IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 16, Issue 5 Ser. I (May. 2023), PP 46-52
www.iosrjournals.org

Maximizing The Cropland Functionalities Using The Iot Driven Observation Method

Komal Rathee[1] , Dr. V. K. Srivastava[2]
[1] PhD Scholar, Department of Computer Science and Applications, Baba Mastnath University, Asthal Bohar, Rohtak-124021, Haryana, India
[2] Professor and Head, Department of Computer Science and Applications, Baba Mastnath University, Asthal Bohar, Rohtak-124021, Haryana, India

Abstract
The Internet of Things (IoT) technology is being used in the rapidly expanding sector of "smart agriculture" to improve agricultural quality and output. Real-time monitoring and management of the agricultural process are greatly facilitated by the integration of IoT technology with farming practises. In this research work, an IoT-based observation approach is proposed to monitor soil conditions, temperature, humidity, and rainfall utilising NodeMCU and numerous linked sensors in order to maximise the usefulness of croplands.
The NodeMCU board, which acts as the main controller, and sensors that gather environmental data in real-time, such as temperature, humidity, and soil moisture levels, are among the many parts of the proposed system. The farmer's smartphone receives this data through Wi-Fi, where it is analysed and processed. In case of any substantial changes in the environment, the system may also send SMS warnings to the farmer's phone.
There are several benefits to IoT technology deployment in agriculture. First off, real-time environmental monitoring enables farmers to choose wisely between irrigation, fertilisation, and other agricultural techniques. Second, IoT technology automates several agricultural processes, like fertilisation and irrigation, increasing productivity and saving time. By optimising the use of water and fertilisers, IoT technology also helps to cut waste and minimise environmental effects.
In sum, the suggested IoT-driven observation strategy provides a viable means of maximising agricultural functionality. Farmers may take necessary actions and make wise choices to increase crop output and quality thanks to real-time environmental monitoring and analysis. The use of IoT technology in agriculture has the potential to completely transform the agricultural sector by boosting productivity, lowering waste, and maximising resource utilisation. To fully use IoT technology in agriculture, further study in this field is required.
Keywords: *IoT technology, Smart agriculture, Environmental monitoring, Crop yield*
Resource utilization & Efficiency

Date of Submission: 15-05-2023 Date of Acceptance: 25-05-2023

I. Introduction

More than 58% of the population of India depends on agriculture as a source of income, making it a vital sector of the economy and a significant employer. It entails the breeding of cattle and the cultivation of crops in order to provide food, fibre, and other necessary goods. However, it is anticipated that climate change will have a considerable influence on agriculture, leading to an increase in water demand and a decrease in agricultural output in regions that need irrigation the most. To combat this, a number of techniques have been created to support better crops, including irrigation systems, rain-fed agriculture, and groundwater irrigation. These techniques, however, could not utilise water effectively, which might result in waste and decreased output.

A smart irrigation system has been developed to automate the flow of water into fields, increasing water efficiency while minimising human effort. Using this approach will increase agricultural output while preserving resources. Farmers may efficiently manage water resources and increase agricultural yields by deploying this smart system, resulting in improved livelihoods and sustainable development.

Traditional agricultural methods often waste water; thus, smart agriculture, which integrates robots and the Internet of Things (IoT), has been created as a substitute. This method employs technology to boost output reliability and efficiency. Utilising the characteristics of the soil to identify the ideal water supply is part of smart agriculture. Farmers may learn important information about their crops and prevent water waste by regularly monitoring soil moisture, humidity, and temperature. [1]

A rain-drop sensor may also be used to detect rainfall, alerting the controller to limit or stop the water flow depending on the moisture content at the time. To satisfy the crop's unique humidity, temperature, and moisture needs, the system may be modified. This research focuses on a system that measures soil moisture, humidity, temperature, a rain detector, and other factors to assess if the environment is favourable for crop development. Through Node MCU, these sensors are linked to the internet and a smartphone. [2]

II. Overview of IoT-Driven Observation Methodology

IoT technology is being used more and more in agriculture since it is a possible means of enhancing crop yields and lowering expenses. The cutting-edge IoT-driven observation technique collects real-time data on a variety of agricultural growth parameters, such as temperature, soil moisture, and air humidity. The crop's state and prospective problems are then revealed via the analysis of this data using machine learning algorithms, giving farmers the information they need to manage their crops effectively. This strategy may increase the effectiveness of fertilisation, irrigation, and other techniques, which would eventually result in higher yields and lower costs. As a result, the IoT-driven observation approach is becoming more and more popular as a useful instrument for increasing farmland production.

