International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
***Article Received**: 08 October 2022 **Revised**: 14 November 2022 **Accepted**: 02 December 2022*

Edge Computing and Blockchain in Smart Agriculture Systems

[a] **Ch G V N Prasad** , [b] **A.Mallareddy** , [c]**M.Pounambal** ,, [d] **Vijayasherly Velayutham**

[a] Professor, Department of CSE, Gurunanak Institute of Technology, Hyderabad, Telangana
[b]Associate Professor, Department of Information Technology, CVR College of Engineering, Hyderabad, Telangana.
[c]Associate Professor Sr, School of Information Technology & Engineering, Vellore Institute of Technology ,Vellore -14
[d]Associate Professor Grade 1, School of Computer Science and Engineering, Vellore Institute of Technology Vellore -14
E-mail: [a]chgvnp@gmail.com, [b]mallareddyadudhodla@gmail.com,[c]mpounambal@vit.ac.in,[d]vvijayasherly@vit.ac.in

Abstract— The advancement of Internet-based technologies has made huge progress toward improving the accessibility of "smart agriculture." With the advent of unmanned and automatic management, smart agriculture is now able to accomplish monitoring, supervision, and real-time picture monitoring. It is not possible to know for sure that the data in a smart agriculture system is complete and secure from intrusion. This article investigates and assesses the potential of edge computing and blockchain for use in smart agriculture. We combine the advantages of blockchain technology and the edge computing framework to create a smart agriculture framework system that is based on a very straightforward analysis of the evolution of smart agriculture. The study proposes a thorough method for emphasizing the significance of agriculture and edge computing, as well as the advantages of incorporating blockchain technology in this context. This paper also proposes an intelligent agricultural product traceability system design: edge computing with blockchain for smart agriculture. The study concludes with a discussion of outstanding problems and difficulties that can arise during the creation of a blockchain-based edge computing system for smart agriculture systems.

Keywords- Smart agriculture, Edge Computing, Blockchain, Food and Crops Supply Chain

1. INTRODUCTION

When it comes to employment and economic impact, agriculture is a major factor in the development of many nations. In 2030, poverty is predicted to rise by 35% [1]. To fulfil the demands of an expanding population, more efficient manufacturing processes would be required. The industry has undergone significant transformation as a result of the proliferation of new technologies; however, there are still many openings for the introduction of cutting-edge solutions that are compatible with Industry 4.0. Smart agriculture is one of the best approaches to increasing production to compete with the increasing population of our country. Smart agriculture helps increase the production of different crops by transforming or reorienting agricultural systems. Smart agriculture, also known as precision agriculture, helps to maintain the production of food using minimal resources such as fertilizer, water, and seeds, irrespective of climate change. Sensors involved in the system help in controlling or monitoring the use of resources in large proportions, which also helps in reducing impacts on the environmental system. "Blockchain agriculture" is a popular term for farming and food production that employs distributed ledger technology. Blockchain technology is being used by all parties involved in the agricultural and agribusiness industries, including farmers, farm produce wholesalers, food processing firms, and supply chain operators, at every stage of the "farm to our plates" process. Blockchain is a decentralized, unhackable ledger that records financial and agricultural transactions with absolute integrity. The blockchain's immutability, decentralized nature, and ability to track and verify transactions are all key features that make it a game-changer for today's farmers. Large areas are currently being investigated in the field of smart agriculture systems [3], including the development of big data platforms, smart agriculture's operational mode, and the integration of IoT technologies. From a data-centric perspective, few people can analyze the information covered [4]. In addition, it is easy for the database information to leak into the agricultural system, which is detrimental to the sector's progress. Furthermore Despite the long history of "smart farming" technologies, the collected data is not being managed or used effectively. There isn't even a universal, all-encompassing security system in place. Due to its centralized nature, the traditional agricultural system's data is prone to a number of errors and distortions. Information can be misinterpreted, duplicated, etc. because of the way it is collected. In addition, there is a significant risk of information leaks and cyber-attacks throughout the system as a whole. Blockchain has gained popularity as a digital currency technology due to its decentralized security record,

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
***Article Received**: 08 October 2022 **Revised**: 14 November 2022 **Accepted**: 02 December 2022*

which can guarantee data security but whose storage capacity is inadequate [5]. Edge computing technology can make up for blockchain's drawbacks. As a result of blockchain technology's widespread use, all participants in the agricultural sector can now independently develop, gather, access, and store data such as seed information, crop yields, and market prices. The immutability and security of blockchain-stored data make the entire process transparent.

The remaining paper is organized as follows: section 2 presents a background study of the model; section 3 presents blockchain in agriculture and its benefits; section 4 presents edge computing in smart agricultural systems and its significance; and section 5 presents an intelligent agricultural product traceability system. System Design: Edge Computing with Blockchain for Smart Agriculture, Section 6 presents the open challenges and issues; Chapter 7 concludes the paper.

2. BACKGROUND STUDY

Possible Uses of Blockchain Technology in Farming Let's look at how the Internet of Things (IoT) and blockchain might help farmers make better decisions.

