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Certain Investigations on IoT Based Smart Agriculture

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Abstract
Now a days Agriculture plays an important role in Society by using Internet of things (IoT). Not only has it Increased Agricultural production and agricultural output, but it has also enhanced the quality of agricultural products, reduced labour costs, improved municipal efficiency and realize agricultural modernization and intelligence. The decline in Indian agriculture has negatively affected crop production, making it crucial to find effective solutions to enhance agricultural growth. One of the most promising approaches is modernizing field monitoring through the Internet of Things (IoT). The incorporation of IoT devices into agriculture makes the process a lot smarter and easier. IoT offers various applications that improve farming practices, including automated irrigation, real-time water and soil monitoring, Precision farming and advanced pest control techniques. With the use of remote systems and wireless communication, farmers can collect and analyze data to make informed decisions. Different IoT sensors and models have been tested, demonstrating their potential to revolutionize agriculture by providing accurate insights and automation. By combining IoT with agricultural practices, farmers can develop innovative solutions to address existing challenges, optimize resources, and boost crop growth. The implementation of smart technologies in agriculture will lead to more sustainable and productive farming methods, ensuring long-term benefits for the industry. In agricultural fields, Various IoT sensors can be utilized to track the important Factors that determine productivity Based on some model's analysis of the soil's Nitrogen, Phosphorous, Potassium (NPK) value, it Seeks to suggest the best crops for the particular field. In this paper to deliver what are all the challenges, issues are solved by using IoT Technologies in agriculture and what are all the models and sensors are used to tested and what are all the applications developed to support the agriculture by using IoT Technologies and includes a review of the exploration on intelligent factory complaint discovery and forestalment systems that use a variety of detectors, crops, and complaint algorithms.
Keywords: *Smart Agriculture, Precision Agriculture, IoT Technologies, Plant disease detection, Plant disease prevention, Crop production.*

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I.INTRODUCTION

The Smart Agriculture plays an important part in the improvement of farming land. In India, nearly 70 percentage of the population is reliant on agriculture. Agricultural problems have always hindered the improvement to the country. Whenever automation Was implemented and people were replaced by automatic, Yields improved and therefore, to increase yields, technology and modern science must be used in agricultural sector [1]. The sensors Internet of Things can be installed in dams, tunnels, electricity grids, water systems, buildings, gas and pipes etc. And also connected with internet to observe them and control all the operations remotely. The entire sensor can be connected to the central computer for the communication. The central computer can control other equipment and the operations of the machines using internet and improve the quality of production and lifestyle in detailed and dynamic manners [2].

Now a day's people increase the demand of food production to feed the population. Different IoT methods are being used in farming to provide finest solutions to get data and process it. The water calamity and change in weather demands new technologies or methods for new farming. Smart decision-making systems and self-monitoring in fields Gets more important. Sensor networks, Internet of Things, Wireless technologies, and machine learning etc. Got famous in agricultural fields Farmers require information and knowledge about the agriculture to take correct decision regarding farming and Agriculture. With the help of information management system, the enquiries and doubts of the farmers regarding farming can Be solved easily with the access the management system. The Applications of information and communication technology Are used to improve the agriculture aspects in the countries. Different techniques are used to solve the difficulties of Agriculture using mobiles, wireless network and technologies to reduce the consumption of power, energy and cost to Enhance the development of smart agriculture [2].

The Smart Plant Disease Detection and Prevention System uses IoT-enabled cameras, drones, and sensors to capture images and environmental data. These are analyzed by computer vision and machine learning algorithms to detect early signs of diseases or pests, allowing automated interventions like pesticide application or nutrient adjustment. This system offers higher accuracy, efficiency, and sustainability compared to traditional methods [7].

The integration of sensor-based systems, intelligent lighting, and IoT technologies is transforming agriculture by enabling real-time monitoring, precise disease prediction, and optimized resource use. Environmental factors like soil moisture and humidity are key to forecasting crop diseases, while LED lighting systems enhance indoor farming despite challenges like heat and sensor interference. IoT devices, such as the Libelium Agriculture Kit and MooMonitor, support efficient, data-driven farm management. These innovations collectively promote sustainable, year-round agriculture, though continued research is needed to improve reliability and standardization. This paper emphasizes the technologies used, Applications, detection models, algorithms, challenges and issues in IoT for smart Agriculture.

