

Counterfeit Product Identifications using Blockchain Technology

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Abstract—Counterfeiting remains a significant challenge in the online retail sector, with approximately 20% of products being fraudulent. To combat this issue, blockchain technology offers a decentralized approach, enabling consumers to authenticate products without reliance on distributors. This paper presents a decentralized blockchain network designed to tackle counterfeiting by linking product serial numbers with customer IDs. Unlike traditional methods such as RFID tags and QR codes, blockchain ensures secure and tamper-resistant product identification and traceability. By leveraging blockchain's decentralized nature, the proposed system enhances transparency and minimizes the risk of counterfeit products entering the supply chain. This approach addresses shortcomings of existing solutions like QR code replication and computational intensity of artificial intelligence. With blockchain, data integrity is maintained through consensus, ensuring heightened security and protection against vulnerabilities.

Index Terms— QR Code, Fake Products, Blockchain System, and Authenticity of Products.

I. INTRODUCTION

The integration of blockchain technology within supply chains stands as a robust solution to combat the proliferation of counterfeit goods, ensuring heightened security and authenticity verification. This amalgamation of blockchain with emerging technologies like IoT, NFC, and AI has witnessed extensive adoption across various sectors including pharmaceuticals, finance, and liquor industries, all aiming to detect and safeguard against counterfeit products. While previous research has explored additional technologies such as RFID, barcode scanning, and machine learning within blockchain-based supply chains, they often encountered complexities and lacked user-friendly features. Notably, dynamic authentication methods were absent, hindering the scalability and efficiency of supply chain operations. To address these limitations, this paper proposes the integration of a simple yet effective authentication method: the One-Time Password (OTP). By employing OTPs within the supply chain, stakeholders can seamlessly verify authenticity, enhancing user experience and mitigating the risk of counterfeit products. Specifically, receivers must validate their identity by entering the OTP provided by the sender, ensuring secure access to the goods. This streamlined approach promises to foster a hassle-free environment while bolstering counterfeit detection mechanisms within the supply chain ecosystem. Furthermore, the paper aims to elucidate the pivotal role of blockchain technology in bolstering supply chain integrity and combating counterfeit risks. Through network transparency, cost-effective measures, and supplier relationship management, blockchain empowers both end-users and suppliers to track product provenance securely. By presenting a comprehensive anti-counterfeit system leveraging blockchain, this paper endeavors to

equip stakeholders with the tools necessary to safeguard product integrity and fortify brand reputation. In essence, the proposed system offers a robust framework for addressing the pervasive challenge of counterfeit products, ensuring sustained trust and reliability within global supply chains.

II. RELATED WORK

Kalpana Devi et al. [1] have introduced a distributed Blockchain-based system with the aim of combating product forgeries, empowering consumers to independently verify product legitimacy. This approach streamlines the retail sector by reducing manufacturers' expenses on quality control through the elimination of intermediaries. Leveraging distributed ledger technology (Blockchain) enables transparent tracking of product information, encompassing seller earnings and available stock. Identity verification is facilitated through digital signatures, while vendor-side verification adds an additional layer of security. However, the research underscores the importance of maintaining simplicity in code to optimize resource utilization in Ethereum-based applications, thus minimizing costs. While presenting a viable technique to counter product forgery, the study lacks comprehensive insight into the inner workings and technical implementation of the Blockchain system. Furthermore, unresolved concerns regarding security and scalability present challenges for large-scale implementation. Addressing these issues through further research is imperative to bolster the system's security and scalability.

Kalpana Devi et al. [2] introduce a distributed Blockchain-based system aimed at combating product forgeries by enabling consumers to verify product legitimacy independently. By eliminating intermediaries, this approach reduces manufacturers' expenses on quality control in the retail sector. Leveraging distributed ledger technology (Blockchain) facilitates transparent tracking of product information, including seller earnings and available stock. The system employs digital signatures for identity verification and offers vendor-side verification. However, the research highlights the importance of maintaining simple code to optimize resource usage in Ethereum-based applications and minimize costs. While presenting a viable anti-product forgery technique, the study lacks sufficient depth regarding the inner workings and technical implementation of the Blockchain system. Additionally, concerns regarding security and scalability remain unaddressed, posing challenges for large-scale implementation. Further efforts are necessary to address these issues and enhance the system's security and scalability.