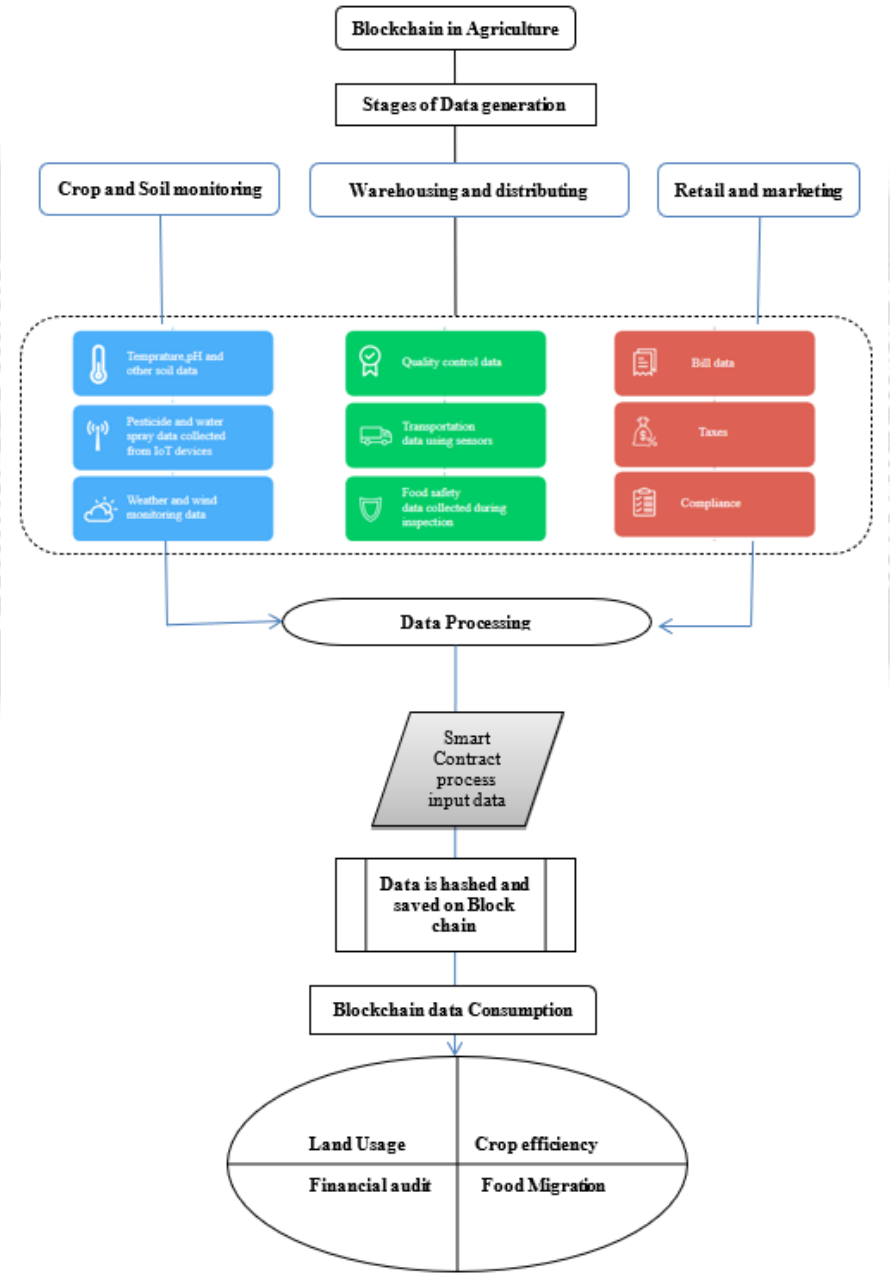

Figure 1. Flow model of Blockchain in Smart agriculture

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
***Article Received**: 08 October 2022 **Revised**: 14 November 2022 **Accepted**: 02 December 2022*

The ways in which blockchain technology can revolutionize agricultural and food productions are outlined below. There are four ways in which blockchain technology can revolutionize the agricultural and food industries

1. IoT devices generating data
2. Cleaning and Enrichment of the collected data
3. Making the data more insightful with machine learning algorithms
4. The data is stored on the blockchain.

2.1 Smart Farming

Smart farming, often known as "smart agriculture," is the practice of employing cutting-edge technology like the Internet of Things and blockchain to enhance the consistency and efficiency of agricultural operations. In addition to the Internet of Things and blockchain, other prominent technologies employed in smart agriculture include sensors, machine learning, data gathering and analytical devices, aerial vehicles like drones, etc. [6].

Smart farming model:

