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An Efficient and Transparent Agriculture Product Supply Chain Using Blockchain Technology

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ABSTRACT: A Web project to user identification and access control mechanisms to fill the gap for each supply chain participant. This application works on the basis of block chain technology, to avoid the modification data during transmission. This service boosts business communication and brings transparency in the system.[1] The agricultural information system provides ++ its users to get information about, farming products etc. Blocks of time-stamped product details are stored on all systems across a value chain. In the ever-evolving landscape of agriculture, the integration of technology is becoming increasingly crucial for streamlining processes, enhancing communication, and ensuring transparency across the supply chain.[2]

One of the ground breaking solutions to address these challenges is the implementation of a web-based project that incorporates user identification and access control mechanisms, leveraging the power of block chain technology. This innovative system aims to eliminate data tampering during transmission, fostering trust among supply chain participants and revolutionizing the agricultural information system.[3] Block chain, the distributed ledger technology, is renowned for its security, transparency, and immutability. These features make it an ideal candidate for addressing the vulnerabilities present in traditional agricultural information systems. In the proposed web project, block chain acts as the underlying technology, ensuring that every piece of information is securely stored in a decentralized and tamper-proof manner. This not only mitigates the risk of data manipulation but also establishes a reliable and transparent framework for all participants involved in the agricultural supply chain.[4]

I. INTRODUCTION

Agriculture is a big part of the economy of any country because it helps feed the entire population. It connects and communicates with all of the related industries. If the agriculture base is strong, it is generally regarded as a socially and politically stable society. Many modern farms make use of cutting-edge technology and scientific and technological ideas. The following are some of the reasons for food supply chain problems and processing environment challenges. The maximization of the profits relies on some farmers' vegetables and fruits with chemicals. Chemical fertilizers, insecticides, and other compounds are used in several plants and fruits.

As a result, pesticide residues in vegetables and fruits become excessive. It is a significant health risk. Food gets contaminated with heavy metals. The irrigation water source of crops is polluted by the excessive intrusion of heavy metal elements such as lead, tin, mercury, and zinc, which are dangerous to human health. Food additives are used excessively in food processing. Some nefarious enterprises use excessive food additives, antibiotics, hormones, and harmful substances.

As a formal definition, the blockchain is a distributed ledger to share transactions or sensitive data across untrusted multiple stockholders in a decentralized network. The data are recorded in a sequential chain of hash-linked blocks that facilitate the data distribution to be more manageable than other traditional data storage formats. In addition, the duplicates of these data are stored in all involved nodes to ensure no tampering. To make agricultural applications more efficient and reliable, we can divide blockchain applications into four categories. The first is the provenance of traceability and food authenticity. The second category is smart agricultural data management. The third category is trading finance in supply chain management. The last is the category of other information management systems.

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In agriculture, collecting data is frequently prohibitively expensive. The blockchain provides a dependable source of truth about the state of crops, inventories, and contracts. Food provenance is tracked using blockchain technology, which aids in the creation of trustworthy food supply chains and develops trust between producers and consumers. It also enables timely payments among stakeholders generated by data changes when used conjointly with smart contracts. Many characteristics of the blockchain make it unique and promising for future industrial applications. For example, blockchain is decentralized, transparent, immutable, irreversible, autonomous, open-source, ownership, provenance (authenticity and origin), and task automation. Contract automation (smart contracting) eliminates the need for a traditional contract while improving security and lowering transaction costs. Smart contracts are designed with rules and actions that applied to all parties participating in the transaction.

E-agriculture, or smart farming, refers to building innovative methods to use modern information and communication technologies (ICTs), such as the Internet of Things (IoT), cloud computing, machine learning, big data, and blockchain, to move towards more feasible agricultural and farming practices. Blockchain technology in agriculture is gaining traction because of its ability to move away from the centralized approach that now governs the farm value chain. The new technologies have produced Agriculture 4.0 or smart farming .

Smart contracts help manage the challenges in implementing the revenue sharing algorithm and improve productivity, transparency, security, traceability, and full integration between supply chain levels. Smart contracts are considered a flexible type of planning because they provide cost metrics that get used to accomplishing high productivity within plans for producing and delivering products in the context of current market restrictions and then executing the established programs. All innovation results from an attempt to solve a problem, and blockchain technology is no exception. After learning about the origins of blockchain technology, it is evident that blockchain solves a flaw in existing centralized agricultural systems.

