International Journal of Research and Development in Engineering Science
ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/
Regular Issue, Vol. 6, Issue. 4 (July – August), 2024 , Pages: 8 – 14
Received: 03 May 2024 ; *Accepted:* 12 June 2024 ; *Published:* 02 July 2024
https://doi.org/10.63328/IJRDES-V6RI4P2
Original Paper : Action Research – Persuasive Research Paper

Blockchain-Powered Counterfeit Detection in Supply Chain Systems: Enhancing Product Integrity

M. Indrasena Reddy [1*], B. Sruthi Laya [2], B. Siri [3], B. Vyshnavi [4]

[1,2,3,4] Computer Science and Engineering, BVRIT Hyderabad College of Engineering for Women, Hyderabad, India;
[1] indrasenareddy.m@bvrithyderabad.edu.in , [2] 20wh1a05b5@bvrithyderabad.edu.in ,
[3] 20wh1a0575@bvrithyderabad.edu.in , [4] 20wh1a0509@bvrithyderabad.edu.in

* *Corresponding Author:* indrasenareddy.m@bvrithyderabad.edu.in

Abstract: The proliferation of counterfeit products poses a significant threat to businesses and consumers, undermining brand reputation and potentially endangering consumer safety. Blockchain technology emerges as a promising solution to this pressing issue, offering a decentralized and transparent method for verifying product authenticity. This paper explores the innovative use of blockchain in combating the spread of fake goods, scrutinizing its core features and potential in establishing a secure mechanism for product verification. Our proposed approach involves leveraging blockchain's capabilities alongside smart contracts to streamline the verification process. Manufacturers can securely register their products on the blockchain, assigning each item a unique digital identity. Subsequently, consumers can verify product authenticity by scanning a QR code to access its digital identity, ensuring transparency and trust in the product's origin. The adoption of blockchain-based product identification offers numerous benefits, including heightened transparency, reduced instances of fraud, and enhanced consumer confidence. However, challenges such as scalability and compatibility must be addressed for widespread implementation. In summary, blockchain technology presents a promising solution to the counterfeit product dilemma. Its decentralized and tamper-proof nature provides a robust platform for verifying product authenticity, protecting both businesses and consumers from the harmful effects of counterfeit merchandise while fostering integrity in the marketplace.

Keywords: Blockchain Technology, Meta mask, Ethereum, Decentralized, QR code, Counterfeit.

1. Introduction

In today's swiftly advancing technological landscape, the continuous global advancement of products and technologies brings along the ever-present threat of counterfeiting and replication. This poses risks to company integrity, revenue streams, and even consumer well-being. The primary aim of this project is to establish the authenticity of purchased products, ensuring that consumers receive genuine items. A comparison between traditional supply chains and blockchain technology reveals stark differences in data security. Traditional supply chains function within a centralized network, granting companies control over data that may be susceptible to manipulation and lacks robust security measures. Counterfeit products exploit the perceived value of authentic items, emphasizing the necessity for secure verification systems. In contrast to traditional supply chains, blockchain offers a decentralized database where each transaction, including product data, is recorded and validated by a peer-to-peer network. Manufacturers can utilize blockchain to certify product authenticity, thereby increasing customer trust and fortifying brand reputation. Within blockchain, each block contains data, a hash, and the previous block's hash, creating an immutable record that prevents unauthorized alterations.

This immutability stands as a notable advantage over centralized architectures, ensuring customers receive accurate and unaltered product information, fostering transparency and consumer confidence. Within supply chains, the presence of counterfeit products creates logistical challenges, disrupts operations, and increases costs for businesses. Overall, the pervasive influence of counterfeit goods necessitates concerted efforts from

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 6, Issue 4 , 2024 , https://doi.org/10.63328/IJRDES-V6RI4P2

stakeholders across sectors to implement effective strategies for detection, prevention, and enforcement.

