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Optimized Combination of E-Commerce Platform Sales Model and Blockchain Anti-Counterfeit Traceability Service

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ABSTRACT

With the rise of e-commerce and the increasing prevalence of counterfeit products, there is a pressing need for robust anti-counterfeit measures. This research aims to explore the optimized combination of an e-commerce platform sales model and a blockchain-based anti-counterfeit traceability service strategy. By integrating the strengths of e-commerce platforms and blockchain technology, this study proposes a comprehensive approach to enhance consumer trust, reduce counterfeit products, and improve supply chain transparency. The research investigates various e-commerce sales models, such as business-to consumer (B2C) and consumer-to-consumer (C2C), to identify their effectiveness in combating counterfeiting. Additionally, the study explores the implementation of blockchain technology to establish a decentralized and immutable traceability system that ensures the authenticity and integrity of products. The proposed strategy leverages smart contracts, cryptographic hashing, and consensus mechanisms to enable real-time product verification and anti-counterfeit tracking throughout the supply chain. Through this optimized combination, it is anticipated that consumer confidence will be bolstered, counterfeit products will be mitigated, and stakeholders across the e-commerce ecosystem will benefit from improved transparency and accountability. The findings of this study contribute to the development of effective anti-counterfeit strategies and provide insights for e-commerce platforms and stakeholders seeking to enhance trust and combat counterfeit activities.

Keywords: Consumer, Product, Blockchain, Hashing Algorithm, e-commerce, traceability, authenticity, integrity, Anti-Counterfeit.

1 Introduction

Along with the accelerated pace of consumer upgrading, the e-commerce market is expanding rapidly at an alarming rate]. The 2021 Global Payments Report, published by World pay, shows that China has become the largest e-commerce market in the world, with the e-commerce market expected to be worth \$3.17 trillion by 2024. In previous e-commerce markets, e-commerce platforms operated primarily as resellers, reselling products purchased from upstream suppliers (e.g., Amazon resells music under iTunes), and in this model, the e-commerce platform owns the product. With the development of the ecommerce market, some retail giants such as Amazon and Walmart have broken with traditional sales methods and



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turned to agency sales (e.g., Amazon Marketplace, iBook Store), where e-commerce platforms act as agents, allowing suppliers to make decisions on key factors such as retail prices and sell products directly to consumers, but with a percentage fee paid to the e-commerce platform. Due to more open and transparent retail prices, many ecommerce platforms are keen to adopt the agency sales format (e.g. Chinese smartphone manufacturer Xiaomi, well-known brand Sephora sells its products through Jingdong Mall, etc.) Despite the growing momentum of agency sales, some industries still use the resale sales model. The second annual “SME Impact Report” released by Amazon 2021 shows that revenue from reselling products amounted to \$114.8 billion and total sales from agency selling exceeded \$160 billion. As a result, the issue of choosing a sales model for e-commerce platforms has become a hot topic in recent years.

In recent years, a wide range of products on the mall, the enterprise brand marketing efforts to increase the entire e-commerce field has brought a huge impact, some industry pain points have also emerged. Fierce competition among brands, the market is flooded with counterfeit goods, counterfeiting, and the sale of counterfeit problems are repeatedly prohibited. In Asia, counterfeit medicines are up to 60%, the fashion luxury industry is no exception.

According to the Harvard Business Review [19], the total trade in counterfeit goods is estimated to be as high as \$4.5 trillion in 2019, with counterfeit luxury goods totalling more than \$270 million and 40% of luxury counterfeit sales taking place online. How to solve these pain points becomes a difficult issue for companies, on the one hand, suppliers need to take action and be responsible for the quality improvement of their products (product innovation), continuous improvement of quality can positively contribute to goodwill.

On the other hand, e-commerce platforms use their own advantages, based on a large number of consumer transactions and behaviour data, based on data-driven analysis of marketing activities, consumer demographic insights, advertising precision targeting and other data marketing services across the chain, that is, data-driven marketing (DDM), can also stimulate demand. In addition, counterfeit products seriously harm the interests of brands and consumers, damage the reputation of the entire consumer market, and are not conducive to the sustainable development of the market, product anti-counterfeiting has been pushed to the forefront of the times and the blockchain anti-counterfeiting traceability system was born.

