A PROJECT REPORT

on

"Smart Irrigation System for Mini Gardens"

Submitted to

KIIT Deemed to be University

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN COMPUTER SCIENCE AND ENGINEERING

BY

BIBEK KC	20051722
DHIRAJ KUMAR MISHRA	20051839
RUPESH KUMAR SHAH	20051750

UNDER THE GUIDANCE OF
MANAS RANJAN LENKA

SCHOOL OF COMPUTER ENGINEERING
KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
BHUBANESWAR, ODISHA - 751024

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KIIT Deemed to be University
School of Computer Engineering
Bhubaneswar, ODISHA 751024

CERTIFICATE

This is certify that the project entitled

"Smart Irrigation System for Mini Gardens"

submitted by

BIBEK KC	20051722
DHIRAJ KUMAR MISHRA	20051839
RUPESH KUMAR SHAH	20051750

is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Science & Engineering) at KIIT Deemed to be university, Bhubaneswar. This work is done during year 2023, under our guidance.

Date: 05/05/2023

MANAS RANJAN LENKA
Project Guide

Acknowledgements

We are profoundly grateful to **MANAS RANJAN LENKA** of Operating System and Computer Networks for his expert guidance and continuous encouragement throughout to see that this project rights its target since its commencement to its completion.

Bibek KC
Dhiraj Kumar Mishra
Rupesh Shah

ABSTRACT

The Smart IoT Irrigation System using Blynk Server is an emerging technology that aims to improve the efficiency and effectiveness of the irrigation process. Traditional irrigation systems often result in water wastage, inefficient water distribution, and over or under-watering of plants, which can lead to poor plant growth and low yield. These systems are also labor-intensive, as they require manual monitoring and control. With the increase in water scarcity and the need for sustainable agriculture practices, there is a need for a smart irrigation system that can automate and optimize the irrigation process.

The proposed system employs soil moisture sensors to monitor the moisture level in the soil, and then automatically activates the irrigation system when the moisture level falls below the predefined threshold. The system is based on the Internet of Things (IoT) technology, which allows the system to be remotely controlled and monitored using a mobile application. The system is controlled by a microcontroller, which is connected to the Blynk cloud server, providing a user-friendly interface to monitor and control the system from anywhere in the world.The Smart IoT Irrigation System using Blynk Server has many benefits, including reduced water consumption, improved plant growth and health, and reduced labor costs. By automating the irrigation process and using sensors to monitor soil moisture levels, the system can ensure that plants receive the right amount of water at the right time, reducing water waste and improving plant health by preventing over or under-watering. The system can also be set to operate on a schedule or to activate only when the soil moisture levels fall below a certain threshold.

Keywords: Sensors, actuators, microcontroller, IOT, blynk Server

Contents

1.Introduction

Advanced technologies have the potential to revolutionize the way we live and work, bringing benefits to the majority of people. In recent years, the Internet of Things (IoT) has emerged as a powerful technology that is transforming various industries, including agriculture and the environment. IoT is a network of interconnected devices, sensors, and software that can collect and transmit data in real-time. It can enable farmers and environmentalists to monitor and control their operations remotely, and also provide valuable insights into crop growth, soil moisture, and other environmental factors. Agro-Industries, environmental-fields can get benefits of IoT the most, they are the real candidate for utilizing and deployment of IoT technologies and solutions because they are spreaded in larger scale and in wide areas that need to be continuously monitored and controlled.

Installation of Wireless Sensors Network(WSN) has improved the productivity, efficiency, effectiveness of farmers as it helps in evaluating field variables such as soil moisture, temperature, humidity, biomass of plants and insects in the field etc. WSN can be used to monitor and control factors that impact crop growth and yield, including determining the optimal time to harvest and detecting diseases. It focuses on collecting data on temperature, humidity, and soil moisture in crop fields and using this data to control automatic watering of crops. A database system will be designed and implemented as a web-based application, with the stored data used for decision making and predicting the water needs of crops in the future.

Data mining techniques in agriculture are used to discover hidden relationships among agricultural data attributes. Association rules approach is used to analyze and establish hidden relationships among the attributes of agricultural data, supporting scientific decision-making. The study utilized association rules and the Apriori algorithm to acquire general rules, along with linear regression to model the relationships between input and outcome variables. The use of these techniques helps to analyze the hidden relationships among the attributes of agricultural data, enabling scientific decision-making in precision agriculture. The system aims to support mixed crop farming by providing farmers with real-time data about their crops, including temperature, humidity, and soil moisture levels and offer anytime and anywhere connectivity through a smartphone or web application. Overall, the study highlights the potential benefits of data mining techniques and WSN systems in supporting scientific decision-making in agriculture and the benefits.

This article is divided into following sections for clear observations : Section 2 describes Basic Concepts , Section 3 describes the system and its model purposed to apply smart irrigation system, Section 4 explains result and analysis and methodology , Section 5 conclusion and future scopes and followed by Acknowledgements and References used.

