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Fake Product Identification Using Blockchain

Dr. shrishti Bhatia
Department of Electronics and Telecommunication Engineering
Thadomal Shahani Engineering College
Shrishti.bhatia@thadomal.org

Govind Nair
Department of Electronics & Telecommunication Engineering
Thadomal Shahani Engineering College
nairgovind01@gmail.com

Het Patel
Department of Electronics and Telecommunication Engineering
Thadomal Shahani Engineering College
hetpatelhp2808@gmail.com

Yogesh Saini
Department of Electronics and and Telecommunication Engineering
Thadomal Shahani Engineering College
yogeshsaini9466@gmail.com

Abstract :-

Fake product identification is a crucial problem in the modern world, with counterfeit goods causing significant economic and social harm. Blockchain technology, known for its decentralized and immutable nature, can play a vital role in verifying the authenticity of products. This paper presents an abstract on how blockchain technology can be used to identify fake products.

In a blockchain-based system, each product is assigned a unique identifier that is recorded on a distributed ledger. The identifier contains all the relevant information about the product, including its origin, manufacturing details, and distribution history. As the product moves through the supply chain, each transaction is recorded on the blockchain, creating an unalterable record of the product's journey.

When a consumer purchases a product, they can scan a QR code or NFC tag to access the product's blockchain record. The record verifies the product's authenticity, as any tampering or alteration would be immediately visible. This process not only protects consumers from counterfeit products but also helps to identify and track down counterfeiters.

Furthermore, blockchain technology enables greater transparency and accountability in the supply chain, allowing manufacturers to track and verify their products' authenticity at each step of the way. This transparency can also help to reduce the amount of waste and inefficiency in the supply chain, leading to cost savings and environmental benefits.

In conclusion, the use of blockchain technology for fake product identification has the potential to revolutionize the way we authenticate and track products. By creating an immutable and transparent record of a product's journey, consumers can trust that they are purchasing genuine products, and manufacturers can protect their brand

reputation while reducing waste and inefficiency.

1. Introduction

The problem of fake products has become a major issue in today's global economy. Counterfeit products not only harm the economy but can also pose significant risks to consumers' health and safety. This has led to an urgent need for a reliable and efficient method of identifying and verifying the authenticity of products.

Blockchain technology, which underpins cryptocurrencies like Bitcoin, has gained significant attention in recent years as a secure and transparent method of tracking and verifying transactions. The immutable and decentralized nature of blockchain makes it an ideal solution for tracking and verifying the authenticity of products. By creating an unalterable record of a product's journey, blockchain technology can help prevent the production and distribution of counterfeit goods, protect consumers, and enhance supply chain transparency.

Let's dive deeper into some of the challenges and limitations that blockchain-based solutions for fake product identification may face.

One significant challenge is the need for all parties involved in the supply chain to participate in the blockchain network. For the system to work effectively, manufacturers, distributors, and retailers need to agree to share data and use the same blockchain platform. This can be challenging, as companies may have different preferences for blockchain technology, or some parties may be resistant to the idea of sharing their data.

Another challenge is the cost of implementing a blockchain-based system. Building and maintaining a blockchain network can be expensive, and smaller businesses may struggle to afford the necessary infrastructure. However, this cost can be offset by the potential savings from reduced waste and inefficiency in the supply chain, as well as the cost of dealing with counterfeit goods.

Another limitation of blockchain-based solutions is the potential for human error or fraud. While blockchain technology can prevent unauthorized changes to the data stored on the blockchain, it cannot prevent mistakes made by people when entering data. Additionally, a bad actor within the network could potentially manipulate the data to create fake records, undermining the system's effectiveness.

Despite these challenges, the potential benefits of using blockchain technology for fake product identification are significant. By creating a transparent and immutable record of a product's journey, blockchain technology can help protect consumers, prevent counterfeiting, and enhance supply chain efficiency. Moreover, blockchain-based solutions could enable manufacturers to protect their brand reputation and increase consumer trust in their products.

In conclusion, while implementing blockchain-based solutions for fake product identification may face challenges, the potential benefits for both consumers and manufacturers are substantial. As blockchain technology continues to evolve and mature, we may see increasing adoption of these solutions in the fight against counterfeit goods.

