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"A Smart Blockchain-Based Platform for Fake Product Detection and Secure Product Verification"

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Abstract: Users in today's digital marketplace often struggle to verify the authenticity of products due to the rapid growth of counterfeit goods and the lack of reliable verification systems. Most existing product authentication methods rely on centralized databases or manual verification processes, which are vulnerable to data manipulation and lack transparency. These systems do not effectively provide secure traceability, product verification, and consumer trust within a single platform. This paper proposes a blockchain-based fake product detection system that utilizes decentralized technology to improve product authentication and supply chain transparency. The system records product information such as manufacturing details, batch number, and ownership history on a blockchain network, ensuring that the data remains secure and immutable. Consumers can verify the authenticity of products by scanning a QR code or unique product identifier linked to the blockchain record. In addition, the system enables stakeholders to track product movement across different stages of the supply chain. This helps in preventing counterfeit distribution and allows reliable product verification. Overall, the design demonstrates how a transparent and secure blockchain-based system can support better product authentication, consumer trust, and protection against counterfeit goods.

Keywords: Blockchain technology, Fake product detection, Product authentication, Counterfeit prevention, Supply chain transparency, QR code verification, Decentralized ledger system, Product traceability, Consumer trust, Secure product verification.

I. INTRODUCTION

Consumers in today's digital marketplace often struggle to verify the authenticity of products due to the increasing presence of counterfeit goods and the lack of reliable verification systems. Important information such as product origin, manufacturing details, and supply chain history is often scattered across different databases or controlled by centralized authorities, making it difficult for consumers and retailers to verify product authenticity effectively.

A major limitation of current product verification approaches is the absence of a transparent and tamper-proof system that ensures secure product tracking and authentication. Traditional methods such as barcodes or manual verification rely on centralized databases, which are vulnerable to data manipulation and lack proper traceability. As a result, consumers find it difficult to identify genuine products, analyze product history, or prevent counterfeit purchases effectively.

To address this problem, this paper proposes a blockchain-based fake product detection system that uses decentralized technology to improve product authentication and supply chain transparency. The system records important product details such as manufacturing information, batch numbers, and transaction history on a blockchain network. Consumers can verify product authenticity by scanning a QR code or unique product identifier that links directly to the blockchain record.

The main objective of this work is to demonstrate how a secure and transparent blockchain-based platform can support reliable product verification and counterfeit prevention. The proposed system enables secure data storage, real-time product verification, and supply chain traceability, making it suitable for applications such as product authentication systems and consumer protection platforms, while maintaining a strong focus on security, transparency, and trust.

II. LITERATURE REVIEW

A. Traditional Product Authentication Systems

Traditional product authentication systems rely on technologies such as barcodes, RFID tags, and centralized databases to verify product information. These systems help manufacturers track products across supply chains and provide basic

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verification mechanisms. However, many existing solutions depend on centralized storage, which makes them vulnerable to data manipulation and reduces transparency.

B. **Counterfeit Detection and Supply Chain Monitoring Systems**

Existing counterfeit detection systems focus on monitoring the movement of products throughout the supply chain to identify irregularities. These systems record product information at different stages such as manufacturing, distribution, and retail.

C. **Blockchain-Based Product Verification Systems**

Blockchain technology has emerged as a promising solution for improving product authentication and supply chain transparency. Blockchain-based systems store product data in a decentralized and immutable ledger, ensuring that once information is recorded it cannot be altered. These systems allow manufacturers, distributors, and consumers to access secure and verified product records.Simulation and Scenario-Based Learning Systems.

III. SYSTEM OVERVIEW

The proposed system is a blockchain-based fake product detection platform designed to verify product authenticity and prevent the circulation of counterfeit goods in the market. The system focuses on providing a secure, transparent, and reliable method for tracking products across the supply chain and enabling consumers to verify product authenticity through digital verification techniques.

A. System Overview

The system is built around the concept of integrating blockchain technology, QR code-based product identification, product registration, verification mechanisms, supply chain tracking, and a user-friendly interface into a single platform supported by a decentralized blockchain network.

B. System Components

The system is comprised of the following modules:

- Product Registration Module (Manufacturer)
- Product Verification Module (Consumer)
- Blockchain Storage Module
- Supply Chain Tracking Module
- User Interface

C. System Workflow

The system begins with manufacturers registering products on the platform by entering important product details such as product name, batch number, manufacturing information, and product identification data. After registration, each product is assigned a unique QR code or digital identifier that is securely stored on the blockchain network. As the product moves through different stages of the supply chain, related information can be recorded to maintain transparency and traceability.