2.Basic Concepts

An IoT smart irrigation system is a technology that allows you to automate the process of watering plants, crops, and lawns. The system relies on sensors, software, and other connected devices to collect data and control water distribution, ensuring that plants receive the right amount of water at the right time. Here are some basic concepts to keep in mind for an IoT smart irrigation system:

1. Sensors: Sensors are the heart of an IoT smart irrigation system. They can be soil moisture sensors, weather sensors, or even flow sensors. Soil moisture sensors detect the moisture content of the soil and can determine whether plants need watering or not. Weather sensors measure environmental factors such as temperature, humidity, wind speed, and rainfall to predict the water needs of plants. Flow sensors measure the amount of water that is flowing through the irrigation system and can be used to detect leaks and other issues.

2. Connectivity: An IoT smart irrigation system relies on connectivity to function. This means that sensors, controllers, and other devices must be connected to the internet or a local network to communicate with each other. The most common connectivity options are Wi-Fi, Bluetooth, and cellular.

3. Controllers: Controllers are devices that connect to the sensors and other devices in the irrigation system to manage water distribution. They can be simple timers or more sophisticated devices that can adjust water distribution based on the data collected by sensors.

4. Automation: An IoT smart irrigation system can automate the process of watering plants. This means that the system can turn on and off the water supply based on pre-set parameters or data collected by sensors. This can save water, reduce labor costs, and ensure that plants receive the right amount of water at the right time.

5. Data analytics: An IoT smart irrigation system can collect and analyze data to optimize water distribution. This data can be used to adjust watering schedules, detect leaks and other issues, and improve overall efficiency. Data analytics can also help farmers and gardeners make informed decisions about watering and crop management.

In this section, we have also our studies relating to IoT in Agriculture, its usage and applications. It is explained in two aspects : The first aspect is the application of Internet of Things (IoT) devices in agriculture, and the second aspect is agricultural data analysis, which is based on the use of IoT devices.

3.Problem Statement / Requirement Specifications

Traditional irrigation systems are inefficient, as they rely on scheduled watering regardless of the actual moisture needs of the plants. This leads to wastage of water, which is a precious resource. On the other hand, manually monitoring and adjusting the watering schedule for individual plants can be time-consuming and labor-intensive. Therefore, there is a need for an automated and efficient irrigation system that can optimize water usage and save time and effort.

3.1 Requirement Specification

A smart irrigation system typically involves the use of sensors, weather data, and other technology to optimize water usage for crops, lawns, and other vegetation.This includes the useage of sensors, actuators, microcontroller, and connectivity to the mobile and web dashboard.The requirement specification are listed below:-

3.1.1 Sensors

Sensors are devices that detect and respond to changes in their environment, such as temperature, pressure, light, sound, and motion.The various types of sensors used are listed below.

1. DHT11

The DHT11 as shown in fig(1) is a popular digital temperature and humidity sensor that is commonly used in electronic projects, particularly those related to the Internet of Things (IoT).The DHT11 sensor has a single-wire digital interface that communicates with a microcontroller or other circuit board. It uses a proprietary communication protocol to send data to the microcontroller, which can then interpret the data and use it for various purposes. The sensor has a range of 0-50 °C for temperature readings with an accuracy of ±2°C and a range of 20-80% for humidity readings with an accuracy of ±5%.

Fig. 1(DHT11)

2. Soil moisture sensor

A soil moisture sensors as shown in fig(2) is a device that measures the amount of water content in soil. The sensor typically consists of two metal probes that are inserted into the soil, and the electrical resistance between the probes is used to determine the moisture level. As the soil becomes wetter, the electrical resistance between the probes decreases, and as it becomes drier, the resistance increases.Soil moisture sensors are widely used in agriculture, gardening, and landscaping to optimize watering schedules and reduce water waste. By providing real-time data on soil moisture levels, these sensors can help farmers and gardeners make informed decisions about when and how much to water their crops or plants.

