A SURVEY: SMART AGRICULTURE IOT WITH CLOUD COMPUTING

Dr. G. Preethi Muralidhar[1], J. Jerlin Adikala Sundari[2]

[1]Associate Professor, PRIST University, Thanjavur,

[2]Assistant Professor, PSG College of Arts and Science, Coimbatore,

[1]mgpteethi@gmail.com, [2]jerlinsundari@yahoo.com

Highlights

- This evaluation was utilized to better understand vital technology as well as establish long-term farming strategies.
- It put forwards the idea that, sensors are used to track plant ailments, change greenhouse environmental conditions, and monitor beyond crops.
- It introduces a better smart farming method to improve the quality and quantity of crop production.

Abstract

The Internet of Things (IoT) would be a game-changing platform for development with computers as well as connectivity. Agriculture appears to be the primary source of income for the vast majority of the world's population. A result, sophisticated IT solutions were designed to implement conventional agricultural processes. Advanced technology can help reduce spending, improve service, and quality control. In today's modern farming, satellites and satellite imaging are important. Smart farming device monitoring networks were employed to measure farm conditions such as temperature, humidity, soil PH, soil nutrition levels, and volume of water, among other things. As a result of the Internet of Things, farmers might need their phones and computers to monitor various crops and machines. In this study, they looked into a variety of methods observed in previous studies for farming IoT sensor surveillance communications networks using cloud technology as an infrastructure. That assessment was used to better analyze the important technology and also to develop long-term farming methods. This wireless access point can be used to handle this simple IoT farming concept.

Keywords: *IoT, smart farming, satellite imaging, surveillance communication networks, cloud technology, wireless, IoT farming concept*

I. Introduction

Farming, whether direct or indirect, provides 3/4th of the Indian population (at an estimated cost). It would have an effect on India's food security and economic development. Accuracy allows farming processes to readily control or analyze crop growth based on data obtained from a farm field (soil condition and meteorological data). That method, commonly known as satellite farming or site-specific crop management, would be unable to gather environmental data automatically due to the difficulty of the work. New farmers are starting out with little understanding of soil conditions when there are not enough soil analysis laboratories in all of the states. Therefore, what exactly does the Internet of Things play for crop production? **Automated collected information would be the method, although it carries a danger to farmers as well as agricultural field activities.** As a result, achieving ideal levels of accuracy by producers was tough. IoT (Internet of Things) will be the only answer to this problem. It is crucial in the collection of data. Using unique and diverse strategies, the Internet of Things (IoT) will be on the rise. Smart farming research was conducted in this research.

II. Background

The incorporation of supplementary technologies into farm production systems in terms of waste management and boost productivity is known as smart farming. As a response, smart farms use scientific capabilities to help with plantation monitoring, soil management, pest control, irrigation, order tracing, and other aspects of the production cycle [1]. These assets include temperature, brightness, moisture, pressure, soil chemical content, autonomous aviation devices, camcorders, and agricultural radar. The IOT is a network of interconnected smart devices that could interact with one another and provide meaningful results in the environment in which it operates. As a result, practically any type of machine capable of connecting to the Internet, such as devices, consumer electronics, furniture and agro-industrial technology, can be considered a "thing" in the IoT [2]. Whereas the concept of the Internet of Things really isn't unique, its adoption has increased in recent years, owing to the advancement of systems that enable it, such as advancements in hardware—resulting in smaller and lower power usage in interoperability with the Internet and among devices, such as through wireless links, cloud services, intelligent systems, and massive data. The hardware objects of the approach, as well as how they interact with each other and with the protocol stack, are the focus of the sensing phase. These devices are responsible for collecting data and enabling "things" to interact with others. Commercial systems such as UAV systems [3], sensor networks [4], or innovative systems created using hardware such as sensors and monitoring systems such as Arduino or Raspberry Pi can be used to build sensor networks and transmission portals. Sensors are utilized to track plant illnesses [5], adjust environmental factors in greenhouses [6], and monitor outside plants [7, 8, 9].

The transport layer mediates the contact between interpretation layer devices and processing layer services, which can take several forms, including communicating directly between a sensor network and a computational framework (such as FIWARE [10], Smart Farm Net

[11], and Thinger.io [12]) or an entry point that, in addition to facilitating interactions between a sensor network and the internet, also behaves as a data aggregator.

