DRUG TRECEABILITY USING BLOCK CHAIN

A PROJECT REPORT

Submitted by

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1. INTRODUCTION

1.1 Project Overview

Healthcare supply chains are complex structures spanning across multiple organizational and geographical boundaries, providing critical backbone to services vital for everyday life. The inherent complexity of such systems can introduce impurities including inaccurate information, lack of transparency and limited data provenance. Counterfeit drugs is one consequence of such limitations within existing supply chains which not only has serious adverse impact on human health but also causes severe economic loss to the healthcare industry. Consequently, existing studies have emphasized the need for a robust, end-to-end track and trace system for pharmaceutical supply chains. Therein, an end-to-end product tracking system across the pharmaceutical supply chain is paramount to ensuring product safety and eliminating counterfeits. Most existing track and trace systems are centralized leading to data privacy, transparency and authenticity issues in healthcare supply chains.An Ethereum blockchain-based approach leveraging smart contracts and decentralized off-chain storage for efficient product traceability in the healthcare supply chain. The smart contract guarantees data provenance, eliminates the need for intermediaries and provides a secure, immutable history of transactions to all stakeholders.

1.2 Purpose:

- It enhances transparency in the pharmaceutical supply chain by recording each step of a drug's journey ensuring the stakeholders about the origin and movement of drugs.

- It helps prevent the distribution of counterfeit drugs by providing immutable records of each drug's production, distribution, and sale. This discourages fraudulent activities.
- The system can assist pharmaceutical companies in complying with regulatory requirements by providing a secure and auditable record of their activities.
- Patients benefit from improved drug traceability, as they can be more confident in the authenticity and safety of the medicines they use.
- It enhances data security and privacy, protecting sensitive information related to drug production and distribution.

2. LITERATURE SURVEY

2.1 Existing problem:

- While blockchain technology is secure, the accuracy of data input is still reliant on human operators. Mistakes made during data entry can result in inaccurate records.
- Different platforms and systems may not be interoperable, leading to potential data silos. This can hinder the seamless exchange of information across the supply chain.
- Implementing and maintaining this system can be expensive, and smaller companies in the pharmaceutical industry may find it financially burdensome.

