

Preventing Counterfeit Product with Blockchain

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Abstract— Counterfeit products manufacture, and distribution is an important and growing global problem, particularly in developing countries. The annual market value of counterfeit goods has surpassed billions of dollars. One of the reasons for products counterfeiting is the imperfect supply chain system in these industries. Products change ownership from manufacturers to wholesaler, distributor and then selling points before it reaches the customer. Information is not shared between systems, manufacturers do not know what happened to their products in current supply chain system, products regulatory authority has no visibility of the system, and companies cannot follow-up customer. In this paper we explain how to use blockchain technology in production supply chain to add traceability, visibility and security to the products supply system. The proposed system will be used in precious products industry to track the products from its manufacturing until its delivery to customer. A permissioned blockchain will be used for storing transactions and only trusted parties will be allowed to join the network and push data to blockchain.

Blockchain, Information Security, Counterfeiting, Production Supply Chain.

I. INTRODUCTION

Building a brand and Develop a high quality products is a complex process that takes several years of the hard work to reach costumer's trust and loyalty. When all of the steps have been completed and a standard product has been developed, the next challenge for manufacturers is to deliver the product to the end customer in its original form, ensuring that the customer receives a genuine product created by a legitimate manufacturer rather than a counterfeiter. However, the present Supply Chain Management (SCM) system in the products business is antiquated, since it lacks visibility and traceability over goods distribution, and it is unable to withstand cyber-security threats in the twenty-first century. As a result of this SCM environment, counterfeit items are produced, distributed, and consumed. Counterfeit goods producers frequently imitate authentic brand logos to create bogus products that are utilized in everyday life. Counterfeiting is one of the oldest and most lucrative businesses, but technological advancements have greatly aided counterfeiters' operations [1], which is why the FBI has dubbed counterfeiting the crime of the twenty-first century [2], because counterfeited goods can be produced in large quantities in a short amount of time. Counterfeiting, according to the International Anti-Counterfeiting Coalition (IACC), has grown to be one of the world's largest and fastest-growing illicit enterprises, with an annual worth of more than US\$ 600 billion [3]. The valuable products business needs an effective supply chain management system to avoid counterfeit items, and Blockchain technology is the greatest available tool for developing a faultless SCM system. Blockchain is a distributed ledger system (originally described by Satoshi Nakamoto under the pseudonym Satoshi Nakamoto in 2008 [4]) that has shown considerable adaptability in recent years, with a range of industry sectors looking for methods to incorporate its capabilities into their operations. Although the financial services industry has received most of the attention thus far, initiatives in other service-related fields including as healthcare, energy, and law firms have begun to use this technology. One area of supply chain security that has lately received attention is supply chain security. The benefits of Blockchain are obvious for any product that goes through a delicate manufacturing process and has extensive reputational difficulties linked with the finished product. When privacy and data security are the most important considerations, blockchain is the ideal option.

II. BACKGROUND REVIEW

A. Why Blockchain?

To aggregate up what a Blockchain technology is, this paper defines it as: It is a Public ledger of all transactions that have been executed and shared among all participants in a distributed, secure network without any central server. Every participant verifies each transaction in the ledger and, once entered, no one can erase it. A Blockchain has an accurate, detailed and verifiable record with a timestamp of every single transaction or digital event ever made. Every node on the network keeps a local copy of the ledger, and any slight changes in the local ledger are replicated to the entire network, with each node updating their local ledger. It has no influence on the network if one node fails or is unplugged. The security of Blockchain technology in a system like production SCM is the primary reason to utilize it. Blockchain is the finest alternative for providing cyber-security in the twenty-first century, and it has yet to be breached. It is meant to prevent any single individual from altering the data or transactions. As a result, blockchain can assist to boost confidence and reduce bias in traditional supply chain systems. Participants can anonymously swap digital assets using blockchain, as they do not need to know or trust each other or a third party for their transaction. As a result, in a trustless society, blockchain is the greatest alternative for transferring trust. One of



the reasons we recommend blockchain for production SCM systems is that it is the most effective way to track a product's travel across the supply chain. Every time the product's ownership changes, a new transaction is added to the blockchain. Keeping track of a product's history makes it simple to discover its true origins and milestones. Transactions in the industrial supply chain will be more transparent as a result of this method. The potential of blockchain is not restricted to the production of bitcoin; it can also be used to generate and track any sort of digital asset. When a manufacturer creates a product and registers it on the network, it becomes a digital asset that can be transferred to other participants in the same way that bitcoin can. In terms of privacy protection, blockchain is once again at the top of the list. Every member in a blockchain network is given a key-pair¹ as an identify. Every transaction is done from one participant's public key to the public key of the other, and each participant's private data is kept private. The smart contract is the last and most essential justification for implementing blockchain in a production SCM system. A smart contract is a piece of code that contains the real rights and obligations of all signees, including the terms and conditions for payment and delivery of goods and services, and may be automatically performed. Smart contracts can give blockchain additional intelligence and power. They may be utilized to create cutting-edge bespoke blockchain-based systems that are state-of-the-art [5].