2 Problem Statement

The problem of counterfeit products poses a significant threat to both consumers and manufacturers. Counterfeit products not only deceive consumers, but they can also damage a manufacturer's reputation and undermine their brand value. Moreover, counterfeit products can pose safety risks, particularly in the case of counterfeit pharmaceuticals or electronic goods.

Traditional methods of product authentication, such as serial numbers and holograms, are often inadequate as they can be easily replicated by counterfeiters. This leads to the need for more advanced solutions, such as blockchain-based systems, that provide a more secure and reliable way to authenticate products.

However, implementing a blockchain-based system for fake product identification faces several challenges, including the need for all parties in the supply chain to participate, the cost of implementing the technology, and the potential for human error or fraud. These challenges must be addressed to ensure the effectiveness and feasibility of blockchain-based solutions for fake product identification.

Therefore, the problem statement for fake product identification using blockchain is how to develop a secure, reliable, and cost-effective solution that can prevent the production and distribution of counterfeit products, protect consumers, and enhance supply chain efficiency, while overcoming the challenges associated with implementing a blockchain-based system

3. Literature Survey

Several studies have explored the potential of using blockchain technology for fake product identification. For instance, in a study conducted by Zhang et al. (2020), blockchain technology was used to authenticate products using unique identifiers stored on a distributed ledger. The study found that blockchain-based solutions can provide a reliable and secure method for authenticating products, protecting consumers and manufacturers alike.

Another study by Li et al. (2020) proposed a blockchain-based solution that combines radio-frequency identification (RFID) tags with blockchain technology to track and verify the authenticity of products. The system was tested in a simulated supply chain environment and demonstrated its effectiveness in preventing counterfeiting and enhancing supply chain transparency.

Similarly, a study by Kim et al. (2019) proposed a blockchain-based system for authenticating luxury goods. The study used a unique identification code to track products and recorded each transaction on a blockchain network, creating an immutable record of the product's journey. The study found that the blockchain-based system could help protect consumers from counterfeit goods and enable manufacturers to better monitor their supply chain.

In a review article by Costa et al. (2019), the authors discuss the potential of blockchain technology for supply chain management, including the authentication of products. The authors argue that blockchain technology can increase transparency, security, and efficiency in the supply chain, ultimately reducing the risk of counterfeit products.

Finally, a study by Xu et al. (2020) proposed a blockchain-based system for tracking pharmaceuticals, a sector that is particularly vulnerable to counterfeiting. The study found that the blockchain-based system could help prevent the production and distribution of fake drugs and improve transparency and accountability in the pharmaceutical supply chain.

Overall, the literature suggests that blockchain technology can provide an effective solution for fake product identification. By creating a transparent and immutable record of a product's journey, blockchain technology can protect consumers, prevent counterfeiting, and enhance supply chain efficiency. While there are some challenges to implementing these solutions, the potential benefits for both consumers and manufacturers are significant.

One common thread throughout the literature is the potential of blockchain technology to provide a more transparent and secure way to authenticate products. Blockchain's decentralized and immutable nature makes it ideal for creating an unalterable record of a product's journey, which can help prevent the production and distribution of counterfeit goods.

Many of the studies also highlight the importance of all parties in the supply chain working together to implement a blockchain-based solution. This can be a challenge, as some companies may be resistant to sharing data or using a particular blockchain platform. However, the potential benefits of a blockchain-based solution can ultimately outweigh these challenges, as it can help protect consumers, increase efficiency, and enhance brand reputation.

Another common theme is the potential for blockchain-based solutions to be applied in various industries, from luxury goods to pharmaceuticals. Each industry has its unique challenges in terms of counterfeiting and supply chain transparency, and blockchain-based solutions can be tailored to meet the specific needs of each sector.

Finally, the literature suggests that while there are some challenges to implementing blockchain-based solutions, the potential benefits are significant. By reducing waste and inefficiency in the supply chain and

preventing counterfeiting, blockchain-based solutions can lead to increased consumer trust, reduced costs for manufacturers, and a safer marketplace for all.

