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Fake Product Identification Using Blockchain

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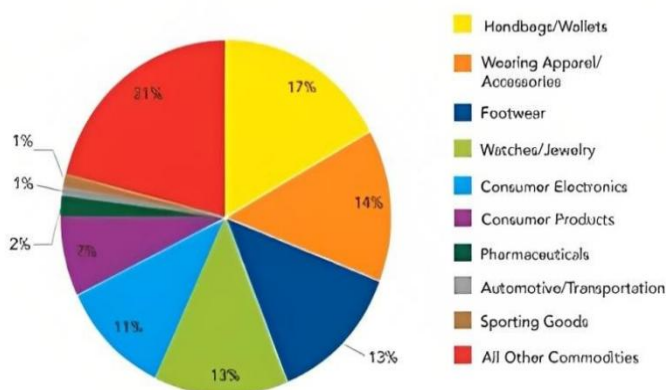
Abstract: One of the greatest challenges in today's retail market is the counterfeiting of products. Counterfeiting Products are merely low-quality counterfeits of a certain brand. Over time, many different methods have been adopted to prevent the proliferation of counterfeit products such as RFID tags, Artificial intelligence, machine learning, QR code base system, and many more. Nevertheless, the disadvantages of such methods are severe, e.g., QR codes that may be copied from real products to fake ones, and artificial intelligence and machine learning must have high computational power for carrying out operations; however, a large number of other techniques currently exist but this method was not developed. We've tried to improve it in this project. With the help of the blockchain, detection of counterfeit products technology. The way we do it is to store the supply chain. Products at all stages of the product's transaction with a new party with the help of a QR code. Blockchain helps us to store the supply chain of goods as a blockchain system makes a decentralized system and one of the main advantages of blockchain is that if the data is recorded in the system, then nobody can change it at any cost so it makes our data more Secure and guarded against third parties.

Keywords: Blockchain, supplyChain, bitcoin, decentralization, Counterfeited Product identification, QR code.

I. INTRODUCTION

Any product is subject to several risk factors such as counterfeiting and duplication, that can affect the brand name, reputation, revenue, or customer satisfaction at all stages of development. Counterfeit products are rapidly being traded and marketed. Full operation of a blockchain system is suggested to identify and monitor counterfeit goods or products, while at the same time combating this phenomenon. Only companies have to spend very little effort, and they don't longer need to worry about counterfeit products. Due to Counterfeit products, manufacturers are going to lose a lot of money. The reputation of a company's name and its brand value because customers thought that it was a product manufactured by the company That's why, based on a counterfeit product, they look at it. A decentralized distributed ledger technology system can be adopted to resolve this problem. Blockchain is a distributed decentralized-based This is the technology to store data in blocks within a database, and it links with chains. If new data are added to databases, it will update existing data by linking a chain of these records to an existing block. Blockchain does not allow any user to update the existing data each time blockchain will add data as a new block to existing data. Therefore, the data in the blockchain that leads to data security and data protection cannot be deleted or modified. The issue of counterfeit products is being addressed by Blockchain technology. The figure below indicates some of the common counterfeited products in 2020.

Fiscal Year 2020



Number of Seizures: 26,503

II. BLOCKCHAIN

Blockchain is a community of computers that stores and disseminates the digital log of transactions, in its most fundamental form. A record of its miles shall be entered on every man's or woman's ledger at each time a new interested party is legitimately taking over the account. There are many transactions with each of the blockchains.

A blockchain, or a set of documents that are interconnected in the manner of cryptography, is an emerging series of documents. It is due to the fact that records can no longer be changed once they have been entered; this does not allow them to be altered again without affecting subsequent blocks. Although data on the community are available. However, It's possible to modify the Blockchain, which is an example of a distributed computing device with a high level of Byzantine error tolerance. It's said to be "an open, distributed record system that reports transactions

Between two parties quickly and in a verifiable manner permanent shape," the blockchain is a decentralized database.

