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Monitoring and Detecting Plant Diseases Using Cloud-Based Internet of Things

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Abstract: - The farming field is currently going through an upheaval as a consequence of the Internet of Things (IoT), which is offering farmers a respectable spectrum of tackles that include precision and sustainable agriculture for confronting problems within the industry. IoT technology is used to obtain data on ambient conditions which include soil moisture, air temperature, and atmospheric moisture that are advantageous to the enhancement of the various microorganisms and the propagation of farm-related problems. Farmers' ambition to connect through their farms from any location around the globe at any time is fostered by IoT. Wirelessly connected devices record the situation of the farm, and microcontrollers are implemented to automate and regulate farm operations so that conditions may be observed remotely. Farmers can leverage IoT on their mobile devices to be warned about the ongoing state of their cultivated land at any time and at nearly any point across the world. IoT technology can help traditional farming become more profitable while lowering the hurdles it faces. Farmers possess real-time access to the details, which allows them to determine a health condition that originates from favorable ambient conditions. Farmers subsequently become professionals at sustaining the ecosystems of their crops. Furthermore, farming industries necessitate greater numbers of workers and more staff people. Unfortunately, a rising number of human beings are departing the agriculture industry, which has rendered the lack of employees severe. As an outcome, intelligent agricultural technologies are essential in agriculture to shrink the amount of workforce demanded while providing the rising requirements imposed by rising populations.

Keywords: IoT; Cloud Based Farming; Intelligent Agriculture Technologies; Easy Access of Farm Data.

I. INTRODUCTION

In several ways, agricultural IoT, or AgIoT, has helped significantly to the rapid development of agriculture. The acquisition of agricultural data, formation of an agricultural database network, the adoption of agricultural technological devices, climate forecasting, as well as efficient use of natural resources to help improve farming are some of the primary impacts of AgIoT. Smart and precision agriculture has benefited enormously via the applications of artificial intelligence, micro and nanotechnology, robotics, ubiquitous computing, ubiquitous network integration, and other sectors. The Internet of Things (IoT) combines all of these technologies with many more. The key objective of AgIoT is to meet the rising requirements of humans by bolstering any amount and quality of crops and other foods. The crop monitoring system, which has practical value as a large-scale application in redefining agriculture into a fast-moving industry remains one of the most prevalent uses of IoT in agriculture, considering its numerous additional uses. Climate monitoring includes keeping an eye on local and global climate changes and reporting them to agriculture departments so that suitable actions can be taken to stop crop damage regarding climate change and/or maximize the production of crops. To provide scientific guidance and countermeasures for agricultural production, research is being done worldwide for tracking the expansion pattern and physical characteristics of crop growth, the impact of climate on the crops, and the impact created by seasonal shifts due to global warming. To increase agriculture's overall efficiency, a model of the surrounding conditions from different crop locations and environmental growth patterns can be established.

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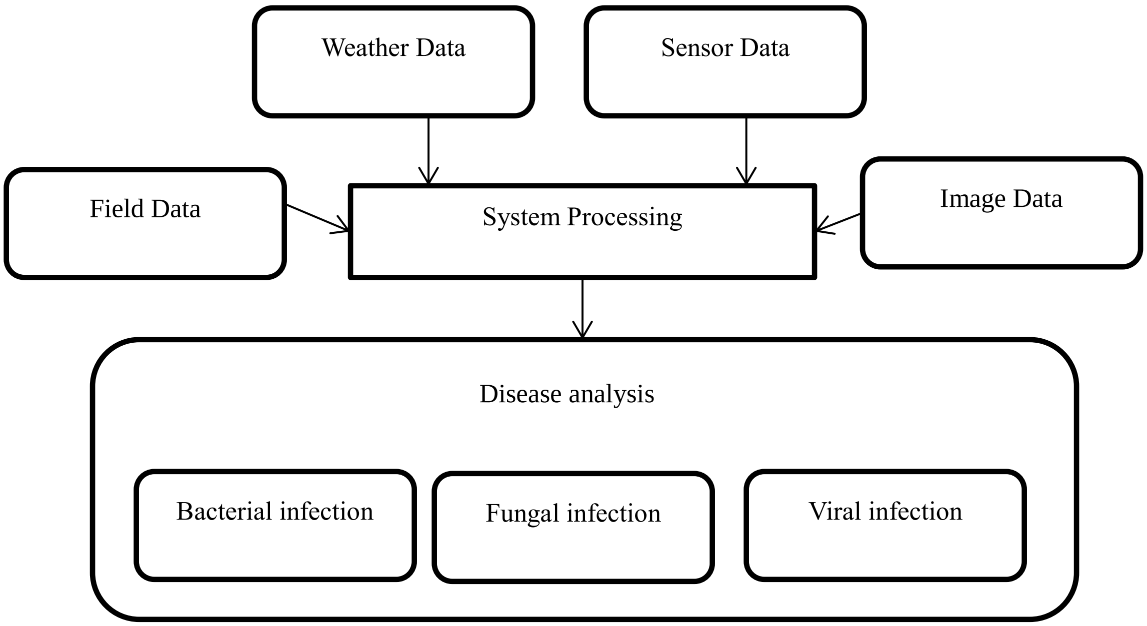

Figure 1.1. Determination of Leaf Disease

Figure 1.1 displays how to spot leaf diseases considering just a handful of the signals. We make use of leaf photographs and software to process them to identify the diseases [1]. The Internet of Things describes a system of physical objects that are embedded with sensors, software, and electronic parts like microcontrollers although those parts cannot be directly connected to the internet. Weather variables like humidity and temperature, along with an excellent irrigation system, and harm cultivating crops. Information referring to weather, downpours, humidity, temperature, and soil moisture can be obtained by deploying Internet of Things technology. Wireless cameras are used to look at scenarios remotely in the form of photographs and videos, while wireless networks of sensors are used to monitor the conditions of fields. Microcontrollers are used to automate and manage farm practices. Using IoT, farmers can utilize a smartphone to stay notified concerning the currently underway instances of their agricultural land at any time and virtually any place around the world. IoT technology may enhance traditional farming's generating while trimming expenses. The development of a graphical user interface and the effective use of cloud services should render healthy monitoring straightforward. Farmers are not obligated to appreciate the concepts of using the data; an intuitive user interface will make it relatively easy to allow them to make the appropriate decisions [2]. To eliminate plant infections, proper plant health monitoring must take place during all phases of plant growth. Understanding plant illnesses optically is a harder task; applying a robotic method will require less effort. Image processing is used to anticipate plant ailments. According to a survey, there are numerous types of plant diseases. The most prevalent are brown and yellow spots, early and late scorch, and various other bacterial, viral, and fungal diseases. The median filter is employed to smooth off images and mitigate noise in images. As soon as utilized for image de-noising, median filtering is highly efficient [3].

