A

Project Report on

MODULAR APPROACH FOR IRRIGATION USING IOT AND MACHINE LEARNING TO OPTIMIZE WATER USAGE

submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science & Engineering

by

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under the guidance of
Mr. S. B. Patil

Department of Computer Science & Engineering

BHARATI VIDYAPEETH'S COLLEGE OF ENGINEERING, KOLHAPUR

YEAR: 2022-23

CERTIFICATE

This is to certify that the project report entitled **"MODULAR APPROACH FOR IRRIGATION USING IOT AND MACHINE LEARNING TO OPTIMIZE WATER USAGE"** submitted by **Mr. Rishikesh Dattatray Yedge , Miss. Jyoti Maruti Patil , Miss. Priti Dinesh Potdar , Miss. Pallavi Tanaji Patil , Miss. Divyani Dilip Tibile** for the partial fulfilment of the requirement for the award of degree of final year B. Tech in **Computer Science & Engineering** to the **Shivaji University**.

This report is record of students' team work carried out by them under my supervision and guidance.

Date:

Place:

Guide Mr. S. B. Patil	**HOD** Mrs. S. M. Mulla
Ext. Examiner	**Principal** Dr. V. R. Ghorpade

ACKNOWLEDGEMENT

It is our privilege to acknowledge with deep sense of gratitude to our project guide Name of the Guide for his valuable suggestions and guidance throughout our course of study and project.

We express our gratitude to Mrs. S. M. Mulla (HOD) for their kind help and co-operation and special thanks to our Principal Dr. V. R. Ghorpade for giving us an opportunity to work on this topic.

We are highly obliged to the entire staff of the Computer Science &Engineering Department for their kind co-operation and help. We also take this opportunity to thank all our colleagues, who backed our interest by giving useful suggestions and all possible help.

1 .Mr. Rishikesh Dattatray Yedge

2 .Miss. Jyoti Maruti Patil

3 .Miss. Priti Dinesh Potdar

4 .Miss. Pallavi Tanaji Patil

5 . Miss. Divyani Dilip Tibile

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In order to declare their joint intention to cooperate in some or all the fields of academics and industrial endeavor for their mutual benefit.

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Party 2: Department of Computer Science & Engineering, Bharati Vidyapeeth's College of Engineering, Kolhapur.

Agrees to explore opportunities for collaboration in the areas described here under:

1. Sponsorship of final year project: **Confido: Modular approach for irrigation using IOT and Machine learning to optimise water usage.**
2. Sharing the technology for academic purpose only.
3. Internship program for students as per requirements.
4. Any other academic activity with mutual consent.

Netsoft technologies and Department of Computer Science & Engineering Bharati Vidyapeeth's College of Engineering. Kolhapur agrees to share the information in strict confidence and will respect the intellectual property rights of each other.

Head, Dept. of Computer Sc. & Engineering, Bharati Vidyapeeth's College of Engineering Kolhapur

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To Principal,

Bharati Vidyapeeth's College of Engineering, Kolhapur

Subject Sponsorship and internship for final year project of engineering

Respected Sir,

We are pleased to inform you that our organisation "Netsoft Technologies, Kolhapur" has chosen following students for being sponsored and given internship under our Student Development and Encouragement Program for completing their final year project.

1. Rishikesh Dattatray Yedge
2. Jyoti Maruti Patil
3. Priti Dinesh Potdar
4. Pallavi Tanaji Patil
5. Divyani Dilip Tibile

Title: Confido: Modular approach for irrigation using IOT and machine learning to optimise water usage.

Confido: The Smart irrigation System has wide scope to automate the complete irrigation system. Here we are building a IoT based Irrigation System using DHT11 Sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the Data to Cloud Server to keep track of the land condition. The System will consist a water pump which will be used to sprinkle water on the land depending upon the land environmental condition such as Moisture, Temperature and Humidity.

After completing the project, we shall consider a demonstration of the project and if it fits to our organization's requirements, we shall buy this project from students in the future The expenses provided by us should be spent on the study materials, stationery and instruments required for establishing setup of the project.

Thanking You

Mr. Vijay Sadalekar

(Managing Director)

Netsoft Technologies, Kolhapur

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ABSTRACT

The increasing global demand for food production and the growing scarcity of water resources have underscored the importance of efficient and sustainable irrigation practices. In response to these challenges, the concept of a smart irrigation system has emerged as a promising solution. A smart irrigation system integrates advanced technologies, such as sensors, data analytics, and automation, to optimize water usage and improve crop yield while minimizing water wastage and environmental impact.

This abstract presents an overview of the key components and functionalities of a smart irrigation system. The system employs a network of soil moisture sensors strategically placed throughout the agricultural field to continuously monitor the moisture levels in the soil. These sensors provide real-time data that is transmitted to a central control unit, which utilizes sophisticated algorithms to analyze the data and determine the precise water requirements for each area of the field.

Based on the analyzed data, the smart irrigation system autonomously controls the water supply to each irrigation zone, ensuring that crops receive an adequate amount of water without overwatering. The system can be programmed to account for various factors such as weather conditions, crop type, and growth stage, further enhancing its precision and adaptability.

Furthermore, the smart irrigation system offers remote monitoring and control capabilities, enabling farmers to access and manage the system from anywhere using mobile or web applications. This feature allows farmers to remotely adjust irrigation schedules, receive real-time alerts and notifications, and track water consumption, promoting convenient and efficient management of water resources.

The implementation of a smart irrigation system offers numerous benefits, including improved water efficiency, reduced water usage, increased crop productivity, and reduced labor and operational costs. By optimizing water usage and minimizing water wastage, the system contributes to sustainable agriculture practices, conserves water resources, and mitigates environmental impacts associated with irrigation.

LIST OF FIGURES

1. Introduction

Most of the farmers use large portions of farming land and it becomes very difficult to reach and track each corner of large lands. Sometime there is a possibility of uneven water sprinkles. This result in the bad quality crops which further leads to financial losses. In this scenario the Smart Irrigation System using Latest IoT technology is helpful and leads to ease of farming.

The Smart irrigation System has wide scope to automate the complete irrigation system. Here we are building a IoT based Irrigation System using DHT11 Sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the Data to Cloud Server to keep track of the land condition. The System will consist a water pump which will be used to sprinkle water on the land depending upon the land environmental condition such as Moisture, Temperature and Humidity.

This system is specific for a crop and hence its usage is limited. Proper scheduling of irrigation is critical for efficient water management in crop production, particularly under conditions of water scarcity. The effects of the applied amount of irrigation water, irrigation frequency and water use are particularly important. To improve water efficiency there must be a proper irrigation scheduling strategy. So, our project devices a simple system, using a microcontroller to automate the irrigation and watering of small potted plants or crops with minimal manual interventions.[10]

This project has been designed for surveillance of irrigation systems in farms without the need of manual checking of irrigation systems. For example, if you are staying in Pune, and have your farm in Kolhapur or elsewhere and it is not possible for you to go to the farms every time to keep a tab on the plants. Instead, this project allows you to check up on your plants using a simple IoT system. The positive part of this project is that, the node used to connect the system to your smart device, also controls the flow of water from the pump and also the timing intervals in between the irrigation cycles.

1. Need of the Work

Until quite recently, India enjoyed abundant water resources. But population growth and overexploitation has led to a situation where the demand for water is exceeding supply. Among others, the agriculture domain is mostly explored area of concerning the application of IoT in improving the traditional methods of farming. The rapid growth in nano technology that took place in last decade, has enabled the creation of small and cheap sensors.

The self-contained nature of operation, together with modular sized hardware platforms, scalable, and cost-effective technologies, has enabled the IoT as a potential tool towards the target of self-organized, decision making, and automation in the agriculture cum farming industry. In this regard, precision agriculture, automated irrigation scheduling, optimization of plant growth, farm land monitoring, green-house monitoring, and farming production process management in crops, are among a few key applications.

However, IoT is in nascent stage of development, hence it has a few limitations such as interoperability, heterogeneity, memory constrained hardware platforms, and security. These limitations invite challenges in the design of IoT applications in agriculture. In agriculture, most of the IoT based applications are targeted for various applications. For example, IoTs for environmental condition monitoring with information of soil nutrients is applied for predicting crop health and production quality over time. Irrigation scheduling is predicted with IoTs by monitoring the soil moisture and weather conditions.

The issues present in such applications are centered on the device interoperability, technology heterogeneity, security, measurement interval, and routing protocols. In the overall scenario, the IoT based farming solutions need to be of very low cost to be affordable by end users. However, with the increasing population, the demand of food-grain is exponentially rising. A recent report warns that the growth in food grain production is less than the growth in population. This has led the researchers to demand to boost production by incorporating advanced technologies. As per a recent report published by Food and Agriculture Organization, food grain requirements in world shall touch 3 billion tons by 2050. Consequently, new and modern technologies are being considered in many agricultural applications to achieve the target. This pace needs to be accelerated by incorporating IoT while making the agriculture smart and definite in nature

2. Thesis Overview

This report consists of an overview of the tasks we performed toward the completion of our project. The report comprises the literature we reviewed with data we considered while designing this project and what we understood from the given literary information. Following by literature overview you will see the proposed work consisting of system architecture, modules, and methodology. Then software design comprising of software and hardware requirements, and technologies we used. After that, the implementation is presented in the sixth point followed by our conclusion and references. We have also attached the MoU, Sponsorship Letter, Funding letter and Completion letter too. The report comprises of various diagrams related to work done such as System architecture, Circuit Diagram, Flowchart, DFD’s, Control flow diagram, Algorithm Diagram, Sequence Diagram. The Certificates of the National Conference on Emerging Trends in Engineering & Technology (NCETET-2023) of all the group members with the published paper has been attached at the end of the report.

2. AN OVERVIEW OF THE RELEVENT LITERATURE

Installation of a device which includes geo-tagged sensors so that it can keep track of moisture content in soil at various critical control points in the farm with continuous streaming of data and analysis which can help in monitoring as well as controlling the irrigation process more efficiently. Currently there are lot of techniques which are used to perform this task and but the problem in those technique is that it doesn’t includes any real-time collection of data and its analysis which again comes to the same problem and that’s why these approaches are not efficient enough for scheduling of irrigation process also it doesn’t include any automated technique to irrigate the farm[7].

This model includes Artificial Neural Network because it can generate results very accurate and it can analyze and process a large amount of data very fast which is very important for all such kind of systems to generate instantaneous results. This model will be used to find out all the patterns after which a particular section of farm will needs to irrigate with a correct amount of water, and it will be able to detect such situation in advance which will be very beneficial. This model made in such a way that it will identify such patterns and it will use it to guide the hardware device irrigate the correct portion of farm with a correct amount of water without the use of any human effort[7].

Wireless monitoring of field irrigation system reduces human intervention and allows remote monitoring and controlling on android phone. Cloud Computing is an attractive solution to the large amount of data generated by the wireless sensor network. The real-time environmental parameters like soil moisture level, ambient temperature and tank water level have continuous influence on the crop lifecycle. By forming sensor network, good monitoring of water regulation in the agriculture field can be achieved[8].

The decision for controlling action is taken at cloud server and the corresponding action is performed at the node. It shows the cloud server with android application. The decision making is based on comparison between sensed values (of soil moisture, air temperature, tank water level) and respective threshold values. Master node receives the control command from the cloud and transmits it to the node which performs the corresponding action. Thus, system automatically controls drip irrigation depending on decision from the real time values.[8]

Due to efficiency of water, it was necessary to seek solution for good control and rational management for it . An application is developed and connected via Wi-Fi shield for control the temperature , soil moisture as well as humidity . An automatic irrigation system based on IOT is realized which allows the optimal remote control of the water consumption. The main objective of this work is to achieve a technological solution based on IOT , to facilitate the task of help the farmers and reduce its efforts[9].

An IOT based platform based on Thingspeak Arduino is developed and tested where the goal is the farmer will able to control the irrigation by using a PC or smartphones from anywhere and anytime . To monitoring the parameters of water and refuse his work and optimize the use of water. The system has a soil moisture sensor that measures the soil moisture level and sed it to the Thingspeak cloud via Wi-Fi module ESP8266 to monitor the soil condition . If the humidity level is at well- defined intervals, you can know the state of soil if it is dry or wet, which opens the solenoid valve and thus provides water to irrigate the soil [9].

