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B-SAFE: BLOCKCHAIN SECURE AUTHENTICATIONF OR FAKE ELIMINATION

OMKAR DESAI[1], ROHAN CHAVAN[2], ANIKET THOMBARE[3], MOHIT GANDE[4] , PROF. ANIL NAIK[5]

[1,2,3,4] (Students, Department of Computer Engineering), S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC), CHH.SAMBHAJINAGAR , India
[5](HOD, Dept. of Computer Engineering), S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC), CHH.SAMBHAJINAGAR , India

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Abstract - Blockchain innovations have gained significant interest in recent years. One of the most widely discussed applications is in currency exchange; however, blockchain technology is not limited to digital currency alone and has the potential to influence various business sectors. It offers greater transparency and efficiency in large-scale transactions and can be effectively used to detect counterfeit products.

In today's market, a major concern for consumers is determining whether a product is genuine or counterfeit. The widespread presence of counterfeit goods has had a serious negative impact on economic growth. To address this issue, it is essential to provide transparency about products and make this information accessible to consumers. The increasing circulation of counterfeit and unsafe products worldwide is a growing concern, and blockchain technology represents a significant step toward eliminating this problem.

The use of blockchain can reduce the production and distribution of counterfeit goods, but public awareness is also crucial. By ensuring proper manufacturing and packaging, each product can be assigned a unique digital code that serves as its identity. Through a package implementation process, the product code is scanned using an application, which then verifies whether the product is genuine or counterfeit.

Key Words*: *Supply Chain Security , Product Verification , Smart Contracts , Secure Identification

1.INTRODUCTION

Blockchain is a technique for storing cryptographically linked records across multiple parties within a shared network, making data tampering extremely difficult. Originally developed to support Bitcoin transactions, blockchain technology has since evolved into a powerful tool for many other applications. Each block contains a collection of verified transactions or records, along with a timestamp and a cryptographic hash. This hash is generated from the contents of the current block and the hash of the previous block, forming a secure and continuous chain.

Modern businesses depend heavily on information, and the speed and accuracy with which data is accessed play a crucial role in efficiency and decision-making. Blockchain technology is well suited for this purpose because it enables fast, shared, and transparent access to data stored on an immutable ledger. Access to this data is restricted to authorized participants within the network. A blockchain-based system can track orders, payments, documents, manufacturing details, and many other activities. Since all participants share a single, consistent view of the data, every stage of a transaction can be monitored from start to finish, increasing trust, improving efficiency, and creating new opportunities for optimization.

Blockchain also enables end-to-end visibility within supply chain management. Organizations can digitize physical assets and record them on a decentralized and permanent ledger, allowing assets to be traced from production through delivery and final use by the customer. This increased transparency improves visibility for both businesses and consumers.

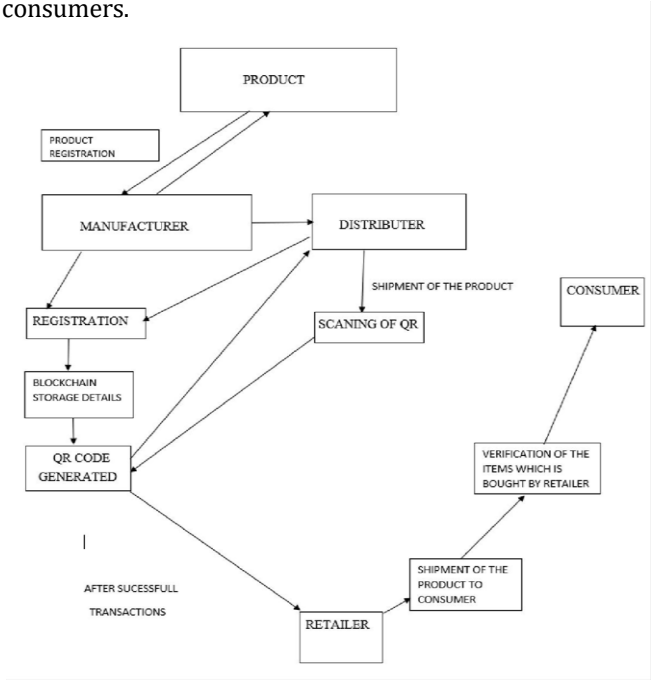

Fig 1: System Architecture

In today's technology-driven world, online shopping has grown rapidly and has become an integral part of daily life. Purchasing products without leaving home or sending gifts across long distances with minimal effort has become commonplace. Although e-commerce has grown

significantly, it still represents a small percentage of total retail activity, indicating substantial room for future expansion. Blockchain can play a key role in supporting this growth by improving trust and security in digital transactions.

