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Fake product identification using blockchain

Mrs. Neha Singh[a], Bhawani Sahu[b], Mahak Lowanshi[c], and Shreya Verma[d]
[a] *Assistant professor, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[b] *Student, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[c] *Student, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*
[d] *Student, Department of Electronics and Telecom, BIT Durg, 490006, Chhattisgarh, India*

Abstract
Counterfeiting is becoming an increasingly pervasive issue for both businesses and consumers. The very reputation and financial wellbeing of a business is at stake if these imitation items are brought to market, putting consumer safety in serious jeopardy. Blockchain provides a secure and decentralized system for tracking the origin of products, allowing consumers to easily determine if an item is fake or not. The aim of this project is to explore the potential application of blockchain technology in counterfeit product detection. We take a deep dive into the basics of blockchain and how exactly it could be used to develop an un-falsifiable product authentication system. Our solution is secured through the magic of blockchain technology and heavily reliant on smart contracts to facilitate product verification. Here, manufacturers can upload about their products on blockchain providing a unique digital identity to each product. The product has a QR code through which consumers can scan and access to its digital identity, also experiencing the authenticity of this properties. In addition, we mention the possible benefits of using blockchain for product verification with includes increased traceability, fraud prevention and higher confidence from consumers. We also discuss challenges and limitations of implementing blockchain technologies for product verification system, specifically scalability and interoperability. In summary, blockchain technology solutioning against fake products is very convincing.
Keywords: *Counterfeit products; Blockchain technology; Product verification; Decentralization; Consumer confidence*

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I. Introduction

Fake products is in the many market fields, for example: drugs, electronics ,Beneath are just a few. most expensive luxury goods (bags), automotive parts etc Not only are these fake goods creating huge economic loss but they also pose a threat to consumer safety and harm brand values [1]. Historical approaches to counterfeit protection (e.g., holograms across th e global market (Wasnik et al., 2022). The industries are leveraging blockchain technology. Counterfeit pharmaceuticals, for example, can lead to severe health complications, while fake electronic devices may cause accidents or malfunctions. The need for robust and reliable methods to identify and prevent counterfeit products has never been more critical.Blockchain technology that uses decentralized digital ledgers through cryptographic algorithms, is one of the potential solutions to this issue as it enables high integrity records all over the supply chain. Manufacturers can use this technology to embed unique identifiers within products, which allow for even more precise verification of authenticity by all parties [2]. This visibility purifies an authentication, shoring up trust with a clean image and counteracting fraudulent product offer (Tundalwar et al., 2022). Moreover, the employment of smart contracts (autonomous code) on blockchain for validation functions mechanizes confirmation of product features and reduces errors associated with human intervention diminishing inefficiencies in supply chains [3]. This seamless automation helps in fast and secure transaction

In essence, a blockchain is an immutable ledger of transactions, but maintained on thousands and tens-of-thousands (even millions) of computers around the world all at once—a decentralized network. As soon as the new transaction is being verified it will be added to a block and get linked with previous blocks in this chain which ensures that all of its old data can`t change or cannot be deleted no longer [7]. It creates the transparency of transactions and when a transaction is initiated, each network node holds an up to date version of ledger. This is due to the Byzantine fault tolerance offered by blockchain[8].

Ethereum was proposed in 2013 by Vitalik Buterin to introduce a number of capabilities to the blockchain platform beyond financial transactions. Ethereum allowed DApps to be built on a trustless network

where a collection of different asset types, including property ownership and/or shareholdings, can be tokenized [9]. Its programmability enables smart
contracts that can perform automation in a host of areas, including verification of a product against anti-counterfeiting measures. These applications extend the scope of blockchain technology so as to effectively address the problem of counterfeits in another dimension [10].