The product anti-counterfeiting traceability based on blockchain technology can realize the full traceability of products through the combination of its unique distributed ledger record characteristics and technologies such as Internet of Things, including the information collection records of product sources, raw material source traceability, production and processing links, logistics information, anti-counterfeiting authentication, etc., Since its invention in 1962 (Leiner et al., 1997), the internet has changed social life, communication, access to information, payment systems, and commercial activities. Web applications, which emerged as an internet service in the mid-1990s, led to the widespread use of the internet and to the emergence of e-commerce activities (Xu & Gao, 2021). E-commerce, which can be



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briefly defined as online shopping of products and services, has become an important supporter for companies in realizing financial growth and meeting the needs of consumers (Kumar et al., 2020). Initially developed to facilitate transactions between large enterprises, e-commerce is now frequently used for transactions between businesses and consumers (OECD, 2019). Developments in network communication technologies and big data, global trends in trade and unpredictable external shocks (such as COVID-19 pandemic) have caused e-commerce to become one of the most important retail channels (M. Li et al., 2020; Zhou et al., 2021).

The Organization for Economic Co-operation and Development [OECD] (2019) states that digital transformation will increase economic efficiency and that businesses that do not operate in the field of e-commerce will have less or even no chance to compete. Retail e-commerce differs from traditional retail stores, with the former offering benefits such as providing competitive advantage, reducing costs, offering product variety, expanding the customer portfolio, and eliminating physical restrictions. With e-commerce, companies can promote, market, and sell their products or services to more consumers without interruption, while consumers can reach more types of products faster. For example, Walmart's physical stores offers a range of approximately 120,000 products, while its online store offers a range of approximately 35 million products (OECD, 2019). Moreover, marketing all products via an electronic platform with detailed information, receiving feedback, measuring consumer satisfaction (Shorman et al., 2019), and offering personalized services (Frey et al., 2016) make e-commerce platforms much more useful for both consumers and businesses.

2 Related Works

[1] Developing an anti-counterfeit system using blockchain technology Anthony-2019

Blockchain is an up-and-coming technology designed to ease the process of verifying legitimate products without the need of a centralized system. An example of a well-known technology using Blockchain is Bitcoin and Ethereum cryptocurrency. Blockchain technology will ensure that data residing within each block cannot be tampered with by anyone other than the owner. This paper uses Blockchain technology to develop a system where customers can validate a product legitimacy without the need of a corresponding merchant. This system will be able to be used by manufacturers and companies to ensure that their products will be harder to counterfeit, therefore they will gain more trust from customers. The Ethereum blockchain is used to build the proposed model that is capable of tracing every item's creation and transactions, ensuring the credibility of an item's genuineness. Our simulation results in an effective model and a cost analysis that shows that the model uses an average gas amount of 715,046.3 gwei.



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[2] Blockchain-based anonymous anti-counterfeit supply chain framework N ANITA-2020

For the last decade, businesses and industries have been facing difficulties in tracking their products. During the supply chain process, the attackers add their counterfeit products into the market along with legitimate products. With the increase in the number of counterfeits entering the open market, it is hard to discover the source of the counterfeit product. Most of the existing anti-counterfeit solutions are centralized. However, current solutions lack in anti-counterfeiting, decentralization, auditing, transparency, traceability, and tag cloning. To mitigate these issues, we proposed a Blockchain-based Anonymous Anti-Counterfeit (BA2C) supply chain framework that exploits Radio Frequency Identification (RFID) and blockchain technologies. The proposed model streamlined all the transactions through Ethereum, a blockchain-based platform with the support of Proof of Authority (PoA) consensus. Furthermore, the confidentiality of transactions is gained by incorporating zk-SNARKS on the Ethereum blockchain. In this work, the proposed model was tested in terms of transaction cost, latency, and throughput. Further, it was compared with the existing system and was found to perform better transactions in the supply chain management in terms of lower cost and higher scalability. This work concluded that the proposed model was more appropriate to evaluate the critical issues of the supply chain.

[3] Anti-BIUFF: towards counterfeit mitigation in IC supply chains using blockchain and PUF, Leonardo Aniello-2020

The complexity of today's integrated circuit (IC) supply chain, organised in several tiers and including many companies located in different countries, makes it challenging to assess the history and integrity of procured ICs. This enables malicious practices like counterfeiting and insertion of back doors, which are extremely dangerous, especially in supply chains of ICs for industrial control systems used in critical infrastructures, where a country and human lives can be put at risk. This paper aims at mitigating these issues by introducing Anti-BIUFF (Anti-counterfeiting Blockchain- and PUF-based infrastructure), an approach where ICs are uniquely identified and tracked along the chain, across multiple sites, to detect tampering. Our solution is based on consortium blockchain and smart contract technologies; hence, it is decentralised, highly available and provides strong guarantees on the integrity of stored data and executed business logic. The unique identification of ICs along the chain is implemented by using physically unclonable functions (PUFs) as tamper-resistant IDs. We first define the threat model of an adversary interested in tampering with ICs along the supply chain and then provide the design of the tracking system that implements the proposed anti-counterfeiting approach. We present a security analysis of the tracking system against the designated threat model and a prototype evaluation to show its technical feasibility and assess its effectiveness in counterfeit



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mitigation. Finally, we discuss several key practical aspects concerning our solution and its integration with real IC supply chains.

