Fake Product Identification using Blockchain

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***Abstract*—Manufacture and sale of counterfeit goods has been plaguing several business sectors for many years. The production of counterfeit goods are increasing, this has an impact on the sales and earnings of the businesses. By stifling revenues, economic growth, and consumer health, it has an impact on governments, global trade, businesses, and consumers. The current technology used for combating counterfeit goods rely on a centralised authority. Issues with this design include single point processing, failure, and storage. Blockchain technology has can be used as an alternative to address all these issues for these problems [12].**

We can use Qr code with a blockchain hash code to uniquely identify every single product that ever enters the supply chain, hence no fake product can flood the supply chain.Ethereum blockchain is utilized and smart contracts are deployed to store the data about each and every product. Each products whole history can be tracked by using its QR code.

***Index Terms*—Blockchain, Ethereum, smart contract, QR code.**

I. Introduction

This paper aims to use blockchain technology to create a secure and transparent system for tracking and verifying the authenticity of products throughout the supply chain. Each product is given a unique identifier that is stored on the blockchain, allowing customers and stakeholders to trace the product's journey from manufacturer to consumer and verify its authenticity.

A. Block Chain

Blockchain is a decentralized ledger, which is considered to be the most advanced among all other decentralized ledgers [8].

i Blockchain technology provides several unique features that make it a suitable solution for various applications, including fake product identification systems.

ii The main advantage of blockchain is Its distributed ledger is tamper-proof, providing a high level of security against data manipulation.

iii Blockchain technology is decentralized, meaning there is no central authority controlling the network.

iv Transactions on the blockchain are visible to all network participants, ensuring transparency and traceability.

Overall, blockchain technology provides a security, transparency, and efficiency . By leveraging the unique features of blockchain, businesses and consumers can benefit from a reliable and trustworthy system for identifying fake products.

B. Consensus Protocol

Consensus algorithm in blockchain is a method used to ensure that all nodes in a decentralized network come to an agreement on the current state of the ledger [9]. This is achieved through a process of validation and verification, where nodes compete to solve a complex mathematical problem. The first node to solve the problem is rewarded with newly created cryptocurrency, and the solution is then added to the blockchain, which updates the ledger and ensures that all nodes have the same copy of the network [8].

The SHA-256 algorithm is a cryptographic hash function used to generate Blockchain blocks. It is simple to validate but challenging to reverse-engineer since it takes an input data and generates a fixed-size output that is specific to that input. This algorithm is employed in the process of mining bitcoins, where miners compete to discover the best hash by solving a challenging mathematical problem. Miners compete to figure out a solution to a challenging mathematical issue. Finding a hash that satisfies these requirements is required. The blockchain refreshes the ledger and makes sure that every node has the same copy of the network after a miner adds a solution to it.

C. Ethereum

Ethereum is a decentralized, open-source blockchain platform that enables developers to build decentralized applications (DApps) [3]. Smart contracts, which are self-executing contracts with the terms of the agreement explicitly put into code, can be created on Ethereum by developers. When specific criteria are satisfied, these smart contracts, which are stored on the blockchain, are automatically carried out.

Additionally, Ethereum has its own cryptocurrency, called Ether (ETH), which is used to fund network transactions. Its potential uses span a variety of industries, including supply chain management, healthcare, and finance, making it a platform with enormous room for innovation.

D. Testnet

A testnet is a mocked-up version of the mainnet (or live) blockchain network that uses fake or test currency instead of the real ones. Developers may test their dApps on testnets in a secure and economical manner without putting real money at risk or interfering with the mainnet. Before releasing on the mainnet, developers may test out new features, mimic network circumstances, and find flaws or vulnerabilities using testnets. In this project we have used the Sepolia testnet.

E. Motives

A growing issue that affects both customers and legal businesses is counterfeit goods. These products, which range from fake gadgets and drugs to designer handbags and clothing, can be hazardous and are typically of inferior quality. Currently counterfeit goods in the market are on the rise, 3rd party sellers on e-commerce sites like amazon, flip kart are a boon for counterfeit product sellers.