A. Working of Blockchain

When a new transaction is entered, it is then transmitted in a network of peer-to-peer computers scattered across the world. The network of computers then solve the equations to confirm the validity of the transaction. They are called miners. Once confirmed to be legitimate transactions, they are clustered together into blocks. The miner then receives an award as a proof of work. These blocks are then chained together creating a long history of all transactions that are permanent. The transaction is complete. Whole procedure is done as shown in figure below :

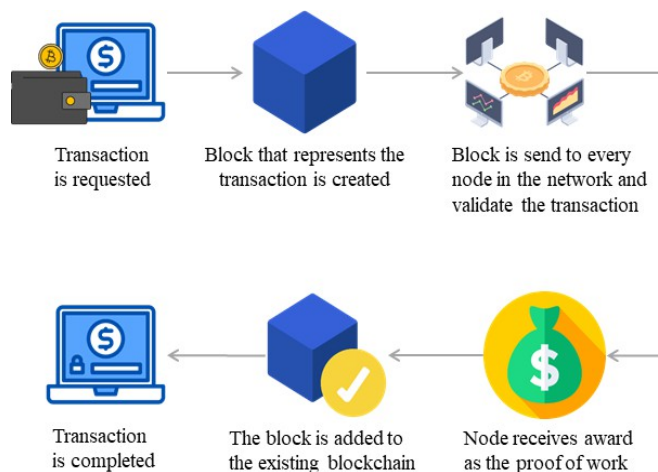


Figure 1: Working of Blockchain

B. ETHEREUM

In late 2013, ethereum was first presented in a White Paper by programmers and cofounders of bitcoin mag Vitalik Buterin, who intended to create decentralised packages. Buterin urged the use of Bitcoin and blockchain technology in more than just financial transactions, saying that a scripting language is needed for apps to be developed. This may result in actual International Assets, such as shareholdings and real property, being added to the Blockchain. Buterin produced the colored cash challenge's white paper explaining capability use cases for blockchain generation in 2013 whilst working briefly with eToro CEO Yoni Assia's a part of this venture. But after failing to reach an agreement as to how the project should proceed, he recommended that a new platform be set up with more universal scripting language which might ultimately lead to Ethereum.

C. COUNTERFEIT

Counterfeit refers to the imitation of genuine goods for purposes of stealing, destroying or altering their authenticity. use in criminal activities or other ways of convincing people to believe that counterfeits have a higher value than they do. genuine article. Counterfeit products shall be considered as fakes and illegally copied copies of the real product. They're products that are fake. They are often created with a view to making money from the greater value of counterfeit goods. There is a widespread use of the term "counterfeit." It refers to counterfeit money and official documents, as well as imitations of goods like jewellery, handbag, shoes, cosmetics.

D. What does BLOCKCHAIN do?

The major goal of blockchain is to make records immutable, as it has been pointed out in the above discussion. In almost five steps, there is a simple explanation of the Blockchain's functioning:

- 1) The authentication of the user must be performed by the blockchain client when entering the transaction.
- 2) The new block containing transaction information will be established once the authentication has been completed.
- 3) Every node in your computer network is allocated a newly formed block.
- 4) The approved nodes perform the verification steps and when they have verified that transaction information has been entered into existing blocks, it is added by way of a chained mechanism.
- 5) The updates continue to be transmitted from one network to another. Thus, above finalize that the transaction history is stored in blockchain databases.

E. Benefits Of Blockchain

- 1) Accuracy: as we know that the blockchains are distributed systems. A blockchain database is spread amongst the different network nodes that are part of the computer network. This means that the user never comes to know from where the database of blockchain is coming. This result is that this technology does not involve humans at all, which leads to reduced human error and thus decreases the number of errors. A computing error caused by Blockchain technology, resulting in this great accuracy.
- 2) Cost Reductions: Blockchain eliminates the involvement of third parties, such as banks, which has a very positive impact on cost reductions in transactions. For example, a small fee is deducted from the bank's payment to provide services whenever an enterprise owner accepts payments by credit card. Nevertheless, there will be no and minimal transaction fees on the Blockchain because it does not have Central Authority.
- 3) Decentralization: As we know from the above definition of blockchain that blockchain is a decentralized distributed system. So, the blockchain database has many copies and is spread across the different computers in computer networks. Therefore, if we are going to make a new block in the database, every computer has to add it as part of their blockchain and reflect this change. As a result, it's harder to hack the blockchain. Even if a hacker tried to make a change to the blockchain then only that copy is affected other remains the same. As a result, the decentralization property of blockchain has been helpful in data protection.
- 4) Efficient transaction: Blockchain is a type of transactions. Decentralized and it's not supervised by an authority of any kind. Because we're aware that the authorities are operating their business. And if we start a transaction during the working hours, it'll be three days before the transaction is completed on Friday. This means that the Blockchain's up and running 24 hours a day until Monday. Also, the transaction can be completed more quickly with blockchain 10 minutes. Also, it takes almost the same amount of time to build a Blockchain Complete trade between countries, if it is performed by another country. Due to the fact that there is a difference in time, authorities are taking more time zone issue and many more reasons. Thus, Blockchain provides an efficient way of carrying out transactions.
- 5) Transparency: Cryptocurrencies provide transparency as the majority of them are freely available software. So, we'll have the ability to check our code, which will give us some suggestions for improving blockchain technology. Therefore, for users, the blockchain is a complete transparency. Only if the majority of network users' consent, these proposals will be put into practice.

