QR based Fake Product Detection using Blockchain

Rivaa Vadher[1], Rishith Vadher[2], Vaibhav Parikh[3], Mrs. Sanketi Raut[4], Dr. Yogita Mane[5], Mr. Akshay Agarwal[6]

[1,2,3]*Dept. of Information Technology, Universal College of Engineering, Mumbai, Maharashtra*

[4,6]*Assistant Professor, Dept. of Information Technology, Universal College of Engineering, Mumbai, Maharashtra*

[5]*HOD, Dept. of Information Technology, Universal College of Engineering, Mumbai, Maharashtra*

***Abstract*—The proliferation of counterfeit products poses a significant challenge to consumers and brand owners alike. Current software solutions for counterfeit detection lack the robustness and transparency needed to combat this pervasive issue. This project proposes a novel approach to address this problem by leveraging blockchain technology in conjunction with QR codes.**

Our software solution combines blockchain technology and QR codes to create a secure and transparent anti-counterfeiting system. Each authentic product is assigned a unique QR code linked to a blockchain-based ledger. When consumers scan the QR code, they can instantly verify the product's authenticity and access detailed information about its origin, manufacturing, and distribution history. The immutable nature of blockchain ensures data integrity, making it nearly impossible for counterfeiters to manipulate or replicate.

By integrating blockchain with QR codes, this software enhances consumer confidence and empowers them to make informed purchasing decisions. Furthermore, brand owners gain real-time insights into their supply chains, enabling them to identify and mitigate counterfeit production more effectively. This project represents a significant step forward in the fight against counterfeit products, providing a secure and transparent solution that benefits both consumers and brand owners while minimizing the economic and safety risks associated with fake brands.

Keywords— Ledger, Blockchain, QR code

I. INTRODUCTION

In the ever-evolving landscape of digital commerce, the proliferation of fake products poses a significant threat to consumers and brands alike. The rise of e-commerce platforms has led to an influx of counterfeit goods, jeopardizing trust and consumer confidence. Traditional methods of detecting and preventing the circulation of fake products often fall short due to their limitations in efficiency, accuracy, and adaptability to emerging counterfeit techniques.

Enter blockchain technology—an innovative solution poised to revolutionize the fight against fake products. Blockchain, renowned for its decentralized and tamper-resistant nature, offers a promising avenue for developing a robust system to detect and prevent the proliferation of counterfeit goods. This research paper delves into the conception, implementation, and evaluation of a blockchain-based fake product detection system, aiming to address the shortcomings of conventional detection methods.

The forthcoming sections will provide a thorough examination of the relevance of blockchain technology in combating counterfeit products, elucidate the technical intricacies of our blockchain-based system, and explore the practical implications for diverse industries. Additionally, we will delve into the regulatory landscape and compliance considerations, acknowledging the imperative need to align with established legal frameworks.

This research endeavor extends beyond theoretical exploration, offering empirical evidence to showcase the efficacy of a blockchain-based fake product detection system. Performance metrics will be analyzed to demonstrate the system's superiority in terms of accuracy, speed, and adaptability when compared to traditional detection approaches.

As technology continues to reshape the dynamics of commerce, understanding the potential of blockchain in the realm of fake product detection becomes not only a theoretical pursuit but a pragmatic necessity. The system discussed in this research paper represents a pivotal step towards redefining how industries combat the proliferation of counterfeit goods, envisioning a future where consumers can trust the authenticity of the products they purchase in the digital age.

Thus, to summarize, this research embarks on a journey to explore the transformative capabilities of blockchain technology in the context of fake product detection. It lays the groundwork for a comprehensive analysis of the blockchain-based system, offering a glimpse into a future where the battle against counterfeit goods is fortified by the principles of transparency, security, and technological innovation.