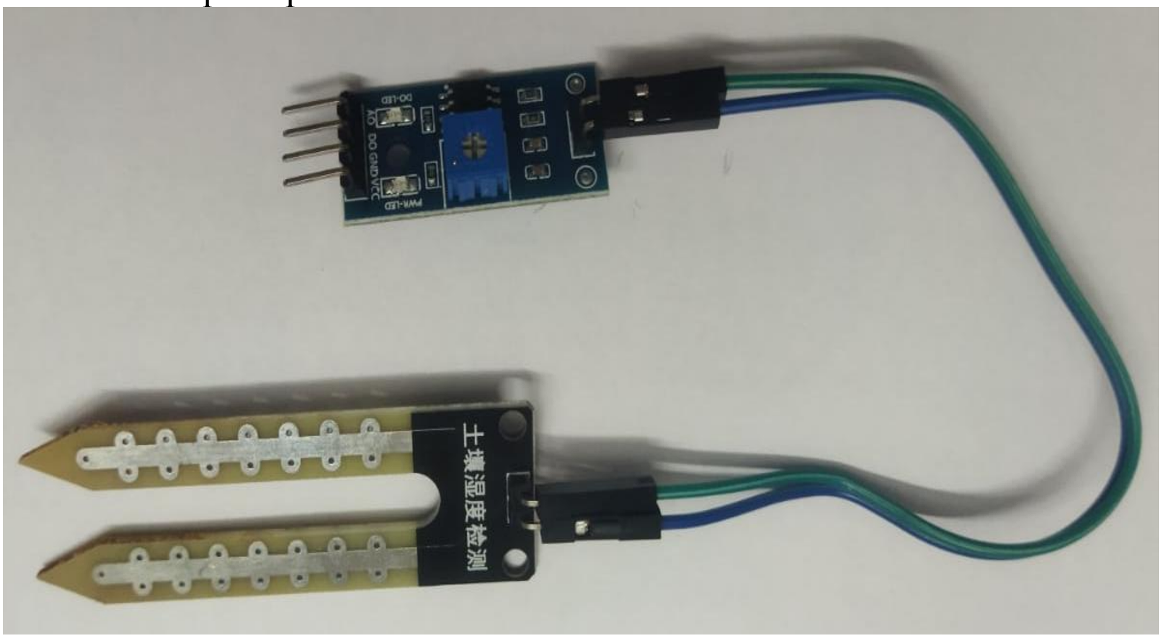

Fig. 2(Soil Moisture Sensor)

3.1.2. Actuators

Actuators are devices that convert electrical, hydraulic, or pneumatic energy into mechanical motion or force.The various types of sensors used are listed below.

1. Motor

A motor as shown in fig(3) converts electrical energy into rotational motion, which can be used to perform work or control other devices. There are different types of motors available, including DC motors, AC motors, stepper motors, and servo motors, each with their own characteristics and advantages.DC motors are commonly used in applications where precise speed control is required, such as in robotic arms and CNC machines

Fig. 3(Motor)

2. Batteries

A 12-volt battery as shown in fig(4) is a common type of battery that is used in many applications, including automotive, marine, and industrial applications. It is a lead-acid battery that consists of six cells, each with a voltage of 2 volts, connected in series to produce a total voltage of 12 volts.

Fig. 4(Batteries)

3. Relay

A relay as shown in fig(5) is an electromagnetic switch that is commonly used in electronic circuits to control high-power devices or to switch between multiple circuits. It consists of a coil, a set of contacts, and a mechanism for moving the contacts.When an electric current is passed through the coil, it creates a magnetic field that pulls the contacts together or pushes them apart, depending on the type of relay. This movement of the contacts allows the relay to switch between circuits, turning devices on or off.

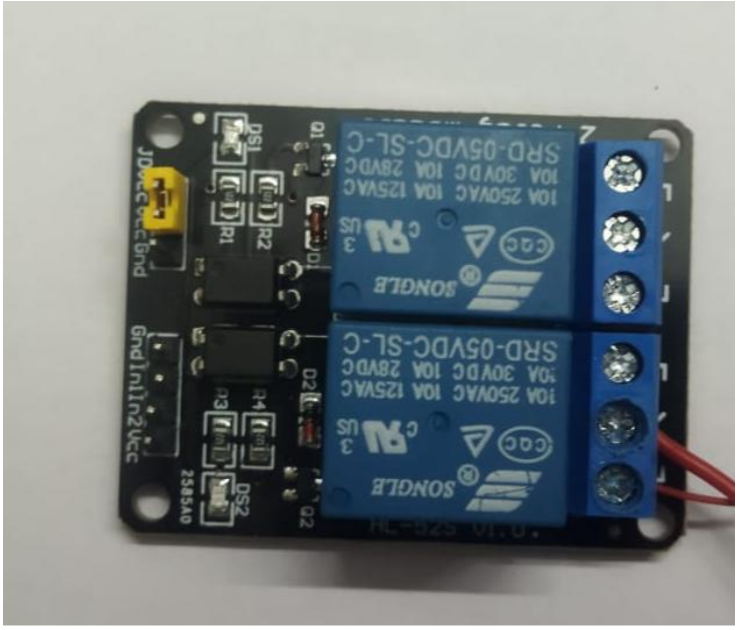

Fig. 5(Relay)

3.1.3 Microcontroller

A microcontroller is a small computer on a single integrated circuit that is designed to control specific functions or devices. It is commonly used in embedded systems, which are systems that have a specific function or purpose and are integrated into a larger system or product.

1. ESP-32

ESP32 as shown in fig(6) is a low-cost, low-power, Wi-Fi and Bluetooth enabled system-on-a-chip (SoC) microcontroller developed by Espressif Systems. It is widely used in IoT (Internet of Things) and embedded applications due to its powerful processing capabilities, built-in Wi-Fi and Bluetooth connectivity, and low-power consumption.

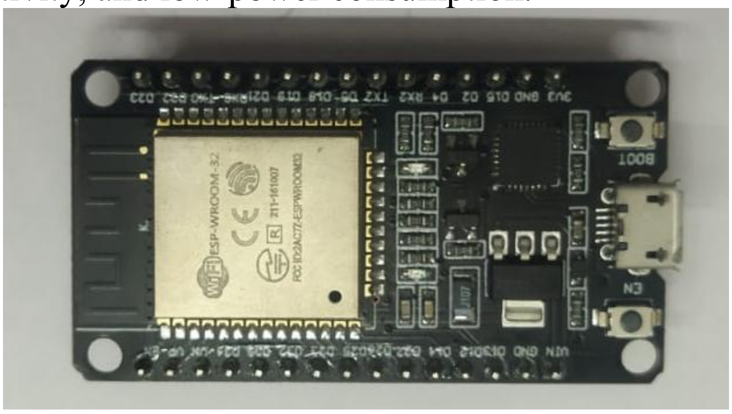

Fig. 6(ESP32)

3.1.4 Connectivity

Connectivity includes below parts:-

1. Jumper Wires

Jumper wires as shown in fig (7) are wires that are used to connect electronic components on a breadboard or other prototyping platform. They are typically made of insulated wire with a solid or stranded core, with one or both ends terminated with a connector or pin.Jumper wires come in different lengths, colors, and gauges, and are often sold in sets with different types of connectors, such as male-female, male-male, or female-female. Male connectors have pins that can be inserted into female headers or sockets, while female connectors have sockets that can accept male pins or connectors.

