JSRT JOURNAL
PAGES:47-59
6/10/23
JOURNAL OF SCIENTIFIC RESEARCH & TECHNOLOGY (JSRT) VOLUME-1 ISSUE-3 JUNE
Journal Recognised by Government of India

Smart Agriculture Using IoT and Machine Learning

Dr. Rekha J Patil[1], Indira Mulage[2], Nishant Patil[3]

[1]*Professor, Department of Computer Science, PDA College of Engineering, Kalaburagi, India*
rekha.patilcse@gmail.com
[2]*Student, Department of Computer Science, PDA College of Engineering, Kalaburagi, India.*
indiramm15@gmail.com
[3]*Student, Department of Computer Science, PDA College of Engineering, Kalaburagi, India.*
patilnishant99@gmail.com

ABSTRACT

Smart agriculture systems have emerged as a result of the convergence of IoT and ML technologies, which have had a profound impact on the agricultural sector. The Internet of Things (IoT) and machine learning (ML) are used in this abstract to present an overview of a smart agriculture system that maximizes crop yields and product quality. The Internet of Things (IoT) has several practical uses in agriculture, including helping farmers keep tabs on soil moisture, temperature, pH levels, and water storage levels in real time. The use of smart farming technologies improves agricultural productivity and allows for the prediction of the optimal planting location.

Key Words: Smart Agriculture, IoT and ML.

I. INTRODUCTION

Agriculture is the backbone of the Indian economy and the principal employment in India. Large numbers of rural people in emerging and poor nations rely on agriculture for both food and economic security. Farming is the practice of keeping domesticated animals for the purpose of harvesting their meat, milk, eggs, fiber, and many other useful byproducts. More than 58% of India's population relies on agriculture for their livelihood.

Irrigation systems, rain-fed agriculture, and groundwater irrigation are all threatened by the rising demand for water, which in turn reduces agricultural yields in places where irrigation is most important. new techniques for growing better crops that may not be the most water-wise option. A clever technique is developed for effective water use. Because of this technique, farmers may focus on other tasks without worrying about whether or not their crops are getting enough water. People may be wasting a lot of water if they continue to use outdated practices. As a result, the idea of automated farming using a combination of IoT technologies has emerged. Production efficiency increased dramatically as a result of technical developments, making the system stable.

Smart water management is determined by understanding soil conditions. Smart farming practices allow farmers to learn about factors like soil pH and temperature. Using Internet of Things (IoT) based solutions to develop smart agriculture not only boosts output but also reduces water waste. Sensors that measure soil moisture, humidity, and temperature collect real-time data that is sent to a smartphone through a cloud service. The controller may be reconfigured to account for the crop's specific needs after data on things like humidity, temperature, and moisture content has been collected and analyzed. In this study, we present a system that employs a number of sensors to determine whether or not a certain crop can be successfully cultivated. These sensors include a soil moisture detector, a rain sensor, and a ph value detector. The breadboard, the internet, and a mobile device are all linked to the array of sensors and NodeMCU.

II. LITERATURE SURVEY

[1] Sameer. M. Patel, Smart Agriculture System using IoT Smart Agriculture using IoT and Machine Learning [2021]

In this study, we propose an Internet-of-Things (IoT)-based Smart Agriculture system to provide farmers with advice that takes into account environmental elements like as humidity, temperature, pH, wetness, and rainfall. Soil variables including nitrogen, phosphorus, and potassium levels would be used to recommend fertilizers to farmers. The suggested system's fundamental feature is the incorporation of IoT principles. Various environmental factors, including moisture in the soil, temperature, pH of soil, UV radiation, etc., will be measured by a simple hardware device. After the readings have been taken, they will be sent to an AWS S3 database before being retrieved by a NodeJS web app. On contrary, a Bluetooth module will be included so that the gadget may be linked to a React Native mobile app. After that, the phone will be used to push the information to the server housing the database.

[2] Rushika G, Prediction of Crop Yield using Machine Learning: International Research Journal of Engineering and Technology, February [2018]

The goal of this endeavor is to provide assistance to farmers by analyzing soil quality data using data mining techniques. Therefore, the system prioritizes analyzing soil quality to foretell cultivatable crops based on soil type and optimize crop production via fertilizer recommendations. User inputs of pH and location are required for soil test analysis. This module's analysis result is the fraction of certain nutrients in the soil. The soil crop matching module looks through the crop database to determine whether crops are compatible with the soil in question. The fertilizer module advises the user on the best fertilizer to use for maximum crop output. The user may choose a crop and read up about it in the section dedicated to that purpose. Users may get data on various fertilizers by using the module dedicated to that purpose. Because of this approach, fewer farmers would kill themselves due to the hardships they encounter. It will serve as a conduit for disseminating useful knowledge to farmers, allowing them to increase yields and earnings while decreasing farmer suicide rates.

