Fake Product Identification By QR Code Using Blockchain

[1]Siddharth Mekala, [2]Rahul Maru, [3]Manoj Raske, [4]Mrs Manjiri Gogate

[1]Student, [2]Student, [3]Student, [4]Assistant Professor

[1]Department Of Electronics and Computer Science,

[1]Shree L R Tiwari College of Engineering, Mira Road, India

Abstract: Our current supply chains struggle with hidden inefficiencies and vulnerabilities due to limited transparency. This opacity fuels the rampant issue of counterfeiting, often undetectable by sight. Existing methods like RFID tags and AI offer some solutions, but they're hampered by limitations like replicability and high computational demands. This project proposes a novel approach: harnessing the power of blockchain technology. By creating a decentralized, tamper-proof ledger that tracks every step of a product's journey, this system guarantees transparency and traceability throughout the supply chain. Blockchain based system, makes everything decentralized that may be accessed by several parties at the same time. One of its main advantages is that the recorded data is difficult to change without the consent of all parties concerned which makes the data extremely secure and protect from all vulnerabilities. This paper presents system designed using blockchain technology for detection of counterfeit products.

Keywords: "Blockchain", "Counterfeit, RFID", "Artificial Intelligence", "QR code".

I. INTRODUCTION

Global consumers and enterprises are suffering as result of product counterfeiting, that is, the selling of goods under fake labels. According to one recent analysis, an estimated 30% of the market makes up the counterfeit industry which resulted into a loss of around $323 billion in online business just last year. The sectors of apparel-making, FMCG and automotive are most affected by this phenomenon with prevalence of fakes everywhere you turn. [1]

The threats of counterfeit products extend far beyond financial losses. They pose serious health and safety risks to consumers. Fake cosmetics, for instance, can be laden with harmful chemicals that trigger allergic reactions, skin diseases, and even rashes. Counterfeit electronics, built with substandard components, can malfunction at best and lead to dangerous mishaps like fires or explosions at worst. Even seemingly harmless items like clothing and shoes, if poorly made, can cause discomfort, blisters, or even injuries due to inadequate support or faulty materials. Hence, this issue necessitates finding a solution for the sale of counterfeit products.

Counterfeiting also results in damaging the reputation of a company. Due to the Unawareness among customers about the counterfeit nature of the item they possess, they tend to blame the authentic company when the knock-off product malfunctions, quickly falls apart, or fails to meet their expectations. Customers are requesting compensation from the rightful company, either in the form of a reimbursement or a replacement product, and they are directly approaching the company for it. Many impacted businesses might encounter a situation where they have to handle a dissatisfied customer who is expressing discontent over the poor quality of a product. However, the customer service representative is not aware that the product in question is actually a counterfeit. Companies find themselves in a difficult position as they try to balance the need to prevent wasting time and effort on dealing with inferior copies of their products, while still striving

to maintain customer satisfaction. The negative consequences caused by counterfeiters go beyond impacting customer connections.

By giving priority to transparency, cost-control, and supplier relationships, companies can develop strong supply chains that are more resistant to counterfeit intrusion. Hence the aim of this paper is to introduce a system developed to combat counterfeiting by leveraging Blockchain technology and to provide an overview of its functionality and to give end user and supplier power to track supply chain of product in a secured environment. In a nutshell, the proposed system addresses brand counterfeiting by allowing customers, vendors, and suppliers to verify product integrity. The underlying technology, blockchain, is commonly linked to cryptocurrencies like Bitcoin. It functions as a decentralized, globally maintained database that records and validates transactions across a network of computers.

II. UNDERSTANDING BLOCKCHAIN TECHNOLOGY

Blockchain technology is commonly linked with digital currencies like Bitcoin. It operates as a decentralized database recording transactions, upheld and verified by a network of computers globally. Unlike traditional systems overseen by a central authority, such as a bank, Blockchain relies on a vast community to validate records. This distributed nature ensures no single entity holds control, and once recorded, transaction histories cannot be altered or removed. As compared to a conventional centralized database the information cannot be manipulated due to blockchain's built in distributed nature of structure and confirmed guarantees by the peers.[2].

