A Blockchain-Based Solution for Counterfeiting in Textile Industry

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***Abstract*— The textile industry holds a significant position in the global economy, making substantial contributions to employment, GDP, and international trade. It stands as a major job provider across various sectors, including manufacturing, design, marketing, and retail. This diverse industry offers a wide range of products, starting from raw materials like cotton and culminating in finished apparel. Its presence supports and fuels economic growth in numerous ways. Amidst the positive aspects, the textile industry encounters significant hurdles, primarily posed by counterfeit products. The proliferation of fake branded clothing and accessories results in substantial revenue losses and brand devaluation for legitimate businesses. This issue becomes increasingly problematic as consumers gravitate towards branded products. Counterfeiting not only hurts the industry financially but also introduces quality and safety concerns. Such risks undermine the industry's steadfast commitment to innovation and, more importantly, the trust consumers place in its products. To combat these challenges head-on, our project has devised a groundbreaking solution that revolves around blockchain technology. This cutting-edge approach aims to detect and authenticate textile items with unparalleled accuracy. By leveraging blockchain through a user-friendly mobile app or web interface, our mission is to enhance transparency within the textile sector while verifying the legitimacy of products. Central to our solution is the incorporation of smart contracts, which have revolutionized the way transactions are conducted. By automating the verification process, we can significantly improve efficiency and reliability in addressing the spread of counterfeit goods. The robustness of blockchain technology combined with the automation provided by smart contracts ensures a formidable defense against counterfeiters.**

Keywords—Counterfeit products, Blockchain, Smart contract

I. INTRODUCTION

Counterfeit products have become a major challenge for the textile industry, undermining consumer trust and damaging business reputations. Around 20% of the fashion garments that are showcased on social media platforms turn out to be counterfeit. In fact, as many as 3 out of 10 fashion purchases end up being fake, and a staggering 8 out of 10 counterfeit products are obtained through online transactions. These alarming statistics reveal the magnitude of the issue at hand. The impact of counterfeit products on the fashion textile industry is not just limited to consumer trust. In 2020 alone, the industry suffered losses exceeding $50 billion due to counterfeit products. Even more astonishing is the fact that the global counterfeiting industry is estimated to have reached a staggering $4.2 trillion in 2022. This not only illustrates the financial strain faced by legitimate businesses but also the immense scale of the counterfeit market.

To combat this pervasive issue, we have developed an innovative solution that leverages the power of blockchain technology. Blockchain technology is much more than just a decentralized data recording system. Its unique features, such as decentralization and data immutability, ensure a secure and transparent record of transactions, mitigating the risk of counterfeit products. By organizing data into blocks linked in a sequential chain, blockchain offers a reliable way to maintain data integrity. Our project focuses on utilizing blockchain for product authentication through unique IDs and smart tags, ensuring a seamless tracking process from manufacturing to delivery. While our primary focus is on textiles, our solution extends beyond this industry. By utilizing blockchain technology, we aim to provide a potential remedy for counterfeiting in a wide range of sectors. This holds the promise of enhancing overall safety and protecting not only fashion brands but also consumers across diverse industries.

To facilitate the verification process, we have developed a user-friendly web and mobile application. Through this intuitive interface, users can effortlessly verify a product's authenticity by simply entering its unique ID. This streamlined approach ensures a hassle-free experience for consumers. Trust lies at the heart of any successful solution, and for that, we rely on the power of smart contracts. These digital agreements between buyers and sellers play a pivotal role in establishing trust within our system. By utilizing smart contracts, we provide a secure and transparent platform for all transactions, further strengthening consumer confidence. To guarantee the security and transparency of our verification process, we utilize a robust local blockchain tool called Ganache. This tool creates secure blocks for each

verification, providing a reliable foundation for our authentication process. By incorporating Ganache into our system, we prioritize the privacy and safety of our users' data.

II. LITERATURE SURVEY

In this literature survey, various works related to Blockchain-based solutions for counterfeit products have been reviewed. Sanidhya Raut et al [1], explored blockchain technology to fight the growing problem of fake goods in today's vast global market. The widespread availability of fake goods presents a growing problem that decreases consumer confidence and damages the hard-earned reputation of genuine brands, placing a heavy financial strain on legitimate firms. The application of blockchain technology stands out as a powerful response to this urgent issue. They use the robust and transparent blockchain technology as the cornerstone of their plan. This distributed ledger technology offers a way to conduct safe, auditable transactions. This system makes use of blockchain technology to create an impermeable and immutable record of the whole supply chain. This crucial aspect of blockchain technology acts as a strong deterrent to the manufacture and sale of counterfeit goods, protecting both consumers and legitimate businesses.