4. Existing Applications

4.1 Limitations of Existing Applications

- RFID avoids the limitations of barcode scanning, which requires line-of-site access to each barcode and can only be used to scan one item at a time. Instead, RFID tags do not require line-of-site, and multiple RFID tags can be detected and read remotely and simultaneously
- RFID involves assembling and inserting a computerized chip; which works out to be more expensive.
- RFID readers struggle picking up information when passing through metal or liquid.
- Reader collision can occur where two signals from different readers overlap and the tag is unable to respond to both.
- Tag collision can occur when numerous tags in the same area respond at the same time.
- RFID still has two separate chips (read only and readable/writable), which cannot be read by the same machine.

4.2 Solution

As most people shop from remote places, there is the possibility of getting Counterfeit or fake products. This fake product affects the customer as well as company name. They have to face major loss from this situation. There is no right solution before dealing with this problem. As easily copied barcodes there is no guarantee system, or a good solution to distinguish counterfeit products from real products. Blockchain is the most promising technology emerging in recent years that can help to solve that type of problem. Blockchain Technology can be used to monitor and keep track of shipped products so that users only get the right product. The main purpose of the project was to bring transparency about the product during customer purchasing and help customers to see if the product they are buying is original or counterfeit easily.

In this proposed system, we do Fake product Identification Using Blockchain Technology. The first step is to bring all the manufacturers to the blockchain network and collect their major product information. Product verification is done by registering and providing them with the correct id and password. The manufacturer will be the main owner of the item. The manufacturer will ask the manager to add the product to the network while the QR code will be assigned to that product. The regulator will register the product and the manufacturer on the network if the applicant is the actual manufacturer. Once the product is recorded on the network it will create a smart contract with the unique QR code of the product where the product details are stated in the encrypted text form. To protect the QR code from copying there is a Copy Sensitive digital image in the QR code. In the next step the manufacturer will

send the product to the distributor and the status is set as shipping; it will not change the ownership of the product until a request from both parties for the purchase and sale of the product is approved. As soon as both parties agree to a joint venture, its ownership in the blockchain network will be transferred in the form of a smart contract automatically after payment has been made. At this stage clients will be provided with the Android app and consumers can scan the QR code assigned to the object using the Android app. The scanner scans the product and removes the encrypted text in the algorithm provided and receives information about the current manufacturer and owner of the product and can decide whether to purchase the item or not.

5. Design Methodology

As the final product is a prototype website based on blockchain, this is completely a software project and no hardware other than a computer system having following requirements is needed.

System Requirements

- **Operating system:** Windows 10/11
- **Coding Languages:** HIML, CSS, Javascript, Solidity, Node JS
- **Development Environment**: VScode, Ganache(Truffle framework)
- **Browser Extension:** MetaMask

5.1 Software Details

This project is the integration of many types of software. Major softwares and modules used are mentioned below and explained briefly. These modules are supported by many other minor modules which might not be listed by their contributions are significant to the overall product.

5.1.1 Node JS

Node.js is an open-source, cross-platform runtime environment that allows developers to build server-side applications using JavaScript. It uses an event-driven, non-blocking I/O model, which makes it lightweight and efficient, and allows for building scalable network applications.

Node.js is built on top of Google's V8 JavaScript engine, which is also used by Google Chrome web browser, and it provides a powerful set of libraries and frameworks for building web applications, APIs, and other types of server-side software.

Fig 5.1.1.1 Node JS

One of the main advantages of using Node.js is that it allows developers to use the same programming language (JavaScript) for both the client-side and server-side components of

a web application. This simplifies the development process and makes it easier to write and maintain code.

Node.js has become very popular in recent years, and it is widely used by companies such as Netflix, LinkedIn, and Walmart to build high-performance, scalable web applications. It has a large and active community of developers who contribute to its ecosystem of libraries, tools, and frameworks, making it a powerful and versatile platform for building modern web applications.

5.1.2 Ganache

Ganache is a personal blockchain that is used for development and testing of Ethereum-based applications. It is an Ethereum client that runs on your local machine and provides a user interface to interact with the blockchain.

Ganache creates a local Ethereum network with a configurable number of accounts and allows developers to simulate different network conditions such as network latency, gas prices, and mining speeds. It also provides a detailed log of every transaction on the network, which makes it easy to debug smart contracts and applications.

Ganache is particularly useful for developers who want to test their smart contracts before deploying them on the Ethereum mainnet. By using Ganache, developers can quickly and easily test their code in a safe and controlled environment without having to spend real money on gas fees.

