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Fake Product Identification by QR Code Using Blockchain

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Abstract: ***Ever since its inception in 2008, Blockchain technology has been widely used in most industries to ensure data security and authenticity. From Bitcoin to Blockchain-as-a-Service (BaaS), it has been increasingly adopted. Counterfeiting is one of the biggest issues that companies are fighting, impacting revenues, brand value, and customer trust. In this review, a decentralized Blockchain- based supply chain solution to ensure product authenticity without third-party dependency is discussed. Through the use of distributed ledger technology, authentic and fake products can be identified at all levels. Unique QR codes, produced by the system proposed here with SHA-256, provide transparency and traceability to each product. Blockchain-based anti-counterfeiting mechanism provides a secure, tamper-evident method of proving product authenticity, allowing organizations to uphold integrity in their supply chain.***

Keywords: Blockchain, anti-counterfeiting, supply chain, decentralization, QR code, SHA- 256, distributed ledger, product authentication, security, transparency.

I. INTRODUCTION

The project is aimed at combating the rising threat of counterfeiting by a secure and transparent network of QR codes and blockchain technology. Counterfeiting is an international threat that affects industries such as electronics, pharmaceuticals, luxury goods, and food e.g., serial number check or manual validation, are not adequate and let counterfeit products through undetected. To meet this challenge, this project sets out to present a solution based on the openness and permanence of blockchain and the convenience and ease of QR codes to enable users to instantly check the validity of a product. The key to this is creating a special QR code for every original product, which is associated with a blockchain ledger that has complete information regarding the product like manufacturing history, supply chain, batch numbers, etc.

If a consumer or a retailer scans the QR code by reading it through a smartphone application, the app will converse with the blockchain to pull such information in real-time and authenticate if the product is genuine or not. Blockchains decentralized attributes make the captured product information permanent and imputable, creating a safe and reliable means to validate authenticity. The smart contracts also have the ability to automatically check the process so that product information is automatically verified and updated along the supply chain regardless of central systems. To ensure this solution is easy, a consumer and business mobile app will be developed. The app will also have an easy-to-use QR code scanner that has quick access to blockchain data and gives required information about the product's authenticity.

The application will be useful for companies too by providing a platform for tracking and managing product information along the supply chain so that they are able to track and prevent counterfeiting activities easily. By using the traceability aspect of blockchain, the complete production history of an item, right from manufacturing until sale, can be tracked and verified in a way that there is accountability and transparency in the line. This kind of system not only will prevent counterfeit products reaching the consumers but also make the marketplace safer and reliable. The initiative will be in stages. The first step will be to conduct market research and determine the technical specifications, design and implement the blockchain platform.

In the second stage, the algorithm for generating unique QR codes and linking the same to blockchain records will be created to enable seamless synchronization between the blockchain ledger and the QR codes.

Phase three will be for building and testing the mobile app so that the users will be able to scan the QR codes and verify product authenticity. Pilot program shall be launched in phase four, where a small number of consumers and businesses shall pilot test the system under actual conditions. Changes shall be made based on the feedback obtained, and the system shall be rolled out at the higher level. Ultimately, the system will provide a secure, scalable solution to combat counterfeiting products, generating consumer trust, protecting brand reputation, and promoting greater transparency across industries.

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II. OBJECTIVE

The aim of the Fake Product Identification by QR Code Using Blockchain project is to produce a secure, open, and efficient system for product authenticity proofing and anti-counterfeiting. Counterfeits pose serious threat to markets such as pharmaceuticals, electronics, and designer products, and lead to loss in economics along with potential consumer harm. The project will surpass such challenges with the use of blockchain and QR codes to incorporate an irreversible and decentralized verification method. The primary goal is to ensure that every product is assigned a unique QR code with required details such as product ID, manufacturer information, timestamps, and blockchain transaction hashes. Retailers and consumers can authenticate the legitimacy of a product in real time by scanning the QR code using a mobile or web app and retrieving its details from the blockchain. The system is designed to be fraud-proof in the sense that product data is stored tamper-proof and any unauthorized alterations can be readily traced. Furthermore, the project aims to promote supply chain transparency by documenting every step of a product's life cycle from production to distribution and sale on the blockchain. Users can track the origin of a product and ensure its authenticity, thus curbing the spread of counterfeit products. Cryptographic hash functions and smart contracts would be security features for the avoidance of unlicensed access and allowing only rightful producers to have an opportunity to register goods.