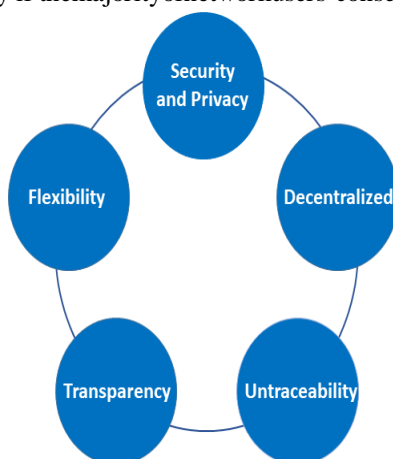


Figure 2: Features of Blockchain

III. TECHNOLOGIES AND ALGORITHM USED

A. SHA-256

SHA-256 (Secure Hash Algorithm 256-bit) is a cryptographic hashing algorithm that yields a 256-bit fixed-size output from an input message of any length. To make the input message a multiple of 512 bits, extra bits are inserted as padding. The algorithm is given a set of starting hash values, also known as initialization vectors, which are a collection of constant values. A set of mathematical operations are performed on each 512-bit block of the padded message during processing.

A new hash value is generated by combining the results of each block with the existing hash value and then applying a compression function. The concatenation of the hash values generated for each block is the final hash value. The SHA-256 algorithm converts the input message into a fixed-size output by combining bitwise operations, modular arithmetic, and logical operations. Since it is intended to be a one-way function, it is computationally impossible to identify two distinct inputs that result in the same hash value. Digital signatures, authentication, and verification are just a few of the uses for which SHA-256 is frequently employed. Although it is thought to be a secure and reliable hash function, it is not impervious to some assaults, such as collision attacks, in which an attacker can discover two different inputs that result in the same hash value.

B. METAMASK

MetaMask is a browser extension and mobile application that allows users to control their cryptocurrency wallets and access Ethereum-based decentralized applications (dApps) using MetaMask, a browser extension and mobile app. It serves as a link between a user's web browser and the Ethereum blockchain, offering an intuitive and safe way to engage with decentralized apps. Users are able to send and receive Ethereum and other ERC-20 tokens, examine account balances, manage multiple Ethereum wallets, interact with smart contracts, and establish and manage multiple Ethereum wallets using MetaMask. Additionally, it offers a function for securely managing and saving private keys, which are necessary for accessing and controlling cryptocurrency wallets. Decentralized exchanges (DEXs), gaming platforms, and apps for decentralized finance (DeFi) are just a few of the web3-enabled dApps and platforms that are supported by MetaMask. Users can easily link their web3-enabled dApp accounts across different platforms, offering a convenient and consistent experience. For Chrome, Firefox, and Brave browsers as well as mobile devices running iOS and Android, MetaMask is accessible as a browser plugin. With millions of users all over the globe, it is among the most widely used Ethereum wallet solutions.

C. SOLIDITY

The Ethereum network uses the programming language Solidity to create smart contracts. It is a high-level computer language that focuses on contracts and objects and is intended to be used to build smart contracts that execute on the Ethereum Virtual Machine (EVM).

The norms and regulations specified in the contract code are automatically enforced by smart contracts, which are self-executing contracts stored on the blockchain. They can be used to automate a variety of operations and deals, including the transfer of tokens, the trading of assets, and the execution of sophisticated financial instruments. A variety of features are supported by the statically typed language Solidity, including inheritance, modules, and sophisticated user-defined types. Because of its resemblance to JavaScript and C++, developers with prior expertise in these languages will find it simple to pick up and begin using Solidity programming right away. The Ethereum Virtual Machine executes the bytecode that Solidity code has been converted into. Deployed on the Ethereum blockchain, Solidity-written smart contracts can be accessed and used by other smart contracts, decentralized apps (dApps), and users. For creating smart contracts on the Ethereum network, Solidity has emerged as one of the most used programming languages. Developers use it frequently to create new digital assets and construct decentralized applications.