In their research, Mallegowda et al. [3] utilized blockchain technology in conjunction with QR technology to combat counterfeit products. Integration of the product's QR code with the blockchain allows for counterfeit detection through QR scanning. Consequently, the system necessitates storing database blocks containing unique codes and product details. Upon request, the user's unique code is compared to entries in the blockchain database. If a match is found, the consumer gains access to comprehensive product information; otherwise, authenticity evidence is lacking. Although the study presents the product's history, direct verification remains essential. The authors neglected to recommend specific categories for inclusion in the authentication process, a crucial aspect of the research. Furthermore, the proposed study fails to identify product categories and markets, thereby leaving significant gaps in the research.

Saxena et al. [4] have proposed an application tool based on the Ethereum blockchain, developed using AWS, designed to record and timestamp the transfer of goods at each stage of the pharmaceutical supply chain. Barcode scanning will be utilized to note and timestamp all these processes. To formulate this solution, the researchers conducted interviews with 30 individuals from the pharmaceutical industry, the majority of whom expressed concerns regarding counterfeit drugs. However, numerous challenges and limitations exist with current approaches. The researchers also highlighted the costly nature of implementing this technology and the need to address scalability issues. This study primarily focused on the pharmaceutical industry, with no indication from the author regarding its applicability to other sectors.

Aadeesh Bali et al. [5] emphasize the crucial role of fully functional applications in bolstering retail market expansion by enabling the discernment of product authenticity. These applications not only ensure end-user security by guaranteeing the legitimacy of purchased items but also assist manufacturers in protecting their company reputation and value. In the contemporary technological landscape, blockchain emerges as a leading technology, offering heightened security and functionality for stored data. Consequently, blockchain-based applications serve as vital assets for both customers and manufacturers, providing a lifeline for trust and transparency in retail transactions. The paper presents a comprehensive application designed to empower users in distinguishing between counterfeit and genuine products. Manufacturers initiate the process by storing product details in the blockchain and generating an embedded QR code. Subsequently, additional information is

appended by various stakeholders throughout the product's journey. Upon receipt, customers can scan the QR code to access the product's history, enabling them to make informed decisions regarding its authenticity.

Abhijeet and Andrew et al. [6] examine various findings regarding counterfeiting within global supply chain contexts, drawing from analyses of numerous papers and online surveys conducted among professionals associated with a national purchasing body and affiliated UK purchasing groups. The research reveals a significant rise in counterfeiting across sectors such as low-cost spare parts and the pharmaceutical market. Industries employ diverse strategies to combat this issue, including avoidance, prevention based on past experiences, and product destruction. However, counterfeit products pose challenges for consumers, as they are often difficult to distinguish due to the availability of forged certificates.

J. Kevin Timothy et al., [7] in their paper titled "Fake Product Detection Using Blockchain Using QR Code," propose a system designed to address major issues prevalent in existing systems and effectively mitigate product counterfeiting. The system will operate on Ethereum Blockchain technology and utilize the MERN stack for developing the web portal and necessary interfaces. Smart contracts will be developed using Solidity, and all stakeholders in the ecosystem will require a Metamask wallet for system access. End users will not need any credentials to access product details; they will simply scan the QR code to retrieve all pertinent information from the web portal. In the future, the project's scope includes integration with the company's website, enhancing accessibility and usability. This system is anticipated to significantly reduce product counterfeiting, thereby promoting the consumption of genuine quality products from legitimate brands. The implementation of this system will benefit consumers, brands, and society as a whole by ensuring product authenticity and integrity throughout the supply chain.

Kumar and Tripathy [8] introduced a methodology based on private blockchain technology, wherein the certificate authority issues digital signatures to regulatory bodies. Leveraging QR technology, this approach enables the traceability of medicines from manufacturers to end-users and facilitates the detection of counterfeit drugs. The focus of the authors lies in the pharmaceutical supply chain, aiming to monitor and identify each step of the supply chain at the individual drug level. Employing Public Key Infrastructure (PKI) and digital signatures in their proposed framework enhances protection against replay and Man-in-the-Middle (MiTM) attacks. However, the authors' framework lacks a concrete, practical workflow and fails to suggest whether it can be implemented in the consumer goods sector.

