Designing Agricultural Supply Chain Tracking System by using Blockchain

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Abstract—In today's continuous business arrangements, there is a call for an efficient solution to handle complex scenarios and address security risks related to the supply chain. One of the supply-chain is related to agriculture where business and stake-holders can't afford any security breach and need transparency and tracking of transactions between stakeholders. There have been many frauds and scams due to a lack of transparency in supply-chain which resulted into customer getting counterfeit products. These issues have provided a route to the blockchain topology that ensures data security, process transparency and all partners will have equal access to the information vault in contrast to the accepted practice. Perhaps the Blockchain can appropriately address the difficulties of rural and urban division using a circulating system that is integrated. Blockchain is used to ensure that any exchange, whether of a product or applications for administration are reviewed and stored with care. An accessible archive that almost anyone can access. Blockchain can calmly handle the problems arising throughout the farm produce supply-chain.In this report, it suggest that readers understand the problems plaguing the agribusiness supply chain stake-holders and how the given solution can be applied to assist them in the overall supply chain process giving the transparency by using blockchain and qr code.

Keywords—Blockchain, qr-code, supply chain, farmer, crop, distributor, retailers

I. INTRODUCTION

Blockchain is a public ledger that many parties may view simultaneously. The fact that the information is recorded and difficult to modify without agreement from all stakeholders is one of its main advantages. Blockchain makes it easier to verify and track multi-step transactions that need such services. It can expedite data transfer operations, provide secure transactions, and save compliance costs. Blockchain technology can facilitate contract administration and verify a product's provenance. Bitcoin cryptocurrency uses blockchain technology.

It has a wide variety of uses outside of cryptocurrency. The agriculture sector, a little-studied area, may be changed in a variety of ways utilizing blockchain. To guarantee product safety, it is essential to monitor the growth of agricultural products and manage logistics effectively in the food and agricultural supply chains. Growing worries about food safety and contamination hazards have refocused attention on the need for improved supply chain traceability. Agriculture is a process that requires farmers to go through a number of steps and transitions in order to supply their goods to consumers. They could run into issues with crop quality, the food supply chain, or food safety information while doing this. It is crucial to keep the appropriate quantity of information for each step; doing so will promote transparency and prevent different block stakeholders from being misled in any manner. It is challenging to monitor and trace items in the agricultural production and the food supply chain since information is dynamic and products are generated, processed, and delivered through several intermediaries. Product contamination and its effects on public health place a high emphasis on traceability as a crucial policy instrument for ensuring the quality and safety of food. As a result, a secure framework must be developed to track information regarding the place of origin, the agricultural techniques used, and the safety of the food product throughout the supply chain cycle without the involvement of a third party or centralized management. Provenance and protocol rules across various distributors, processors, and retailers are a few more significant problems in this chain cycle that need to be resolved. Using blockchain technology and QR codes, we present a framework of solutions for traceability and visibility in the agricultural supply chain.

II. RELATED WORK

According to Akram, [1] to understand the challenges developed in the horticulture sector and how innovation may be used to address the issue in the overall cultivating procedure utilising a unified distributed organise viewpoint employing BLOCKCHAIN. Blockchain enables to perform a transaction, which is secure, and transparent to everyone on the open network, nobody can alter him or her unless there is a need.of transaction. Each participant in a blockchain network owns and updates the state of the data independently that is consensually shared and replicated. Blockchain may be used to centralize the process of agriculture from farmer sowing the crops to consumers buying them from a retailer. Farm to fork farming is a process of centralizing farming process through the use of technology, blockchain can be used to create a block of data with the essential information required to carry out a valid transaction to maintain transparency. To address the issue of food data we can create a block for each product and store relevant information about that particular product.

In paper [2] ,The globalisation of agricultural production and distribution places a fresh emphasis on the safety, quality, and validity of numerous critical criteria in agriculture and food supply chains. The suggested approach relies on the use of smart contracts to manage and control all interactions and transactions among all supply chain ecosystem players. All transactions are recorded and maintained in the blockchain's immutable ledger, which is linked to a decentralised file system, giving all stakeholders with a high degree of transparency and traceability into the supply chain ecosystem in a safe, trustworthy, dependable, and efficient manner. The food and agriculture supply chain is receiving a lot of interest from the academic community because the excessively lengthy supply chain from raw materials to the end customer makes tracking back the origin of a product particularly difficult and time-consuming. The primary goal of this article is to show how blockchain and Ethereum smart contracts can easily monitor and track business transactions and processes in the agricultural supply chain. This paper's main contribution may be summarised as follows: We can provide a blockchain-based solution and framework for traceability supply chain using Ethereum smart contracts.

