International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 05 | May 2021 www.irjet.net p-ISSN: 2395-0072

TRACE AND TRACK FOOD SUPPLY CHAIN BASED ON BLOCKCHAIN

K.Balasubramanian[1], G.Deepiga[2], G.Abinayasri[3], T.Gangadevi[4]

[1]Assistant Professor, Dept. of CSE, E.G.S.Pillay Engineering College, Tamil Nadu, India
[2]UG student, Dept. of CSE, E.G.S.Pillay Engineering College, Tamil Nadu, India
[3]UG student, Dept. of CSE, E.G.S.Pillay Engineering College, Tamil Nadu, India
[4]UG student, Dept. of CSE, E.G.S.Pillay Engineering College, Tamil Nadu, India

---

Abstract The food supply chain is the most complex and fragmented of all supply chains. The production is found all over the world both on land and in water. A lot of the producers and intermediaries are difficult to identify and track. For all the participants in the production chain this creates uncertainty and risk. Mitigating this uncertainty comes at a cost, and the outcome may still be insufficient. Examples of problems that have been difficult or impossible to solve with current technologies include establishing reliable provenance and preventing fraud and counterfeiting. These issues can have knock-on effects on public health and the environment, and reduce financial costs of unnecessary recalls of food products.

To overcome the above challenges, a blockchainbbased food traceability system (BIFTS) is proposed in this study, to achieve the following: (i) to integrate blockchain technology for effective and efficient traceability, and (ii) to support shelf life adjustment and quality decay evaluation for improving quality assurance. For the sake of better computational load, the blockchain is modified as a lightweight blockchain to be associated with cloud computing to support IoT monitoring, and can be vaporized after the entire life cycle of traceability to release computational resources of the system. By using such a reliable data source, the decision support in food quality can be made by using fuzzy logic to determine adjustment of shelf life, rate, and order of quality decay, according to different situations for each batch of perishable foodstuffs at food processing sites. Therefore, the proposed traceability model is extended to the modern food supply chain environment, resulting in reliable and intelligent monitoring, food tracking, and quality assurance.

Key Words: **Supply chain; Traceability; Blockchain; Distributed ledger technology; Smart contract**

1.INTRODUCTION

Blockchain has huge potential to impact global Food Product supply chain (FPSC) by increasing productivity in terms of supply chain performance. Among many challenges the United States Center for Diseases Control (CDC) estimates that 48 million people get sick from expired medical product usage , 128,000 are seriously hospitalized, and 3,000 die each year in the U.S. alone. Apart from illness, economically and criminally motivated Medical Product adulteration is also a growing concern due to globalization and wide growing supply chain networks. Real-time monitoring of the medical product quality and visibility of that quality index would prevent outbreak of food-borne illnesses, economically motivated adulteration, contamination, food wastage due to misconception of the labeled expiry dates, and losses due to spoilage, which have broad impacts on the medical product security.

In order to improve safety and prevent wastage, modern Blockchain based technologies are required to monitor the Food product quality and increase the visibility level of the monitored data. There are a number of Block Chain based tracking and tracing infrastructures such as Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID), and QR codes which are primarily targeted for automatic package level tracking. However, the role of these technologies is limited in identifying the medical product package and does not provide any information pertaining to the state of the Food product quality. This limitation prevents quick removal of a defective product from reaching higher levels of the FPSC. For example, when a quality control lapse is identified along the FPSC, the company is forced to recall all the Food products within a certain time frame leading to a huge economic loss, which can be mitigated with the availability of individual Food Product package quality information resulting in targeted recalls. In literature, a number of sensing techniques compatible with existing tracking and tracing infrastructure are proposed for monitoring Food products.

These can be invasive or non-invasive in monitoring the physical or chemical properties of medical products such as pH, conductivity, and permittivity or the packaging environment such as temperature, humidity, moisture or aroma. In general, these are aimed to prevent defective products from reaching the consumers. Furthermore, these sensors help in identifying key bottlenecks in the FPSC to improve the overall efficiency. Currently, little work has been done in integrating these to the tracking and tracing infrastructures. Moreover, the collected tracking as well as sensing data is more centralized and selectively used by specific entities of the FPSC. The consumers have to trust the quality of the product based

on the printed expiry date without any additional knowledge of its current quality. To move beyond a "traceability-centric" or "income-centric" to a "value-centric" supply chain, a more decentralized approach is needed in terms of data sharing. However, a trade off exists between providing sufficient information to the consumer about an individual product and at the same time safe guarding the operational privacy of the FPSC.