1.1. Impact of Fake Products

Counterfeit products wield a significant impact across various spheres, with repercussions spanning economic, social, and even health dimensions. Economically, counterfeit goods undercut legitimate businesses, resulting in revenue losses, decreased market share, and diminished brand value. Moreover, they undermine consumer confidence and trust, leading to long-term damage to brand reputation and loyalty. From a social standpoint, fake products pose serious health and safety risks to consumers. In industries such as pharmaceuticals and food, counterfeit items can be hazardous, leading to adverse health effects or even fatalities. Furthermore, counterfeit operations often involve illegal labour practices and contribute to organized crime, exacerbating social inequalities and instability. Addressing the impact of fake products requires multifaceted approaches involving collaboration among governments, businesses, and consumers. Strengthening regulatory frameworks, enhancing supply chain transparency, and raising awareness among consumers are crucial steps in mitigating the adverse effects of counterfeit goods and safeguarding public health and welfare.

1.2. Objectives:

The primary goals of this system encompass:

- Safeguarding consumers and brand integrity.
- Preserving company revenue streams.
- Ensuring adherence to regulatory standards.
- Upholding ethical business practices.

2. Related Work

The paper by Li and He (2020) conducts a comparative analysis of Bitcoin, Ethereum, and Libra, focusing on various aspects such as architecture, consensus mechanisms, transaction processing, and smart contract capabilities. It explores the fundamental differences and similarities among these prominent blockchain platforms, highlighting their strengths and limitations. Through detailed examination and empirical evaluation, the authors aim to provide insights into the distinctive features and potential use cases of each platform. The study contributes to the understanding of blockchain technologies and assists stakeholders in making informed decisions regarding their adoption and implementation in different contexts [6].

The paper by Jaya Prasanna et al. (2021) presents a blockchain-based management system designed to detect counterfeit products in the supply chain. Their system utilizes blockchain technology to create a transparent and immutable record of product transactions, enhancing traceability and authenticity verification. Through the integration of smart contracts and cryptographic techniques, the authors aim to ensure secure and tamper-proof product identification. The study underscores the importance of addressing the pervasive issue of counterfeit products and highlights blockchain's potential in effectively combating this problem. Overall, their proposed system contributes to advancing solutions for enhancing trust and security in supply chain management [9].

The paper by Tambe et al. (2021) delves into the application of blockchain technology for detecting counterfeit products. They present a framework that leverages blockchain's inherent features such as decentralization, transparency, and immutability to establish a trustworthy system for identifying fake goods within supply chains. The study emphasizes the importance of blockchain in enhancing product authentication processes and reducing the prevalence of counterfeit items. By proposing a practical approach for fake product detection, Tambe et al. contribute to the ongoing discourse surrounding the utilization of blockchain technology to address challenges in supply chain management and consumer protection against fraudulent activities [3].

The paper by Wasnik et al. (2022) focuses on utilizing blockchain technology to detect counterfeit products. Their research proposes a method that integrates blockchain into supply chain management systems to enhance product authentication and combat fraudulent activities. They discuss the benefits of blockchain, such as decentralization and transparency, in providing a reliable and immutable record of product transactions. Through case studies and analyses, they demonstrate the effectiveness of their approach in identifying counterfeit goods and improving trust within supply chains. The study underscores the importance of blockchain in addressing the persistent challenge of counterfeit products and protecting consumers and businesses alike [2].

The paper by Nruthya Ganapathy et al. (2022) introduces a system for detecting counterfeit products through blockchain technology. Their method utilizes blockchain's decentralized ledger to establish a transparent and immutable record of product transactions, enhancing authenticity verification within supply chains. By integrating cryptographic techniques and smart contracts, they aim to ensure secure and tamper-proof product identification. The study emphasizes the importance of addressing the proliferation of fake products and highlights blockchain's potential in mitigating this issue

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 6, Issue 4 , 2024 , https://doi.org/10.63328/IJRDES-V6RI4P2

effectively. Through their proposed system, the authors contribute to advancing solutions for combating counterfeit goods and fostering trust among consumers and businesses in the marketplace [8].

