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Comparative Analysis of Fake Product Identification System Using Blockchain Technology

Abstract: - Fictitious products have emerged as a substantial challenge in the manufacturing sector, inflicting adverse consequences on a company's financial health, reputation, and overall prosperity. Thankfully, blockchain technology provides an effective remedy for discerning fake items and verifying the legitimacy of authentic ones, all within a decentralized and widely distributed digital ledger. Quick Response (QR) codes serve as pivotal tools in the fight against fictitious goods, as each product is now furnished with a QR code that acts as a direct bridge to the blockchain system, essentially bestowing each item with a digital identification card. QR code scanners communicate with the blockchain to promptly validate whether a product is genuine or fictitious. Moreover, customers can harness this technology to track a product's journey through the supply chain and authenticate ownership details, akin to a digital breadcrumb trail that securely preserves product information and unique codes as database blocks. Considering the globalized business landscape and the perpetual advancements in technology, industrial manufacturers and distributors are wholeheartedly committed to optimizing their supply chain processes, ensuring they remain one step ahead of fictitious product proliferation and fortifying their operations against the dissemination of spurious items. In this paper we compare Different Fake product identification Methods like Barcodes, QR Codes, RFID Tags, Serial numbers with methods using Blockchain technology which is having high security, transferability & traceability throughout Supply Chain.

Keywords: Hoax; Fake; Blockchain; supply chain

I. INTRODUCTION

In recent years, the global spread of ficticious goods has increased. There are several ficticious items in the current supply chain. According to the report, the prevalence of fake items has lately surged. It is critical to have a system in place that allows customers or users to check all product details in order to decide whether or not the item is genuine. In India, there is currently no procedure in place to detect fictitious goods.[1] As a result, the solution comprises a simple QR code-based identification that may aid the end-user or customers in scanning and authenticating the legitimacy of the goods using a smartphone. Counterfeiting and copying are risks linked with the global expansion of a technology or product, and they can hurt a company's brand, revenue, and client base.[2][3] The primary purpose of the project is to identify whether or not the customer's purchased goods is genuine. When it comes to dealing with these issues, there's the traditional supply chain on one side and innovative blockchain technology on the other.[4] The traditional supply chain, as it stands, is like a centralized hub where the company can manipulate data as they please. It’s not the most secure system. Fictitious goods and replicas thrive because they can exploit the popularity of the genuine ones. Detecting fake products has been a perplexing challenge for all parties involved in the supply chain. It's causing losses in sales and profits on a global scale, impacting industries such as textiles and pharmaceuticals. With the rise of e-commerce, social media, and online anonymity, counterfeiters have found it easier than ever to produce knockoffs, commonly referred to as fictitious products, which pose a serious threat to innovation and economic growth.[5]

Blockchain, on the other hand, is like a team effort. It's a network where everyone can verify the truth. Manufacturers can use it to ensure their customers receive genuine products, building trust and enhancing their brand's reputation [6]. In blockchain, every transaction is like a block, and each one is linked to the previous, forming an unbreakable chain. This means you can trust the data you see, unlike in traditional centralized systems, where data can be tampered with.

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Quick Response (QR) codes play a crucial role in our system to combat fictitious products. When a product's QR code is linked to the blockchain, a quick scan with a QR code reader can instantly tell you if it's genuine.[3] This system stores product information and its unique code as blocks in a database, checking it against the user's unique code in the blockchain. If they match, you get all the product details. If not, it raises a red flag that the product might be a fake. So, our article is like a roadmap for this decentralized application system built on the Ethereum blockchain. It simulates a real supply chain, ensuring that product ownership is securely documented on the blockchain. What's even more exciting is that this approach can significantly enhance the safety of online shopping. While RFID technology has been tried in the past, blockchain is better at addressing the security and privacy concerns that arise in this context.[7][8]

II. PROBLEM STATEMENT

In the ever-evolving world of technology and product development, we often find ourselves facing risks such as

forging and duplication, particularly in the case of fictitious goods. These issues not only jeopardize a company's reputation but also pose serious threats to the well-being of consumers. Identifying fictitious products has become a pressing challenge, impacting businesses globally. Countries like India are actively engaged in combatting this problem, and our proposed solution leverages Blockchain technology to create QR codes[9]. Within this innovative framework, trade records are securely stored in tamper-resistant blocks, and QR codes serve as a potent tool for promptly detecting fictitious products. This initiative is our response to a pervasive issue that affects businesses and consumer safety on a global scale. This framework is our response to a pressing issue that affects both businesses and the safety of consumers worldwide.

