"IOT Based Smart Agriculture System"

A Major Project Report Submitted to

Rajiv Gandhi Proudyogiki Vishwavidyalaya

Towards Partial Fulfillment for the Award of

Bachelor of Engineering in Computer Science Engineering

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EXAMINER APPROVAL

The Major Project entitled **"IOT Based Smart Agriculture System"** submitted by **Aayushi Jain(0827CS201007), Amisha Linjhara (0827CS201029), Ankur Nagar(0827CS201035), Atharva Pagare (0827CS201048)** has been examined and is hereby approved towards partial fulfillment for the award of **Bachelor of Technology degree in Computer Science Engineering** discipline, for which it has been submitted. It understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed, or conclusion drawn therein, but approve the project only for the purpose for which it has been submitted.

(Internal Examiner) | **(External Examiner)**

Date: | **Date:**

RECOMMENDATION

This is to certify that the work embodied in this major project entitled **"IOT Based Smart Agriculture System"** submitted by **Aayushi Jain (0827CS201007), Amisha Linjhara (0827CS201029), Ankur Nagar (0827CS201035), Atharva Pagare (0827CS201048)** is a satisfactory account of the bonafide work done under the supervision of *Dr. Kamal Kumar Sethi*, is recommended towards partial fulfillment for the award of the Bachelor of Technology (Computer Science Engineering) degree by Rajiv Gandhi Proudyogiki Vishwavidhyalaya, Bhopal.

(Project Guide)

(Project Coordinator)

(Dean Academics)

STUDENTS UNDERTAKING

This is to certify that the major project entitled **"IOT Based Smart Agriculture System"** has been developed by us under the supervision of Dr. Kamal Kumar Sethi. The whole responsibility of the work done in this project is ours. The sole intention of this work is only for practical learning and research. We further declare that to the best of our knowledge; this report does not contain any part of any work which has been submitted for the award of any degree either in this University or in any other University / Deemed University without proper citation and if the same work is found then we are liable for explanation to this.

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Executive Summary

"IOT Based Smart Agriculture System"

This project is submitted to Rajiv Gandhi Proudyogiki Vishwavidhyalaya, Bhopal (MP), India for partial fulfillment of Bachelor of Engineering in Information Technology branch under the sagacious guidance and vigilant supervision of Dr. Kamal Kumar Sethi. The Smart Agriculture IoT project introduces cost-effective and user-friendly IoT solutions tailored for farmers. This project equips farmers with sensors to monitor soil moisture, humidity, light intensity, and temperature, facilitating informed decision-making for improved crop cultivation. This data empowers farmers to make informed decisions, optimize resource usage, and enhance crop yields. By providing remote control, this system streamlines agriculture operations, reduces costs, and contributes to sustainable farming practices while ensuring food security.

Keywords: BOLT IoT, Arduino UNO, Sensors, LDR, LM35, DHT11, FC28, ESP8266.

“Where the vision is one year,

cultivate flowers;

Where the vision is ten years,

cultivate trees;

Where the vision is eternity,

cultivate people.” -

Oriental Saying

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List of Abbreviations

Abbreviation	**Full Form**
IoT	Internet of Things
LDR	Light Dependent Resistor
LM35	Linear Monolithic 35
ESP8266	Embedded Serial Port 8266
DHT11	Digital Temperature And Humidity Sensor
Wi-Fi	Wireless Fidelity
GSM	Global System for Mobile Communications
GPRS	General packet radio service
IDE	Integrated Development Environment
ROI	Return on investment

Chapter 1. Introduction

Introduction

In the face of increasing global food demand and the need for sustainable agricultural practices, farming operations play a critical role. To address the unique challenges faced by farmers and promote efficient, sustainable, and productive farming practices, we introduce the Smart Agriculture IoT Project. This initiative harnesses the power of the Internet of Things (IoT) to empower farmers with affordable and accessible technology solutions. With a focus on simplicity and user-friendliness, our project aims to bridge the technology gap, enabling farmers to compete in an increasingly digital agricultural landscape while contributing to sustainable food production and local economic growth.

1.1 Overview

This project seeks to address the unique idea to users . By deploying IoT sensors to monitor vital environmental factors such as soil moisture, humidity, light intensity, and temperature, the project enables data-driven decision-making for crop cultivation. These sensors provide real-time data that is easily accessible via mobile apps, allowing farmers to make informed choices about irrigation, planting and soil health .

1.2 Background and Motivation

Agriculture is a fundamental pillar of global food production and economic development. To thrive in the ever-evolving agricultural landscape, farmers, both large and small, must adopt modern farming practices. In recent years, the Internet of Things (IoT) has emerged as a transformative technology in agriculture. IoT sensors provide real-time data on crucial environmental factors, enabling precise decision-making, resource optimization, and sustainable farming practices. The project's motivation is rooted in the belief that successful IoT technology adoption can have a profound impact on food security, economic development, and sustainable agriculture worldwide. It aims to ensure that farmers of all scales can benefit from IoT solutions tailored to their needs, thereby improving global food production and environmental sustainability.

1.3 Problem Statement and Objectives

In the realm of modern agriculture, where precision and sustainability are paramount, a significant challenge lies in the lack of accessible and affordable IoT solutions for users. This deficiency hinders their ability to harness real-time data on crucial environmental factors, including soil conditions, humidity, light intensity, and temperature. As a result, farmers face difficulties in making informed decisions, optimizing resource usage, and adopting sustainable practices that are essential for increased crop productivity. To address this issue, the Smart Agriculture IoT Project seeks to develop and implement a cost-effective and user-friendly IoT system that empowers farmers with the data-driven insights required to improve agricultural operations.

Objectives:

- Develop an IoT-based system that enables real-time monitoring of key agricultural parameters, including soil moisture, temperature, humidity, light intensity, and weather conditions.
- Provide training materials and support to farmers for the effective use of the monitoring system. Ensure that the technology is accessible to users with varying levels of technical expertise.

1.4 Scope of the Project:

- **Data Management and Analysis:** Develop a robust data management system to store, process, and analyze the collected data. Utilize data analytics and machine learning to derive actionable insights.

- **Crop Monitoring and Management:** Implement solutions for crop health monitoring, disease detection, and yield prediction.

- **Resource Optimization:** Optimize resource usage, such as water, energy, and fertilizers, to reduce waste and environmental impact.

- **Training and Support:** Provide training and ongoing support to farmers to ensure efficient use of the IoT system.

- **Integration with Existing Systems:** Ensure compatibility and integration with existing farm management software and equipment.

- **Security and Data Privacy:** Implement robust cybersecurity measures to protect data and the IoT infrastructure.

1.5 Team Organization

Ankur Nagar

Ankur Nagar took the lead in software coding for the project. He was responsible for developing the code that interfaced with the BOLT Cloud Platform, enabling data transmission and communication between the BOLT IoT Kit and the cloud-based system. Also he ensured that data from various sensors was efficiently processed and displayed in real-time.

Atharva Pagare

Focused on configuration for the ESP8266 WiFi module and Arduino Uno, ensuring that these microcontrollers effectively communicated with the sensors and relayed data to the BOLT Cloud Platform. Ensured the seamless integration of the IoT devices, played a crucial role in optimizing the performance of the system.

Aayushi Jain

Focused on documentation for the project using UML diagrams such as Data Flow Diagram, ER Diagram and Use Case Diagram .Along with the used case worked on Report and Research Paper along with the Posture . Gain Knowledge about Sensors along with the graph.

Amisha Linjhara

Played a crucial role in the realm of documentation, particularly in the comprehensive exploration and elucidation of research papers, reports, technical diagrams, and studies pertaining to sensors and circuit boards. With a meticulous approach, she delves into the intricacies of technological advancements, meticulously compiling and articulating information to create detailed documents.

1.6 Report Structure

The project **Smart Agriculture system using IOT** project report is categorized into five chapters.

Chapter 1: Introduction- introduces the background of the problem followed by rationale for the project undertaken. The chapter describes the objectives, scope and applications of the project. Further, the chapter gives the details of team members and their contribution in development of the project which is then subsequently ended with a report outline.

Chapter 2: Review of Literature- explores the work done in the area of Project undertaken and discusses the limitations of the existing system and highlights the issues and challenges of the project area. The chapter finally ends up with the requirement identification for present project work based on findings drawn from reviewed literature and end user interactions.

Chapter 3: Proposed System - starts with the project proposal based on requirement identified, followed by benefits of the project. The chapter also illustrates the software engineering paradigm used along with different design representations. The chapter also includes ER diagrams and details of major modules of the project. Chapter also gives insights of different types of feasibility study carried out for the project undertaken. Later it gives details of the different deployment requirements for the developed project.

Chapter 4: Implementation - includes the details of different Technology/ Techniques/ Tools/ Programming Languages used in developing the Project. The chapter also includes the different user interfaces designed in the project along with their functionality. Further it discusses the experiment results along with testing of the project. The chapter ends with evaluation of the project on different parameters like accuracy and efficiency.

Chapter 5: Conclusion - Concludes with objective wise analysis of results and limitation of present work which is then followed by suggestions and recommendations for further improvement.

Chapter 2 . Review of Literature

Review of Literature

The Internet of Things (IoT) technology has revolutionized various aspects of people's lives by introducing smart and intelligent solutions. IoT involves a network of interconnected devices that form a self-configuring network. The development of intelligent IoT-based devices for Smart Farming is significantly transforming agricultural production. These devices not only enhance agricultural practices but also make them cost-effective, reducing wastage in the process. The main objective of this project is to propose a novel IoT-based solution for agriculture, enabling users to access live data such as temperature, light intensity, humidity and soil moisture. This real-time information facilitates efficient environmental monitoring, empowering users to engage in smart farming practices, thereby increasing their overall yield and product quality.

2.1 Preliminary Investigation

2.1.1 Current System

- **Agrisense:** It is a sophisticated agricultural technology platform equipped with a range of essential features. It enables real-time monitoring and analysis of crops, livestock, and environmental conditions such as soil health and weather patterns. Key functionalities include precise data collection, resource optimization, task automation, and actionable insights. Agrisense empowers farmers to make informed decisions, enhancing productivity and sustainability in farming practices.

- **Greenfield IoT:** It refers to the application of Internet of Things (IoT) technology specifically in new, previously undeveloped areas or projects, often focusing on sustainable or environmentally friendly initiatives. Greenfield IoT solutions leverage interconnected devices equipped with sensors and actuators to collect and exchange data in these fresh, untapped environments.

- **SmartAgro IoT:** It refers to the application of Internet of Things (IoT) technology specifically tailored for the agricultural sector. It involves the integration of connected devices, sensors, and data analytics in farming practices to enhance productivity, efficiency, and sustainability.

2.2 Limitations of Current Systems

- **Agrisense:** Limited compatibility and integration with certain types of sensors or agricultural equipment.

- **GreenField IoT:** It has Interoperability Issues, IoT devices have compatibility issues.

- **SmartAgro:** User interface complexity, potentially impacting the ease of use for farmers with varying levels of technical expertise.

2.3 Requirement Identification and Analysis for Project

The study underscores the holistic approach of the smart agricultural monitoring system. By combining data from multiple sensors, the system aims to provide farmers with a comprehensive understanding of their agricultural environment. The interplay of these factors allows for a nuanced analysis of the conditions influencing crop growth, enabling farmers to make data-driven decisions.

Furthermore, the real-time nature of the data collection enhances the system's responsiveness. Farmers can receive immediate alerts and insights, allowing them to proactively address issues such as water scarcity, suboptimal temperature ranges, or excessive humidity. This proactive approach contributes to resource optimization, improved crop quality, and ultimately, increased agricultural sustainability. The study brought out the critical factors that impact crop growth. In this context, the four selected parameters—light intensity, soil moisture, humidity, and temperature—play crucial roles in agricultural productivity. Effective light exposure is fundamental for photosynthesis, the process by which plants convert light energy into chemical energy to fuel their growth. Monitoring light intensity enables farmers to assess whether crops receive the required amount of sunlight for optimal development. Soil moisture content directly influences plant hydration and nutrient absorption. Insufficient moisture can lead to drought stress and hinder nutrient uptake, affecting crop health and yield. Conversely, excessive moisture can lead to waterlogging, root rot, and nutrient leaching. By monitoring soil moisture levels, the agricultural monitoring system can guide irrigation practices, ensuring that crops receive the right amount of water at the right time. This contributes to water conservation, improved crop resilience, and overall resource efficiency.

Humidity levels impact plant transpiration, the process by which water is drawn up through the plant and released into the atmosphere. High humidity can reduce the rate of transpiration, affecting nutrient transport and potentially leading to fungal diseases. On the other hand, low humidity can increase transpiration, leading to water stress. By monitoring humidity, the agricultural system can assist in optimizing greenhouse conditions, preventing disease outbreaks, and improving overall plant health. Temperature is a critical factor influencing plant metabolism, growth, and development. Different crops have specific temperature requirements for optimal growth. Monitoring temperature allows farmers to assess whether the current climate aligns with the needs of their crops.

2.3.1 Functional Requirements

- **Sensor Data Acquisition:** The system shall acquire real-time data from four sensors: Light Dependent Resistor (LDR) for light intensity, FC28 for soil moisture, DHT11 for humidity, and LM35 for temperature.