[3] Sreenivas Pakyala, Smart Agriculture using IoT and Machine Learning, issued on May [2021]

The primary objective of this paper is to collect useful information about the farm, such as the soil's moisture level, the farm's temperature, and the humidity level. We can significantly cut down on water loss by using machine learning algorithms that can tell whether or not a farm needs watering based upon all these soil data. A telegram bot user interface has been developed to allow farmers to wirelessly manage all of these systems. These systems include rainfall-predicting models, which can help farmers decide which crops they can grow, as well as provide them with a good surveillance system of farm. Our proposed system is made up of both hardware and software elements. Different parts of the system are called "modules," and each module performs a particular function. There is the backend API server, the frontend Telegram Bot, and the master and slave modules. Our technique, detailed in this article, has helped farmers save water and cut down on their workload while also reducing the amount of time they spend managing their land by hand. Our solution allows farmers to use a telegram bot connected to the internet to perform remote control and monitoring of their farms. In the future, we may improve surveillance system by mounting camera and motion sensors to a servo motor as well as rotating servo to enhance the field of vision of this system.

[4] S.Sundaresan, Machine learning and IoT-based smart farming for enhancing the crop yield[2022]

The systems discussed in the paper were an effort at implementation. Successful crop recommendation, automated watering, and fertilizer recommendation systems are discussed in this work. In this study, we provide findings from computer simulations of the systems in question. Increasing agricultural output requires developing a comprehensive system that can handle a number of tasks. The crop recommendation system, the automatic watering system, & fertilizer recommendation system all work together to achieve this. If you want to get the most out of this method, try it out on apple, rice, maize, grape, banana, orange, cotton, & coffee. Farmers might make better use of their time and resources by using this technology as a means of decision-making. The proposed technique for predicting agricultural diseases by picture classification may be expanded to include disease prediction in the future.

[5] Anguraj, K, Crop Recommendation on Analysing Soil Using Machine Learning. Turkish Journal of Computer and Mathematics Education, [2021]

Our nation's economic growth is largely due to the contributions of the agricultural sector. Alterations to the weather pattern have had a significant impact on crop productivity. By shifting from conventional to precision farming, we can increase agricultural yields thanks to new technological advancements. Data analysis and the Internet of Things (IoT) are two examples of the cutting-edge tech used. Growing the right crop at the right time is the biggest challenge that hasn't been overcome. Machine learning algorithms have been shown to be an efficient tool for making such predictions. Using IoT, sensors measure and transmit data about the soil's conditions to a graphical user interface (GUI), which displays information like the soil's wetness, temperature, humidity, and pH. An input window (GUI) takes user data and outputs crop recommendations. Thanks to the system built using IoT and ML, farmers are better equipped to make informed choices. Everything is feasible now because of the development of new technology. Machine learning and the Internet of Things (IoT) are two examples of the cutting-edge tech being used. Using an IoT system, data may be gathered in real time from the field itself. The field data is used to feed the trained model. The predictions are then generated by the trained model. The model's output is very useful for planting the right kinds of crops in right places. At first, the open-source dataset is partitioned into two parts: the testing dataset and the training dataset. For the purpose of developing the crop recommendation prediction model, a training dataset is submitted to the ML model. Once a model has been developed with little error & maximum accuracy, it is fed test data. The constructed model is then fed the inputs. The model makes predictions and planting recommendations with a 96.89% degree of certainty.

[6] Archana Gupta , International Journal of computer Engineering and Technology, "Smart Crop Prediction using IoT and Machine Learning" published on [2020]

Smart farming, enabled by the Internet of Things, enhances the whole agricultural system via constant field monitoring. It monitors conditions including humidity, temperature, soil, and more in precise real-time detail. The goal of using machine learning to agriculture is to boost agricultural output without sacrificing crop quality. Appropriate algorithms applied to the sensed data may aid in crop recommendation. The accuracy of three distinct Machine Learning algorithms—Decision Tree, KNN, and Support Vector Machine (SVM)—is compared. The crop yield prediction is ultimately made using Decision Tree due of its superior accuracy. In this study, we provide a novel method for smart agriculture that makes use of two cutting-edge tools: the Internet of Things and machine learning. Using both real-time and previously collected data improves the reliability of the final outcome. The precision of the system is improved by comparing various ML algorithms. Because of this approach, farmers will have less problems to deal with and will be able to do more, better.