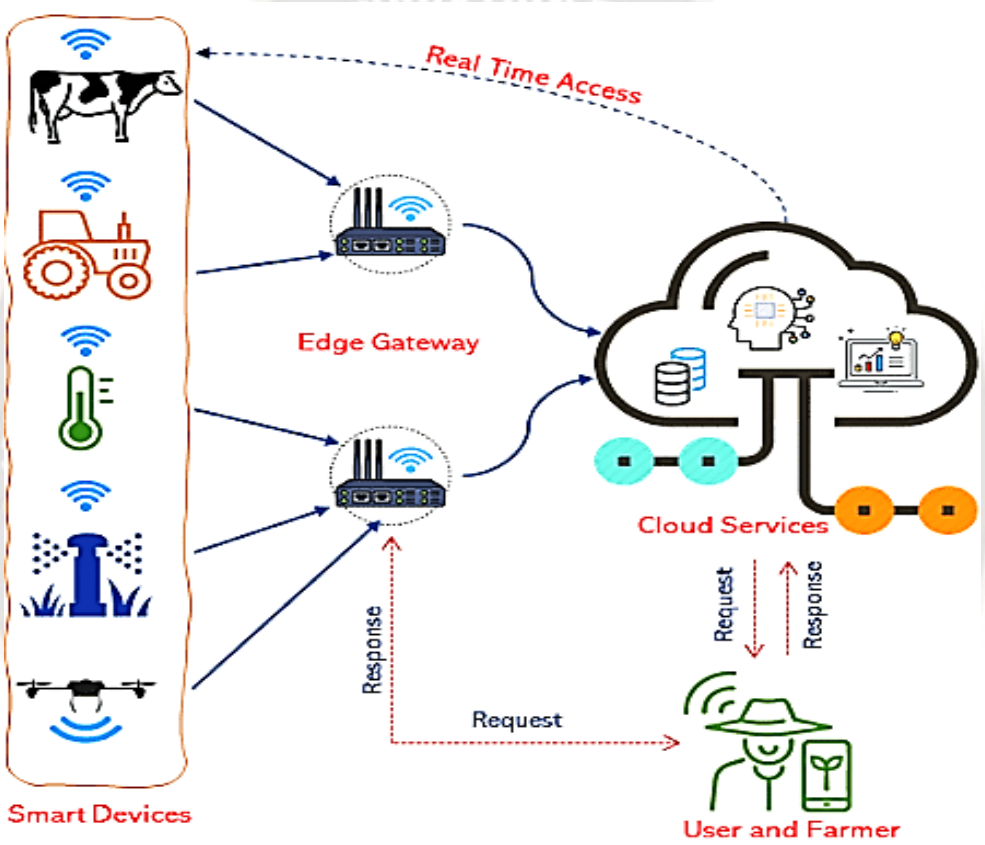

Figure 2 : Smart farming model

In this scenario, the Internet of Things (IoT) connects all the devices and entities involved in farming, such as animals, machines, cars, sensors, etc., so that everyone involved has safe and easy access to the data they need. In a safe and open cloud environment, data may be collected, entered, and accessed by the farmers.

2.2 Food and Crops Supply Chain

With a growing global population, increased market competitiveness, and the effects of globalization, the food and crop supply chains are taking a more aggressive approach. But many issues remain, including those related to food safety and ingredient quality, traceability, trust in suppliers, supply chain efficiency, etc. [7] These problems can be solved with the help of blockchain technology by establishing reliable connections between manufacturers and buyers. Individual product information, such as the origin, processing, and packaging details of a processed baby food, could be provided by the various stakeholders in order to increase supply chain transparency. When data is recorded in a distributed ledger like blockchain, its veracity and authenticity may be guaranteed for all stakeholders.

2.3 Transactions of Agricultural Products

Due to the Blockchains immutability, all farmers in the agriculture [8] market have equal access to the best

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
Article Received: 08 October 2022 Revised: 14 November 2022 Accepted: 02 December 2022

possible rates for their goods from processors and other parties. People who operate in the processed food industry have a similar rationale for price hikes in the event of crop damage due to weather or abrupt trends in farming. Information security and supply chain management are two main benefits of the blockchain agriculture business. Finally, the technology enhances the safety and security of the payment process in general through a number of channels, including the elimination of transaction costs and similar factors. The future use of bitcoin in the blockchain agriculture sector will also help reduce transaction costs.

2.4 Agricultural Insurance

The future use of bitcoin in the blockchain agriculture sector will also help reduce transaction costs.Due to climate change, agricultural ecosystems around the world have seen significant changes. Climate change is affecting every aspect of society, from the quality and quantity of agricultural output (due to extreme weather events) to the viability of seeds (due to their inability to adapt to new environments) to grow properly.

3. BLOCKCHAIN IN AGRICULTURE

Even a decade ago, agriculture was booming, but now, as the industry has grown in complexity, so have the problems it faces. They have become a bottleneck in the agricultural supply chain because of a lack of attention. Because of this, the application of blockchain technology is more crucial than ever before in this industry. The term "blockchain agriculture" (or "blockchain agribusiness") describes the practice of farming and food distribution using blockchain technology [9]. Farmers, farm-produce distributors, food-processing enterprises, and supply chain operators involved in every step from "farm to our plates" are all adopting blockchain technology. More than ever before, this industry requires the use of chains. Blockchain agriculture is the practice of doing agricultural and agribusiness operations using blockchain technology [9]. Farmers, wholesalers of agricultural products, food processors, and all the other people and organizations engaged in the chain of custody of food as it travels from "farm to our plates" are all using blockchain technology. The blockchain is an immutable distributed ledger that records financial and agricultural transactions. Modern agriculture relies heavily on the blockchain due to its immutability, accountability, and transparency. Examples include: agricultural supply chains; insurance for farmers; land registrations; fisheries; forests; agribusinesses; retailers and wholesalers; etc.