One of the major advantages of blockchain is its ability to simplify operational processes and reduce costs by enabling efficient auditing of supply chain data. Tasks that traditionally require weeks, such as manual verification and compliance checks, can be completed much faster using a distributed ledger that records all relevant data in real time. Blockchain technology can significantly enhance supply chain transparency, particularly for high-value goods such as jewelry and pharmaceuticals. It helps organizations track raw materials and finished products across suppliers, reducing losses caused by counterfeit goods and unauthorized resale. At the same time, it builds consumer trust by minimizing the circulation of fake products in the market.

Additionally, blockchain allows organizations to maintain greater control over outsourced manufacturing and production processes. All participants in a production network can access the same verified data, reducing communication errors and data inconsistencies. As a result, less time is spent validating information, and more focus can be placed on improving product quality, reducing costs, or achieving both.

Structurally, a blockchain begins with a genesis block and continues sequentially, with each block containing a unique hash value. These hash values are commonly generated using the SHA-256 hashing algorithm. SHA-256 is one of the most widely used cryptographic algorithms in blockchain systems. Each block typically includes a reference to the next block, a transaction counter that records all transactions, and a nonce. The nonce, meaning "number used once," is a randomly generated value that changes for each block and plays a key role in ensuring security. Once data is added to the blockchain, it cannot be altered without invalidating the entire chain.

SHA-256, or Secure Hash Algorithm 256-bit, is a cryptographic hash function widely used in blockchain systems, including Bitcoin. It produces a fixed-length 256-bit output regardless of input size and is applied twice in Bitcoin for additional security. Beyond blockchain, SHA-256 is used in many security protocols such as SSL, TLS, and SSH, as well as in operating systems like Unix and Linux.

The strength of SHA-256 lies in its security features. It allows data verification without revealing the original information, making it ideal for digital signatures and password verification. Instead of storing actual passwords, systems store hash values, which are compared during authentication. Reversing a hash to obtain the original data is practically impossible, and the likelihood of two different inputs producing the same hash is extremely low. These properties make SHA-256 a reliable and secure foundation for blockchain-based systems.

II. LITERATURE SURVEY

Barcodes have long been used for automated product identification across many applications, while holograms are commonly employed to prevent counterfeiting. Combining barcodes with other security measures can enhance product protection. Holograms offer an additional layer of security, making duplication or forgery more difficult. In one approach, unique, user-defined product identification codes are generated for each item and then converted into QR codes. These QR codes can further be transformed into multidimensional or 3D images to provide stronger security. Holographic QR codes can be implemented using computer-generated holography techniques, such as those programmed in MATLAB. Decoding the barcode from the hologram retrieves the product's unique ID, improving security and authenticity verification for products and preventing counterfeiting.

In addition to product verification, academic research highlights the role of behavioral and environmental factors in student performance. Academic outcomes are influenced by teachers, curriculum, study environment, study hours, infrastructure, and financial conditions. A learner's behavior—including study skills, attitude, and motivation—interacts strongly with performance outcomes. Teachers can assess student behavior through observation and questioning, but this becomes challenging in large classrooms. Developing automated tools to monitor and collect behavioral data can help educators create better strategies to support learning without excessive manual effort.

The rise of counterfeit goods in online and offline markets poses a significant challenge to supply chains. Government regulations alone are often insufficient to prevent counterfeiting. Blockchain technology can provide a solution by storing detailed product transaction data in a secure, shared ledger accessible to all authorized participants. This system allows both producers and consumers to verify the authenticity of products in real time. Using encryption, customers can confirm product details and check the remaining stock available from sellers. A blockchain-based supply chain framework can track products from manufacturing to final sale, helping to detect counterfeit goods and ensure genuine products reach end users.