At the security level, we can never eliminate vulnerability; it can only be decreased and lessened. When parties sought to establish an agreement, groups have always functioned as third-party lawmakers to reduce suspicion. One party expects fair goods, while the other hopes to receive the negotiated cash. Even though the buyer and seller have no reason to trust one another, they complete the deal because they trust the third party. Blockchain claimed to overcome these issues by helping apps develop in a decentralized and safe way and ensuring some guaranteed level. One of the critical reasons for blockchain's widespread adoption was this. Implementing blockchain and smart contracts and profiting from their advantages is a big motivation to improve the agricultural system model and make it more secure.

When we talk about the tracked product, we discuss the collected environmental data in which the goods have grown. The network members will get all the growth humidity, temperature, light, and soil pH details. They have code that says "If *x* event occurs, perform *y* action." The participant will receive the updated data every period. When the customer knows all data about the product that he will buy, he will be satisfied with all this shared information and glad to be a part of this commercial deal. Also, when the farmer controls all the necessary conditions to grow the optimum quality, he will build the confidence to share information with customers and gain their trust. Another example of an advantage for the supply chain management provided by the scheme is allocating goods arrived and which container is in it. Blockchain allows tracking and storing information.

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Concerning the prospective research gap and research challenge, we noticed that many researchers built a scheme that consists of a single blockchain that stores data about farms, entities, products, financial business, deals, and trades all in one distributed ledger. We reckon that the data in our system need to be more structured. The research challenge is placing data related to individuals into "the user blockchain," data describing products into "the product info blockchain," and data related to deals between entities into "the transaction blockchain. Also, the relationship between entities builds on trust, and each participant knows their responsibilities and rights. On the other hand, we have seen that some researchers do not automate specific tasks, such as detecting environmental sensor data without intervention. So after doing some studies, we have decided to work with smart contracts as a blockchain companion.

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II. SYSTEM ANALYSIS

Existing System:

The traditional way of traceable applications gathers information and stores it in a centralized model which is maintained by an enterprise/government center may not be feasible. There are not many traceability solutions available to trace the origin of the product. This kind of centralized and retailer-oriented traceability solution may be faulty due to the possibilities of data alteration happen in between the retailing enterprises. The demand in the current supply chain situation is to adopt a transparent, secured and supporting traceability solution with advanced technological potential.

Limitations:

Difficult for stakeholders to trace the journey of agricultural products from farm to consumer. This lack of transparency can result in inefficiencies, fraud, and difficulties in verifying the authenticity and quality of products. Traditional supply chains susceptible to counterfeiting and fraud. Participants in the supply chain may not fully trust each other due to the lack of transparency and verifiability.

Proposed System:

Implement agriculture supply chain to ensure product provenance, information transparency, prevention of false information and product adulteration. In this application User needs to register themselves with their personnel details like mail id, mobile number, Adhar number and their location. This confidential information will be hashed and stored in the blockchain database. By leveraging features of blockchain such as distributed ledger, cryptographic hashing, and timestamped records, a blockchain based traceability solution for the agriculture supply chain has been proposed and deployed here.

Expected Merits:

Authentication process helps to cross check the authentication of the owner in case of product quality and anti-counterfeiting concerns. The block chain guarantees traceability and non-degradability of information. It decreases the success rate of attackers. Keep track of daily information exchange at the server by the administrator.

SYSTEM REQUIREMENTS

Hardware Requirements:

- System : Pentium IV 2.4Ghz
- Hard disk : 100Mb
- Monitor : 14 Inch Color Monitor
- RAM : 1 Gb

Software Requirements:

- Operating System: Windows
- Front End : ASP.NET
- Back End : SQL Server
- Tool : Visual Studio 2010

Software Description:

ASP.NET:

The front end of a web application is the part of the application that users interact with directly. It is typically built using HTML, CSS, and JavaScript. ASP.NET is a web development framework that makes it easy to create front ends for web applications.

SQL Server:

The back end of a web application is the part of the application that handles the data and logic. It is typically built using a programming language such as C# or Visual Basic. SQL Server is a relational database management system that is often used to store and retrieve data for web applications.

Visual Studio 2010:

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Visual Studio 2010 is an IDE that is used to develop Microsoft .NET applications. It provides a variety of tools and features that make it easier to develop and debug applications.