P.M. Lavanya et al. [9] address supply chain challenges like service duplication and lack of transparency, exacerbated by rising counterfeiting issues. Traditional methods like QR Codes and AI have limitations, prompting their proposal to link product SN with customer ID using Blockchain. This decentralized approach ensures data security and traceability, mitigating vulnerabilities in counterfeit detection.

Swathi Y et al. [10] delineate the multifaceted repercussions of counterfeiting, which not only jeopardize consumers' financial, health, and safety but also impede the economic growth of original manufacturers and businesses. To address these grave consequences, they propose the implementation of a blockchain-based system for authenticating original products and detecting counterfeit items. By leveraging Blockchain technology, which ensures data immutability, the system safeguards the identification of genuine commodities. Through the integration of QR codes linked to the blockchain, product information is securely preserved, with unique codes stored as blocks in the database. Counterfeit products are identified through camera scanning, with consumers receiving notifications verifying the authenticity of items based on code matches. This approach empowers consumers to independently verify product authenticity, reducing reliance on retailers for counterfeit detection.

Amogh Gupt et al. [11] present a solution to address the prevalent issue of fictitious merchandise, which poses a significant risk to consumers and impacts company sales. The proposed application, "Fictitious Merchandise Detection Using Blockchain," leverages Blockchain technology to mitigate the prevalence of fake products. Blockchain, characterized by its decentralized and distributed ledger system, ensures data integrity by prohibiting unauthorized updates. Each block within the Blockchain is assigned a unique hash value generated through algorithms like SHA-512 or SHA-256, establishing an independent ledger that operates without reliance on third-party intermediaries. The application employs a QR code scanner to verify product authenticity by matching scanned QR codes with entries in the Blockchain database. Upon successful verification, a popup message indicating "Concrete Merchandise" is generated, while mismatches prompt a notification of "Fictitious Merchandise," enabling consumers to make informed purchasing decisions.

III. PROPOSED MODEL

This framework employs Blockchain technology to detect counterfeit products efficiently. Manufacturers are required to register on the Blockchain platform before selling authentic products. Subsequently, manufacturers

contribute product details to the Blockchain database. A new smart contract is implemented to manage product data within the Blockchain network, thereby retaining the authority to incorporate every detail accurately. Upon integration into the network, each product undergoes a cryptographic hashing process to generate a unique QR code. This QR code serves as a validation mechanism at later stages. Manufacturers may monitor seller inquiries, subsequently generating QR codes for their products. Seller details are added alongside the product information upon manufacturing the QR code. Additionally, vendors include customer codes within the sales list, enabling verification of the merchandise buyers. This system offers consumers two primary functionalities: access to purchase history and product verification. Consumers can enter their codes, thereby accessing their purchase history in one section, while verifying product authenticity in another (refer to Figure 1).