- **Circuit Configuration:** The system shall be configured with appropriate circuitry to interface with the Bolt IoT module, facilitating the seamless integration of sensor data.

- **Data Transmission to Bolt Cloud:** The system shall transmit sensor data securely to the Bolt Cloud using appropriate communication protocols.

- **Real-Time Visualization:** The system shall provide real-time visualization of sensor data through the Bolt Cloud dashboard.

2.3.2 Non Functional Requirements

- **Reliability:** The system shall operate reliably, with a minimum of 99% uptime, ensuring continuous monitoring and data availability.

- **Scalability:** The system shall be scalable to accommodate an increasing number of sensors and devices, allowing for future expansion.

- **Performance:** The system shall process and transmit sensor data with low latency, providing near real-time updates to the Bolt Cloud dashboard.

- **Interoperability:** The system shall be interoperable with common IoT protocols, allowing for integration with other agricultural management tools and systems.

2.3.3 Conclusion

This chapter reviews the literature surveys conducted to explore existing knowledge and research in the field. The literature review critically evaluates and compares different perspectives, theories, and approaches, contributing to a deeper understanding of the research context and guiding the development of the proposed smart agricultural monitoring system.

Chapter 3 .Proposed System

IOT Based Smart Agriculture System

3.1 The Proposal

The main idea of this project is development of an IoT-based system for real-time monitoring of soil moisture, temperature, and environmental factors to optimize crop growth and reduce water usage. The system minimizes manual intervention and promotes sustainable farming practices. Through advanced data analytics and machine learning, the system provides actionable insights for farmers to make informed decisions. By leveraging IoT technology, the system aims to enhance agricultural productivity, resource efficiency, and long-term food security.

IoT-based Smart Agriculture System revolutionizes traditional farming practices by seamlessly integrating cutting-edge technologies into agricultural processes. Through the strategic deployment of sensors and interconnected devices, this innovative approach empowers farmers with real-time data and advanced analytics. From monitoring soil conditions and optimizing irrigation to precision farming and livestock management, the system aims to enhance efficiency, productivity, and sustainability in agriculture. This small-scale introduction encapsulates the transformative potential of IoT in reshaping the landscape of modern farming.

3.2 Benefits of the Proposed System

Based on the identified gaps and the comparison of existing systems, the specific objectives to be addressed during the development of an IoT-based system for real-time crop monitoring and optimization are as follows:

Integration of Additional Environmental Factors :

The proposed system is economic as there will not be any person required to keep a watch on the entrance.

Improved Crop Compatibility and Soil Conditions:

Enhance the system's compatibility with a wide range of crop types and varying soil conditions to cater to diverse agricultural settings.

Sensor Integration:

The system should support the integration of various IoT sensors to monitor environmental conditions such as soil moisture, temperature, humidity, light intensity, and atmospheric condition.

Data Collection and Analysis:

The system should collect sensor data in real-time and perform data analytics to derive insights and patterns related to crop growth, health, and environmental conditions.

User-Friendly Interface and Accessibility:

Design a user-friendly interface that allows easy access and control of the system for users

3.3 ER Diagram

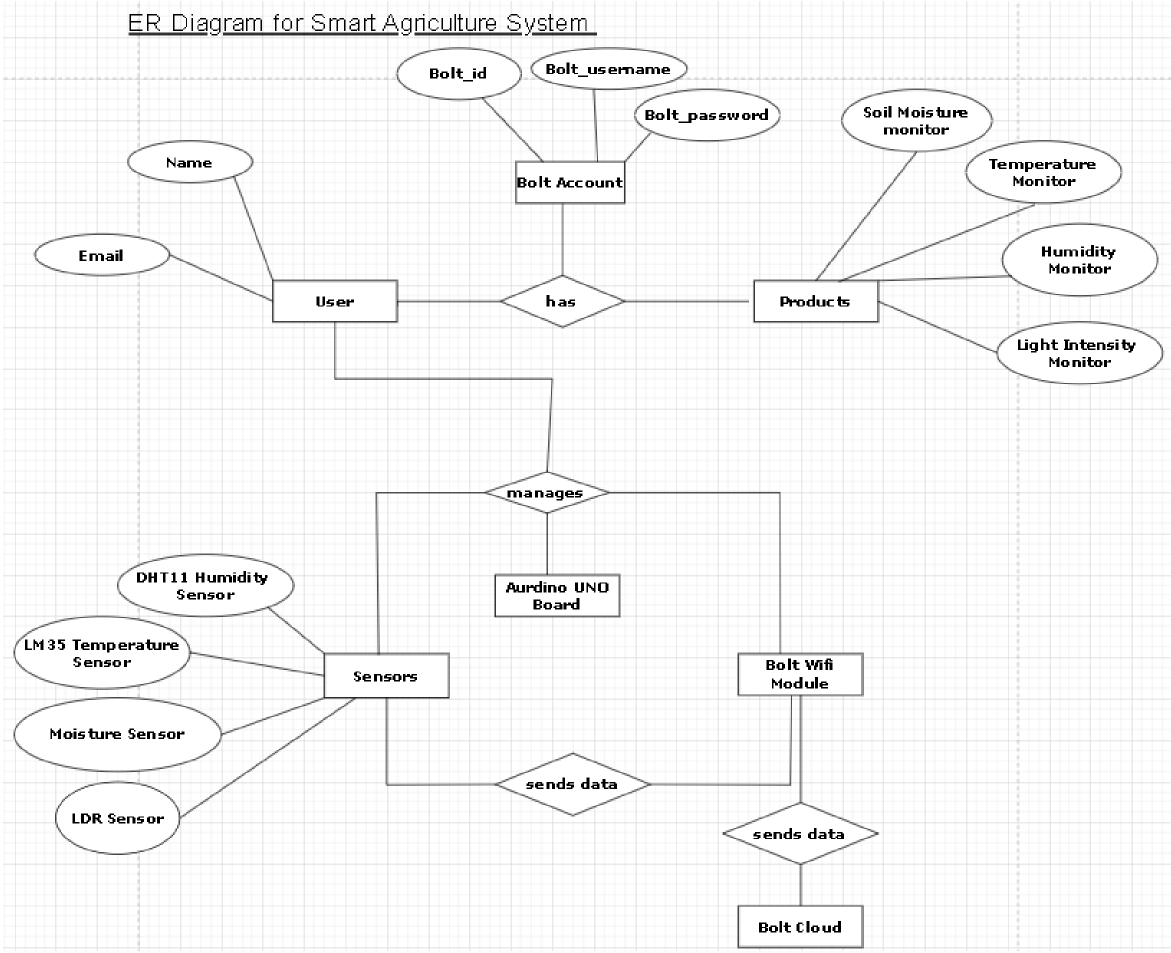

Figure 3-1 : ER Diagram

3.4 Feasibility Study

A feasibility study for IoT-based smart agriculture assesses the viability of implementing IoT technology in farming. It involves analyzing technical requirements, costs, benefits, risks, and regulatory considerations. The study helps determine whether the project is feasible and provides valuable insights for decision-making and planning.

3.4.1 Technical

Hardware Setup:

Acquiring the BOLT module kit, which includes a microcontroller, sensors, and connectivity options. Connecting the BOLT module to the development board or microcontroller.

Sensor Integration:

Sensors that we are using for the project include soil moisture sensors, temperature sensors, humidity sensors, and light sensors.Connecting and integrating the sensors with the BOLT module using the appropriate interfaces or protocols.

Data Collection and Processing:

Configure the BOLT module to collect data from the connected sensors at regular intervals.

Implementation of data processing on the microcontroller to analyze and interpret Connectivity and Communication:

Establish connectivity options for the system, such as Wi-Fi or GSM/GPRS, depending on the availability of network coverage in the agricultural area.
Configure the BOLT module to send the processed data to a centralized server or cloud platform for storage and further analysis.Ensure secure communication between the BOLT module and the server/cloud platform, considering encryption and authentication mechanisms.

User Interface and Control:

We will Develop a user interface for monitoring and controlling the smart agriculture system.It will provide real-time information to users regarding environmental conditions, crop health, and any required actions.

Continuous Monitoring and Maintenance:

Establish a system for monitoring the health and performance of the smart agriculture system, including the BOLT module and connected sensors. We will Regularly maintain and calibrate the sensors to ensure accurate data collection.

3.4.2 Economical

Economically feasible IoT-based smart agriculture is a sustainable approach that utilizes cost-effective IoT technology to enhance farming practices. It focuses on optimizing costs through affordable hardware, efficient data management, scalable solutions, and collaboration, while also assessing the return on investment (ROI) to ensure the economic viability of the project.

3.4.3 Operational

In IoT-based smart agriculture, operational aspects involve managing and maintaining the system on a day-to-day basis. This includes tasks like data collection, processing, automation, remote monitoring, security, scalability, training, maintenance, and cost control. Efficient operations are essential for leveraging IoT technology to improve farm productivity and sustainability.

3.5 Data Flow Diagram:

3.5.1 Data Flow Diagrams(level-0)

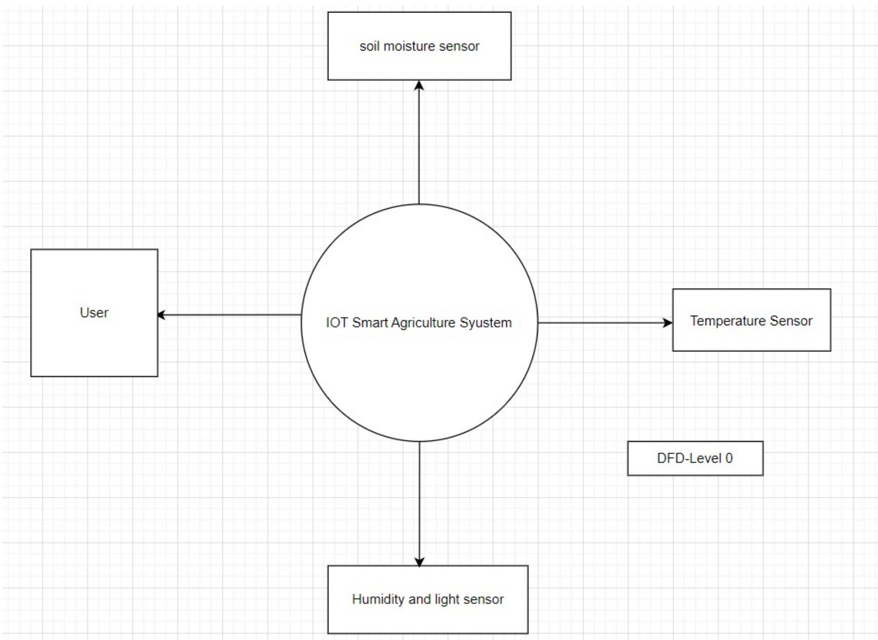

Figure 3-2 : Data Flow Diagram (level-0)

3.5.2 Data Flow Diagram(level-1)

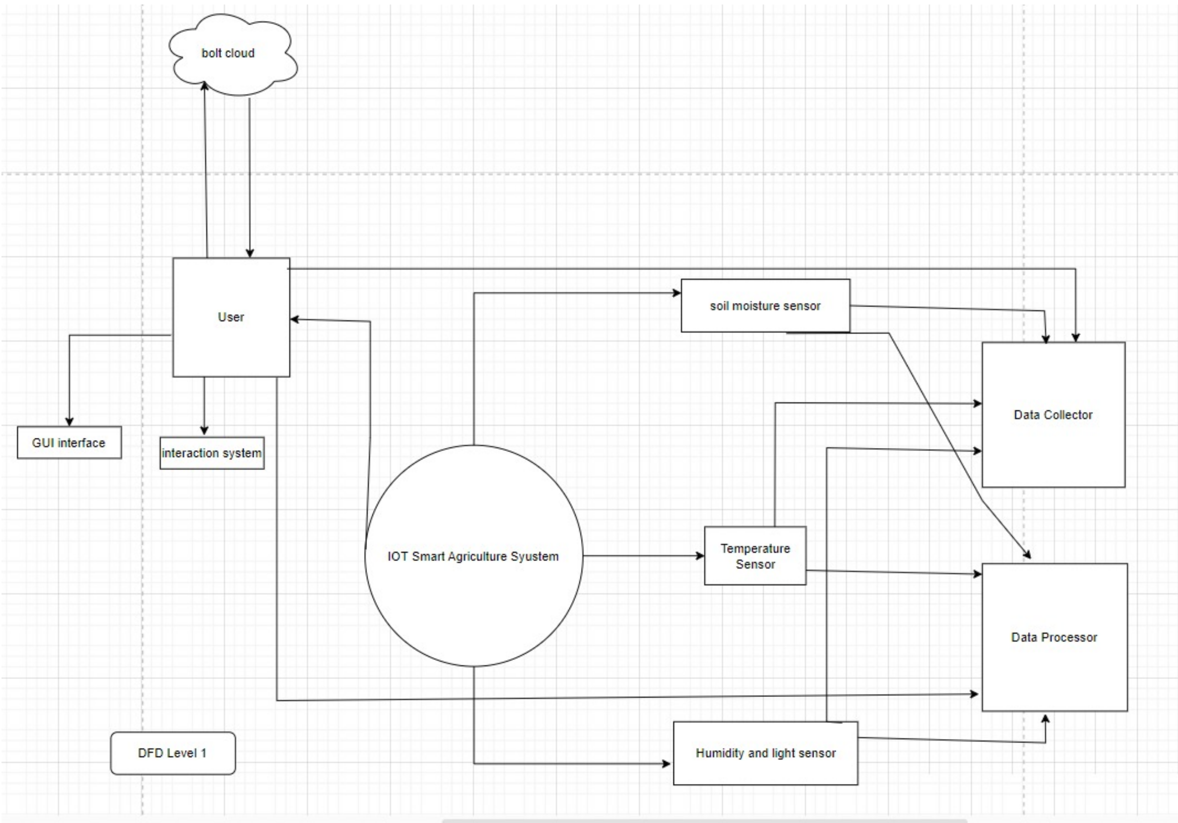

Figure 3-3 : Data Flow Diagram (level-1)

In the Figure 3-2 Data Flow Diagram (level-0) there is a user in data that can retrieve and pass to the IOT smart Agriculture system In which are three types of sensor used for temperature sensor, soil moisture sensor and light and humidity sensor. By leveraging IoT technology, the system aims to enhance agricultural productivity, resource efficiency, and long-term food security.