The format of this essay is as follows. The following section of this article uses cloud-based IoT in agriculture. In Section 3, a thorough overview of the Internet of Things in agriculture will be provided. Section 4 shows how this cloud-based IoT is being implemented. The conclusion on smart farming, plant disease identification, and its new technology is provided in Section 5.

II. RELATED WORKS

[4] The hardware component and the software component are the two portions. The hardware component will comprise putting up polyethylene buildings in the regions and brainstorming which crops to plant for the maximum probable produce. The polyhouse should then get sensors and GPS installed. GPS will estimate the comprehensive separation that occurs between the crops so whose services we can fertilize them adequately also it will offer a proper awareness of the region to navigate it properly. Sensors will understand the dampness in the soil and convey an alert message to the planter which will compose the software portion of the system. Farmers may switch on or off the water emitters to furnish specific moisture if they utilize a web application that is connected to the sensors

and the sensors notice either less or greater moisture than desired. The crop will be reaped by robotic arms that will perform image processing to find out when the crop is ready to be reaped.

[5] Smart farming is an emerging term for farming in the modern world which leverages IoT technologies to improve the amount and variety of agricultural commodities delivered and benefit businesses that use fewer staff members. The invention of IOT has encompassed powerful wearable technology, robotized equipment, and autonomous vehicles. However, the IOT has certainly had an impact on agriculture. Several kinds of sensors have been developed that may assist with agriculture; in this paper, we have used the IR-3000 Moist Tech sensor, the Yara N-sensors to provide better fertilizer, and the DHT11 temperature detector to diagnose crop shortcomings and humidity. The processed data will be stored on cloud platforms. With those mentioned instruments and amenities, IoT thereby streamlines farming operations. A farming assistant can respond to complications in cultivation, seed, weather, nutrition, indispensable fertilizers, plant diseases, and crop estimation. Finally, the system's harvesting assistant feature supplies farmers with an exhaustive guide regarding the way to improve agriculture through Internet of Things services and equipment.

[6] Through the assistance of IoT, landowners could boost profitability by trimming expenses by lowering worker expenses and boosting production. WSN and a variety of sensors are implemented to acquire data concerning yield instances and typical deviations. The ranchers or trappers who undertake remedial training sessions acquire this data via the framework. Regardless of how strong they are on the globe, ranchers are conscious of and involved in the circumstances of their province. A certain number of correspondence-related safeguards want to be conquered by encouraging advancement to make better use of fewer capabilities in addition to by persuading graphical user interface for adaptation. With the assistance of IOT, the rancher can remain apprised associated with the present circumstances of his rural land at any moment, no matter where corner of the world, by an advanced mobile phone. Traditional farming can be carried out more effectively and less costly with the application of IOT innovation.

[7] Single growers may be equipped to deliver their agricultural goods directly to purchasers via the Internet of Things, not merely in confined spaces like in shops or direct marketing, as well as in larger quantities. This will modify the whole supply chain, which is nowadays exclusively regulated by major corporations and might end up in a shorter, more direct relationship involving producers and consumers. Cloud computing might enable the corporate sector to supply rural farmers with all the services they desire at an affordable price. Cloud computing is classified as "a new style of computing from which commodities are provided as a service over the Internet, often in a virtualized and dynamically scalable approach." The integration of multiple domains for online agricultural supply chain monitoring and complex agroecosystem management remains a monumental task, despite improvements to technology, as it involves planned out, synchronized, and joint efforts.

[8] IoT will hopefully promote agriculture's outcome in a bunch of applications. A micro-precision paradigm for agricultural production is about to substitute for the precision model currently applied in farmlands and greenhouses. The perfect growing or reflecting conditions for vegetables and animals will be submitted using distributed, omnipresent technology and precise infrastructure monitoring. Furthermore, to accurately direct the actuators and boost the potential of available assets, autonomous systems will also be able to guide production in compliance with market conditions, expanding profit and lowering expenses regardless of how viable. On the flip side, food supply chains that have been furnished with WSN and RFID devices will be blessed with the power to schedule a product's life cycle, dynamically choose what is needed during the case of a malfunction, and boost the perception of safe eating through the help of an open and frank product lifecycle information network. The optimistic methodology for implementing the Internet of Things in agriculture is stated above.

[9] To increase yields from agriculture, sustainable messaging technologies and Internet of Things-centered sensors should be adopted. It appears to have established that cloud computing, unmanned aerial vehicles, and wireless sensors can serve as useful technologies to maintain sustained agricultural productivity. Smart device integration can improve crop quality and growth capacity by controlling several production cycle tasks, including as irrigation, soil sample and mapping, fertilizer or pest management, yield monitoring, forecasting, and harvesting. This study explored IoT-based smart agriculture technology and equipment, key effective features, important applications, open barriers and possibilities, and open prospects. In the future, this research will be expanded to include privacy and security issues in smart agriculture using IoT methods.

[10] It has been highlighted the importance of data analysis and the Internet of Things to economical and effective farming strategies. The internet connection and design of the WSN nodes were presented. There is also the presentation on an effective application of existing systems in the control system. Of particular importance, making use of cloud-based services for information stores comprising data from various actuator nodes and sensors is advised in this study. In the context of software, this piece of literature suggests using node-red-based applications for control and visualization, as well as time series-based databases. The foremost obstacles are financial and system capability. The government ought to embrace the importance of information that could have been generated via IoT platforms and support farmers by offering them easier access to IoT devices and services as well as reduced interest

rates on loans. To boost system use, farmers should receive proper studies, and programs for vocational training should be forged.

