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Research Article

Analysis of Artificial intelligence Agricultural Crop Monitoring and Irrigation Optimization Environmental Applications

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ABSTRACT

The plantations are one of the largest industries in the modern world, as we all know. It accounts for thirty countries globally. India is a major agricultural nation, and agricultural output has a big impact on the safety of the country's food supply. India has substantially less farmland per person than the global average, lower output values per person, and poorer land yields per unit when compared to other wealthy nation. Therefore, in order to overcome the challenges associated with food production, we need to figure out how to increase output while utilizing the few natural resources that are now available. The use of distributed sensors and a data collection platform to enable global open data for nutrition and agriculture these days, agriculture works with a wide range of variables to ensure a successful harvest, including temperature, rainfall, sunlight, air pressure, and humidity. It is anticipated that an early warning system will be developed if there are parameters that are already in the critical value and could lead to crop failure because there is an abundance of data that can be gathered and examined.

Keywords: Application, Agriculture Productivity, Irrigation, Cloud computing ,Wireless.

INTRODUCTION

The using data mining algorithms, the effect of cloud computing on agricultural advancement the application of smart Agriculture technologies in the context of contemporary farming is examined in this research study[1]. The initiative gathers, processes, and gives farmers real-time insights using a variety of sensor technologies, IoT devices, and cloud-based data analytics[2]. Enhancing data-driven decision-making, increasing resource efficiency, guaranteeing environmental sustainability, and encouraging affordability and accessibility for a broad spectrum of farmers are some of the goals of the project. Advanced sensors, including those for temperature, humidity, light intensity, soil moisture, and barometric pressure, were placed throughout an agricultural field as part of the research technique. These sensors' data was combined with other data sources to create a cloud-based system that gave farmers access to real-time data and insights via an intuitive user interface.

AGRICULTURAL PRODUCTIVITY

The system's efficiency in maximizing irrigation schedules, improving crop health, and preserving resources was shown by the experimental phase's outcomes[3]. Calibration, network stability, and reasonably priced subscription plans solved issues with data accuracy, connectivity, and initial setup expenses, guaranteeing the system's usefulness.The fig1 advances the field of precision agriculture by offering farmers a scalable, integrated, and easily accessible solution[4]. The research highlights sustainable farming methods and data-driven decision-making, which makes it a useful tool for raising agricultural productivity in the face of contemporary difficulties. A complete solution is offered by integrating Explainable AI (XAI), Ensemble Learning, and Internet of Things (IoT) algorithms into the Reinforcement Learning framework[5]. The dynamic paradigm of the framework for precision agriculture boosts productivity while using less resources. Reinforcement Learning allows the system to make real-time adjustments to its surroundings based on the lessons it has learnt from its past experiences. Agricultural equipment may more readily collect and exchange data with cloud servers by integrating IoT algorithms, increasing accuracy and adaptability[6]. Greatly improve our predictive power with Ensemble Learning, which combines multiple models to get dependable results. The public's trust in AI-powered agricultural systems may rise with the use of XAI, which offers context and explanation for calculations. It provides participants with pertinent information and demystifies decision-making. With the aid of this framework, agricultural algorithms may now be easily installed and controlled in order to benefit from the scalability and processing power of cloud resources. This research clarifies how data mining algorithms can address issues of global food security and promote sustainable practices in agriculture.