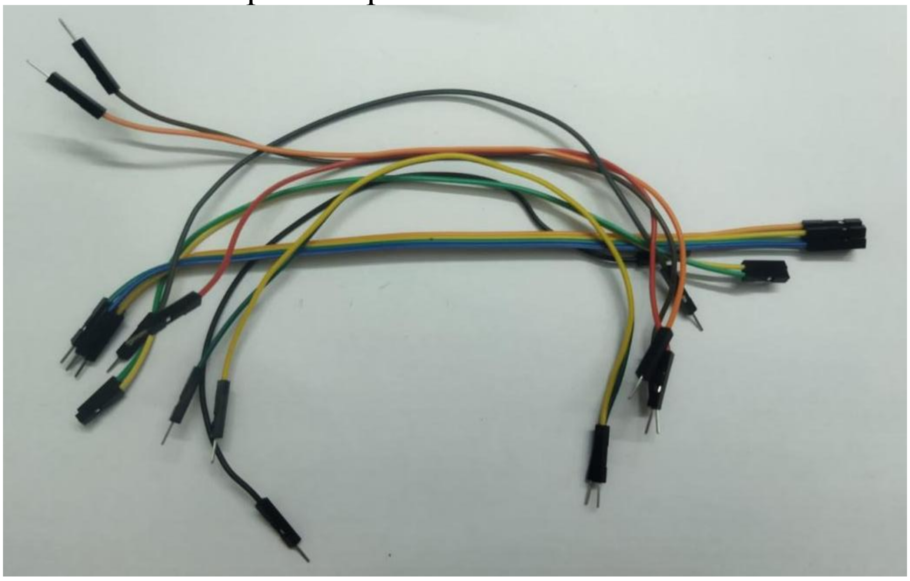

Fig. 7(Jumper Wires)

2. BreadBoard

A breadboard as shown in fig(8) is a prototyping tool used in electronics to build and test circuits without the need for soldering. It is a plastic board with a grid of holes that are used to hold and connect electronic components.Breadboards come in different sizes and configurations, but they typically have two main areas: the terminal strips and the central area. The terminal strips are used to provide power and ground connections, while the central area is used to connect the components and build the circuit.

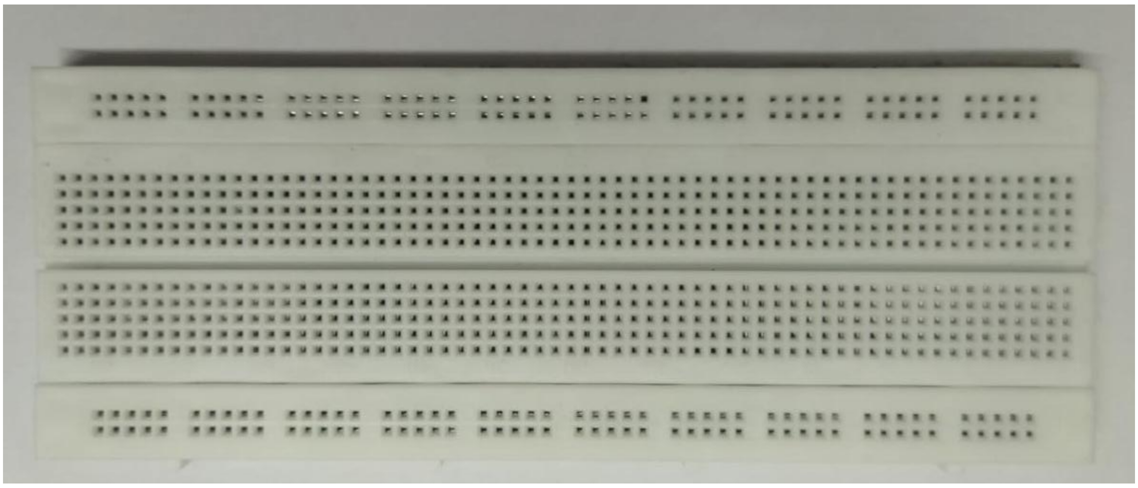

Fig. 8(BreadBoard)

3. Blynk Server

Blynk is a platform for building mobile apps to control and monitor Internet of Things (IoT) devices. The Blynk server is a cloud-based service that connects the mobile app to the IoT device over the internet. It provides a secure and reliable way to control and monitor the device remotely.The Blynk server works by communicating with the IoT device through a protocol called Simple Serial Protocol (SSP). This protocol allows the device to send and receive commands from the server, which are then processed by the mobile app.