III. METHODS AND MATERIALS

The four major terms for IoT-based smart farming are presented in Figure 3.1. Data receiving, data analysis, data analytics, and physical structure constituted the four primary components. The most crucial aspect of precision agriculture for mitigating any negative effects is the physical structure. All of the sensors, actuators, and instruments utilized for the development of the systems are regulated. Multiple activities, encompassing soil, temperature, weather, light, and moisture sensing, can be accomplished by a sensor. Along similar lines, systems perform several control obligations, comprising naming facilities, system recognition, and node exploration. Any computing device or sensor operated by a microcontroller can carry out any of these duties. Every distant machine or workstation hooked up to the Internet is performing this monitoring activity. It is difficult to gather an in-depth summary of every technological innovation employed in IoT growing crop solutions simply because of their overwhelming variation. Because of this, the primary topic of our conversation is an assortment of innovations that have been vital in the modernization of IoT agricultural services. The mingling of IoT and cloud computing within farming implies universal access to shared amenities. Meeting multiple agricultural needs across the network and fulfilling operations require cloud processing. It has been proposed that a cloud-based computing technology could be employed for agricultural activities and information processing and retrieval significantly higher level of precision. In the world of IoT, edge processing is envisioned as an alternative that permits data evaluation at the main level of message generation, which encompasses sensors, actuators, and lots of other embedded components. Fog computing, also referred to as edge computing, represents the framework of cloud computing. This technology is implemented to align with smart farming's characteristics and obligations.

Significant quantities of essential knowledge through agricultural sensors are mashed together to give rise to big data. Diverse accurate crop tool tracking at various scales is part of the processing of large quantities of data. A comprehensive meticulous assessment of big data research in agriculture has been produced. The potential of neural networks to deliver excellent responses efficiently is widely used. The implementation of contemporary design neural network principles and technologies allowed the detection of intrusions. On the flip side, the most essential characteristics of neural networks are their acceptance module and information training. A deep neural network-based hydroponic setup has been constructed [11].

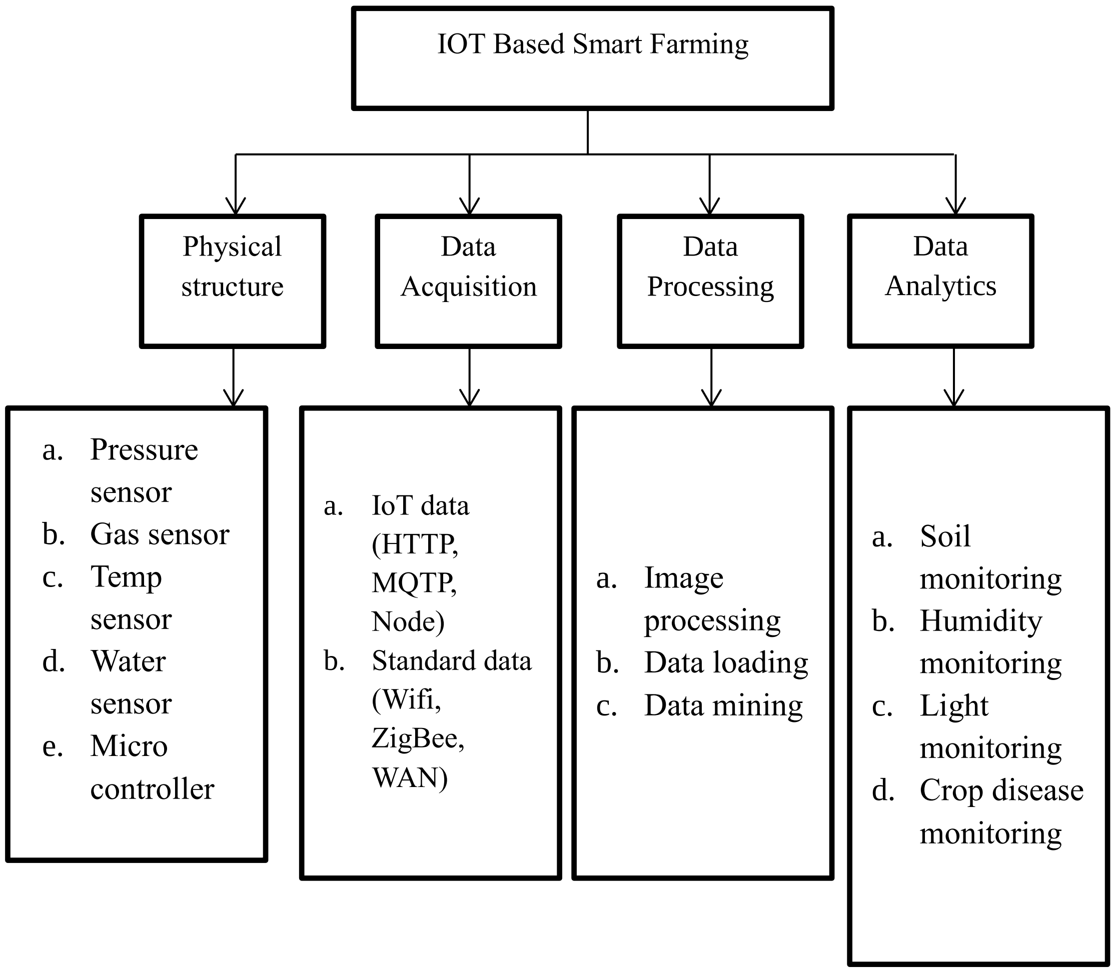

Figure 3.1. Smart Farming Architecture Using Internet of Things

The Internet of Things (IoT) is the fundamental concept implemented in the suggested architecture. A straightforward hardware device will be utilized for gauging multiple states' environmental factors, including UV radiation, temperature, humidity, soil moisture, and pH of the soil. Following that, the measured values will be transported to an AWS S3 database and eventually grabbed back into a NodeJS web application for further computation. In contrast, a Bluetooth module might enable the device to be joined to a React Native phone application. The phone will then be utilized for transferring the data to the database server. The primary aspect of the suggested setup will be a hardware device composed of various kinds of sensors, which include a UV radiation sensor, pH sensor, soil moisture sensor, and humidity and temperature sensor (DHT22).

