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Blockchain Based Fake Product Identification

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ABSTRACT:

Counterfeit products are a growing problem across many industries, damaging company reputations, reducing profits, and even putting consumers' health at risk. Traditional methods to check if a product is real or fake often aren't reliable. In this project, we introduce a system that uses blockchain technology to help identify fake products. In our system, each product is given a unique digital code, and every step in the product's journey from manufacturing to delivery is recorded on the blockchain. This allows customers and businesses to easily check where the product has been and confirm if it's genuine. Our goal is to make it easier to track products, reduce fake goods in the market, and build more trust between companies and consumers using a secure and efficient system. Fake products have become a serious issue in today's global market, leading to financial losses for companies and putting customers at risk. Many existing methods for checking if a product is real or fake can be tricked or are hard to manage. This project presents a smart and secure solution using blockchain technology a system known for keeping data safe and unchangeable. Each product is tagged with a special digital ID, and every time it moves through the supply chain (from factory to customer), its details are saved on the blockchain. This creates a transparent history that anyone can check to confirm if the product is original. Our system helps customers trust what they're buying and gives companies a better way to protect their brand from counterfeits. It's a modern approach to fighting fake products using trusted digital tools.

Introduction

The growing popularity of branded products has also led to an increase in risks such as counterfeiting and duplication. These activities can harm a company's reputation, reduce customer trust, and lead to financial losses. The sale of fake products is rising rapidly and affects the brand value and profits of genuine businesses. It can also be dangerous for unaware customers who buy these fake goods.

To address this issue, our project proposes a basic blockchain-based system that helps identify and trace genuine products in the supply chain. By using this system, companies can reduce the chance of their products being copied and avoid extra losses. One of the main reasons behind profit loss is the presence of these fake products in the market. Using blockchain we can check whether a product is original or not. Blockchain is a secure and transparent technology that stores information in linked blocks. Once product data is saved on the blockchain network, it is delicate to change or remove.

A unique code, called a hash, is generated for each product and its details are stored as records. This makes it easy to track the product's history. In our system, each product will be given a QR code or barcode by the manufacturer, which contains product-related details. The client can scan this code to verify the product's authenticity and get the required information fluently.

The growing popularity of branded products has led to an alarming rise in counterfeiting and product duplication. These malicious activities negatively impact companies by damaging brand reputation, reducing customer trust, and causing substantial financial losses. Counterfeit products not only affect the profits of genuine businesses but also pose serious risks to consumer safety, especially in sectors such as pharmaceuticals, electronics, and food products. As counterfeiters adopt more sophisticated techniques, traditional methods of product authentication—such as holograms, serial numbers, and barcodes are no longer sufficient on their own. To address this pressing issue, our project proposes a blockchain-based system aimed at identifying and tracing authentic products across the supply chain. Blockchain, with its decentralized, transparent, and immutable architecture, offers a robust solution for verifying product authenticity and preventing data tampering. By securely recording product information in a distributed ledger, blockchain ensures that once data is added, it cannot be altered or removed without detection.

This drastically reduces the chances of fraudulent manipulation. Conventional anti-counterfeiting methods, while useful, have shown limitations in terms of scalability, traceability, and data integrity. These systems are often centralized, making them prone to single points of failure or manipulation. Blockchain technology presents a promising alternative by offering a decentralized ledger system where all transactions and updates are securely recorded and permanently visible to all participants in the network. By combining blockchain with QR code technology, we can create a powerful mechanism for product verification. QR codes are easy to implement and scan using mobile devices, while blockchain ensures that the data linked to these codes is authentic and unchangeable. This integration allows manufacturers to encode product-specific information in a secure way, and consumers to validate it instantly, improving trust and transparency across the supply chain.

The solution is designed to be lightweight, cost-effective, and scalable especially for small to medium-sized businesses that may not have the resources to implement complex anti-counterfeiting infrastructure. Through this project, we aim to create a secure and user-friendly verification mechanism that helps manufacturers protect their brand, customers ensure authenticity, and the overall market reduce the circulation of fake products.

Literature Review

In recent years, the problem of counterfeit products has become a significant concern, especially in industries such as pharmaceuticals, luxury goods, and electronics. Traditional anti-counterfeiting techniques like barcodes, holograms, and RFID tags have proven vulnerable to duplication. Several studies have explored blockchain as a solution due to its immutability, transparency, and decentralization. For example, [Author et al., 2021] proposed a blockchain-based product tracking system to ensure supply chain transparency. Similarly, [Researcher et al., 2022] used Ethereum smart contracts to store product histories, enabling customers to verify authenticity. However, most existing systems either lack scalability, rely heavily on centralized databases, or are costly to implement for small businesses. Our work aims to bridge this gap by proposing a lightweight, Android-based blockchain system that uses secure QR codes to detect and prevent product fraud.

