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SMART FOOD TRACER TECHNIQUE USING SMART CONTRACT AND BLOCKCHAIN TECHNOLOGY

Mr. Abhijeet Paritekar, Student, Dept. Computer Science and Engineering (AIML), DY Patil Agriculture and Technical University, Talsande.
Prof. Ravindra Kamble, Assistant Professor, Dept. Computer Science and Engineering (AIML), DY Patil Agriculture and Technical University, Talsande.
Dr. Sangram T. Patil, Dean, School of Engineering and Technology , DY Patil Agriculture and Technical University, Talsande.
Dr. Jaydeep B Patil, Associate Professor (Associate Dean), Dept. Computer Science and Engineering (AIML), DY Patil Agriculture and Technical University, Talsande.

ABSTRACT
A smart contracts ledger based on the Ethereum blockchain promises to revolutionize food tracing in restaurants by giving patrons unmatched transparency and assurance in the food supply chain. The immutability, transparency, and decentralization of the ledger are ensured by this system's use of blockchain technology, while smart contracts simplify and enforce food tracing procedures. Customers will have easy access to detailed information about the origin, journey, and quality of food thanks to QR code scanning integration. Accurately tracking food items across the supply chain is difficult for traditional food tracing systems, which are frequently prone to mistakes and delays. On the other hand, blockchain technology creates a decentralized ledger that safely logs every transaction related to the production, processing, distribution, and sale of food. This ledger, which is replicated throughout a network of nodes, provides redundancy, enhancing security and dependability. Food tracing procedures are automated and enforced by smart contracts, which also ensure regulatory compliance, authenticate products, and notify of irregularities. By giving consumers access to comprehensive information about food items, QR code scanning improves system accessibility, enabling them to make knowledgeable selections and promoting confidence in restaurant food safety. Using a smart contracts ledger system also helps restaurants reduce the risk of foodborne illness, enhance inventory tracking, and streamline supply chain management. Restaurants may more effectively manage resources and concentrate on providing outstanding dining experiences by automating compliance processes and lowering administrative costs.
Keywords: Ethereum blockchain, QR code, inventory tracking etc

I. Introduction
A successful food industry is built on the creation of consistently high-quality, safe food that takes "farm-to-fork" production into account. As a result, a crucial aspect of supply-chain management is the coordination of interdependent processes from the production of raw materials to the delivery of the finished product [1]. The trade of commodities and information across international borders has increased dramatically as a result of the constantly changing global food supply chains (FSCs) and marketplaces [2]. However, there is an urgent need for improved information exchange and credibility because fraud, ineffective transactions, and subpar performance inside FSCs have created questions about the authenticity and quality of items [3]. Globalization, human behavior, cultural norms, and regulatory regulations are just a few of the many variables that affect food supply chain networks. The intricacy of these elements makes it extremely difficult to manage hazards in the industry and conduct efficient information analysis [4]. Knowledge and technology must be developed immediately to meet these issues and guarantee effective supply-chain management. Pressure to increase transparency, promote reliable information sharing, and improve food product traceability across the supply chain has been intense in the global food supply chain [5,6].
In today's fast-paced world, restaurants must meet the needs of consumers who are becoming more concerned about the sustainability, safety, and quality of the food they eat while still operating with

efficiency and transparency. Customers are frequently unaware of the path their food takes from farm to table due to the opaqueness of traditional supply chain procedures. But with the advent of blockchain technology, a game-changing solution—Blockchain-Based Smart Food Tracking—has surfaced. Originally developed as the foundation of cryptocurrencies like Bitcoin, blockchain technology has now developed into a flexible instrument with uses in a wide range of sectors. Blockchain technology provides unmatched security and transparency in the food tracking industry by generating an unchangeable ledger that documents each event or transaction across the supply chain. Every transaction is connected to the one before it and encrypted, creating a chain of blocks that cannot be changed after the fact. This guarantees that accurate and reliable information regarding the origin, transportation, and handling of food products is available to all parties involved, including eateries and their patrons.

Decentralized ledger technology (DLT) frameworks that use smart contracts to automate and enforce contracts in an open, transparent, and untrustworthy way are known as smart contracts ledger systems. When certain criteria are met, smart contracts that are encoded with the terms of the agreement immediately run. This system uses a decentralized ledger, often called a blockchain, that is dispersed throughout a computer network. To ensure redundancy and avoid a single point of failure, every node in the network keeps a copy of the ledger. Blocks of transactions are stored and connected chronologically to form an unchangeable record that cannot be removed or changed. Smart contracts enable trustless execution, doing away with the requirement for middlemen or centralized authorities to uphold agreements. This system lowers transaction costs, improves efficiency, and minimizes errors by automating tasks including asset transfers, contract execution, and payment processing. Enabling decentralized and effective transactional operations, a smart contracts ledger system combines the automation potential of smart contracts with the transparency and security of blockchain technology. One cannot stress how important blockchain-based smart food tracking is for patrons of restaurants. It starts by addressing food safety, which is one of the most important issues facing contemporary consumers. Customers may follow a food product's whole lifecycle via blockchain technology, from the farm where it was grown to the dining establishment where it is served. By reducing worries about contamination, adulteration, and other risks, this transparency gives consumers trust in the food's safety and quality.

