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IOT Enabled Agricultural Green House Monitoring System

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***Abstract*— Ensuring sufficient monitoring is necessary to promote optimal growth and wellbeing of crops, as they are a vital component of maintaining the ecological balance. The aim of the project is to create a greenhouse design that integrates automation and internet of things technology. The topic includes intelligent decision-making based on real-time data on soil levels. The project uses a number of sensors to achieve this objective. The soil moisture sensor is used to gauge the water content of plants. When the water pump is activated, the signal is sent to the board, which is connected to the internet. Once the optimal level is reached, the pumping mechanism is stopped.**

***Keywords*— Agricultural green Housa, IoT, Algorithm, Data analysis**

I. INTRODUCTION

Crops can be grown in agricultural greenhouses under regulated conditions, which results in a larger yield and better quality. These greenhouses' designs have grown to include mechatronics systems, which combine mechanical, electrical, and computer engineering disciplines [1]-[3]. Mechatronics systems have various benefits for the construction of agricultural greenhouses. They make it possible to precisely manage environmental variables like humidity, temperature, and others that are essential to the growth and development of crops [4] – [6]. Additionally, they enable the automation of various processes, including pest control, fertilization, and irrigation, which lowers labour costs and boosts productivity.

To achieve optimal performance, the mechatronic systems used in agricultural greenhouses must be carefully designed and integrated. This entails deciding on the right sensors, actuators, and controllers for the system, as well as creating effective management and control algorithms. Additionally, the application of mechatronics systems necessitates specialised knowledge in a variety of disciplines, including mechanical engineering, computer science and electrical engineering.

By using smart agricultural technology, a plant monitoring system can help in increasing plant growth and efficiency. Smart agriculture technology uses sensors, drones, and other technologies to gather information about crops and the environment [7] –[10]. This technology can be used in a plant monitoring system to keep track of various elements that may affect plant health.

The system can use automation technology to automate processes. It can help maintain treatment and reduce the need for labour. The data gathered by the sensors can be used to make decisions on how to care for plants. Predicting future growth and scheduling the best periods for harvesting can be done with this information. Smart agriculture technology can help in waste reduction and resource efficiency improvement [11]-[13].

The objective of the work is to implement IoT principles in a green house environment to create a smart greenhouse system that can monitor and control the environmental conditions to optimize plant growth and reduce waste. Real-time data on environmental variables such as soil moisture, temperature, humidity, and some more related informations are collected through a combination of sensors and other technological devices in the system.

Based on the real time data, the water supply and other required steps will be well taken care by the IoT module to make an eco-automation green house system is the main aim of this paper.

II. IOT IN AGRICULTURE

The integration of IoT technology in greenhouses has revolutionized agriculture by providing real-time monitoring and control of environmental factors such as humidity, temperature, and light, resulting in improved crop yield and quality. The idea of IoT in agriculture is based on information being gathered from multiple sensors placed in the field, greenhouse, or cattle farm, which is then transmitted to a centralized system for evaluation and decision-making [14]-[17]. The acquired data is used by the system to optimize and automate various agricultural activities, including irrigation, fertilization, insect management, and crop growth and health monitoring, with the aim of boosting efficiency, productivity, and sustainability in agriculture.

Various benefits of IoT in agriculture applications are :

a) Precision farming techniques can now be made feasible in agriculture thanks to IoT, which allows for the increase of crop yields and the advancement of best practices, while also reducing resource consumption and waste.

b) One of the key advantages of IoT technology in agriculture is the ability for farmers to remotely monitor and control environmental factors like temperature, humidity, and soil moisture in their fields and greenhouses. By doing so, farmers can ensure optimal growing conditions, which can lead to increased crop yields and quality, while also minimizing the risk of crop failure due to unfavorable environmental conditions.

c) The use of data analytics and machine learning algorithms in IoT-based systems can enable farmers to identify potential threats to their crops, including pests, diseases, and extreme weather events, and take proactive measures to prevent them. This can not only minimize crop damage and loss but also reduce the need for harmful pesticides and chemicals, leading to a more sustainable and eco-friendly approach to agriculture.

