Fake Product Identification using Blockchain

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Abstract-

Both consumers and the industrial sector are being negatively impacted by the rise in counterfeit goods. The poll indicates that there has been a rise in the use of counterfeit goods in recent years, which has hurt sales, profitability, and brand reputation. Instead than lessening a business's capacity to generate revenue, counterfeiting damages consumers' confidence in the products they purchase on the open market. Without adequate tracking and security protocols, customers eventually lose faith in brands' ability to protect them from theft.

This is occurring as a result of the manufacturing and distribution processes being concealed from customers, making it simple for outsiders to alter or fabricate the information. Therefore, consumers need a way to tell whether a product is real or not. The paper suggests a blockchain-based anti-counterfeiting system for supply chain-wide product traceability. All of the data from the supply chain will be recorded in the blockchain network as immutable, transparent, secure, tamper-proof, and trustworthy blocks by using public or permissionless blockchain.

Keywords - Keywords— Fake product, QR code, Blockchain,

Supply Chain.

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1. INTRODUCTION

Product counterfeiting is a kind of consumer fraud where a product is marketed under false pretenses of being something else. It's an expanding global problem that is affecting many different industries. The apparel, FMCG, and automotive sectors are where it is most prevalent, followed by the agrochemical, durable goods, and pharmaceutical sectors.Furthermore, counterfeiting suppresses innovation across a range of businesses and industries.

The selling of fake items discourages creators and impedes the sale of genuine goods.

As to the Authentication Solution Providers Association (ASPA) research, approximately 25-30% of the products offered in the nation are fake or spurious, and nearly 27 percent of buyers are unaware that the products are fake when they make a purchase.

This study suggests an anti-counterfeiting method to follow the product through the supply chain. With this system, any buyer can use the QR code printed on the product to verify its authenticity.[2][3] Blockchain, a distributed, decentralized network that ensures system transparency and trustworthiness, is utilized for this.[4] A unique identity may be assigned to each product in the supply chain, making every product unique. Blockchain also offers the capability of authenticating and testing products. Once data is saved in the blockchain network, it cannot be edited or changed.[5] It is simple to track out the history of any product to determine its authenticity.

II. BLOCKCHAIN OVERVIEW

The proposed solution uses a blockchain-based platform for decentralized blockchain technology for product identification and counterfeit protection. Its four main components are data analysis, traceability, product authenticity, and counterfeit protection.[7] It is possible to give each product in the blockchain network a unique identity by giving it a digital identity.

When this distinct identification is connected to the product details, tracking back becomes incredibly simple.

the product's uniqueness. Additionally, this offers a real-time view of the movement of items.[8]

Blockchain may incorporate a number of authentication methods into a product's blockchain record, including barcodes, digital signatures, and unique identifiers like QR codes [9]. It can also be connected with IOT devices.

It encourages confidence and collaboration among those engaged in anti-counterfeiting activities. Everyone involved can share data in real time by using a shared blockchain network. Because of this cooperative and collaborative approach, counterfeit cases can be identified and responded to more quickly, leading to more effective enforcement measures. [2] Intellectual property rights are safeguarded by maintaining ownership, trademark, and copyright records on the blockchain. This generates a verifiable and impenetrable record of ownership in addition to stopping the unauthorized use of intellectual property and the manufacture of counterfeit goods.

Reference 10 Therefore, blockchain might be the most effective anti-counterfeiting mechanism.

A novel method of combating fraudulent product identification that makes use of blockchain technology is called blockchain-based classification. A distributed ledger technology called blockchain makes it feasible to store data in an unhackable, transparent, and safe manner. Blockchain is used in the context of counterfeit product identification to track the origin of commodities along the supply chain.[11]

Text or picture analysis is a common technique used in traditional fake product identification methods to identify counterfeit goods. Machine learning algorithms are trained on a dataset comprising images of authentic and counterfeit

products. When a new image is presented to the model, it decides whether it is real or fake based on how closely it resembles those in the training dataset. Text analysis models are trained on a dataset that contains text descriptions of actual and false products. Based on how much a new text description resembles the text descriptions in the training dataset, the model decides whether it is authentic or fraudulent.