Additionally, by empowering eateries to obtain ingredients in an ethical and responsible manner, blockchain-based smart food tracking encourages sustainability. Restaurants may make well-informed decisions that are consistent with their principles and satisfy the rising demand for locally sourced and sustainable food by gaining insight into the sources of their ingredients. Consumers may help create a more sustainable food ecosystem by supporting companies that place a high priority on social responsibility and environmental stewardship. Additionally, by facilitating customized services and recommendations, blockchain technology improves the eating experience. Restaurants can learn more about patron preferences, dietary needs, and consumption trends by examining the data recorded on the blockchain. Equipped with this understanding, businesses may improve client happiness and loyalty by providing personalized menu recommendations, exclusive offers, or loyalty incentives. Furthermore, in the restaurant industry, blockchain-based smart food tracking encourages accountability and trust. Every transaction is safely documented on the blockchain, eliminating the possibility of fraud, deception, or manipulation of data pertaining to food. In addition to shielding customers from dishonest business practices, this promotes an honest and open industry culture. By using blockchain technology, restaurants may get a competitive edge in the market and establish trust with their patrons by demonstrating their dedication to integrity and accountability.

There is great potential for blockchain-based smart food tracking to completely transform dining experiences. Modern customers' worries about food safety, sustainability, and individualized service can be addressed by restaurants by utilizing the transparency, security, and immutability of blockchain technology. The industry as a whole stand to gain from greater consumer happiness, efficiency, and trust as more eateries adopt this cutting-edge method of food tracking.

II. Literature

R.V. George, H. O. Harsh, P. Ray, et al. "Food quality traceability prototype for restaurants using blockchain and food quality data index" [7], Supply chains are becoming more competitive with one other as organizational rivalry changes, and in order to thrive, businesses must provide value to their clients. One of the most important indicators of operational effectiveness in supply chains and, eventually, customer service is traceability. Organizations have used a variety of techniques to provide food traceability over the years. This article looks at the main food traceability techniques that are already in use and suggests a restaurant prototype that uses product identifiers and blockchain technology to provide more trustworthy food traceability. The prototype gathers information from multiple parties involved in the food supply chain, separates it, and then uses the Food Quality Index (FQI) algorithm to provide a FQI value. When determining if a food item is suitable for eating within a given range, the FQI value can be useful. Food safety authorities have established standard storage and handling guidelines, from which the FQI value is obtained. This value is then checked to see if it falls within the acceptable range. The prototype not only improves food (product) traceability but also aids in food quality rating for human consumption. This prototype can be altered to meet new traceability needs in the future that are brought about by fresh data from any supply chain node or stakeholder.

Q. Lin, H. Wang, X. Pei, et al. "Food safety traceability system based on blockchain and EPCIS"[8], Concerns about food safety have been more widespread in society in recent years. Developing a trustworthy traceability system is essential for effectively identifying and preventing issues related to food safety as well as tracking down those responsible. Accurately documenting, exchanging, and tracking specific data is particularly important along the whole food supply chain, encompassing the manufacturing, processing, warehousing, shipping, and retail phases. Issues with traditional traceability systems include data invisibility, manipulation, and disclosure of sensitive information. Blockchain's irreversible time vector, smart contract, consensus algorithm, and other features make it a potential solution for food safety traceability systems. This article develops a prototype system and suggests a blockchain-based food safety traceability system based on EPC Information Services (EPCIS). Additionally, a proposal for an on-chain and off-chain data management architecture is made, which could help the traceability system address the blockchain's data explosion problem for the Internet of Things (IoT). Additionally, during participant information exchanges, the enterprise-level smart contract is made to guard against data manipulation and the disclosure of private information. The Ethereum platform was used to create the prototype system. The test results show that despite the amount of on-chain data and query count are 1GB and 1,000 times per second, respectively, the average duration of information query answer is about 2ms.