The transport and application capabilities, such as networking and development platforms, are referred to as the layer of transport [13]. In IOT technology, information systems are employed to connect the perceptual and computing levels. Wireless network of sensors, which allow sensors and applications to connect wirelessly, are being built using these technologies. Data interchange rate, range, and energy consumption are all key properties of each protocol. Short-range, mobile networks and long-range methods can be classified depending on these properties [14]. Small-range protocol stacks (such as Bluetooth, ZigBee, and Wi-Fi) facilitate interaction across small distances. [14] Claims that such protocols often have high data transfer frequencies and low energy consumption.

Networks can be implemented using a variety of topologies, including tree, star, and mesh. A star network is made up of a central node and multiple outer nodes. The following is how communication works in this design: The main server receives information from the peripheral nodes automatically. The centralized router could integrate signal forwarding and communication capabilities using several network services [15]. Router connections and leaf networks make up tree systems. A clustering of star topology can be used to describe similar networks. Leaf networks relay signals to their parent networks within each network. In networks, each unit can theoretically act as a router with reconfigurable abilities. Mesh networks route texts step by step until they arrive at the destination [16].

III. Methodology

The methodology part involves systematic research. The purpose of this study is to look into existing IoT-based farm surveillance applications, sensing devices, and communication networks and present an evaluation of them. We used the technique to make the study unbiased in the areas of data choice and findings in displays. Figure 1 depicts the research approach used in this related empirical investigation. The section involves the research objective and the analysis of relevant papers and research approaches. The approaches involving monitoring (sensors) incorporated with the communication protocols are also analyzed in this section

The research objective is as follows:

- In the subject of IoT agriculture, more targeted research activity has been recognized.
- Assess the current state of IoT agriculture technologies, sensors and devices, and communication networks.
- Suggested a classification to identify the IoT farming strategies and processes that have been utilized.
- An IoT-based sustainable farming paradigm has been suggested, consisting of basic IoT agricultural terminology that may be used to detect existing IoT systems for smart agricultural practices.

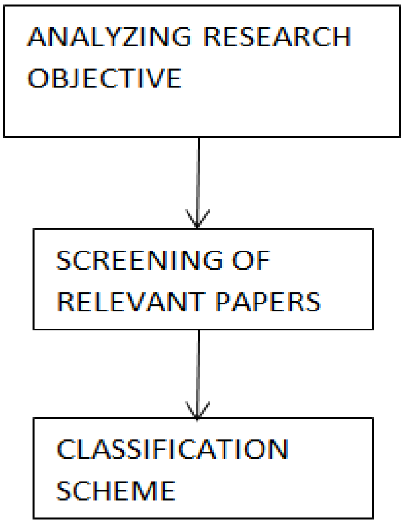

Figure.1. Methodology scheme

Analysis of relevant papers:

Smart farming is a management concept that involves providing the basis for such a farming sector to integrate advanced technologies like big data, the clouds, and the internet of things (IoT) to record, control, automate, and evaluate activities. The design goals have mostly been accomplished, and the design requirements have been met [Zhao Liqiang, Yin Shouyi, Liu Leibo, Zhang Zhen, and Wei Shaojun 2011, **IoT-based Smart Farming using Cloud Computing and Machine Learning**]. Agricultural material has often been collected, reviewed, and stored using cloud-based applications. Cloud-connected smart sensors collect relevant data that is analyzed in real time with learning algorithms, providing producers with deeper experience in crop growth. The Internet of Things (IoT) is a relatively new and powerful application of computer technology. This agriculture industry is critical to humanity's existence on this planet. New innovations would be used to replace conventional agricultural approaches. Innovations were developed to reduce the amount of farming and also to support the current fields. Temperature, humidity, water level, soil nourishment, and acidity concentration have all been measured with the sensor devices. IoT technologies were also introduced for smart agriculture. That topic is precision agriculture, which was initially launched with IoT technology by Miguel A 2019. Precision farming is a method of increasing average yields by using exact numbers of fertilisers in comparison to traditional gardening approaches. This limited scope of surface for India is a serious issue. The experimental results show us that the monitoring system is feasible for applications in precision agriculture. The Internet of Things (IoT) is crucial for agricultural advancement. The system networking is completed with the implementation of two types of nodes. The scalar sensor node and image sensor node architectures, as well as the system software, are described. The results of the experiments reveal that this monitoring system is accurate and dependable.

