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Critical Data Analysis of Various IoT-Based Technologies for Automated Smart Farming

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ABSTRACT
The IoT-based smart farming uses various technologies in agriculture as well as challenges, outcomes, pests and diseases of Crops Cultivations. In this research paper, we studied the various research papers on IoT-based smart farming and its technologies used for automation to smart farming. We especially criticize the Data Analysis of Various IoT-based technologies for Automation Smart Farming to develop farming techniques for increasing the human population and other parameters are developed for any country to boost its economy. We will save money for our country to pay another country to require fulfill food, and also to boost the country's economy by exporting to others countries for food. This research paper aims to improve farming techniques of farmers to use sustainable water and energy. Life without farming is impossible to imagine; it survives for humans easily with food. But problems with the cultivation of crops identify pests and diseases. Here we gather the various articles data to related diagnosis Pests and Diseases of crops as well as automation to farming.

Keywords: IoT, Smart Farming, Agriculture, LoRo, Big Data, Cloud, Deep Learning, Machine Learning, Artificial Intelligence, WSN.

I. INTRODUCTION

Farming is a very important thing for humans to eat food. This farming offers food for humans and it's the backbone of any country to fulfil and boost the economy. Today there are a lot of demands for food because of the increasing human population in every country in this world. So every country needs to develop its farming techniques. The IoT is an abstract idea for changing the future. This IoT interconnects all devices, tools, and gadgets over the Internet to enable these devices to communicate with other devices. IoT finds application in various areas, such as Healthcare, Agriculture, Smart Home, Education, Retails, and Industries. These things are changing the future of humans. The IoT-bases smart farming on achieving the desired outcome for human life.
The Internet of Things (IoT) gives an automatic system that can operate without any human intervention. These systems are really necessary for farm fields and help the farmers to maintain more farm fields. The automatic system notifies the farmers to take the proper decision to deal with various problems the farmers face during farming[1]. A LoRa-based IoT system that aims for a low cost, low power, and wide range wireless

sensor network targeted at smart farms. The presented system integrates already existing Programmable Logic Controllers (PLC) typically used to control multiple processes and devices, such as water pumps, certain machinery, etc., along with a newly developed network of wireless LoRa sensors distributed over the farm. A Telegram bot is also included as a novelty for automated user communication via this mobile phone messaging application[2]. IoT-based agricultural monitoring is reducing human intervention in farming. The system also has an excellent set of decision-makers with reduced manual contributions. Furthermore, the outcomes help us to understand more about the significance of each variable in obtaining healthy plants. This achievement leads to smart water management in farming[3].

II. LITERATURE REVIEW

This Literature Review of IoT-based smart farming uses various technologies for different proposed. This is a literature review of automated farming and agriculture using IoT-based technologies, challenges, outcomes, pests, and diseases of Crops Cultivations. The Critical Data Analysis of Various IoT-based technologies for Automation Smart Farming to develop farming techniques for increasing the human population and other things are developed for any country to boost its economy. We have various paper surveys on smart farming and agriculture about farmers' techniques for sustainable water and energy, challenges, outcomes, pests, and diseases of Crops Cultivations.

The review of this research paper tries to fathom the use of modern technologies in smart farming. Different types of sensors are used to collect the data in a farm field and also cyber security that occurs in the agriculture sector[1]. This paper describes the development of a complete IoT system for a smart farm with three main aims: 1) Provide better storage conditions of the food products inside a warehouse by monitoring the humidity and temperature and set suitable values. 2) Remote monitoring and control of the different devices of the system via the web application. 3) Automate some tasks such as irrigation, or adjusting the temperature inside the warehouse[2]. Smart Agricultural is reducing human intervention in farming using IoT-based Technologies. This process is aimed at educating the farmer on the use of an integrated technology system to monitor and control operations in farming. The system has also reduced manual contributions and its outcomes are helping us to understand healthy plants. This achievement leads to smart water management in agriculture[3]. IoT modernization helps to get information on a situation such as the weather, climate, temperature, and soil fertility. There are many technological transformations in the last decades that have become technology-driven. Smart farming is a new technology in agriculture that makes agriculture more effective and more efficient[4].

III. CRITICAL ANALYSIS OF METHODOLOGY

A detailed review of related papers is conducted and analyzed from various key points of view. The methodology used, outcomes, and limitations are thoroughly studied and summarized in Table-1.

