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Drug Supply Chain Using Blockchain Technology

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Abstract: ***Developing a supply chain in the healthcare sector is quite challenging since a compromised supply chain could risk a patient's life. Lack of transparency, difficulty tracking items, distribution of out-of-date products, a lack of confidence, a lack of safety and security, and many other problems are dealt with in the healthcare industry. Numerous of these issues can be resolved using blockchain technology. The necessity to increase transparency and traceability in the supply chain has arisen as a result of growing concern over drug safety. The use of an efficient, traceable, and transparent supply chain with blockchain technology can also help avoid drug counterfeiting.***

I. INTRODUCTION

Drug safety is one of the most important needs now-a-days as it directly affects the public's health. Many researchers have claimed, to guarantee drug safety the best solution is to build a reliable drug traceability system ranging from drug production, logistics to sales. This paper proposes and develops a block chain based smart tracking and tracing platform to provide a decentralized solution in the drug supply chain in order to address the challenges faced by centralized applications.

II. RELATED WORK

A. Blockchain in Agriculture and Food Industries

The implementation of blockchain can revolutionize the agriculture and food industry by integrating visibility, traceability, transparency, authenticity.

In 2021, Researchers Indra Eluubek kyzy, Huaming Song, Ahmadreza Vajdi, Yongli Wang and Junlong Zhou [2] proposed a practical paradigm in agricultural supply chain management. In this proposed system, the problems of trust ability, scalability, and share amount assignment have been solved.

In 2021, Researchers Tripti Paul, Sandeep Mondal, Nazrul Islam and Sandip Rakshit [3] studied the impact and performance of blockchain on the tea supply chain. Paper discussed the conceptual framework integrating Blockchain Technology into supply chain

B. Blockchain-based application in textile and clothing industries

In 2021, Tarun Kumar Agrawal, Vijay Kumar, Rudrajeet Pal, Lichuan Wang and Yan Chen [4], proposed a Blockchain-based framework for supply chain traceability in textile and clothing industry. It creates a foundation for future research in multiple directions.

C. Blockchain in Logistics

In 2021, Researchers Mikulas Cerny, Marian Gogola, Stanislav Kubalak and Jan Ondrus [5] studied the issues of blockchain technology and its application int the supply chain.

D. Blockchain in Trade

In 2021, Researchers Gokcay Balci and Ebru Surucu-Balci [6] studied the adoption of blockchain in maritime supply chain. The paper examines barriers and salient stakeholders in international trade. The paper uncovers the structural relationships between BT adoption barriers in CIT.

III. METHODOLOGIES

A. Proposed Method

SupplySpark is a Decentralized Logistics application that stores whereabout of the product on the Blockchain. At consumer end, customer can simply scan the QR code of products and get complete information about the provenance of that product hence empowering consumers to only purchase authentic and quality products.

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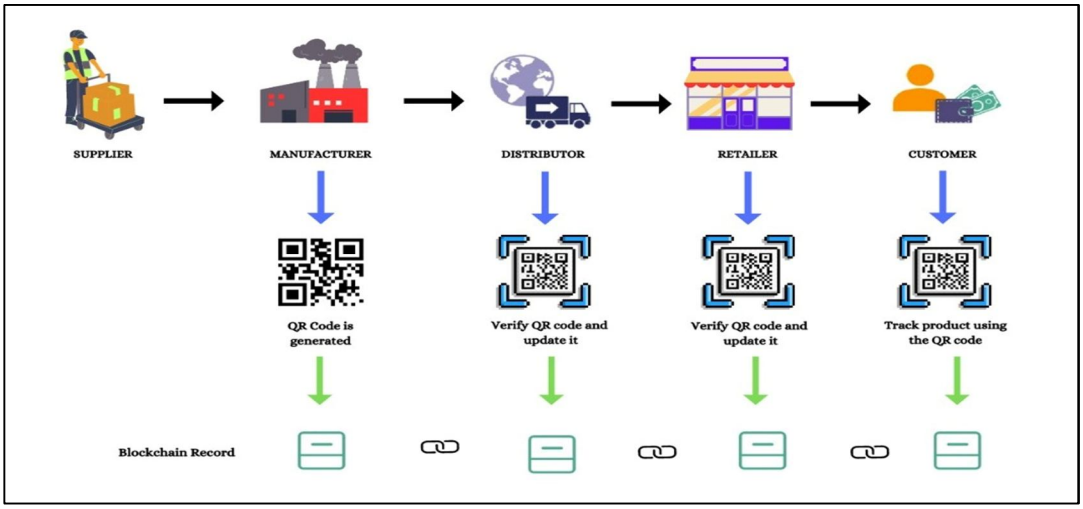


