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Fake Product Identification Using Blockchain Technology

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Abstract

Blockchain technology has founded to detect fakes fast and identify genuine products possible. Essentially, Block chain is a sort of digital ledger which stores business information in blocks across several lots of databases that are connected through chains. The reason why Block chain is secure lies in decentralization that prevents any unauthorized changes to saved facts. By leveraging Block chain technology, clients can guarantee the genuity of their items without intermediate agents. The main approach aimed at tackling fake commodities entails provision of individual QR codes for each product as contained within the Blockchain's blocks. The Authentication of Manufacturer is carried by face Recognition, matching with Manufacturer ID and Manufacturer name. These product codes can be generated by manufacturers or sellers giving a unique QR for product. Whenever users check these QRs into the system, the Blockchain system verifies whether the product is authentic or not. In case there are differences identified, customers are immediately notified about possible whether it is genuine or not.

Keywords: Blockchain technology, distributed ledger, authentication, decentralization, fake

INTRODUCTION

All sectors face dangers from counterfeiting as it threatens customer safety and the reputation of brands. The usual holograms and serial codes are too feeble to overcome this monster thus a need for tougher solutions. Blockchain technology is decentralized secure ledger that improves transparency and accountability in the supply chain.

This technology also enables tamper-resistant records hence anomalies can be identified quickly; through this way, better traceability is enhanced and a safe basis for authenticating goods is established. When Blockchain becomes a part in supply chain processes, product information management will change forever. In essence, Blockchain builds an immutable network that inhibits sale of fake commodities hence increasing dependability in market. Applying Blockchain technology for supply chain operations could lead to the paradigm shifts. Another thing thus is providing credible sources of information by generating unalterable open ledgers which result into better visibility for tracing purposes.

Consequently, all stages right away from manufacturing phase up-to distribution can be monitored without any doubt

whatever since it indicates that it is likely to monitor each stage starting from manufacturing

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phase up-to distribution without any doubt at all. The solidity of security in Blockchain ensures that documents are neither altered nor support frauds in the entire supply chain network (Figure.1).

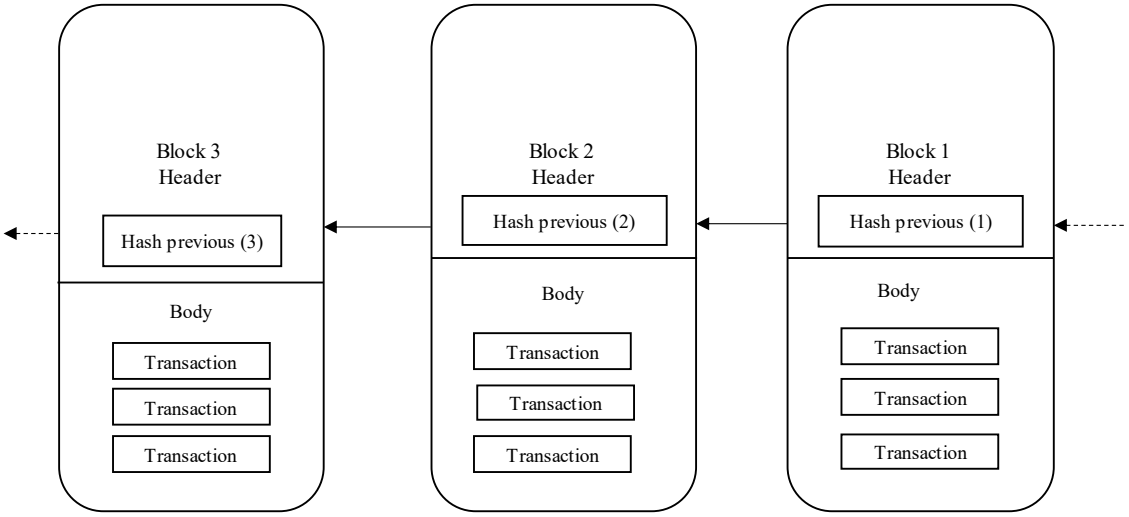

Figure 1. Representation of blocks in block chain

The aim of this research is to demonstrate how much further than tracing, Blockchain can be worked as a means for stakeholders to verify product genuineness? Hence, the objective here is a robust system which will be used in countering counterfeits and establishing an accountable and dependable supply chain. The new approach could thus change our current techniques of managing product information from closedness to openness in relation to market transparency and trustworthiness.