The paper by Jain et al. (2023) explores the use of blockchain technology for identifying counterfeit products. They propose a method that leverages blockchain's immutability and transparency to create a reliable system for verifying product authenticity throughout the supply chain. The study builds upon prior research highlighting blockchain's potential in supply chain management and counterfeit detection. By integrating blockchain with product identification mechanisms, the authors offer a novel approach to addressing the pervasive issue of counterfeit goods. Their work contributes to advancing the practical application of blockchain technology in combating fraudulent practices within various industries [1].

The paper by Patel et al. (2023) presents a system for detecting fake products by employing blockchain technology. Their approach integrates blockchain's decentralized ledger to create a transparent and immutable record of product transactions, enhancing authenticity verification throughout the supply chain. The authors emphasize the importance of tackling counterfeit goods and highlight blockchain's potential in addressing this issue effectively. Through their proposed system, they aim to provide consumers and businesses with a reliable mechanism for identifying fake products and maintaining trust in the marketplace. Overall, the study contributes to advancing solutions for combating counterfeit products using innovative blockchain-based approaches [4].

The paper by Tundalwar et al. (2022) introduces a system for detecting counterfeit products through blockchain technology. Their approach utilizes blockchain's decentralized and immutable ledger to create a reliable record of product transactions, enhancing transparency and authenticity verification within supply chains. By implementing smart contracts and cryptographic techniques, they aim to ensure secure and tamper-proof product identification. The study emphasizes the significance of addressing the proliferation of fake products and highlights blockchain's potential in mitigating this issue. Through their proposed system, the authors contribute to advancing solutions for combating counterfeit goods and fostering trust among consumers and businesses in the marketplace [5].

The paper by Shreekumar et al. (2022) proposes a system for detecting counterfeit products through blockchain technology. They outline a method that leverages blockchain's decentralized ledger to create a transparent and immutable record of product transactions, facilitating authenticity verification in supply chains. The authors emphasize the significance of addressing the pervasive issue of fake products and highlight blockchain's potential in combating this problem effectively.

Through their proposed approach, which integrates cryptographic techniques and smart contracts, they aim to provide a robust solution for identifying and preventing the circulation of counterfeit goods. Overall, the study contributes to advancing strategies for enhancing trust and security in product authentication processes [7].

The paper by Prajapati et al. (2023) discusses the implementation of blockchain-based anti-counterfeiting measures to strengthen supply chain integrity. They propose a system that utilizes blockchain technology to enhance transparency and traceability within supply chains, thereby deterring counterfeit product circulation.

Through the integration of cryptographic techniques and smart contracts, the authors aim to establish a secure and tamper-proof system for product authentication. Their approach emphasizes the importance of addressing the persistent challenge of counterfeit products and highlights blockchain's potential in effectively combating this issue. Overall, the study contributes to advancing solutions for safeguarding supply chain integrity through innovative blockchain-based measures [10].

Block Chain Technology: Ethereum blockchain serves as the foundation for our system, offering robust smart contract capabilities. Ganache provides a convenient environment for creating a private Ethereum blockchain, facilitating seamless testing of contracts. MetaMask integration enables users to interact with the Ethereum blockchain directly from the web application enhancing accessibility and usability [3].

Smart Contracts: Our smart contracts, deployed on the Ethereum blockchain, are designed to handle product verification and authentication. Each product is assigned a unique identifier, which is stored on the blockchain along with detailed information such as manufacturer and production date. We have implemented functions within the smart contracts to verify product authenticity by comparing stored data with physical product attributes.

Website Development: Using HTML, CSS, and JavaScript, we have developed a user-friendly website to facilitate interaction with the blockchain-based system. The website features intuitive interfaces for users to input or scan product information, enhancing user experience and accessibility. Leveraging MetaMask integration, users can seamlessly interact with the Ethereum blockchain directly

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 6, Issue 4 , 2024 , https://doi.org/10.63328/IJRDES-V6RI4P2

from the website, ensuring a seamless user experience. We display the authenticity status of products based on verification results from smart contracts, providing users with real-time information on product authenticity.