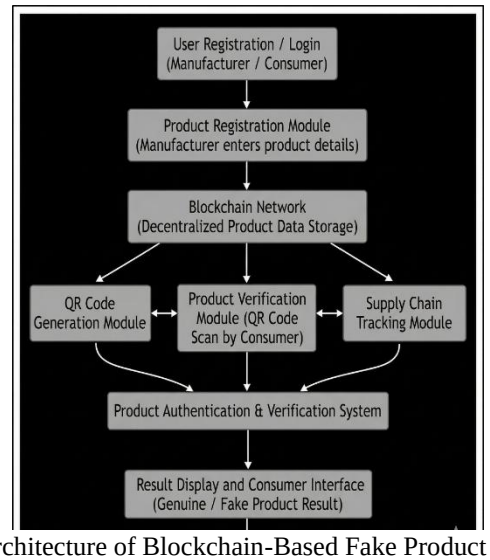

Fig. 1 System Architecture of Blockchain-Based Fake Product Detection System

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IV. DATABASE ARCHITECTURE

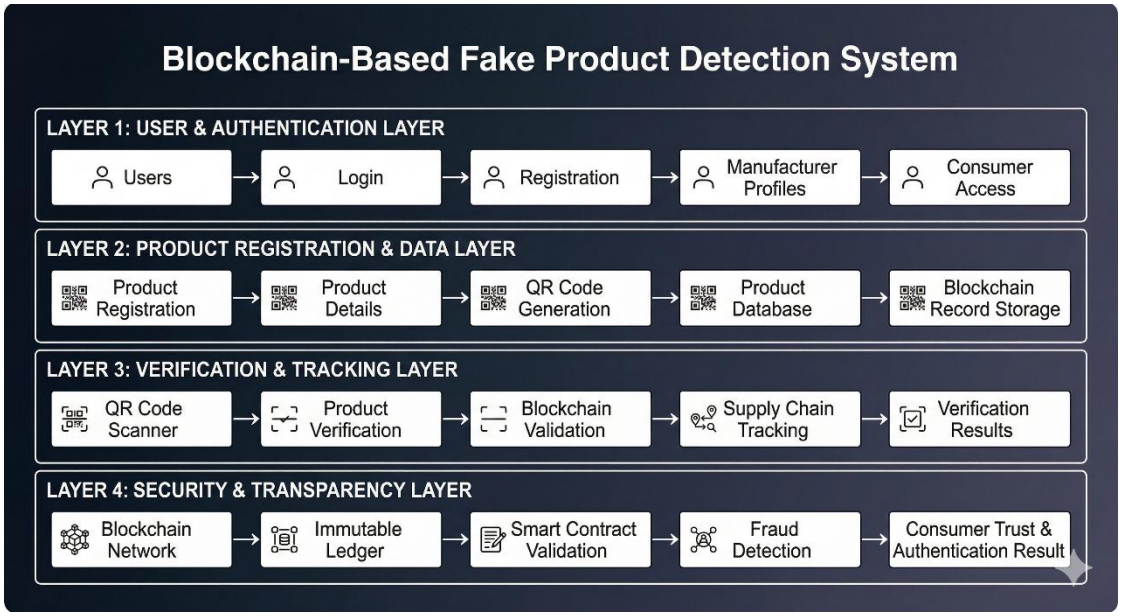
A. Database Design Goals

The database is designed to efficiently manage product information and support secure product verification within the blockchain-based fake product detection system. The system focuses on organizing product records, maintaining supply chain transparency, and enabling reliable authentication for consumers and stakeholders. The key goals of the database include:

- Representation of structured product information and manufacturing details
- Integration of blockchain records with product identification data
- Support for QR code-based product verification
- Supply chain tracking and transaction history management
- Scalability for multiple manufacturers, retailers, and consumers

B. Core Entity Groups

The database is logically divided into multiple entity groups to ensure modularity and efficient data handling:



1) Blockchain Data Layer

This layer stores product-related records on the blockchain network. It maintains immutable transaction data such as product registration, ownership history, and supply chain updates. By using blockchain technology, this layer ensures that product information remains tamper-proof, transparent, and securely accessible to authorized users.

2) Verification & Authentication Layer

This layer manages product verification processes and QR code-based authentication. It enables consumers to scan QR codes or unique product identifiers to verify product authenticity. The system retrieves product information from the blockchain ledger and validates whether the product is genuine or counterfeit.

3) User Data Layer

This layer handles user-related information including manufacturer profiles, consumer access records, product registration activities, and verification logs. It supports system monitoring, product traceability, and secure interaction between manufacturers and consumers.

C. Conceptual Data Model

The system models relationships between manufacturers, products, blockchain records, and verification processes through an interconnected relational schema:

- Manufacturers register products with detailed product information
- Each product is assigned a unique product identifier and QR code
- Product details are recorded and linked to blockchain transaction records
- Consumers scan QR codes to verify product authenticity
- Verification attempts generate transaction and verification logs

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This integrated model enables efficient product registration, secure verification, and transparent supply chain tracking.