Blockchain has emerged as a decentralized public consensus system that maintains and records transactions of events that are immutable and cannot be falsified. Blockchain technology has attracted attention beyond crypto currency due to its ability to provide transparent, secure, and trustworthy data in both private and public domains. The technology is based on a distributed ledger, which is not owned or controlled by a single entity. Data in the public ledger is visible publicly and any authorized entities can submit a transaction, which is added to the Blockchain upon validation. The advantage of Blockchain technology can be applied in FPSC to improve the digital data integrity which is obtained as the product passes through different entities of the FPSC. The complete Medical product visibility across different entities of the supply chain can become a reality with the integration of sensor based Blockchain technology data management systems. The key benefits of applying Blockchain technology in FPSC are: real time tracking and sensing of Food products throughout the FPSC, and allowing identification of key bottlenecks; Discouraging adulteration of Medical products, and identifying weak links on occurance; determining the shelf life of Medical products leading to reduced waste; providing end to end information to the consumer; and allowing specific and targeted recalls. A test prototype of the Unique ID is integrated are demonstrated experimentally in this work. The Unique ID integrated can be attached to a food package to extract information regarding the package along FPSC.

2. LITERATURE REVIEW

2.1 Titlel: Managing Food Safety With Pricing, Contracts and Coordination in Supply Chains

Author: Dung-Ying Lin ; Chieh-Ju Juan ; Ching-Chih Chang.

Objective:

The objective was to design a safe and sustainable food supply chain with food safety mechanisms so that confidence-dependent demand can be positively affected by centralized, decentralized and combined supply chain contracts.

2.2 Title: Blockchain-Driven IoT for Food Traceability With an Integrated Consensus Mechanism

Author: Yung Po Tsang ; King Lun Choy ; Chun Ho Wu ; George To Sum Ho ; Hoi Yan Lam

Objective:

Integrates the novel deployment of blockchain, IoT technology, and fuzzy logic into a total traceability shelf life management system for managing perishable food.

2.3 Title: Internet of Perishable Logistics: Building Smart Fresh Food Supply Chain Networks

Author: Amitangshu Pal and Krishna Kant

Objective:

The ultimate purpose of the paper is to inspire and engage researchers from both communities to holistically examine the numerous difficult problems involved in turning logistics systems into highly agile and efficient cyber-physical systems.

2.4 Title: Robust Authentication of Consumables With Extrinsic Tags and Chemical Fingerprinting

Author: Naren Vikram Raj Masna , Cheng Chen, Soumyajit Mandal , And Swarup Bhunia

Objective:

Mislabeling, re-branding, and false advertising are prevalent in this sector. Existing physical authentication techniques fail to adequately verify integrity of these products and protect the end-users. In this paper, the author addressed this critical problem through the development of a novel authentication solution.

2.5 Title: Wireless EAS Sensor Tags for Volatile Profiling in Food Packages

Author: Saranraj Karuppuswami ; Mohd Ifwat Mohd Ghazali ; Saikat Mondal ; Premjeet Chahal

Objective:

Real-time volatile profiling of packaged food is necessary to estimate shelf life, quality, and freshness of the food products along the supply chain.

3. MODUL DESCRIPTION

Traceability Information Capture Module: This module is designed to collect key traceability information brought forth by the process of production, storage, circulation of food. It can work automatically and manually to identify and create detailed event information from the circulation of food in the supply chain.

Event Information Database: the capture module. This database is mainly used for the preservation and management of all food information from

Information Extraction Module: This module is primarily devised for extracting information that needs to be uploaded on blockchain from the traceability information database as well as preparing the data for the uploading.