There are a number of benefits when comparing blockchain-based classification to conventional fake goods identification techniques. First, blockchain-based classification offers more security. Since blockchain is an impenetrable technology, no modifications can be made to the data kept on it. Because of this, it is harder for counterfeiters to create fake goods that appear to have a genuine origin. Second, BC-based classification offers more scalability. Blockchain allows for the provenance tracking of millions or even billions of things.

technology. Thus, it can be applied in large supply chains. Third, blockchain-based classification yields more accuracy. Image recognition and text analysis models are fooled by counterfeiting organizations because they may create commodities that closely resemble real objects. Blockchain-based classification is less susceptible to this form of fraud since it is data-driven.[12]

It is important to consider the disadvantages of blockchain-based product authentication. Scalability problems arise as the blockchain grows, leading to more costly transactions and slower processing times.

Exorbitant implementation expenses could deter uptake even more. It is challenging to achieve interoperability between different blockchain networks because of differing protocols and standards. Security issues put users at risk because they allow hackers to change or remove data on the blockchain. [13] The intricacy of the adoption process, which necessitates certain knowledge and skills, is another obstacle. Despite these challenges, work is being done to address them and enhance the functionality of blockchain to prevent counterfeiting.

2. LITERATURE REVIEW

A Blockchain-Based Application System for Product Anti-Counterfeiting, Jinhua Ma, Xin Chen, and Hang-Min Sun, 2020. Ethereum serves as the back-end Blockchain operating system for the suggested system, while Solidity, Ethereum's in-house high-level programming language, is used to create smart contracts. Solidity facilitates the import of libraries and inheritance. Ethereum Virtual Machine is the target audience for Solidity (EVM). Solidity's script offers loops and is Turing complete, in contrast to Bitcoin's script. [1].

The distributed application's code simplicity has a direct impact on the overall cost of operating it on the Ethereum public chain. This system's future performance may serve as evidence of its simple code. Because of the distributed application's simple design and lack of redundant code, the user can have confidence .

2]. Shovon Paul, Shaila Sarkar, and Jubair Joy, "Using Social Media to Identify Fake News" Blockchain, 2019. RFID-based anti-theft and anti-counterfeiting programs are appropriate for large-scale

application in settings related to retail. The suggested plan is simple to execute and works well with inexpensive passive RFID tags. The anti-counterfeiting protocol developed by Tran and Hong is applied. DOS assaults cannot harm this machine. An explanation of SCM trends is provided by Habib and Sardar et al.[2]. They look at how they operate and find that transaction problems and executive challenges are SCM issues. so suggested a remedy, SCM, taking into account the blockchain as a technology element to address problems. The transaction procedure should be located at the plan level as the main approach for designing new models.

Low-cost RFID tags can be used in an RFID-based system to automatically identify products, but this approach is not appropriate because RFID tags can be copied. CNN uses greater memory and processing power in AI and machine learning applications. Prior to real deployment, a training and testing phase is required. Artificial intelligence is unable to recognize tag reapplication assaults, in which a counterfeiter takes a valid tag off of an authentic product and reapplies it to a fake or out-of-date product. Customers, retailers, and retailers have no authority to verify the authenticity of the product. [3]. "Blockchain-Based Fake Product Identification in Supply Chain," Ajay Funde, Pranjal Nahar, and Ashwini Khilari, 2019.

The suggested method uses a QR code to identify counterfeit goods. Customers can obtain product data and transaction history by scanning the QR code linked to the product. They can also obtain information about the stages involved in product enrollment, shipping the product to a distributor, and shipping it to a store [3].

Each node in a blockchain-based system stores data, which is subsequently shared throughout the nodes via the network. All Blockchain data is maintained by each node.

Based on its own Blockchain data, the node checks the received transactions, adds them to the new block, and attempts to acquire the privileges of the new block. Keep pertinent data about product sales in blockchain, which is open to all users. It is economical. This article suggests using blockchain technology to share information. The data is within the authority of the owner, making it challenging for outsiders to meddle. Users are continuously conscious of the information being gathered about them and its intended use. Sender, amount, recipient, transaction id, product id, and metadata are all contained in the blockchain block. An open-source blockchain is called Ethereum. Ethereum is the platform that powers applications, international payments, and digital currency. The steps are as follows: open the interface, select a wallet to connect to Ethereum and manage your money, Acquire Ethereum, utilize its apps, and begin developing.