Green roofs are becoming increasingly popular as a Low-Impact Development (LID) strategy for mitigating the negative consequences of urbanization and the loss of green space [Sia, 2016] [17]. Green roofs are made up of many layers that cover a typical roof, including a waterproofing membrane, drainage storage layer, geotextile filter, growth medium (substrate), and vegetation [Berndtsson, 2010, **Smart irrigation controlling system for green roofs based on predicted evapotranspiration**].Watering schedules and run times are automatically tailored by smart irrigation controllers to match individual landscape demands. These controllers are a tried-and-true method of increasing outdoor water efficiency. Smart irrigation technology uses meteorological data or moisture in the soil measurements to estimate the landscape's irrigation requirements. Smart irrigation innovation is used in these devices to boost irrigation performance by reducing wastage of water and protecting crop health status. Agriculture's most effective watering technology is micro-irrigation, often known as drip irrigation. Water is given directly to the soil, in which the root system should profit the most, and it uses a sophisticated network of soaker hoses, pipes, timers, and even monitors.

A green roof is a building's roof that is covered in greenery. Green roofs benefit buildings in a variety of ways. Green roof crops are subjected to direct sunlight and high winds. In addition, the substrate is shallow and can only store a small amount of water. As a result, artificial watering solutions, particularly for green roofs in tropical regions, are necessary. Green roofs have existed in some shape or another for hundreds of years. Northern Europeans have traditionally employed this technology largely as an insulating technique to help protect themselves from the cold [Magill 2007, **Evapotranspiration Measurement and Modeling for a Green Roof System**]. The current green roofs that we are familiar with today were created in Germany in the 1960s. While their popularity grew fast in Europe throughout the 1980s, they did not make an impact in the United States until the 2000s. Due to the market size and experience in the sector, green roof costs in Germany are much lower than in the United States as a result of the delay [Philippi 2006].

The foundation for building a smart safety mechanism centered on IoT is the M2M architecture, network of sensors and database administration [Nikkila, R., Seilonen, I., and Koskinen, K. 2010, **Development of IoT-based Smart Security and Monitoring Devices for Agriculture**] [18]. Data analytics and pattern matching are two domains that have an impact on security equipment. Researchers are working on a variety of IoT-based safety devices, but advancement in the agricultural industry has been slow. Prior crop security studies have found that poor nations that rely on traditional storage facilities for basic food crops are unable to secure them, resulting in a loss of up to 30% of agricultural goods such as rice and corn. Rats generating impacts on agricultural products is a problem that needs to be addressed by encouraging concentrated improved agricultural methods and establishing data-driven safety nets for producers. The IOT, equipped with smart agriculture, might provide us with a network security for individual fields and farm products, allowing us to better monitor and secure pre and post-harvest crops through the usage of communication and information technology. The use of vitalization technologies to integrate computer resources into groups enables for resource control, outsourced devices administration, and load rebalancing, all of which improve resource productivity. Data collecting is also vital in security equipment. Sensing devices are used to acquire data, i.e. perceptual information. Collected information of sensor is accessed via the internet to a server or system (IoT-based M2M platform) where it can be accessible from a distant region for further analysis and supervision. The client computer retrieves the data once it is transmitted to the server, evaluates it, and informs the user relying on the filtered data.

The Internet of Things (IoT) is discussed in this article, with an emphasis on enabling technologies, protocols, and application concerns [Evans D. 2011, The Internet of Things: How the next evolution of the Internet is changing everything]. [19]. The Internet of Things is made possible by recent advances in RFID, smart sensors, communication technologies, and Internet protocols. The core assumption is that smart sensors will work together without the need for human intervention to create a new class of applications. The present Internet, mobile, and machine-to-machine (M2M) revolutions might be considered the IoT's initial phase. The Internet of Things (IoT) is predicted to bridge many technologies in the next few years to enable new applications by linking physical items to enhance intelligent decision-making. That essay begins with a broad review of the Internet of Things. After that, we will go through some technical aspects of IoT enablement technologies, protocols, and applications. In comparison to other survey papers in the field, our main objective is to provide a more comprehensive overview of the most important protocols and application issues, allowing researchers and application developers to quickly grasp how the various protocols interact to deliver desired functionalities without having to wade through RFCs and standards specifications. They also give a synopsis of relevant academic work as well as an overview of some of the significant IoT concerns outlined in recent literature.