F. Supply Chain Transparency

Supply chain transparency is necessary to avoid counterfeit goods.

i Quality control: supply chain transparency helps manufacturers to better understand their suppliers and customers. This helps them to improve the quality of their product

ii Ethics and Sustainability: If companies know about the working conditions of their suppliers and their impact, then they could be more sustainable .

iii Trust: Transparency in the supply chain can boost consumer trust in firms as consumers can see the entire life history of the product they are buying.

iv Management of Risk : Businesses can identify potential risks with supply chain transparency and take preventative measures to lessen them.

II. Literature review

There has been many systems which have proposed to use the blockchain technology to stop counterfeit products in [4], they discuss about a system, in which they make use of the SHA-256 algorith, they proposed a system where each product has its own QR code that is generated using the SHA 256 algorithm. The data gets stored in fire base. The customer has his own android app, which has a scanner, and scans the QR code and verifies the data that is present in the database. The main problem with this approach is it defeats its own purpose, that is to be decentralized. The common database causes a centre of fault.

Multicriteria decision making can be very effective to conclude research findings, In [7] they have considered 2 criteria potential and criteria 2 need whose weights have been calculated using SWARA. WASPAS was also used to properties the sectors for blockchain application. And they have come to the conclusion that counterfeit good are more prevalent in rural areas, and India needs to adopt to distributed ledger technologies. But the paper does not propose any methodologies or framework for the indidan manufacturing base to adopt to.

Pharmaceuticals is the first avenue that is considered while applying technology based solutions. In [2] the authors talk about the vulnerabilities in the current medicine supply chain, and how current technologies like RFID are susceptible to crime . It gives an elaborate overview over how blockchain can be used in the diffrent steps of the supply chain. It also goes over the companies that are currently involved in this novel area. Is gives thorough overview of the benefits that blockchain technology would bring in the medical field. But it does not go over any of the potential drawbacks or flaws of the new proposed system.

The previous paper does not go over any proposed methodologies or framework, it only gives a complete analysis of the potential blockchain has in the pharmaceuticals field. But in [5] paper they have gone over a new paradigm, that could be practically implemented. Here they have utilized a QR code to encrypt the data about a product. They use the previous hash id of the block to encrypt the data, and the customer can verify it. The main flaw with this idea is that the qr code could be easily copied and be applied on a fake product.

The typical architecture of centralized supply chain creates a lot of vulnerabilities like clone products, products with fake expiry dates etc. It also creates a lot of burden on servers, single point of failure, storeage overflow. In [1] they first go over a centralized anti-counterfeiting supply chain and its issues, then they propose a blockchain based solution. Then they improved on this solution by comming up with a new and secures salable consensus algorithm. For the new consensus algorithm they have used tendermint, and they bought down the time complexity of consensus algorithm from o(n-1) to O(nlog(n)). Here instead of qr codes they are storing the product data in NFC tags. The only drawback is the number of validators are static.

In [10] a practical solution for counterfieit product identification in displayed. Here they are using etherum rexim to create and deploy the smart contract. In has two ends the manufacturer end, who adds product to the blockchain, and the customer end, where the customer verifies the product that is added to the blockchain. They use a Qr code to encrypt the product information. But in this system the entire history of the supply chain cannot be verified. So discrepanices can go unnoticed.

In [11] the basic fundamentals of how the supply chain works and how blockchain could be integrated with the current existing supply chain is briefly discussed. It makes a usecase for blockchain in logistics, banking, IOT(Internet of Things). It discusses about the existing companies in this sector like IBM,

UbiMS. It also talks about the potential of blockchain like how it can make paperwork easy, help in identifying counterfeit products, facilitate in tracking the product, use IOT etc. It does not go over any practical solution. But does a good analysis over the potential application of blockchain.

In [6] they discuss about the benifit of using a distributed ledger technology primarily focused on US automotive industry. In the system the assume the automotive parts supply system to be comprised of many nodes. And the will isolate the unauthorised supplier node from the main supply chain. The system will store all the information about all the entities in the supply chain and will ensure that fake products do not enter the supply chain.