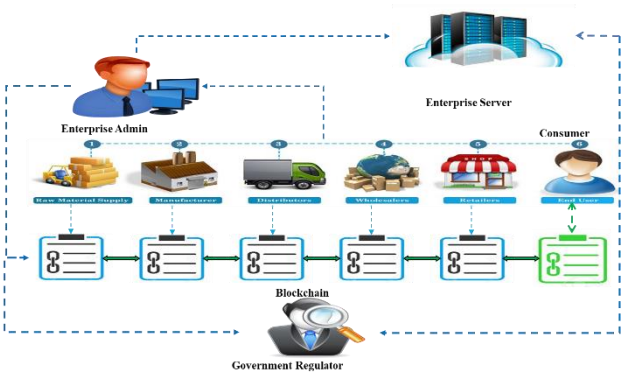
Blockchain Module: Blockchain module has two functions. One is the data interaction including the upload of key traceability information on blockchain, the request of on-chain information and the verification of event information. The other is to provide options for users to be the full blockchain node or the light-weight blockchain node i.e. to decide whether or not to participate in the maintenance of the blockchain.

Interaction Authority Management Module: This module is in charge of the verification of enterprise identity when there is any event information interaction i.e. to determine whether the request who initiates the request for event information is in this supply chain.

Consumer Traceability Client Blockchain Module: This module is designed for the link between the client and system, through which it can request information on the blockchain and verify the legitimacy of the information. A light node is chosen for this module to lower user's maintenance cost.

Information Cache Database: This cache database is built to cache the corresponding food traceability data requested by users.

Technical Design



PROPOSED SYSTEM:

The blockchain is a new set of tools for digitization. The reason blockchain technology is interesting is that there are certain functions that are very valuable for the digital world that hasn't been invented before the blockchain.
Integrated IoT and Blockchain

The data collecting and processing node, that scans a secret code is termed as a 'terminal'. The common network shared by all the terminals is termed as 'shared network'. The scan of a secret ID by a terminal and enlisting the data is termed as a 'transaction'. Once a transaction is validated based on the consensus of participating terminals, the transaction is converted into a 'block' and included in the Blockchain. Apart from terminals, there exists another type of node, a 'manager', that is responsible for policy making and processing requests based on consensus with other nodes. Finally, there exists a third type of node, called 'agent', that requests information about a secret ID from the blockchain by providing a proper cyber address. 'Address collision' is referred to the existence of a minimum of two identical cyber or physical addresses. A typical Food product based supply chain is each packaged food product with an embedded secret ID travels through multiple stages of transactions at different terminals starting from packaging through transportation, storage and finally to a consumer for purchase. A data block is created containing the information about the package at each valid transaction. Once the transaction is verified, the transaction of the secret ID is converted into a block of information and appended to its pre-existing data blocks thus forming a chain of information blocks and thus a Blockchain.