P. Pandey, R. Litoriya, "Securing E-health networks from counterfeit medicine penetration using Blockchain"[9], This article suggests a blockchain-based resilient electronic health network as a means of addressing the issue of fake medications in India. Each year, hundreds of lives are lost as a result of the distribution and use of counterfeit medications. The country's phony medication syndicate network is unabated, and as a result, the players in the healthcare ecosystem must cooperate in the face of a lack of mutual confidence. Each computer node in the decentralized blockchain system retains the same data and can interact with other nodes without needing to trust them. The suggested method is predicated on documenting on the blockchain network the logistics needs for pharmaceuticals, from their manufacture to the patient. In the event that counterfeit medication infiltrates the system, it will be quickly identified and prevented from spreading. A hyper ledger fabric platform is used to mimic the system, and its performance is contrasted with that of other current techniques. The developed method, according to the results, is computationally demanding but provides a dependable countermeasure against the threat of counterfeit medications.

D. Rohmah, S. Maharani, M. Kholis, et al., "Traceability and tracking systems of halal food using blockchain technology to improve food industry competitiveness" [10], Systems for tracking and traceability are crucial for the halal food sector. The notion of halal food encompasses not only food

safety and quality but also food sources, process management, packaging, storage, and customer delivery. Customers are interested in learning about all the processes that go into the production of halal food, in addition to worries regarding whether or not food ingredients are halal. To increase its competitiveness, the halal food business can benefit from digital technologies like blockchain technology. This article reviews the current halal food traceability and tracking systems and discusses how blockchain technology can be used to improve these systems. This paper explores the impact of blockchain technology on the competitiveness of the food sector and suggests the conceptual framework for a halal food traceability and tracking system.

A. Tan, D. Gligor, A. Ngah, "Applying blockchain for halal food traceability"[11], As global supply chains expand, there is an increasing worry over the traceability and complete purity of halal food. The present study aims to identify the traceability problems that Malaysia's food supply chain faces in order to comply with Halal regulations. Within the frameworks of agency theory and institutional theory, we place these difficulties. Our paper immediately responds to Duan et al.'s (2020) request for research on blockchain application in halal food chains that is based on actual real-world data. Therefore, based on the actual Blockchain deployment in three different Halal supply chains, we present a revolutionary traceability architecture built on Blockchain. With input from three Blockchain software companies, the technology with smart contract is suggested with the goal of developing a conceptual framework that combines Halal procedures and technologies to enhance the traceability of the Halal food supply chain from farm to fork. This study examines the impact of blockchain technology on food sector competitiveness through food traceability and tracking systems. the system, it will be quickly identified, and more penetration attempts will be prevented. A hyper ledger fabric platform is used to mimic the system, and its performance is contrasted with that of other current techniques. The developed method, according to the results, is computationally demanding but provides a dependable countermeasure against the threat of counterfeit medications.

III. Problem Statement

Since smart contracts in current approaches are not clearly specified, it is necessary to define them during system construction. To make food tracing information easily accessible to restaurant patrons, a smart food tracer mechanism utilizing blockchain and smart contracts must be developed.

IV. Objective

1. To design web based smart contract system for stake holder's registrations, add and withdraw information contracts based on Block Chain.
2. To implement the Ethereum based block chain system for proposed smart contracts deployment.
3. To generate QR code and establish QR 0oo0956yuyjnm i09ou j7code-based information retrieval system for restaurant customers for food traceability.
4. To validate the information retrieved from QR code.

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V. Design Methodologies

The development proposed smart food training system with use of blockchain technology consist of stages as shown in Figure 1.

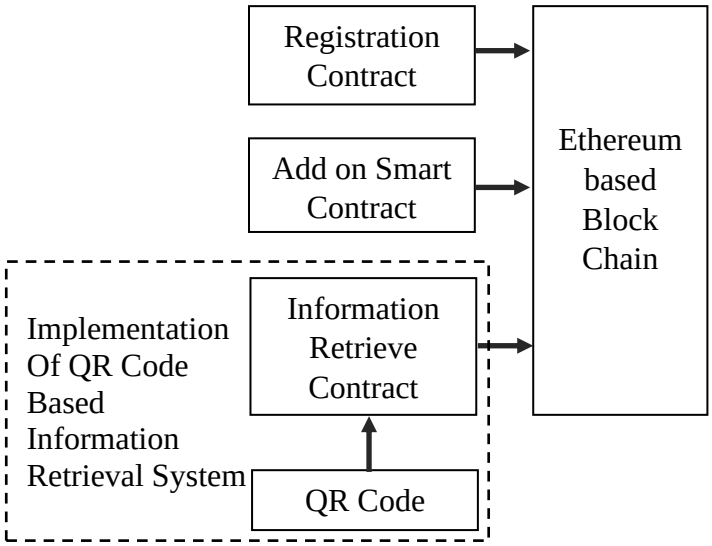

Figure 1: Block Diagram of Proposed Smart Food Tracing System

1. Registration Smart Contract

A registration smart contract in a food traceability system is a type of smart contract that facilitates the registration and validation of various entities involved in the food supply chain. These entities may include food producers, processors, distributors, retailers, and even regulatory bodies. The purpose of this smart contract is to establish a transparent and immutable record of these entities within the blockchain-based food traceability system.