III. OVERVIEW

1. **Sensor Deployment:** Soil moisture sensors, sensors for temperature, moisture sensors, & light sensors are only few of the types of sensors used infarming operations to gather data in real time.
2. **Data Collection:** Soil moisture, moisture, temperature, intensity of light, & air quality are only some of environmental parameters that sensors measure. This information is gathered and sent to a centralized server or the cloud.
3. **Connectivity:** Gateways and wireless sensors that are part of the Internet of Things (IoT) employ networking protocols like Wi-Fi, Bluetooth, and LoRaWAN to connect to one another and send data to a central server in the cloud.
4. **Cloud Platform:** A cloud-based platform with storage as well as processing capabilities is used to house and analyze the acquired data. This service provides a consolidated location from which data may be managed and analyzed.
5. **Data Analysis:** In order to get useful insights and patterns from the data, Machine Learning algorithms are applied to information. Predicting agricultural yields, spotting illnesses or pests, optimizing irrigation schedules, and providing farmers with recommendations are all possible thanks to ML models.
6. **Decision Support:** Decision assistance for farmers is provided by the system based on the studied data and ML-generated insights. Advice on when to water, how much fertilizer to use, and how to keep pests at bay are all part of this process.

7. **Automated Control Systems:** Incorporating actuators & control systems into smart agricultural systems paves the way for automated actions that utilize ML analysis. Whenever soil moisture levels drop under a given threshold, for instance, an ML model might initiate the irrigation system.
8. **Remote Monitoring and Alerts:** Through a web interface or smartphone app, farmers can check in on their fields from afar and see how they're doing. Critical occurrences, such as anomalous temperature, insect infestations, or equipment failures, might trigger immediate warnings and messages from the system.
9. **Resource Optimization:** The technology assists farmers in making the most efficient use of water, fertilizers, and electricity by drawing on the knowledge gained via machine learning. This increases efficiency, saves money, and helps the environment.
10. **Scalability and Adaptabilit**y: IoT and ML-based smart agricultural solutions are flexible and scalable. They are adaptable to both local and large-scale agricultural operations, as well as a wide range of crop varieties and climates.

IV. MOTIVATION

1. **Enhanced Efficiency and Productivity:** Real-time monitoring & assessment of environmental parameters including soil moisture, temperature, & light are made possible by Internet of Things (IoT) devices and sensors combined with ML algorithms. This aids farmers in optimizing irrigation schedules, discovering pests and illnesses early, and making well-informed management choices. Farmers may get the most out of their land and their investments by increasing production and efficiency.
2. **Resource Optimization:** Water, fertilizer, & energy are just a few of precious resources that may be conserved via usage of smart agricultural systems. In order to establish best allocation of resources for a given set of crops and environmental circumstances, IoT sensors collect and transmit real-time data, that is then evaluated by ML algorithms. This helps with sustainable agricultural operations by decreasing waste and expenditures.
3. **Precision Agriculture:** Through the Internet of Things and machine learning, farmers may control their crops with unprecedented accuracy. Farmers may improve efficacy of their watering, fertilizing, & pest-control efforts by gathering and evaluating data from individual plants or distinct regions within a field. This strategic method improves crop health and output with less chemical and input usage.
4. **Early Detection and Prevention:** Machine learning algorithms may analyze data for trends and outliers. Using ML methods, smart agricultural systems may monitor crops for the earliest possible indications of damage from pests or deficits in key nutrients. This enables farmers to take preventative actions, such using targeted treatments or changing agricultural techniques, to limit the extent to which their crops are harmed.
5. **Decision Support and Automation:** When connected to machine learning algorithms, IoT devices aid farmers in making informed decisions. These systems may analyze data and provide insights to suggest when to plant, when to water, how to deal with pests, and more. In addition, ML analysis may be used to activate automated features like as irrigation and fertilization, decreasing the requirement for human involvement.
6. **Remote Monitoring and Accessibility**: Through the use of smartphone apps or online interfaces, farmers may remotely monitor and manage agricultural activities thanks to IoT and ML. This allows them to monitor conditions in the field, get instant notifications, and have access to data insights from any location. Farmers may now make quick choices without having to be on the farm, thanks to the accessibility & remote monitoring capacity.

V. PROPOSED SYSTEM

The suggested system combines IoT and ML technologies to provide a robust and versatile answer to a wide range of problems. Sensors and actuators, both types of Internet of Things devices, are used in this setup to gather data in real time. Temperature, humidity, soil moisture, light intensity, and other parameters are only some of the things that may be measured by these instruments. ML algorithms are used to the gathered data to draw conclusions and provide reliable forecasts.