The study made by Pranav Kamble, Dinesh Hanchate [3] where they have made similar kind of blockchain for supply chain of farm-produce where they have used the SHA-5 algorithm for encrypting data and create a hash.The network in their project preserves a ledger copy, so when a new block is put to the Blockchain, the logger is likewise new to all nodes. The most critical aspect required for dependability and trustworthiness in the Blockchain-enabled supply chain. Blockchain is generated by adding a new block to the end of the chain. This method returns an unreadable format, and n-bits of input can be transformed to 256 bits. In this instance, the hash algorithm comes into play. The acronym SHA stands for secure hashing algorithm. It outlines the rules and regulations that will govern Blockchain transactions. Users

may easily login with their credentials and purchase or sell things based on their job, with the transaction being kept in Blockchain. When adding data to the chain, the entire chain is confirmed by checking the previous hash value of the block before it.

In paper [4] Modern agribusiness supply-chains have evolved from autonomous, independent, and local actors to a globally interconnected system of multi-actors linked by complicated interactions, influencing how food is produced, acquired, processed, transported, and supplied to the end consumer. The prevalence of fraudulent tactics reveals a lack of openness and susceptibility in agri-food supply chains, generating economic losses and diminishing consumer trust and company brand value. Blockchains, which have traditionally been connected with crypto-finance sector, are increasingly being used in the agribusiness sector to address supply chain difficulties.Study has investigated how blockchain platforms improve transparency in supply systems. Blockchain's primary characteristics, including traceability, immutability, audit-ability, and provenance, encourage transparency in supply chains.

The paper [5] explains the underlying concepts of blockchain technology and delves deeper into the potential applications of this technology. Some of the most popularized and famous cryptocurrencies, including Bitcoin, Ethereum, USD Coin, Ripple, and ADA, were taken into account in one section of the examination. The writers examined the use of blockchain technology in supply chains, finance, real estate, health care, voting, and smart cities in their chapter on its applications. The blockchain technology's drawbacks are covered in a different chapter. At the conclusion of the study, the authors draw the conclusion that blockchain technology offers enormous promise for automating and optimising business operations as well as safeguarding user data and privacy. The authors came to the conclusion that blockchain technology's time has not yet come given the businesses' indicated interest in it, their investments, and the demand for personnel who are familiar with it and can develop applications.

Giovanni Mirabellia, Vittorio Solinaa in paper [5] state Given the large number of scientific publications in recent years, the results of a three-step research methodology showed that this technology is rapidly advancing; however, when it comes to the agricultural industry, it can still be considered in its early stages because there are virtually no real-world case studies and because it is currently unclear how an agricultural supply chain can benefit from an organisational and economic perspective. Additionally, it would be important to boost stakeholders' potential tendency to use this technology; significantly, much work needs to be done to improve blockchain's trust and reputation.

According to Bingzhang, Li Zirianov, Vladimir [6] the number of new projects for the implementation of block-chain technology in international transport logistics will significantly rise as a result of boosting supply chain transparency, lowering the human factor, and automating administrative business operations. It is already possible to see how Blockchain and

IoT technologies interact, leading to the creation of VIoT as a brand-new entity. As a result, it will be feasible to connect artificial intelligence and other digital technologies as well as to synchronise the actual flow of goods with the financial and informational flows. The dominance of independent, public open Blockchain networks, which offer greater visibility and accountability in the registration of supply chain transactions, tracking of orders and trade logistics-related documents, and appointment and verification of product certificates and properties, however, can be attributed to the public's demand for greater transparency and openness in logistics processes. Since using public Blockchain networks does not make personal data accessible to the general public, its use will only increase.

Paper [7] states that numerous challenges and problems continue to prevent blockchain from becoming more generally adopted by farmers and food supply chains. Blockchain is a promising technology that might lead to a transparent food supply chain. It will soon be obvious whether and how public and private initiatives can overcome these problems in order to establish blockchain technology as a secure, trustworthy, and transparent mechanism for maintaining food safety and integrity. It would be interesting to observe how blockchain is incorporated with other cutting-edge technologies (such as big data, robots, IoT, RFID, NFC, hyperspectral imaging, 5G, edge computing, etc.) to increase the automation of the food supply operations while enhancing full transparency and traceability.

