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A Decentralized Blockchain-Based Marketplace for Transparent Agricultural Supply Chain and Secure Peer-to-Peer Transactions

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ABSTRACT

The agricultural sector plays a crucial role in the global economy, yet it faces multiple challenges such as lack of transparency, inefficient supply chains, and insecure transaction mechanisms. Traditional agricultural marketplaces often involve intermediaries, leading to reduced profits for farmers and increased costs for buyers. Additionally, the absence of secure and transparent transaction systems can result in fraud and data manipulation. To address these challenges, this project proposes a Blockchain-Based Secure Agricultural Marketplace System developed using the Django web framework.The system enables direct interaction between farmers (sellers) and buyers, eliminating intermediaries and ensuring fair trade. Farmers can register, upload crop details, and manage their products, while buyers can search, view, and purchase crops through a user-friendly interface. The platform incorporates role-based access for administrators, sellers, and buyers, ensuring proper system management and control.

A key feature of the system is the integration of blockchain technology for secure and transparent transactions. Each transaction is recorded as a block containing essential details such as sender, recipient, amount, timestamp, and cryptographic hash. The blockchain ensures immutability, meaning that once a transaction is recorded, it cannot be altered or deleted. This enhances trust among users and reduces the risk of fraudulent activities.The system uses Python-based Django for backend development, providing robust database handling and secure authentication mechanisms. SQLite or other relational databases are used to store user data, crop information, and transaction records. The blockchain module is implemented using a custom Python class that simulates core blockchain functionalities such as block creation, transaction recording, and hash linking.

Additionally, the system includes a cart and checkout feature where buyers can add crops, calculate total costs, and initiate secure transactions. Upon successful payment,

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transaction details are stored both in the database and the blockchain ledger, ensuring redundancy and integrity.The proposed system offers a scalable, secure, and transparent solution for modern agricultural marketplaces. It not only improves efficiency but also empowers farmers by providing direct access to buyers. Future enhancements may include integration with real-time payment gateways, IoT-based crop monitoring, and advanced analytics for market trends.

Keywords: Blockchain, Django, Smart Contracts, Agricultural E-commerce, Supply Chain Transparency, Decentralized Ledger, Peer-to-Peer (P2P) Trading.

I. INTRODUCTION

Agriculture remains the backbone of many economies, particularly in developing countries, where a significant portion of the population depends on farming for livelihood. Despite technological advancements in various sectors, agriculture still faces issues related to inefficiency, lack of transparency, and dependency on intermediaries. Farmers often struggle to get fair prices for their produce due to middlemen who dominate the supply chain. Similarly, buyers face challenges in verifying product authenticity and transaction security.With the rise of digital technologies, there is a growing need for smart agricultural systems that can streamline operations and ensure secure transactions. Web-based platforms have emerged as a solution to connect farmers and buyers directly. However, these systems often lack strong security mechanisms and transparency, especially in financial transactions.Blockchain technology has gained significant attention as a decentralized and secure method of recording transactions. It operates on the principle of distributed ledgers, where each transaction is stored in a block and linked to previous blocks using cryptographic hashes. This ensures data integrity, transparency, and resistance to tampering.

This project aims to develop a Blockchain-Based Agricultural Marketplace System using the Django framework. The system facilitates seamless interaction between farmers and buyers while incorporating blockchain technology to secure transactions. The platform provides features such as user registration, login authentication, crop listing, search functionality, cart management, and transaction processing.The administrator plays a vital role in managing the system by approving users and monitoring transactions. Sellers can upload crop details, including price, description, and images, while buyers can browse available crops, add them to their cart, and complete purchases securely.The integration of blockchain ensures that every transaction is recorded permanently and cannot be altered. This builds trust among users and enhances system reliability. The use of Django ensures scalability, security, and efficient handling of web requests.Overall,

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the proposed system aims to revolutionize agricultural marketplaces by combining web technologies with blockchain, providing a secure, transparent, and efficient platform for all stakeholders.

II. LITERATURE SURVEY (WITH EXISTING METHODS)

Recent advancements in agricultural technology have focused on improving supply chain transparency, reducing intermediaries, and ensuring secure transactions. Traditional e-commerce platforms have been adapted for agriculture, allowing farmers to sell their produce online. However, these systems often lack trust and transparency.Research studies have explored the use of blockchain in supply chain management. Blockchain provides a decentralized ledger that records transactions securely and transparently. Several studies highlight its application in agriculture for tracking product origin, ensuring quality, and preventing fraud.Machine learning and data analytics have also been used in agriculture for crop prediction, price forecasting, and demand analysis. However, these technologies primarily focus on production rather than transaction security.Existing blockchain-based systems in agriculture emphasize traceability, where consumers can track the journey of products from farm to market. While these systems improve transparency, they often do not integrate user-friendly interfaces or complete e-commerce functionalities.Web frameworks such as Django have been widely used for developing scalable and secure applications. Django provides built-in features such as authentication, database management, and security mechanisms, making it suitable for developing complex systems.The proposed system combines blockchain with a Django-based web application, offering both security and usability. Unlike existing systems, it provides a complete marketplace solution with features such as cart management, transaction processing, and admin control.This integration addresses key challenges in agricultural systems by ensuring secure transactions, reducing fraud, and improving efficiency.