In order to handle and analyze the gathered data, the ML part of the system is essential. In order to spot trends, outliers, and other interesting phenomena, ML systems are "trained" on historical data. This allows the system to learn from its past and present and make better predictions and judgments. Examples of the usefulness of ML algorithms include the optimization of irrigation and fertilization schedules and the forecasting of crop growth and disease. The ML models are always learning and improving, so the system becomes better and better over time.

The suggested solution makes it possible to remotely monitor and operate equipment thanks to the Internet of Things. Connectivity between IoT devices through a network enables the transfer of data in real time and the smooth flow of information. Because of this network, farmers and other users may access the system from afar using intuitive interfaces, such as smartphone apps or online dashboards. Irrigation levels, greenhouse temperatures, and automated feeding systems are just a few examples of the actuators that may be monitored, alerted on, and controlled by these systems.

The suggested solution provides farmers and agricultural stakeholders with useful insights and automation skills by merging Internet of Things and machine learning technology. It allows for more informed judgment, better use of available resources, and higher output across a range of agricultural contexts. The technology has the potential to drastically alter agricultural methods, leading to greater efficiency, lower costs, and higher yields.

VI. SYSTEM REQUIRMENTS

Hardware requirments:

1. **Arduino :** Arduino is a free and open-source hardware and software electronics development platform. Arduino takes in data from a wide variety of sensors and then uses that information to influence its physical surroundings via the use of actuators like switches, motors, and more.

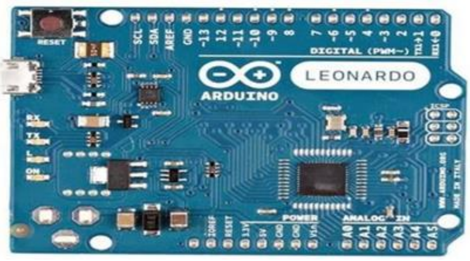

Figure 1. Arduino

2. **Node MCU EPS8826 :** NodeMCU, an open source IoT platform that utilizes the ESP8266 Wi-Fi module and its accompanying software. Arduino IDE is where your C/C++ or Lua scripts will be written. There are sixteen general-purpose input/output (GPIO) pins on the NodeMCU that may be used to manipulate external components. It's possible to utilize these jacks as PWM jacks, too. It runs on the XTOS operating system and has dual UART connections [7]. It has a storage capacity of 4M Bytes. NodeMCU uses a 5V supply power. It has an L106 32-bit CPU running at 80-160MHz.

Figure 2. Node MCU EPS8826

3. Temperature/Humidity DHT11 Sensor : Digital humidity and temperature sensor DHT11 is inexpensive. This sensor can take immediate readings of humidity and temperature when interfaced with a microcontroller like the Arduino, Raspberry Pi, etc. The DHT11 is a sensor and a module that measures humidity and temperature. This sensor is distinct from a module in that it has a pull-up resistor with a status LED. DHT11 measures relative humidity. This sensor employs a thermistor with a capacitive humidity sensor to analyze the ambient air.

Figure 2. DHT11 Sensor

4. Soil /moisture Sensor : One kind of inexpensive electronic sensor used to measure soil moisture is called a "Soil Moisture Sensor." This sensor can determine the exact amount of water present in ground. The Sensing Probs & Sensor Module are two primary components of this sensor. By allowing an electric current to flow throughout soil, probes can measure the soil's resistance and so determine its moisture content. The sensor probes' readings are processed and converted into digital/analog form by Sensor Module. Soil moisture sensors may provide you either a digital or an analog reading of the soil's moisture levels.

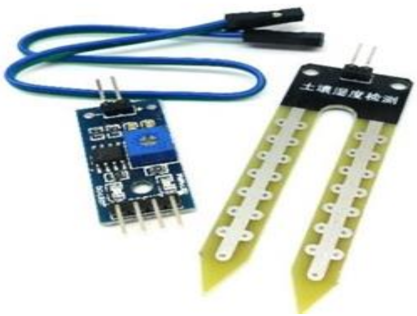

Figure 4. Soil /moisture Sensor

5. **Water Level Sensor :** A water level sensor is an apparatus created to assess the movement of liquid within a container. This soil moisture sensor is a useful tool for keeping tabs on your garden. If water table is too high, a water pump (DC) may be used to drain excess water, and if it is too low, the pump can be used to raise water table to proper level.

Figure5. Water Level Sensor

6. **Relay:** As an electrically driven switch, the relay module enables you to activate or deactivate a circuit at voltages and/or currents well above capabilities of a Microcontroller. The high-power circuit is completely separate from low-voltage circuit controlled by microcontroller. Each circuit is shielded from the others by the relay. There are three different types of connections for every channel

in module: NC, COM, and NO. The usually open (NO) switch may be "closed" at high level input by setting jumper cap to high level effective mode, or normally open (NO) switch can be "opened" at low level input by setting jumper cap to low level effective mode.