B. Characteristics Of Blockchain

Blockchain technology has many characteristics. They are listed below:

1. **The Public ledger.** Every node in the blockchain network can write/read and work like a golden source in the third-party systems.
2. **Proof-of-Work.** Each block will be accepted in the Blockchain should be under a special condition determined by the majority of participants in the Blockchain network. In the private Blockchain, it involves Business policy and terms of a contract, which is called **The Smart Contract**. Similarly, each block accepted provided it contains an answer to a complex mathematical problem.
3. **Verification Entry.** Every node performs the proof of work by verifying each transaction that is initiated inside the chain. The transaction will be accepted and recorded in the ledger once all nodes have verified it.
4. **Customizable Fields.** The structure of the Blockchain is fixed. Each block in the chain has the same size; that is, it has the same number of transactions and meta-data where the owner can add some information and once the block has been entered; more importantly, information can never be erased.
5. **Native Token.** The ownership of the block in the chain can be transferred from user to user. Bitcoins and some other financial applications permit transfer of the ownership of an asset or property.
6. **Smart Property.** The controlling Native token characteristic – is the ownership of a property or asset- via Blockchain.
7. **Independency among Nodes.** The Blockchain is a peer-to-peer network in almost real-time that provides this special level of security in this technology.

C. Related Works

Caro et al. [6] proposed AgriBlockIoT, a blockchain-based Agriculture-Food supply chain. The suggested methodology connects IoT devices to the supply chain and uses IoT to handle all data in the Sensors 2020, 20, 3951 4 of 23 supply chain. AgriBlockIoT similarly combines blockchain and IoT to generate auditable, transparent, and immutable data for supply chain management traceability. The Hyperledger Sawtooth and Ethereum blockchains were used by the authors. The suggested framework also established a "from-farm-to-fork" use case, which compared and evaluated latency, network consumption, and CPU performance to demonstrate the benefits and drawbacks of their system.

Malik et al. [7] presented TrustChain, a three-layered paradigm for trust management. TrustChain is a supply chain application based on blockchain technology that is used to handle trust concerns related to commodity quality. TrustChain employs a consortium blockchain to track interactions with all supply chain participants. It also assigns a reputation score and a trust score based simply on supply chain interactions in a dynamic manner. Their complex architecture is also necessary in order to provide a reputation model that is both asset and agent-based. The authors give an in-depth security study with an emphasis on reputation system risks. The novelty of Trustchain stems from: (a) its reputation model, which evaluates the quality of commodities and the trustworthiness of entities based on multiple observations of supply chain events; (b) its support for reputation scores, which distinguish between a supply chain participant and products, allowing the assignment of product-specific reputations for the same participant; and (c) its support for reputation scores, which separate between a supply chain participant and products, allowing the assignment of product-specific reputations for the same participant, (c) the use of smart contracts for transparent, efficient, safe, and automated reputation score computation, and (d) the low latency and throughput overhead as compared to a simple blockchain-based supply chain architecture. TrustChain will be developed on the IBM blockchain technology, which is designed to trace the origin of jewelry's raw materials while also ensuring transparency and accountability for all transactions and data points that occur across the complicated jewelry supply chain. In the jewelry supply chain, transactions and data points create "blocks" that contain unique information that, if confirmed, become part of a permanent chain that eventually comprises the whole digital record for the piece of jewelry.



The study provided in this paper is the first look at such a framework in connection to product transport protocols, according to our extensive literature search. The work and contributions are innovative because of the planned structure and usage of secure components that, when used together, produce a secure environment, a lot of transparency and the ability to transfer of ownership.