Table.1: Difference Between Block chain and Traditional Data Base:

Traditional Data Base	Block chain
Centralized Control	Decentralized Control
Single Authority	Distributed Network
Data Modification	Immutable Data
Limited Transparency	Transparency and Trust
Trust in Authority	Trust in Cryptography
Centralized Servers	Distributed Nodes

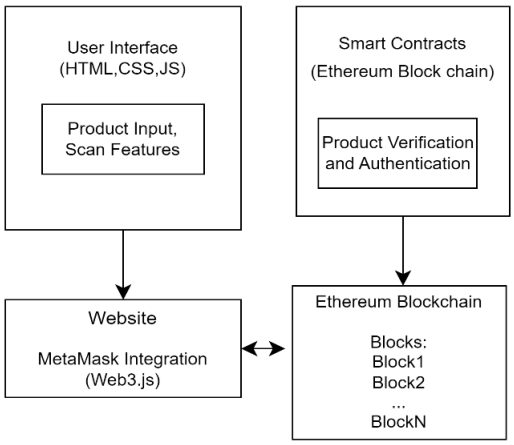

Fig.1.Structure of Block chain System

The above diagram **Fig.1** illustrates the flow of data and interactions between the various components of the blockchain-based fake product detection system, highlighting the integration of front-end user interface, MetaMask wallet, smart contracts, and the Ethereum blockchain. The above diagram illustrates the structure of a traditional database system, highlighting the flow of data and interactions between the user interface, website, and central database.

3. Experimental Method

In this proposed system, Ethereum serves as the backbone, providing a secure and decentralized platform for managing the records and transactions related to products from various companies. Each product is assigned a unique identifier, akin to a digital fingerprint **Fig.2**, which is then registered on Ethereum's blockchain. This digital ledger acts as a comprehensive database, documenting the journey of each product as it traverses through the supply chain, from manufacturing facilities to end consumers. As products move along the supply chain, different parties involved in the process, such as distributors and retailers, contribute to the product's history by recording their interactions with it on Ethereum's blockchain. This creates an immutable and transparent record of the product's lifecycle, enabling stakeholders to trace its origin and track its movement with confidence. The decentralized nature of Ethereum ensures that this information is securely stored and accessible to authorized participants across the network.

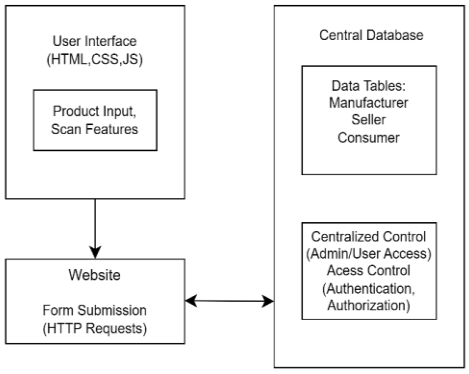

Fig.2 Structure of Traditional Data Base System

To automate the verification process and ensure the authenticity of products, smart contracts are deployed on the Ethereum blockchain. These self-executing contracts are programmed with predefined rules and conditions that govern the verification process. For instance, a smart contract may be designed to compare the unique identifier of a product with the corresponding record on the blockchain to verify its authenticity. If the product passes the verification process, the smart contract can trigger actions such as updating inventory records or initiating payments to relevant parties.

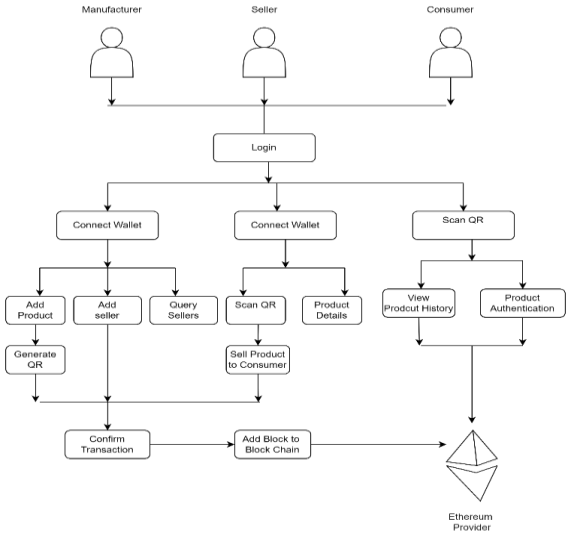

Fig.3 Flow of System model

In the event that a fake product is detected during the verification process, the smart contract can flag it as counterfeit, alerting stakeholders to take appropriate action. This instant detection capability is made possible by the immutability of the blockchain, which ensures that

