Asian Journal of Science and Applied Technology
ISSN: 2249-0698 (P) Vol.12 No.2, 2023, pp.32-38

DOI: https://doi.org/10.51983/ajsat-2023.12.2.4047

A Secure System for Buying and Verifying the Authenticity of Drugs Using Blockchain Technology

K. Ravindran[1], J. Pranav Niranjan[2] and A. Sam Osborn[3]
[1]Assistant Professor, [2&3]Student,
Department of Information Technology, Easwari Engineering College, Tamil Nadu, India
E-mail: ravindran.k@eec.srmrmp.edu.in, jpranavniran@gmail.com, samosborn14dec@gmail.com
(Received 16 October 2023; Revised 5 November 2023, Accepted 29 November 2023; Available online 5 December 2023)

***Abstract* - In the healthcare sector, ensuring the safety and legitimacy of drugs is a top priority. Counterfeit pharmaceuticals are a major problem for the industry, as they not only cause financial losses but also endanger public health and safety. These fake medications are hazardous or inefficient, putting lives at risk. The dissemination of fake medications has not been stopped by the use of conventional techniques for confirming drug legitimacy. This project presents a novel way to improve the security and authenticity of pharmaceutical purchases by utilizing blockchain technology. The key focus of this innovative project is to devise a blockchain-based secure system that will enable drug producers, distributors, and consumers to safely check the legitimacy of pharmaceuticals and track their provenance throughout the supply chain. The utilization of decentralized and immutable properties of blockchain technology makes it possible to create a transparent and impenetrable platform for documenting and confirming drug-related transactions. The blockchain will securely store every stage of the pharmaceutical supply chain, from production to retail, establishing a transparently traceable framework. Implementing a secure blockchain-based system for drug authentication helps effectively build trust within the pharmaceutical supply chain, protect consumers from counterfeit drugs, and make a positive impact on the overall improvement of public health. The transparency and security offered by blockchain technology in drug transactions have the potential to revolutionize the pharmaceutical industry, fostering a more reliable environment for drug procurement and distribution.**
Keywords: **Drugs, Counterfeit, Blockchain, Pharmaceutical, Authenticity, Traceability**

I. INTRODUCTION

Essential medications are supplied by the pharmaceutical sector, which is one of the primary drivers of public health. However, the widespread availability of fake medications endangers public health and patient safety. This initiative overcomes the issue of guaranteeing the legitimacy of medications by developing a safe system using blockchain technology. The decentralized and easily manipulable nature of blockchain makes it an ideal platform for developing an accessible and trustworthy drug verification system. Additionally, the system has an easy-to-use interface that allows manufacturers, pharmacists, and consumers to confirm the legality of drugs quickly and effectively.

The blockchain technology used in this project ensures the reliability and authenticity of data by providing resistance to illegal access and modification, in addition to imparting a secure and transparent drug verification mechanism. Thus, with setting up this type of system, the project in the long run enhances public protection and in addition to increasing the contribution of confidence within the deliver supply chain among consumers.

II. OBJECTIVE OF THE STUDY

The core objective of undertaking this project is to enhance the authentication of drugs by integrating blockchain with, every detail of drug from a manufacturer, including its origin, production date, and batch details, and securely record it in a decentralized and immutable ledger. This guarantees the integrity of the records and prevents unauthorized changes, presenting a better level of belief in the authenticity of pharmaceutical merchandise.

Our project intends to introduce steady transactions in the pharmaceutical deliver chain with the aid of incorporating cryptocurrency. Sellers and customers can use cryptocurrency to buy actual drugs, and these transactions are recorded on the blockchain. The use of cryptocurrency now not only adds an additional layer of security to transactions however additionally streamlines the payment procedure, lowering the reliance on conventional and potentially inclined charge methods.

III. REVIEW OF LITERATURE

In 2016, Marc Pilkington explained about the main working principles of blockchain technology, along with its core concepts through a handbook [1]. Paper [2], which was published on 2018 briefly discusses about the distributed nature of blockchain and BLOCKBENCH, which is a benchmarking tool, used for evaluating the performance of private blockchains by processing workloads. Properties of blockchain which includes transparency, auditability and immutability are explained along with the challenges and

opportunities by a survey paper, which was published on 2019 [3]. Blockchain technology has recently emerged big and its impact on society is revealed by a group of people through their research paper which was published on 2017 [4]. Pharmaceutical companies should follow through good clinical practices to ensure safety of public health, but during many inspections conducted by FDA (US Food and Drug Administration), it was found that many clinical sites do not follow through good standards, this observation was revealed in 2015 by a paper published by Charles Seife [5]. In 2017, a product ownership management system (POMS) developed by Kentaroh Toyoda and his team, makes use of the concept proof of submission offered by blockchain along with radio frequency identification (RFID) for effectively avoiding the purchase of counterfeit products [6].