D. GANACHE

With the help of Ganache, a private blockchain for Ethereum development, programmers may build and test Ethereum-based apps in a local environment. It offers a portable, customisable blockchain that runs locally on a developer's computer, enabling quick prototyping and testing without the need for a real network connection. There are two varieties of Ganache: Ganache CLI (Command Line Interface) and Ganache GUI (Graphical User Interface). For administering the blockchain and engaging with smart contracts, Ganache CLI is a command-line tool that may be combined with other development tools and scripts. Ganache GUI is a standalone desktop programme. With Ganache, programmers can set up numerous accounts, each of which has a unique Ethereum address and private key that can be used to communicate with the local blockchain.

Additionally, it enables a number of testing and debugging functions, such as setting the gas price and limit, manipulating blocks, and inspecting transactions. One of the key benefits of utilizing Ganache is that it lets programmers test their smart contracts and applications in a safe setting without taking on the costs and hazards of putting them into production on the main Ethereum network. This enables developers to rapidly test for potential vulnerabilities and edge cases, revise and improve their code, and guarantee that their applications are operating as intended before releasing them to a live network.

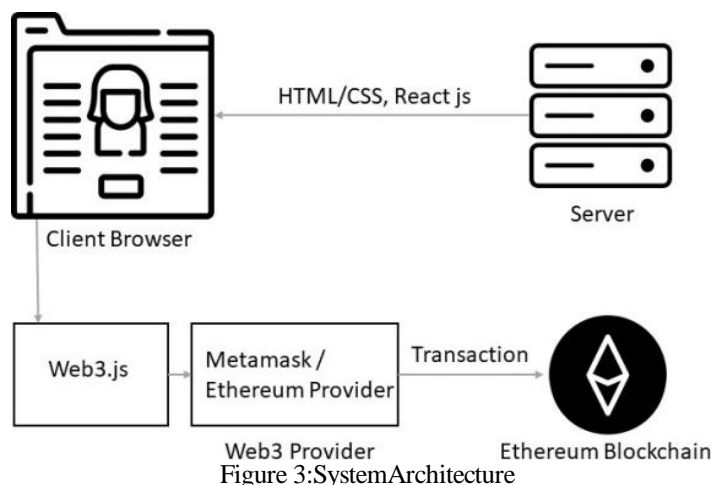
IV. WORKING MODEL

A. Proposed System

Counterfeit has spread worldwide and has huge effects on organizations, manufacturers, and consumers. It affects the influence of the organization and the well-being of the consumers. India is not excluded. The proposed system is aimed at consumer products, and it helps track the products by maintaining the product and the supply chain integrity by using Blockchain. This gives the customer the power to track the history of the entire product from manufacturer to customer using blockchain and QR code.

B. System Model

The proposed system will be a decentralized application (Dapp) which will be implemented using the Ethereum Network as the main blockchain for keeping all the records and managing the transactions regarding the products of the companies listed on Dapp. The basic system architecture is shown in figure below:



C. Flow of Proposed System

The main aim of this proposed system is to maintain the genuinity of the product by helping the customer track the supply chain history of the product. System give customer the power to track the history of an entire product from manufacturer to customer using blockchain. This product anti-counterfeiting system based on Blockchain is composed of three roles, the Manufacturer role, the Seller role, and the Consumer role, as discussed and shown in figure 4.

1) Manufacturer:

Manufacturer logs into the manufacturer account and generates QR Code for Product and adds other required details of the product and by using his Ethereum wallet, the manufacturer adds a block to Ethereum blockchain. The user id of our local database and the wallet address of the entity will be mapped together, if both the things are there, that is a manufacturer logs in from his own account and uses his own wallet then only the block will be added to the digital ledger.

2) Supplier:

Supplier logs into supplier account and scans the QR code on the product. The seller can access information about this product that the manufacturer has entered. It adds its own details of the product like shop destination and pushes it into the Blockchain. The details can be viewed by the buyer.