Ganache also provides a range of other features such as the ability to import/export accounts, track contract events, and inspect the blockchain state. Overall, it is a valuable tool for Ethereum developers who want to streamline their development workflow and ensure that their applications are robust and error-free

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5.1.3 Smart Contract

A smart contract is a self-executing contract that automatically enforces the rules and regulations of a contract when certain conditions are met. Smart contracts are typically written in programming languages, such as Solidity, and are executed on a blockchain network, such as Ethereum.

The primary benefit of a smart contract is that it eliminates the need for intermediaries, such as lawyers or notaries, to enforce the terms of a contract. This makes the process of executing a contract more efficient, transparent, and secure.

Here's an example of how a smart contract works:

Let's say that Alice wants to sell a piece of artwork to Bob for a certain amount of Ether. They create a smart contract that contains the details of the transaction, including the price, the artwork, and the conditions for transfer of ownership. The contract is deployed on the Ethereum blockchain network.

Fig 5.1.3.1 Smart Contract

When the conditions of the contract are met, such as the transfer of the agreed-upon amount of Ether to Alice's account, the contract automatically executes, transferring ownership of the artwork to Bob and releasing the Ether to Alice.

Smart contracts can be used for a wide range of purposes, such as:

1. Financial transactions: Smart contracts can be used to automate financial transactions, such as payments, loans, and insurance.
2. Supply chain management: Smart contracts can be used to track and trace products in a supply chain, ensuring transparency and accountability.
3. Real estate: Smart contracts can be used to automate the buying and selling of real estate, reducing the need for intermediaries and making the process more efficient and secure.
4. Voting: Smart contracts can be used to create decentralized voting systems that are more transparent and secure than traditional voting systems.

Overall, smart contracts are a powerful tool for creating more efficient, transparent, and secure contracts and transactions. They have the potential to transform many industries by eliminating the need for intermediaries and providing a more secure and efficient way of executing contracts.

Smart contracts can be thought of as computer programs that are stored on a blockchain network. They are self-executing and self-enforcing, meaning that they execute automatically when certain conditions are met, and their rules and regulations cannot be modified once they are deployed on the network.

One of the main benefits of smart contracts is their ability to eliminate the need for intermediaries, such as lawyers or banks, to enforce the terms of a contract. This can lead to a significant reduction in transaction costs and an increase in efficiency, as the contract is executed automatically and transparently.

5.1.4 Solidity

Solidity is a high-level programming language used to develop smart contracts on the Ethereum blockchain. Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. The language was developed by the Ethereum Foundation and it is designed to be a contract-oriented, high-level language with similarities to JavaScript and C++.

Solidity is a statically typed language, which means that the data types of variables must be declared before they are used, and it supports features such as inheritance, libraries, and user-defined types. It also has a syntax that is similar to JavaScript, making it easy for developers who are familiar with that language to learn and use.

Fig 5.1.4.1 Solidity

The language is used to write the logic for smart contracts, which are stored on the Ethereum blockchain and can be executed automatically when certain conditions are met. Smart contracts can be used for a variety of applications, such as creating digital assets like cryptocurrencies, creating decentralized applications (dApps), and executing complex financial transactions.

Solidity code is compiled into bytecode, which can be executed by the Ethereum Virtual Machine (EVM), a decentralized computer that runs on nodes across the Ethereum network. Solidity also includes a testing framework for writing automated tests for smart contracts, which helps to ensure their correctness and reliability.

Overall, Solidity is a powerful language that is essential for anyone who wants to develop smart contracts on the Ethereum blockchain. It has a growing community of developers and is constantly evolving to meet the needs of the Ethereum ecosystem.

5.1.5 Metamask and Web3

Web3, also known as Web3.js, is a JavaScript library that allows developers to interact with Ethereum-based decentralized applications (dApps) using the Ethereum blockchain. It provides a simple and intuitive interface for communicating with Ethereum nodes and smart contracts.

Web3.js is built on top of the Ethereum JavaScript API (also known as the EthJS API), which is a low-level interface for interacting with the Ethereum blockchain. It adds additional features and abstractions to make it easier for developers to write dApps and interact with smart contracts.