Figure 1: System Architecture

Smart Contract: Add new Product (Only manufacturer)	
Input: New product details: • ProductName	
Output: Product added and QR code with product information generated.	
1	If (registered)
2	If (role == manufacturer)
3	If (DrugState != created)
4	Create drugstate_by_manufacturer
5	QR code generated automatically using the Qrious library.
6	Else
7	Access denied
8	Else
9	Register onto the system
10	End

B. Algorithm

Smart Contract: Add Product State (Update information only by Retailer and Distributor)	
Input: Current entities information: • Date of receiving product • Location of entity • QR code from previous entity	
Output: Updated product information	
1	If (registered)
2	If (role == Distributor) OR (role == Retailer)
3	Update DrugState
4	Else
5	Access denied
6	Else
7	Register onto the system
8	End

Smart Contract: Track product information	
Input: QR code	
Output: Information of product status	
1	If (registered)
2	Scan QR
3	Get detailed tracking information
4	Else
5	Register onto the system
6	End

C. Mathematical Model

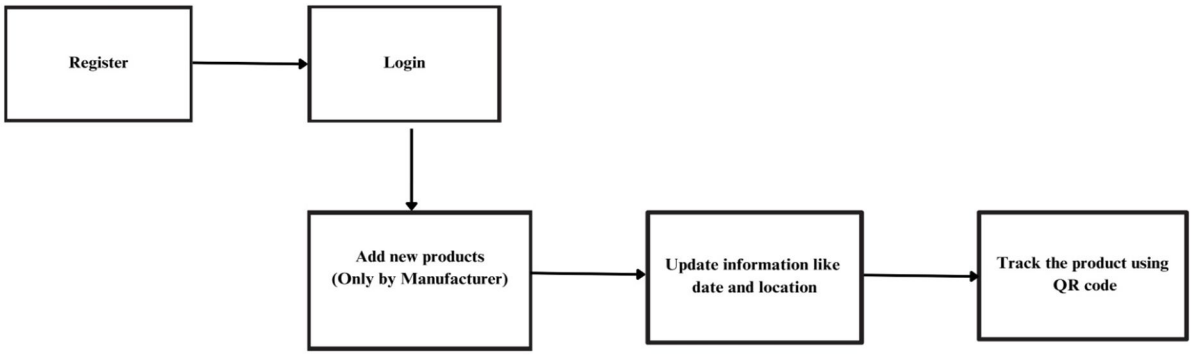


Figure 2: Mathematical model of the system.

- *Set Theory*

S = s, I, O, F, e, V
Where,
s = Start of program
I = I1
I1 = QR code
O = O1
O1 = Tracking status of product
F = F1, F2
F1 = QR Detection
F2 = Location Detection
E = End of program
V = Failures and success conditions.

- *Success if*

• Products added successfully.
• QR code is generated.
• Products can be tracked.

- *Failure if*

• More time consumption by the system.
• Hardware failure.
• Software failure.
• Improper network connection.

- *Space Complexity*

The space complexity depends on slide-summary and desired-shot. More the hashed data means more is the space complexity.

- *Time Complexity*

If system has n records, then, the time complexity of checking the records is O (1) in best case and O(n) in worst case.
E=end of program
T = Failures and success conditions.

IV. EXPERIMENTAL SETUP

Following are requirements for development of system:

1) Operating systems: Windows 10 or later/ Linux.
2) Compatible tools: Ganache Blockchain, Meta Mask, Solidity, Node.js
3) IDE : Remix VM
4) Database: MySQL