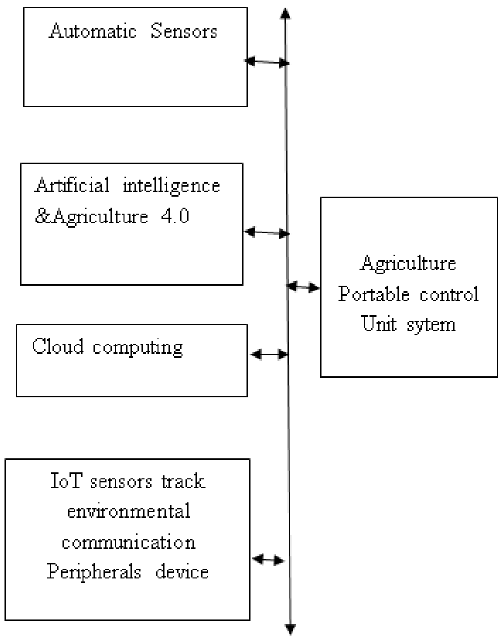

Figure 1. Block diagram

ARTIFICIAL INTELLIGENCE AND AGRICULTURE 4.0

The double edged agriculture 4.0 homeland security issues and highly dependent technologies artificial intelligence and digitalization have permeated every aspect of life[7]. The advent of agriculture 4.0, also known as smart agriculture, has been heralded by the intense merger of historical information technology with traditional agriculture.

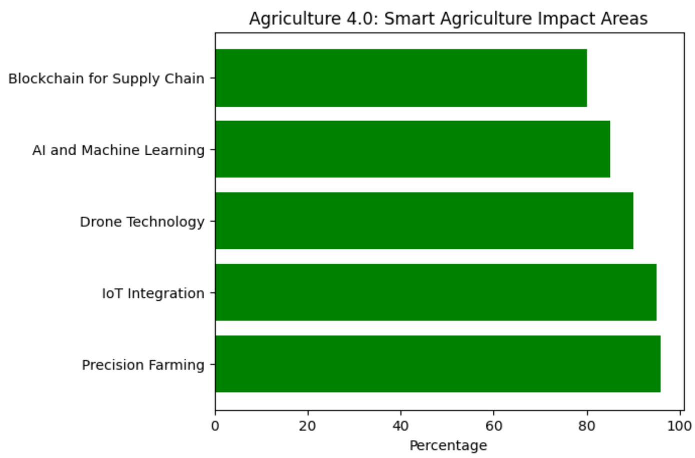

Figure 2 Agriculture 4.0: Smart Agriculture Impact Areas

A wide range of current and emerging technologies, such as blockchain, machine learning, automation, hydroponics, nanotechnology, genome editing, automation, and algae feedstock, are considered to be part of agriculture 4.0[8]. The fig 2 technologies have the potential to significantly impact future agricultural and food systems[9]. While there are numerous advantages to this Fourth Revolution, there are still many unanswered questions and obstacles that need to be overcome before this paradigm change can be implemented.

Future solutions will make data integrity and availability important in order to support farmers; security will also become essential in order to build robust and effective systems. Security addresses challenges such as interoperability, limited funding, and massive data volumes since smart agriculture encompasses a vast range of resources[10]. The authors argue that additional examination is necessary to fully understand the impact of Agriculture 4.0 technology, both in terms of inclusion and exclusion. This article delves into security challenges, primarily cyber-security, and outlines the fundamental technologies of agriculture 4.0 with a clear focus on how they might be applied in authentic globe scenarios. The research would have a practical impact on agriculture 4.0 by highlighting security protocols and paradigms to help farm stakeholders manage the company's digital transformation

CLOUD-CONNECTED AGRICULTURES

Smart Decision Tree (DL) algorithms IoT technologies could aid in the management of soil-borne illnesses agricultural digital revolution. The goal of this project is to prevent soil-borne infections in agriculture by utilizing cloud-connected technologies. In the proposed system, IoT devices collect and store real-time data from cloud computing activities, and a DL algorithm makes intelligent judgments based on this data. Field-based IoT sensors track environmental variables and pathogen prevalence to maintain soil health. A cloud platform's data is analyzed by a DL algorithm to produce insights that can be put into practice. The DT algorithm takes historical disease trends, temperature, and soil moisture into account for predicting and managing soil-borne pathogens[11]. The device connectivity and remote access capabilities of the cloud-connected architecture provide farmers with quick and data-driven decision support. The proposed technique minimizes agricultural yield lost to soil-borne illnesses, according to simulation and real-world experiments. Crop health and sustainable agriculture are enhanced by improved disease prediction accuracy and customized treatment recommendations[12]. This work presents a scalable and efficacious soil-borne pathogen management technique for smart agriculture. Precision and data-driven farming are made possible by proactive disease management made possible by IoT and DT algorithms.