Nafisa Anjum et al [2], in their work, to identify the phony products, they used a Blockchain Decentralized Application. As blockchain technology has quickly gained popularity, it has come to be known that data stored there is secure and permanent. As a result, the project that is being offered here makes use of this idea to handle the transfer of ownership of goods. A user can scan a Quick Response (QR) code produced by the DApp for each product connected to the Blockchain to confirm the product's ownership and distribution details.

Jayaprasanna et al [3], in their proposed system, Barcode readers are used to identify counterfeit goods, and each product's barcode is connected to a Blockchain-Based Management (BCBM) system. Customers can use this technique to securely check a product's legitimacy by scanning the QR code. The promotion of phony products through the manipulation of reviews and the general lack of consumer understanding regarding how to tell real products from fake ones remain major obstacles in the fight against counterfeit goods.

P. William et al [4], they designed a decentralized blockchain system that is specifically made to prevent counterfeiting goods. By enabling manufacturers to supply legitimate products without the need to oversee directly run stores, this ground-breaking solution drastically lowers the costs related to maintaining product quality and authenticity.

Roshan Jadhav et al [5], in their work,they created a blockchain system that can detect fake items is connected to QR codes that are scanned. This process entails entering product details and creating a special identification for each item in a safe database. The technology looks for any matches when a user scans a QR code by comparing the special code to the blockchain database. If a match is discovered, the customer is informed that the product is genuine; if not, the system notifies the customer that the goods is fake. Without relying on outside verification, this strategy offers a solid response to the problem of counterfeit goods.

Nongmeikapam Thoiba Singh et al [6], explored the Blockchain technology to design decentralized blockchain architecture intended to eliminate fake goods, allowing producers to create genuine commodities without having to interact directly with buyers. The cost of ensuring and monitoring product quality is expected to be greatly reduced by this novel approach.

III. PROPOSED WORK

A. Problem Statement

Counterfeit goods pose a growing and pervasive problem in the textile industry. This issue transcends borders and affects various sectors within the industry, including clothes, jewelry, textiles, and raw materials. Both physical retail stores and online marketplaces have become hotspots for counterfeit textiles, which poses a significant threat to consumer confidence and brand reputation.

The textile supply chain is intricate and multi-faceted, encompassing the production of raw materials, manufacturing,, and retail. Unfortunately, this complexity also offers ample opportunities for counterfeit products to infiltrate the market undetected. Traditional methods of product verification, such as holograms and tags, have proven ineffective as counterfeiters continuously refine their strategies.

The implications of counterfeit goods in the textile industry are far-reaching and detrimental. Reputable manufacturers face substantial financial risks, as their profits are eroded by counterfeit products flooding the market. Moreover, consumers are exposed to potential health and safety hazards when purchasing counterfeit textiles, further exacerbating the problem. Brands also suffer reputational damage when their products are imitated and sold as authentic. Addressing this serious issue calls for a complex and innovative technological solution. One promising approach that has emerged is the use of blockchain technology. By leveraging blockchain, the textile industry can authenticate items, enhance transparency, and effectively eliminate counterfeit goods from the supply chain. This, in turn, will help restore customer confidence, protect legitimate manufacturers, and establish a more secure and reliable market for all stakeholders involved.

Blockchain technology offers a game-changing solution to combat the proliferation of counterfeit goods in the textile industry. By utilizing the decentralized nature of blockchain, manufacturers can ensure the authenticity and provenance of their products. Every step in the supply chain can be recorded and verified, providing undisputed transparency and traceability.

Implementing blockchain-based solutions brings a multitude of benefits to the textile industry. Firstly, it offers an effective means of safeguarding legitimate manufacturers against the financial risks imposed by counterfeit products. By eradicating counterfeit goods from the market,

blockchain technology protects consumers from potential health and safety hazards. Moreover, brands can maintain their reputation and trustworthiness, as consumers can confidently purchase genuine products. Counterfeit goods continue to plague the textile industry, posing numerous challenges for all stakeholders involved. However, the integration of blockchain technology has emerged as a promising solution. By implementing blockchain-based solutions, the industry can restore customer confidence, protect legitimate manufacturers, and create a secure and trustworthy market. Embracing innovation is crucial in staying ahead of counterfeiters and ensuring the integrity of the textile industry.