One of the key features of Web3.js is its ability to connect to Ethereum nodes, which are the computers that run the Ethereum blockchain. It can connect to nodes using a variety of methods, including HTTP, WebSocket, and IPC (inter-process communication).

Fig 5.1.5.1 Web3.js

Once connected to a node, Web3.js provides a simple and consistent interface for interacting with smart contracts. This includes functions for reading data from contracts, writing data to contracts, and listening for events emitted by contracts.

Web3.js also includes features for working with Ethereum accounts and transactions, including signing transactions and managing account balances.

Overall, Web3.js is a powerful tool for building decentralized applications on the Ethereum blockchain. It simplifies the process of interacting with the blockchain and smart contracts, allowing developers to focus on building the business logic of their applications.

Metamask is a browser extension that allows users to interact with decentralized applications (dApps) on the Ethereum blockchain. It is a wallet application that allows users to securely store, manage, and use their Ethereum-based digital assets.

Metamask can be installed as a browser extension in Chrome, Firefox, Brave, and

other browsers, and it provides a simple and user-friendly interface for interacting with Ethereum-based dApps.

Fig 5.1.5.2 Metamask

Once installed, Metamask generates a wallet address and private key for the user, which are stored locally on the user's device. The wallet can be used to send and receive Ether (the native currency of the Ethereum blockchain) and other Ethereum-based digital assets, such as ERC-20 tokens.

Metamask also allows users to interact with smart contracts on the Ethereum blockchain, which are self-executing contracts that can be used to automate complex financial transactions and other types of digital agreements.

When a user interacts with a dApp that requires a transaction on the Ethereum blockchain, Metamask will prompt the user to confirm the transaction. The user can review the transaction details, including the amount of Ether or tokens being sent and the gas price (the fee for processing the transaction), before approving the transaction.

Metamask also includes features for managing multiple wallets, viewing transaction history, and configuring gas settings for transactions.

Overall, Metamask is a powerful tool for interacting with the Ethereum blockchain and dApps. It provides a secure and user-friendly interface for managing digital assets and interacting with smart contracts, and it has become a popular choice among Ethereum users and developers.

5.2 Methodology

There are various approaches to go through the process of making this product. We can simultaneously start developing front-end and back-end and integrate it in the end. Or we can design the front end and decide what backend functionalities we require, then go towards back-end development and finally integrate both. Either way, the integration modules are to be used at the end. In this case we went with the later approach as it saves time by deciding what functionalities are required beforehand and eliminates unnecessary efforts.

- The system will detect counterfeit products using QR (Quick response) code, where QR code is chained to a specific product and linked to smart contracts to scan the code using smartphones or any scanner devices. This will notify whether the products are original or fake.
- A company after verification of mail Id and registration process will be given

access to upload the product details with system generated QR code.

- The product details include brand and product name with manufacturing year, price, total quantity, quality of the product and also the details of manufacturer. This will be stored in a database(firebase) and QR code will be stored in a decentralized block using Blockchain technology.
- Each transaction of block will contain a unique QR code which cannot be reused by the manufacturer for different products.
- Manufacturers can make the tracing and identification process more secure and reliable by making use of serialized QR code which can show product information, engage customers and increase sales.
- Customer has to register/login to the system before scanning the QR or barcode of the product.
- After the completion of user authentication, the unique scanned code from the customer will be compared with the code produced by the manufacturer stored in blocks of smart contracts.
- If code matches, then the user will be notified that the product is original with all its details and authentic certificate from the database.
- If code does not match, the user will be notified that the product is fake which can prevent purchasing of falsified product and that may result in significant health or financial losses.
- Even a manufacturer can be benefited if the product is fake then the location of the user will be accessed with permission and alert will be 13 sent to the manufacturer who can take further legal actions on distributor, retailer and black-market manufacturer.
- This ensures customers trust on merchants and increases the user's satisfaction and also can save manufacturer time and money in fighting the defamation and sales because of forged manufacturers