2.2 References:

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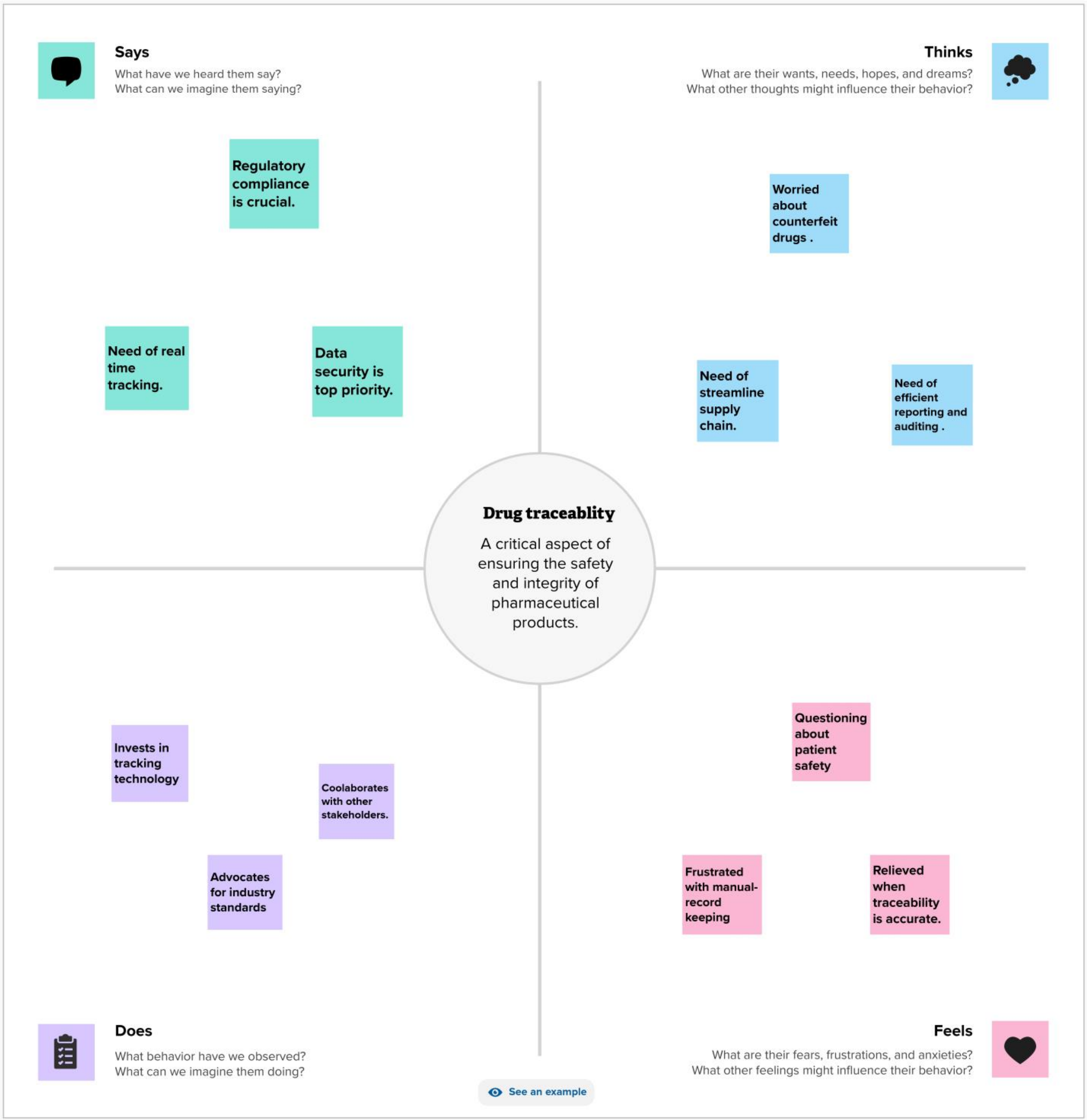
. **2.3 Problem Statement Definition:**