[4] A Blockchain-Based Anti-Counterfeit and Traceable NBA Digital Trading Card Management System Chin-Ling Chen-2020

NBA (National Basketball Association) trading cards are a hot collector's item, with sales increasing rapidly every year. However, with the popularity of online trading, some sellers have started to intentionally and unintentionally sell imitation trading cards, and even PwC (Price water house Coopers) is not immune. However, the PSA (Professional Sports Authenticator), which is the authentication agency, is not liable for this. Faced with the above situation, we moved trading cards online and proposed a blockchain-based anti-counterfeit and traceable NBA digital trading card management system, using blockchain technology to protect digital trading cards, and special digital copyright, to move from relying on other regulators to achieve the fight against counterfeit cards and maintain the security of the digital trading card market. Finally, we analyzed the security of the system and compared it with other methods. Our system uses Hyperledger Fabric to share data while protecting corporate privacy. Proxy re-encryption enables secure and trusted access authorization for digital transaction cards. Asymmetric encryption protects the data and uses signatures to achieve traceability and non-repudiation. Overall, our system solves the problem of counterfeiting and traceability that can occur in the digital trading card process from production to purchase.

[5] Blockchain-Based Traceability for Anti-Counterfeit in Cross-Border E-Commerce Transactions Heongu Lee-2019

Cross-border e-commerce, involving international product transactions via online and mobile platforms, is growing at a dramatic rate around the globe. One of the main concerns of brand firms is preventing counterfeit products from being sold under their names on e-commerce platforms. Counterfeit goods not only create economic losses to both the supply and demand sides, but also undermine efforts to improve sustainability. Proliferating counterfeits harm the brands of supply firms and trust in selling e-commerce platforms. In addition, they discourage participants in the supply chain from investing in social and environmental sustainability. If end-customers have access to detailed and comprehensive product information with a traceability system that can help overcome information uncertainty and asymmetry, losses can be prevented. The result of the pilot test has shown that securely shared in-depth product information among supply chain stakeholders from the supply side to end-customers can help prevent counterfeit goods from proliferating further by enabling consumers to determine the authenticity of products and report forgeries before paying.



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3 Proposed Work

Proposed anti-counterfeiting system ideas and methods from the perspectives of machine learning, IoT anti-counterfeiting sharing and anti-counterfeiting penalties. However, the traditional product anti-counterfeiting technology is difficult to realize the open and transparent information of production and sales chain, which leads to the product anti-counterfeiting cannot be truly realized. However, product anti-counterfeiting traceability based on blockchain technology can ensure product data security, tamper-proof and traceability, and effectively solve the problem of product counterfeiting proposed a new decentralized consensus protocol based on this. Liu and Li [27] constructed a blockchain-based framework for cross-border e-commerce supply chains and proposed corresponding techniques and methods to achieve product and transaction traceability in supply chain management.

The difference between our paper and this series of literature is that we consider the rights of consumers. That is, our model sets the e-commerce platform to provide blockchain anti-counterfeiting traceability service strategy for consumers, so that consumers can get more specific product information, inspection and quarantine information and distribution and storage information, etc. through the traceability code of goods and the corresponding blockchain code, so that illegal transactions and fraudulent counterfeiting are nowhere to be found and consumers' rights and interests can be effectively ensured. For example, Jingdong's intelligent supply chain ecosystem is open to the "Jingdong Blockchain Anti-counterfeit Traceability Platform", which protects goods through information security sharing, tamperproof and traceable blockchain technology, so that consumers can buy authentic products. At the same time, we also take into account the interests of e-commerce platforms, i.e. we build a model to analyze which option would be more profitable for ecommerce platforms to build their own BATP or cooperate with third-party BATPs. This is also the innovation of this paper.

3.1 Advantages of Proposed Work

Improved security: By combining blockchain anti-counterfeit traceability with ecommerce platforms, customers can be assured of the authenticity of the products they purchase, thus reducing the risk of fraudulent products and ensuring a higher level of security.