Radio-frequency identification (RFID) technology is another method for product authentication. RFID systems typically consist of two components: a tag verification module and a database validation module. The tag verification module confirms product authenticity without exposing sensitive information, allowing customers to inspect tags securely. The database module ensures the accuracy of tag status and prevents the circulation of counterfeit products. However, RFID is generally more suitable for high-value items due to cost considerations.

Decentralized storage systems integrated with blockchain, such as IPFS combined with Ethereum and attribute-based encryption, address challenges in traditional cloud storage.

These systems allow secure and verifiable storage of digital content, including books, music, and other media, ensuring authenticity, originality, and integrity. Smart contracts and blockchain records provide reliable validation for uploaded content, which can be extended to any type of digital asset. To further enhance supply chain integrity, blockchain-based frameworks can support intelligent quality management and information resource management in distributed organizations. Counterfeit goods harm both revenue and brand reputation, making it essential to continuously update and strengthen authentication methods. Machine learning and image recognition technologies allow consumers to verify products using simple devices like smartphones. By capturing images of product packaging, logos, or accreditation marks, consumers can send requests to a server for processing and receive verification results. In cases of counterfeit detection, these systems can report findings to government monitoring platforms, such as the EU Safety Gate.

In summary, combining holograms, QR codes, RFID, blockchain, and machine learning provides a multi-layered approach to product authentication. Each technology contributes to ensuring product authenticity, preventing counterfeiting, and protecting both consumers and businesses. Holographic QR codes, implemented through computer-generated techniques, add an extra layer of security and provide a reliable method for verifying unique product IDs, enhancing trust and credibility in modern supply chains.

Keywords: Blockchain, QR Code, Hologram, RFID, Anticounterfeiting, Supply Chain Transparency, Product Authentication

III. PROPOSED METHODS FOR PRODUCT ANTI COUNTERFEITING USING BLOCKCHAIN

This paper presents a secure and comprehensive blockchain-enabled anti-counterfeiting system designed to protect products throughout the supply chain. In the proposed model, manufacturers register product and sales-related data on a blockchain platform, where the information remains transparent and accessible to all participants. This approach prevents vendors from manipulating sales records, as both the total number of items sold and the available inventory can be verified by users at any time.

The system allows consumers to perform real-time vendor-side product verification using the tools provided by the application, significantly reducing the risk of counterfeit goods entering the market. The overall system architecture, along with the user interface design, is illustrated in the system diagram to clearly explain the workflow and interactions among different components.

At present, there is no fully reliable solution to address the problem of product counterfeiting. Conventional identification techniques, such as barcodes, are easy to duplicate and fail to provide strong assurance of product authenticity. In contrast, blockchain technology has emerged as a powerful solution for securing and monitoring supply chains by maintaining immutable and tamper-resistant records. This enables effective tracking of products from manufacturing to sale, ensuring that consumers receive only genuine items.