III. Real-World Application of IoT-Driven Observation Methodology in Cropland Management

A game-changer for the agricultural industry, the adoption of IoT-driven observation methods has given farmers the capability to manage their croplands effectively and efficiently. Farmers may make educated choices that result in higher crop yields and lower costs by using IoT devices to collect real-time data on important environmental factors like soil moisture, temperature, and nutrient levels. These sensors' data may also be used to improve irrigation and reduce water use, which further lowers costs. Overall, this technology has the potential to revolutionise the agricultural sector by giving farmers the knowledge they need to make data-driven choices that maximise output and reduce waste.

IV. Advantages of IoT-Driven Observation Methodology in Cropland Management

Numerous advantages come from the management of crops using IoT-driven observation methods. Real-time crop status monitoring is a significant benefit that enables farmers to act swiftly and decisively in the event of changes or threats. Farmers may increase crop yields and quality by making educated choices regarding irrigation and fertilisation and collecting data on moisture content, temperature, and nutrients. Additionally, IoT-based sensors contribute to the reduction of physical labour, which helps farmers save a lot of money. Early identification of agricultural abnormalities or illnesses allows farmers to take the appropriate action to stop their spread and protect the health of their crops, which is another advantage. Additionally, predictive models may be created using the data gathered by IoT sensors, enabling the best crop management and production. The agricultural supply chain is made more transparent and traceable thanks to IoT-driven observation techniques, which also help to guarantee that food safety and quality criteria are followed.

V. Key Factors for Successful Implementation of IoT-Driven Observation Methodology in Cropland Management

Several important elements must be taken into account to successfully apply IoT-driven observation methods to farmland management. The development of sophisticated data analytics tools that can effectively analyse the enormous volumes of data gathered by IoT sensors is one of the key drivers. In order to help farmers swiftly make wise choices, these technologies should be simple to use and provide real-time information.

The need for reliable communication technologies to provide smooth connections between IoT devices and data analytics tools is another crucial element. To maximise their potential for efficient field management, IoT-driven observation methods must be integrated with existing agricultural management systems like weather forecasting and soil monitoring.

To ensure that farmers have the ability to fully utilise the potential of this equipment, appropriate training programmes must be implemented. For IoT-driven observation methods in farmland management to be successful over the long term, funding and support for continued acceptance and implementation are also essential. The agriculture sector can fully reap the rewards of IoT-driven observation methods in increasing production, reducing waste, and optimising resource utilisation by addressing five crucial elements.

VI. Challenges and Limitations of IoT-Driven Observation Methodology in Cropland Management

Although the IoT-driven observation approach has a lot of promise to improve agricultural management, there are a few obstacles that must be solved for it to work. The administration and processing of the massive volumes of data produced by IoT devices is one of the major issues. The necessity for IoT device compatibility with various crops is another issue, since certain crops could need particular sensors and gadgets. It's also important to consider the IoT technology's own constraints, such as those related to location and internet access. A big issue that has to be solved is the high cost of integrating IoT technology. To fully realise the potential advantages of IoT-driven observation methods in farmland management, these difficulties must be overcome.

VII. Future Prospects and Trends in Maximizing Cropland Functionalities with IoT-Driven Observation Methodologies

By maximising the productivity and sustainability of croplands, the use of IoT-driven observation approaches has the potential to revolutionise the agricultural sector. Real-time monitoring of environmental conditions and crop development enables farmers to make data-driven choices, increasing yields and lowering waste. Additionally, IoT device integration with drones and automated equipment might aid in lowering labour costs, and AI algorithms can forecast agricultural diseases and pests, thereby reducing losses. By lowering water and fertiliser use, fostering environmental conservation, and assuring farmers' financial viability, IoT-driven monitoring techniques have the potential to promote sustainable food systems. In conclusion, the adoption of IoT-driven observation methodology offers the agricultural sector thrilling potential to attain effective and sustainable crop production, with promising future improvements to solve the issues of contemporary agriculture.