d) Farmers can track the health, behavior, and nutrition of their animals in real-time with the help of the internet of things. Farmers will be able to spot health issues before they become serious problems. There could be an increase in the production and welfare of animals and a decrease in the price of feed and veterinary treatment. Farmers can use the internet of things technology to manage their animals more effectively.

e) Real-time tracking of food goods from farm to table is becoming more and more common in agriculture because of systems for supply chain management. Ensuring that food products are transported and kept under the proper circumstances helps increase food safety and quality. Enhancing supply chain transparency from production to distribution can aid in waste reduction and guarantee fair pricing for farmers. The agriculture sector could benefit from this.

III. IOT BASED AGRICULTURE GREEN HOUSE

The ability to give farmers real-time data and insights into the environmental conditions of their greenhouses is unique to the IoT-based agriculture greenhouses. They can make informed decisions and take preventative measures to increase crop yields. The use of automation in greenhouse farming reduces the need for manual labour and limits the use of hazardous chemicals, resulting in a more sustainable method of farming.

The revolutionary system of smart agriculture, famously known as the Internet of Things (IoT) based agriculture greenhouse, leverages interconnected devices and advanced sensors to oversee and manage critical environmental factors such as humidity, temperature, light intensity, and CO2 levels in greenhouses. This state-of-the-art technology allows growers to have precise control over the greenhouse's climate, ensuring optimal growth conditions for plants. By employing high-tech sensors, environmental parameters are continuously assessed and monitored in real-time, enabling growers to swiftly adjust the greenhouse environment to suit the specific needs of their crops. Moreover, the sensor data can be transmitted and analyzed in real-time over the internet, enabling growers to make data-driven decisions that lead to better yields, reduced resource consumption, and ultimately, sustainable agriculture.

The monitoring of room temperature and soil moisture levels in green agriculture businesses through the deployment of components in the Internet of Things (IoT) is considered essential for ensuring optimal crop growth and minimizing resource wastage. By placing sensors and other IoT devices in the soil, the right amount of water can be ensured for crops, and the chances of overwatering can be avoided, leading to efficient resource utilization. The IoT components facilitate the continuous monitoring of soil moisture levels and room temperature, providing farmers with real-time data. This data can then be used by farmers to make informed decisions regarding crop management and resource allocation, ultimately leading to sustainable agriculture practices.

Algorithm:

The programme would incorporate a number of sensors that gather information from important environmental variables like temperature, humidity, light, and CO2 levels. These sensors would send data to a centralised hub for real-time analysis.

Step 1 **-** Install sensors: Install a variety of sensors in the greenhouse to start gathering information on important environmental variables including temperature, humidity, light, and CO2 levels. These sensors can be set up in various places and at various heights to get a full picture of the greenhouse's surroundings.

Step 2 **-** Connect sensors to the internet: To enable real-time data transmission to a central hub, link the sensors to the internet and follow the IoT protocols that can be used to obtain connectivity.

Step 3 **-** Analyze data: Use machine learning techniques to instantly analyse the sensor data for trends and insights. Farmers can use this study to guide data-driven decisions about crop management and resource allocation.

Step 4 **-** Control greenhouse environment: The best growing conditions for the crops can be provided by controlling the greenhouse environment. The internet of things is used to automate irrigation systems, and cooling systems.

Step 5 **-** Use predictive analytics: Predicting changes in the environment is possible with the use of predictive analytics. The ideal growing conditions for crops can be preserved even when environmental elements change.

Step 6 **-** Enable remote monitoring and control: To enable remote monitoring and control of the greenhouse's environment. A mobile application or web-based dashboard can be used to implement this feature.

Step 7 **-** Continuously monitor and optimize: When new information comes to light, adjust the system and maintain a constant eye on the greenhouse's surroundings. This could increase crop yields, cut down on resource waste, and encourage the use of sustainable agricultural methods.