III. EXISTING SYSTEM

Traditional agricultural marketplace systems are largely centralized and depend heavily on intermediaries such as agents, wholesalers, and brokers. These intermediaries often create inefficiencies in the supply chain, leading to increased costs for buyers and reduced profits for farmers. Additionally, these systems lack transparency, making it difficult for users to verify product authenticity and pricing fairness.Most existing systems store data in centralized databases, which are vulnerable to cyber-attacks, data manipulation, and unauthorized access. This lack of security raises concerns about the integrity of transaction records. Furthermore, conventional platforms do not provide mechanisms to ensure trust between farmers and buyers, especially during financial

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transactions.Although some modern web-based agricultural platforms have been introduced, they still rely on traditional database architectures. These platforms improve accessibility but fail to address core issues such as trust, traceability, and transaction security. In many cases, users must rely on third-party services or payment gateways, which increases dependency and risk.

Research indicates that agricultural systems face challenges such as lack of trust, inefficient supply chain management, and poor traceability of products . Existing blockchain-based solutions attempt to improve transparency but are often limited to supply chain tracking rather than providing a complete marketplace solution.Moreover, many systems are not user-friendly and require technical expertise, limiting their adoption among small-scale farmers. There is also a lack of integration between user management, product listing, and secure transactions within a single platform.Therefore, existing systems fail to provide a comprehensive, secure, and transparent solution for agricultural trading, highlighting the need for an improved system.

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IV. PROPOSED METHOD

The proposed system introduces a Blockchain-Based Agricultural Marketplace that provides a secure, transparent, and efficient platform for farmers and buyers. The system eliminates intermediaries, enabling direct interaction between users and ensuring fair pricing.The system consists of three main modules: Admin, Seller (Farmer), and Buyer. The admin manages user registrations and activates accounts, ensuring controlled access. Sellers can upload crop details, including price, description, and images, while buyers can search for crops, add them to a cart, and initiate purchases.A key feature of the system is the integration of blockchain technology. Blockchain acts as a decentralized ledger that records transactions securely and immutably. Each transaction contains details such as sender, recipient, amount, timestamp, and cryptographic hash, ensuring that data cannot be altered once recorded. This enhances trust and transparency among users.

Studies show that blockchain improves traceability, security, and efficiency in agricultural supply chains . The system also incorporates cart management and checkout features, where buyers can calculate total costs and perform transactions.The Django framework is used for backend development, ensuring scalability, security, and efficient database management. The system provides a user-friendly interface, making it accessible to both technical and non-technical users.Overall, the proposed system addresses the limitations of existing systems by combining blockchain security with a fully functional web-based marketplace, ensuring transparency, reliability, and efficiency.

V. IMPLEMENTATION

The implementation of the Blockchain-Based Agricultural Marketplace System is carried out using the Django web framework, which follows the Model-View-Template (MVT) architecture. This structure ensures modularity, scalability, and efficient separation of concerns.The **Model layer** defines database structures for users, crops, cart items, and transactions. Separate models are created for sellers, buyers, cart management, and blockchain transactions. Django's ORM (Object Relational Mapping) is used to perform database operations efficiently without writing complex SQL queries.

The **View layer** handles business logic and user requests. Functions such as user registration, login authentication, product search, cart operations, and transaction processing are implemented in views. Session management is used to maintain user login states and store relevant information such as user ID and email.The **Template layer** is responsible for the front-end interface. HTML pages are designed for different modules, including admin dashboard, seller pages, buyer pages, and transaction results. The interface is user-friendly and allows easy navigation.User authentication is implemented

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for secure access. Admin users can activate seller and buyer accounts. Sellers can upload crop details, and buyers can browse products and add them to their cart. The cart functionality calculates the total cost using aggregation functions.The blockchain module is implemented using a custom Python class. It includes functions for:

- Creating new transactions
- Generating blocks
- Linking blocks using hashes

Each transaction is recorded in the blockchain with attributes such as sender, recipient, amount, timestamp, proof, and previous hash. This ensures immutability and transparency.During checkout, the system initiates a blockchain transaction. A random proof value is generated to simulate mining. The transaction is stored both in the database and blockchain ledger, ensuring redundancy and data integrity.Research shows that blockchain enhances security, transparency, and trust in agricultural systems by providing immutable transaction records .

The system also includes features such as:

- Product search using filters
- Cart management
- Transaction history tracking
- Admin monitoring

Overall, the implementation ensures a complete workflow from user registration to secure transaction processing.

VI. ALGORITHMS

The system utilizes several algorithms to ensure efficient functionality and security:

1. Blockchain Algorithm:
The blockchain algorithm creates a chain of blocks where each block contains transaction data, timestamp, proof, and the hash of the previous block. This ensures immutability and prevents tampering. Blockchain provides a decentralized and secure method of storing transaction records .

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2. Proof Generation Algorithm:
A random proof value is generated to simulate mining. This proof is used to validate and add a new block to the blockchain.

3. Search Algorithm:
The system uses a case-insensitive search algorithm to retrieve crop data from the database. It allows buyers to search for crops using keywords.

4. Aggregation Algorithm:
The total price of items in the cart is calculated using aggregation functions such as SUM. This ensures accurate billing.

5. Authentication Algorithm:
User credentials are verified using database queries. Only activated users are allowed to access system features.

These algorithms collectively ensure system efficiency, security, and reliability.

VII. SYSTEM DESIGN

The system design follows a modular and layered architecture based on Django's Model-View-Template (MVT) framework. This design ensures scalability, maintainability, and efficient system performance.