PRECISION AGRICULTURE

Cloud based processing for precision agriculture using drone Images the agricultural sector constantly makes significant financial investments and is vital to society. This is due to the fact that cultivating crops entails a variety of lengthy procedures.

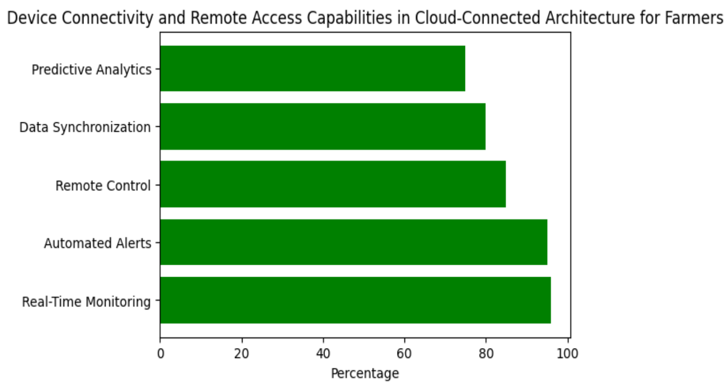

Figure 3 Device Connectivity and Remote Access Capabilities in Cloud-Connected Architecture for Farmers

Agriculture still heavily relies on physical labor in the majority of nations. Nonetheless, a lot of precision agriculture procedures can be enhanced or automated with today's technologies. Traditional plant health examination is one of these, and it's frequently ineffective and time-consuming. The fig 3 work aims to address a research gap concerning the challenging challenge of ongoing crop monitoring. Agriculture still heavily relies on physical labor in the majority of nations[13]. Nonetheless, a lot of precision agriculture procedures can be enhanced or automated with today's technologies. Traditional plant health examination is one of these, and it's frequently ineffective and time-consuming. This work aims to address a research gap concerning the challenging challenge of ongoing crop monitoring. The research attempted to address this issue by putting forth a novel approach that used cloud-based processing for aerial pictures to evaluate plant health[14]. It was influenced by both the Internet of Things and ongoing drone efforts. It processed data automatically in the cloud using information gathered from drone sensors. The methodology of Attribute-Driven Design (ADD) served as the foundation for the software architecture utilized to do this[15]. The study's conclusions showed that the average response time for classifying plant states was 430 ms. Furthermore, if an unexpected state was reached, the cloud architecture included the ability to sound an alarm. In the end, a colored map was made to facilitate improved visibility[16].

RESULT AND DISCUSSION

Smart agriculture using technological developments: approaches and difficulties many countries are experiencing a shortage of arable land as a result of industrial expansion. Another big worry is finding enough labor to do the essential agricultural tasks fig 4 . In order to meet the needs of a big population, the agriculture sector is expected to produce fig 5 more due to the limited amount of farming area and labor[17]. There are several ways that technology might help the agriculture sector increase productivity. Smart agriculture is the application of cutting-edge technology like blockchain, robotics, machine learning, and the Internet of Things to the agricultural sector in order to increase productivity more effectively .

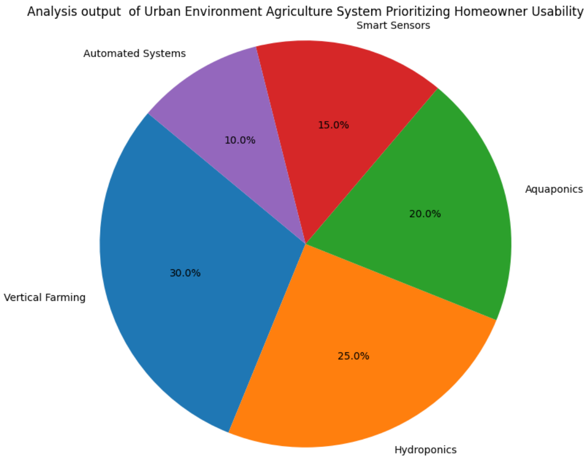

Figure 4 Analysis output of Urban Environment Agriculture System Prioritizing Homeowner Usability