In paper [8] the product verification system deploys smart contracts in blocks using the Ethereum blockchain. There are two types of users: manufacturers and consumers. Manufacturers may use the blockchain to store product information like as the price, name, production date, manufacturing location, and expiration date as a smart contract that can be recorded inside QR codes and NFC tags. This QR code and the NFC serve as a digitalized invoice for the product, which may then be used in the product. Where clients may authenticate the product or can view the product by scanning the NFC tag or the QR code to acquire product details. Solidity is used to build the smart contracts, and the Truffle blockchain deployment tool was used to finish the deployment. Through the usage of Firebase, the authentication capabilities have been handled, and it is now possible to see the numbers of customers who have successfully authenticated themselves as well as other analytics. The goal of the entire competition was to reduce supply chain management fraud and product tampering.

Paper [9] offered a blockchain-based solution that eliminates the requirement for a secure centralised structure, middlemen, and information exchanges, improves performance, and complies with a high standard of safety and integrity. In order to track and manage all interactions and transactions within the supply chain network among all of the stakeholders, their strategy solely relies on the use of smart contracts. Their method validates each transaction, which is then recorded and kept in a central database of the interplanetary file system. The stakeholders can use a safe and economical supply chain system. As a result, the proposed model provides an accurate, transparent, and traceable supply chain system. With a

throughput of 150 transactions per second and a convergence time of 5 seconds, the proposed system was determined to be efficient for agricultural product traceability.

In article [10], the authors suggested a blockchain-based supply chain management system that uses QR codes to improve supply chain security, traceability, and transparency. The solution enables stakeholders to access and check the legitimacy of items at every step of the supply chain by using smart contracts, digital signatures, and QR codes. Numerous advantages of the suggested method include increased confidence, less fraud, and greater supply chain effectiveness. The results of this study demonstrate how blockchain-based supply chain management solutions have the potential to completely transform the logistics and supply chain sector.

With the use of QR codes, the authors of paper [11] created a blockchain-based supply chain management system that allows for transparency and traceability in the pharmaceutical sector. The technology offers stakeholders a safe and impenetrable platform to monitor the flow of medications from producers to patients. By ensuring that the pharmaceuticals' quality and validity are maintained, the suggested approach lowers the possibility of fake drugs entering the supply chain. The results of this study demonstrate how blockchain technology has the potential to increase the security and transparency of the pharmaceutical supply chain.

In paper [12], the authors suggested a blockchain-based approach to handle supply chain difficulties with food traceability and quality. The system tracks the flow of food goods and logs details about their quality, provenance, and other pertinent information using QR codes. The authors gave examples of how the suggested strategy enhanced transparency and decreased supply chain fraud. The suggested remedy guarantees that food products remain original and of high quality, minimising the possibility of tainted or expired goods entering the supply chain.

In paper [13], the authors looked into how to increase transparency and lower fraud in agriculture supply chains by using blockchain technologies. The authors emphasised how the traceability, immutability, and provenance of blockchain technology may promote supply chain transparency and foster confidence among stakeholders. The authors also noted a number of difficulties with putting blockchain ideas into practise, including scalability and interoperability problems. The study's conclusions show that the agriculture supply chain has a great deal of potential to be revolutionised by blockchain-based solutions.

For the textile sector, the authors of paper [14] created a blockchain-based supply chain management system that uses QR codes to trace the movement of materials and clothing. At every step of the supply chain, the system enables stakeholders to confirm the items' legitimacy and guarantee that they adhere to quality requirements. The authors gave examples of how the suggested strategy enhanced transparency and decreased supply chain fraud. By guaranteeing product quality and authenticity across the supply chain, the suggested solution has the potential to completely transform the textile sector.

Using QR codes, the authors of paper [15] suggested a blockchain-based system for tracking and controlling the supply chain of essential medical products. In particular during situations like pandemics, the system offers stakeholders a safe and transparent platform to follow the transfer of medical supplies and assure their validity and quality. By ensuring that medical supplies are delivered effectively, the suggested approach lowers the possibility of shortages or overstocking. The study's findings show how blockchain-based solutions might help with supply chain issues and guarantee the prompt delivery of vital medical goods.