1. Architecture Overview

The system is divided into three main layers:

- Model Layer (Database)
- View Layer (Business Logic)
- Template Layer (User Interface)

2. Modules

Admin Module:

- Manages user registrations
- Activates seller and buyer accounts
- Monitors transactions

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Seller Module:

- Uploads crop details
- Manages product listings

Buyer Module:

- Searches crops
- Adds items to cart
- Performs transactions

Blockchain Module:

- Records transactions
- Generates blocks
- Ensures data integrity

3. Workflow

1. User Registration
2. Admin Approval
3. Seller uploads crops
4. Buyer searches products
5. Buyer adds to cart
6. Checkout process
7. Blockchain transaction
8. Data stored in database and blockchain

4. Data Flow

User inputs → Processing → Database storage → Blockchain recording → Output display

5. Advantages of Design

- Modular structure allows easy updates
- Blockchain ensures transparency

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- Django ensures security and scalability

Studies highlight that blockchain-based systems improve transparency, traceability, and efficiency in agricultural supply chains .

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SYSTEM DESIGN IMAGES

Home page:

Seller Registraion:

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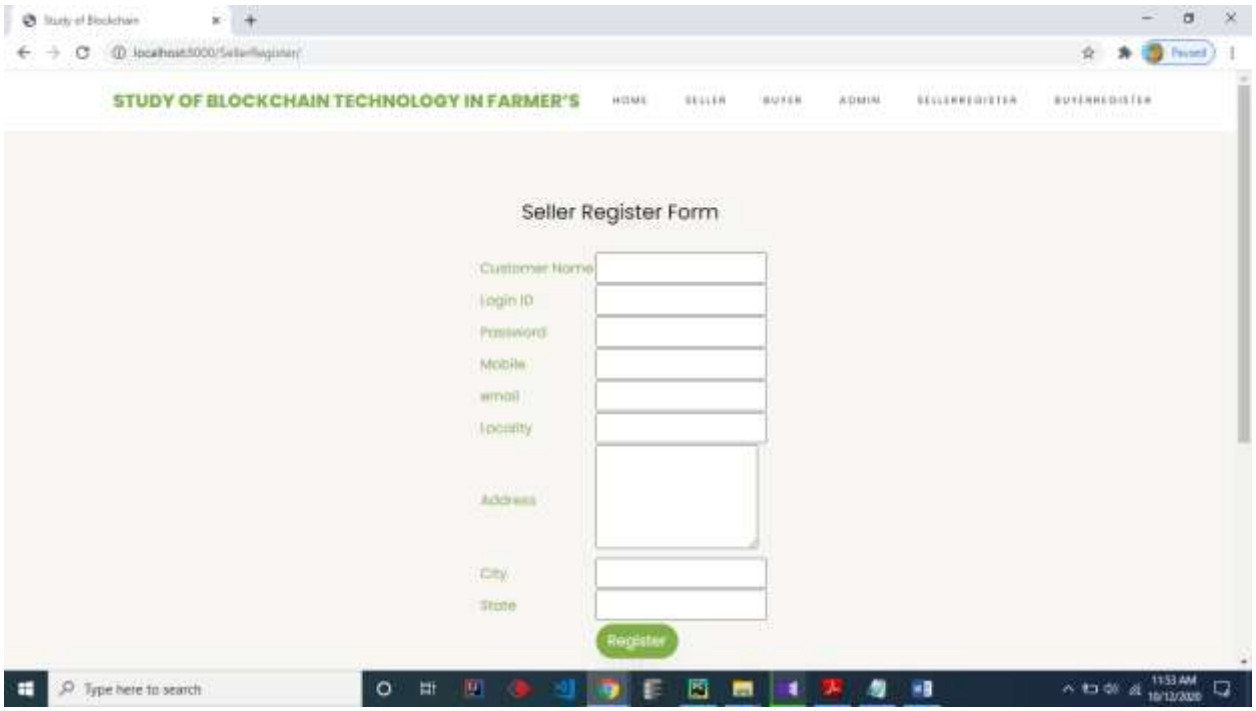

Buyer Registration:

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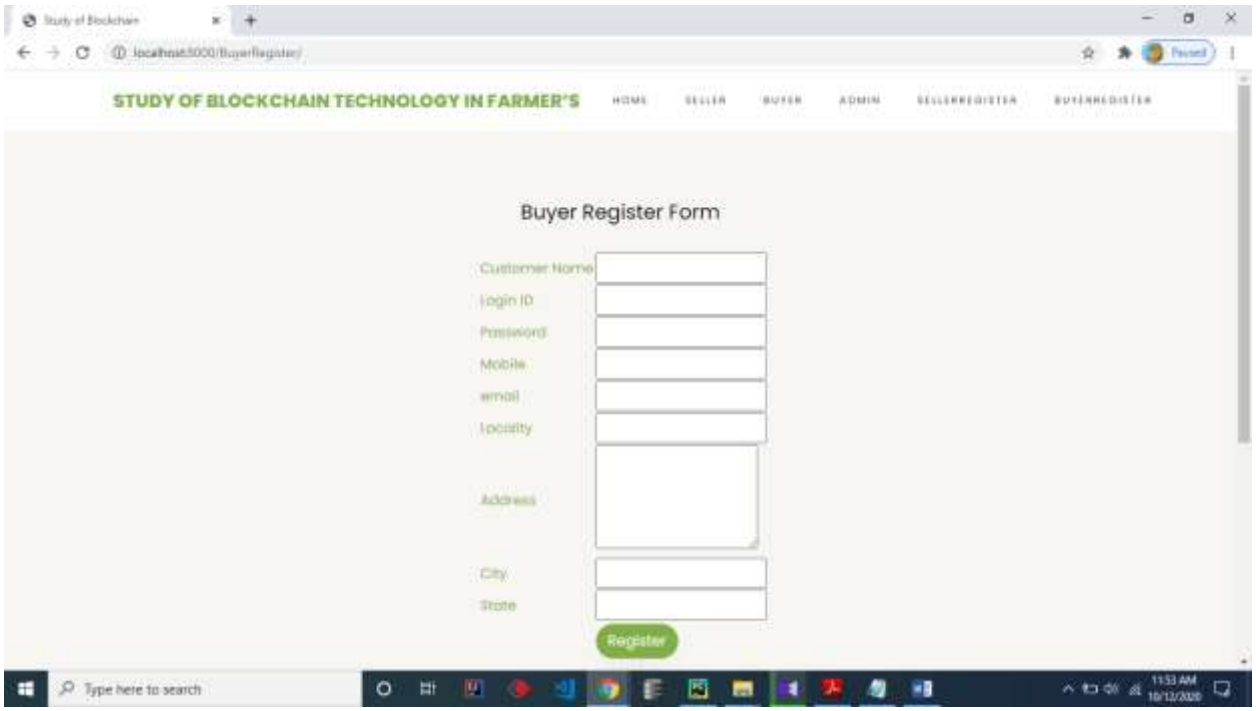