VIII. Recommended Smart Farming System

The study's suggested smart farming system is built on a microcontroller called NodeMCU that has an ESP8266 Wi-Fi module that enables it to connect to the internet and send data to a smartphone app via a cloud service. The system makes use of a number of sensors, including a soil moisture sensor, a humidity and temperature sensor (DHT11), and a rain detection sensor, which operate in concert to monitor environmental conditions and decide if the crops need to be watered. [3]

A DC motor linked to a water pump that irrigates the crops is activated by the NodeMCU if the soil moisture level drops below a certain threshold value. To manage the DC motor and make sure that the crops are only irrigated when required, the system makes use of the proper functions and conditional expressions. The atmospheric conditions, which are crucial for assessing if the crops are suitable for growth, are information that the humidity and temperature sensors deliver. The raindrop sensor also detects rainfall intensity and aids in deciding whether crops need to be watered or not. [4]

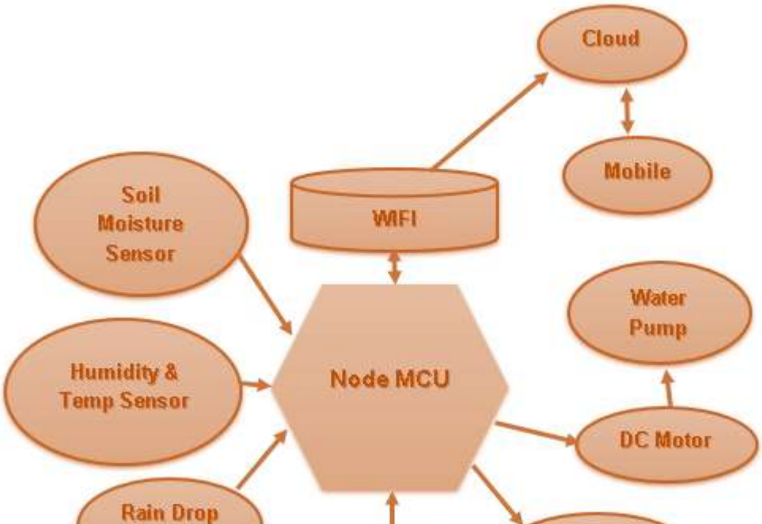
The NodeMCU's Wi-Fi module transmits the sensor data to the Blynk cloud, which is subsequently sent to the Blynk app on the farmer's smartphone. The farmer can check the soil's moisture content, humidity, and temperature using the app. He can also get alerts regarding rainfall and whether the DC motor is on or off. The farmer may use the app to operate the DC motor using a variety of buttons and switches as well. The data is analysed by the NodeMCU when it gets a command from the app, and the DC motor is then controlled appropriately. The data then proceeds along the same channel via the Wi-Fi module. [5]

Overall, the suggested system offers an effective and dependable method for monitoring and controlling agricultural irrigation, ensuring that water is utilised effectively and lowering the possibility of crop damage from over- or under-watering. [6]

IX. Employment of Smart Farming System

Fig. 1 displays the schematic structure of the envisaged IoT-based smart farming framework:

Fig 1: Schematic Diagram of the Smart Farming System



The DHT11 sensor, as shown in Figure 2, is made up of an integrated circuit, a thermistor, and a humidity-detecting component. By adjusting its resistance in reaction to temperature changes, the thermistor determines the environment's temperature. A substrate that traps moisture between two electrodes is part of the humidity sensor component. The integrated circuit measures and processes this change in resistance between the electrodes, which is brought on by the air's humidity level. For future usage, the NodeMCU receives the humidity value from this IC. The DHT11 features a 3.3V to 5V operating voltage range, a 0°C to 50°C temperature range, and a 20% to 90% RH humidity range.

Fig 2: Humidity & Temperature Sensor

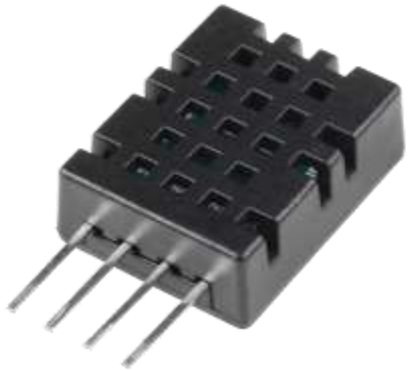
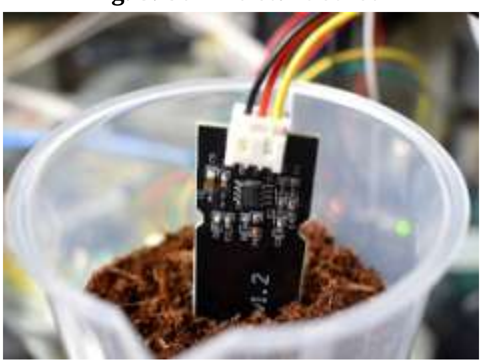


Figure 3 depicts a soil moisture sensor that is made specifically to measure the average soil dielectric permittivity throughout the sensor's length. The technique is based on the correlation between soil water content and dielectric permittivity. The dielectric permittivity value increases with soil moisture content and vice versa. As a result, the sensor's measurement of dielectric permittivity may be used to calculate the soil moisture content.

