Project report on

Drug Traceability

Using Blockchain technology

NM ID: NM2023TMID10678

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

Blockchain technology is a decentralized, distributed ledger system that provides an efficient and trusted solution for product traceability. Blockchain technology powers the crypto currencies and has been applied to variety of industries such as banking, supply chain, energy, commodities trading, healthcare and many businesses involving transaction processing. To deal with the issue of counterfeit drugs, blockchain technology has the potential to provide pragmatic solution for drug traceability and provenance in a secure and immutable manner. counterfeiting of drugs is increasing globally, pharmaceutical companies are adapting blockchain technology to prevent counterfeiting. The supply of medicines is from manufactures to wholesalers, distributors, and pharmacy stores before it is purchased by customers; the counterfeiters come in between this supply chain and thus fake medicines get supplied and distributed. This project is a blockchain-based solution “Drug-chain” to

improve on the end the end transparency of the drug in supply chain.

1.2 PURPOSE

The purpose of this project is to enable real-time visibility into the movement of drugs across the supply chain. All authorized parties, including manufacturers, distributors, pharmacies, and regulatory authorities, can access the blockchain to track the journey of drugs from production to consumption. This transparency helps in quickly identifying and addressing issues such as counterfeiting or diversion.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

The pharmaceutical industry faces a significant challenge in ensuring the authenticity and safety of drugs throughout the supply chain. Despite regulatory efforts and advancements in traceability technologies, the global market still grapples with the infiltration of counterfeit drugs. These counterfeit drugs pose serious threats to patient safety, erode public trust in the healthcare system, and create substantial financial losses for pharmaceutical companies. The problem is exacerbated in developing countries with weaker regulatory infrastructures, making it easier for counterfeit drugs to enter the market undetected. Current traceability systems lack uniform standards, interoperability, and real-time information sharing, hindering the industry's ability to promptly identify, track, and remove counterfeit drugs from circulation.

2.2 PROBLEM STATEMENT DEFINITION

Counterfeit drugs are a significant concern in many regions. These fake medications can enter the supply chain, posing serious risks to patients' health. Tracking counterfeit drugs back to their source is difficult due to the complexity of global supply chains. Pharmaceutical supply chains are often extensive and involve multiple stakeholders, including manufacturers, distributors, wholesalers, pharmacies, and healthcare providers. Managing the flow of drugs across these diverse entities can be complex and challenging.