B. Methodology

Our main objective revolves around using blockchain methodology to combat the production of counterfeit products. In today's rapidly evolving world, it's crucial to stay one step ahead of the game, and that's where the latest trend of blockchain technology comes into play.

One of the key tools employed in the project was the use of smart tags. These intelligent tags played a crucial role in product identification. At each step of the process, thorough product inspections took place. By simply scanning the smart tags or utilizing the unique product ID, the origin and manufacturing location of the product could be easily verified. The producer maintained a comprehensive database of all their manufactured products, providing users with reliable and accurate information.

The following are the tools we used in the project and the methods we used to implement blockchain technology.

Visual Studio Code: To aid in the development process, the project made use of Visual Studio Code. This Integrated Development Environment (IDE) played a significant role in app creation, deployment, and web application design. Equipped with powerful tools, including those for Graphical User Interface (GUI), Visual Studio Code provided seamless code editing and debugging capabilities.

Ganache: To test smart contracts, a private blockchain called Ganache was implemented. Ganache served as a valuable platform for advancing Ethereum-based projects. To tackle counterfeiting, a specialized smart contract was developed using this platform. With its user-friendly GUI and seamless integration with smart contracts, each transaction triggered the generation of a new block. This chain of interconnected blocks ensured the authenticity of each product was verified every time it underwent inspection. This blockchain was maintained by the Truffle Suite, facilitating the effective implementation of smart contracts.

Truffle: In the development process, the Truffle framework played a critical role in deploying smart contracts on the Ethereum blockchain, including Ganache. Truffle offered a range of benefits, such as comprehensive testing of smart contracts and convenient User Interface (UI) libraries that aided in the creation of Decentralized Applications (DApps). By leveraging Truffle, the project benefited from a streamlined development experience.

Solidity: A high-level programming language, was utilized for writing smart contracts. These contracts primarily facilitated agreements between sellers and buyers within the project. Shining as one of the most popular languages for developing smart contracts on the blockchain, Solidity enabled the creation of transparent and decentralized networks. The adoption of decentralized applications further bolstered the project's commitment to fostering a trustworthy environment.

React: A key aspect of the project involved creating user interfaces (UI), and React emerged as the go-to solution. React proved indispensable in developing user interfaces that were not only visually appealing but also efficient in updating and validating various elements. This versatile framework empowered the team to design top-notch applications and web interfaces while serving as a vital component in the development of full-stack apps.

TABLE I . SOFTWARE COMPONENTS

Number	Software Components	Use
1	Visual Studio Code	Visual Studio Code is a user-friendly code editor with useful features for writing, editing, and debugging code.
2	Ganache	Ganache is a personal blockchain for Ethereum development and testing.
3	Truffle	Truffle is a development framework for Ethereum that simplifies smart contract deployment, testing, and migration.
4	Solidity	Solidity is a programming language for developing smart contracts on blockchain platforms like Ethereum.
5	React	React is a JavaScript library for building user interfaces, particularly single-page applications where components update efficiently.

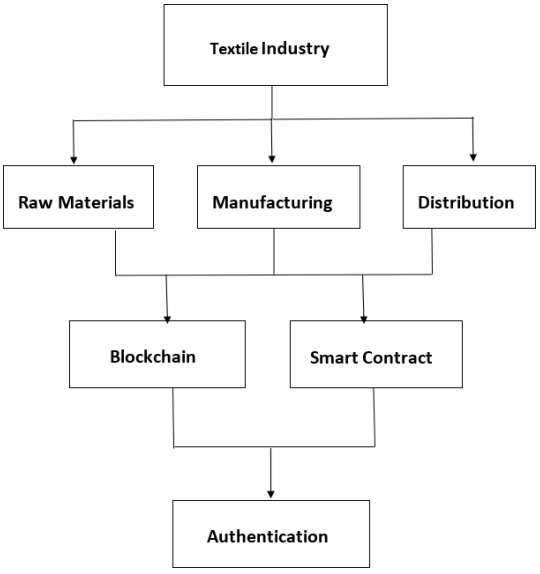


Fig. 1. Textile Industry Flow Diagram: From Raw Materials to Authentication

The textile industry is a multifaceted and global sector encompassing the production and dissemination of textiles, comprising fabrics derived from fibers. This industry is generally segmented into three key phases: raw materials, manufacturing, and distribution.