5. SNEAKPEEKS OF IMPLEMENTATION

Fig 2 Food supply chain

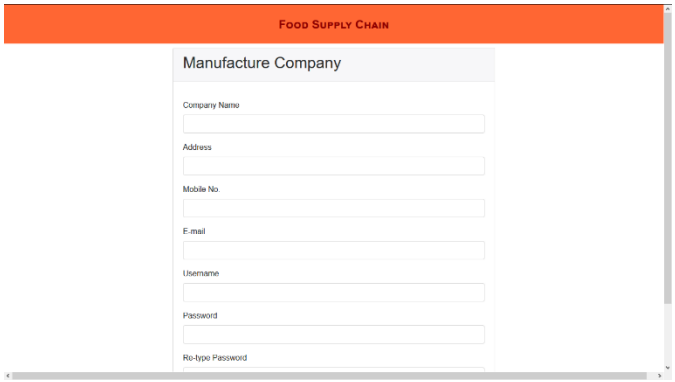


Fig 3 Manufacturing company

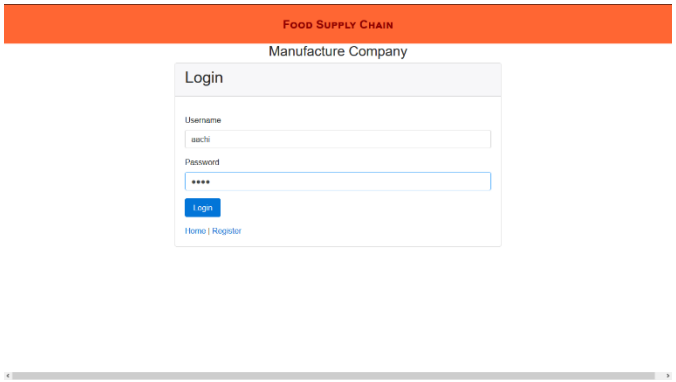


Fig 4 Login

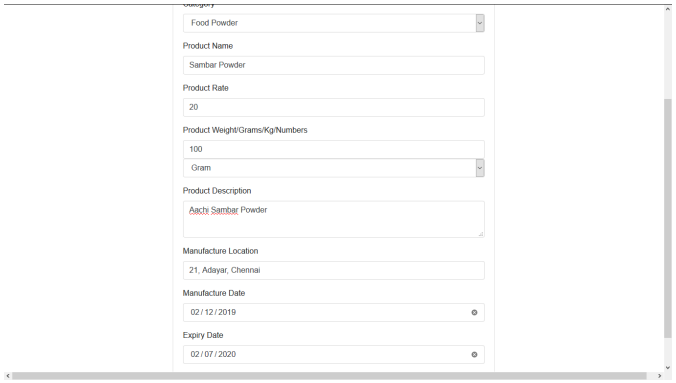


Fig 5Product registration

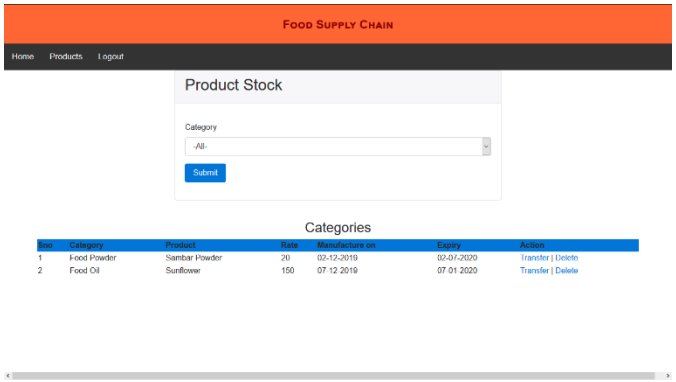


Fig 6 Product stock

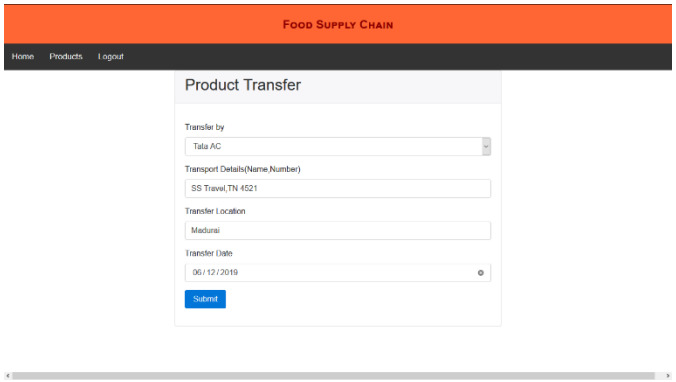