Figure 5 Analysis output of Agriculture Portable kit

Figure 6 Agricultural Productivity daily market on flowers

FUTURE WORK

Smart Planter a managed environment agriculture system that puts urban home owner usability first In urban settings, controlled environment agriculture, or CEA, is frequently carried out on a medium to large scale. The CEA systems are frequently promoted as a way to shorten the distance between the farm and the plate and as a potential solution to the issue of food deserts. As with rooftop gardens, the CEA arrangement occasionally serves as an example of green architecture in the city.The research suggested the Smart Planter, an Internet of Things (IoT) enabled agricultural setup that homeowners who might struggle to cultivate herbs and food indoors can utilize pleasantly. The fig 6 Smart Planter's system architecture preserves a number of operational features and automation from the larger CEA systems, giving urban homeowners the chance to cultivate their own crops. The Smart Planter was designed to provide urban homeowners with the leisure, educational, and convenient access to nourishment that comes with living in a city. A physical model of the automated system that can sense and control its surroundings is the study's output.

CONCLUSION

The new method for cloud-based, edge-fog-based smart agriculture is a novel idea that enhances quality and productivity in the agricultural sector by utilizing cutting-edge technologies. The area of smart agriculture has gained further dimension due to the growth of the IoT. It is anticipated many technology being employed in the creation of smart agriculture systems, including cloud computing, artificial intelligence, and the Internet of Things, would significantly raise the system's quality and efficiency. The agricultural sector can benefit from these developments by raising productivity and cutting expenses. system based on Edge-Fog-Cloud that can lower energy usage and thus lower network traffic. With the right technology, the suggested method can be utilized to run programs according to its resource needs and the data gathered from sensors in the agricultural field. This approach can lessen the energy usage of the system and improve network traffic as well.

REFRENCES

[1] Selvaraj S, Challenges and opportunities in IoT healthcare systems: A systematic review. SN Applied Sciences, 2020,

[2] G. K. Shyam and I. Chandrakar, "A Novel Approach to Edge-Fog-Cloud Based Smart Agriculture," 2023 International Conference on New Frontiers in Communication, Automation, Management and Security (ICCAMS), Bangalore, India, 2023, pp. 1-5, doi: 10.1109/ICCAMS60113.2023.10526104.

[3] Sneha, P. Singh and V. Tripathi, "Optimizing Cloud-Based Smart Agriculture," 2023 International Conference on Computer Science and Emerging Technologies (CSET), Bangalore, India, 2023, pp. 1-5, doi: 10.1109/CSET58993.2023.10346687.

[4] M. M. Alaty and Y. A. Younis, "Integrating Cloud and Fog Technologies with IoT to Create Smart Agriculture," 2023 IEEE 3rd International Maghreb Meeting of the Conference on Sciences and Techniques of Automatic Control and Computer Engineering (MI-STA), Benghazi, Libya, 2023, pp. 535-540, doi: 10.1109/MI-STA57575.2023.10169450.

[5] S. Jombo and M. Abd Elbasit, "Bibliometric Analysis of Cloud Computing in Agriculture using Remote Sensing Data," 2023 IST-Africa Conference (IST-Africa), Tshwane, South Africa, 2023, pp. 1-9, doi: 10.23919/IST-Africa60249.2023.10187834.

[6] Z. Cai, Z. Qian, G. Liu, Z. Liu, Y. Qi and C. Jin, "Effects of Reduced Point Cloud Density on Grain Volume Measurement," 2021 International Conference on Electronic Information Technology and Smart Agriculture (ICEITSA), Huaihua, China, 2021, pp. 496-504, doi: 10.1109/ICEITSA54226.2021.00100.