Transparency: The blockchain-based system provides a transparent and immutable ledger of transactions and product information, giving customer's confidence in the authenticity of the products they are buying.

Increased efficiency: Blockchain technology can streamline the supply chain process, reducing the time and costs associated with product tracking and authentication. This can lead to faster delivery times and increased customer satisfaction.

Enhanced customer experience: By implementing a traceability service strategy, customers can easily track the origin and history of the products they purchase, providing them with a better understanding of the product and increasing their trust in the brand.



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Competitive advantage: Companies that implement this strategy can differentiate themselves from their competitors by offering a higher level of security, transparency, and efficiency.

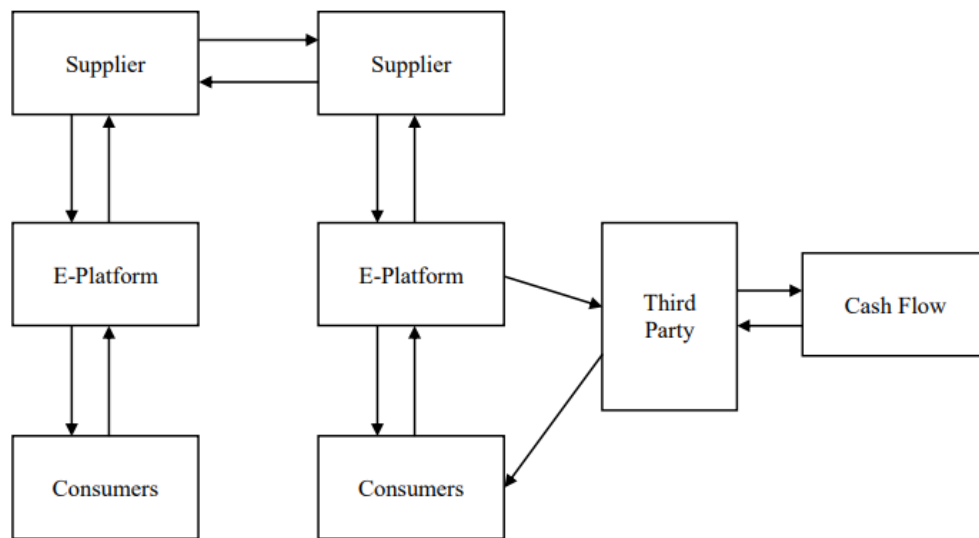


Figure 2: Proposed Framework

3.2 Modules

Authentication Module This module is responsible for verifying the authenticity of the products listed on the e-commerce platform. It uses blockchain technology to create a transparent and immutable record of the products' origin and movement throughout the supply chain, enabling customers to verify the authenticity of the products they purchase.

Traceability Module This module is responsible for tracking the movement of the products from the point of origin to the point of sale. It uses blockchain technology to create a transparent and immutable record of the products' movement throughout the supply chain, enabling businesses to track the products' location and status in real-time.

Integration Module This module is responsible for integrating the blockchain-based authentication and traceability services with the e-commerce platform. It enables businesses to list their products on the e-commerce platform and link them to the blockchain-based authentication and traceability services.

User Interface Module This module is responsible for providing a user-friendly interface for customers to verify the authenticity of the products they purchase and track their movement throughout the supply chain. It enables customers to access the blockchain-based authentication and traceability services directly from the e-commerce platform.

Reporting Module This module is responsible for generating reports on the movement and authenticity of the products listed on the e-commerce platform. It enables businesses to monitor the performance of their products and identify any issues or opportunities for improvement.



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Security Module This module is responsible for ensuring the security and integrity of the blockchain-based authentication and traceability services. It implements security measures such as encryption, access control, and audit trails to protect the system from unauthorized access or tampering.

4 Result and Discussion

Improved Customer Trust: By leveraging blockchain's traceability capabilities, customers can now verify the authenticity and origin of products before making a purchase. This transparency builds trust, reducing the risk of counterfeit purchases and increasing customer confidence in the e-commerce platform.

Enhanced Brand Protection: The combination of e-commerce platforms with blockchain technology enables brands to protect their reputation and intellectual property rights.

With the ability to track and authenticate products throughout the supply chain, brands can identify and prevent the circulation of counterfeit goods, preserving their brand value.

