

## ETHEREUM REINFORCED FRAMEWORK FOR FAKE PRODUCT IDENTIFICATION

**J.Madhula Veronica**

MSc -Computer Science & Technology, Women's Christian College, Chennai, India  
madhula.veronica@gmail.com

**Dr.K Glory Vijayaselvi**

Associate Professor, Dept of Computer Science & Technology, Women's Christian College  
Chennai, India, gloryvijayaselvi@wcc.edu.in

**Abstract**-In recent days, fake products have a big impact in product manufacturing industries. This affects the sales, profit and reputation of companies. Blockchain technology can be used for identification of real products and detect the fake ones. Blockchain technology is a distributed, decentralized digital ledger that keeps track of transactions stored in blocks that are linked together through chains. Blockchain technology is secure, as the data stored once in the chain is immutable and the blocks cannot be changed or hacked. Customers or consumers do not need to rely on third parties to certify the legitimacy and safety of a product with the help of blockchain technology. In this paper, Ethereum - Blockchain is used to add a QR (Quick Response) code to the products while manufacturing. This is to detect original product based on the QR code. This system uses QR codes that provides a robust technique to fight against the practice of counterfeiting the products. When a product's QR code is connected to Blockchain, counterfeit goods can be found using a QR code scanner. So, this system is used to store product details and generate unique QR code of that product. The product details along with its QR code are stored as blocks in the blockchain. It collects the unique code from the user and compares the code against the entries in the Blockchain. If the code matches, it gives the information of the product else it will give the notification to the customer that the product is fake. The proposed framework with Ethereum helps the developers to develop a decentralized application with higher security.

**Keywords**— Blockchain, Ethereum, QR Code, Fake Product, Smart Contracts

### Introduction

The current Supply Chain contains a large number of counterfeit goods. It is necessary to have a system for end user to check whether the product is genuine or not. Counterfeit goods have been a significant factor in the manufacturing of goods in recent years. Block technology is used for the identification of real products and detect fake products. Blockchain is a distributed, decentralized network that exists simultaneously on numerous computers. Blockchain is decentralized and immutable which simplifies the tracking of assets and the recording of transactions within a corporate network. Blockchain is also referred as a decentralized ledger that tracks digital assets on a peer-to-peer network. On a blockchain network, virtual value of anything may be tracked and traded which lowers the risk and expenses for all users. The decentralized, distributed ledger maintained by blockchain technology is made up of

unchangeable, extremely secure blocks connected by chains. This technology makes it possible for customers to independently confirm the legitimacy of a product, which benefits both the customers and the product's owner. [1]

Figure 1 depicts the overall architecture of the proposed system.



**Fig.1 System Architecture**

A traditional supply chain offers centralized networks, which are unsafe since the company selling the service or the product has control over the data and is free to modify. Counterfeit goods are produced in order to earn profit by cheating the consumers. As mentioned earlier, traditional supply chains offer centralized networks, whereas blockchain offers decentralized networks, and each transaction includes the data value for the commodity. This is accomplished by establishing a record whose veracity can be checked by everyone in the network as blockchain operates on a peer-to-peer basis. The manufacturer might use this approach so that the duplicates can be easily identified and the buyer receives genuine products. This will contribute to preserve the client's confidence and raising the market worth of the product's brand. Each block in a blockchain is made up of data, a hash, and the previous block's hash. Both the data and the hash contain the necessary information. As the person changing the data must hold the majority of the network, it is impossible to change the data of any block. The hash will change if we attempt to modify any block's data. As a result, the immutability of the data in blockchain technology makes it as a significant advantage over traditional centralized design, ensuring that the buyer purchasing the goods receives accurate information about it.

### **1.1 OBJECTIVE OF THE WORK**

- To use Ethereum blockchain to improve the security level.
- To propose a framework to identify fake products in the supply chain management system.