In response to these challenges, researchers and developers have started exploring blockchain technology as a tool for securing supply chains and authenticating products. Blockchain's core features are immutability, decentralization, and transparency which make it particularly suitable for detecting fake products and ensuring data integrity.
Some commercial solutions have also adopted blockchain. For example, IBM's Food Trust and Ever ledger use blockchain to track diamonds and food products. These systems store each transaction in a shared ledger, making it possible to identify tampered or fake items.

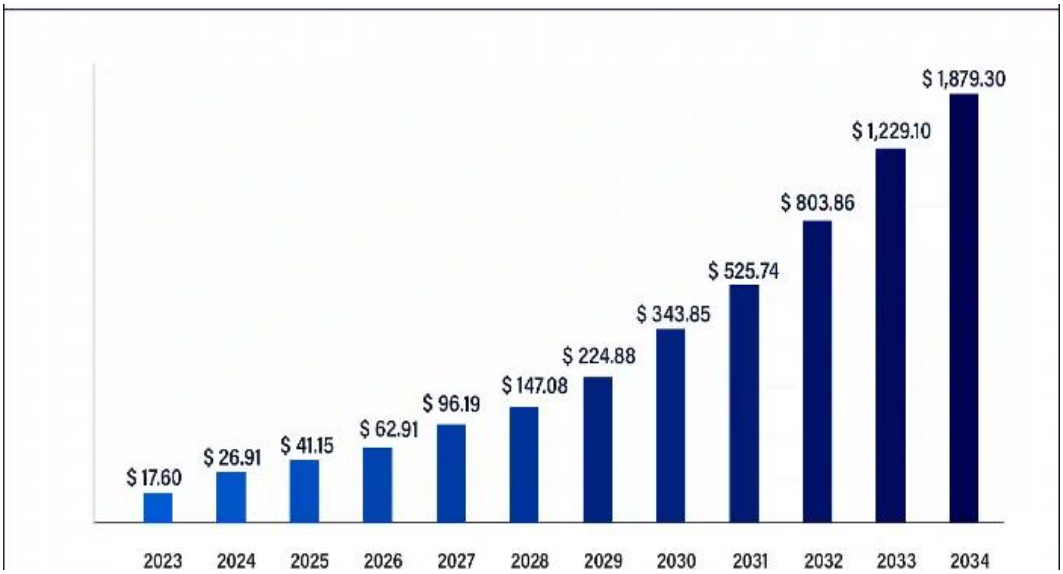
The issue of counterfeit products continues to challenge industries worldwide, prompting the need for advanced and reliable authentication systems. Traditional anti-counterfeiting techniques, such as barcodes, QR codes, RFID tags, and holographic seals, are increasingly being compromised due to technological advancements in duplication. While these methods offer basic verification, they are often centralized and vulnerable to tampering or data breaches. To overcome these challenges, many researchers have proposed blockchain as a viable solution due to its tamper-proof, distributed, and transparent nature. Blockchain records are immutable, meaning once data is written, it cannot be changed without consensus, making it ideal for tracking and verifying the authenticity of products.

Verma et al. (2020) developed a blockchain-based system for pharmaceutical supply chains. Their model tracked the origin and movement of drugs from manufacturer to end-user, significantly reducing the risk of counterfeit medications. Their findings showed increased transparency and traceability, especially in developing countries where counterfeit drugs are a serious public health issue.
Sarmah et al. (2021) proposed a blockchain-enabled IoT framework that used sensor data to authenticate perishable goods. Although their focus was on food quality and freshness, the combination of IoT and blockchain could also be applied to fake product detection, offering real-time monitoring and validation.
Despite these advancements, most blockchain-based solutions remain complex, expensive, and not user-friendly, especially for end consumers. Many require specialized hardware or enterprise-level infrastructure, which limits adoption in small-scale markets. Additionally, integrating blockchain with mobile platforms remains an area of active research.