[4]. A Blockchain-based Supply Chain Quality Management Framework, Si Chen, Rui Shi, Zhuangyu Ren, and Jiaqi Yan, 14th IEEE International Conference on eBusiness Engineering, 2017.

Si Chen, "A Blockchain-based Framework for Supply Chain Quality Management." We provide a blockchain-based paradigm in this study. This framework will offer a theoretical foundation for supply chain quality management that is intelligent and powered by blockchain technology. Moreover, it offers a framework for the development of theories on the management of information resources in dispersed, virtual companies.[4].

SCQI is explained by Chen and Shi et al. Structure for blockchain-based Theoretically, supply chain intelligent quality management based on blockchain 7 technology is supported by SCQI. RFID technology is utilized to capture trans-actional and quality information. Quality control and other tasks are carried out by smart contracts.

[5] M. Nakasumi, "Block chain-based information sharing for supply chain management" chain technology, IEEE Business Informatics Conference 19th (CBI), 2017.

In order to guarantee authentic product identification along the whole supply chain, functional .The usage of blockchain technology helps to stop the counterfeiting of goods. Blockchain technology eliminates the need for customers to rely on reliable outside parties to determine the product's safe source. In this work, a barcode reader is used to identify counterfeit goods by connecting the product's barcode to a Blockchain Based Management (BCBM) system. Therefore, product information and its unique code might be stored as database blocks using the suggested technique. It obtains the customer's unique code and compares the This essay illustrates a practical and contemporary phenomena utilizing the

High levels of security and transparency are provided by supply chain and blockchain technology, but to enhance these qualities, some additional aspects are added in this study, which uses One Time Password (OTP) authentication to verify the legitimacy of supply chain participants and products, as well as to update product details in the blockchain upon sending them to the subsequent supply chain stage. Additionally, the Quality Control Officer, who is assigned by the factory in charge for the same, keeps an eye on the standards of the products. Drawing inspiration from relevant research, scientists have created a variety of innovative models that have greatly aided the community in preventing the counterfeit of products in different industries.

So, the proposed system may be used to store product

details and the unique code of that product as blocks in the database. It collects the unique

code from the customer and compares the code against entries in the blockchain database.

If the code matches, it will give a notification to the customer, otherwise it gets information from the customer about where they bought the product to detect counterfeit product manufacturers.

3. METHODOLOGY

a. System Architecture

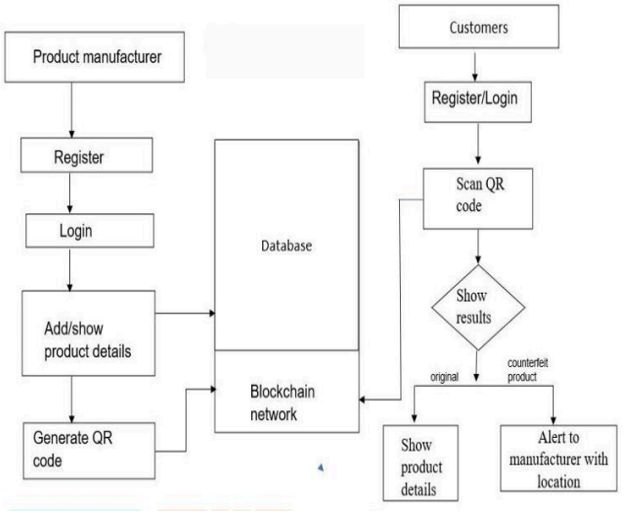


Fig. System architecture

The recommended blockchain-based approach for spotting counterfeit goods is made up of multiple components that cooperate to ensure a product's genuineness. The product maker, blockchain network, nodes, smart contracts, retailer, and client are some of these constituents. The suggested work on blockchain-based counterfeit product identification has ledgers that are made to allow tracking of the flow of goods along the chain of supply.

