



ROLE OF BLOCK CHAIN IN SMART AGRICULTURE

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ABSTRACT

Agriculture is a vital aspect of any country's economy since it feeds the whole population. By 2050, the world's population is expected to grow by about 2 billion people, resulting in a fast increase in food consumption. Despite considerable progress, the globe is still trailing behind in achieving the "Zero Hunger" objective, according to a recent prediction. To feed the world's population sufficiently by 2050, 70 percent additional food production will be required. To meet the demands of a growing population, the agricultural industry must be modernized, smartened, and automated by incorporating existing technologies such as Artificial Intelligence (AI) and Machine Learning (ML), as well as Distributed Ledger Technology (DLT), which ensures data integrity and security. Various difficulties of smart agriculture may be handled with the use of blockchain asymmetric encryption technology, consensus mechanism, smart contract, P2P network, and other fundamental technologies, which will cut costs and enhance efficiency. The applications of blockchain technology in smart agriculture are discussed in this study.

Keywords: Block chain, smart agriculture, Distributed Ledger Technology, Transparency

1. INTRODUCTION

Agriculture is the world's most important industry. It is a big contributor to the global economy. A country is considered socially and politically stable if it has a strong agricultural foundation. Smart farming has been more valuable to farmers in recent years since it provides farmers with access to current technology and gadgets that aid in the improvement of agricultural product quantity and quality, as well as the decrease of farming costs. The advantages of smart farming in agriculture include increased crop yields, reduced fertilizer, pesticide, and water consumption, reduced pollution, and increased farm and farmer safety. Blockchain is a peer-to-peer network. A peer-to-peer network is one that is administered by a network of peers. It's a system for storing and retrieving data. The basic purpose of blockchain is to eliminate discrepancies. The effectiveness of smart agriculture can be improved using blockchain. The application of blockchain technology to promote the development of smart agriculture in India is still in its early stages, according to Indian academics.

2. SMART AGRICULTURE

Smart agriculture is the incorporation of technology such as the Internet of Things (IoT), Big Data, GPS, Cloud Computing, and Artificial Intelligence (AI) into traditional agriculture. Smart agriculture is an innovative method of carrying out farming tasks that reduces human effort while making the most use of available resources. It has the potential to address the issue of agricultural workforce shortages, increase agricultural production's capacity to withstand hazards, and assist small, vulnerable farmers in producing large-scale networks and intelligent transformation. The use of sensors, gateways, cloud servers, and other technologies to regulate agricultural output via mobile or computer platforms would improve conventional agriculture's "intelligence." The focus of "Smart Farming" is on accessing data and using that data to optimize a complicated system in order to improve produce quality and output while reducing human work.

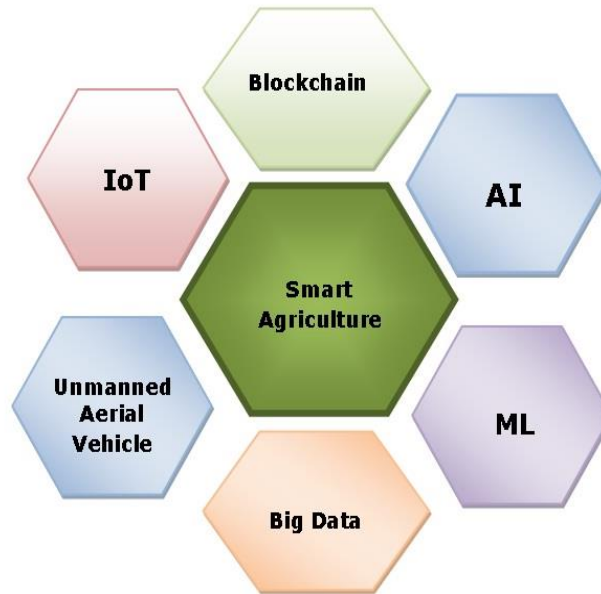


Fig1: Technologies used in Smart Agriculture

2.1 Benefits of smart agriculture compared to traditional agriculture

Among the many advantages of smart agriculture are:

- Conservation of water.
- Efficient use of fertilizers and insecticides. As a result, produce is more nutrient-dense and devoid of toxins.
- Increased crop yield efficiency.
- Lowering operational expenses.
- Establishment of nontraditional farming areas in cities and deserts.
- Reduce greenhouse gas emissions.
- Less soil erosion.
- Farmers may get real-time data.