Finally, we can see that there are now many research studies on edge computing. This new twist While studies on IoT, sensors, etc. have been conducted, data studies have been neglected in the field of "intelligent agriculture." In terms of data analysis, edge computing and blockchain are two relatively new techniques that offer significant benefits but also have certain drawbacks. Both of these technologies have significant implications for studies of mobile networks. Image recognition is a key area of research for edge computing. Even though Blockchains benefits have numerous potential areas of application, they remain underutilized in the area of smart agriculture. As a result, investigating the use of edge computing and blockchain in smart agriculture systems is absolutely critical.

3.1 Benefits of Block chain in Agriculture

3.1.1 Improved Quality Control and Food Safety

There will be more transparency in the supply chain, inefficient procedures will be eliminated, and quality control will be optimised with the use of blockchain technology. For instance, farmers all across the world struggle with crop failure. Common causes include uneven rainfall and unpredictability in the weather. IBM is just one company pouring millions of dollars into precision agriculture by developing Internet of Things (IoT) devices for farmers to keep tabs on things like soil health, pests, and watering needs. When these gadgets are linked to a blockchain ledger, the data may be updated in real time and seen via a mobile app. By using this method, farmers will be able to check that everything is functioning properly. They will be alerted right away if anything goes wrong, giving them a chance to fix the situation before it worsens. Also, it provides the means to quickly identify the origin of problems like food-borne illness outbreaks. It has the potential to save lives along the supply chain, as well as time and money.

3.1.2 Increased Traceability in the Supply Chain

The standards at which consumers hold their food suppliers are constantly increasing. Most significantly, there has been a rise in interest among customers in tracking the origins of their food. By revealing to buyers the identities of the farmers who grew their food and the precise date it was harvested, blockchain technology offers a viable solution. Employees can simply scan the goods at each step to add new details to the database[10].

An increase in supply chain transparency has the potential to significantly impact the following areas: the prevention of food fraud and mislabeling; the elimination of middlemen; the just compensation of producers; and the education of consumers. Farmers will benefit from enhanced traceability because they will be able to keep better track of their crops from planting through harvesting, storage, and transportation as shown in figure 3.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
***Article Received**: 08 October 2022 **Revised**: 14 November 2022 **Accepted**: 02 December 2022*

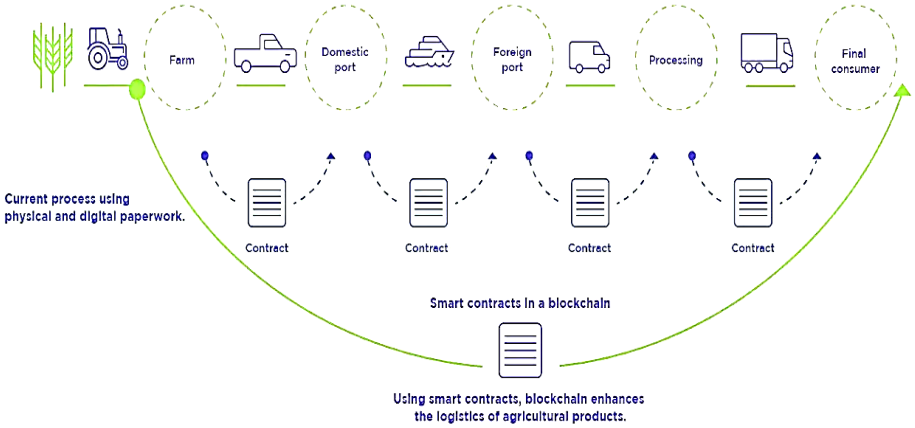

Figure 3: How Block chain transforming supply chain for Agricultural goods [11]

3.1.3 Increased Efficiency for Farmers

With the use of blockchain technology, farmers could save all of their data in a central location that could be accessed by everyone who needs it, streamlining the process and saving a lot of time and effort. For instance, they would be able to record data like: What they want to accomplish with their company and how they intend to do it what they consume and how often they need to be fed, how many animals there are, any health problems the animals may have, etc. When were the various crop kinds planted, and how are they faring thus well [12, 13]? When and how much money will be given to workers, how many hours each worker has put in, what the company's income and expenses are, etc. There is less confusion and less possibility of important data being lost when everything is tracked in one place rather than using several different approaches.

3.1.4 Logistics and Payments

Logistics is a major difficulty in the agricultural supply chain, and this is now widely recognized by all but the smallest farms [14]. The fact that farmers often have to wait weeks to be paid in full is only one of the many issues that make it challenging for them to get compensated for their crops. And the standard methods of payment typically wire transfers; sometimes deduct a hefty fee from the farmers' take-home income [15].

Smart contracts built on the blockchain are able to automatically transfer funds whenever a certain, predetermined condition has been met, and they do so with negligible or no transaction fees.

This might potentially allow farmers to get paid immediately upon delivery of their commodities, rather than having a sizable chunk of their earnings withheld by middlemen. Additionally, many farmers have a hard time getting a good price for their goods at market. There is a significant disparity between the amount of effort put in by each party and the quantity of profit earned by the intermediaries.

Using smart contracts, producers might bypass middlemen and communicate directly with retailers. As a result, they'd be able to charge a more reasonable price for their wares.

Eventually It may be difficult for the agriculture sector to manage financial, accounting, and administrative data. Also, this could make it more challenging to set reasonable rates for the goods. Implementing blockchain technology can make the data management process more open, easily accessible, efficient, and real-time. Farmers may find blockchain's ability to maintain immutable records useful.