In the Figure 3-3 Data Flow Diagram (level-1) where we used cloud to retrieve and used data to send it to the user. Users can take data from GUI interaction and Interaction system by using a monitor or laptop.In which Data collection and Data processor is directly connected to user where exchange information of sensors and giving input and producing outputs to the system in the form of graphs.

3.6 Use Case Diagram:

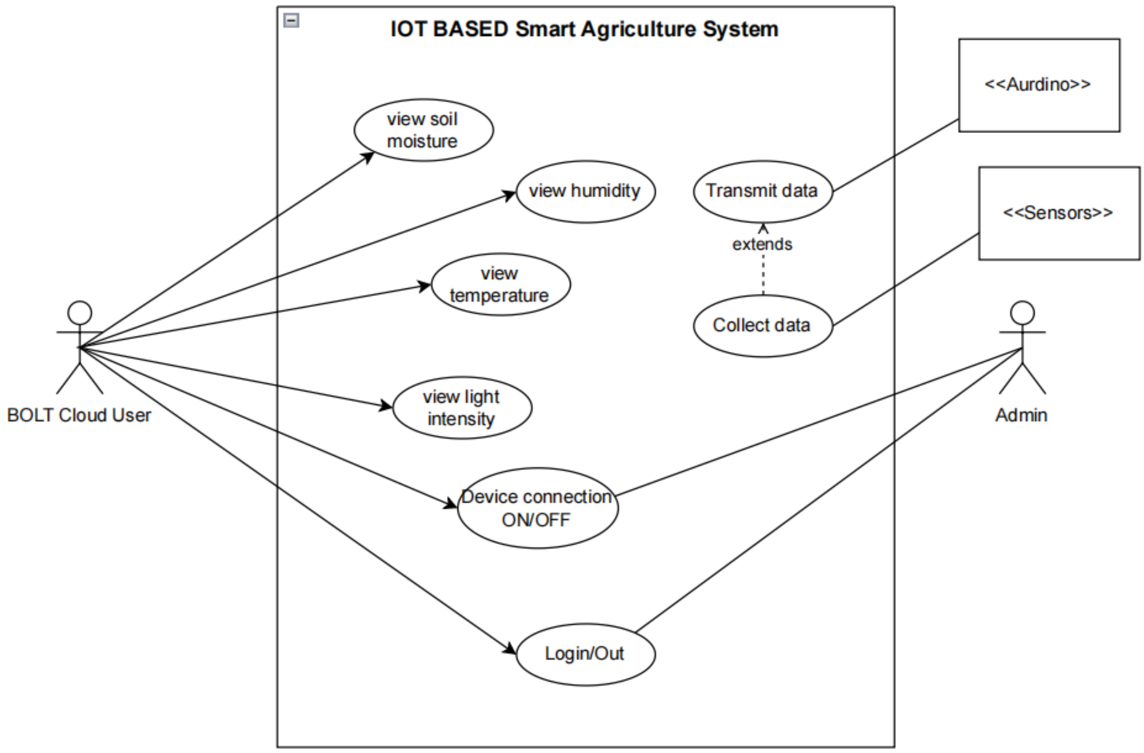

Figure 3-4: Use Case Diagram

In the Figure 3-4 Use Case Diagram about the flow of implementation throughout the project users can view temperature,humidity, light intensity and soil moisture. User also switches the system to turn on and off the system. Admin will collect the data and transmit data to the user . Admin will be able to access sensors and arduino. Admin can also access the switch system to turn on and off.This diagram can show the flow of the overall project .

3.7 Sequence Diagram:

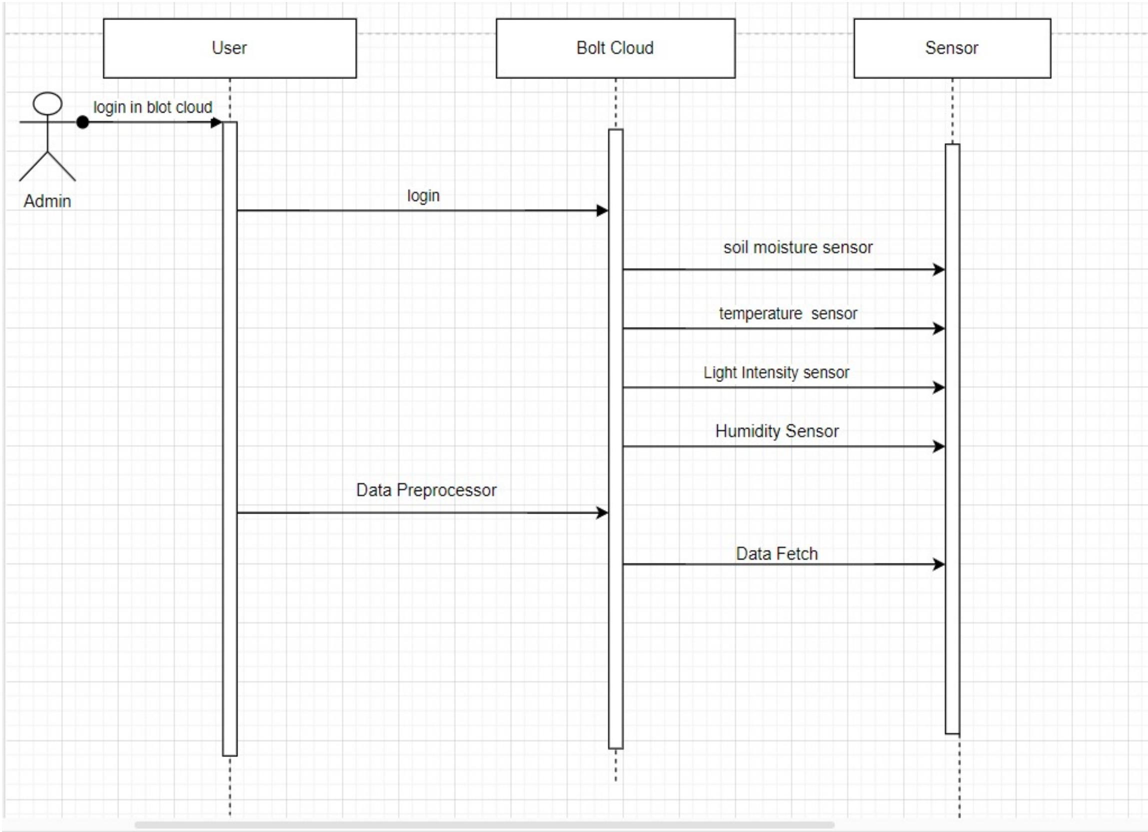

Figure 3-5: Sequence Diagram

3.8 Hardware Components of Project:

Short description for each component of our Smart Agriculture IoT project:

Humidity Sensor:

Measures and provides real-time humidity levels in the environment, crucial for monitoring and maintaining optimal growing conditions.

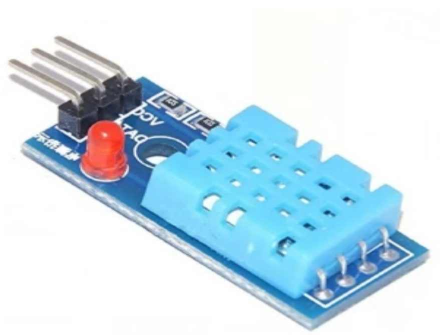

Figure 3-6: DHT11 Humidity Sensor

Temperature Sensor:

A temperature sensor that accurately measures ambient temperature, helping ensure the crop's temperature requirements are met.

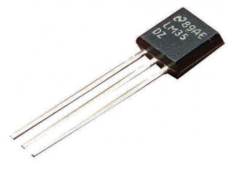

Figure 3-7: LM35 Temperature Sensor

Soil Moisture Sensor:

Monitors soil moisture levels, assisting in irrigation management and preventing over or under-watering.

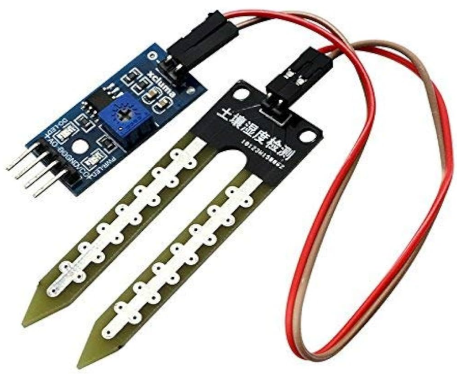

Figure 3-8: FC-28 Soil moisture Sensor

Light Intensity Sensor:

Detects light intensity, aiding in optimizing crop growth by adjusting artificial lighting when natural light is insufficient.

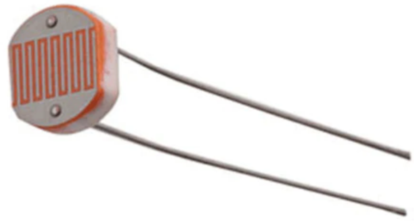

Figure 3-9: LDR Light Intensity Sensor

BOLT ESP8266 Wi-Fi Module:

Enables wireless communication between sensors and the cloud, allowing remote monitoring and control of agricultural parameters.

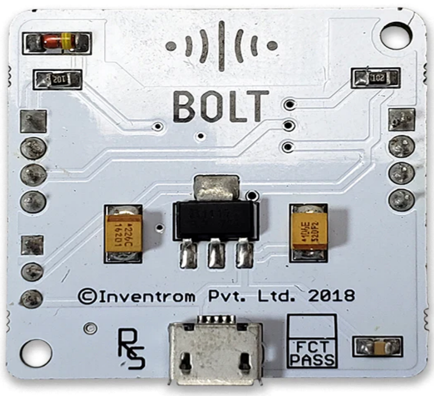

Figure 3-10: BOLT ESP8266 Wi-Fi Module

Arduino UNO Board:

Serves as the project's microcontroller, responsible for processing sensor data and controlling connected devices for automated farming tasks.

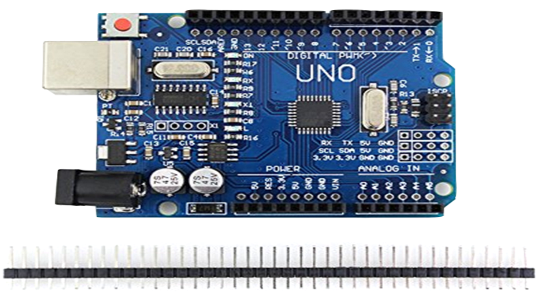

Figure 3-11: Arduino UNO Board

Chapter 4 . Implementation

Implementation

The implementation of a smart agriculture system using IoT, which encompasses the monitoring of environmental parameters such as temperature, humidity, soil moisture, and light intensity, represents a groundbreaking step towards modernizing and enhancing agricultural practices. This innovative project leverages the power of the Internet of Things (IoT) to create a more efficient and data-driven approach to farming.

4.1 Tools Used

4.1.1 Bolt IoT

Bolt is an IoT platform that helps enterprises and makers to connect their devices to the internet. Bolt comes with a WiFi/GSM Chip to connect your sensors to the Internet. You can configure this system over the Bolt cloud to receive, store and visualize the data.

Figure 4-1: Bolt IoT Kit

Hardware Components:

BOLT IoT Kit: The BOLT IoT Kit includes a variety of sensors, an IoT module, and other essential components. These kits are designed to work seamlessly with the BOLT Cloud Platform.

- BOLT IoT Module: This module is the heart of the kit and provides Wi-Fi connectivity and a variety of digital and analog input/output pins.

- Sensors: The kit typically includes sensors for temperature, humidity, light intensity, and soil moisture, which are essential for your smart agriculture system.

- Connecting Wires: You'll need wires to connect the sensors to the BOLT IoT module.

Software and Platforms:

- BOLT Cloud Platform: The BOLT Cloud Platform is the central hub for data collection, storage, analysis, and remote control of your smart agriculture system. You will need to set up an account and configure your devices.