Ma et al. [8] suggest using Ethereum's Blockchain architecture to keep track of product ownership on the Blockchain. Consumers do not need to totally rely on trusted third parties to safely know the source of the acquired goods because of Blockchain's untrace ability and transparency qualities, as well as the guarantee that each record on the Blockchain cannot be falsified. SMEs can implement the anti-counterfeit application system presented in this research for a reasonably low cost in operating fees in order to provide safe and unforgeable anti-counterfeit authentication.

III. PROPOSED SOLUTION

Now we can realize that the production industry need an updated supply chain system. Blockchain technology provides the highest level of transparency, security and privacy as well which can be considering as a new perspective on security. For instance, it is easy to steal a piece of chocolate from a chocolate jar, kept in a secluded place than stealing the chocolate from a chocolate jar kept in a market place, which is being observed by thousands of people. The new system's goal is to include blockchain technology's characteristics and bring traceability and security to the industrial supply chain, as well as offer insight to SCM system makers. In situations when data privacy and accessibility are required at the same time, blockchain technology is the ideal option. Every time a product changes hands, the transaction may be recorded in order to generate a permanent record of the product's life cycle, from creation to sale. This will drastically minimize the amount of time, money, and human error that now occurs in transactions.



Figure 1

To integrate blockchain technology into a Production supply chain system, we must first comprehend how the blockchain ledger works. A cryptographically secure key pair is integrated into the blockchain as an identity method (as mentioned in the above section). These keys are used to assign each network member to a specified activity. A gadget, person, or entity can all be participants. These keys reveal the players' original identities, which are hidden. A key pair includes no information about the participant, but it can be linked to other information (such as name, contact information, or professional qualifications)[9]. However, keeping this additional data off-chain and merging it with on-chain data (key pair) using their IDs is the optimal strategy. Participants in product supply chain management include the producer, packager, distributor, and customer, among others. On the network, each of these members will be identifiable by their unique key pair. Precious items will be considered assets, with each having its own unique key (or hash). In the form of a QR code, the ID will be affixed to the merchandise. A permissioned blockchain is a superior alternative in the case of product supply chains. The next step is to preserve the transaction record on a specific blockchain network.

IV. EVALUATION/ RESULTS ANALYSIS

The blockchain-based SCM system for the manufacturing industry's purpose and features:

1. **Traceability.** Once a product is manufactured, it is registered on the blockchain, where it can then be tracked, traced, and validated at each stage of its journey. As the physical ownership of a goods changes, the ownership of that product will also change on the blockchain network. Product makers will be able to track their products' progress from manufacturing through packagers and then to distributors at any time.

Only trusted manufactured can mine new blocks in the chain. Therefore, no way to add counterfeit products to the blockchain. Each mined block has a new product ID which will be a QR code for this product.



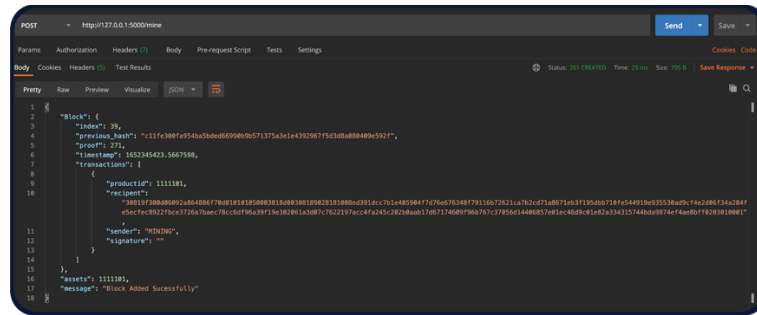


Figure 2 Mining a new block

2. **To Increase Trust and Transparency.** By being able to trace items along the supply chain, manufacturers and customers will be able to trust one another. Manufacturers will be able to ensure that the items they wish to provide are delivered safely to the intended customer. Clients, on the other hand, will be able to see that the goods they wish to buy was created by a reputable company and that they received it in its original state.

Hash function provide a chain of continues related blocks, no one can change or delete anything in the ledger, each transaction will be on this ledger on each node on the network. In other words, this QR code (product ID) will has related chain from manufacturer to the end customer.