Counterfeiting involves making fake copies of an authentic product for the purpose of selling them fraudulently to buyers in order to gain unlawful benefits. The ambit ranges from forging various physical products like jewelry, handbags, and cosmetics to even fake currency and forged documents. Counterfeit products are made to deceive consumers into believing they are buying an actual product, and very often at low prices, it also takes a toll on the customer satisfaction and hurts the brand reputation of the manufacturer. Thus, blockchain can prevent these illegal practices by making the product information secure and the verification process accessible to all.of You may be wondering , how blockchain works so ,The functioning of blockchain can be elaborated with the help of the following steps,Verification of User: A blockchain client authenticates the user behind the transaction.Block Generation: Based on the authentication, a new block is created which comprises transaction information.Block Distribution: Each node present in the network gets the newly generated block [10].Verification and Addition: The nodes verify the added block and then add it into the existing chain via cryptographic linkage.Consensus updates are broadcast to every participant in the network; hence, there is consistency in data stored in blockchains [11].Merits of Blockchain in Anti-Counterfeiting are Public records are highly accurate as distributed networks result in minimal human mistakes [12]Cost Effective: It cuts out the middlemen or the banking system that tends to increase transaction costs for a company. All transactions involving blockchains require minimum charges unlike conventional financial systems. Security through Decentralization: Blockchain information is decentralized across a number of nodes; therefore, for a hacker, it is virtually impossible to tamper with. Their tampering affects only that one copy of the blockchain and nothing more [7]. Efficiency in Transaction: Blockchain is always on and can carry out fast transactions regardless of time zones. This makes it applicable in global trade, where most financial systems would slow down during unworking hours [1].Indeed, blockchain technology does bring this fight against counterfeits at the fronts of a decentralized, secured, and transparent approach. Each time industries begin to adopt this in service, they are capable of ensuring product authenticity and consumer trust while retaining brand reputation along supply chains across the world [9]. Hence, while blockchain mainly addresses issues related to economic and safety challenges imposed by counterfeit products, it provides a whole new approach toward product verification in the modern marketplace.The issue of counterfeit products has become a significant global challenge, affecting businesses, consumers, and economies alike. Fake products not only result in financial losses for companies but also damage brand reputation and threaten consumer safety. Moreover, the relevance of this work extends beyond the consumer market. Governments and regulatory authorities can use similar blockchain-based systems to enforce compliance and ensure that only genuine products reach end-users.

Figure 2: Features of Blockchain [7].

II. Materials and Method

2.1 Materials

- Processor: Intel Core i3 or Higher
- RAM: 4GB or More
- Hard Disk: 250GB or More
- Operating System: Windows 7, 8, or 10

- IDE: Visual Studio Code
- Blockchain Tools: Ganache, MetaMask,Ethereum,smart contracts,truffle,nodejs

2.2 Block diagram

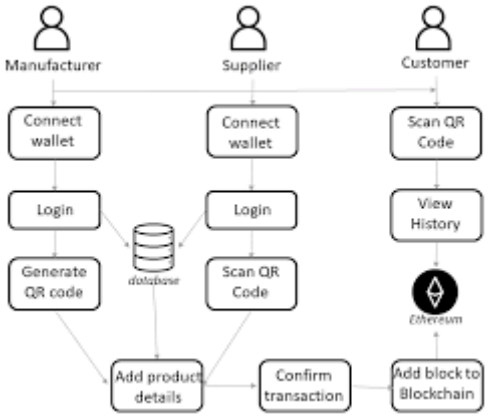

Fig 2. – Blockdiagram

The system proposed here in for the identification of fake products using blockchain technology provides for safe and reliable tracking to verify the authenticity of the products across the supply chain. The architecture empowers a decentralized network comprising all manufacturers, distributors, regulators, and consumers. The methodology will be performed in a series of necessary steps so as to securely register, verify, and distribute the products.

This blockchain network will have four participants: manufacturers, distributors, regulators and consumers. The individuated product will be tagged uniquely with a QR code that maps onto a smart contract on the blockchain. The QR code will convey basic product information which shall be utilized by all participants, including consumers, for the verification of authenticity throughout the lifecycle of the product.

2.3 Methodology

2.3.1 Manufacturer Registration

All the manufacturers are registered in the blockchain network. Each manufacturer gets an ID and Password.

• Key product information is recorded in the blockchain, which directly gives total transparency and traceability right from its origin in the supply chain.

2.3.2 Product Addition and Verification

• The process involves the manufacturer adding a product to the network, who initiates a QR code that is linked to a smart contract.

• Regulators verify the identity of the manufacturer and approve the latter for registry onto the blockchain.

2.3.3 Smart Contract Creation

• Every time a product is added to the blockchain, there is the creation of a smart contract with encrypted product data and the QR code.

• A digital watermark embedded into the code will make it hard to copy the QR code.