II.BACKGROUND SURVEY

Agriculture continues to be a critical sector for sustaining livelihoods and ensuring food security, particularly in developing nations such as India, where it employs a significant portion of the population. However, the sector faces mounting pressure due to factors such as population growth, climate change, water scarcity, and resource inefficiency. According to projections by the Food and Agriculture Organization (FAO), global food production must increase by approximately 70% by 2050 to meet the needs of the anticipated 9.6 billion people. Traditional farming techniques, which are labor-intensive and often imprecise, are increasingly inadequate to address this challenge.

In response, the concept of smart agriculture leveraging Internet of Things (IoT) technologies has emerged as a transformative approach. IoT enables the interconnection of physical agricultural components such as soil, crops, and irrigation systems through sensors and networked devices that collect, transmit, and analyze real-time data. This integration facilitates data-driven decision-making enhances resource optimization and supports automated agricultural processes including irrigation control, environmental monitoring, and precision farming.

Recent literature provides extensive insights into the potential and deployment of IoT in agriculture. Thakare and Rojatkar (2021) highlighted the benefits of cloud-based sensor networks in automating irrigation and improving yield prediction. Kaur et al. (2022) reviewed a broad spectrum of IoT applications, including soil and water monitoring, greenhouse control, and pest management, emphasizing the need for cost-effective and interoperable systems. Pyingkodi et al. (2022) presented a detailed

taxonomy of sensor types used in agriculture ranging from electrochemical and optical sensors to LIDAR and telematics underscoring the importance of selecting context-appropriate technologies for smart farming implementations.

Despite promising advancements, several challenges persist. These include high costs of sensor deployment limited internet connectivity in rural areas lack of standardization across devices and concerns regarding data privacy and system security. Moreover, the adoption of IoT-based farming practices is hindered by a lack of technical expertise among farmers and insufficient support infrastructure in many developing regions. Nevertheless, the convergence of IoT, cloud computing, and machine learning presents a compelling framework for next-generation agriculture. By enabling continuous monitoring, predictive analytics, and efficient resource allocation, these technologies can significantly enhance productivity and sustainability. As such, ongoing research and innovation are essential to bridge the gap between conceptual potential and practical deployment, especially in resource-constrained environments.

The global agricultural sector is undergoing a technological revolution in response to mounting challenges such as climate change, population growth, land degradation, and water scarcity. With the global population projected to surpass 9.7 billion by 2050, the demand for food production is expected to increase significantly, placing immense pressure on traditional agricultural systems to produce more with fewer natural resources (FAO, 2021). In this context, smart farming the application of advanced technologies to agriculture has emerged as a critical paradigm for sustainable food production.

At the core of smart farming lies the Internet of Things (IoT)**,** which facilitates the real-time monitoring and automation of farming activities through interconnected devices and sensors. IoT enables precise control of variables such as soil moisture, temperature, humidity, and crop health, leading to enhanced productivity, resource efficiency, and environmental sustainability. Recent studies such as [6]and [14] demonstrate how IoT systems can be utilized to collect and analyse environmental and crop-specific data, thereby optimizing decision-making processes in farming operations.

Moreover, the techniques employing deep convolutional neural networks (DCNN) and long short-term memory (LSTM) models have shown high accuracy in identifying and classifying crop diseases in real time, especially in edge devices deployed in-field [10]. These technologies are crucial in reducing pesticide misuse and crop loss by enabling timely and targeted intervention. Beyond crop health, IoT has also been leveraged in horticulture lightening system where smart lighting platforms adjust spectral output and intensity based on plant growth stages. This approach has demonstrated potential in maximizing growth rates and minimizing energy consumption in indoor farming environments [9].

In addition, studies have addressed the role of environmental and soil parameters disease propagation, such as the germination of leaf spot disease, underscoring the importance of monitoring microclimatic conditions to predict and prevent outbreaks [8].

Despite the proven benefits, a few reviews have identified persistent barriers to the widespread adoption of IoT in agriculture. These include the high cost of implementation, lack of infrastructure in rural regions, data privacy concerns, and the need for farmer training. Moreover, there is limited standardization in system architecture and data protocols, which hampers interoperability among different platforms [14]. Overall, the literature indicates a strong consensus on the transformative potential of IoT in agriculture. However, it also reveals critical research gaps and technical challenges that must be addressed to achieve scalable and equitable smart farming solutions.

III.SYSTEM ARCHITECTURE

The main goal of this paper is to explore and summarize the current advancements in smart agriculture. To guide the review and ensure a structured approach to analysis, key research objectives (ROs) have been defined, focusing on critical aspects of smart agriculture.