In a paper published in 2018, credit is evaluated by smart contracts and the obtained results are used for supervision and management by regulators [7]. In 2017, a system was developed to utilize Hazard Analysis and Critical Control Points (HACPP), which is a method used to identify and reduce food related risks. It is used along with blockchain to create a supply chain for food [8]. Again in 2018, proof of concept property of blockchain was utilized to time-stamp the consent obtained from patients during clinical trials [9]. Ram Krishna Jha and his associates made use of a ledger which has the details of channel-artefacts, crypto-config, docker configurations files and fabric scripts. They were considered as first module and the second model was containing smart contracts like registration contract, node modules, transfer drug and fabric contract Api.

Finally, the third module was designed to have the user interface [10]. In 2021, an application was developed to authenticate medicines in a supply chain which included manufacturers, wholesaler, distributers, pharmacist, and consumers. It implemented the concept of QR code generation to verify by using a smart contract but only a limited number of people were given the access to verify the authenticity and it was also not designed to provide the details of the drug [11]. A drug management system, which was designed in 2021, segregates spurious and substandard drugs. The application was developed to perform limited functionalities and does not provide the purchaser an option to verify the authenticity of the drug before making a purchase [12]. The paper published by Yulia Kostyuchenko and Qingshan Jiang in 2021 offers different solution to combat fake drugs but they were not providing a practical model of implementation [13].

IV. METHODOLGY

The blockchain based system is implemented by using frontend technologies like HTML, CSS, and JavaScript, along with backend technology called Solidity.

HTML, or Hypertext Markup Language, is a simple code used for making web pages that we see in web browsers. It helps in creating the basic parts and layout of a webpage.

Cascading Style Sheets (CSS) is a styling language used for defining the presentation of documents written in languages such as HTML or XML. It is used to determine aspects of web pages such as layout, formatting, colours, backgrounds, borders, padding, margins, fonts, icons, positions, and many different HTML elements.

JavaScript, a simple object-oriented programming language, which plays a major role in scripting webpages for numerous websites. It has syntax and structure similar to that of C programming language, JavaScript acts as an interpreted, robust programming language, bringing dynamic interactivity to HTML documents on websites.

Solidity is a sophisticated programming language, which has been developed specifically for the creation of smart contracts on multiple blockchain platform. Solidity facilitates the incorporation of complex user functions, extensive libraries, and inheritance features. Its design draws inspiration from Python, C++, and JavaScript, and it operates within the Ethereum Virtual Machine (EVM). It stands as the foremost language used for managing blockchain operations. The versatile applications of Solidity include the development of contracts for diverse functions such as voting systems, crowdfunding initiatives, product authentication, and multi-signature wallets.

Tools like Visual Studio Code, Apache Tomcat, Truffle Ganache, MetaMask wallet and Google Chrome were used to build the system.

V. PROPOSED SYSTEM

The drug manufacturers have their own portal, and they have to login using the credentials which they used for registering. Once after logging-in they have options to register their product, delete their product and view their inventory. If they choose to add their product, they are prompted to enter the details of their product and if there is no already existing product with the same details from the same manufacturer, then a unique QR code is generated for the product and the details of the product are stored using a smart contract. Product deletion requires the manufacturer to enter the product-id. If a matching product from the same manufacturer is found, then it is removed. Show inventory option allows the manufacturer to have a look at the list of products listed by the manufacturer.

Sellers also have a portal, similar to the one used by manufacturers, and after logging-in they are given the options to buy products from the manufacturer using cryptocurrency, verify products using QR code and show inventory. If they choose to buy, then they are prompted to upload the QR code, if the QR code is valid and the corresponding product belongs to only a manufacturer, then the seller can proceed to buy it using Ethereum cryptocurrency and after successful purchase, ownership of the product is changed to the seller. Also, the sellers can verify the details of a product using verify product QR code option, which displays the complete details of a valid

product or else it shows product not found. Show inventory lets them to view the details of products owned by them.
Customers after successfully logging-in, they are given options to buy a product from sellers using cryptocurrency, verify product and show inventory. These options work similarly to those used by sellers as intended, but customers can only buy products from sellers which were not already purchased by other customer.