Fig 7 Product transfer

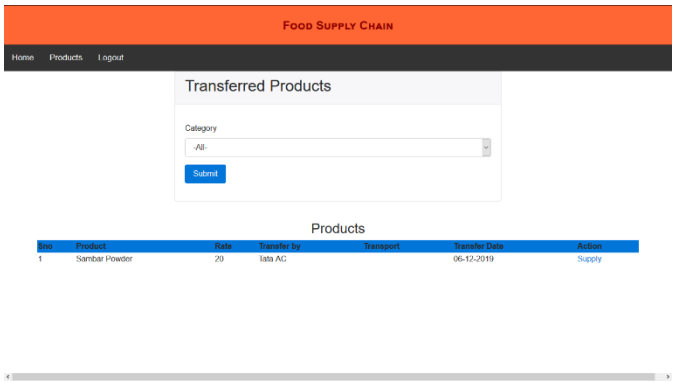


Fig 7

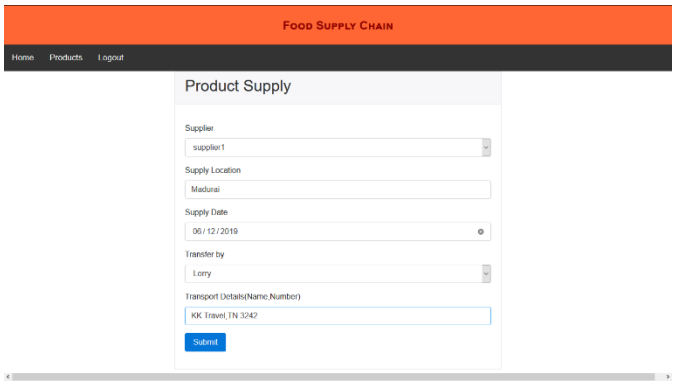


Fig 8 Product supply

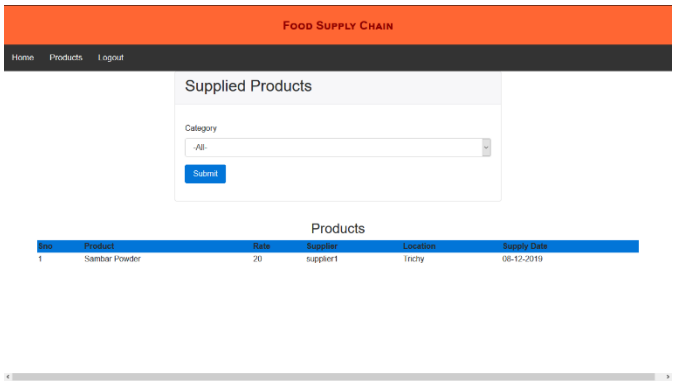


Fig 9 Supplied products

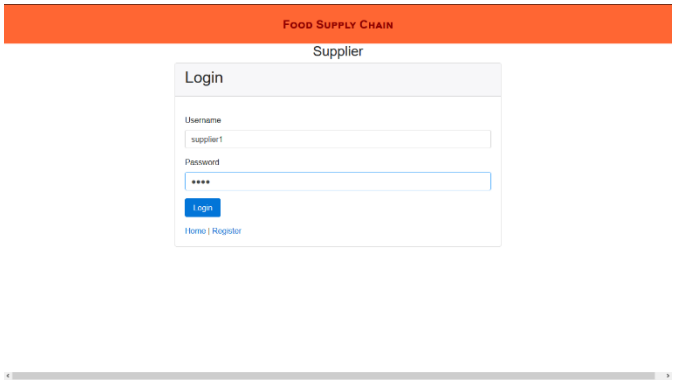


Fig 10 Sipplier

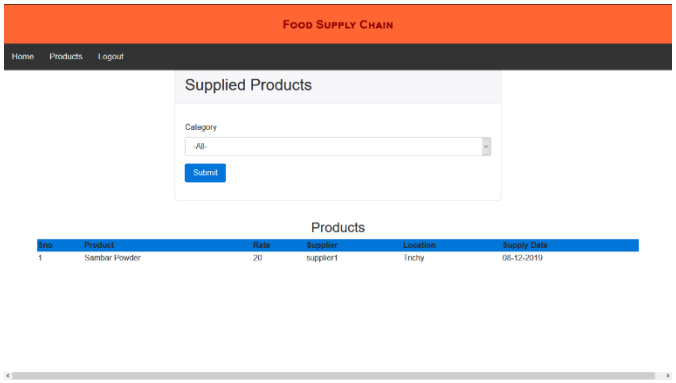


Fig 11

.