- To address important elements of smart agriculture.
- To access the effectiveness and utilization of sensors used in Agriculture.
- To Evaluate the Major components, Protocols and technologies used in IoT based smart agriculture systems.
- To identify plant diseases prevention and detection techniques in IoT based smart farming.
- To analyse the applications, models widely used in smart agricultural fields and investigate security and privacy considerations in IoT based smart agriculture.

3.1 Sensor Integration for Smart Agriculture

Smart sensors in agriculture provide data to help farmers monitor and optimize their yields and keep up with changing environmental and ecosystem factors. Smart farming sensors help identify animals, detect fever, monitor health, and help sick cows isolate and treat herds while they are finding and tracking them. Smart sensors in agriculture enable farmers to understand their crops and productivity, conserve resources and protect or manage their crops from the environmental impact of disasters [1].

3.2 Role of Sensors in Smart Agriculture

Sensors used in agriculture for smart agriculture are well-known agricultural sensors. They provide data to help farmers monitor and optimize their crops, considering environmental conditions and challenges. These agricultural sensors are installed and fixed in drones, meteorological stations, and robots used in agriculture. Sensors in agriculture were invented to meet the growing demand for food with minimal resources such as water, fertilizers and seeds. They are easy to use, easy to use, and easy to maintain. Sensors are cheap and of the highest quality. These sensors are enabled to a wireless chip that can be controlled remotely [1].

3.2.1 Ultrasonic Sensor

Sensor in the area is an excellent option because of their affordable rate, capacity to work in a variety of situations, and customization, as well as ease of usage, Sample rate, tank monitoring, and spray distances just are some few possibilities [1].

3.2.2 Humidity Sensor

This sensor is utilized to sense and measure the humidity level in air. It also measures the actual air temperature and moisture in air [13].

3.2.3 Airflow Sensor

The reflection spectrum allows the photoelectric sensor to distinguish between plants and soil [1].

3.2.4 Weed seeker Sensor

Weed detectors are standalone devices, are typically equipped with optics and electronics, to detect and spread weeds [1].

3.2.5 Wind Speed Sensor

A wind speed sensor is a physical device used to measure wind speed [1].

3.2.6 Leaf Wetness Sensor

Leaf wetness sensors are used to detect the presence of surface moisture or soil moisture. It's primarily used for environmental applications [1].

3.2.7 Temperature Sensor

The Temperature sensor is a tool used to measure temperature. This can be the temperature of air, the temperature of a liquid, or the temperature of a solid [1].

3.2.8 Soil Moisture Sensor

These sensor measurements allow farmers to take action when field conditions, such as low water levels at, trigger a stress response [13].

3.2.9 PH Sensor

PH sensor is used to monitor accurate amount of nutrients in the soil which is necessary for irrigation [13].

3.2.10 Gas Sensor

By observing the number of infrared radiations consumed gas sensor measures the quantity of toxic gases in the greenhouses and livestock. It consists of two factors low range and high range [13].

3.2.11 Barometric Pressure Sensor

Pressure sensor measures the atmospheric pressure when it is low then rainfall can be expected but it is expected that when pressure is high then there will be less chances of rainfall [13].

3.2.12 Crop health sensors

A variety of sensors or imaging technologies are used to measure the health of crops by examining chlorophyll stages, leaf color, or other environmental stress or disease signs.

3.3 System Architecture of IoT Based Smart Farming

IoT-based smart farming is built on four key components: physical structure, data acquisition, data processing, and data analytics.