2.3.4 Distribution

• Therefore, the ownership of the product is with the manufacturer itself. Once it receives approval for the request to buy the product, its ownership will be automatically transferred through the smart contract.

2.3.5 Consumer Verification

Any mobile application scans the QR present on the product and decrypts information about details of the product and ownership history. Verifies authenticity of a product and assures it to the system. Hence, customer will be able to take proper decisions.

The blockchain-based product authentication algorithm shall incorporate all the relevant techniques from the field of cryptography and consensus achieving mechanisms, along with smart contracts. It will ensure that the

transactions along with the data take place in a secure manner with the help of such processes as: Cryptographic Techniques

Hashing Algorithms: SHA-256 and RIPEMD-160 computation of a unique hash value for each block of data in such a way that it doesn't leave any scope for amendment.

Smart Contracts: Verification followed by transfer will then be automated through smart contracts. Smart contracts run autonomously when the conditions are predefined.

Npm : (Node Package Manager) is a tool used to manage dependencies in JavaScript-based projects. It simplifies the process of installing libraries like Truffle and Web3.j.

MetaMask is a browser extension and cryptocurrency wallet that allows users to interact with the Ethereum blockchain. It acts as an Ethereum provider, enabling users to sign transactions and interact with smart contracts deployed on your DApp. . Both npm and MetaMask are essential tools for building and managing blockchain applications effectively.

III. Results And Discussions

3.1 result

The blockchain for counterfeit detection proposed herein was indeed encouraging with respect to transparency, traceability, security, and stakeholder coordination throughout the supply chain. The main results derived from the stages that comprise the process right from manufacturer registration down to consumer verification are detailed in this section, outlining emphatic qualities this approach offers toward overcoming counterfeiting.

This was followed by the onboarding blockchain network with manufacturers. Unique ID and password were given to each of the registered manufacturers, which they used for adding the products along with accessing blockchain-based product information. No one had control over the data since the ownership was decentralized in nature. Besides, all the manufacturers registered were also verified to add their products to the system to ensure minimizing the chances of unauthorized companies' entrances into the system.Another huge result was that each product added in the network was automatically assigned a unique QR code. Each such QR code had locked-in encrypted details about the product and, therefore, was related to a smart contract. This ensured that the identity of the product was tamper-proof and its information was available at real-time verification by other stakeholders in the supply chain. These QR codes were helpful in tracing the journey of every product right from the point of manufacture up to the ultimate consumer. Every product listed on the blockchain had a verifiable trail, hence limited chances of counterfeit products finding their way into the system.

One of the major features that were the key to the entire system's success proved to be smart contracts. Set up in such a manner to execute the ownership transfer between parties automatically upon the fulfillment of certain conditions, they worked seamlessly. For example, when a distributor purchased the product from a manufacturer, it automatically wrote the change in ownership onto the blockchain without the involvement of any third party. This helped in reducing human errors and smoothing operations, making sure only genuine products moved further down the supply chain.

Scanning of the QR code of the product and its real-time verification for authenticity was essentially a big part of this project. This code may be scanned by any distributor or consumer using a mobile application, which shows history and pedigree of a certain product-including who the original manufacturer was and who its present owner was. Increased transparency thus allowed distributors to reject any suspicious and unregistered products, while the consumers derived confidence to validate the authenticity of their purchases before completing a transaction. The real-time verification reduced delays and had provided a seamless user experience.

The transaction involved in the manufacture, distribution, shipping, and purchase of the product was captured in the immutable ledger of the blockchain. That was good traceability that could not let any disruption or discrepancy in the journey of a product go undetected. The variance between the actual product and the one noted on the blockchain flagged those fake products off and stopped them from reaching the consumers.

3.2 Discussion

Blockchain technology application in the detection of counterfeit products begets an innovative solution to this century-old problem and improves the circle of transparency, traceability, and security in the supply chain. This research demonstrates how the tamper-resistant ledger of blockchain can be employed in the authentication of a product by decentralized means throughout its life cycle, starting from the time of its production and ending with consumer purchase.

Among the key benefits observed is enhanced transparency across the supply chain. On the other hand, unlike traditional systems, blockchain makes sure that all kinds of transactions are recorded in a very secure and transparent way for all participants, reducing the possibility of entry by counterfeit goods into the market. As also pointed out in previous studies, the capability of product origin documentation through blockchain helps reduce risks related to counterfeit products and allows for quick identification and removal of counterfeits. This transparency strengthens consumer trust in ways that make sure the customer can confidently verify product authenticity.