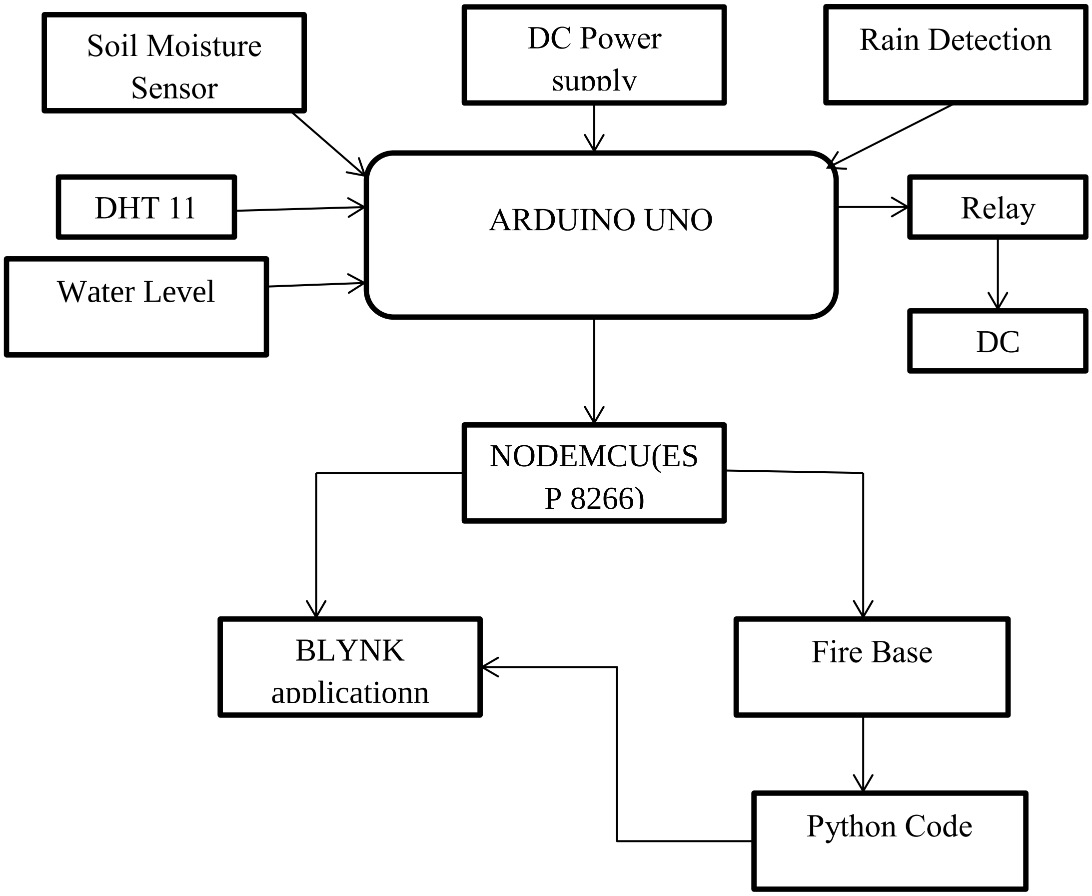

Figure 3.2. Arduino-based Smart Irrigation System Architecture

The general layout of an IoT- and ML-connected farming system is displayed in Figure 3.2. How the microcontroller has a relationship to several distinct sensors is shown in the following diagram. These sensors comprised a temperature, humidity, and moisture detector. The voltage connected to the microcontroller is 4.36 volts. Depending on the moisture content of the soil, the microprocessor transfers a signal to the relay. If the relative humidity breaks below 16%, a notification is automatically sent to the user's smartphone and the motor initiates. This block diagram of an Arduino-based smart irrigation system joins three sensors to the controller; the data that the sensors detect is sent out to a mobile app [12].

3.1 Soil Moisture

The soil moisture detector observes the volume of water in the soil and the outcomes of the moisture content of the soil. The soil moisture detection device YL-69 is a resistance-based sensor. Current is permitted to pass by conducting the soil from an individual sensor to another terminal to obtain the moisture content of the soil. The amount of water in the soil influences the value of the current. The current moving via soil is directly equivalent to the quantity of moisture. Moisture assessment enables to monitoring of the freshwater amount available around the plant.

$$S_v = \frac{\frac{S_3}{S_1+S_3}+\frac{W_n}{W_T}}{1-\left(\frac{S_3}{S_1+S_3}+\frac{W_n}{W_T}\right)} S_2 \quad (1)$$

Where W_n is the voltage provided by the source and W_T is the voltage to be constantly tracked with regard to soil humidity and S_1, S_2, S_3, S_v are the resistances of the arms in the Wheatstone Bridge.

3.2 Temperature and Humidity Sensor

The humidity and temperature are determined using the DTH11 sensor. Observing the external environment's temperature and humidity is profitable. Depending on the operating temperature, the thermistor in the measurement device has an alternative resistance. The farmer can figure out the appropriate temperature for the greenery to live in by performing its temperature measurements. DTH11 contains two electrodes to measure the air's moisture content. The conductive polymer situated between these electrodes reads the humidity. Rain interferes with the resistance that lies between the electrodes. These sensors are distinct in height and what they can accomplish. There are two varieties of humidity sensors: comparative humidity sensors (RH) and exact humidity sensors (AH). Temperature is recognized by the RH sensor, which converts it to relative humidity. By evaluating the variation in conductivity to a known temperature, the AH sensor calculates humidity. The RH sensor incorporates two electrodes isolated by a polymer comb alongside a capacitive sensor. Temperature exerts a ripple impact on capacitance. Changes in capacitance generate differences in voltage over the capacitor, which indicates the air's live humidity at the specific temperature.

At an equilibrium point, the water shrinks. The equation that follows is the formula to determine the relative humidity:

$$SI = \left(\frac{\sigma_{\varphi}}{\sigma_T}\right) \times 100\% \tag{2}$$

Where σ_{φ} is the water vapour amount and σ_T is the saturated water vapour.