Seller Login:

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Seller Home:

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Seller Adding crops Details

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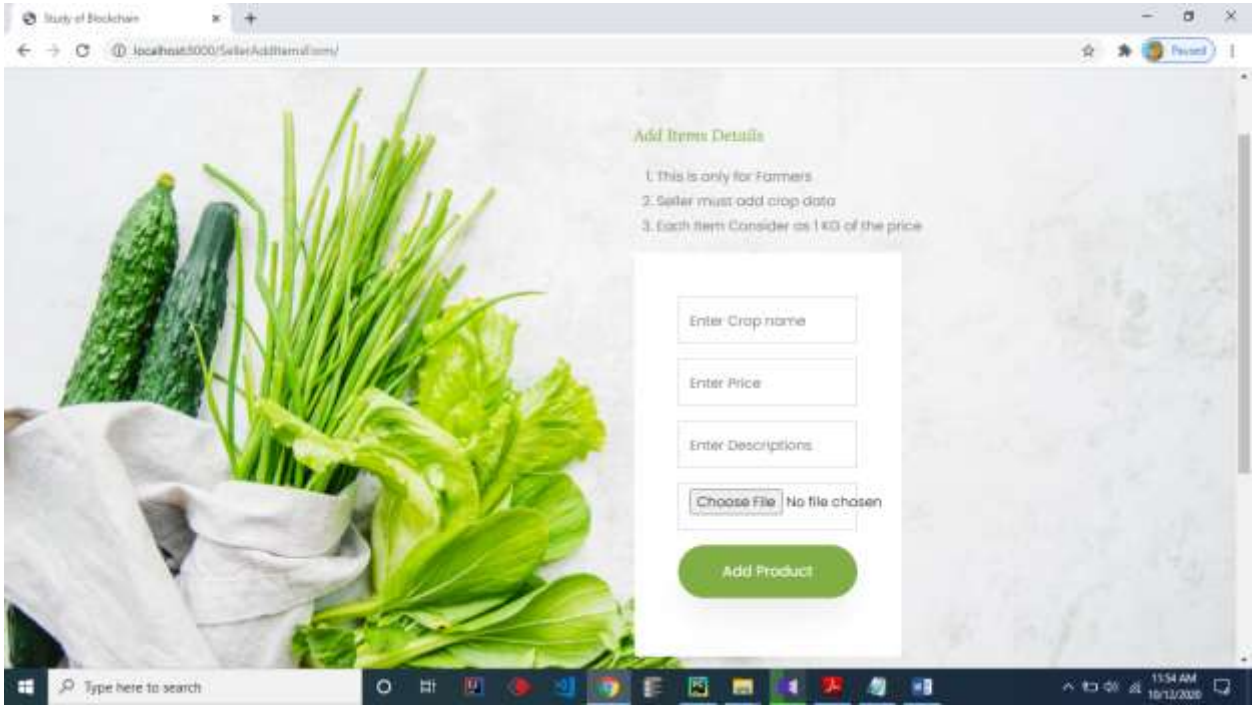

Seller Commodities:

