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Sensors, Internet and Cloud computing-Based Smart Agriculture

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***Abstract*— With the help of review papers published from 2016 to 2019, this review paper was created based on the impact of the Internet of Things (IoT) on the agriculture area. These papers are organized into four categories: sensor layer, network layer, middleware layer, and application layer, all of which are concerned with the use of sensors, data collection, and transmission, and data storage in agriculture. It examines the evolution of agriculture and the issues that have arisen as a result of the rapid adoption of IoT technology in order to transition from the conventional approach to the modern method. We require energy as humans to carry out our daily tasks. That's correct.**

***Index Terms*— Internet of Things (IoT), smart agriculture, sensors, internet, cloud computing.**

I. INTRODUCTION

The Internet of Things (IoT) is a network formed by the connecting of any physical things over the internet. The embedded sensors, technology, and software aid in the network building process. It assists in the collection and transfer of data between devices without the use of humans, as it is done through an automated procedure.

IoT devices are now employed in all fields, including agriculture, with no restrictions. Every organism in this cosmos requires food to live a long and healthy life. There is no other choice that can take the place of food's physiological functions. It gives you the chemical energy you need to get things done every day. Food is necessary for the body's systems to function properly. [4]

In agriculture, the Internet of Things plays a vital role. The rationale for this is that working with them is more costeffective because these automated systems monitor all of the work [2]. When machinery that consumes a lot of fuel and emits harmful gases that create the greenhouse effect isn't used, the amount of pollution in the environment is reduced. Solar energy, which is provided by nature, is used mostly here. Data can be captured and exchanged via IoT gateway using IoT devices, and subsequently, data can be analyzed. Because of network construction and cloud computing, data may be accessed from anywhere, at any time, using smart devices.

Agriculture is a country's lifeblood. It is crucial to the economy's growth. Agriculture is becoming more specialized as a result of urbanization, political considerations, natural disasters, and stress caused by harvest failure. Farmers become demotivated and lose income as their crop yields decline. [3]

Technology advancements have the ability to boost productivity and provide human beings with nutritious nourishment. With the support of Internet of Things devices, automated agriculture systems will boost economic growth.

The purpose of forming a network and storing data in the cloud via a server is to gather and analyze data in order to make future decisions about the development of agricultural land, crops, and other variables that are necessary for plant growth. Humans can use a mobile device to analyze and manage water supplies, crop parts, crop diseases, identify damage caused by hazardous pests or weeds using images or video footage, and determine the texture of the soil. Farmers can make modifications to their crops, fertilizers, water flow speed, and pesticide and weedicide usage by monitoring their crops.

II. BACKGROUND

This review paper uses IoT devices to deliver information on the smart agricultural area. It provides in-depth information on how IoT devices can be used to improve the agricultural field in every sector with the help of contemporary technology. The majority of the research papers focused on the role of IoT devices in the automation of the system, from soil texture identification to watering systems, sensing environmental changes such as temperature and humidity, detecting pests and weeds, as well as other damages and changes to the plants, harvest, and transportation. [5]

It explains how large-scale agriculture is linked to satellites in order to maximize the IoT project's benefits.

The way data is communicated is unique. Sensors collect data and send it to an IoT gateway, which connects to a server through Wi-Fi or Bluetooth, where it is stored in a database. Finally, the user acquires the processed data (i.e. information)

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and employs it to make informed judgments. WNS (Wireless Sensor Network) assists in making accurate decisions in relevant scenarios, and so WNS assists in making decisions to solve agriculture-related problems. [1]

When employing modern technologies, there are various obstacles to overcome. The majority of people working in agricultural fields are unaware of how to use technology, and have relied on conventional farming practises for decades. Several causes are cited, including weak and insufficient knowledge on how to use a mobile device, as well as a lack of knowledge of how to read and comprehend. [3]

Other reasons such as a lack of energy, changes in weather conditions, and physical damage during the growing of plant crops growth might cause the nodes that detect the signal passed from sensors to malfunction. Because nodes communicate signals wirelessly, the aforementioned factors cause significant damage, obstruct signal transmission, and interfere with realtime data collection. [4]

When it comes to agricultural property, deploying IoT is first highly costly, but it pays off handsomely later. Farmers' concerns are always given precedence, even in the early stages of agriculture, according to the research paper, and they are not prepared to overcome financial and technological challenges in

IoT devices. [6]

III. DISCUSSION

These research papers are on the use of IoT in agriculture and the issues that come with using smart devices instead of manpower. They're broken down into four different tiers. The sensor layer, Network Layer (Communication Layer), Middleware Layer, and Application Layer are the layers that make up this system.

A. Sensor Layer

A device that responds to a physical stimulus (as heat, light, sound, pressure, magnetism, or a particular motion) and transmits a resulting impulse (as for measurement or operating a control).