V. RESULT

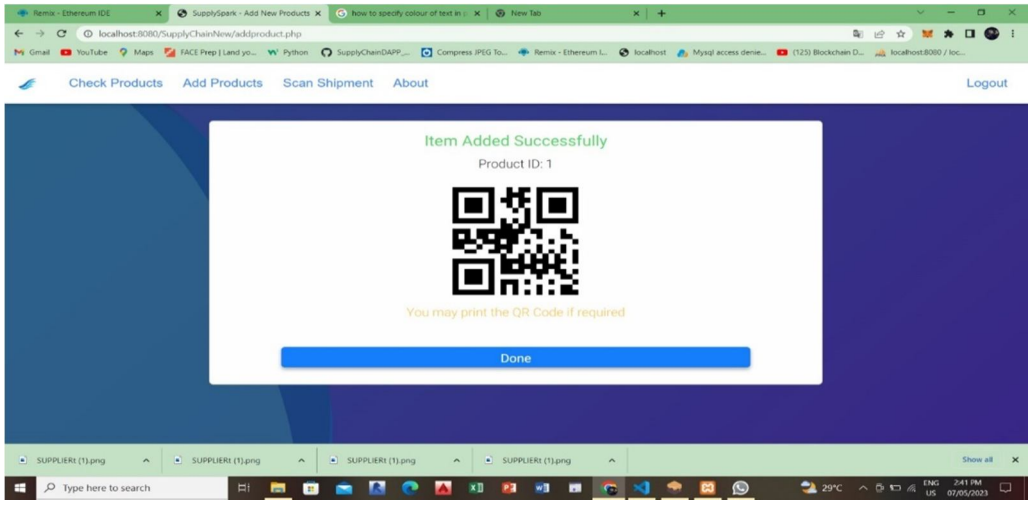


Figure 3A: Product added by Manufacturer

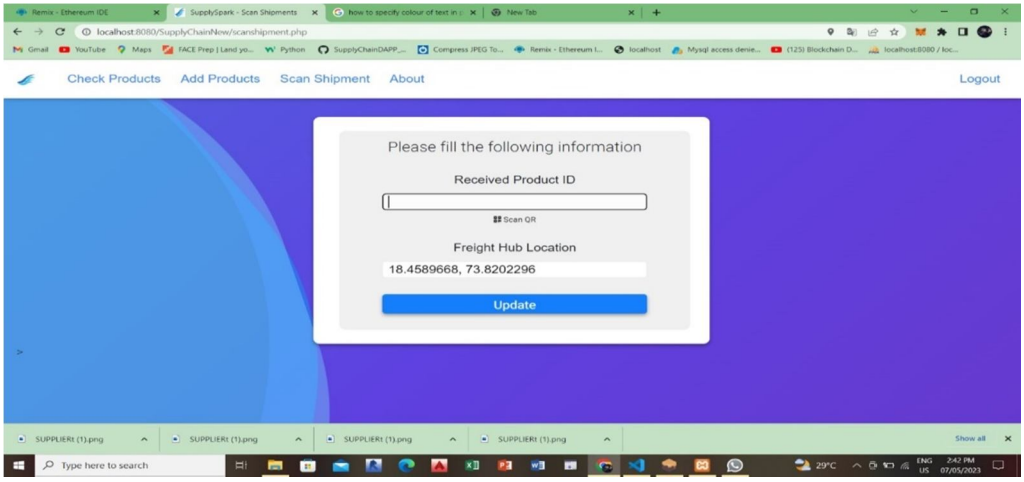


Figure 3B: Update information

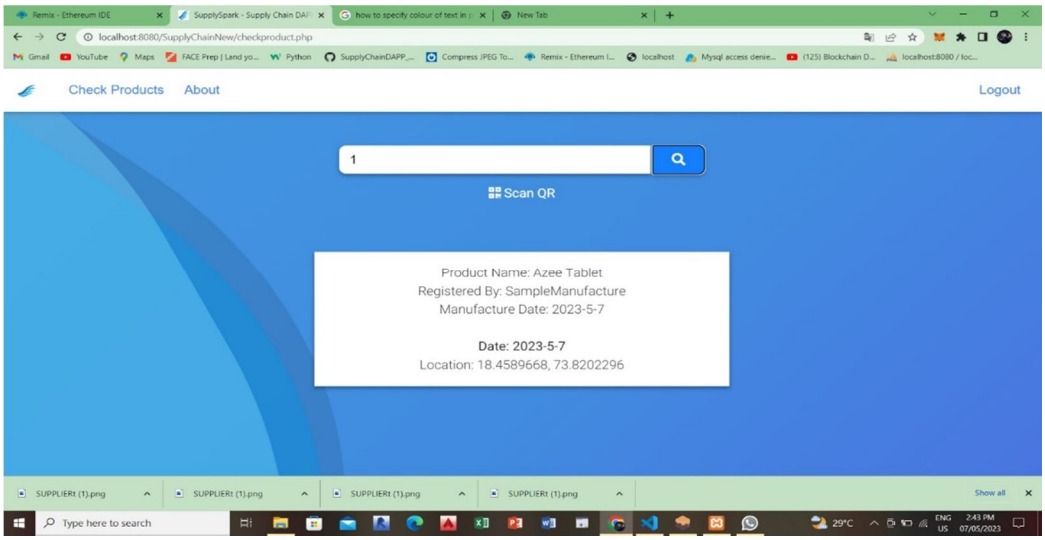


Figure3C: Information updated after scanning QR code.