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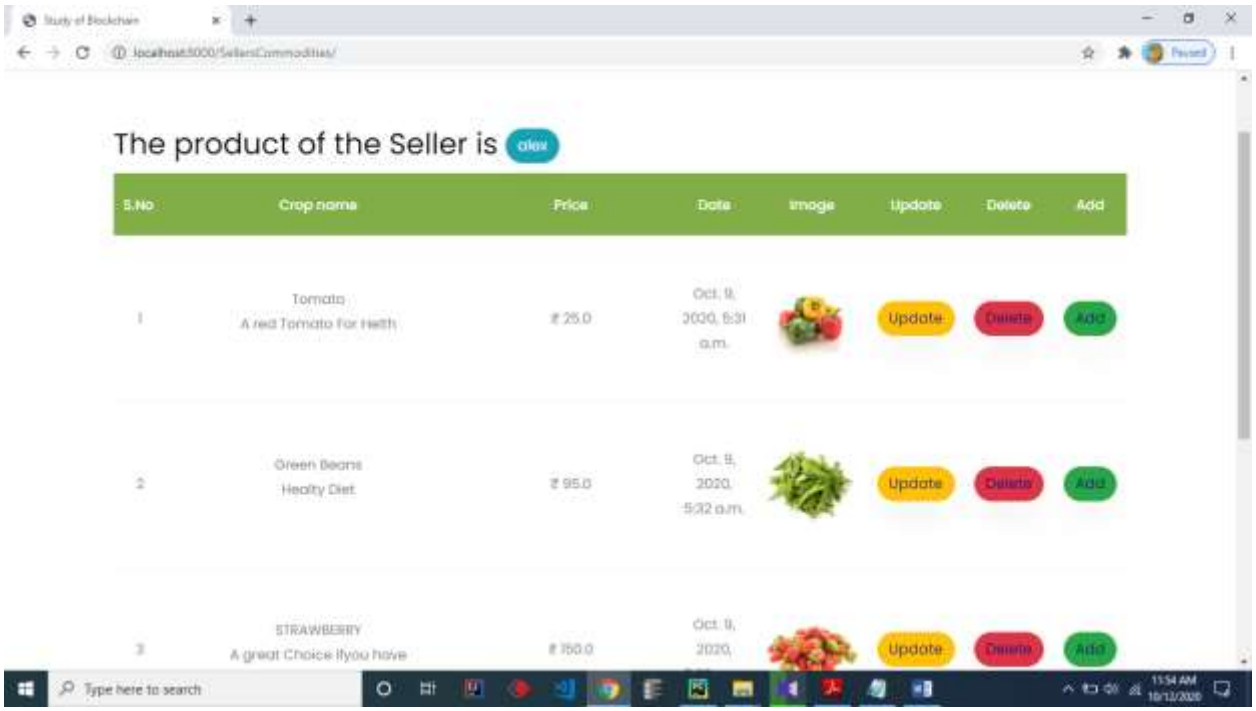

Updaing Crops:

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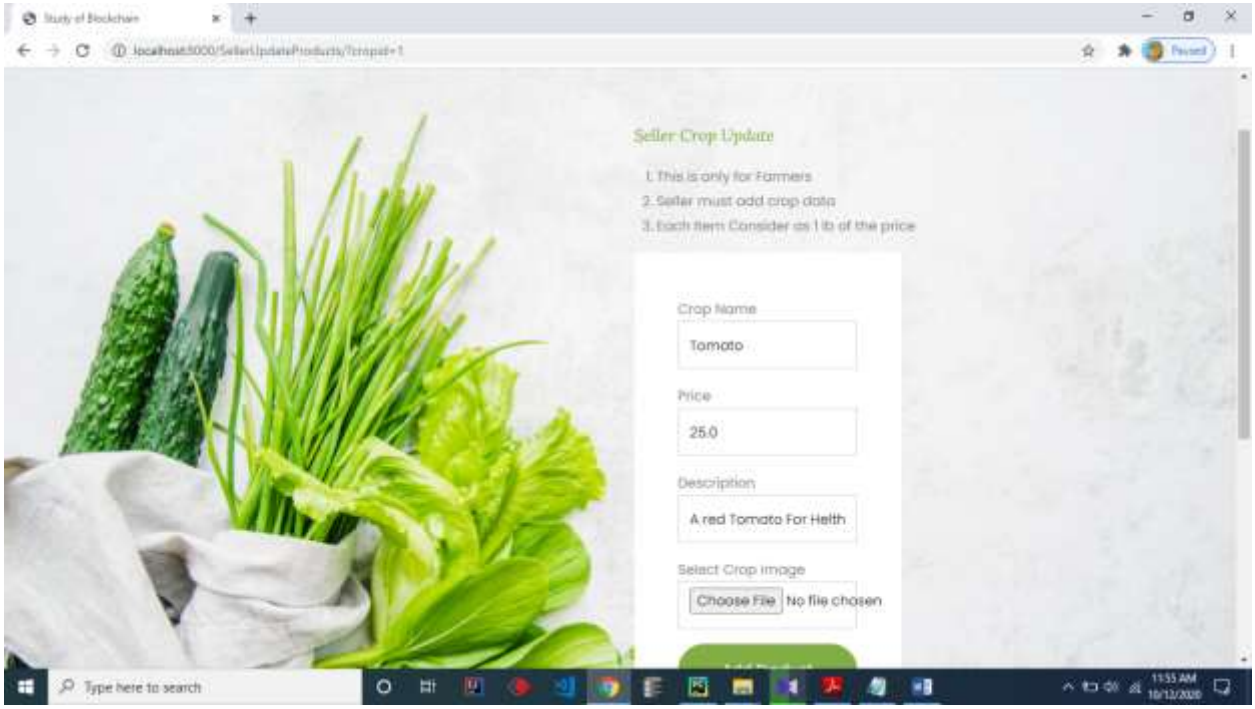

