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Medicinal Supply Chain Using Blockchain And AI

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ABSTRACT: Now a days, Counterfeit drugs poses a serious threat to human life. Managing supply chain is a difficult task and major impact on Healthcare Sector and if it's not implemented transparently then it has direct impact on public health. Our Project Deals with this issue using two technologies – Blockchain and AI. Blockchain records transaction between two parties using Smart contracts and as Blockchain are decentralized, immutable and transparent, they can solve the issue of counterfeit medicines. AI in pharmacology helps in analysing performance all along the supply chain which include manufacturing and packaging of the drugs and it's distribution. We built Rasa chatbot that is integrated into flutter app which will help in customer services like ordering and tracing back medicines. DApp is built using React and smart contract is deployed on Ganache.

KEYWORD: Supply chain, Counterfeit Drug, Blockchain, Smart contract, Artificial Intelligence, Rasa.

I. INTRODUCTION

The supply chain is a highly intricate process that spans over extended periods, potentially months or more, and encompasses numerous stages across various global regions. It comprises various entities such as suppliers, manufacturers, transporters, wholesalers, distributors, and retailers. Consequently, monitoring the journey of each medical drug within this chain and tracing its origin becomes a laborious task. The issue of drug counterfeiting is a widespread concern, with reports from the Health Research Funding organization indicating that approximately 10-30% of drugs in developing countries are counterfeit. These counterfeit products pose significant risks to human health, as they can lead to different adverse effects. According to the World Health Organization, roughly 30% of all medication sold in Africa, Asia, and Latin America is counterfeit. The primary concern lies not in counterfeiting itself, but rather in the fact that counterfeit drugs can have distinct detrimental effects on human health compared to genuine medications.

The current system suffers from a lack of transparency, making it exceedingly challenging for customers or buyers to ascertain the true value of products. Investigating potential tampering within the supply chain due to suspicions of illegal or unethical practices is also a daunting task. Consequently, such supply chains are highly inefficient, as vendors and suppliers struggle to establish connections among the various entities and determine who requires what, when, and how. The unreliability of these chains further exacerbates the problem, as retailers and manufacturers grapple with identifying the needs of their counterparts. This lack of clarity hampers customers and buyers in accurately assessing the worth of goods. Blockchain technology emerges as a revolutionary solution to these challenges.

Blockchain offers a distributed hyperledger with no central authority, ensuring that each transaction is immutable, safeguarding sensitive data like drug and customer information from tampering. It fosters complete transparency, thereby cultivating trust among the key entities in the supply chain, including manufacturers, intermediaries like distributors and suppliers, and end-users like customers, retailers, and hospitals. Products within the chain can be seamlessly transferred between authenticated entities using an event request-response mechanism, with all transactions recorded in the blockchain through smart contracts.

For any business, prioritizing customer experience is paramount, as satisfied and contented customers lead to greater returns. Artificial Intelligence (AI) plays a pivotal role in enhancing customer service, loyalty, and brand reputation, allowing employees to focus on higher-value tasks. AI-powered bots proactively engage with customers, offering pertinent information and assisting at every touchpoint throughout the customer life cycle. This empowers customers to obtain the answers they need without relying on company employees, resulting in improved satisfaction. The proposed system leverages the Rasa framework, known for developing industrial-grade chatbots powered by AI. It is widely used by developers worldwide to create contextual assistants and chatbots.

This chatbot is then integrated into a mobile application developed using the Flutter framework, which facilitates the creation of cross-platform (Android/iOS) mobile applications. Through the app, customers can interact with the chatbot

to place orders, track their status, and identify their source. Finally, a Decentralized App (DApp) is developed using the React Framework, and smart contracts are deployed on a private local blockchain provided by Ganache. Web3.js and the Truffle framework are employed to connect the DApp to the blockchain.

II. LITERATURE REVIEW

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III. PRELIMINARIES

1) Blockchain:

Blockchain is an emerging technology that has gained popularity alongside the rise of digital currencies like Bitcoin. It functions as a decentralized ledger database, recording transactions through a database maintained by all network nodes. This process is characterized by its openness, transparency, and irreversibility. Participants classify blockchain into three main types: public, consortium, and private. Consortium and private blockchains are collectively known as permissioned blockchains

2) Ethereum and Smart Contract:

Bitcoin's applicability is limited due to its focus on virtual currency applications and its lack of Turing completeness. This has led to the development of various other blockchain technologies that support a wide range of software through smart contracts. Ethereum was the pioneer in recognizing the seamless integration of blockchain and smart contracts. Once a smart contract is deployed on the blockchain, it adheres strictly to pre-established rules, and no one has the ability to modify it. In Ethereum, smart contracts are written in a low-level bytecode language known as EVM code, which is executed by the Ethereum Virtual Machine.

