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Fake Product Identification by QR Code using Blockchain

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ABSTRACT: Supply chain management frequently faced issues such as service redundancy, poor coordination between several departments and lack of stand-alone status as a company. Product counterfeiting is something which is very common now-a-days and it's almost impossible to detect a counterfeit product just by looking at it. Counterfeiters cause significant challenges for legitimate firms, yet far too many people have no idea of the entire amounts of counterfeit items influence on brands.

Counterfeit goods not only device consumers but also in-flict financial losses and reputational damage on legitimate manufacturers. Traditional methods of authentication often fall short, prompting the need for innovative solutions that leverage emerging technologies. QR codes provide a convenient interface for consumers to access product information, while blockchain ensures tamper-proof and transparent record-keeping. By combining these technologies, this project aims to enhance consumer confidence and mitigate the impact of counterfeit products on the market.

KEYWORDS: Supply chain Management, Product Counterfeiting, Authentication QR Codes, Blockchain, Brand Production & Customer Trust.

I. INTRODUCTION

Blockchain technology can significantly enhance the security and decentralization of fake product identification systems using QR codes. By implementing decentralized identity management, products can be authenticated securely, ensuring that only authorized parties can verify their authenticity [1]. Smart contracts facilitate an automated verification process, allowing for real-time updates and ensuring that only genuine products are recognized [2]. Additionally, blockchain-based supply chain tracking enables continuous monitoring of products from manufacturing to delivery, effectively preventing counterfeiting [3]. QR code encryption further secures product information, ensuring that access is restricted to authorized users and preventing tampering [4]. Finally, decentralized data storage solutions, such as the Inter Planetary File System (IPFS), provide a tamper-proof environment for storing product information, enhancing trust & privacy [5]. Together, these elements create a robust framework for identifying fake products, leveraging the strengths of blockchain technology.

Product counterfeiting happens when a product is sold pre-trending to be another product. It is consumer fraud and commonly defined as deceptive business practices that cause consumers to suffer financial or other losses. Counterfeit goods include counterfeits handbags, clothing, cosmetics and electronics. It not only has negative effects on the economy, but on citizen too. For examples poor cosmetics can affect skin and cause skin diseases and rashes, counterfeit electronic components can cause malfunction in gadgets and can lead to unfavorable situations and mishaps. Poor quality clothes, shoes when worn can cause discomfort. Hence this issue necessitates finding some solution for the sale of counterfeit products.

Another consequence of counterfeiting is that a company's reputation suffers. Because many customers are unaware that the object they are holding is a knock-off, they often blame the genuine company if the counterfeit product fails to





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performs properly, breaks easily, or does not meet their expectations. Customers demand recompense, either in the form of a refund or a new product, and they seek it directly from the legitimate company. Many affected businesses find themselves in a situation where they are dealing with unhappy customers complaining about the poor quality of an item, while the customer care representative remains unaware that the items in question is counterfeit. Companies are caught in a tough situation, attempting to avoid wasting time and effort on poor imitations of their goods while still striving to maintain customer satisfaction. The harm caused by counterfeiters extends beyond customer relationships.

II. LITERATURE SURVEY

A. Overview of Blockchain

Blockchain represents a transformative distributed ledger technology that ensures secure, transparent and immutable recording of transactions. Unlike traditional centralized system, blockchain operates on decentralized network of nodes, each holding a copy of the ledger. Transactions are validated through cryptographic hashing and consensus mechanisms, such as Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS) and Proof of Authority (PoA).

The blockchain consists of a series of blocks, each containing transaction data, a timestamp and a cryptographic hash of the previous block. This structure ensures that any alteration in a block invalidates subsequent blocks, making the system tamper-proof. The transparency and security inherent to blockchain make it a preferred solution for applications requiring trust in untrusted environments.

Key features of blockchain include decentralization, transparency, immutability, security, automation through smart contracts, scalability and interoperability. Unlike traditional databases managed by a central authority, blockchain distributes data across all nodes in the network, enhancing fault tolerance and eliminating single points of failure. All transactions are visible to participants on the network, and once recorded, data cannot be altered without consensus from the majority of nodes.

B. Research Done on the QR Code Integration

The issue of counterfeit products has been extensively studied, with various researchers proposing different technological solutions for their detection and prevention. The approaches examined in the literature primarily leverage **Artificial Intelligence (AI), QR codes, Machine Learning (ML), Blockchain, and RFID** technologies to enhance product authenticity verification and supply chain transparency.