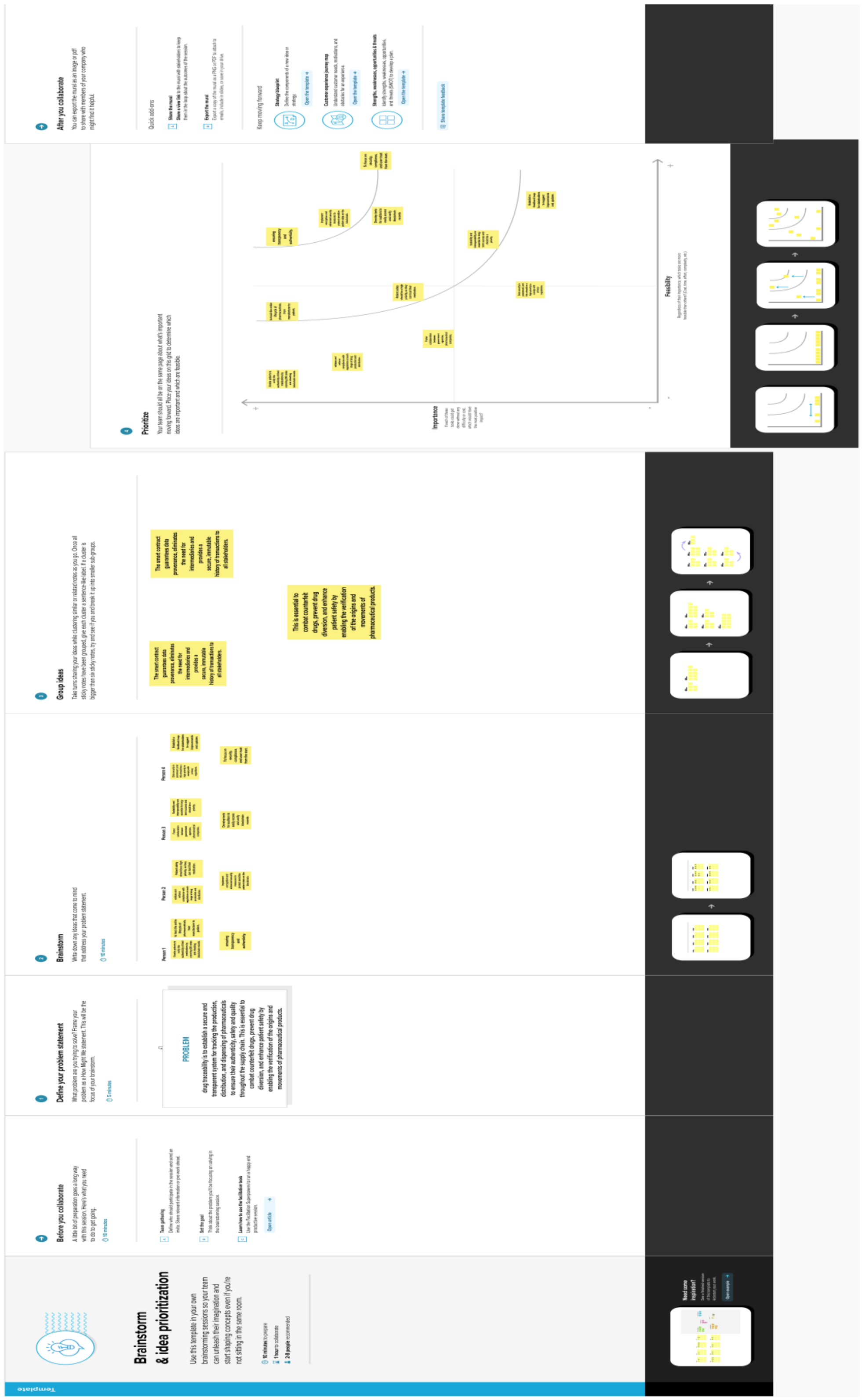
The "Drug Traceability Smart Contract on Ethereum Blockchain" is a pioneering solution poised to revolutionise pharmaceutical supply chain management. In response to the urgent need for enhanced transparency and security in drug tracking, this smart contract leverages blockchain technology. It establishes a decentralised network of nodes, underpinned by non-repudiation and robust security features, to ensure the verifiable traceability of pharmaceuticals. Traditional drug management systems often struggle with issues of authenticity and accountability, making them susceptible to counterfeit drugs and inefficiencies. In contrast, this Ethereum-based smart contract offers a transformative approach. It enables stakeholders to monitor the entire lifecycle of drugs, from production to distribution and ultimately to the end-user, with unparalleled transparency and trust. This innovation promises to usher in a new era of pharmaceutical traceability, where each drug's journey can be traced immutably on the blockchain. By doing so, it not only safeguards patient health but also protects the integrity of the pharmaceutical industry. This article explores the architecture and capabilities of this smart contract, shedding light on how it can instill confidence in drug tracking and contribute to a more secure and accountable pharmaceutical landscape.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:



4. REQUIREMENT ANALYSIS

4.1 Functional requirement:

The functional requirements for a system describe what system do.

i) The developed system should recognize tracaibility.

ii) System shall show the error message to the user when given input is not in the required format.

iii) System must provide the quality of service to user

4.1 External Interface Requirements

4.1.1 User Interfaces

The system specifies the user interfaces are as follows:

i) Open application

ii) Login.

iii) Supply chain

4.1.2 Hardware Interfaces

The entire system interface with java and library.

4.1.3 Software Interfaces

The system works on database so system fetch the data.

4.1.4 Communication Interfaces

The system should also use standard protocols for image processing so we are uses various library for our project.