Streamlined Supply Chain Processes: The integration of blockchain-based traceability services optimizes supply chain efficiency. Real-time tracking and verification of product movements ensure transparency and reduce the likelihood of counterfeiting. This streamlined approach helps in identifying bottlenecks, improving inventory management, and enhancing overall supply chain operations.

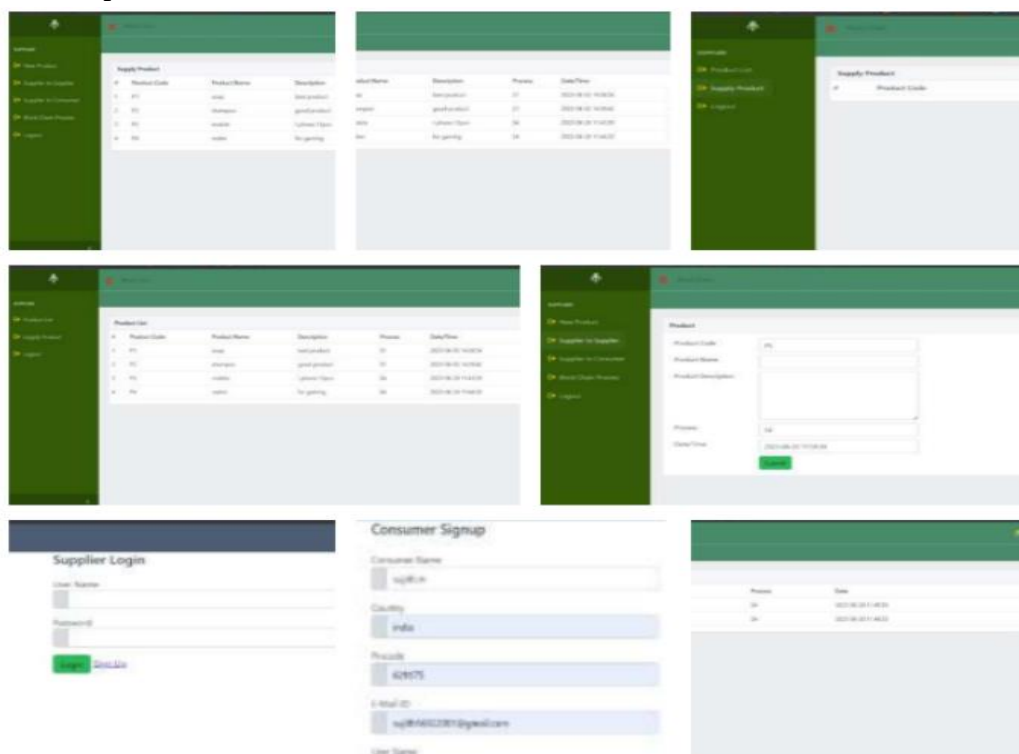


Figure 2: Interfaces of the Proposed Application



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Improved User Experience: The optimized combination provides a seamless and user friendly experience for customers. The anti-counterfeit traceability service is seamlessly integrated into the e-commerce platform, allowing customers to easily access and utilize the authentication features. This user-centric approach enhances the overall shopping experience.

Scalability and Interoperability: The solution ensures scalability to accommodate a large number of products, multiple brands, and increasing transaction volumes. Compatibility with existing e-commerce platforms and interoperability with different blockchain networks have been considered, allowing for seamless integration and adoption.

5 Conclusion

In conclusion, the optimized combination of e-commerce platform sales model and blockchain anti-counterfeit traceability service strategy can greatly benefit businesses and consumers alike. By leveraging the advantages of both e-commerce platforms and block chain technology, businesses can improve their supply chain management and reduce the risks of counterfeit products. Consumers can also enjoy greater transparency and trust in the products they purchase. Conclusions, we draw the following management comments. First, the market size will promote the retail price of products and increase the motivation of suppliers to invest in technology. The impact of market size on anti-counterfeit traceability service strategy and DDM strategy under different models is determined by different conditions. Second, by comparing the retail prices of the products under the four models, it is found that the highest retail prices of the products under the RO model. By comparing the anti-counterfeit traceability service strategies under the four models, it was found that the results depend on the interaction between the wholesale price, the unit price of anti-counterfeit traceability service charged by the third-party BATP, and the market size. In addition, we found that suppliers' profitability under different models can be constrained by multiple factors. On the one hand, the interaction of market size and wholesale price, when the market size is maintained at a medium level or below, with the increase in wholesale price, the situation where suppliers can achieve higher profits will evolve from ME to RO. Higher profits are realized in the ME model when the market size is above the medium level.

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