Agriculture automation is a major concern and emerging topic for all countries. Smart irrigation is emerging as new scientific disciplines that use data-intensive methods to increase agricultural productivity while reducing its environmental impact. Modern agricultural operations generate data from a variety of sensors, leading to a better understanding of both the operation environment and the operation activities . This enables more accurate and efficient decision-making The SMART irrigation system enhances the performance and is an emerging technique that automates irrigation systems and conserves water usage. This technique adjusts irrigation based on actual soil and weather conditions; therefore, it allows farmers to meet their demand with a new adopted technique which conserves the water for irrigation process . the SMART irrigation system includes data acquisition (sensor), irrigation control, wireless communication, data processing and fault detection. Each of these components can be used in IoT devices. Internet of Things (IoT), smartphone tools, and sensors are technologies that further enable farmers to know the exact status of their field, including soil temperature, amount of water required, weather conditions, and much more[10].

Monitoring in the particular context of precision irrigation inculcates collecting data, which adequately leads to reflect the real-time status of the plant, soil, and weather of irrigation areas through the use of the Internet of Things (IoT) and Wireless Sensor Networks (WSN). One of the most vital steps in good irrigation water management is regarded as knowledge of basic soil, crop relationship and water. With regards to the implementation of IoT devices, the used communication technologies could be considered as a vital and imperative point to attain successful operations. Two other noticeable technologies that have been established more recently are Long Range (LoRa) and Message Queuing Telemetry Transport (MQTT). Two of the most imperative and mostly used storage systems could be regarded as cloud and traditional database. There are several prospects for farmers and stakeholders who combine machine learning forecasting with portable software solutions. Water use efficiency can be enhanced by improving the predictions on irrigation needs, matching timing and volume to plant water needs, and adaptively compensating for water loss[10].

Day to day activities peoples forget to water their pants avoid this problem to improve the growth of plants automated irrigation system is developed. Our project provides smart irrigation system to water the plants & inform the user. This project helps the user about water level present in tank & gives soil moisture content & determine temp & humidity of soil. Sensors and microcontroller available to determine plants need to water. Project develop microcontroller system to irrigate plant automatically information is sent to the farmer this technique soil moisture is kept near the root of plants sensor senses the moisture &transmit information to microcontroller which control flow of water to plant[11].

Smart irrigation system is implemented in agricultural lands. The moisture sensor is kept in the soil and it gives the analog signal to the arduino and the analog signals from the water level sensor and temperature and humidity sensor is given to the arduino signals are converted into digital signals and the motor gets turned ON. The message signals are given to the user as a message and the user knows whether the motor gets turned ON or OFF[11].

It shows the use of Arduino and ESP8266 based monitored and controlled smart irrigation systems, which is also cost-effective and simple. It is beneficial for farmers to irrigate there land conveniently by the application of automatic irrigation system. This smart irrigation system has pH sensor, water flow sensor, temperature sensor and soil moisture sensor that measure respectively and based on these sensors arduino microcontroller drives the servo motor and pump. Arduino received the information and transmitted with ESP8266 Wi-Fi module wirelessly to the website through internet. This transmitted information is monitor and control by using IOT. This enables the remote-control mechanism through a secure internet web connection to the user. A website has been prepared which present the actual time values and reference values of various factors needed by crops. Users can control water pumps and sprinklers through the website and keep an eye on the reference values which will help the farmer increase production with quality crops.[23]

Despite the world being in 21 st century most of the developing and under-developed nation use traditional method for farming we requires tremendous energy and hectic schedule from a small scale farmer with a very measly return in terms of profit moreover the water wastage and continuous monitoring required to keep check in plants condition is just unjustified but with 58% of population having agriculture as primary income source most of the Indian farmers having extremely low income it seems impossible for them to hop over costly machineries. But now with the cost-effective processors out there in the market can provide a solution to all these issues faced by Indian farmers. With exponential progress of Internet of Things (IoT) devices in the market smart irrigation systems are becoming a new trend. smart irrigation system using NodeMCU to wirelessly operate a network of irrigation modules by irrigating the field when required by measuring the water content of soil and keep checking condition of plant using a camera this paper also provide insight of how to keep safe integrity of data which travels from NodeMCU to user smartphone using ciphering methods and by keeping proposed system reliable and cost effective.[24]

Wireless sensor network (WSN) for irrigation management has proved out to be helpful for water savings. WSN as the name suggests, is a connected network of sensor nodes that nodes directly interact with the environment and provide real time information that is helpful in identifying farm areas in need. It can be used as both a data collection device and a decision-making tool for real time monitoring. Gutierrez et al. (2014) presents a WSN for plant water usage optimization. The system is powered by photovoltaic panels for long working duration. Similar work using solar power has been proposed by Miranda et al. in Miranda et al. (2005), and, authors in Dursun and Ozden (2011) have also presented a WSN for controlled irrigation and monitoring. In Vellidis et al. (2008) a low-cost system for irrigation scheduling in cotton using real-time wireless sensors is proposed. Similar works using WSN but targeted to mango orchard and apple orchard have been presented in Nooriman et al., 2018, Meng et al., 2018 respectively. A new place where WSN could be implemented is presented by authors in Lopez-Iturri et al. (2018) where a WSN combined with cloud for data storing and an app as an educational resource platform in school gardens, with the aim of enhancing technological skills in students.[25]

Current irrigation systems make use of direct parameter thresholds, fuzzy logic to get the water requirement. The parameters that are tracked mostly include the ambient temperature, humidity, soil water content and they do not form a simple relationship with the crop water needs. This requires to get into complexities and make use of neural network (NN) to decide for irrigation. NN is a subset of machine learning that mimic the human brain and can process information similar to it. Alike the human brain, NN comprises of various connected elements called neurons that work to solve problems. This is also addressed in this paper, and also one of the targeted users is the Indian farmer, an economically feasible equipment would be beneficial. Current solutions are crop specific and more generic systems are needed. To achieve this, a novice user-device interaction is introduced here. It thus suggests that it is essential for technology to contribute in farming sector as well by making best use of current advancements and implementing them in traditional methods. People should be more aware and, adopt techniques to reduce the burden and provide easy access even from distant place. Thus, considering the current research in India in smart farming domain, this paper presents a crop monitoring and automatic irrigation system that performs:

- Interacts with user and gets planted crop details.
- Estimates beforehand the irrigation schedule for complete season.
- Gets ambient and soil statistics.
- Performs evapotranspiration and neural based irrigation decision.
- Alerts irrigation unit to enable zone-wise watering.
- Sends sensor data to MQTT broker to allow remote data monitoring.[25]

Farming and agriculture accounts for a major portion of GDP (Gross Domestic Product) not only of developing countries but also for many developed nations. Thus, improvising and optimizing the current farming technologies is the need of the hour. It will not only help in flourishing sustainable development of mankind, flora and fauna but will also help in dealing with the global crisis such as climate change and epidemics such as draught. With better technology comes better yield; thus, will help prevent situations like starvation and malnutrition. The technology should be available at an affordable price so that its impact could reach to billions of people worldwide. The smart home systems are being extensively research and developed but this major area of Agriculture and specially Smart Agriculture tends to lag behind other domains and require quite a lot of R&D to achieve sustainable goals not only at industrial level but at the root level of this agriculture industry. Automation of conventional irrigation techniques can lead to many folds increase in crop yield. This paper proposes a state-of- the-art solution to the farm Irrigation using IoT (Internet of Things) and Machine Learning techniques, a wireless sensor network field needs to be established throughout the farm field or even in the household garden to monitor all the parts of the field. The proposed research presents the best possible solution to the farm needs, irrigation needs based on various open-source databases available online and Machine learning algorithms(Classification and Regression). Irrigation needs varies with the crops and that too with the seasons. During various phases of crop production, crop water needs vary substantially. Over Irrigation or less irrigation both would affect the yield and the nature, so automation of Irrigation systems is necessary. Efficient Irrigation ensures a sustainable use of water and also helps in replenishing groundwater. Irrigation based on soil topology and weather pattern is shown in the study conducted by using various sensor modules and various micro-controllers like Raspberry Pi, Arduino Uno and Arduino Mega. This paper presents an economical and easy to understand approach of automating irrigation systems. These chips along with the sensors, transducers and actuators monitors, controls soil temperature, moisture and soil fertility[26].

The solution proposed in this research study is based on Literature Review and experimentation of high-quality research articles and Machine learning algorithms.

In the current age of high competition and risk in markets, technological advancements are a must for better growth and sustainability. The same applies to the agriculture industry. Every farmer has high stakes on the crops, their yield and quality. Rising water issues and need for proper methodologies for farm maintenance is a hot issue that needs to be tackled at utmost propriety. An automation of irrigation systems in farms is proposed in this research. The proposed solution is based on the Internet of Things (IoT), which would be a cheaper and more precise solution to the farm needs. A Monitoring system whose main purpose is to solve the over irrigation, soil erosion and crop-specific irrigation problem will be developed to case and efficiently manage Irrigation problems. Since it is a well-known fact that the water is a scarce resource and over wastage of such an essential resource should be minimized. The proposed solution will be developed by establishing a distributed wireless sensor network (WSN), wherein each region of the farm would be covered by various sensor modules which will be transmitting data on a common server. Machine learning (ML) algorithms will support predictions for irrigation patterns based on crops and weather scenarios.[26]

3. Problem Definition and Methodology Adopted /Proposed work

1. Formalization of the Problem

The primary objectives of this research are as follows:

- Design and implement a flexible and scalable irrigation system using IoT (Internet of Things) and machine learning techniques.
- Optimize water usage.
- Improve water efficiency.
- Enhance crop yield and quality .
- Developing an intuitive interface for farmers or end-users to interact with the irrigation system, monitor data, and adjust settings if required.
- Reducing the overall cost needed to build the entire setup.
- Remote monitoring and control.
- Precision Irrigation.
- Environment Sustainability.

2. Technologies

Function	Resources
Coding Languages	Android-Java 000Webhost-MYSQL Arduino-C
Development Platforms	Android Studio VS Code Arduino IDE
Data Transfer	Cloud MQTT
Computer Boards	ESP 8266 Lua WIFI Module Node MCU
Sensors	DHT 11 Sensor Soil Moisture Sensor Rain Drop Sensor
Other Hardware	Solenoid Values 5V Charger Water Pump Two Channel Relay PCB Board
Other Software	000WebHost Draw.io

3.2.1. HARDWARE USED

1. ESP 8266 Lua WIFI Module-

The ESP 8266 Lua WIFI module is an open-source board with inbuilt ESP-12E WIFI module. This is not a weakling like the Arduino's, with 512kb of memory and a processor at 40Mhz there is not a shortage of sources. This sign is extremely suitable for starting IoT (Internet of Things) applications. Programming the ESP 8266 Lua WIFI module is slightly different than normal, with the API that looks like NodeJS, this module receives the commands through the LUA scripts that are uploaded.[16]

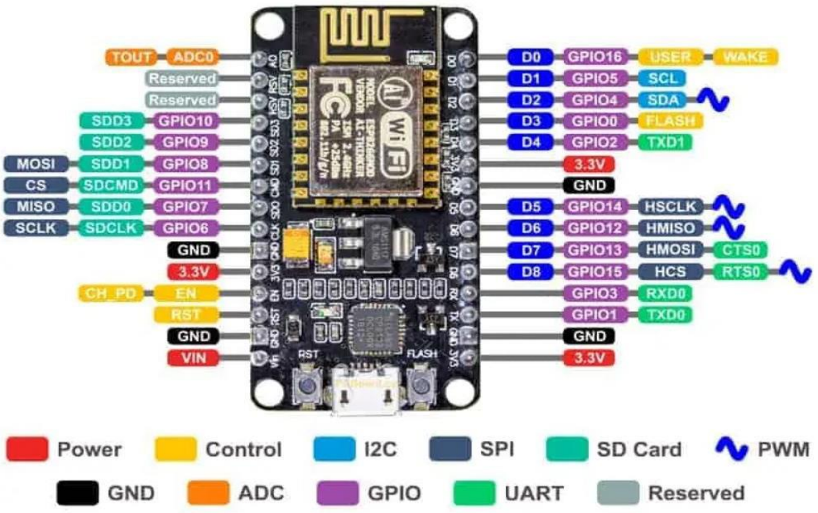


Fig.3.1: ESP 8266 Lua WIFI

- VCC Pins -There are four power pins. VIN pin and three 3.3V pins.
- GND – These are the ground pins of ESP8266
- I2C Pins –These are used to connect I2C sensors and peripherals.
- GPIO Pins- These are the general-purpose input output pins
- ADC Pins- These are Analog to digital converter pins
- UART Pins- These are universal asynchronous receiver transmitter used to exchange serial data between two devices
- SPI Pins- Serial peripheral interface used to send data serially
- SDIO Pins-Secure digital Input Output(D1-D8)
- PWM Pins- Pulse Width Modulation the PWM output can be implemented programmatically and used for driving digital motors and LEDs. Power