Figure 6. Relay

7. **PH Value Sensor** : A pH sensor gives a reading among 0 and 14 that indicates the water's acidity or alkalinity. As the pH drops below 7, the water becomes more acidic. The higher the value, the more alkaline the solution. Different types of pH sensors provide distinct readings on the water's purity.

Figure 7. PH Value Sensor

8. **Rain Detection Sensor :** If rain falls on the sensor, Arduino board can detect it and take appropriate action. There are several potential applications for such a system, including agriculture & automotive industry. Using sensors to track precipitation allows for hands-free control of watering schedules. Farmers may use this intelligent device to automatically irrigate their crop upon constant rainfall data.

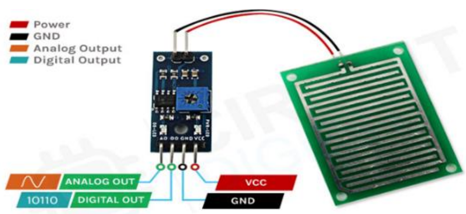

Figure 8. Rain Detection Sensor

Software Requirements :

Arduino IDE : Creating and transferring code to the board is a breeze using free and open-source Arduino Software (IDE). Any Arduino board is supported by this program. For information on how to install, please visit Getting Started page. GitHub is hub of Arduino's active development community. It communicates with and uploads programs to Arduino hardware. Sketches are the shorthand term for Arduino Software (IDE) programs. Text editor is used to create these drafts, which are then saved with extension.

Blynk :

Blynk is a platform made specifically for IoT devices. It features remote hardware control, sensor data presentation, data storage and visualization, and much more.

The core features of platform are as follows:

Blynk App - enables you to design stunning user interfaces using the widgets we supply.

Blynk Server - responsible for handling all data transfers across phone and its peripherals. Our Blynk Cloud is available, or you may host your own Blynk server on your own network. It's free and open-source, with the capacity to manage thousands of devices simultaneously.

Firebase - offers a cloud-based server infrastructure as a service (BaaS). It gives programmers access to many resources that may be used to create useful programs, expand their user base, & increase their revenue. It leverages Google's existing platform. Data in Firebase is stored as documents similar to JSON, making it a NoSQL database.

Blynk Libraries - Allow interaction with server & handle all incoming and outgoing commands for most common hardware platforms.

Python - It's a popular language for creating apps and websites, automating processes, and analyzing data. Python is a general-purpose language, which means it may be used to create numerous kinds of programs and isn't tailored to solve any particular kinds of issues.

VII. PROPOSED ARCHITURE

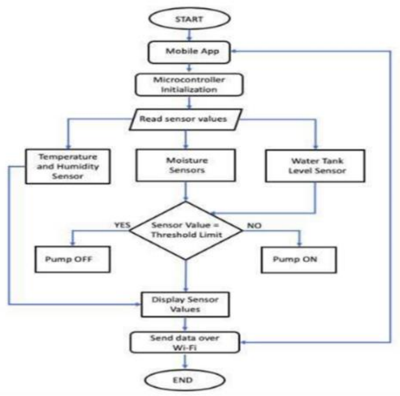

Figure 9. Flow of Proposed Model

The suggested system's Machine Learning flowchart is shown in Figure.9. The program's main feature is crop prediction. Parameters (relative humidity, temperature, and pH) for two crops (rice and kidney beans) are compiled into a dataset. The model is trained with the help of a decision tree algorithm. The user may examine results according to parameters using the blynkapplication, which is interfaced with firebase to access the trained model. We'll put a number of algorithms to test to see which one works best, and then use the results to make predictions about our harvest.

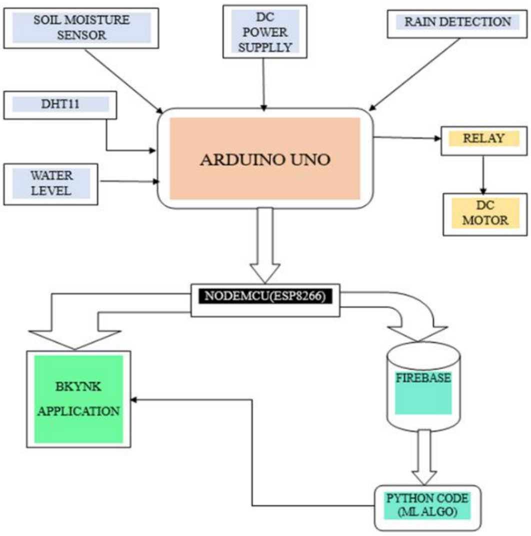

Figure 10: System Architecture

Figure 10 depicts the overall framework for a connected farming system that makes use of IoT and ML. The following diagram shows how the microcontroller is linked to various sensors. These sensors include a moisture detector, humidity detector, and temperature detector. The microcontroller receives a voltage of 4.25 volts. The microprocessor sends a signal to the relay based on the soil moisture content. The motor turns on and a notice is delivered to the user's smartphone if relative humidity drops below 15%. Three sensors are linked to the controller in this block diagram of an Arduino-based smart irrigation system, and the data they detect are sent to a mobile app.

