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SecQRMark:Fake Product Detection using Blockchain

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Abstract - In response to the global challenge of counterfeit products, this paper presents an advanced anti-counterfeit system leveraging blockchain technology. The system utilizes Ethereum, Solidity, and Ganache to establish an immutable and transparent ledger, enabling real-time tracking of products from manufacturer to consumer. Manufacturers register their products on the blockchain, generating unique QR codes with Copy Sensitive digital images for secure identification. Consumers employ an Android application to scan these QR codes, decrypting the encrypted text to access vital information about product authenticity. This system not only empowers consumers with instantaneous verification but also provides businesses with a robust defense mechanism against counterfeit threats, safeguarding their reputation and revenue. The integration of innovative technologies revolutionizes the authentication process, instilling trust in consumers and bolstering brand integrity. Our solution stands as a pioneering force in the battle against counterfeit production, offering a scalable and efficient method for detecting fake products using blockchain technology.

***Key Words*:** Block chain, smart contracts, QR(Quick Response) code, anti- counterfeit.

1.INTRODUCTION

Blockchain technology, with its decentralized and immutable ledger system, stands at the forefront of combating counterfeit products. By leveraging blockchain, stakeholders across supply chains can establish a transparent and secure framework for verifying product authenticity and tracing its journey from production to consumption. Smart contracts, embedded within the blockchain, automate various aspects of the supply chain, ensuring compliance with agreed-upon standards and protocols. Additionally, QR (Quick Response) codes play a pivotal role in the anti-counterfeit efforts by serving as unique identifiers linked to product information stored on the blockchain. Consumers can easily scan QR codes to access real-time authentication data, empowering them to make informed purchasing decisions and thwart counterfeit attempts effectively.

Through the integration of blockchain technology, smart contracts, and QR codes, anti-counterfeit efforts are bolstered with enhanced transparency and accountability. Blockchain's immutable ledger ensures the integrity of transaction records, while smart contracts automate supply chain processes, reducing the risk of counterfeit infiltration. QR codes serve as gateways to real-time authentication data stored securely on the blockchain, enabling consumers to verify product authenticity with ease. This multifaceted approach not only strengthens consumer confidence but also fosters trust and integrity across supply chains, ultimately mitigating the pervasive threat of counterfeit products in the global marketplace

2.Literature Review

In recent years, the proliferation of counterfeit products has significantly impacted various industries, posing challenges to sales and profitability. To address this issue, blockchain technology has emerged as a promising solution, offering enhanced security and transparency throughout the supply chain [1]. By leveraging blockchain, consumers can independently verify the authenticity of purchased products without relying on third-party intermediaries. In a notable study, a blockchain-based management system was proposed for detecting counterfeit products using barcode readers [2]. This system stores product details and unique codes as blocks in the blockchain database, allowing customers to verify product authenticity by comparing the provided code with entries in the database. Additionally, advancements in blockchain and supply chain technologies have led to innovative approaches for combating counterfeiting [3]. For instance, the integration of one-time password (OTP) authentication enhances security measures, while quality control officers monitor product standards to ensure

authenticity [4]. These developments underscore the importance of continuous research and technological advancements in addressing counterfeit product detection and prevention. As the landscape evolves, future enhancements may include the development of mobile applications for seamless verification and tracking, further enhancing transparency and stability in supply chain operations. Additionally, the automatic detection of fraudulent activities, such as fake product reviews, remains a critical area for future research, requiring innovative solutions to safeguard consumer trust and integrity in the marketplace.The proposed system for fake product detection using blockchain technology:
Manufacturers play a crucial role in establishing product legitimacy. They log in to the system using their manufacturer accounts and provide detailed information about their products. This information can include specifications, materials, and unique identifiers. The system then generates a unique QR code for each product. To ensure data integrity, the manufacturer's user ID in the local database must be mapped to the wallet address used for adding a block to the Ethereum blockchain. In simpler terms, only authorized manufacturers using their registered accounts and wallets can add product information to the blockchain ledger.Suppliers can leverage the system to access product information. By scanning the QR code on a product, they can view the details that the manufacturer has already entered into the system. Additionally, suppliers can add their own information to the blockchain, such as the product's destination shop. This transparency allows everyone involved in the supply chain to track the product's movement.