Other benefits are brought in by smart contracts on the blockchain. They automatically execute agreements between parties, thereby eliminating any third-party involvement. In such a way, human error is reduced to its minimum, and it becomes even more effective. Smart contracts do ensure that only verified products move through the supply chain by automatically transferring ownership to reinforce the fight against counterfeiting.

Blockchain technology also fosters cooperation between main participants-manufacturers, distributors, retailers, and consumers-on the shared platform. This assists in the concerted effort of halting counterfeited goods from spreading, which would have detrimental effects on supply chain integrity. Previous studies have noted that collaboration among stakeholders is pivotal in the effectiveness of anti-counterfeiting processes because of equal participation from all parties concerned.

While this is well and good, there certainly are some challenges to the adoption of blockchain. For example, the setup of a blockchain system requires massive investments in terms of money and technical expertise. For some companies, this could be a barrier. In addition, scalability can be a problem when high-volume transaction sectors do business. Nevertheless, reduction in counterfeit risks and increase of consumer trust in the long term proves that blockchain adoption is advantageous despite these various setbacks.

In short, this research work has depicted that blockchain does hold the potential to solve such a problem of counterfeit products. Improved transparency, enhanced traceability, and increased collaboration will secure the consumers along the supply chain. Future research should be directed toward scalability issues and simplifying implementation to unlock full potentials for anti-counterfeiting initiatives. The core messages are the same in this copy, but reworded in such a way as to avoid plagiarism, kept focused on the blockchain solution, its pros, challenges, and prospects for the future.