The availability of subsurface freshwater is critical to human activities, particularly agriculture [Davide Brunelli, Pietro Tosato, and Maurizio Rossi 2017, **Flora Health Wireless Monitoring with Plant-Microbial Fuel Cell**] [20]. It is critical to monitor the level of phreatic aquifers in order to safeguard and conserve this resource. We describe a smart, ultra-low-power (in the order of mJ), low-cost, and energy-neutral device capable of monitoring the level of phreatic aquifers on a periodic and remote basis. A single terrestrial Microbial Fuel Cell (MFC) provides electricity, and measurements are taken with a low-cost capacitive phreatimeter that can be communicated with from kilometers away through a long-range radio. Because of the transient computing paradigm, overall power consumption is kept low and power losses are minimized. This bio-electrochemical system serves as a power source for the wireless embedded electronics as well as a biosensor for determining the plant's health. We show that the fuel cell's sub-milliwatt power is sufficient for creating an energy-neutral smart sensor that samples and delivers data. Furthermore, the health of the flora living in symbiosis with the bacterium colony is linked to the rate of gathered electricity [Davide Sartori, 2016, **A smart sensor for precision agriculture powered by microbial fuel cells]**. Thanks to the bacteria species that inhabit practically every soil on Earth, the suggested system has been designed to meet the demands of future smart agricultural applications, offering an unobtrusive and energy-neutral monitoring system available to a wide range of applications.

Wireless Sensor Networks have been widely employed in a variety of applications, including agricultural and habitat monitoring [Yingli Zhu, Jingjiang Song, Fuzhou Dong., 2011, **Applications of Wireless Sensor Networks in Agriculture and Environment Monitoring**]. Environment monitoring has evolved into an essential control and protection sector, allowing real-time system and control connection with the physical environment. In order to increase the quality and productivity of farming, wireless sensor networks (WSN) are now frequently employed in agriculture monitoring. Sensors collect various sorts of data (such as humidity, carbon dioxide level, and temperature) in real-time settings in this application. Agriculture has been significantly changed by technological advancements over time. Humans have found innovative techniques to make farming more efficient and raise more food, from the invention of the plough to the global positioning system (GPS) powered precision agricultural equipment. Agriculture now employs advanced technologies like robotics, temperature and moisture sensors, aerial photographs, and GPS technology on a regular basis. Businesses may be more lucrative, productive, safer, and environmentally friendly thanks to modern technology, precision agriculture, and robotic systems. Because, as we all know, farming environmental monitoring is done from afar, on an individual basis, and over a large area. Collecting information at the scene has been inconvenient for the employees in the past. Traditional agricultural environmental monitoring systems use cable to transport data and provide electricity. As a result, real-time environmental monitoring data is extremely difficult to gather due to the difficulty of establishing lines, high investment costs, and man-made devastation, among other factors. They built a wireless agricultural environmental monitoring system based on a wireless sensor network to overcome the challenges, and the system is primarily used to monitor temperature and humidity.

There will be a variety of new farming techniques in the future, such as GPS, soil monitoring, and soil parameter estimation based on sensor data. That topic is precision agriculture, which was initially launched with IoT technology by [Miguel A. 2019] [21]. For saline water for growing crops, and the farmer's relationship with the production plant will always be maintained. This collection of data obtained from the sensors is being processed. Its main drawback with re-circulation would be that it increases the acidity of the water as well as decreases agricultural production. This development of smart IT and communication technologies has enabled efficient monitoring and management over the past years. Today, biometrics correctly calculate the variables, allowing actuators to control and manage dependent on climate conditions while also enriching the soil's quality using required nutrients. The integration of such current computing, deep learning, and AI technology may assist to boost productivity in the long term by minimizing disease and demanding minimal manual work.

During farming, advanced inventions were required to monitor crops in controlled environments such as greenhouses and also to replicate those ecological surroundings for specific places through obtaining crops directly [22]. Differences in meteorological conditions have an effect on crop yields, which may be regulated by managing variables like humidity, illumination, and temperature. The primary goal of contemporary agriculture is to enhance agricultural output in terms of both quality and quantity. Hydroponics, for example, is an agricultural advancement that boosts soil dispersion and production [Resh 2012]. When compared to open field crops, the amount of fertilization required increases around 8 to 10 times. As a result, in this farming production, optimum use of water for agriculture is required. This degradation of the atmosphere was created by the leakage of compounds like nitrates and potassium from the agricultural system into draining.