4.2 Non-Functional Requirements :

Non-functional requirements are not directly related to the functional behavior of the system.

4.2.1 Performance Requirement

i) System must be user friendly, simple and interactive.

ii) The user interface is designed in such way that novice users with little knowledge of library, should be able to access this application.

iii) Users are required to have some knowledge regarding library module.

4.3 System Requirements

4.3.1 Database Requirement

MySQL Database

4.3.2 Software Requirement

i) Operating System: Windows 8 or higher.

ii) Platform: Eclipse.

iii) Technologies used: Java.

5.5.3 Hardware Specifications

i) Processor: i3 or higher.

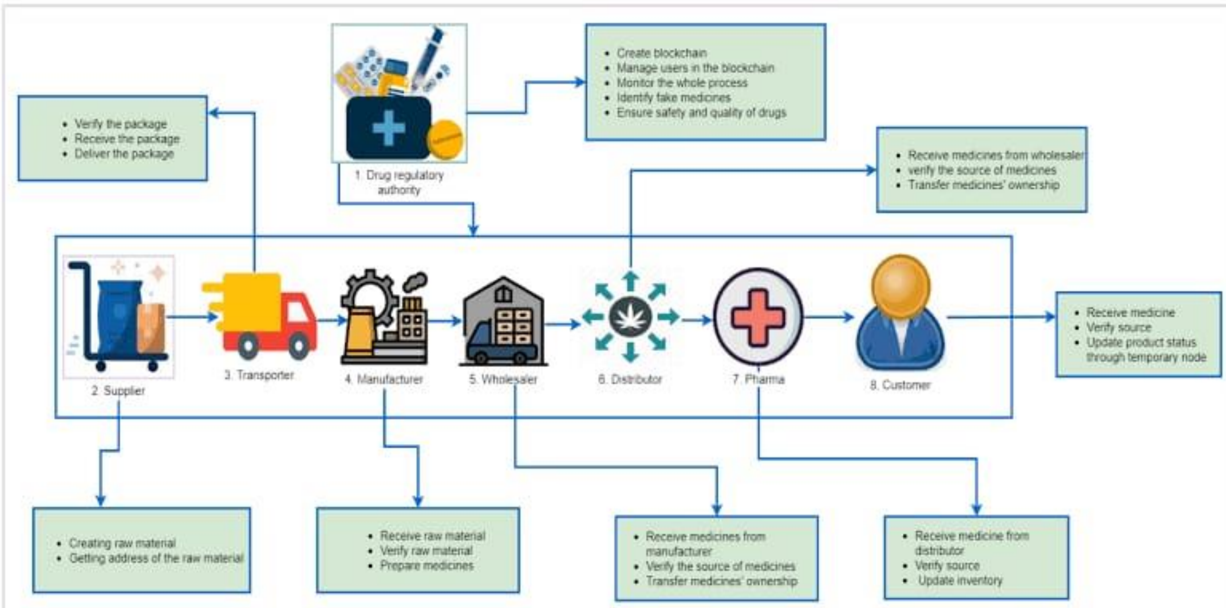
ii) Processor speed: 2.0GHz.

iii) RAM: 4 GB.