Methodology

Blockchain

It is decentralized/not centralized technology i.e. does not have database or save data on one single server database is distributed all over the blockchain among the millions and billions of the nodes. customer operations of affiliated businesses can read or tack sale records to the blockchain. sale records submitted to any knot are validated and committed to the tally database on all the bumps of blockchain network. Married deals are inflexible because each block is linked with its former block by means of hash and hand values. Protocols similar as Gossip and Consensus ensure that the submitted deals are transferred to all bumps and committed on all blockchain bumps constantly. As shown in Figure 1, blockchain ecosystem consists of blockchain customer, blockchain knot, blockchain network, sale processor and agreement process. Blockchain customer is an operation that creates sale communication in a specified format and submits it to blockchain knot through web API. It may be any being operation, which posts sale communication to blockchain knot. guests are confined using Public Key structure (PKI) technology at blockchain knot position. The Blockchain knot is a garçon knot that runs blockchain services responsible for entering the sale and transmits the sale to other blockchain bumps. With respect to the design, the knot participates in agreement process to commit the block of sales data to tally database.



Graph.1. Growth of blockchain market (in Billions) [1]

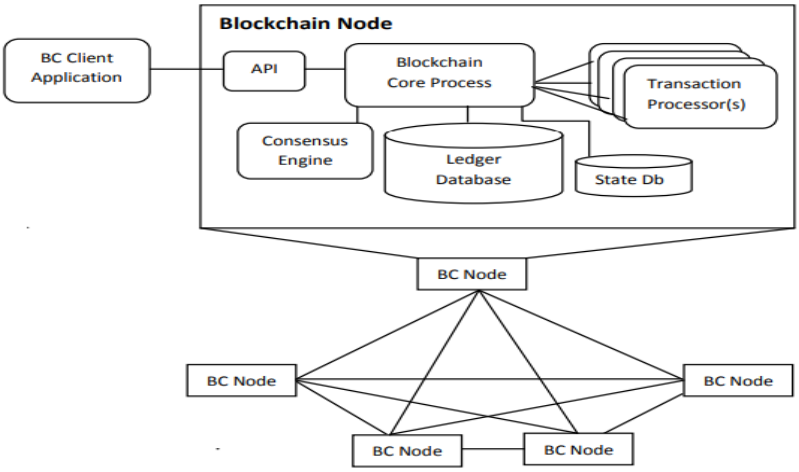


Fig.1. Blockchain ecosystem [2]

Ethereum

Ethereum is the digital currency but in the case of house rental system we are not only going to use this in for transaction but also as gas fees for blockchain. As in this work we are going to use blockchain which is based on the Ethereum which means it will give us the security and we will pay it with the Ethereum this is the process how blockchain works in. We need to pay to use the blockchain. In the case of payment, we should also have the Ethereum wallet which we will further connect to the blockchain and website which makes it easy to accept and deny the request of transaction at every time instance.

MetaMask

MetaMask is utility or wallet which is required to keep and use our currency aka gas fees it helps to make it easy to use and store Ethereum. In general, MetaMask is a basic component of a blockchain-based decentralized house rental system. It provides a user-friendly interface for association with the Ethereum organize and its keen contracts, and enables secure and consistent exchanges utilizing cryptocurrencies.

Hardhat

Hardhat is the development environment for Ethereum and smart contract i.e. we can write and deploy smart contract.

Architecture

Architecture of our system is full of crucial process. The architecture that we have made or used to make the working much smoother and easy. Website consists of some authentication, creation, booking, etc. processes. First of all, it is important to state that website is made for owner and tenants both so each user has to go through the authentication process. Verification process has to be done at every time instance and step which is the main difference between decentralized system and centralized system.

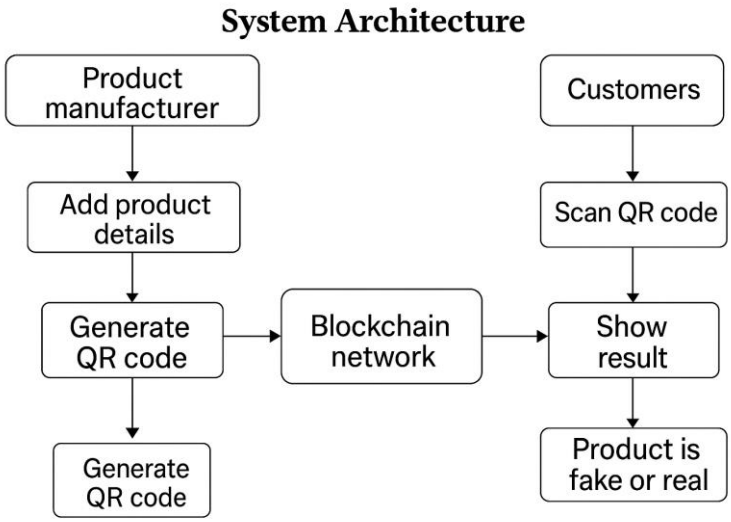


Fig.2.Architecture [3]

Authentication: As we have talked about the nature of the website is dual i.e. For owner and tenants to identify the nature of the user we authentication process is very important.