2. **DHT11 sensor-**

The **DHT11** is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So, if you are looking to measure in this range then this sensor might be the right choice for you.[13]

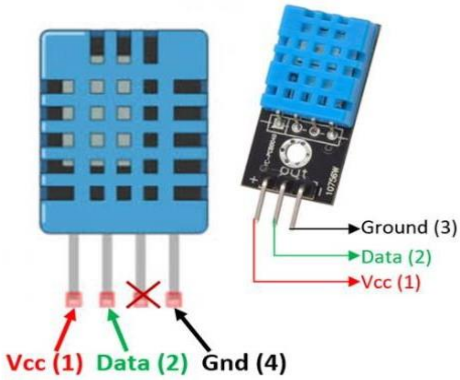


Fig.3.2:DHT11 Sensor

- VCC Pin- Power supply 3.5V to 5.5V
- Data Pin- Outputs both Temperature and Humidity through serial Data
- NC Pin- No Connection and hence not used
- Ground Pin- Connected to the ground of the circuit

3. **Soil Moisture Sensor-**

The **soil moisture sensor module** is used to detect the moisture of the soil. It measures the volumetric content of water inside the soil and gives us the moisture level as output. The module has both digital and analog outputs and a potentiometer to adjust the threshold level. The moisture sensor consists of two probes that are used to detect the moisture of the soil**.** The moisture sensor probes are coated with immersion gold that protects Nickel from oxidation.

These two probes are used to pass the current through the soil and then the sensor reads the resistance to get the moisture values.[9]

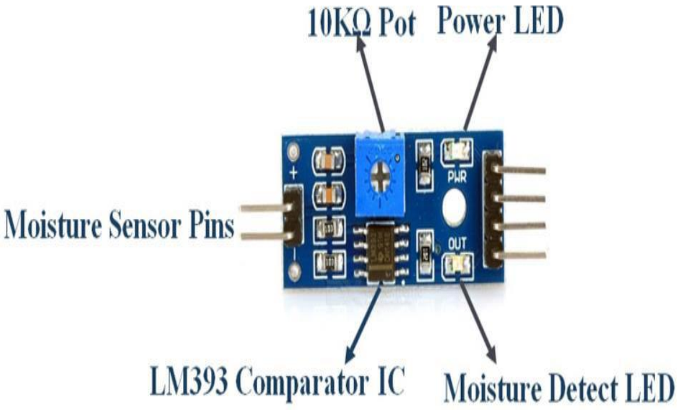


Fig.3.3:Moisture Sensor

- VCC Pin – The Vcc pin powers the module, typically with +5V
- GND Pin- Power Supply Ground
- DO Pin- Digital Out Pin for Digital Output.
- AO Pin- Analog Out Pin for Analog Output.

4. **Rain Sensor-**

It's a device that communicates with your sprinkler timer about the level of rainfall. If enough rain has fallen, then the sensors let the timer know to skip the next cycle and not run. It's a convenient piece of technology. If you're out of town or just unaware of the weather forecast, the rain sensor will make sure your lawn isn't overwatered.[12]

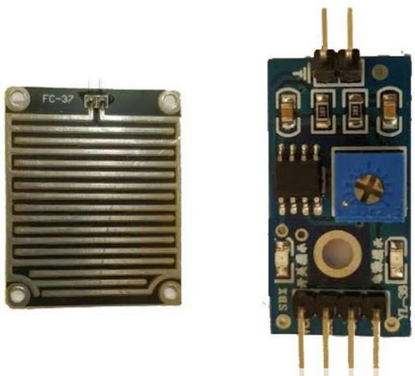


Fig.3.4:Rain Sensor

5. Two Channel Relay Module-

The two-channel relay module is designed to allow your Arduino to control two high-powered devices. It has two relays, each with a maximum current rating of 10A at 250VAC or 30VDC.At the core of a relay is an electromagnet (a wire coil that becomes a temporary magnet when electricity is passed through it). A relay can be thought of as an electric lever; you turn it on with a relatively small current, and it turns on another device with a much larger current.[21]

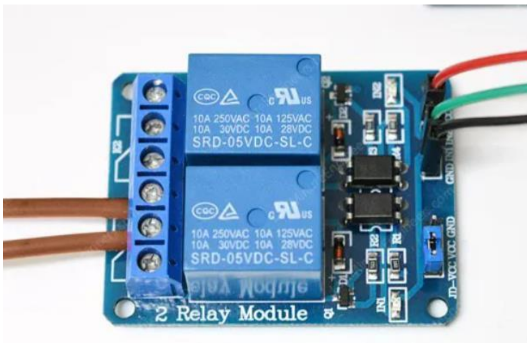


Fig.3.5:Two Channel Relay

6. Water Pump –

A low cost, small size Submersible Pump Motor which can be operated from a 3 ~ 6V power supply.

Fig.3.6:Mini Water Pump

- Operating Voltage : 3 ~ 6V
- Driving Mode : DC

3.2.2. SOFTWARE USED

Arduino CC(IDE): -

The Arduino IDE is a software which is used for coding for all Arduino boards. This application compiles your code before uploading to the Arduino board to find errors. In this IDE, we use basic embedded C. Also, one may need to create their own header files to carry out certain operations. This helps to increase the functionality.[10]

Android Studio: -

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as primary IDE for native Android application development.[14]

MySQL:-

MySQL is an open-source relational database management system (RDBMS) that is widely used for managing structured data. It is one of the most popular databases used in web applications and is known for its scalability, reliability, and performance.
MySQL uses a client-server model, where the database server handles the storage, retrieval, and management of data, while clients, such as applications or command-line tools, interact with the server to perform various operations on the data.[19]

000Webhost:-

It is a popular web hosting provider. Web hosting is a service that allows individuals or organizations to make their websites accessible on the internet. 000webhost offers free web hosting services, which means users can create and host their websites without paying any fees. It provides a user-friendly control panel (cPanel) that allows website owners to manage their websites, databases, email accounts, and other related settings.

3.3.3. ALGORITHMS

Machine Learning Algorithm Used:

Linear regression is a popular algorithm used for predicting a continuous numerical value based on one or more input features. It assumes a linear relationship between the input variables and the target variable. The goal of linear regression is to find the best-fitting line that minimizes the difference between the predicted values and the actual values.
The general form of a linear regression model with one input feature is given by:

$$y = b0 + b1 * x$$

where:
- y is the target variable (the variable we want to predict)
- x is the input feature
- b0 is the y-intercept (the value of y when x is 0)
- b1 is the slope of the line (the change in y for a unit change in x).[14]

The linear regression algorithm estimates the values of b0 and b1 that minimize the sum of the squared differences between the predicted values and the actual values. This process is known as "ordinary least squares."

There are several variations of linear regression, including simple linear regression (with one input feature) and multiple linear regression (with multiple input features). In multiple linear regression, the equation expands to:

$$y = b0 + b1 * x1 + b2 * x2 + ... + bn * xn$$

where x1, x2, ..., xn are the input features, and
b1, b2, ..., bn are the corresponding coefficients.[14]

To find the optimal values of the coefficients (b0, b1, ..., bn), linear regression algorithms typically use optimization techniques such as gradient descent or matrix algebra methods.

Linear regression has some assumptions, such as linearity, independence of errors, homoscedasticity (constant variance of errors), and normality of errors. Violations of these assumptions may affect the accuracy and reliability of the model's predictions. Additionally, linear regression is sensitive to outliers and can be influenced by the presence of multicollinearity (high correlation between input features).

In multiple linear regression (with multiple input features), the relationship is represented by a hyperplane in a higher-dimensional space. However, it becomes difficult to visualize the hyperplane directly when there are more than two input features. Instead, we rely on the coefficients to understand the impact of each input feature on the target variable. The coefficients are estimated through a process called model training, where the algorithm learns from historical data to find the best-fitting line or hyperplane that minimizes the difference between the predicted values and the actual values.

Once the model is trained and the coefficients are determined, we can use the equation to make predictions on new data by plugging in the values of the input features. The model then calculates the predicted value of the target variable based on the learned coefficients and the provided input values.

Linear regression is widely used in various fields, including statistics, economics, finance, social sciences, and machine learning. It serves as a foundation for more advanced regression techniques and can provide valuable insights into the relationships between variables.

Linear regression can be applied to smart irrigation systems to help optimize water usage and improve the efficiency of irrigation processes. Here's how linear regression can be used in the context of smart irrigation:

1. Predicting Water Requirements: Linear regression can be used to predict the water requirements of plants based on various input features such as weather data (temperature, humidity, rainfall), soil moisture levels, and plant characteristics. By training a linear regression model on historical data, it can estimate the water needs of plants in real-time, helping to determine the optimal amount of water to be applied.[21]

2. Adjusting Irrigation Schedules: Linear regression models can analyze historical irrigation data and correlate it with environmental variables to develop a model that determines the ideal irrigation schedule. By understanding the relationship between input features (such as

temperature, rainfall, and evaporation rates) and the required irrigation quantities, the model can suggest adjustments to irrigation schedules to ensure water is applied efficiently and at the right times.[21]

3. Soil Moisture Prediction: Linear regression can be used to predict soil moisture levels based on various factors such as temperature, humidity, and precipitation. By analyzing historical data and training a linear regression model, it becomes possible to estimate soil moisture content in real-time. This information can help in determining when and how much water should be applied to maintain optimal soil moisture levels.[21]

4. Water Conservation: Linear regression models can identify patterns and relationships between weather conditions, soil moisture levels, and water usage. By analyzing historical data, these models can highlight inefficiencies and identify areas where water usage can be reduced. This information can be used to optimize irrigation practices and conserve water resources.[21]

It's important to note that while linear regression can provide useful insights and predictions in smart irrigation systems, other machine learning techniques and algorithms may also be employed to enhance the accuracy and effectiveness of the models. Additionally, domain expertise and considerations of local conditions should be taken into account when implementing smart irrigation systems.[20]

3.3. Methodologies

CLOUD

Cloud computing is a form of computing in which networks, data storage, applications, security and development tools are all enabled via the Internet, as opposed to a local computer or an on-premise server in your organization[16].

The cloud part processes the collected data in real-time, including data visualization and system health monitoring.

IOT

The Internet of things (IoT) describes physical objects (or groups of such objects) with sensors , processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. Internet of things has been considered a misnomer because devices do not need to be connected to the public internet, they only need to be connected to a network and be individually addressable.[10]

Machine Learning

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.