This sensor can operate at temperatures between 10°C and 30°C, and it needs a voltage of 5 volts to be powered. Accurate and trustworthy measurements of the soil moisture levels may be obtained by determining the average dielectric permittivity of the soil over the length of the sensor. In a variety of industries, like agriculture, where soil moisture levels must be closely monitored to maximise crop development and output, this information may be very helpful.

Fig. 3. Soil moisture sensor



The raindrop sensor in Figure 4 operates according to a straightforward theory. Raindrops form a parallel connection when they land on the nickel lines of the sensor, reducing resistance and, in turn, the voltage drop across the lines. Water is a good conductor of electricity, which is why this happens. It starts to rain when the voltage drops below a certain level.

The sensor is made up of a rain board, a control board, a power indication LE5 volts.D, and an adjustable sensitivity potentiometer. It has a resistance rangekOhm100 KOmOhmo 2 MOhm and runs at a voltage of 5V. The user may set the threshold at which the sensor detects rain by altering the sensor's sensitivity using the potentiometer.

This raindrop sensor may be used for a number of purposes, including automatic irrigation systems, home automation systems, and weather monitoring.

Fig. 4 Raindrop Sensor

Figure 5 depicts a DC motor, an electrical apparatus that applies Lorentz's law to convert DC electrical power into mechanical power. Depending on the polarity of the voltage supplied to its terminals, it has the capacity to spin in both clockwise and anticlockwise orientations. The DC motor, which operates between 3 and 9 volts and rotates at a speed of 3000 RPM, has several uses in agriculture, particularly in irrigation and automated agricultural systems.

A strategy for improving the functions of crops is the IoT-driven observation method. Farmers may optimise irrigation and fertilisation practises to produce the highest crop yield by using a variety of IoT devices to gather data on environmental elements like soil moisture, temperature, and humidity. In this approach, the DC motor is crucial since it powers irrigation pumps that provide water to crops as well as automated agricultural equipment like robotic harvesters or self-driving tractors.

In order to use water efficiently, generate the least amount of waste, and reduce labour expenses, DC motors must be used in farming. It is possible to boost crop output while lowering expenses by using IoT devices to gather data and optimise the DC motor's functioning. Additionally, labour expenses may be decreased and productivity increased by automating agricultural chores like tilling and harvesting using a DC motor.

To summarise, the DC motor is a crucial part of the IoT-driven observation approach for maximising the functionality of crops. It is used in farming to power irrigation systems, robotic agricultural equipment, and other machinery-dependent operations. Farmers may increase crop output while lowering waste and labour expenses by employing IoT devices to gather data and optimise the DC motor's functioning.

Fig. 5: DC Motor

Due to its accessibility, adaptability, and simplicity of use, the NodeMCU IoT platform is often employed in smart agricultural applications. NodeMCU's integrated Wi-Fi functionality, which allows it to connect to the internet and transport data wirelessly, is one of its main features. This increases the overall effectiveness of farmers' agricultural operations by enabling remote monitoring and control of farming machinery, sensors, and actuators.

Additionally, the NodeMCU has 16 GPIO ports that may be used to connect to a variety of sensors and peripherals, including temperature and soil moisture sensors. This makes it possible for farmers to gather information on environmental elements that affect crop development and production, which can then be used to improve farming methods and raise productivity.

Additionally, NodeMCU may be used to operate a variety of actuators, such as motors, valves, and pumps. This makes it possible to automate a number of agricultural procedures, including fertilisation and irrigation, which lowers labour costs and increases crop output. PWM, which offers fine control over the speed and intensity of different devices, is also supported by NodeMCU.

NodeMCU may be programmed using the well-known Arduino IDE and is versatile in that it supports two programming languages: C/C++ and Lua. This makes it simple for programmers and farmers to design unique apps and change already-existing ones to suit their particular requirements.

In conclusion, NodeMCU is a strong and adaptable platform that may be used for a range of smart agricultural applications. For farmers wishing to improve their agricultural practises, save expenses, and boost production, it is the perfect option thanks to its wireless connection, GPIO ports, and compatibility with several programming languages. [7]

Fig.6: NodeMCU

Figure 7's Deek Robot is an interface device that assists in driving the output device, in this instance, a DC motor. It serves as a current amplifier, supplying the motor with enough current to operate. The Deek Robot has in-built clamp diodes and over-temperature protection to make sure it performs safely and effectively. Additionally, it has a high noise immunity level, which means it can withstand electromagnetic interference from other devices and operate steadily and dependably.