3) Customer:

Customers can check the integrity of the product by scanning QR code which will list the history of transactions and thus verifying the genuinity of the product. At the time of customer purchasing the product after the QR scan in supply chain history, if the last location is not matched with the purchase location, the customer will know that the product is not genuine. It concludes that the QR code was copied and the customer becomes aware of counterfeiting.

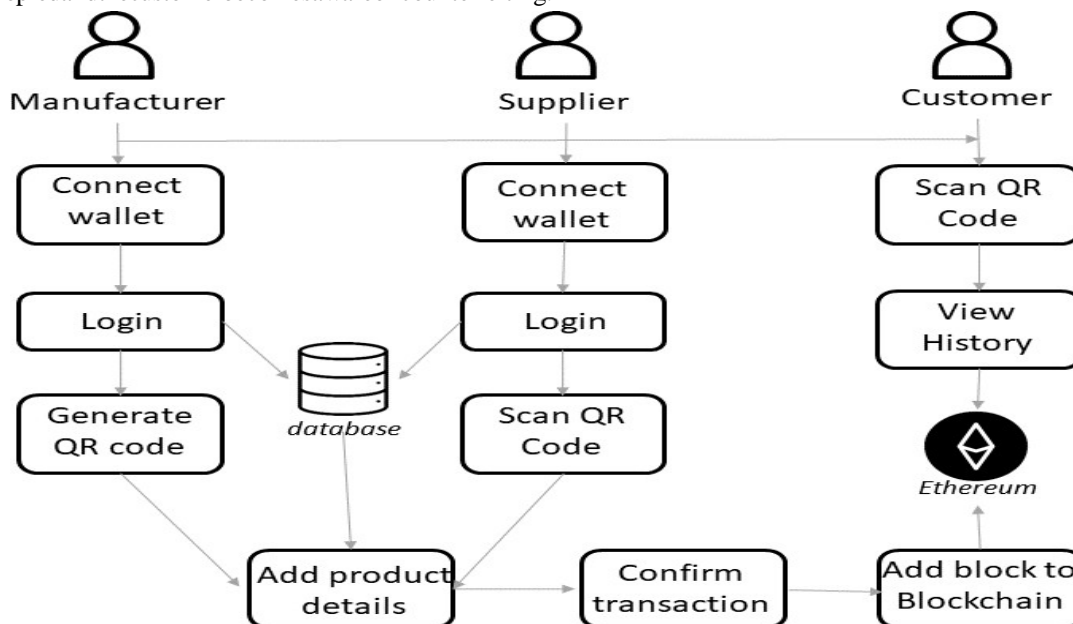


Figure 4: The process of detecting a counterfeit product by the customer while purchasing