For integrating and streaming analytics to detect anomalies from the six environmental data in real-time.[21]

Android

Android is an open source, Linux-based software stack created for a wide array of devices and form factors. Android is an open source and Linux-based **Operating System** for mobile devices such as smartphones and tablet computers. Android was developed by the *Open Handset Alliance*, led by Google, and other companies.[14]

4. Software Design

4.1. System Architecture

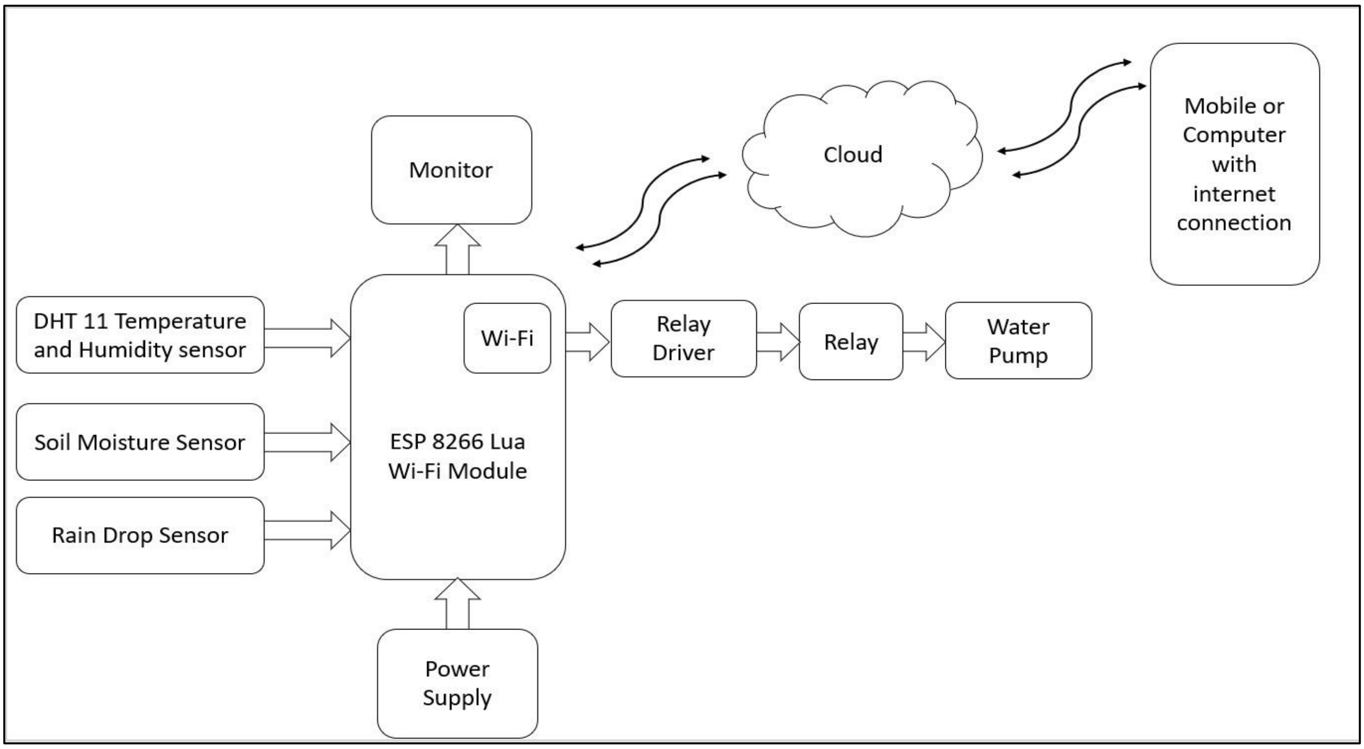


Fig.4.1: System Architecture

The system here consists of ESP 8266 Wi-Fi Module where Soil Moisture, Humidity, Temperature and Rain Drop Sensors deployed in soil are connected to the microcontroller which gives their respective data. Machine learning algorithm been employed for predicting the soil condition based on Moisture and Temperature level. The predicted output is then used for sending the control signal via the serial communication to ESP 8266 for controlling water pump for watering the field accordingly. The last and final component is recording the soil moisture and Temperature level and prediction with date and time in the cloud server for farmers to access from their mobile to have good knowledge and understanding on field being irrigated.