II. LITERATURE SURVEY

A. Blockchain and its Benefits in Business

Blockchain for business operates on a shared and unchangeable ledger with restricted access, requiring permission from network members. It is often referred to as a "trustless" network not due to distrust among partners but because trust is inherent in the technology. This trust is established through enhanced security, heightened transparency, and immediate traceability provided by blockchain. In addition to fostering trust, blockchain offers further business advantages, such as cost savings derived from improved speed, efficiency, and automation. The technology minimizes paperwork and errors, leading to reduced overhead and transaction costs, and potentially eliminating the necessity for third-party verification in transactions.

B. Improving supply chain management system using blockchain

According to authors of paper Detection of Counterfeit Products using Blockchain most successful way to handle counterfeit product is improving the supply chain system's network transparency, cost control and pre-supply evaluation approaches, and supplier relationship management.[1]

Blockchain facilitates real-time tracking of inventory levels across the supply chain, preventing overstocking or stockouts. Access to accurate and up-to-date data enables more precise demand forecasting, helping organizations optimize their production and distribution processes.

This system is efficient while tracking any order which is directly getting delivered to customer from company. But when we want to buy product not directly from the owner and from someone else at that time it proves to be a little bit inefficient because user will not have the whole tracking option when it is purchased from an individual other than authorized store and there are chances that the individual selling it can fake it.

C. The issue of the rise in fake products in the market

As discussed in the paper Fake Product Detection Using Blockchain Technology the authors have stated that nowadays, with the rise of technology and markets the problem to differentiate with original and duplicate has also incurred a lot of damage to consumers, distributors, retailers and also manufacturers. [2]

The manufacturing and marketing of counterfeit or duplicate products and goods leads to consequential financial, health and safety threat to end users. It also impacts on the economic growth of original manufacturers and businesses through revenue loss, product defamation, downtime, replacement expenses, forcing brands to spend money fighting counterfeits, trust among business partners can also be at risk, stealing sales etc.

The issue of fake products in the market is a pervasive challenge affecting various industries globally. Counterfeit goods, ranging from electronics to pharmaceuticals, pose significant risks to consumers and brand reputation. The proliferation of fake products is fueled by sophisticated manufacturing techniques, global supply chain complexities, and the rise of online marketplaces. Addressing this issue requires concerted efforts from governments, businesses, and technology solutions to enhance product authentication, improve regulatory measures, and protect consumers from the potentially harmful consequences of counterfeit items.

D. Why Blockchain is nowadays used for projects

In recent years we can see there are many projects that are more focused on blockchain because block chain has been effectively solving the double-spending problem but also it can confirm the legitimacy of transactional records without relying on a centralized system to do so [3].

Because of this increase in counterfeit products there is a massive amount of rise in loss of profit from not only big but also small companies. Because big companies at one time can recover because they have enough capital left but on the other hand small companies doesn't have that amount of capital. So, they face loss and recovering from that is quite difficult.

In conclusion, the literature survey provided here gives us a general overview of the current technologies related to the identification of fake product. With these

references we can infer that there is an urgent need to have a defined way to create a software which can reduce the issue of counterfeit product in the market.

III. EXSISTING AND PROPOSED SYSTEM

A. Exsisiting System

The existing system for counterfeit product detection often relies on conventional methods that are susceptible to manipulation and error. Typically, manufacturers employ holograms, serial numbers, or physical labels on their products to establish authenticity. Consumers are then required to manually verify these features, which can be cumbersome and subject to human error. Moreover, counterfeiters have become increasingly skilled at replicating these physical attributes, making it challenging for consumers to differentiate genuine from counterfeit goods.

In addition to these limitations, the existing system lacks transparency and real-time tracking. Once a product leaves the manufacturer's facility, its history becomes difficult to trace. This opaqueness not only hampers consumers' ability to verify product authenticity but also makes it challenging for manufacturers to identify and counteract counterfeit production.

Furthermore, the current system places a significant burden on consumers, who must invest time and effort in verifying products, often without a foolproof method to do so. This uncertainty erodes trust and can lead to financial losses and safety risks.