3.IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP

An empathy map is created with a sample consumer and is attached below

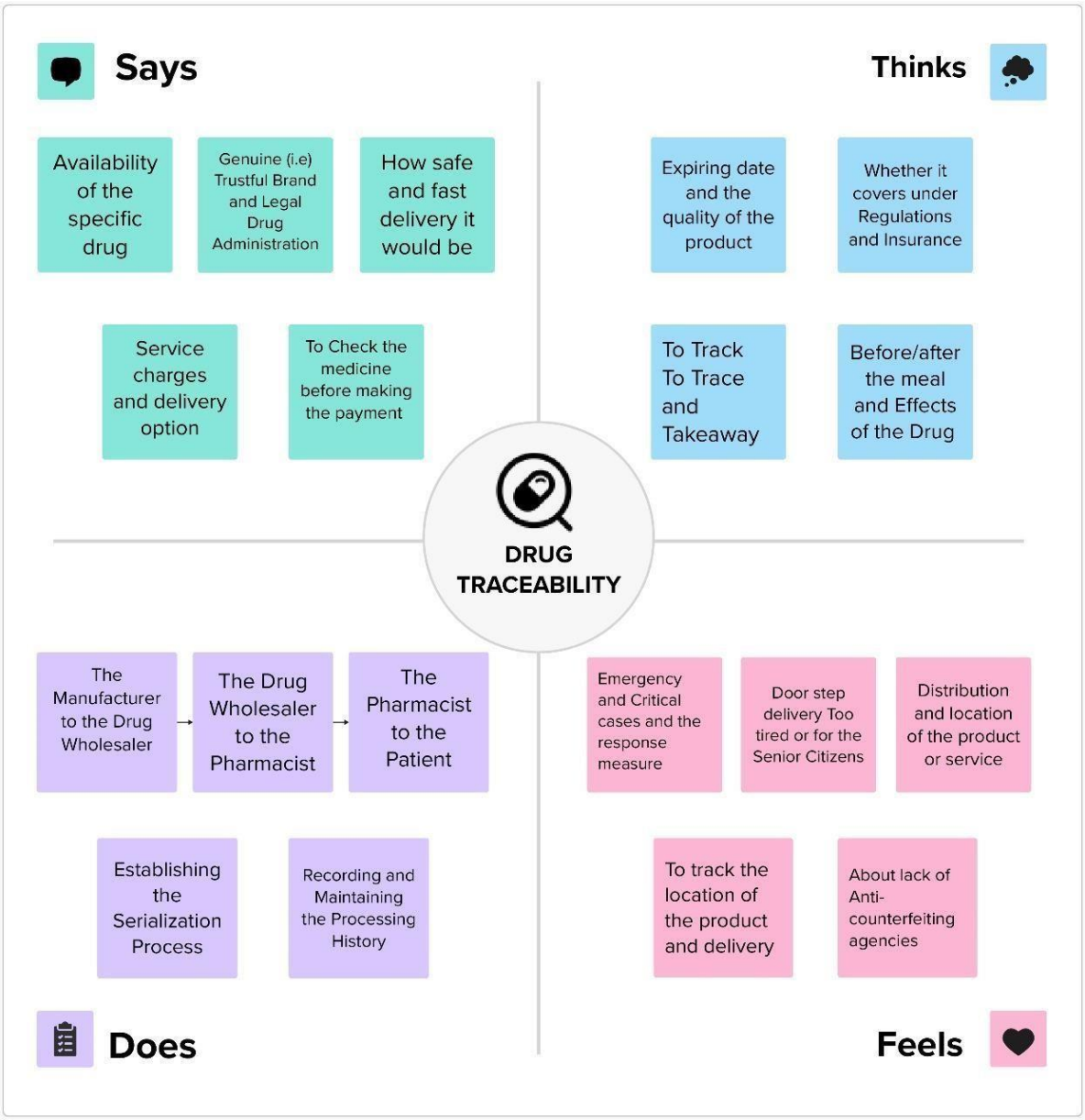


Fig 1: Empathy map

3.2 BRAINSTORMING AND IDEATION

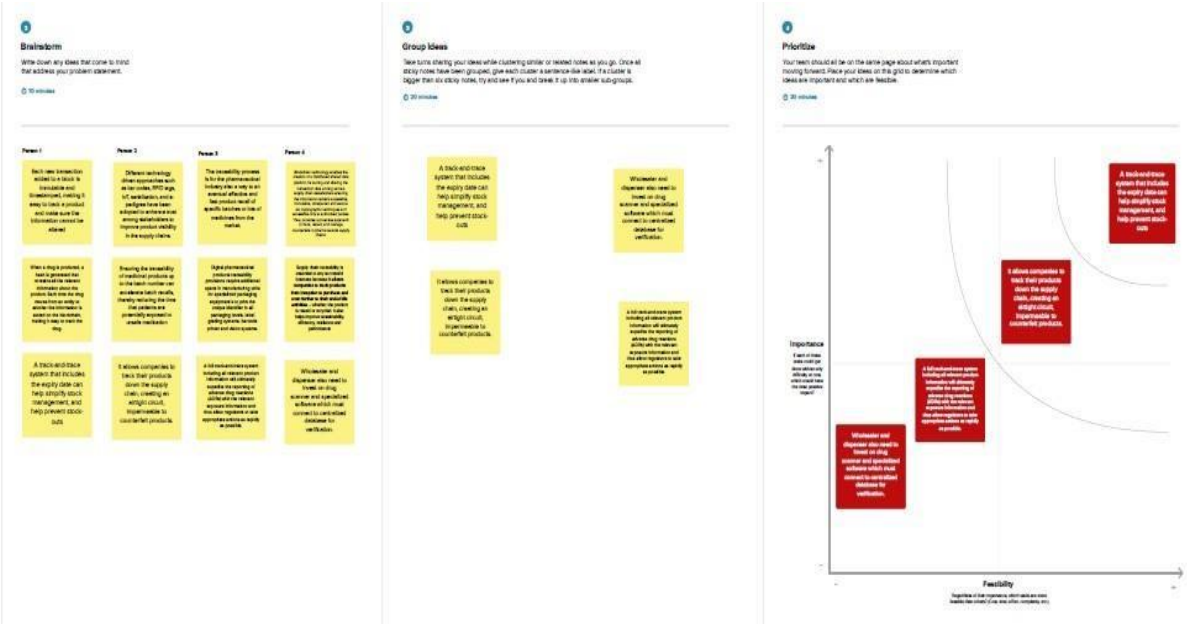


Fig 2: Brainstorming and ideation

4.REQUIREMENT ANALYSIS

4.1 Functional Requirements

User Registration and Authentication: Users, including consumers, producers, and distributors, should be able to register and authenticate their identities securely.

Product Registration: Producers and distributors should be able to register food products on the

blockchain, providing details such as origin, production date, and quality information.

Data Entry and Verification: The system should allow for real-time data entry and verification, including QR code scanning or IoT device data integration.

Blockchain Integration: Smart contracts should be used to ensure the integrity of data recorded on the blockchain and to automate quality checks and authenticity verifications.

4.2 Non-Functional Requirements

Performance:

- Response Time: The system should respond promptly to user requests, ensuring real-time data access and tracking.
- Scalability: The system must be able to scale to accommodate a growing number of users and data without compromising performance.
- Throughput: The system should handle a high volume of transactions and data entries efficiently.

Security:

- Data Encryption: All sensitive data on the blockchain should be encrypted to protect user privacy and information integrity.
- Access Control: The system should implement strict access controls to ensure that only authorized users can perform specific actions.
- Data Integrity: The blockchain should maintain data integrity and prevent unauthorized modifications.

Reliability:

The system should be highly reliable, ensuring minimal downtime and data loss.

Backup and Recovery: Regular data backups and a robust recovery plan should be in place.

Usability:

The user interfaces should be intuitive and user-friendly, requiring minimal training for users to navigate and use the system effectively.

Compatibility:

The system should be compatible with a variety of devices and web browsers to ensure accessibility for a broad user base.

Regulatory Compliance:

The system must comply with relevant food safety and data privacy regulations in the regions where it operates.

Scalability:

The system should be designed to scale horizontally or vertically to accommodate an increasing number of users, products, and transactions.

Availability:

The system should be available 24/7, with minimal planned downtime for maintenance or updates.The

system should maintain comprehensive logs of all user actions and system events for auditing purposes.

Disaster Recovery:

A disaster recovery plan and backup mechanisms should be in place to ensure data and system recovery in case of unexpected events.

Environmental Considerations:

The project should consider the environmental impact of its operations, including energy efficiency and

sustainable practices.

Traceability: Consumers should be able to trace the journey of a food product from its source to the point of purchase, viewing all relevant information on the blockchain.

User Interface: User-friendly interfaces for consumers, producers, and distributors should provide easy access to tracking information and data.

Data Analytics and Reporting: The system should offer advanced data analytics tools that provide

insights into supply chain performance, reducing waste and improving operational efficiency.

Security: The system should have robust security measures, including encryption, to protect user data and maintain the integrity of the blockchain.

Compliance and Regulatory Features: The system should ensure compliance with food safety and regulatory standards, enabling the tracking of relevant compliance data.

Alerts and Notifications: The system should send alerts and notifications to users in the event of recalls, safety concerns, or changes in product status.

