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SMART AGRICULTURE AND CROP MONITORING WITH THE INTERNET OF THINGS: A RESEARCH PAPER

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Abstract:
Smart agriculture is still a relatively new concept since IoT sensors may offer information about agricultural fields and then act on it based on user input. The key accomplishment of this study is the development of a sensor-based system that can track changes in moisture, temperature, and even movement in a field that could harm crops. Smart agriculture is still a relatively new concept since IoT sensors may offer information about agricultural fields and then act on it based on user input. The project's objective is to use cutting-edge technology, like the Internet of Things (IoT) and automated smart agriculture, to accomplish its objectives. IoT-based technology could increase agriculture's productivity and accuracy. IoT is applicable to many facets of agriculture and farming. IOT is useful in many different industries and has a wide range of applications. Agriculture, where the technology has not been adopted because of the farmer's financial situation, is still devoid of it. The software must be updated after the hardware has been constructed to accommodate evolving requirements and technologies. A new software version is used to describe the upgraded hardware. To guarantee that the modifications made in the previous version are correctly implemented and do not introduce bugs in other areas of the software, this new version has to be tested. This is necessary because altering one piece of hardware could have unforeseen effects on other pieces.

Keywords - Internet of Things (IOT), Smart Agriculture using IOT, Arduino, Soil Moisture Sensor, IOT, Agriculture, Smart farming, Crop Monitoring, IOT Challenges, IOT Application.

I. Introduction

The goal of the agricultural management concept known as "smart farming" is to increase both the quality and output of agricultural goods. Farmers today have access to technology like GPS, soil scanning, data management, and the Internet of Things. The creation of a system to aid in farm management decision-making is the goal of enhanced agricultural research. Smart farming prioritises addressing the issues of population growth, climate change, and labour, all of which have received much technical attention, from crop planting and irrigation through health and harvesting. In the agricultural sector, technology is essential for minimising human labour while also minimising water waste. In IOT-based smart agriculture, a system is built to monitor the agricultural field using sensors (light, humidity, temperature, soil moisture, etc.) and automate the irrigation system. IOT (Internet of Things) in the agricultural setting refers to using sensors,

cameras, and other devices to turn every element and action involved in farming into data. Smart agriculture is still a relatively new concept. IoT sensors may provide information on the agricultural area and then act on it based on user input. The Internet of Things (IoT) and wireless sensor networks have been used to develop a number of systems that can monitor and forecast soil conditions for irrigating fields. In the field of agriculture, predicting the sorts of crops is the most challenging endeavour. Numerous factors affect the crop used in agriculture. The growth of agricultural crops is influenced by the weather, soil characteristics, soil moisture, and surface temperature. Numerous aspects of agriculture and agricultural activity depend on forecasts, which don't always materialise. In the event that farmers are unable to tolerate severe losses, they risk committing suicide. Due to changes in soil structure brought on by fluctuating weather patterns, farmers are unsure which crop would be most suited for growing in that soil. Farmers can use the Internet of Things (IoT) system to address this issue. Future generations won't find working in agriculture to be particularly exciting. There are several causes for this, some of which are grave and require immediate attention. The failure of seasonal rains across the nation along with ground water scarcity, conversion of farmland into residential or other infra development purposes, and the fact that many in agriculture are still unaware of using the most recent and cost-effective farming techniques are some of the major factors preventing agriculture from growing. India is a country with a wide variety of soil types and climates. India's farmers deal with problems like illnesses, poor weather forecasts, and damage to already-planted crops in their fields brought on by sudden rain.

II. Literature Review

In this section, we provide a review of some newly released research articles on Internet of Things (IOT) and smart farming, with a particular emphasis on a study on various crop management systems. An updated summary of IoT-based smart agriculture and crop management was provided in this section.

In S. B. Choudhury et al.'s [1] investigation, the author followed the agricultural cycle for four months while observing a real-world Okra study. With the use of automated irrigation decisions and low-cost IOT, pests and nutrient deficiencies were found. The use of IOT in precision agriculture led to a 10% increase in yield, according to the author.

A. K. Gupta [2], A. K. To foresee plant diseases, drones with cameras were employed. The author also illustrated the high accuracy of CNN by contrasting it to SVM. Because the current method only works on leaves, the author concentrated on them.