1) Leaf Sensors: Leaf sensors, also known as photometric devices, are little sensor clips that are attached to the plant's random leaves. Leaf Sens, an Israeli business, invented the first leaf sensor in 2001. Leaf sensors are little devices that help farmers determine when the optimal time is to irrigate their crops. The sensors check the leaf thickness and electrical capacitance of the plant to see if it needs to be watered. When a plant receives enough water, the leaves of the plant naturally enlarge. The thickness of the plant's leaves begins to decrease and the electrical capacitance in the leaves changes as soon as the plant is exposed to any sort of water stress.

2) Soil Sensors: The amount of organic material in the soil also affects its ability to hold water. Organic matter absorbs water, thus as the amount of organic matter in the soil increases, so does the water-holding capacity. A balanced soil with a modest water-holding capacity is considered to be healthy. A soil with a high water-holding capacity will stay overly wet and eventually rot off the roots, whereas a soil with a low water-holding capacity will not be able to provide enough nutrients to the plant.

3) Temperature Sensor: For most plants to successfully photosynthesize, the leaf surface temperature must be between 15 and 30 degrees Celsius (59 and 86 degrees Fahrenheit). Pine and arctic plants, on the other hand, require colder temperatures to photosynthesize, while desert plants require warmer temperatures. A plant's leaf surface temperature is also determined by CO2 availability. *Evaporation is used by* many plant species to reduce the temperature of their leaf surface. A high humidity level also aids in the warming of the leaves and relieves the plant of the need to use its natural evaporation mechanisms to cool down.

4) Moisture Sensors: There must be a suitable mix of water, nutrients, and oxygen within a plant's root zone. For plants to thrive, the substrate must retain water and nutrients while simultaneously giving enough oxygen and eliminating enough carbon dioxide. Water retention against aeration in a growing medium is a sensitive balance, as overwatering limits the amount of oxygen in the media for root respiration, resulting in anaerobic conditions.

5) Light Sensors: The lamp source determines the light intensity, and there are high and low light intensity fixtures, lamps, and bulbs. High-intensity discharge lamps, for example, produce a high amount of light, whereas fluorescent lights produce a "cool" or low-intensity light. When it comes to gardening, different light intensities have different applications. Young plants, for example, need lower light intensity than vegetative and flowering plants. Furthermore, indoor cultivation necessitates a higher light intensity in general, as there is no natural light source coming in, unlike a greenhouse, and the intensity of the lamp(s) must compensate for this.

6) Soil pH Sensors: The pH of the soil is a measurement that reveals whether the soil is alkaline or acidic. It runs from 0 to 14 and is obtained by determining the negative logarithm of the hydrogen ion concentration in the soil. The pH of soil indicates how acidic or alkaline it is. The lower the pH, the more acidic the soil is, and the higher the pH, the more alkaline it is. A pH of 7 is considered neutral soil. The acidity or alkalinity of soil impacts how quickly plants may absorb nutrients from it, hence pH is an important measurement.

7) Ultra Sensors: Devices that create or sense ultrasound energy are known as ultrasonic transducers and ultrasonic sensors. Transmitters, receivers, and transceivers are the three broad categories they fall under. Transceivers can both transmit and receive an ultrasound, whereas transmitters turn electrical signals into ultrasound. Wind speed and direction

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(anemometer), tank or channel fluid level, and speed through air or water can all be measured with ultrasound. A gadget that measures speed or direction employs numerous detectors and calculates speed based on relative distances to particulates in the air or water. The sensor detects the distance (ranging) to the surface of the fluid to monitor the tank or channel liquid level, as well as sea level (tide gauge).

B. Network Layer(Communication Layer)

The primary purpose is to link the hardware (such as sensors) to the application layer. There are two sorts of data transmission methods. There are a few Communication over a Wireless Networking End-to-end data transfer capabilities can be classified into three layers that interact with each other to deliver smart agriculture services.

- *Layers of the Backbone:* The backbone, also known as the core network, is a component of a computer system (Smart Agriculture System) that connects networks and allows data to flow between subnetworks. The Backbone layer is primarily made up of wired communication technology. These are the elements that make up this layer. Base Station for Unmanned Aerial Vehicles (Drones)
- *Layers of the Bridge*

In this layer, data is transferred using the ways listed below.

1) *Zigbee:* Is a wireless technology that allows you to communicate with other people. Zigbee is an open worldwide standard for low-cost and lowpower wireless IoT networks.
2) *Bluetooth:* is a wireless technology that connects two devices wirelessly Bluetooth is a wireless technology standard for transferring data between fixed and mobile devices over short distances using UHF radio waves in the ISM bands (2.402 GHz to 2.480 GHz) and for constructing personal area networks (PAN).
3) *Lora WAN*: A non-profit organization dedicated to (Short Range) LoRa is a lowpower, longrange wireless technology that's used in IoT. Because of its low power consumption, it allows wireless sensors to communicate with the Cloud via LPWAN (Low Power Wide Area Network).
4) *Sigfox:* Is a French worldwide network operator that was formed in 2010 and is also utilized to give high-speed network communication services to low-power objects like "things." It uses narrowband or ultranarrowband technology to encode data by altering the phase of the carrier radio wave in very small bits of spectrum. Zig fox has been able to send data from hundreds of sensors at the same time.
5) *RFID:* Stands for radio frequency identification (Radio-frequency identification) RFID (radiofrequency identification) is a system that classifies and monitors tags attached to items by using electromagnetic fields. An RFID system includes a radio transponder (which monitors and controls devices), a radio receiver, and a transmitter.
6) *4G*: Is the fourth generation of mobile technology. The fourth generation of wireless networking, dubbed 4G, provides 10 times the speed of current third-generation, or 3G, networks.
7) *WIRELESS INTERNET:* The term "Wireless Fidelity" is abbreviated as Wi-Fi. Wi-Fi is a wireless networking technology that employs radio waves to provide high-speed internet access across short distances. NFC, BLE, 6LoWPAN, Z-Wave, EDGE, ISM/SRD860,
Thread, Weightless-N/W, NB-IoT, and LRWPAN are some of the other bridge layer technologies available.