This will make it simpler to identify phony products and prevent them from entering the market.

Product information, which consists of the product's name, batch and serial numbers, manufacturing and expiration dates, and other pertinent data, is used to create ledgers. The ledger is used to monitor the flow of goods. the starting point, final destination, and any stops in between for the goods. Products can have unique IDs made for them by manufacturers, which can subsequently be used to monitor product movement in the supply chain.

After the product is manufactured, its unique identification code is used to generate a unique QR code. This unique QR code, along with the product's unique identification code, price, manufacturer, and transaction history, are all stored in the decentralized ledger that the blockchain

network serves as. Nodes—individual computers or devices that participate in the blockchain network and validate transactions—store a copy of the blockchain.

To verify a product's legality, a smart contract is utilized to look up its unique identification number and transaction history.[15] Retailers can accomplish this by searching the ledgers or scanning the product's unique identification number to view its transaction history on the blockchain. [16] Before offering a goods to a customer, retailers are responsible for verifying its legality. The final users of the goods, the customers, can verify its authenticity by scanning its unique identification code and seeing its transaction history on the blockchain. Use Case Diagram which shows various use cases and different types of users the system has. The use cases are represented by either circles or ellipses. The actors are often shown as stick figures. Use Case diagram is helpful in exposing the requirements and planning the project during the initial stage.

The below table shows all the types of events and transactions that invokes smart contract.

TABLE I. Types of events and transactions

Name of Component	**Type**	**Job**
New product is added	Transaction	Add new product with detail such as manufacturer id, Product SN, Product Price, Product name, Product Brand
Add new seller	Transaction	Add new seller with details. e.g. Seller name, seller code, seller manager, manufacturer ID, seller Brand, Seller phone no., seller address
Sell product to seller	Transaction	Scan an image file of QR code, enter seller code
Sell product to consumer	Transaction	Scan an image file of QR code, enter consumer code
Verify products	Transaction	Scan an image file of QR code, enter consumer code
Share product verification result	Event	Share verification result, that the productis authentic or not

b. Smart contract

The addProduct function adds a new product to the blockchain and stores its details, such as the name, brand, price, availability status, and serial number, in the productItems mapping.

function addProduct(bytes32 _manufactuerID,

bytes32 _productName, bytes32 _productSN,

bytes32

_productBrand,

_productPrice) public {

uint256

productItem memory newProductItem =

productItem(productCount,

_productSN,

_productName, _productBrand, _productPrice,

"Available");

productItems array productMap[_productSN] = productCount;}

The second function, addSeller, populates the sellers mapping with the information of newly added merchants to the blockchain.

The seller code is additionally added to the list of sellers for the designated manufacturer ID in the sellersWithManufacturer mapping. By adding the product serial number to the seller's list of products sold and designating the seller code as the product's current owner, the third function, manufacturerSellProduct, allows the manufacturer to sell a product to a specific seller.

sellersWithManufacturer[_manufacturerId].pus

h(_sellerCode);

The

fourth

function,

sellerSellProduct, is used to sell a product to a

consumer.

productsWithSeller[_sellerCode].push(_produc

tSN)

To verify a product's legality, a smart contract is utilized to look up its unique identification number and transaction history.

c. Backend Technologies

Solidity is a programming language used for developing smart contracts on the Ethereum blockchain. [17] It was applied when creating the phony product identification system. The front-end construction of the web application that communicates with the blockchain, gathers user data, and shows the outcomes of the product verification procedure uses JavaScript. The web application interface's design and layout are made using HTML and CSS.

A JavaScript package called Web3.js offers an interface for communicating with the Ethereum blockchain. Additionally, Node.js is an open-source, cross-platform JavaScript runtime environment that makes it possible to create server-side applications that are highly performant and scalable.