3) Rasa:

Rasa is an open-source machine learning framework designed for automated text and voice-based conversations. It empowers systems to comprehend messages, engage in conversations, and interface with messaging platforms and APIs. Here is the sequence of steps that an assistant constructed using Rasa follows to respond to a message:

- 1.The incoming message is fed into the interpreter, which translates it into a dictionary containing the original text, intent, and identified entities. This process is managed by NLU (Natural Language Understanding).
- 2.The tracker object keeps a record of the ongoing conversation's current state. It receives notification of a new incoming message.
- 3.The policy module receives the current state information from the tracker.
- 4.Based on the information received, the policy module determines the next action to take.
- 5.The tracker logs the action that has been selected.
- 6.A response is generated and sent back to the user

4) System Architecture:

- This section presents the system model for the product traceability process, leveraging the decentralization and data immutability offered by blockchain technology. Within this framework, any node has the capability to possess attributes associated with both demand and supply. In the process of forming product transactions, we have implemented an event response mechanism to guarantee mutual agreement between the transaction participants regarding the receipt and delivery of medical drugs. All transaction data will be securely and permanently recorded in the blockchain through the utilization of smart contracts. Additionally, we have developed a mobile application that seamlessly integrates with the Rasa chatbot to enhance customer service.

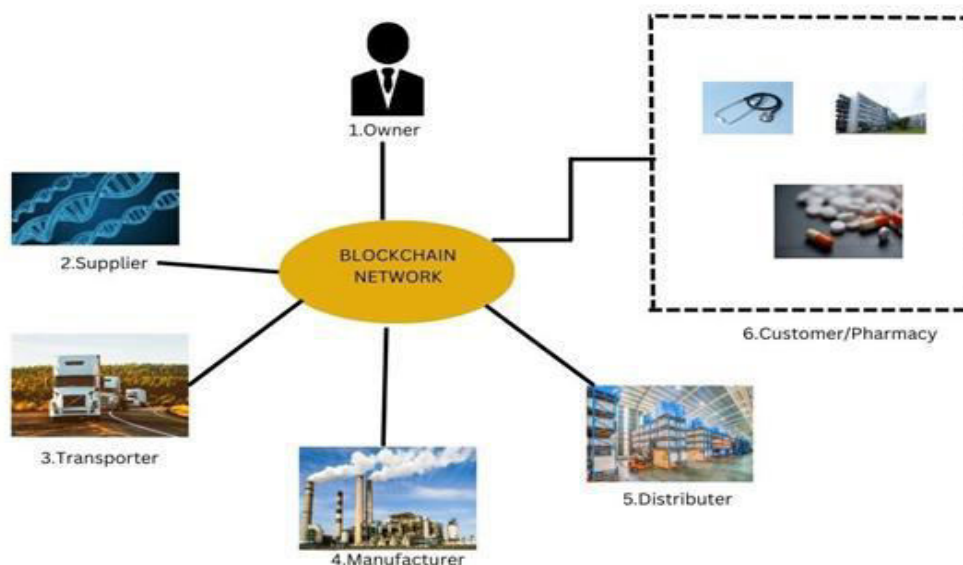


Fig. 1 Overview of the proposed Architecture

- The proposed system, depicted in Figure , encompasses various entities including suppliers, transporters, manufacturers, wholesalers, distributors, and customers/retailers, all interconnected through a decentralized network. Each entity within this supply chain is represented as a node on the public blockchain, each equipped with its own Ethereum account to denote its identity. Here are the specific roles and functionalities of each entity:

Owner

CREATE: Introduce a new user to be included in the chain.

READ: Access the information of any user.

UPDATE: Modify the roles of a user.

DELETE: Remove a user from the chain.

Transporter

Verify the package (Raw Material or Medicine).

Collect the package from an entity, depending on the type of transporter.

Deliver the product to an entity.

Supplier

CREATE: Generate a Raw Material.

GET: Retrieve the addresses of the Raw Materials created

Manufacturer

Receive the Raw Material from the Supplier via the Transporter.

Validate the source of the received product.

CREATE: Produce a new Medicine using the received raw materials.

Wholesaler

Medicines will be received from manufacturer through transporter.

Confirm the source of the medicine.

Transfer the ownership of the medicine.

Distributor

Receive the medicine from the Wholesaler through the Transporter.

Confirm the source of the medicine.

Transfer the ownership of the medicine.

Customer

Medicines will be received from distributor through transporter

Confirm the source of the medicine.

Place orders using the Rasa chatbot.

IV. CONCLUSION

The paper introduces a anti-counterfeit drug supply chain system that leverages blockchain technology and artificial intelligence. Through the utilization of smart contracts with product registration and transfers, all records of product movement are immutably recorded in the ledger, rendering them unalterable. The integration of smart contracts facilitates seamless product tracking. Moreover, consumers are afforded the opportunity to actively engage in the process of maintaining information flows. Notably, the proposed system exhibits pronounced decentralized attributes, significantly mitigating the potential for unauthorized data manipulation. The incorporation of the Rasa chatbot enhances customer service and augments transparency regarding drug details and the progress of orders throughout the supply chain.

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