BLOCK CHAIN TECHNOLOGY

Outside of cryptocurrencies, Blockchain technology is very dynamic and has revolutionized several sectors with its secure, transparent and efficient functionalities. Its main purpose, as a decentralized system of record keeping, promotes trust in digital asset transactions by offering secure storage and transfer facilities that are immune to hacking. A chain of blocks is formed through the cryptographic algorithms which connect together validated transactions contained within them [1]. With all the data on each block secured by a chain of cryptographic hash functions, this guarantees the permanency of the information therein hence making it a safe and strong system. Using Blockchain

 technology's strength builds resilient systems for industries to combat fake products or create secure supply chains. Current market trends have seen this new paradigm improve product tracking while improving stakeholder's confidence hence introducing transparency and reliability into business environment (Figure.2).

For a secure and open distributed ledger to be created in block chain system, three key components come together At first, we have Blocks which groups transactions together. Each block has a header that contains important metadata such as timestamps or time signatures, the hash code in the previous block and nonce used for mining operations. Second are transactions, records of digital assets or information exchanged between participants that are collected into blocks. Lastly, these blocks from the "Chain" by being connected one after another. This chain ensures data integrity and immutability in ledger records by integrating cryptographic hash of prior blocks into every new block. This method of chaining leads to an uninterrupted sequence of blocks resulting in a traceable record on transaction history with tamper-proof features [3-4]. These elements work together to establish a decentralized and secure basis for Blockchain technology that enables trustful and transparent record keeping across different applications. RIEPEMD, a summary of the RACE original integrity check message, is a hash function algorithm developed by the COSI research team of the University in Leuven, Belgium. RIPEMD-160 is the most common version of RIPEMD [5].

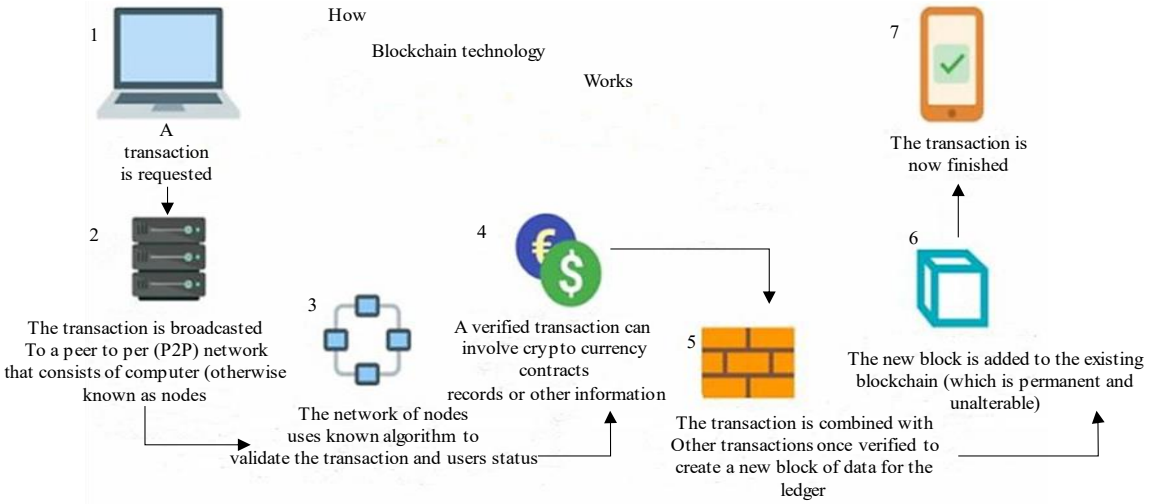

Figure 2. The sequence of works in block chain technology.