VI. SYSTEM ARCHITECTURE

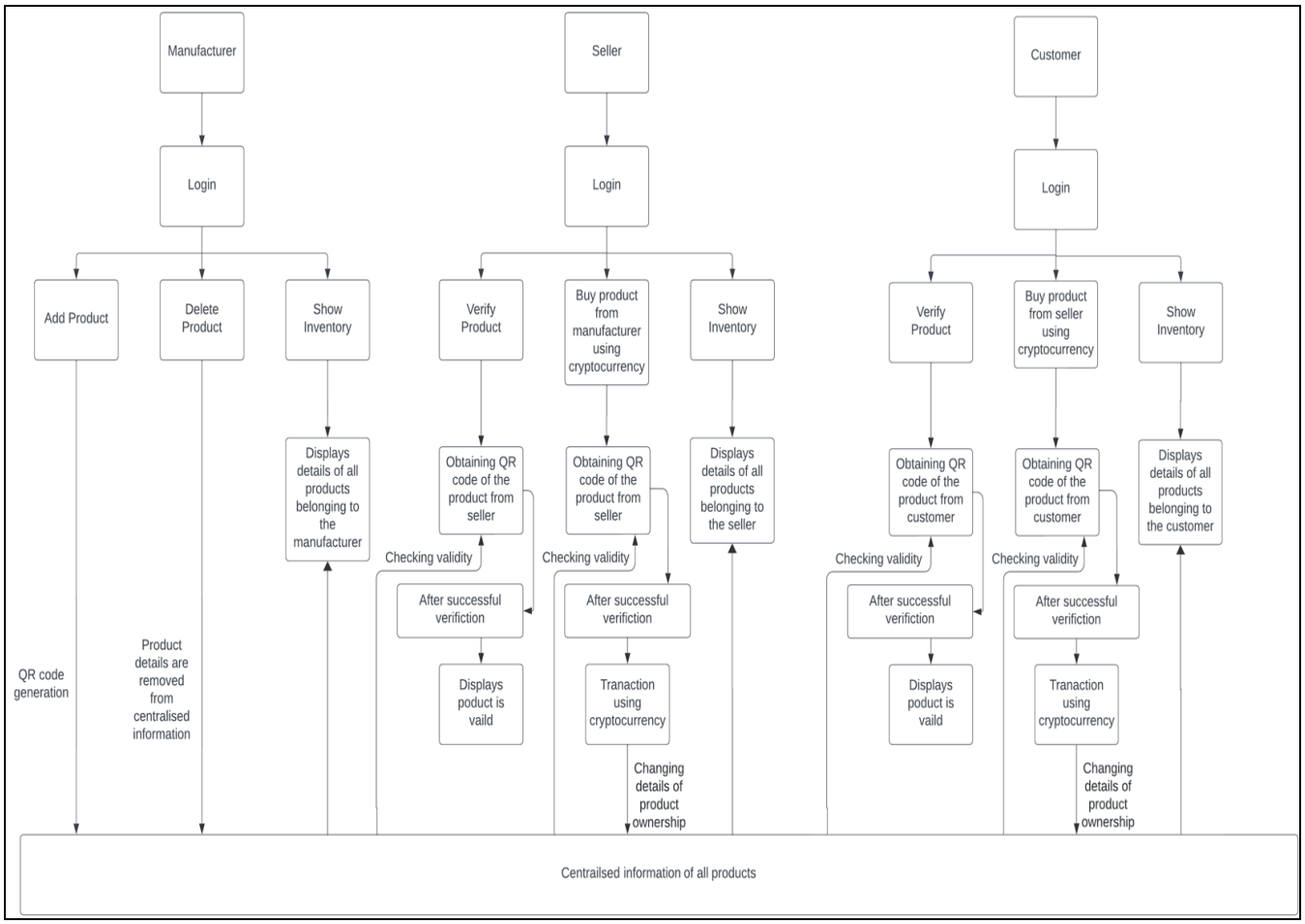

Fig. 1 Image of the system design

VII. SAMPLE IMPLEMENTATION

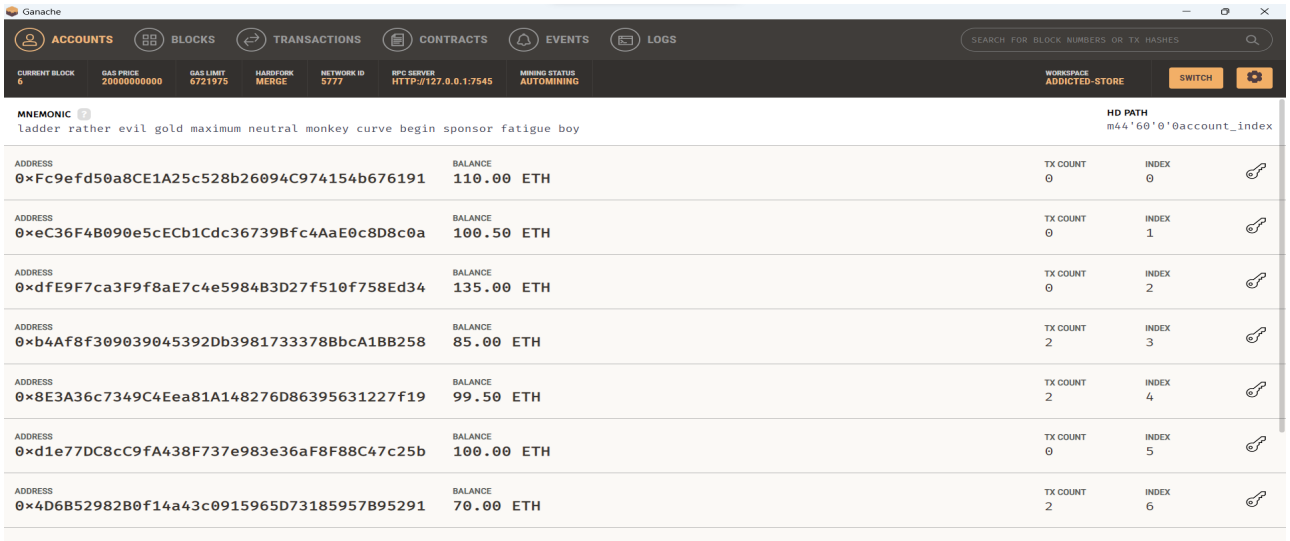

Fig. 2 Image of all wallet address in the blockchain network with their balance

