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Abstract

The Smart Irrigation System is an Internet of Things (IoT) based innovative solution that is designed to simplify and automate the process of irrigation. In today's fast-paced world, people require everything to be automated, and this system fulfills that requirement by providing a remote-controlled irrigation facility. This system is developed using advanced electronics and is aimed at making the lives of millions of people simpler and more convenient. A system that automates the process of irrigation by monitoring and controlling the watering of plants in real-time. The system is designed to reduce water wastage and increase efficiency in agricultural and landscaping practices. The system includes sensors that detect soil moisture, temperature, and humidity levels, as well as weather conditions such as rainfall and temperature.These sensors send data to a central server, which analyzes the data and generates an output that determines the amount of water needed for the plants. The system uses web-based applications that allow farmers and gardeners to monitor and control the irrigation process remotely. The applications provide real-time data on the soil moisture level, temperature, and humidity, as well as weather forecasts, and enable users to adjust the irrigation schedule and settings accordingly.The system can also be programmed to send alerts and notifications to users when certain conditions are met, such as low soil moisture levels or extreme weather conditions. The system is cost-effective and environmentally friendly, reducing water usage and improving crop yields while minimizing the use of harmful chemicals. Overall, a smart irrigation system is an innovative solution that brings together IoT and web applications to revolutionize the way we irrigate crops and maintain our landscapes.

1. Introduction

1.1 Purpose of this report

The purpose of the report for a smart irrigation system project is to provide a comprehensive overview of the project, its design and implementation, functionality, and performance. The report should explain the objectives and scope of the project, the challenges encountered during the implementation process, and the hardware and software components used. Additionally, the report should detail the benefits of the system, such as water savings, crop yield, and efficiency gains. An evaluation of the system's performance against its objectives should also be included, as well as any areas for improvement or optimization. The report should serve as a portfolio piece to showcase the designer's skills and expertise in creating innovative and environmentally friendly solutions.

1.2 Project Summary

The Smart Irrigation System project is an IoT-based solution that incorporates sensors, Hardware controllers, and web applications to optimize and automate the irrigation processes for agricultural and landscaping purposes. The project includes two dashboards: the Admin dashboard and the Farmer dashboard. The core hardware components of the system include sensors, a microcontroller, a wireless communication module, and valves. The Admin dashboard provides features such as adding and removing Farmers, monitoring the entire system, and viewing system statistics. Meanwhile, the Farmer dashboard offers automatic and manual irrigation modes. In automatic mode, the system uses sensors to detect soil moisture, temperature, and humidity levels to determine the watering schedule for the crops. The system also considers weather forecasts to ensure efficient irrigation. In manual mode, the Farmer can override the system and schedule irrigation according to their preference. The hardware-side solution that is designed to automate the process of irrigation. It consists of a set of hardware components that work together to provide an efficient and reliable irrigation system. Overall, the hardware components of the Smart Irrigation System work together with software to provide an efficient and reliable irrigation system that can help conserve water and improve crop yield.

1.3 Purpose of Project

The project purpose to minimize water wastage, reduce costs, and increase crop yield. With the help of IoT and web-based applications, the Smart Irrigation System can help farmers and landscapers to manage irrigation processes effectively and efficiently. Overall, the project offers a cost-effective and environmentally friendly solution to irrigation management.

1.4 Scope

Smart Irrigation System project includes designing and implementing an IoT-based solution that incorporates sensors, controllers, and web-based applications for efficient and optimized irrigation processes. The project focuses on the use of technology to minimize water wastage, reduce costs, and increase crop yield.

The project aims to develop hardware as well as software for the solution. The software solution includes two dashboards, the Admin dashboard, and the Farmer dashboard, to provide users with real-time data on soil moisture levels, temperature, humidity, and weather forecasts. The Farmer dashboard offers features such as automatic and manual irrigation modes, while the Admin dashboard allows the administrator to add and remove farmers, monitor the entire system, and view system statistics. The hardware solution includes the following Scope:

Sensors: The hardware product should include sensors that measure environmental factors such as temperature, humidity, and soil moisture levels.

- Current Sensor WCS1500A measuring capability upot 200A
- SPDT Relay to turn on/off AC powered motors pumps
- Capcitive soil sensor
- DHT11 temperature sensor

Control system: The hardware product should include a control system that regulates the flow of water based on data collected from the sensors.

- Arduino uno/Esp8266 as microcontroller board

Connectivity: The hardware product should have connectivity options to enable communication with software systems, enabling remote monitoring and control.

- GSM Board SIM900A

Power management: The hardware product should be designed to consume low power to ensure it can run on solar or battery power.

- 12V-2A adapter
- 30000 MAH battery backup
- Solar panel for recharging battery

Durability: The hardware product should be designed to withstand outdoor conditions and have a long lifespan.

Expandability: The hardware product should be designed to be scalable, allowing for the addition of sensors and other components as needed.

- Arduino comes with 14 digital pins and 6 analog pins
- Further can be expanded with help of multiplexer and demux

Ease of installation: The hardware product should be designed for easy installation and maintenance, with clear instructions and minimal technical knowledge required.

Security: The hardware product should include security features to prevent unauthorized access and protect against data breaches.

Constraints (considering same with hardware capabilities)

- Compatibility: The software should be compatible with a variety of sensors, valves, and pumps to ensure flexibility in its design.
- Power management: The software should be designed to operate on low power to ensure it can run on solar or battery power.

- Security: The software should be secure and protect against unauthorized access.
- Scalability: The software should be designed to scale up or down depending on the size of the irrigation system it is going to be used. It should be scalable with the User, Software, and Hardware persecptive.

The Smart Irrigation System project aims to improve the irrigation process by providing users with an efficient and cost-effective solution. By incorporating IoT technology and web-based applications, the system can analyze and interpret data to determine the appropriate watering schedule for crops. The project also promotes sustainable farming practices by reducing the use of harmful chemicals and minimizing the environmental impact of irrigation practices.

The scope of the project includes designing, implementing, and testing the system to ensure its effectiveness, accuracy, and reliability. The project also aims to identify areas for improvement or optimization in the system to enhance its functionality and increase its efficiency. Overall, the scope of the Smart Irrigation System project is to provide a sustainable and effective solution for managing irrigation processes in agriculture and landscaping.

1.5 Intended audience

1. The intended audience for a smart agriculture system would likely be farmers and agricultural producers who are looking to optimize their crop yields, increase efficiency, reduce costs, and improve sustainability. Other potential audiences could include:

2. Agricultural consultants and advisors who work with farmers to provide advice and guidance on best practices for crop management.

3. Agricultural researchers and scientists who are studying the impact of new technologies on crop growth and development.

4. Government agencies and policymakers who are interested in promoting sustainable agriculture practices and improving food security.

5. Investors and venture capitalists who are looking for opportunities to invest in innovative agriculture technologies.

6. Suppliers and manufacturers of agriculture equipment, software, and services who are interested in developing products that can integrate with smart agriculture systems.

7. Consumers who are interested in supporting sustainable and environmentally-friendly farming practices and who are willing to pay a premium for products that are grown using these methods.

1.6 Problem Specifications

- Overwatering: Traditional irrigation systems often use a set schedule for watering, regardless of the actual needs of the plants. This can result in overwatering, which wastes water and can damage the plants. A smart irrigation system can monitor soil moisture levels and only water when necessary, reducing the risk of overwatering.

- Underwatering: On the other hand, traditional irrigation systems may not provide enough water for plants, resulting in dehydration and stunted growth. A smart irrigation system can adjust watering schedules and duration to meet the specific needs of each plant based on factors such as weather conditions and soil type.

- Water waste: Traditional irrigation systems can be very inefficient, with water being lost due to evaporation, runoff, and other factors. A smart irrigation system can reduce water waste by only watering when necessary and using techniques such as drip irrigation and soil moisture sensors.

- High water bills: Traditional irrigation systems can lead to high water bills due to overwatering and water waste. A smart irrigation system can help reduce water usage and lower bills.

- Inconvenient maintenance: Traditional irrigation systems may require manual adjustment and maintenance, which can be time-consuming and inconvenient. A smart irrigation system can be set up to automatically adjust watering schedules and provide alerts when maintenance is required.

- Environmental damage: Overuse of water in agriculture can lead to environmental damage, such as soil erosion and water pollution.

- Farmers face an issue of unstable electricity supply or power cuts due to high usage, which affects the irrigation process of crops. In order to irrigate the crops.

- Farmers need to visit the fields at night or during any season depending on the water needs of the crops. This requires additional labor as a single farmer cannot irrigate the entire field at once.

- One of the major challenges faced by farmers is the time and effort required for irrigation and field monitoring.

1.7 Literature Survey

Here are a few existing solution/startups in India and globally that are involved in smart Irrigation systems.

Fasal (www.fasal.co): It is an Indian agriculture technology company that provides farm management solutions to farmers. Some of the services they offer include real-time weather forecasting, crop monitoring, and advice on optimal farming practices. It provides a smart irrigation solution that uses soil sensors and algorithms to optimize water usage for crops.

Price: Information on the pricing of Fasal's services is not publicly available. You will need to contact the company directly for more information on pricing.

Facilities: Fasal provides its services through a combination of mobile apps and field visits by agricultural experts. The company's services are aimed at helping farmers improve crop yields, reduce costs, and make more informed decisions.

Special features: Some of the special features offered by Fasal include are

- Real-time weather forecasting
- Crop monitoring
- Agricultural advice based on best practices
- Automated irrigation system

Unique Selling Proposition (USP): Fasal's USP is its use of technology to provide customized solutions to farmers based on their specific needs and conditions. The company's combination of agricultural expertise and technology sets it apart from other agriculture companies.

Kriya Agri (www.kriya.ag): A smart irrigation indian startup that uses IoT technology to improve water efficiency and crop yields. specializes in developing innovative solutions to address the challenges faced by farmers, with a focus on improving crop yield and reducing costs. Kriya Agro offers a range of services and products, including precision agriculture, soil testing, crop management, and farm advisory services, which are aimed at helping farmers optimize their farming practices and improve their profitability.

Price: Information about the pricing of Kriya Agri's products is not readily available on the company's website. You may have to contact the company directly for this information.

Special features: Kriya Agri is a smart irrigation startup that uses IoT technology to improve water efficiency and crop yields. This helps farmers save water, energy and money, and increase crop yields.

Unique selling proposition: Kriya Agri's solution is unique in that it uses IoT technology to improve water efficiency in agriculture, which sets it apart from other traditional irrigation systems.

Some other existing solution with its USP are listed below:

Echogen (www.echogen.com) : A Smart irrigation solutions for large-scale agriculture that uses heat recovery technology to conserve water.

Rain Bird(www.rainbird.com): A Leader in smart irrigation technology, offering a range of solutions for both residential and commercial use.

Netafim (www.netafim.com) : A global leader in precision irrigation solutions that use innovative technology to conserve water and improve crop yields.

Sky Greens (www.skygreens.com) : An Innovative vertical farming system that uses smart irrigation to optimize crop yields in urban environments.

1.8 Proposed Solution

We are aiming an agri-tech project in the agriculture field that aims to improve the efficiency and productivity of farmers in India. A smart irrigation system in which an automated watering system for plants that uses technology to optimize water usage and improve the health and growth of crops. These systems typically include sensors, pump controllers, and software that can measure factors such as soil moisture levels, weather conditions, and irrigation pump controller systems to determine when and how much water should be applied to plants automatically and manual with user inputs from field. An web-dashboard and user friendly language supported mobile application will be available at end user to control their respective agriculture field.

We plan to offer a range of services that include soil moisture data, crop analysis, and crop management solutions. that provides AI-powered crop monitoring solutions to help farmers increase their yield and reduce losses. We combinatory uses sensors and machine learning algorithms to analyze real-time data on weather conditions, soil moisture, temperature, and other factors that affect crop growth. This data is then used to generate personalized recommendations for farmers on when to water, fertilize, or harvest their crops. We will use the latest technology and scientific techniques to help farmers make data-driven decisions and increase their crop yields. we also aim to provides farmers with access to financial services and markets to help them get the best prices for their produce. With above mentioned features, we stand unique in ourself with rest agri-tech in same field. The project mission is to empower farmers and improve the quality of their lives through sustainable agriculture practices.and following best practices of agriculture activities.

The proposed solution of the Smart Irrigation System involves the use of sensors, controllers, and software to automate the irrigation process and optimize water usage. The system includes moisture sensors that detect the moisture level in the soil and transmit the data to a controller. The controller then activates the irrigation system when the moisture level drops below a certain threshold, ensuring that the crops receive the required amount of water.

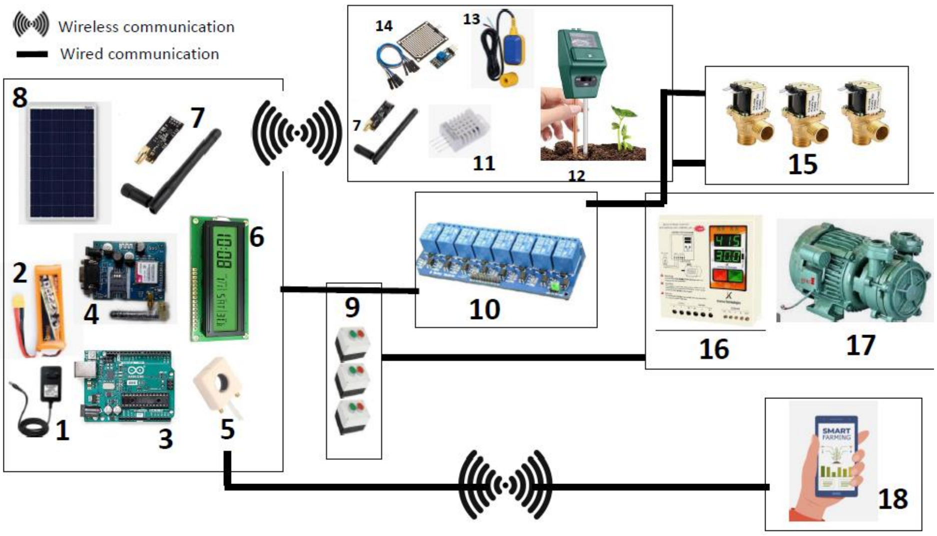


Figure 1.1 Proposed System

1. Power Supply
2. Battery
3. Microcontroller (Arduino)
4. GSM SIM900A
5. Current Measurement sensor (WCS1500)
6. LCD Dislay
7. NRF24L01 transceiver module
8. Solar panel
9. Manual Control Switch
10. 12V Relay Control board
11. Temperature sensor
12. Soil sensor
13. Water level sensor
14. Rainfall detector sensor
15. Solenoid valve 12V
16. 3Phase motor starter
17. Water Pump
18. Web-Application

The Proposed solution is designed to be user-friendly and can be controlled through a mobile app or web interface. The system provides farmers with real-time monitoring and alerts, allowing them to stay informed about the irrigation process and make adjustments as needed. The proposed solution is shown in above figure, this figure describe the wireless communication and wired communication between the intersystem. Two major point where wireless communication can be done. To gather data from sensor from the field and get command & control from the end user to control the valves and pump in the field.

The farmer control panel in an irrigation automation system should have the following features:

1. Irrigation timing settings: The user should be able to set time settings on the control panel to determine the irrigation schedule. automatic and manual options should be available.

2. Water sensors: The control panel can be equipped with sensors to monitor soil moisture levels, temperature sensors and water pressure.

3. Reporting: The control panel should provide detailed reports on irrigation operations and notify when irrigation is switched off and on.

4. Alarm settings: The control panel should alarm in case of water loss, leakage or any other problem.

5. User access: The control panel should be farmer-specific and a user name and password should be provided.

6. Map: The farmer should be able to see his/her field on the control panel, see the valves inside his/her field and take action by pressing the valve.

The admin panel for an irrigation automation needs to have the following:

1. Control and management: The administrator should be able to add new farmers or remove old farmers.

2. User management: Management of access rights of multiple users and management of user accounts.

3. Adding valves: The administrator must be able to add or remove valves.

4. Reporting and analytics: Reports and analytical data showing irrigation system performance should be available.

5. Alarm system: The control panel should see the alarm in case of water loss, leakage or any other problem.

6. Farmer Tracking: The administrator should be able to access any farmer and monitor their status.

Overall, the Smart Irrigation System offers an efficient and cost-effective solution to the challenges faced by farmers in irrigating their crops, helping them to improve yields, save resources, and increase profitability.

Proposed Solution Management Information:

1. Efficient use of resources: Smart agriculture systems can help farmers optimize their use of resources such as water, fertilizers, and pesticides, resulting in reduced costs and higher yields.