Blockchain technology has some core characteristics that make it extraordinary and robust in nature. Firstly, it works without any central system or person since it is decentralized, allowing it to function effectively across networks without any single point. This decentralization promotes trust among actors, making it possible for one-to-one transactions without using middlemen or any third person. Transparency is also important so that all network users can access and validate the entire ledger or record block, thus promoting openness and responsibility. With immutability as its third feature, once a transaction has been entered on the Blockchain, it becomes difficult to change thereby creating an immutable and verifiable database which the details cannot be changed further.[2] This paper briefly introduces the cryptographic techniques such as hash algorithm, asymmetric encryption algorithm and digital signature, also elaborates the blockchain infrastructure, the blockchain structure, bitcoin address, digital currency trading and other technologies of blockchain, and also explains how cryptography technology protects privacy and transaction maintenance in the blockchain in detail. Finally, cryptographic techniques and consensus mechanisms like proof-of-work or proof-of-stake enhance Blockchain security enhancing the integrity, confidentiality and genuity of transactions in decentralized networks. Together these core features make Blockchain technology robust and transparent with uses ranging from finance to supply chain management and beyond.

LITERATURE SURVEY

Fake Product Detection Using Blockchain Technology

The research paper explores the execution of Blockchain technology in addition with Quick Response (QR) codes to reduce the problem of counterfeit products in manufacturing industries. Highlighting the adverse impact on companies' reputation and financials, the paper proposes a protected system and decentralized system where each product is given a unique QR code linked to a Blockchain database. This system enables users to easily verify product authenticity by scanning the QR code, ensuring traceability in the supply chain while reducing losses with counterfeit goods.

Fake product identification with the use of block chain technology

This research paper explores the significant impact of genuine less products on businesses and proposes a decentralized Blockchain-based system to tackle the issue. The paper tells the work of Blockchain, citing Bitcoin as a well-known example that solves the double-spending problem and ensures tamper-free data. This system aims to enable consumers to independently verify the genuity of goods, reducing reliance on retailers. It addresses financial challenges faced by small and medium-sized enterprises by suggesting the make of Ethereum-provided Blockchain architecture for cost-effective counterfeit prevention. The paper delves into the technical aspects of Blockchain, explaining its decentralized nature, consensus mechanism, and proof-of-work algorithm. Ultimately, the research underscores Blockchain's potential to disrupt traditional trust- based transactions and enhance product quality assurance in the supply block chain.

Blockchain-Based Anti-Counterfeiting System

Gao et al. (2022) [10]. developed a system consist of Blockchain to combat counterfeiting in supply chains, focusing on end-to-end tracking and authenticity verification of raw materials. Employing digital signatures and smart contracts, the study addressed the root cause of counterfeiting. Digital signatures ensured the legitimacy of raw materials, while smart contracts automated and enforced rules throughout the supply block chain, minimizing the chances of unauthorized products entering the market. The system's holistic approach, from production to end consumers, provided comprehensive anti-counterfeiting measures. By combining material authenticity verification and smart contract automation, Gao et al.'s system represents a significant advancement in supply chain security, offering a proactive solution to combat counterfeit products at every stage [6].

An Ethereum based fake product identification system using smart contract

This paper addresses the escalating issue of counterfeit and fake products in the manufacturing industry and its adverse effects on brand reputation, sales, and profits. Leveraging Blockchain technology, the authors propose a system designed for product genuineness and counterfeit detection. Blockchain, as a well-protected and distributed digital ledger, ensures tamper resistance, by removing the need for intermediaries or third parties in product security verification. The system employs serial numbers uniquely assigned to products, effectively combating counterfeits. With a focus on emerging trends in Blockchain technology, the project utilizes Ethereum and Solidity to create a comprehensive system that stores product information and generates distinct codes for items. Users can verify product authenticity by matching codes present in Blockchain network [7]. The proposed system provides notifications to users, distinguishing between genuine and counterfeit products. Keywords include Blockchain, Ethereum, Authentication, Counterfeit, Serial number, and Solidity. The introduction emphasizes the risks associated with technology development, the prevalence of counterfeit and fake products in the supply chain, and the potential of Blockchain technology in the system to ensure product integrity.

PROBLEM STATEMENT

The prevalence of counterfeit or deceptive products introduces intricate challenges that adversely affect various facets, including consumer safety, brand reputation, and the overall integrity of markets. Due to the complex of distinguishing authentic products from their fraudulent counterparts underscores the demand for innovative solutions. In response to this challenge, Blockchain technology has make a good focal point due to its potential to introduce unprecedented clarity and traceability within complex supply chains.