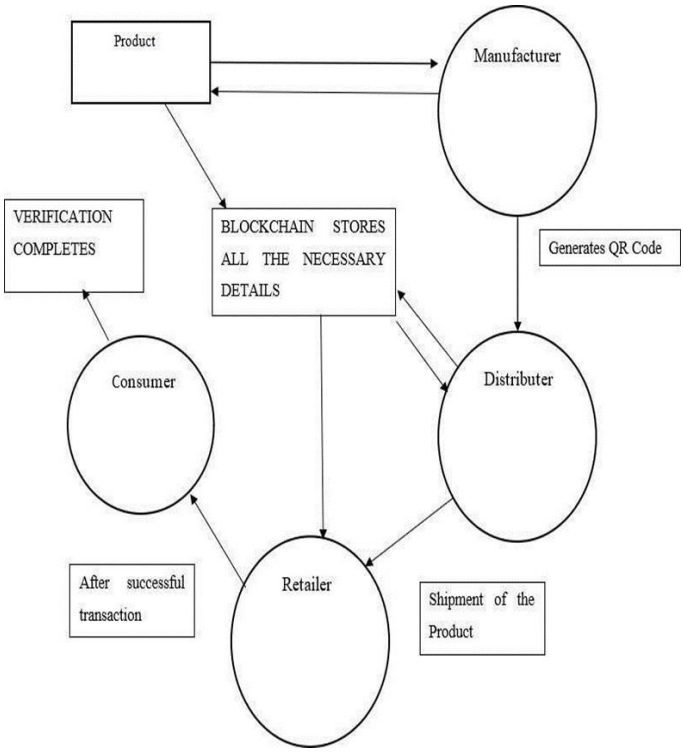

Fig 1: System Flow

The primary objective of this project is to help consumers easily identify whether a product is authentic or counterfeit at the time of purchase. The proposed solution is implemented as a distributed application (DApp) supported by a blockchain network developed using Hyperledger Fabric, an open-source blockchain framework. The network employs consensus mechanisms such as PBFT/DPoS to ensure reliability, security, and efficient transaction validation. By leveraging the key properties of blockchain—transparency, decentralization, and immutability—the system delivers a low-cost, efficient, and trustworthy anti-counterfeiting solution for manufacturers, sellers, and consumers.

Execution Stages:

Step-1: ProductRegistration

Manufacturers register each product on the blockchain by generating a unique digital identity. Product details such as batch number, manufacturing date, and origin are securely stored, ensuring immutability and authenticity.

Step-2: QR Code / Unique Identifier Generation

A QR code or unique hash is generated for every registered product. This identifier is linked to the blockchain record and is attached to the physical product for easy verification.

Step-3: Blockchain Data Storage

All product-related information, including production and sales data, is recorded on the blockchain ledger. Since the ledger is decentralized and tamper-proof, unauthorized modifications are prevented.

Step-4: Supply Chain Tracking

As the product moves through distributors and vendors, each transaction is updated on the blockchain. This provides complete traceability and transparency throughout the supply chain.

Step-5: Vendor Authentication

Vendors verify product authenticity before selling by accessing blockchain records. This prevents counterfeit products from entering authorized sales channels.

Step-6: Consumer Verification

Consumers scan the QR code using the B-SAFE application to instantly check product authenticity. The system retrieves blockchain data and confirms whether the product is genuine or fake.

Step-7: Fake Product Detection

If product information does not match blockchain records or has been previously verified, the system flags it as suspicious or counterfeit.

Step-8: Consensus & Validation

All transactions are validated through the blockchain consensus mechanism (PBFT/DPoS), ensuring data integrity and secure authentication.

Step-9: User Interface & Reporting

A user-friendly interface displays verification results and transaction history. Reports can be generated for manufacturers and regulators to monitor counterfeit activity.

3. CONCLUSIONS

This paper presents a blockchain-based framework designed to effectively prevent the circulation of counterfeit products. The proposed system operates as a fully functional authentication platform that allows users to verify product legitimacy without incurring any transaction fees. By using this framework, customers can confidently purchase items without the risk of receiving counterfeit goods.

The system enables end users to scan the QR code assigned to a product and instantly access detailed information such as ownership records and transaction history stored on the blockchain. Based on this transparent and immutable data, users can easily determine whether a product is genuine or fraudulent. As a result, the framework provides a reliable solution for identifying counterfeit items across the supply chain and enhances trust among manufacturers, sellers, and consumers.

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ABOUT THE AUTHORS

MR.OMKAR DESAI
Pursuing Poly (Co)
S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC)

MR.ROHAN CHAVAN
Pursuing Poly (Co)
S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC)

MR. ANIKET THOMBARE
Pursuing Poly (Co)
S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC)

MR.MOHIT GANDE
Pursuing Poly (Co)
S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC)

PROF. ANIL NAIK
HOD, Dept. of Computer Engineering
S.Y.P SHREEYASH COLLEGE OF ENGINEERINGAND TECHNOLOGY (POLYTECHNIC)