2. Crop management: Smart agriculture systems can help farmers monitor and manage their crops, enabling them to detect and respond to issues such as pests, diseases, and nutrient deficiencies before they become significant problems.

3. Weather monitoring: Smart agriculture systems can provide farmers with real-time weather data, enabling them to make informed decisions about planting, harvesting, and other farming activities.

4. Soil management: Smart agriculture systems can help farmers monitor soil health, enabling them to adjust fertilization and irrigation practices as needed to maintain healthy soil.

5. Equipment management: Smart agriculture systems can help farmers monitor and manage their equipment, enabling them to optimize equipment usage and schedule maintenance as needed.

6. Data management: Smart agriculture systems can help farmers collect and analyze data related to their farming practices, enabling them to make informed decisions about crop management, resource usage, and other important factors.

1.9 Motivation

The Smart irrigation project is a perfect choice. With the increasing demand for food and decreasing supply, there is an urgent need to improve food production technology. Agriculture is the backbone of our society, and this project has the potential to revolutionize the industry by providing an efficient and automated irrigation system. Not only will this help reduce the workload for farmers, but it will also save valuable resources such as water, time and energy.

By working on this project, we will be making a significant contribution to the development of the economy and society as a whole. The smart irrigation project is a perfect opportunity to showcase your innovation and creativity, while also making a positive impact in the world. So, take up the challenge and make a difference!

1.10 Area of Utility

The smart irrigation project has a wide range of areas where it can be applied. The primary focus of this project is to help farmers reduce their workload and make irrigation more efficient.

Perennial plant irrigation

The smart irrigation system can be implemented in land that is used for the cultivation of perennial plants, such as fruit trees or grapevines. The system can be designed to provide the right amount of water at the right time, which can help improve crop yields and reduce water usage.

Gardening land

The project can also be applied in small-scale gardening, such as in households or community gardens. This can help individuals with limited gardening experience to efficiently grow their own vegetables or fruits without the need for constant attention to watering.

Agricultural research

The smart irrigation system can also be used in agricultural research to study the effects of different irrigation methods on plant growth and yield. This can help in developing new and more efficient methods of irrigation.

Urban farming

With the rise of urban farming, the smart irrigation system can be applied in small-scale urban farming settings, such as rooftop gardens or indoor farms. This can help in efficient use of water and increase the productivity of the crops.

1.11 Programming languages and Software tools used

- **HTML/CSS/Bootstrap:** Frontend technology.
- **PHP:** Server-side programming.
- **MySQL DB:** Database.
- **SendGrid Mail API:** For Email Services.
- **cPanel Platform:** For deploying/hosting web apps.
- **C++:** Arduino is an open-source platform that uses a programming language based on C++.
- **Arduino Software (IDE)**: It connects to the Arduino hardware to upload programs and communicate with them.
- **The Proteus Design Suite:** It is a proprietary software tool suite used primarily for electronic design automation.

2. Project Management

2.1 Project Planning

The project planning stage of the software construction process begins with a set of activities known as project planning. Software project planning's goal is to create a framework that allows the administrators tomake appropriate resource, cost, and schedule estimations.

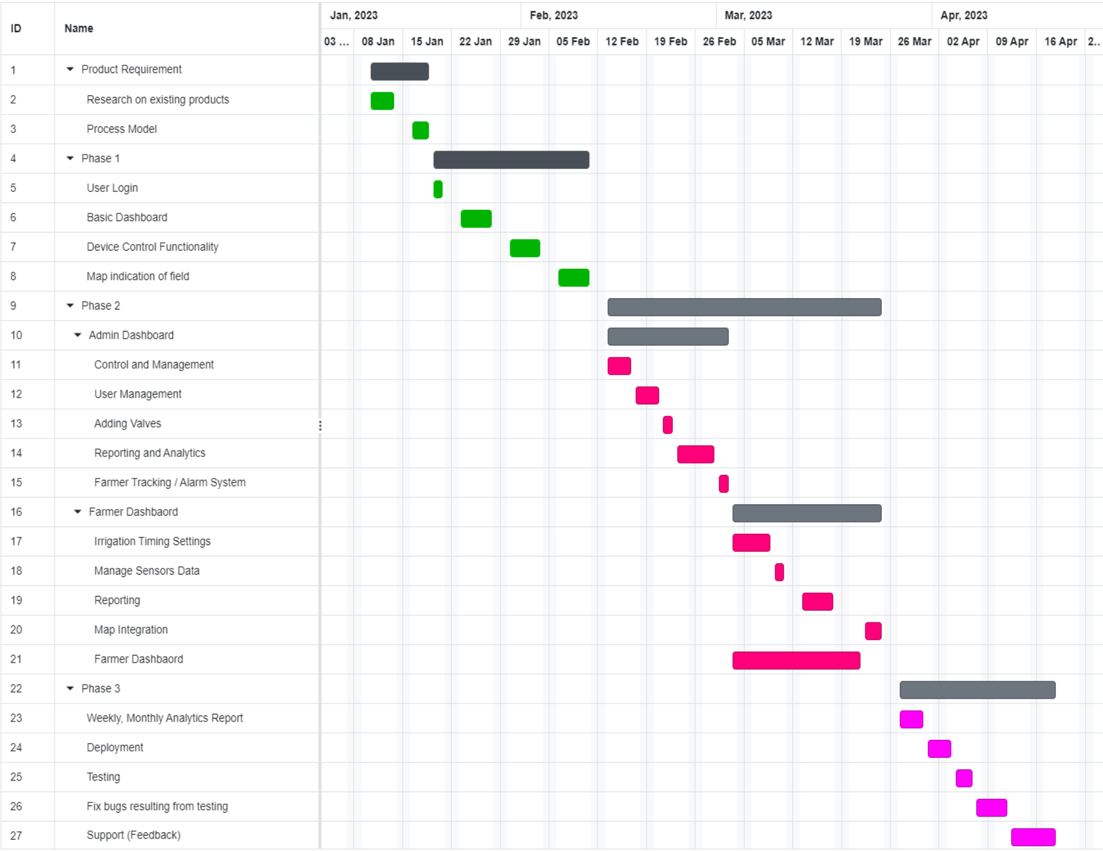


Figure 2.1 Project Planning

Project management and project planning are crucial aspects of any project, and the use of Gantt charts is an effective tool to aid in these areas. In our project, we utilized Gantt charts to assist in project management and planning. The Gantt chart allowed us to visualize the project timeline, identify critical milestones, and monitor the progress of each task. By breaking down the project into smaller, manageable tasks and assigning each task a specific duration and deadline, we were able to keep the project on track and avoid delays. The chart also helped us to prioritize tasks and allocate resources efficiently. The Gantt chart was regularly updated throughout the project to reflect any changes in the timeline or tasks. This helped us to stay on top of the project and make necessary adjustments to the schedule as needed.

2.2 Software Development Model

We aim for our project, which allows users to automate control and remote operation from anywhere,to be modular, flexible and scalable. Which means that it may require to be continuously updated and/or modified as per the need according to different farmer's needs. Say for example, this project can be expanded to also suggest the users to purchase good suitbale fertilizer to your crops, small-scale crop trading to inter city business hubs, local vegetable sellers, etc. which might interest or help them to boost their bussiness. Thus, to incorporate those changes, apart from the initial design during the development process, we need a method that is suitable for the same. Scrum, an Agile methodology, caters to this need of our project.

Scrum:

Scrum is a subset of Agile and among the most widely used Agile process frameworks. It is an iterative software development approach for managing the development of complex software and products. It takes astep-by-step approach to work in order to successfully complete projects faster. Fixed-length iterations, called sprints lasting one to two weeks long, allow the team to ship software on a regular cadence.

Why Scrum?

Scrum is a highly prescriptive framework and basically caters to the needs of our project development process. It provides more transparency and project visibility through each meeting, identifying and resolvingissues and confusions on the spot. All team members work together and help each other, improving the teamaccountability. It's easier to cope with and adjust changes when you have short sprints and regular feedback.Effective communication and feedback ensure that the team is aware of all issues and changes as soon as they arise, helping to lower expenses and increase quality. Apart from this, the roles and responsibilities of each team member is well defined, which helps in improving their efficiency. Even though Scrum requires a good amount of commitment, risk management and experience it is better from other software development models like Waterfall, V-model, Spiral, Extreme

Programming, Kanban, etc. in terms of the above mentioned advantages. It allows the project to be developed autonomously with regular feedback on changes and improvements. The development process is quite optimized and adaptive.

3. System Requirements

This section outlines the system's functional and quality criteria. It provides a comprehensive overview of thesystem and its features.

3.1 External User Requirements

This section contains a full description of the system's inputs and outputs. It also includes a description of the software communication interfaces as well as basic user interface prototypes.

3.1.1 Software

To use this web application, we required any browser (Google Chrome/Firefox/Edge), It could be onany device like laptop, mobile or tablet. And we required Internet Connection on that device.

3.1.2 Hardware

External user requirements for hardware in smart irrigation systems are crucial to ensure that the system is reliable and efficient in its operation. The power supply and battery are essential components that should provide uninterrupted power to the system.The microcontroller (Arduino) acts as the brain of the system, and it should be able to manage all the other hardware components effectively.

The communication module (GSM SIM900A) with micro-sim card having active internet plan is necessary to send and receive data from the smart irrigation system remotely. The current measurement sensor (WCS1500) should be precise to ensure that the system is efficient in energy usage. The LCD display is necessary to provide real-time information on the system's operation. The NRF24L01 transceiver module enables wireless communication between the sensors and the controller.

The solar panel is necessary to ensure that the system is powered efficiently without any need for grid electricity. The manual control switch should be accessible for users to manually control the system. The 12V relay control board should effectively control the operation of the solenoid valve 12V and the 3-phase motor starter. The temperature sensor, soil sensor, water level sensor, and rainfall detector sensor should be precise in their readings to ensure the system's proper functioning. The water pump should provide the necessary water flow to irrigate the crops, and the web-application should enable remote access to the system.

Reliability ensures that the device performs consistently without any unexpected failures, crashes or errors. Efficiency refers to the speed and performance of the hardware components, which impact the overall usability and responsiveness of the device.

Finally, ease of use relates to how intuitive and user-friendly the hardware device is, The Hardware components must meet the external user's requirements for reliability, efficiency, and ease of use.

3.1.3 Communicational

Since the various components of the system rely on one another, communication between them is essential. However, the system is unconcerned about how communication is accomplished, and the underlying operating systems for the web portal are in charge of tha and hardware side specific communication module are allocated to have successful of communication between web-app and system.

3.2 Functional Requirements

3.2.1 User Class-1: The Admin

- **Control and management**
  The administrator should be able to add new farmers or remove old farmers.
- **User management**
  Management of access rights of multiple users and management of user accounts.
- **Adding valves**
  The administrator must be able to add or remove valves.

- **Reporting and analytics**

  Reports and analytical data showing irrigation system performance should be available.

- **Alarm system**

  The control panel should see the alarm in case of water loss, leakage or any other problem.

3.2.2 User Class-2: The Farmer

- **Irrigation timing settings:**

  The user can able to set time settings on the control panel to determine the irrigation schedule. automatic and manual options should be available.

- **Reporting:**

  The farmer dashboard will provide detailed reports on irrigation operations and notify when irrigation is switched off and on.

- **Alarm Setting:**

  The farmer dashboard alarm in case of water loss, leakage or any other problem.

- **User Access:**

  The farmer dashboard should be farmer-specific and a user name and password should be provided.

- **Area Map:**

  The farmer should be able to see his/her field on the farmer dashboard, see the valves inside his/her field and take action by pressing the valve.

- **Power Supply and Battery:**

  Provide uninterrupted power supply to the system to ensure that irrigation timing settings are maintained, and reporting is accurate.

- **Microcontroller (Arduino):**
  Enable the user to set irrigation timing settings through a control panel and ensure that these settings are followed by the system.

- **Communication Module (GSM SIM900A):**
  Provide a communication channel between the system and the farmer dashboard to send reports on irrigation operations and notify the user when irrigation is switched off and on.

- **Current Measurement Sensor (WCS1500):**
  Measure the current used by the system during irrigation operations to enable accurate reporting.

- **LCD Display:**
  Display the irrigation timing settings and provide real-time information on the system's operation.

- **NRF24L01 Transceiver Module:**
  Ensure that the system can receive instructions from the control panel and send data to the farmer dashboard for reporting.

- **Solar Panel:**
  Ensure that the system is powered efficiently and reliably to maintain the irrigation timing settings and enable accurate reporting.
- **Manual Control Switch:**
  Enable the user to switch the system to manual mode if necessary to override the irrigation timing settings.

- **12V Relay Control Board:**
  Control the solenoid valve 12V, 3-phase motor starter, and water pump to follow the irrigation timing settings set by the user.

Temperature Sensor, Soil Sensor, Water Level Sensor, and Rainfall Detector Sensor Provide data on the environmental conditions to ensure that the system irrigates the crops effectively and efficiently.

3.3 Non-Functional Requirements

3.3.1 Security

Admin Login Account:

- Security of accounts.
- If a admin tries to log in to the web portal with a non-existing email account or without accountverification, then they should not be logged in. They should be notified about log-in failure.
- It has to happen 100% of the time.

Farmer Login Account:

- Security of accounts.
- If a farmer tries to log in to the web portal with a non-existing email account or without accountverification, then the user should not be logged in. The user should be notified about log-in failure.
- Must happen 100% of the time.

Hardware Physical Security:

- Power Supply and Battery - Provide a secure power supply to the system to prevent unauthorized access or tampering with the system's operations.
- Communication Module (GSM SIM900A) - Ensure that the communication channel between the system and the farmer dashboard is secure to prevent unauthorized access or tampering with the system's operations.

- Manual Control Switch - Ensure that the manual control switch is secure to prevent unauthorized access or tampering with the system's operations.
- Temperature Sensor, Soil Sensor, Water Level Sensor, and Rainfall Detector Sensor - Ensure that the sensors are secure to prevent unauthorized access or

tampering with the system's operations.Security of accounts.

3.3.2 Maintainability

Application extensibility:

- The application should be easy to extend. The code should be written in a way that it favorsimplementation of new functions.
- In order, for future functionality can be readily added to the application.
- No Dependency

3.3.3 Portability

Application portability:

- If hosted, the application should be able to run in any browser.
- The adaptable platform for the application to run on.
- No Dependency

3.3.4 Performance

Response Time:

- The fastness of the changing between different web pages
- The response time of the different output webpage after performing some event.
- No more than 5 seconds (desirable - 2 seconds), must happen 100% of the time.

System Dependability:

- The fault tolerance of the system.
- If the system gets some strange input or loses the connection to the Internet, the user should beinformed.
- Must happen 100% of the time.

3.3.5 Availability

System Availability:

- Accounting the availability of the system of the times it is used. There is no System‘Downtime’.
- The average system availability without taking into consideration the network failure.
- More than 98% of the time.
- Must happen 100% of the time

Internet Connection Requirement:

- The web application should be connected to the Internet.
- In order for the application to communicate with the database.
- No Dependency

3.3.6 Scalability

System Scalability:

- The System should be scalable to n-number of users.
- Must happen 100% of the time.

3.4 Product Design Architecture

Product architecture refers to the fundamental structures of a software system and hardware system and the discipline of creating such structures and systems. Each structure comprises software elements, relations among them, and properties of both elements and relations.