Blockchain, as a decentralized with the addition of immutable ledger, has garnered attention for its capacity to provide an incorruptible and transparent record. This technology serves as a robust mechanism for tracing the whole lifecycle of products, encompassing their origin, movement, and authenticity. Its inherent features, such as cryptographic hashing, consensus mechanisms, and decentralized consensus, contribute to its ability to create a well-protected and tamper-proof ledger. The primary research objective is to design and make an efficient system that harnesses the capabilities of Blockchain innovative technology to effectively identify and counteract counterfeit products. The envisioned system's core functionality revolves around the comprehensive tracking and verification of product authenticity throughout the whole supply chain. This process spans from the initial stages of production, through distribution channels, and ultimately to end-user consumption. The secondary research tells that there is a chance even the fake manufacturer with fake products is able to make unique QR codes as real manufacturer. The objective is to make a difference between the fake and real manufacturer.

The overarching goal of the proposed system is to markedly reduce or eradicate the dissemination of counterfeit goods. This reduction is achieved by increasing the support to the intrinsic security and transparency offered by Blockchain technology system. The decentralized character of Blockchain ensures that no single individual or any third- party entity has control over the entire system, mitigating

the risk of fake or manipulation. Furthermore, the transparent and verifiable nature in the Blockchain allows stakeholders at each stage of the supply chain, including manufacturers, sellers, and consumers, to confidently validate the authenticity of products [9].

In conclusion, the research focuses on the practical implementation of Blockchain technology in order to address the multifaceted challenges posed by counterfeit products, employing technical mechanisms to establish a secure, protected, transparent, and efficient system within the supply block chain ecosystem.

Proposed System

To handle fake goods, the proposed system is extensively inbuilt of Blockchain system, Ethereum, MetaMask and Ganache. At its core is a Blockchain that provides decentralization and tamper-proofing of transactions made on products. Products behavior on the chain is defined by Ethereum's smart contracts functionality with a specialized product smart contract which captures the attributes that are essential. MetaMask enables manufacturers to register with it as well as add products hence automatically creating corresponding smart contracts for such entities within the Ethereum Blockchain. Admins form an integral part in verifying product information and producing QR codes that are securely linked to smart contracts. These QR codes contain encrypted data about the products thus simplifying their authentication by consumers.

Ganache serves as a controlled environment for local Blockchain development and testing, facilitating rapid smart contract deployment. The overall system ensures transparency by recording all transactions records on the decentralized Blockchain, eliminating manipulation risks. MetaMask enhances security in user interactions, and Ganache provides a secure and protected development space for testing purposes. The addition of these components offers a robust solution to combat counterfeit and fake products in the whole product lifecycle (Figure.3).