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 6, Issue 4 , 2024 , https://doi.org/10.63328/IJRDES-V6RI4P2

the integrity of the records remains intact and tamper-proof. By leveraging Ethereum's blockchain and smart contract functionality, the proposed system provides **Fig.3** a robust solution for detecting and preventing the circulation of counterfeit products, thereby enhancing trust and transparency in the supply chain ecosystem.

Manufacturer: The manufacturer is the entity responsible for creating products. They log in to the system and enter details about the products they manufacture. Upon entering product details, the system generates a QR code for each product, which likely contains essential information about the product **Fig.5-9**. Manufacturers can query sellers to retrieve information about which sellers are distributing their products. This querying functionality allows manufacturers to track the distribution network of their products and monitor sales channels. Manufacturers may also use this feature to assess the performance of different sellers and make informed decisions about their distribution partnerships.

Seller: The seller is another entity involved in the selling process. They can log in to the system and add products to their inventory. Sellers can also sell products to consumers. Additionally, they have the ability to query product details. This could involve retrieving information about the products they have in stock, such as quantity, pricing, or any other relevant information. Consumer:

Consumer: Consumers are the end-users who purchase products. They can access product history details, likely by scanning the QR code associated with the product. Product history details might include information about the manufacturer, seller, date of purchase, and any other relevant data. Consumers can authenticate products, which means they can verify the authenticity of a product by scanning its QR code or checking its history details.

4. Results and Discussion

Our system allows both manufacturers and suppliers tos securely add their transaction details to the blockchain without altering each other's information. We're using a local network for testing, using Ganache. Once our smart contracts are written, they're compiled and deployed using Truffle. Now, for the interface, we've built a user-friendly website using HTML, CSS, and JavaScript. This interface allows users to interact with the Ethereum blockchain. To achieve **Fig.4** this interaction, we've employed the Web3.js library.

For the security and ease of access, we're using MetaMask, a browser extension that acts as a digital wallet to connect to the Ethereum blockchain. Manufacturers and suppliers import their accounts from Ganache into MetaMask. When they want to add their blocks to the blockchain, they confirm the transactions using MetaMask. Finally, for end-users who want to verify the integrity of the goods, they can simply scan a QR code. This allows them to check **Fig.4** the entire supply chain journey of the product, ensuring its authenticity.