Consumers are empowered to verify the authenticity of products before purchasing them. Using a mobile app, they can scan the QR code on the product. The app then communicates with the blockchain network to retrieve the product's information and transaction history. If the QR code is valid and the information matches the blockchain records, the app confirms the product's authenticity. A key advantage of this system is the ability to detect potential counterfeits. If the last recorded location in the product's history doesn't match the store where the consumer is about to buy it, the app would raise a flag, indicating a potential mismatch. This would warn the consumer that the product might be counterfeit.
In essence, this system leverages the power of blockchain technology to create a secure and verifiable ecosystem for product authentication. By combining unique QR codes, tamper-proof blockchain storage, and decentralized verification, this system offers a promising solution for combating counterfeiting in various industries.

3. WORKING MODEL

3.1 Proposed system :

Counterfeiting poses a significant challenge globally, impacting organizations, manufacturers, and consumers alike. To combat this issue, manufacturers implement a blockchain-based solution utilizing a unique identifier for each product akin to the Aadhaar Card's 16-digit number.

Upon production, manufacturers log this unique identifier on the blockchain. As the product traverses the supply chain, each participant, such as distributors and retailers, appends their digital record to the blockchain. These records encompass crucial details like product location, purchaser information, pricing, brand specifics, and seller details.

Consumers wield the ability to verify product authenticity by scanning the unique identifier (encoded as a QR code) using their smartphones. This action grants them access to all digital records associated with the product on the blockchain, spanning from the manufacturer's entry to subsequent entries made by supply chain intermediaries. In cases where counterfeit products infiltrate the supply chain, lacking valid blockchain records, consumers swiftly discern their illegitimacy upon scanning the unique identifier.

This model leverages blockchain's immutable ledger to mitigate the influx of counterfeit products, fostering transparency, traceability, and accountability across supply chains. Consequently, it shields manufacturers' reputations, curtails economic losses, and bolsters customer satisfaction by ensuring the provision of authentic goods.

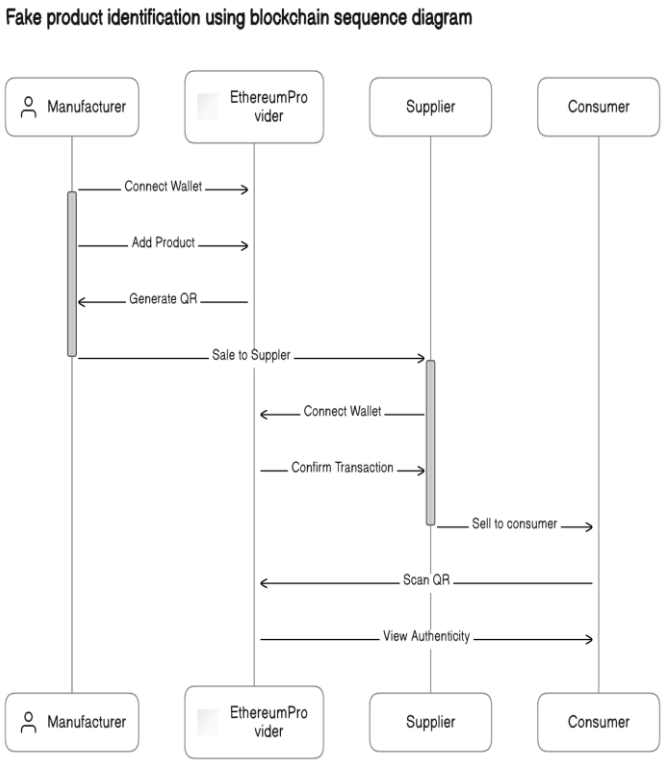

Fig-1: Sequence diagram of fake product identification using blockchain

3.2 System Model:

The proposed system will be a decentralized application designed to utilize Ethereum as the primary blockchain infrastructure for storing records and managing transactions related to the products offered by companies listed on the platform. The architecture of the system is illustrated below.