3.2 Project Planning

Internet of Things (IoT) technology provides a solution to this problem by enabling the development of smart irrigation systems. A smart irrigation system can monitor the moisture level of the soil and other environmental factors such as temperature and humidity, and adjust the watering schedule accordingly. This can result in significant water savings while ensuring that the plants receive the right amount of water.Such that we can irrigate our plants accurately and efficiently.The planning includes:

1.Study about required IoT materials i.e. sensors, actuators, microcontroller, etc.
2.Individual material testing and isolated implementation for each device.
3.Individual responsibility and works distributed.
4.Literature and other works review.
5.Aggregate sensors and acutators with microcontroller in breadboard and setup.
6.Hosting the results from sensors and motor decision from web server and mobile dashboard.
7.Result analysis , conclusion and future scope.

3.3 Project Analysis

The Smart Irrigation System uses sensors to measure soil moisture and other environmental factors to determine the optimal amount of water required by plants. It consists of sensors, a microcontroller, a watering system, and a mobile app or web interface. The benefits include reduced water consumption, increased crop yields, time-saving, and customizability. This system is a step towards achieving efficient and sustainable agriculture practices.

3.4 System Design

System design includes knowledge for circuit connection , connection with the cloud server which display the result in web and mobile dashboard.

3.3.1.System Architecture:

The Smart Irrigation System consists of the following components:

- Sensors for measuring environmental factors such as soil moisture, temperature, and humidity.
- A microcontroller to process the data collected by the sensors and control the water supply.
- A water supply system that includes pumps, pipes, and sprinklers to supply water to the plants.
- A mobile app or web interface to control the system and monitor its performance.
- Role of user is to controll sensor , Monitoring the blynk mobile and web dashboard, and controlling the monitor using blynkk dashboard according to temperature, humidity and moisture as shown in fig(9).

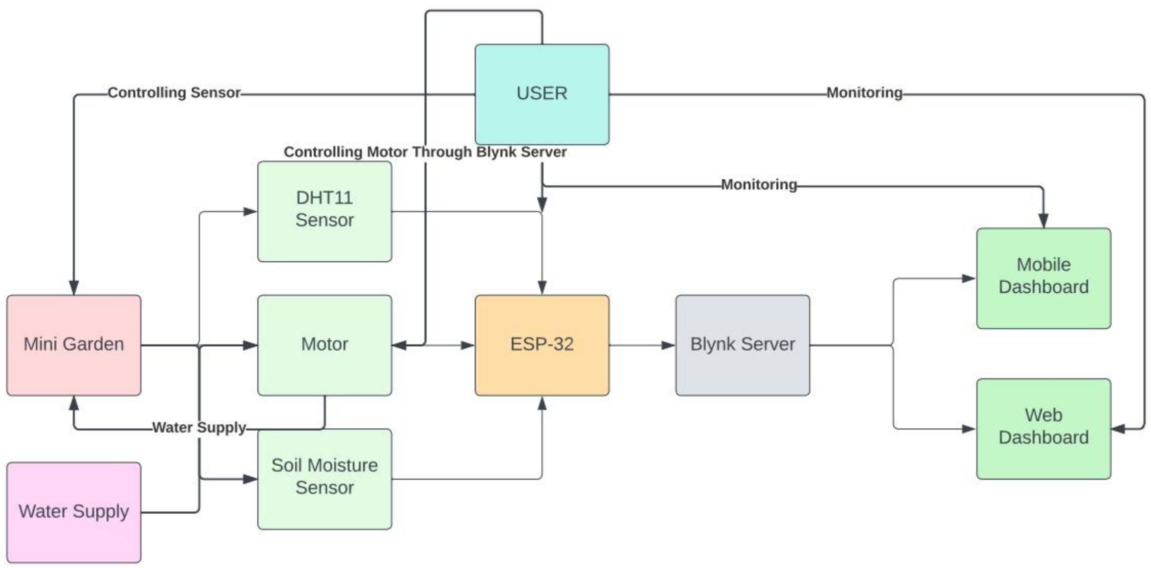

Fig-9 System architecture user and device.

3.3.2 Design constraints

The system design includes below constraints:

- Cost:-The system should be designed to be cost-effective and within the budget of the users.
- Power Consumption:-The Smart Irrigation System should be designed to operate efficiently with low power consumption.
- Reliability:-The Smart Irrigation System should be reliable and function properly under different environmental conditions.
- Maintenance:-The Smart Irrigation System should be designed to be easy to maintain and repair.
- Compatibility:-The Smart Irrigation System should be designed to be compatible with different platforms and operating systems.
- Communication:-The Smart Irrigation System should be designed to provide reliable communication between the sensors, microcontroller, water supply system, and mobile app or web interface

4. Implementation

Smart irrigation system using IOT includes implementation of sensors, actuators, microcontroller through blynk server and arduino IDE.This implementation includes DHT11(temperature and humidity sensor), soil moisture sensor, ESP32, motor, pipe, sprinkler, jumper wires, breadboard, relay and hardware resources and blynk server , arduino IDE and coding as software reources.The implementation video can be seen through this link https://drive.google.com/file/d/1q6ofT2TkJb5wPTU5IqAIK44y5YOvb0F1/view?usp=drivesdk