2.2 Smart Agriculture: Challenges

Following are the main challenges in smart agriculture

- Lack of Technical skills
- lack of supporting hardware/infrastructure
- Power Issues
- Data Security and Privacy
- Scalability and Reliability

3. BLOCKCHAIN TECHNOLOGY: CONCEPTS AND CHARACTERISTICS

A distributed system for recording and preserving transaction records is known as blockchain. Transaction data is saved in "blocks" that are linked together to form a "chain" in block chain. As the number of transactions rises, so does the length of the chain. There is no central authority in a blockchain system. Instead, all network members maintain and share transaction records. Rather than having a single database that controls all of the records, the database is dispersed over the networks, and transactions are encrypted. As a result, blockchain eliminates the requirement for an intermediary who would normally conduct or track such transactions. All transactions on the blockchain are immutable, which means they can't be reversed. As a result, blockchains are built to be safe and tamper-proof.

3.1 Components of a Block chain

Block chain mainly has four components:

1. **Network of Nodes:** All nodes linked to the internet collaborate to keep track of all transactions done on a block chain network, and the legitimacy of each transaction is verified by a protocol. When a new transaction happens, the records of that transaction are added to the ledger of previous transactions, a process known as 'mining.' The proof of work is verified by the other nodes on the network.
2. **Distributed database system:** The database is made up of blocks of data that are copied to each system node. Every block contains a transaction list, a timestamp, and information about the preceding block.
3. **Shared ledger:** The ledger is made public and is incorruptible, and it is updated every time a transaction is completed.
4. **Cryptography:** Data is bound by a crypto method, making it difficult for unauthorized individuals to access or tamper with it.

3.2 Transaction completion procedure of block chain

1. A node/user starts a transaction by first creating and then digitally signing it with its private key.
2. This transaction is propagated (flooded) by using a flooding protocol, called Gossip protocol, to peers that validate the transaction based on preset criteria. Usually, more than one node is required to verify the transaction.
3. Once the transaction is validated, it is included in a block.

