Hyperledger Based Farm Product Traceability Using Blockchain

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ABSTRACT

Consumers nowadays are very interested in food product quality and safety. It is challenging to track the provenance of data and maintain its traceability throughout the whole supply chain network without an integrated information system. For this purpose, Agriculture and Food(Agri-Food) force chains are developing complex systems which are responsible, in addition to track and store orders and deliveries, to guarantee translucency and traceability of the food product and metamorphosis process. Food force chains have a tremendous complexity which is regularly the cause of need for plumpness and traceability. In the proposed method, all the partners taking part within the agri supply chain (beginning from the agriculturists to the retail marketers) feed details like crop collected date, cleansing and packaging processes held in an permissioned blockchain network called as hyperledger fabric. The hyperledger fabric network requires all the nodes to be certified some time recently. Thus, it assures,only the trusted and certified partners can take part. By using the proposed model, the transparency of the product details are extended to the customers with Hyperledger Fabric.

Keywords — *Supply chain, Food security, Blockchain, traceability system, Hyperledger, Docker, Traceability, Hyperledger Fabric*

INTRODUCTION

Over usage of chemicals within the production process, use of uncertified chemicals and mechanisms for preservation and ripening processes, are the most important issues that impact on agricultural product's quality also as overall health of the consumers. Nowadays, consumer's concerns regarding food provenance and quality are extremely high, leading to the tendency to spend more cash on food products whose origin is certified. Existing systems lack transparency and consumers' trust because of the unavailability of a quick and trustworthy platform to retrieve information on the product's provenance. In our work we propose a whole model of a blockchain based agri-food supply chain traceability system and achieve transparency with Hyperledger Fabric. It's built on the Hyperledger Fabric platform where all data is stored on blockchain ledgers and are accessible throughout the complete supply chain from producer to consumer.

LITERATURE SURVEY

In the existing system the authors propose the use of a three- layered sharded armature that ensures trustability and vacuity of data for consumers and scalability with respect to sale prosecution outturn.[1] In the existing method, supply chain traceability, A dual storage structure of "database +

blockchain" is constructed to reduce load pressure of the chain and realize efficient information query [2] In the proposed method, smart contracts are used to switch and handle all communications and dealings amongst all shareholders in the supply chain network. AgriBlockIoT is a blockchain-based traceability key that comprises facts since IoT devices in the supply chain [3].Walmart thought that blockchain technology might be a good fit for the decentralized food supply ecosystem. [4] To test this hypothesis, the company created a food traceability system based on Hyperledger Fabric.The Hyperledger Fabric blockchain-based food traceability system built for the two products worked. In the existing system,TheProvider-Consumer Network is a blueprint for creating such a

prototype to assemble the components.[5] They described the usage of token, smart contracts in Ethereum Platform To Integrate Between nodes in the supply chain Management. The being system makes use of RFID(Radio- frequence IDentification) and blockchain technology in erecting the agri-food force chain traceability system [6].

RELATED WORK

- ## HYPERLEDGER FABRIC

Hyperledger Fabric is meant to serve as a framework for constructing modular applications or solutions. Hyperledger Fabric supports plug-and-play components like consensus and membership services. Its flexible and adaptable architecture meets a wide range of industry application cases. To compare Ethereum to Hyperledger Fabric, you must first understand how Ethereum works in practice. The Ethereum Virtual Machine (EVM), a Turing-complete programme, is used in the majority of the procedures. Essentially, it executes certain scripts over a dispersed network of devices. Furthermore, it enables smart contract execution and records everything from the DAO (what is DAO) to smart contract laws. In reality, developers may construct decentralized apps on top of the Ethereum framework. As a result, there are many organizations, games, distributed registries and other fun programmes.

