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Blockchain based Alimentary Agricultural Product Provenance: A Manufacturing Synthesis

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Abstract*: *The research proposes a blockchain based traceability system on agricultural products supply chain, where each exchange is rearranged as a block in the chain and is noticeable to the authorized members concerned. The Paper is based on a methodology in which an effective method for recognizing a guaranteed product using blockchain innovation is used; that is, to store information from chemical lab test in sequence and chronological order, so that they are difficult to control a short time later. Here we try to understand how blockchain technology is applied in tea powder production and delivery. The data blocks are permanent as any change to the recorded data, breaks the link. In the general process of converting tea leaves to the tea powder bundles, the traceability framework proposes security, transparency and safety. The need for a traceability system for the food supply chain is unavoidable when irrational chemicals and hazardous synthetic substances are manufactured, adulterated, processed and used. Adulterants are to a great extent added to food products to diminish production costs, sell it at a more significant cost or to attract the purchaser in some other way. To beat these issues, food supply industry needs a transparent system which empowers a purchaser to confirm the structure of each food product from the farm to the retailer.

Keywords: **Blockchain, Agri-food Supply chain, Multichain**

I. INTRODUCTION

Blockchain is currently gaining momentum miraculously in the markets, affecting various industries: with the increasing need for modernization in our daily lives. With the blockchain, programs that worked brilliantly under a trustworthy intermediary can now operate in a decentralized way, with no need for a testing gadget to achieve better performance and attain the same kind of accuracy and quality. It may not have been feasible until they had developed the blockchain. Trustless networks emerged due to the implementation of Blockchain. This is possible because, you could make transfers in network that use blockchain without coordinating with other participants [4].

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With the dearth of midwayers, transactional exchanges between participants turn out to be quicker than before. The application of cryptography in blockchain often guarantees the integrity, security and confidentiality of data [6].
can be interpreted as a massive accounting ledger that keeps account of entire operations performed by the participants.

A Blockchain is an appropriated, decentralized record, or a persistently refreshed rundown of transactions which records information, agreements, and deals [7]. This centralized system, originally created to help with digital money, can be used without a middle party for any form of transactions. Blockchain technology protection depends on solid cryptographic plans to validate and chain each block of exchanges together. To outperform the hashing sensitivity of the target scheme, an intruder would need to bargain half the framework. Thus, it is computationally unreasonable to alter transactions that are entered in a blockchain.

Blockchain arrangement outside finance has been generally exploratory. Blockchain is defined as a financial technology, which calls for and describes what the period at the onset entails in assessing the logistics management capability. In addition, installed practices inside this area of studies will be explored to evaluate the potential of implementation inside logistics. The reason of this paper is to discover the capability application of blockchain in the area of logistics in regard to supply chain transparency and shipping settlement fulfillment concerning sustainability clauses.

II. LITERATURE REVIEW

Enthusiasm for the utilization of Blockchain is developing over different ventures in view of its intrinsic uniqueness in guaranteeing transaction integrity over numerous elements. It is widely used in both financial field such as cryptocurrency and non-financial fields such as legal, healthcare, transportation, education, insurance, real estate etc. Blockchain can be utilized in the production network to store and impart information to different groups, e.g., manufacturer, clients, and so on., or to think about the information gotten with other hub information, or outside information, for confirmation.

The qualities recognized in Blockchain are immediately adjusted to inventory network activities, because of the item traceability [8]. Perhaps the best model is the evolved way of food chain, where the customer can be sure about the credibility of merchandise, including the natural effects and laborers conditions during the whole creation process [8][9]. Undertaking blockchains guarantee that inside the inventory network, everybody recognizes what parts were made, what number of, who fabricated them,

just as other key information unlike in the traditional method of utilizing a third party, i.e. everything is transparent [10].

Blockchains can play a significant job in stolen merchandise recovery and in staying away from fraudulent transactions [11].

Organizations such as Walmart are seeking to use emerging technology of blockchain for implementing its food provenance pilots with the help of IBM's Blockchain solution to enhance supply chain traceability using Hyperledger [12]. As McDermott says (2017), "Blockchain solves business problems where trust is part of the solution", provides that conventional databases cannot provide: data immutability, speed and protection of dissemination (as cited in [12]).