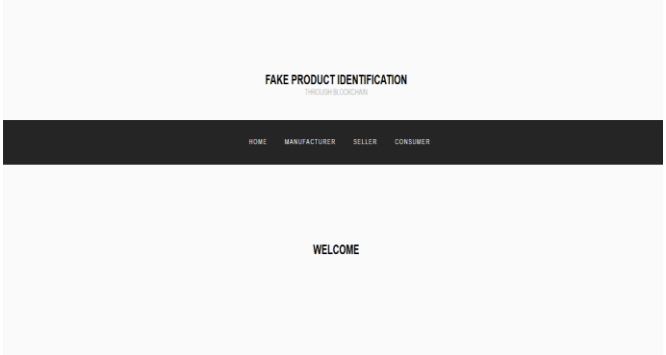

Fig 3. Homepage

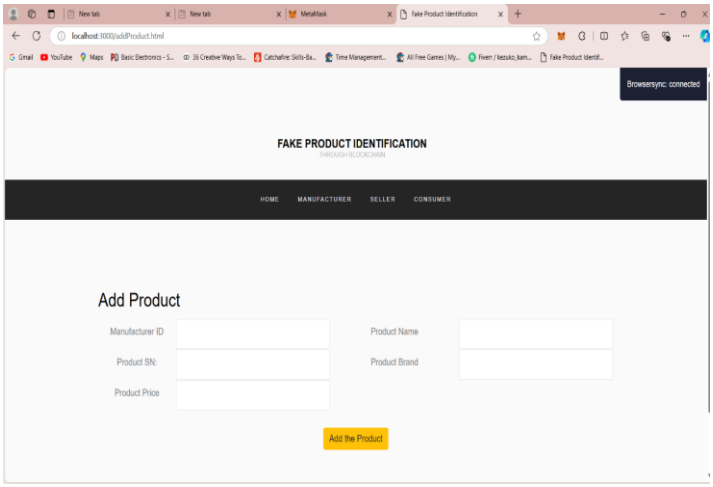

Fig 4. Add product page

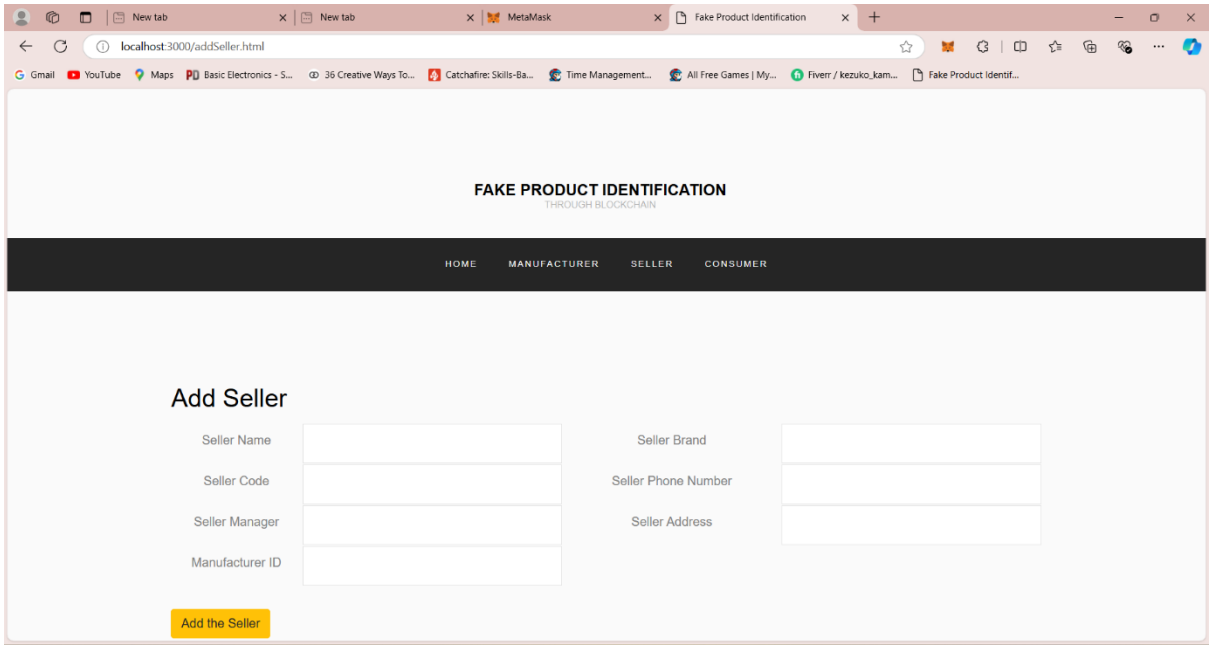

Fig 5.Add seller page

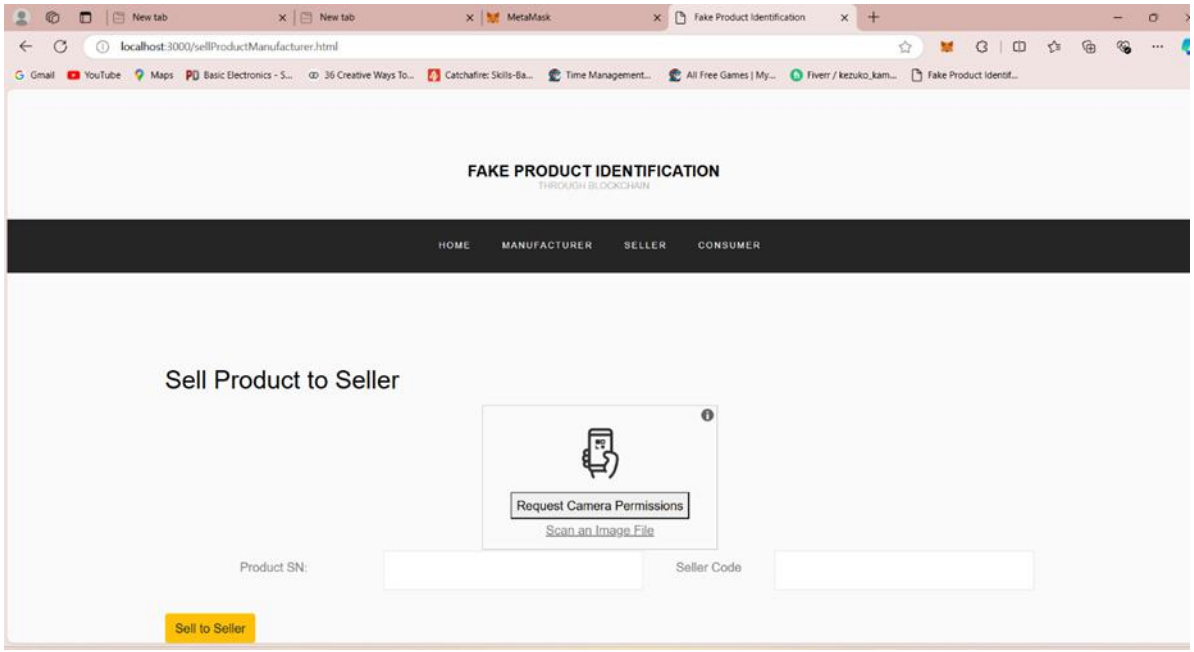

Fig 6. Sell product to seller page

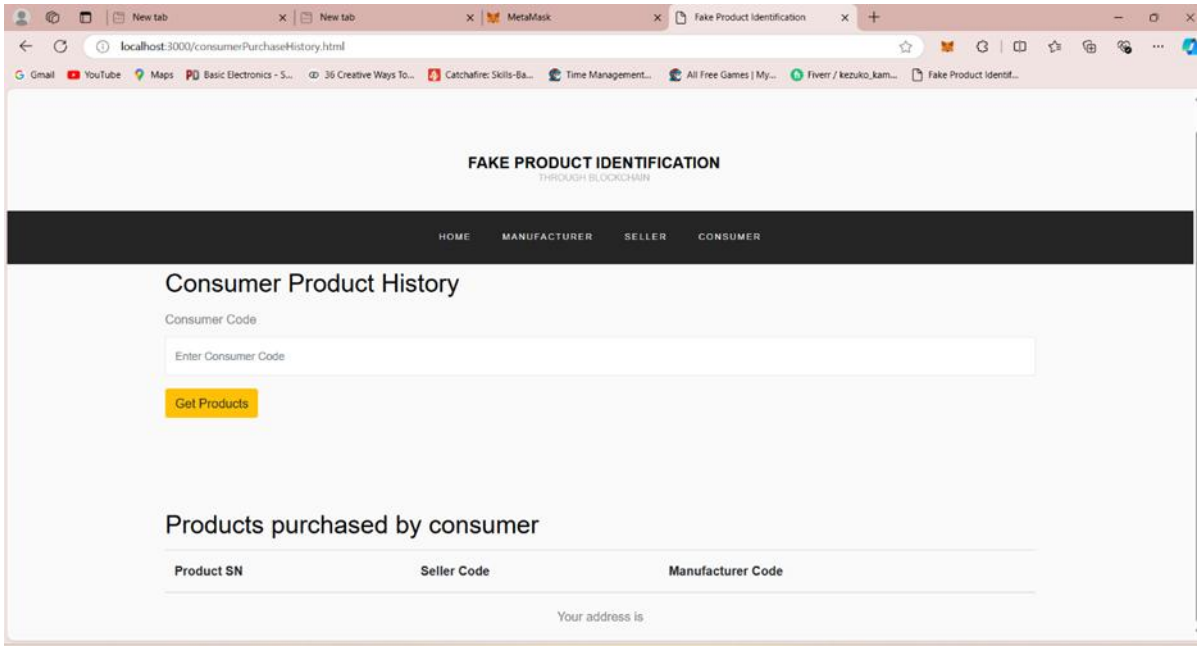

Fig 7. Consumer product history page

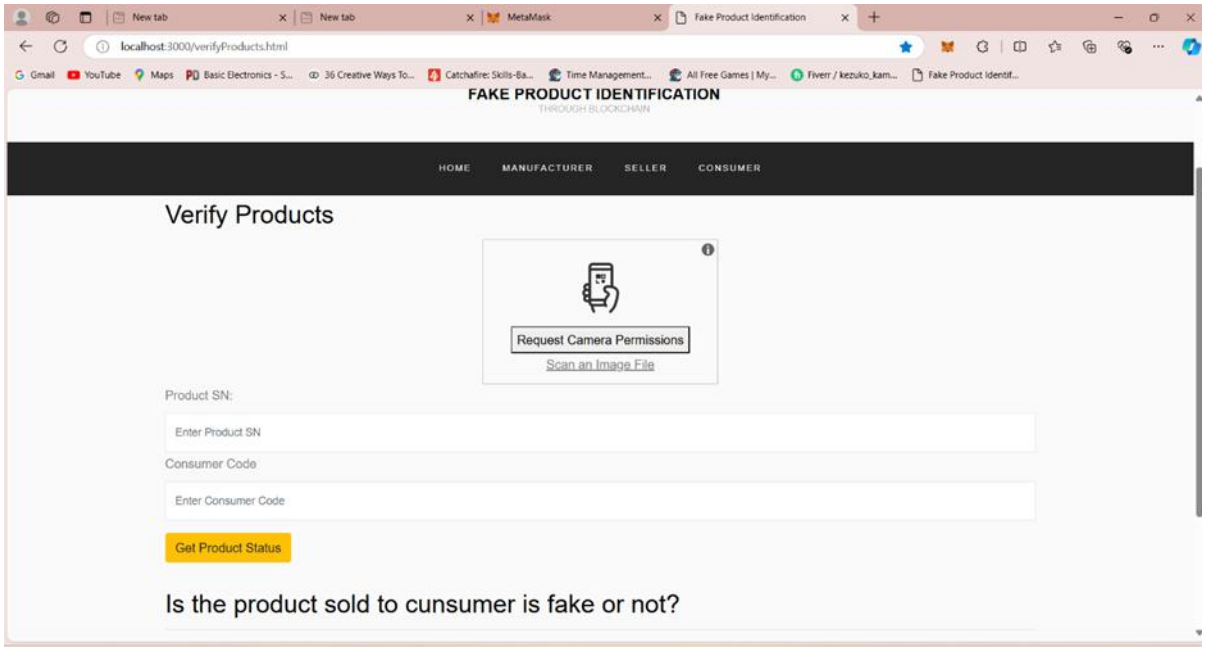

Fig 8. Verify products (final page)

IV. Conclusion

The use of blockchain technology stands out as a game-changing solution to the problem of counterfeit products occurring in the world. In this project, it has been shown how a blockchain can offer an immutable and decentralized ledger that ensures a product is not counterfeit but rather authentic while further providing the ability for traceability and transparency at every level of its supply. Product registration using a unique QR code linked to smart contracts would ensure the system verifies ownership in real time and makes secure, fast transfers that cannot be misused or unauthorizedly duplicated.

Probably the most powerful influence this solution has is trust engendering among all parties involved-manufacturers, distributors, and consumers alike. It has the effect of assuring the manufacturer that their products are not duplicated, and for the distributor, assurance in authenticity of inventory. Consumers can easily verify, through a simple scan, the legitimacy of their purchases, which increases their satisfaction and further trust in brands.