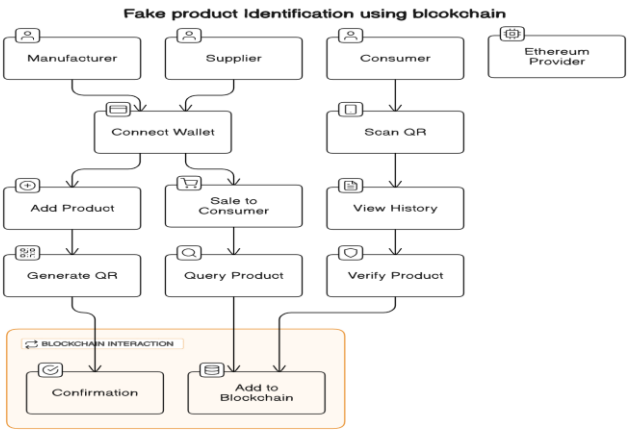

Fig- 2:System Architecture

Ethereum's role in combating counterfeit products through smart contracts involves establishing a decentralized system for authenticating products across the supply chain. Leveraging Ethereum's smart contract functionality enables the creation of self-executing agreements governed by predefined logic and conditions.

Here's a technical overview of the process:

1.Product Identification and Blockchain Recording:

- Manufacturers assign a unique identifier to each product, which is then logged onto the Ethereum blockchain.
- This identifier serves as a cryptographic seal, providing a verifiable trail of the product's origin and journey.

2.Immutable Record Creation:

- At each stage of the supply chain, involved parties (distributors, retailers, etc.) contribute transactional data to the blockchain ledger.
- These transactions are cryptographically hashed and appended to the blockchain, establishing an immutable record of the product's lifecycle.

3.Automation via Smart Contracts:

- Smart contracts are deployed to automate the verification process, enforcing predefined rules and actions.
- For instance, a smart contract may validate a product's unique identifier against blockchain records to confirm authenticity.
- Upon successful verification, the smart contract can autonomously execute actions, such as triggering payments to stakeholders.

4.Detection of Counterfeit Products:

- If a counterfeit product is identified during verification, the smart contract flags its status as fraudulent.
- The immutability of blockchain records ensures the integrity of the verification process, making tampering or alteration impossible.

3.3 Flow of Proposed System:

The main aim of this proposed system is to maintain the Genuity of the goods and tracking the supply chain history of the goods. System gives power to customers for tracking the history of an entire goods from manufacturer to customer using blockchain. This system based on Blockchain is composed of three roles, the Manufacturer, the Seller, and the Consumer, as discussed and shown in figure below.

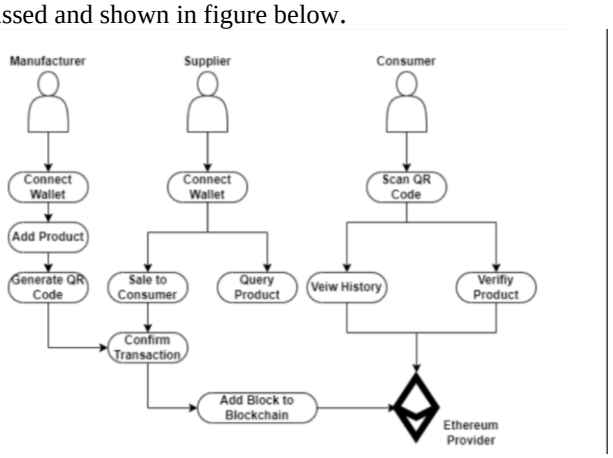

Fig -3: System Flow

Manufacturer: The manufacturer initiates the process by logging into their dedicated account, where they can generate a unique QR Code for each product they produce. They then input essential details about the product, including its specifications and origin. Utilizing their MetaMask wallet, the manufacturer securely adds a block to the Ethereum blockchain, ensuring an immutable record of the product's existence and attributes.

Seller: Upon receiving the product, the seller scans the QR code associated with it. Through this scan, the seller gains access to comprehensive information provided by the manufacturer, facilitating informed sales transactions. The seller is empowered to transfer ownership of the product to the consumer upon purchase.

Consumer: The consumer plays a crucial role in the verification process by scanning the QR code affixed to the product. This action triggers a query to the blockchain, revealing a transparent history of transactions associated with the product. By scrutinizing this transaction history, the consumer can verify the authenticity of the product. In the event that the product is identified as counterfeit, the system promptly flags it as such, thereby alerting

the consumer to potential fraudulent activity and safeguarding against the purchase of counterfeit goods.