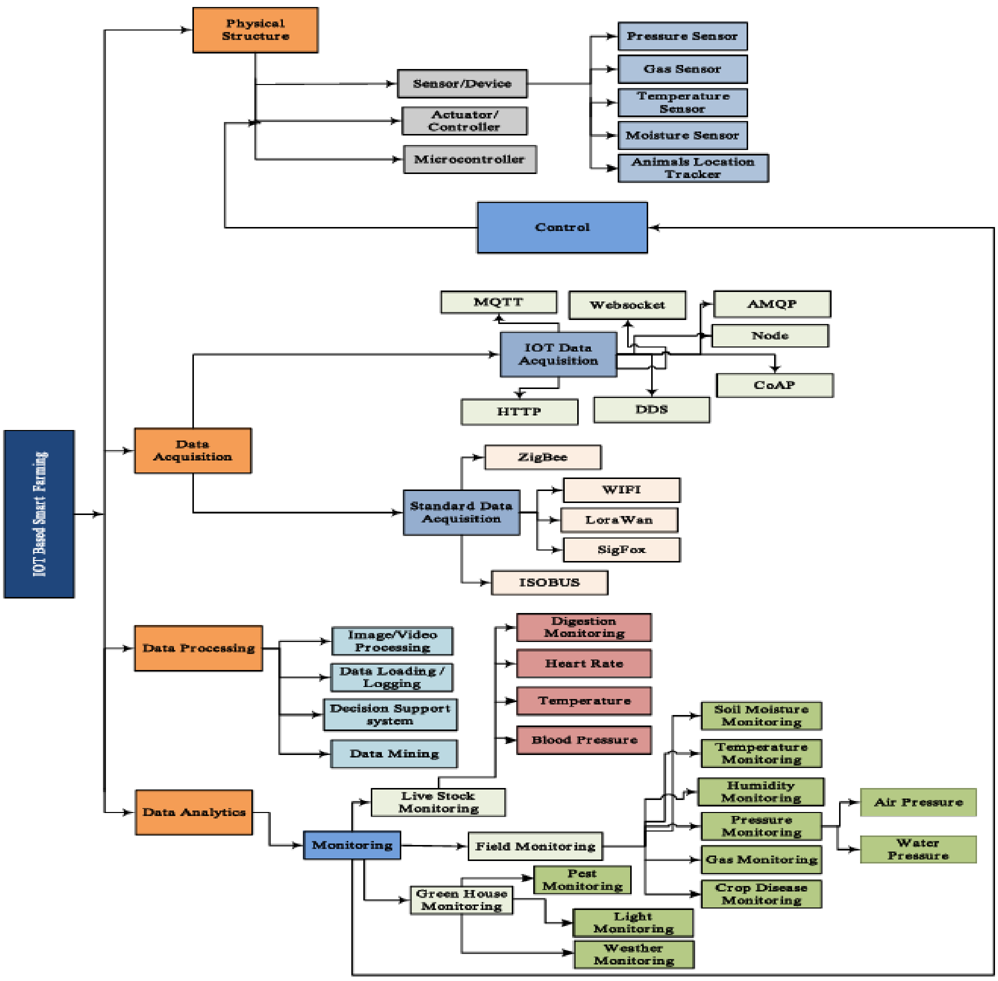

Figure: 1 Architecture of IoT based Smart Farming

The physical structure includes sensors, actuators, and control devices managed by microcontrollers, enabling remote operation via the Internet. Data acquisition is split into IoT-based (using protocols like MQTT and HTTP) and standard methods (using ZigBee, Wi-Fi, LoRa WAN, etc.) to ensure effective wireless communication. Data processing involves image/video analysis, data mining, and decision support, tailored to farm needs. Data analytics supports monitoring of livestock, fields, and greenhouses, using sensors to track health, soil quality, climate, and disease. All collected data is stored in the cloud for remote access and informed decision-making via smart devices.

IV.IoT AGRICULTURAL TECHNOLOGIES

A wide array of technologies is being integrated into IoT-based agricultural solutions, making it difficult to detail every single one. However, several core technologies have emerged as essential in modernizing IoT agricultural services.

4.1 Cloud and edge computing

Cloud and edge computing significantly enhance agricultural efficiency by supporting smart farming technologies. Cloud computing allows farmers to access shared resources and services remotely, enabling accurate data processing and task execution. Edge computing, or fog computing, complements this by processing data locally at the source such as sensors and devices facilitating real-time decision-making. Together, these technologies improve responsiveness and accuracy in agricultural operations.

4.2 Big data analytics and machine learning

Big data analytics and machine learning are revolutionizing agriculture by enabling more efficient crop monitoring and management. Large volumes of sensor data are analyzed to gain insights across crop growth stages. Neural networks offer fast, optimal solutions for tasks like intrusion detection and system training, while deep learning models are applied in IoT-based hydroponic systems to automate and enhance crop growth conditions.