4.2. Designed Modules

4.2.1. Circuit Flow Diagram

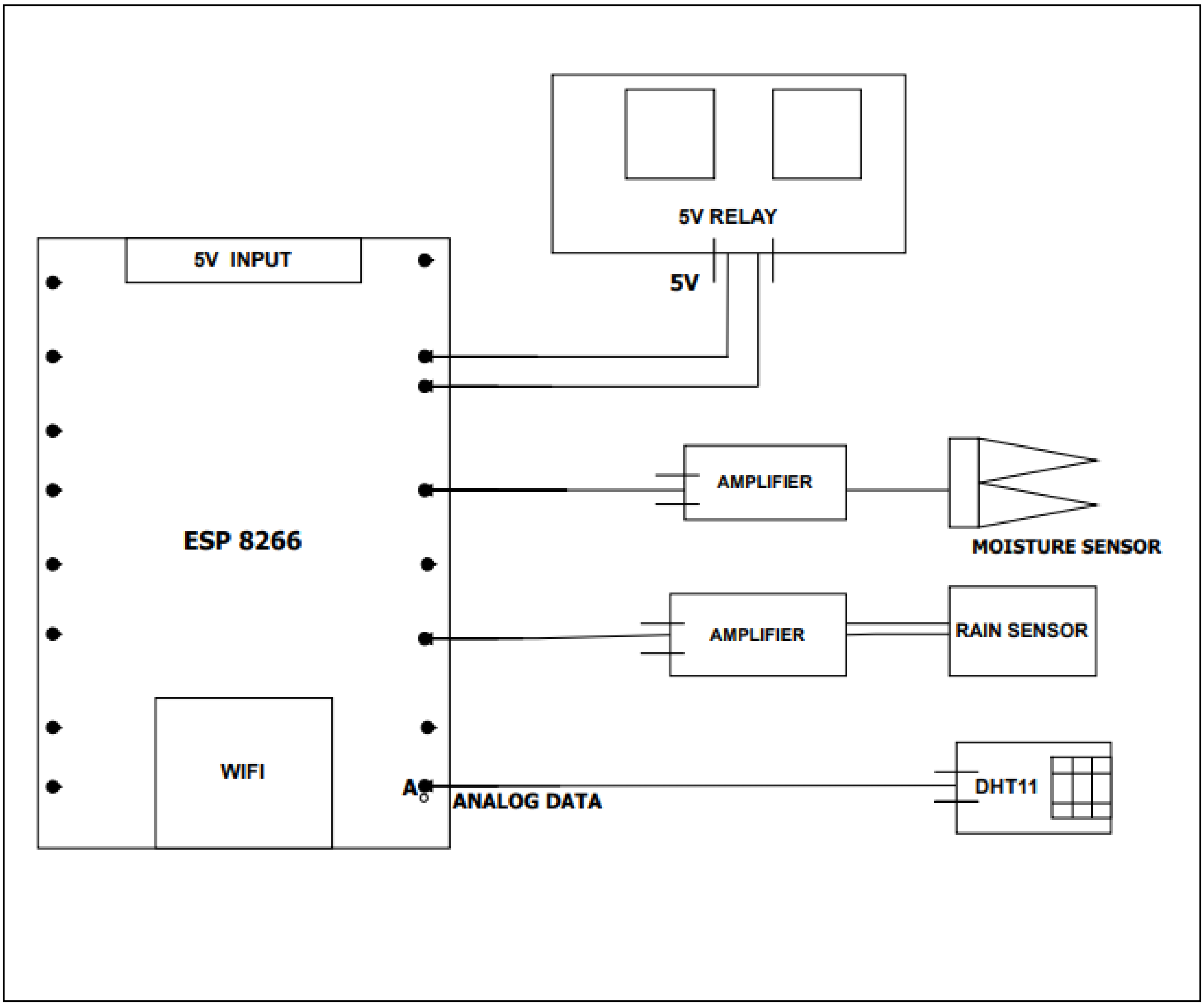


Fig.4.2: Circuit flow Diagram

4.2.2. Algorithm

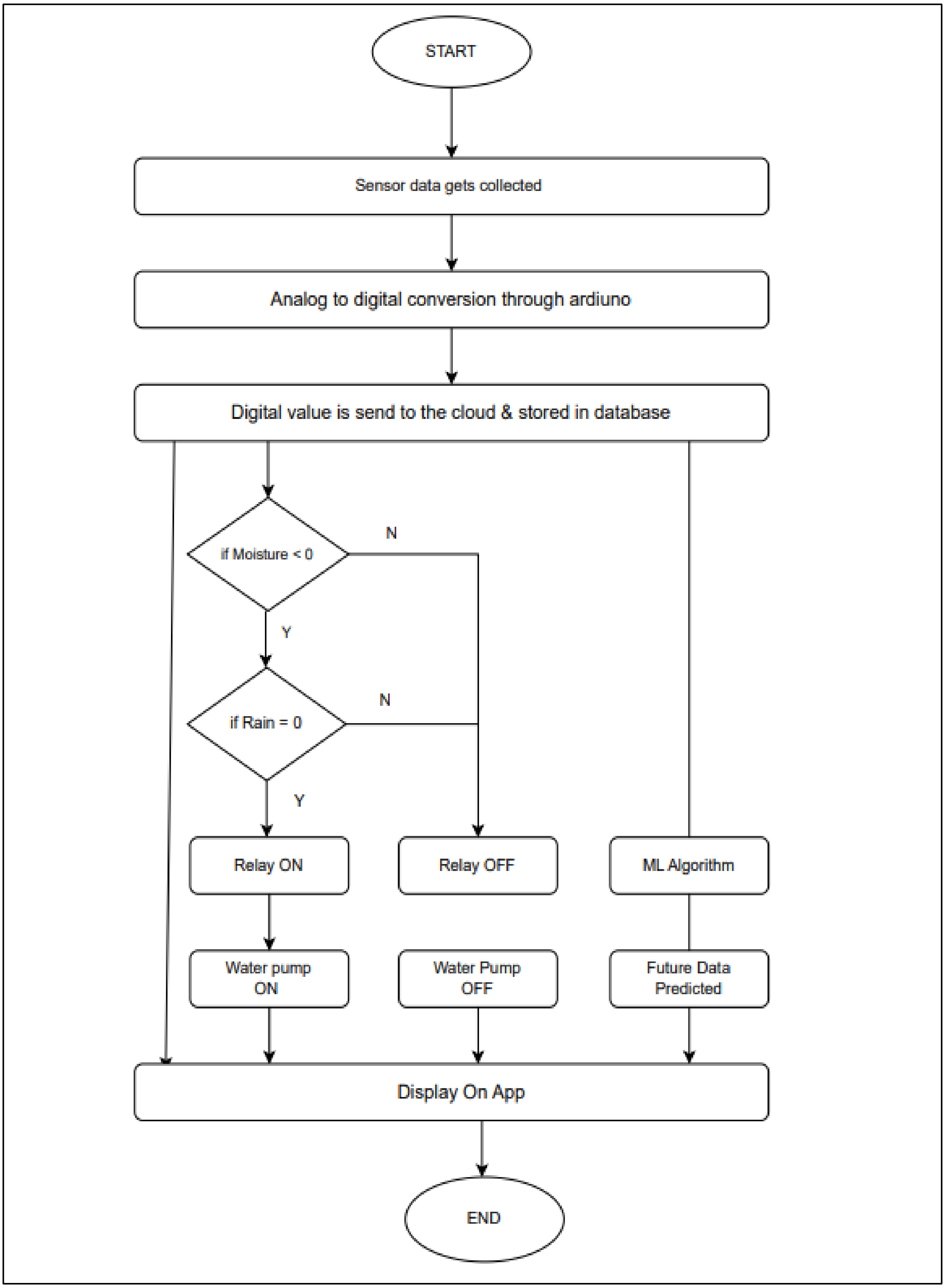


Fig.4.3:Algorithm

4.2.3. Flow Chart

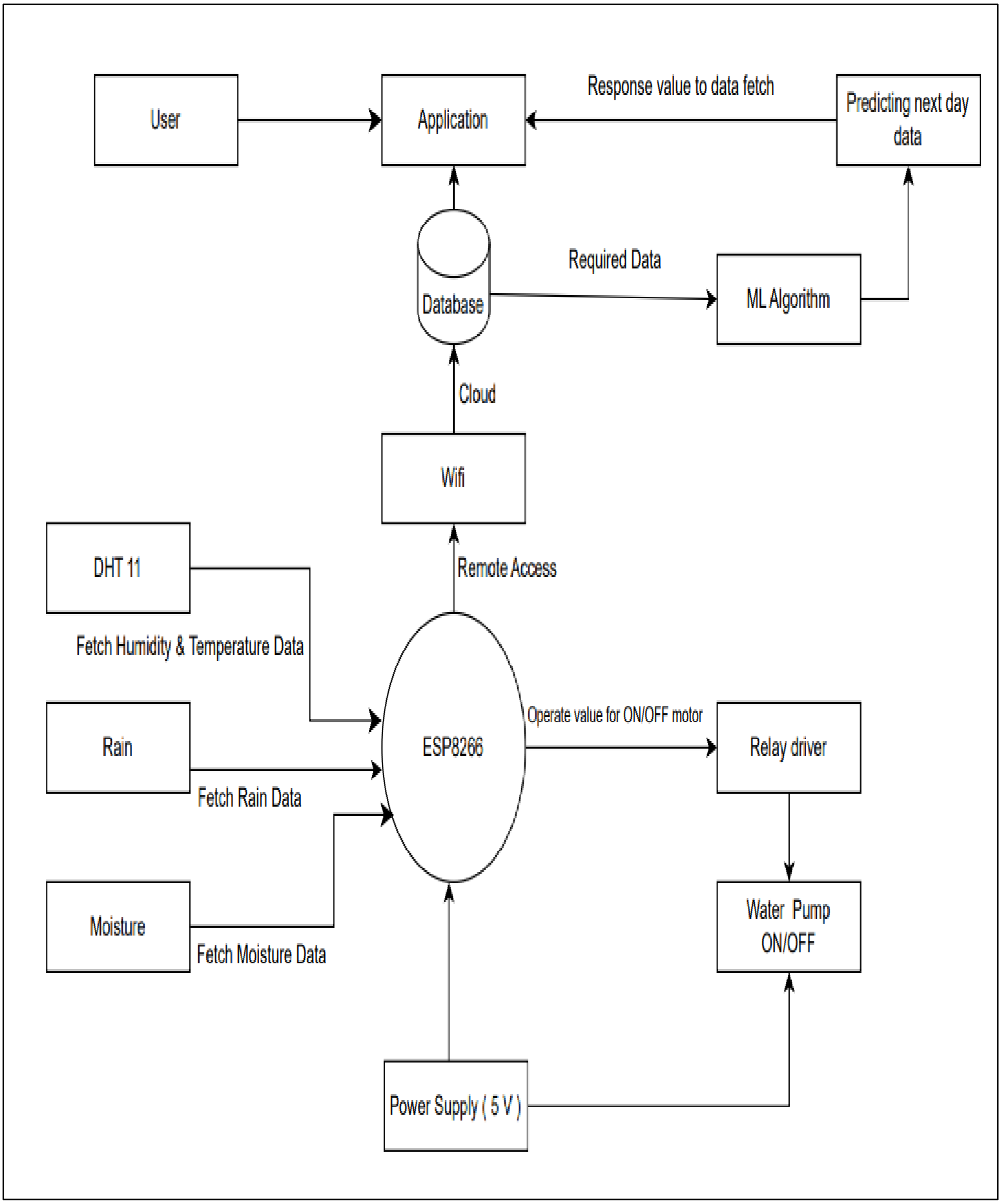


Fig.4.4:Flow Chart

4.2.4. DFDs

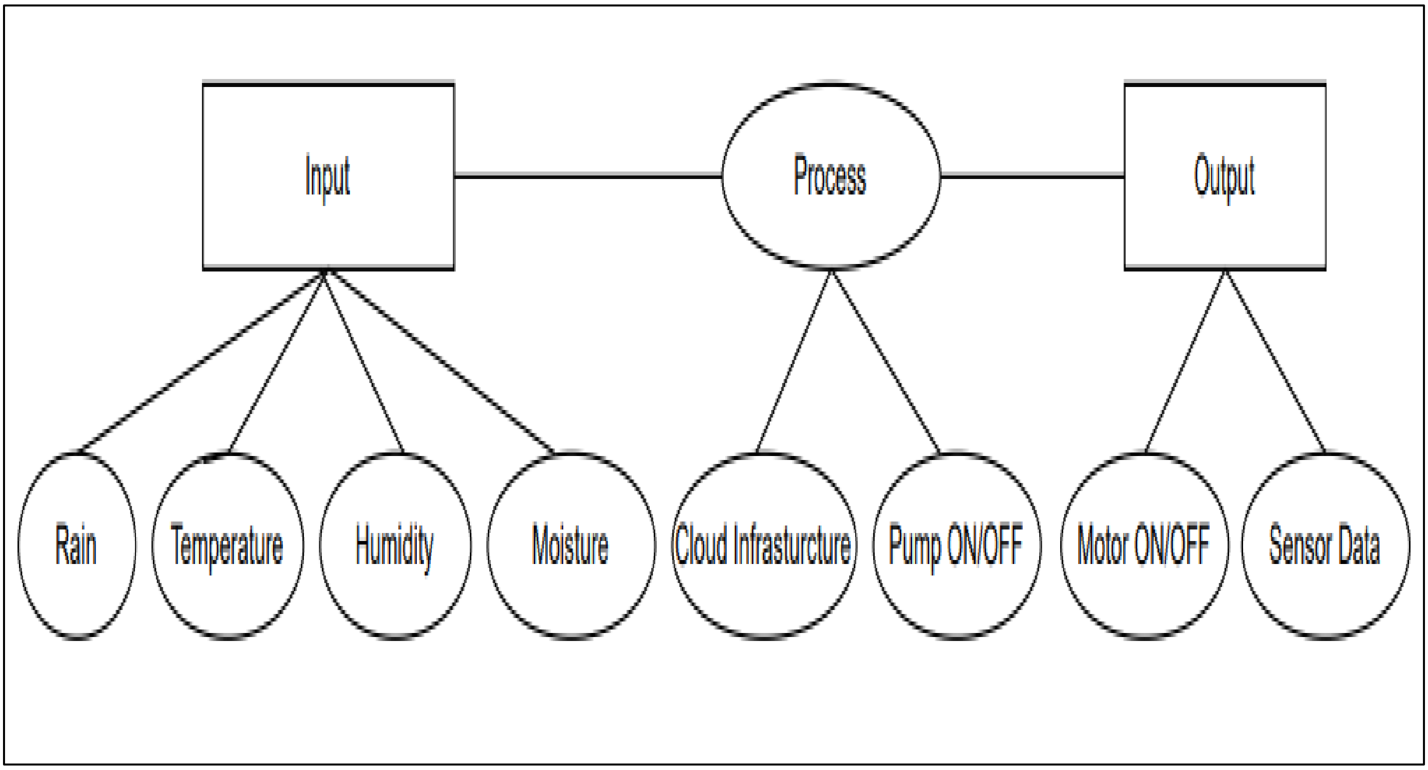


Fig.4.5: Level 0 DFD Diagram

Level 0 DFD: The level-0 (DFD) diagram shows the main serviceable areas of the system under investigation. As with the context diagram, any system under investigation should be presented by only a single level-0 (DFD) diagram. Above figures helps visualize the DFD diagram .There are three dissimilar processes, which offer a realistic way to begin the analysis. These are sensing the live data of temperature and humidity, setting processes through application and applying all at the end i.e., to control the motor, pump, through application and sensor data.

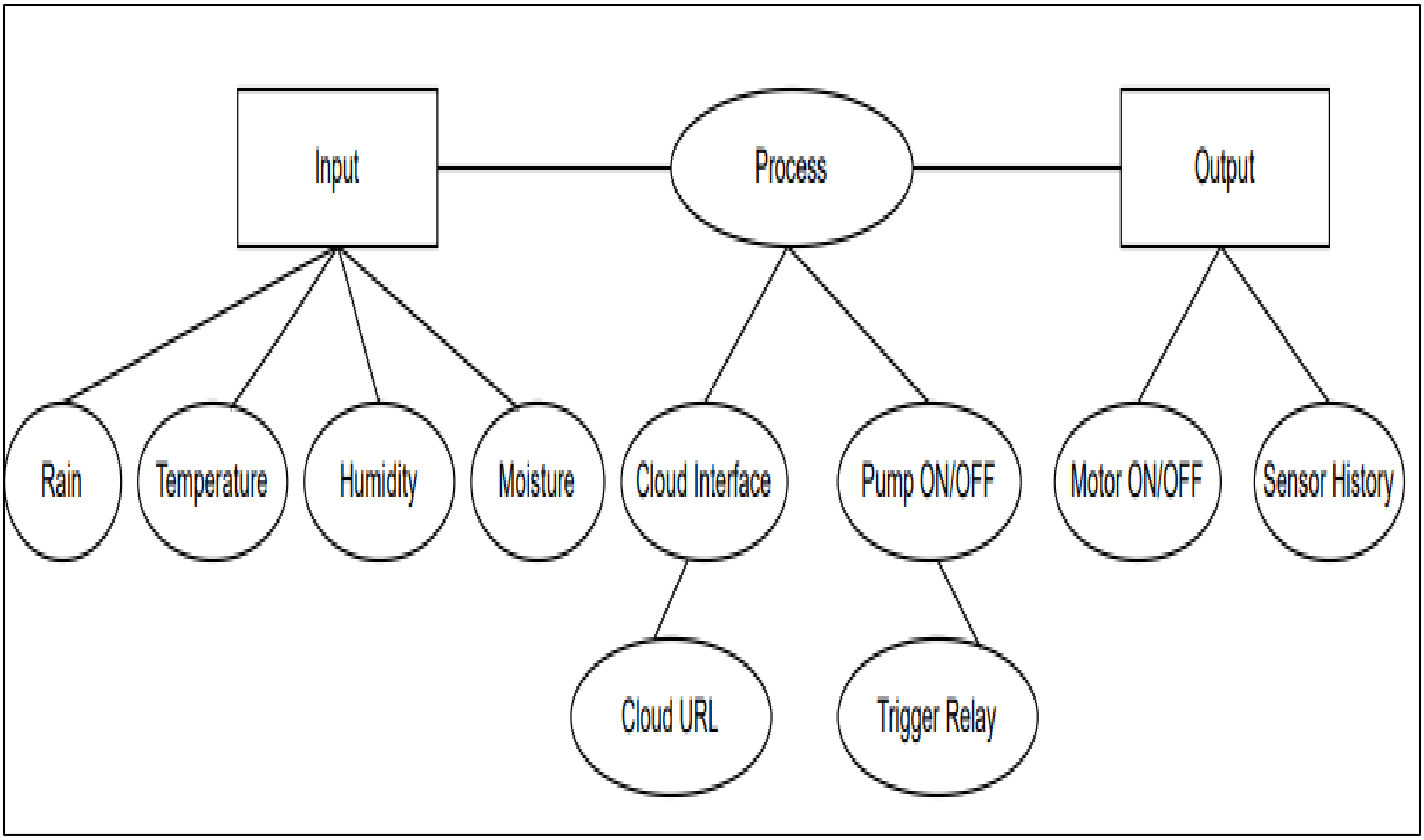


Fig.4.6: Level 1 DFD Diagram

Level 1 DFD: Level-1 (DFD) diagram shows another important functional area of the system under investigation. As with the level 1 (DFD).There is no formula that can be useful in deciding what is, and what is not. Level-1 (DFD) process describes only the main serviceable areas of the system, and the temptation of including lower-level processes must be avoided on this diagram. Here the overall processing of the system is shown. What is done and how it is done has been clearly described in the level-1 DFD. Only the main sub processes are described here