Fig. 3 Image of a smart contract called Product Contract being deployed

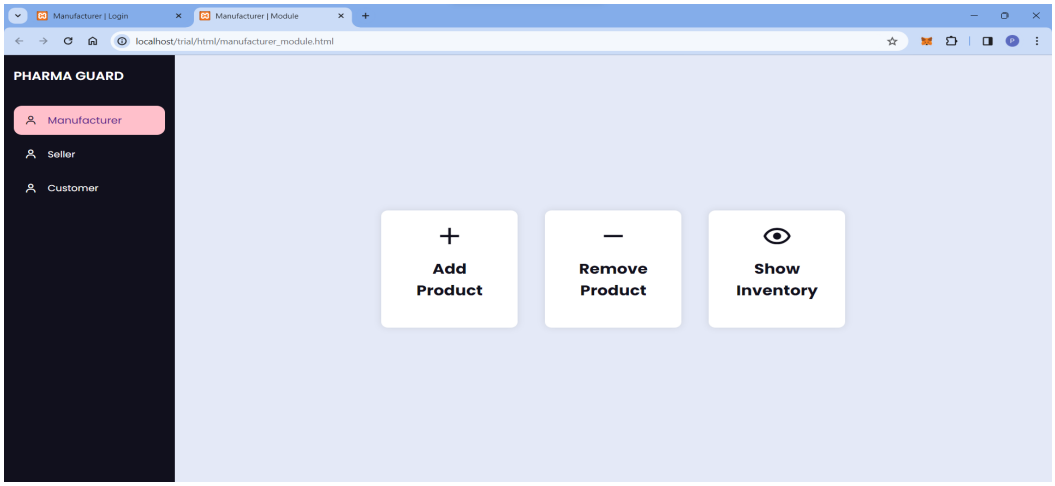

Fig. 4 Image of all operations in the manufacturer's module

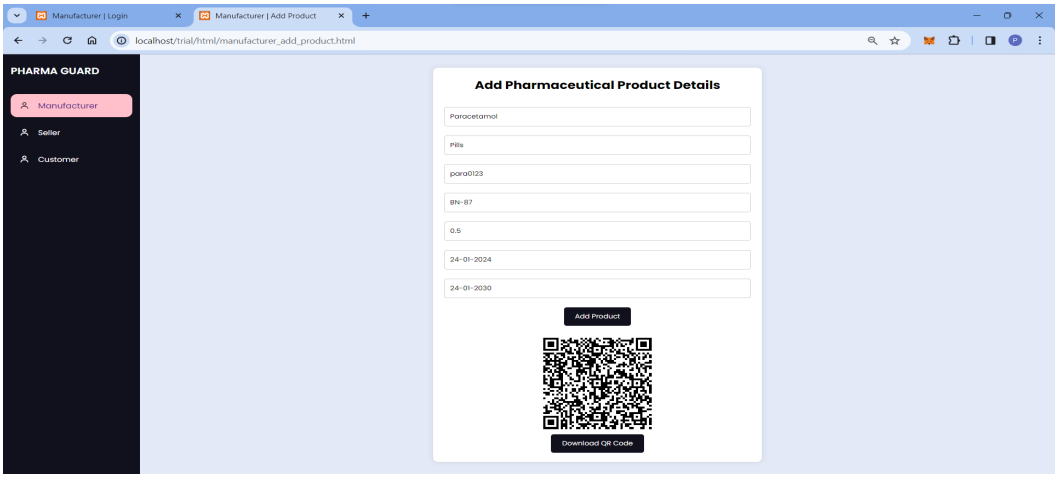

Fig. 5 Image of manufacturer, adding the details of a drug and generating a QR code