4.3 Communication networks and protocols

Communication networks and protocols are the backbone of any IoT agricultural system. Agricultural IoT networks typically rely on a mix of long-range and short-range communication technologies to connect various sensors and devices across the field. These protocols are essential for the seamless transmission of agricultural data and ensure that devices can reliably exchange information across the network. IoT-based smart agriculture relies on a range of communication protocols across multiple layers to ensure efficient and secure data transmission. At the perception layer, technologies like IEEE 802.15.4, Bluetooth, RFID, Infrared, and UWB enable low-power data collection and precise tracking. The network layer uses protocols such as WiFi, LoRaWAN, Zigbee, 6LoWPAN, and cellular technologies (NB-IoT, LTE-M, etc.) for reliable long-range connectivity in field environments. At the application layer, protocols like CoAP, MQTT, XMPP, AMQP, and HTTP facilitate data exchange between devices and platforms. Finally, the data processing layer integrates and analyzes data from various sources using machine learning and statistical tools to support real-time, data-driven decisions in agriculture, such as yield prediction and irrigation optimization.

4.4 Robotics

Robotics has greatly advanced smart farming by introducing Agri-bots that reduce manual labor and enhance precision in tasks like weeding, spraying, and sowing. Integrated with IoT systems, these robots improve crop productivity and resource efficiency. More advanced multi-sensor robotic systems are also being developed for complex functions such as field characterization and ground mapping.

V.IoT BASED SMART AGRICULTURE APPLICATIONS

IoT agriculture system applied as an array of wide variety of elds such as, Precision farming, livestock monitoring, and greenhouse monitoring. Agriculture applications have been categorized into three sections: IoT agricultural applications, Smartphone based applications and sensor-based applications. IoT and sensor-based applications categorization has been illustrated in which is framed by reviewing the todays available IoT solutions in agriculture.

5.1 IoT Application Domains in Agriculture

IoT agriculture applications are revolutionizing farming by improving resource efficiency and productivity across key domains such as precision farming, livestock monitoring, greenhouse management**,** and agricultural drones. Smart Irrigation**:** IoT-based systems use sensors and weather data to optimize irrigation, reducing water usage and increasing yields. AI-powered tools now predict soil moisture and automate irrigation adjustments, with mobile apps enabling remote management. Soil Management: IoT sensors monitor soil moisture, pH, and nutrient levels in real time, providing insights that help maintain soil health and inform fertilization and planting decisions. Weather Management: IoT weather stations deliver real-time data on temperature, humidity, wind, and rainfall. This information, combined with predictive analytics, helps farmers anticipate weather trends and mitigate risks like pest outbreaks and crop loss. Nutrient Management: Continuous monitoring of soil and plant nutrients allows for precise fertilizer application. Technologies like drones and autonomous vehicles deliver fertilizers more efficiently, reducing waste and environmental harm. Waste Management**:** IoT solutions help track and manage agricultural waste, from monitoring post-harvest conditions to implementing smart sorting and recycling systems. These tools support sustainability and reduce environmental impact.

5.1.1 Precision farming

Precision farming, powered by IoT, enhances agricultural productivity by enabling smart, data-driven decision-making and automation across all stages of crop management. IoT sensors monitor soil quality, weather, moisture, and crop conditions to optimize harvesting, irrigation, and pest control. Advanced platforms and architectures integrate data analysis, ecological monitoring, and cyber systems to improve efficiency.
Key applications are,

- Climate and Soil Monitoring: Real-time data from weather stations and soil sensors guide decisions on planting, fertilization, and irrigation.
- Pest and Disease Detection: IoT systems and image processing enable early identification and response, reducing crop damage and revenue loss.
- Smart Irrigation: Combines weather and soil data to optimize water use, monitor quality, and automate irrigation systems.
- Planting and Harvesting Optimization: Cloud computing and sensors determine the best timing, enhancing yield and reducing risk.
- Tracking and Tracing: RFID and GPS provide real-time data for effective field and asset management.
- Farm Management Systems (FMS): Centralize data from across the farm to support informed, remote decision-making.
- Agricultural Drones (UAVs): Assist in crop health analysis, aerial spraying, soil assessment, and GIS-based mapping.

5.1.2 Greenhouse Monitoring

Greenhouse cultivation relies on precise environmental control, and IoT combined with Wireless Sensor Networks (WSNs) plays a vital role in automating and optimizing these operations. By continuously monitoring factors such as temperature, humidity, and light, IoT systems reduce labor, conserve energy, and enable real-time remote decision-making. Sensor data is transmitted to a central server for analysis, allowing growers to maintain ideal conditions for plant growth. Key IoT applications in greenhouses include water management, plant health monitoring, and climate control. Smart irrigation systems use soil moisture sensors and automated drip mechanisms to deliver water efficiently, minimizing waste. Plant monitoring is enhanced through sensors and cameras that detect abnormalities and alert growers, while cloud storage enables long-term data analysis. Climate control systems integrate management of temperature, CO_2, ventilation, and oxygen levels, ensuring a stable environment that boosts productivity and resource efficiency.