4.1 Methodology

- Sensor Placement:-The first step in implementing a Smart Irrigation System is to place the sensors in the soil and proper circuitation as mentioned in circuit diagram.
- Microcontroller Programming:-The microcontroller is the brain of the Smart Irrigation System. The microcontroller should be programmed to read the data from the sensors and control the water supply system.
- Water Supply System Installation:-The water supply system should be installed to supply water to the plants based on the data collected by the sensors. The water supply system should be designed to ensure that water is supplied to the plants evenly and efficiently.
- Mobile App or Web Interface Development:-The mobile app or web interface should be developed to allow the user to control the Smart Irrigation System remotely. The app should provide real-time data on the system's performance, including soil moisture levels, temperature, and water usage. The app should be user-friendly and easy to navigate.
- Integration and Testing:-The sensors, microcontroller, water supply system, and mobile app or web interface should be integrated to ensure that the system works seamlessly.
- Maintenance and Upgrades:-The Smart Irrigation System should be maintained regularly to ensure that it operates efficiently. The system should be designed to allow for easy maintenance, including sensor replacement and software updates.

4.2 Testing

This includes testing of individual devices(sensors,actuators and microcontroller) and proper implementation for the coding and blynk server. Testing the sensors data in web and mobile dashboard. Controlling of motor for watering to the plant.Proper circuit diagram implementation. Water supply and intergation of all the devices. Once the Smart Irrigation System is installed in the field, it should be tested under real-world conditions to ensure that it performs as expected. The system should be tested under different weather conditions and with different plant types to ensure that it is reliable and provides accurate data.

4.3 Result Analysis AND Screenshots

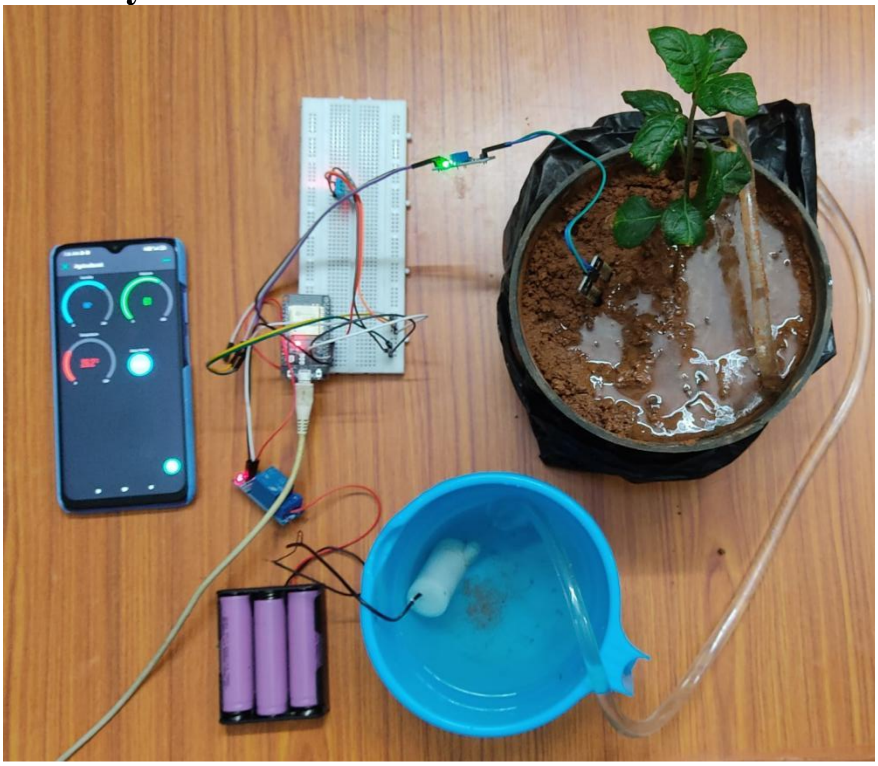

Fig. 10(Implementation of the circuit diagram)