Table-1: Critical Data Analysis of Various IoT-based technologies for Automation Smart Farming

Sr. No.	Title of the paper	Authors	Journal /Year	Methodology/ Objective	Outcomes/ Advantages	Limitations/ Disadvantages
1	IoT Enabled Smart Farming: A Review	A. Y and A. S. Poornima	(ICICCS) 2022	1) Smart Irrigation using IoT. 2) Cyber Attack	1) Data Security 2)Reviews different research papers on IOT Base Farming	1) Only Irrigation and data Security 2) Doesn't Diseases Identification Of crops
2	Deployment of a LoRa-based Network and Web Monitoring Application for a Smart Farm	M. Saban, O. Aghzout and A. Rosado-Muñoz	IEEE, 2022.	1) LoRa-based IoT system 2) cloud-based monitoring application	1) a low cost, low power and wide range wireless sensor network.	1) warehouse control 2) Only Irrigation and No data Security.
3	Real Time Automation of Agriculture Environment for Indian Agricultural System using IoT	E. D, K. SB, G. N and D. S. Kumar	(ICSES) 2022	1) IoT-based real-time dynamic and manual irrigation 2) Sensor-based IoT technology.	1) Reduce water use by using a more efficient method. 2) Watering may be automated and monitored at the same time.	1) Only watering base on moisture level of soil. 2) It is a major challenge for uneducated farmers.
4	IoT Based Smart Agriculture	M. Jeyaselvi, M. Sathya and B. Prasad	(ICASI) 2022	1) IoT based applications in agriculture 2) Deep Learning and Machine Learning based farming.	1) IOT based agriculture are making farmer to smarter in farming. 2) Identify to Healthy and diseased of crops using images of plant leaf.	1) It's challenging for uneducated farmers. 2) Identify to Healthy and diseased of crops but not a solution.
5	Internet-of-Things (IoT)-Based Smart	M. Ayaz, M. Ammad-Uddin, Z.	IEEE Access, 2019	1) IoT based farm area network (FAN).	1)Sustainable IoT-based sensors and	1) New agricultural practices can be

	Agriculture: Toward Making the Fields Talk	Sharif, A. Mansour and E. -H. M. Aggoune		2)Hydroponics and vertical farming (vf) 3) Machine learning and analytics.	communicatio n technologies 2) Predict which genes are best suited for crop production. 3) Crop disease and pest management	very crucial to overcome the geographic and resource limitation challenge. 2) Respective locations and climate conditions crops cultivation.
6	Effective Utilization of IoT for Low-cost Crop Monitoring and Automation	P. Suriyachai and J. Pansit	2018 21st Internation al Symposiu m on (WPMC)	1) IoT-based crop monitoring and automation system. 2) IoT cloud-based platform	1) The system consists of low-cost sensor nodes. 2) web application for both real-time and historical data displays	2) The system uses an open weather API to obtain a weather forecast. 2) IoT- requires a constant internet connection. 3) IoT-related devices enable farmers to learn.
7	Agricultural Production System Based on IoT	M. Lee, J. Hwang and H. Yoe	2013 IEEE	1) IoT-based agricultural production system 2) IoT-based monitoring system to analyze crop environment	1) Developed the decision support system to forecast agricultural production using IoT sensors. 2) farmers observe whole cycle from seeding to selling using this IoT-based decision support system	1) Demand of agricultural products has not been controlled properly. 4) Uneducated farmers challenges' to observe whole cycle from seeding to selling.

8	Intelligent Farming System With Weather Forecast Support and Crop Prediction	U. Shandilya and V. Khanduja	2020 5th (ICCCS)	1) state-of-the-art technology to provide the water to the agricultural field based on the soil moisture value, which is detected using IoT sensor. 2) The system is activated using the mobile application; this can be accomplished with the help of ON/OFF buttons.	1) The proposed system suggests the farmers about crops that are suitable for a particular region. 2) This automated irrigation system, weather prediction and notification regarding new government policies.	1) Crops harvesting based on the past year's data 2) Doesn't Identify to Healthy and diseased of crops.
9	A Novel Approach towards using Internet-of-Things in Smart Agriculture Monitoring System	S. C. Shah, A. Chakraborty , Y. S. Kumar, T. Samant and S. Swayamsiddha	2021 IEEE 15th International Conference on (AICT)	1) The entire architecture is based upon Wireless Sensor Network (WSN). 2) linear regression model 3) binary logistic regression model	1) Remotely monitor natural conditions like soil moisture, humidity temperature, pressure, unwanted presence, detect the presence of light, rain.	1) It is a major challenge for future Large-scale implementations of smart farming. 2) Security major challenge WSN. 3) Plant disease detection and solution.
10	Wireless Communication Technologies for Internet of Things and Precision Agriculture: A Review	D. K. Singh and R. Sobti	2021 6th (ISPCC)	1) IoT wireless communication technologies deployed in agriculture are ZigBee, Bluetooth, WiFi, RFID, GSM, 4G, SigFox, and LoRa. ZigBee	1) Suitable for short-distance communication and offers good power efficiency. 2) Wireless communication technologies	1) If scalability is not suitable for long-distance communication range. 2) Wireless communication technologies different devices