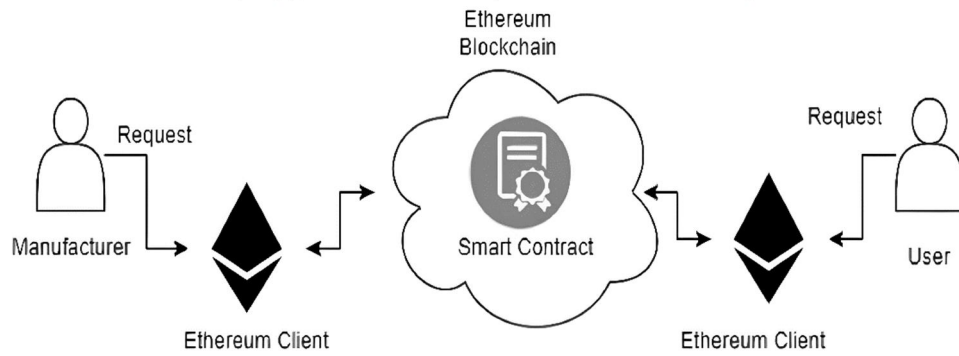


Figure 1. Proposed framework

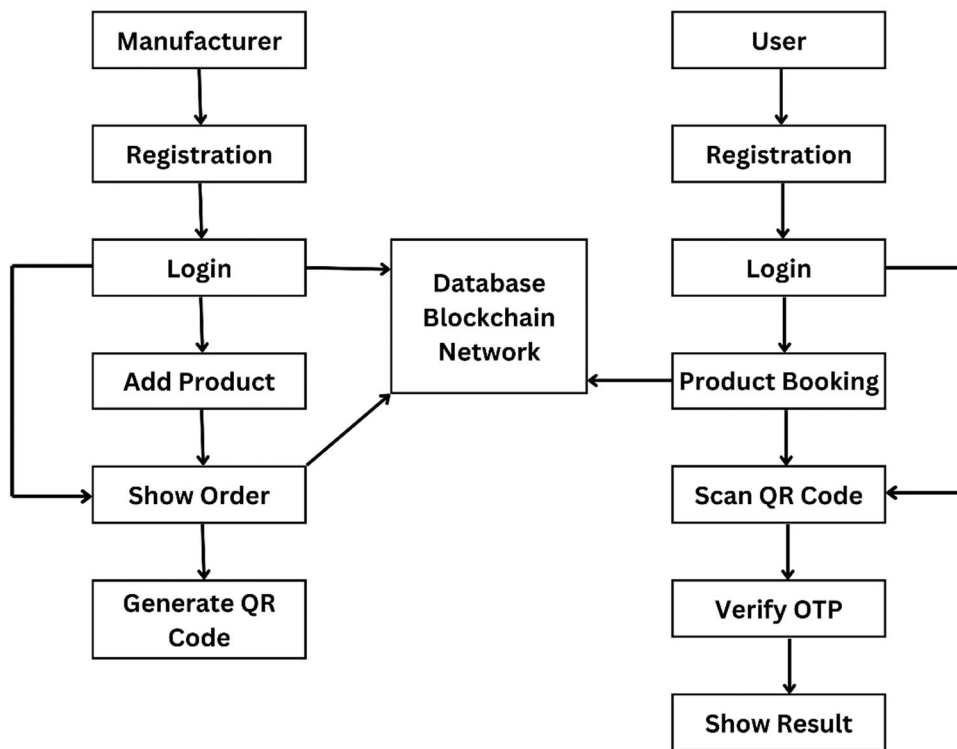


Figure 2. Block diagram of proposed model

The system maintains the ownership status of the product, including details such as the manufacturer, current owner, and ownership history, along with a QR code for identification.

In Stage 1, known as the Product Registration Process, the manufacturer initializes ownership by registering the product on the blockchain database and assigning a QR code for subsequent data updates.

Moving to Stage 2, involving Distributor chains, the manufacturer ships the product to the distributor. Upon receipt, the distributor scans the QR code to add a new chain containing their details, product ownership, timestamp, and date to the network.

In Stage 3, Retailer chains, the retailer receives the product from the distributor and scans its QR code using a dedicated scanner. Subsequently, they add a new chain with their ownership details to the network.

In Stage 4, known as the End User stage, the customer assumes ownership of the product. Upon acquiring the product, the customer visits the designated website and uploads the QR code associated with the product. Subsequently, the customer gains access to comprehensive details regarding the product, spanning from its origin with the manufacturer to the most recent retailer. Armed with this information, the customer possesses the autonomy to make an informed decision regarding the purchase of the product.

IV. CONCLUSION

In conclusion, this paper introduces an advanced paradigm integrating Blockchain and Supply Chain technologies, ensuring enhanced security and transparency within the system. By incorporating additional features such as One-Time Password (OTP) authentication and real-time product updates on the blockchain, we bolster the integrity of supply chain processes. Quality control monitoring by designated officers further ensures adherence to product standards throughout the supply chain journey. Drawing inspiration from prior research, which has demonstrated innovative models for combating product counterfeiting, our study contributes significantly to the advancement of supply chain integrity across diverse industries. From the aforementioned discussion, it is evident that the development of a fully functional application capable of discerning between genuine and counterfeit products is imperative for the growth and sustainability of the retail market. Such applications not only provide consumers with assurance regarding product authenticity but also enable manufacturers to safeguard their reputation and brand value. In today's technologically driven world, blockchain emerges as the quintessential technology, offering unparalleled security and functionality for data storage. Thus, blockchain-based applications serve as indispensable tools for both customers and manufacturers, ensuring trust and reliability in supply chain management. Our proposed application represents a significant stride towards combating counterfeit products, paving the way for a more transparent and stable supply chain ecosystem.

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