Hyperledger Fabric not only meets compliance requirements, but it also helps organizations reduce counterfeiting and theft by letting them trace conflict commodities along the supply chain. It safeguards the interests of transporters, buyers, and suppliers while preserving the integrity of the system and deterring counterfeiting. The levels of scalability, performance, and trust have all improved. One of the issues with the blockchain ecosystem is that trust and verification points are scattered over numerous nodes, producing latency and choppy performance and hindering enterprises from scaling up the network. Hyperledger addresses this issue by dividing sale processing into three sections: sale ordering, distributed sense processing and agreement (chaincode), and sale confirmation and collaboration. This reduces the quantum of trust and verification that's needed across multitudinous bumps. Hyperledger Fabric ensures that only read/ write sets and autographs are rotated across the network. This increases the flexibility of the transaction process by reducing the amount of data that must be sent across the network. Furthermore, it helps businesses achieve high scalability and peak performance. It also reduces the amount of trust required across the various points of the blockchain system, ensuring greater security. This is a useful feature in situations where the transaction volume increases rapidly as the number of participants increases. Real-time equity trades in the capital market are a great real-world example. In these situations, instant scalability, consistent performance, rapid speed, and higher levels of security are all required. Because of its chaincode execution and other important features, Hyperledger Fabric distributes the load while carefully partitioning the trust levels to ensure maximum network security. As previously stated, the Hyperledger Fabric transaction flow mechanism is built on the "execute-order-validate" paradigm.

The method is as follows:

1. The endorsement proposition is sent to the group participants via the client application.

2. After verifying the client's identity, peer members examine to see if the output of the transaction delivered by the client application fits the expectation. If the endorsements match, theendorsement is returned to the customer.

3. After obtaining all of the endorsements specified in the endorsement policy, the client launches the ordering service for the transactions.

4. The transactions are ordered sequentially before being added to the blocks using the ordering technique. When these blocks arrive, corporate network nodes validate transactions. Once the block has been validated, it is added to the blockchain.

Enterprises are increasingly using the Hyperledger Fabric architecture to provide modularity to their products and applications. It enables these firms to take advantage of improvements in blockchain technology and simplify their operations in order to enhance production. Differences between Blockchain and other technologies Zero-knowledge proof asset management protocols built on Hyperledger Fabric permissioned blockchains are cutting-edge.

Strong privacy is maintained, ensuring not only the anonymity of transaction participants but also the total unlinkability of assets moved from one party to the other (that is, UTXO graph concealment).Furthermore, these protocols are suited to the requirements of permissioned systems. Individual users' long-term identities are taken into account, as are strong accountability and non-repudiation of user involvement in transactions, as well as robust and secure auditing capabilities on the privacy-preserving transactions broadcast in the blockchain. The Hyperledger Fabric protocols offer an audit architecture in which auditors are allocated to one or more system users but do not participate.On a more technical level, Hyperledger Fabric protocols depend on conventional cryptographic assumptions and have a lightweight configuration that is readily dispersed. Finally, these show consistent transaction generation and validation times that are independent of the amount of transactions previously submitted to the ledger.

- **COMPONENTS OF FABRIC NETWORK**

In Hyperledger Fabric, smart contract is referred to as chain code, which is program code that implements the application logic and runs during the execution phase. it's one amongst the integral parts of the distributed application hosted on Fabric Blockchain.

Peer:

A blockchain network consists of peer nodes, each of which can hold copies of ledgers and copies of smart contracts.

Chain code:

Chaincode could also be a chunk of code that's written in one in every of the supported languages like Go or Java. it's installed and instantiated through an SDK or CLI onto a network of Hyperledger Fabric peer nodes, enabling interaction therewith network's shared ledger.

The proposed model uses chaincode which can be a container for deploying Smart contracts on Fabric networks integrated with mobile applications running on smartphones. One or several smart contracts for various functionalities are often defined within a chaincode involved in Ecommerce. Every smart contract includes an identity that's uniquely identified during a chaincode. Chaincode is executed within a secured Docker container isolated from the endorsing peer process. It initializes and manages ledger state through transactions submitted by application.

The chaincode can address the smart contract for:

Authentication:

This smart contract can address the matter of authenticating the seller through a predefined channel because the regulatory governmental bodies in-scribe. This ensures the services reachability to the marginalized/non marginalized farmers with the required Consumer demand.

Traceability:

The factor of traceability relies on the strategy of the products transaction similarly because the danger involved just in case of damaged/spoiled goods. The logistical approach of Hyperledger Fabric within the primary scenarios relies on the parties exchanging the products on a step and creating changes within the network supporting the future step till the products reaches to the last word stakeholder. Within the second scenario, since the knowledge obtained from authentication makes the strategy of origin of the products involved traceable, just in case of any food hazard involved can be further reported to the regulatory authorities.