					differ in their data communicatio n range and power efficiency. 3) The collected information helps the farmers to plan agricultural activities efficiently.	in their different range and power capacity. 3) farmers to plan agricultural based on the past year's data
11	IOT Based Monitoring System in Smart Agriculture	S. R. Prathibha, A. Hongal and M. P. Jyothi	2017 (ICRAECT)	1) IOT Based Monitoring System	1) Wireless monitoring of field reduces the human power. 2) User to see accurate changes in crop yield.	1) In future this system can be improved by adding several modern techniques like irrigation method, solar power source usage.
12	Agricultural Water-Saving Precision Irrigation Control Strategy based on Internet of Things and Rainy Season Prediction	L. Qi	2022 6th (ICOEI), Tirunelveli , India.	1) The system completes Intelligent irrigation. 2)Agricultural Water-Saving Irrigation	1) utilization rate of agricultural Irrigation water and the water-saving efficiency reach 96.3%.	1) water-saving efficiency reaches 96.3%.
13	IoT, big data science & analytics, cloud computing and mobile app based hybrid system	S. Roy et al	2017 8th (IEMECO N), Bangkok, Thailand.	1) IoT, Big Data Analytics, Cloud Computing and Mobile Applications based Hybrid	1) Efficiency of agriculture 2) harvesting rainwater and groundwater,	1) High cost maintenance to hybrid system. 2) It's implementation are difficult for

	for smart agriculture			Solution for Smart Agriculture. 2) AgroTick.	and predicting effective utilization.	Farmers.
14	Agro-tech: A digital model for monitoring soil and crops using internet of things (IOT)	O. Pandithurai, S. Aishwarya, B. Aparna and K. Kavitha	2017 Third (ICONSTEM), Chennai, India.	1) AGRO-TECH is IOT application. 2) AGRO-TECH to update the activities of several sensors. 3) A. Farmer registration B. Installation of sensors C. Water level sensor in well and irrigation sprinkler D. AGRO-TECH Software E. Cloud storage	1) User friendly to be interactive with the farmers. 2) Updated to farmers through proposed system methodology. 3) Sprinkle the water in the field sufficiently. 4) Fast and effectively using cloud sensor. 5) Power management using solar radiation sensors. 6) Irrigation sprinkler to be effectively used water scarcity.	1) It's implementation are difficult for Farmers. And Long process. 2) It is a major challenge for future Security. 3) In future work, track a wide area to monitor critical aspects like abnormal weather conditions, pests and fungal infestations.
15	A LoRa based Wireless Smart Irrigation System	M. R, A. T, V. T and V. S	2022 6th (ICECA) Technology, Coimbatore, India.	1) LoRa-based Wireless system 2) automated irrigation systems on the basis of Internet of Things	1) a low cost, low power and wide range wireless sensor network. 2) Automated irrigation systems.	1) Only Irrigation system and No data Security. 2) Doesn't monitor, pests and fungal infestations. 3) Only based on

						the moisture data to pump is turned ON or OFF.
16	IoT based Smart Agriculture using Machine Learning	K. S. Pratyush Reddy, Y. M. Roopa, K. Rajeev L.N. and N. S. Nandan	2020 Second (ICIRCA), Coimbatore, India.	1) Supervised machine learning algorithms- decision tree Raspberry pi. 2) smart irrigation system which predicts the water requirement for a crop, using machine learning algorithm. 3) decision tree algorithm	1) Farmer can decide himself to water the crop only when required, avoiding the wastage of water use. 2) Crop yield making it more profitable and reduce irrigation wastages. 3) Decision tree algorithm is used to solve several regression and classification problems.	1)Limited to only water irrigation
17	Ensemble Classification and IoT-Based Pattern Recognition for Crop Disease Monitoring System.	G. Nagasubramanian, R. K. Sakthivel, R. Patan, M. Sankayya, M. Daneshmand and A. H. Gandomi	IEEE Internet of Things Journal, Aug.15, 2021.	1) Analytical statistics on plant growth and disease patterns, the proposed framework uses machine learning (ML) techniques, such as support vector machine (SVM) and convolution neural network (CNN).	1) System that observes the crops' growth and leaf diseases. 2) Efficient crop condition notifications to terminal IoT components which are assisting in irrigation, nutrition	1) Limited to Pattern Recognition of Crop growth and Disease. 2) Doesn't Irrigation and data Security. 3) In the future, this work is to be extended using a huge data set of multiple plants and its parts