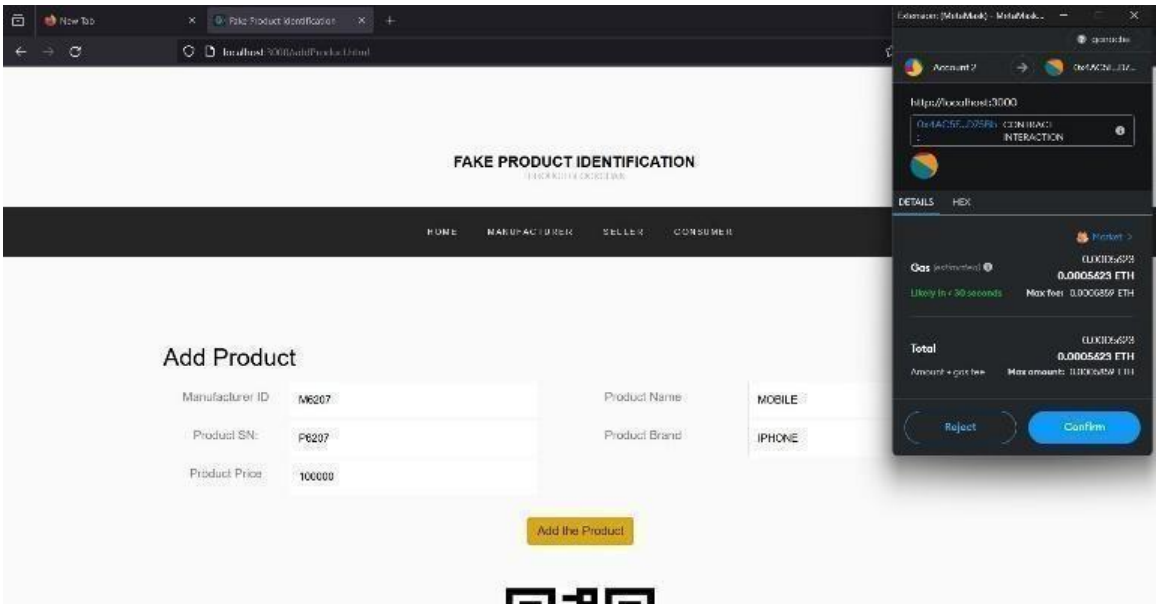

Figure 3. Connecting to MetaMask

Meta mask

MetaMask integration serves as a pivotal component in the proposed system, enabling manufacturers to securely interact with the Ethereum Blockchain throughout the product lifecycle. As a browser extension, MetaMask functions as a secure Ethereum wallet, seamlessly integrating with the system to facilitate user registration and Ethereum wallet integration. By securely managing private keys, MetaMask ensures the authenticity and integrity of transactions, allowing manufacturers to confidently engage in Blockchain-related activities such as product registration and ownership transfers (Figure.4).

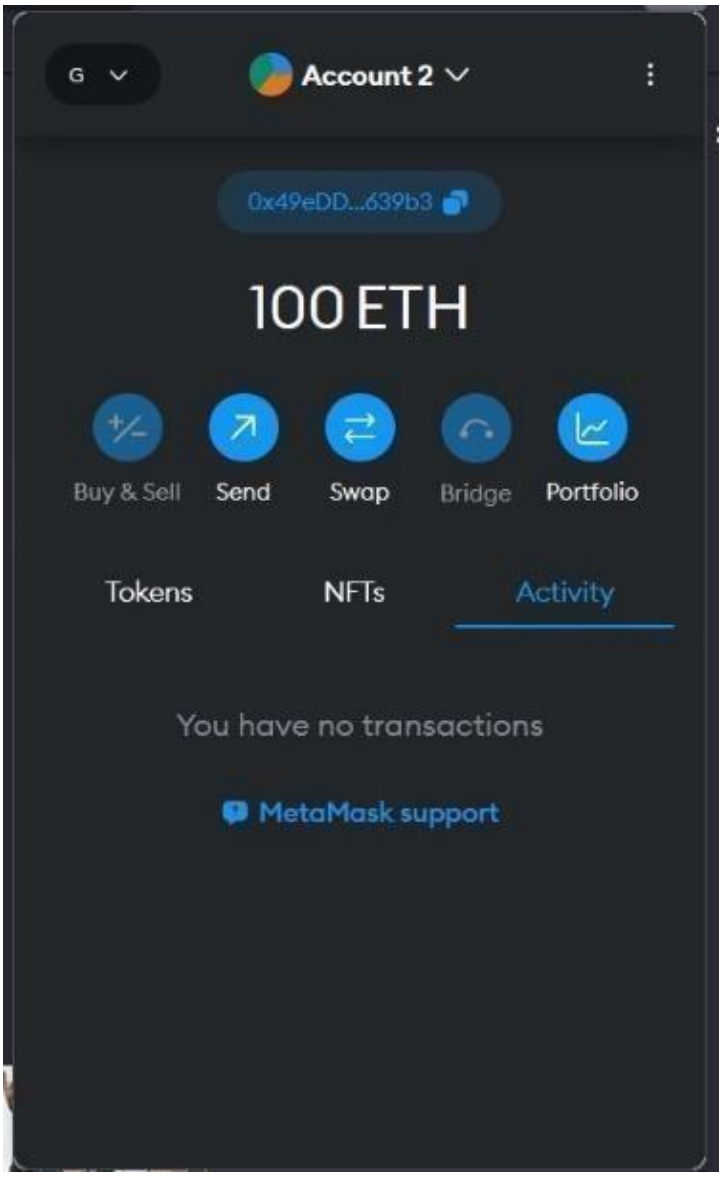

Figure 4. Deploy of smart contracts

Additionally, MetaMask operates as an interface between the Ethereum consisted Blockchain and the system, serving as a secure and protected gateway to the Blockchain for manufacturers that would not have to expose or any third party cannot see their private keys which also may be targeted by the hackers to get the data. The user-friendly user interface helps to abstract away challenges of interacting with the Blockchain technology hence making it more accessible for producers. By integrating MetaMask, this proposed system can make feel manufacturers safely control their Ethereum wallets, ensure siged transactions integrity and confidently engage in block chain related activities during product life cycle thus leading into streamlined and secured product management process. instant payment for goods might be released. Gray stated that "We see great potential in the area of smart contracts—using Blockchain technology and coded instructions to automate legal contracts."