4. RESULT AND DISCUSSION

The implementation of the proposed system marks a significant advancement in supply chain management by leveraging blockchain technology to enhance transparency, traceability, and security. This section discusses the results obtained from the system's implementation and explores its implications for manufacturers, suppliers, and end-users.

4.1 System Architecture and Components

The proposed system architecture encompasses various components, including smart contracts deployed on the Ethereum blockchain, a user interface developed using HTML, CSS, and JavaScript, and integration with MetaMask for secure interaction with the blockchain. The system utilizes Web3.js library to facilitate communication with smart contracts, enabling functionalities such as reading and writing data to the blockchain.

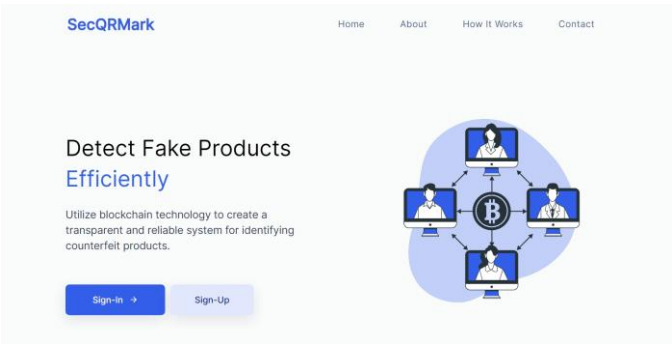

Fig- 4: Accounts can be categorized into manufacturer, supplier, and customer

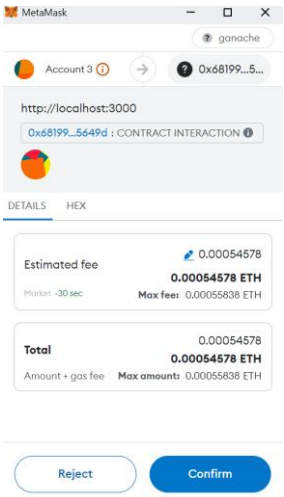

Fig-5: Connecting Ethereum using metamask wallet.

4.2 Testing Environment and Deployment

During the development and testing phase, Ganache, a local blockchain network, was utilized to simulate Ethereum's functionality in a controlled environment. This allowed for thorough testing of smart contracts and interactions with the blockchain without incurring actual gas costs. Truffle, a popular development framework, was employed to compile and deploy smart contracts onto the Ethereum blockchain.

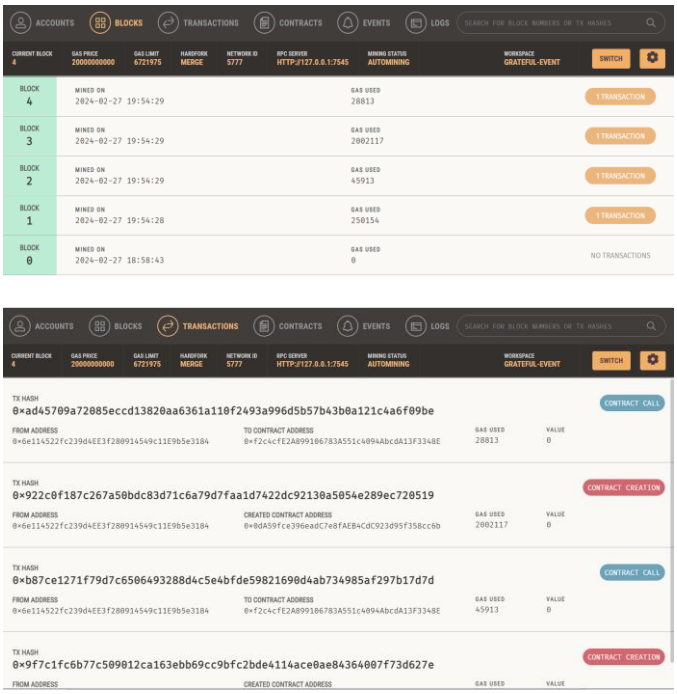

Fig -6&7:Blocks and Transactions in Ganache

4.3 Manufacturer and Supplier Interaction

The system empowers manufacturers and suppliers to seamlessly interact with the blockchain by adding their respective blocks containing transaction details without compromising the integrity of other participants' blocks. Manufacturers can securely record product information on the blockchain, including origin, specifications, and ownership details, using their MetaMask wallet for transaction confirmation.