To simplify monitoring and controlling the watering of the agricultural field, the Smart watering System has been included into the mobile application system. An interface for reading sensor data is built into the mobile app platform with the aid of Firebase, a cloud service that acts as an intermediary between the sensors and the cloud database. The mobile app's primary user interface is the main menu, which leads to the system's login page. The purpose of this is to ensure that no one else may access a client's private information without their express permission. After a successful login, the app will provide the user with a secondary menu from which they may manage the sprinkler system. In order to navigate the system, the user must choose one of the available alternatives. The user may choose to manually turn the water pump "ON" or "OFF," or to switch to "AUTO" mode, in which the pump is controlled automatically depending on the value of a sensor. The user is then directed to open the BLYNK App via the control system. This method displays a percentage of all sensor readings to show the soil condition of the farm. The Smart Irrigation System's functionality as it relates to the mobile application platform.

Agricultural growth needs not just massive financial assistance, but also a massive information technology infrastructure. This intricate system is composed of sensors, in addition to hundreds of pieces of networking hardware and processing processors. It's clear that in order to achieve severe reliability and efficiency improvement requirements, the operational and maintenance costs of such a complicated real-time system would need to be much higher. In the case of a smart irrigation management system, each field will need to be outfitted with a highly efficient and dependable set of sensors and data control unit. Creating a sustainable economic and cultural ecology in rural areas should be a top priority.

Direct access to the global market has been a huge barrier owing to various middlemen and a shortage of qualified personnel, and these problems have not gone away. Although most people in the world live in rural areas, we never seem to be able to enhance their access to essential goods and services by developing more efficient agricultural methods.

VIII. Working of the Proposed system

Using real-time data, a smart agricultural system based on the Internet of Things makes irrigation choices. First, farmer accesses system utilizing an Android app, entering his personal information like his password and username. The harvest of that year is therefore up to his or her discretion.

The system is rolled out in three distinct stages.

- Sensing
- Processing
- Information distribution.

During this stage, physical characteristics including temperature, wetness, humidity, and motion are measured. The microcontroller board Arduino Uno R3 is equipped with all these sensors. Since it can send information to the cloud, this board serves as the "Internet of Things gateway" in the finalized setup. The ESP8266 Wi-Fi module is used for this broadcast.

In this setup, cloud is used for processing. To make judgments based on collected data, cloud includes Web Server, a database, and a decision logic. The results of decision-making process will be transmitted to Android app and subsequently IOT gateway at the dissemination stage. The smart farming system's whole algorithm.

IX. SYSTEM IMPLEMENTATION

Weather Monitoring System:

In this article, we propose an advanced online weather reporting infrastructure. The internet-based reporting of weather parameters is made possible by our suggested system. People may get weather data they need directly, without going via a third party like a weather service. The system employs sensors for measuring temperature, humidity, and precipitation to deliver real-time meteorological data. Using a temperature sensor and a humidity sensor, the system keeps a continual eye on the weather. Over a wifi connection, the system continuously sends this information to a microcontroller, which then interprets it and continuing sending it to an internet web server. This information is available on a real-time, internet server. Additionally, the system notifies user if user-specified weather parameters exceed the user-defined thresholds. Consequently, IoT-based weather reporting system offers a reliable online weather reporting service to its customers.

Soil Moisture Detection System:

When designing a smart irrigation system or automatic plant watering system, soil moisture sensor is first component to consider. With this sensor and some help from an Arduino, we can build a system to water your plants just when they need it. Here, we'll connect an Arduino to soil moisture sensor in order to get a volumetric reading of soil's moisture content. This sensor is designed to simultaneously provide digital and analog data streams. We will utilize serial monitor or an LED with PWM to show the status of the analog output, and an LED to show the digital output. So, let's not waste any more time and go in.