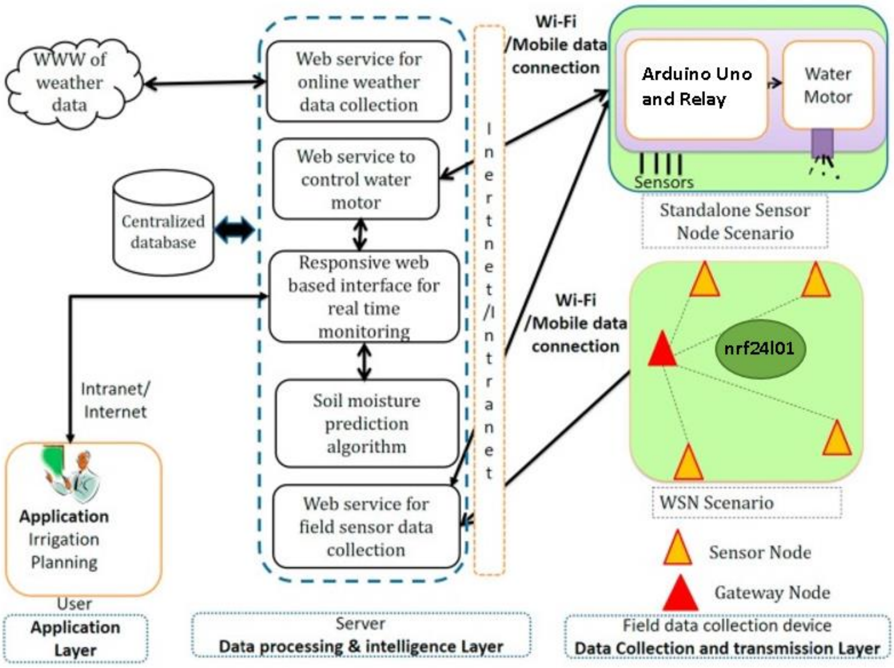


Figure 3.1.1 High Level Architecture

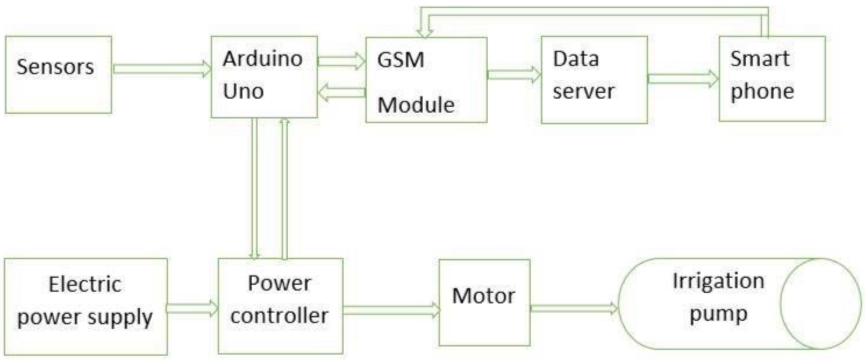


Figure 3.1.2 Product Design Architecture

4. System Analysis

4.1 Use Case Diagram

A use case diagram's main goal is to depict a system's dynamic aspect. It collects the requirements of the system, which include both internal and external factors. It refers to people, use cases, and a variety of otherthings that refer to the actors and factors responsible for use case diagram execution. It depicts how an entityfrom the outside world can interact with a system component.

The following are the objectives of a use case diagram:

- It collects the system's requirements.
- It considers both internal and external influences on the system.
- It depicts the interaction between the characters.

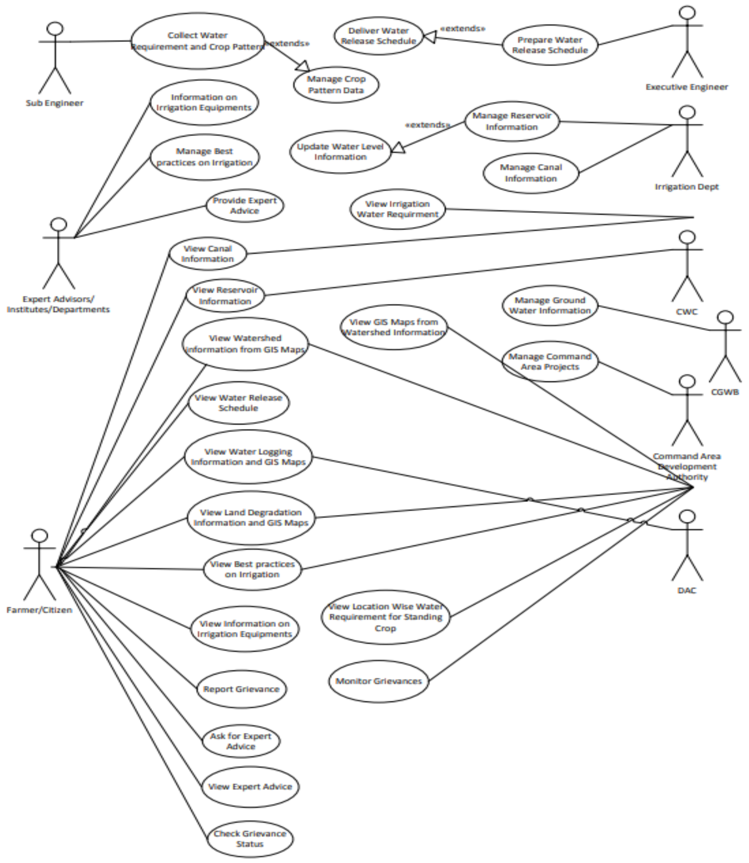


Figure 4.1.1 Use Case Diagram

4.2 Data Flow Diagram

The data flow diagram depicts how data moves through an information system. It concentrates on the processaspects and does not include any information about the process order or timing. A data flow diagram can beused to depict a system with various levels of abstraction. DFDs at a higher level are divided into lower layers, allowing for more information and functional elements to be hacked. In DFD, levels are numbered 0,1, 2, and higher. The data flow diagram is divided into three levels: 0-level, 1-level, and 2-level DFDs.

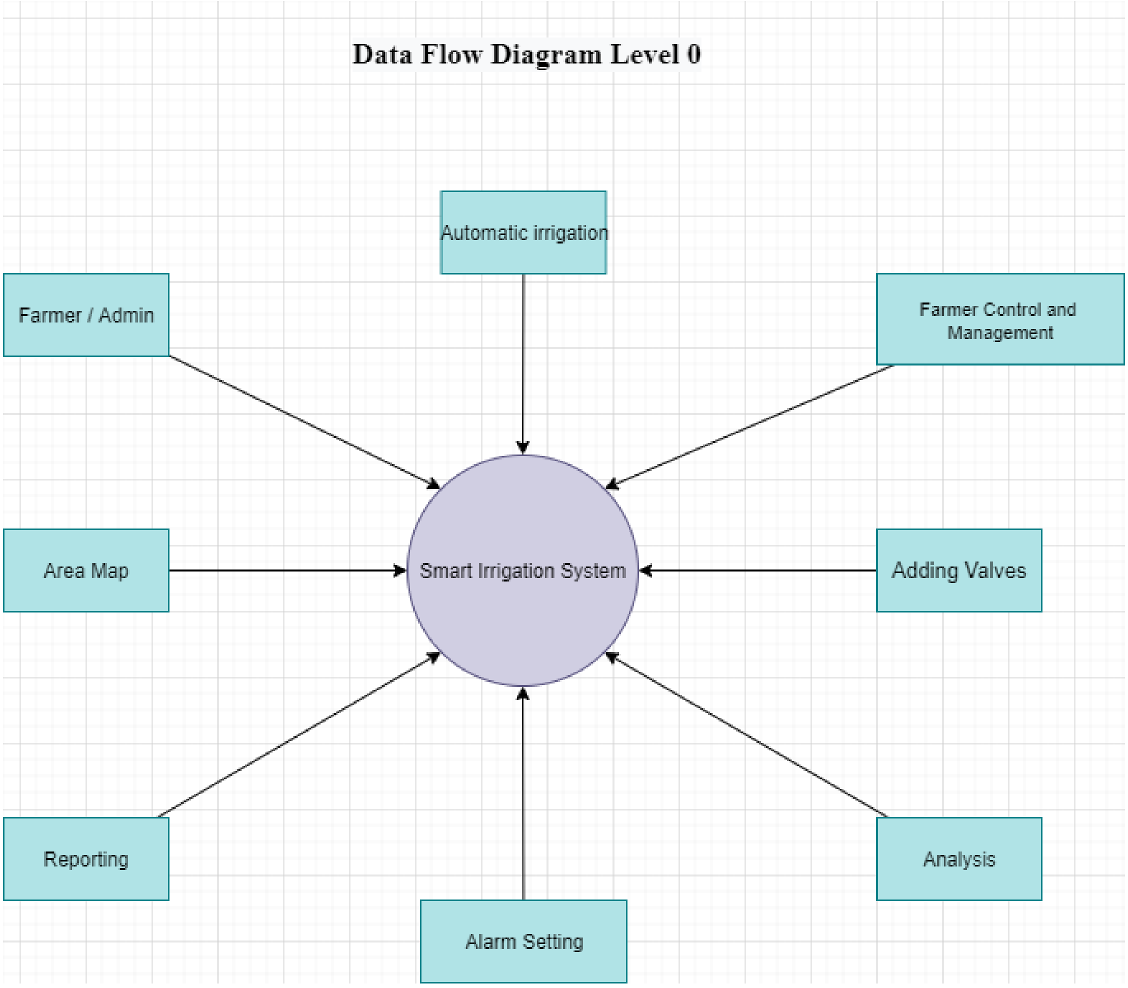


Figure 4.1.2 Context Level DFD

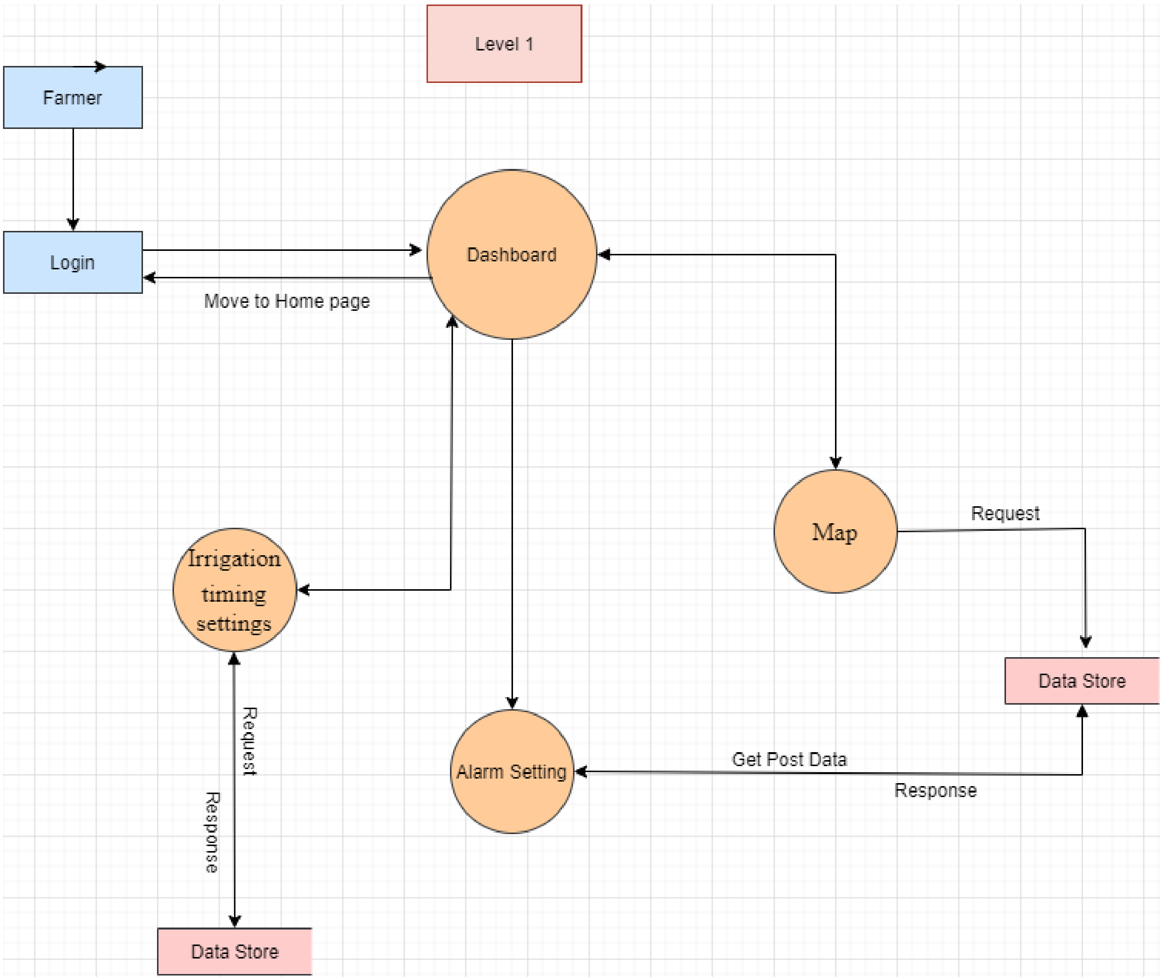


Figure 4.1.3 Level-1 DFD

Any system's context level data flow diagram gives information on the system's interactions with the external environment and data flow boundaries. It gives useful information about the system's boundaries, external entities engaged, and the level of interaction and information flow between those entities and the system already in place. Level 0 flow diagrams are another name for it. A level 1 diagram depicts and discusses the system's core processes.

4.3 Sequence Diagram

Sequence diagrams show how processes are carried out.

Purpose of Sequence Diagram:

- Model the interaction between active objects in a system at a high level.
- Model the interactions between items in a collaborative effort to complete a task.

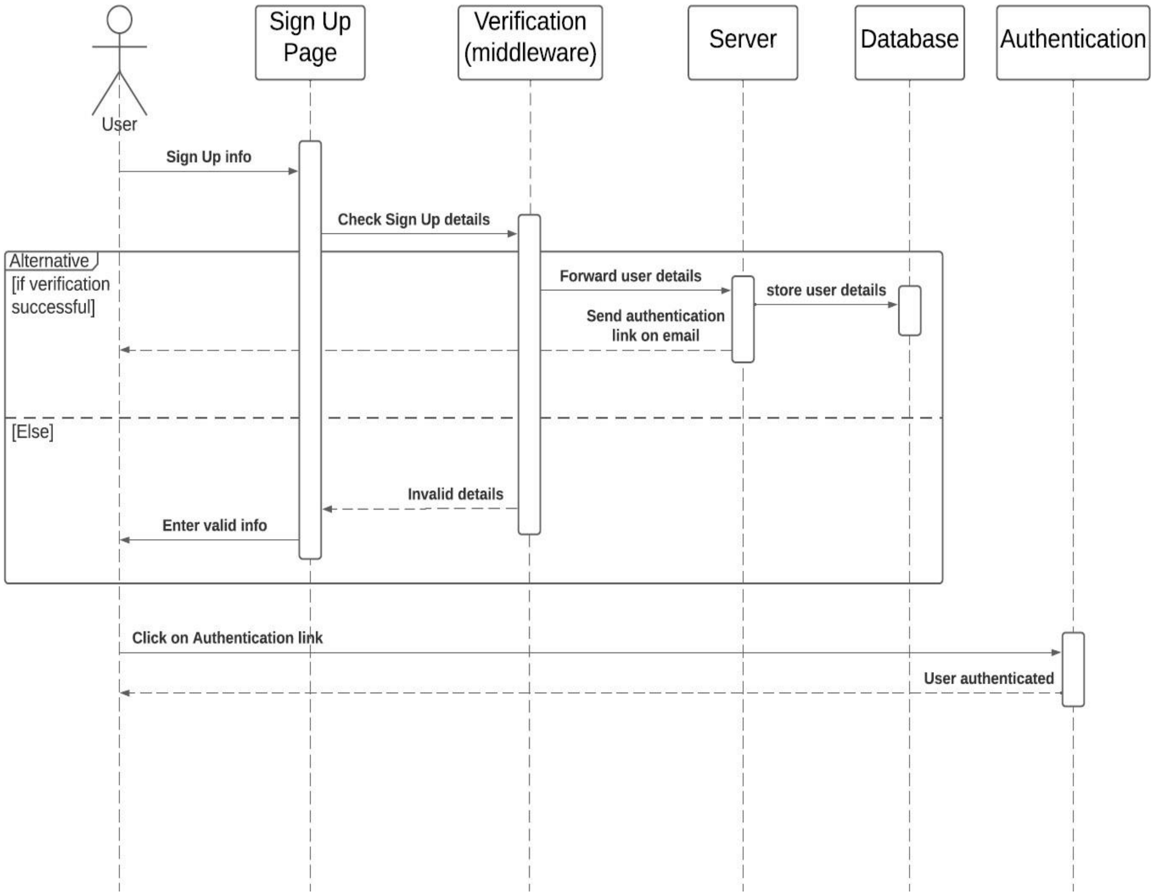


Figure 4.1.4 Sequence Diagram (Sign Up)

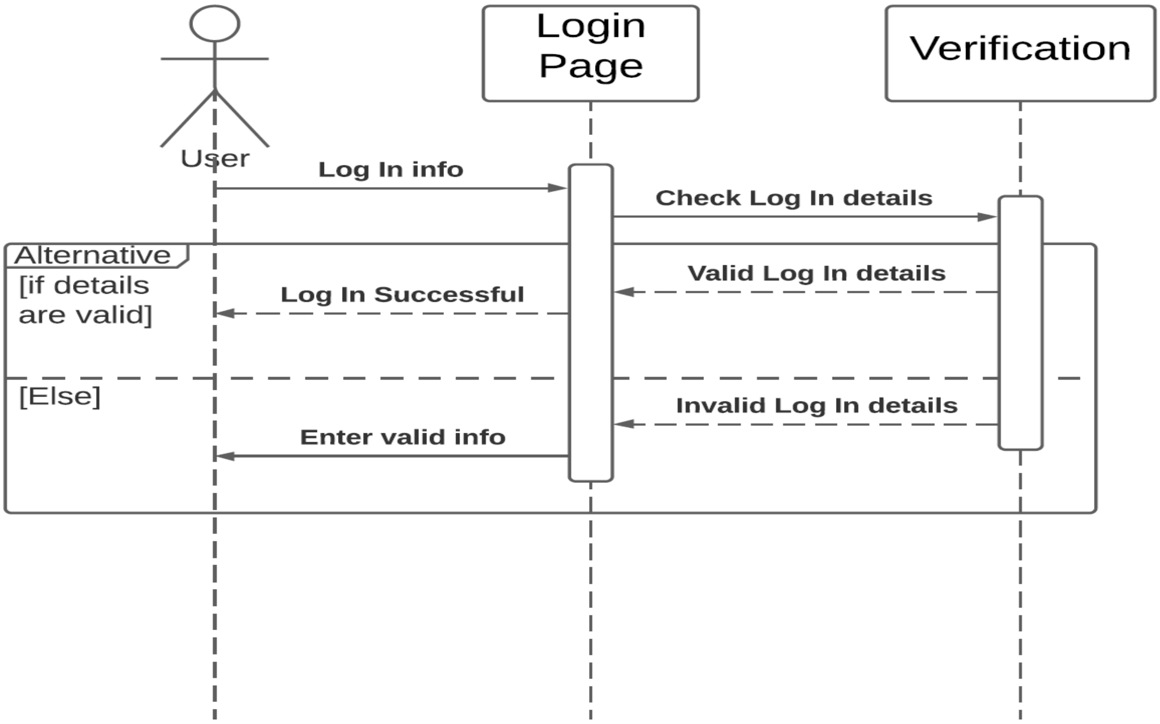


Figure 4.1.5 Sequence Diagram (Login)

5. Hardware Design & Implementation

5.1 Business requirements

The business requirements of hardware design and implementation for a smart irrigation system include cost-effectiveness, scalability, reliability, maintainability, interoperability, and compatibility. Meeting these requirements is essential for improving the efficiency and productivity of the irrigation system while minimizing costs and environmental impact.