4. EDGE COMPUTING IN SMART AGRICULTURE SYSTEMS

With the help of Edge Computing [6], farmers will have a better chance of gaining access to and making use of smart agriculture services. It may not completely solve the issue of limited internet connectivity, but it can assist. This presents a problem for service providers that must incorporate an Edge model into their designs. In fact, the agricultural sector, and more specifically the farm level, presents an excellent proof of concept for the edge computing model for smart service delivery. That's why the purpose of this study is to evaluate the use of edge computing in the broader field of agriculture by the academic community.

The agriculture sector has undergone profound changes worldwide, promoted by new technologies that are modernizing the countryside and creating new trends for its future. The concept of smart farming, based on digital applications, Big Data and IoT, is the next step in the modernization of rural labor and production and an ongoing process in agriculture’s digital revolution. The transformation and digital inclusion on farms have enabled so-called smart farming. Geotechnological integration and

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
Article Received: 08 October 2022 Revised: 14 November 2022 Accepted: 02 December 2022

the evolution of artificial intelligence, along with other computational resources, are the basis of these changes. the agricultural management of small and large producers in tasks such as: herd management; weather forecast; identification of animal diseases; irrigation and quotation and marketing of products.

4.1 **Edge Computing Use Cases for Smart Farming and Agriculture**

Video Analytics: The key to "smart farming" is gathering relevant information for efficient resource management. Just like in every other industry, the agricultural sector is experiencing a revolution brought on by artificial vision technology powered by artificial intelligence. Drones and vision-based harvesting, weeding, and other agricultural tasks are driving the adoption of vision-based automation and data analytics in the smart agriculture industry. In order to do analytics locally and provide fast access to data and visualizations that are graphically intensive, it is necessary to deploy computational capabilities employing eventless industrial PCs at the edge. Additionally, the widespread availability of 4G/LTE/5G connectivity has played a significant role in facilitating the development of high-resolution visual data collecting in out-of-the-way places. According to their built-in LTE connectivity, Industrial Communication Gateways are a fantastic onsite compute platform that can also communicate wirelessly with the cloud. [16]

Environmental Monitoring: The ability to remotely monitor various aspects of a farm's agricultural activities is one of the greatest benefits that edge computing has given to farming and agriculture over the past few years. Soil, weather, humidity, temperature, acidity, and pH levels are some of the variables that can be monitored by networks of sensors, which can consist of anywhere from a few strategically positioned sensors to thousands of interconnected devices. Edge computing allows some data processing processes to be handled at the edge devices themselves, allowing the generation and collection of data required to supply such solutions to occur considerably closer to the source. In the agricultural industry, one of the most appealing features of cutting-edge technologies is the ability to gain in-depth knowledge about the surrounding environment. The ability to provide farmers and agricultural employees with deep insights into their operational settings is a huge selling point for any new technology, and edge computing is no exception.

Agribots : Tractors and other robotic farming equipment that can operate autonomously by exchanging data with adjacent sensors. Agribots are equipped with computer vision and pre-loaded field data, allowing them to determine the most effective paths to cover the required area in light of the type of activity performed, the number of vehicles currently in the field, the size of implements, etc. Additionally, they may either automatically reroute around an impediment or come to a complete halt if necessary (such as when a person or animal is in their path). Because of this, the intelligent machinery may runoff or weed certain sections of the field as needed, or even harvest the crops on their own.

Farm Automation : IoT edge computing, much like agribots, can automate the operation of an entire farm or greenhouse. Because of this, the closed ecosystem can take care of itself, doing things like watering plants, feeding cattle, regulating the room's temperature, light, and humidity, etc., without needing help from an external server. Similar to agribots, edge computing would allow the farm or greenhouse to function even when it loses network connectivity to the central server, by making choices locally based on data from local sensors. As a result, this has the potential to increase reliability and decrease waste in agricultural processes, making them more environmentally friendly.

Vertical Farming: Agriculture is a valuable resource, but like many others on Earth, it is limited. There is a worldwide increase in the issue of soil degradation, and the total area of arable land is gradually shrinking. Researchers and farmers from all over the world have banded together to create "vertical farming" as a solution to this pressing problem. Instead of using traditional farmland, vertical farms make use of a network of Internet of Things (IoT) sensors and devices to maximise crop yields. For instance, in vertical farms, humidity is managed by a system of sensors that continuously measure the amount of mist surrounding each plant. The use of edge computing means that much of the data processing involved in such processes can be done on the edge devices themselves, rather than forwarded to the cloud.