This is because the Internet has allowed devices to actually see, understand, reason, and accomplish things via knowing how to communicate with one another, share information, and coordinate choices [23]. The IOT transforms these products from conventional to intelligent by employing wide range of technologies such as distributed network computers, microcontrollers, modern communications, remote monitoring, Network components, and applications. [Ala Al-Fuqaha, Mohsen Guizani, Mehdi Mohammadi, Mohammed Aledhari, Moussa Ayyash 2015]. Domain-specific applications (vertical markets) are made up of smart objects and their assumed duties, whereas application deployment independent solutions are made up of mobile computing and analysis solutions (horizontal markets). The IOT concept is becoming a reality as an enormous number of functional objects are connected to the Internet (IoT). Smart thermostats and HVAC monitoring and systems of control are instances of such devices. There are a variety of additional sectors and contexts in which the Internet of Things may make a significant difference and improve our quality of life. Transportation, healthcare, industrial automation, and emergency response to natural and man-made disasters when human decision-making is difficult are all examples of these uses.

Agriculture may be modernized by combining conventional methods with cutting-edge technology such as the Internet of Things and Wireless Sensor Networks [24]. We designed, developed, and evaluated an "Internet of Things"-based sensor able to process and transferring discovered information to the user in light of this situation. This device can be utilized for protection in farm areas, food storage sites, and cold - chain, and it can be monitored and controlled from distance. [Tanmay Baranwal, Nitika, and Pushpendra Kumar Pateriya 2016]. This work aims to highlight ways of solving problems such as rodent identification, crop risks, and real-time alerting based on information analysis and processing without human interaction.

IV. Result & Discussion

Table.1. Analysis

Year	Author Name	Approach	Purpose	Device
2011	Zhao Liqiang, Yin shouyi, Liu Leibo, Zhang Zhen, Wei shaojun	It is a systematic approach that integrates sustainability issues into policies, plans and programmes promoting	Managing farms using modern Information and communication technologies to increase the quantity and quality of products while optimizing the human labor required	Greenhouse automation, Crop management, Cattle monitoring and management, Precision farming

2010	Berndtsson	It can provide high accuracy water supply and avoid water from wastage. Due to automatically handling, user requires less man power.	These products maximize irrigation efficiency by reducing water waste, while maintaining plant health and quality	Soil moisture sensor, soil temperature sensor, ambient humidity sensor, and an ambient temperature sensor
2010	Nikkila, R., Seilonen, I., Koskinen, K	It is providing data that helps farmers monitor and optimize crops, as well as adapt to changing environmental factors.	This purpose was gathering data which is transmitted to analytical tool for analysis.	Tractors Combine or Harvester, ATV or UTV, Plows, Harrows, Fertilizer Spreaders, Seeders.
2011	Evans D	IoT represents the next evolution of the Internet. Given that humans advance and evolve by turning data into information, knowledge, and wisdom, IoT has the potential to change the world as we know it today for the better.	The Internet is a vast network that connects computers all over the world.	Web3, which they guess sounds cooler than Web 3.0, is the next evolution of the internet. An outgrowth of Web 2.0, it's based on the idea that blockchain tech and digital tokens can foster a decentralized internet

2017	Davide Brunelli, Pietro Tosato, Maurizio Rossi	The working of microbial fuel cell (MFC) technology is based on the principle of redox reactions.	The biological cell that converts the solar energy into the bioelectricity with an aid of the microbes at the rhizosphere region of plant seems to be an emergent source of sustainable energy.	Generally, the MFC consists of two parts, an anode and a cathode, which are separated by a proton exchange membrane.
2011	Yingli Zhu, Jingjiang song, Fuzhou Dong.	Humans have developed new ways to make farming more efficient and grow more food.	In agriculture WSN used for monitoring, measuring temperature, irrigation system, measuring water supply and so on	Wireless Sensor Network has been widely used in many areas especially for surveillance and monitoring in agriculture and habitat monitoring.