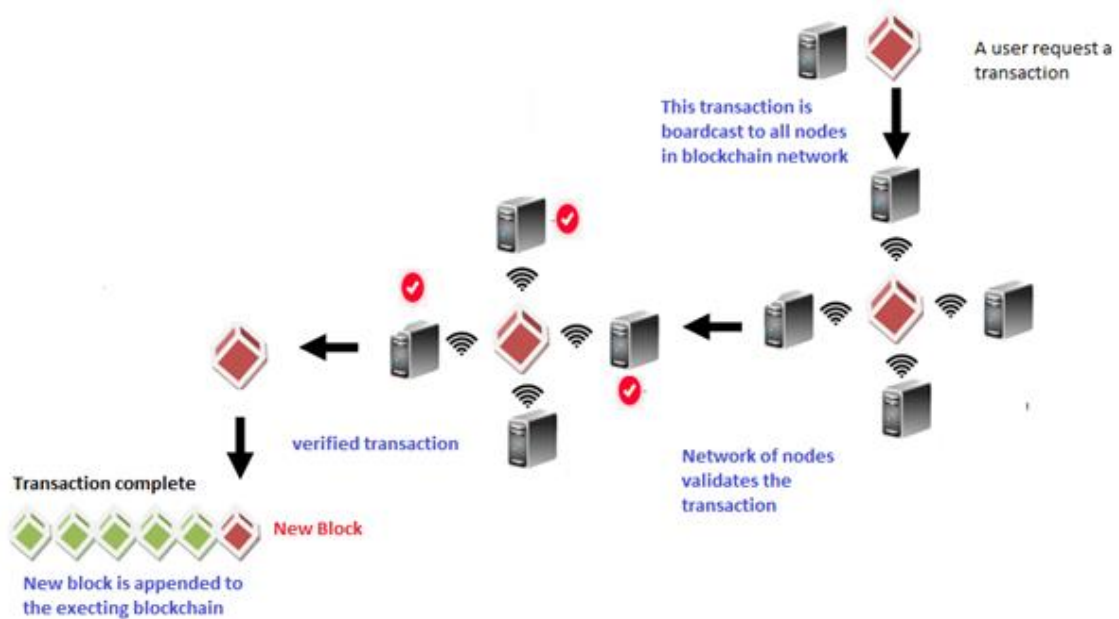
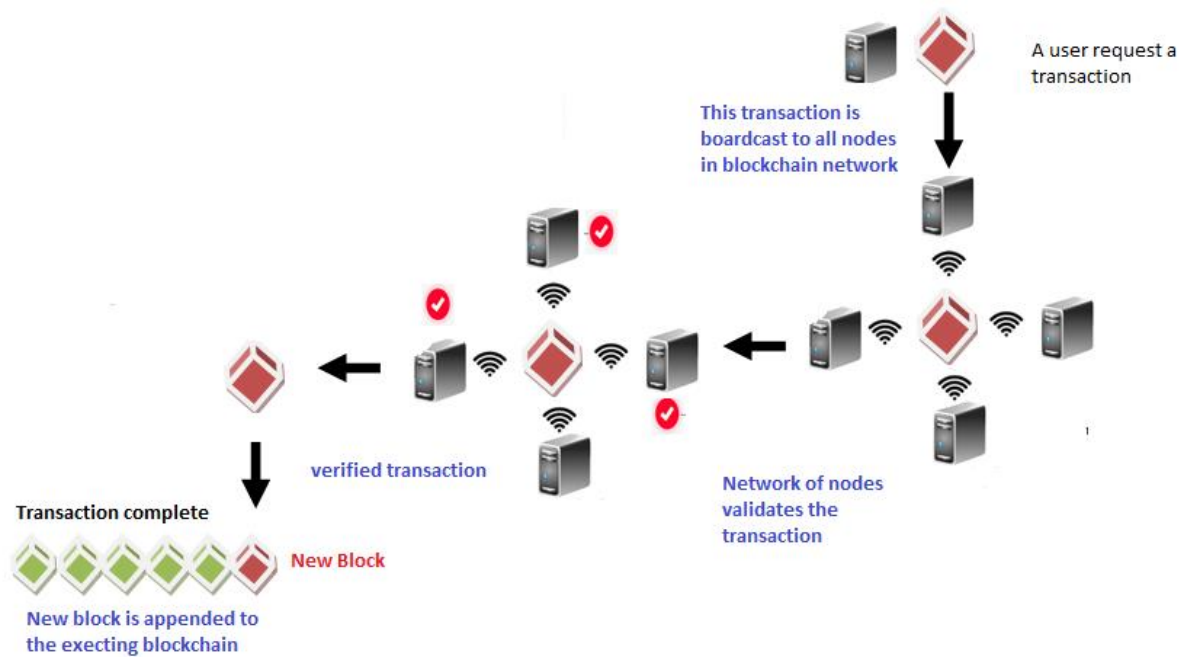


Fig2: Transaction completion procedure of block chain



3.3 Types of Block chain

Public, private, and hybrid blockchains are the three types of blockchain.