5. INTELLIGENT AGRICULTURAL PRODUCT TRACEABILITY SYSTEM DESIGN: EDGE COMPUTING WITH BLOCKCHAIN FOR SMART AGRICULTURE

To protect the privacy of sensitive information, only authorized users should have access to it, and those users must verify the data's accuracy before using it. Make sure that only authorized users and processes can make changes to data using those techniques. Modifications to agricultural data pose a significant threat to data integrity in the smart clothing business as it is developed. It will damage national security and social stability by raising concerns

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
***Article Received**: 08 October 2022 **Revised**: 14 November 2022 **Accepted**: 02 December 2022*

about food safety and upsetting the established trading order of the agricultural goods market. The economic benefits of agriculture can be severely diminished if a large number of crucial pieces of equipment conduct erroneous actions due to data leakage. This could involve, for example, spraying excessive amounts of pesticide, operating too many or too few automatic ports, or making significant mistakes in environmental monitoring. Furthermore, the scientificity and correctness of essential reform programmers may be diminished if crucial statistical monitoring data, including agricultural production circumstances, agricultural output statistics, and agricultural economic benefit statistics, are illegally altered. It is important to protect the privacy and security of sensitive information when developing a system for smart agriculture. Blockchain's inherent security has led to its adoption in a broad variety of non-financial contexts, including the Internet of Things, healthcare, data storage, and financial statistics. Every industry has its own unique methods of doing business. Even though there are many benefits to using blockchain technology, there are also some drawbacks. For instance, the blockchain's scalability is weak, and the network's ability to accommodate a growing number of users requires improvement. The blockchain's reaction time is slow since the implementation of its features is contingent on the success of the consensus process.

Figure 4 depicts the basic operation of the blockchain-based, Edge Computing- and IPFS-enabled agriculture product traceability system. Edge computing facilitates the operation of local networks, the compression and distribution of data, and the provision of processing resources. Large-memory items, such as images and videos, are stored via the IPFS mechanism, which is transferred from the intelligent terminal to the edge node via the edge gateway. When a file is saved, the cloud server returns a hash value. This value is sent to the edge node. Together with the preceding data, the value is encoded in JSON format before being recorded as a transaction in the blockchain. The data in the blockchain is immutable once the transaction is finalized, and it can be queried in real time using the hash value. Specifically, edge nodes only process data in the security traceability architecture of blockchain solutions that rely on edge computing. The effectiveness of identity identification and the safety of data transfer are ignored. Blockchain's ability to facilitate the development of a decentralized system means it can serve as an enabling technology for the Internet of Things (IoT) and contribute to the resolution of its pervasive security problems. Also, there are several potential use cases for blockchain technology within the IoT.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
Article Received: 08 October 2022 Revised: 14 November 2022 Accepted: 02 December 2022

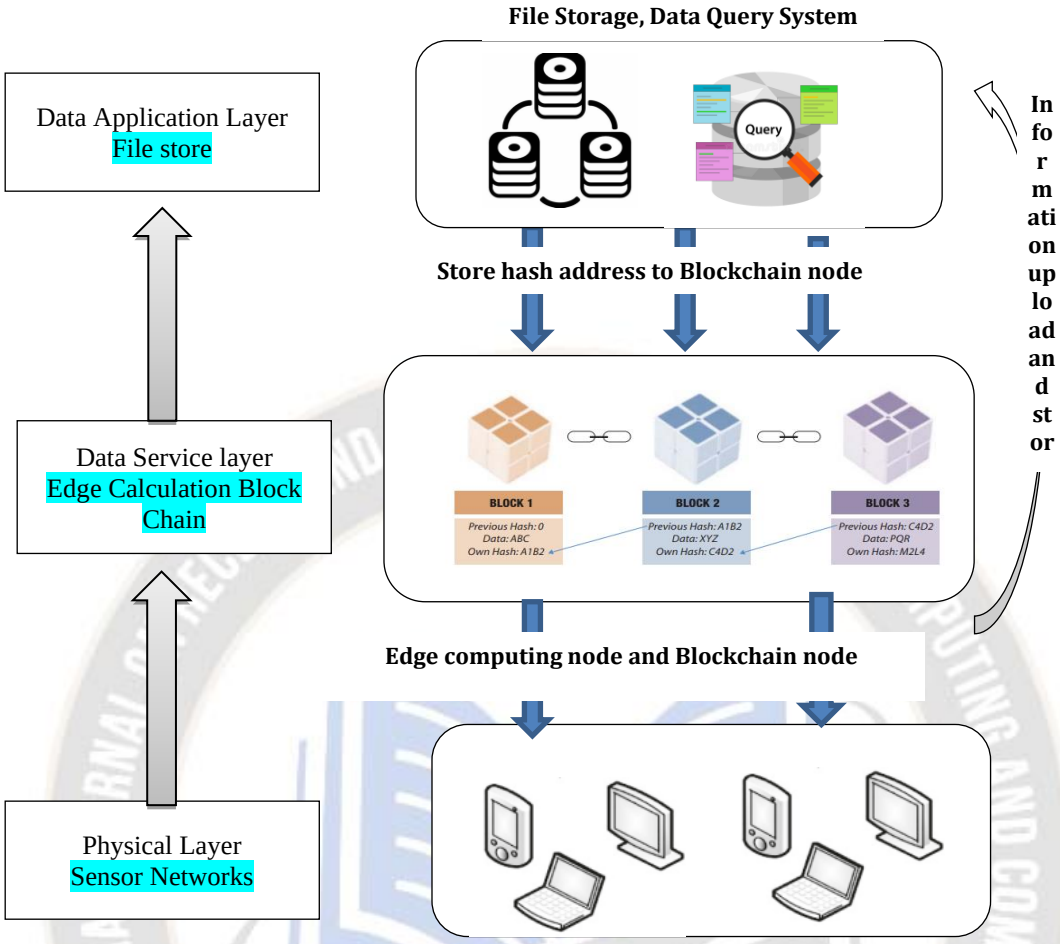

Figure 4: overall design of the smart agricultural system using Edge Computing with Blockchain.