- BOLT IoT App: The BOLT IoT App is available for both Android and iOS and allows you to monitor your devices remotely, receive notifications, and control connected actuators.

- BOLT IoT Developer Console: This web-based console enables you to create and manage your IoT projects, set up triggers and alerts, and visualize data collected from your sensors.

- Programming Environment: You can use the BOLT IoT module with the BOLT Cloud Platform by writing code using the BOLT JavaScript library. This library allows you to interface with sensors, send data to the cloud, and execute control functions.

4.1.2 Google Charts

Google Charts is a free, web-based tool provided by Google that allows developers and data analysts to create interactive and visually appealing charts and graphs for websites and applications. It's a popular choice for data visualization due to its simplicity, flexibility, and integration with other Google services.

4.2 Sensors and Circuit Configuration

4.2.1 Light Sensor:

- Light sensors measure the intensity of light in a given area, typically in lux or other light measurement units.
- They are used to monitor natural light conditions, which is essential for photosynthesis in plants.

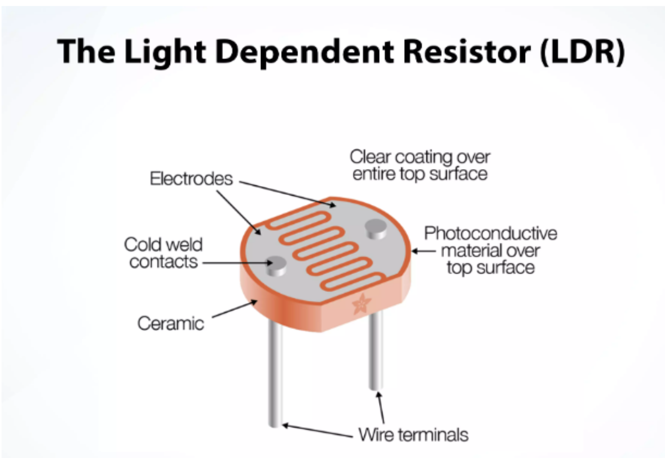

Figure 4-2: LDR Labeled Diagram

Functionality:

- One leg is connected to the ground (GND).
- The other leg is connected to the power supply (VCC) or an analog input pin.

Circuit Configuration:

- Connect one leg of the LDR to the A0 (analog input) pin on the Bolt WiFi module.
- Connect the other leg of the LDR to the GND pin on the Bolt WiFi module.

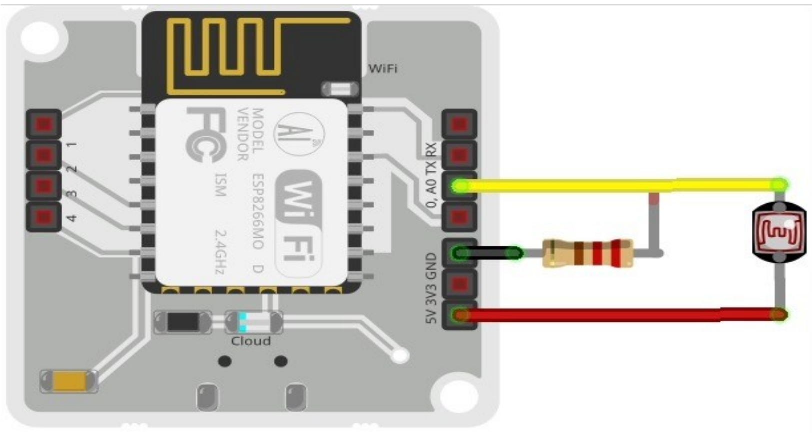

Figure 4-3: LDR Circuit Configuration

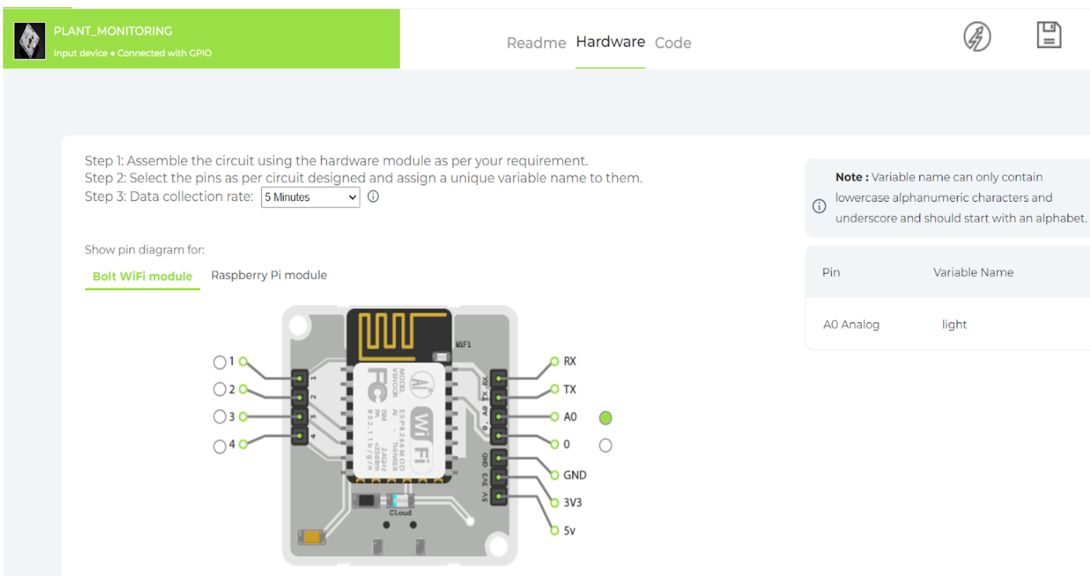

Figure 4-4: LDR Hardware Setup

4.2.2 Humidity Sensor:

- Humidity sensors, also known as hygrometers, measure the amount of moisture in the air.
- They are crucial for monitoring air humidity, which affects plant transpiration and overall plant health.

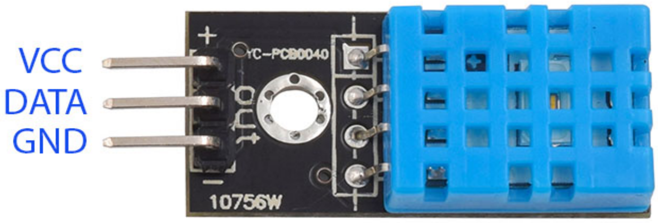

Figure 4-5: DHT11 Labeled Diagram

Functionality:

- VCC: Connects to the power supply.
- GND: Connects to the ground.
- Data: Connects to a digital input/output pin for data communication.

Circuit Configuration:

- Connect VCC to the power supply, GND to the ground, Data to a digital input/output pin on the microcontroller.

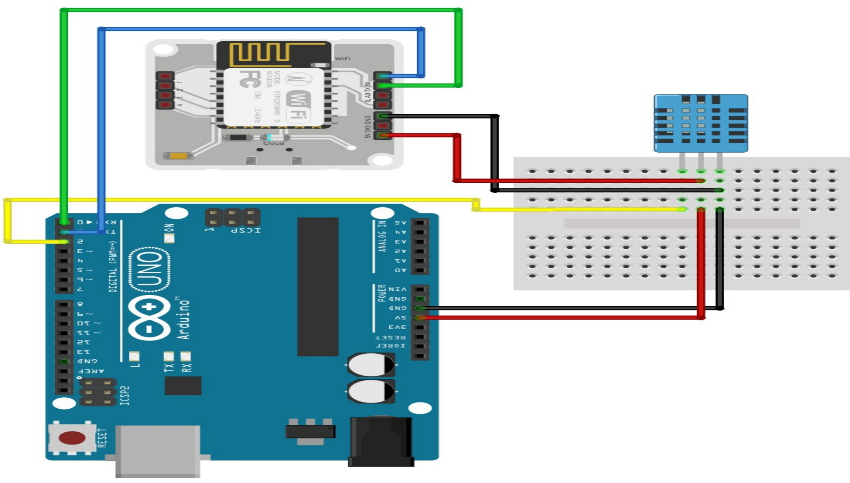

Figure 4-6: DHT11 Circuit Configuration

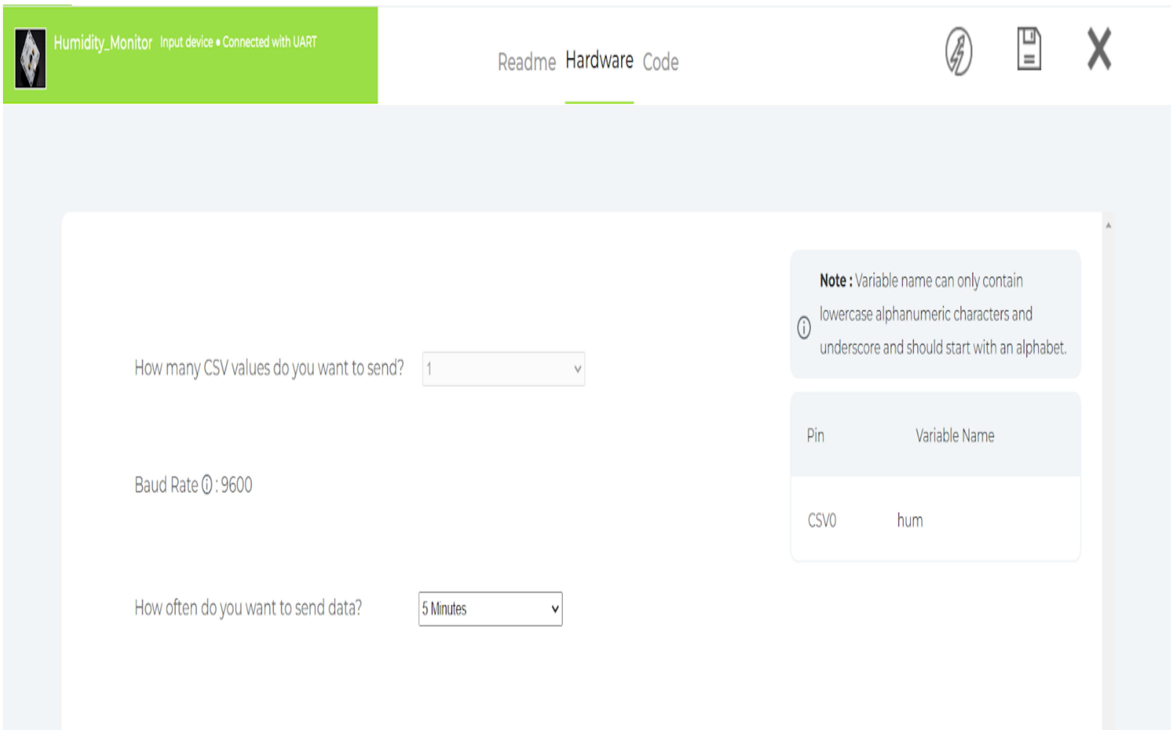

Figure 4-7: DHT11 Hardware Setup

4.2.3 Temperature Sensor:

- Temperature sensors measure the ambient temperature in an area.
- They are essential for tracking temperature fluctuations that can impact plant growth.

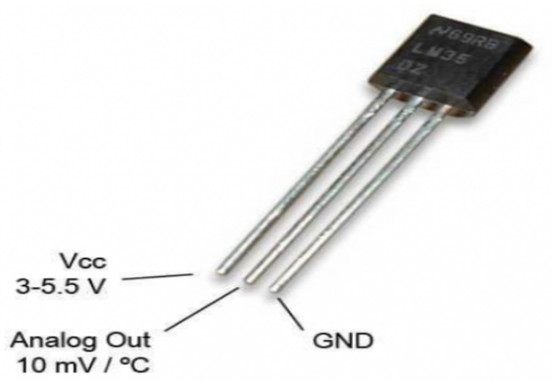

Figure 4-8: LM35 Labeled Diagram

Functionality:

- VCC: Connects to the power supply.
- GND: Connects to the ground.
- OUT: Outputs the analog voltage proportional to the temperature.

Circuit Configuration:

- Connect the VCC pin of the LM35 sensor to the A0 (analog input) pin on the Bolt WiFi module.
- Connect the GND pin of the LM35 sensor to the GND pin on the Bolt WiFi module.
- Connect the OUT pin of the LM35 sensor to an analog input pin (e.g., A2) on the Bolt WiFi module.