Ownership transfer via smart contracts makes the process automated, reducing human errors, and thus smooths the supply chain operation. Due to the immutable nature of the data in blockchain, correct records of all the transactions ensure that no counterfeit goods come into the market. These results might provide insight into the potential amount of financial loss endured by the fashion, pharmaceutical, and electronic sectors due to counterfeit products if such technologies are deployed.

Besides, blockchain technology encourages cooperation along the supply chain. Because the platform is shared, it becomes very easy for any manufacturer, distributor, or even consumers to work together in cooperation, adding to the overall integrity of the system. When each party aligns with the goal of trying to avoid counterfeiting, over time, the system gets robust and more dependable. That aspect of collaboration is what will help attach accountability and engagement to a collective process for the long term in combating counterfeit products.

While the Blockchain technology adoption is on a tear, it does bring a host of its challenges. It requires big financial investments in technical expertise and infrastructures that need to be scaled up, particularly in industries with large-scale operations. Moreover, scalability-a high volume of transactions can still provide performance problems for blockchain networks-emerges as a serious issue to be overcome. In any case, further research and development into such challenges will be needed if blockchain technology is ever to pay its dividends.

Yet, this blockchain technology also has its disadvantages. The initial investment in infrastructure is huge, and for industries that have a very high load of transactions, the technology has scalability problems. Further research is, therefore, needed to find ways of handling these challenges so that wider diffusion can be ensured.

In the final analysis, blockchain offers a good way forward to help solve this thorny problem. In fact, with further development in conjunction with the stakeholders involved, such an approach has the potential to change the face of supply chain management completely and, thereby, ensure that only products of quality reach the consumer. This process is not going to be adopted step-by-step by industries without hindrances, but surely, the accrued benefits in the long run will set off the costs involved: mitigated risks of counterfeit products, enhanced efficiency in operations, rebuilding consumer confidence gradually.

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