I. Marcu, G. Suciu, The author of this study built a precision agriculture decision support system using cloud computing. The field study on grapes employed an IOT ADCON-based system with solar energy for improved power efficiency and lower costs.

Diseases of Tomato Plants by A. H. Deepak and A. Gupta [3]. CNN was used to diagnose the disease by examining several soil types and moisture levels. The accuracy was evaluated using a live image, and it was discovered to be 84 percent accurate. The system is built using WiFi, NodeMCU, and the Blynk cloud.

M. Inoue and N. Kitpo[4] To identify early rice sickness, image processing is put to use. This technique uses position mapping to identify the location and presence of disease on a leaf. It was done using the SVM (supervised machine learning method).

The author of this article, J. Su et al., [5], used Deep Learning U-Net and UAV technologies on a wheat field to identify rust sickness. The performance of the author's spectral-based classifier was shown to be superior than others. Investigations were done on various input band combinations.

Smart Irrigation and Crop Health Monitoring Using an Autonomous Rover [6] S. Gobhinath. The system detected infections and nutritional deficiencies early on. This work by Shekhar [7] suggests an IOT-based irrigation approach. The KNN (K- Nearest Neighbour) classification machine learning algorithm has been presented for evaluating sensor data for water irrigation prediction.

In this work, conducted by B. Sridhar, [8], data analysis was based on cloud computing and numerous deep learning algorithms were used. The author observed a field study on extensive coconut groves.

The author of this study, Patil K [9], employed a Remote Monitoring System (RMS). Crop diseases are also identified using image analysis and SMS-based alerts.

Unmanned aerial vehicles (UAVs) were used by BACCO, [10] to monitor and manage agricultural cultivations. These vehicles exchange information using a variety of ground sensors. An aerial vehicle and stationary ground sensors communicate using a system based on IEEE 802.15.4.

Ibrahim Mat, et al.'s [10] ongoing research made predictions about how the Internet of Things (IOT) might change practical endeavours for a better world, including how it might affect the farming sector. The horticulture sector will need to cope with IOT by 2050 in order to support the 9.6 billion people who will be living on the planet. In order to satiate the want to survive, challenges such as harsh climatic circumstances and accelerating atmospheric change will be surmounted. Smart farming based on IOT advancements will allow cultivators and farmers to decrease waste and improve efficiency across the board, from the amount of manure used to the number of adventures the ranch vehicles have had. It involves applying contemporary ICT (Information and Communication Technologies) to the horticultural industry.

According to M. K. Gayatri et al. [11], cloud computing helps us adapt our ingrained business agriculture. Applications can be made by making financial use of distributed computing devices that can create an entire figurative biological community, from sensors to equipment that collects data from human on-screen characters and images of agricultural fields on the ground and precisely feeds it into databases along with their location as GPS coordinates. Overall, sensors can now identify where water sources are located in a subject that is being studied. Our progress is still being hampered by problems discovered with farmers.

According to Mahammad Shareef Mekala and colleagues. IoT is a cutting-edge idea that considers how registration and correspondence will function in the future. The vast majority of humans in all universes depend on agribusiness. Smart IT developments are therefore anticipated to cohabit with established gardening practises. With the aid of contemporary technology, it is possible to control costs, offer support, and guarantee execution. Satellites and heightened metaphors are essential in modern farming. The measurement of agri-related data, such as temperature, moisture, soil PH, soil sustenance levels, water level, and so forth, is frequently done using an accuracy agribusiness sensor checking system. IOT enables farmers to remotely monitor their harvest and equipment using phones and computers.

The intermittent variations in the atmosphere and precipitation over the past ten years are explained by Prof. K. A. Patil et al. [12]. As a result, many Indian farmers have adopted environmentally brilliant strategies known as brilliant agribusiness in recent years. Keen horticulture utilises the Internet of Things (Internet of Things) and is an automated and coordinated data innovation. IoT is spreading quickly and becoming more connected in a variety of remote settings. Based on the actual circumstances of the horticulture framework, this research has taken into account and investigated sensor innovation and remote systems integration as parts of IOT innovation. A combined methodology using web and remote correspondences is called Remote Monitoring System (RMS).
The web of things is crucial to smart farming, according to Prathibha S. R., et al. With the use of IoT sensors that can collect data on horticultural regions, the idea of brilliant farming is starting to take off. The study promotes the utilisation of cutting-edge technologies like mechanised gardening and the Internet of Things (IoT). Monitoring ecological components is crucial for enhancing the output of skilled harvests. In this paper, sensors based on the CC3200 single chip are used to measure the temperature and humidity in horticulture areas. To snap images and send them through MMS to the farmer's mobile device over Wi-Fi, the camera is connected to the CC3200.