## **2 BLOCKCHAIN**

Blockchain is a distributed, decentralized, peer-to-peer network that acts as a digital ledger (a digital record of transactions or data held in several locations on a computer network) that is immutable (unchangeable, meaning a transaction or file recorded cannot be modified).[2]

Immutability and transparency are the two essential characteristics of a blockchain. One can always rely on the ledger's accuracy because of its immutability. This distributed nature of the blockchain shields it from network intrusions. Each entry or record on the ledger is kept in a separate "block." For instance, blocks on the blockchain for Bitcoin typically contain more than 500 Bitcoin transactions. A chain of transactions is created over time as a result of the dependence and connections between the data in each block, which are linked to one another. Therefore, the term "blockchain" is used. In order to manage orders, payments, accounts, and other transactions, you can utilize blockchain technology to establish an unchangeable or immutable ledger. A common picture of these transactions is made consistent by the system's built-in features, which also stop illegitimate transaction submissions.[3]

## 2.1 WORKING OF BLOCKCHAIN

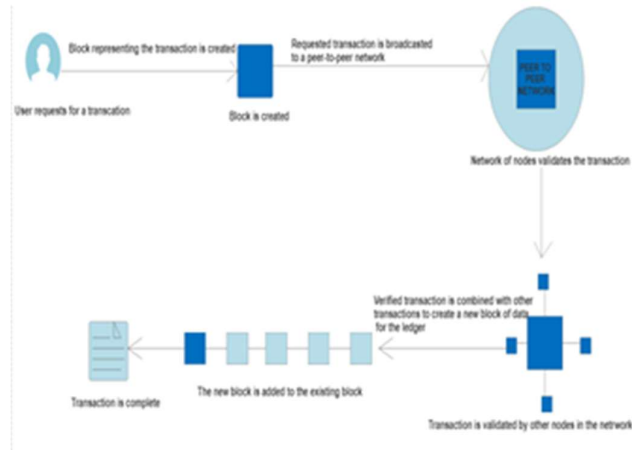


Fig .2 Working of Blockchain

1. Request for Transaction: When the blockchain network receives a new transaction, all the data that needs to be communicated is double encrypted.
2. Verifying transaction: The transaction is sent through the global network of peer-to-peer computers. If there is sufficient balance available to complete the transaction, all nodes on the network will verify its legitimacy.
3. Forming a new block: There are many nodes and multiple transactions are confirmed at once in a typical blockchain network. The transaction will be included in the mem pool once it has been confirmed as valid and proclaimed so. A mem pool is created by all the verified transactions at a specific node, while a block is created by several mem pools.
4. Consensus Mechanism: To make a block permanent, the nodes that generate it will attempt to add it to the blockchain network. Nevertheless, if every node is permitted to add blocks in this way, the blockchain network will no longer function as intended. The nodes utilize a consensus process to address this issue and guarantee that each new block added to the blockchain represents the sole version of the truth accepted by all of the nodes. Only a valid block is then safely attached to the blockchain. We refer to the node that is chosen to add a block to the blockchain and it is done with the help of “miners”. For that block, the consensus algorithm generates a hash code that is necessary for adding the block to the blockchain.
5. Adding blocks to blockchain: Once the freshly formed block has been authenticated and assigned a hash value, it is prepared to be added to the existing chain. A blockchain is made up of blocks that are cryptographically connected to one another through the inclusion of the hash value of the preceding block in every new block. The open end of the blockchain receives a fresh block.
6. Transaction completion: The transaction is finished as soon as the block is uploaded to the blockchain, and the specifics of this transaction are permanently recorded in the blockchain. Anybody can obtain the transaction's specifics and confirm the transaction.[4]

## 2.2 FEATURES OF BLOCKCHAIN

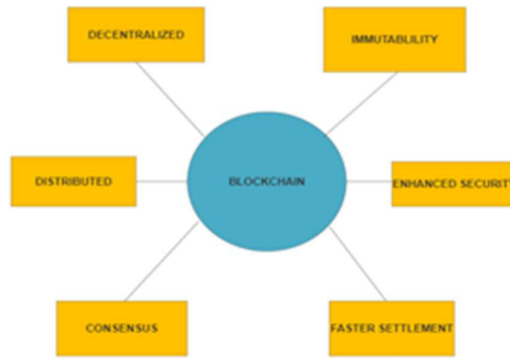


Fig.3 Block chain Features

1.Data stored is immutable: The key benefit that establishes blockchain as the most innovative and resilient technology of the future is the ability to create immutable ledgers. A centralized database has a degree of risky faith in external parties. But with blockchain, the ledger continues to advance indefinitely and maintains the data's security.