Transaction Records:

The transaction record of the mutual exchange of products with the financial data is also further pushed to the smart contract which could cater to the data being added to the chain of records within the ledger history of both the parties. this might make both the parties being adhered to the products being exchanged between them as per the acknowledged terms altogether aspect.

PROPOSED SYSTEM

- **SYSTEM OVERVIEW**

Food force chains have a vast complexity which is frequently the cause of lack of translucency and traceability. On top of that, a major issue directly affecting public health is food safety. Low quality agrarian products are added to the request daily. Over operation of chemicals in the product process, use of uncertified chemicals and mechanisms for preservation and growing processes, are the major issues that impact on agrarian product's quality as well as overall health of the consumers. currently, consumers ' enterprises regarding food provenance and quality are extremely high, performing in the tendency to spend further plutocrats on food products whose origin is certified. Existing systems warrant in translucency and consumers ' trust due to the attainability of a fast and secure way to recoup information on the product's provenance.In our work we propose a complete model of a blockchain grounded agri- food force chain traceability system and achieve the translucency with HyperledgerFabric.Our approach fully relies on the use of block chain to cover and manage all dispatches and deals within the force chain network among all of the stakeholders and to make to make every detail of the product visible toconsumers.It's erected on the Hyperledger Fabric, an permissioned

blockchain network which allows only hyperledger fabric certified bumps to share in the network. The farmers, factory members, wholesale & retail shop keepers are hence certified and are trustworthy. These stakeholders feed the details in the ledger. The block is initiated by the farmer when the product is harvested, then the factory member enters details about cleansing process, packaging process and when the retail shop keeper feeds the details about the product reaching the market the block ends and is verified and committed. When a customer buys the product, he/she

can scan the code present in the packaging which locates the block containing information about the particular product and it displays the entire blockchain to them. Hence the details of the farm products are stored safely and the transparency is also extended to the customers.The different stakeholders taking part in the supply chain are given in Figure 4.1.

Figure 4.1: System diagram of proposed model

IMPLEMENTATION PHASES

The stakeholders participating in the agricultural supply chain (starting from the farmers to the retail marketers) to feed details like crop harvested date, cleansing and packaging processes taken place in the factories in an permissioned block chain network called as hyperledger fabric. The hyperledger fabric network requires all the nodes to be certified before joining. Hence, only the trusted and certified stakeholders can participate. Various stages of working is explained in detail.

1. Sign Up : When a new stakeholder is being added to the permissioned network, they are asked to sign up as a new user. While signing up, they provide Email, a strong password and type of stakeholder.

2. Sign In : When the existing node of a network needs to provide details about the supply chain, they just sign in by providing the Email and password. Any existing or new product pending in their account is shown up where they can complete the pending work.

3. Customer View: It is a specialized view page for end users. It does not require any kind of sign up/sign in. Instead, there is a product id attached to every product. A customer can use our website and navigate to the "Track Product" link. Here, they can enter the product id and click on track. The entire supply chain along with the details fed by the stakeholders is shown.

EXPERIMENTAL RESULTS

This paper focuses on development of a hyperledger fabric based agricultural farm products traceability using blockchain. The following results show the output received from various stages of the proposed method.

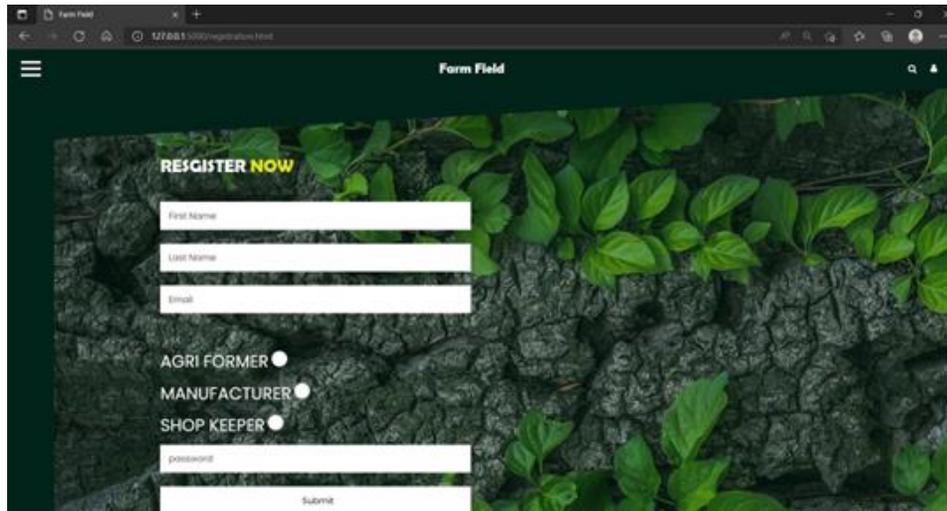For a new stakeholder, a sign up page is shown in Figure 5.1.