III. LITRETURE SURVEY

- **Title** : Blockchain-based solution for the traceability of spare parts in manufacturing [2020]
- **Author** : Hasan, Haya R., Khaled Salah, Raja Jayaraman, Raja Wasim Ahmad, Ibrar Yaqoob, and Mohammed Omar
- **Concept** : Propose a blockchain based smart contract to trace and track the parts ownership details from the original equipment manufacturer to the supplier and end-users.
- **Limitation:** Some of these challenges include scalability, governance, energy, privacy, security of smart contract codes, transaction costs, and interoperability.
- **References:** Hasan, Haya R., Khaled Salah, Raja Jayaraman, Raja Wasim Ahmad, Ibrar Yaqoob, and Mohammed Omar. "Blockchain-based solution for the traceability of spare parts in manufacturing." IEEE Access 8 (2020): 100308-100322.

- **Title** : A blockchain based solution for medication anti-counterfeiting and traceability [2020]
- **Author** : Zhu, Peng, Jian Hu, Yue Zhang, and Xiaotong Li.
- **Concept** : Proposes a blockchain based method for medication information, and anti-counterfeiting along a medication supply chain.
- **Limitation** : All information is stored on blockchain as proposed, which will demand and consume large amount of storage resources Blockchain technology can be used to record and store data along a medication chain.
- **References** : Zhu, Peng, Jian Hu, Yue Zhang, and Xiaotong Li. "A blockchain based solution for medication anti-counterfeiting and traceability." IEEE Access 8 (2020): 184256-184272.
- **Title** : A trusted blockchain-based traceability system for fruit and vegetable agricultural products. [2021]
- **Author** : Yang, Xinting, Mengqi Li, Huajing Yu, Mingting Wang, Daming Xu, and Chuanheng Sun.
- **Concept** : Designs a traceability system based on blockchain technology for storage and query of product information in supply chain of agricultural products.
- **Limitation:** The data deluge in blockchain can result in increased network congestion and higher latency.
- **References:** Yang, Xinting, Mengqi Li, Huajing Yu, Mingting Wang, Daming Xu, and Chuanheng Sun. "A trusted blockchain-based traceability system for fruit and vegetable agricultural products." IEEE Access 9 (2021): 36282-36293.
- **Title** : Design and implementation of food supply chain traceability system based on Hyperledger Fabric. [2020]
- **Author** : Gao, Kui, Yang Liu, Heyang Xu, and Tingting Han.
- **Concept** : Implement a food supply chain traceability system called FSCTS which aggregates all the enterprises and organisations along the food supply chain to make deals and transactions on the blockchain.
- **Limitation:** Need to improve the query efficiency of the system
- **References:** Gao, Kui, Yang Liu, Heyang Xu, and Tingting Han. "Design and of food supply chain traceability system based on Fabric." International Journal of Computational Science and Engineering 23, no. 2 (2020): 185-193.
- **Title** : Blockchain-based traceability and visibility for agricultural products: A decentralized way of ensuring food safety in India. 2020]
- **Author** : Prashar, Deepak, Nishant Jha, Sudan Jha, Yongju Lee, and Prasad Joshi.
- **Concept** : Proposed a blockchain-based solution that removes the need for a secure centralized structure, intermediaries.
- **Limitation** : The authenticity of registered information still needs verification.
- **References** : Prashar, Deepak, Nishant Jha, Sudan Jha, Yongju Lee, and Gyanendra Prasad Joshi. "Blockchain-based traceability and visibility for agricultural products: A decentralized way of ensuring food safety in india." Sustainability 12, no. 8 (2020): 3497.

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IV. CONCLUSION

In conclusion, the proposed scheme achieves high security in agriculture product sales through web application. Each transaction has unique hash code for verification. Blocks are interconnected with hash code, it ensures the security enhancement in agriculture application. Blockchain and IoT technologies can aid in developing a secure, transparent, open, and innovative ecological agriculture system that involves all participants. This work aims to provide a possible technique to build practical blockchain-based applications and change the agriculture industry, even though the evolution of blockchain and agriculture research studies is still in its infancy. This model is considered a prototype for reducing financial loss and agricultural pollution. The system defines the three primary entities in the agriculture domain: data, process, and stakeholders. Adding a cryptocurrency process for the interaction between the entities and registering/tracking the seller's land will be a big step for this blockchain system model.

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1. Hasan, Haya R., Khaled Salah, Raja Jayaraman, Raja Wasim Ahmad, Ibrar Yaqoob, and Mohammed Omar. "Blockchain-based solution for the traceability of spare parts in manufacturing." IEEE Access 8 (2020): 100308-100322.
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