4. PROJECT DESIGN

4.1 SOLUTION ARCHITECTURE

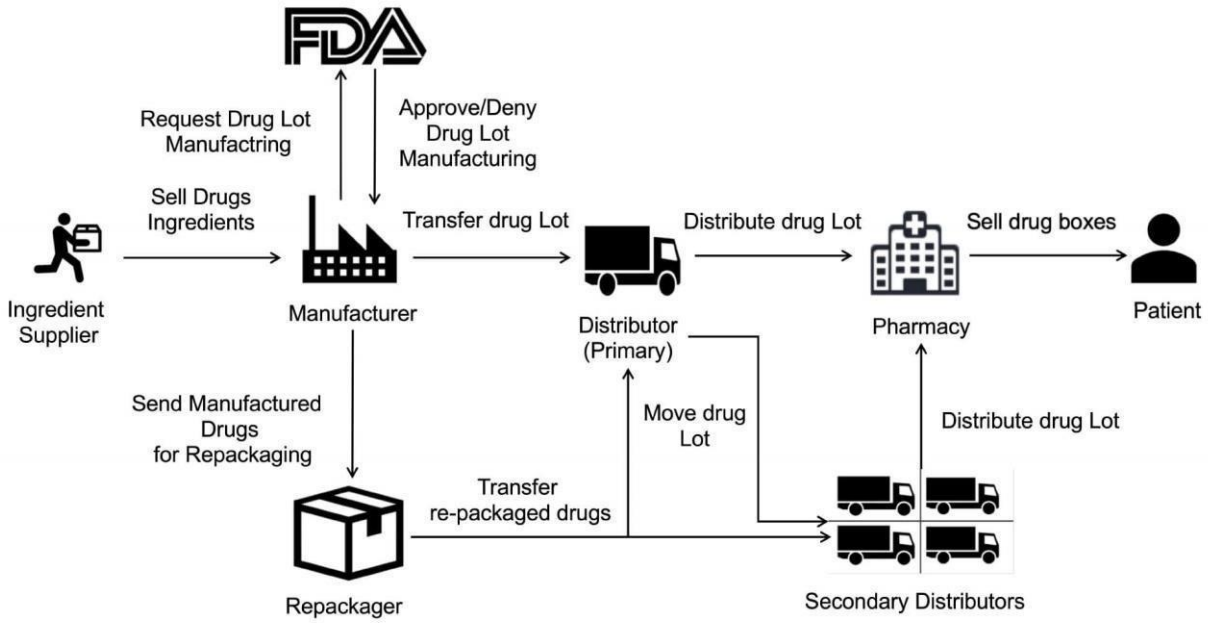


Fig 3: Solution architecture for the problem

4.2 DATA FLOW DIAGRAM

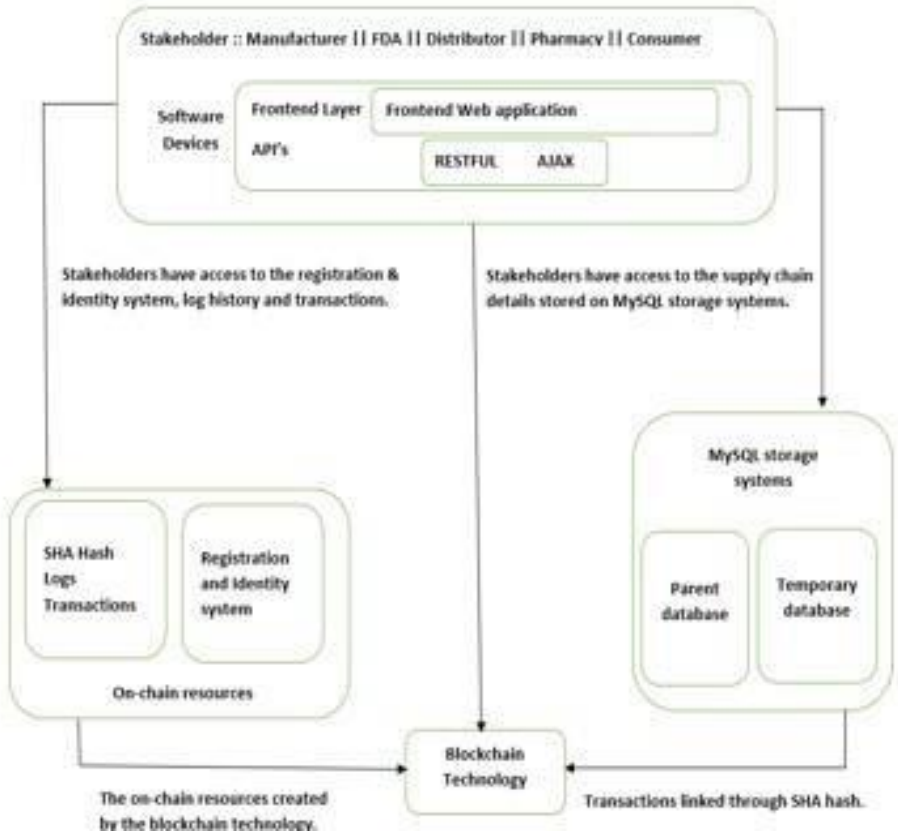


Fig 4: Data flow diagram

5. CODING AND SOLUTIONING

5.1 CODE

Home drug_tracing.sol 1

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

contract Drug{
    address public owner;

    constructor() {    939414 gas 914200 gas
        owner = msg.sender;
    }

    modifier onlyOwner() {
        require(msg.sender == owner, "Only the owner can perform this action");
        _;
    }

    struct Drug {
        string drugName;
        string manufacturer;
        uint256 manufacturingDate;
        address trackingHistory;
    }

    mapping(uint256 => Drug) public drugs;
    uint256 public drugCount;