5.3 System architecture

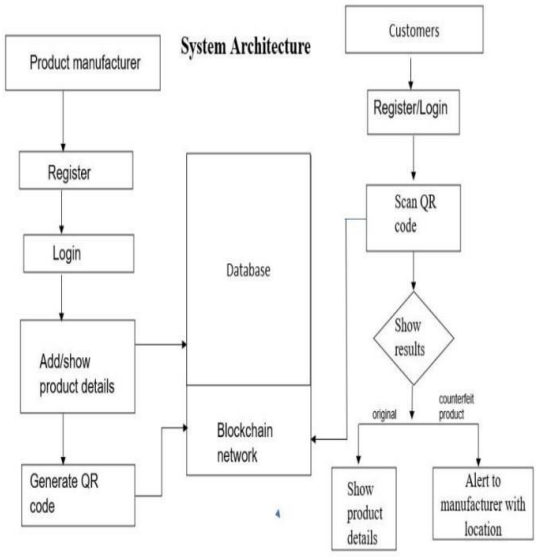


Fig 4.3.1 System Architecture

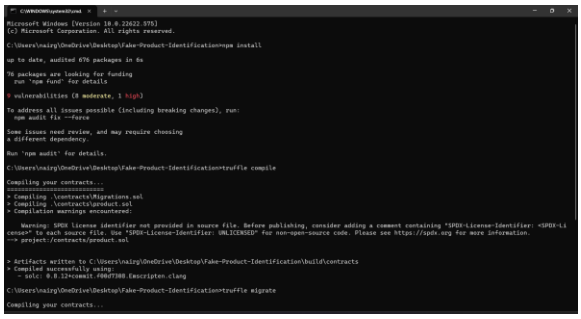
6. Implementation

The product is majorly divided into 2 parts i.e. the front-end and the back-end. Front-end is the client side website made using express js and node js. And, back-end side is the blockchain server and Ganache IDE.

Front-end:

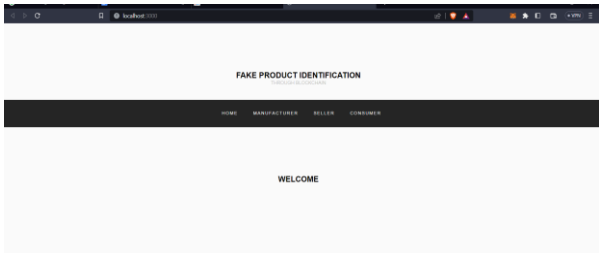
It's a website which our users can visit as either manufacturer or seller or consumer and manage their order and check the originality of the product easily. Few of the web pages showing process for both seller and manufacturer are shown below

Launching the app.js file:



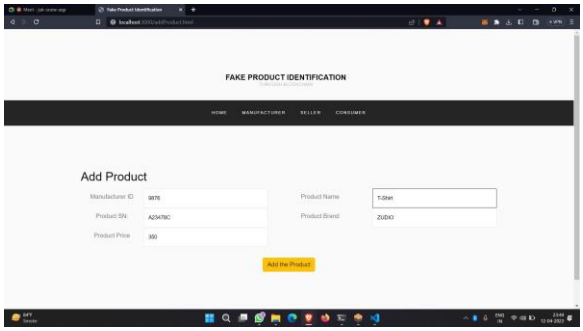
This is done using git bash and node js. All the web pages are routed through app.js file only and the backend is integrated here as well.

Home Page :

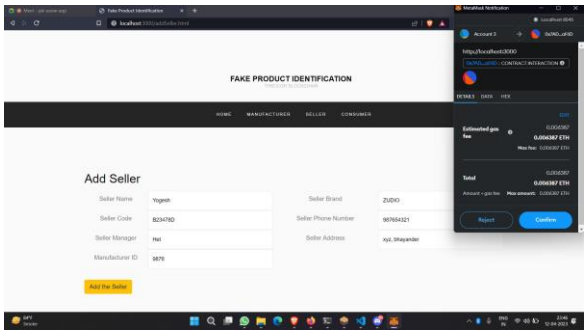


Manufacturer :

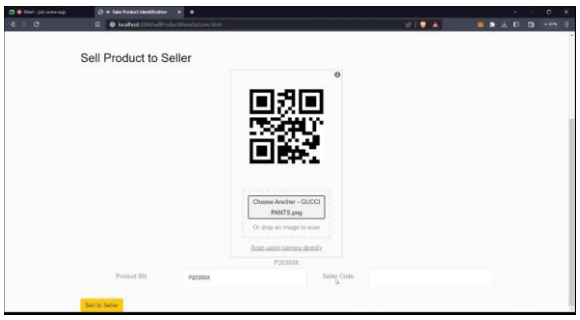
Adding the product from manufacturer in blockchain network