4.2.5. Control Flow Diagram

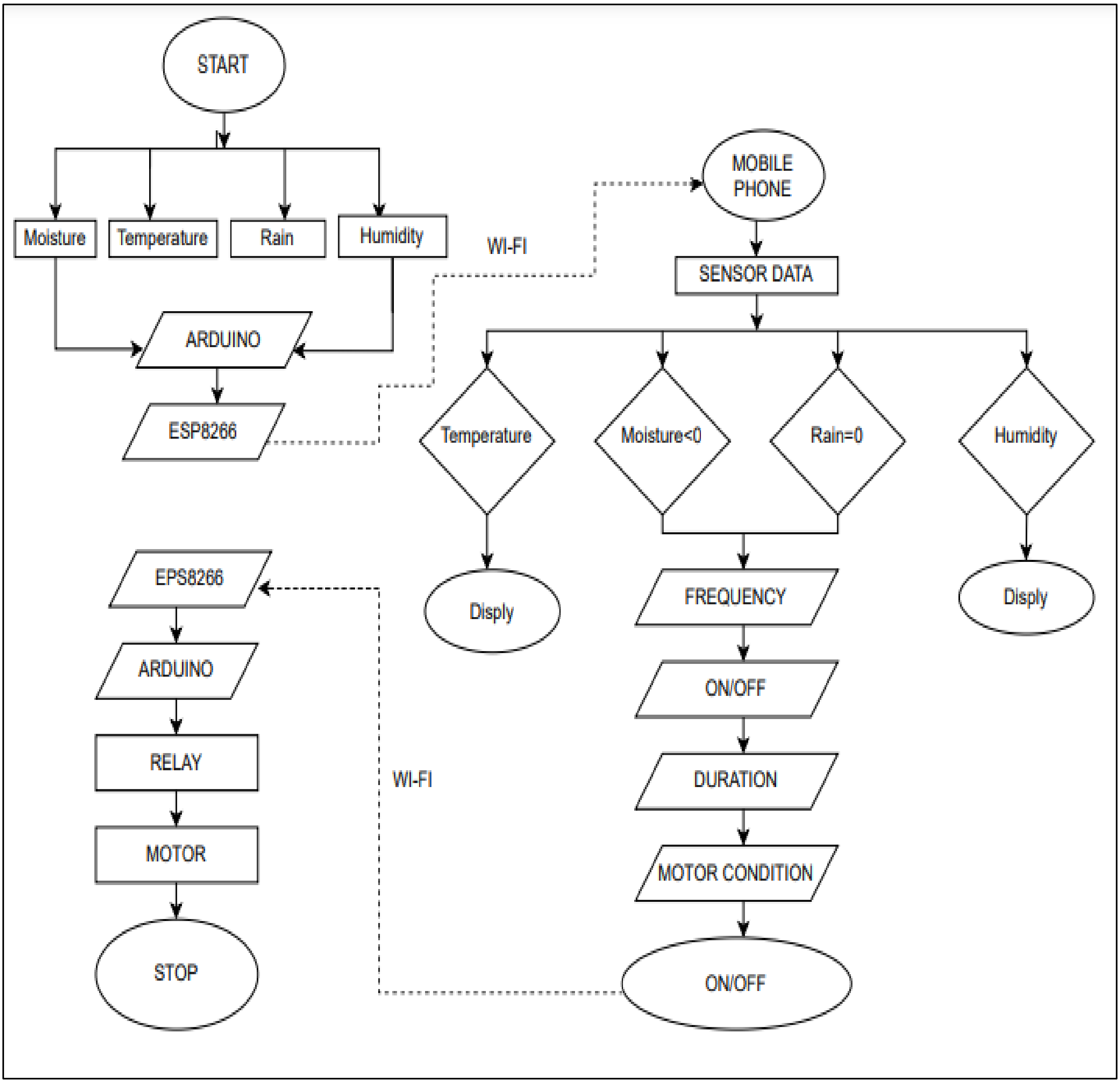


Fig.4.7:Control Flow Diagram

4.2.6. Sequence Diagram

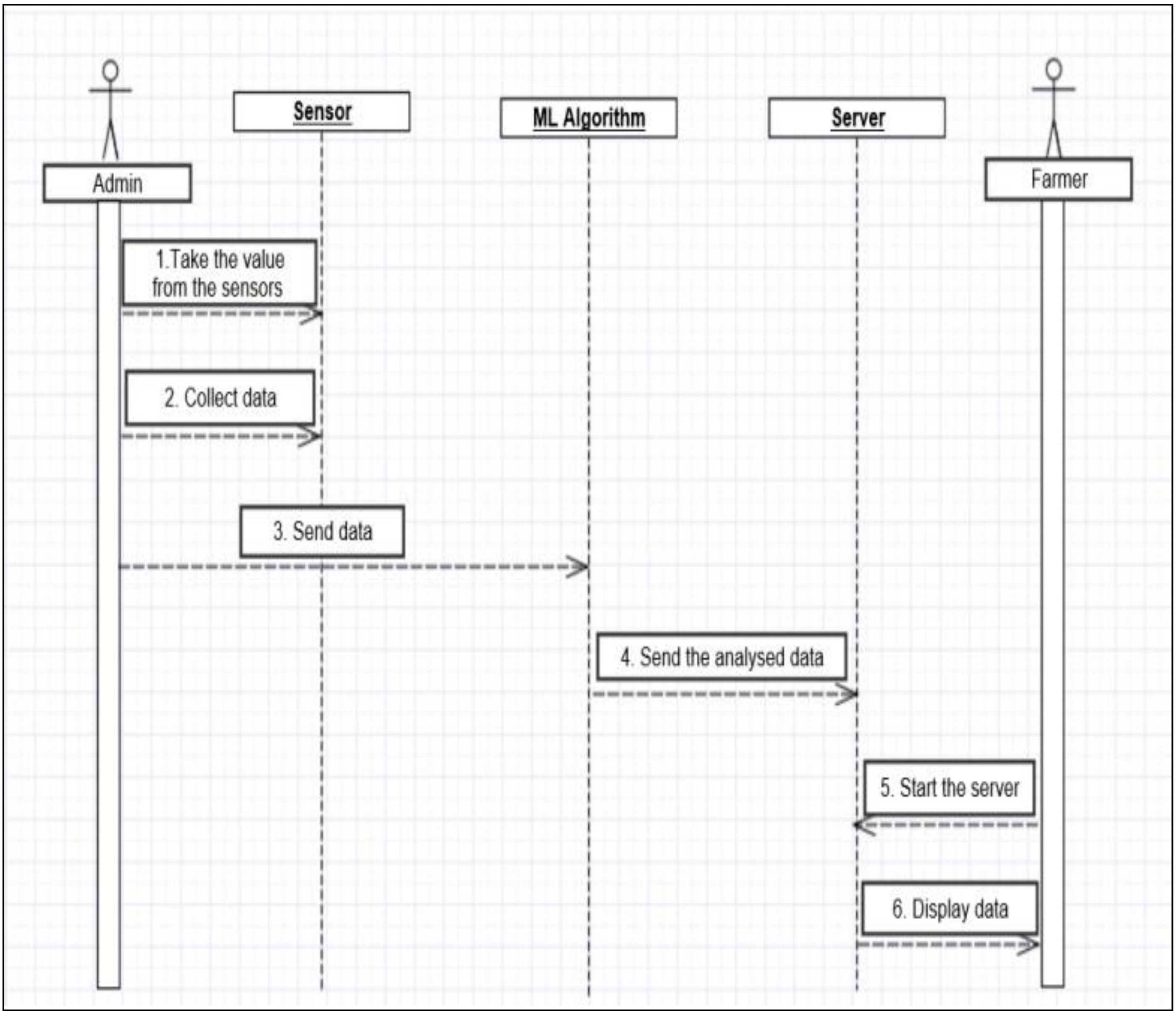


Fig.4.8:Sequence Diagram

4.3. Software and Hardware Requirements

1) Software Requirements

1. **Operating System:** Windows 10 home and above version.
2. **Language:** Java, Embedded C, MYSQL.
3. **Source Code Editor:** Android Studio, Arduino IDE.

2) Hardware Requirements

1. **Processor: -i3**
2. **Ram: 4 GB & ABOVE**
3. **HDD: 512 GB SSD**

5. Implementation Details

Sensing side

At the sensing side, data can be collected from a variety of IoT end-devices including soil moisture, temperature, rainfall, humidity and rain sensors. A ESP 8266 device—which acts as an IoT gateway—is used to aggregate these data and coordinate the connectivity of the end-devices to each other and to the cloud side. Accurately, the gateway keeps aggregating the received sensor data until a sufficient number of them have been received to detect an interesting event such as a change in the level of soil moisture in an agricultural field. Gateways either send updates periodically or when they observe a new event, to the IoT hub at the cloud side through the device provisioning service. The IoT hub sends a set of parameters to the gateway advising it on how to detect events, construct their messages, and how often to send them (once or periodically, how frequently, etc.).

The IoT Hub Device Provisioning Service is a helper service for the IoT Hub that enables zero-touch real-time provisioning of IoT end-devices. All IoT end-devices must be enrolled with a Device Provisioning Service instance by sending a registration request to the service. Once the device has been provisioned, it can boot up, and call the provisioning service to be recognized and assigned to an IoT hub.[13]

Cloud side

At the cloud side, the IoT Event Hub is used to receive and aggregate the events sent from the gateway at the sensing side. The Event Hub is a streaming service that is capable of collecting and processing millions of events contained in telemetry messages produced by IoT end-devices. The Event Hub also implements some security mechanisms to ensure that the incoming telemetry messages are legitimate. Event Hubs enqueue the received messages in a partitioned consumer model in which each consumer application only reads a partition of the message stream. This model enables horizontal scale for event processing that can be easily integrated into the big data and analytics services of Azure, including Databricks, Azure Stream Analytics, etc.

000WebHost is a serverless event processing engine that can be used to analyse data streams generated from IoT end-devices in real time. The 000Webhost is employed to implement our automatic irrigation algorithm by detecting the pattern of the change in moisture specifically, the analytics service collects aggregated events until a sufficient number of them have been received (as determined by a sufficiency condition) and then triggers actions such as creating alerts, feeding information to a reporting tool, or storing transformed data for later use.

An 000Webhost job consists of an input, a transformation query, and an output. The events sent from the sensing devices are considered the input source for a job. The transformation query, which is based on SQL query language, is used to aggregate the streaming sensor data to produce the actions which are considered the output of the job.[9]

To control our sensing devices connected to the IoT hub remotely, we used a cloud-to-device interaction model by invoking the direct methods on the IoT end-devices. Direct methods represent a synchronous request-reply interaction with an IoT hub and a sensing device. For instance, direct methods can be used to send an action message to control a water pump in the agriculture field. The users can send the sensed data to the cloud using both the CoAP and MQTT protocols.[12]

User side

Nontechnical users (e.g., farmers) can easily monitor and control the agricultural field conditions from anywhere with the help of various sensors and actuators (e.g., rain, humidity, temperature, soil moisture, etc.). We developed a Graphical User Interface (GUI) which can be accessed from personal computing devices such as PCs and smartphones. The GUI will help users to access the deployed IoT system remotely, which will eliminate the need for constant manual monitoring. This design provides cost-effective and optimal solutions for farmers with minimal manual intervention. Furthermore, the GUI can be used to extract real-time insights and actionable information using the 000WebHost, which would aid the decision-making of both small- and large-scale farmers. This would improve management and crop yields significantly.