Limitations:

Susceptibility to Manipulation: The reliance on conventional methods like holograms and serial numbers makes the existing system vulnerable to manipulation by counterfeiters. They can replicate these features with increasing accuracy, making it difficult for consumers to differentiate between genuine and fake products.

Manual Verification Process: Consumers are required to manually verify product authenticity based on physical features like holograms and serial numbers. This manual verification process is cumbersome and prone to human error, diminishing its effectiveness in detecting counterfeit products.

Lack of Transparency: Once a product leaves the manufacturer's facility, its history becomes difficult to trace, leading to a lack of transparency in the supply chain. This opacity makes it challenging for consumers to verify product authenticity and for manufacturers to identify and counteract counterfeit production.

Real-Time Tracking Absence: The existing system lacks real-time tracking capabilities, which means there is no mechanism to monitor the movement of products throughout the supply chain. This absence of real-time tracking further exacerbates the difficulty in identifying and preventing counterfeit products from entering the market.

Burden on Consumers: Consumers bear a significant burden in verifying the authenticity of products, investing time and effort without a foolproof method to do so. This uncertainty erodes trust and can result in financial losses and safety risks for consumers who unwittingly purchase counterfeit goods.

B. Proposed Sytem

Our proposed system is designed to provide an efficient and secure solution for detecting counterfeit products and ensuring the authenticity of genuine goods. Key components of the system include:

QR Code Integration: Each genuine product will be assigned a unique QR code during the manufacturing process. This QR code will serve as a digital fingerprint for the product.

Blockchain Ledger: A blockchain-based ledger will be employed to record and securely store all relevant information about the product, including its origin, manufacturing details, distribution, and sales history.

User-Friendly Interface: An intuitive mobile or web application will be developed, allowing consumers to easily scan the product's QR code.

Real-time Verification: Upon scanning the QR code, the system will query the blockchain ledger in real-time to verify the authenticity of the product. Users will receive an immediate notification confirming whether the product is genuine or potentially counterfeit.

Scalability: The system will be designed with scalability in mind, allowing for potential expansion to cover a wide range of products and industries.

By integrating QR codes, blockchain technology, and user-friendly interfaces, our proposed system aims to provide a convenient and secure method for consumers to verify product authenticity, while also offering manufacturers a tool to protect their brands and streamline supply chain management. This innovative approach will contribute to reducing the impact of counterfeit products on both consumers and legitimate businesses.

IV. METHODOLOGY

A. Problem Statement

The manufacturing and sale of counterfeit or duplicate products continue to pose significant financial, health, and safety threats to consumers, while undermining the economic growth and reputation of legitimate manufacturers and businesses. Existing methods for verifying product authenticity rely on manual and often error-prone processes, failing to provide a robust and transparent solution to the persistent problem of counterfeit goods.

Moreover, the lack of real-time tracking and transparency in the supply chain exacerbates this issue, making it difficult for consumers to confidently identify genuine products. This uncertainty can lead to financial losses, safety risks, and a decline in trust among consumers.

To address these challenges, our project aims to develop a blockchain-based system integrated with QR codes that enables consumers to easily and reliably verify the authenticity of products they purchase. This system must ensure secure, real-time tracking of product history and provide a user-friendly interface for consumers to access information and receive instant confirmation of a product's legitimacy. Ultimately, the project seeks to mitigate the adverse effects of counterfeiting, protecting consumers and the interests of legitimate manufacturers while enhancing trust in product authenticity.

B. System Overview

Blockchain is a technology that has desirable features of decentralization, autonomy, integrity, immutability, verification, fault-tolerance, anonymity, auditability, and transparency.[4]

The envisioned QR-based fake product detection system aims to revolutionize supply chain integrity and consumer trust by harnessing the capabilities of blockchain technology. Traditional supply chains often suffer from counterfeit products and lack transparency, leading to consumer distrust and economic losses. By leveraging blockchain, this system ensures the authenticity of products and enables seamless verification through QR codes.