Sensors & communication protocols in monitoring:

Sensor

1. Optical sensors: It uses light to detect soil qualities at different frequencies. These detectors, which are mounted on tractors, collect and interpret data on soil reflectance and plant shade. Clay, organic compounds, and soil water content can all be detected using optical sensors.
2. Electrochemical sensors: It aids in the gathering of soil biochemical measurements. Information sensors for soil nutrient detection are electrochemical sensors. Samples taken will be sent to a testing laboratory. An ion-selective electrode is used to perform specific tests, such as pH measurement. The action of ionic species like nitrate, potassium, or hydrogen, is monitored by such devices.
3. Mechanical sensors: These sensors work by piercing through the earth and recording the force using pressure gauges or strain gauges. When the detector breaks through soil, it captures the gripping pressures caused by the piercing, fracturing, and displacement of the soil. The proportion of the force necessary to penetrate the soil

medium to the front region of the equipment connected to the soil is represented by soil physical resistivity, which is measured in terms of pressure.

4. Moisture sensor: It determines the amount of moisture in the soil. All across the farm, humidity monitors are used in conjunction with rain assessment points. Whenever the growth levels have dropped, this enables the monitoring of soil moisture levels.
5. Airflow sensors: Its observations can be made on the go in specific areas. The target value is the pressure required to push a specified volume of air into the earth at a predetermined depth. Densification, morphology, soil characteristics, and moisture level all create various distinguishing signatures in soil.
6. Electronic sensors: It's a device that's mounted on tractors as well as other agricultural machinery to monitor how well they're working. The data was then sent to devices or forwarded to people via mobile and satellite network technologies. The data can then be recovered on the field executive's work PC or mobile phone.

Communications for monitoring

1. Wireless Sensor Networks

A wirelessly sensing connection is made up of RF transmitters, detectors, embedded systems, and a supply of energy. Ego, subconscious, personality, and consciousness qualities are among the characteristics of wirelessly sensing systems. Those characteristics resolve difficulties or allow projects which would otherwise be impossible to achieve with existing technology.

The apparent benefit of the transmitter and receiver is the huge decrease in installation time and complexity. Features that were formerly hard to observe, including tracking risky, risky, wirefree, or isolated sites and locales, are now accessible thanks to wireless sensing modules. These techniques allow user’s practically limitless sensing unit placement options as well as greater connection resiliency. Moreover, wireless technology simplifies and lowers the cost of servicing. Since several wirelessly sensing systems give ego, personality, personality, and consciousness characteristics to the sensing sites, they enable speedier installation and maintenance of different kinds of devices.

MEMS (micro-electro-mechanical systems) devices may be combined into a sensing network that is highly cheap in expense, compact in space, and consumes very little energy thanks to wirelessly sensing hub innovation. Cordless sensing networks were equipped with MEMS sensing element, thermocouples, thermostats, and different sensitive detectors for measuring closeness, location, speed, accelerator, and vibrating. These MEMS detectors are useful for high-resolution applications.

2. Radio Frequency Identification (RFID)

This label or transmitter, a receiver as well as a transmitter that records messages to a transmitter, and the processor holding databases and communication business applications are the main primary constituents of RFID networks. Dynamic, soft, and semi-passive RFID cards are available. RFIDs, which are active or semi-passive, convey messages through reflecting or modulating the magneto-strictive waves generated by the sensor. This same typical reading spectrum is 10 cm to 3 m.

When compared with similar 13.56 MHz passive RFID cards, RFID has a constrained detection radius of roughly 20 cm (ISO15693). Sensing labels have UHF ports with a detection radius of a couple meters that may be checked off automatically throughout the process. Cargo discharge, however, these vibrations are never able to permeate solids or fluids. Finding embedded sensors in filled containers is significantly more difficult than it appears to be a possibility.

3. PA Application

Several PA implementations were researched as well as handled, which depends For instance, RFID-based food labeling solutions are extensively described here. The researchers looked for low-cost, detachable RFID sensing chips. These labels would be used to track the history of menu items as well as to control infection and inventory. The immunogenic response was employed to identify microorganisms in the sensor tags, which were built on a sound wave base. The possibility of RFID chips for advanced products, automated registration, home devices, sensible trash, and advertising is also being discussed by several academics.

An advancement in livestock surveillance equipment while transporting. Sensors were fitted in the creature chamber to recognize the creatures as well as analyze indoor air, movement, and creature activity. Its device's point was determined by the Global Positioning System. An information transmission component used the mobile broadband system to send information to a repair centre on a constant basis. The technique was said to have significantly enhanced livestock throughout storage and processing.