III. Methodology

Internet of Things use in the field of intelligent agriculture The world's population is predicted to increase to 9.6 billion people by the year 2050, which will present a tremendous challenge for agriculture. The need for additional food must be met despite challenges including unpredictable weather, accelerating climate change, and the negative effects of farming on the ecosystem. To meet these rising needs, agriculture must turn to cutting-edge technologies. Thanks to new smart farming apps based on IoT technologies, the agriculture sector will be able to reduce waste and enhance output. It occurs when modern information and communication technologies (ICTs) are applied to farming. In IOT-based smart farming, a system is created to monitor the crop field using sensors (light, humidity, temperature, soil moisture, etc.).
Soil moisture sensor implementation in smart agriculture: The volumetric water content is measured using soil moisture sensors to determine how much water is present in the soil. Reflected microwave radiation, which is used for remote sensing in agriculture and hydrology, is influenced by the moisture content of the soil. Tools for portable probing can be used by farmers and gardeners. You can better regulate your irrigation with the use of soil moisture sensors. Crop yields are increased, input costs are decreased, and profitability is increased by irrigation management. Soil moisture sensors can be used by irrigators to monitor the root zone of a crop.
Water Level Sensor Implementation in Smart Agriculture: In addition to being a crucial element of our overall quality of life, water is a necessary and significant component of agricultural and farm output. Monitoring the water level of a water source, like a water tank or a bore well, is essential in agriculture. Monitoring the water level of a water source, like a water tank or a bore well, is crucial for effective water management. You may save water and gain more knowledge about how water works by keeping tabs on the water level in a water source. Monitoring water levels is therefore a crucial duty in agriculture. The proposed system in this prototype experiment connects to the Internet using an Ethernet shield and an Arduino UNO board.

Field Monitoring Implementation Smart agriculture with drones: Smart farming uses agricultural drones, also referred to as UAVs (unmanned aerial vehicles), to collect agricultural data. Drones can do tasks that previously needed human labour, such as agricultural planting, pest and infection management, cultivation spraying, crop tracking, etc., in addition to their monitoring capabilities.

Implementation of Sensors in Cattle Monitoring and Management: Similar to other application areas, farm animals can be fitted with IoT agriculture sensors to monitor their performance and health. Monitoring and tracking livestock helps gather data on the condition, welfare, and whereabouts of cattle. Farmers can segregate sick or hurt animals from the herd to prevent infection by using cattle monitoring sensors, which can identify the animals. Drones for tracking cattle also enable farmers to reduce personnel costs.

IoT Sensors in Pesticide and Fertilizer Management: Monitoring pesticide levels on crops can aid farmers in increasing crop yield. A farmer may need to use pesticides more frequently when it rains, yet the effects of a storm on various parts of a field might lead to over- and under-application of pesticides in certain areas. Chemical levels can be monitored by sensors placed in the ground or above ground close to plants. With the proper use of pesticides and fertilisers, we can regulate pests and their activity, location, and patterns.

IV. Conclusion

In contrast to performing it manually, our automated Smart Agriculture system saves time and money. This system is driven by the Internet of Things. Additionally, the device can gauge the amount of water present in a field's soil. This method functions effectively when the circumstances are favourable, such as when there is adequate lighting or lightning, and it could be further enhanced when the circumstances are less than perfect. An updated assessment of IoT applications in smart agriculture for crop management was offered in this paper. There are several preliminary studies gathered from electronic databases to address research issues. This article looked at the value of IoT in smart agriculture for crop monitoring as well as problems with its deployment. Various IoT application domains and their technology stack layers were also covered. The most focused sections of several research articles on the subject of crop monitoring are analysed, and any gaps or areas that are not covered are indicated. A thorough analysis of numerous studies is offered, with an emphasis on farm management, disease detection, and crop monitoring.

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