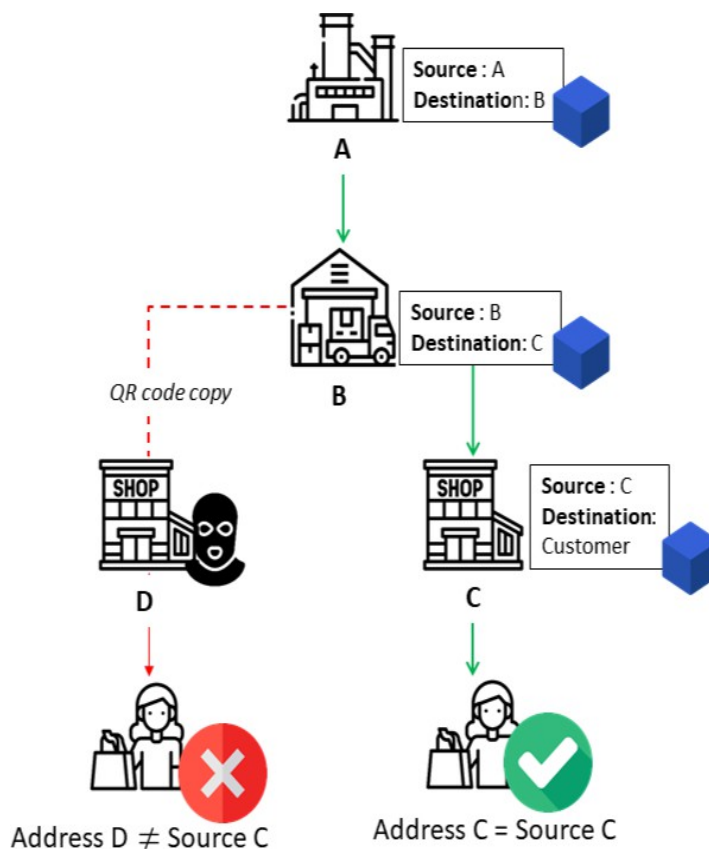


Figure 5: Dealing with Counterfeit Product

V. LITERATURE SURVEY

A. Literature Survey

Table 1: Deep Literature Survey of Blockchain Based Systems

SrNo.	Paper Title	Publication Details	Author Name	Limitations	Challenges
1	Fake Product Detection using Blockchain	IEEE-Access 2020	Tejaswi Tambe, Sonali Chitkala	Limited Coverage	Data Accuracy
2	Detection of Counterfeit Products using Blockchain	IRJMETS 2022	Kunal Won-Shik, Isha Sondawale	Cost	Privacy and confidentiality
3	Identifying Counterfeit Products using Blockchain Technology in Supply Chain System	IJARIE 2022	Pramit Dutta	Technical Complexity	Scalability
5	Fake Product Detection Using Blockchain Technology	IJARCE 2022	Sri Krishna Shastri C, Vishal K	Lack of Standardization	Efficiency
6	Blockchain based product identification system.	ITM Web of Conference 2022	M. Suhana S. Sujatha	Less Secure	Privacy and confidentiality
7	Anti-Counterfeiting Blockchain Using a Truly Decentralized, Dynamic Consensus Protocol	PDX Scholar	Naif Alzahrani, Nirupa ma Bulusu	Technical Complexity	Complexity
8	Fake Product Identification System Using Blockchain	IEEE 2022	Anita Kanavali, Kushagara Gupta	Technical Complexity	Data Accuracy
9	A Blockchain-Based Fake Product Identification System	IEEE 2022	Yasmeen Dabbagh, Reem Khoja	Cost	Efficiency

B. Algorithmic Survey

Table 2: Algorithmic Survey of Research Studies

SrNo.	Algorithm Used	Time Complexity	Space Complexity	Advantages	Disadvantages
1	Secure Hash Algorithm (SHA)	$O(n)$	$O(1)$	Strong Security, Large key space.	Deterministic.
2	Proof of Work (PoW)	Slower than Proof of Stake	Slower than Proof of Stake	Decentralized, Simple Design.	Consumes large amount of energy
3	Proof of Stake (PoS)	Faster than Proof of Work	Depends upon network size and traffic	Consumes less amount of energy.	Security risk.

C. Live Survey

Table3:LiveSurveyofRecentBlockchainBasedSystemsonVariousOrganizations

SrNo.	Organization Name	YearEstablished	StatedWord	Algorithmused	Time & Space Complexity
1	RealItems Foundation	2017	REAL Items are verifiable products with a blockchain smart labels each with a digital identity stored on blockchainwithNon-Fungible Tokens.	NFT Standard Algorithms	Directlydependent onnumberofinput andnetworksize.
2	IBMResearch	2018	Developed supply chain system for tracking specific goodsandmedicinettracking system help developing countries.	Proof of Work, SHA Security	Lesserascompared tostandardsystem due to limited network size.

D. Analyses Of Various Anticounterfeiting Technologies

Different anti-counterfeiting technologies are displayed in the following table [1], along with comparisons between them.

Index	Technology	Product Type	Advantage	Limitation	Blockchain
1	RFID	Any	Dependable track and trace in any setting.	Reader conflict. Cannot communicate through metal items.	No
2	Magnetic strips	Hotel key cards	Less vulnerable than barcodes. Quick and simple to use.	May sustain damage from even minor scratches. Doesn't operate at a distance.	No
3	Security Hologram	Currency	If removed, it leaves behind residue.	Production takes a lot of time and money. Easily replicable.	No
4	Barcode scan	Daily use products	1. Efficient execution. 2. Scalable	1. Simple to copy. 2. Modifiable.	No
5	Fingerprinting	Digital Content	1. Extreme security. 2. Exclusive to the user	Failures of the system. High price.	No
6	Blockchain	Any	1. Can be applied at the time of manufacturing 2. Data once stored cannot be modified.	Requires a lot of memory. It is costly to implement	Yes

