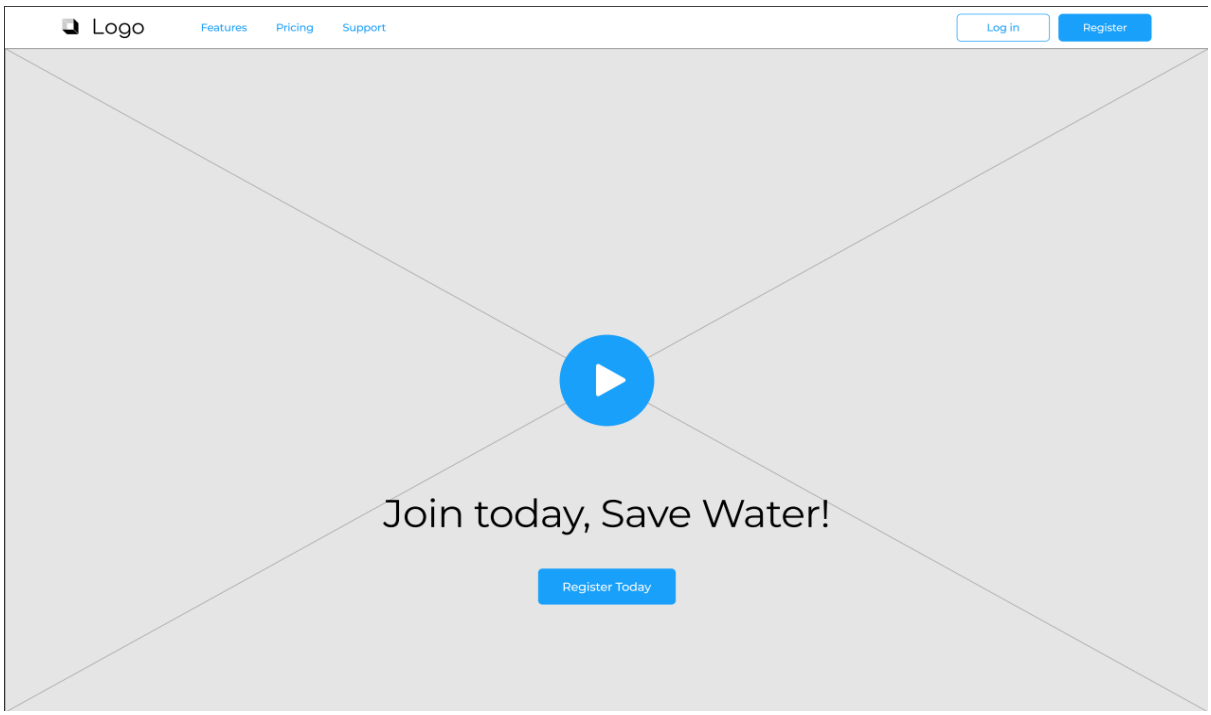


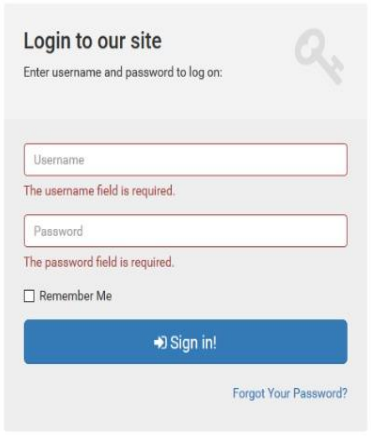
13. MVC architecture

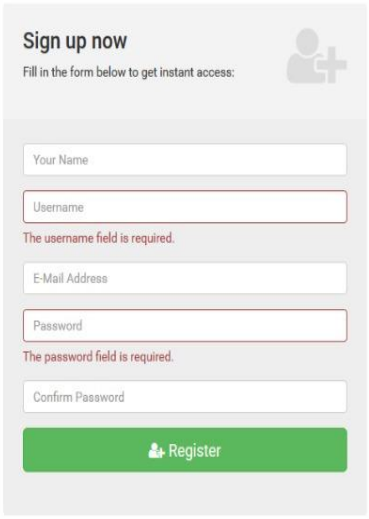


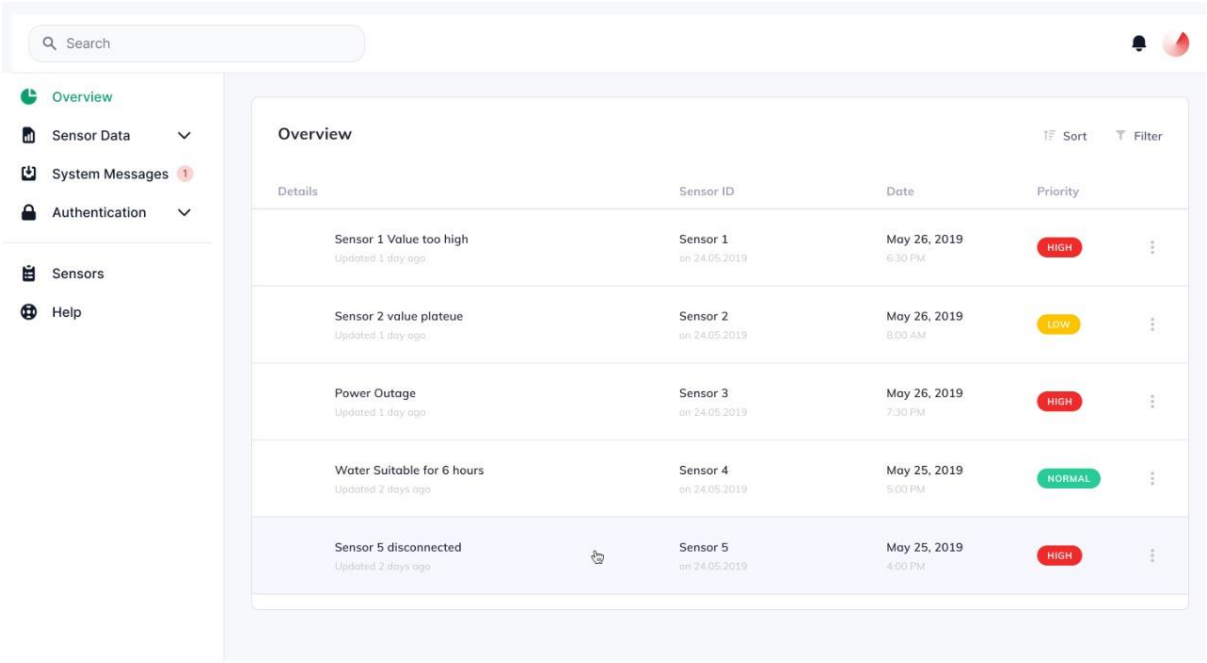
14. GUI

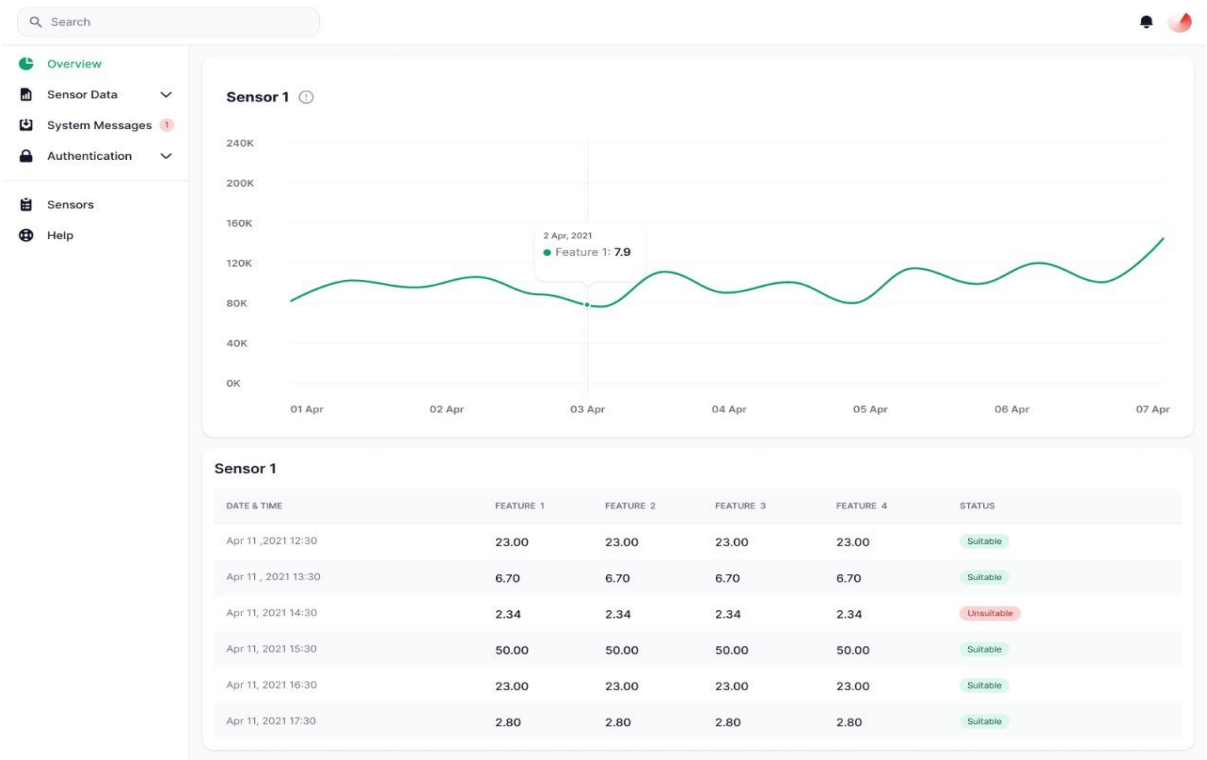
Landing page











Sensor 1

DATE & TIME	FEATURE 1	FEATURE 2	FEATURE 3	FEATURE 4	STATUS
Apr 11 ,2021 12:30	23.00	23.00	23.00	23.00	Suitable
Apr 11 , 2021 13:30	6.70	6.70	6.70	6.70	Suitable
Apr 11, 2021 14:30	2.34	2.34	2.34	2.34	Unsuitable
Apr 11, 2021 15:30	50.00	50.00	50.00	50.00	Suitable
Apr 11, 2021 16:30	23.00	23.00	23.00	23.00	Suitable
Apr 11, 2021 17:30	2.80	2.80	2.80	2.80	Suitable

15. Cost Analysis

Items Purchased	Cost
Temperature Sensor	Rs. 95
Turbidity Sensor with module	Rs. 745
Liquid PH value Detection Sensor for Arduino	Rs. 1095
Water Flow Sensor	Rs. 749
Arduino UNO	Rs. 585
ESP8266 WiFi Module	Rs. 165
LoRa Module	Rs. 375