2.Decentralization: All the information is contained in a single network, which makes managing entities very simple. The blockchain does not have the idea of a centralized system, hence no single entity has complete power. One of the most effective ways to move the web towards decentralization is through a Blockchain network. Decentralization, makes the technology excellent for digital currency and for many other uses. The technique enables members to share a private key, which gives them access to the public key, directly. It offers the owner the freedom to be more secure and to make decentralized transfer of their digital asset to anybody they wish.

3.Distributed ledger: One of the fundamental components of blockchain is "distributed ledger." The use of technology makes it possible for users to observe all the details of a transaction through a digital ledger. Every action that is taken and disseminated throughout the network will be recorded. Activities can be tracked in real-time since no one else has the ability to edit, remove, or update them. As a result, it is very simple to maintain track of the procedure by giving each user an authentic copy of the ledger, this empowers them to examine and confirm the transactions.

4.Security of Data: Blockchain encourages encryption to guarantee data security. One of blockchain's outstanding qualities is this. The network offers a safe data storage by enabling users to maintain control over their data. Data security is made more secure because of blockchain's transparency. Since it is an open ledger, anyone may join the network at any time and verify all the information on it. Members also share a single version of the truth, allowing you to see all the specifics of a transaction from beginning to end.

5.Consensus Mechanism: Every blockchain technology has a consensus algorithm, which greatly enhances the effectiveness of the blockchain technology. Using the consensus mechanism, all acts are validated and confirmed on the blockchain. For various blockchains, multiple consensus algorithms exist. For the active nodes on the network, consensus makes decision-making simpler and better. Each algorithm employs a different strategy to enhance decision-making and address the shortcomings of the previously mentioned network. Every

blockchain must develop a consensus algorithm in order to advance the web towards a decentralized network.

6.Faster Settlement: Blockchain technology eliminates the middleman to increase the transactional speed and efficiency. The scope of blockchain expands with transaction speed. The information can be delivered most effectively using the blockchain network. Additionally, it offers immediate, verified, and entirely visible data that is stored on an immutable ledger. Blockchain promotes quicker transaction movement and speeds up the actions, saving time and money over the long run.[5]

### **2.3 IMPORTANCE OF BLOCKCHAIN**

For storing financial transactions, traditional database methods provide a number of difficulties. Take the sale of a property, for instance. The property belongs to the buyer once the money has been exchanged. Both the buyer and the seller can independently keep track of the financial transactions, but neither source can be relied upon. Both the buyer and the seller can claim that they have paid the money even when they haven't, and both parties can readily deny doing so. Transactions must be monitored and verified by a dependable third party to prevent potential legal problems. The existence of this centralized authority not only makes the transaction more difficult, but it also establishes a weak spot. Both parties may be harmed if the main database is compromised. Blockchain eliminates these problems by developing a decentralized, unchangeable mechanism for transaction recording. Blockchain generates separate ledgers for both the buyer and the seller in the case of a real estate transaction. All transactions are subject to both parties approval and are automatically updated in real time in both of their ledgers. These characteristics of blockchain technology have made it useful across a wide range of industries, including the development of virtual currencies such as Bitcoin. Applications that allow many parties to deal directly via a peer-to-peer network without a need for a central authority to oversee transactions created using blockchain technology. There is no one network owner, and each network participant has access to a shared ledger that records all transactions in an immutable and cryptographically secure manner.[6]

Supply chain industries can use blockchain to record production updates to a single shared ledger, providing total data visibility and a single source of truth. Companies can access a product's status and location at any moment because transactions are constantly time-stamped and accurate. By doing so, problems like fake products, noncompliance, delays, and wastage can be reduced in supply chain. Moreover, the ledger audit trail ensures regulatory compliance and allows for quick response to situations such as product recalls. Additionally, supply chains can automate monitoring the circumstances of production, transportation, and quality control by merging blockchain with intelligent technologies like the Internet of Things. As a tool to confirm the legitimacy of products and moral supply chain procedures, businesses can also decide to share track and trace data with their clients.[7]