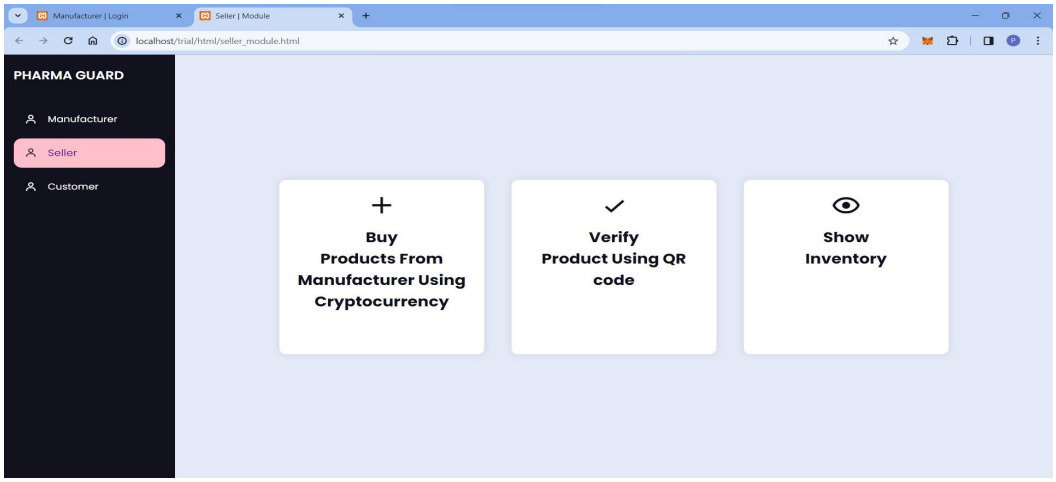

Fig. 6 Image of all operations in the seller's module

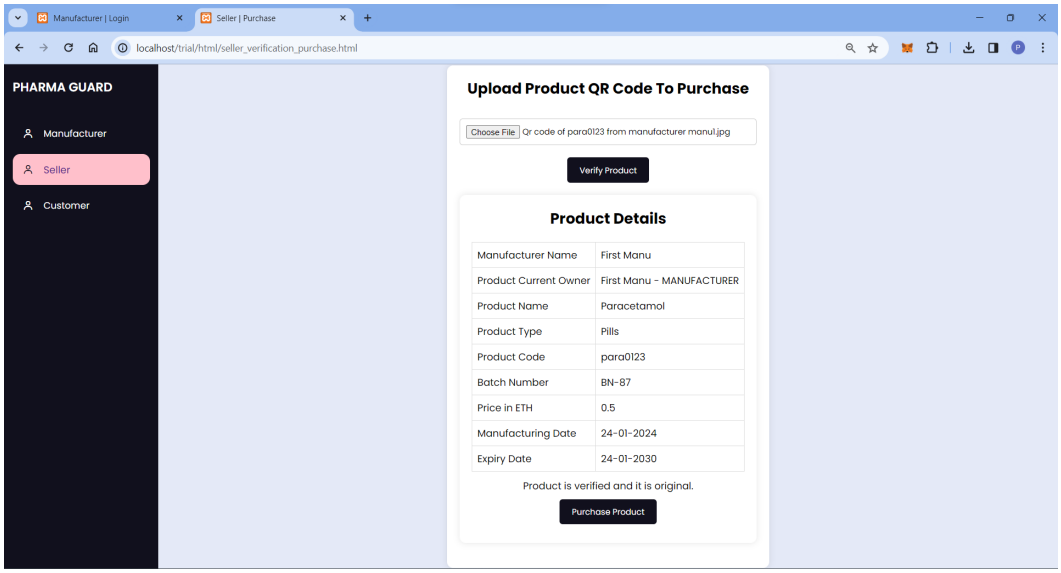

Fig. 7 Image of seller scanning the QR code to verify the product, before purchasing it from a manufacturer