5.2 Introduction to Controller Boards Arduino Board

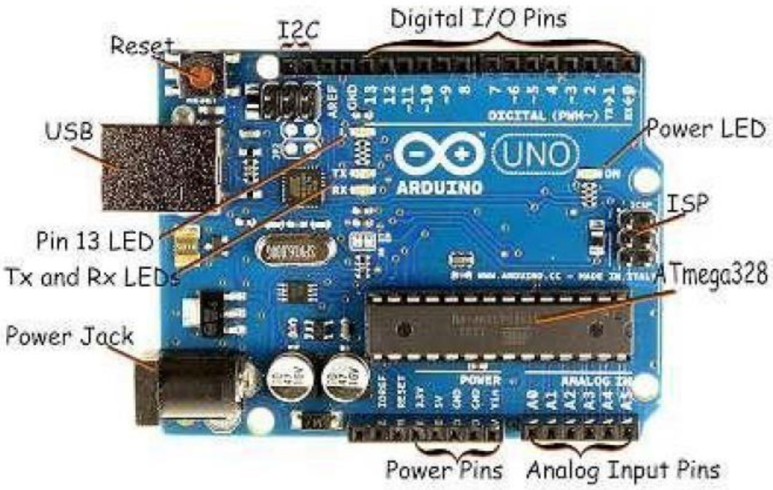


Figure 5.1 Arduino

The ATmega328P-based Uno is a microcontroller board that comes with a USB connection, a reset button, and a power jack. It features 14 digital input/output pins that can be used as either input or output, six analog inputs, and six PWM outputs. The digital pins can handle up to 20 mA of current, with an internal pull-up resistor of 20-50k ohm. It operates at 5 volts and has a maximum limit of 40mA on any I/O pin to prevent damage to the microcontroller. It also has a 16 MHz quartz crystal and can be programmed using the pinMode(), digitalWrite(), and digitalRead() functions.

The Uno board has six analog inputs labeled A0 through A5, each providing 10-bit resolution, or 1024 different values. By default, they measure from ground to 5 volts, but it is possible to change the upper range using the AREF pin and the analogReference() function. The board also features additional pins, including the AREF reference voltage for the analog inputs and a reset pin that can be used to reset the microcontroller by bringing the line LOW. The reset pin is often used to add a reset button to shields that block the one on the board.

5.2.1 GSM SIM900A

Figure 5.2 GSM SIM900A

The GSM SIM900A is a communication module that enables devices to connect to the cellular network and exchange data. It is designed to operate on the global system for mobile communication (GSM) network and supports the 2G standard. The module is equipped with a SIM card slot and a serial interface that allows devices to communicate with it using AT commands. It has a small form factor and low power consumption, making it suitable for use in various applications, including smart irrigation systems, remote monitoring, and tracking. The module requires an external antenna and a power supply to operate.

AT	To check the RX & TX of GSM with arduino
AT+HTTPINIT	This command initializes the HTTP service on the module.
AT+HTTPPARA	This command sets the parameters for the HTTP operation, such as the URL, content type, and data
AT+HTTPDATA	This command sends the data for the HTTP operation, either as plain text or in binary format.
AT+HTTPACTION	This command performs the HTTP operation, such as GET, POST, or HEAD.
AT+HTTPREAD	This command reads the response from the HTTP operation.
AT+HTTPTERM	This command terminates the HTTP service on the module.

Table 5.2.3 GSM SIM900A - HTTP AT COMMAN

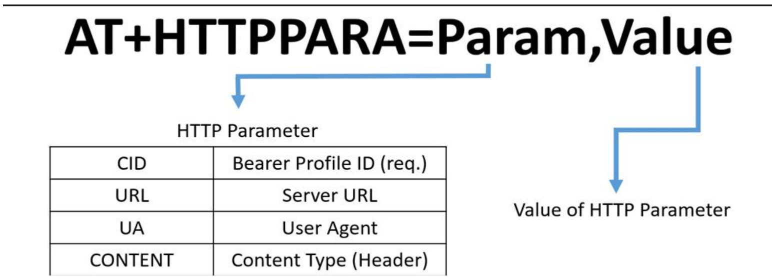


Figure 5.3 HTTP AT Command

Above Figure shows that AT+HTTPPARA is an AT command used for setting parameters for HTTP requests made through a GSM/GPRS module. This command is used to configure various parameters required for HTTP GET, HTTP POST, and HTTP HEAD requests.The following are the parameters that can be set using the AT+HTTPPARA command:

- CID: This parameter sets the context identifier to be used for the HTTP connection.
- URL: This parameter sets the URL of the web page to be requested.
- UA: This parameter sets the user agent string for the HTTP request.
- CONTENT: This parameter sets the content type for the HTTP request.
- TIMEOUT: This parameter sets the timeout value for the HTTP request.
- REDIR: This parameter sets whether or not to follow HTTP redirects.
- DATALEN: This parameter sets the length of the HTTP request data.
- SSL: This parameter sets whether or not to use SSL encryption for the HTTP request.

5.2.2 Soil Moisture Sensor

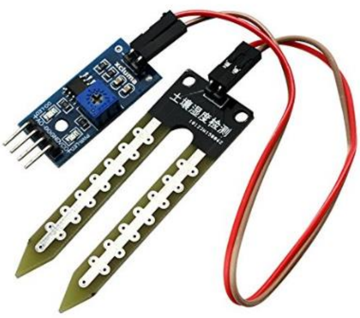


Figure 5.4 Soil Sensor

A soil moisture meter, also known as a soil sensor, is a device that measures the water content in soil. This sensor can be used to detect the moisture level of soil by outputting a high or low signal based on the soil moisture deficit.

The soil sensor operates at a voltage range of 3.3V to 5V and has a dual output mode - digital and analog.

5.2.3 Relay Switch

Figure 5.5 Relay Switch Board

A 6V relay is a versatile and widely used electromagnetic switch that can be used in a variety of applications. Its key features include a coil voltage of 6V, a contact rating of up to 20A at 250V AC, and a choice of NO, NC, or CO contacts. It can be mounted on PCBs using through-hole or surface-mount technology, and is operated by applying a 6V DC voltage to the coil.

5.2.4 Current Sensor

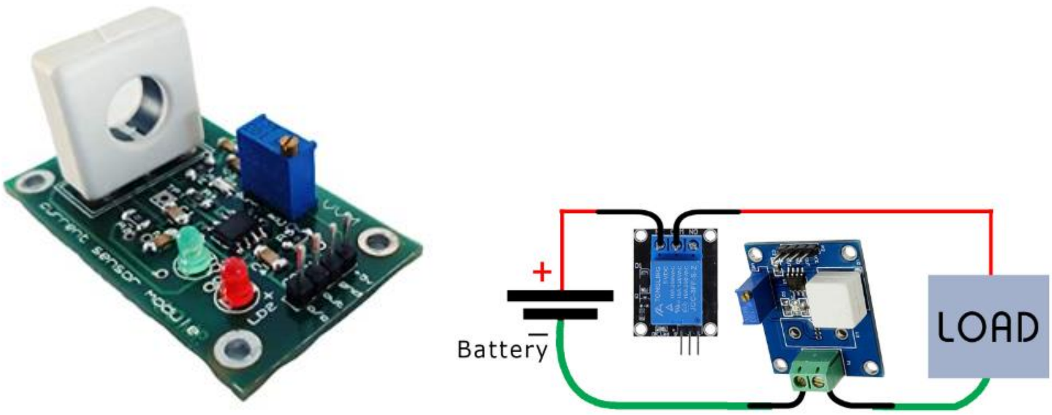


Figure 5.6 WCS1500 200A

Hall Effect based current sensing is an efficient and convenient way to measure both AC and DC currents without the need to break wires or the system. This technology can be interfaced with Arduino or any microcontroller, and is capable of measuring a DC current range of +/- 200A and an AC current range of 150A RMS. The output voltage is proportional to the current being measured, with a sensitivity of 11mV/A for a 5V supply.

The sensor features a 9.0mm diameter conductor through hole and a board size of 49mmx30mm, and is made in India. Overall, Hall Effect current sensing is a reliable and cost-effective solution for current measurement in a wide range of applications.

5.2.5 Solenoid Valve

Figure 5.7 Solenoid Valve

A solenoid valve is an electrical device that controls the flow of fluid or gas in a system. It consists of a coil of wire wrapped around a ferromagnetic core, a plunger, and a valve body. The plunger is connected to the valve body and moves in and out of it, opening or closing the valve. When an electric current is applied to the coil of wire, it creates a magnetic field that pulls the plunger into the coil. This movement opens the valve and allows the fluid or gas to flow through it. When the electric current is removed, the magnetic field disappears, and a spring inside the valve body pushes the plunger back into its original position, closing the valve and stopping the flow.

Solenoid valves are a reliable and effective means of controlling the flow of fluids and gases in a wide range of applications. With proper selection, sizing, and maintenance, they can provide accurate and consistent control for many years.

5.3 Hardware System

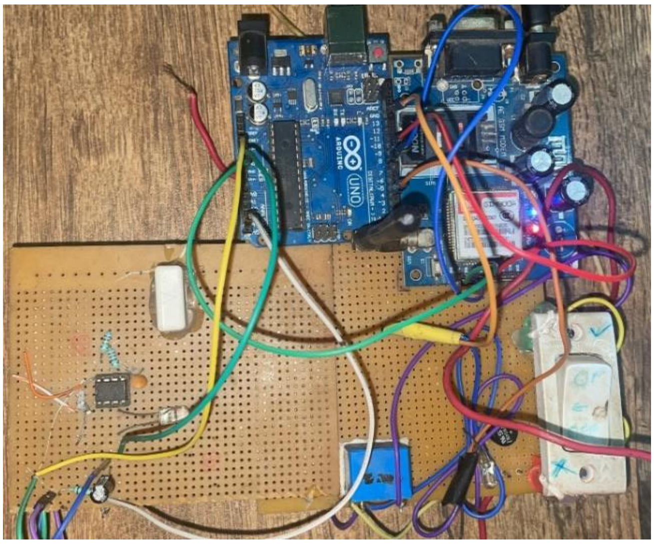


Figure 5.8 Implemented Hardware System

Above hardware system is a smart irrigation system that is designed to monitor and control the irrigation process of plants based on their specific water requirements. The system includes hardware components and an architecture that work together to ensure efficient water usage and plant growth.

Hardware System: The hardware system of a smart irrigation system comprises various components that work together to automate the irrigation process.

The components include:

1. GSM Module: The GSM module is used to connect the irrigation system to a network, which enables the user to control and monitor the system remotely.
2. Arduino: The Arduino is a microcontroller that controls the entire system. It receives data from the sensors, processes it, and sends instructions to the water pump and other components.
3. Relay: The relay is an electronic switch that controls the water pump. It is used to turn the pump on or off based on the water requirements of the plants.
4. WCS Current Sensor: The WCS current sensor is used to measure the current flowing through the water pump. It is used to monitor the pump's performance and ensure that it is working properly.
5. Soil Sensor: The soil sensor is used to measure the moisture level in the soil. It provides data to the Arduino, which uses it to determine the water requirements of the plants.
6. Manual Switch: The manual switch is used to turn the irrigation system on or off manually. It is used as a backup option in case of a network or power outage.
7. Water Pump: The water pump is used to pump water from a water source to the plants. It is controlled by the relay and the Arduino.
8. Power Adapter: The power adapter is used to power the entire system.
9. Architecture System: The architecture system of a smart irrigation system is designed to ensure efficient water usage and plant growth.

The architecture system includes the following components:

1. User Interface: The user interface is designed to provide the user with real-time information about the system. It displays the moisture level in the soil, the water usage, and other relevant data.
2. Control Unit: The control unit receives data from the sensors and the user interface. It uses this data to determine the water requirements of the plants and control the water pump accordingly.

3. Data Logger: The data logger is used to store data about the system’s performance. It stores data such as the moisture level in the soil, the water usage, and the pump’s performance.

Working Details: The working of a smart irrigation system involves the following steps:

- The soil sensor measures the moisture level in the soil.
- The Arduino receives the data from the soil sensor and determines the water requirements of the plants.
- The Arduino sends instructions to the water pump to turn on or off based on the water requirements of the plants.
- The relay controls the water pump, turning it on or off as required.
- The WCS current sensor measures the current flowing through the water pump and sends the data to the Arduino.
- The user interface displays real-time data about the system's performance, including the moisture level in the soil and the water usage.
- The data logger stores data about the system's performance, which can be used for analysis and optimization.

User Flow: The user flow of a smart irrigation system involves the following steps:

- The user turns on the system using the manual switch or the remote control.
- The system measures the moisture level in the soil and determines the water requirements of the plants.
- The system pumps water to the plants based on their specific water requirements.
- The user can monitor the system's performance using the user interface.
- The system stores data about its performance in the data logger, which can be used for analysis and optimization.
- The end user can turn off/on the system using the manual switch.

6. Software Design & Implementation

6.1 Business requirements

- The smart irrigation system should be designed to conserve water by using water-efficient methods of irrigation. This would help to reduce the amount of water used while still ensuring that crops or plants receive adequate moisture.
- The system should be automated, so that it can operate without the need for manual intervention. This would reduce the workload for farmers or gardeners, and ensure that the system operates efficiently.
- The system should be able to be monitored remotely, using a mobile app or web interface. This would allow farmers or gardeners to monitor the system from anywhere, and to make adjustments as needed.
- The system should be cost-effective, so that it can be accessible to farmers and gardeners of all sizes. This can be achieved through the use of affordable technologies, and through partnerships with government agencies and other organizations that can help to subsidize the cost of the system.

6.2 Database Design

6.1.1 Entity Relationship diagram:

An entity relationship diagram depicts how certain entities are related to one another. ER diagramshelp to explain the logical structure of databases.