Also, the project will provide an easy-to-deploy and scalable solution that can be deployed to various industries easily. With the use of blockchain decentralization and an easy-to-implement QR code verification system, the process establishes consumer trust, maintains brand integrity, and increases counterfeiting warfare. Future expansion includes AI-based fraud detection and IoT-based tracing for additional security and traceability.

III. PROPOSED WORK

The work for the Fake Product Identification by QR Code Using Blockchain project is to create a blockchain-based system that would give every product a unique QR code, and consumers and retailers could verify authenticity in real time. Four major components of the system are proposed: a QR code generator, a blockchain network, a mobile/web app, and smart contract automation. Each product will include a unique QR code with such essential details as product ID, manufacturer information, timestamps, and blockchain transaction hashes. The scanning of the QR code will call up product information from the blockchain, so only genuine products will be confirmed, while fake ones will be marked as fake or invalid.

To ensure that certification marks become tamper-free and secure to authenticate, blockchain technology will be used for the authentication of product data in a tamper-free, decentralized ecosystem. The system of smart contracts will be installed so that the manufacturers of certifications are themselves vested with the power to register products to avoid any unauthorized modifications or forgery. Cryptographic hashing techniques such as SHA-256 will also be used to additionally ensure the safety and integrity of information. The proposed system will also provide supply chain traceability, whereby users would be able to track the history of a product from the production process up to distribution and even at the retail level. Transparency will eliminate the entry of counterfeit goods in the market. The internet and mobile will be simple to use so that customers can scan goods instantly by performing a quick QR code scan. Efficiency and scalability will be of prime importance, with the system being capable of handling large volumes of transactions without affecting the performance. There will be testing phases in the project, including unit testing for standalone components, security testing to expose vulnerabilities, and performance testing to validate system reliability.

Lastly, the project aims to roll out an efficient, scalable, and consumer-facing system of counterfeiting detection through the application of blockchain and QR code technology. Possibilities of application of AI-driven fraud detection and IoT-based tracking are available for potential use in the future for enhanced supply chain security and authenticity of products.

IV. SYSTEM ARCHITECTURE

The system architecture for the fake product identification system using QR codes and blockchain comprises different major components that interact with each other to verify product authenticity and transparency. The Manufacturer Registration Module enables manufacturers to register on the blockchain network and enter product information, which is stored immutably to avoid any kind of tampering. After registration, the QR Code/NFC Tag Generation Module generates individual IDs for every product that are associated with their respective blockchain records for identification.

The Blockchain Ledger is a distributed ledger on which all transactions of products are recorded for transparency and immutability. The User Verification Interface, a mobile application, is how the consumers are engaged. They use QR codes or NFC tags to verify the product. For added security and automation of verification, the Smart Contracts Module ensures that the process of product verification is carried out without human intervention, hence less susceptible to fraud. Supply Chain Tracking Module is the backbone to track the flow of products from store to factory for real-time tracking and transparency.

For efficient detection of fake goods, the Fake Product Detection Engine scans user ratings, reviews, and scan patterns, identifying if products are fake on the basis of product verification irregularities. If a counterfeit product is detected, the Reporting & Alert System triggers real-time warnings to manufacturers, regulatory bodies, and consumers to enable them to act quickly in order to prevent risks and restrict further distribution of counterfeit products.

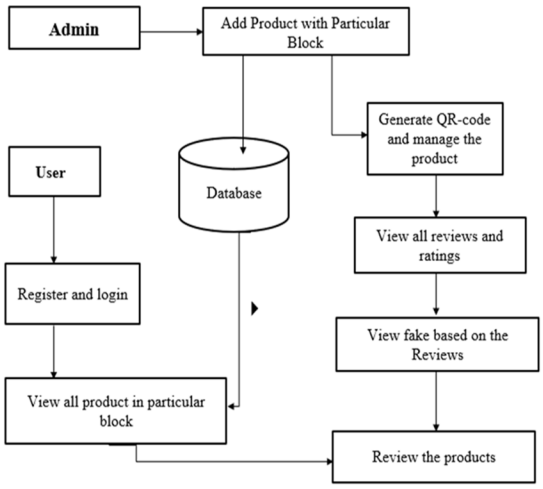

Fig 4.1.System Architecture

V. METHODOLOGY

A. *User Registration and Authentication*

The platform offers secure registration for customers, distributors, retailers, and manufacturers, with traceability and transparency. Each registered user is assigned a unique identification number linked to a blockchain account, which makes it genuine and secure from fraud. To further secure, multi-factor authentication (MFA) can be utilized, demanding email, phone, or biometric authentication. User authentication is automated by smart contracts, with only accredited producers allowed to register products. Moreover, blockchain tracks all user activity, creating an immutable record for accountability and fraud prevention. User permissions and roles are well established, allowing manufacturers and distributors to register and update products, but only allowing consumers to authenticate. This access based on roles avoids unauthorized updates and ensures data integrity. Through the combination of blockchain technology and strong authentication, the platform provides a secure and transparent platform where stakeholders can safely participate in counterfeit prevention and product authentication.