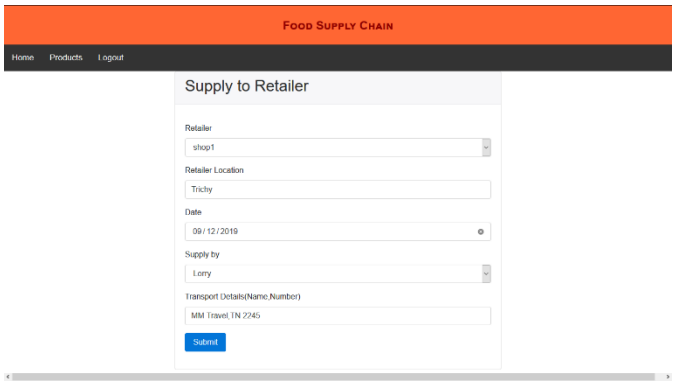


Fig 12 Supply to Retailer

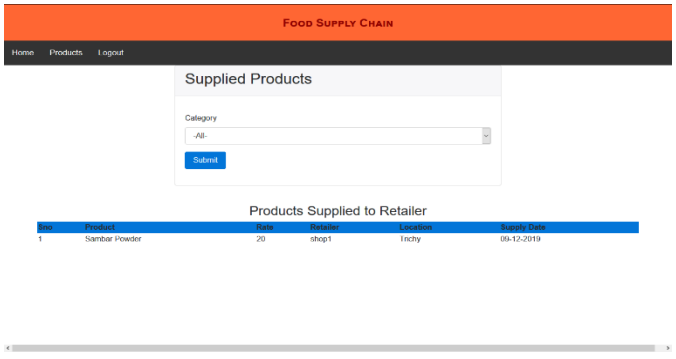


Fig 13

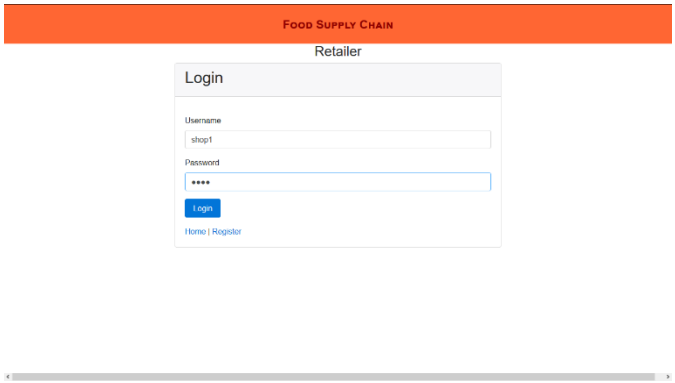


Fig 14 Retailer

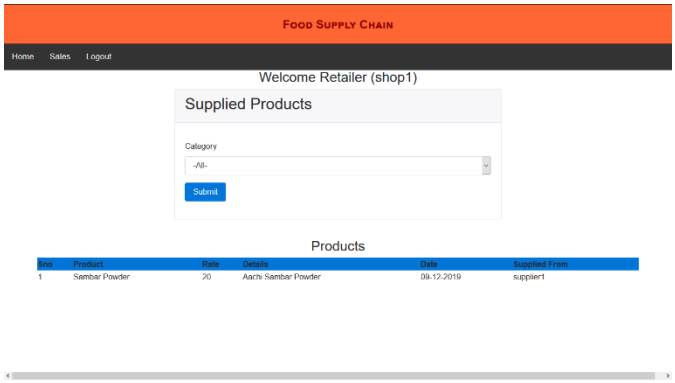


Fig 15 Shop

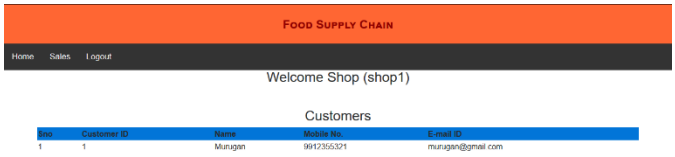


Fig 16

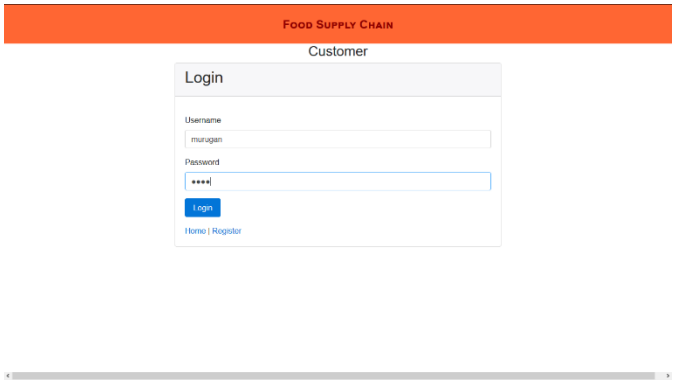


Fig 17 Customer

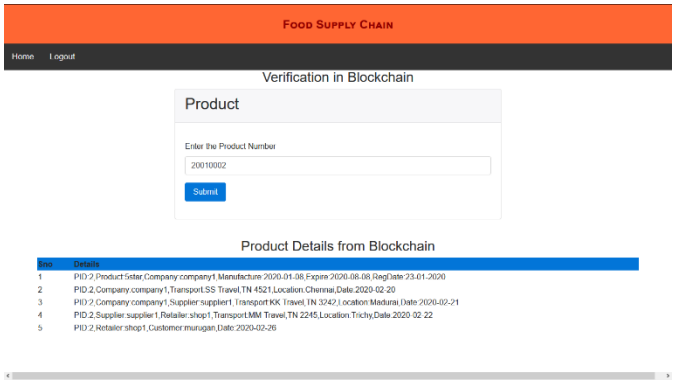


Fig 18 verification in blockchain

CONCLUSION:

An Blockchain based FSC monitoring architecture has been proposed in this work. Sensing modality was integrated with identification identification with a small footprint for tracking and quality monitoring of the Food product packages. When the Food Product pack ages are scanned at different retailers, logisticor storage stage within the supply chain, the real time sensor data is updated in a blockchain providing a tamper-proof digital history. Any consumer or retailer can check the public ledger to obtain information regarding the specific Food product packages. The information helps in updating the shelf life, identifying key bottlenecks in the FSC, implementing targeted recalls and moreover increasing visibility. A single secret ID integration was demonstrated in this work. The proposed architecture takes consensus from participating terminals in the network before updating the blockchain data. The broader participation of all the nodes helps to keep the network decentralized. The security analysis showed that the validation of a fake block drops with a higher number of node participation in the network and multiple consensus stages.

REFERENCES

[1] M. M. Aung and Y. S. Chang, ``Traceability in a food supply chain: Safety and quality perspectives,'' *Food Control*, vol. 39, pp. 172_184, May 2014.

[2] T. Bosona and G. Gebresenbet, ``Food traceability as an integral part of logistics management in food and agricultural supply chain,'' *Food Control*, vol. 33, no. 2, pp. 32_48, 2013.

[3] J. Hobbs, ``Liability and traceability in agri-food supply chains,'' in *Quan- tifying the Agri-Food Supply Chain*. Springer, 2006, pp. 87_102.

[4] D. Mao, Z. Hao, F. Wang, and H. Li, ``Novel automatic food trading system using consortium blockchain,'' *Arabian J. Sci. Eng.*, vol. 44, no. 4, pp. 3439_3455, Apr. 2018.

[5] L. U. Opara and F. Mazaud, ``Food traceability from _eld to plate,'' *Outlook Agricult.*, vol. 30, no. 2, pp. 239_247, 2001.

[6] F. Dabbene and P. Gay, ``Food traceability systems: Performance evaluation and optimization,'' *Comput. Electron. Agricult.*, vol. 75, no. 2, pp. 139_146, 2011.

[7] J. Storoy, M. Thakur, and P. Olsen, ``The TraceFood framework_ Principles and guidelines for implementing traceability in food value chain,'' *J. Food Eng.*, vol. 115, no. 2, pp. 41_48, 2013.

[8] M. A. Khan and K. Salah, ``IoT security: Review, blockchain solutions, and open challenges,'' *Future Gener. Comput. Syst.*, vol. 82, pp. 395_411, May 2018.

[9] L. Lucas. Financial Times. (2018). *From Farm to Plate, Blockchain Dishes Up Simple Food Tracking*. Accessed: Jun. 12, 2018. [Online]. Available: https://www.ft.com/content/225d32bc-4dfa-11e8-97e4-13afc22d86d4

[10] A. Bogner, M. Chanson, and A. Meeuw, ``A decentralised sharing app running a smart contract on the Ethereum blockchain,'' in *Proc. 6th Int. Conf. Internet Things*, 2016, pp. 177_178.

[11] K. Salah, M. Rehman, N. Nizamuddin, and A. Al-Fuqaha, ``Blockchain for AI: Review and open research challenges,'' *IEEE Access*, vol. 7, pp. 10127_10149, 2019.

[12] H. Hasan and K. Salah, ``Combating deepfake videos using blockchain and smart contracts,'' *IEEE Access*, vol. 7, no. 1, pp. 41596_41606, Dec. 2019.

[13] R. Beck, J. S. Czepluch, N. Lollike, and S. Malone, ``Blockchain-the gateway to trust-free cryptographic transactions,'' in *Proc. ECIS*, May 2016, p. 153.

[14] M. E. Peck, ``Blockchains: How they work and why they'll change the world,'' *IEEE Spectr.*, vol. 54, no. 2, pp. 26_35, Sep. 2017.

[15] K. Toyoda, P. T. Mathiopoulos, I. Sasase, and T. Ohtsuki, ``A novel blockchain-based product ownership management system (POMS) for anti-counterfeits in the post supply chain,'' *IEEE Access*, vol. 5, pp. 17465_17477, 2017.