A standard voltage divider network as well as a thermistor has been employed to measure temperature. The temperature bears a consequence on the voltage across. Five independent measurements of this analog voltage are gathered and subsequently averaged. The following formula is capable of being performed to calculate the resistance of a thermistor:

$$S_U = \frac{S}{\frac{1023}{ADC_{value}}} - 1 \tag{3}$$

where, S corresponds to resistance and ADC for the potential across S_U.

The following expression has the potential to be employed to determine the temperature across a thermistor:

$$\frac{1}{U} = \frac{1}{U_0} + \frac{1}{\gamma} ln\left(\frac{S}{S_0}\right) \tag{4}$$

where U is the ideal observation temperature. Room temperature is expressed with U_P, the thermistor's beta value is γ. The thermostat's resistance at room temperature is designated as S_P.

3.3 pH Sensor

A key element of all chemical reactions, biological processes, and all life forms is the pH of the surrounding environment. Mammalian cells, fungi, and bacteria are all dependent on pH, which contains hydrogen ions. Soil pH can be performed to evaluate the acidity or alkalinity of soil. Equilibrium corresponds to a pH of 7.0. Anything that qualifies as alkaline or basic is throughout 7.0, and anything whose pH is below 7.0 is considered to be acidic. The accessible quantity of calcium, phosphorus, and magnesium diminishes in acidic soil. Nevertheless, manganese and aluminum which are detrimental are more easily available. Alkaline soil has lowered phosphorus and other micronutrient availability. Agriculture necessitates evaluating the soil's alkalinity considering most crops demand an alkaline environment. The farmer may influence the chemical makeup of natural plant communities, the structure of the soil a microbiome, and the abundance of mineral nutrients through the application of pH sensors. Sudden shifting in soil pH entails periodic changes to nutrient-acquisition procedures.

$$F = F^0 + 2.303 \left(\frac{S.U}{o.G}\right). \log b_{I^+} \tag{5}$$

Where F is the electrode to earn potential sensing, F^0 is the reference electrode's potential, S is the gas constant, U is the temperature, o is the ion's valency, G is the Faraday constant, and b_{I^+} is the I^+ activity. The aforementioned expression changes this temperature-measured potential into pH:

$$F(U) = F^0(U) - 0.1984UpH \tag{6}$$

The liquid ph0-14 observed is employed to measure the pH of the soil. It assesses the various sorts of minerals that dominate the soil. The reaction rate of hydrogen ions that circulate in the soil is displayed by the pH sensor. The pH of the soil ought to average between 6.5 and 7.5 for plants to grow effectively in it. Different plants need different pH levels to grow thoroughly. The pH of the soil is susceptible to being altered by the particular type of soil used to grow vegetation the amount of fertilizer implemented, and the amount of water delivered. The potential varies with relationship to temperature if the soil's pH continues to remain consistent and the temperature increases. For the aforementioned reasons, when measuring pH, the temperature really ought to stay constant. When fertilizer and water are introduced to the soil to encourage plant growth, the pH value of the soil can vary.

3.4 Vibration sensor

If there is wind, which could damage crops, the farmer gets notifications from the vibration sensor (801S). Vibrations are transformed into fluctuations in resistance by this sensor. Even with microshock identifying this sensor can provide data concerning vibration in real time. In the lack of vibration, the sensor outputs a low voltage. When the sensor suspects vibration, the square gets displayed as the result. Major wind assault on the plant is feasible. A vibration sensor may identify whether or not a plant is being split down, moving, or tampered with by a human, parasite, or reptile of any variety. Although the sensor was going to notify the cloud if the plant was harmed, this procedure would make farmers extra cautious about maintaining their plants. If any impairment is noticed by the vibration sensor, a red LED will illuminate up. By revolving the sensor's screw, one may customize the vibration indicator to an appropriate range and figure out whether the plant has been negatively destroyed.

3.5 Smart Drip Irrigation Technique

Irrigation techniques are available in various forms. Since the beginning, historically, surface irrigation has proven to be the most preferred type of irrigation. Here, the water passes across the land's surface to nourish the plant life and get into the soil. Here, the sole element that is less productive is the water application. Sprinkler irrigation, which employs an alternating sprinkler to irrigate plants, is the second strategy. It's not an intelligent decision to engage in sprinkler irrigation in desert terrain regions like the United Arab Emirates. When implementing a sprinkler regarding irrigation, 40% of the water is absorbed through the plant's soil and 60% of the water vanishes owing to hot temperatures. The entire region does not get uniformly blanketed by the 40% of water. The plant's status might deteriorate as a consequence of this variability. Drip irrigation is extremely complicated and considerably more efficient at retaining water in those situations. While water is sprayed on every single plant by raindrops that fall into a piped network at low pressure, it is additionally known as trickle irrigation. The initial step manner of micro-irrigation is the drip irrigation system. Because it decreases the total amount of water and soil nutrients thrown away it is especially beneficial. Although it is positioned so close to plant roots, water evaporation is minimized.

Furthermore, the currently exists a worldwide scarcity of water resulting from increasing standards of life and altering water usage customs. Effective strategies for irrigation will be required in new countries to manage the supply of water. In an attempt to protect water, Israel turned to drip irrigation systems that consume less water. The soil moisture sensor will utilize the Internet of Things to enhance your functionality of drip irrigation. In Figure 3.3, drip irrigation systems will be taken into taking into account effective irrigation. This drip irrigation involves employing intelligent devices. An important part of an integrated irrigation system is the soil moisture sensor. This sensor analyzes the soil's humidity level. The irrigation system's motor will be switched on when the soil's moisture content diminishes. The motor that pumps freshwater is turned off when the moisture content of the soil achieves a specific level.