Another term associated with blockchain is the smart contracts. Smart contract is an implementable code which runs on the blockchain to promote, execute and approve an agreement's clauses. A smart contract's primary purpose is to automatically implement the clauses of an agreement once the agreed conditions are met. In this way, smart contracts guarantee low transaction costs in comparison to conventional systems that require a trusted third party to maintain and implement the clauses of an agreement. The capacity of this Smart Contract doesn't rely upon the technology, however rather on legal, political and business establishments. There are different blockchain platforms that can be used to create Smart Contracts, however Ethereum is the most well-known one. This is on the grounds that Ethereum's language supports Turing-completeness feature that permits making further developed and customized contracts. Different blockchains, for example, Ethereum have developed as the second era of blockchain to permit building complex distributed applications past the cryptocurrencies. Ethereum blockchain is the most well-known blockchain for creating Smarts Contracts. Ethereum is an open blockchain with an implicit Turing-complete language to permit composing any smart contract and decentralized application. [13]

A fusion of Blockchain and RFID (Radio Frequency Identification) is also being used in many areas such as inventory control, logistics, automatic object tracking, warehousing, production, distribution, etc. RFID is a form of automated recognition method that incorporates contactless interactions between a chip and a reader [14]. Through this the customers can check the authenticity of a product. RFID offers the capacity to spare organization's time and expenses by empowering information of traceability, identification, communication, and location continuously for both people and assets. However, the constraints of the RFID system are economical, technological, organizational and above all, confidentiality and security [15].

III. PROPOSED SYSTEM

The proposed system incorporates the transactions of many primary entities. For the sake of a simple implementation six entities namely, Production, Processing, Lab Details, Marketing, Distributor and Retailers are taken into consideration in this system. There is some information that are to be kept private and confidential. To guarantee this confidentiality every entities and participants has a public and private key distributed to them. The public key is shared with every other participant, so as to get authenticated by a miner before adding a block to the chain. Prior to validating a block, the miner will decrypt the encrypted information in the block and will also check the identity of the block creator.

The supply chain begins at the tea plantation where the tea leaves are cultivated and harvested. This information is gathered and a block is created by the production head. The block is joined to the chain subsequent to being verified or validated by the miners in the system. A batch number is used to identify the batch of tea powder produced by the manufacturer. The same procedure is carried out by other entities and different blocks are verified and added to the chain.

By using this traceability system, the customers can trace the origin and the processing details of every pack of tea powder. They can get the complete information by inputting the batch number of each tea packet. Here it is assumed that every batch of tea powder is associated with a crypto-block. The data stored or published by each entity are:

A. Production

The producers are the main stakeholder of this system as they are the ones who cultivate and harvest the tea leaves.

B. Processing

They are the people who perform different procedures on the collected tea leaves and produce the tea powder which is the final product.

C. Lab Details

They are the people who test and confirm the quality of the tea powder produced. For this purpose, various tests are performed and the results are inputted into the block.

D. Marketing

They are the people who decides the market where the product is distributed and the price of the product. They provide the tea powder in bulk to the distributor.

E. Distributor

They are the people who receive the bulk of tea packets from the manufacturer and distribute it to different retailers. They are ones responsible for the transportation of the product.

F. Retailer

They are the ones who is responsible for the selling of the product to their customers. They are the direct point of contact with the customers.

IV. METHODOLOGY

A blockchain implementation of the proposed traceability scheme is implemented on the Multichain platform. Multichain is off-the-rack framework which creates and organizes private blockchains. It intends to beat a key obstacle to the implementation of blockchain technology, by giving the security and control required in an easy-to-use bundle. The center point is: (a) to guarantee that the blockchain's activities are only visible to authorized members, (b) to present controls over which transactions are allowed, and(c) to allow mining to happen safely without proof of work and its related costs. This implements a round-robin schedule,

in which the allowed miners must make blocks in rotation so as to create a substantial blockchain.[16]

We have made a blockchain named 'MTC' which is known as the genesis block on the first server. Then we have additionally initialized the blockchain, including mining the genesis block. We connect all the respective six entities to the genesis block 'MTC', and streams are created. Among them Producer, Distributor and Lab Details are relegated as the excavators. Upon formation of the blockchain stream, the entities will create and move blocks of transactions in the chain. Every stream is joined by a specific transaction id, number of things, and hub location that created it. After creation of a stream, a unique blockchain key for your case is made on the platform. The key is utilized to get to your MultiChain hub utilizing json-rpc, either from an application facilitated in the platform or straightforwardly by means of http calls. We use json-rpc calls to communicate with the MultiChain instance.