### **3.LITERATURE REVIEW**

Nilu, Udhaya et al [8] aimed to detect the fake medications. By including additional information on the medication in its QR code, this has been made possible. Python and My SQL were used in the creation of the fake product identification system. With the use of block

chain and encrypted QR (quick response) code security, this paper attempted to address the problem of drug safety. The user is made aware of fake medications by the web application developed. Each product will have a QR code created by the manufacturer. The consumer can then utilize a QR code on the website to purchase the medication. It will produce a bogus identification if the medication is fake.

Hongekar, Avishkar et al [9] surveyed some papers and projects related to the topic and studied how they have implemented their systems. By using this information, the Author has planned to develop the system to identify fake products. Author has also discussed about solutions to fight against malpractices of forging of the products. As a result, the suggested method can assist customers in detecting fake products. Users can scan QR codes attached to products to obtain product information, allowing the end-user to determine if the goods are genuine or not. Thakur, Kashish, and Mir Aadil [10] made a comparative study on identifying fake products. This model is employer profit pushed analytical model based on Stackelberg equilibrium. This method is used to illustrate the advantages of blockchain supported e-trade structures in preventing product counterfeiting. This proposed system gave a helpful way in maintaining the record of the products. In addition to detecting alteration, cloning, and tag replication attacks, the blockchain ledger can track products without the use of a centralized managing server. The application will be developed using .NET Core MVC framework. And the data of the user is going to be stored on SQL Server. The blockchain will be implemented using Hyperledger fabric framework.

Tambe, Tejaswini, et al [11] developed the proposed system as a mobile application using Android Studio. The data is being stored in Firebase. This real-time system can be implemented to check whether the product is a counterfeit product or original product. In this paper, the SHA-256 algorithm was used to generate a QR code in blockchain technology. The generated QR code is scanned by the user to check whether the product is fake or real.

Chen, Si, et al [12] proposed a block chain based on 'supply continuous quality improvement'(SCQI). This conceptual framework gave a theoretical foundation on blockchain-based intelligent supply chain quality management. It also serves as a framework for ideas concerning the administration of information resources in distributed, virtual organizations, including distributed, cross-organizational, and decentralized management theory. Domain experts will be asked for suggestions to review the framework for their upcoming study. The framework will be used to create an intelligent SCQI system for a practical application.

Nakasumi, Mitsuaki [13] suggested a brand-new blockchain information exchange strategy. For supply chain management, it offers a number of advantages. Transaction data shouldn't generally be placed in the hands of third parties because they can be stolen and used inappropriately. Users should control and own their data instead, without sacrificing security or impeding businesses' and governments' capacity to offer encrypted transactions. By fusing a blockchain with a homomorphic encryption technique, the technology makes this possible. Users are always informed of the information that is being gathered about them and how it is used, and they are not obliged to put their trust in any third party. The blockchain additionally acknowledges people as the owners of their encrypted data. In turn, businesses are free to concentrate on using data rather than worrying too much about compartmentalizing and

properly safeguarding it. A decentralized platform should also make it easier to make legal and regulatory judgements regarding gathering, storing, and exchanging sensitive data. In addition, laws and rules may be encoded directly into the blockchain for automatic enforcement. The ledger can serve as legal proof in other circumstances so that data can be accessed or stored.

Yiu, Neo CK [14] analyzed whether anti-counterfeiting and traceability technologies are effective in the supply chain industry. Among a series of security evaluations, functional analyses conducted against NAS, present supply chain industry solutions could gain from a certain amount of decentralization. A summary of the core system needs for a decentralized version on NAS is also defined, along with potential opportunities. Additional statistical analyses on the research references used in this study were also carried out. Of the 86% of research references used in this study that were published between 2012 and 2021, 44% had actually been published within the previous 5 years, and 20% had been published by IEEE. In order to justify why decentralized solutions should be produced using current Blockchain 2.0 implementations and why blockchain technology should be used to decentralize existing solutions, a complete description of blockchain technology is given in this exploratory study. These decentralized solutions have mostly detected two types of dangers: threats from physical NFC tags and threats from systems. The discussion of the research findings revealed several prospects, which are precisely the possible benefits of decentralizing the current supply chain anti-counterfeiting solutions where it has been maintained only by product producers.