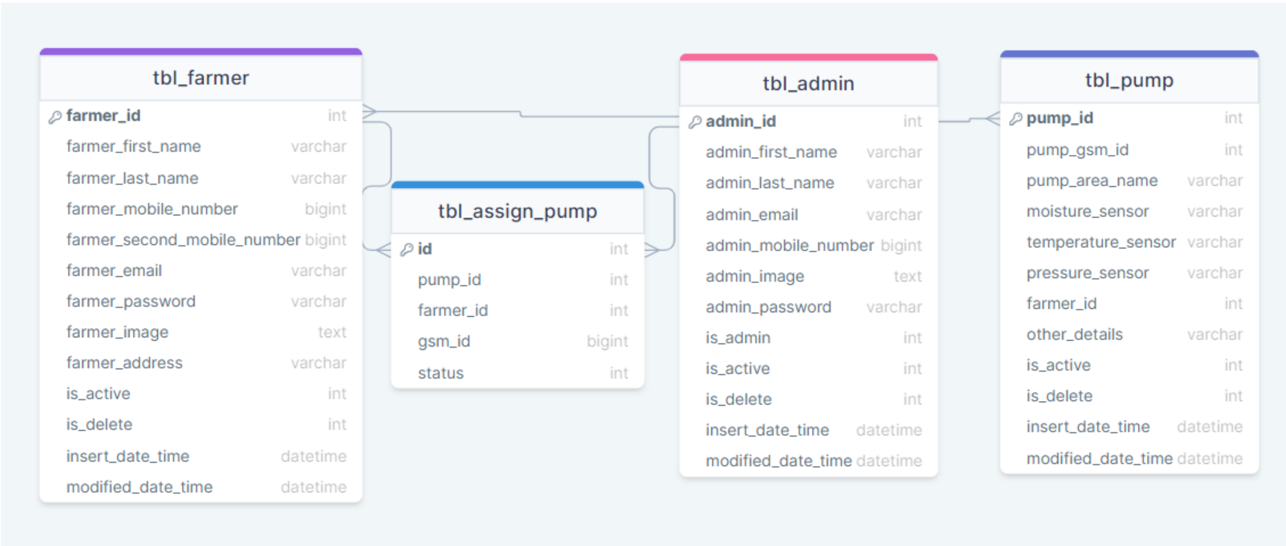


Figure 6.1 ER Diagram

6.2.2 MySQL database:

Admin / Farmer:

#	Name	Type	Collation	Attributes	Null	Default	C
1	**admin_id**	int(11)			No	*None*	
2	**admin_first_name**	varchar(250)	utf8_unicode_ci		No	*None*	
3	**admin_last_name**	varchar(250)	utf8_unicode_ci		No	*None*	
4	**admin_username**	varchar(250)	utf8_unicode_ci		No	*None*	
5	**admin_email**	varchar(250)	utf8_unicode_ci		No	*None*	
6	**admin_mobile_number**	bigint(20)			No	*None*	
7	**admin_image**	text	utf8_unicode_ci		No	*None*	
8	**admin_password**	varchar(250)	utf8_unicode_ci		No	*None*	
9	**is_admin**	int(11)			No	1	
10	**is_active**	int(11)			No	1	
11	**is_delete**	int(11)			No	0	
12	**insert_date_time**	datetime			No	*None*	
13	**modified_date_time**	datetime			No	*None*	

Figure 6.2 Admin Table

#	Name	Type	Collation	Attributes	Null	Default
1	**farmer_id**	int(11)			No	*None*
2	**farmer_first_name**	varchar(250)	utf8_unicode_ci		No	*None*
3	**farmer_last_name**	varchar(250)	utf8_unicode_ci		No	*None*
4	**farmer_username**	varchar(250)	utf8_unicode_ci		No	*None*
5	**farmer_mobile_number**	bigint(20)			No	*None*
6	**farmer_whatsapp_number**	bigint(20)			No	*None*
7	**farmer_email**	varchar(250)	utf8_unicode_ci		No	*None*
8	**farmer_password**	varchar(250)	utf8_unicode_ci		No	*None*
9	**farmer_image**	text	utf8_unicode_ci		No	*None*
10	**farmer_address**	varchar(250)	utf8_unicode_ci		No	*None*
11	**is_farmer**	int(11)			No	1
12	**is_active**	int(11)			No	1
13	**is_delete**	int(11)			No	0
14	**added_by**	varchar(250)	utf8_unicode_ci		No	*None*
15	**insert_date_time**	datetime			No	*None*
16	**modified_date_time**	datetime			No	*None*

Figure 6.3 Farmer Table

Pumps / Valves:

#	Name	Type	Collation
1	pump_id	int(11)	
2	pump_gsm_id	varchar(250)	utf8_unicode_ci
3	pump_name	varchar(250)	utf8_unicode_ci
4	power_consumption	varchar(250)	utf8_unicode_ci
5	other_details	varchar(250)	utf8_unicode_ci
6	is_assigned	int(11)	
7	is_active	int(11)	
8	is_delete	int(11)	
9	insert_date_time	datetime	
10	modified_date_time	datetime	
11	added_by	varchar(250)	utf8_unicode_ci

Figure 6.4 Pump Table

#	Name	Type	Collation
1	id	int(11)	
2	valve_id	varchar(255)	utf8mb4_general_ci
3	valve_name	varchar(255)	utf8mb4_general_ci
4	voltage	varchar(255)	utf8mb4_general_ci
5	max_current	varchar(255)	utf8mb4_general_ci
6	pressure_rating	varchar(255)	utf8mb4_general_ci
7	size	varchar(255)	utf8mb4_general_ci
8	notes	mediumtext	utf8mb4_general_ci
9	is_assigned	int(11)	
10	added_by	varchar(255)	utf8mb4_general_ci
11	is_delete	int(11)	
12	insert_date_time	datetime	
13	modified_date_time	datetime	

Figure 6.5 Vavle Table

Irrigation Timing:

#	Name	Type	Collation	Attributes
1	**id**	int(11)		
2	**irrigation_title**	varchar(250)	utf8mb4_general_ci	
3	**irrigation_start_date**	date		
4	**irrigation_start_time**	time		
5	**irrigation_end_date**	date		
6	**irrigation_end_time**	time		
7	**farmer_username**	varchar(250)	utf8mb4_general_ci	
8	**gsm_id**	varchar(50)	utf8mb4_general_ci	
9	**is_start**	int(3)		
10	**is_end**	int(3)		
11	**is_failed**	int(3)		

Figure 6.6 Irrigation Timing Table

Sensors:

#	Name	Type	Collation	Attribute
1	**id**	int(11)		
2	**gsm_id**	varchar(255)	utf8mb4_general_ci	
3	**location**	varchar(255)	utf8mb4_general_ci	
4	**temperature_sensor**	varchar(255)	utf8mb4_general_ci	
5	**soil_moisture_sensor**	varchar(255)	utf8mb4_general_ci	
6	**pressure_sensor**	varchar(255)	utf8mb4_general_ci	
7	**power_detail**	int(11)		
8	**actual_current**	varchar(255)	utf8mb4_general_ci	
9	**added_by**	varchar(255)	utf8mb4_general_ci	
10	**farmer_username**	varchar(255)	utf8mb4_general_ci	
11	**insert_date_time**	datetime		
12	**modified_date_time**	datetime		

Figure 6.7 Sensors Details Table

6.3 User Interface design

Home Screen

- This is the first page that comes up when the admin/farmer accesses the website.
- Farmers can log in is he/she is an existing user or the Admin can register farmer if the farmer is new to thesystem.

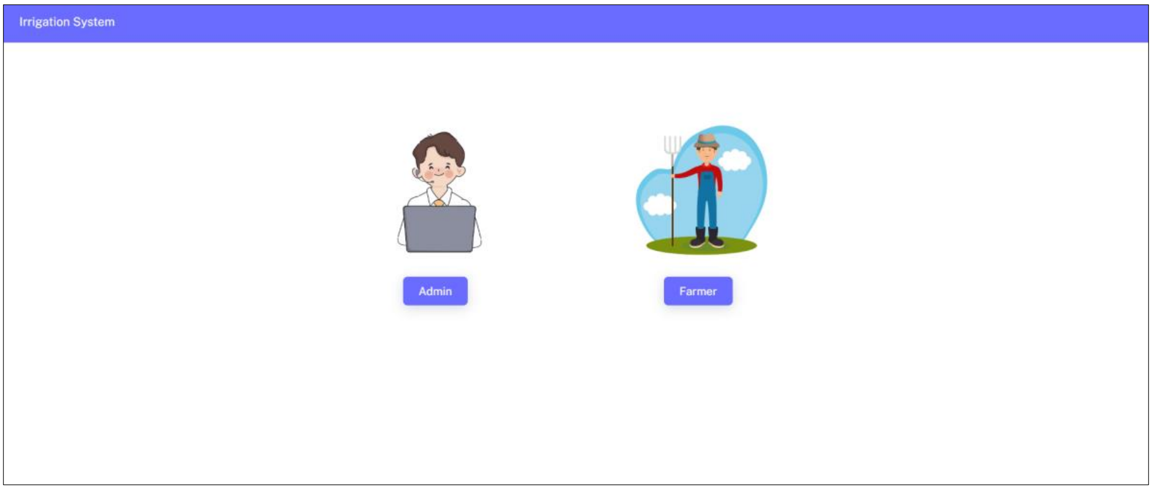


Figure 6.8 Home Screen

Login

- Here the Admin/Farmer can log in using their credentials. The admin/farmer have to enter their username andpassword.
- For new admin, a signup option is provided.
- If the farmer/admin enters incorrect credentials, then the error message is displayed.

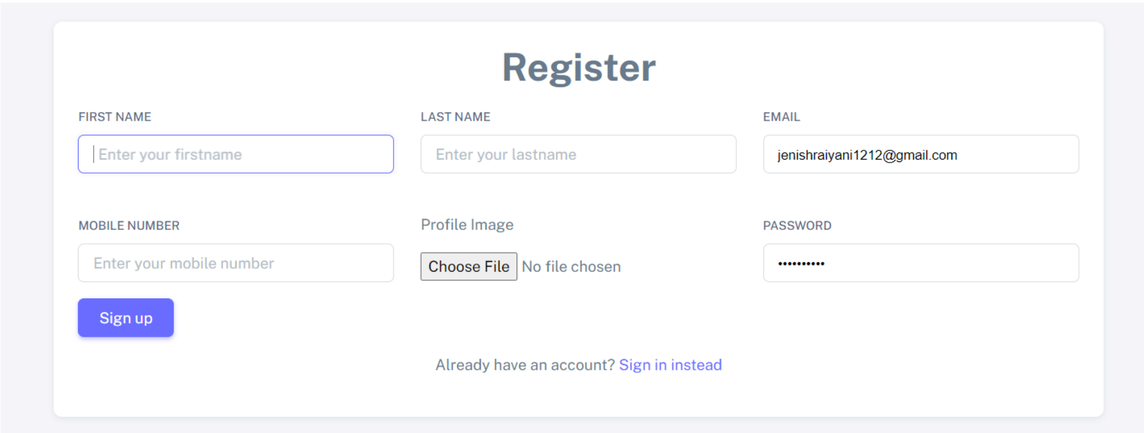


Figure 6.9 Admin Registration

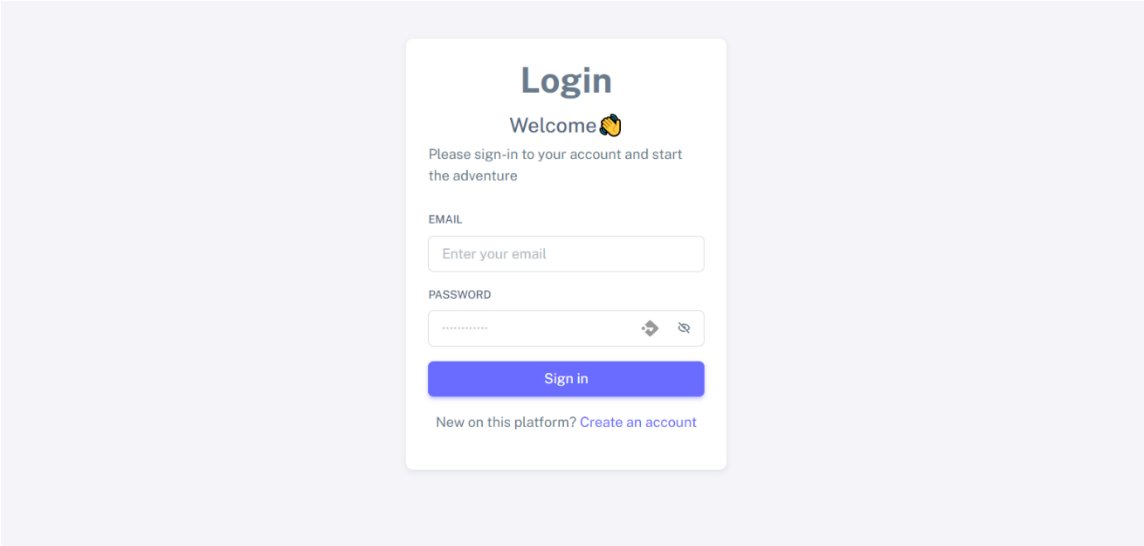


Figure 6.10 Login Screen

Admin Dashboard

This is the screen that should come when the after successfully login In this page basic statistic details are available like total farmers, total pumps, valves and many other details.

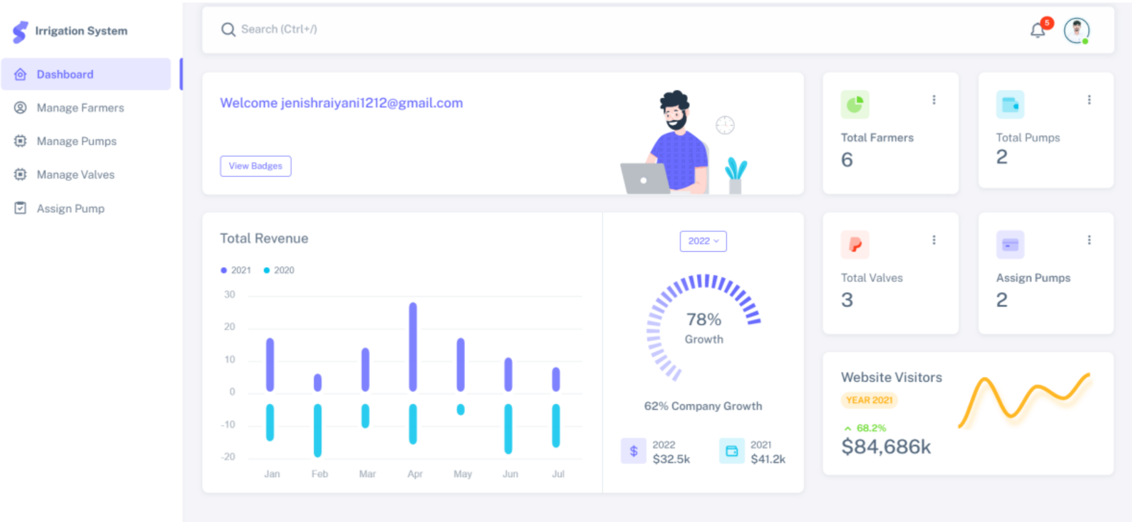


Figure 6.11 Admin Dashboard

Farmer List

- In this page all farmers list is available and admin can search farmer, sort farmer, add farmer and many other features.

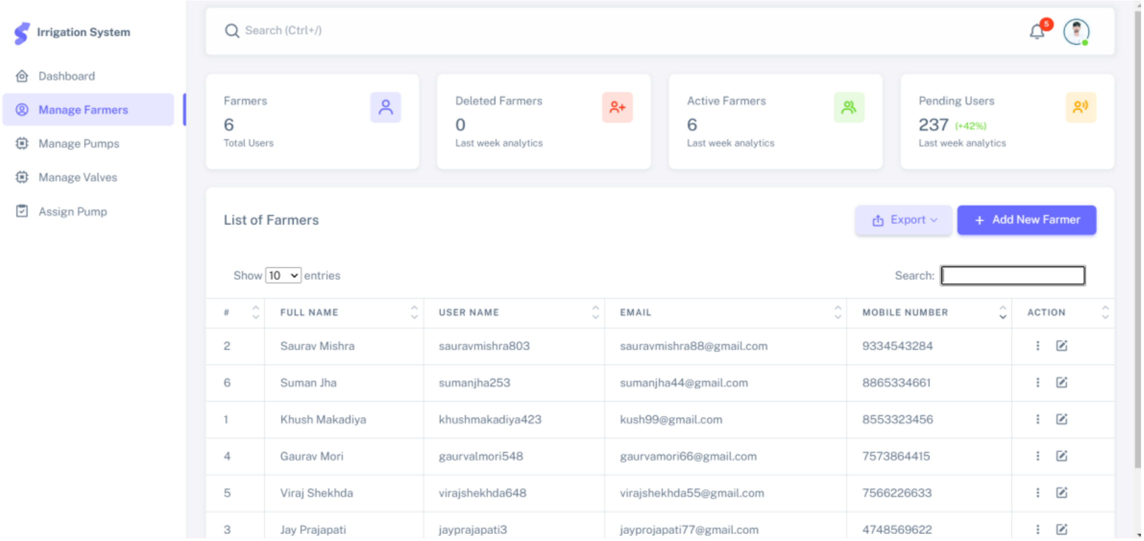


Figure 6.12 Farmers List

Pumps Details

- Here admin can add pumps and manage the pumps and also list of pumps are available in table.