Here's how a registration smart contract typically works within a food traceability system:

a. Entity Registration: When a new entity wishes to participate in the food supply chain and contribute to the traceability system, they initiate a registration process. This process involves providing relevant information such as business details, certifications, licenses, and contact information.

b. Verification and Validation: The registration smart contract verifies the authenticity and validity of the information provided by the entity. It may cross-reference this information with external sources or databases to ensure compliance with regulations and standards.

c. Record Creation: Once the information is validated, the registration smart contract creates a unique record for the entity on the blockchain. This record contains essential details about the entity, such as its name, location, certifications, and permissions within the traceability system.

d. Permission Management: Depending on the role and responsibilities of the entity within the food supply chain, the registration smart contract may assign specific permissions or access levels. For example, a food producer may have permission to upload information about their products, while a distributor may have permission to track the movement of goods.

e. Updates and Maintenance: The registration smart contract also handles updates and maintenance of entity records. If there are any changes in the entity's information or status (such as obtaining a new certification or license), the smart contract can facilitate the update process and ensure that the records remain accurate and up to date.

Overall, a registration smart contract plays a crucial role in establishing trust, transparency, and accountability within a blockchain-based food traceability system. By maintaining immutable records of participating entities and their credentials, it enables seamless collaboration and information sharing across the entire food supply chain, ultimately enhancing food safety, quality, and consumer trust.

2. Add On Smart Contract

An add-on smart contract within a food traceability system serves as a specialized extension that augments the core functionalities of the traceability framework. These smart contracts are developed to address evolving needs and requirements not covered by the primary system, offering tailored features or services to enhance the management of the food supply chain. Upon identification of specific needs, developers create and deploy these add-ons, ensuring seamless integration with the existing infrastructure. Integrated with the core traceability system, add-on smart contracts leverage its data and functionalities to provide specialized services, such as advanced analytics, certification management, or sustainability tracking. Their flexible nature allows for customization to accommodate diverse use cases and business processes, empowering stakeholders to tailor the system according to their unique requirements. By offering enhanced insights and decision-making capabilities, add-on smart contracts contribute to optimizing operations, improving transparency, and ensuring food safety and quality throughout the supply chain.

3. Information Retrieval System

QR code generation involves encoding data into a matrix of black squares arranged on a white square grid, which can be scanned and decoded by a QR code reader. The process typically begins with selecting a QR code generator tool or library. Users input the desired data, such as a URL, text, or contact information, into the generator. The generator then processes this data and applies error correction algorithms to enhance the QR code's readability, ensuring it remains scannable even if partially obscured or damaged. Next, the generator converts the data into a QR code pattern using specific encoding standards. Finally, the QR code is generated and displayed as an image that can be downloaded, printed, or integrated into digital platforms. QR codes offer a convenient and versatile method for quickly sharing information and are widely used in marketing, payment systems, and inventory management.

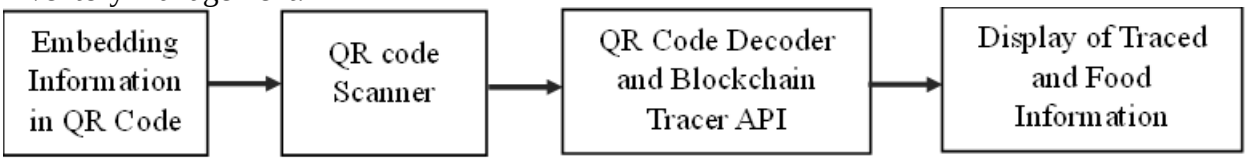

Figure 2: QR Code Based Block Chain Tracing and Information Retrieval System

Figure 2 shows the details of development stages of proposed QR code based embedding and decoding information of Food.

Embedding food tracing information in a QR code involves encoding relevant data into the QR code format, which can then be scanned by a smartphone or QR code reader to retrieve the information. Here's how food tracing information can be embedded in a QR code:

- **Data Encoding**: Determine the type of information to be embedded, such as product origin, production date, batch number, and any relevant certifications or quality assurance details. This information needs to be encoded into a format compatible with QR codes.
- **Structured Data Format**: Organize the information into a structured data format that can be easily interpreted by both humans and machines. This could involve using standardized data formats such as JSON (JavaScript Object Notation) or XML (eXtensible Markup Language).
- **QR Code Generation**: Utilize QR code generation software or libraries to create a QR code containing the encoded information. There are various online tools and software packages available for generating QR codes.