Ma, Jinhua, et al [15] introduced a fully operational anti-product forgery system in Blockchain. Users of the system no longer have to worry about buying a fake product because they only have to pay a tiny transaction charge. Manufacturers can utilize the system to maintain pertinent sales data for their products in a publicly accessible blockchain. Both the seller's maximum possible sales and the number of products they have remaining on the market are transparent. The user can use the features offered by the system to carry out vendor-side verification right away. This method can successfully lower the bar for preventing the counterfeiting of branded goods and offer businesses with limited financial resources a simpler way to give customers the assurance that they won't buy counterfeit items.

Paul, Shovon, et al [16] discussed a way to detect the fake news in social media. The concept of decentralization, Ethereum smart contract and Breadth First Search algorithm are used for calculating proximity of a user. A final rating was generated by doing some simple calculations and using BFS algorithm, block chain and smart contract concepts. The derived score which is on a scale of 1 to 5 is allocated for the news published in social media. So that one can verify the originality of the news. If news value is 1, in the rating scale of 1 to 5, it is not considered to be trustworthy. The more rating can be achieved, the more reliable the news is. If any news gets value 5 out of 5, then it can be said that the news is trustworthy and dependable. After completing the news validation procedure by submitting everyone's rating and by obtaining the final ratings, this rating will be placed on top wherever the news is broadcasted. The validators in the Blockchain who is validating the news for evaluations are known as miner. The miners who are professionals are rewarded with some ethers for reviewing the news from Ethereum chain.

**4 INTERPRETATION**

Several strategies have been used in the past to identify fake products. From the previous review done, fake products can be detected by different techniques. Table 1 shows summary of different strategies that were used to identify fake products. To identify fake products different platforms have been used. Some of them are Python, .net and Android. But in these frameworks, database has been used for storing the product details which is not effective. The data stored in database is not immutable and can be modified by the database administrator which does not fulfil the process of identifying fake products. To overcome this limitation, blockchain technology has been introduced. Since blockchain is a decentralized network, we can store product details along with its QR code into blockchain instead of storing it in a centralized database. The hazards of data being tampered by third parties is eliminated when decentralized control is made possible.

**Table 1: ANALYSIS OF DIFFERENT FAKE PRODUCT IDENTIFICATION TECHNIQUES**

Title/ Author/ Publication	Year of Publication	Domain	Methodologies used	Limitation/ Future scope
A Survey on Fake Product Identification System [2] Authors: Hongekar, Avshikar. Publication: International Journal of Engineering and Technical Research	2023	Blockchain	Android and Firebase Cloud, SHA-256 Algorithm	-Firebase is used to store all the product details and hash value
Comparative Study on Identifying of Fake Product [3] Authors: Thakur, Kashish, and Mir Aadil. Publication: International Research Journal of Engineering and Technology (IRJET)	2022	Blockchain	NET MVC Framework, MySQL Server and Hyperledger.	-Database is used to store all the product details
Fake News Detection in social media using Blockchain [9] Authors: Paul, Shovan, et al Publication: 7th International Conference on Smart Computing & Communication (ICSCC), IEEE,	2019	Blockchain	Breadth First Search Algorithm, Ethereum	-Improvement can be done by using equations of bias and weight in order to achieve trustness rating that will be more accurate.
Fake product detection using blockchain technology [4] Authors: Tambe, Tejaswini, et al. Publication: technology International Journal of Advance Research, Ideas and INNOVATIONS in Technology	2021	Block chain	Android Studio, Firebase Cloud, SHA -256 Algorithm	- All the product details, block name, a hash value is stored in the firebase cloud database

Hence, the framework has to be constructed with high security features. And it should also allow Manufacturers and Distributors to keep anonymous, publicly accessible statistical data on product sales and purchases in the Blockchain.