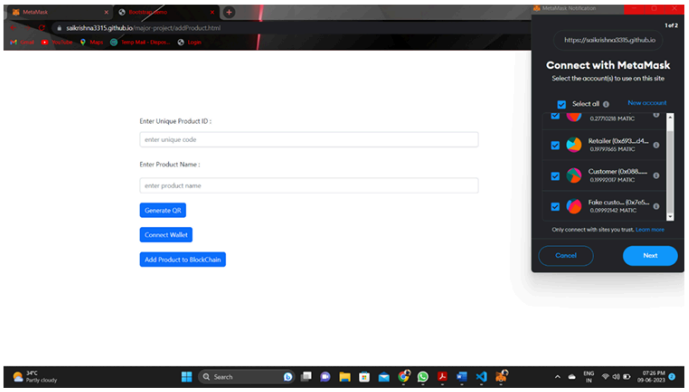
d. Development environment

To store transaction and product data, the Ethereum blockchain is used which offers a secure transparent ledger. MetaMask, a browser extension, is used to interact with the Ethereum blockchain and manage user accounts. Users can store, manage, and transfer Ethereum and other ERC-20 tokens using MetaMask as a wallet. It gives users safe access to and interaction with the Ethereum network.

Ganache is a local blockchain development environment that is used for testing and debugging smart contracts. Developers can test their smart contracts in a simulated setting using Ganache's local blockchain environment before uploading them to the Ethereum blockchain.

The Truffle suite is used to write, test, and implement smart contracts on the Ethereum network. The creation, testing, and deployment of smart contracts can be streamlined with the help of the Truffle development framework, which speeds up the creation of Ethereum-based apps.

V. RESULTS



The above Figure 5.2 shows, how we connect to the MetaMask wallet when we click on the connect wallet button from create new product page.

After that, clicking next in the Metamask prompt, makes you connect to the Metamask wallet.

It will generate a connected successfully prompt For the generating the QR Code of the product, we should enter product id and name then press .This will generate QR code.

After generating the QR, we should add it to the Blockchain, when we click on Add product to Blockchain button, again a metamask prompt appears to confirm .

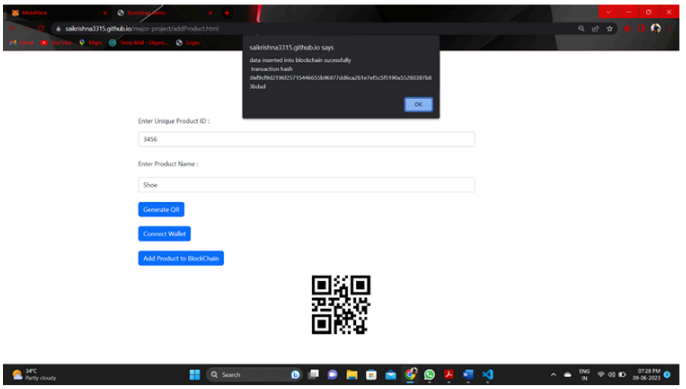


Figure 5.6 Successfully added the product to the Blockchain

We can get details of the product from get details screen, which ask you scan the QR. After that it fetch the complete details of the product like id, name, current owner address and product holder .

We can transfer the product from transfer product screen, by clicking transfer ownership button, which again prompts you to confirm in MetaMask and it generates a alert of successfully transferred .

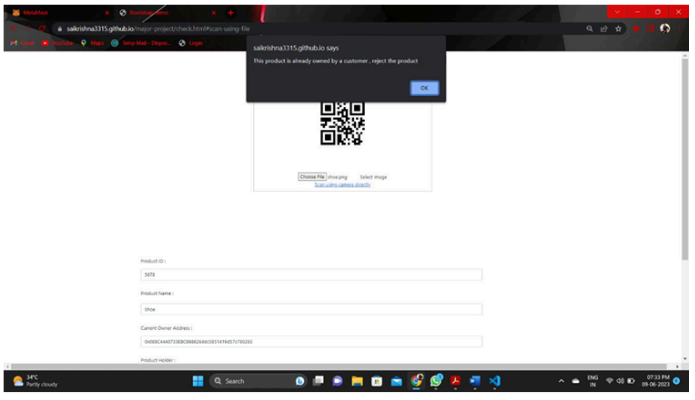


Figure 5.10 Fake product alert

After transferring the product, we can validate the product whether it is fake or original in authenticate product screen. If it is fake, it will generate a alert as shown in Figure 5.10 and if it is original, it will generate alert .