VI. CONCLUSION AND FUTURE WORK

This paper introduces a blockchain-based smart tracking and tracing platform to achieve a transparent, secured and a practical method that guarantees blockchain network performance in data storage and meets the data privacy requirements of the drug stakeholders. Smart contracts are designed and developed, which could provide a consistent solution from drug production to usage for solving the fake/poor-quality drugs issues.

Blockchain will change the way the supply ecosystem operates and can facilitate increased transparency alongside reducing the costs and risks associated with it. Blockchain technology in the supply chain will eliminate the threat of duplicate orders, invoice fraud, company counterfeiting and unaccounted spending.

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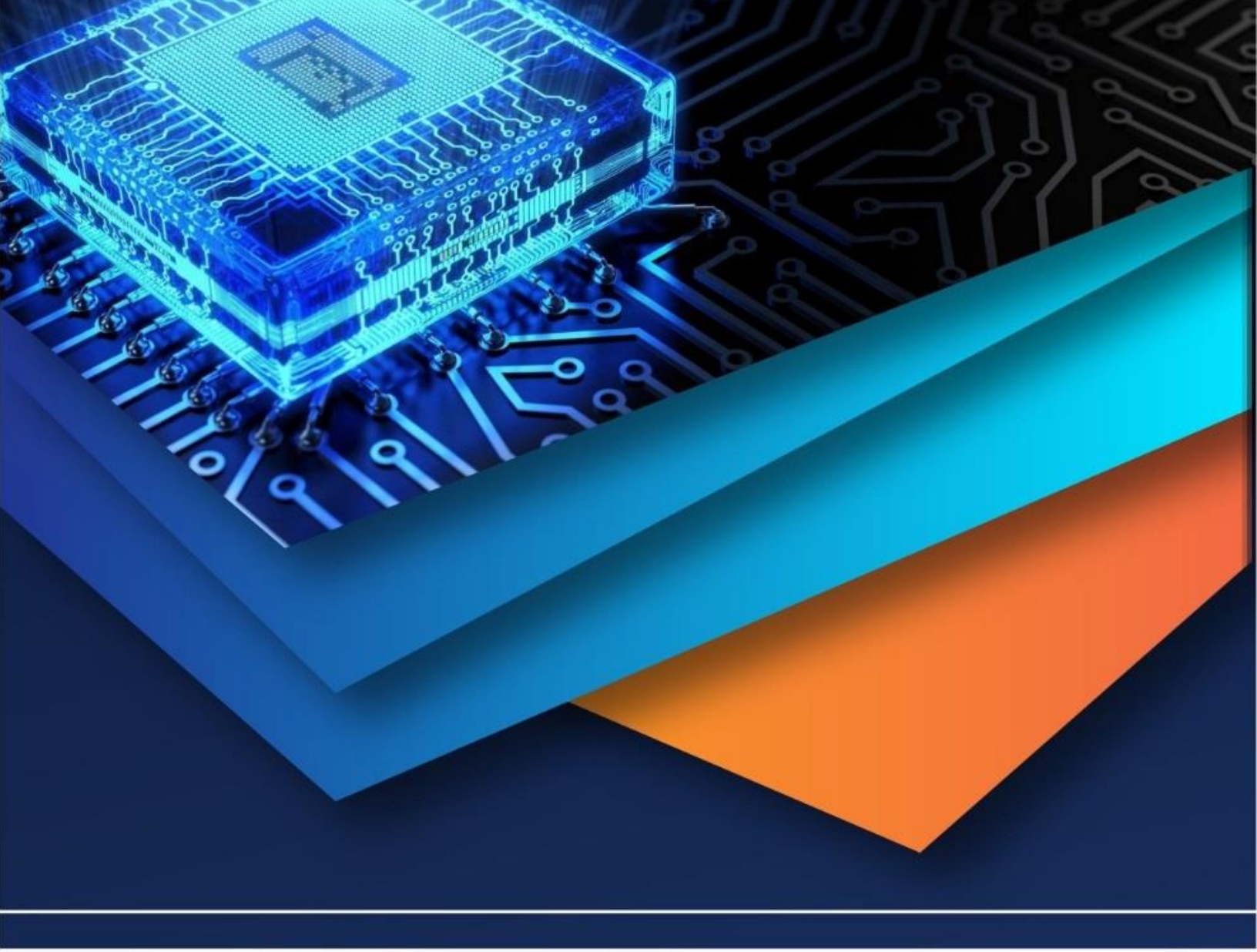
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