				2) Ensemble classification and pattern recognition of crop.	planning, and environmental compliance related to the farming lands. 3) (ECPRC) to identify plant diseases at the early stages	using the deep learning approaches.
18	Affordable Smart Farming Using IoT and Machine Learning	R. Varghese and S. Sharma	2018 Second (ICICCS), Madurai, India.	1) Machine learning based real-time analytics is performed to predict the future condition of the crops base on its past data.	1) Affordable system which deployed will give an insight into the real time condition of the crop. 2) State-of-the-art methods in order to improve the accuracy. 3) Minimal human intervention	1) Reliability 2) cyber-attacks on field from anywhere in the world.
19	An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges	O. Elijah, T. A. Rahman, I. Orikumhi, C. Y. Leow and M. N. Hindia	IEEE Internet of Things Journal, Oct. 2018	1) Cloud platform, sensors and camera, communication technology	1) Increase productivity of crop yield	1) Range of communication distance, data rate, battery life, mobility, latency, security
20	Sensor Based Smart Agriculture with IoT Technologies: A Review	M. Pyingkodi et al.,	(ICCCI), Coimbatore, India, 2022.	1) Precision agriculture 2) Acoustic Sensor Field-Programmable Gate Array (FPGA)-Based Sensor 2) Optical Sensors	1) IoT sensor-based agriculture is now widely recognized as the new age of farming 2) It is already in use in large	1)IoT-Smart farming requires a constant internet connection. 2) IoT-related devices enable farmers to learn and realize how

				3) Ultrasonic Ranging Sensor 4) Humidity Sensors 5) Airflow Sensor 6) Temperature Sensor 7) Moisture Sensors 8) Soil Water Content Sensor 9) PH Sensor 10) Optoelectronic Sensor	farms and industrialized nations 3) It may quickly Solve world hunger. 4) Green revolution and pave the way for progress in a nation like India	to implement technology 3) It is a major challenge for future Large-scale implementations of smart farming. 4) Security measures, Different types of network attacks. 5) IoT framework is extremely complex
21	IoT Based Smart Agriculture Automation in Artificial Intelligence	K. Parasuraman, U. Anandan and A. Anbarasan	2021 Third (ICICV) on Technologies and Virtual Mobile Networks Tirunelveli, India.	1)Data Collection Module(Soil Parameters:Soil Type, Soil Ph value), (Climatic Parameters:Humidity, Temperature, Wind, Rainfall) 2) Recurrent Neural Network (RNN) 3) Multi-Layer Perception (MLP).	1)Productive harvest proposal Framework utilizing classifier models. 2) The crop detection algorithm Accuracy of 99.96%.	1) The crop detection algorithm Accuracy of 99.96%. Not a 100%.
22	Predictive Analytics for Complex IoT Data Streams	A. Akbar, A. Khan, F. Carrez and K. Moessner	IEEE Internet of Things Journal, Oct. 2017.	1)Adaptive Moving Window Regression 2) Complex event processing (CEP), data streams, Internet of Things (IoT), machine learning (ML),	1) AMWR as described below. I) Selection of regression algorithm. II) Finding optimum training	1) Real-time and historical data processing using CEP and ML. 2) Prediction algorithm called AMWR for realtime data. 3) Prediction

				predictive analytics (PAs)	window size. III) Size of the prediction horizon. 2) Prediction algorithm was validated on traffic data with accuracy up to 96%.	algorithm was validated on traffic data with accuracy up to 96%.
23	IoT, Big Data, and Artificial Intelligence in Agriculture and Food Industry	N. N. Misra, Y. Dixit, A. Al-Mallahi, M. S. Bhullar, R. Upadhyay and A. Martynenko	IEEE Internet of Things Journal, MAY 1, 2022	1) IoT, big data, and artificial intelligence (AI) 2) ML algorithms. I) Supervised Learning, II)Unsupervised Learning, III) Reinforcement Learning IV) Representation Learning: 3)block chain-based digital traceability	1) IoT and big data technologies will be potentially impacting are economical (e.g., increased productivity, lower production cost, and higher quality), environmental (e.g., less resource consumption, lower emission, and carbon footprint).	1) It is a major challenge for future Large-scale implementations of ML algorithms. 1) Supervised Learning: 2) Unsupervised Learning: 3) Reinforcement Learning: 4) Representation Learning:
24	Internet of Things in Greenhouse Agriculture: A Survey on Enabling Technologies, Applications, and Protocols	M. S. Farooq, S. Riaz, M. A. Helou, F. S. Khan, A. Abid and A. Alvi	IEEE Access 2022	1) Internet of Things in Greenhouse Agriculture. 2) IoT-enabled greenhouse network structure based on cloud and big data	1) IoT backbone and help farmers to increase crop productivity. 2) Remotely monitor the greenhouse	1) IOT based Greenhouse Agriculture is a major challenge for future Large-scale implementations .