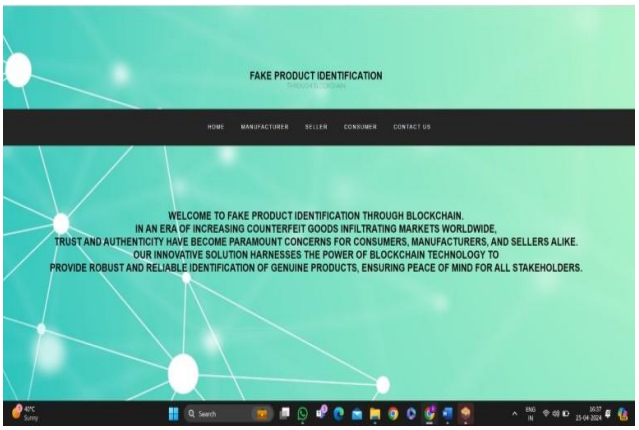

Fig.4 Sign up Page

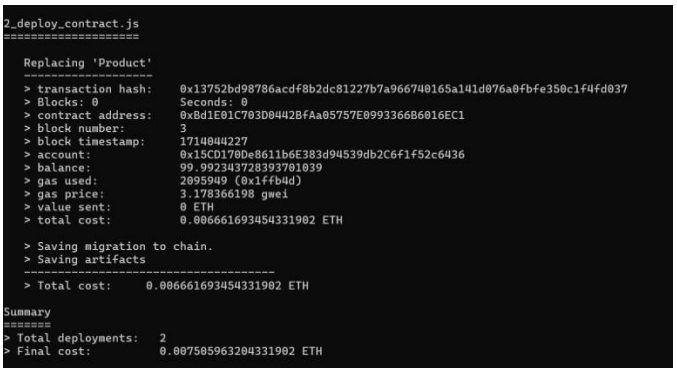

Fig.5 Deployment of Product Smart Contract

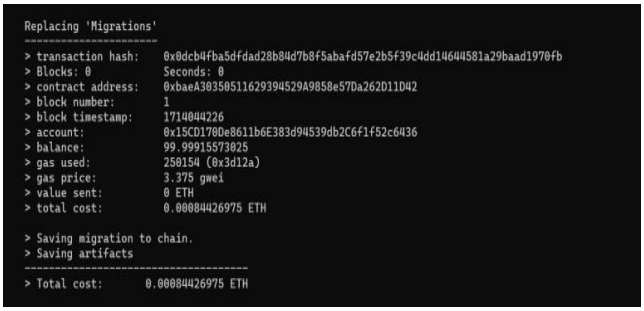

Fig.6 Deployment of Migrations Smart Contract

Fig.7 Manufactuer adding Product Details Page

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 6, Issue 4 , 2024 , https://doi.org/10.63328/IJRDES-V6RI4P2

Fig.8 Seller selling product to consumer

Fig.9 Manage Courses on Admin Side

5. Conclusion and Future Scope

Blockchain technology has emerged as a powerful tool not only for enhancing supply chain transparency and authenticity but also for empowering consumers by granting them access to comprehensive product information stored securely on the blockchain. This technology leverages unique and immutable digital identities assigned to each product, enabling customers to verify product authenticity before making a purchase, thus reducing the risk of falling victim to counterfeit or fake products. Manufacturers and suppliers storing product details on the blockchain make this information accessible to consumers, allowing them to scrutinize the entire supply chain history of a product. This transparency instills confidence in consumers, enabling them to confirm the legitimacy of the goods they intend to purchase and fostering trust in the integrity of their transactions. The application of blockchain extends beyond supply chain management into various sectors, including healthcare, voting systems, online shopping, and banking. In healthcare, patients can verify medication authenticity by accessing blockchain records, mitigating the risk of counterfeit drugs entering the market. Similarly, in online shopping and banking, customers can verify product and transaction legitimacy, enhancing security and trust in digital transactions. Real-time blockchain systems facilitate the creation of decentralized marketplaces prioritizing authenticity and transparency. These systems verify product information, reducing the risk of fraud and counterfeiting in online transactions, fostering a more secure and trustworthy digital marketplace ecosystem.

The future of blockchain for fake product identification holds promise, with potential developments in global adoption, interoperability, and enhanced data analytics. Integration with IoT devices enables real-time tracking, promoting supply chain transparency. Regulatory compliance alignment is crucial for legal adherence. Advanced technologies like machine learning and AI can improve counterfeit pattern detection accuracy. Streamlined user interfaces and mobile applications can boost technology adoption. Collaboration among stakeholders, including manufacturers, governments, and consumers, is essential for effective implementation. Overall, future advancements aim to strengthen authenticity verification, mitigate counterfeit infiltration, and foster greater trust in products across industries.

Author Contributions

IMR: Conceptualization, drafting, data collection and analysis, Supervision;
BSL: Writing and method, Supervision, Methodology and review, writing and Data Collection, and Editing
BS: Drafting, Interpretation and Data Collection;
BV: Drafting, , Data Collection and Analysis, Writing;

Declaration

Conflicts of Interest: The authors declare no conflict of interest.
Author contribution: All authors wrote the main manuscript text and also consent to the submission
Ethical approval: Not applicable.
Consent to Participate: All authors consent to participate.
Funding: Not applicable, and No funding was received
Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Not applicable.
Personal Statement: We Declare with our best of Knowledge that this research work is purely Original Work and No third party material Not used in this article drafting. If any such kind material found in further online publication, we are responsible only for any judicial and copyright issues.