Raw Materials: At the outset, the focus is on procuring raw materials. These may be either natural, like cotton, wool, and silk, or synthetic, such as polyester and nylon. Natural fibers are cultivated from plants or animals, while synthetic ones are chemically manufactured.

Manufacturing: After the collection of raw materials, the subsequent step involves transforming them into yarn and fabric. Various processes, including spinning, weaving, knitting, and dyeing, are integral to this stage. Spinning entails twisting fibers into yarn while weaving and knitting involve the creation of fabric from yarn. Dyeing is the application of color to the fabric.

Distribution: The concluding phase of the textile industry is the distribution of finalized products to consumers. This encompasses diverse channels, including wholesale distributors, retail outlets, and online retailers.

Blockchain, a decentralized ledger technology, is employed to trace the movement of goods and materials within the supply chain. Smart contracts, being self-executing, automate transactions in the buying and selling of goods and services. Blockchain is utilized to track the origin of textiles, ensuring it does not originate from forced labor camps. Smart contracts contribute to automating worker payments, mitigating the risk of fraudulent activities. In each process, the product is authenticated and executed in the smart tag - place of origin, manufactured place. So, the buyers can scan or input the product ID and get the original products with the help of smart contracts. Everything is stored in the blockchain using the application.

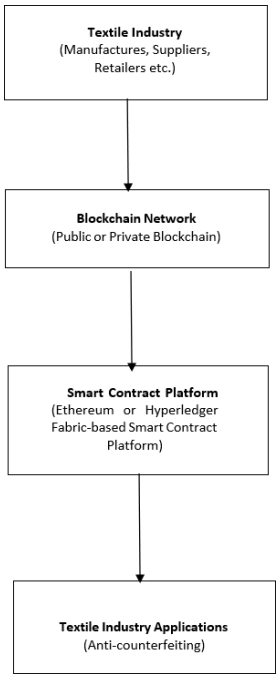


Fig. 2. Textile Industry Flow Diagram with Blockchain

Smart tags play the main role in the textile industry, every role is registered in it. It is stored in the blockchain network, Ganache, a private blockchain. Whenever a customer scans it, the data is visible from the blockchain using various platforms. Smart contracts are written using solidity language and are tested and used in the framework of web applications. Finally, every process of app development is made, and the decentralized application is designed and created for the user's purpose. The process starts with the manufacturer, the product will be registered there at first, then to the distributors, the distributors distribute the products to the retailers, and then the customers. Thus, in every step, the places are noted or registered in the smart tags. Every process is stored in a blockchain-enabled database. And at last, if the customers scan the product using the product ID or smart tag, using our decentralized application which comes under a smart contract.