Figure 5.1 : Sign Up page

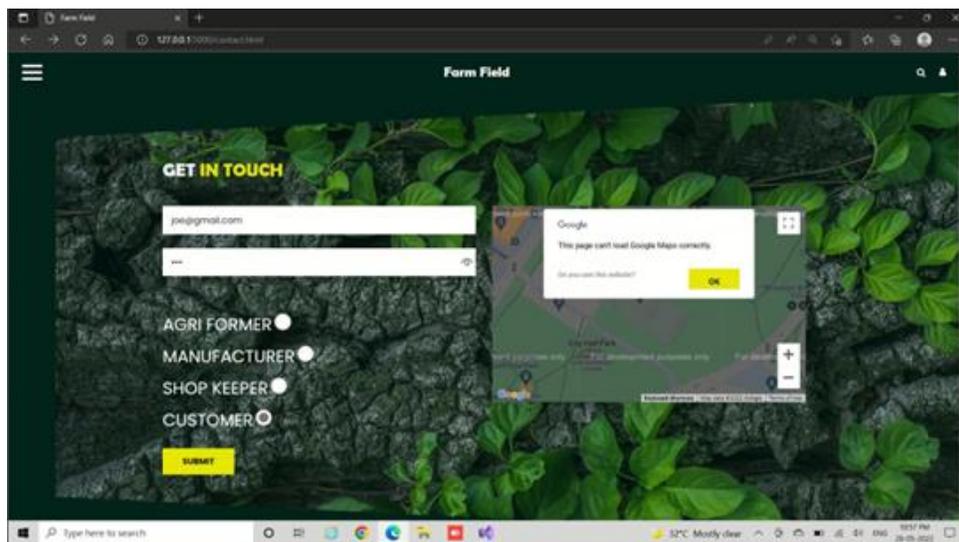For a existing stakeholder, a sign in page is shown in Figure 5.2.

Figure 5.2 : Sign In page

Farmer : The farmer acts as a primary stakeholder. The block will be initialized by the farmer providing the details about the quantity of the crop harvested. After feeding the details about the crop, the farmer sells the product to the manufacturer for further process.

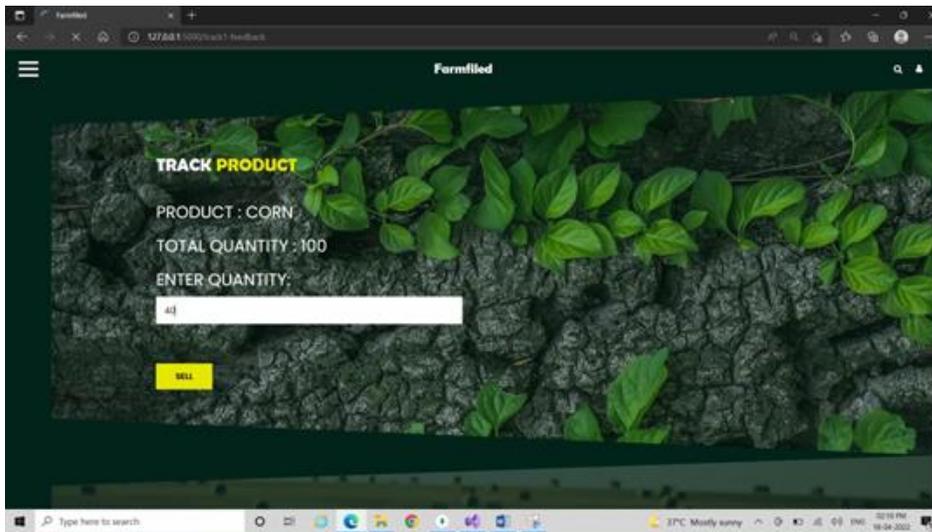The farmer's data entry page is shown in Figure 5.3.