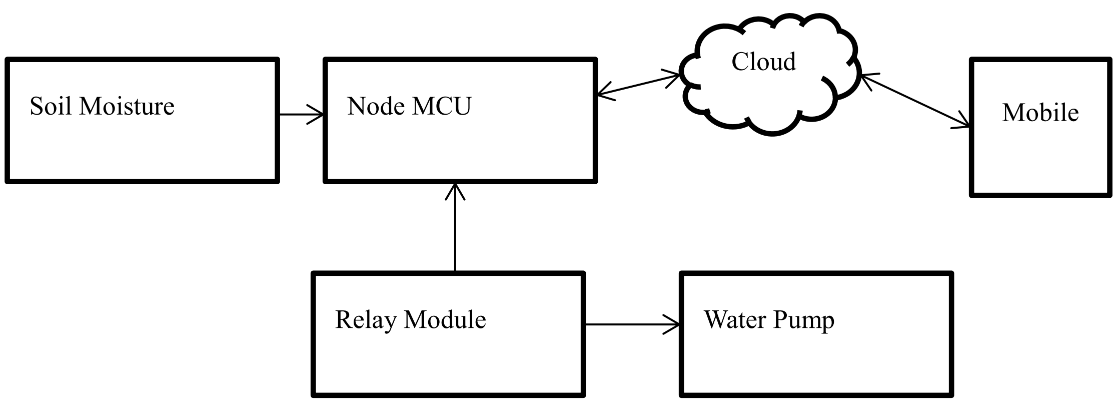

Figure 3.3. Drip Irrigation System

3.6 Node MCE

The ESP8266 WiFi module, illustrated in Figure 3.4, is a TCP/IP-enabled system on-chip (SOC). This module generates sensor-specific IoT. The AT command is preprogrammed inside this computer chip. It is equipped to navigate and store data. Here, every part is interconnected for Internet of Things projects employing the Node MCU. This exact location leverages the Blynk app to retrieve data on the plant from all of the sensors provided.

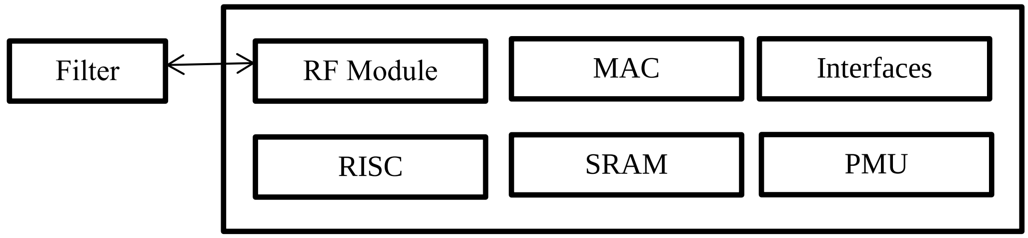

Figure 3.4. Node MCU Functional Diagram

3.7 Blynk

IoT leverages the open-source Blynk platform to oversee hardware that is positioned in a distant place. Figure 3.5 demonstrates the three key elements within this platform: Blynk App, Blynk Server, and Blynk Library. Connectivity between agricultural devices and smartphones is configured by the Blynk server. Blynk libraries encourage communication between the server and hardware and maintain all commands. Blynk App incorporates many kinds of widgets to create a decent graphical user interface. The Blynk platform was developed to store data, visualize the whole procedure, depend on hardware, and showcase sensor data [13].

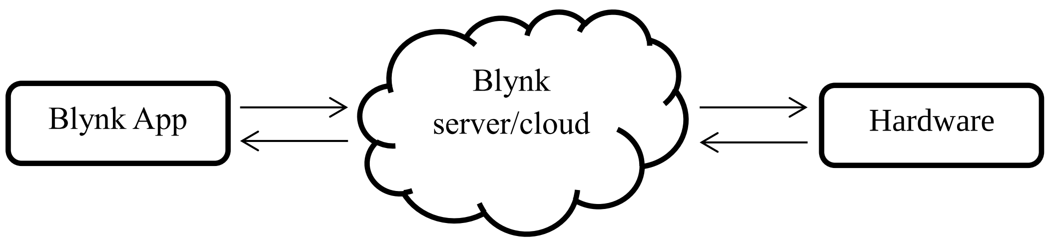

Figure 3.5. Blynk Cloud

IV. IMPLEMENTATION AND RESULTS

The government's assistance will be required for a widespread implementation of Agriculture IoT. By sacrificing user-friendly tactics and principles, it may assist in adoption. It may supply infrastructure and equipment at cheaper rates that farmers might not otherwise be permitted to obtain. It's fundamental to manage the gaps in the farming supply chain. In order to give both farmers and consumers the highest benefits, the middleman's role needs to be revisited and remedied. These weaknesses might stop such technology from getting widely deployed. We will take the farming community's lack of information and the essential abilities exceptionally seriously. It is essential to teach farmers concerning the beneficial effects of IoT in their business. Farmers may alleviate their anxieties and earn an understanding of how to cope with novel equipment with the assistance of training programs. To keep up with the changing patterns of the world, they are forced to give up the traditional the farming process.

The listing that follows is a list of the separate implications [14]:

- Lacking of government guidance and investment
- Excessive spending on communication
- Gaps in the supply chain for either agriculture
- Improper knowledge and expertise
- Insufficient knowledge and social farming
- Right now in its pilot phase, agriculture IoT

The BLYNK App, the software portion of the recommended system, is connected directly to the NODE MCU microcontroller. The NODE MCU operates as a WiFi module. A new project entitled IoT Irrigation was launched and designed by the Blynk app. The Blynk app has created a new project entitled IoT Irrigation, in which soil moisture, temperature, and humidity can be gauged through three-parameter gauges. Furthermore, the two bottoms were additionally developed to accommodate the light and water pump. The system is divided into two distinct parts; the initial component is the management of illuminating and watering, and the additional part is the monitoring employing all three sensors. Both surveillance and oversight of the system are made straightforward with the Blynk app. The system was assembled in tandem employing all of it's components, and the ESP8266 module's proposals were developed and resolved using the Arduino IDE software. Instructions and Wi-Fi connections yielded arbitrary values and graphs. The values of the different variables have been put in Table 1, and Figure 4.1 exhibits the proper graph. Table 2's soil conditions are examined to assess the different levels of soil moisture. Figure 4.2 conveys the Table 2 graph in full detail below. Table 3 symbolizes the variations between the forecast and actual soil moisture value determined through the scattering of this technique. Thus, Figure 4.3 illustrates an immediate graph for this [15].