Working of Blockchain: When a new transaction is initiated, it is subsequently propagated across a network of decentralized computers distributed globally. These computers collaborate to solve complex equations, a process that verifies the legitimacy of the transaction. They are called miners. Once confirmed to be legitimate transactions, they are clustered together into blocks. After successfully validating a transaction, the miner is rewarded with a proof of work. These validated transactions are then linked together sequentially, forming an unbroken chain that records the entire transaction history permanently. This concludes the transaction process, depicted in Figure 1.1. [3]
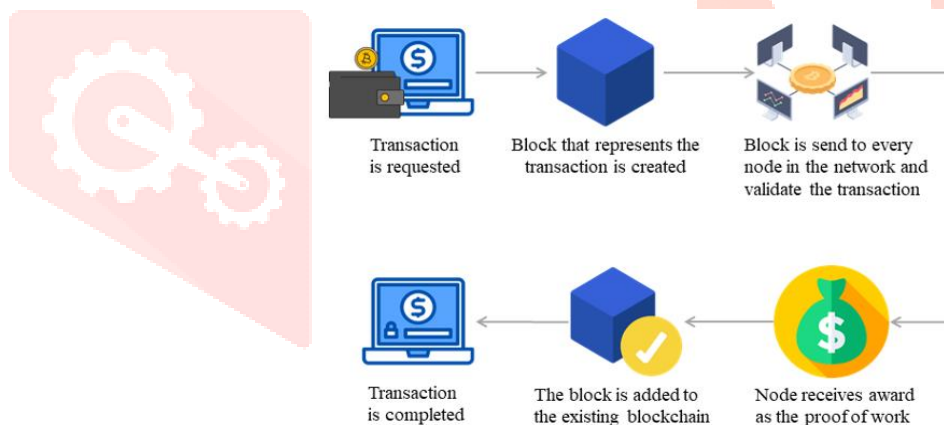

Figure 1.1

III. LITERATURE REVIEW

The survey focused on understanding the sources of counterfeits, impact on the society. There exist various systems of fake product detection, which use Artificial Intelligence, QR codes, Machine Learning and Blockchain.
Mr. Cheman Shaik proposed a two-pronged approach to combat counterfeiting. First, products would be equipped with a QR code containing both public and private keys. To verify authenticity, a dedicated app with built-in decryption capabilities would scan the QR code. Additionally, manufacturers would maintain a server that validates the scanned item code against the purchaser's information, ensuring a match between the product and its legitimate owner. [4]

Khalil and Doss et.al comes up with the solution of using RFID based system to reduce counterfeiting. This system allows consumers to query in-store the tag attached to an item to verify its legitimacy. RFID-based anti-counterfeiting and anti-theft schemes are suitable for large scale implementation in retail environments. The proposed scheme is lightweight and suitable for implementation using low-cost passive RFID tags. Tran and Hong's anti-counterfeiting protocol are used. This system is immune to DOS attacks [5].

Daoud and Vu et.al focuses on the architecture of AI Application. It has three main parts: the data set, detection models, and trained model. Anti-counterfeiting machine learning-based solution to detect fake products. Two essential steps are involved: training models and detecting logos. Faster R-CNN delivers superior accuracy while maintaining a relatively fast training speed. [6]. Chen and Shi et.al explains SCQI. Framework for blockchain based SCQI provides a theoretical basis to intelligent quality management of supply chains based on blockchain technology. RFID technology is used to record quality information, transaction information. Smart contracts are used to execute quality control and improve the efficiency of the supply chain [7]. Toyoda, Kentaroh and Mathiopoulos, P Takis et.al The suggested approach aims to identify counterfeit products utilizing QR code technology. End users can scan the QR code assigned to product to get the product details and transaction history, the steps in- volved Product enrolment, ship product to distributor, and ship product to retailer, end user gets details about the product [8].