III. Proposed Methodology

A. Manufacturers End

The manufacturer has his own website. The manufacturer has to login to the website using his metamask wallet address and his private key. Each manufacturer will have his own instance. When a manufacturer receives an order either for the customer or the distributor, before distributing the product, he will enter the metamask wallet address of the buyer, the product details, like date, time and location of origin. Then he will have to authenticate the transaction from his metamask wallet. Then he will use the transaction hash to create the unique QR code for the product. This qr code will be pasted on the original product and shipped off.

B. Intermediary Nodes

The intermediaries in the supply chain like local seller and distributors, must also login using their metamask wallet address and private key, they must update the product details by scanning the qr code. If they find out that the product is not authentic, then they could take actions immediately, otherwise they will update the product details and move on.

C. Customer end

The customer will have an app, through which he can verify the product. The customer also has to login using his metamask wallet address and private key. When the customer scans the QR code he can see the entire transaction history of the product. He can verify if there are any discrepancies. If the data on the qr code matches, the nteh customer can be certain that they have received an authentic product.

D. Metamask

In this project Metamask is used, it is a popular crypto currency wallet and it mainly supports ethereum based tokens and NFTs. It is necessary for this project to function, since it helps in accessing the blockchain.

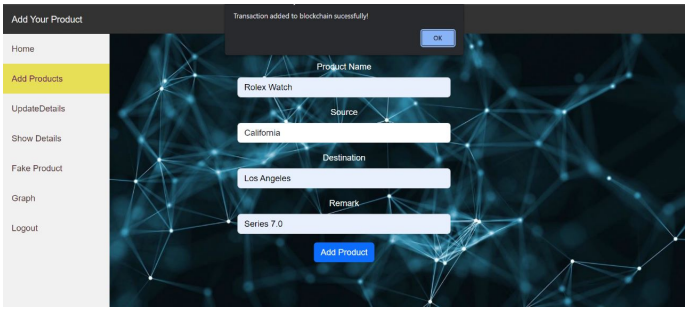

Fig. 1: Addition of products to blockchain

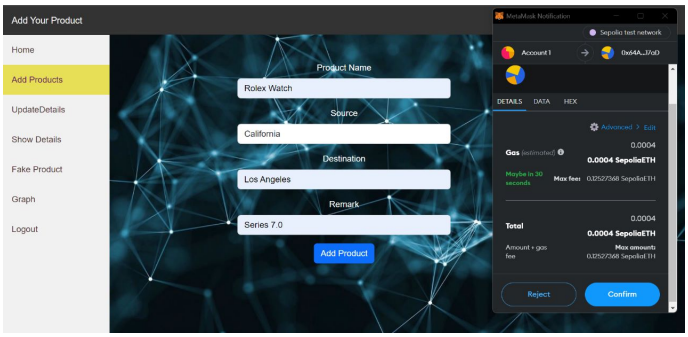

Fig. 2: Metamask Authentication

IV. Results

A. Smart Contract

The Solidity contract is designed to manage product data on a blockchain network. The contract contains a data structure, which consists of several fields such as the product ID, name, source, destination, remark, current block timestamp, date and the address of the account that added or updated the data.

The contract contains functions to manage the product data like - add(), update(), and show(). The add() function allows adding new product data to the blockchain network, while the update() function enables updating the existing product data. The show() function returns all the product data for a given product ID.

ID. Multiple instances of transactions can be added to the same product ID, allowing for a history of changes to the product data to be recorded on the blockchain. The contract leverages the unique features of blockchain technology, such as immutability, transparency, and decentralization, to create a secure and tamper-proof system for managing product data. By storing product data on the blockchain, manufacturers and consumers can verify the authenticity and integrity of products, ensuring that they are not counterfeit or adulterated. Overall, this contract provides a reliable and efficient method for managing product data on a blockchain network.