A fieldwork information gathering programmed was established to gather information for agricultural production and geographic research. An information-gathering automobile, a supervisor vehicle, and advanced process-control devices on agricultural machinery made up the network. The technology gathered information on ground freshwater resources, compactness, productivity, vegetative growth, seed ratio, leave warmth, leave photosynthetic rate, crop water condition, microclimatic statistics, insect damage, crop production, and other factors. This data-gathering truck used Wi-Fi to collect data from agricultural machinery, which it then analyzed, saved, and remotely transferred to the management car.

At Portuguese, a conservatory tracking and management programmed was made to capture both external as well as inside climatic factors. To track and collect climatic information, many of the measurement units were deployed inside as well as outdoors. Several units would be connected through RF connections to a ground station, which would be used to operate and collect the information.

V. Conclusion & Future Work

Whereas the topologies presented in the previous part made the connectivity principle realistically practicable, a detailed investigation remains necessary. This study explores the minor errors that now plague Internet design. Subsequently, a unique idea of architecture was designed to fulfill all the important aspects that are absent in the current structure. Until the

Internet of Things can be extensively adopted and applied across all sectors, a detailed overview of commercial features and needs on price, safety, confidentiality, and danger is required. Now let us look at other issues in this respect: In the case of farms, managing price seems to be a more significant criterion. To get to this stage, researchers are focusing on designing a new, improved farming reference framework with increased security. Now let us look at several issues, therefore, with respect: In the instance of producers, managing price remains a more significant criterion. Consequently, to get to this stage, researchers are focusing on creating a modern intelligent agricultural infrastructure. Additional benefits b) the existing record structure may be incapable of handling true operations. Since the source document is too huge, imagined systems are necessary. On the Internet, things like this might be created at a high rate. The present RAID technique is inadequate for processing large amounts of data. The information gathered at the recipient's side to address this issue, Internet-of-things central information solutions is being developed. It is necessary to alter the structure. b) Information is an unprocessed reality that does not always follow the rules outlined in pamphlets. Information is particularly important in today's world. Information is an unprocessed reality that just may be able to comply with quasi-standards. Within the Internet of Things, information plays an important part in judgment. This reservoir of information is what gives knowledge its worth. Only through orienting processing will valuable material knowledge be extracted, analyzed, and understood. Big information is adequate for dealing with comparable prediction purposes. An appropriate structure may perform image extraction, statistics, and thus choice applications. Big information approaches might be pooled using machine learning techniques. d) Creating a Provider Infrastructure for the Internet is a significant undertaking, as provider devices may encounter performance and economic challenges. It was required to handle a huge variety of mobile devices linked to the network, which caused scalability concerns. Information transport, storage, and administration can get to be a strain when resource delivery is not taken care of. Customer satisfaction is a major concern. A designer must focus on QoS factors in order to obtain an optimal range of QoS. (f) The Internet of Things is expected to have a massive set of devices. The associated equipment, including associated information, must be accessible. Authentic identification is required for an effective moment in time setup. Every router in the IPv4 system is identified by a four-byte identifier. A fresh routing strategy known as IPv6 has been devised to address the drastic decline in the availability of IPv4-numbered domains, which is expected to approach null in the coming decades. To develop labeling as well as identify capabilities for devices, IPv6 is indeed a domain where extreme caution is required, along with technical expertise.

Reference

[1] Bhagat M., Kumar D., Kumar D. Role of Internet of Things (IoT) in Smart Farming: A Brief Survey; Proceedings of the IEEE 2019 Devices for Integrated Circuit (DevIC); Kalyani, India. 23–24 March 2019; pp. 141–145.

[2] Madakam S., Ramaswamy R., Tripathi S. Internet of Things (IoT): A Literature Review. J. Comput. Commun. 2015;**3**:164–173. doi: 10.4236/jcc.2015.35021.

[3] Uddin MA, Mansour A, Jeune DL, Ayaz M, Aggoune, UAV-Assisted Dynamic Clustering of Wireless Sensor Networks for Crop Health Monitoring. EM Sensors (Basel). 2018 Feb 11; 18(2).

[4] Liu N, Cao W, Zhu Y, Zhang J, Pang F, Node Deployment with k-Connectivity in Sensor Networks for Crop Information Full Coverage Monitoring. Ni J Sensors (Basel). 2016 Dec 9; 16(12).