In a Blockchain based system the data is stored on each node, then the nodes exchange information with each other over the network. Each node maintains all Blockchain data. The node verifies the received trans- actions and include them in the new block based on its own Blockchain data, and try to obtain the rights of the new block. Ethereum as the back-end Blockchain operating system. Store relevant information on product sales in Blockchain which is accessible to everyone. It is cost efficient [3]. In this, proposal suggests utilizing blockchain technology for sharing information. With this approach, data ownership remains with the original owner, making it challenging for third parties to interfere. Users maintain constant awareness of the data collected about them and its usage. The blockchain block contains sender, amount, receiver, transaction id, product id and metadata [9]. Ethereum is a open-source Blockchain. Ethereum is a technology that's home to digital money, global payments and applications. The process is simple as to get into the portal, pick a wallet that lets you connect to Ethereum and manage your funds, Get the ETH, use applications powered by Ethereum, start building [10].

The limitations in the current systems are that brands used QR codes on products to prove the Authenticity of the product. But the QR code can be copied and used to label counterfeit products [4]. In the RFID based system that low Cost RFID tags can be used for auto identification of products, but due to cloning of RFID tags, this method is not suitable [5]. In AI and machine learning application, CNN takes more time and memory. It needs training and testing phase before its actual deployment. While Artificial Intelligence may be a powerful tool, it falls short in identifying a specific type of counterfeiting known as "tag reapplication attacks." In this scheme, attackers remove the genuine tags from authentic products and place them on counterfeit or expired goods, fooling AI systems that rely solely on tag presence for verification. [10]. There is no power for the customer, suppliers and retailers to check the integrity of product.

IV. PROPOSED SYSTEM

Counterfeiting poses a global threat, impacting organizations, manufacturers, and consumers on a massive scale. Its ramifications extend to the reputation of organizations and the welfare of consumers, with India being no exception. The proposed system focuses on consumer goods, facilitating product tracking and maintaining supply chain integrity through the utilization of Blockchain technology.

System Model: The proposed system will function as a decentralized application (Dapp), utilizing the Ethereum Network as its primary blockchain infrastructure. It will manage and store all records related to product transactions for the companies listed on the Dapp. The basic system architecture is shown in figure 1.2.
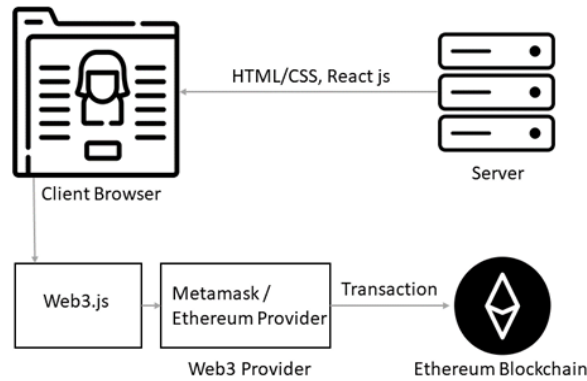
Figure 1.2

Ethereum: It is a decentralized blockchain which uses a proof-of- work consensus mechanism. Proof-of-work is adding block to the blockchain by solving the mathematical expressions. Solving the puzzle "proves" that nodes have done the "work" by using computational resources. It confirms that the block is added and recorded in the blockchain. This process is known as mining. Mining is typically brute force trial and error, but successfully adding a block is rewarded in Ethereum (ETH).[17]

Smart contracts: This are programs that are stored inside Blocks. Smart contracts replace the involvement of third- party members. These are basically protocols that execute when the conditions are satisfied. They never change, that means no one can tamper with the contract.