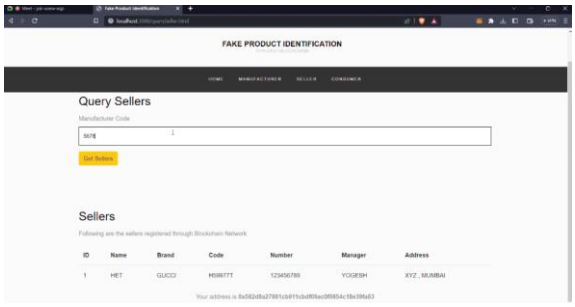
Adding Seller to Blockchain Network



Selling the product to Seller

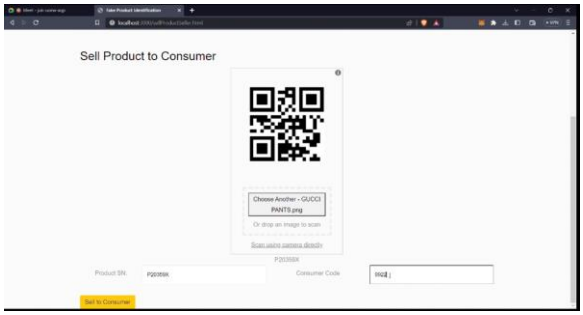


Query Seller



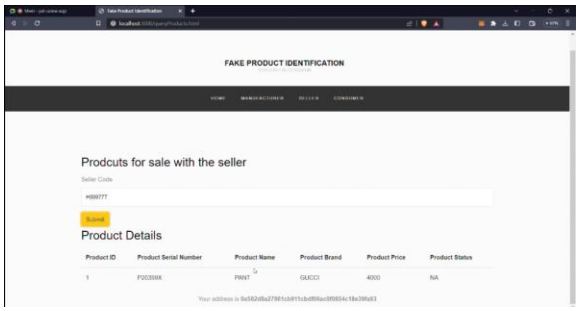
Seller :

Selling the product to consumer

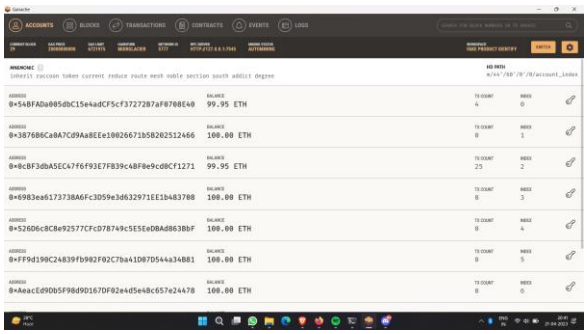


Here all the Ganache transactions are updated. The Ganache local Ethereum network displays all user accounts along with their balance. We can also see the list of transactions made by various users along with gas value for each transaction. All the complete copy of newly formed local blockchain is also seen here.

Products Available for Sale

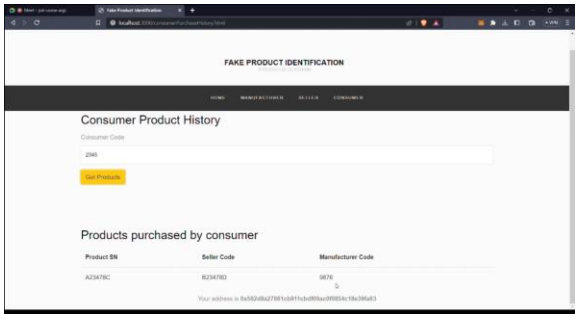


1. User Accounts

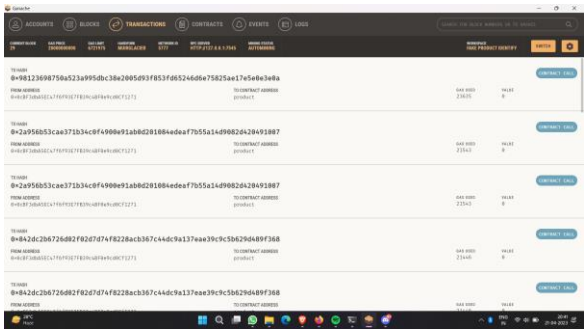


Consumer :