iv) Disk Space: 20 GB or higher

5. PROJECT DESIGN

5.1 Data Flow Diagrams & User Stories



5.2 Solution Architecture

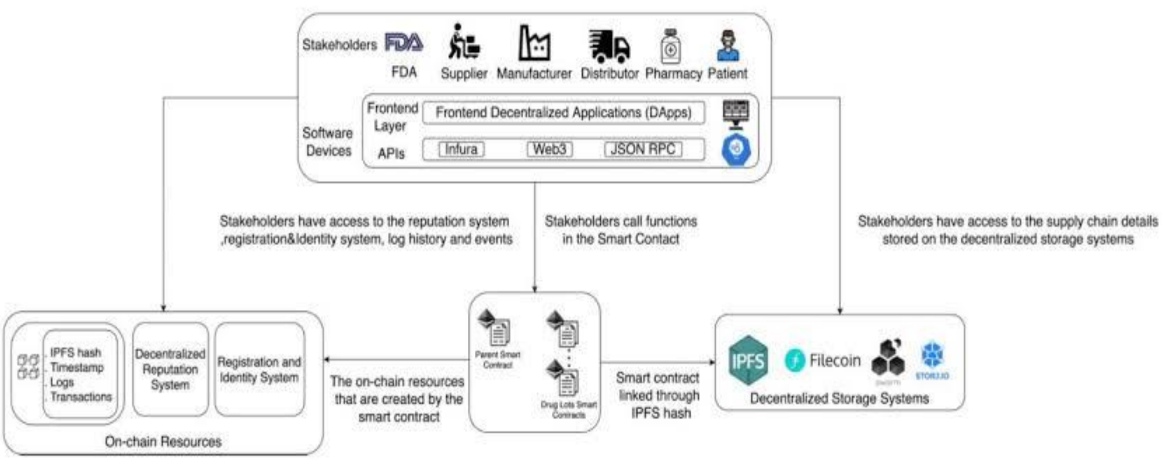
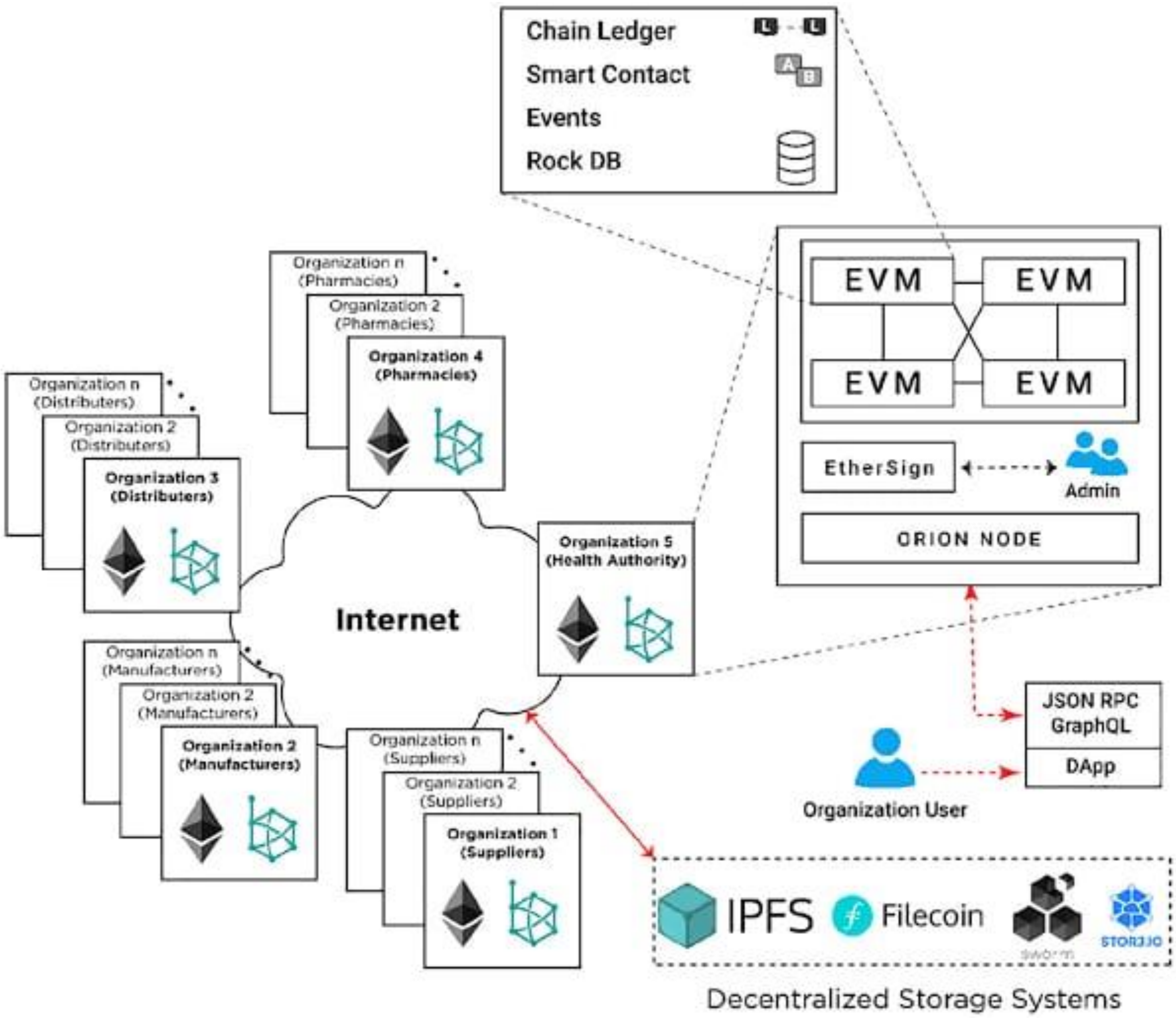