Table 1. Values of Different Parameters

No.	Parameter	Morning time	Afternoon Time (full sun light)	Night time
1	Soil moisture (%)	57	55	59
2	Soil Temperature (ºC)	30.12	37	23
3	Relative Humidity (%)	66	67	65

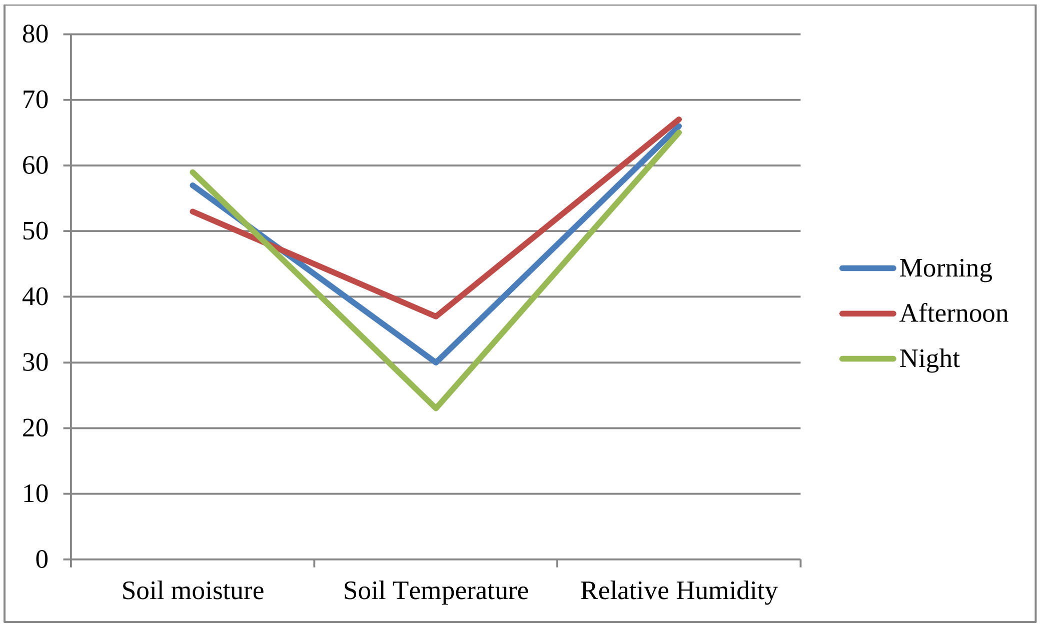

Figure 4.1. Standards of different parameters

Table 2. Different Soil Moisture Value in the Various Soil Conditions

No	Parameter	Dry soil	Optimum soil condition	Excess of water
1	Soil moisture (%)	10	68	81
2	Soil Temperature (ºC)	29.7	27	25
3	Relative Humidity(%)	67	65	66

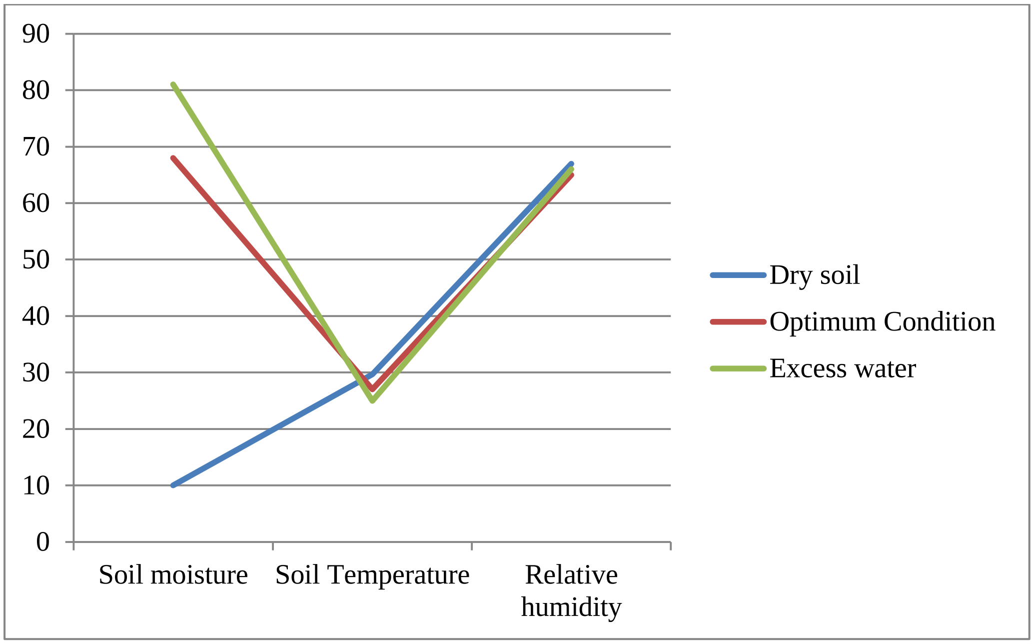

Figure 4.2. Variation of Soil Moisture Values According to their Corresponding Soil Conditions

Table 3. Differentiation of predicted and Actual Value of Soil Moisture

Day	Actual value of soil moisture (%)	The predicted value of soil moisture %	Variation between actual and predicted value
1	54	57.355	-4.358
2	53	53.20	-2.58
3	55	54.89	0.127
4	57	57.84	-0.84
5	62	61.58	0.63