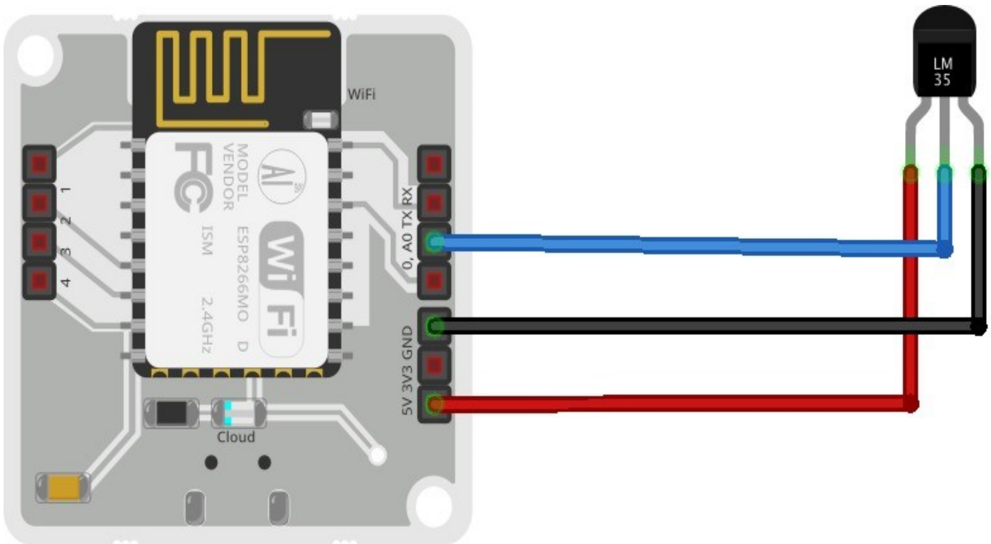

Figure 4-9: LM35 Circuit Configuration

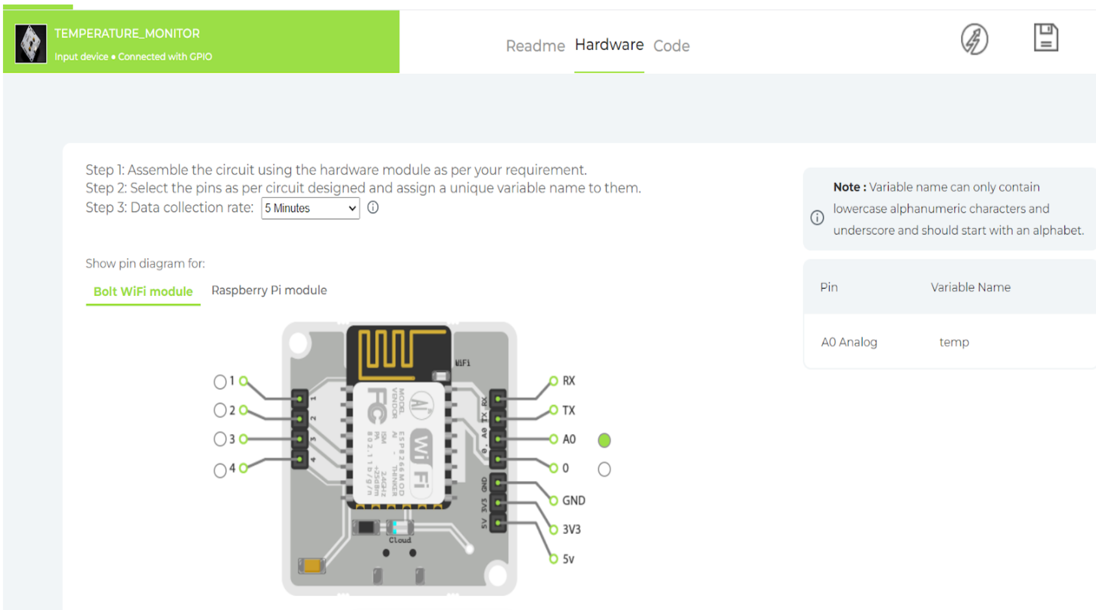

Figure 4-10: LM35 Hardware Setup

4.2.4 Soil moisture sensors:

- Soil moisture sensors determine the moisture content in the soil, which is crucial for understanding the water needs of the plants.
- They can be placed at different soil depths to monitor moisture levels at various depths.

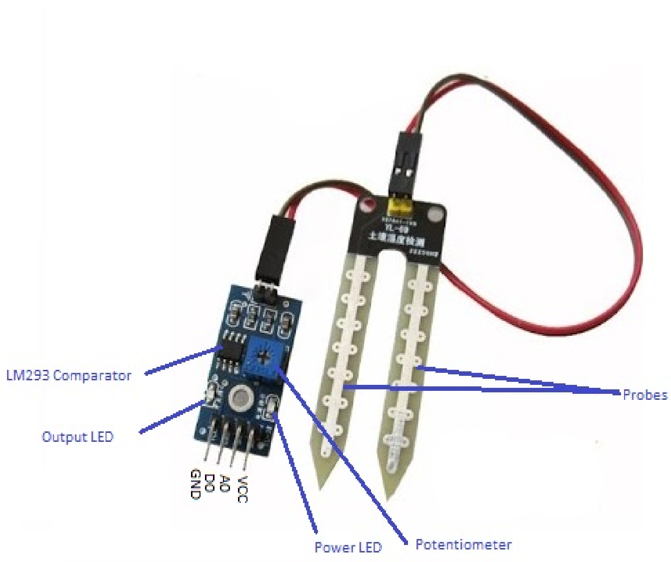

Figure 4-11: FC-28 Labeled Diagram

Functionality:

- VCC: Connects to the power supply.
- GND: Connects to the ground.
- SIG: Connects to an analog or digital input pin for data communication.

Circuit Configuration:

- Connect the VCC pin of the FC28 sensor to the 3.3V or 5V pin on the Bolt WiFi module.
- Connect the GND pin of the FC28 sensor to the GND pin on the Bolt WiFi module.
- Connect the SIG pin of the FC28 sensor to an analog input pin (e.g., A1) on the Bolt WiFi module.

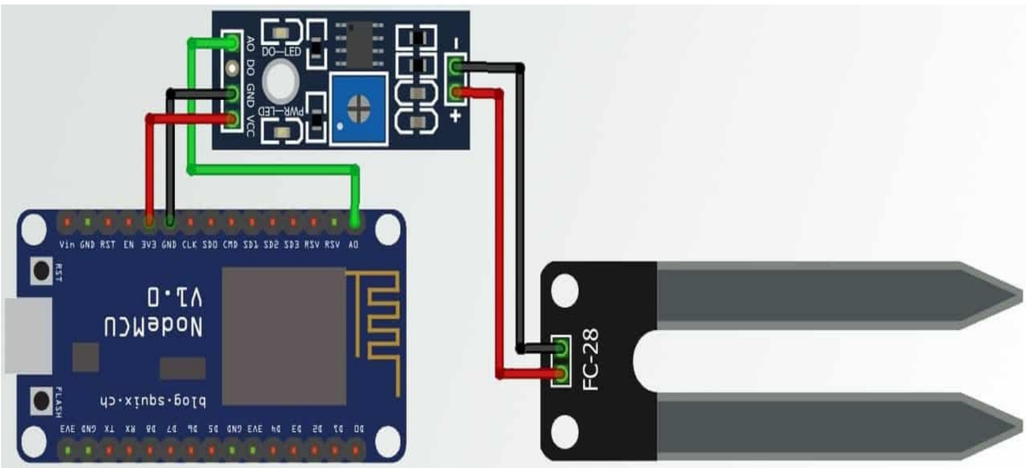

Figure 4-12: FC-28 Circuit Configuration

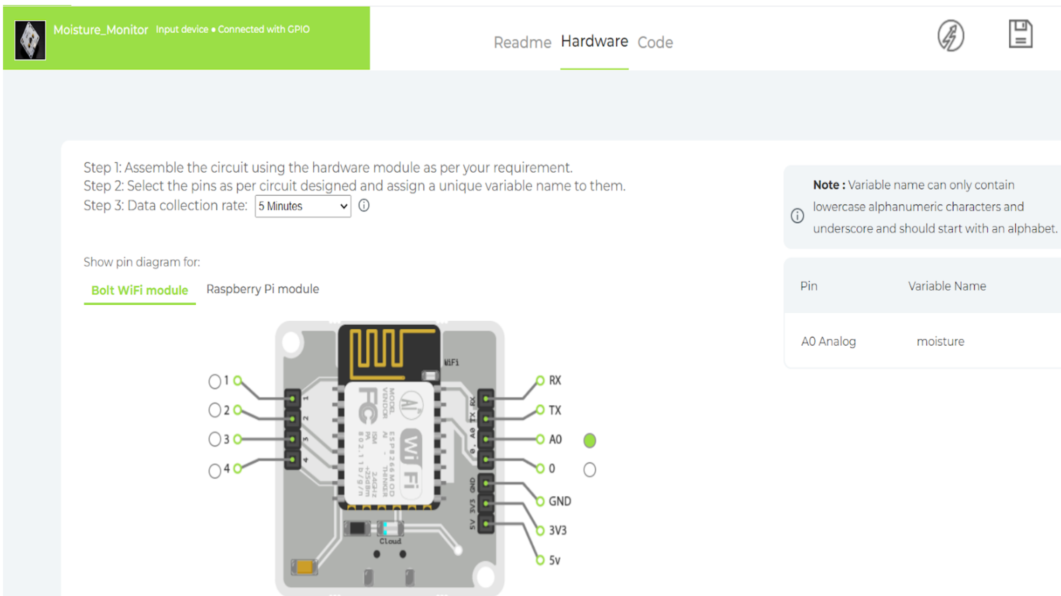

Figure 4-13: FC-28 Hardware Setup

4.3 Language Used

JavaScript:

JavaScript is a widely used programming language for developing IoT applications, including smart agriculture systems. When implementing a smart agriculture system using the BOLT IoT Kit and BOLT Cloud Platform, JavaScript can be utilized in various ways:

Device Programming:

- BOLT IoT Module: The BOLT IoT Kit often comes with a microcontroller that can be programmed using JavaScript. You can use JavaScript to read data from temperature, humidity, soil moisture, and light intensity sensors connected to the BOLT IoT module. The BOLT Python library, which is often used for programming these devices, provides JavaScript functions that allow you to interact with the sensors and send data to the BOLT Cloud Platform.

Data Visualization:

- Charting and Graphs: JavaScript libraries like Google Charts can be employed to create interactive charts and graphs that visualize the data collected from temperature, humidity, soil moisture, and light intensity sensors. These visualizations are valuable for farmers and stakeholders to analyze data.

Integration with the BOLT Cloud Platform:

- API Calls: You can make API calls to the BOLT Cloud Platform using JavaScript to fetch and update data, control devices, and trigger actions based on sensor data.

4.4 Testing

Testing is the process of evaluation of a system to detect differences between given input and expected output and also to assess the features of the system. Testing assesses the quality of the product. It is a process that is done during the development process. .

4.4.1 Strategy Used

Tests can be conducted based on two approaches –

Functionality testing

Implementation testing

The testing method used here is Black Box Testing. It is carried out to test functionality of the program. It is also called 'Behavioral' testing. The tester in this case, has a set of input values and respective desired results. On providing input, if the output matches with the desired results, the program is tested 'ok', and problematic otherwise.

4.4.2 Test Case and Analysis

TEST CASE: 1

Test Case ID	TC001
Test Case Summary	It will show the change in Temperature through a line graph.
Test Procedure	configure the connection and test the sensor in different environmental conditions.
Expected Result	The temperature at 11:18 is 34 degree celsius. This should get lower till 11:25 and should rise again.
Actual Result	It gets lower till 11:25 and then rises again.
Status	PASS

Table 1 : Test Case 1

TEST CASE 1 OUTPUT

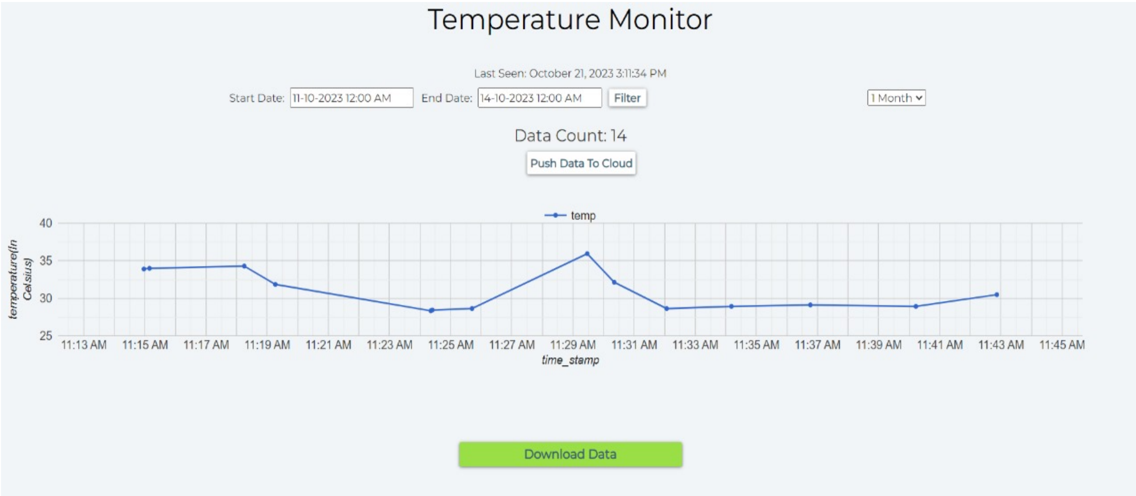

Figure 4-14: Test Case 1 Output

TEST CASE: 2

Test Case ID	TC002
Test Case Summary	It will show a change in moisture content.
Test Procedure	configure the connection. The current value of sensor is 1023(no moisture) now put the sensor in water.
Expected Result	The value on the line graph should touch 0 (max moisture).
Actual Result	Line graph showing 0(max moisture).
Status	PASS