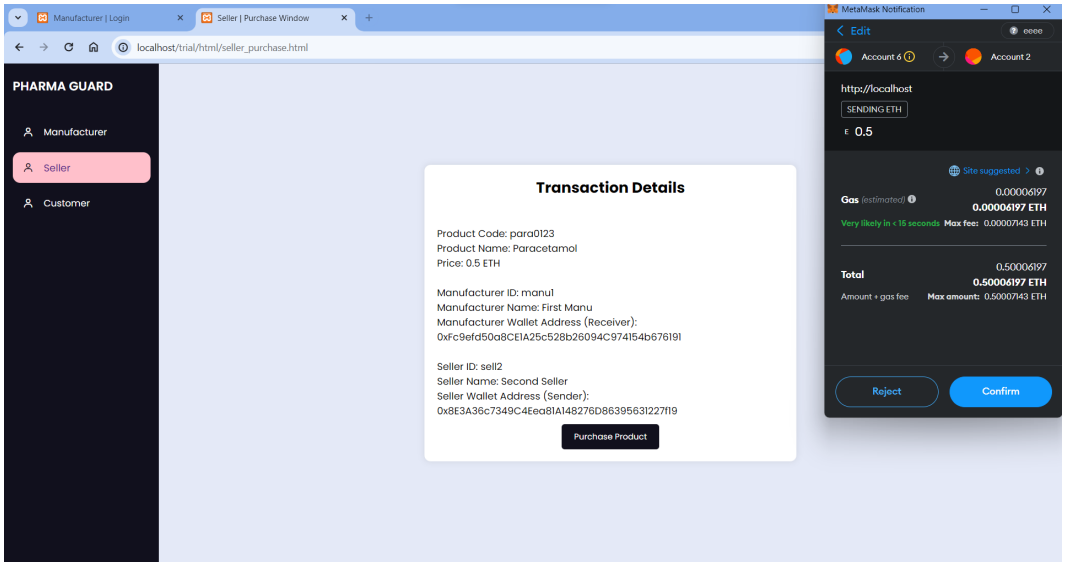

Fig. 8 Image of seller confirming the purchase

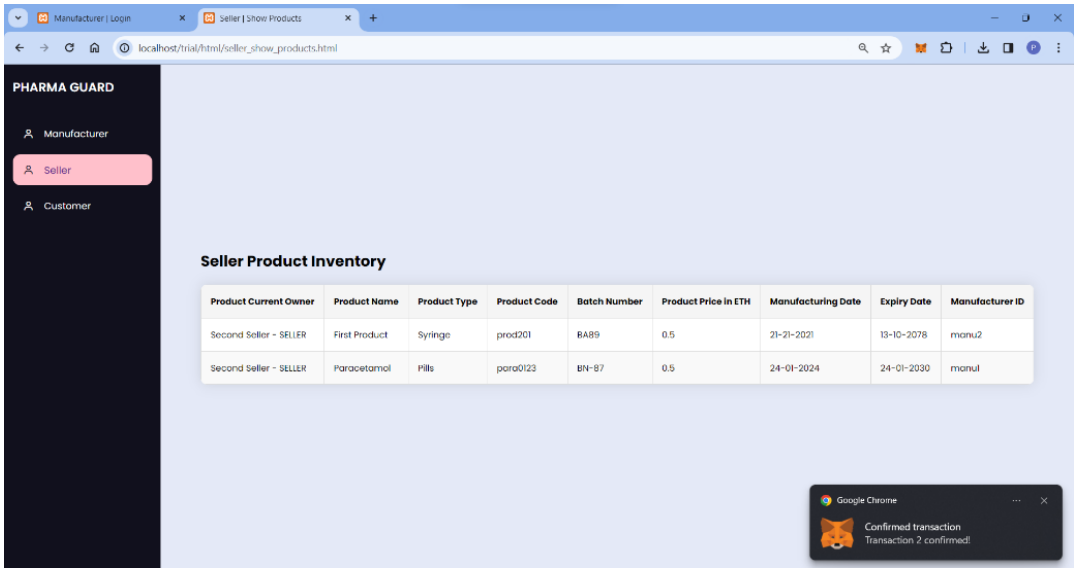

Fig. 9 Image of the seller's