Shaik et al. introduced a method for counterfeit detection using **QR codes with cryptographic functionalities**. In their proposed system, each product is assigned **public and private keys** embedded within a QR code. The corresponding application used for scanning the QR code must possess cryptographic functionality to decrypt the encoded information. Additionally, manufacturers maintain a **server** that processes requests, matches the buyer's identity with the product's item code, and validates its authenticity. This method enhances security by ensuring that only authorized users can verify product legitimacy.

Toyoda, Kentaroh, and Mathiopoulos et al. introduced a **QR code-based counterfeit detection system**, where end users can scan a QR code assigned to a product to retrieve **detailed product information and transaction history**. The proposed system follows a structured workflow, including product enrollment, shipment to distributors and retailers, and verification by the end user. This method allows consumers to **authenticate products** at different stages of the supply chain.

The reviewed studies emphasize the role of advanced technologies such as Blockchain, AI, Machine Learning, QR codes, and RFID in combating counterfeit products. While cryptographic QR codes and RFID-based verification ensure product authenticity, blockchain integration enhances supply chain transparency and security.

C. Ethereum Overview

In 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. Ethereum as the back-end Blockchain operating system. Store relevant information on product sales in Blockchain which is accessible to everyone. In this blockchain technology for





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information sharing is proposed. Is this the information is in the control of the owner so third party interference is difficult. The blockchain block contains sender, amount, receiver, transaction id, product id and metadata.

Abhijeet and Adrewet. al. discusses various finding on counterfeiting in global supply chain environments based on various papers and online surveys of professionals targeted at a national purchasing body and affiliated UK purchasing groups. It was found that counterfeiting is widely increasing in areas of low-cost spare parts and sectors like drug market. The counterfeit products were difficult to identify for customers due to availability of forged certificates.

III. BLOCKCHAIN SYSTEM

Blockchain is collection blocks that are linked together which stores information. Each block has a timestamp, transaction data and hash of its own and hash of previous block, so it is difficult to tamper with data. Blockchain is a decentralized system. It ensures that every new block added to the blockchain is the one and only true version that is agreed to the blockchain is the one and only true version that is agreed upon by all nodes in the Blockchain.

1) Working of Blockchain

When a new transaction is made, it is sent to a network of peer-to-peer computers around the world. These computers, called miners, solve mathematical problems to check if the transaction is valid. Once verified, the transactions are grouped together into **blocks**. The miners who complete the verification is rewarded through a process called **Proof of Work**. These blocks are then linked together, forming a **secure and permanent record** of all transactions. This completes the transaction process. Whole procedure is done as shown in figure 1.



Figure 1: Working of Blockchain

2) Blockchain Features

Blockchain can store data in its database without needing a **central authority** to manage or approve it. Instead, it relies on **consensus algorithms** to ensure that all transactions are valid. Since blockchain is a **publicly accessible database**, it is highly **secure and trustworthy**. The key features of blockchain technology are explained in detail below and are illustrated in figure 2.





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Figure 2: Features of Blockchain

- 1. Security and Privacy: Blockchain uses cryptographic techniques to protect data. A private key is used to sign the data, while a public key helps verify if the data has been altered or remains genuine. Just like a bank OTP or password, users must keep their private keys secure to prevent unauthorized access and ensure their data's safety on the blockchain.
- 2. **Decentralization:** In a decentralized blockchain network, users do not need to trust or rely on a central authority. Every participant in the network holds an identical copy of the distributed ledger. If any participant's data is changed or corrupted, the network automatically detects it, and the majority of participants will reject the invalid data.
- 3. **Immutability:** Once a block is added to the blockchain, it cannot be modified. If someone attempts to alter the data, the blockchain system will immediately reject or remove the corrupted block, ensuring data integrity.
- 4. **Transparency:** The information stored in the blockchain is completely visible to all participants, promoting openness and trust within the network.
- 5. Flexibility: Blockchain is open-source, making it highly adaptable. Users can choose between public and private blockchains depending on their needs and the type of application they want to build.

3) Importance of Blockchain

Blockchain ensures trust and security by eliminating the need for third-party verification. Smart contracts execute automatically when predefined conditions are met. Each block contains data and the hash of the previous block, making alterations nearly impossible. Any attempt to modify a block changes its hash, creating a mismatch with the next block. To alter the entire blockchain, an attacker would need control over more than half of the network, which is extremely difficult due to high computational and financial costs. Additionally, the network participants would quickly detect any tampering, ensuring blockchain remains secure and tamper-proof.

IV. PROPOSED METHODOLOGY

Counterfeiting is a global problem that negatively impacts businesses, manufacturers, and consumers. It affects a company's reputation and can also pose risks to consumer safety. India is also facing this issue.