Table 2: Test Case 2

TEST CASE 2 OUTPUT

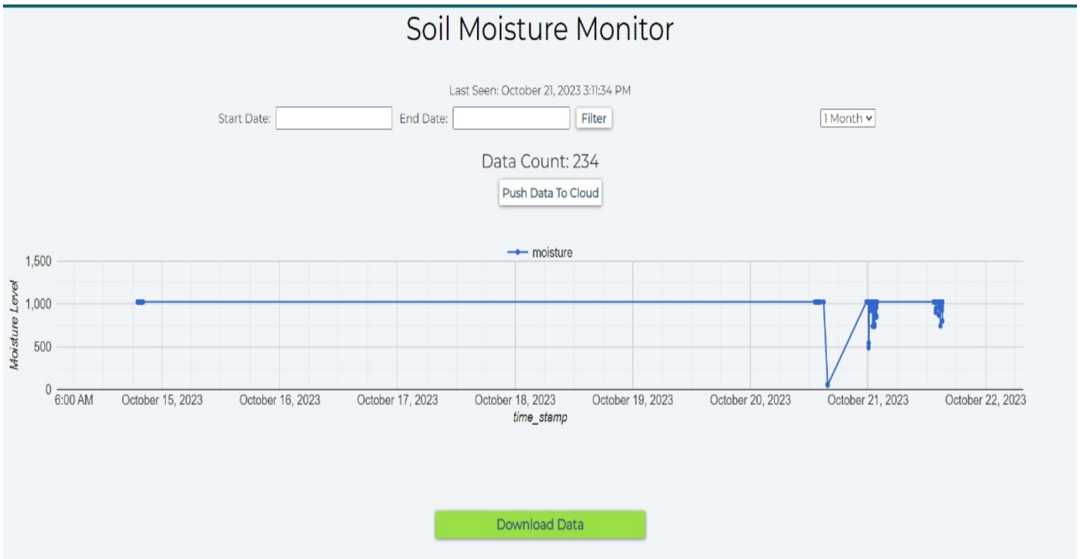

Figure 4-15: Test Case 2 Output

Chapter 5.Conclusion

Conclusion

5.1 Conclusion

The Smart Agriculture Monitoring System represents a significant step towards bridging the technological gap in agriculture, especially for small-scale farmers. This project leverages the power of Internet of Things (IoT) technology to empower farmers with affordable, accessible, and user-friendly solutions that provide real-time data on crucial environmental parameters. By doing so, it addresses the core challenges faced by farmers, enabling data-driven decision-making, resource optimization, and sustainable agricultural practices.

5.2 Limitations of the Work

The implementation of a smart agriculture system using the BOLT IoT Kit and BOLT Cloud Platform is undoubtedly a promising and innovative approach to modernizing farming practices. However, it is essential to acknowledge and address the limitations associated with this technology to fully understand its capabilities and potential challenges.

Reliability of Internet Connectivity: IoT systems heavily rely on internet connectivity. If the area where the agriculture system is deployed lacks a stable and robust internet connection, data transmission, real-time monitoring, and remote control may be compromised.

Cost Implications: Acquiring and maintaining the necessary hardware for four monitoring systems can be costly. Each additional sensor, along with its associated components, may add to the project's overall expenses.

Hardware Compatibility: One significant limitation of the smart agriculture system using the BOLT IoT Kit and BOLT Cloud Platform is that the four monitoring systems, specifically the soil moisture, humidity, temperature, and light intensity sensors, cannot work concurrently. This limitation arises from the distinct hardware connections and kits provided for each type of sensor. Additionally, the system is designed in a way that it does not provide live data from all the sensors simultaneously, meaning that only one sensor can be used at a time.

Environmental Factors: Extreme weather conditions, such as heavy rain, strong winds, or excessive heat, can affect the performance and longevity of sensors and IoT devices.

Educational and Training Requirements: Users, including farmers and agricultural workers, may require training to effectively use and manage the smart agriculture system.

5.3 Suggestion and Recommendations for Future Work

While the smart agriculture system using the BOLT IoT Kit and BOLT Cloud Platform offers several benefits and capabilities, there is always room for improvement and future enhancements. Here are some suggestions and recommendations for future work to address the limitations and further optimize the system:

Alerts and Notifications: Implement a robust alerting system that can notify users of critical conditions or changes in environmental parameters, allowing for proactive response.

Scalability: Design the system with scalability in mind, allowing users to easily expand the monitoring capabilities as their agricultural operations grow.

Educational Initiatives: Develop educational resources and training programs to help users, particularly farmers and agricultural workers, understand the system's capabilities and how to maximize its potential for improving crop yields and resource management.

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Source Code

Light Intensity Monitoring System(using LDR):

```
setChartLibrary('google-chart');
setChartTitle('Light intensity Monitoring System');
setChartType('areaGraph');
setAxisName('Time','Light_Intensity');
plotChart('time_stamp','light');
```

Temperature Monitoring System (using LM35):

```
setChartLibrary('google-chart');
setChartTitle('Temperature Monitor');
setChartType('lineGraph');
setCrosshair(true);
mul(0.0977);
setAxisName('time_stamp','temperature(In Celsius)');
plotChart('time_stamp','temp');
```

Soil Moisture Monitoring System (using FC-28):

```
setChartLibrary('google-chart');
setChartTitle('Soil Moisture Monitor');
setChartType('lineGraph');
setCrosshair(true);
var MinReading =0 // The minimum reading for dry soil;
var MaxReading =1023// The maximum reading for saturated soil;
var SensorReading =
[350,670,435,234,100,1020,876,576,762,486,60,51,545,541,498,965,988,929,739,834,936,
836,757,768,850,864,962,945,1023,0]
var Percentage = ((100 - SensorReading ) / (MaxReading - MinReading)) * 100;
moisture= Percentage
setAxisName('time_stamp', 'Moisture Level');
plotChart('time_stamp', 'moisture');
```

Humidity Monitoring System(using DHT11):

```
setChartLibrary('Humidity Monitoring');
setChartLibrary('google-chart');
setChartTitle('Humidity Monitor');
setChartType('lineGraph');
setAxisName('time_stamp', 'hum');
plotChart('time_stamp','hum');
```

Guide Interaction Sheet

Date	Summary of Work and Discussion	Action Plan
05/07/2023	Discussion of topic for major project	IOT was decided as the domain and “Smart Agriculture System” was decided as the title
11/07/2023	Major Project Synopsis Presentations	Presentation of problem statement and objectives, solution proposed was finalized.
31/08/2023	Project progress ppt and UML Diagram submission	Sensors and Iot Platform finalized.
18/9/2023	Project progress ppt	Google charts finalized as a tool for graphical visualization.
11/10/2023	Implementation Demo	demonstration of Light intensity and Temperature monitoring project implementation was performed.
18/10/2023	Project based Research Paper Submission	Research paper was published at IJSREM Journal.
9/11/2023	Video and Technical poster and Project Report feedback	Evaluation of Project video , Technical poster , research paper, project report was done and Feedback was given to perform some required changes.
20/11/2023	Final Project Submission	Final Submission with Complete Implementation, project report,Research paper, synopsis and Poster.

IoT Based Smart Agriculture Monitoring System

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Computer Science and Engineering

Acropolis Institute of Technology and Research, Indore (M.P.)

Abstract: The population increase, climate change, and shortage of resources are posing hitherto unheard-of difficulties to the agriculture sector. The application of Internet of Things (IoT) technology to agriculture, or "smart agriculture," has become a game-changing response as a result. An IoT-based Smart Agriculture System intended to transform conventional farming methods is presented in-depth in this paper. In order to maximise crop output, preserve resources, and advance sustainable farming practises, the suggested system makes use of sensor technology, data analytics, and real-time monitoring. Numerous sensors for monitoring temperature, nutrient levels, and soil moisture are among the main elements of the Internet of Things-based Smart Agriculture System. These sensors' wireless transmission of data to a centralised cloud-based platform, where sophisticated data analytics algorithms process the data, is done. This platform is accessible to users via

Keywords: Internet of Things (IoT), Sensor Technology, Data Analytics, Sustainability, Crop Monitoring, Agricultural Productivity.

I. INTRODUCTION

IoT systems provide solutions that will allow users to manage irrigation, ensuring crops receive the right amount of water basic needs. By monitoring such as humidity and temperature, the system will provide accurate and timely information to optimize the allocation of resources andsupport crop growth.

II. EXISTING SYSTEM

Internet of Things-based smart agriculture has proven to be beneficial for users. In fact, users face problems with harvesting even after harvesting.To answer all the questions, it is important to create an integrated approach that addresses all factors affecting profitability at all levels: light intensity, temperature, humidity etc. The starting point of weather conditions can be determined by the environment in a region.The system can also detect animal infestation, which isthe main cause of crop loss. The system creates a water system based on real-time data from the fields and data from cloud storage.The system can tell users whether they need water or not. A constant Internet connection is required. This can be overcome by continuing to send advice to users via SMS directly to their phones using GSM modules instead of mobile applications.

III. OBJECTIVE

This introduction provides an overview of the project, Based on the analysis of differences and comparisons of

including the name of the project, a brief description of the existing systems, specific objectives should be addressed

solution, and the motivation behind the particular solution.

during the development of IoT-based real-time crop
The project aims to create an IoT system that can monitor monitoring and processing. These are advantages:
real-time changes in humidity, temperature and other environmental factors to improve crop growth and reduce
1)Integration of other environments:Integrate sensors and agricultural water. The system will also ensure resource data collection mechanisms to monitor other environment
efficiency and support permaculture practices.[1] such as soil moisture and light intensity.Design and
The motivation behind solving this particular problem stems distribute sensors that measure humidity and light intensity from the increasing global demand for food production and in the crop's environment. the need to solve agricultural water scarcity and environmental health problems. Using IoT technology, we 2)Advanced Data Analysis and Predictive Modeling: Use can leverage the power of real-time data and machine advanced data analysis techniques and predictive modeling utilization to optimize crop production and reduce resource algorithms to derive insights from collected data. Using waste.[2] machine learning algorithms to analyze historical and eal-time data allows the system to predict best results and create irrigation plans based on crops and the environment.

Improve crop compatibility and soil conditions: Improve compatibility with different crop types and soil conditions to meet the needs of different farms.: Conduct research and experiments to identify and correct poor methods and techniques to accommodate different crop and soil combinations.

User-friendly interface and easy access: To create a Research and innovation: IoT-based smart agriculture opens up opportunities for research and innovation, leading to the development of new technologies, sensors and farming practices.

The scope of smart agriculture using IoT technology is huge and its potential benefits are numerous, including increased productivity, sustainability and economic efficiency in the agricultural sector. It offers the promise of solving some of the critical challenges facing global food production.[4][5]
user-friendly interface for users to easily access and manage

V. REQUIREMENT ANALYSIS

information informing the system.Create a website and intuitive dashboard that allows users to monitor sensor data, set water schedules, and receive alerts and recommendationsin real time.

IV. SCOPE

The scope of an IoT-based smart agriculture system is vastand has significant potential to transform the agricultural industry. Here are some key aspects of its scope:

- Improved crop monitoring: Smart farming systems can continuously monitor crops using sensors to measure parameters such as soil moisture, temperature, humidity and light conditions. This data helps users make informed decisions about irrigation, fertilization and pest control.
- Precision Farming: IoT systems enable precision farming by providing real-time data on crop conditions. Users can optimize the use of resources,reduce waste and increase yields. This can lead to more sustainable farming practices.
- Environmental monitoring: Smart agriculture can also be used to monitor environmental conditions. This includes weather forecasting, air quality and soil quality assessment.
- Data analysis and decision support: IoT systems generate huge amounts of data. By leveraging data analytics and artificial intelligence, users can make data-driven decisions for crop management, resourceallocation and risk assessment.
- Remote monitoring and control: users can remotely monitor and control various aspects of their farms, allowing for early intervention when problems arise.
- Water resource management: In water-scarce regions, IoT-based systems can help in efficient water management through automated irrigation systems, water level monitoring and leak detection.
- Sustainability and environmental impact: Smart farming systems can help reduce agriculture's environmental impact by optimizing resource use,reducing chemical inputs and minimizing waste.
- Scalability: The scope of IoT-based smart agricultureis scalable, meaning it can be applied to small family farms as well as large agribusinesses.

Functional Requirement:

- Sensor Integration: The system should support theintegration of various IoT sensors to monitor environmental conditions such as soil moisture, temperature, humidity, light intensity, and atmospheric condition.
- Data Collection and Analysis: The system should collect sensor data in real-time and perform data analytics to derive insights and patterns related to crop growth, health, and environmental conditions.
- Crop and Livestock Monitoring: The system shouldenable monitoring and tracking of crop health, growth stages, disease outbreaks, and livestock behavior, facilitating early detection and timely intervention.
- Decision Support: The system should provide decision support to farmers, offering recommendations for irrigation schedules, fertilization, pest control, and other farming practices based on analyzed data and algorithms.
- Remote Access and Control: The system should allow farmers to remotely access and control the agricultural processes, monitor real-time data, receive alerts, and adjust settings through web ormobile interfaces.