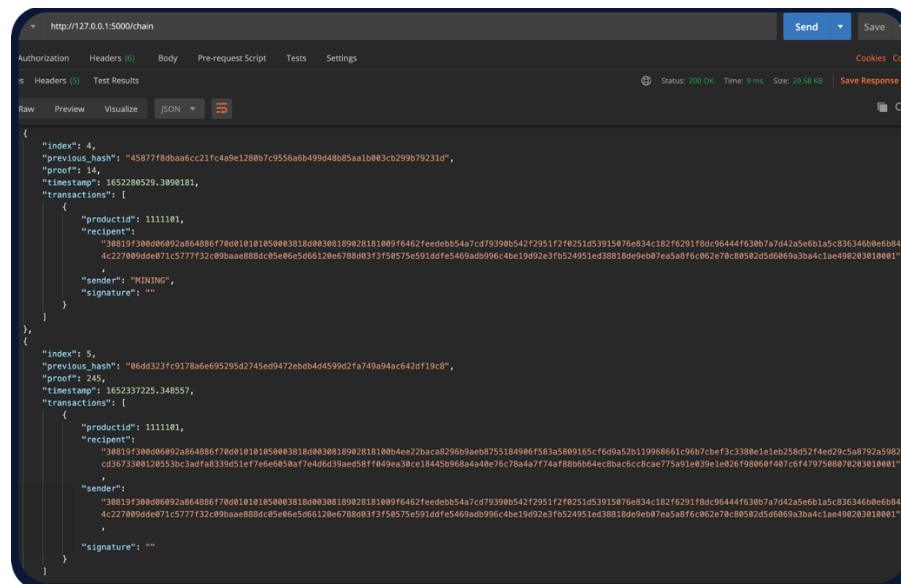


Figure 3 The chain and public ledger

Each node in the chain own a productid has ability to transfer this product ownership to another node in the network.

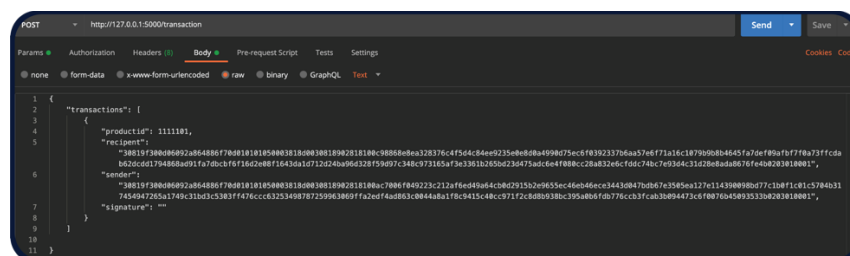


Figure 4 Create a new transaction

3. **Extended Security.** Blockchain is widely regarded as one of the world's most secure ledger systems which providing all the three components of the CIA triad.



Blockchain is an immutable database, which means that information recorded on it cannot be erased or updated once it has been saved which provide the **Integrity**. Each node has a copy of the public ledger where the Doss attack is not possible which provide the **Availability**. Public and Private Keys will provide the **Confidentiality** where the assets will be sent to the node's public key and the signature will be calculate with the private key of the node.

A permissioned blockchain will be employed in the proposed system, which is more secure than a public blockchain since only authentic players will be allowed credentials to push data to the blockchain.

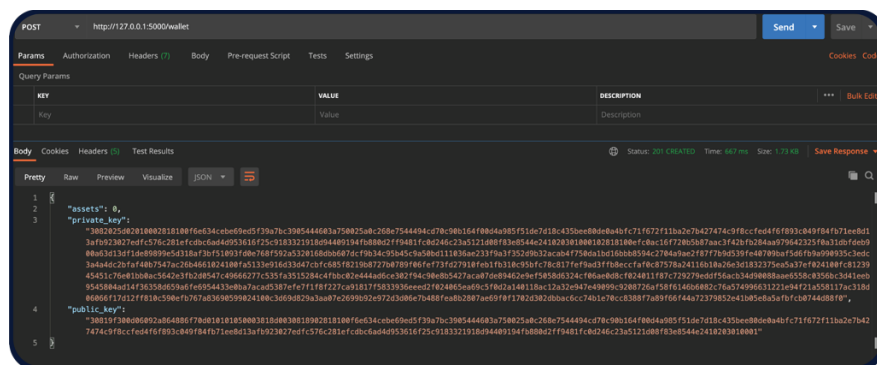


Figure 5 The public and Private keys for each node

V. CONCLUSION

In this paper, we proposed a further use case of blockchain technology in precious products industry. We pointed out the issues in current product supply chain management, and explained how blockchain can be used to add traceability and visibility to product supply and overcome the issue of counterfeiting. How the identity mechanism of blockchain works and how is it helpful to share data is explained. In the last we explained the working of the suggested system with an example that shows how the system will be easily used by different participants.

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