DC Motor:

Direct current (DC) is used to power electric motors, which are known as DC motors. A direct current (DC) power supply provides direct current (DC) voltage to an appliance. Power is required for all Arduino boards. A power supply, also known as battery, USB cable, AC adapter, or regulated power source device, is what's utilized to provide boards with electricity. The power provided by a USB port is sufficient for Arduino boards to function. A computer, wall adapter, or portable power bank may all provide port's 5V DC current.

Android is the platform used in creation of the Smart Farming App.

Here are some of the functionality highlights of this app:

1. The water pump may be turned on or off using switch.
2. Recommendation of a certain insecticide for agricultural usage.
3. Animals have invaded the land, and the farmer needs to know about it.

X. RESULT AND DISCUSSION

The user, a Farmer, may utilize our service to obtain reliable advice on what crops to plant based on fac tors like average temperature, humidity, soil pH, and precipitation. In addition, user may monitor farm-specific data in real time through Blynk app, which will provide with real-time readings from sensors.

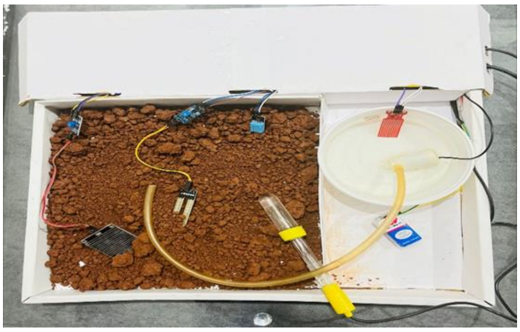

Figure 11. System module

Data Visualization:

Data from the agricultural system's many sensors may be shown in real time through the Blynk app. Par ameters such as temperature, humidity, soil moisture, and light intensity might be recorded. Users may keep tabs on the present circumstances and acquire insights into the developing environment by seeing t his information in the form of graphs, charts, or gauges.

Historical Data Analysis:

Access to data that has been stored for a while is another useful feature of the Blynk app. Patterns, trend s, & correlations that might affect crop results can be discovered via analysis of this data. It is possible t o use past data to train ML systems to forecast crop performance, yield, and disease incidence in the fut ure.

ML Model Integration:

The Blynk app may be used in conjunction with ML models that have been developed using historical d ata. These models may use either previous sensor data or data in real time to provide forecasts or sugge stions. The Blynk app may show these forecasts, such as crop output, development phases, or susceptibi lity to illness. This data may be used by readers to improve their crop management choices.

Notifications and Alerts:

Notifications and warnings may be triggered in the Blynk app according on thresholds you set or machi ne learning predictions. The program may send a warning to the user if specific conditions are met, suc h as a particular temperature being reached or a disease breakout being predicted by a machine learning model. Users are able to take preventative measures and improve agricultural yields thanks to these sign als.

Blynk's real-time data display, historical data analysis, ML model integration, and alerts are all vital, bu t the app itself may not be able to precisely forecast crop outcomes. Farmers and other agricultural stake holders may benefit from these qualities by making better choices, enhancing crop management, and increasing yields.

The water pump is managed by an Arduino UNO and monitored for environmental data including temperature, humidity, soil moisture, ph, and precipitation over the Internet of Things. Using the Wi-Fi module NODEMCU(ESP8266), all of these readings are sent to the mobile device. This system ensures sufficient water pumping and makes effective use of rainwater. Farmers really benefit from this technique since they must often pump water and inspect their crops. Blynk is an app that allows farmers anywhere in the globe monitor environmental conditions, such as humidity, temperature, soil moisture, ph value, and whether or not the water pump is on.

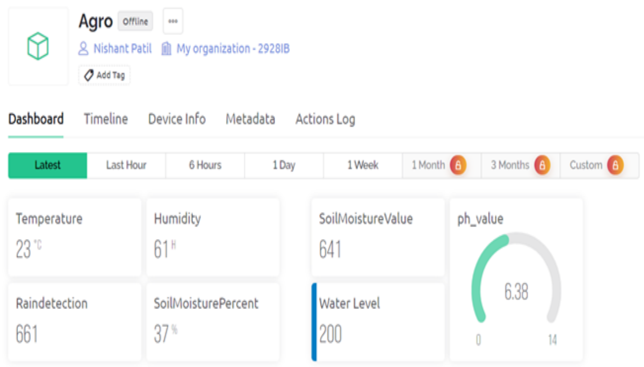

Fig 12 : Predicted result on application

Figure.12 depicts the end outcome of program; the user will have access to real-time data from sensors through Blynk application, allowing him to keep tabs on farm-specific information in real time.