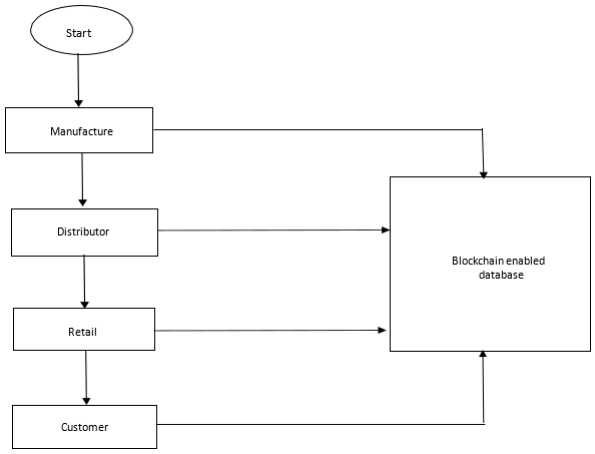


Fig. 3. Blockchain-enabled Supply Chain Management in the Textile Industry

IV. RESULT & DISCUSSION

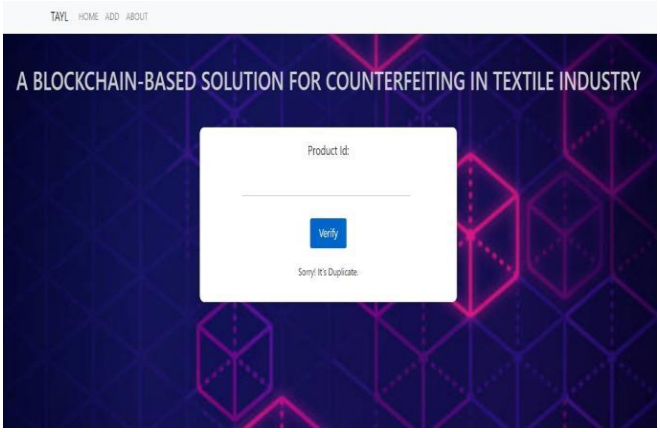


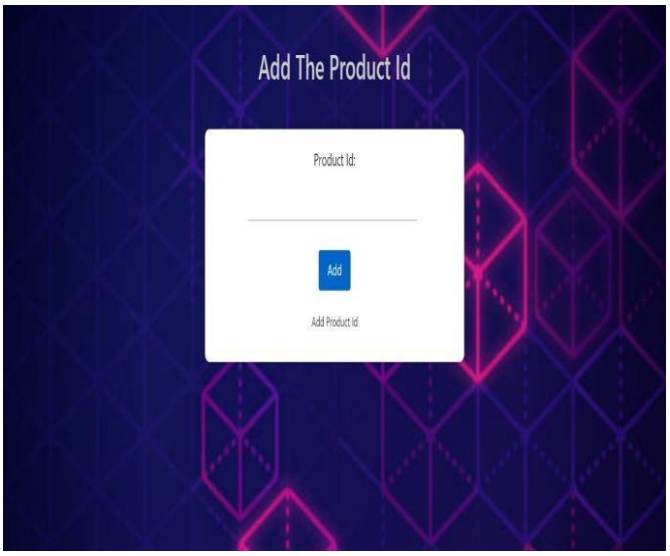
Fig.4. Home page

Fig 4 is the home page of our web application; we have developed the application, framework using React, Visual Studio code, and Truffle. The product ID is given as input to verify the authentication of the product by the smart contract written using solidity language.

Step 1: The customer should give their product ID in the smart tag.

Step 2: Click Verify.

Step 3: If the product is real, it gives the output as “Original Product” and if it is a counterfeit product, it gives the output as “Sorry! It’s Duplicate”.



The above fig 5 shows how the product should be added by the manufacturers, retailers, and distributors. These data are stored in the blockchain, using ganache. They are immutable. So, when the customer verifies the product using this application, they can get the output. So that the counterfeit products can be avoided. Thus, customers can get the original products.

V. CONCLUSION

Thus, Blockchain helped us to overcome the problems that are in the textile industry such as counterfeiting the products, which is not from the company’s manufacturer. Hence it verifies the authenticity of the products. Not only in the textile industry but also in other industries like cosmetics, medicine, electrical components, electronic devices, etc., Smart contracts help us to accomplish the project. Thus, it provides a transparent and secure way to give the original products to the customers. Hence it develops trust among the customers.

VI. FUTURE SCOPE

The future scope of the proposed blockchain-based solution for countering counterfeiting in the textile industry holds significant promise. This entails integrating the system with the Ethereum blockchain for enhanced security and decentralization, transitioning to real-time implementation within the textile supply chain, and ensuring scalability to accommodate a growing number of products and users. The user interface will continue to be refined based on feedback, with a strong focus on bolstering security, privacy, and data protection measures. The solution also seeks to explore interoperability with other blockchain networks, stay compliant with evolving regulations, expand its adoption internationally through collaboration, and introduce token-based incentives and loyalty programs. Robust analytics and reporting features will provide valuable insights, and educational initiatives will help stakeholders effectively utilize the blockchain-based authentication system.

REFERENCES

[1] Shivani Bhalerao, Siya Agarwal, Shruthi Borkar Shruti Anekar, Nikita Kulkarni, Sumedha Bhagwat’’ Supply Chain Management Using Blockchain”, 2019, Conference: 2019 International Conference on Intelligent Sustainable Systems (ICISS), DOI:10.1109/ISS1.2019.8908031

[2] Manal Hader, Abderrahman Elmhamedi, Abdellah Abouabdellah “Blockchain technology in supply chain management and loyalty programs: toward blockchain implementation in the retail market”,2020, 13th International Colloquium of Logistics and Supply Chain Management - LOGISTIQUA 2020 - December, 02 - 04 HST (EST) - Sidi Mohamed Ben Abdellah University –Morocco, DOI:10.1109/LOGISTIQUA49782.2020. 9353879