Similarly, suppliers can contribute to the blockchain by adding relevant transaction data, such as shipping details and receipt confirmation, ensuring a comprehensive and immutable record of the product's journey through the supply chain. The integration with MetaMask enables secure and authenticated transactions, enhancing the overall integrity of the supply chain ecosystem.

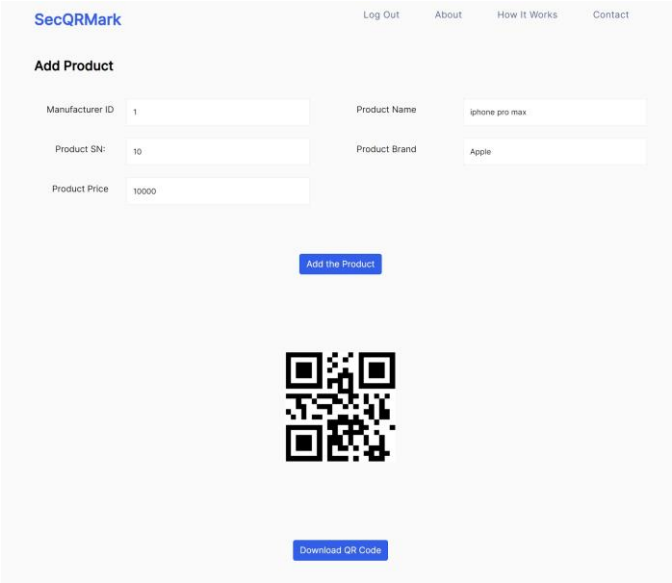

Fig- 8: Manufacturer adds product details using the MetaMask Wallet.

4.4 End-User Experience

End-users benefit from the transparency and accountability afforded by the blockchain-based supply chain system. By scanning the QR code affixed to the product, consumers can quickly ascertain whether the product is genuine or counterfeit. This immediate access to authenticity information instills confidence in the quality and integrity of the product, empowering consumers to make informed purchasing decisions.

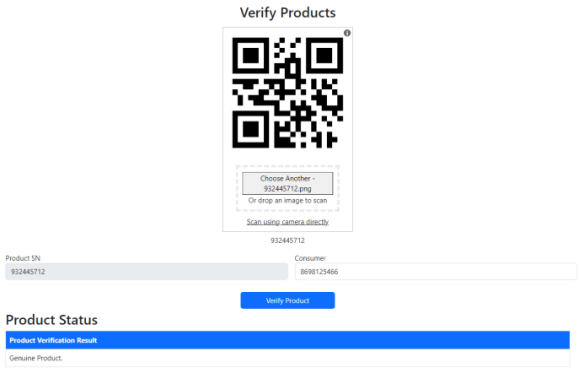

Fig 9: Product Verification by Consumer.

3.5 Implications and Future Directions

The implementation of the proposed system holds significant implications for various stakeholders in the supply chain industry. Manufacturers can establish a verifiable record of product provenance and maintain brand integrity, while suppliers can enhance trust and accountability in their operations. Moreover, end-users benefit from increased transparency and confidence in the products they purchase.

Moving forward, further enhancements and refinements can be made to the system to improve scalability, interoperability, and user experience. Integration with emerging technologies such as Internet of Things (IoT) devices and Artificial Intelligence (AI) algorithms can further enhance supply chain visibility and efficiency. Additionally, collaboration with industry partners and regulatory bodies can facilitate the adoption of blockchain-based solutions across the supply chain ecosystem, driving widespread innovation and transformation.

5.Conclusion:

The blockchain-based supply chain system proposed in this study offers a robust solution to combat counterfeit products and enhance trust in the market. By leveraging blockchain technology, manufacturers can establish unique digital identities for each product, ensuring traceability and authenticity throughout the supply chain. This fosters transparency and accountability, empowering consumers to verify the genuineness of the products they purchase. Moreover, the system's decentralized nature and tamper-resistant properties provide a secure framework for data storage and transaction verification, thereby reducing the risk of fraud. Overall, the adoption of blockchain technology in supply chain management holds the promise of creating a more reliable and trustworthy ecosystem for businesses and consumers alike.

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