**5 METHODOLOGY**

In the proposed framework, QR codes offer a reliable method to combat the practise of product counterfeiting. A QR code that is linked to a Blockchain allows the users to identify fake products. This system will be used to keep track of a product's specifications and its unique code. Information about the product, manufacturer, and distributor will be available on this decentralized application. A unique QR code is generated for each product. After the product details are saved on the blockchain (Ethereum), a hash code for the product is generated, and the Metamask wallet is used to keep track of the transactional information for the product. A



distributor can also login to verify the products to be sold, by scanning the QR code of the product. If the product is found to be fake, it is reported to the manufacturer. QR code is generated for a particular product and customers scan the QR code using the smartphone’s QR code reader. To monitor the products along the distribution chain, the Blockchain system ultimately stores these product details along with a history of transactions. All the product details, block name, hash value are stored in blockchain.

**5.1 PROPOSED FRAMEWORK**

The proposed framework is constructed utilizing the Ethereum Network as the main blockchain for preserving all the records and managing the transactions related to the goods of the companies registered on DApp. Figure 4 displays the proposed model.

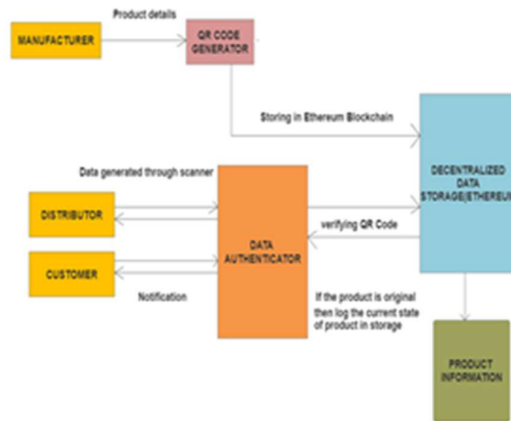


Fig 4. Ethereum Reinforced Framework

Using the proposed system, both distributors and manufacturers can interact to add their own blocks carrying transaction details on Ethereum blockchain.

**5.2 FLOW OF PROPOSED SYSTEM**

**5.2.1 MANUFACTURER MODULE**

A module is designed for the manufacturers with a login and registration page. The manufacturer can login with their wallet which navigates to the dashboard that contains options to add product details, keep track of products added and also to view the list of distributors. To add a new product, a separate form which contains the product details has to be filled and submitted. After which the QR Code is generated for each product and is stored in blockchain.

**5.2.2 DISTRIBUTOR MODULE**

A module is designed for the distributors with a login and registration page. The distributor can login with their wallet which navigates to the dashboard. The distributor has to fill a registration form which contains the distributor details. After registration, the distributor scans the QR Code to check whether the product is original or fake. If the product is identified as fake product, then it has to be reported to the manufacturer.

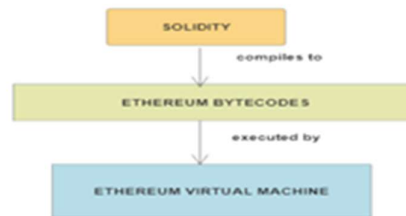
**5.2.3 PRODUCT AUTHENTICATION**

A module is designed for product authentication using QR Code. This can be used by both distributors and users to check the product's originality. If the product is identified as original product, the product details will be displayed along with hash value. The end user can check the authenticity of the product using smartphone's QR code scanner.

### 5.3. ETHEREUM

It is an open-source software or a protocol based on blockchain technology. It is actually a protocol (a set of rules or procedures) like "HTTP" or "HTTPS." The actual-value transactions occur on Main net which is the primary public Ethereum production blockchain. The native crypto used for Ethereum is Ether (ETH). The Ethereum Virtual Machine (EVM) is one of the best blockchain developments. Figure 5 depicts the working of Ethereum Virtual Machine.

All Ethereum accounts and smart contracts live in the EVM environment. Smart contracts are computer programmes that launch automatically when certain criteria are satisfied. The EVM's continuous, uninterrupted, and unchangeable operation is the only goal of the Ethereum protocol.