FIGURE 2. A high-level architecture for the proposed blockchain-based system for pharmaceutical supply chain

6. PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture



7.PERFORMANCE TESTING

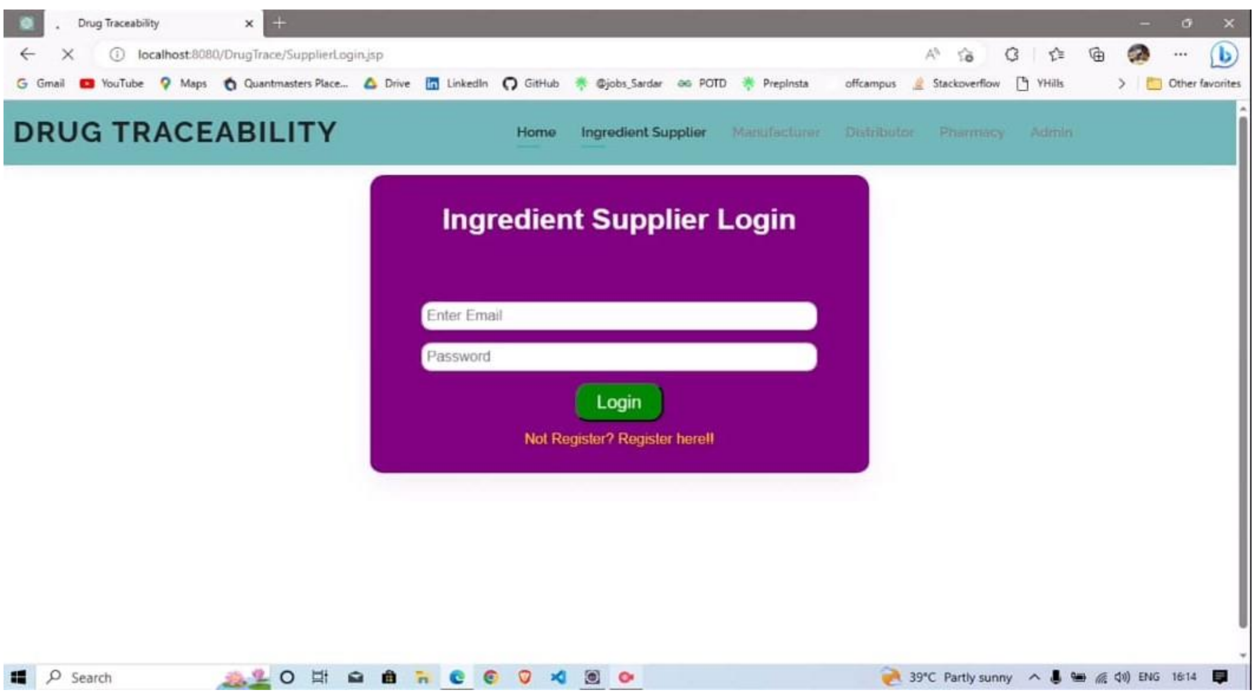
7.1 Performance Metrics

The developed Ethereum smart contract for drug traceability was analyzed using specialized tools to reveal any code vulnerabilities in addition to the aforementioned security analysis. Those tools were used in code development iterations to improve the reliability of the smart contract. Remix IDE that was used to develop the smart contract provides some code debugging and run-time error warnings. However, they are not sufficient to establish trust in the smart contract robustness. Smart Check was used to detect vulnerabilities in the code at different severity levels. After multiple iterations of smart code modification, the smart code was bug-free as reported by the output. Smart Check analyzed the smart contract comparing it to its knowledge base and verified that it was free from risks that would make it susceptible to exploitation and cyber-attacks. Oyente tool was also used to explore the smart contract security.

8. RESULTS

In this paper, we discuss how blockchain technology can be leveraged for drug traceability application in the pharmaceutical supply chain. We proposed two blockchain architectures based on Hyperledger Fabric and Hyperledger Besu. Such architectures provide a shared, trusted, permissioned and decentralized platform for storage and communications among different pharmaceutical supply chain stakeholders, and in a manner that can fulfill key requirements and features that include security, privacy, accessibility, transparency, and scalability. We present a comparison of the two platforms, and outlined a number of implementation challenges that hinder the wide spread adoption of blockchain technology for effective drug traceability.

8.1 Output Screenshots



10. ADVANTAGES & DISADVANTAGES

Advantages:

Patient Safety: Ensures the authenticity and quality of drugs, reducing the risk of counterfeit or substandard medications reaching patients.

Regulatory Compliance: Helps pharmaceutical companies comply with government regulations, such as the Drug Supply Chain Security Act (DSCSA) in the United States.

Recall Management: Facilitates faster and more precise recalls of defective or contaminated drugs, enhancing public health and safety.