Non-Functional Requirements:

- Scalability: The system must be scalable, accommodating a large number of sensors, farms, and users. It should handle increasing data volumesand growing farming operations effectively.
- Reliability: The system should offer reliability, ensuring continuous operation to minimize downtime. Critical farming operations must not bedisrupted, ensuring uninterrupted functionality.
- Security: Robust security measures must be implemented to protect data privacy, prevent unauthorized access, and guard against cyber threats.This is vital to maintain the integrity of the system and secure farm operations.
- Energy Efficiency: The system should optimize energy consumption, ensuring efficient operation ofIoT devices, sensors, and communication systems. Maximizing battery life is essential for prolonged and sustainable system functionality.
- User Experience: The system must provide a user-friendly interface with intuitive navigation, clear data

visualization, and easy-to-understand
alerts and notifications. This ensures a positive userexperience for farmers and stakeholders, enhancingsystem usability.

VI. DIAGRAMS

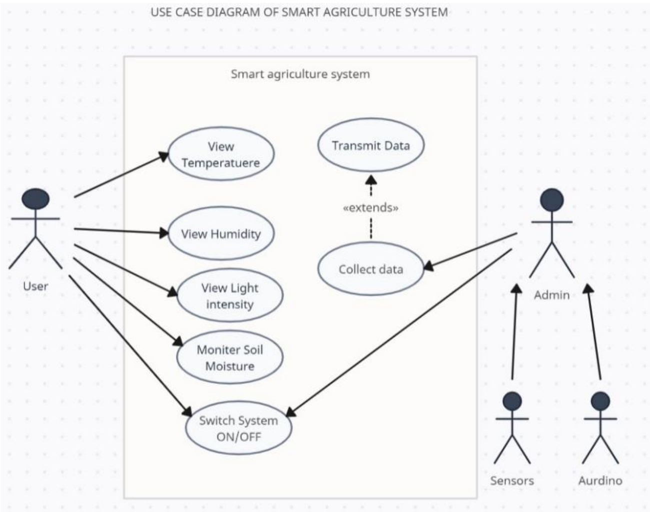


Fig. 1 Use Case diagram of Smart Agriculture. In fig 1 explain about the flow of implementation throughout the project users can view temperature,humidity,light intensity and soil moisture.User also switches the system to turn on and off the system.Admin will collect the data and transmit data to the user .Admin will be able to access sensors and arduino. Admin can also access the switch system to turn on and off.This diagram can show the flow of the overall project .

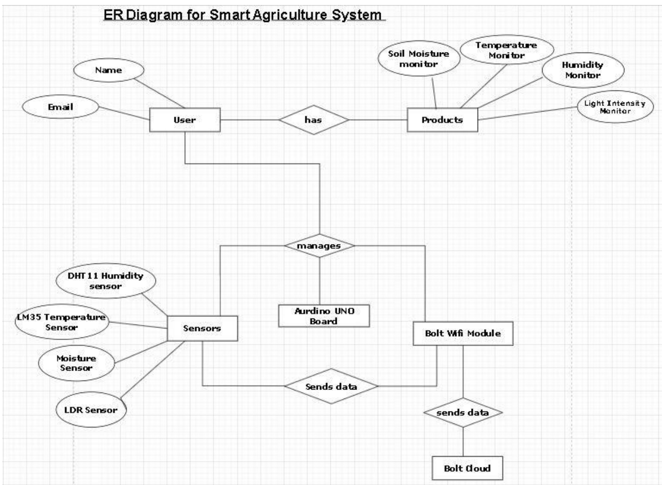


Fig. 2 ER Diagram for Smart Agriculture

In this fig 2 there are five major factors:User,Product,Sensors,Arduino Uno Board and Blot wife module.User will access website through email and Name has relation with Products where there IOT based products are there soil monitor ,Temperature monitor

,Humidity monitor and Light Intensity monitor. User manages Sensors , Arduino uno board and Bolt wife Module.There are four type of sensor used in this project which are DH11 Humidity sensor , LM 35 Temperature sensor,Humidity sensor and LDR sensor.These sensors senddata to bolt wifi module then wifi module sends data to blotcloud .

VII PROJECT DESCRIPTION

The Smart Agriculture IoT-Based Project is a cutting-edge initiative aimed at transforming traditional farming methods through the integration of Internet of Things (IoT) technology. This project involves the deployment of sensors to monitor soil moisture, temperature, humidity, and crop health in real time. The collected data is processed using advanced algorithms, enabling farmers to make data-driven decisions. Automated irrigation systems and precise resource management are implemented, ensuring optimal conditions for crop growth. The project promotes sustainable farming practices, reduces resource wastage, andenhances overall productivity. Through a user-friendly interface, farmers can remotely monitor their fields, receive timely alerts, and control farm operations, ushering in a newera of efficient and eco-friendly agriculture.[5]

VIII. SOLUTION PURPOSED

- Hardware setup:

Get the BOLT module kit including microcontrollers, sensors, and connectivity options. Connect the BOLT module to the development board or microcontroller.[1]

- Sensor Integration:

The sensors used in this project include soil moisture sensors, temperature sensors, humiditysensors and light sensors.[2]
Connect and connect the sensor to the BOLT moduleusing the appropriate interface or protocol.

- Data collection and processing:

Develop a BOLT module to collect data fromconnected sensors.[6]
Perform data processing on microcontrollers toanalyze and interpret collected data.

- Connection and communication:

Wi-Fi or GSM/GPRS etc. for the system dependingon the availability of network services in the area. Create connection options such as.[6]
Develop BOLT module to send completed data to central server or cloud platform for further storageand analysis.
Ensure secure communication between the BOLT module and the server/cloud platform, taking into account encryption and authentication mechanisms.

- User Interface and Management:

We will create a user interface for monitoring and managing smart agriculture.It will provide users with instant information about the environment, crophealth and everything that needs to be done.

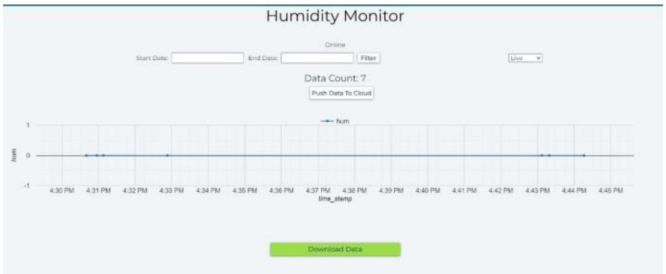
- Continuous Monitoring and Monitoring:

Enable monitoring of the health and operation of thesmart farm, including BOLT modules and connectedsensors.
We will regularly check and evaluate the indicatorsto ensure accurate data.

IX. EXPECTED OUTCOME

The development of an IoT-based system for real-time monitoring of soil moisture, temperature, and other environmental factors to optimize crop growth.There are four sensors :

1. DHT11 Humidity Sensor: Measures and provides real-time humidity levels in the environment, crucial for monitoring and maintaining optimal growing conditions.



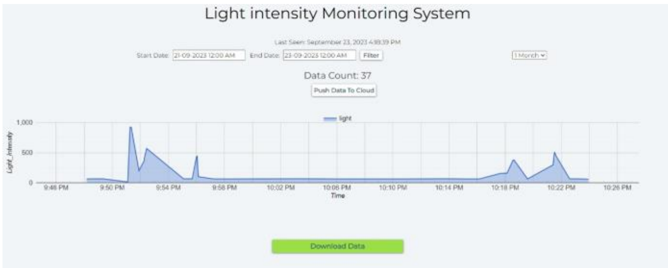


Fig 3. Humidity Monitor

DHT11 is a simple and inexpensive humidity and temperature sensor that can be used in many applications, including real-time monitoring of the environment. You usually need a microcontroller like Arduino or Raspberry Pi to use the DHT11 humidity sensor and monitor the data.

2. LM35 Sensor: A temperature sensor that accurately measures ambient temperature, helping ensure the crop's temperature requirements are met.

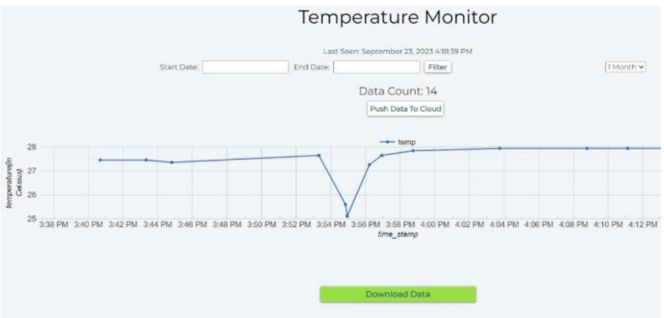


Fig 4.Temperature Monitor

In fig 4 The LM35 is a popular analog temperature sensor that provides a linear output voltage proportional to the temperature in Celsius.[6][4]

4. Moisture Sensor: Monitors soil moisture levels, assisting in irrigation management and preventing over or under-watering.

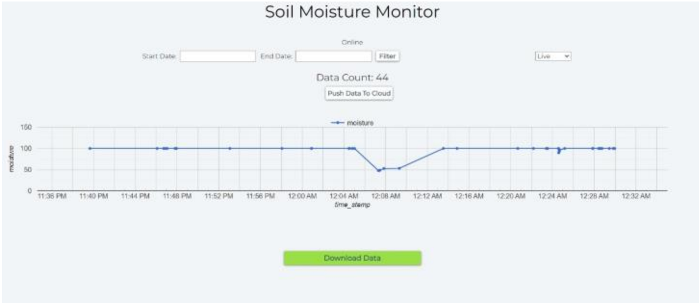


Fig 5. Soil Moisture Monitor

Creating a soil moisture monitor involves using a soil moisture sensor to measure the moisture content of the soil and a microcontroller to collect and process the data.

5. LDR Sensor: Detects light intensity, aiding in optimizing crop growth by adjusting artificial lighting when natural light is insufficient.

Fig 6. Light Intensity Monitoring System

Used light examines light measuring machines used in a particular environment and can be used for many applications such as cultivation, home lighting control or security. To set up a light source, you need a light source (like a photodetector or photodiode) and a microcontroller (like an Arduino or Raspberry Pi).[6]

There are two main feature used in sensors to retrieve data are:

1) BOLT ESP8266 Wi-Fi Module: Enables wireless communication between sensors and the cloud, allowing remote monitoring and control of agricultural parameters[5]

2) Arduino UNO Board: Serves as the project's microcontroller, responsible for processing sensor data and controlling connected devices for automated farming tasks.[6]

X. CONCLUSION

IoT technology plays a crucial role in advancing smart farming practices. By utilizing IoT, the system can accurately predict soil moisture levels and humidity, enabling efficient monitoring and control of irrigation systems. IoT applications span various farming domains, enhancing time efficiency, water conservation, crop monitoring, soil management, and the precise application of insecticides and pesticides. This system not only reduces human labor but also simplifies farming techniques, leading to the evolution of smart farming. Beyond its inherent benefits, smart farming facilitates market expansion for farmers, offering a streamlined approach with minimal effort and a single touch.

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Smart Agriculture System

A Major Project Synopsis Submitted to

Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal
Towards Partial Fulfillment for the Award of

Bachelor of Technology
(Computer Science and Engineering)

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1. Abstract

IoT-based environmental monitoring uses wireless sensor networks to communicate across the land to collect accurate and timely data. Soil moisture sensors measure moisture in real-time, providing appropriate water management based on crop needs. Temperature sensors monitor environmental conditions for optimum crop growth and reduce the risk associated with climate change. Additionally, other environmental factors such as light intensity and humidity can be incorporated into the system to further enhance the cultivation strategy.

2. Introduction of the Project (1 paragraph)

The increase in world population and environmental problems have put great pressure on agriculture to maximize crop yields while minimizing resource use. In this context, creating IoT systems that can monitor humidity, temperature, and other environmental factors has become a promising trend. This presentation presents new ways to improve crop growth and reduce water use through the integration of IoT-based environmental monitoring. The system is designed to provide farmers with accurate and timely information on key factors affecting crop health and growth. Using wireless sensors, automated irrigation, and fertilization systems, the system enables farmers to make informed decisions that improve resource allocation, improve crop quality and reduce environmental degradation.

3. Objective (100 words)

The aim of the project is to create an IoT system that can monitor soil moisture, temperature, and other environmental factors in real-time to improve crop quality and reduce water use. Suggesting the use of wireless sensors throughout the site, the system will provide continuous monitoring and monitoring of key points. This information will be used to guide farmers in making informed decisions about water management so that crops will receive the right amount of water for their specific needs. The system will also include automatic irrigation and fertilizer application to efficiently distribute water and nutrients to stimulate crop growth and maximize yields. Also, using advanced data analysis techniques, advice and recommendations will be made to help farmers improve their breeding strategies.
The overall aim is to use IoT technology to improve resource management, increase crop productivity and contribute to sustainable and profitable agriculture.

4. Scope (100 words)

In Iot Technology regarding Smart agriculture generally prefers in sensing,automation and analysis of data .There are various aspects of smart agriculture:

- Monitoring and control: The system includes monitoring and control of environmental conditions such as humidity, temperature, humidity, light intensity and weather. It also includes monitoring the health and behavior of crops and livestock.