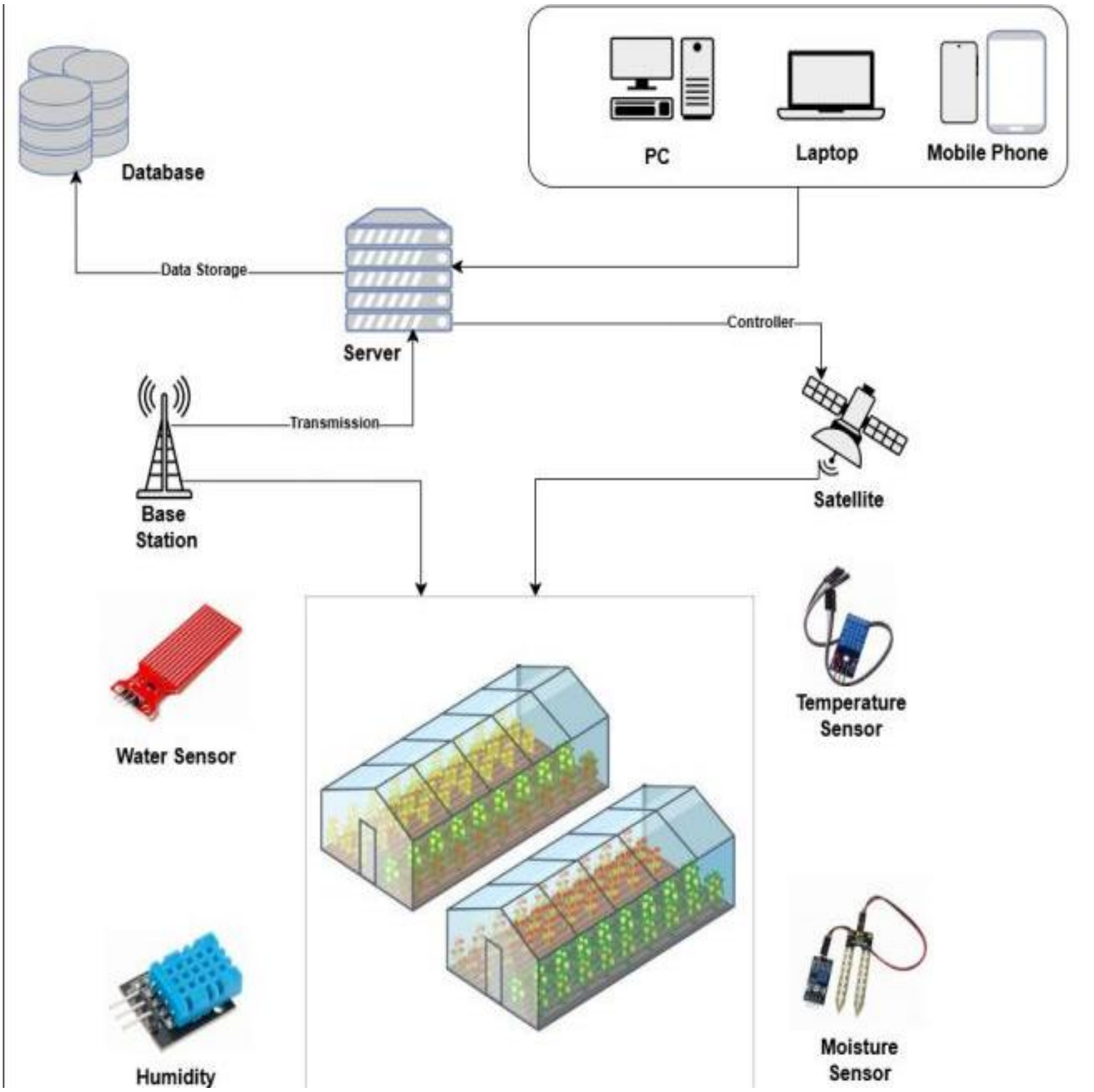

Figure: 2 Greenhouse Monitoring

5.1.3 Livestock monitoring

IoT-based livestock monitoring enhances animal health, productivity, and farm management by providing real-time data through sensors and smart devices. These systems track key metrics such as milk quality, humidity, pest presence, water conditions, and animal behavior. RFID tags and GPS enable individual tracking and location monitoring to prevent theft and ensure safety. Wearable devices monitor health indicators like temperature, heart rate, and rumination, helping detect diseases, manage heat stress, and analyze stress or behavioral changes. Data is stored in the cloud and accessible remotely, enabling informed decisions. Companies like Cowlar and SCR have adopted these technologies to improve herd management, especially on large-scale farms, where wireless sensors also detect harmful gases and enhance operational efficiency.