The inspiration for this project sprouted from the alarming surge in fictitious products flooding the market.

1. We’re crafting a cutting-edge anti-functions system empowered by blockchain technology.
2. Harnessing the simplicity and effectiveness of QR codes to safeguard essential product data.
3. Our top priority is ensuring our customers feel safe and secure by granting them access to critical information

III. EXISTING WORK

As we delve into the system described in "A Comparison Survey Study on RFID Based Anti-Hoax Systems," it's clear that the focus in recent years has shifted towards utilizing radio frequency identification (RFID) tags to combat the proliferation of fictitious objects.[7][8] This system operates by emulating a real-world scenario in which a subject examines products for duplicity through the use of RFID tags [10][7][8]. Among the various technologies explored for remote monitoring and detection, RFID and remote sensor networks have emerged as the leading choices. However, it's worth noting that RFID tags, much like the sensors, require a control signal and a power source to function effectively. In this setup, RFID employs low-frequency radio waves, a stark contrast to the laser-based technology found in certified tags, to pinpoint and record concrete evidence of tagged objects.[7][8] This innovative approach promises to enhance the way we tackle the issue of fictitious goods.

IV. METHODOLOGY

To create this system, we used a combination of practical tools and technologies. We kicked things off with the XAMPP server, which offers a user-friendly interface through phpMyAdmin for efficient database management. To make our blockchain work, we implemented a PHP-based proof-of-work system and leveraged the MetaMask cryptocurrency wallet to interact with the Ethereum blockchain. For local blockchain development, we employed the powerful Ganache tool and the Remix IDE to run our Smart Contract Program.

The setup process involves launching Ganache and setting up a MetaMask account. Then, we accessed the accounts tab in Ganache to grab a private key from one of the accounts, which we pasted into the import section. This private key is essential for signing and authorizing transactions. With that in place, we dived into the Remix IDE to write the Smart Contract code, saved it, and assembled the code. We chose the Injected Web3 environment and deployed it. Next, we copied the ABI and the contract address into the app.js file. To get everything up and running, we fired up the XAMPP server, ensuring that the htdocs folder contains our project directory. We utilized

PhpMyAdmin to craft and execute SQL queries, setting up the necessary database. Finally, we accessed the decentralized shopping platform through the localhost URL.

In this innovative system, manufacturers take on the crucial role of adding their firm to the blockchain, registering their business, and determining the minimum registration fee for potential buyers and sellers. Manufacturers are the gatekeepers, holding the authority to include products in the network. They also manage product ownership and oversee the distribution process when a seller acquires product stock. Their core responsibilities involve product addition and distribution, facilitated by Algorithm 1.

For vendors looking to join the platform, a straightforward registration process involves paying the manufacturer's reasonable registration fee. This registration is a one-time effort, granting merchants the ability to purchase items and oversee their delivery. As a product moves from the manufacturer to the seller, its status transforms from "Ready To Go" to "Shipped."

Customers play a pivotal role in ensuring the authenticity and ownership of products. They can use the QR code that comes with each product to verify the transfer of ownership from the manufacturer to the merchant. This empowers customers to stay informed about product ownership and distribution status.

Blockchain technology is introducing exciting possibilities for redefining the way, we manage supply chains. It operates on a decentralized network, where every node holds a complete copy of the blockchain database. This network can effectively track, share, and secure various aspects of supply chain management, including orders, payments, accounts, and product pricing.

Let's dive into the key features of blockchain technology in supply chain management:

1. Enhanced Traceability: Blockchain allows for the creation of a tamper-proof, transparent ledger of all transactions and events in the supply chain. Every step, from production to distribution, is recorded, making it possible to trace the journey of a product with utmost accuracy. This not only aids in identifying and isolating fictitious products but also helps in quality control and recalls.

2. Streamlined Compliance: Supply chains often involve multiple stakeholders and complex regulatory requirements. Blockchain simplifies compliance by automating processes through smart contracts. These self-executing contracts ensure that each party involved follows the necessary regulations, reducing errors and disputes, and ultimately ensuring product authenticity.

3. Improved Efficiency: Traditional supply chain processes can be marred by inefficiencies, delays, and paperwork. Blockchain optimizes these operations by reducing paperwork, streamlining transactions, and improving inventory management. As a result, manufacturers, vendors, and customers benefit from a more efficient and cost-effective supply chain.