Improved Supply Chain Efficiency: Allows better inventory management, reduces waste, and optimizes distribution processes.

Enhanced Transparency: Provides transparency into the supply chain, building trust with stakeholders and the public.

Counterfeit Prevention: Deters the production and distribution of counterfeit drugs by making it harder for criminals to infiltrate the supply chain.

Disadvantages:

Implementation Costs: Establishing a robust drug traceability system can be expensive, particularly for smaller pharmaceutical companies.

Technical Challenges: Adapting to new technologies and standards can be complex, and not all companies have the resources to do so effectively.

Data Privacy and Security: Gathering and storing traceability data can raise concerns about data privacy and cybersecurity risks, particularly if not adequately protected.

Potential for Overregulation: Excessive regulation can lead to bureaucratic burdens and cost increases without necessarily improving patient safety.

Resistance to Change: Some stakeholders in the pharmaceutical supply chain may resist adopting traceability systems due to concerns about disruption or added complexities.

Limited Global Consistency: Lack of uniform traceability standards and regulations across countries can hinder the effectiveness of traceability efforts.

11. CONCLUSION

The challenge of drug traceability within pharmaceutical supply chains highlighting its significance especially to protect against counterfeit drugs. I have developed and evaluated a blockchain-based solution for the pharmaceutical supply chain to track and trace drugs in a decentralized manner. Specifically, my proposed solution leverages cryptographic fundamentals underlying blockchain technology to achieve tamper-proof logs of events within the supply chain and utilizes smart contracts within Ethereum blockchain to achieve automated recording of events that are accessible to all participating stakeholders

12. FUTURE SCOPE:

The integration of emerging technologies like blockchain, IoT (Internet of Things), AI, and machine learning will enhance the accuracy and efficiency of drug traceability. These technologies will enable real-time monitoring, data analysis, and automation, making traceability systems more robust.

13. APPENDIX

GitHub Link:https://github.com/poorvika0812/drug_traceability_using_blockchain.git