D. Schema Design Rationale

The database follows a structured design to ensure data integrity, security, and efficient data management. Product information is stored separately from blockchain transaction records to maintain modularity and simplify updates. Relationships between products, manufacturers, and verification records are managed through mapping tables.

E. Key Tables and Relationships

TABLE I: CORE DATABASE TABLES AND THEIR FUNCTIONS

Table Name	Role	Purpose
Users	System Actor Data	Store system login and access information.
Manufacturers	Brand Owner Profile	Identify and manage registered brand manufacturers.
Product_Catalog	Static SKU Data	Define specific product types and specifications.
Unique_Items	Item Instance Records	Register individual products with unique serial numbers.
Blockchain_Links	Ledger Reference Pointers	Map unique items to blockchain transactions.
Item_Status	Verified Authenticity Data	Display final product provenance and status results.

F. Database Workflow

The database supports a structured workflow for fake product detection and verification

- Manufacturers register products and enter product details
- Each product is assigned a unique identifier and QR code
- Product information is stored and linked to blockchain records
- Consumers scan QR codes to request product verification
- The system retrieves blockchain data and validates authenticity
- Verification results and logs are recorded for monitoring

V. LEARNING AND THREAT SIMULATION PROCESSING

The proposed system improves product authentication by integrating product registration, blockchain data storage, and real-time verification processes. Instead of relying on traditional centralized verification methods, the system processes product information through multiple stages to ensure transparency, security, and reliable counterfeit detection.

Initially, manufacturers register products on the platform by entering important details such as product name, manufacturing information, batch number, and product specifications. Once the product is registered, the system generates a unique product identifier and QR code. This information is securely recorded on the blockchain network to ensure that the data remains immutable and tamper-proof.

Based on product verification results and blockchain validation processes, the system generates authentication outcomes and records verification logs. These records help identify genuine products and detect counterfeit attempts within the supply chain. The system continuously processes product registration data, blockchain records, and consumer verification requests to maintain transparency and security.

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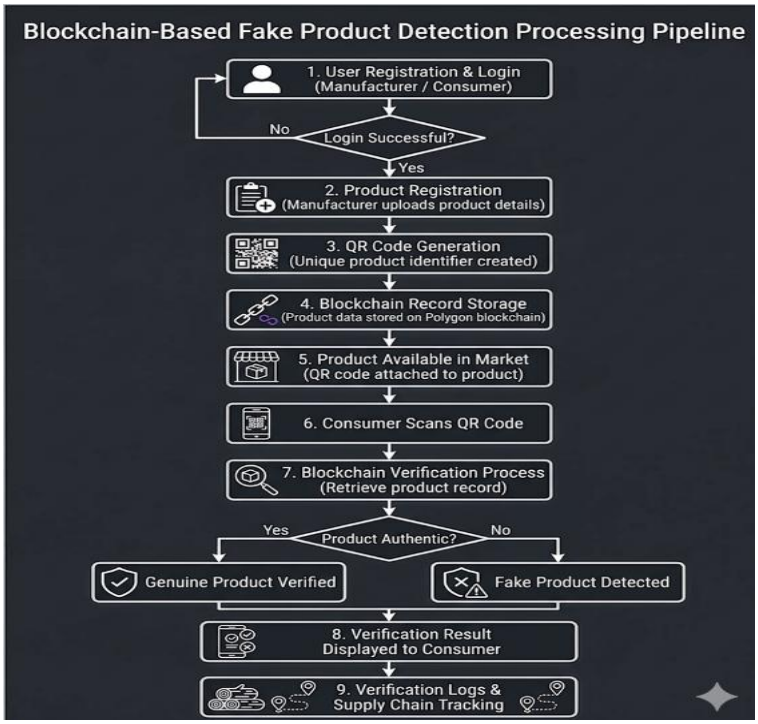

Fig. 3 Processing Pipeline of the Blockchain-Based Fake Product Detection System

V. CONCLUSION

This research introduces a blockchain-based approach for managing product authentication, verification, and counterfeit detection. The proposed system integrates product registration, blockchain data storage, QR code-based verification, and supply chain tracking within a unified system framework. It combines product information, blockchain transaction records, and consumer verification processes to create a secure and transparent product authentication environment.

The primary objective of this research is to demonstrate how the proposed architecture enables the system to go beyond traditional centralized verification methods and actively support secure product tracking, counterfeit detection, and transparent supply chain management. By incorporating technologies such as blockchain storage, QR code verification, and immutable transaction records, the system enhances both product traceability and consumer trust.

Overall, the proposed system establishes a strong foundation for the development of advanced product authentication platforms and counterfeit prevention solutions. It highlights the potential of integrating blockchain technology with modern verification techniques to improve product transparency, brand protection, and consumer confidence in digital marketplaces.

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