Figure 5.3 : Farmer page

Manufacturer : The manufacturer receives the crop when the farmer sells it to them. The manufacturer takes the responsibility of cleansing and packaging. These processes of cleansing, packaging and other processes may require one or more stakeholders in addition. The details about the product cleansing and packaging is fed into the block. As soon as the product is cleansed and packed, it is sold to the wholesalers or retailers.

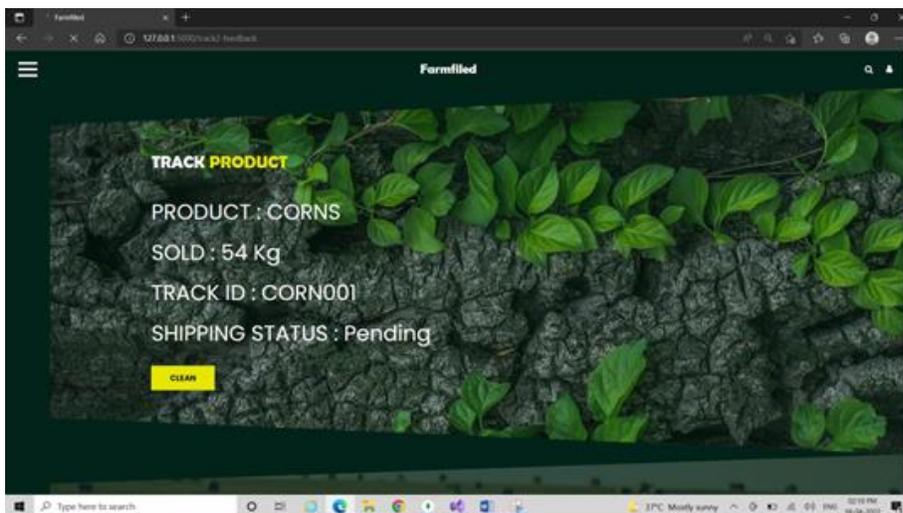The manufacturer's data entry page is shown in Figure 5.4.

Figure 5.4 : Manufacturer page

Shopkeeper : The cleaned and packed product is sold to the shopkeepers. The shopkeeper makes the last addition to the block by providing the information about the sales of the product.

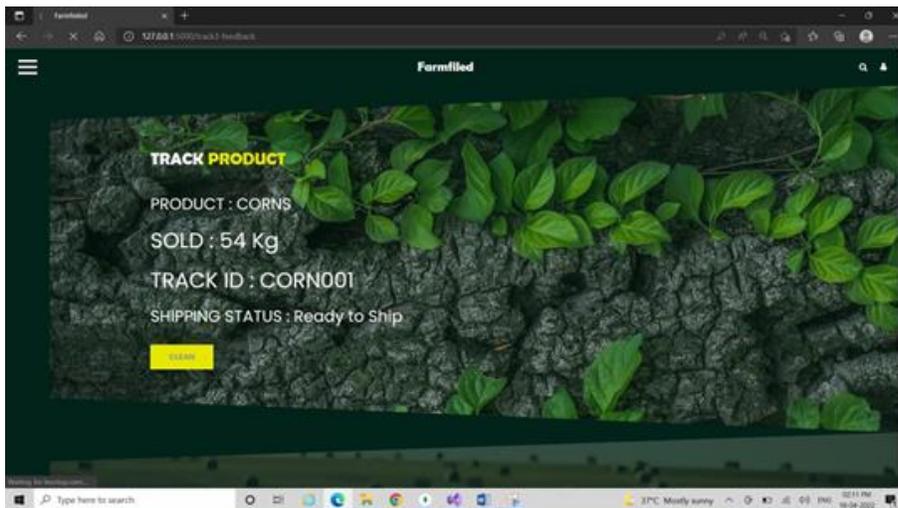The shopkeeper's data entry page is shown in Figure 5.5.