    event DrugManufactured(uint256 indexed drugId, string drugName, string manufacturer, uint256 manufacturingDate);
    event DrugTransferred(uint256 indexed drugId, address indexed from, address indexed to, uint256 transferDate);
```

Fig 5: Solidity code 1

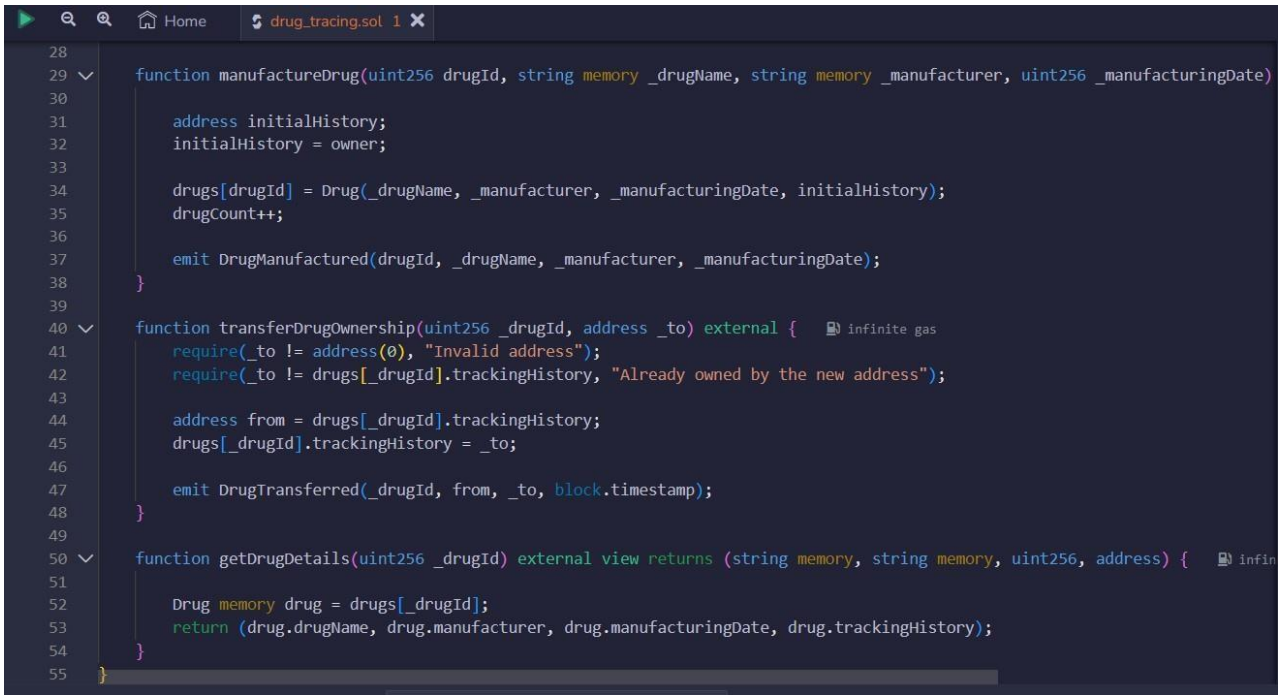


Fig 6: Solidity code 2

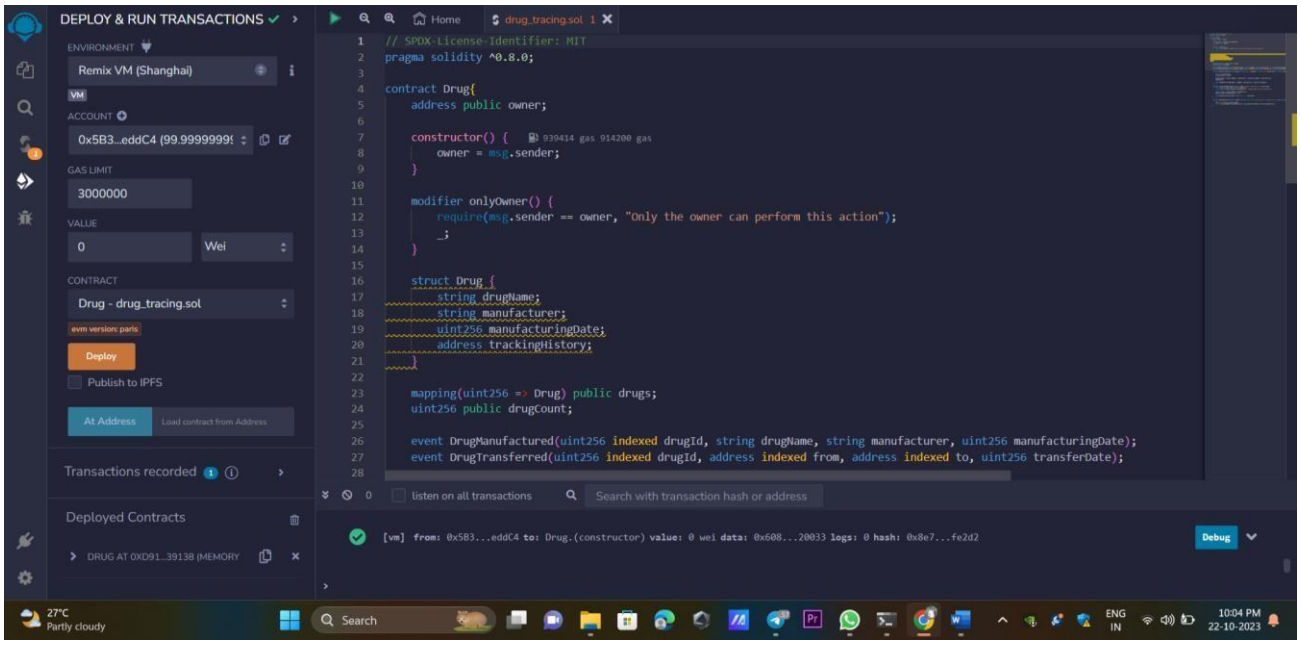
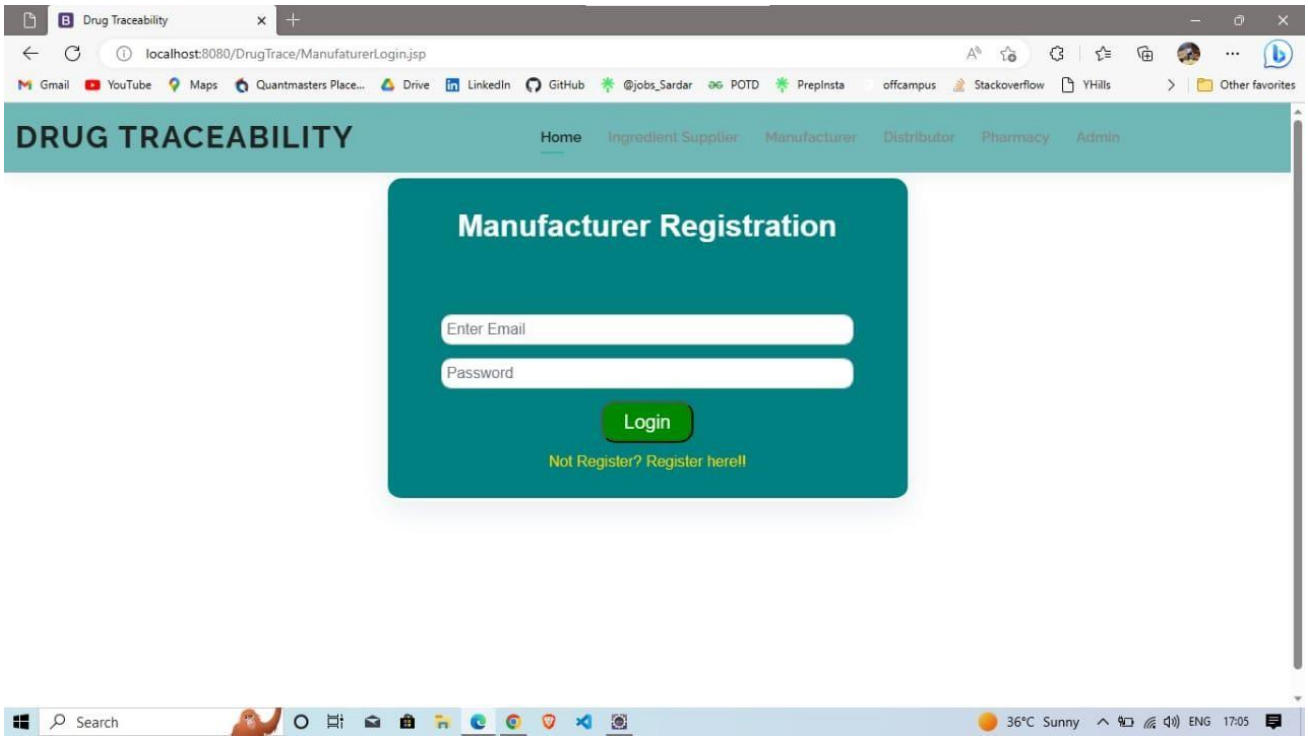
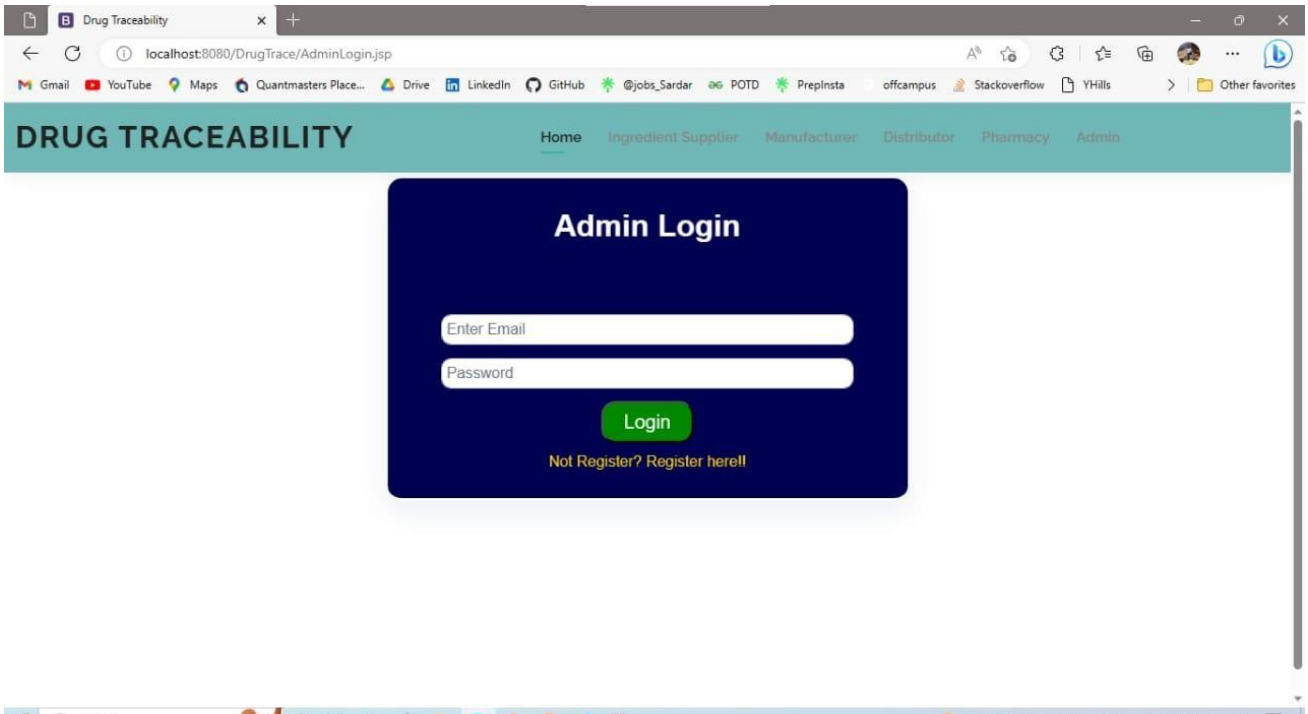


Fig 7: Deployment of contract using Remix

6. RESULT

Fig 8: Project frontend

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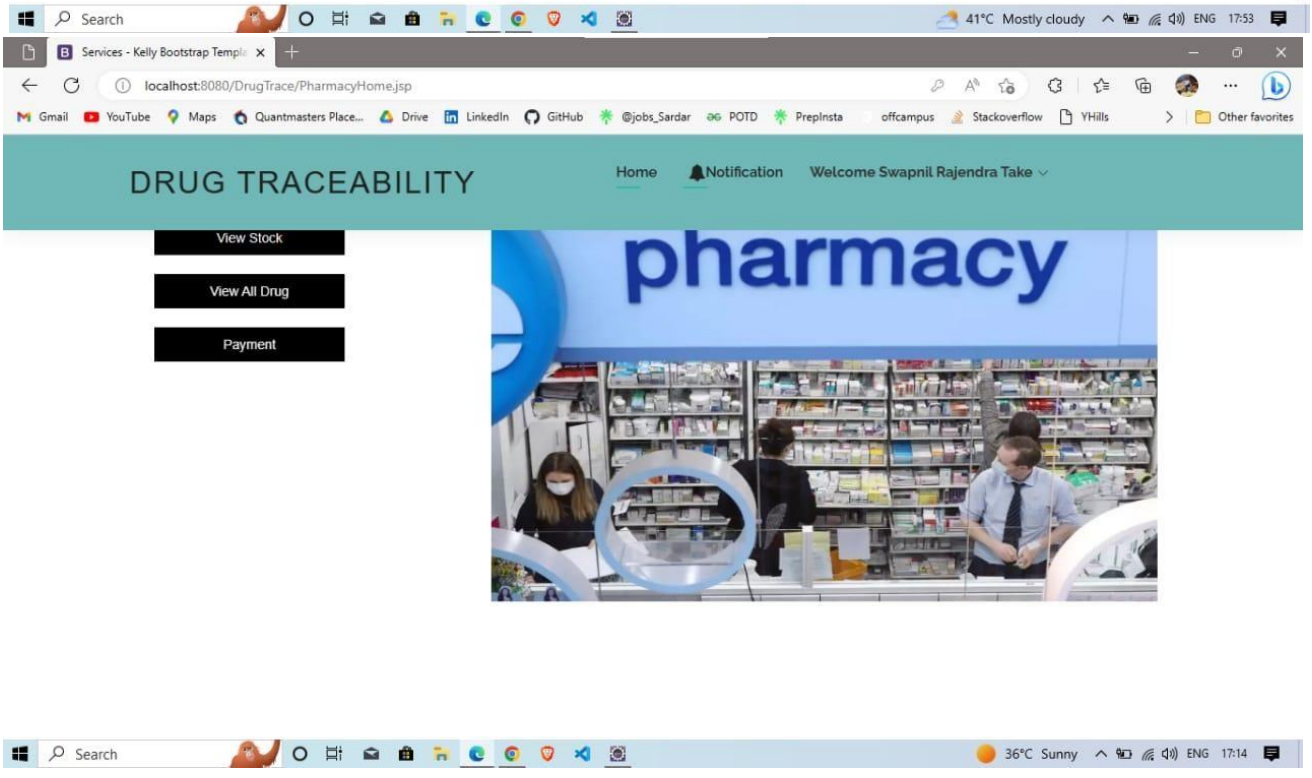
Manufacturer
Distributor
Pharmacy
Admin
Admin Login
Enter Email
Password
Login
Not Register? Register here!!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View Stock
View All Drug
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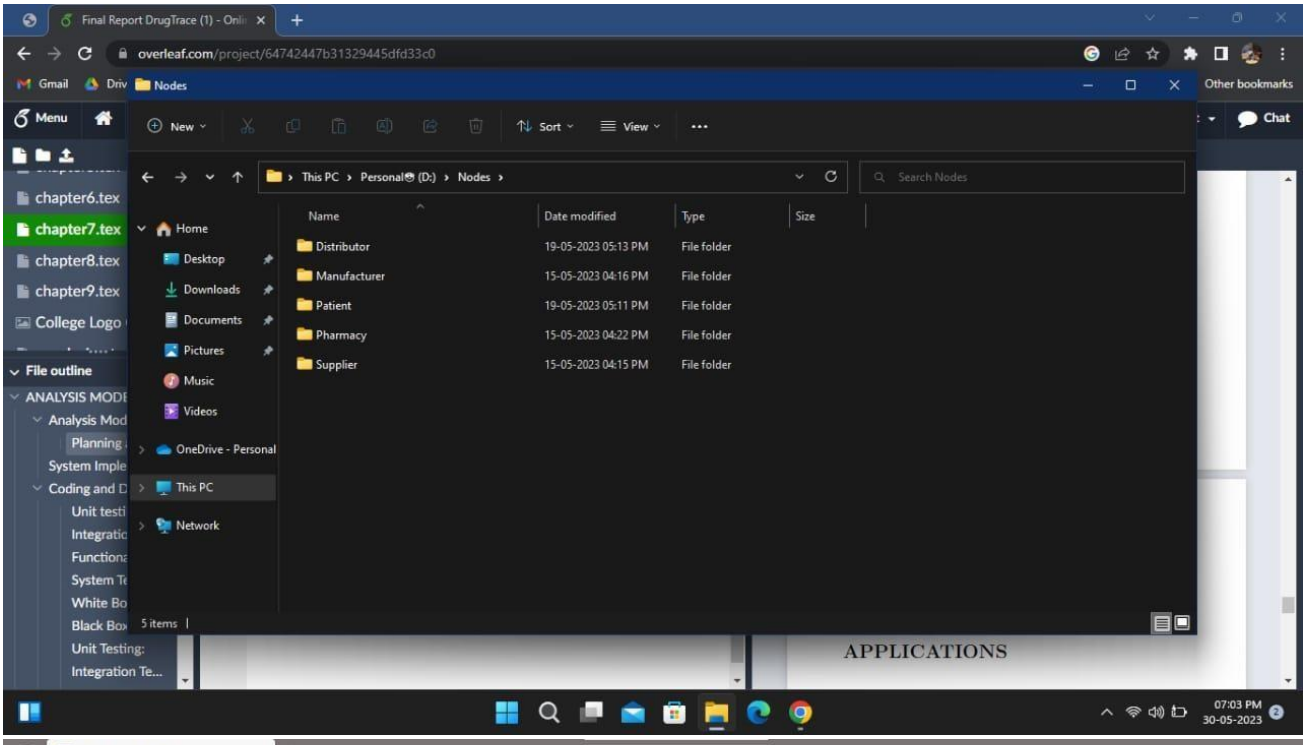
pharmacy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chapter8.tex
chapter9.tex
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Search Nodes
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Patient 19-05-2023 05:11 PM File folder
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APPLICATIONS
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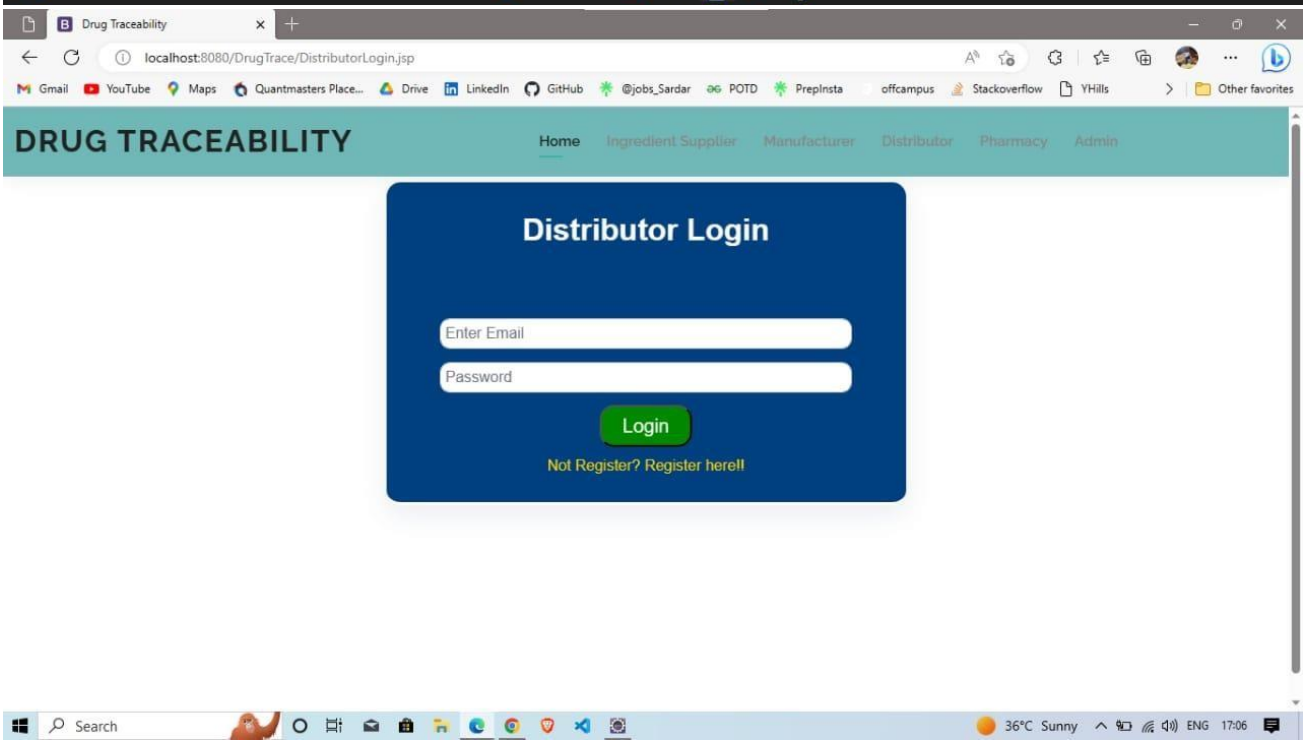
Drug Traceability
localhost:8080/DrugTrace/DistributorLogin.jsp
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Manufacturer
Distributor
Pharmacy
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Not Register? Register here!!