6. Experimental Results and Testing

6.2. IOT Device Model

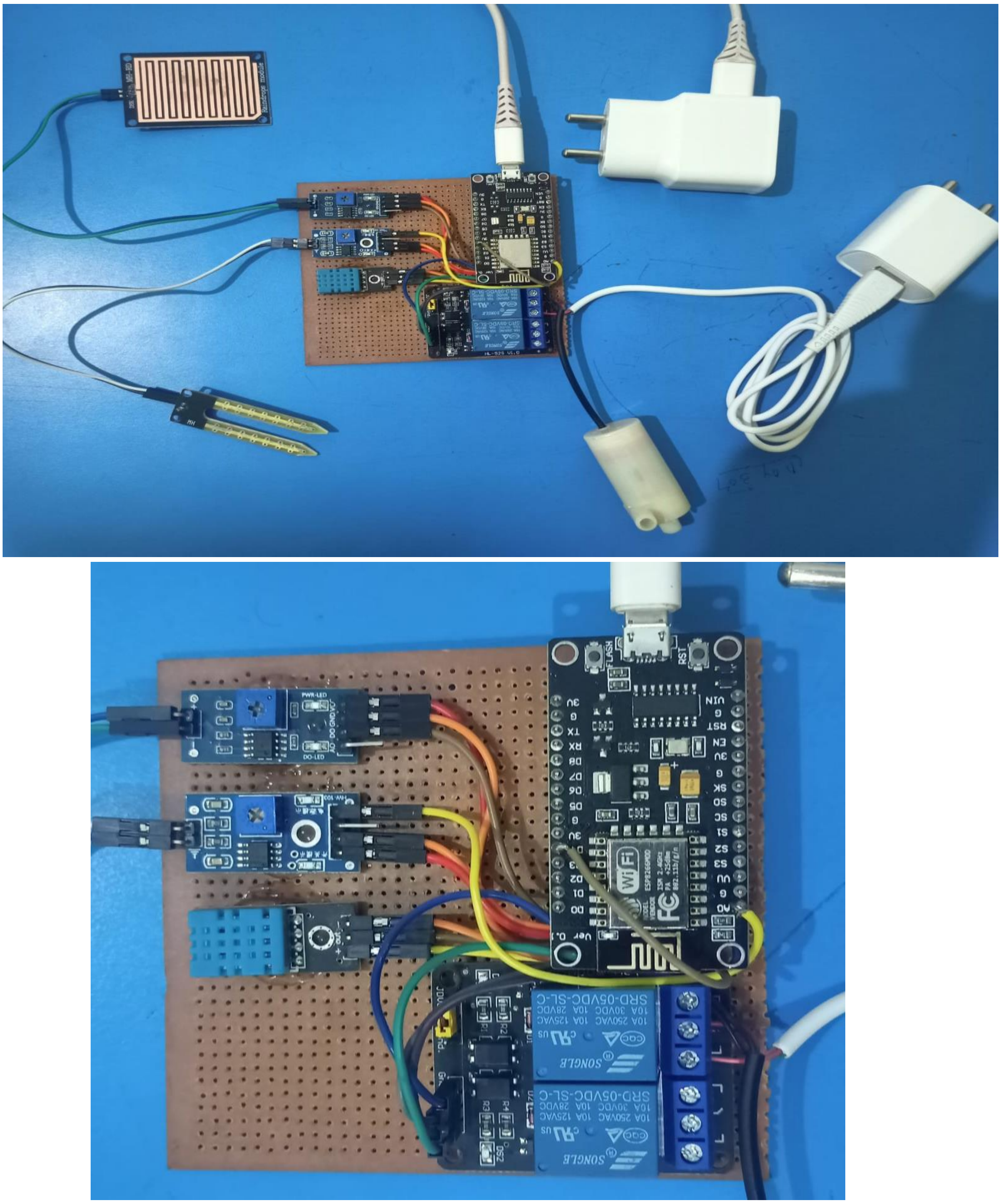
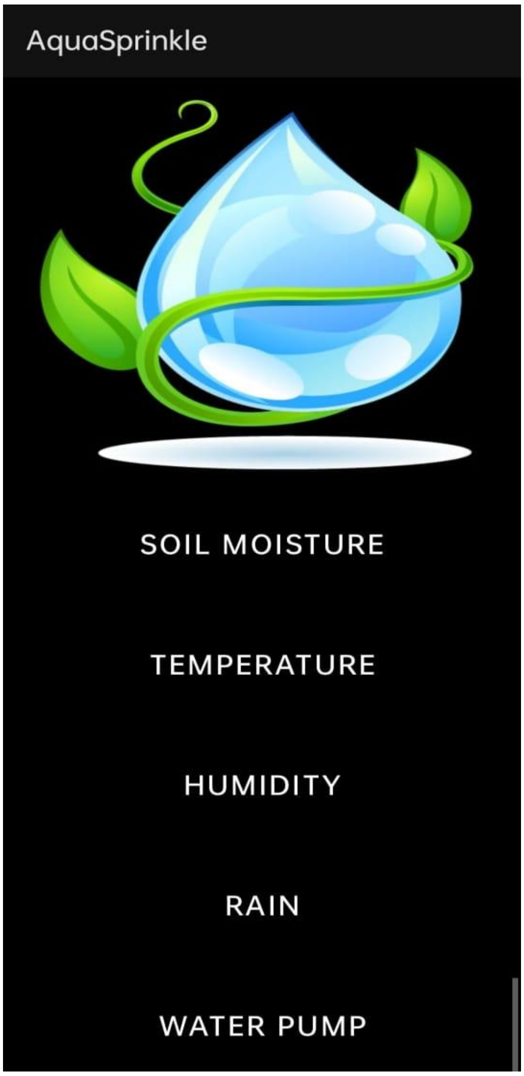


Fig.6.1: IOT Device Model

The fig.6.1 shows the IOT device picture which consists of Soil Moisture Sensor, DHT11 Sensor, Rain Sensors, two channel Relay Driver, 5V motor pump, 8266 Lua Wi-fi Module, Pcb Board,5V Power Supply. The IOT device is connected to database using Wi-Fi which send the data of sensors after every 60 seconds of time interval.

6.3. Screenshots of the Application



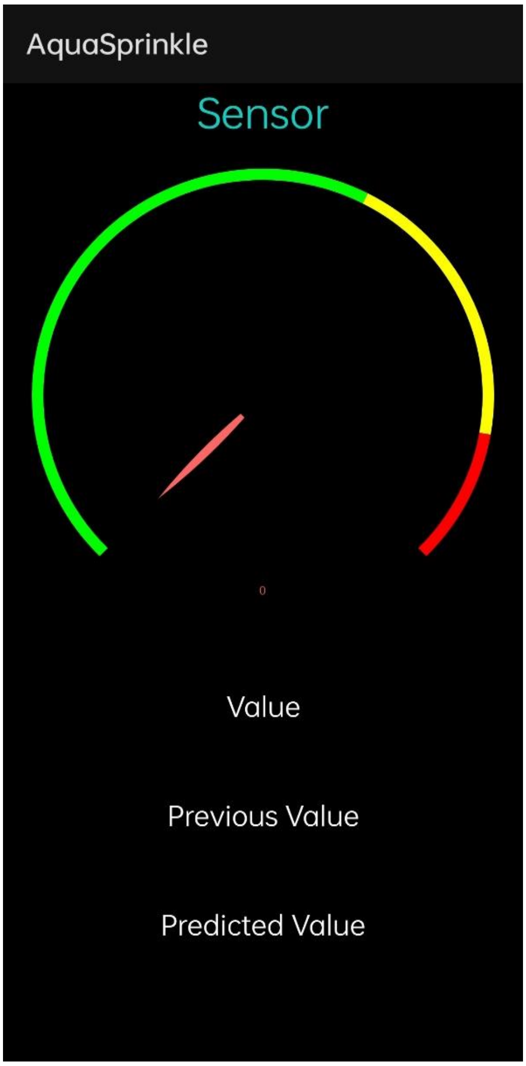


Fig.6.2: Startup Activity

Fig.6.3: Sensors Common Activity

The Fig.6.2 Depicts the startup activity shown at first after opening of the application. It shows the application name and logo, also buttons are provided to navigate to that particular activity.

The Fig.6.3 shows the common activity used in the application for display of data of all the sensors which then automatically directs to their respective activity. It includes speedometer gauge ,Current value, Previous value Button ,Predicted value .

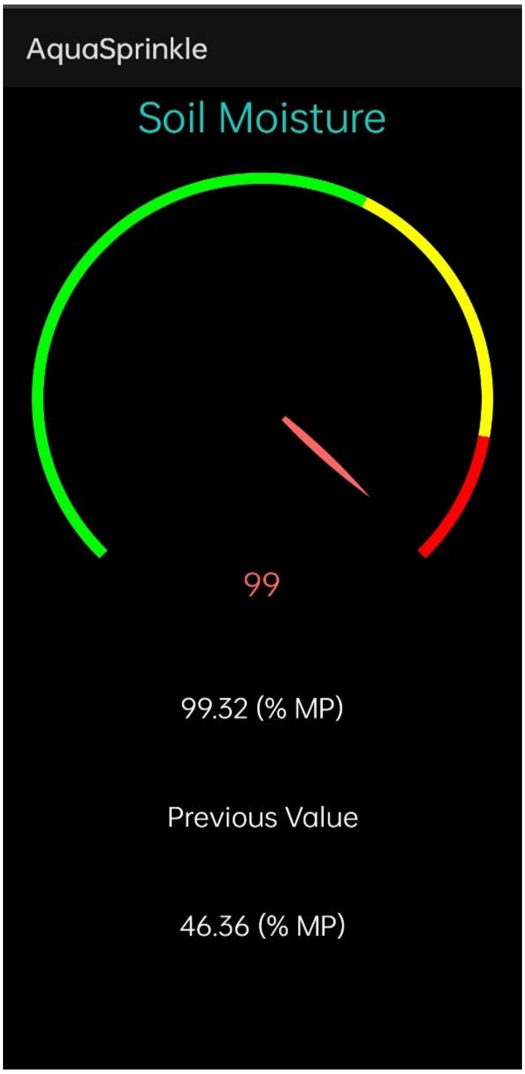


Fig.6.4: Soil Moisture Activity

Fig.6.5: Previous Moisture Values

The Fig.6.4 shows the current value data fetched from the Soil Moisture sensor of IOT device, the Button Previous Value directs the user to another activity(fig.6.5) showing the previous data entries. A predicted value is shown at the last, which is being computed from the machine learning algorithm. Also, we have a speedometer which ranges from 0-100 (%MP) that changes in the real time with the sensor values, value in the Speedometer is in the form of MP (Moisture in percentage)

Fig.6.6: Temperature Sensor Activity

Fig.6.7: Previous Temperature Values

The Fig.6.6 shows the current value data fetched from the Temperature sensor of IOT device, the Button Previous Value directs the user to another activity(fig.6.7) showing the previous data entries. A predicted value is shown at the last, which is being computed from the machine learning algorithm. Also, we have a speedometer which ranges from 0-50 (°C) that changes in the real time with the sensor values, value in the Speedometer is in the form of °C (Degree Celsius)

Fig.6.8: Humidity Sensor Activity

Fig.6.9: Previous Humidity Values

The Fig.6.8 shows the current value data fetched from the Humidity sensor of IOT device, the Button Previous Value directs the user to another activity(fig.6.9) showing the previous data entries. A predicted value is shown at the last, which is being computed from the machine learning algorithm. Also, we have a speedometer which ranges from 50-100 (%RH) that changes in the real time with the sensor values, value in the Speedometer is in the form of %RH (Relative Humidity)

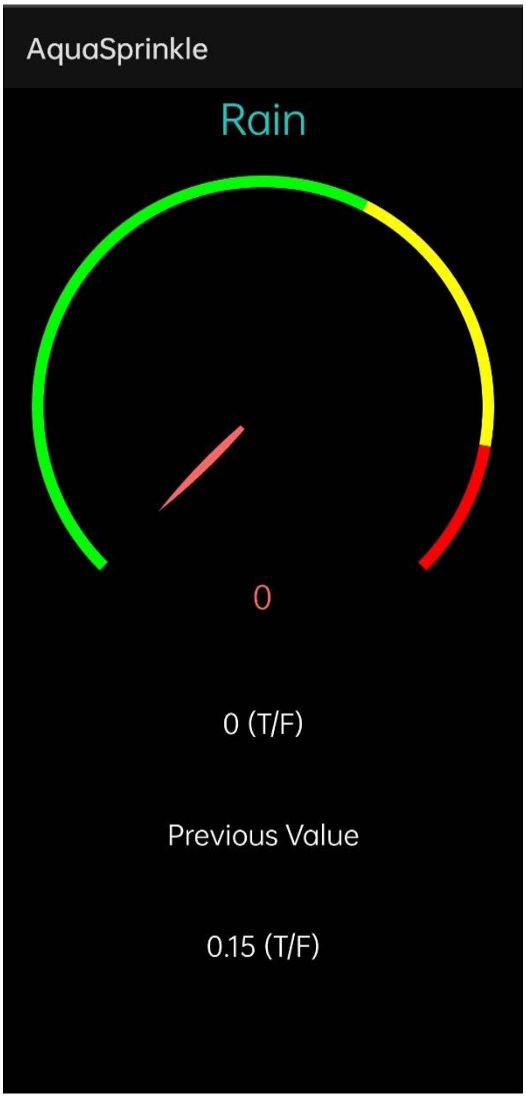
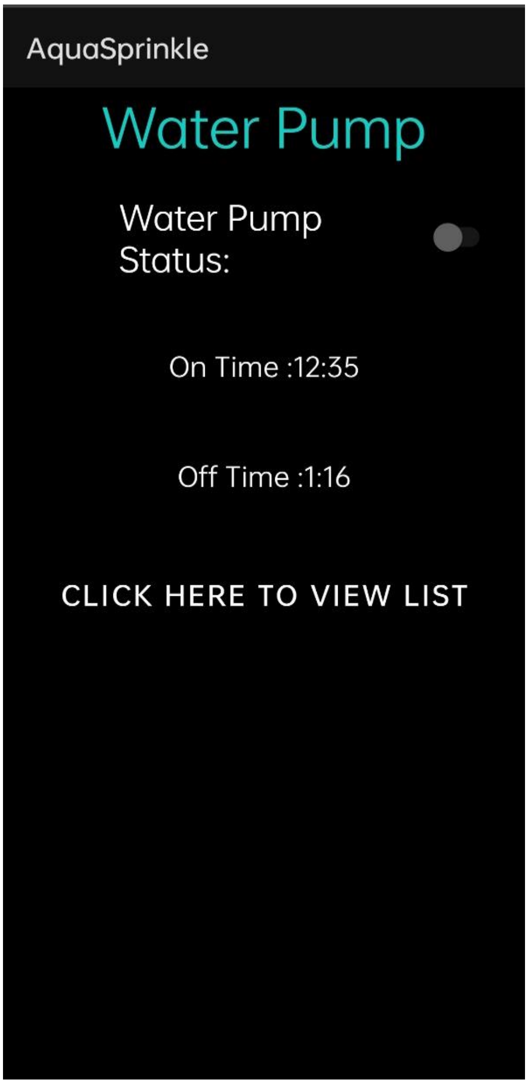