				analysis. 3) Technology based cultivation techniques of greenhouse.	parameters such as CO2, PH, moisture content, humidity, temperature, and irrigation by using IoT sensors and devices.	
25	Machine learning and data analytics for the IoT	Adi, E., Anwar, A., Baig, Z. et al.	Springer Nature 2020	1) Machine learning and data analytics 2)classification of various analytics techniques for IoT(Descriptive, Predictive , Prescriptive ,Adaptive analytics for IoT, 3) Classification of IoT data analytics based on Technological (Cloud, Edge , Fog computing)	1) Machine learning and data analysis and highlight the current challenges.	1) Intelligent applications for the IoT 2) cyber security
26	IoT-based Plant Health Analysis using Optical Sensors in Precision Agriculture	H. Bagha, A. Yavari and D. Georgakopoulos	(DICTA), Gold Coast, Australia, 2021.	1) Devising plant models from RGB and multi-spectral data. 2) UAVs and IoT can be used to automatically capture and analyse the images and multi-spectral data for advancing PA.	1) RGB image analysis provides a relatively cheap method to analyse visible light colours and determine plant health status at different stages. 2) Multi	1) plant variety profiles to determine the performance and health of the plants across entire crops

					spectral data analysis enables analysis of invisible lights in particular NIR.	
27	IoT based Soil Nutrients Analysis and Monitoring System for Smart Agriculture	M. Pyingkodi, K. Thenmozhi, M. Karthikeyan, T. Kalpana, S. Palarimath and G. B. A. Kumar	(ICESC), Coimbatore, India, 2022	1) Soil sensor and Arduino can be used to quickly determine the nutrient content of the soil. 2) Soil fertility can be detected by using NPK sensors 3) analyses and compares different nutrient levels in soil by using kernel density estimation algorithm and machine learning.	1) Soil nutrient content in Nitrogen, phosphorus, and potassium increase the crop fertility.	1) Spectral analysis method is inconvenient, where the records are only 60-70% accurate. 2) Lack of nutrients cannot be identified in the soil.
28	Smart Farming – IoT in Agriculture	R. Dagar, S. Som and S. K. Khatri	2018 (ICIRCA)Coimbatore, India, 2018.	1) Poly House 2) Water Volume Sensor 3) Soil Moisture Sensor Air Temperature Sensor 4) Motion Detector Sensor	1) Farming can be made more efficient & accurate with the implementation of IoT device. 2) We can control water wastage then we are automatically controlling electricity wastage	1) Poly House

29	Modeling and Simulink of Smart Agriculture Using IoT Framework	T. Krongthong and B. Muangmeesri,	(ICORIS) Denpasar, Indonesia, 2019	1)Fuzzy Logic Controller 2) Temperature control 3) Soil moisture control 4) Humidity control 5) Smart Agriculture Enhanced by Cloud-Based and Networking Technology.	1) IoT to smart agriculture and sustainable agriculture 2) cooling system control and to adjust the environmental higher conditions such as the speed of the fan motor, the air volume, the flow rate, the vibration and various energy of smart agriculture.	1) agri-food such as fruit, vegetable only. 2) IoT to better support the smart agriculture and sustainable agriculture.
30	IoT Based Smart Greenhouse Framework and Control Strategies for Sustainable Agriculture	M. S. Farooq, R. Javid, S. Riaz and Z. Atal,	IEEE Access, 2022	1) IOT Smart Greenhouse Framework. 2) IoT-based network framework for a sustainable greenhouse environment and implement control strategies for efficient resources management 3) cloud computing, big data analytics, security attacks	1) IOT based Greenhouse framework help farmers to increase crop productivity. 2) efficient resources management 3) IoT deployment challenges, and security issues are stated as outcomes	1) IOT based Greenhouse framework is a major challenge for Large-scale implementations. 2) Smart greenhouse farming challenges and security issues. 3) IoT-based greenhouse farm security attacks.