inventory after successful purchase

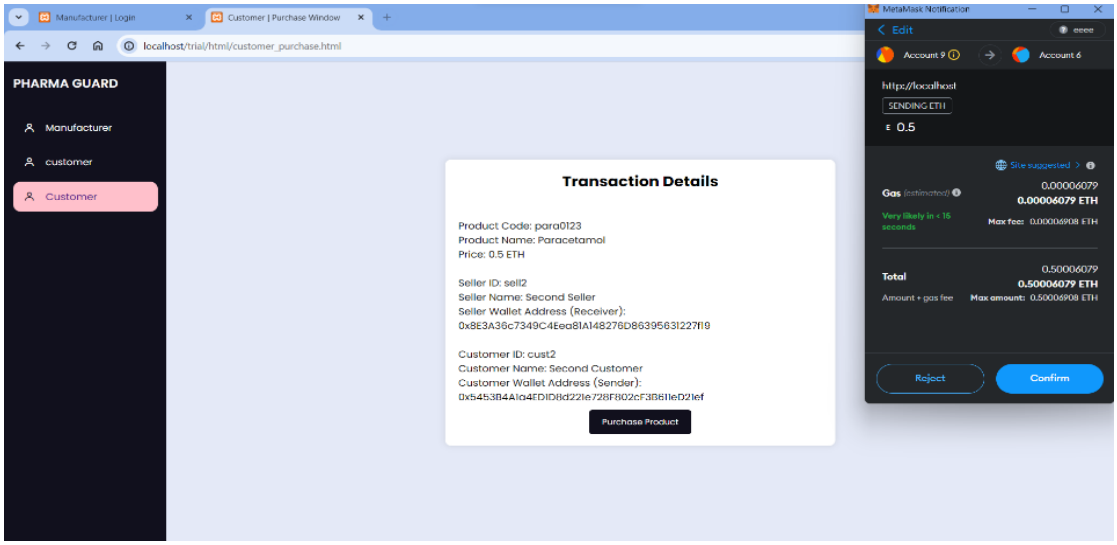

Fig. 10 Image of customer confirming the purchase after successful QR code verification