Smart Contracts

Moreover, another innovation is self-executing contracts or "smart contracts". These digital contracts are well designed and well prepared such that they automatically execute themselves upon occurrence of certain conditions. For instance, if a buyer and seller meet all specified parameters for a deal (Figure.5)

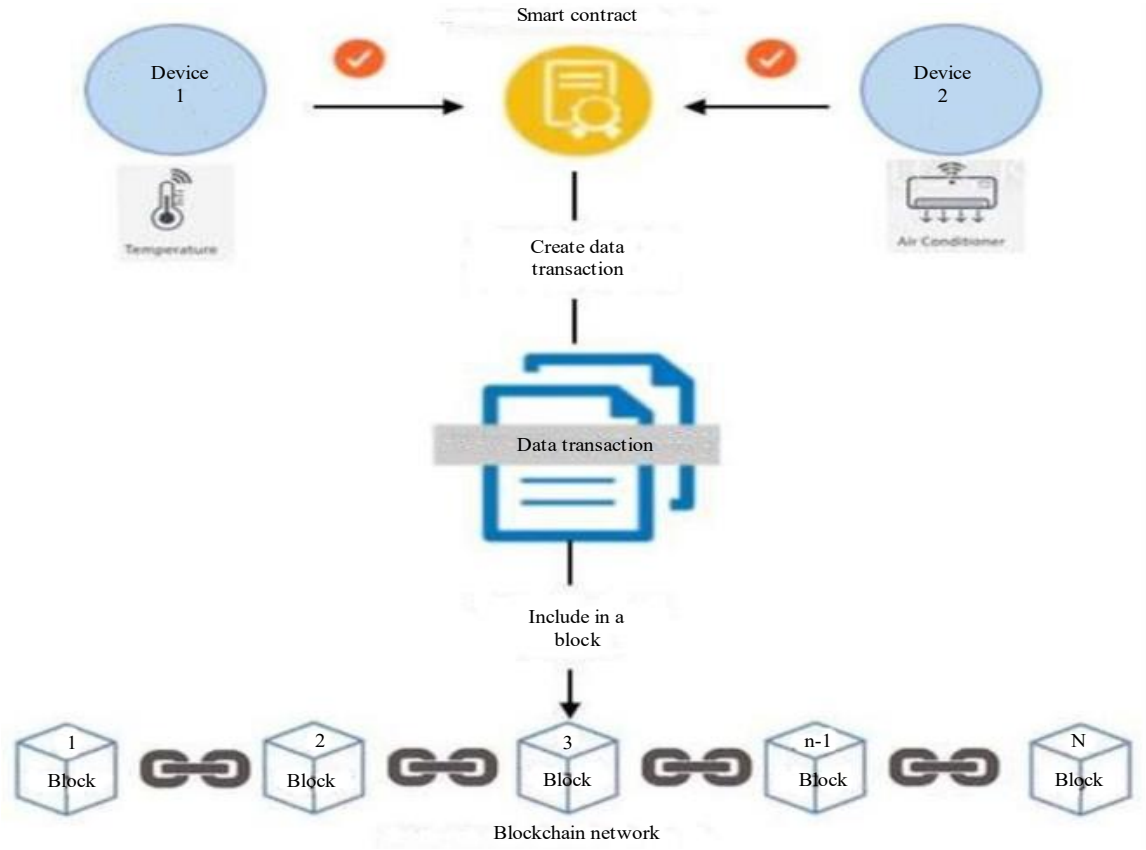

Figure 5. Smart contract and its overview

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Ethereum

Important to note, Ethereum is a basic Blockchain platform for the truth is that it offers sophisticated smart contract-based applications. Smart contracts are similar to contracts in which there will be conditions are encoded in the code of a transaction. Selecting Ethereum was wise because it can run these smart contracts thus making it decentralized and safe enough to manage and validate transactions related to product behavior and ownership.