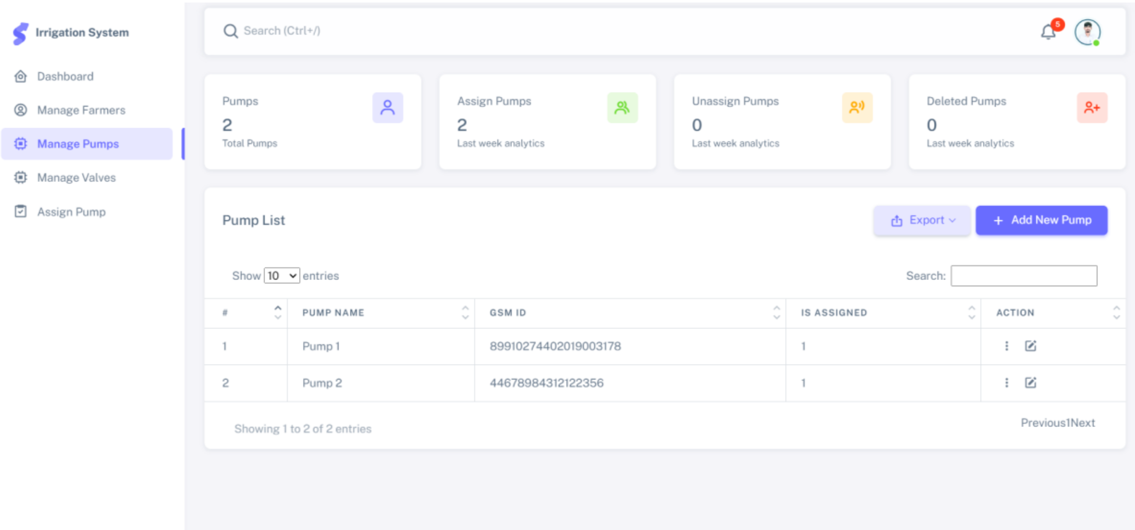


Figure 6.13 Pump List

Valves Details

- After adding pump, admin need to add valves and need to fill required details in form like valve number, voltage and many more.
- Here admin can delete valves also.

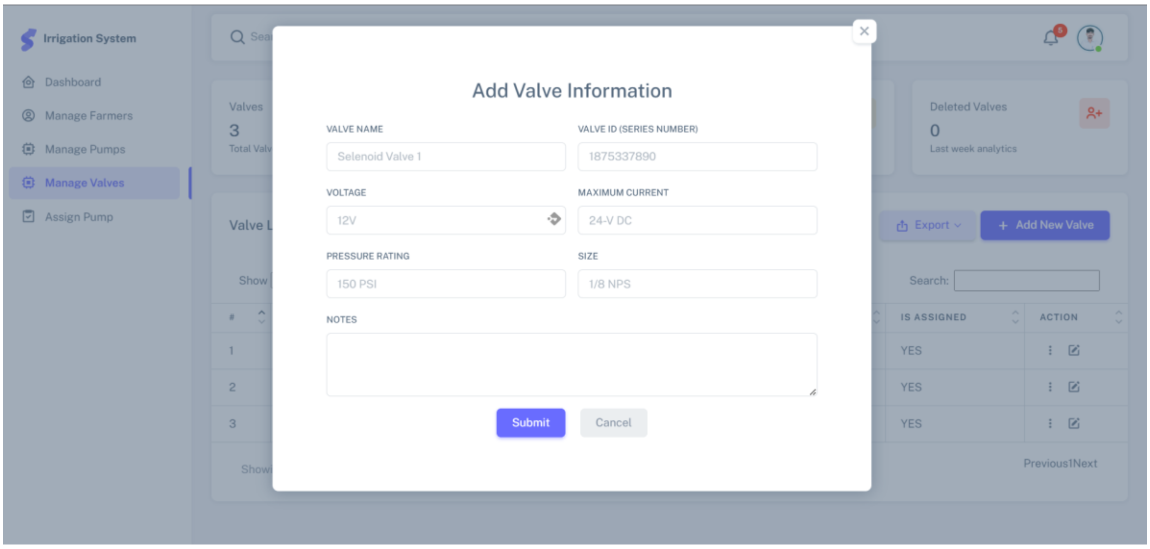


Figure 6.14 Valve List

Assign Pump

- In this section, the admin can assign pump to particular farmer.
- Admin can also delete assigned pump and when admin click on view button, another page will open from that page admin can also turn On/Off the pump of farmer.

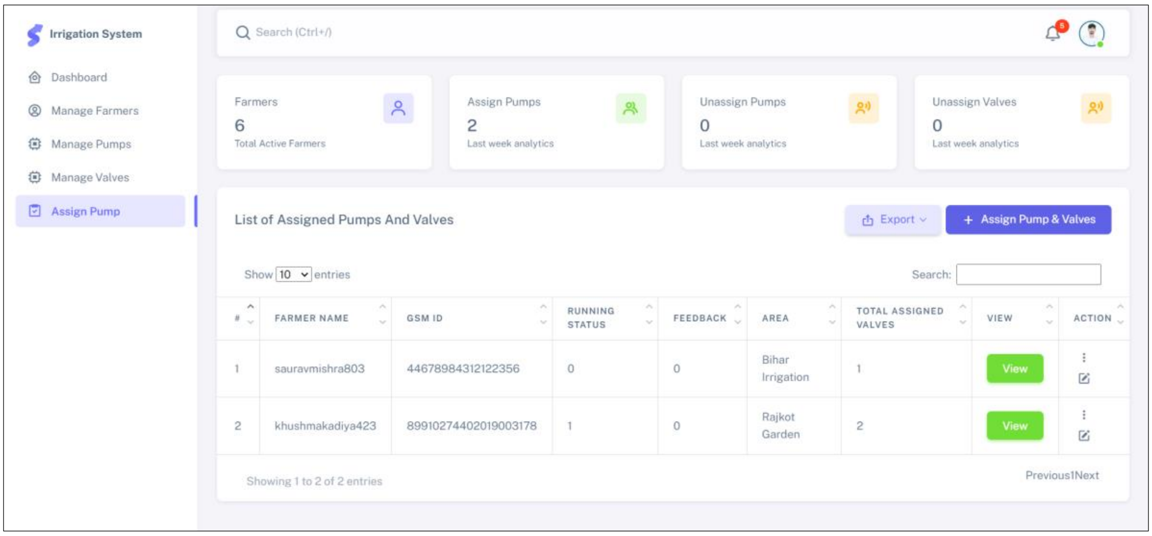


Figure 6.15 Assign Pump

Admin side pumps/valves management

- Here we have give the open to admin to manage pump/valve of farmer and analyze the field status.

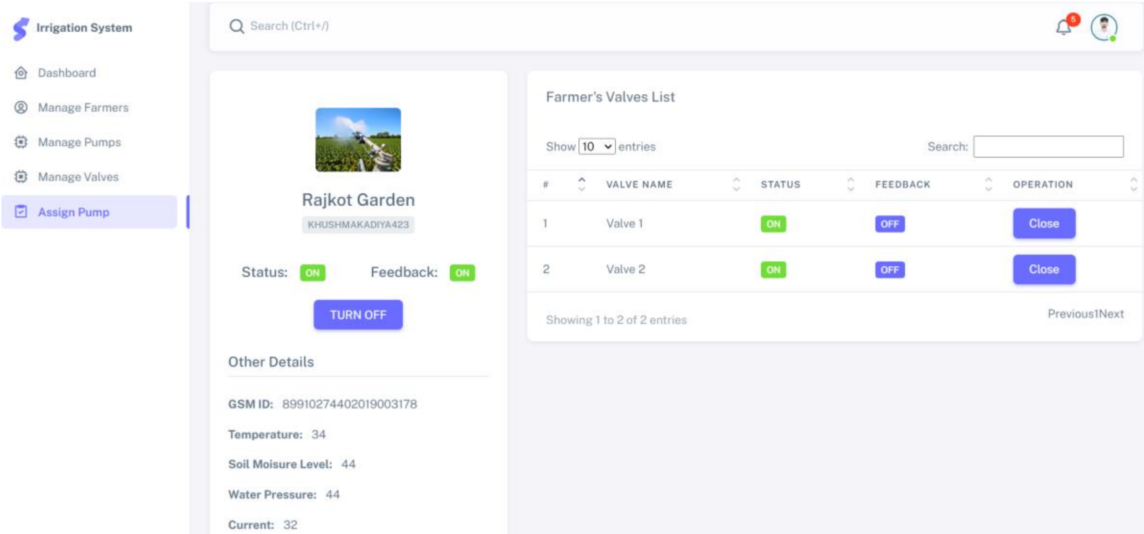


Figure 6.16 Manage Pump

Farmer Dashboard

- In this page farmer can see field details like temperature, water pressure and many more details of sensors.

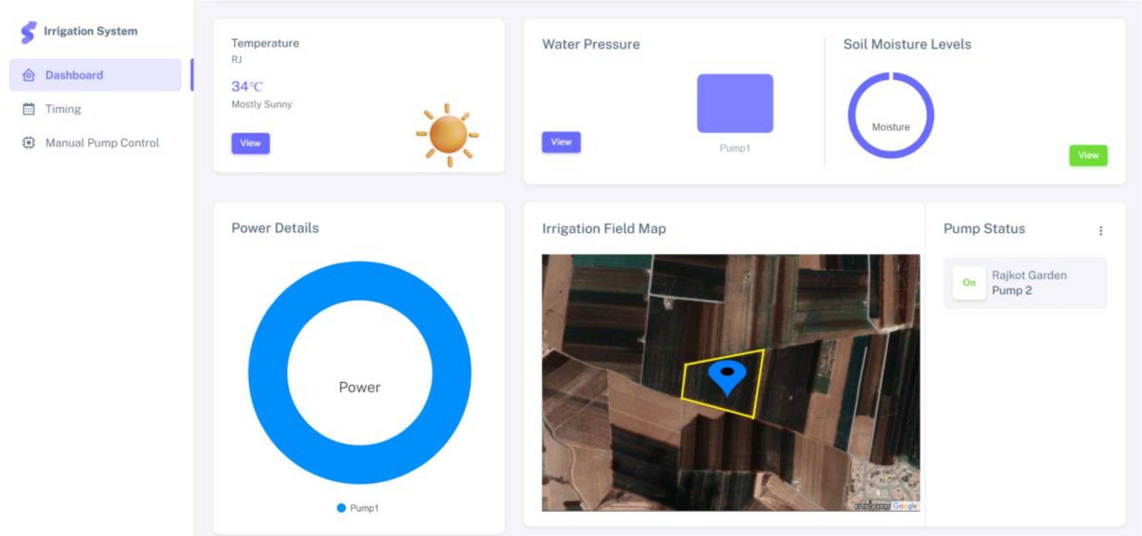


Figure 6.17 Farmer Dashboard

Irrigation Timing

- In this page user can see details of scheduled irrigation timing and if irrigation is run successfully then it show in green label, if failed then it show red label.
- Here the farmer can add, delete and can also edit the irrigation details.

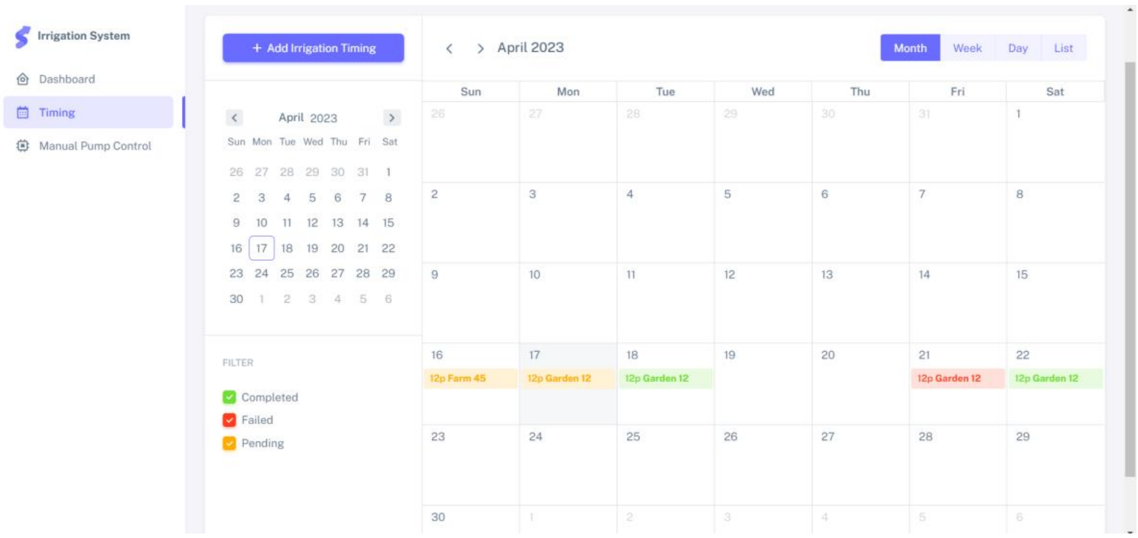


Figure 6.18 Irrigation Timing

Manual Pump Control

- Here farmer can control their pump manually.
- Also farmer can open/close their valves.

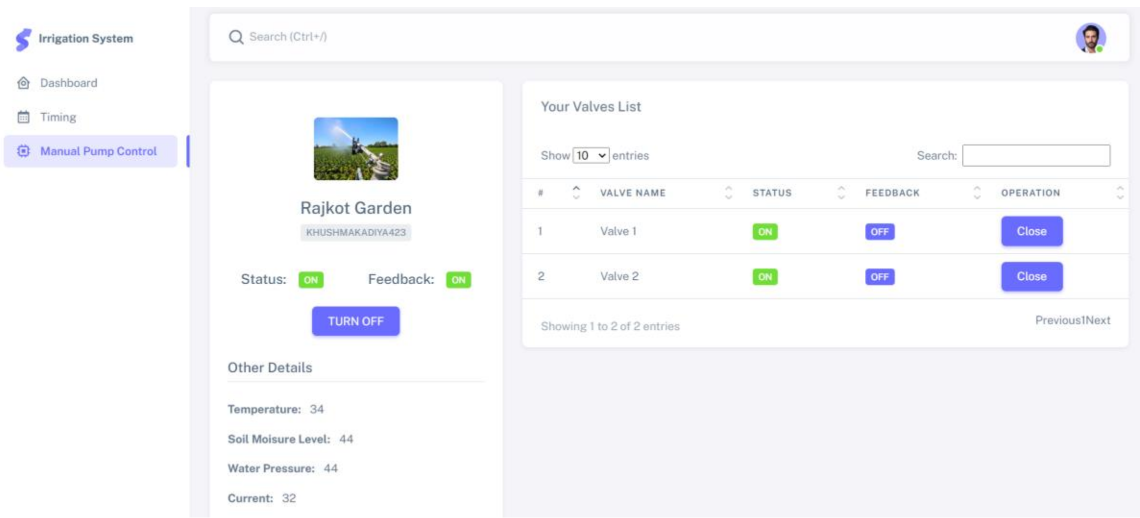


Figure 6.19 Manual Pump Control

6.4 Testing and Verification

Sr. No	Module	Input	State	Expected Output	Actual Output	Test Result
1	Login	Valid Email & Password, Submit	Logout	Login Success	Login Success	Pass

2	Login	Valid Email & Invalid Password, Submit	Logout	Password or email is incorrect	Password or email is incorrect	Pass
3	Login	Invalid Email & Valid Password, Submit	Logout	Password or email is incorrect	Password or email is incorrect	Pass
4	Login	Invalid Email & Invalid Password, Submit	Logout	Password or email is incorrect	Password or email is incorrect	Pass
5	Schedule Irrigation	Valid Startdate, Enddate, Starttime, Endtime	Add Irrigati on	Irrigation schedule successfully.	Irrigation schedule successfully.	Pass
6	Schedule Irrigation	Enddate > Startdate, Valid Starttime and Endtime	Add Irrigati on	Startdate must be greater than enddate.	Startdate must be greater than enddate.	Pass
7	Schedule Irrigation	Valid Enddate, Startdate, Endtime > Starttime	Add Irrigati on	Starttime must be less than endtime.	Starttime must be less than equal to endtime.	Pass
8	Schedule Irrigation	Valid Startdate, Enddate, Starttime, Endtime, Areaname	Add Irrigati on	Check time conflicts with existing irrigation in database.	Already irrigation was schedule on your give date and time.	Pass
9	UI Testing	Current not avaialble on field	UI	Pumps button should be disable.	Pumps button should be disable.	Pass
10	UI Testing	Current is avaialble on field	UI	Pumps button should be enable.	Pumps button should be enable.	Pass
11	Hardware Side API Testing	API pump response 1	API	Pumps should be on.	Pumps should be on.	Pass
12	Hardware Side API Testing	API pump response 0	API	Pumps should be off.	Pumps should be off.	Pass
13	Hardware Side API Testing	API feedback response 1	API	Change feedback status on in	Change feedback status on in	Pass

				dashboard.	dashboard.	
14	Hardware Side API Testing	API feedback response 0	API	Change feedback status off in dashboard.	Change feedback status off in dashboard.	Pass

6.5 Results and Analysis

Input and result are shown below in screen shot according to the test case listed above table.