III. PROPOSED SYSTEM ARCHITECTURE

In our suggested approach, we evaluated three common stakeholders found in every agricultural supply chain. The first is a farmer, who is in charge of creating the product known as a crop, which includes fruits, vegetables, grains, and so on. The distributor is the one in charge of delivering items to certified merchants. The last one is the retailer, who is in charge of inspecting the product and selling it to the buyer. The end user of any supply chain is the end user who can buy the goods and determine if it is real or not.The method that we have presented uses blockchain and QR codes to record information about the goods, transaction, and stakeholders engaged in the transaction. With the use of the Ethereum blockchain, information will be stored and transferred from one stakeholder to another. The alternative method is to use qr codes, which will be created at each stage of the supply chain and will include the same information as the product. Customers and stakeholders will be able to trace and validate the goods by comparing the information produced by QR codes and blockchain.Fig 1 indicates the working of our proposed system .

A. Features Functionality

a) Authentication module: Authentication of the user is necessary since there are three stakeholder and each one will have different privileges and role. Through this module we can collect the personal and professional info about stakeholder to display others to decide weather they are authentic or not based on provided information.:

b) Generating Scanning QR Code: In each and every transaction a qr code will be generated to ensuring wheather the product given to the stakeholder is fake or not. It is the only storage medium to travel along with the product. It will so that user will scan and verify the product with blockchain data.:

c) Ensuring Transparency and Traceability using Ethereum Blockchain: Ethereum blockchain will be another medium to store data. As soon as user registers some information ethereum address will be generated to ensure the transcperancy of that information.:

d) Creating, Confirming and Rejecting the transactions: This role will be given only to stakeholders involved in supply chain to ensure that counterfeit product must not enter into supply chain:
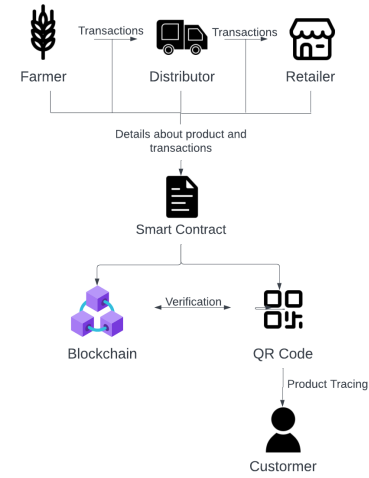
Fig. 1. Outline of Proposed System.

IV. RESULTS

So far we have developed the back-end part of are system which is implementing smart contract with the assistance of Solidity and simulated it on Remix IDE. The Smart contract basically stores the information of product and stakeholders which were involved in the supply-chain transfer of the product and also display it as a track-list . We basically used the algorithm mentioned in paper [1] and modified as per our proposed system which involves three stakeholder which are farmer,distributor and retailer. Fig 2 and Fig 3 are the screenshot of output of smart contract ran and simulated on remix ide.
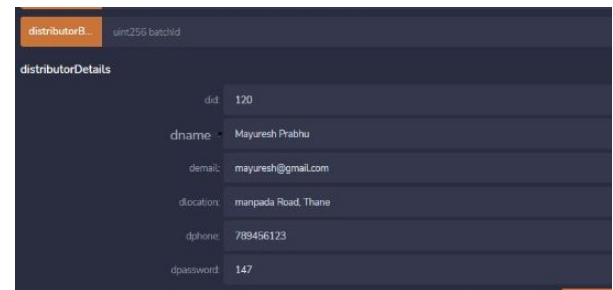
Fig. 2. Simulation of storing data into blockchain.

For users i.e stakeholders and customer to interact with the smart contract, the frontend is developed using the flutter framework through which the mobile application will be cross-platform. Than the smart contracts will be deploy through truffle frame work where user will directly able to interact with blockchain. The QR Scanner is also embedded on the mobile app to scan and see the tracking list. After scanning, the information about the agri-product will be shown in the form of a stepper widget. A stepper widget represents progress via a series of stages.

Fig. 3. Simulation of displaying data into tracking list.

Fig. 4. User Interface of Scanner and the result.

V. CONCLUSION

If we summarise the aforementioned information, our proposed supply chain tracking support will not only just track the path of the product but also gives the functionality of the activity done in an supply chain for instance farmer's crop registration and distributor distributing products to retailer. Further more it also give customer information about the product , information about stake-holders which supervise that product and the traceability path. With the help of block chain it has been possible to make these functionalities which are related to transactions so that at the end of supply-chain customer wouldn't get a counterfiet product.

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