User View In Cart

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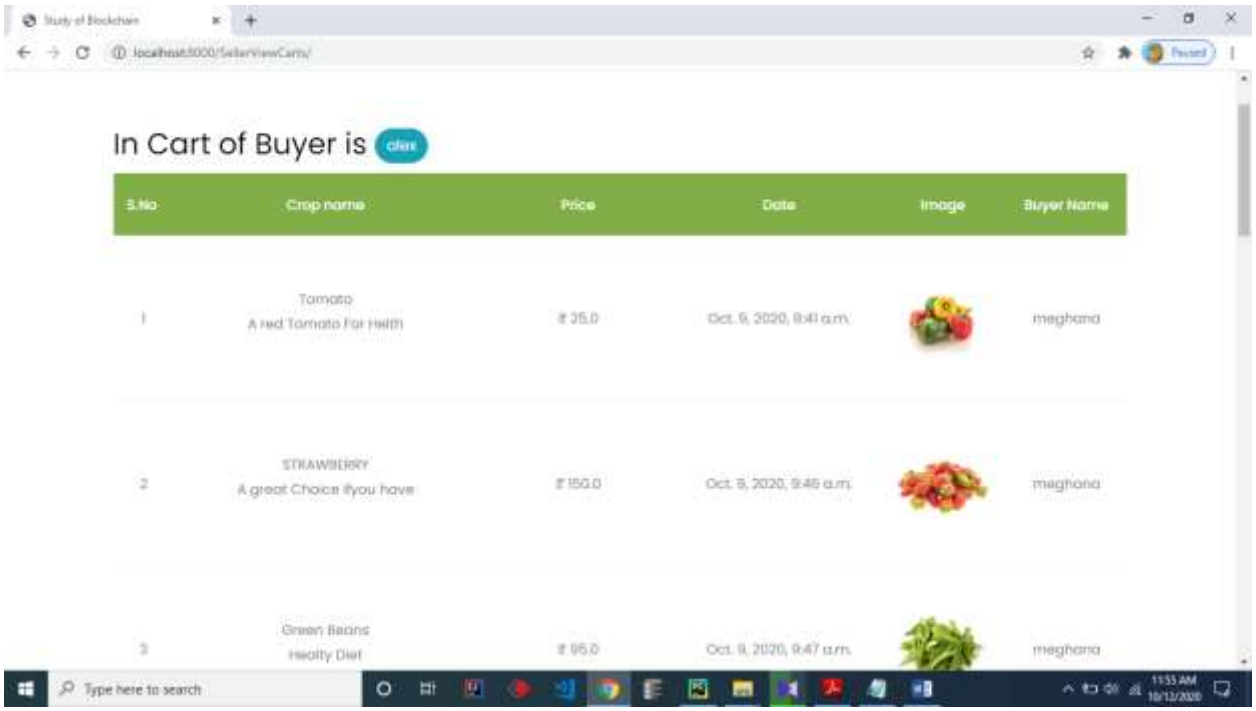

Buyer Login:

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Buyer Home:

Search Results:

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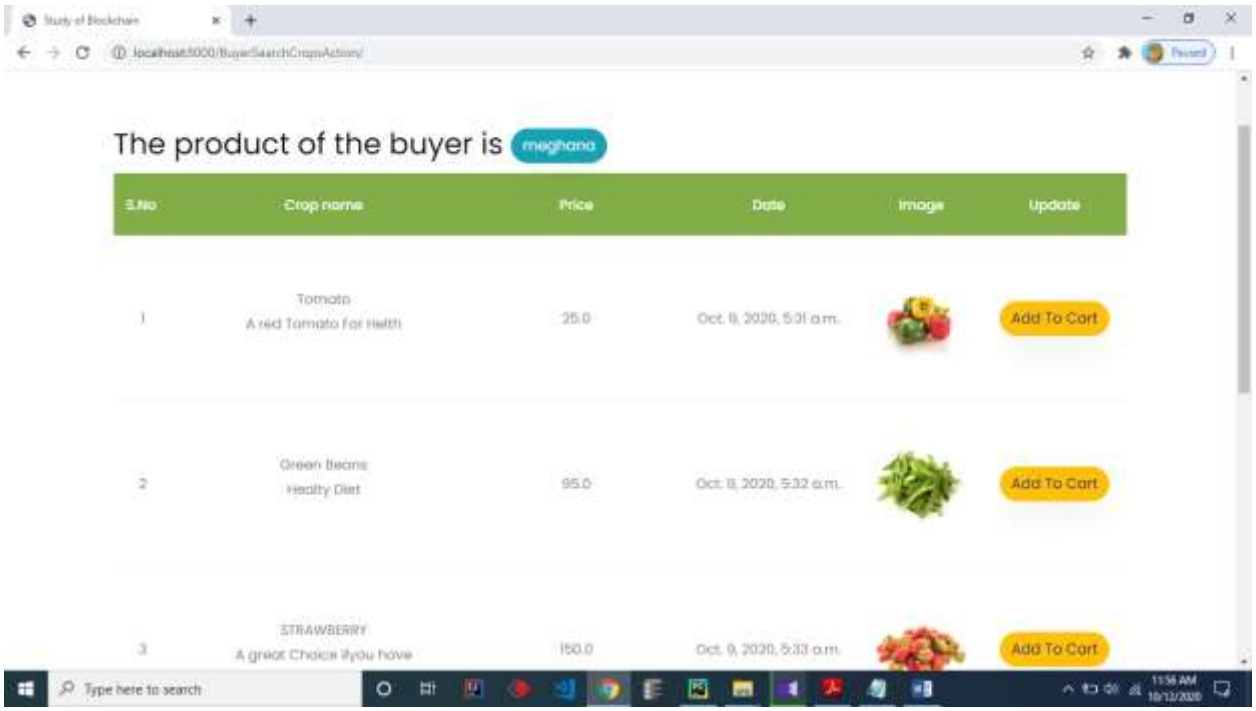