Login Testing:

If admin or farmer enter wrong username and password than error will occur and farmer/admin not able to access dashboard.

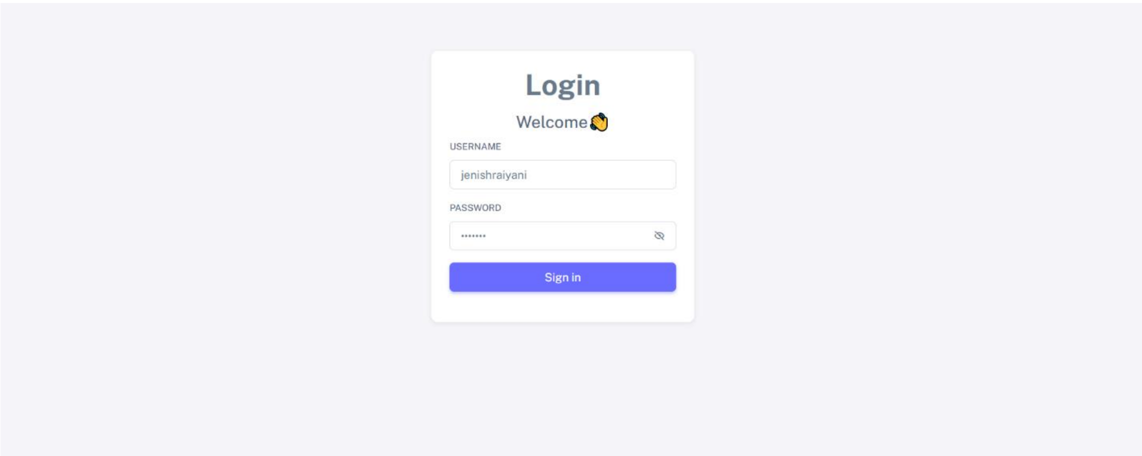


Figure 6.20 Login Module Testing

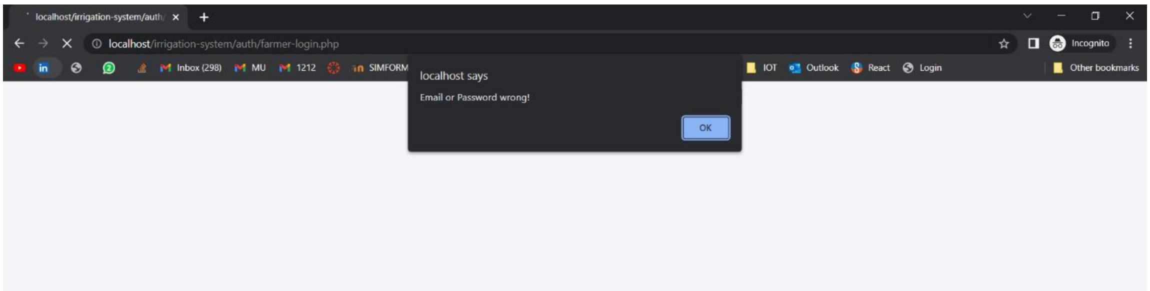


Figure 6.21 Login Page Validation

Automatic Irrigation Testing:

- Here if farmer enter same date and time that already entered before than farmer can have below error and not able to schedule irrigation
- So, in short, we not allow any time conflict on irrigation.

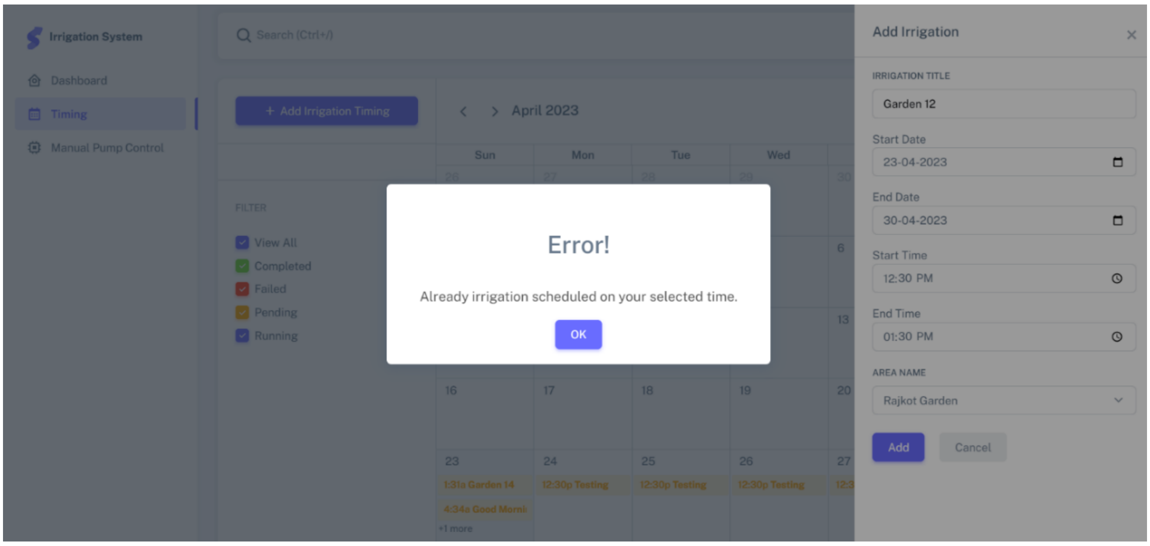


Figure 6.22 Irrigation Time Conflict Testing

- If user enter end time less than start time and below error will be occur and farmer will not able to schedule their irrigation.

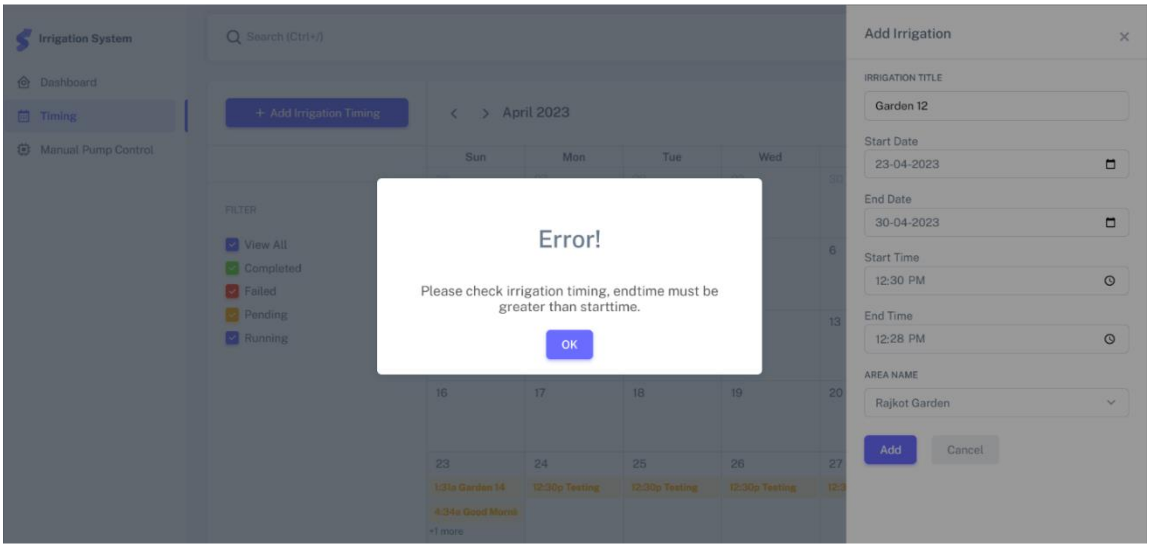


Figure 6.23 Irrigation Time Testing

- Here if farmer enter wrong date means end date is less than start date than below error will occur.

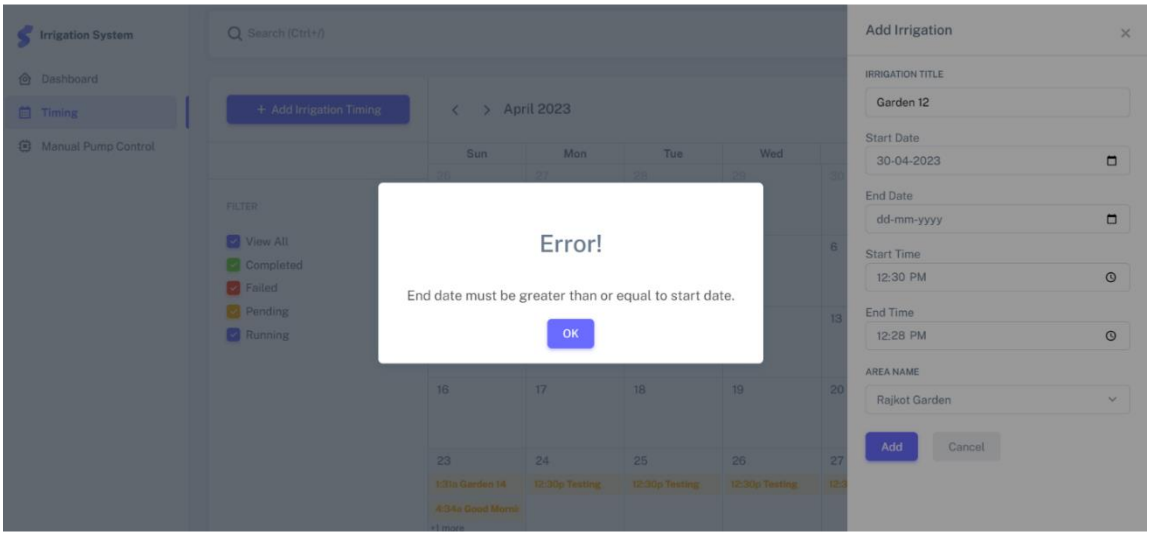


Figure 6.24 Irrigation Date Testing

- After entering all current value in form fields when farmer click on add button, we are showing confirmation box for time duration, so if farmer by mistake enter wrong time than they can edit before schedule it.

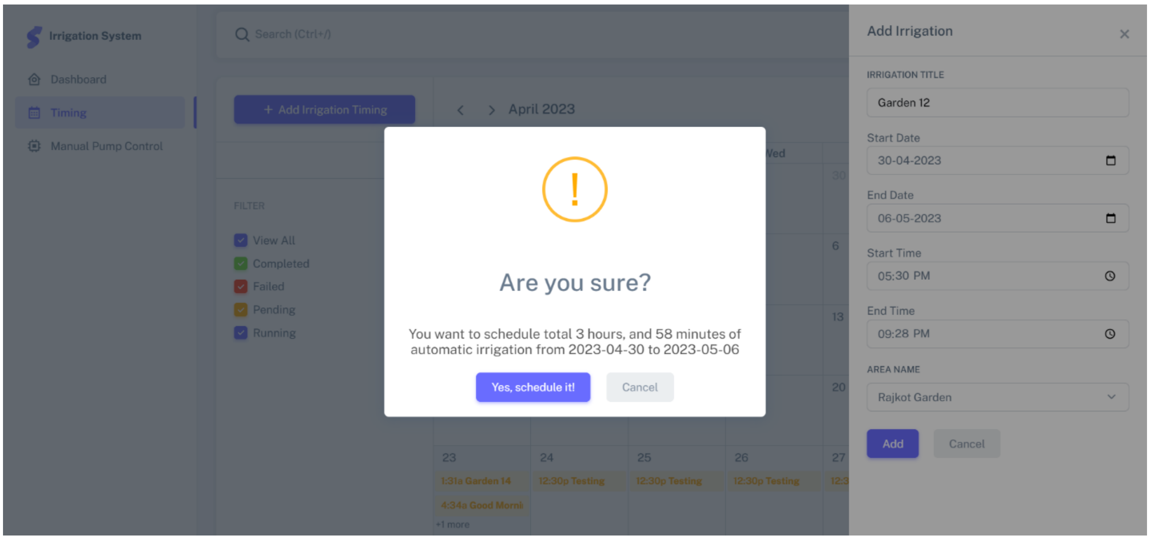


Figure 6.25 Irrigation Confirmation Box

- After confirming message irrigation will schedule successfully and in full screen calendar farmer can see their irrigation details.

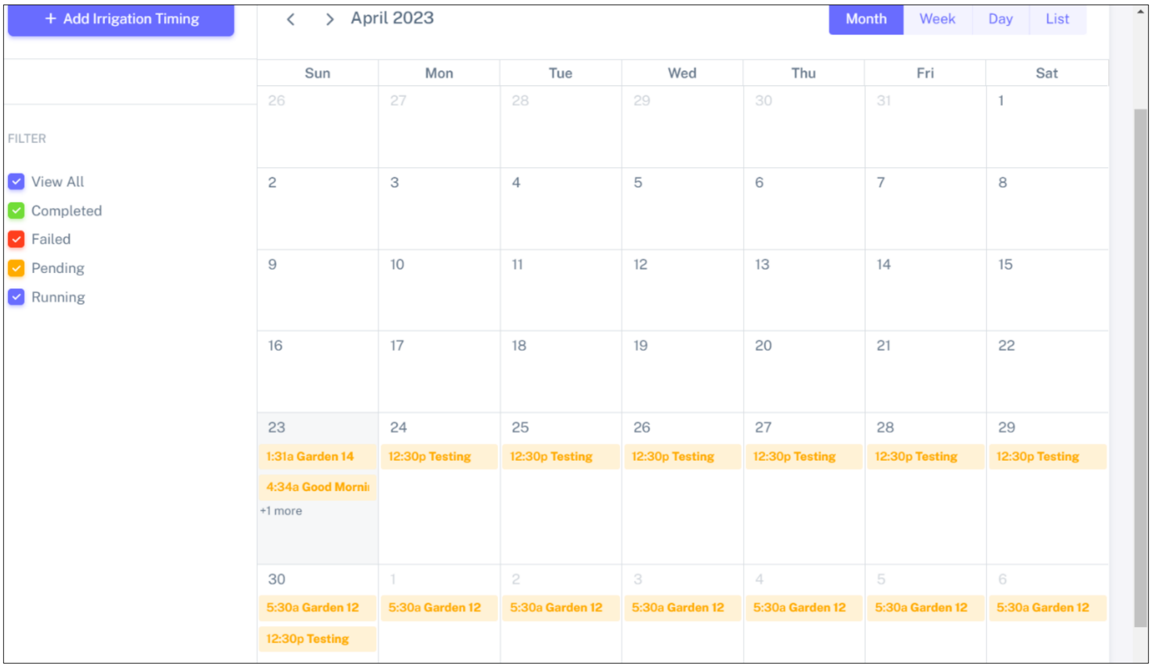


Figure 6.26 Display Irrigation

API Testing

- We are getting actual status of pumps through API like if pumps are started than from hardware side, we are getting response 1 (One) through API and then we are updating feedback status on dashboard.