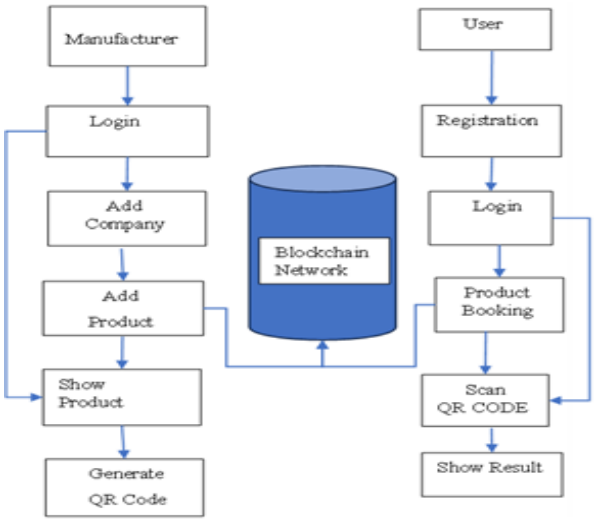

Fig 1.a: System Architecture

In our approach, we utilize the Ethereum Blockchain's Rinkeby Test Network to implement smart contracts and the MetaMask cryptocurrency wallet for seamless transactions. The system involves three primary parties: the manufacturer, the vendor, and the user.

The system's basic design, as shown in Ethereum Application Framework Fig.1.a, features a user interface created using ReactJS. When a user interacts with the smart contract, the DApp leverages Web3.js, which communicates with MetaMask via its provider. MetaMask utilizes the user's private key to generate and sign a transaction, which is then transmitted to the Ethereum network. The transaction undergoes validation and is added to a network block, ensuring that users can safely engage with the network without their private keys being compromised at any point during the process[6].

This innovative technology opens up exciting possibilities for supply chain management, promoting security, decentralization, and transparency.

V. RELATED WORK

A number of scholars have put out several strategies for setting up a supply chain management system based on blockchain.[10] One of them demonstrated a solution for identifying fake goods using an Android application that allows users to search for goods on the Blockchain network. Another article demonstrated a blockchain-based method for detecting phoney products that uses the SHA-256 algorithm to identify a product[11].

There used to be no reliable method for distinguishing real from fake goods. Blockchain technology has the potential to help with these problems. Helping consumers distinguish between genuine and fake products is the main goal of the initiative.

Our blockchain-based false product detection system was offered as a web application for the detection of counterfeit products. The proposed method ensures that fake items are recognized in day-to-day activities. Three main parts comprise the proposed system: a cloud or database, a web application for the maker or business, and the same web application for the customer or consumer.

The initial application that requires registration is the Manufacturers or Corporate Side application. After registering, we have a number of options for login into the program. A product where the manufacturer may add information about the product is one option. An alternative option would be to present the order so that they may examine the details of the clients' requests and decide whether or not to accept them. It is also possible for the manufacturer to verify if the products were delivered.

The Customer application is a secondary program that mandates in-app registration prior to allowing users to authenticate using an ID and password. Users are granted the capability to peruse product details within this application, encompassing product name, total quantity, price, and manufacturer information. Upon entering the product quantity, users can proceed to book the product. The application also features a "display my order" function, allowing users to review their orders, including product details such as name, quantity, date and time of order, price, and delivery status. Additionally, the program incorporates a QR code scanner, enabling users to authenticate the legitimacy of a product by scanning its QR code. An alternative verification method is the utilization of blockchain technology, revealing information such as the block's name, product quantity, generated hash value, and the product's integrity status.[4]

The application for this project requires the customer to log in. He signs on and provides the details required to place the order and hold the product. The product's order may be displayed to the producer. decides whether to approve or reject the product request. After receiving the order, the manufacturer generates the unique QR code for the product. A hash code is generated for each product when it is saved on the network, facilitating simple tracking of the product's transaction. Under the suggested technique, a QR code is generated for a particular product. Consumers can scan the QR code printed on a product or packaging using a customer application or the QR code reader app on their smartphone. We can determine if the things are genuine or not after scanning. The Blockchain system eventually keeps these product details together with a history of transactions to track the items along the supply chain. All of the product details, including block name and hash value, are contained in the Firebase Cloud Database[6].

VI. RESULTS

The Created DApp has 4 parties including the manufacturer, the Retailor, the distributor and the user or the consumer.