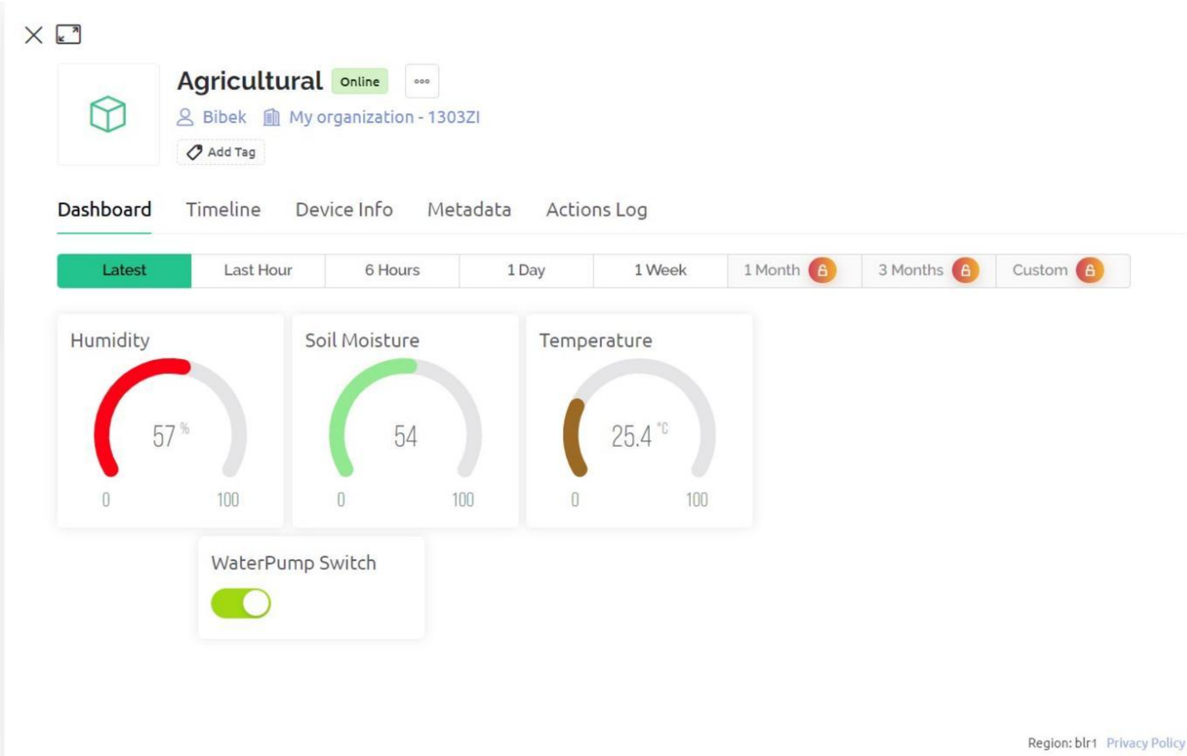

Fig. 11(blynk server implementation for web dashboard)

Fig. 12(blynk server implementation for mobile dashboard)

4.4 Quality Assurance

Quality assurance is critical to ensure the successful development and deployment of a smart irrigation system. Quality assurance activities include requirements analysis, design reviews, code reviews, testing and validation, documentation, training, and security. By applying these activities, the smart irrigation system can be designed, developed, and deployed with confidence that it meets the user's requirements and expectations.

5. Conclusion and Future Scope

5.1. Conclusion

After implementing IoT devices, specifically ESP32, in smart irrigation, we observed significant improvements in crop yields, quality, and cost reduction. In this project, we proposed the application of wireless sensor networks (WSNs) for crop watering and designed and implemented a system to control environmental factors in crop fields. This system consisted of three parts: hardware, a web application, and a mobile application. The hardware part, which was designed in control box form, included electronic control systems and sensors to obtain data on crops. The system connected to and received IoT information from any field in the study. The web-based application was designed to manipulate crop data and field information, and it stored large-scale data from IoT for data analysis. One key contribution of our work was applying data mining by association rules to discover useful information on the effects of the environment and climate on crop productivity. Our results showed that the suitable temperature for high productivity of homegrown vegetables and lemons was between 29°C and 32°C, and the suitable humidity for high productivity of lemons was within 72–81%. We also developed a mobile application that allowed for automatic and manual functional control of crop watering, based on data from soil moisture sensors. This system sent notifications through the LINE application.Our project demonstrates the high potential of digital technology applications, specifically IoT devices, in agriculture.

5.2.Future Scope

Based on the successful implementation of the smart irrigation system using IoT devices in this project, some potential future scope and possible improvements could be:

- Integration of more sensors and actuators: The system could be further improved by adding more sensors and actuators to measure and control other factors affecting crop growth, such as air quality, light intensity, and CO_2 levels.
- Integration with other technologies: The system could be integrated with other technologies like Artificial Intelligence (AI) and Machine Learning (ML) to develop advanced algorithms that can analyze crop data and provide accurate recommendations for crop management.
- Expansion to larger areas: The system could be expanded to cover larger agricultural areas and could be implemented on a large scale to improve crop yields, quality, and reduce costs in the agriculture sector.

- Integration with a wider range of crops: The system could be adapted to a wider range of crops to provide tailored irrigation solutions for each crop, resulting in better yield and quality.
- Real-time monitoring: Real-time monitoring of the crop and irrigation system could be achieved using advanced communication protocols, which would allow farmers to receive live updates and alerts about the status of their crops and irrigation system, thereby enabling them to take appropriate actions in real-time.
- Integrating device into robot: Advancing the device by adding mobility to it can help save the cost of setting multiple devices in an area.
- These are just a few examples of future scope and possible improvements for the smart irrigation system using IoT devices.

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4. DHT11 (Temperature and Humidity Sensor)

5. Interfacing ESP-32 with DHT11

6. Interfacing ESP-32 with Soil Moisture Sensor

7. Interfacing ESP-32 with Relay and Motor with web server

8. Application of blynk Server for web dashboard

9. Application of blynk Server for mobile dashboard

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SMART IRRIGATION SYSTEM

BIBEK KC
20051722

ABSTRACT

Traditional irrigation systems are inefficient, as they rely on scheduled watering regardless of the actual moisture needs of the plants.The Smart IoT Irrigation System using Blynk Server is an emerging technology that aims to improve the efficiency and effectiveness of the irrigation process. Traditional irrigation systems often result in water wastage, inefficient water distribution, and over or under-watering of plants, which can lead to poor plant growth and low yield. These systems are also labor-intensive, as they require manual monitoring and control. With the increase in water scarcity and the need for sustainable agriculture practices, there is a need for a smart irrigation system that can automate and optimize the irrigation process.