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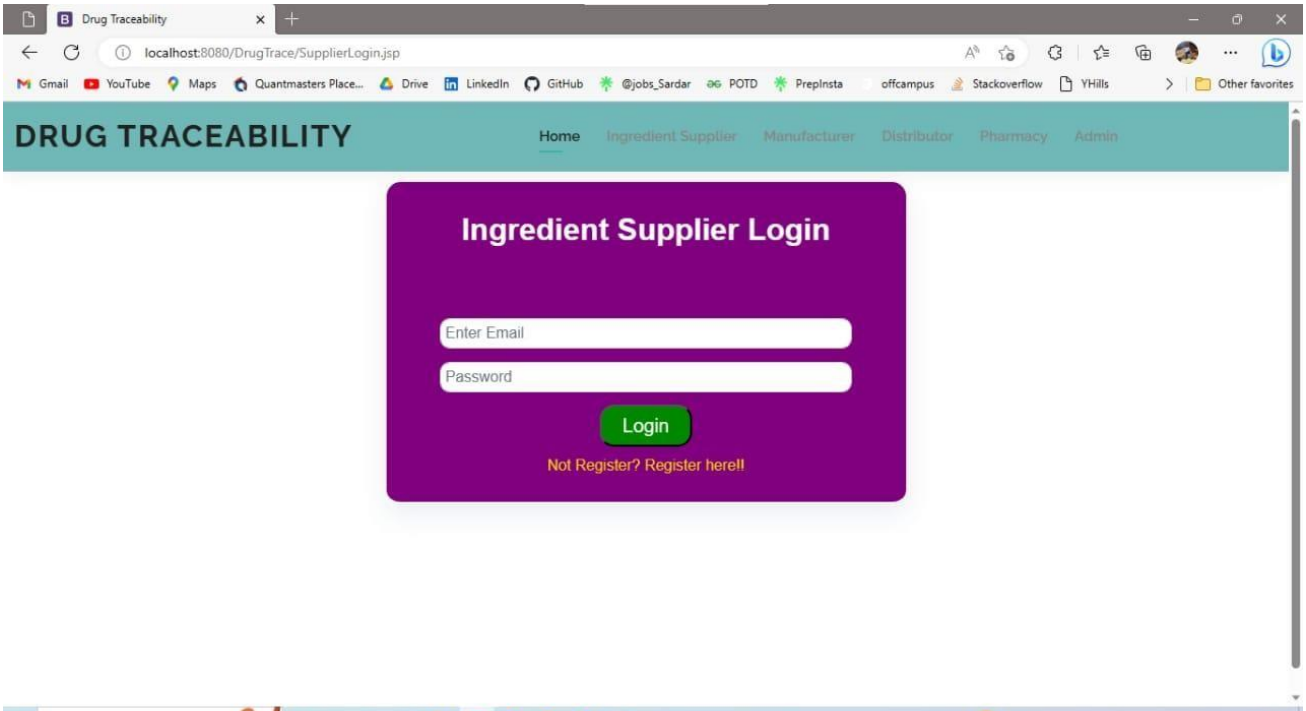
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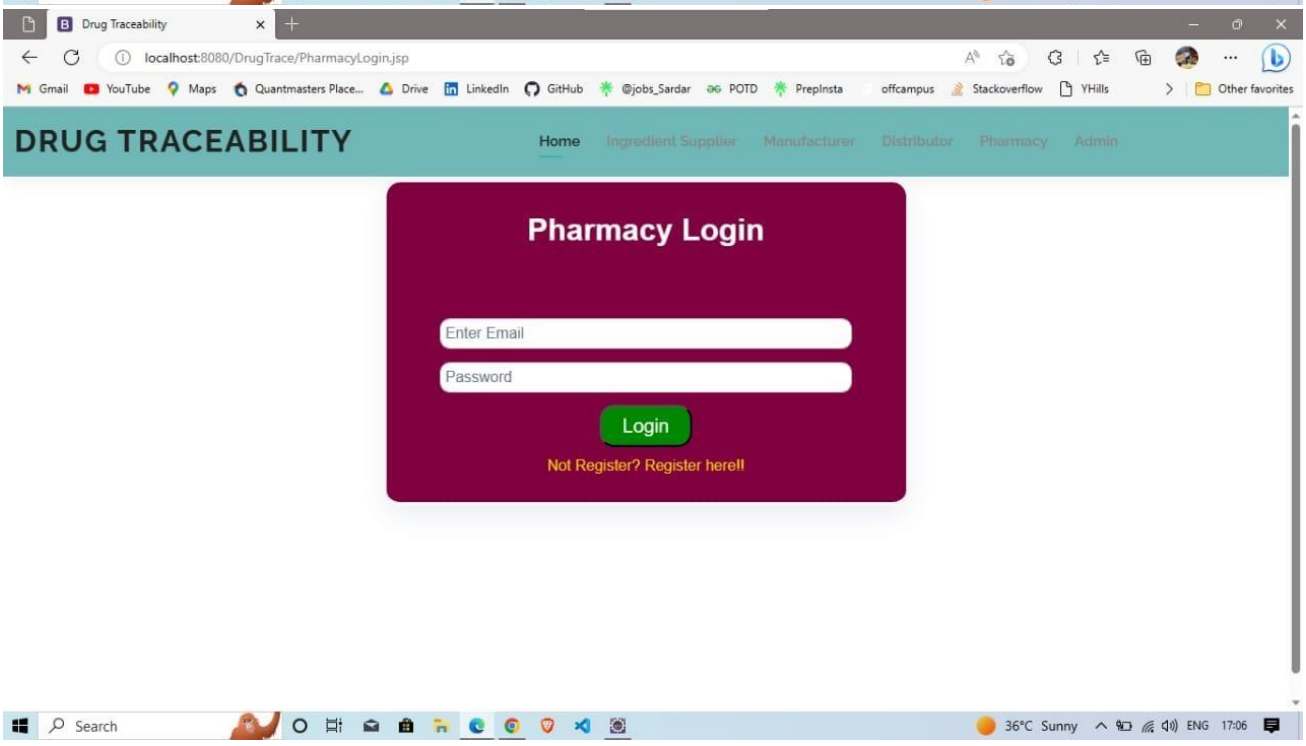
Not Register? Register here!!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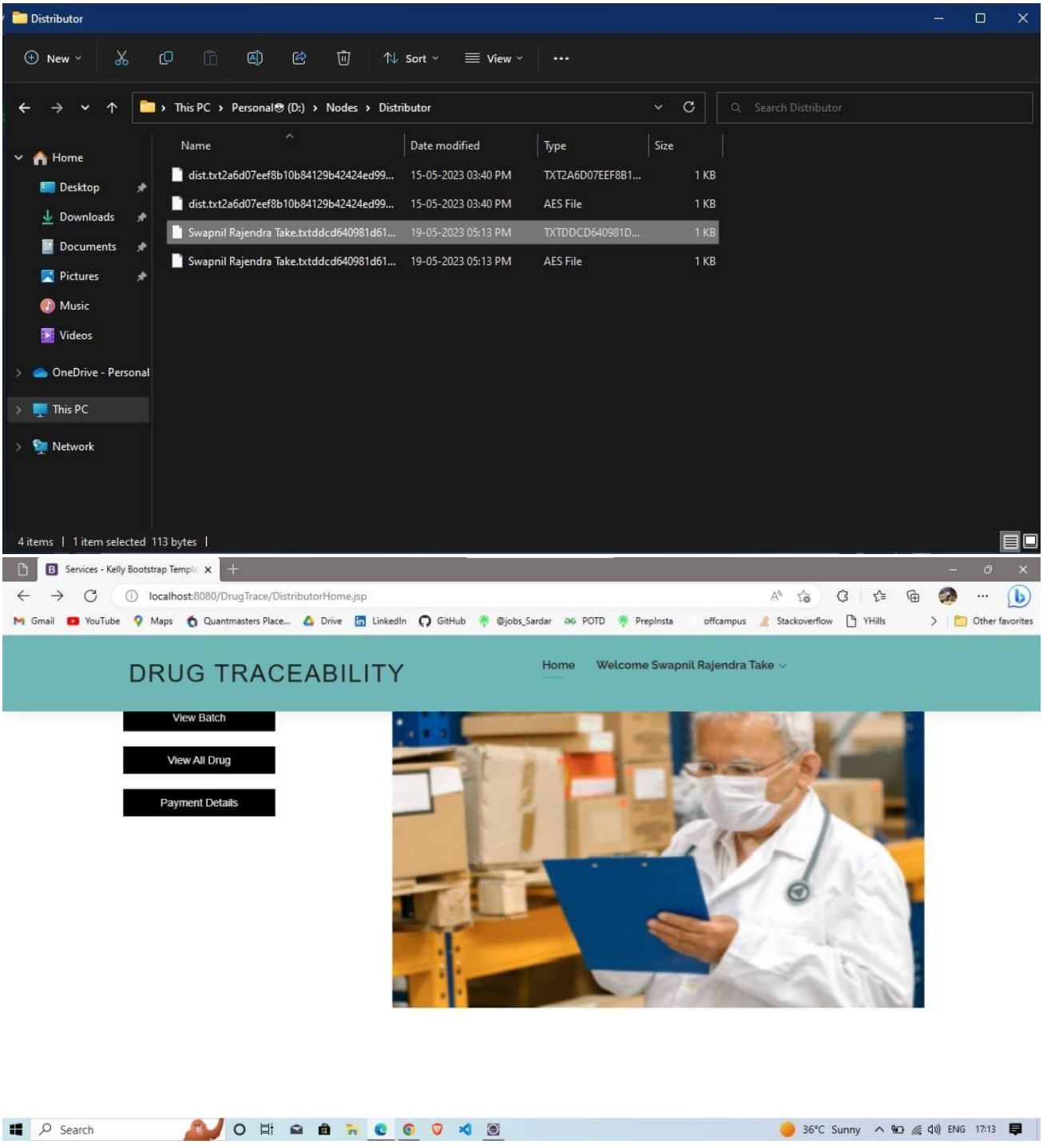
Login
Not Register? Register here!!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Services - Kelly Bootstrap Templ
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Maps
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Drive
LinkedIn
GitHub
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POTD
PrepInsta
offcampus
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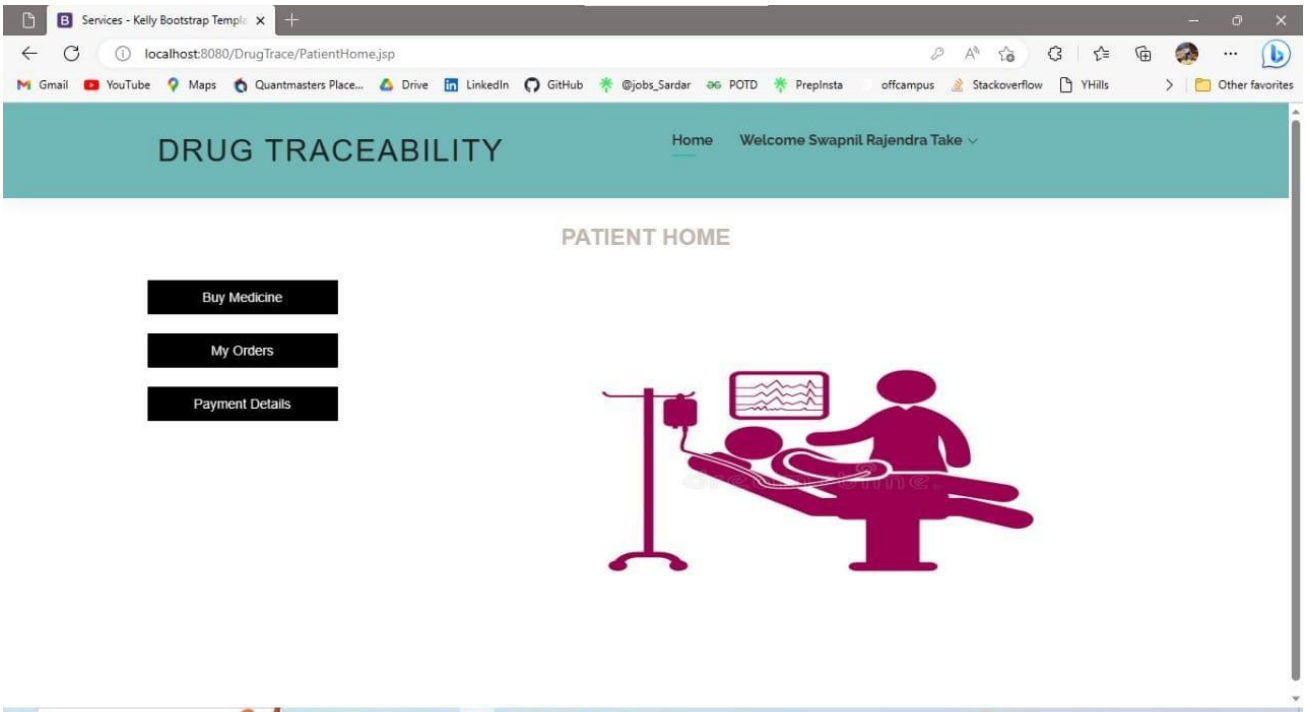
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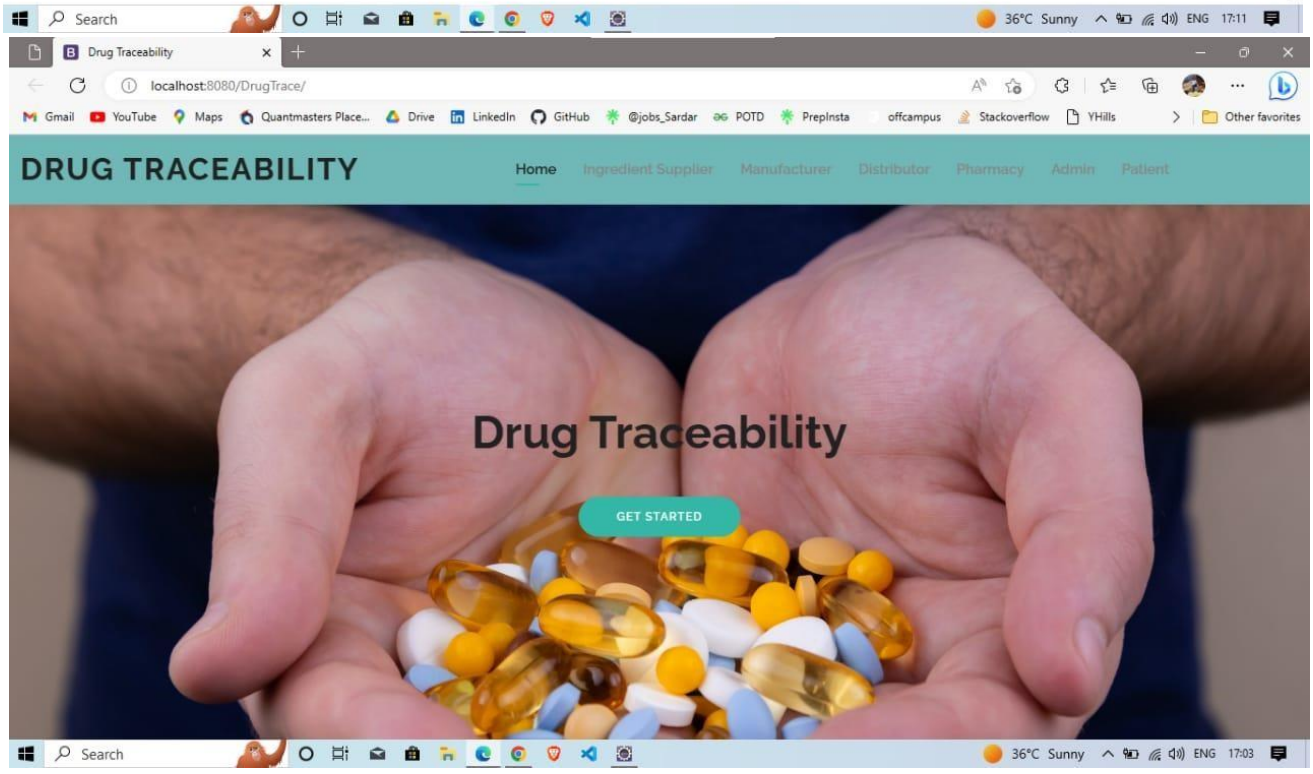
Home
Welcome Swapnil Rajendra Take
PATIENT HOME
Buy Medicine
My Orders
Payment Details


Drug Traceability
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DRUG TRACEABILITY
Home
Ingredient Supplier
Manufacturer
Distributor
Pharmacy
Admin
Patient
Drug Traceability
GET STARTED

10. ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

- increased protection of patients from falsified medicines
- reduction of operational cost and time
- Increased accountability
- Enhanced Traceability
- Improved Transparency

10.2 DISADVANTAGES

- Implementation cost
- Scalability
- Standardisation
- User adoption

11. CONCLUSION