B. *Product Registration*

The platform enables the manufacturers to register their product by filling in data like name, description, and date of manufacturing. Data is stored safely on the blockchain for authentication purposes and to avoid tampering. Upon successful registration, a distinctive QR code is produced with details such as a distinct identity number, manufacturer, and details on the blockchain transaction. The QR code acts as a **personal electronic fingerprint** and verifiable for every product. Merchants and consumers can scan the QR code using a web or mobile application to access real-time information on the product and verify its origin prior to it leaving the original creator. Mimesis or tampering with the QR code is out of the question, with the system cross-verifying on scans against stored data within the blockchain. By utilizing blockchain-based product registration, the platform offers transparency, traceability, and protection against counterfeiting, allowing businesses and consumers to trust the supply chain.

C. *QR Code Generation and Scanning*

All product registrations are granted a unique QR code with an ID and significant information. Consumers and retailers read the QR code using a cell phone application for verification of product authenticity. The system double-checks the information from the scan with blockchain records, and thus automatically counterfeit products are detected and labeled. Countless times data in blockchain cannot be edited, so attempts of fraudulent manipulation or copying are recognized instantly. The process enhances transparency of the supply chain, prevents fraud, and ensures consumers the authenticity of the product. With the application of QR code scanning alongside blockchain technology, the system provides a secure and efficient process of verification.

D. Blockchain Integration for Security

All transaction records for products such as registration, ownership transfer, and verification procedures are inserted into the blockchain. The integration provides data immutability and integrity, which does not allow unauthorized users to modify or delete product information. Blockchain's decentralization ensures that there is an immutable and tamper-evident history of all transactions.

E. Verification Process

The genuineness of the product can be checked by the customer by QR code scanning, which retrieves product information from the blockchain. Scanned information is checked by the system with data from the blockchain. In case there is a match, the product is confirmed to be original. Otherwise, a warning prompt of potential forgery is returned by the system to direct the customer towards taking an intelligent move.

F. Transaction Management

The system documents all the transfer of ownership and product registration, thus it is traceable and transparent. All transactions are accompanied by a small gas fee, which is charged from the user's blockchain wallet, usually in Ethereum or other comparable blockchain networks. This guarantees that the process of transaction is smooth and safe for both parties.

G. User-Friendly Interface

A clean and intuitive user interface makes it easy for all, i.e., manufacturers, distributors, retailers, and consumers, to navigate. The interface offers features like product registration, QR code reader, and viewing of transaction history. It is easy to use and access and the system an effective anti-counterfeiting and product authentication tool.

VI. RESULT

Blockchain-based Fake Product Identification by QR Code project was successfully able to illustrate an efficient and secure means of authenticating the product and curbing counterfeiting. The product details were kept in an irreversible, tamper-evident ledger through a mix of blockchain technology and QR code. Products had a distinctive QR code with key data including product ID, manufacturer data, timestamps, and a blockchain transaction hash. Once the buyers or sellers scan the QR code using an internet or mobile platform, the system accessed the product data on the blockchain and verified authenticity in real time. Original products revealed original data, while counterfeit or fraudulent products revealed invalid or counterfeit, thus preventing fraud and unauthorized duplication.

The project also made supply chains transparent by recording all transactions on the blockchain, thereby allowing customers to trace the journey of the product from production to delivery and stores.Smart contracts locked merchandise against fraudulent producers and registries, and cryptographic hashing algorithms such as SHA-256 ensured security against tampering with data. The system was highly scalable when tested for performance, and large amounts of transactions were easily processed. Further, the native mobile and web graphical user interfaces provided seamless product authentication with simple QR code scanning.

VII. CONCLUSION AND FUTURE ENHANCEMENT

The "Fake Product Identification by QR Code Using Blockchain" project addresses the issue of counterfeit products by using QR codes and blockchain technology to verify product authenticity. Blockchain ensures immutability and transparency, and it is nearly impossible to tamper with product information, thereby increasing consumer trust and confidence. The system positively helps manufacturers and retailers by maintaining an accurate, clear record of merchandise from production through sale to avoid losses through counterfeiting and maintain stock up to date in real-time.