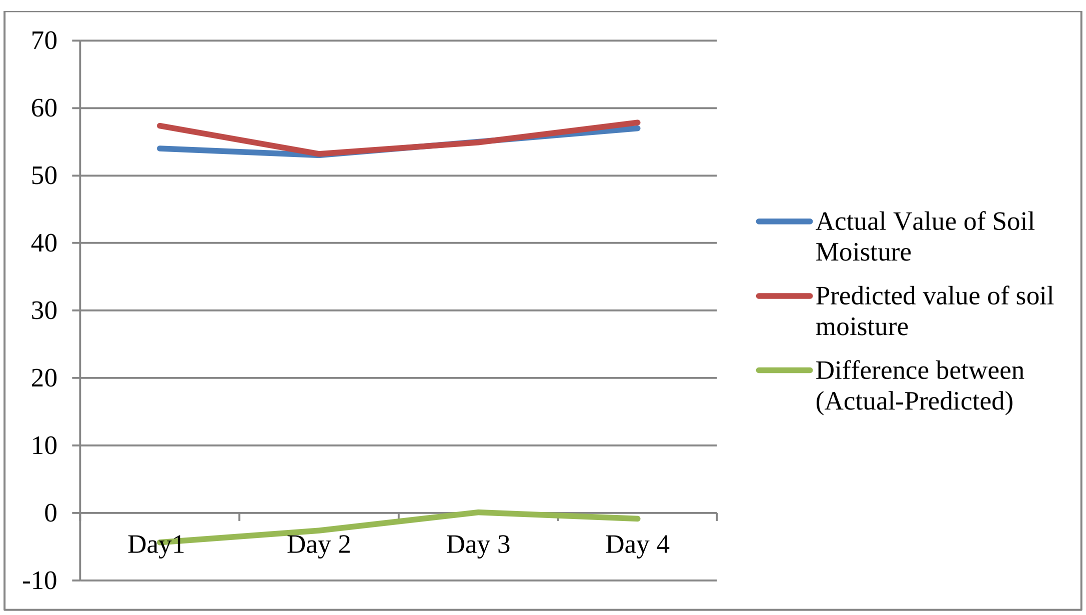

Figure 4.3. Relationship of the Actual and Projected Soil Moisture Rates

V. CONCLUSION

Farmers may boost performance on numerous levels with minimal effort if they frequently track the well-being of their crops plants. With respect to the health of the plant, the farmers will gain advantages from the just-right environment generated through the cloud technology. If the health of the crop is continuously monitored, farms can yield exceedingly well. The Internet of Things (IoT) based Crop Health Monitoring System is an embedded system alongside a capacity to monitor the crop's health safely and provide the information to agriculture professionals to strengthen the agriculture sector by means of e-Agriculture or Agriculture Informatics. Technologies that enhance performance might turn out beneficial for agriculture. To facilitate the successful growth and development of the food sector, high-tech protected farming, nanotechnology, biotechnology, and complex irrigation systems must be built. When employed accurately, these technologies have the potential to enhance profitability and productivity. Farmers' opportunities for earnings will be safeguarded with the assist of technology. With remote monitoring, the farmer can maintain an appropriate distance from the plant while yet keeping close tabs on it. As an outcome, the number of people working has declined. This methodological approach replaces the place of farm labor resources, which are becoming tougher to enter by in the modern era. Agriculture can finally be digitally inspected and managed in real time with the help of IoT technology. The Blynk app will provide you all notifications and agricultural land reading you desire. With this approach, all agriculture is fully protected at the same time pursuing the greatest revenue with a minimal amount of manpower.

REFERENCES

[1] Narasegouda, S. (2020). A decade survey on internet of things in agriculture. *Internet of Things (IoT) Concepts and Applications*, 351-370.

[2] Jaiswal, A., Jindal, R., & Verma, A. K. (2020). Crop health monitoring system using IoT. *Int. Res. J. Eng. Technol*, 2485-2489.

[3] Fuke, M. R. P., & Raut, N. V. (2020). IOT based solution for leaf disease prediction. *International Journal of Innovative Research In Computing*, 76-81.

[4] Suhag, S., Singh, N., Jadaun, S., Johri, P., Shukla, A., & Parashar, N. (2021, June). IoT based soil nutrition and plant disease detection system for smart agriculture. In *2021 10th IEEE International Conference on Communication Systems and Network Technologies (CSNT)* (pp. 478-483). IEEE.

[5] Kanimozhi, J. (2021). A Smart Farming Assistant-Collaborative Help From Internet And Agricultural Experts. *Acta Technica Corviniensis-Bulletin of Engineering*, *14*(1), 111-118.

[6] Balakrishna, G., & Nageshwara Rao, M. (2019). Study report on using IoT agriculture farm monitoring. In *Innovations in Computer Science and Engineering: Proceedings of the Sixth ICICSE 2018* (pp. 483-491). Springer Singapore.

[7] Patil, V. C., Al-Gaadi, K. A., Biradar, D. P., & Rangaswamy, M. (2012). Internet of things (Iot) and cloud computing for agriculture: An overview. *Proceedings of agro-informatics and precision agriculture (AIPA 2012), India*, *292*, 296.

[8] Tzounis, A., Katsoulas, N., Bartzanas, T., & Kittas, C. (2017). Internet of Things in agriculture, recent advances and future challenges. *Biosystems engineering*, *164*, 31-48.

[9] Rehman, A., Saba, T., Kashif, M., Fati, S. M., Bahaj, S. A., & Chaudhry, H. (2022). A revisit of internet of things technologies for monitoring and control strategies in smart agriculture. *Agronomy*, *12*(1), 127.

[10] Jaiswal, S. P., Bhadoria, V. S., Agrawal, A., & Ahuja, H. (2019). Internet of Things (IoT) for smart agriculture and farming in developing nations. *International Journal of Scientific & Technology Research*, *8*(12), 1049-1056.

[11] Kethineni, K., & Pradeepini, G. (2023, May). An overview of smart agriculture activities using machine learning and IoT. In *AIP Conference Proceedings* (Vol. 2477, No. 1). AIP Publishing.

[12] Patil, R. J., Mulage, I., & Patil, N. (2023). Smart agriculture using IoT and machine learning. *Journal of Scientific Research and Technology*, 47-59.

[13] Rajak, A. A. (2022). Emerging technological methods for effective farming by cloud computing and IoT. *Emerging Science Journal*, *6*(5), 1017-1031.

[14] Haq, M. Z. U., Anwar, A., Ullah, M. I., Zafar, U., & Ijaz, S. L. (2019). Challenges of Practical Implementation of Internet of Things in Agriculture. *J. Inf. Eng. Appl*, *9*(7), 17-22.

[15] Raza, A., Khan, M. B., Ali, W., Memon, M. J., & Daudpota, R. (2021). An IoT based Smart Agriculture Monitoring and Control. *International Journal of Electrical Engineering & Emerging Technology*, *4*(SI 1), 8-14.