5.1 Combination of Edge Computing and Applications of Blockchain: Research Literature Review

Blockchain technology helps with the problem of easily fabricated data, but it has severe limitations in terms of scalability and storage capacity. Blockchain and edge computing technologies worked together to address the issue. In table 1, we see a summary of the uses of edge computing and blockchain systems. For the first time, Liu et al. (17) suggested new-generation electric cars with cloud and edge computing (EVCE) as a typical application scenario of the Internet of Things, which includes the transmission and transaction of information and energy. Using blockchain and edge computing technology, Xu et al. [18] created a system to track the provenance of goods. The blockchain serves to safeguard transactions from being tampered with fraudulently. Using the blockchain node as a computation partner, the edge server executes a complex hash calculation and sends the result back for validation. If a blockchain node's internal storage is full, it can send the entire blockchain to an external server (known as "storage offload") and keep only the most recent blocks. The computing power of edge nodes is an additional factor to take into account, which is a drawback. As such, Stanciu suggested that smaller Docker containers be used for the deployment of computation on the edge nodes. In [19], we find a brief discussion of the three-layer edge model. It is made up of on-premises hardware and software, locally hosted infrastructure, and remote servers and networks. To safeguard transactions and guarantee their authenticity, the blockchain is implemented on the top layer. Since agricultural IoT terminal equipment has low processing power and high energy requirements, blockchain computing applications can be inconvenient. Edge computing eliminates this problem. However, the article does not address the inefficiency of identity verification or the security of the link between the edge node and the terminal. In [20], we see a proposal for a distributed trusted authentication system that uses edge computing and blockchain. There are three layers to the system: the physical network, the blockchain's edge, and the

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
Article Received: 08 October 2022 Revised: 14 November 2022 Accepted: 02 December 2022

blockchain's core network. Edge computing is used at the blockchain's periphery nodes to offer smart contract-based name resolution and identity authentication services at the edge. To further enhance the hit rate and decrease the delay, the edge computing cache technique is suggested.

TABLE 1 an Overview of the Use of Blockchain Technology in Conjunction with Edge Computing

Source	Description
[17]	Collaborative Operations that Integrate Data Processing and Analysis
[18]	conducted more complicated hashing operations
[19]	Using edge computing, data is processed at the Blockchains periphery.
[20]	Operated local area networks, bundled data formats, and supplied processing power.

6. OPEN CHALLENGES AND ISSUES

- **Data Processing:** Edge computing overcomes data processing difficulties in the agricultural IoT, which generates a vast amount of data. When it comes to data creation, edge nodes require storage plans that identify the data as being either organized, semi-structured, or unstructured. Therefore, the IT team needs to be aware of how much and what kind of data the edge node will have on the farm in the near and distant futures. In some scenarios, the data obtained is kept for a very long time. However, there are circumstances where only a subset of the data needs to be maintained or stored for a limited time.
- **Task assignment:** The terminal, edge nodes, and cloud centre in the Agricultural IoT all cooperate to provide a seamless end-to-end experience. Therefore, the efficiency and effectiveness of a task depend on how well it is delegated. In an edge environment, partitioning must break down the application into subcomponents based on information about the node's resources, energy consumption, and latency in responding to requests. Edge server resource allocation, power and loan allocation, and user-local computing resource allocation are the three sub-problems derived from the original problem of task offloading and resource allocation.
- **Privacy protection and Security:** When it comes to privacy and security, computing near to the data source is the way to go. However, in the context of edge computing, there are some difficulties with privacy and security.

    1) Farmers' awareness of privacy and security is weak.
    2) Edge device data is more useful than IoT terminal data because most edge devices operate in an unregulated environment open to the outside world.
    3) There is a shortage of reliable resources for ensuring the confidentiality and safety of sensitive information. There are a variety of approaches to data security, but not all of them work with edge computing designs. An increasingly dynamic setting makes the networks outside more susceptible to hacking. An increasingly dynamic setting makes the network's periphery more susceptible to hacking.
    4) Managing a distributed workforce is more challenging.

- **Service availability:** All of the farms are spread out over a large area, so they are essentially in the middle of nowhere and have a weak signal. Stability of service is crucial. The four qualities of any trustworthy system are uniqueness, scalability, isolation, and dependability.

7. CONCLUSION

As a new network design, edge computing has enabled localized services and better user experience. Many industries, including retail, banking, and even agriculture, use edge computing. In this research, we explore the use of blockchain and edge computing in "smart agriculture," defining each term in depth. We have advanced the state of research into edge computing with blockchain from its previous iteration as an investigation into agricultural uses of edge computing. Edge computing addresses the issues with blockchain technology brought by insufficient processing power and low power reserves in endpoint devices. The blockchain ensures the integrity and confidentiality of the data stored in the edge server. We identified and discussed four open research problems. This study gives information for future researchers to learn about the application of edge computing in the agricultural

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 1s
DOI: https://doi.org/10.17762/ijritcc.v10i1s.5848
Article Received: 08 October 2022 Revised: 14 November 2022 Accepted: 02 December 2022

industry and improves research to overcome ongoing challenges.