Flow of Proposed System: The main aim of this proposed system is to maintain the Genuity of the product by helping the customer track the supply chain history of the product. System gives customers the power to track the history of an entire product from manufacturer to customer using blockchain. The anti-counterfeiting system built upon Blockchain technology comprises three distinct roles: Manufacturer, Seller, and Consumer. These roles are elaborated upon and depicted in the figure.1.3.
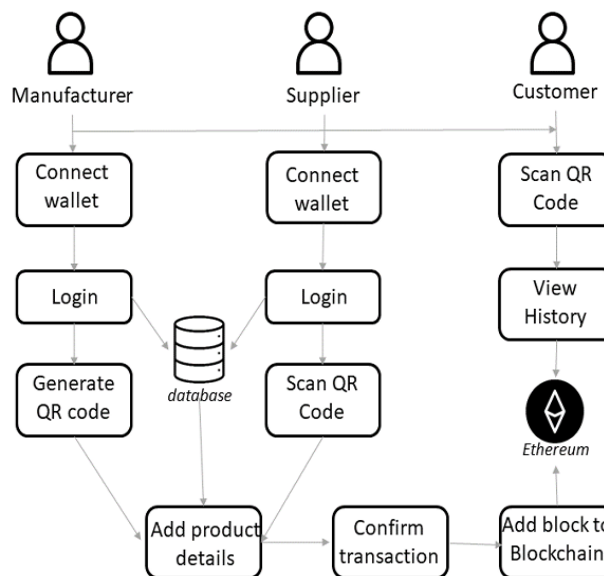

Figure 1.3

1. Manufacturer: The Manufacturer accesses their account and generates a QR code for the product while inputting necessary product details. Using their Ethereum wallet, the manufacturer adds a block to the Ethereum blockchain. A linkage is established between the user ID in our local database and the entity's wallet address. Only when a manufacturer logs in from their own account and utilizes their own wallet will the block be appended to the digital ledger.
2. Supplier: The supplier accesses their account and scans the product's QR code. Subsequently, the seller gains access to the manufacturer's product information entered into the system. The seller then supplements

this information with additional details such as the destination shop and uploads it onto the Blockchain. These updated details are then accessible to the buyer for viewing.

3. Customer: Customers can check the integrity of the product by scanning QR code which will list the history of transactions and thus verifying the genuinity of the product. At the time of customer purchasing the product after the QR scan in supply chain history, if the last location is not matched with the purchase location, the customer will know that the product is not genuine. It concludes that the QR code was copied and the customer becomes aware of counterfeiting.

The process of detecting a counterfeit product by the customer while purchasing is shown in figure 1.4.
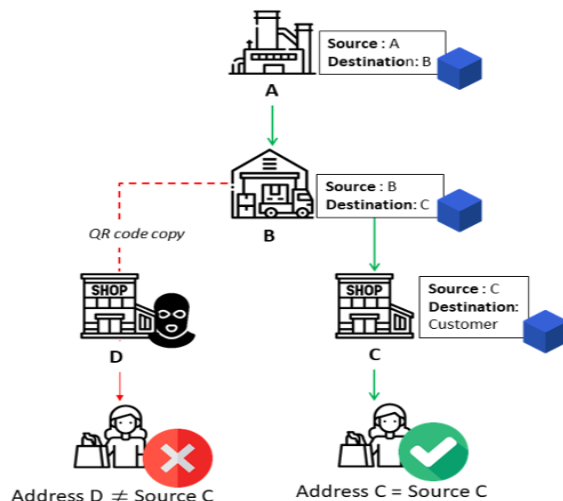

Figure 1.4

V. CONCLUSION

Blockchain is a decentralized system, therefore the local suppliers cannot interfere with the checking or counterfeiting of the product in the proposed system. Manufacturers suppliers have the option to utilize the system for storing product information on the Blockchain. This technology provides inherent features like resistance to tampering, consistent data, and confidentiality, ensuring the security and privacy of the stored data. Customers can access and review the entire supply chain history of a product, thus verifying its authenticity. This transparency allows customers to have confidence in the integrity of the goods they intend to purchase. The proposed system can effectively lower the rate of counterfeiting of branded goods and provide the companies with an easier approach to provide consumers with the confidence that they will not purchase counterfeit goods. This system will help to build trust and good bonding between manufacturer and customer and in deed it will help in improving economy and reducing corruption. Further system can be extended to avoid frauds done in banking, healthcare, voting system, online shopping and so on.

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