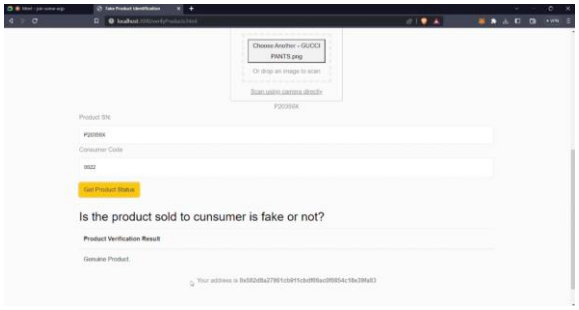
Consumer Purchase History



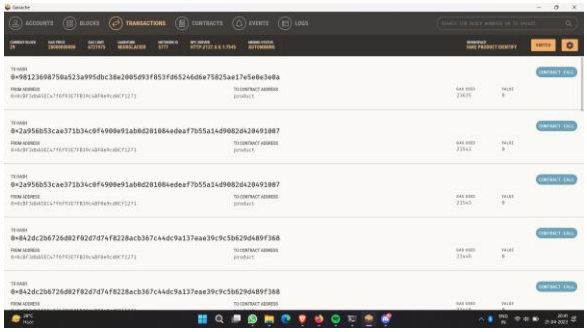
2. All Transactions



Verify Item



3. All Blocks in Blockchain



Back-End :

7. Deployment and Future Scope

7.1 Deployment

Once the implementation is successful, testing will be done for one function at a time.

The final product is expected to perform at the least basic functions like successful booking and transaction. Once all functions are proper, the smart contracts will be permanently deployed in the local Ethereum Environment after which the smart contracts cannot be modified.

As it is a website, ideally it should be hosted on the internet with proper Domain name and address. However, this is a final year project and will be demonstrated on the local computer itself.

7.2 Future Scope

There are several areas of future work that could be explored in the field of using blockchain for fake product identification. Some potential areas of research and development include:

1. Scalability: As blockchain-based solutions for fake product identification become more widely adopted, there will be a need to ensure that the technology can handle large volumes of transactions and data. Developing more efficient consensus mechanisms and optimizing the blockchain architecture could help address scalability concerns.

2. Interoperability: Different blockchain networks and platforms can have varying standards and protocols, which can make it challenging to create interoperable systems for fake product identification. Further research could be done to establish interoperability standards and protocols that can be used across different blockchain platforms.

3. Integration with other technologies: Blockchain technology could be integrated with other technologies, such as artificial intelligence, to enhance the accuracy and efficiency of fake product identification. For example, machine learning algorithms could be trained to detect patterns in supply chain data and identify potential instances of counterfeit products.

4. Regulatory frameworks: The use of blockchain for fake product identification raises important questions about how such systems will be regulated and governed. Future work could explore the development of regulatory frameworks that ensure the privacy and security of consumer data, while also facilitating the adoption and implementation of blockchain-based solutions.

5. Adoption and implementation: Finally, there is a need for research on the practical implementation of blockchain-based solutions for fake product identification. This includes assessing the cost-benefit analysis of implementing such systems, as well as identifying the key stakeholders who will need to be involved in the adoption and deployment process.

8. Conclusion

Based on current research and development in the field of blockchain technology, it is possible to use blockchain to help identify and combat fake products. By creating a secure and immutable record of a product's origin and journey through the supply chain, blockchain can increase transparency and reduce the risk of counterfeit products entering the market.

One potential use case for blockchain in fake product identification is through the use of unique identifiers, such as QR codes or NFC tags, that can be scanned by consumers to verify the authenticity of a product. This information can be stored on a blockchain ledger, allowing consumers to track the product's journey from the manufacturer to the point of sale.

Additionally, blockchain can enable greater collaboration and information sharing among supply chain participants, helping to identify and address issues related to fake products. By providing a decentralized and transparent platform for sharing information, blockchain can help prevent fake products from entering the market and increase consumer trust in the products they purchase.

Overall, while there are still challenges and limitations to implementing blockchain-based solutions for fake product identification, the potential benefits make it an area of ongoing research and development in the blockchain industry.

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