REFERENCES

[1]. World Economic Forum. "Here's How We Can Use Agriculture to Fight Climate Change," September 20, 2019. https://www.weforum.org/agenda/2019/09/here-s-how-we-can-use-agriculture-to-fight-climate-change/.

[2]. M. Jayalakshmi and V. Gomathi, "Sensor-cloud based precision agriculture approach for intelligent water management," *International Journal of Plant Production*, vol. 14, no. 2, pp. 177–186, 2020.

[3]. P. Dan, F. Stoican, G. Stamatescu, L. Ichim, and C. Dragana, "Advanced UAV–WSN system for intelligent monitoring in precision agriculture[J]," *Sensors*, vol. 20, no. 3, p. 817, 2020.

[4]. Q. Li, B. Cao, X. Wang, J. J. Wu, and Y. K. Wang, "Systematic water-saving management for strawberry in basic greenhouses based on the Internet of things," *Applied Engineering in Agriculture*, vol. 37, no. 1, pp. 205–217, 2021.

[5]. T. Wang, Y. Lu, J. Wang, H.-N. Dai, X. Zheng, and W. Jia, "EIHDP: Edge-intelligent hierarchical dynamic pricing based on cloud-edge-client collaboration for IoT systems," *IEEE Transactions on Computers*, vol. 70, no. 8, pp. 1285–1298,2021.

[6]. R. S. Alonso, I. Sitton-Candanedo, O. Garcia, J. Prieto, and S. Rodriguez-Gonzalez, "An intelligent Edge-IoT platform for monitoring livestock and crops in a dairy farming scenario," *Ad Hoc Networks*, vol. 98, no. 5, Article ID 102047, 2020.

[7]. M.J. O'Grady, D. Langton, G.M.P. O'Hare, Edge computing: A tractable model for smart agriculture?, Artificial Intelligence in Agriculture, Volume 3, 2019, Pages 42-51, ISSN 2589-7217, https://doi.org/10.1016/j.aiia.2019.12.001.

[8]. A. Haleem, S. Khan, M.I. Khan ,Traceability implementation in food supply chain: a grey-DEMATEL approach Information Processing in Agriculture, 6 (3) (2019), pp. 335-348

[9]. R. Yang, F. R. Yu, P. Si, Z. Yang and Y. Zhang, "Integrated Blockchain and Edge Computing Systems: A Survey, Some Research Issues and Challenges," in *IEEE Communications Surveys & Tutorials*, vol. 21, no. 2, pp. 1508-1532, Secondquarter 2019, doi: 10.1109/COMST.2019.2894727

[10]. G.Chandra Sekhar and P. Balamurugan, "Block-Chain Compliance for IoT Security: A Survey", International Journal of Computer Engineering In Research Trends, 7(9):pp:23-33, September-2020.

[11]. Media, AgriChain Social. "4 Ways Blockchain Is Transforming Supply Chain Management | Agri Chain." AgriChain, January 18, 2019. https://agrichain.com/blockchain-transforming-supply-chain-management/.

[12]. M. Montecchi, K. Plangger, M. Etter, It's real, trust me! Establishing supply chain provenance using Blockchain. Bus Horiz 62(3), 283–293 (2019)

[13]. Kamilaris, Andreas & Fonts, Agusti & Prenafeta Boldú, Francesc. (2019). *The Rise of Blockchain Technology in Agriculture and Food Supply Chains*. Trends in Food Science & Technology. 10.1016/j.tifs.2019.07.034.

[14]. Xiong H, Dalhaus T, Wang P and Huang J (2020) *Blockchain Technology for Agriculture: Applications and Rationale*. Front. Blockchain 3:7. doi: 10.3389/fbloc.2020.00007

[15]. Shelke, Vishakha & Khakhkhar, Smit & Jani, Yash. (2022). Fundraising through Blockchain. International Journal of Computer Engineering in Research Trends. 9. 73-78. 10.22362/ijcert/2022/v9/i04/v9i0402.

[16]. Singh, Ayushi & Shujaat, Gulafsha & Singh, Isha & Tripathi, Abhishek & Thakur, Divya. (2019). A Survey of Blockchain Technology Security. International Journal of Computer Engineering in Research Trends. 6. 10.22362/ijcert/2019/v6/i04/v6i0401.

[17]. Shalimov, Alexey. "3 Edge Computing Use Cases for Smart Farming | Eastern Peak." Eastern Peak - Technology Consulting & Development Company, April 5, 2019. https://easternpeak.com/blog/3-edge-computing-use-cases-for-smart-farming/.

[18]. H. Liu, Y. Zhang and T. Yang, "Blockchain-enabled security in electric vehicles cloud and edge computing", IEEE Netw., vol. 32, no. 3, pp. 78-83, May 2018.

[19]. F. Xu, F. Yang, C. Zhao and C. Fang, "Edge computing and caching based blockchain IoT network", *Proc. IEEE HotICN*, pp. 238-239, Aug. 2018.

[20]. A. Stanci, "Blockchain based distributed control system for edge computing", *Proc. 21st Int. Conf. CSCS Bucharest*, pp. 667-671, 2017.

[21]. S. Guo, X. Hu, S. Guo, X. Qiu and F. Qi, "Blockchain meets edge computing: A distributed and trusted authentication system", IEEE Trans. Ind. Informat., vol. 16, no. 3, pp. 1972-1983, Mar. 2020.