B. Website

1) login: First the website needs each user to login. So a user can register using his meta mask wallet address and his private key. The users Wallet address and his private key are essential for the verification step.

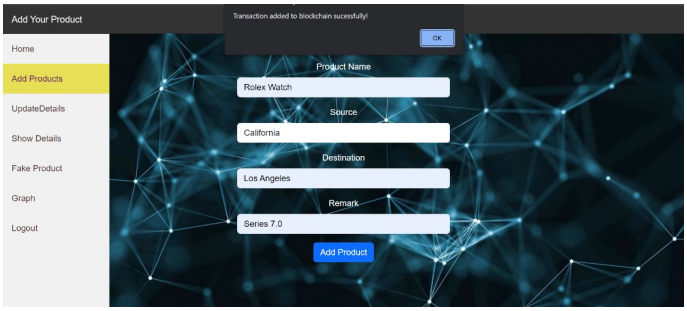

Fig. 3: QR code generation

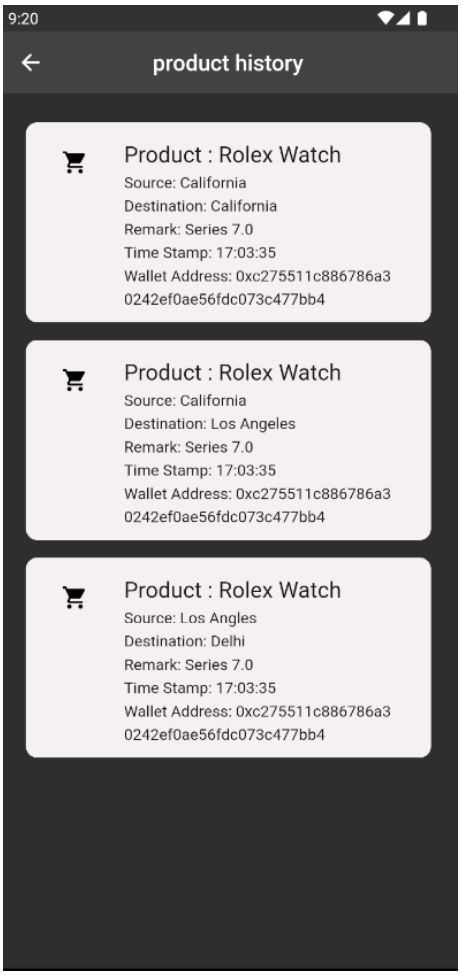

Fig. 4: Product verified using app

2) product page: The website is intended for the manufacturer, There are many sub pages in the website, The product page can be used by the manufacturer, to enter the product details to the blockchain. Next is the update page, If the user has entered nay wrong data, he can use the key here to update the contents of the previously entered product.

3) seller page: Next we have the seller or distributor page, where the seller or anyone else in the intermediary can update data into the product. The sellers have to identify the product using its unique key, and they have to update details about the product like, date, time etc. s

C. app

The app is used for verification purpose. The app is linked with the smart contract. In the app the user will have to login using in wallet address and his private key. Then to verify the product the user can either manually enter the product id or, he can scan the product ID. Then the app will verify whether the product is registered in the block chain. If it is present then it will display all the transaction history, of the product up to this point. This adds a further level of protection, since we can see that there has been no discrepancy in the delivery of the product.

There is a user login and signup page, where the user

V. Conclusions

This paper goes over a vital solution for the problem of counterfeit products in various industries. Its innovative use of blockchain technology offers numerous benefits, including increased product authenticity, improved supply chain transparency, and reduced customer risk. This project has the potential to revolutionize the way companies and consumers interact with products, providing a secure and transparent system that benefits everyone involved in the supply chain. It is very much more secure than centralized counterfeit product identification system.

VI. Future Enhancement

The one abject issue with this concept is, that the counterfeit manufacturers could steal the real Qr code. This could be avoided by using NFTs, where the manufacturer mints the NFT and then he transfers it to the seller, the seller transfers it to the distributer, the distributer transfers it to the customer.

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