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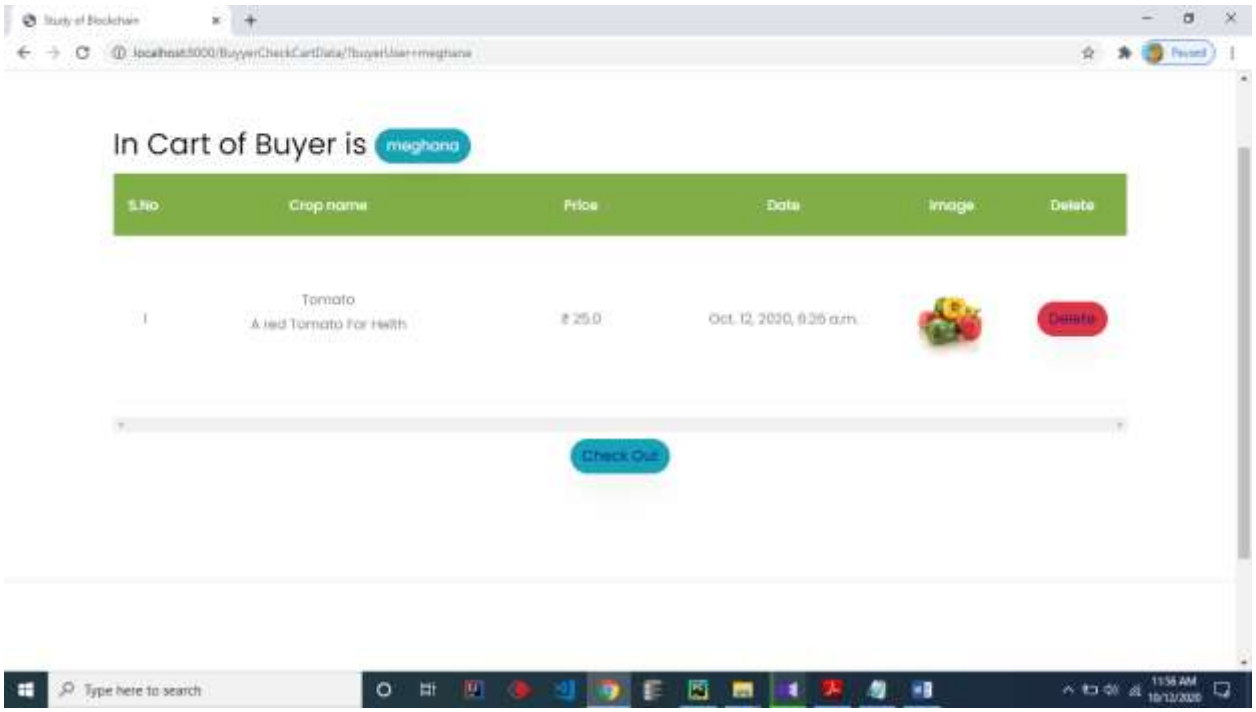
Buyer Cart View:



Block chain :

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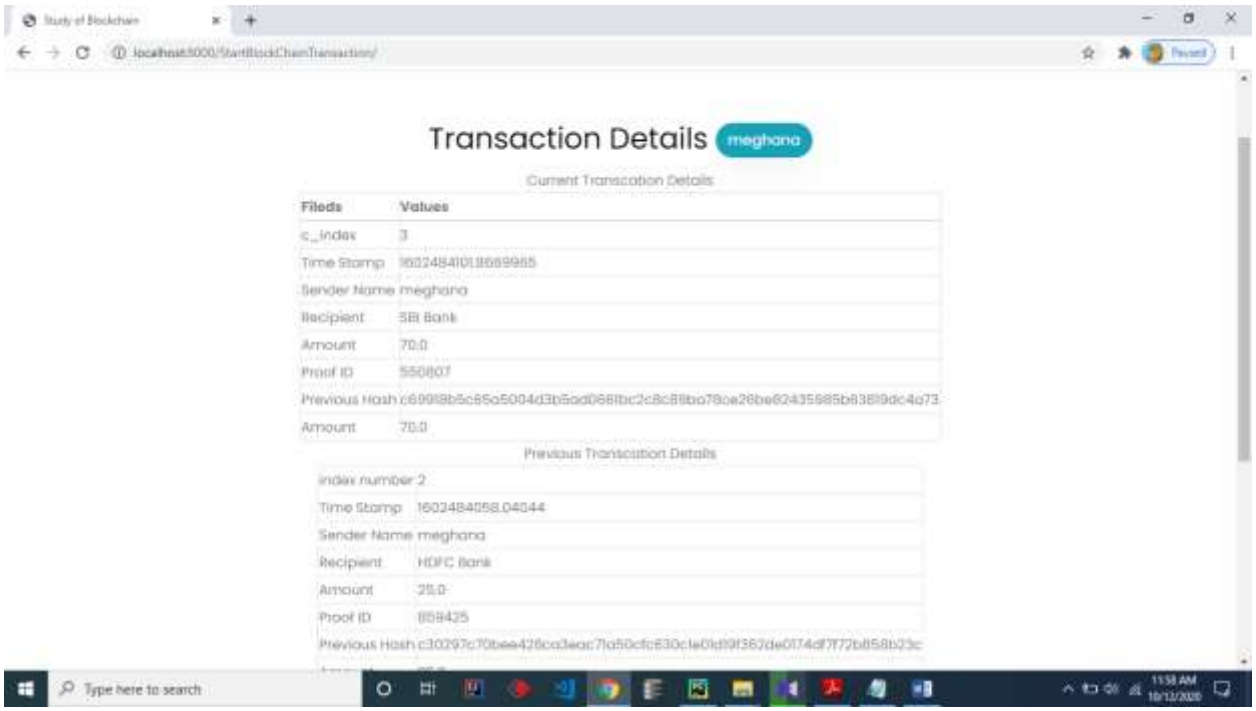