This system caters to three main user roles: manufacturers, sellers, and customers. Manufacturers utilize the platform to register their products, generating unique QR codes linked to each item. These QR codes serve as digital fingerprints, containing immutable information about the product's origin, production details, and authenticity. Manufacturers can then sell the products along with their respective QR codes to sellers.

Sellers, upon receiving the products, can scan the QR codes to verify their authenticity and access detailed information stored on the blockchain. Additionally, sellers can also register themselves on the platform, enabling them to generate QR codes for products they sell, thus extending the chain of authenticity.

Finally, customers play a crucial role in the system by scanning the QR codes using their smartphones. By scanning the QR codes, customers can instantly verify the authenticity of the product and access relevant information, such as manufacturing date, ingredients, and warranty details. This transparency fosters trust between consumers and sellers, ultimately reducing the prevalence of counterfeit goods in the market.

C. System Architechture and design

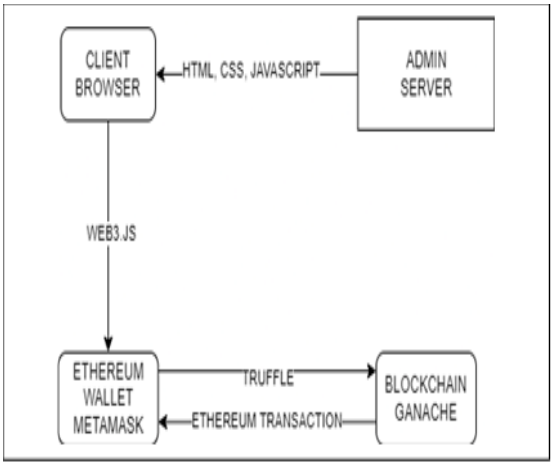

Fig. 1. Architechture of the system

Each individual element of the system architechture have its own importance and use:

Client - This refers to the user's web browser.
HTML, CSS, Javascript - These are programming languages used to design and develop the user interface that users will interact with.

Admin - This refers to the server side of the application.

Server - This is the computer that stores the blockchain and runs the software that validates transactions.

Web3.js - This is a library that allows Javascript applications to interact with the Ethereum blockchain.[5]

Truffle - This is a framework for developing, deploying, and testing smart contracts on the Ethereum blockchain.

Ganache - This is a local Ethereum blockchain simulator that can be used for development and testing purposes.

MetaMask - This is a popular cryptocurrency wallet that can be used to store Ethereum and interact with blockchain applications.[6]

Client (User): This can represent the consumer using a mobile app or web interface to interact with the system. In the image, this might be depicted as a web browser or mobile device icon.

Admin (Server): This represents the backend server managing the system's logic and data storage. In the image, it could be represented as a server icon.

Blockchain: This is the core technology underlying the system. The image might depict a chain of blocks or a distributed ledger symbol.

Workflow:
Manufacturer: Creates an initial block on the chain with the product's information (image: block creation symbol).

Distribution: Each ownership transfer (image: arrows or transaction icons) creates a new block with updated ownership details.

Consumer Verification: Consumers scan a QR code or RFID tag (image: scanning symbol) linked to the product's information on the blockchain.