Fig.6.10: Rain Sensor Activity

Fig.6.11: Previous Rain Values

The Fig.6.10 shows the current value data fetched from the Rain sensor of IOT device, the Button Previous Value directs the user to another activity(fig.6.11) showing the previous data entries. A predicted value is shown at the last, which is being computed from the machine learning algorithm. Also, we have a speedometer which ranges from 0-1 (T/F) that changes in the real time with the sensor values, value in the Speedometer is in the form of T/F (True/False)



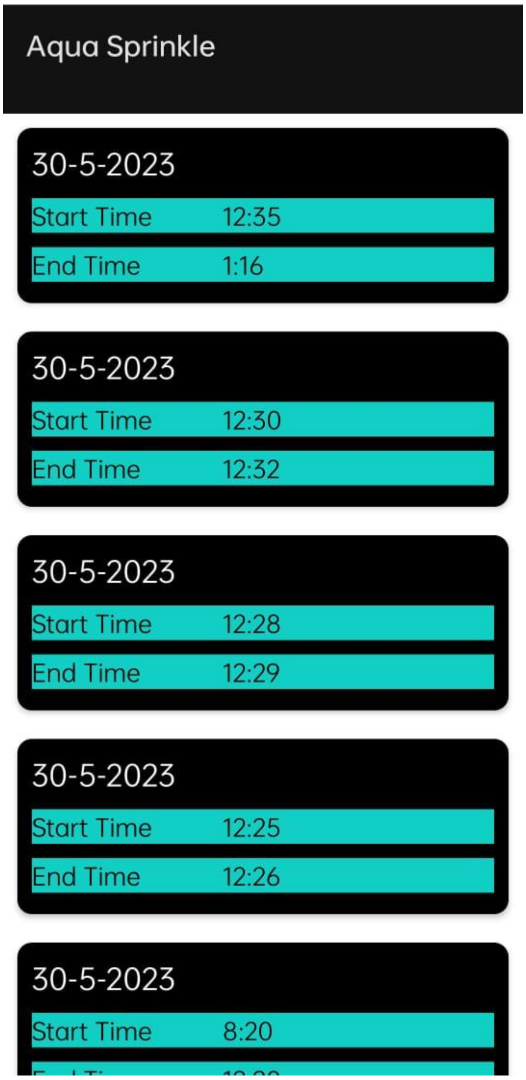


Fig.6.12: Water Pump Activity

Fig.6.13: Water Pump On/Off Values

The Fig.6.12 shows Water Pump Activity showing the current status of the water pump which cannot be changed through application also it depicts the previous on time of the motor and the off time of motor. Also, a button (Click here to view list) redirecting to the previous data value of the Motor pump On\Off values.

7. Conclusion and Future Scope

The Project ‘Modular Approach for Irrigation using IOT and Machine Learning to Optimize Water Usage’ is used for the optimization use of water in agricultural field without the intervention of farmer by using soil moisture Sensor that senses the moisture content of the Soil using Microcontroller that turn ON/OFF the pump automatically according to the need of water for irrigation and hence helpful in saving water. This system is quite affordable and feasible. This system of irrigation is also helpful in the region where there is scarcity of water and improves their sustainability.

The developed system is tested and implemented successfully in laboratory and also in Greenhouse field as a smart Agriculture System and we found the systems working precisely and accurately. The system providing the advanced features like easy portable, low cost and standalone system. The System can be installed in urban and remote places as well, prevents from wastage of water and thus reducing the manual labor, which is very useful for the farmers and also agriculture research scientists in increasing yield of crops. The scope of future work is planned to add a greater number of devices/sensors for proper monitoring and installation of communication systems to the help the user by providing real time conditions of the field in the form of MMS facility with video capturing of the field.[13]

For future developments, it can be enhanced by developing this system for large acres of land. Also, the system can be integrated to check the quality of the soil and the growth of crop in each soil. The sensors and microcontroller are successfully interfaced and wireless communication is achieved between various nodes. Also, the system can be further improved by adding machine learning algorithms, which are able to learn and understand the requirements of the crop, this would help the field be an automatic system. The observations and results tell us that this solution can be implemented for reduction of water loss and reduce the man power required for a field.[19]

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9. PUBLICATION

Research Paper

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Modular Approach for Irrigation Using IoT to Optimise Water Usage

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ABSTRACT

Interconnection of number of devices through internet describes the Internet of things (IoT).The Internet of Things (IoT) describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. Irrigation is one of the traditional practice and involves more number of labours in daily agriculture sector. To water the plants automatically, sensors and Microcontrollers are available to determine when the plants needs water. Automation involves improving the speed of production, reduction of cost, effective use of resources. The main role of this project is to develop a Microcontroller system to irrigate the plant automatically and the information is been sent to the farmers.

Keywords: *IoT, Smart Irrigation System.*

I. INTRODUCTION

Most of the farmers use large portions of farming land and it becomes very difficult to reach and track each corner of large lands. Sometime there is a possibility of uneven water sprinkles. This result in the bad quality crops which further leads to financial losses. In this scenario the Smart Irrigation System using Latest IoT technology is helpful and leads to ease of farming.

The Smart irrigation System has wide scope to automate the complete irrigation system. Here we are building aIoT based Irrigation System using DHT11 Sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the Data to Cloud Server to keep track of the land condition. The System will consist a water pump which will be used to sprinkle water on the land depending upon the land environmental condition such as Moisture, Temperature and Humidity.

This system is specific for a crop and hence its usage is limited. Proper scheduling of irrigation is critical for efficient water management in crop production, particularly under conditions of water scarcity. The effects of the applied amount of irrigation water, irrigation frequency and water use are particularly important. To improve water efficiency there must be a proper irrigation scheduling strategy. So, our project devices a simple system, using a microcontroller to automate the irrigation and watering of small potted plants or crops with minimal manual interventions.

This project has been designed for surveillance of irrigation systems in farms without the need of manual checking of irrigation systems. For example, if you are staying in Pune, and have your farm in Kolhapur or

10. CERTIFICATES

National Conference on Emerging Trends in Engineering & Technology

CERTIFICATE

This is to certify that

Rishikesh Yedge

has presented and published a paper titled

Modular Approach For Irrigation Using IOT To Optimise Water Usage

during the National Conference NCETET-2023 with ISBN : 978-93-91535-44-5

held on 31st March 2023

Organized By Bharati Vidyapeeth's College of Engineering, Kolhapur

&

International Association of Research and Developed Organization

[Under the Banner of India Educational Charitable Trust (Regd.)] Ghaziabad (India)

ISBN: 978-93-91535-44-5

NCUGB-29

Mr. R.R.Suryawanshi, Convener | Dr. K.R.Desai, HOD(E&TC) | Dr. V.R.Ghorpade, Principal | Dr. Atul Kumar Sharma, Director IARDO

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National Conference on Emerging Trends in Engineering & Technology

CERTIFICATE

This is to certify that

Jyoti Patil

has presented and published a paper titled

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This is to certify that

Priti Potdar

has presented and published a paper titled

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This is to certify that

Pallavi Patil

has presented and published a paper titled

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This is to certify that

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11. Completion Chart

PERIOD	**WORK COMPLETED**
24 AUG 2022 - 26 AUG 2022	Group Creation
05 SEPT 2022 - 10 SEPT 2022	Topic Selection
10 SEPT 2022 - 10 SEPT 2022	Project Discussion
17 SEPT 2022 - 29 SEPT 2022	Started Working on Synopsis
05 OCT 2022 - 09 OCT 2022	Requirement Gathering and Analysis
22 OCT 2022 - 22 OCT 2022	System Planning
22 OCT 2022 - 10 NOV 2022	Designing, Implementation, Integration of few models of IOT and deploying codes
1 DEC 2022 - 1 JAN 2023	Setting up data on webhost cloud
1 JAN 2023 – 15 FEB 2023	Creating Application and Integrating it with Database
16 FEB 2023 – 2 APRIL 2023	Working on Machine Learning algorithms and Predictions
3 APRIL 2023 – 30 MAY 2023	Final changes for the Project

FUNDING LETTER

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To,

The Principal

Bharati Vidyapeeth's College of Engineering, Kolhapur

Subject: Financial Assistance for the project titled " AQUASPRINKLE:Modular Approach for Irrigation using IoT to optimise Water Usage"

Dear Sir,

This is to inform that our company is sponsoring the final year student project of Computer Science and Engineering department which is titled "AQUASPRINKLE:Modular Approach for Irrigation using IoT to optimise Water Usage" with maximum amount/ expenses of Rs 5,000/-(Five Thousands Only).

The sponsorship will be in terms of software's, devices, high testing and expert resources or workshop needed for project. The sanctioned amount is to be utilized for the above project and during the academic year 2022-2023 only. The duration for complication of above project will be one year.

Kindly allow the following group of students to work under the Guidance/ Principal investigator of Mrs. S.M.Mulla Assistant Professor Bharati Vidyapeeth's College of Engineering, Kolhapur.

Name of Students:

1. Mr. Rishikesh D. Yedge
2. Miss. Jyoti M. Patil
3. Miss. Priti D. Potdar
4. Miss. Pallavi T. Patil
5. Miss. Divyani D. Tibile

Kindly consider letter as sanction letter, this is for your kind information and further needful action

Thanks and Regards

Yours faithfully,

Mr.Vijay Sadalekar

NET SOFT TECHNOLOGIES NST *KOLHAPUR*

(Managing director)

Netsoft Technologies,Kolhapur

Vasudha Apartment Basement, Near Hindustan Bakery, Rajarampuri 8th Lane, Kolhapur 416008
Email : enquiry@netsofttechnologies.com, vijay@netsofttechnologies.com,
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COMPLETION LETTER

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To,

The Principal

Bharati Vidyapeeth's College of Engineering, Kolhapur

Subject:- Completion of final year project in engineering.

Respected Sir,

This is to certify that below project group members has successfully completed an academic project entitled "AQUASPRINKLE:Modular Approach for Irrigation using IoT to optimize Water Usage" with our organization. The project work which is completed is genuine and legitimate.

1. Rishikesh D. Yedge
2. Jyoti M. Patil
3. Priti D. Potdar
4. Pallavi T. Patil
5. Divyani D. Tibile

During the tenure of their project with our company, they have shown the great passion and understanding towards their work. The project team has demonstrated high academic understanding and creative skills while carrying out the assigned project.

Thanking You,

NET SOFT TECHNOLOGIES NST *KOLHAPUR*

Yours faithfully,

Mr.Vijay Sadalekar

(Managing director)

Netsoft Technologies,Kolhapur

Vasudha Apartment Basement, Near Hindustan Bakery, Rajarampuri 8th Lane, Kolhapur 416008
Email : enquiry@netsofttechnologies.com, vijay@netsofttechnologies.com,
Website : www.netsofttechnologies.com, Contact : 0231- 6519050, 6614061

Name of the Project Group Members	Phone No.	Email	Signature
Mr. Rishikesh Yedge	8483848189	yegderishikesh2803@gmail.com	
Miss. Jyoti Patil	8766511215	jyotimarutipatil@gmail.com	
Miss. Priti Potdar	9607569960	pritipotdar4172@gmail.com	
Miss. Pallavi Patil	9579546364	pallavipatil5701@gmail.com	
Miss. Divyani Tibile	8626066263	divyanitibile2222@gmail.com	

Mr. S. B. Patil

Project Guide

Mrs. R. V. Jadhav

Project Coordinator

Ext. Examiner

Mrs. S. M. Mulla

H.O.D