Implementing a QR code-based information retrieval system involves a series of steps to effectively encode, distribute, and decode information. Initially, the type of information to be encoded, such as URLs, text, or contact details, must be identified. Once determined, a suitable QR code generator tool or library is selected to create the QR codes. These generators allow users to input the desired information and customize the appearance of the QR code. Once generated, the QR codes can be printed on physical media like posters or product packaging or displayed digitally on websites or mobile apps. Users then scan the QR codes using a smartphone or dedicated QR code scanner app,

which decodes the information embedded in the code. The retrieved information is presented to the user, typically through actions such as opening a web page, displaying text, or connecting to a Wi-Fi network. Accessibility considerations are important, ensuring alternative methods for accessing the encoded information are available for all users. Additionally, tracking mechanisms can be implemented to monitor QR code usage and gather analytics if needed. Overall, implementing a QR code-based information retrieval system provides a convenient and efficient way to share information with users across various contexts.

4. Etherium Block Chain

An Ethereum-based blockchain refers to a network constructed on the Ethereum platform, renowned for its capability to execute smart contracts and deploy decentralized applications (DApps). Unlike traditional blockchain networks, Ethereum allows for the creation of self-executing contracts, known as smart contracts, which autonomously execute transactions when predetermined conditions are met, effectively eliminating the need for intermediaries. At its core, Ethereum operates through a distributed ledger system, where a network of nodes maintains an immutable record of transactions. Ether (ETH), Ethereum's native cryptocurrency, incentivizes network participants to validate transactions and execute smart contracts. Ethereum's versatility is a standout feature, enabling developers to create a diverse array of DApps spanning multiple industries and use cases beyond simple currency transactions. Security is ensured through consensus mechanisms like Proof of Work (PoW), with plans to transition to Proof of Stake (PoS) in the future. Ethereum's decentralization fosters resilience and censorship resistance, with no single entity controlling the network. The platform boasts a vibrant community of developers, users, and contributors, continuously innovating and expanding the ecosystem, facilitating collaboration and growth. Overall, Ethereum-based blockchain serves as a robust platform for executing smart contracts, deploying DApps, and facilitating secure and transparent transactions across various industries and applications.

VI. Results

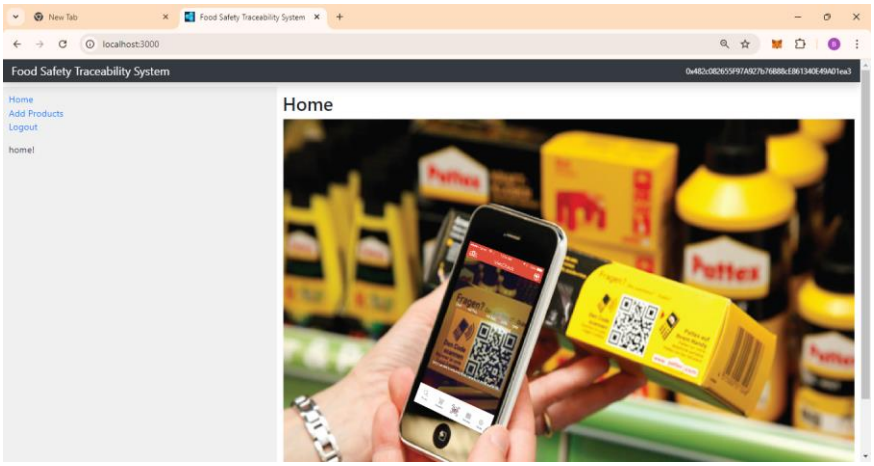

Figure 3: Login Page

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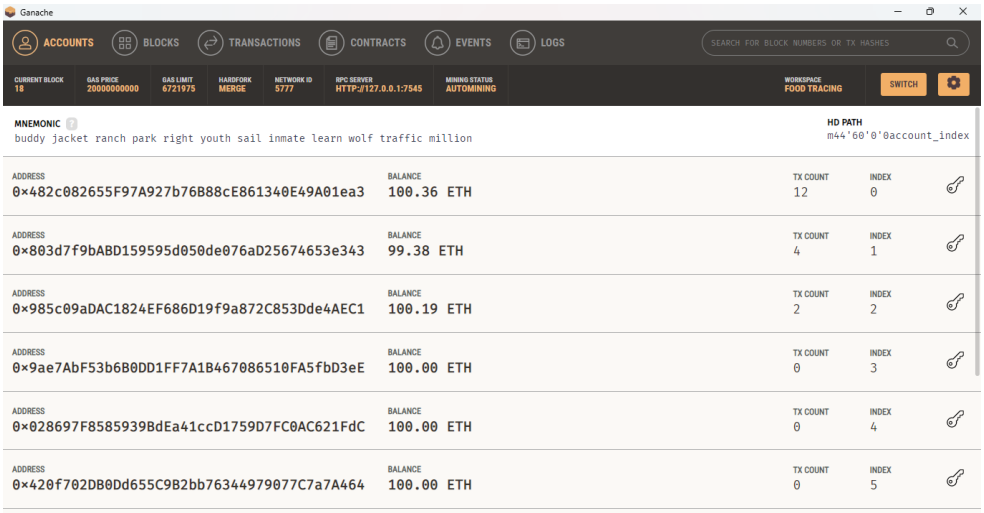