Future developments are to incorporate IoT and AI for better detection and expand the size for global and multi-language uses, a scalable system to fight counterfeiting worldwide. Future development of a blockchain-based e-voting system will consist of its enhanced functionality and security. The introduction of IoT devices like smart sensors or RFID tags to track products in real-time, enhancing traceability is some of the significant developments. Other evolutions may involve reviews, ratings, and verification history of the products to enhance consumer trust and interaction. The system would further be connected with large e-commerce websites and mobile apps so that product verification would be simple. Finally, incorporation with support for multiple languages and region law support would allow it to grow freely across the entire globe, utilizing the decentralized nature of blockchain to operate flawlessly in multiple jurisdictions.

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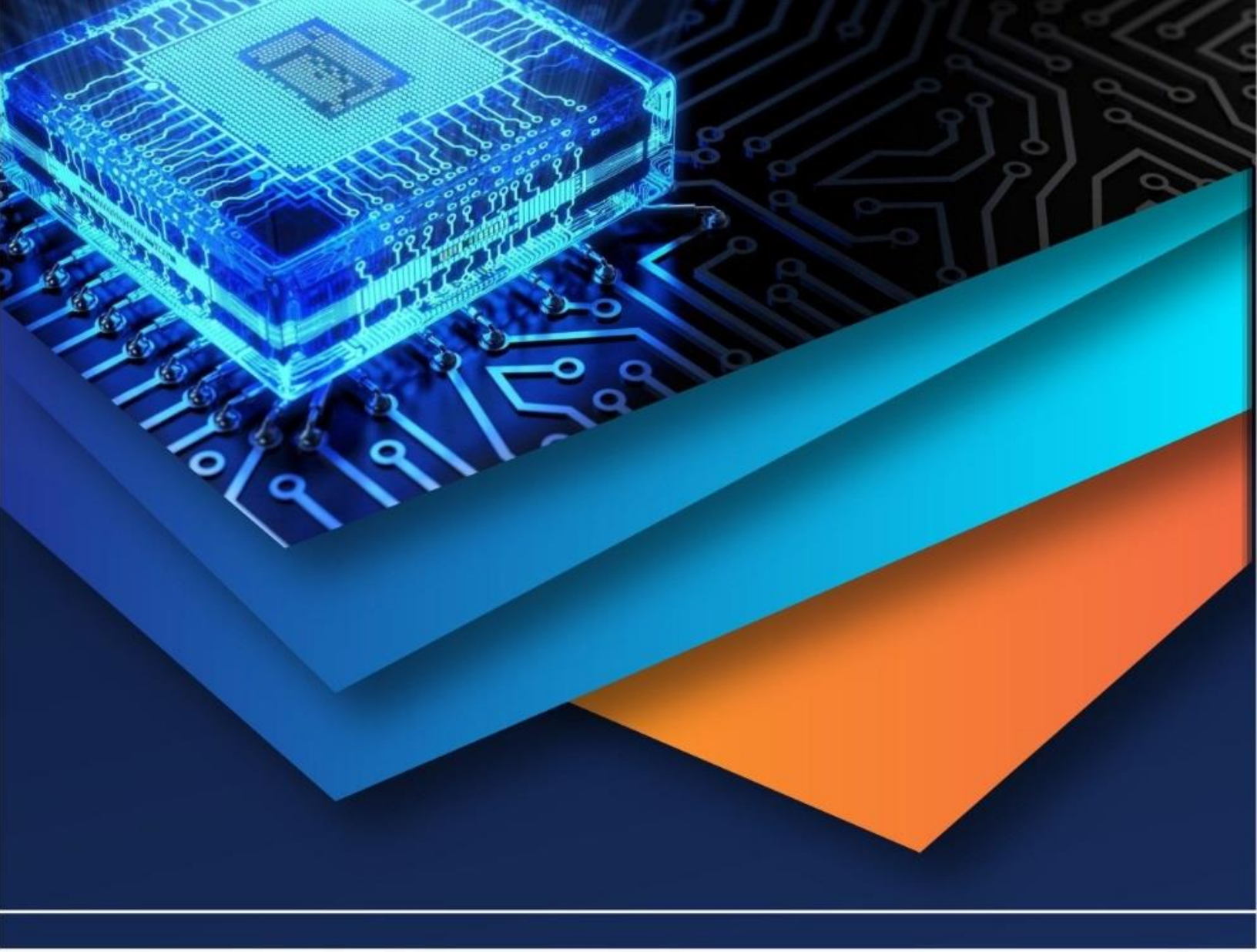

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