Figure 5.5 : Shopkeeper page

Customer : When an customer buys the product, he/she can scan the code present in the packaging which locates the block containing information about the particular product and it displays the entire blockchain to them.

The customer facility to view the product supply chain is shown in Figure 5.6.
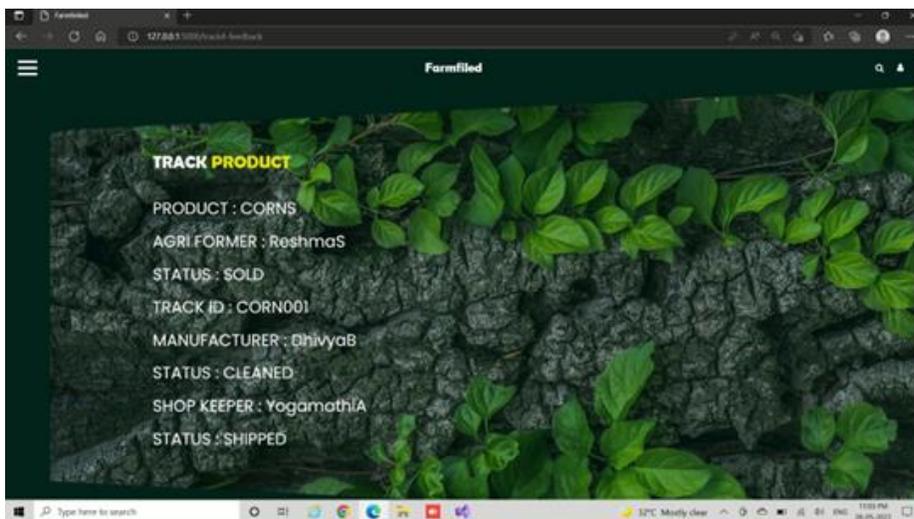

Figure 5.6 : Customer track product page

PERFORMANCE METRICS

Hyperledger Fabric is a framework for private permissioned blockchains. It's best suited for ensuring transparency for groups of organizations that do not fully trust each other. Fabric helps organizations keep their information for authorized parties only and is designed for entities that

want to have more control over data and more privacy with fine-grained permission control. The study from 2021, conducted based on a literature review, shows that Hyperledger Fabric is the most promising and useful blockchain framework for various industries when compared to other blockchain frameworks like Ethereum or Multichain.
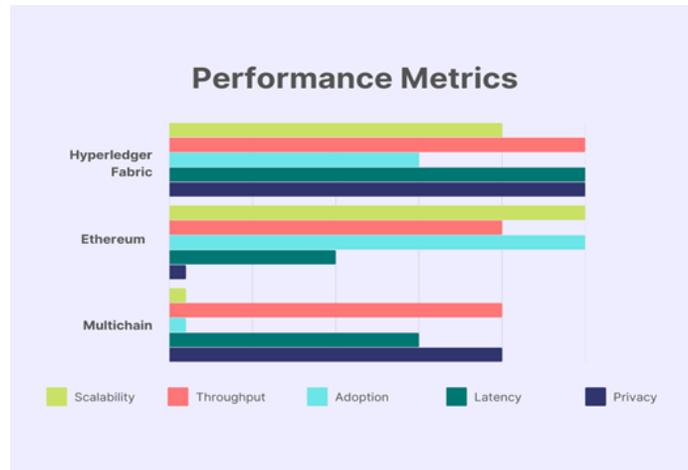

Figure 6.1 : Performance Metrics

CONCLUSION

The development of a HyperLedger Fabric based Agricultural Farm Product traceability using Blockchain. It is built on the Hyperledger Fabric, an permissioned blockchain network which allows only hyperledger fabric certified nodes to participate in the network. The farmers, factory members, wholesale & retail shop keepers are hence certified and are trustworthy. These stakeholders feed the details in the ledger.The block is initiated by the farmer when the product is harvested, then the factory member enters details about cleansing process, packaging process and when the retail shop keeper feeds the details about the product reaching the market the block ends and is verified and committed. Hence the details of the farm products are stored safely and the transparency is also extended to the customers. From the evaluation results the proposed method has high accuracy in classification and also provides results with less time consuming and accurate results without false positive and false negative classification.

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