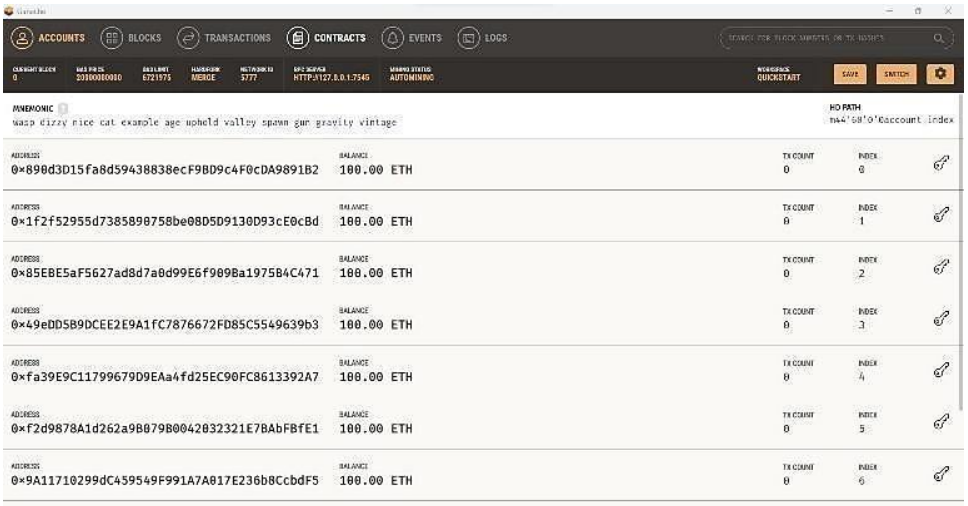

Figure 6. Ganache private keys

This research uses Ethereum smart contracts as fundamental mechanisms by which product behavior and structure is defined on the Blockchain (Figure.6). Purpose built product smart contract designed for each individual registered product. This smart contract contains all vital features regarding this product such as every information about this product, as well as data concerning its ownership.

PROPOSED MODEL

In the proposed system, MetaMask integration plays a crucial role in ensuring secure interactions between manufacturers and the Ethereum Blockchain. MetaMask, functioning as a browser extension, serves as a secure Ethereum wallet, offering a user-friendly interface for managing private keys and signing transactions securely. Here's a detailed explanation of how MetaMask is utilized in the project:

Admin Authentication, Manufacturer Face Recognition and Id Verification

Admin Logins and registers the Manufacturers with Id and name. Manufacturer undergoes a face recognition in which when it matches, the manufacturer is allowed to ID Verification, then manufactures are allowed to add the products. With the face recognition and matching of manufacturer Id and manufacturer name gives more safety and able to give the difference between fake and real manufacturer since each manufacturer has its own unique manufacturer ID (Figure.7).

Figure 7. Face Recognition of Manufacturer.

Product registration and ethereum wallet integration

Manufacturers register the products on the system, initiating the onboarding process. During registration, manufacturers integrate their Ethereum wallets with MetaMask. This integration involves securely linking the user's MetaMask wallet to their account within the system.

Secure Private Key Management

MetaMask provides a secure and protected environment for managing private keys, which are essential for authorizing transactions on the Ethereum based Blockchain. Private keys are cryptographic keys that grants access and opens to the user's Ethereum assets and facilitate secure interactions with Blockchain.

Transaction signing

When manufacturers perform actions on the system that involve interactions with the Ethereum Blockchain, such as making and adding products or transferring ownership, MetaMask facilitates the signing of these transactions. Transaction signing involves the genuine use of the user's private key to generate a cryptographic signature, ensuring the authenticity and integrity of the transaction.

Interface Between System As Well As Ethereum Blockchain

MetaMask acts as the intermediary interface between the system and the Ethereum Blockchain. It enables seamless communication, allowing manufacturers to make a touch with the Blockchain without directly exposing their private keys to potential vulnerabilities.

Secure user interactions throughout the product lifecycle

Throughout the product lifecycle, from product registration to ownership transfers, MetaMask ensures secure user interactions. Manufacturers can confidently engage in Blockchain-related activities, knowing that MetaMask enhances the security of their Ethereum wallet and private key management.

User-Friendly Integration

The integration of MetaMask enhances the overall user experience by providing a familiar and user-friendly interface. It abstracts away the complexities of directly interacting with the Ethereum Blockchain, making it more accessible for manufacturers.