Figure: 3 Livestock Management

VI.SMART PLANT DISEASE DETECTION AND PREVENTION SYSTEM

Smart Plant Disease Detection and Prevention Systems have been widely researched for their effectiveness in identifying plant diseases with high accuracy. These systems offer key benefits such as early detection, reduced pesticide use, increased crop yields, and scalability for large-scale monitoring using IoT devices like sensors, cameras, and drones. Machine learning techniques—such as Support Vector Machines (SVM), random forests, and k-nearest neighbors—are commonly used for classifying plant diseases based on leaf images. Studies report accuracies as high as 99.16% using ensemble learning and 98.95% with infrared thermal imaging. Transfer learning combined with deep learning models like Convolutional Neural Networks (CNNs) has significantly enhanced classification accuracy while reducing training time. Feature extraction techniques such as Grey Level Co-occurrence Matrix (GLCM) and Local Binary Patterns (LBP) have also contributed to improved performance. Mobile applications using deep learning enable real-time, field-level disease diagnosis, and systems using hyperspectral imaging further advance non-invasive disease detection. One study focused on a Multilayer Perceptron (MLP) model using sensor-derived data from Gujarat, India, achieved 85.51% accuracy and demonstrated strong performance through metrics like precision (87.54%), recall (84.21%), and F1-score (85.84%). Overall, these technologies play a vital role in early disease intervention, sustainable farming, and enhancing food security.

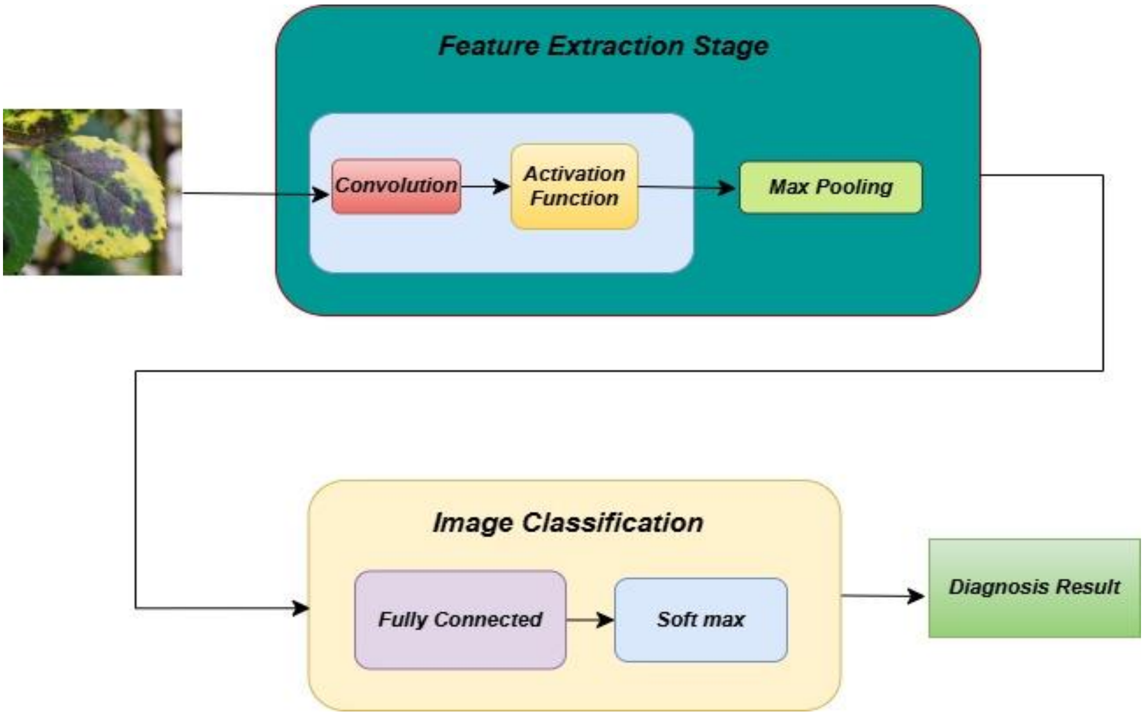

Figure: 4 Model Implementation

DEVICES/TECHNIQUES	ALGORITHMS	ACCURACY
Smartphone, camera, computer vision	CNN	99%
Hyperspectral imaging, machine learning	Random forests, SVM	94%
IoT sensors, machine learning	KNN, SVM, NB, MLP	92.5%
UAV imagery, machine learning	CNN, SVM, K-means	97%
Smartphone camera, machine learning	SVM, KNN, RF, MLP	95.7%
RGB camera, deep learning	CNN, transfer learning	91.7%
IoT sensors, machine learning	SVM, ANN, RF	94%
Smartphone camera, decision tree	Decision tree	94.5%