VI. RESULTANDDISCUSSION

The proposed system allows both manufacturers and suppliers to interact with the system to add their respective blocks containing the transaction details to the blockchain without modifying the other's block. Since the code is running on a local network, Ganache has been used for local testing. The contracts are then compiled and deployed using Truffle. The interface is created using HTML, CSS, and JavaScript. To allow interaction with the Ethereum blockchain, Web3.js library is used which is used to perform actions like reading, and writing data from smart contracts. MetaMask is installed on a browser which is a wallet to interact with the Ethereum blockchain. Accounts from Ganache are imported into the MetaMask. To add supplier and manufacturer blocks, they must confirm the transactions using their account MetaMask wallet which is connected using Web3.js. The end-user can then check the supply chain by scanning the QR code to check the integrity of the goods.

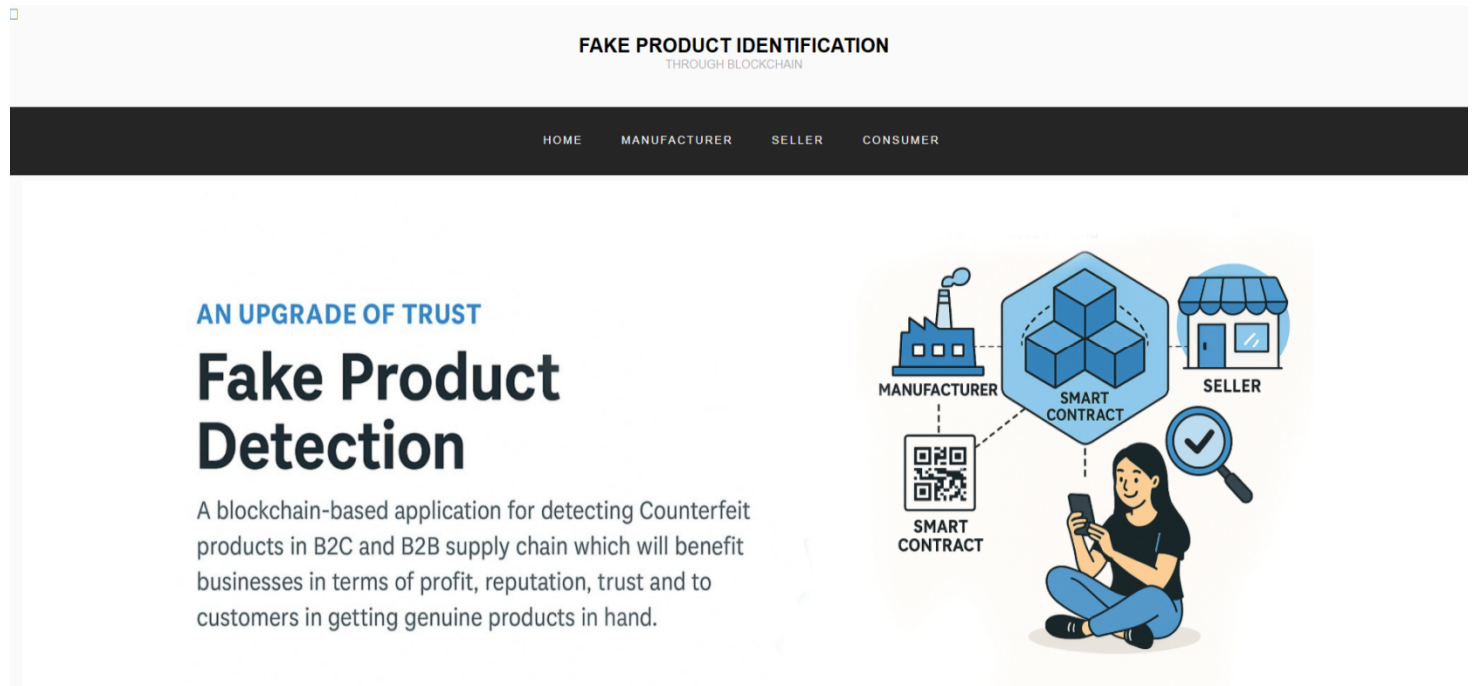


Fig4.1: Accounts can be categorized into manufacturer, supplier, and customer.