All these parties have their own set of a authorities that they need to take care of and update on regular basis. The manufacturer has the responsibilities of adding the product in the blockchain and later on the distributor and the retailors update the same data on the successful arrival of the product and at last the user can check its product validity using the QR code of the product. The snapshot for the same are represented below:

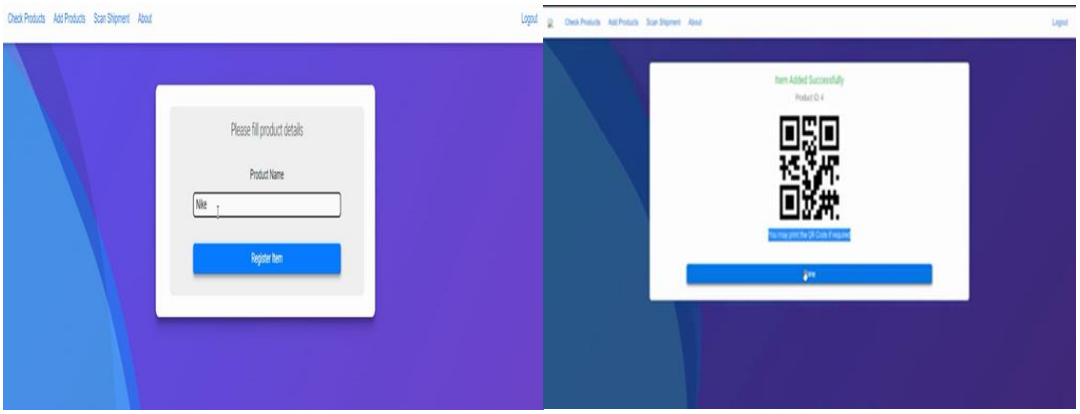

fig 2a. Adding new item **fig 2b. QR generation**

Manufacturer has the accessibility of adding products with unique id and based on that id a QR is generated which could be used for physical contact with the product shown in Fig 2.a.

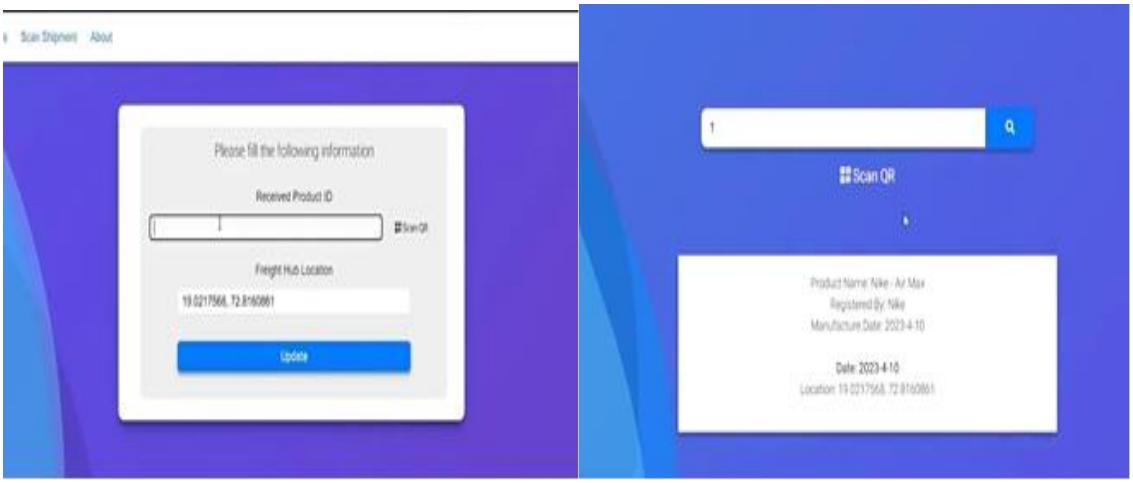

fig 3a. Updating Location **fig 3b. Product details**

Along with Manufacturer, Retailors, distributors and even the consumer can scan and get the information about the product stored by the manufacturer to check its authenticity.

Product details can be obtained by all the users but it can only be updated completely by manufacturer and partially by retailors and distributor in terms of location. Location of the product can be manipulated by the retailor and distributor on arrival of the product using its id or QR. This makes the product transparent throughout its course making it more trustworthy.