[7] J. R. M. Cam, E. G. S. de la Cruz, F. M. S. López and V. G. R. Urbano, "Cloud-Based Processing on Drone Imaging for Precision Agriculture," 2023 IEEE 14th International Conference on Software Engineering and Service Science (ICSESS), Beijing, China, 2023, pp. 10-14, doi: 10.1109/ICSESS58500.2023.10293111.

[8] A. Kumar, R. G. Tiwari and N. K. Trivedi, "Smart Farming: Design and Implementation of an IoT-Based Automated Irrigation System for Precision Agriculture," 2023 3rd International Conference on Innovative Sustainable Computational Technologies (CISCT), Dehradun, India, 2023, pp. 1-6, doi: 10.1109/CISCT57197.2023.10351483.

[9] S. S. Shireshi and R. Raman, "Soil-Borne Pathogens Management in Cloud-Connected Agriculture: An IoT and Decision Tree Algorithmic Approach," 2024 International Conference on Emerging Smart Computing and Informatics (ESCI), Pune, India, 2024, pp. 1-5, doi: 10.1109/ESCI59607.2024.10497395.

[10] S. Arya, S. Tripathi, A. Srivastava, S. Aggarwal, N. Soni and S. A. Ansar, "Double-Edged Agriculture 4.0: Hodiernal Expedient Technologies and Cyber-Security Challenges," 2023 6th International Conference on Contemporary Computing and Informatics (IC3I), Gautam Buddha Nagar, India, 2023, pp. 313-320, doi: 10.1109/IC3I59117.2023.10398136.

[11] S. K. Saravanan, F. Nisha, V. R. Rohit, J. Lenin, P. D. Selvam and M. Rajmohan, "Impact of Cloud Computing on Agricultural Advancement using Data Mining Algorithms," 2023 2nd International Conference on Automation, Computing and Renewable Systems (ICACRS), Pudukkottai, India, 2023, pp. 1570-1575, doi: 10.1109/ICACRS58579.2023.10404669.

[12] M. Ravishankar, S. Siddharth, A. A. Yadav and S. R. Kassa, "Integrating IoT and Sensor Technologies for Smart Agriculture: Optimizing Crop Yield and Resource Management," 2023 IEEE Technology & Engineering Management Conference - Asia Pacific (TEMSCON-ASPAC), Bengaluru, India, 2023, pp. 1-5, doi: 10.1109/TEMSCON-ASPAC59527.2023.10531339.

[13] S. Venkatachalam, P. Kavitha, P. K. Ingle, G. Ramachandran, R. Sasikala and T. Muthumanickam, "Analysis of Internet of Things Based Agriculture Fertilizer Nutrient Management Soil Health Irrigation System and its Applications," *2024 2nd International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT)*,

[14] H. A, V. J and M. P. R. M, "A Real-Time Monitoring System for Soilless Agriculture Tomato Plants Using Sensors and the Internet of Things," 2023 International Conference on Emerging Research in Computational Science (ICERCS), Coimbatore, India, 2023, pp. 1-6, doi: 10.1109/ICERCS57948.2023.10434219.

[15] R. Thirisha et al., "Precision Agriculture: IoT Based System for Real-Time Monitoring of Paddy Growth," 2023 International Conference on Sustainable Emerging Innovations in Engineering and Technology (ICSEIET), Ghaziabad, India, 2023, pp. 247-251, doi: 10.1109/ICSEIET58677.2023.10303483.

[16] K, T. P, K. I. J, K. M and K. P. Sambrekar, "Design and Development of an Efficient Agriculture Management System in Cloud Computing using Machine Learning," 2023 IEEE 8th International Conference for Convergence in Technology (I2CT), Lonavla, India, 2023, pp. 1-7, doi: 10.1109/I2CT57861.2023.10126486.

[17] M. M. Raikar, P. Shavi, N. Patil and S. Mudavi, "IoT prototyping using Block based programming: An use case of smart agriculture," 2023 3rd International conference on Artificial Intelligence and Signal Processing (AISP), VIJAYAWADA, India, 2023, pp. 1-5, doi: 10.1109/AISP57993.2023.10134851.