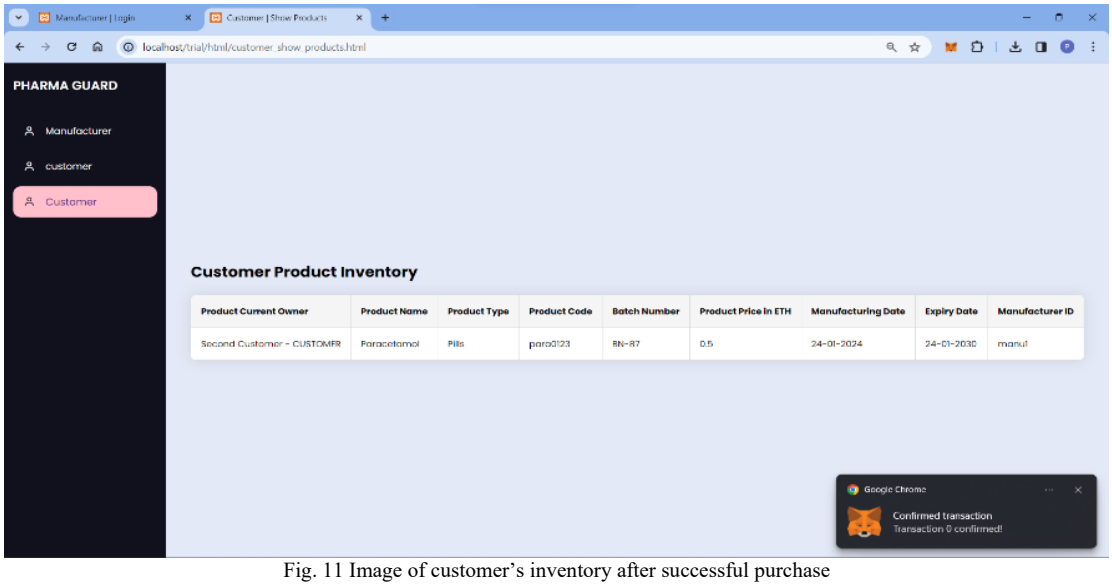

Fig. 11 Image of customer's inventory after successful purchase

VIII. CONCLUSION

The implementation of a steady solution for purchasing and verifying the authenticity of medication using blockchain technology marks a groundbreaking stride closer to ensuring the protection and well-being of individuals worldwide. This progressive project not only addresses the crucial trouble of counterfeit tablets but also establishes a strong basis for an obvious and tamper-proof delivery chain. The impact of this steady drug verification system extends beyond mere technological development. It represents a commitment to safeguarding public health, as customers can now make informed choices about the medications they rely on.

REFERENCES

[1] M. Pilkington, "Blockchain technology: principles and applications," in *Research Handbook on Digital Transformations*, 2016, DOI: https://doi.org/10.4337/9781784717766.00019.

[2] T. T. Dinh *et al.,* "Untangling blockchain: A data processing view of blockchain systems," in *IEEE Transactions on Knowledge and Data Engineering*, vol. 30, no. 7, pp. 1366-1385, 2018, DOI: https://doi.org/10.1109/tkde.2017.2781227.

[3] A. A. Monrat, O. Schelen, and K. Andersson, "A survey of blockchain from the perspectives of applications, challenges, and opportunities," in *IEEE Access*, vol. 7, pp. 117134-117151, 2019, DOI: https://doi.org/10.1109/access.2019.2936094.

[4] T. Aste, P. Tasca, and T. Di Matteo, "Blockchain technologies: The foreseeable impact on society and industry," in *Computer*, vol. 50, no. 9, pp. 18-28, 2017, DOI: https://doi.org/10.1109/mc.2017.3571064.

[5] C. Seife, "Research misconduct identified by the US Food and Drug Administration," in *JAMA Internal Medicine*, vol. 175, no. 4, pp. 567, 2015, DOI: https://doi.org/10.1001/jamainternmed.2014.7774.

[6] K. Toyoda *et al.,* "A novel blockchain-based product ownership management system (POMS) for anti-counterfeits in the post supply chain," in *IEEE Access*, vol. 5, pp. 17465-17477, 2017, DOI: https://doi.org/10.1109/access.2017.2720760.

[7] D. Mao *et al.,* "Credit evaluation system based on blockchain for multiple stakeholders in the food supply chain," in *International Journal of Environmental Research and Public Health*, vol. 15, no. 8, pp. 1627, 2018, DOI: https://doi.org/10.3390/ijerph15081627.

[8] F. Tian, "A supply chain traceability system for food safety based on HACCP, blockchain & Internet of things," in *2017 International Conference on Service Systems and Service Management*, 2017, DOI: https://doi.org/10.1109/icsssm.2017.7996119.

[9] M. Benchoufi, R. Porcher, and P. Ravaud, "Blockchain protocols in clinical trials: Transparency and traceability of consent," in *F1000Research*, vol. 6, pp. 66, 2018, DOI: https://doi.org/10.12688/f1000research.10531.5.

[10] R. K. Jha *et al.,* "Counterfeit drug prevention in Pharma supply chain using blockchain technology," in *2023 3rd International Conference on Intelligent Communication and Computational Techniques (ICCT)*, 2023, DOI: https://doi.org/10.1109/icct56969.2023.10076043.

[11] T. S. *et al.,* "Med secure: A blockchain based authenticated system for counterfeit medicine in Decentralized Peer to peer network," in *2021 Asian Conference on Innovation in Technology (ASIANCON)*, 2021, DOI: https://doi.org/10.1109/asiancon51346.2021.9544648.

[12] S. Raxit, J. Hossain Gourob, and H. Kabir, "A comprehensive drug management system by segregating spurious and substandard drugs using blockchain technology," in *2021 International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI)*, 2021, DOI: https://doi.org/10.1109/acmi53878.2021.9528238.

[13] Y. Kostyuchenko and Q. Jiang, "Blockchain applications to combat the global trade of falsified drugs," in *2020 International Conference on Data Mining Workshops (ICDMW)*, 2021, DOI: https://doi.org/10.1109/icdmw51313.2020.00127.