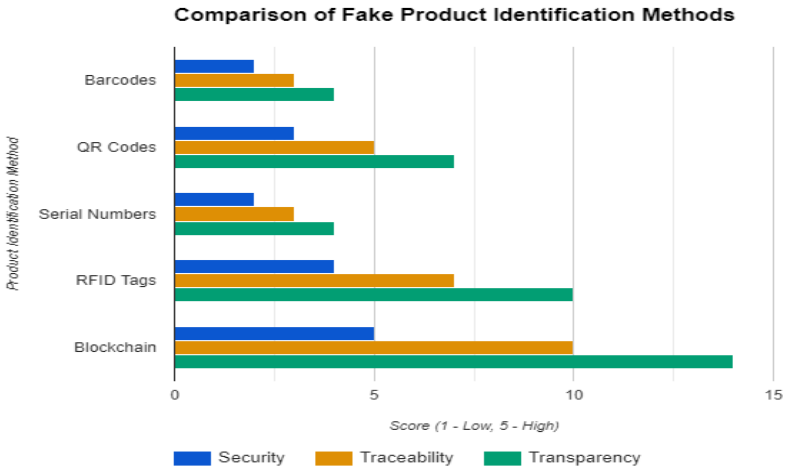

fig 4. Comparison Chart

The chart in Fig.4 visually emphasizes the limitations of traditional methods and highlights the significant advantages offered by blockchain technology. Its decentralized nature, enhanced security features, and improved supply chain transparency position it as a revolutionary tool in the fight against counterfeiting

Table 1. Comparison Table

System	Description	Advantages	Disadvantages	Cost	Scalability	Data Ownership	Auditability	Sustainability
Barcodes (UPC, EAN, etc.)	Most common system, uses optical scanners to read a series of lines	Low cost - Widely adopted - Easy to scan	Limited data storage - Not unique (same code for multiple items) - Prone to counterfeiting	Low	High	Centralized	Low	Low
QR Codes	Two-dimensional barcode that can store more data than traditional barcodes	More data storage - Can link to webpages for detailed information	Requires smartphone scanner or dedicated reader - smaller scanning area	Low-Medium	Medium	Centralized	Low	Low
RFID Tags	Radio Frequency Identification tags,	Faster reading than barcodes - Can	Higher cost compared to barcodes - Requires	Medium-High	High	Centralized	Medium	Medium

	use radio waves to transmit product data	track location in real-time - Can be rewritten	special reader equipment - Susceptible to interference					
Serial Numbers	Unique identifier assigned to each individual product	Enables item-level tracking - Useful for warranty and recall purposes	Manual data entry prone to errors - Difficult to track through supply chain	Low	Medium	Centralized	Low	Low
Product Identification using Blockchain	Distributed ledger technology for secure and transparent product data storage	Enhanced security and tamper-proof data - Improved traceability throughout supply chain - Increased transparency for consumers	Relatively new technology, not widely adopted yet - Requires integration with existing systems	Varies (depends on platform)	High	Distributed	High (Immutable record)	Potentially higher due reduced need for physical verification

Through the above table it is very clear that while some traditional methods offer some level of security, blockchain technology provides a more comprehensive and tamper-proof solution for identifying fake products. Its decentralized nature, immutable records, and increased transparency make it a revolutionary tool in the fight against counterfeiting. Table 1 clearly compares the use of Blockchain and other possible ways in solving the problem along with its advantages and disadvantages.

VII. 7. CONCLUSIONS

The range of products available on the internet has led to a significant increase in the sale of fictitious items. As a result, it is imperative to identify fake items, and blockchain technology is used to do this. Furthermore, a QR code containing the data has been generated. Once the QR code is scanned, customers or consumers may recognize a phony product. Product-related digital data may be stored as blocks in blockchain technology. In order to combat the malpractices of product Hoax, we have examined the system and its solution in this article. We have also supplied end consumers with a useful way for determining the authenticity of a product by looking at its history throughout the supply chain. End customers may confirm the legitimacy of the products by scanning the QR code linked to it to see all the data that has been published to the blockchain throughout the supply chain.

The ownership tracking system is changing due to distributed ledgers based on blockchain technology. The rapid growth in the e-commerce and commercial sectors is influencing current supply chain patterns. It is safe to utilize the DApp developed here for e-commerce, since it ensures greater openness in supply chain management. This method eliminates complicated procedures and administrative costs. Furthermore, huge chain stores can save a substantial amount of money because each product in the proposed model only costs 0.000209 ether, or 0.65 US dollars, to register. Additionally, the model has an end-user QR code verification mechanism, and Etherscan may be used to verify transactions. Subsequent development of the proposed model can improve the services provided and raise the reliability of supply chain management..

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