Drug traceability, especially when implemented using advanced technologies like blockchain, plays a pivotal role in ensuring the safety, authenticity, and efficiency of pharmaceutical supply chains. The challenges associated with counterfeit drugs, supply chain complexities, regulatory compliance, and data accuracy are met with innovative solutions through traceability systems.

12. FUTURE SCOPE

The future scope for drug traceability is promising, with advancements in technology and regulatory requirements driving its expansion. Some key aspects include:

1. Blockchain Technology: Implementing blockchain for secure and immutable records of drug supply chains to prevent counterfeiting and enhance transparency.

2. IoT and Sensors: Integrating Internet of Things (IoT) devices and sensors for real-time monitoring of drug shipments and conditions, ensuring product integrity.

3. Serialization and Barcoding: Wider adoption of serialization and unique product identification through barcodes or QR codes to track individual drug units.

4. Artificial Intelligence: Utilizing AI for data analysis, anomaly detection, and predictive modeling to enhance supply chain efficiency and detect potential issues.

5. Regulatory Compliance: Ongoing development of regulations and standards, like the Drug Supply Chain Security Act (DSCSA) in the United States, driving global compliance efforts.

6. Mobile Apps: Enhanced patient engagement and safety through mobile apps that allow consumers to verify the authenticity of their medications.

7. Data Sharing and Interoperability: Improved collaboration and data sharing between stakeholders in the pharmaceutical supply chain to ensure end-to-end traceability.