Table 1: Existing plant disease detection and prevention systems [7].

VII.MAJOR SECURITY CHALLENGES AND PRIVACY CONCERNS IN SMART AGRICULTURE

Farmers face several major challenges in adopting IoT technologies for agriculture. A primary issue is the lack of communication infrastructure, especially in remote rural areas with poor internet connectivity, which undermines the effectiveness of real-time data collection and monitoring systems [1].

In developing countries like India and its neighbours, adoption is further limited by the unavailability and high costs of sensors, particularly those suitable for difficult terrains like hills. Sensors can also be inaccurate**,** especially when Western-designed devices are used in different environmental conditions. Moreover, natural disasters, animal interference, and fragile designs make sensors prone to damage, and repairs often require specialized technicians who may not be locally available. Finally, the need for large datasets and additional equipment for optimal sensor performance adds to the complexity and cost, reducing economic feasibility for many farmers [1].

7.1 Stack Challenges

Middleware layer also plays a vital role in IoT to increase security. Middleware stands in between application layer and network layer which is responsible to process data and pro vide interface for communication between these layers. [11].

7.2 Threat Model

Both IoT agricultural devices and networks are at risk because of increasing attack surface. IoT agricultural threat model consist of three scenarios. First one is cloud networks, second is native networks expansion and third is cloud services. Threat may be generated from internal or external network. If an attack is arisen from an agriculture device then it will be considered as one of the more severe attacks [11].

7.3 Attack Taxonomy

There are many types of attacks in IoT paradigm due to which an attacker may attack by adopting a method on future or existing IoT agriculture devices and networks. In IoT agricultural threat may be tangible, predictable or un predictable. In this paper existing and possible threats are classified on the basis of three key factors which are Information Disruption, Host, and networks. Attacks on the basis of networks properties Two types of attacks can be arisen on basis of networks properties. Namely standard protocol compromise (to threat service availability like integrity and authenticity where attacker deviates from standard protocols) and network protocol stack (consist of different types of vulnerabilities) [11].

7.4 Multi Layered Security Threats

The IoT-based agriculture system faces a wide array of multi-layered security threats due to its reliance on interconnected devices and internet-based communication. At the perception layer, threats include signal jamming, node capturing, spooling, routing attacks, and data transit interference, all of which can disrupt monitoring, automation, and precision farming. The Figure3 illustrates the key challenges encountered in the development, deployment, and operation of Internet of Things (IoT) systems. In this paper, these challenges are examined comprehensively to emphasize the limitations and constraints currently affecting the growth and efficiency of IoT technologies.

VIII.CONCLUSION AND FUTURE DIRECTION

IoT sensor-based agriculture is now widely recognized as the new age of farming. It will shortly exchange traditional farming practices also enhance agricultural output [1]. A complete approach was presented, from a set of images used for training and testing to pre-screening and image development and then to CNN's in-depth and efficient training approach. By using these imaging techniques, we can accurately determine and classify various plant diseases [7]. This review article provides an extensive and enhanced analysis of IoT-based agriculture systems, spanning technical advancements, sector developments, device sustainability, applications, communication standards, gaps in research, significant privacy and security concerns, and solutions that are distinctive to IoT in agriculture, It presents an in-depth explanation of IoT technologies and how they might be used in different sectors of agriculture. Additionally, it emphasizes significant application fields and research opportunities, offering valuable data to researchers and industry experts. Finally, from the analysis of all the techniques CNN Performs better than others. The importance of IoT security, including technological developments like blockchain for risk mitigation [14]. In order to improve the effectiveness and accuracy of automation, modelling, and forecasting systems in agriculture, the debate predicts the rise of hybrid technologies that combine big data analytics, data mining and the Internet of Things [14]. Further increases the level of accuracy in plant diseases to overcome the above-mentioned algorithms.

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