Contribution and findings:

In this project I am mainly focused and contributed on the hardware and circuit part. Study of different hardwares and their connection is mainly comes under my responsibility. The main hardware used under this projects are DHT11 sensor, soil moisture sensor, Breadboard, motor, 3 12V battery, ESP-32, Relay, water Source and jumper wires. Interfacing of each sensor and testing them by implementing code for each sensors and at last aggregrating all the components for the final outcome.Implementing the code through arduino IDE for ESP-32 and each sensor and monitoring the result through the serial monitor. Major experience from this project is that we are able to understand working of hardware as well as software achitecture of the IOT appliances. Testing of each sensors and finding of desired output through serial monitor is done.

Contribution to project report preparation:

We had divided the project report preparation plan into our three group members on which my part includes [3] Project Planning and [4]Implementation part. These part includes study about required IoT materials i.e. sensors, actuators, microcontroller, etc., individual material testing and isolated implementation for each device.,individual responsibility and works distributed,literature and other works review, aggregate sensors and acutators with microcontroller in breadboard and setup, hosting the results from sensors and motor decision from web server and mobile dashboard, Result analysis , conclusion and future scope.These things are mentioned in th project report as per my part.

Full Signature of Supervisor: Full signature of the student:
Bibek Kc

SMART IRRIGATION SYSTEM

DHIRAJ KUMAR MISHRA
20051839

ABSTRACT

Traditional irrigation systems are inefficient, as they rely on scheduled watering regardless of the actual moisture needs of the plants.The Smart IoT Irrigation System using Blynk Server is an emerging technology that aims to improve the efficiency and effectiveness of the irrigation process. Traditional irrigation systems often result in water wastage, inefficient water distribution, and over or under-watering of plants, which can lead to poor plant growth and low yield. These systems are also labor-intensive, as they require manual monitoring and control. With the increase in water scarcity and the need for sustainable agriculture practices, there is a need for a smart irrigation system that can automate and optimize the irrigation process.

Contribution and findings:

In the project, I have mainly studied the basic concepts of IoT and its needs in agriculture and how it could be implemented. After reading some research paper we come to use the proposed system. The other side of my findings and contributions are list below :-

- Study the sensors needed and gather it from related place/market.
- I have studied the DHT11 sensors, its pin and working. Coding part for the sensor is done in arduino IDE seperately for testing purpose of the sensor and it was fine and good.
- I found that it has 3pins(Vcc,Data & Ground) and used for different purposes. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±2°C and ±5% respectively.
- Implemented the sensor in the project as whole and combine with Blynk server.
- Design, overall model presentation and video demonstration.

Contribution to project report preparation:

I have prepared about the introduction and basic concepts of report that includes Inroduction to IoT in introduction (topic 1) & Basic concepts on Iot(topic 2). I along with other members contributed in writing abstract and references. In addition, Sensors details and information gathered and document for implementation the sensor (specifically DHT11) is written me. The presentation part (preparing the ppt) is carried by all the members collectively. We discussed the blynk web app and mobile app design and implemention where I presented the temperute humidity and moisture sensor working and implementation.

Full Signature of Supervisor:

Full signature of the student:
Dhiraj Kumar Mishra

SMART IRRIGATION SYSTEM

RUPESH SHAH
20051750

ABSTRACT

Traditional irrigation systems are inefficient, as they rely on scheduled watering regardless of the actual moisture needs of the plants.The Smart IoT Irrigation System using Blynk Server is an emerging technology that aims to improve the efficiency and effectiveness of the irrigation process. Traditional irrigation systems often result in water wastage, inefficient water distribution, and over or under-watering of plants, which can lead to poor plant growth and low yield. These systems are also labor-intensive, as they require manual monitoring and control. With the increase in water scarcity and the need for sustainable agriculture practices, there is a need for a smart irrigation system that can automate and optimize the irrigation process.

Contribution and findings:

- During my involvement in the project, I mainly focused on studying the functionality of the relay and its implementation in the irrigation system. I have also contributed to the coding of the relay module in the Arduino IDE for controlling the relay module.
- I researched the various pins available on the ESP32 boards and their functions. This allowed me to understand how to use the board to control the different components of the smart farming system, such as sensors, actuators, and relays.
- I also contributed to the project by working on the Blynk server and designing the mobile application , which was used to host the data collected from the sensors and control and used to control the irrigation system.I was responsible for designing the user interface and integrating the necessary functionalities.

Finding:

- Through my work on the project, I discovered that the relay plays a crucial role in automating the irrigation system. The relay can be programmed to turn the water pump on and off based on the data collected from the sensors, ensuring that the crops receive the optimal amount of water.
- Furthermore, I found that the Blynk server and mobile application is a powerful tool for hosting data and accessing it from remote locations. It provides a simple and user-friendly interface that can be used to monitor the system's performance and make necessary adjustments.

Contribution to project report preparation:

I have prepared conclusion and future scope part from the report that also includes expansion on blynk server in future. I also with other members contributed in writing the abstract for the report.

Full Signature of Supervisor: Full signature of the student:
Rupesh Kumar Shah