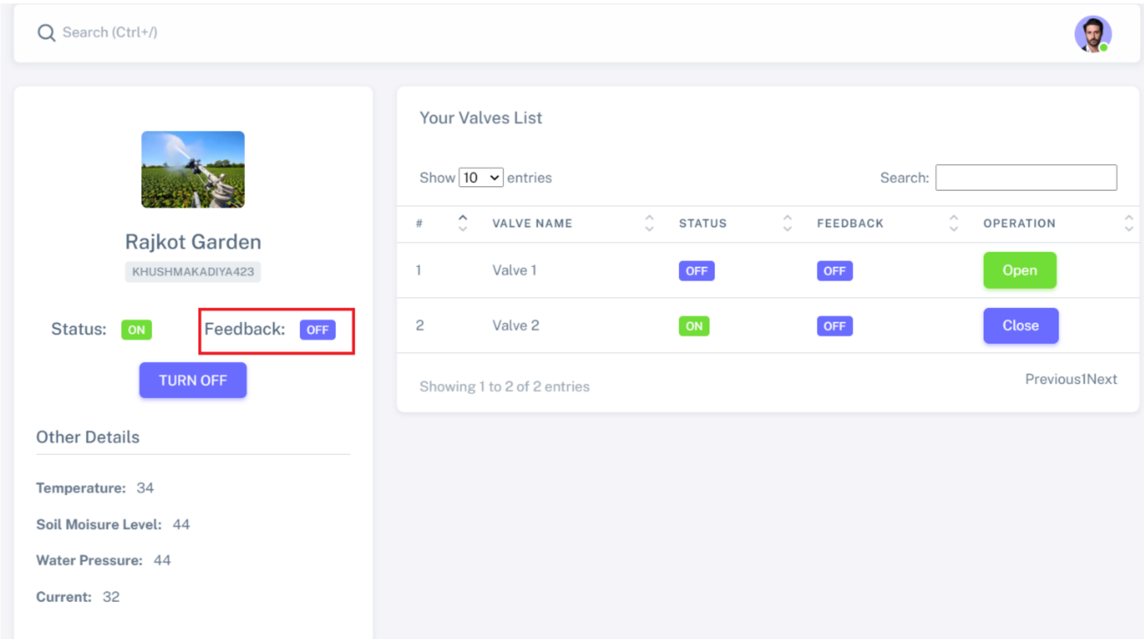
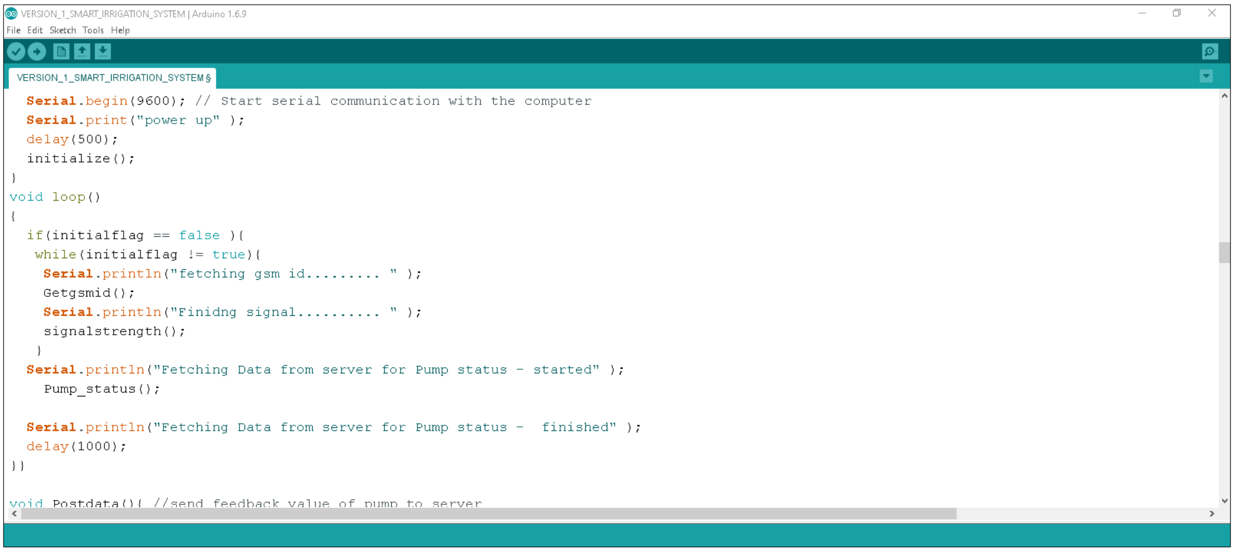


Figure 6.27 Feedback API Testing

6.6 Arduino IDE Programming Snippets




```
  Serial.begin(9600); // Start serial communication with the computer
  Serial.print("power up" );
  delay(500);
  initialize();
}
void loop()
{
  if(initialflag == false ){
   while(initialflag != true){
    Serial.println("fetching gsm id......... " );
    Getgsmid();
    Serial.println("Finidng signal.......... " );
    signalstrength();
   }
  Serial.println("Fetching Data from server for Pump status - started" );
    Pump_status();

  Serial.println("Fetching Data from server for Pump status -  finished" );
  delay(1000);
}}

void Postdata(){ //send feedback value of pump to server
```

Figure 6.28 Initial call function of system

The code provided is for a smart irrigation system that is designed to monitor and control the water supply for crops or plants.

The code begins with the setup function, which initializes the pins for the system. The first three pins are for the power LED, pump one and current sensor, respectively. The for loop sets up the remaining seven pins as output pins. These pins will be used to control various devices such as valves and pumps.The next two lines start the serial communication for the system. The first one initializes the communication for the GSM module and the second one initializes the communication for the computer.The code then prints the message "power up" and waits for 500 milliseconds. The "initialise()" function is called following the delay. The initial flag is set to false and the variables are initialised using this function.

The loop function is where the main functionality of the system lies. It starts by checking if the initial flag is false. If the flag is false, the loop enters a while loop, which continuously fetches the GSM ID and signal strength. Once the initial flag is true, the loop moves on to fetch the pump status from the server using the "Pump_status()" function.The "Getgsmid()" function is responsible for fetching the GSM ID of the module. This ID is used to communicate with the server and retrieve the necessary data. The "signalstrength()" function is responsible for finding the signal strength of the GSM module. The signal strength is important to ensure that the communication between the module and the server is reliable.Once the initial flag is set to true, the "Pump_status()" function is called. This function fetches the status of the pump from the server. The pump status determines whether the pump should be turned on or off. The code uses the seven output pins initialized in the setup function to control the pump and other devices.

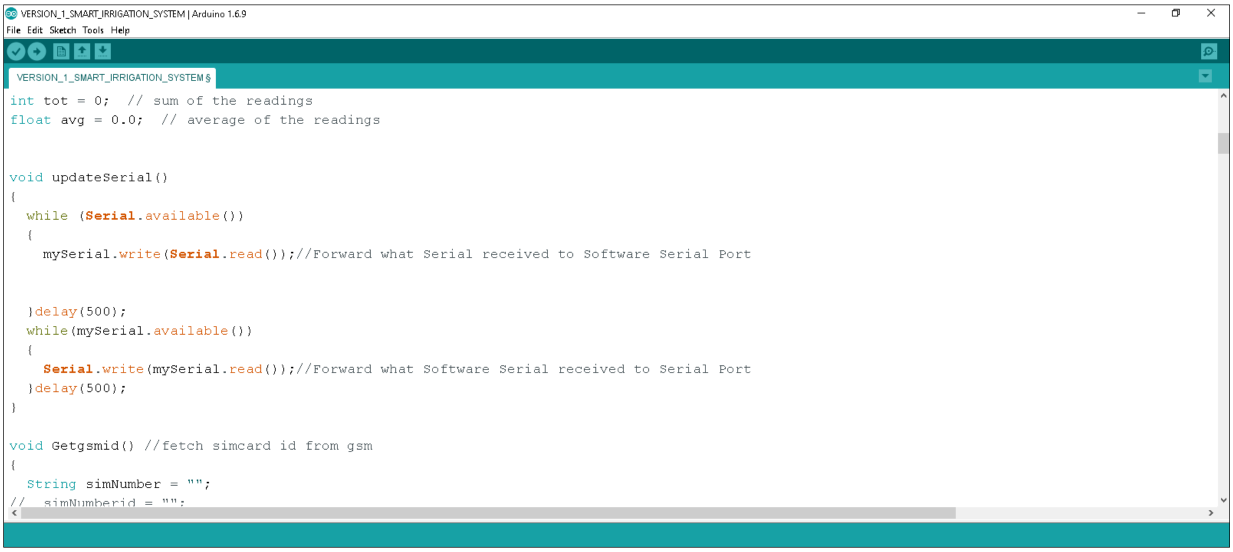
The code initializes the necessary pins and variables, communicates with the server to fetch data, and controls the irrigation system based on the data received. The system can be customized to meet the specific needs of the user and can help to save water and improve crop yield.


```
// Send HTTP GET request
mySerial.println("AT+HTTPINIT");
delay(3000);
updateSerial();
mySerial.println("AT+HTTPPARA=\"CID\",1");
delay(3000);
updateSerial();
Serial.println("sending to server");
mySerial.println("AT+HTTPPARA=\"URL\",\"http://irrigationsystem.ictmu.in/API/post-api-pump-feedback.php?gsm=" + String(simNumberid) + "&feedb
delay(5000);
updateSerial();
Serial.println("Data successfully sended to server");
mySerial.println("AT+HTTPACTION=0");
delay(3000);
updateSerial();
mySerial.println("AT+HTTPREAD");// Read HTTP response
delay(5000);
updateSerial();
mySerial.println("AT+HTTPTERM"); // Terminate HTTP session
delay(3000);
updateSerial();
```

Figure 6.29 Creating HTTP Tunnel

The code begins by sending an HTTP GET request to the server using the GSM module. The "mySerial.println()" function is used to send AT commands to the module. The first command initializes the HTTP service on the module. The "delay()" function is used to pause the execution for a specified time, allowing the module to process the command.The next command sets the Context ID (CID) to 1. The CID is used to specify the context of the HTTP request. In this case, the CID is set to 1, which is the default value for HTTP requests.The next command sets the URL for the HTTP request. The URL is set to the server's API endpoint with the parameters "gsm" and "feedback" values. These parameters are used to send the GSM ID and feedback value to the server. The URL is concatenated using the "String()" function.

Once the URL is set, the HTTP request is initiated using the "AT+HTTPACTION=0" command. The "0" in the command specifies that the request is a GET request. The "delay()" method is then used to wait for a predetermined amount of time before sending the "AT+HTTPREAD" command to receive the HTTP response from the server. The response is then displayed on the serial monitor using the "updateSerial()" function.Finally, the "AT+HTTPTERM" command is used to terminate the HTTP session. the code sends an HTTP GET request to the server using the GSM module to send feedback on the pump status. The feedback is sent in the form of parameters in the URL. Once the request is initiated, the code waits for a response from the server and terminates the session once the response is received.



VERSION_1_SMART_IRRIGATION_SYSTEM | Arduino 1.6.9

File Edit Sketch Tools Help

VERSION_1_SMART_IRRIGATION_SYSTEM §

```
int tot = 0;  // sum of the readings
float avg = 0.0;  // average of the readings


void updateSerial()
{
  while (Serial.available())
  {
    mySerial.write(Serial.read());//Forward what Serial received to Software Serial Port


  }delay(500);
  while(mySerial.available())
  {
    Serial.write(mySerial.read());//Forward what Software Serial received to Serial Port
  }delay(500);
}

void Getgsmid() //fetch simcard id from gsm
{
  String simNumber = "";
//  simNumberid = "";
```

Figure 6.30 Fetching Data

The "updateSerial()" function is used to forward data received from the hardware serial port (Serial) to the software serial port (mySerial) and vice versa. The "Serial.available()" function is used in the function to determine whether any data is currently available on the Serial port. If there is any data available, it is read using the "Serial.read()" function and then sent to the software serial port using the "mySerial.write()" function.Next, the function waits for a specified delay of 500 milliseconds using the "delay()" function. This delay is added to ensure that there is enough time for the data to be transmitted between the two serial ports.The function then checks if there is any data available on the software serial port using the "mySerial.available()" function. If there is any data available, it is read using the "mySerial.read()" function and then sent to the hardware serial port using the "Serial.write()" function.

Again, a delay of 500 milliseconds is added using the "delay()" function to ensure that there is enough time for the data to be transmitted between the two serial ports. the "updateSerial()" function is used to forward data between the hardware and software serial ports in a bidirectional manner. This function helps to ensure that data is correctly received and transmitted between the two ports.

7. Coding Standards

7.1 Standard headers for different modules

- The header of separate modules should match the following standard format and information for betterunderstaning and maintenance of the code.
- Name of a class, function: (Ex: ViewFarmer.php, Irrigation-Timing.php)
- The module's name must be written in the above format and included in the Construction detailsdocument.

7.2 Naming conventions for variables and functions

- Meaningful and understandable variable name helps anyone to understand the reason for using it.
- Local variables should be named using camel case lettering starting with a small letter (e.g., counter)whereas Global variables names should start with a capital letter (e.g., Counter). Constant names should be formed using capital letters only (e.g., PI).
- It is advisable to avoid the use of digits in variable names declaration.
- The function name should be written in camel case starting with small letters.
- The name of the function must describe the reason for using the function clearly and briefly.

7.3 Indentation

- Proper indentation is very important to increase the readability of the code. For making the code readable, programmers should use White spaces properly. Some of the spacing conventions are givenbelow:
- There must be a space after giving a comma between arguments of same function.
- Each nested block should be properly spaced and indented.
- All braces should begin on a new line, and the code following the braces should begin on a new lineas well.

7.4 Error return values and exception handling conventions

- All functions that encounter an error condition should either return a 0 or 1 for simplifying the debugging.

8. Conclusion

The "Smart Irrigation system based on GSM module using Arduino" is a highly efficient and effective solution for automating the irrigation process. By integrating advanced sensors and controllers, the system can monitor environmental conditions in real-time and deliver precise amounts of water to plants based on their specific water requirements.

The system's hardware components work together seamlessly to ensure efficient water usage and plant growth. The GSM module connects the irrigation system to a network, enabling users to control and monitor the system remotely. The Arduino microcontroller processes data from the sensors and sends instructions to the water pump and other components. The soil sensor measures moisture levels in the soil, providing data that the Arduino uses to determine the water requirements of the plants. The relay controls the water pump, turning it on or off as needed, while the WCS current sensor measures the pump's performance.The system's architecture system is designed to maximize efficiency and effectiveness. The user interface displays real-time data about the system's performance, including moisture levels and water usage, while the control unit uses sensor data to determine water requirements and control the water pump. The data logger stores data about the system's performance, allowing for analysis and optimization. A web-application is used as command & control for end- user.

A smart irrigation system is an excellent investment for anyone looking to improve the health and beauty of their plants while conserving water and reducing costs. Its advanced sensors and controllers make it a highly efficient and effective solution for automating the irrigation process, and its scalability and customizability make it a great long-term investment. Overall, a smart irrigation system is a must-have for anyone who wants to optimize their irrigation process and contribute to sustainable water use.while the "Smart Irrigation system based on soil moisture using Arduino" is already a highly effective and efficient solution for automating the irrigation process, there are several potential improvements that could further enhance its performance and functionality. By incorporating machine learning algorithms, additional sensors, improved user interfaces and data logging capabilities, and renewable energy sources, the system could become even more powerful and sustainable in the future.

9. References

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10. Review Cards

Review 1

Marwadi University Marwadi Chandarana Group	**Marwadi University** **Faculty of Technology** **Department of Information and Communication Technology**
Semester: 8th	**Subject: Project (01CT0801)**
A.Y. 2022-23	**Date: 11/2/2023**

Project review 1

Project title: Smart Irrigation System

Name of guide: prof C.d parmar sir

Name and address of company (if it is industrial project):

NA

Email ID of industrial guide: NA.

Enrolment no.	Name of the student	Signature
91900133026	VIRAJ SHEKHDA	VRS
91900133042	JENISH RAIYANI	K.Raiyani.

Members of examination	Prof. Nishith Kotak	Kotak

Remarks from examination panel:

1). It is not clear, whether sensors are planted in the field / over the field / position & location to plant sensors is not discussed in the WSN-based literature survey.

2). Multiple times use of WSN and IoT is used. Diff^ce bet^n them is not clear, as part of literature survey.

3). Is there any mathematical model to determine dist^n bet^n two sensors/~~pumps~~ valves, based on type of land in farm?

4). Approach releted to controling quantity of water?

5). Turning ON & off of pump is human-dependent or pre-set. Can it be automized?

6). mentioned about health of crop. How it can be done using sensors? OR any other technique?

7). Need to work on Presentation skills.

Review 2

Marwadi University Marwadi Chandarana Group	Marwadi University Faculty of Technology Department of Information and Communication Technology
Semester: 8th	Subject: Project (01CT0801)
A.Y. 2022-23	Date: 25/3/2023

Project review 2

Project title: Smart Irrigation System

Name of guide:

Name and address of company (if it is industrial project):

Email ID of industrial guide:

Enrolment no.	Name of the student	Signature
	Viraj Shekhda	
	Jenish Raiyani	

Members of examination	Prof. Nishith Kotak	
	Prof. Rakesh D Oza	

Remarks from examination panel:

1. Regulating the flow of water based on the requirement, needs to be improved
2. Feedback system ensuring the turning on/off of the pump, to the user, needs to be developed