**Fig 5: Working of Ethereum Virtual Machine**

Ethereum only has one "canonical" or singular state at a given block. The guidelines for calculating new valid states from one block to the next are defined by EVM. A sizable number of linked computers (nodes) running an Ethereum client like Geth or Open Ethereum maintain the EVM as a single entity. The software that allows nodes to read blocks on the blockchain and smart contracts is known as a client. The two most often used Ethereum standards are ERC-721 and ERC-20 (for fungible tokens like stablecoins) (for non-fungible tokens). Next, there are ERC-777 (an ERC-20 improvement) and ERC-1155 (which contains both fungible and non-fungible assets). As each Ethereum transaction uses up computing resources, there is a cost called "gas" associated with each transaction.

Advantages of using Ethereum Blockchain

- The Ethereum main net provides as an illustration of how a network with millions of users and hundreds of nodes may function.
- Businesses can build on either public or private networks with the help of a number of open-source protocol layers. Ethereum makes sure the solution satisfies all legal and security criteria.
- Ethereum offers consensus methods that ensure immediate transaction certainty and reduce the need for infrastructure.
- It is very trustworthy since it is free from corruption.

#### 5.3.1 CONSENSUS ALGORITHM

The Consensus mechanism used by Ethereum blockchain are as follows.

Proof of work:

- In Proof of Work, miners compete to solve the difficult mathematical problem based on a Cryptographic hash algorithm.
- Miner spends a lot of time and resources to solve the problem.
- When the block is solved, the transactions contained are considered confirmed.
- Miners receive a reward when they solve the complex mathematical problem.

Proof of stake:

- Proof-of Stake is a different way to validate transactions and achieve distributed consensus.
- In Proof-Of-Stake, the creator of a new block is chosen in a deterministic manner by its wealth, which is also referred to as stake.
- No block reward is provided.
- As the number of digital currencies is fixed in the PoS system, there is no block reward.
- Miners take the transaction fees and are miners are called as Forgers.

### 5.3.2 SMART CONTRACTS

Smart contracts are high-level program codes compiled into EVM before being posted to the Ethereum blockchain for execution. Figure 6 shows how smart contract works.



Figure 6. Working of Smart Contract

It enables you to conduct trustworthy transactions without the involvement of a third party; these transactions are traceable and irreversible. Programming languages commonly used to create and write smart contracts are Serpent, Solidity etc. In the proposed system, solidity programming will be used to write smart contracts.

## 6 CONCLUSION

With the vast variety of products available online, counterfeit products are expanding tremendously. So, there is a critical need to identify original goods and blockchain technology is employed to do so. In this paper, the systems and solutions to combat the malpractice of product counterfeiting and a method that helps end users determine if a product is fake or not by looking at the product's history across the supply chain are discussed. Moreover, a QR code with the product information has been created. Buyers or consumers can identify original product after scanning the QR code. Blocks of digital product information can be saved using blockchain technology. Manufacturers and Distributors can make use of the system to store product information in Blockchain, which has features like tamper-resistance, data consistency, and confidentiality that guarantee the security and privacy of the data on the network. The customer examines the product's history along the supply chain to confirm its authenticity.

Consumers may be confident in the quality of the products they buy. The proposed solution can effectively reduce the number of branded items that are counterfeited by giving businesses an easier way to give customers confidence that they won't buy fake products. This technique will help to strengthen the relationship between the company and the client and will actually improve the economy and lower corruption.

## 7 FUTURE ENHANCEMENT

The decentralized application will be implemented using Ethereum blockchain following the framework proposed in this paper. The front end will be developed using the React JS. Solidity programming will be used for writing smart contracts. For implementing the smart contracts and front-end, Visual Studio Code Editor will be used. Hardhat development environment will be used to test, compile, deploy the application on Ethereum blockchain. The Quick node API, Goerli faucet and Metamask wallet will be used to handle operations including sending ether, confirming transactions, reading, and writing data from smart contracts in order to enable interaction with the Ethereum blockchain.

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