[3] Mitsuaki Nakasumi,” Information Sharing for Supply Chain Management based on Block Chain Technology”, 2017 IEEE 19th Conference on Business Informatics, DOI: 10.1109/CBI.2017.56

[4] Santichai Wicha, Sai Woon Sheng,” The Proposed of a Smart Traceability System for Teak Supply Chain Based on Blockchain Technology”, 2021, The 6th International Conference on Digital Arts, Media and Technology (DAMT) and 4th ECTI Northern Section Conference on Electronics, Computer and Telecommunications Engineering (NCON), DOI:10.1109/ECTIDAMTNCO N51128.2021.9425780

[5] Si Chen, Rui Shi, Zhuangyu Ren, Jiaqi Yan, Yani Shi, Jinyu Zhang," A Blockchain- based Supply Chain Quality Management Framework",2017, The Fourteenth IEEE International Conference on e-Business Engineering, DOI:10.1109/ICEBE.2017.34

[6] Mrs.M.C.Jayaprasanna, Ms.V.A.Soundharya, Ms.M.Suhana, Dr.S.Sujatha "A Block Chain based Management System for Detecting Counterfeit Product in Supply Chain",2021, Proceedings of the Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks(ICICV2021), DOI:10.1109/ICICV50876.2021.938856

[7] Bhagya Hegde, Dr. B Ravishankar, Mayur Appaiah," Agricultural Supply Chain Management Using Blockchain Technology", 2020, Proceedings of the International Conference on Mainstreaming Block Chain Implementation (ICOMBI) 2020, DOI:10.23919/ICOMBI48604.2020. 9203259.

[8] Surjandy, Meyliana, Hareo Leslie Hendrie Spits Warnars, Edi Abdurachrnan," Blockchain Technology Open Problems and Impact to Supply Chain Management in Automotive Component Industry", 2020,6th International Conference on Computing Engineering and Design (ICCED), DOI:10.1109/ICCED51276.2020.9415836

[9] Soha Yousuf, Davor Svetinovic:" Blockchain Technology in Supply Chain Management: Preliminary Study", 2019, Sixth International Conference on Internet of Things: Systems, Management, and Security (IOTSMS), DOI:10.1109/IOTSMS48152.2019.8939222

[10] Hanqing Wu, Jiannong Cao, Yanni Yang, Cheung Leong Tung, Shan Jiang, Bin Tang,Yang Liu, Xiaoqing Wang, Yuming Deng," Data Management in Supply Chain Using Blockchain: Challenges and A Case Study", 2019 28th International Conference on Computer Communication and Networks (ICCCN), DOI:10.1109/ICCCN.2019.8846964.

[11] B. Jinakan, R. Phoewhawm, and S. Wicha, "Knowledge Extraction and Designing of Child Development Detection System for a New Parent," 2020 Joint International Conference on Digital Arts, Media, and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON), Pattaya, Thailand, 2020, pp. 49-52.

[12] 0lnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing.

[13] Mohan, T. (2018). Improve food supply chain traceability using blockchain.

[14] S. Madumidha, P. S. Ranjani, S. S. Varsinee and P. S. Sundari, "Transparency and Traceability: In Food Supply Chain System using Blockchain Technology with Internet of Things," 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India, 2019, pp. 983-987.

[15] Wohrer, M., & Zdun, U. (2018, March). Smart contracts: security patterns in the Ethereum ecosystem and solidity. In 2018 International Workshop on Blockchain Oriented Software Engineering (IWBOSE) (pp. 2-8).

[16] Z.Xu, Y.Liu, J.Zhang, Z.Song, J.Li and J.Zhou, "Manufacturing Industry Supply Chain Management Based on the Ethereum Blockchain," 2019 IEEE International Conferences on Ubiquitous Computing & Communications (IUCC) and Data Science and Computational Intelligence (DSCI) and Smart Computing, Networking and Services (SmartCNS), Shenyang, China, 2019, pp. 592-596.

[17] Christodoulou, P., Christodoulou, K., & Andreou, A. (2018). A decentralized application for logistics: Using blockchain in real-world applications. The Cyprus Review, 30(2), 181- 193.

[18] Espineira, M., & Santaclara, F. J. (Eds.). (2016). Advances in food traceability techniques and technologies: improving quality throughout the food chain.