Table II. Transaction and execution n costs per function

Function	**transaction cost**	**execution cost**
addSeller	401586	323162
viewSellers	646893	550581
addProduct	398742	320762
viewProductItems	510143	510143
sellerSellProduct	404334	326362

Table 2.

These results Table 2. represent the costs associated with executing each function or the entire program on the blockchain. The transaction cost refers to the cost of executing the function in terms of gas consumed in the blockchain network. The execution cost indicates the computational resources used during the function execution. And transaction cost for the entire program is 2000809, and execution cost is 1808105.

VI. CONCLUSION

Establishing a strategy for identifying counterfeit products is a crucial measure in guaranteeing consumer security and safeguarding companies' reputations. The accuracy and effectiveness of such a system can be considerably increased by utilizing cutting-edge technology like blockchain and QR codes. When there are multiple levels of identification and verification, counterfeiters find it more difficult to produce phony goods that could deceive customers. Additionally, the technology can help businesses trace their products along the supply chain, enabling them to identify and address any possible issues. All things considered, putting in place a system for identifying counterfeit products can benefit companies as well as customers and is a necessary investment in the current global economy.

The system could be extended to incorporate digital signatures involves using cryptographic techniques for the QR code to create a more secure and tamper-proof QR code authentication system. It would be possible to develop a system that gives even greater transparency and accountability by utilising the immutable characteristics of blockchain technology, making it increasingly harder for counterfeiters to produce fake goods.

Consumer Protection: Blockchain can provide consumers with a secure and transparent way to verify the authenticity of a product. This can help build trust between brands and consumers, and ensure that consumers are not unknowingly purchasing counterfeit products.

REFERENCES

[1]. Jinhua Ma, Xin Chen, hung-Min Sun, “A Blockchain-Based Application System for

Product Anti-Counterfeiting”, 2020.

[2]. Shovon Paul, Jubair Joy, Shaila Sarkar, “Fake News Detection In Social Media using

Blockchain”, 2019.

[3]. Ajay Funde, Pranjal Nahar, Ashwini Khilari, “Blockchain-Based Fake Product

Identification in Supply Chain”, 2019.

[4]. Si Chen, Rui Shi, Zhuangyu Ren, Jiaqi Yan, “A Blockchain-based Supply Chain

Quality Management Framework”, 14th IEEE International Conference on e-Business

Engineering, 2017.

[5]. M. Nakasumi, “Information sharing for supply chain management based on block

chain technology”, IEEE 19th conference on business informatics (CBI), 2017.

[6]. J. Leng, P. Jiang, K. Xu, Q. Liu, J. L. Zhao, Y. Bian, and R. Shi, Makerchain: A

blockchain with chemical signature for self-organizing process in social

manufacturing," J. Cleaner Prod., vol. 234, pp. 767-778, Oct. 2019.

[7]. N. Alzahrani and N. Bulusu, ``Block-supply chain: A new anti-counterfeiting supply

chain using NFC and blockchain," in Proc. 1st Workshop Cryptocurrencies Blockchains

Distrib. Syst. (CryBlock), 2018, pp. 30-35.

[8]. M. Rosenfeld. (2012). [Online]. Available: https://bitcoil.co.il/BitcoinX.pdf

[9]. S. Matthew English and E. Nezhadian, ``Application of bitcoin data-structures & design

principles to supply chain management," 2017, arXiv:1703.04206. [Online]. Available:

http://arxiv.org/abs/1703. 04206

[10]. F. Tian, ``An agri-food supply chain traceability system for China based on RFID &

blockchain technology," in Proc. 13th Int. Conf. Service Syst. Service Manage.

(ICSSSM), Jun. 2016, pp. 1-6.

[11]. S. Shepard, RFID: Radio Frequency Identification. New York, NY, USA: McGraw

Hill, 2005.

[12]. Q. Lu and X. Xu, ``Adaptable blockchain-based systems: A case study for product

traceability," IEEE Softw.,vol. 34, no. 6, pp. Nov./Dec2017.