In addition to the miner's address, the block includes the hash of the stream element and the miner's signature. This specific address recognizes the miner who verified and authenticated the block first before attaching the block into the chain. Thus, each member of the MTC inventory network creates its own blocks and, after being validated by the miners, the blocks are eventually included in the stream consecutively.

The retailer records the buying data for every single batch of tea in the blockchain. The most notable highlights of the proposed tea logistics traceability framework are that if that data is available, everybody in the distribution network will be able to trace the origin, production, manufacturing and purchase history of each single pack. Any client can check the provenance and validness of the acquired tea powder by entering the Batch ID in the system framework. After obtaining the batch ID, firstly the system recognizes the tea powder batch and then tracks all transactions made by different entities for the corresponding element in the production network. Consumers are shown the details of each transaction. Because the blockchain source is permanent t, forging and relabeling wouldn't be effective in the proposed system. Thus, customers can see the farm to fork information about the acquired tea powder utilizing json calls that communicate with the MultiChain instance ensuring transparency and security in the general procedure of the tea powder inventory network.

V. RESULT

The fig.1 shows the connection details of all the nodes connected to the blockchain, such as IP address, handshake address and latency of the nodes. The fig.2 shows the permissions granted to each connected node in the blockchain. The granting and revoking of the permissions are handled by the admin node. The fig.3 shows the details of the streams created in the blockchain by each authorized node. All the transaction details are entered by means of these streams and viewed here.