C. Middleware Layer:

Between the network layer and the application layer, the middleware layer creates connections. The complexity of the lower layers are hidden through middleware. such as the operating system, the main network, and the sub-smart Networks of agriculture system (Sub Sensor System) to make it easier to integrate new and outdated systems. There are many critical services in this layer, such as Devices that can be controlled directly, data storage, and data analytics access to data via a suitable application All remote databases have a programming interface (API). This layer is where you'll find them. The most appropriate databases Badger, Berkeley DB, Level DB, and others are available for IoT projects. Realm, Redis, Rocks DB, SQLite, EC2, Objective Box, Realm, as well as Azure. The system can also save data locally.

D. Application Layer:

The communication issues in an IoT projects are solved by application layer protocols based on TCP and UDP. XMPP, MQTT, and REST/HTTP communication protocols are all enabled by the TCP protocol. DDSI is enabled by the UDP protocol, and TCP/IP implementations are available. This layer provides communication protocols and interacts with the user via an interface. The middleware data is delivered to the application layer, where the user can view it by logging into a web or mobile application (Android apps and IOS apps). These web and mobile applications received encrypted data, which they decrypted and stored using software they developed themselves. For users, locally. Because of nodes, wireless communication is possible. Here are a few examples: application-layer software Aquifer for crops system of management, pest control, and pest management smart farming, system, food production, and safety Livestock management, intelligent lighting, and garbage management are just a few of the issues that need to be addressed weather, greenhouse management system, for monitoring .[3]

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IV. CONCLUSION

IoT devices give information to users via a network structure that processes data and delivers relevant data to clients as needed. The sensor layer, network layer, middleware layer, and application layer are the four key aspects of this review study. It is to obtain a better understanding of the functions of IoT devices in the modern world in order to make work easier by saving time, money, workers, and energy while increasing profits in the agricultural field. The machines conduct the task that the automated system is supposed to do, and the relevant data is updated and saved in the cloud. With an internet connection and a smart device, the data may be analyzed from anywhere. With ancient farming, time and human energy were wasted, and workers were paid on a daily basis. This is not the case in modern farming. It aids in the making of sound decisions and the resolution of difficulties. In current technology, a stress free life is possible with a reliable and powerful system, so the leftover time may be put to good use in other areas.

After reading the review papers listed below, it is clear that the usage of IoT devices in agriculture is critical and must be prioritized. Automated systems, provides a plethora of opportunities and opens up new avenues for the younger generation.

REFERENCES

[1] Muangprathub, J., Boonnam, N., Kajornkasirat, S., Lekbangpong, N., Wanichsombat, A. and Nillaor, P., 2018. Wireless Sensor Network in precision agriculture application. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/abstract/document/6878963>

[2] GOYAL, A., 2019. How the Internet of Things (IoT) is transforming the agriculture sector?. [online] Business of AppsInternet of Things (IoT) is transforming the agriculture sector?. Available a - t:How Business of Apps

[3] Verma, S., Gala, R., S, M. and Burkule, S., 2018. 978-1-5386-5257- 2Smart Agriculture. [online] researchgate.net. Available at: /18/$31.00 ©2018 IEEE An Internet of things (IoT) architecture for <https://www.researchgate.net/publication/332678949_ An_Internet_of_Things_IoT_ Architecture_for_Smart_ Agriculture>. - Search (bing.com)

[4] Bing, F., 2016. The research of IOT of agriculture based on three layers architecture. [online] Ieeexplore.iee.org. Available at: <https://ieeexplore.ieee.org/abstract /document/7868325 /keywords#keywords>. - Search (bing.com)

[5] Ayaz, M., Ammad-Uddin, M., Sharif, Z., Mansour, A. and M. Aggoune, E., 2019. Internet-of-Things (IoT)- Based Smart Agriculture: Toward Making the Fields Talk. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore .ieee.org/document/8784034/ authors#authors> - Search (bing.com)

[6] Ruan, J., Wang, Y., Sun Chan, F. and Hu, X., 2019. A Life Cycle Framework of Green IoT-Based Agriculture and Its Finance, Operation, and Management Issues. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/ abstract/ document/8663998/ keywords #key words> - Search (bing.com)