31	Automation in Agriculture and IoT	V. Puranik, Sharmila, A. Ranjan and A. Kumari	2019 4th International Conference on (IoT-SIU), Ghaziabad, India, 2019.	1) IoT based Automation in Agriculture 2) Soil moisture sensor, pH Sensor, Temperature and Humidity Sensor.	1) Automate the Maintenance, Control of Insecticides and pesticides, Water Management and Crop Monitoring. 2) Minimizing human labour	1) Require human intervention not done completely automation.
32	A model for smart agriculture using IoT	K. A. Patil and N. R. Kale	(ICGTSPICC), Jalgaon, India, 2016	1) smart agriculture using IoT to combined with internet and wireless communications, Remote Monitoring System (RMS) 2) smart agriculture to develop real time monitoring system 3) Proposed system has methods as follows.	1) Real time data of agriculture production environment t provides easy access for agricultural facilities through SMS and advices on weather pattern, crops. 2) Improve the quality and quantity of productivity of agriculture. 3) Efficient management and utilization of resources.	1) Real-time and historical environment information is expected to help to achieve efficient management and utilization of resources. 2) IOT based smart agriculture is a major challenge for Large-scale implementations . 2) Smart agriculture using IoT in challenges of security issues.
33	Internet of Things (IoT) for Precision Agriculture Application	M. Dholu and K. A. Ghodinde	(ICOEI), Tirunelveli , India, 2018	1) application of cloud based IoT in the agriculture 2) Agriculture parameters are Soil Moisture,	1) Precision agriculture is to provide right amount of resources at and for exact	1) Limited resources are water, light, pesticides etc. 2) Network attacks.

				Temperature & Relative Humidity around plant, Light intensity.	duration of time. 2) implement precision agriculture the benefits of IOT has been utilized water, light, pesticides etc 3) Irrigation valve is actuated based on soil moisture readings.	
34	IoT Applications in Smart Agriculture: Issues and Challenges	M. R. M. Kassim	2020 IEEE	1) IoT Applications in Smart Agriculture of Issues and Challenges	1) Increasing of world population to agriculture products will have be a very high demand In future Agriculture. 2) IoT and related technologies will be the potential solution to solve the agricultural and food demand issues.	2) Limited agriculture products for increasing population of world. 3) It's challenging for uneducated farmers.
35	A Study on IoT based Low-Cost Smart Kit for Coconut Farm Management	S. Jaisankar, P. Nalini and K. K. Rubigha, "	International Conference on I-SMAC, Palladam,	1) Low cost smart kit of coconut farm.	1) Manage their farmland efficiently without any manpower resources.	1) farms major reasons; The frequent intrusion of elephants in the fields, Scarcity of

			India, 2020			water to supply to grow coconut trees, Common pests attacking coconut trees.
36	A Survey on the Role of IoT in Agriculture for the Implementation of Smart Farming.	M. S. Farooq, S. Riaz, A. Abid, K. Abid and M. A. Naeem	IEEE Access 2019	1) IOT base .automatically maintains and monitors agricultural farms. 2) IoT based smart farming. 3) cloud computing, big data storage and analytics	1) Minimal human involvement. 2) Efficient and reliable.	1) Major challenge Implementation of Smart Farming. 2) Security issues.
37	AgriTalk: IoT for Precision Soil Farming of Turmeric Cultivation	W. -L. Chen et al	IEEE Internet of Things Journal, June 2019	1) AgriTalk 2) biopesticides	1) turmeric quality has been significantly enhanced 2) user-friendly GUI called AgriGUI. 3)Maintenance of IoT precision farming is effective by using the IoTtalk	1) To apply these biopesticides precisely before diseases occurring and pest damage
38	Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies.	O. Friha, M. A. Ferrag, L. Shu, L. Maglaras and X. Wang	IEEE/CAA Journal of Automatica Sinica, April 2021	1) IoT platforms, (SDN), (NFV) technologies, cloud/fog computing. 2) IoT applications for smart agriculture.	1) water management, , disease management, harvesting, supply chain management.	1) Sustainable resources and Energy.

39	Internet of Things (IoT) for Next-Generation Smart Systems: A Review of Current Challenges, Future Trends and Prospects for Emerging 5G-IoT Scenarios	K. Shafique, B. A. Khawaja, F. Sabir, S. Qazi and M. Mustaqim	IEEE Access, 2020	1) cloud-based platforms and IoT devices based edge computing. 2) advances in artificial intelligence, machine and deep learning 3) Fifth Generation (5G) (MIMO, massive-MIMO, coordinated multipoint processing (CoMP), (D2D) communications, (CRAN), (SD-WSN), (NFV) and cognitive radios (CRs)	1) higher data-rates, large bandwidth, increased capacity, low latency and high throughpu	1) High Cost implementation of 5G-IoT.
40	Sustainable Water Resource Management Using IOT Solution for Agriculture	H. H. Kadar, S. S. Sameon and P. A. Rafee	2019 9th IEEE (ICCSCE), Penang, Malaysia, 2019	1) IoT for smart farming 2) smart water management 3) smart water management system AGRI2L.	1)Sustainable Water Resource Management. 2) optimum use of water resources	1) Limited to water irrigations. 2) around 70% of water resource for irrigation
41	IoT Based Smart Agriculture Management System	G. S. Nagaraja, A. B. Soppimath, T. Soumya and A. Abhinith	2019 4th International Conference on (CSITSS)Bengaluru, India.	1) Smart Agriculture Management System(SAMS). 2)ThingSpeak IoT Cloud platform.	1) Farmers to increase the crop production. 2) Reduce resource wastage. 3) Crop prediction and crop efficiently	1) Limited to production.