- Data Collection and Analysis: The system collects data from sensors sent in the fields and animal shelters. This information includes environmental measurements, crop growth measurements, and animal behavior. The collected data is then processed and analyzed to extract useful insights and patterns.

- Irrigation Management: Intelligent irrigation systems are a part of this system and make water use efficient by correcting water activities in a timely manner according to sensor data. It includes water management tools and the ability to adjust water parameters for different crops.

- Fertilization and Pest Control: The system may include features to optimize crop production and pest control. By analyzing sensor data and historical data, it can offer recommendations for the timely use of fertilizers and pesticides, reducing waste and reducing environmental impact.

- Decision Support and Advice: The system provides decision support to farmers by giving advice and recommendations. It helps make informed decisions about irrigation, fertilization, pests and diseases, and scheduling of the entire crop.

- Data integration and scalability: The system can integrate data from multiple sources, including sensors, weather forecast and historical data. It should also be scalable to accommodate larger farms and accommodate future expansion or integration with other systems.

Reference link:https://www.digiteum.com/iot-agriculture

5. Study of Existing System (200 words)

Existing System/Application 1: SmartFarm

Problems Addressed:
- Monitoring soil moisture levels and temperature in real-time.
- Optimizing irrigation and fertilizer application based on crop requirements.
- Reducing water consumption and improving crop yield.

Advantages:
- Real-time monitoring enables timely intervention and adjustments.
- Automated irrigation and fertilizer systems ensure precise resource allocation.
- User-friendly interface allows remote monitoring and control.
- Integration with weather data enhances decision-making accuracy.
- Historical data analysis provides insights for improved cultivation practices.

Disadvantages:
- Initial setup costs and infrastructure investment can be high.
- Limited scalability for large-scale agricultural operations.
- Reliance on stable network connectivity for continuous data transmission.
- Sensor calibration and maintenance require periodic attention.

Gaps Identified:
- Lack of integration with other environmental factors like humidity and light intensity.
- Limited support for crop-specific recommendations and predictive models.
- Potential for further optimization of data analytics and insights generation.

Reference link: https://www.smart-farm.io/

Existing System/Application 2: AgriSense

Problems Addressed:
- Monitoring soil moisture, temperature, and humidity for precision irrigation.
- Preventing overwatering and underwatering to optimize crop growth.
- Enhancing resource efficiency and reducing water waste.

Advantages:
- Wireless sensor network enables real-time data collection.
- Customizable thresholds and alerts for proactive management.
- Remote access and control through a web-based interface.
- Data-driven recommendations for irrigation scheduling.
- Compatible with various crops and soil types.

Disadvantages:
- Sensor placement and coverage optimization may be challenging.
- Limited support for advanced analytics and predictive modeling.
- Initial setup and sensor calibration require technical expertise.
- Power source management for long-term deployments.

Gaps Identified:
- Integration with additional environmental factors such as light intensity.
- Opportunities for enhanced data visualization and trend analysis.
- Integration with automated irrigation systems for seamless control.

Reference link: https://agrisense.cc/

Existing System/Application 3: CropMonitor

Problems Addressed:
- Monitoring soil moisture, temperature, and rainfall patterns.
- Assessing crop stress and water requirements.
- Optimizing irrigation strategies for sustainable agriculture.

Advantages:
- Wireless sensor network for real-time data acquisition.
- Mobile application for convenient access and control.
- Advanced data analytics for insightful reports and recommendations.
- Integration with weather forecasts and evapotranspiration data.
- Supports multiple crops and soil types.

Disadvantages:
- Initial setup costs and sensor installation may require expertise.
- Limited scalability for large-scale farms.
- Sensor maintenance and calibration for accurate readings.
- Dependence on network connectivity and power supply.

Gaps Identified:
- Integration with additional environmental factors like humidity and light intensity.
- Potential for improved user interface and data visualization.
- Integration with automated irrigation systems for seamless control.

Reference link: https://www.cropmonitor.co.uk/

6. Project Description (200 words)

The IoT-based Shrewd Farming Framework extends points to create a comprehensive code that coordinates IoT innovations to revolutionize conventional cultivating homes. The framework will utilize sensors, information analytics, and robotization to optimize rural forms, upgrade efficiency, and advance feasible cultivating homes. Real-time information and brilliantly decision-making will help agriculturists in making educated choices and progressing generally cultivate administration.

- Network installation: IoT sensors are installed in farm fields and animal pens to monitor key environmental factors such as humidity, temperature, humidity, light intensity and weather.

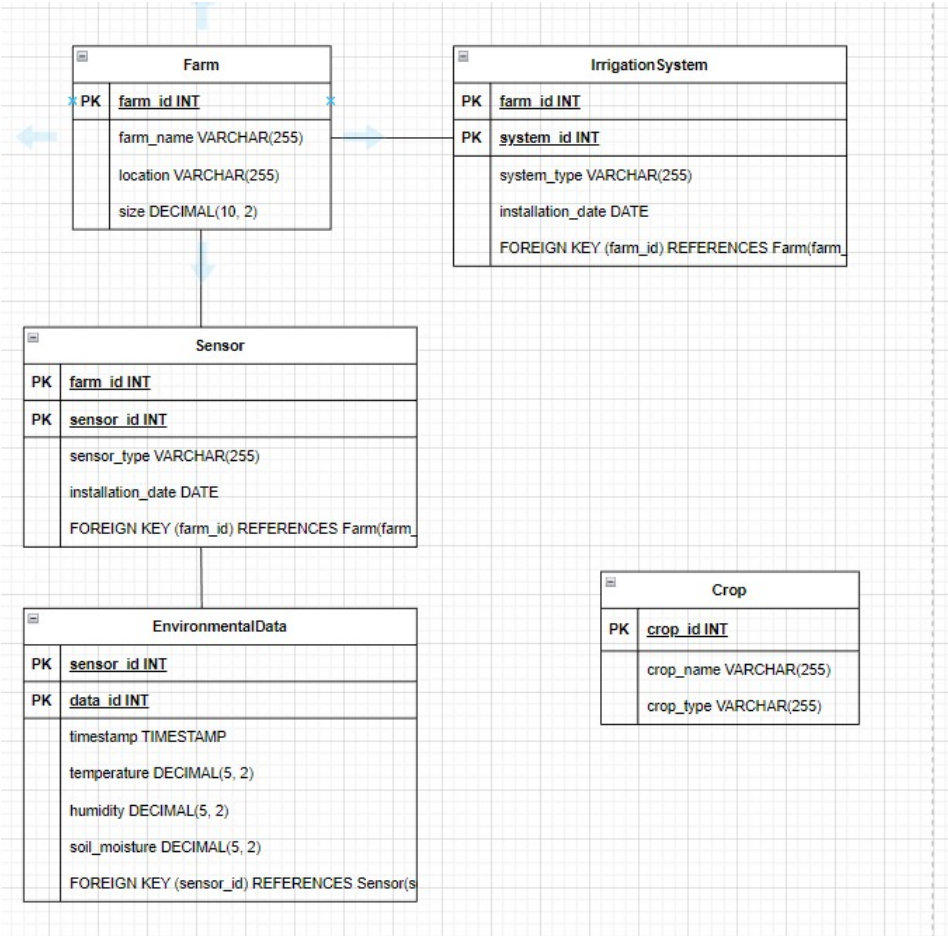
- Data Collection and Communication: Development of a data center to collect data from sensors and creation of a wireless communication system to send data to a cloud-based platform for further analysis.

- Cloud-Based Analytics: Use cloud-based platforms to securely store, process, and analyze data using advanced data analytics techniques. Machine learning algorithms can be used to extract visual content and patterns.

- Crop and Livestock Monitoring: Integrated cameras and equipment to monitor crop health, growth and animal behavior. This leads to preventive measures, early detection of problems and general health care.

- Precision Agriculture and Farming: Using different fertilizer and pesticide applications based on sensor data, improving resource use and reducing environmental impact. Explore automation technologies such as drones and robots for tasks such as crop monitoring and spraying.

- User Development: Development of user-friendly web or mobile-based interfaces that provide farmers with real-time information access, analysis and business management. This allows for remote monitoring, decision making and control of agricultural processes.



ER Diagram :Smart Agriculture

7. Methodology/Planning of the Project work (200 words)

1. Hardware Setup:
   - Acquiring the BOLT module kit, which includes a microcontroller, sensors, and connectivity options.
   - Connecting the BOLT module to the development board or microcontroller.
2. Sensor Integration:
   - Sensors that we are using for the project include soil moisture sensors, temperature sensors, humidity sensors, and light sensors.
   - Connecting and integrating the sensors with the BOLT module using the appropriate interfaces or protocols.
3. Data Collection and Processing:
   - Configure the BOLT module to collect data from the connected sensors at regular intervals.
   - Implementation of data processing algorithms on the microcontroller to analyze and interpret the collected data.
   - Determine the specific parameters and thresholds for decision-making.

4. Connectivity and Communication:
    - Establish connectivity options for the system, such as Wi-Fi or GSM/GPRS, depending on the availability of network coverage in the agricultural area.
    - Configure the BOLT module to send the processed data to a centralized server or cloud platform for storage and further analysis.
    - Ensure secure communication between the BOLT module and the server/cloud platform, considering encryption and authentication mechanisms.
5. User Interface and Control:
    - We will Develop a user interface for monitoring and controlling the smart agriculture system.
    - It will provide real-time information to users regarding environmental conditions, crop health, and any required actions.
6. Continuous Monitoring and Maintenance:
    - Establish a system for monitoring the health and performance of the smart agriculture system, including the BOLT module and connected sensors.
    - We will Regularly maintain and calibrate the sensors to ensure accurate data collection.

8. Expected Outcome (100-150 words)

1. Improved Resource Management:

    Efficiently manage fertilizer and nutrient application based on soil nutrient levels, minimizing waste and improving crop health. It will monitor environmental conditions such as temperature and humidity to optimize growing conditions and reduce crop stress.

2. Enhanced Crop Monitoring and Control:

- Real-time monitoring of crop health indicators, such as soil moisture, temperature, and light levels, to detect potential issues and take timely action.
- Automated control of environmental factors, such as temperature or humidity, to create optimal growing conditions for specific crops.

3. Increased Productivity and Yield:

- Data-driven insights and decision support for farmers, enabling them to make informed choices about crop management strategies, resulting in higher productivity and yield.

- Improved crop quality through precise control of environmental conditions and optimized resource management.
- Reduction in crop loss or damage by addressing issues promptly and effectively.

4. Remote Monitoring and Control:

   Enable farmers to remotely monitor and manage their agricultural operations, providing flexibility and convenience.

5. Cost Savings and Efficiency:

   Optimize resource usage, such as water, fertilizers, and energy, leading to cost savings and reduced environmental impact.

9. Resources and Limitations (150 words)

Hardware requirements:

- Soil sensors for measuring moisture, pH, and temperature.
- Weather sensors for monitoring temperature, humidity, and rainfall.
- Crop health sensors for detecting chlorophyll levels and disease symptoms.
- Livestock monitoring devices for tracking behavior and body temperature.
- Actuators for automated control (irrigation valves, ventilation systems, etc.).
- Gateways and communication modules for data transmission.

Software Requirements:

- Cloud-based IoT platform for data storage, processing, and analysis.
- Data analytics algorithms for generating insights and recommendations.
- User interfaces for visualizing data, receiving alerts, and remote control.
- Integration with existing farm management systems or external services.

Limitations :

- Cost: Implementation costs can be high, making it challenging for small-scale farmers or those with limited financial resources to adopt IoT technologies.
- Connectivity: Limited internet connectivity in rural or remote areas can hinder the seamless operation of the IoT system and data transmission.
- Technical Expertise: Setting up and maintaining IoT systems requires technical expertise, which may be lacking among farmers.
- Data Security and Privacy: Collecting and managing sensitive agricultural data raise concerns about data security and privacy.
- Data Interpretation and Integration: Extracting meaningful insights from large volumes of data and integrating IoT data with existing systems can be challenging.
- Environmental Factors: Harsh environmental conditions can impact the reliability and durability of IoT devices.

10. Conclusion (100-150 words)

The Smart Agriculture IoT Project exemplifies how IoT technologies can change conventional farming methods. The initiative enables farmers to monitor, evaluate, and control many aspects of their agricultural systems in real-time by integrating hardware and software resources. The project's implementation results in increased output, resource optimization, and environmentally friendly agricultural methods.

The future of the agriculture business will be more productive and sustainable because of ongoing research and development in IoT technology, data analytics, and automation. This will further improve the capabilities of smart agriculture systems.The successful implementation and positive outcomes of the project lay the foundation for the future development and expansion of smart agriculture practices, the Smart Agriculture IoT project offers a transformative approach to farming, empowering farmers with real-time data, automation, and remote monitoring capabilities. By optimizing resource utilization and implementing sustainable practices, it contributes to improved productivity, profitability, and environmental stewardship in the agricultural sector.

11. References

Mention the sources referred for the study and development of the project. References include literature, books, websites or any other kind of resource directly or indirectly referred for development of project and its report. All the references should be listed in **IEEE format.**