Wallet creation: As we have talked about decentralized technology before we know that for using blockchain we need a wallet and wallet also a medium of the authentication.

Contract interaction: Each step in the process result in some interaction with contract.

Saving to chain: As the user has Done authentication and done renting and booking of the apartment/room through the frontend interface blockchain has to save the process to its blocks so it will go smoothly further without any difficulties. As we have already deployed smart contract on the blockchain it will as we written in the contract e.g. Only the owner can create, delete, and update the room/house also we have stated in the contract that the refund amount will be refunded to the tenant excluding security fee(security fee is the concept which helps local owner to avoid scams) which is 5% of the price of the room/house for example I am a tenant who has house out on website at 30000rs/day if someone wants refund after booking, the amount that will be refunded will be 28500rs.

Implementation

This project leverages blockchain technology to ensure the authenticity of products by enabling a system where customers can verify if a product is genuine or fake by scanning a QR code. The implementation involves two key users: manufacturers and customers. The system processes the information in a streamlined manner, ensuring secure, transparent, and immutable storage of product details on the blockchain.

1. Manufacturer Side (Product Maker):

- Add Product Details: The process begins with the manufacturer entering applicable details about the product. This includes information such as the product name, year of manufacture, price, quantity, quality, and the manufacturer's name or unique identification number. These details are critical for ensuring the traceability of the product.
- Generate QR Code: Once the product details are entered, the system generates a unique QR code for each product. This QR code acts as a digital signature for the product. It is generated using an algorithm that ensures that the QR code is unique to each product and different for every instance. It links directly to the product's details and cannot be replicated for any other product.
- Store on Blockchain: After generating the QR code, both the QR code and the associated product information are saved on the blockchain. Blockchain is used for its decentralized, secure, and immutable characteristics. By storing the data on the blockchain, it ensures that the product

details are not tampered with or deleted after they have been added. This guarantees the integrity of the product's data and builds trust with consumers.

2. Customer Side (Buyer):

Scan the QR Code: Customers can scan the QR code on the product using their smartphone or any other scanning device. The scanning process is designed to be quick and easy, allowing the customer to instantly access the product's data.

- Check the Code in Blockchain: Once the QR code is scanned, the system checks the scanned code against the data stored in the blockchain. This is where the blockchain's security comes into play. Since blockchain stores the product information in a decentralized ledger, it can be easily accessed and verified in real-time to check if the product is authentic.
- View Results: If the QR code is found in the blockchain, the system confirms that the product is original. This provides the customer with peace of mind, knowing that the product is genuine. On the other hand, if the QR code is not found or if it does not match any records on the blockchain, the system will flag the product as fake. This point effectively prevents the trade of fake products.
- Show Product Information: For products that are verified as original, the system also displays the full details associated with the product. This includes the product's name, price, manufacturing date, and details about the manufacturer. This added translucency farther strengthens the consumer's trust in the product.

3. Blockchain Use:

All the product data, including the QR code, are stored as individual blocks in the blockchain. The crucial benefits of using blockchain in this context include:

- Data Immutability: Once data is stored on the blockchain, it cannot be altered or deleted. This makes sures that the properties regarding the product's legitimacy remains unchanged over time, indeed if the product changes hands or power.
- Prevention of Fraud: By associating a unique QR code with each product and storing this information on the blockchain, it is insolvable for counterfeiters to use the same QR code for a fake product. This significantly reduces the threat of fraud in the market.
- Easy Product Tracking and Verification: Blockchain allows for the easy tracking of products across the supply chain. Each product's journey from manufacture to sale can be traced, ensuring that the customer always knows the product's origin and authenticity.

Results and Discussion

Home Page

The home page gives us the main interface for both manufacturers and customers. It offers options to add a new product, scan and verify existing products, and view records. The design is kept user-friendly to ensure ease of navigation and accessibility for all users.