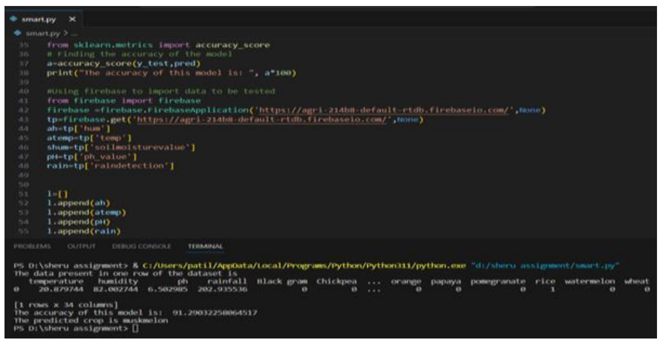

Fig 13: Specific output

The weather, soil, and air conditions are only some of the variables that make up the training dataset utilized to hone the crop prediction model shown in Figure.13's Specific Output (2). Through the use of a Machine Learning algorithm on the Decision Tree dataset used for training. The user, a Farmer, may utilize our service to obtain reliable advice on what crops to plant based on factors like climate, soil conditions, and precipitation.

XI. CONCLUSION

With the information provided by these IoT and ML-based suggestions, farmers will be better equipped to make strategic choices and save expenses wherever possible. Millions of people in India will benefit from this since it leads to a scalable and trustworthy solution.

Therefore, this approach prevents water waste due to over- or under-irrigation, preserves topsoil, and pr events erosion. Agricultural irrigation is made possible by using this technology. As a result, the cost an d efficiency of this system are superior than those of competing automation systems. High-sensitivity se nsors may be used for broad swaths of farmland in big-scale applications. Since farmers need to often p ump water and inspect their crops, this technique is of great assistance to them. Anywhere in the globe, farmers can check the app on their phones to see what the humidity, temperature, and soil moisture valu es are, whether or not the DC motor is on, and which plants will thrive in their environment.

REFERENCES

1] Sameer. M. Patel, Mittal. B. Jain, Sarvesh. S. Pai, Sagar. D. Korde, “Smart Agriculture using IoT and Machine Learning” 2021.
2] Rushika G, Juilee K, Pooja M, Sachee N, Priya R, “Prediction of Crop Yield using Machine Learning,” International Research Journal of Engineering and Technology, February, 2018
3]Sreenivas Pakyala, Chandra Viswanath Balusu, Ashish Teja Motupalli, Prof. Sundar S,” Smart Agriculture using IoT and Machine Learning” April 2021.
4] S.Sundaresan , S.Daniel Johnson , V.Mani Bharathy , Mohan Pavan Kumar , Dr.M.Surendar, “Machine learning and IoT-based smart farming for enhancing the crop yield” 2022.
5] Anguraj.Ka, Thiyaneswaran. Bb, Megashree Gc, Preetha Shri.J.Gd, Navya Se, Jayanthi, Crop Recommendation on Analyzing Soil Using Machine Learning ,2021.
6] Archana Gupta, “Smart Crop Prediction using IoT and Machine Learning” 2020.
7] Kalaiselvi Bakthavatchalam, Balaguru Karthik, Deepa Jose, Ketan Kotecha and Vijayakumar Varadarajan,” Predicting the Crop Using Machine Learning Algorithms”, 2022.
8] Jeeni Patel, Ashutosh Dubey, Ashutosh Singh, Bibin Mathew, “Automatic Drip Irrigation using IoT and Machine Learning”2021.
9] Pavankumar Naik, Arun Kumb, Nagaraj Telkar, Kirthishree Katti” Automatic of Irrigation system using IoT ” 2021.
10] Anneketh Vij, Singh Vijendra, Abhishek Jain, “T and Machine Learning Approaches for Automation of Farm Irrigation System” 2019.
11] Shweta B. Saraf, Dhanashri H. Gawal,” IoT Based Smart Irrigation Monitoring and Controlling
12] Vaishali S, Suraj S, Vignesh G, Dhivya S and Udhayakumar S,” Mobile Integrated Smart Irrigation Management and Monitoring System Using IOT”,2017
13] System”.2017 Dweepayan Mishra, Arzeena Khan2 Rajeev Tiwari3, Shuchi Upadhay” Automated Irrigation System-IoT Based Approach”,2018.
14] Izzatdin Abdul Aziz, Mohd Hilmi Hasan, Mohd Jimmy Ismail, Mazlina Mehat, Nazleeni Samiha Haron, “Remote Monitoring in Agricultural Greenhouse Us- ing Wireless Sensor and Short Message Service (SMS)”, 2008.
15] Shrihari M” A Smart Wireless System to Automate Production of Crops and Stop Intrusion Using Deep Learning” 2020.
16] G. Sushanth1, and S. Sujatha” IOT Based Smart Agriculture System”2018.