The proposed system focuses on protecting consumer products by ensuring that both the products and supply chain remain secure and trustworthy. This is achieved using Blockchain technology, which helps maintain accurate records of a product's journey from the manufacturer to the customer. By integrating Blockchain with QR codes, consumers gain the ability to track the complete history of a product, ensuring its authenticity and reducing the risk of purchasing counterfeit goods.





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1) System Model

The proposed system will be decentralized application (Dapp) which will be implemented using the Ethereum Network as the main blockchain for keeping all the records and managing the transactions regarding the products of the companies listed on Dapp. The basic system architecture is shown in figure 3.



Figure 3: System Architecture

Ethereum

Ethereum is a decentralized blockchain that uses the Proof-of-Work (PoW) consensus mechanism. In this process, nodes compete to solve complex mathematical puzzles, which requires significant computational power. Successfully solving the puzzle proves that the node has done the required work, allowing it to add a new block to the blockchain. This process, known as mining, is based on trial and error. Miners who successfully add a block are rewarded with Ethereum (ETH) as an incentive.

Smart Contract

Smart contract 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.

2) Flow of Proposed System

The primary goal of this proposed system is to ensure product authenticity by allowing customers to track the entire supply chain history of a product. Using blockchain technology, customers can verify a product's journey from the manufacturer to the end-user, ensuring transparency and preventing counterfeiting. This blockchain-based anticounterfeiting system consists of key participants: the Manufacturer and the Consumer, each playing a vital role in maintaining product integrity, as illustrated in figure 4.



Figure 4: System Flow





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Manufacturer:

The manufacturer logs into their account and generates a QR code for the product, adding all the necessary product details. Using their Ethereum wallet, the manufacturer then adds a block to the Ethereum blockchain. To ensure authenticity, the system maps the user ID from the local database with the wallet address. A block will only be added to the blockchain if the logged-in manufacturer is using their own verified wallet, maintaining security and integrity in the digital ledger.

Customer:

Customers can verify a product's authenticity by scanning its QR code, which provides a complete transaction history. If the last recorded location in the supply chain does not match the purchase location, the customer will recognize that the product is not genuine. This discrepancy indicates that the QR code has been copied, alerting the customer to potential counterfeiting. The process of detecting a counterfeit product by the customer while purchasing is shown in figure 5.

V. RESULT & DISCUSSIONS

The proposed system enables both manufacturers and suppliers to interact with the platform independently by adding their respective blocks containing transaction details to the blockchain. Each party can do this without altering the other's block. The contracts for the manufacturer and supplier blocks are developed using Solidity. Since the system operates on a local testing network.

The user interface is developed using React. To enable interaction with the Ethereum blockchain, the Web3.js library is used. This library facilitates actions such as sending Ether, confirming transactions, and reading or writing data to smart contracts. MetaMask, a browser-based Ethereum wallet, is used to connect the application to the blockchain, allowing users to access their Ethereum accounts directly through the browser.

To add blocks for both the supplier and manufacturer, they must confirm their transactions through their MetaMask wallets, which are integrated with Web3.js. Finally, the end-user can verify the supply chain and ensure product authenticity by scanning a QR code.



Figure 5: Homepage



A smart contract was created using the Solidity programming language. To deploy and interact with this contract, MetaMask—a browser-based Ethereum wallet—was used to connect to the Sepolia testnet, which is a public Ethereum test network. By linking a MetaMask account to the Sepolia network, the contract could be deployed and tested using test Ether, allowing secure and cost-free development before deploying to the main Ethereum network.





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Figure 7: Sepolia Network

The Sepolia test network is an official Ethereum testnet that allows developers to safely test and deploy smart contracts and dApps using test Ether, which has no real value. It operates on a Proof of Stake (PoS) system, mirroring the mainnet, and is supported by tools like MetaMask and Hardhat. Sepolia provides a secure, cost-free environment for debugging, performance testing, and validating blockchain applications before mainnet deployment.

VI. CONCLUSION

Since blockchain is a decentralized system, local suppliers cannot interfere with or counterfeit products in the proposed system. Both manufacturers and suppliers can securely store product information on the blockchain, which ensures tamper-resistance, data consistency, and confidentiality. These features guarantee the security and privacy of data on the network.

Customers can view the complete supply chain history of a product and verify its authenticity, giving them confidence in the goods they purchase. This system helps reduce the risk of counterfeit branded products and provides companies with a reliable way to assure customers of product genuineness. It strengthens trust and builds a stronger relationship between manufacturers and consumers, ultimately contributing to economic growth and reduced corruption. In the future, this system can be expanded to prevent fraud in sectors like banking, healthcare, voting systems, online shopping, and more.

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