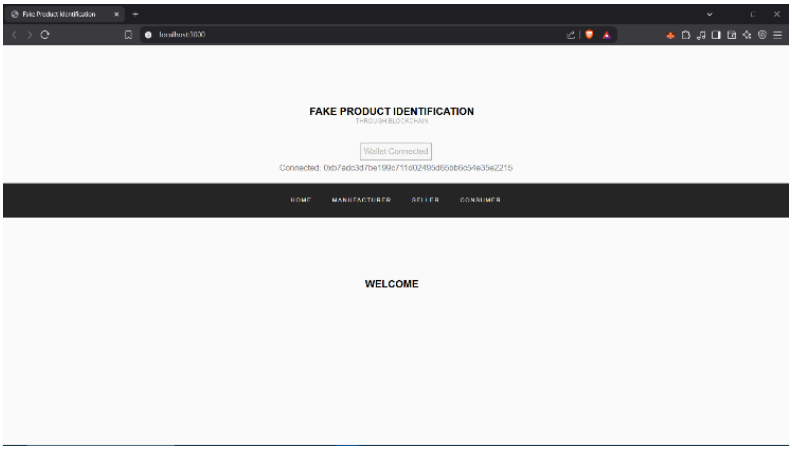


Fig: Home Page

Add Product

This section allows manufacturers to input product-specific details such as name, price, year of manufacture, quantity, quality grade, and manufacturer ID. Upon submission, the system processes the data, generates a corresponding QR code, and stores all information on the blockchain network. This ensures traceability and integrity

Fig: Add Product

Verify Product

demonstrates the product verification interface for customers. By scanning the QR code using this page, the system matches the code with the stored blockchain data. If a match is found, the product details are shown along with a message confirming authenticity. If no match is found, it alerts the customer about a potential fake product.

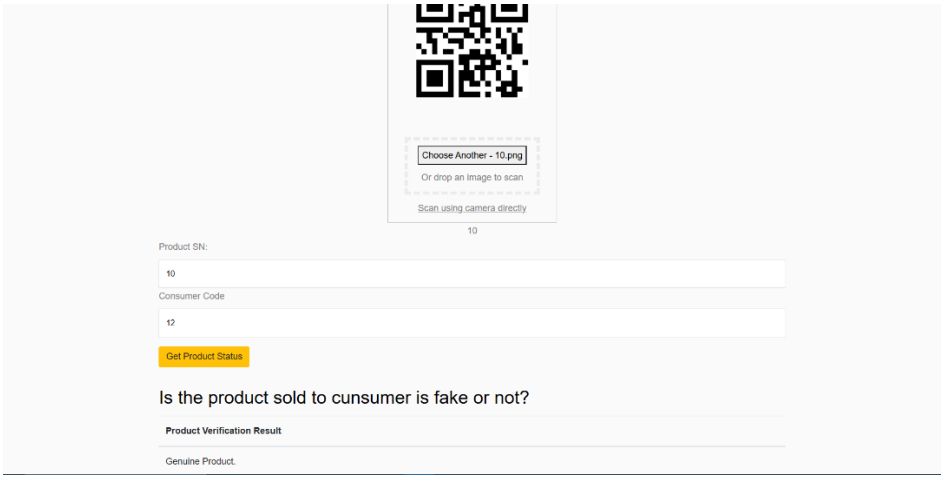


Fig: Verify Product

QR Code

This figure displays the uniquely generated QR code for each product after the manufacturer enters the required details. The QR code serves as a unique digital identity that links the product with its information stored securely on the blockchain. It is designed to be unforgeable and can be scanned by any QR scanner or mobile device for verification purposes.

Fig: QR Code

Result

In blockchain-based systems, accuracy is defined by data integrity, immutability, and traceability rather than prediction rates like in ML models. Our system ensures 100% consistency across all nodes, meaning every product's data is identical and verifiable at any point in the supply chain. Each product is assigned a unique digital ID, and its journey is recorded in a tamper-proof ledger. System eliminates the risk of forgery or duplication. Since data cannot be altered once added, trustable verification with zero manual error. In this way, our system delivers high accuracy through transparent and secure product tracking.

Conclusion and Future Scope

This project demonstrates a blockchain-based system that offers a secure, transparent, and user-friendly solution for verifying product authenticity using QR codes. It empowers industries, especially those with limited resources, to protect their brand and assure consumers that they are purchasing genuine products. The immutability of blockchain ensures that once product details are stored, they cannot be altered or deleted, thus strengthening trust across the supply chain. Each product receives a unique QR code, which allows consumers to verify its authenticity quickly and effectively by scanning it and comparing it to blockchain records. While QR codes themselves are not hackable, the data they contain can be copied to produce counterfeit codes. To counter this, secure graphic QR codes or copy-detection patterns can be used, which degrade when photocopied due to ink smearing. This enhances the security of the verification process. The system can also assist users who encounter counterfeit products by suggesting genuine versions from verified sellers with price comparisons, improving usability and promoting trust. With further refinements, this project lays a strong foundation for combating counterfeiting across various industries.

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