8. Anti-Counterfeiting Technologies: Continued innovation in anticounterfeiting features such as tamper-evident packaging and holograms.

9. Global Expansion: Expanding traceability initiatives to a broader range of pharmaceutical products, beyond just high-value or high-risk drugs.

10. Environmental Sustainability: Integrating eco-friendly practices and materials into traceability solutions to reduce the environmental impact.

The scope for drug traceability will continue to evolve as the pharmaceutical industry seeks to enhance safety, security, and transparency throughout the supply chain.

13. APPENDIX

SOURCE CODE

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5internals": "5.1.1-v1",
        "eslint-visitor-keys": "^2.1.0",
        "semver": "^6.3.1"
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      "engines": {
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        "@babel/helper-optimise-
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"^7.22.5",
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"node_modules/@babel/helpersplit-
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      "resolved":
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export

contract Drug{
address public owner;

    constructor() {
owner = msg.sender;
    }
```

```
    modifier onlyOwner() {
require(msg.sender == owner, "Only
the owner can perform this
action");
        _;
    }

    struct Drug {        string
drugName;        string
manufacturer; uint256
manufacturingDate;
address trackingHistory;
    }

    mapping(uint256  =>  Drug)  public
drugs;     uint256 public drugCount;

    event DrugManufactured(uint256
indexed drugId, string drugName,
string   manufacturer,       uint256
manufacturingDate);     event
```

```
    DrugTransferred(uint256 indexed
drugId, address indexed from,
address indexed to, uint256
transferDate);


   function manufactureDrug(uint256
drugId, string memory _drugName,
string memory _manufacturer,
uint256 _manufacturingDate)
     external onlyOwner {

       address initialHistory;
       initialHistory = owner;


      drugs[drugId]                    =
Drug(_drugName,      _manufacturer,
_manufacturingDate, initialHistory);
drugCount++;


       emit DrugManufactured(drugId,
_drugName,              _manufacturer,
_manufacturingDate);
   }
```

```
    function
transferDrugOwnership(uint256
_drugId, address _to) external {
require(_to != address(0), "Invalid
address");
        require(_to     !=
drugs[_drugId].trackingHistory,
"Already owned by the new
address");

        address from =
drugs[_drugId].trackingHistory;
drugs[_drugId].trackingHistory = _to;

        emit DrugTransferred(_drugId,
from, _to, block.timestamp);
    }

    function getDrugDetails(uint256
_drugId) external view returns (string
memory, string memory, uint256,
address) {
```

```
        Drug memory drug =
drugs[_drugId];        return
     (drug.drugName,
drug.manufacturer,
drug.manufacturingDate,
drug.trackingHistory);
   }
}0
```

PROJECT DEMO LINK

https://drive.google.com/file/d/1wAaGyA7ZxnKA91SxxyNIyUCENo0OpwMo/view?usp=sharing