IV. RESULT AND DISCUSSION

Incorporating various technologies to optimize the growing conditions for mushrooms is involved in designing a mushroom greenhouse through IoT for a prototype model. It is possible to monitor and control the temperature, humidity, lighting, watering, and nutrient delivery inside the greenhouse by installing sensors, automation systems, and other IoT devices. Data from all the devices and sensors can be collected and processed by the IoT network, allowing the growing conditions to be adjusted and optimized automatically. Increased yields, reduced labor costs, and improved efficiency can be achieved as a result. The system's effectiveness and prevention of unauthorized access and hacking require a reliable and secure IoT network. Overall, mushroom production can be optimized, and growers' profitability can be increased by incorporating IoT technologies into the design of a mushroom greenhouse prototype model. Various components used in this model are:

a) NodeMCU
b) DHT11
c) YL-64 & HL-69
d) Motor Driver
e) 5V Single-Channel Relay
f) 4 Pin OLED Display

The maintenance of the appropriate balance of humidity, temperature, fresh air, and light is crucial for the successful cultivation of mushrooms in a room or greenhouse. While the options discussed are excellent for home growers, there is always room for creativity in developing a design that meets individual needs.

For watering a motor is used, while the sensors used for mushroom cultivation data collection. To ensure optimal conditions, sensors for moisture, humidity, and temperature are be placed inside the room, and a motor can be located outside the room. After collecting the data, it can be analyzed to determine if the moisture content is normal or low. If it falls below the optimal level, the motor will turn on automatically until it will reach to required level , after which it will turn off.

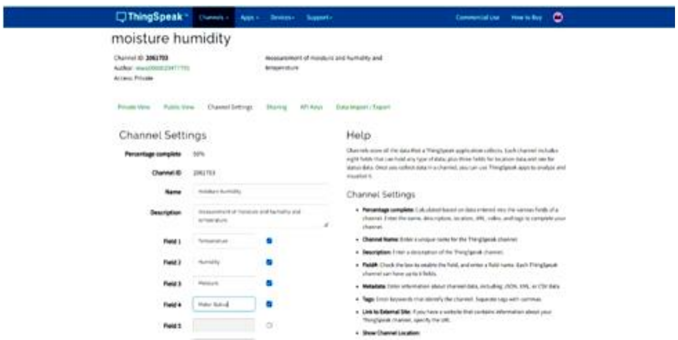

Fig. 1. Moisture and humidity

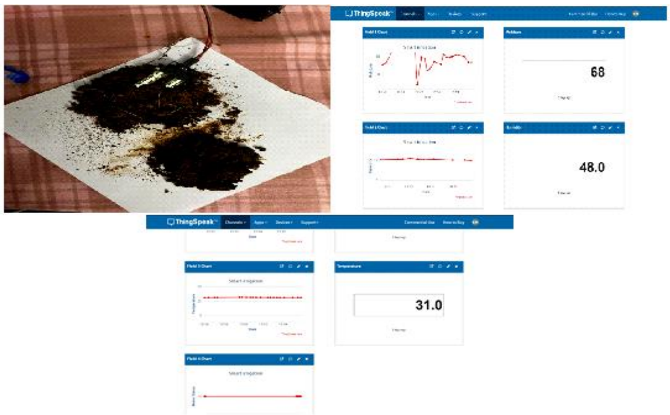

Fig. 2 . Experimental setup and results

V. CONCLUSION

In conclusion, the project highlights the significance of integrating agricultural network technology, particularly the Internet of Things, to enhance farming production and growth. The implementation of IoT in agricultural water irrigation systems can greatly improve water usage efficiency, and further advancements in network hierarchy resources and device design can make these systems more powerful, faster, and more affordable. IoT has the potential to make agricultural systems autonomous by using advanced technologies to predict consumer behavior, weather conditions, and harvest time, providing enormous opportunities for efficiency and yield. The use of soil moisture sensors and online monitoring in the current system shows promising results, indicating that IoT can not only reduce water usage but also increase growth yields and crop quality through better soil moisture management. The incorporation of IoT in farming has enormous potential for development and improvement in the field of agriculture. It is essential to acknowledge the significance of proper implementation and management of IoT systems to realize the full potential of this technology.

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