D. System Flow

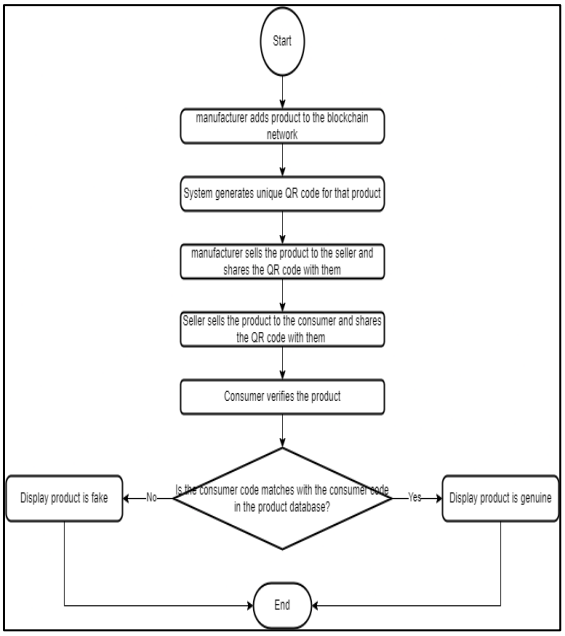

Fig. 2. System Flow

The project processes multiple tasks which include connection of the website with the blockchain network as well as metamask. The overview of the process is defined below:
Adding the Product to the Blockchain: The manufacturer initiates the process by creating a digital record of the product on a blockchain network. Think of a blockchain as a secure, shared public ledger, where every transaction is recorded and visible to everyone on the network. This record likely includes details like the product ID, origin, and perhaps even materials used.

Unique QR Code Generation: A unique QR code, a special type of barcode readable by smartphones, is then generated for the specific product. This code acts like a digital fingerprint, linking the physical product to its corresponding record on the blockchain.

Product Journey: The manufacturer then sells the product to a seller, who in turn sells it to the consumer.

Throughout this journey, the QR code stays associated with the product.

Consumer Verification: Here's where the power of blockchain comes into play. The consumer, wanting to ensure the product's legitimacy, scans the QR code using their smartphone. This scan likely triggers an app or opens a webpage.

Blockchain Verification: Behind the scenes, the system checks the scanned QR code against the product database stored on the blockchain. If the codes match, congratulations! You've got yourself a genuine product. If not, well, you might want to reconsider the purchase, as it might be counterfeit.

This blockchain-powered process empowers consumers to take charge and verify product authenticity with ease. It fosters trust and transparency within the supply chain, potentially reducing counterfeiting and fraudulent activities. While still evolving, blockchain technology holds immense promise for revolutionizing various sectors, including product authentication and supply chain management.

ACKNOWLEDGMENTS

This is a great pleasure and immense satisfaction to express our deepest sense of gratitude and thanks to everyone who has helped us in completing our work successfully. Inspiration and guidance are invaluable in every aspect of life, especially in the field of academics, which we have received from our respected Project Guides. Besides, we take this opportunity to express our sincere gratitude to the We would also like to thank all our staff and friends who have directly or indirectly guided and helped us in the preparation of this report and also for giving us an unending support right from the stage this idea was conceived.

REFERENCES

[1] Kunal Wasnik, Isha Sondawle1, Rushikesh Wani and Namita Pulgam, “Detection of Counterfeit Products using Blockchain”, ITM Web of Conferences 44, 03015 (2022)

[2] T.Shreekumar, Puneet Mittal, Sukhwinder Sharma, Rajesh N Kamath , Sreeja Rajesh, B. Nruthya Ganapathy, “Fake Product Detection Using Blockchain Technology”, JOURNAL OF ALGEBRAIC STATISTICS Volume 13, No. 3, 2022

[3] Jinhua Ma, Shih-Ya Lin, Xin Chen, Hung-Min Sun, Yeh-Cheng Chen, (Graduate Student Member, Ieee) and Huaxiong Wang, “A Blockchain-Based Application System for Product Anti-Counterfeiting”, IEEE Access (Volume: 8), 2020

[4] Huaqun Guo, Xingjie Yu, “A survey on Blockchain Technology and its security”, Institute of Infocomm Research, Singapore (2021)

[5] “web3.js – Ethereum JavaScript API”, web3 Online Documentation. [Online], Available: https://web3js.readthedocs.io/en/v1.10.0/ [Accessed: Feb. 23, 2024]

[6] “The Ultimate Crypto Wallet for DeFi, Web3 Apps and NFTs”, MetaMask Official Website. [Online], Available: https://metamask.io/ [Accessed: Feb. 23, 2024]