Acknowledgements
We thank everyone who inspired our work.

References

[1]. Jain, Aryan, Arya Vats, Kuhu Bhatnagar, Meghna Tyagi, and Pooja Tripathi, "Fake Product Identification Using Blockchain," Journal of Current Research in Engineering and Science, Vol. 6, No 2, pp. 1-7, 2023.
[2]. Wasnik, Kunal, Isha Sondawle, Rushikesh Wani, and

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 6, Issue 4 , 2024 , https://doi.org/10.63328/IJRDES-V6RI4P2

Namita Pulgam, "Detection of counterfeit products using blockchain," In ITM Web of conferences, EDP Sciences, India, pp. 1-9, 2022.

[3]. Tejaswini L. Tambe, Madhavi G. Varpe, Manali B. Khurud, S. Y. Raut and Sonali P. Chitalkar, "Fake Product Detection Using Blockchain Technology," Internation Journal Of Advance Research And Innovative Ideas In Education, Vol.7, No 4, pp 314-319, 2021.

[4]. Kriti Patel, Muskan Sonker, Ajay Kumar Srivastava,Divya Jyoti Srivastava, "Fake Product Detection System Using Blockchain," International Journal of Advances in Engineering and Management, Vol 5, No 4, pp 1041 – 1044, 2023.

[5]. Tundalwar, Rashmi, Sanket Sonkusare, Girish Teli, Tanishq Yadav, and Aakash Solanki, "FAKE PRODUCT DETECTION USING BLOCKCHAIN," International Journal of Engineering Applied Sciences and Technology, Vol.7, No 7, pp 69-72, 2022.

[6]. Li, Wenzheng, and Mingsheng He, "Comparative analysis of bitcoin, ethereum, and libra," In 2020 IEEE 11th International Conference on Software Engineering and Service Science (ICSESS), IEEE, China, pp. 545-550, 2020.

[7]. Shreekumar, T., Puneet Mittal, Sukhwinder Sharma, Rajesh N. Kamath, Sreeja Rajesh, and B. Nruthya Ganapathy, "Fake product detection using blockchain technology," Journal of Algebraic Statistics, Vol 13, No 3, pp 2815-2821, 2022

[8]. Nruthya Ganapathy B, Keerthan Kumar, Poojary Shreya Jaya, Rajath D Shetty, Dr. Shreekumar T, "FAKE PRODUCT DETE CTION USING BLOCK CHAIN TECHNOLOGY," International Journal of Creative Research Thoughts, Vol 10, No 7,pp b928 – b932, 2022.

[9]. M. C. Jayaprasanna, V. A. Soundharya, M. Suhana and S. Sujatha, "A Block Chain based Management System for Detecting Counterfeit Product in Supply Chain," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks, ICICV, India, pp. 253-257, 2021.

[10]. shubham Prajapati, Jayesh Gadhari, Tushar Sawant, Juilee Kini, Sheetal Solanki, "Strengthening Supply Chain Integrity with Blockchain-based Anti-Counterfeiting Measures," 2023 International Conference on Innovative Data Communication Technologies and Application (ICIDCA), India, pp.786-790, 2023.

Author's Profiles

Dr. M. Indrasena Reddy is currently working as a professor in the Department of Computer Science and Engineering at BVRIT Hyderabad College of Engineering for Women, Hyderabad, India.

B. Sruthi Laya is currently pursuing a B. Tech in the Department of Computer Science and Engineering at BVRIT Hyderabad College of Engineering for Women, Hyderabad, India.

B.Siri is currently pursuing a B. Tech in the Computer Science and Engineering Department at BVRIT Hyderabad College of Engineering for Women, Hyderabad, India

B. Vyshnavi is currently pursuing a B. Tech in the Computer Science and Engineering Department at BVRIT Hyderabad College of Engineering for Women, Hyderabad, India.