Figure 4: GANACHE HOME PAGE

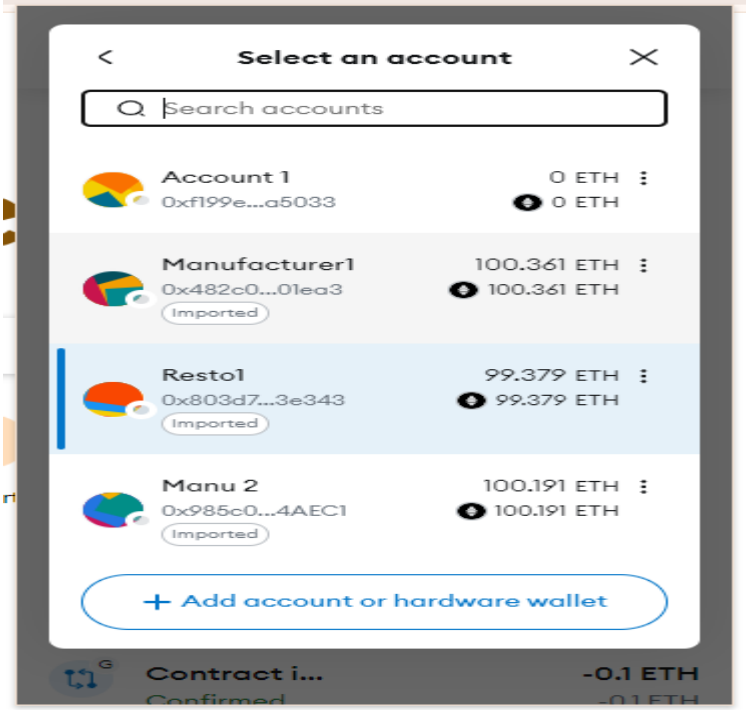

Figure 5: CREATE ACCOUNT ON META MASK

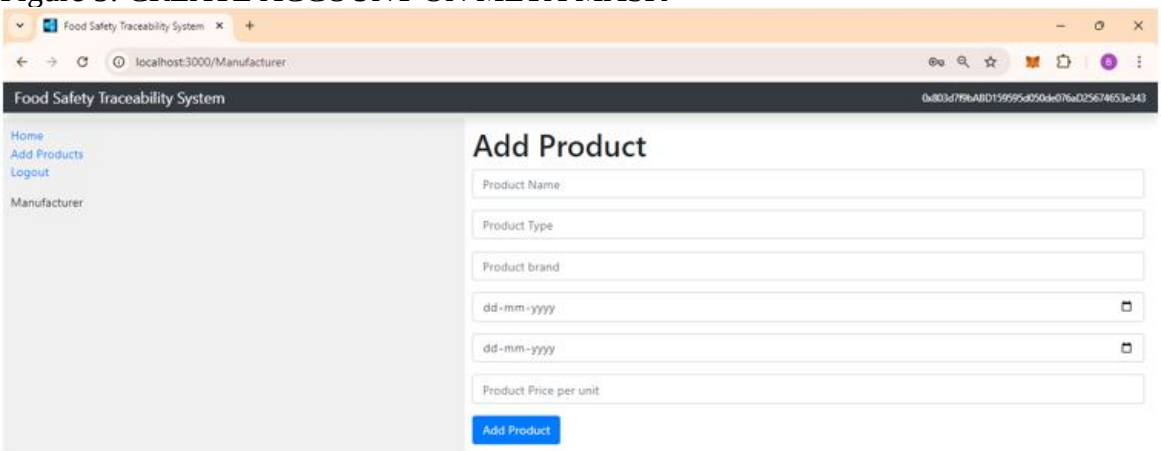

Figure 6: Manufacturer - Products Add

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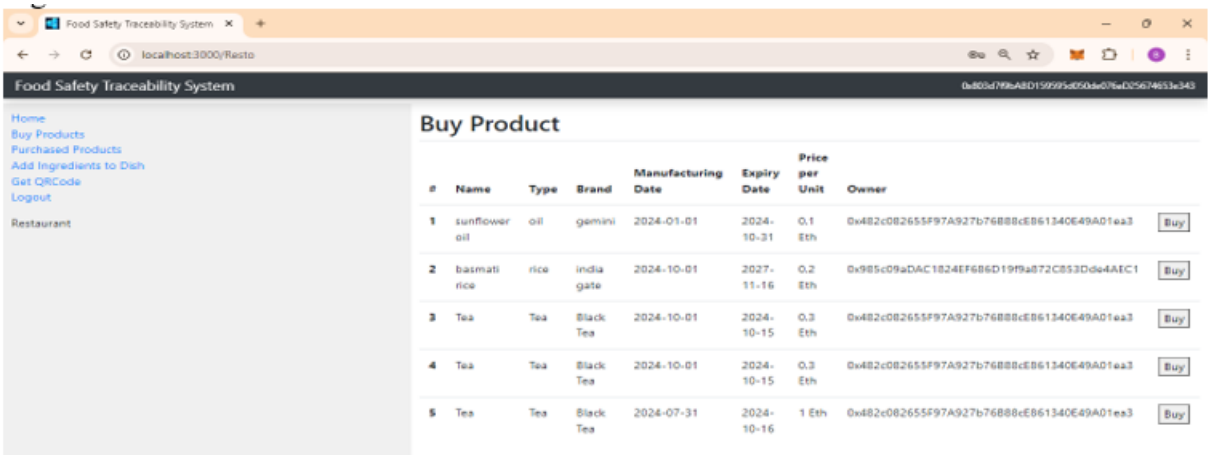