Within the Add Product portal, the Manufacturer inputs various details such as Product Serial Number, Product Name, Product Company, Product Price, Seller ID, Seller Name, Seller Phone Number, Seller Address, Manufacturer ID, and Manufacturer Name. Clicking "Add Product" triggers the making of a Blockchain block containing the entered product details, marking the conclusion of the Manufacturer's involvement.

The process transitions to the Seller section, where the Seller logs in using their Seller ID. The interface displays a list of different products provided by manufacturers. The Seller is responsible for selling the selected product to the end customer (Figure.8).

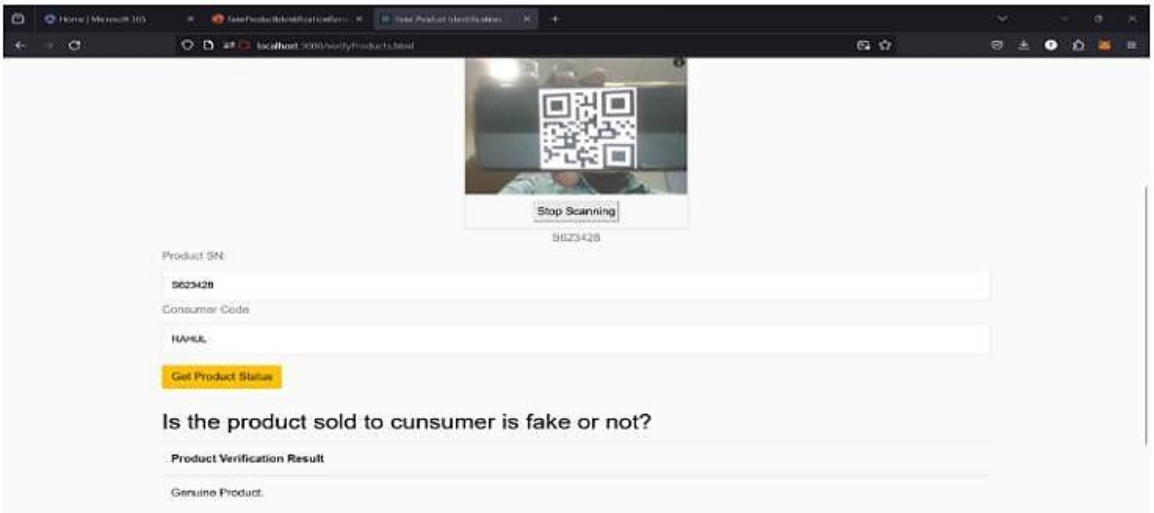

Figure 8. Fake product identification.

In the final stage, the Customer engages with the system. The Customer scans the QR code of the purchased product, prompting a verification process against the Blockchain data. Whether the QR code matches, the system displays "Genuine Product," accompanied by essential details such as Seller ID, Product Serial Number, and Manufacturer ID. The Customer can then make an informed decision on whether to proceed with the purchase based in displayed information.

CONCLUSION AND FUTURE WORK

In conclusion, the adding of Blockchain technology in the identification of counterfeit products offers a well promised solution to the pervasive issue of fraudulent goods. The inherent characteristics of transparency, immutability, and decentralization within Blockchain have the potential to significantly elevate supply chain integrity and instill greater confidence among consumers. By establishing a tamper- proof and decentralized ledger, each product is endowed with a unique and individual identifier that meticulously records its journey throughout the entire supply chain. This not only ensures a

heightened level of transparency and traceability but also empowers both consumers and businesses to authenticate the legitimacy and origin of product in real-time. The rapid identification and removal of counterfeit items from the market serve as a crucial safeguard, shielding consumers from the risks associated with fraudulent and potentially harmful products.

Looking forward, the evolution of this technology could encompass advanced authentication methods, such as iris authentication, specifically tailored for manufacturer logins. The incorporation of biometric authentication introduces an additional layer of security, allowing only authorized individuals access to and contribution within the Blockchain. This proactive approach fortifies the overall security of the system, enhancing resilience against unauthorized access or tampering. Furthermore, the collaborative potential of Blockchain-based solutions is noteworthy, fostering a shared platform for seamless information exchange among stakeholders—manufacturers, distributors, retailers, and consumers. This collaborative effort establishes a trusted ecosystem where data integrity is assured, creating a united front against counterfeit or fake products and yielding mutual benefits for both businesses and consumers in the continuous battle against fraudulent goods.

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