42	Smart Cropping based on Predicted Solar Radiation using IoT and Machine Learning	S. Ghosh, A. Sarkar, A. Mitra and A. Das	2020 IEEE (ICATMRI), Buldhana, India.	1) predicting solar radiation data 2) machine learning algorithm 3) renewable power	1) optimizing crop production 2) boost up cropping	1) Limited to solar radiation data.
43	Adaptive Power System for IoT-Based Smart Agriculture Applications	S. S. A. Emira, K. Y. Youssef and M. Abouelatta	(ICENCO), Cairo, Egypt, 2019	1) Power source represented as either solar panel or battery. 2) Architecture for monitoring Agro systems. 3) simulation results for energy efficient algorithm	1) energy optimization, sustainable, energy efficient	1) No Security and Prediction.
44	Precision Agriculture: Renewable Energy Based Smart Crop Field Monitoring and Management System Using WSN via IoT	M. S. Islam and G. K. Dey	2019 International Conference on (STI), Dhaka, Bangladesh, 2019	1) Precision agriculture (PA), wireless sensory network (WSN). 2) sustainable technology such as solar panel 3) Monitor the crop field conditions by using smartphone.	1) sustainable technology 2) avoid interrupted power supply due to the load shedding	1) limited to sustainable technology
45	Security and Privacy for Green IoT-Based Agriculture: Review, Blockchain Solutions, and Challenges.	M. A. Ferrag, L. Shu, X. Yang, A. Derhab and L. Maglaras,	IEEE Access, 2020	1) Security and privacy of green IoT-based agriculture. 2) blockchain-based 3) Precision agriculture 4) Four-tier green.	1) state-of-the-art of existing security and privacy solutions	1) Limited to existing security and privacy.
46	Machine Learning based soil moisture prediction for Internet of	G. Singh, D. Sharma, A. Goap, S. Sehgal, A. K. Shukla and	2019 5th (ISPCC), Solan, India.	1) Soil moisture prediction. 2) Smart Irrigation System	1) Optimize the irrigation water. 2) Soil moisture of a	1) Limited to water irrigation.

	Things based Smart Irrigation System	S. Kumar			field.	
47	Machine Learning-based Smart Irrigation Monitoring System for Agriculture Applications Using Free and Low-Cost IoT Platform	H. Youness, G. Ahmed and B. E. Haddadi	(ICM), Casablanca , Morocco, 2022	1) Machine Learning 2) Smart Irrigation Monitoring System for Agriculture 3) Artificial intelligence	1) Free and Low-Cost IoT Platform 2) agriculture in waste of water and the quality of products.	1) Limitation to irrigation system.
48	An IoT Based Smart Farming System Using Machine Learning	A. Dahane, R. Benameur, B. Kechar and A. Benyamina	2020 (ISNCC), Montreal, QC, Canada, 2020.	1) Smart Farming System. 2) Machine Learning 3) artificial intelligence 4) Precision agriculture. 5) EDGE-Fog-IoT-Cloud	1) Optimize plant growth. 2) feasible and cost effective for optimizing water resources	1) Limited to Optimize plant growth and Prediction.
49	Raspberry Pi as Visual Sensor Nodes in Precision Agriculture: A Study	R. Kamath, M. Balachandra and S. Prabhu	IEEE Access, 2019	1) Precision agriculture, Raspberry Pi 3, Computer vision, wireless visual sensor network. 2) To monitor paddy for weeds using Raspberry Pi	1) Enhance the crop production.	1) Limited to crop producers.
50	Crop Yield Prediction using Machine Learning Algorithm	D. J. Reddy and M. R. Kumar	2021 5th (ICICCS), Madurai, India.	1) Crop Yield Prediction 2) Artificial Neural Network, Convolution Neural Network, Crop yield prediction,	1) Crop Yield Prediction.	1) Limited to Crop Yield Prediction. 2) Security issues.