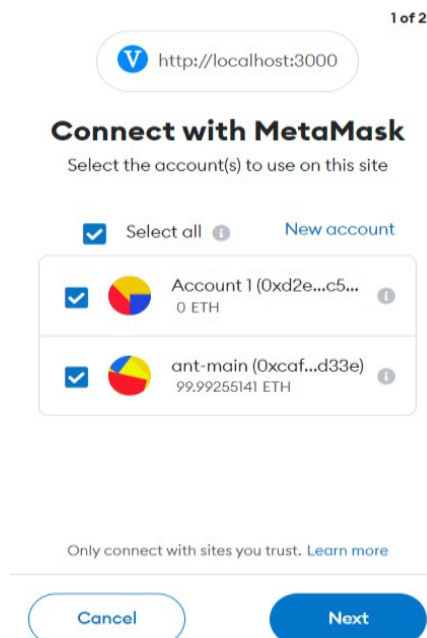


Fig4.2: Connecting Ethereum using metamask wallet.

FAKE PRODUCT IDENTIFICATION
THROUGH BLOCKCHAIN

[HOME](#) [MANUFACTURER](#) [SELLER](#) [CONSUMER](#)

Add Product

Manufacturer ID	<input type="text"/>	Product Name	<input type="text"/>
Product SN:	<input type="text"/>	Product Brand	<input type="text"/>
Product Price	<input type="text"/>		

Add the Product

Fig4.3: Manufacturer adds product details using the MetaMask Wallet.

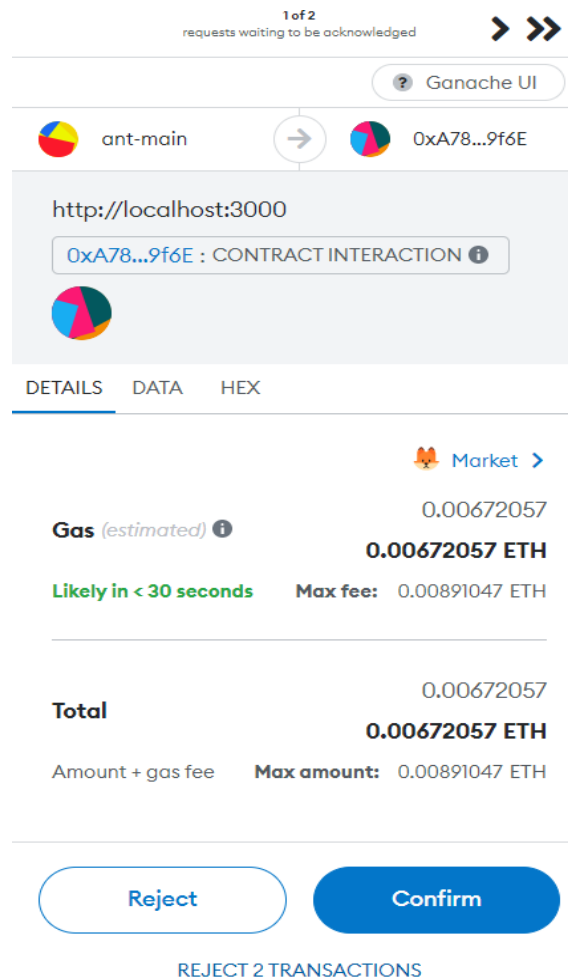


Fig4.4: A MetaMask confirmation popup is displayed which asks for the confirmation

Product SN:

1

Consumer Code

123

Get Product Status

Is the product sold to consumer is fake or not?

Product Verification Result

Fake Product.

Your address is 0x7f9edb3926f31c9f08f597dbea9035fe82f51e9b

Fig4.5:ProductVerificationbyConsumer.

VII. CONCLUSIONS

Using blockchain, manufacturers can create a unique and immutable digital identity for each product, enabling the traceability and verification of product information throughout the supply chain. This allows consumers to easily verify the authenticity of a product, reducing the risk of purchasing counterfeit or fake products.

Manufacturers and Suppliers can use the system to store product details in Blockchain which offers certain properties such as security and privacy of the data on the network. The customer views the good's supply chain history and verifies if the goods are genuine.

Customers can be sure about the integrity of the goods they purchase. This system helps to lower the rate of counterfeiting and boost the economy. Further system can be extended to avoid frauds done in healthcare, voting system, online shopping, banking, and so on.

Moreover, these real-time systems can enable the creation of decentralized marketplaces that prioritize authenticity and transparency, reducing the risk of fraud and counterfeiting in online transactions.

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