- Blockchains that are open to the public (such as Bitcoin and Ethereum) allow anybody to join and contribute. This technique is entirely decentralized and enables complete transparency of recorded data and transactions. When analyzing transactions, selected parties (such as Bitcoin miners) received incentives.
- Private blockchains (such as Hyperledger Fabric or Corda) are controlled by a single business or consortium and utilize access restrictions to limit participation to those who are already members of the network.
- The third form of Blockchain is the Hybrid Blockchain (such as XinFin, Ripple, and Dragonchain), which was designed with the goal of combining the greatest features of both public and private blockchains. It allows transparency while also defining user permissions. Hybrid IoT is one of the most relevant hybrid implementation situations, since it provides complete transparency to external users (such as consumers) while restricting network access to trusted parties. Sensors, for example, have access to the public network, while the general public would only have access to the public portion of the Blockchain.

4. BENEFITS OF BLOCKCHAIN IN SMART AGRICULTURE

In smart agriculture, block chain technology has been used. The agriculture industry benefits from blockchain technology in the following areas: traceability, crop insurance, smart farming, food supply chain, weather crisis management, agricultural product transactions, and security.

Increased Efficiency for Farmers: Farmers benefit from increased efficiency since blockchain technology allows them to keep their data in one location where it can be quickly accessible by those who need it. This streamlines the entire process, saves time and energy, and improves the farmer's efficiency.

Controlling Weather Emergencies: When raising crops, farmers are frequently confronted with inclement weather. Crop survival depends on the ability to forecast and monitor weather conditions. The installation of agricultural weather stations on farms can aid in the generation of critical data such as temperature, rainfall, wind speed and direction, and atmospheric pressure. The parameters are monitored, recorded, and maintained in the block chain, allowing farmers to have transparent access to them.

Crop Insurance: Crop insurance is a type of agricultural insurance that has long been used to handle weather-related risks. Farmers may use smart contracts to cover their crops and file claims with insurance firms.

Fairer Payment for Farmers: Weather conditions, inelastic demand and supply, and global market circumstances may all have an influence on most farmers' incomes. Farmers are typically compensated for their commodities for weeks under the existing system, and payment methods such as wire transfers are usually expensive. Farmers will be able to negotiate better pricing thanks to a blockchain-linked mobile storage of transaction data. Smart contracts based on the blockchain function by automatically initiating payments when a certain, previously determined condition is met. As a result, farmers may obtain paid for their products as quickly as possible.

Improved Quality Control and Food Safety: Crop failure, for example, is a common problem for farmers all around the world. It frequently occurs as a result of bad meteorological circumstances, such as uneven rainfall and irregular weather. We can use blockchain to ensure that we have the best quality control conditions possible.

Information Security: Block chain technology offers private key encryption, which is a valuable tool for meeting authentication needs. The block chain technology protects existing data from being hacked or tampered with by any intermediate.

Secure Food Supply Chain: Blockchain technology allows items and people to be traced in real time across the supply chain. That is why retail behemoths like Walmart use blockchain to track the origins of food goods. The time it takes to find out where food comes from has been substantially reduced to only 2 seconds.

Transparency and Trust: The blockchain may be used to monitor the provenance of food and assist in the development of reliable food supply networks. Consumers will be free of imposters and recover faith in ecommerce. Between producers and customers, this will foster trust, transparency, and confidence.

Digital documentation, crop and food production, agricultural financial management, information systems, fraud protection, job automation, and information decentralization are some of the other uses of blockchain technology in agriculture.

5. CONCLUSION

The integration of IoT technology and the blockchain network creates a secure data storage solution for livestock, crops, and other elements. Soil quality, pests, irrigation, and a range of other elements may all be tracked using special phones or tablets that use particular sensors. As a result, blockchain technology is being utilized to improve a number of farm operations. It can assist in the development of a trusted, self-organized, open, and ecologically smart agriculture system that engages all ecosystem participants, even if they do not trust one other. With blockchain systems, food safety can be improved through traceability. Several agriculture companies are already using blockchain technology to enhance the tracking of food supply chains. By utilizing well-organized SC network, blockchain technology can help meet the need for high-quality food items.

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