				Machine learning.		

IV. APPLICATIONS

Recently, various algorithms are frequently used that are used according to application and their performance is given below in Table 2. Such as Big Data, Cloud, Artificial Intelligence, Machine Learning, and Deep Learning have been widely used in farming and agriculture, such as classification, crop health monitoring, prediction of crop disease, etc.

Table 2: Big Data, Cloud, Artificial Intelligence, Machine Learning and Deep Learning for automation smart farming and agriculture

Application	Models / Algorithms used
IoT Based Smart Agriculture[4]	Deep Learning and Machine Learning
Crop disease and pest management[5]	Machine learning and analytics.
in Smart Agriculture Monitoring System[9]	Cloud, linear regression model, binary logistic regression model
AgroTick ;Smart Agriculture[13]	Big Data Analytics, Cloud Computing and Mobile Applications
Smart Irrigation System[15]	LoRa, Machine Learning
IoT based Smart Agriculture[16]	Machine Learning, Supervised machine learning algorithms-decision tree, Raspberry pi.
IoT-Based Pattern Recognition for Crop Disease Monitoring System[17]	Machine learning (ML) techniques, such as support vector machine (SVM) and convolution neural network (CNN).
Affordable Smart Farming[18]	Machine Learning
Data Analytics in Agriculture: Benefits and Challenges[19]	Cloud platform
IoT Based Smart Agriculture Automation[21]	Artificial Intelligence, Recurrent Neural Network (RNN), Multi-Layer Perception (MLP).
Classification of IoT data analytics[25]	Machine learning , Cloud, Edge , Fog computing)
IoT-based Plant Health Analysis[26]	Precision Agriculture , multi-spectral data
IoT based Soil Nutrients Analysis and Monitoring System for Smart Agriculture[27]	Machine learning.
Smart Greenhouse Framework and Control Strategies for Sustainable Agriculture[30]	Cloud computing, big data analytics, security attacks
Low-Cost Smart Kit for Coconut Farm Management[35].	Big Data, Artificial Intelligence and Machine Learning

Agriculture for the Implementation of Smart Farming[36].	Cloud and edge computing, Big data analytics and machine learning
AgriTalk: IoT for Precision Soil Farming of Turmeric Cultivation[37]	Artificial intelligence
smart agriculture sensors enable, analyzed supply chain management of IoT Base agricultural[38]	Cloud/fog computing, block-chain
Internet of Things (IoT) for Next-Generation Smart Systems[39]	Cloud-based, edge computing, artificial intelligence, machine and deep learning
smart agriculture management system (SAMS), NodeMCU and Raspberry Pi3 [41]	Machine Learning, Precision Agriculture, Message Queuing Telemetry Transport (MQTT)
Smart Cropping based on Predicted Solar Radiation[42]	Machine Learning
Smart Irrigation System based on Soil moisture prediction[46]	Machine Learning
Smart Irrigation Monitoring System for Agriculture [47]	Machine Learning, Raspberry Pi, artificial intelligence
Smart Farming System ,optimize plant growth [48]	Machine Learning, Raspberry Pi, Artificial intelligence, Precision agriculture.
To monitor paddy for weeds using Raspberry Pi[49]	wireless visual sensor network for precision agriculture, Random forest and support vector machine
To analyze crop yield prediction [50]	Artificial Neural Network, Convolution Neural Network, Machine learning

V. CONCLUSION & FUTURE SCOPE

In this research paper, we surveyed different IoT applications to control the environment of crop fields. For these reasons, we have a system based on an IoT-based application to predict pests, diseases, and moisture in crops. So that increasing food for human demands of the growing population can be fulfilled.

Automated Smart Farming using IoT was applied in farming to improve crop yields, improve quality and reduce costs.

Extensive literature, we found that precision agriculture and farming use an IoT basis. Furthermore, the applications of these technologies in precision agriculture are highlighted. Moreover, the paper tried to address one of the problems faced by crop cultivation in a country like India. Since crop growers are still using the classical approaches of disease prediction without any technological intervention like IoT/ WSN, one of the major advantages of the proposed approach will be real-time measures against any possible disease of crops.

We have many challenges ahead before the survey of IoT-based farming framework on various technologies. The IoT is an abstract idea for changing the future. Here, Critical Data Analysis of Various IoT-based technologies for Automation Smart Farming to develop farming techniques for increasing the human population and other things are developed for any country to boost its economy. The research paper aims to

automate farming using IoT-based technologies, challenges, outcomes, pests, and diseases of crop cultivation. IoT-based Automation Smart Farming enables the future of agriculture.

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