Figure 7: Buy Products from Manufacturer by Retailer

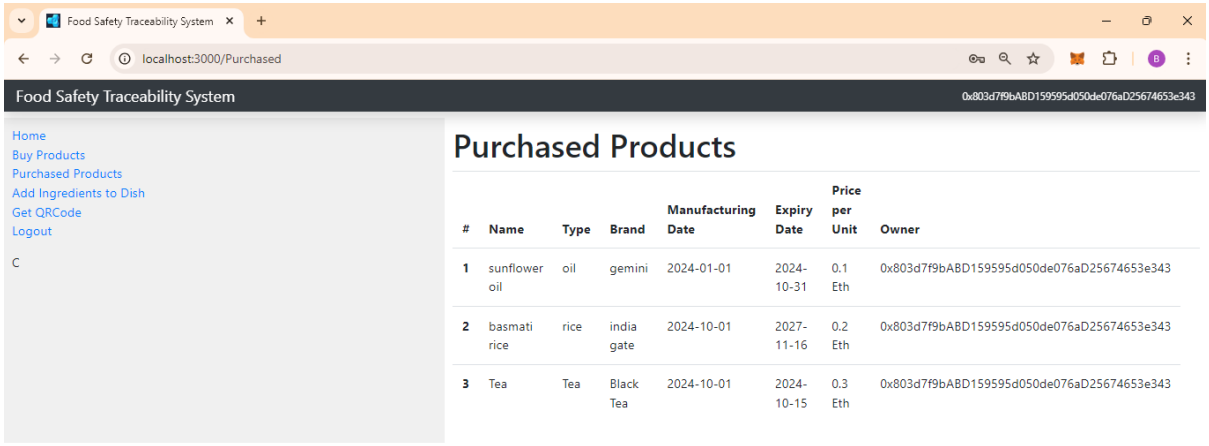

Figure 8: Purchased Products from Manufacturer

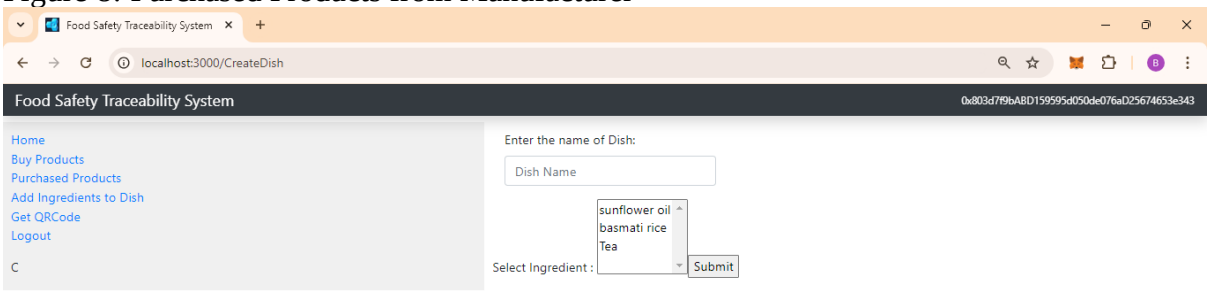

Figure 9: Adding Ingredients to Dish by Restaurant Owner

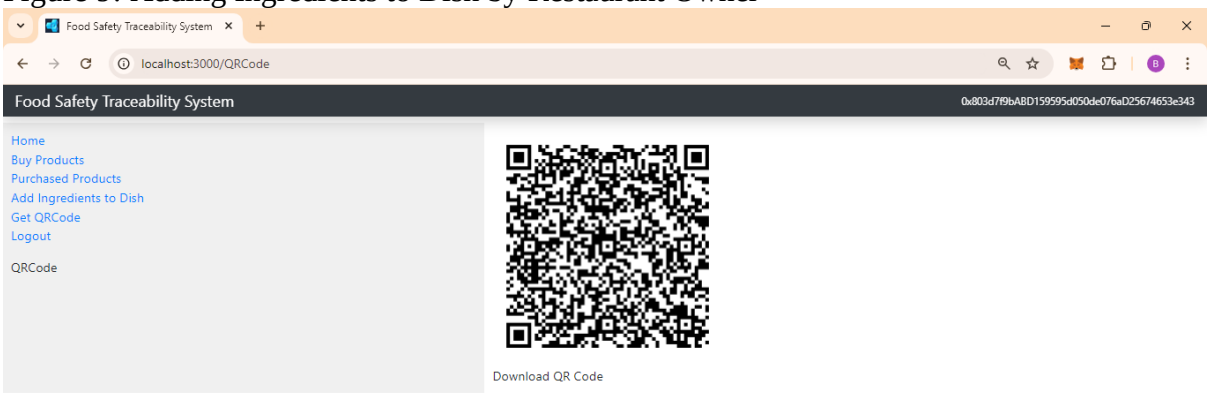

Figure 10: Obtain QR Code for Scanning

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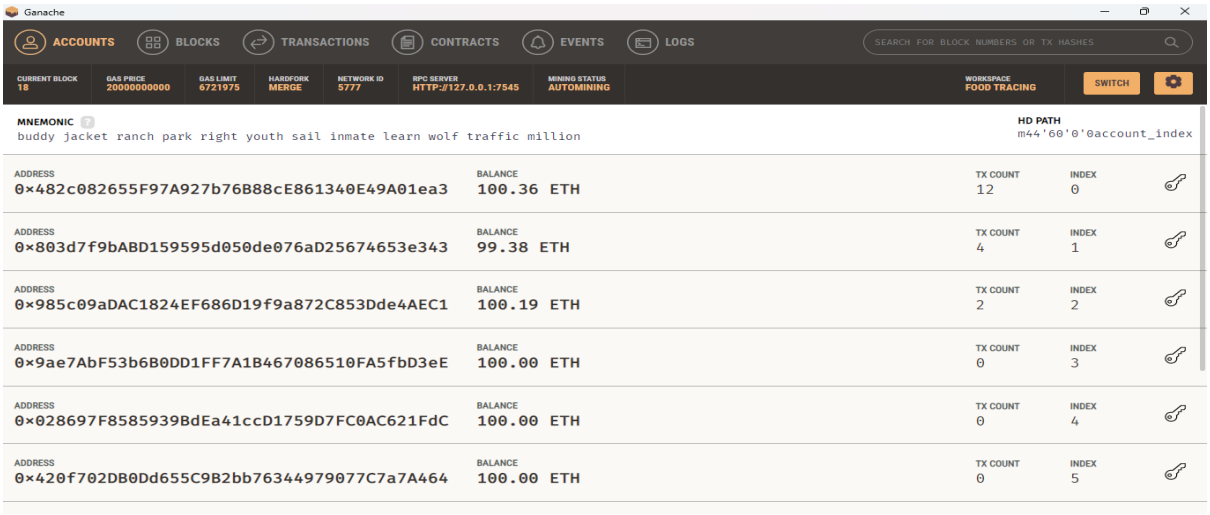

Figure 11: Check Ganache for Deduction

VII. Conclusion

We are implemented food traceability. But, Blockchain is an unchangeable, decentralized, and documented ledger of things that aren't clear-cut or abstentions. It is widely used in many applications due to these unique characteristics. In this study, a food safety architecture with a blockchain-based food traceability application is presented. Customers of restaurants can use this application to quickly trace and track the types of ingredients used in the dishes that the restaurant serves. Smart contract verification governs data security and traceability. Participants in the supply chain can also benefit from this application because all recorded transactions are open to the public. The blockchain makes it simple for anyone to follow or trace the records. This makes it possible for customers and chain network players to interact with digital trust.

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