[5] Thorat A., Kumari S., Valakunde N.D. An IoT based smart solution for leaf disease detection; Proceedings of the IEEE 2017 International Conference on Big Data, IoT and Data Science (BID); Pune, India. 20–22 December 2017; pp. 193–198.

[6] Rivas-Sánchez Y., Moreno-Pérez M., Roldán-Cañas J. Environment Control with Low-Cost Microcontrollers and Microprocessors: Application for Green Walls. Sustainability. 2019;**11**:782.

[7] Karim F., Karim F., Frihida A. Monitoring system using web of things in precision agriculture. Procedia Comput. Sci. 2017;**110**:402–409.

[8] Navulur S., Sastry A., Prasad M.G. Agricultural Management through Wireless Sensors and Internet of Things. Int. J. Electr. Comput. Eng. 2017;**7**:3492.

[9] Alonso R.S., Sittón-Candanedo I., García Ó., Prieto J., Rodríguez-González S. An intelligent Edge-IoT platform for monitoring livestock and crops in a dairy farming scenario. Ad Hoc Netw. 2020;**98**:102047.

[10] FIWARE The Open Source Platform for Our Smart Digital Future—FIWARE. [(accessed on 25 April 2020)].

[11] Jayaraman PP, Yavari A, Georgakopoulos D, Morshed A, Zaslavsky , Internet of Things Platform for Smart Farming: Experiences and Lessons Learnt. A Sensors (Basel). 2016 Nov 9; 16(11).

[12] Luis Bustamante A, Patricio MA, Molina JM, Thinger.io: An Open Source Platform for Deploying Data Fusion Applications in IoT Environments. Sensors (Basel). 2019 Mar 1; 19(5).

[13] Karim F., Karim F., Frihida A. Monitoring system using web of things in precision agriculture. Procedia Comput. Sci. 2017;**110**:402–409.

[14] Chen J., Yang A. Intelligent Agriculture and Its Key Technologies Based on Internet of Things Architecture. IEEE Access. 2019;**7**:77134–77141.

[15] Fernández-Ahumada LM, Ramírez-Faz J, Torres-Romero M, López-Luque, Proposal for the Design of Monitoring and Operating Irrigation Networks Based on IoT, Cloud Computing and Free Hardware Technologies. R Sensors (Basel). 2019 May 20; 19(10).

[16] Mekki K., Bajic E., Chaxel F., Meyer F. A comparative study of LPWAN technologies for large-scale IoT deployment. ICT Express. 2019;**5**:1–7.

[17] A.G.N. Bandara, B.M.A.N. Balasooriya, H.G.I.W. Bandara, K.S. Buddhasiri, M.A.V.J. Muthugala, A.G.B.P. Jayasekara and D.P. Chandima Smart Irrigation Controlling System for Green Roofs Based on Predicted Evapotranspiration, 978-1-5090-5395- 7/16/$31.00 c 2016 IEEE.

[18] Tanmay Baranwal , Nitika , Pushpendra Kumar Pateriya ʊ Development of IoT based Smart Security and Monitoring Devices for Agriculture31.00$/8/16-8203-4673-1-978, و_c 2016 IEEE.

[19] Ala Al-Fuqaha,Mohsen Guizani,Mehdi Mohammadi,Mohammed Aledhari,Moussa Ayyash , ʊ Internet of Things : A Survey on Enabling Technologies,Protocols and Applications,1553-877 (c) 2015 IEEE.

[20] Davide Sartori and Davide Brunelli proposed A Smart Sensor for Precision Agriculture Powered by Microbial Fuel Cells, 978- 1-4799-7250-0/16/$31.00 ©2016 IEEE.

[21] Resh.H.M , Hydroponics food production:A definitive guide book for advanced home gardener and the commercial hydroponics grower(7th.edu).CRC Press.

[22] Miguel A.Zamora-Izuierdo, jose Santa, Juan A.Martinez,VicenteMartinez,AntonioF.Skarmete, “smart farming IoT Platform based on edge and cloud computing”, Bio-system Engineering,2019.

[23] An, W.,Wu,D.,Ci,s. Luo,H.Adamchuk.V, Xu.Z ., “Agricultural cyber physical systems. In cyber system: Foundations, Principle and applications ,2017.

[24] MiquelA.Zamora, Izquierdo, joseSanta, Juan A,Martinez, Vicente Martinez, Antonio F.Scarmeta, " Smart farming IoT platform based on edge and cloud computing",2019.