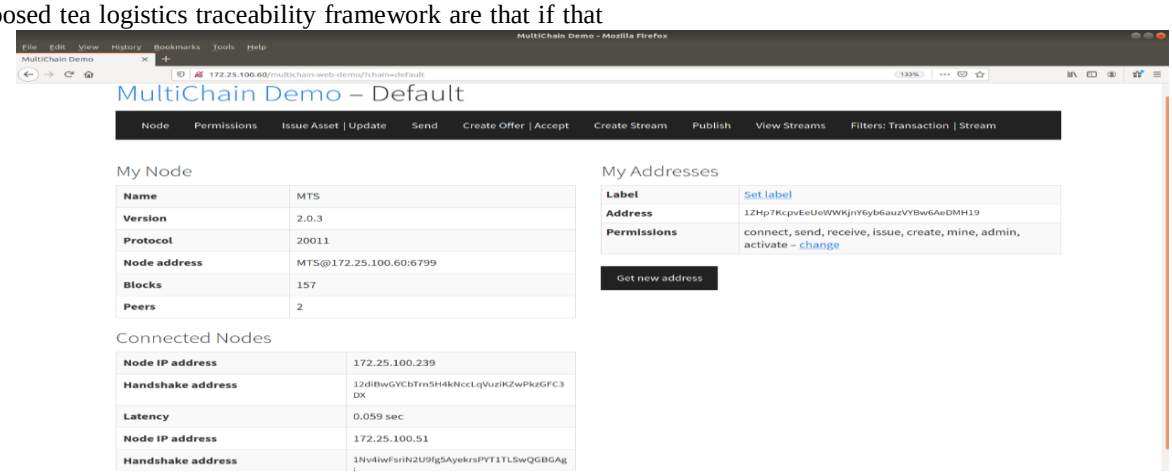

Fig. 1. Connection Details

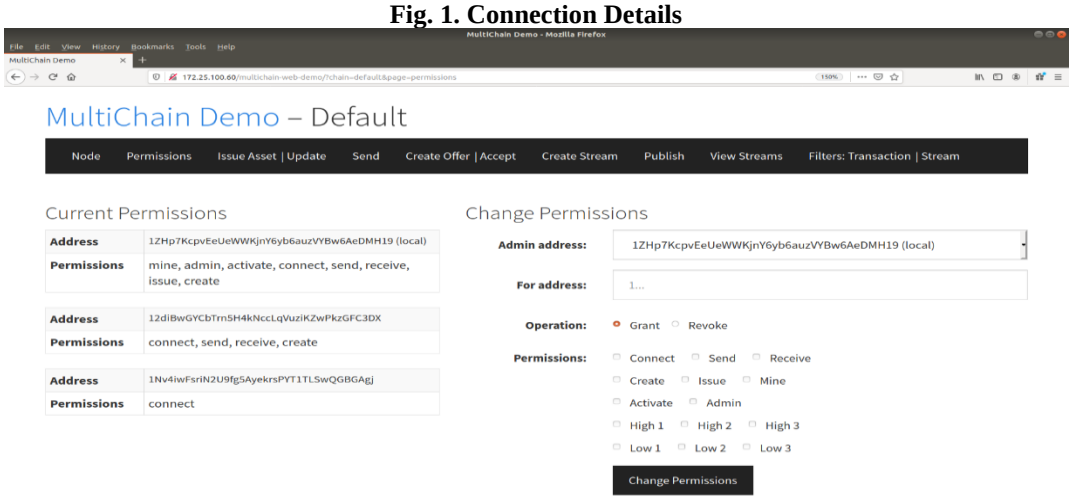

Fig. 2. Permissions

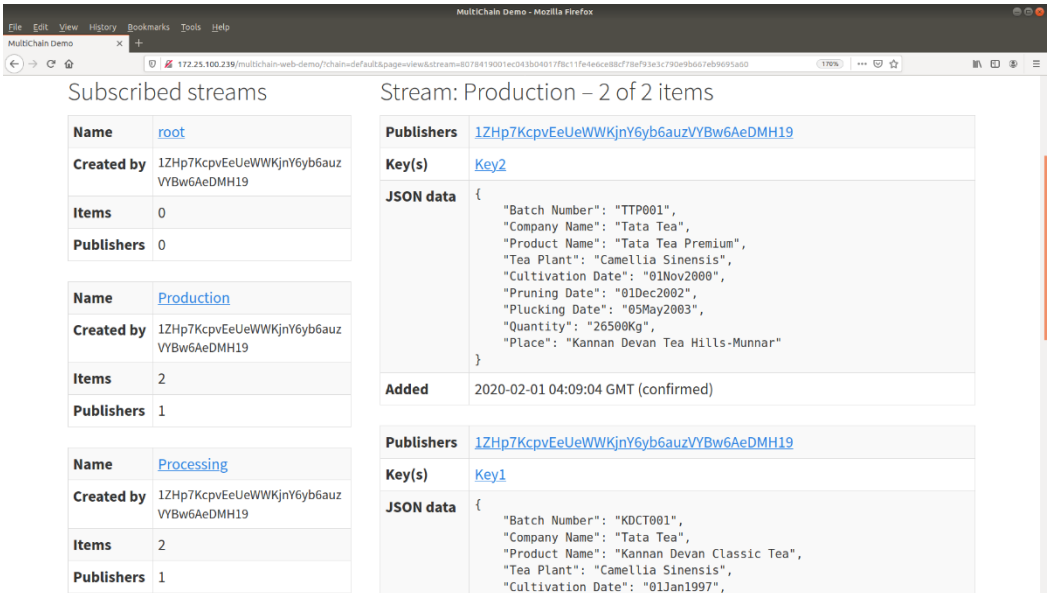

Fig. 3. Stream Details

VI. CONCLUSION

This paper envisages a traceability system based on blockchain for the tea inventory network to provide provenance, quality assurance transparency, authentication and protection. Since the worldwide market has seen an expansion of debased and hued tea powders, blockchain is a good solution to beat the issue. In the proposed traceability framework, a private blockchain with six entities has been executed that permits the members to scramble hidden data. Subsequently, the equivalent blockchain stream could be utilized to record organizations basic data just like the public information.

Privacy is one of the drawbacks of blockchain innovation, as no company or person might want to share all the data to an open database. Yet, proprietary blockchains, with the cryptographic approach can be used to efficiently tackle these issues. Important data can be kept hidden in private blockchain network by encoding them with a pre-dispersed cryptographic signature while open data is used to store the plain content. The proposed system only deals with the Publicly accessible data. Another constraint is that the present framework merely provide restricted directions for data storage in the chain based on command line.

Our future projects intend to build a graphical UI (GUI) and further create an Application Programming Interface (API) for easily retrieving and storing data into the chain effortlessly. Furthermore, we imply integrating both interior and exterior components of the tea supply chain into our hypothetical use. This model shows that there is a profound hunger for trustworthy providers in the supply chain business. In the way, a key component of the blockchain technology-based model is that each product exchange is open to public scrutiny, which is particularly significant in acquiring the trust of each individual customer.

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