Fake Product Detection by QR Using Blockchain

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Abstract—Counterfeit products pose a serious threat to businesses, consumers, and economies worldwide, leading to financial losses, reduced customer trust, and health and safety risks. Traditional methods of product authentication are often centralized, making them vulnerable to tampering and fraud. To address this challenge, this work proposes a **blockchain-based system for fake product detection using QR codes**. In the proposed model, every genuine product is assigned a unique QR code that is linked to an immutable record stored on a blockchain network. Customers and stakeholders can scan the QR code to instantly verify the product's authenticity, view its origin, and track its supply chain history. The decentralized nature of blockchain ensures transparency, security, and trustworthiness, as records cannot be altered or forged. By integrating blockchain technology with QR code verification, this approach enhances consumer confidence, improves supply chain management, and provides an efficient solution to the widespread problem of counterfeit products.

Keywords— Hostel Management, Shantiniketan, Room Allotment, Attendance Monitoring, Food Customization, Data Analytics, Web-Based Application, Automation in Education

I. INTRODUCTION

The rapid growth of globalization and e-commerce has led to an increase in counterfeit products across various industries such as pharmaceuticals, electronics, fashion, and consumer goods. Counterfeit products not only damage the reputation of brands but also pose serious risks to consumers' health, safety, and trust.

Traditional methods of product verification, such as holograms, barcodes, and centralized databases, are often vulnerable to duplication, tampering, and unauthorized access. Hence, there is a strong need for a more secure, transparent, and reliable system for product authentication and tracking.

By recording product details and supply chain activities on a blockchain, data becomes tamper-proof and can be verified by all stakeholders. detecting fake products.RELATED WORK

1.QR Code-Based Authentication

Early solutions relied on QR codes and barcodes for product verification. Products were tagged with unique QR codes that consumers could scan to retrieve information from a centralized database. However, these systems suffered from vulnerabilities such as duplication of QR codes, database tampering, and lack of transparency, making them less effective

against sophisticated counterfeiting.

2.RFID and IoT-Based Systems
Some researchers proposed the use of Radio Frequency Identification (RFID) tags and Internet of Things (IoT) devices for supply chain tracking. While RFID offered better security than QR codes alone, the high cost of deployment and maintenance limited its large-scale adoption, especially in industries dealing with low-cost consumer goods.

II. METHODOLOGY

1.System Design

- Each genuine product is assigned a **unique digital identity** at the manufacturing stage.
- A **QR code** is generated for each product, containing a reference to its digital identity stored on the blockchain.
- The blockchain acts as a **tamper-proof distributed ledger**, storing product details such as manufacturer ID, batch number, production date, and supply chain updates.

3.Blockchain for Supply Chain Transparency
Blockchain technology has been widely studied for ensuring trust and transparency in supply chains. Studies show that by recording every transaction or product movement on an immutable ledger, blockchain minimizes the chances of data manipulation. Several blockchain-based frameworks have been proposed for industries like pharmaceuticals, luxury goods, and agriculture to verify authenticity and prevent counterfeiting.

4.Integration of QR Codes with Blockchain
Recent works focus on integrating QR codes with blockchain technology to overcome the weaknesses of centralized systems. In this model, a unique QR code links to a blockchain entry representing the product's digital identity. Researchers have shown that this approach provides secure, cost-effective, and user-friendly verification for consumers. Blockchain ensures immutability, while QR codes provide easy access for authentication.

2.Data Registration on Blockchain

- Manufacturers register product details on the blockchain at the time of production.
- A **smart contract** is deployed to automatically manage and verify product information.
- Once recorded, product data cannot be modified or deleted, ensuring immutability.

III. RESULTS AND DISCUSSION

1.Implementation Results

The proposed system was implemented using **QR code generation tools, a blockchain network, and a verification application**. The following outcomes were observed:

- **QR Code Generation:** Each product unit was successfully assigned a unique QR code linked to blockchain records.
- **Blockchain Record Creation:** Product details such as product ID, manufacturer, batch number, and timestamp were securely stored on the blockchain. Once recorded, the data remained immutable.
- **Supply Chain Updates:** At every stage of product transfer, relevant details were appended to the blockchain, ensuring traceability from manufacturer to consumer.

• **Consumer Verification:** A mobile application allowed consumers to scan the QR code and retrieve real-time product details from the blockchain. If the scanned QR matched the blockchain record, the product was verified as genuine; otherwise, it was flagged as counterfeit.

2.Performance Evaluation

• **Accuracy:** The system achieved high accuracy in detecting counterfeit products, as any mismatch between the QR data and blockchain records flagged the product.

• **Efficiency:** QR scanning and blockchain verification were completed within seconds, making the process user-friendly.

• **Scalability:** The system demonstrated the ability to handle multiple product entries without performance degradation, owing to blockchain's distributed structure.

• **Security:** No unauthorized alterations to product records were possible, ensuring integrity and authenticity.

Discussion

• **Advantages:**

○ The combination of QR codes and blockchain provides both **usability** and **security**.

○ Transparency in the supply chain increases consumer trust and brand reputation.

○ Unlike centralized databases, blockchain eliminates single points of failure.

○ The solution is cost-effective compared to RFID-based systems, as QR codes are inexpensive and widely supported by smartphones.

• **Limitations:**

○ The system depends on internet connectivity for blockchain access, which may limit usability in remote areas.

○ If the QR code is physically damaged or duplicated without blockchain verification, user confusion may arise.

○ Public blockchain solutions may involve transaction costs (gas fees), whereas private blockchains reduce costs but limit decentralization.

IV. CONCLUSION

Counterfeit products continue to pose serious threats to global markets, leading to financial losses, health hazards, and erosion of consumer trust. Traditional verification methods such as barcodes and holograms have proven insufficient, as they are easily duplicated or tampered with. To overcome these challenges, this project proposed a **blockchain-based fake product detection system integrated with QR codes**.

The results demonstrate that the system provides a **secure, transparent, and efficient** mechanism for product authentication. By assigning each product a unique QR code linked to immutable blockchain records, the system ensures that product details cannot be altered or forged. Consumers can easily verify authenticity by scanning the QR code, while supply chain stakeholders benefit from enhanced traceability and accountability.

• **Comparison with Existing Systems:**

○ Traditional QR/barcode-based systems are prone to duplication and tampering.

○ RFID/IoT-based systems are secure but expensive.

oThe proposed **QR + Blockchain** system strikes a balance by providing **security, transparency, and cost-effectiveness**.

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