A key element of several smart farming applications that use DC motors is the Deek Robot. It may be used, for instance, in irrigation systems to assist in powering the pumps that irrigate crops. It may also be used in agricultural automation systems, such as self-driving tractors or robotic harvesters, where it helps power the motors that direct the motion of the machinery.

Overall, the Deek Robot is a crucial tool for ensuring the correct operation of DC motors in applications for smart farming. Its capacity to boost current, guard against overheating, and withstand noise interference makes it a dependable and secure solution for farmers wishing to automate and make data-driven decisions to improve their agricultural practises.

Fig 7:Deek Robot

Users may remotely operate and monitor devices, store and visualise data, and show sensor data using the flexible open-source platform Blynk, which was created expressly for IoT applications. It has three primary parts: an app, libraries, and a server that may be privately hosted or shared. When data is communicated from the Blynk app, it first travels to the Blynk Cloud before being forwarded to the hardware. Wi-Fi, Bluetooth, GSM, Ethernet, and other technologies may be used to create a link between the cloud and the app. Users of Blynk widgets may change the hardware pins' states using a variety of instructions. After starting a project, an authentication token is created, acting as a special identification between the hardware and the smartphone. [8]

The NodeMCU's digital pins receive data from sensors including humidity, temperature, and raindrop sensors, while the analogue pin receives information from the soil moisture sensor in the Smart Farming system. The Deek Robot, which is attached to two digital pins of the NodeMCU, is used to connect the DC motor to the NodeMCU. The serial monitor shows sensor data if serial functions are included in the code and there is serial connectivity between the NodeMCU and the device. The Wi-Fi network name, password, and authentication token needed for the hardware to connect to the Blynk app are all included in the code. Crop and soil conditions, as well as the state of the DC motor, can all be checked on a smartphone through Wi-Fi when the code has been uploaded to the hardware. Figures 9 demonstrate how Blynk displays notifications.

Fig 9: Notification In Blynk When The Dc Motor Is Pumping Water To The Crops At The Farm

X. Conclusion

In conclusion, this study suggests an observation strategy based on the Internet of Things that may enable croplands to perform to their full potential. Real-time monitoring and analysis of crucial environmental data, including temperature, humidity, soil moisture levels, and rainfall, are made possible by the combination of NodeMCU and numerous sensors. Farmers may use this information to influence choices about agricultural practises like fertilisation and irrigation, which can help improve crop yield and quality.

Additionally, the system's automation of certain agricultural procedures like fertilisation and irrigation may increase production and save time. Additionally, it may optimise the use of fertiliser and water, which can reduce waste and have a positive influence on the environment. Additionally, farmers are able to take quick action to avoid crop loss by receiving SMS warnings in the event of any substantial changes in the environment.

With the help of the Blynk app, farmers can easily access information from anywhere on the globe, which may increase production and provide them with more flexibility when managing their crops. The IoT technology has a lot of promise for agriculture, and additional study is required to create more sophisticated systems that can help both farmers and the environment even more.

References:

[1] Brian Gilmore,"The Next Step in Internet Evolution: The Internet of Things", Internet of Things, cmswire, Jan 2014.
[2] Pradyumna Gokhale, Omkar Bhat, Sagar Bhat,"Introduction to IOT", International Advanced Research Journal in Science, Engineering and Technology (IARJ SET), Vol. 5, Issue 1, January 2018.
[3] A.Anusha, A.Guptha, G.Sivanageswar Rao, Ravi Kumar Tenali, "A Model for Smart Agriculture Using IOT", International Journal of Innovative Technology and Exploring Engineering (IJITEE),ISSN: 2278-3075, Volume-8 Issue-6, April 2019.
[4] Muthunoori Naresh, P Munaswamy," Smart Agriculture System using IoT Technology", International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-7 Issue-5, January 2019.
[5] Nikesh Gondchawar, Prof. Dr. R. S. Kawitkar, "IOT based smart agriculture", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 5, Issue 6, June 2016.
[6] Anand Nayyar, Er. Vikram Puri," Smart Farming: IoT Based Smart Sensors Agriculture Stick for Live Temperature and Moisture Monitoring using Arduino, Cloud Computing & Solar Technology", November 2016.
[7] www.wikipedia.org
[8] Sweksha Goyal, Unnathi Mundra, Prof. Sahana Shetty," SMART AGRICULTURE USING IOT", International Journal of Computer Science and Mobile Computing, Vol.8 Issue.5, pg. 143-148, May 2019.