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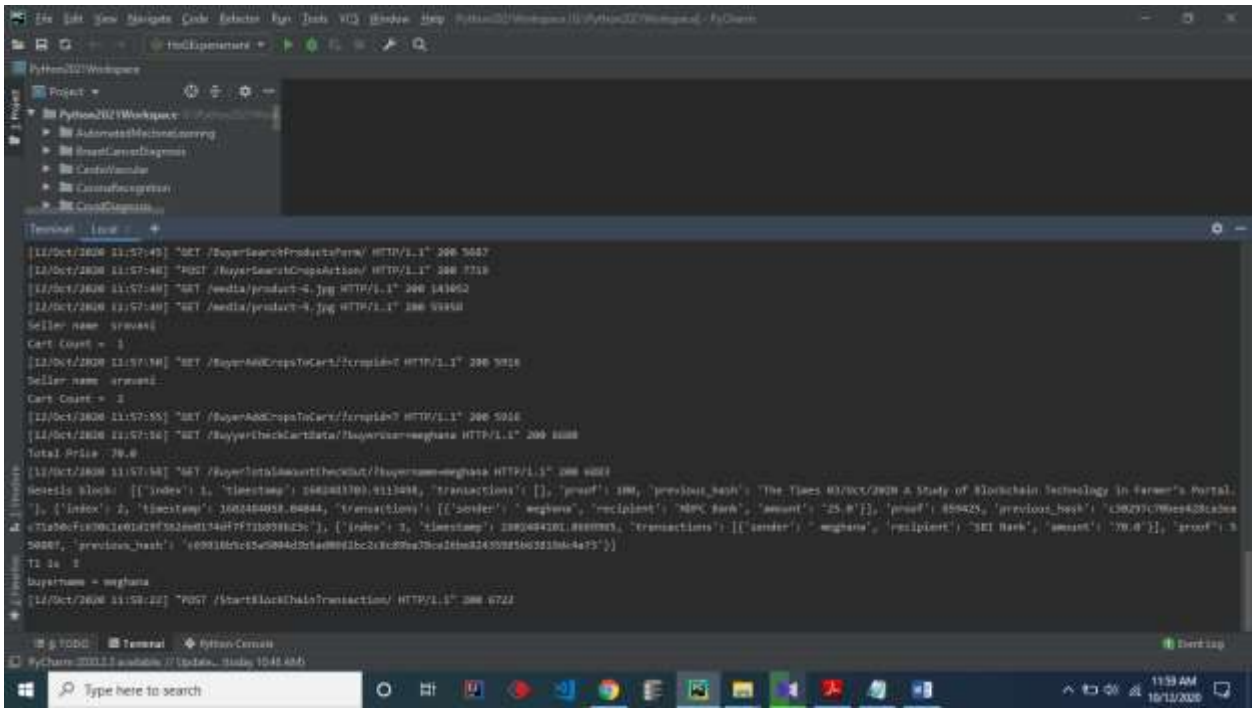
Blockchain Transaction:



Buyer View Transaction

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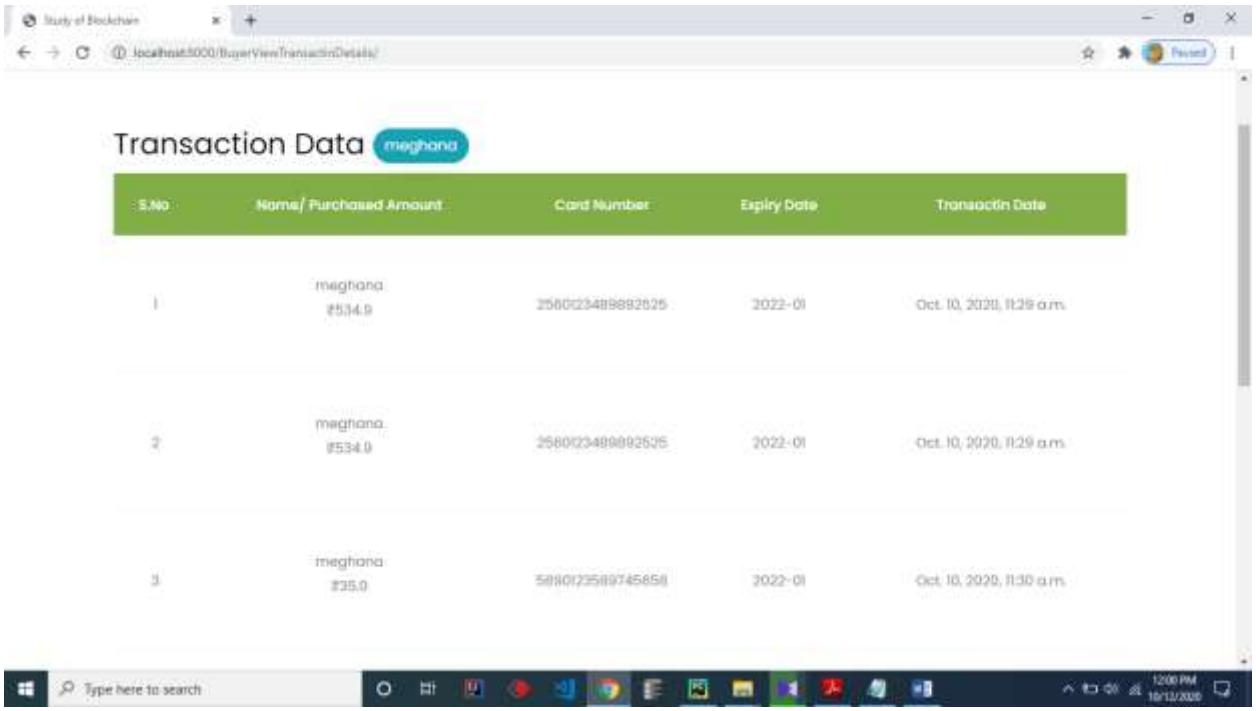

Purchased Crops

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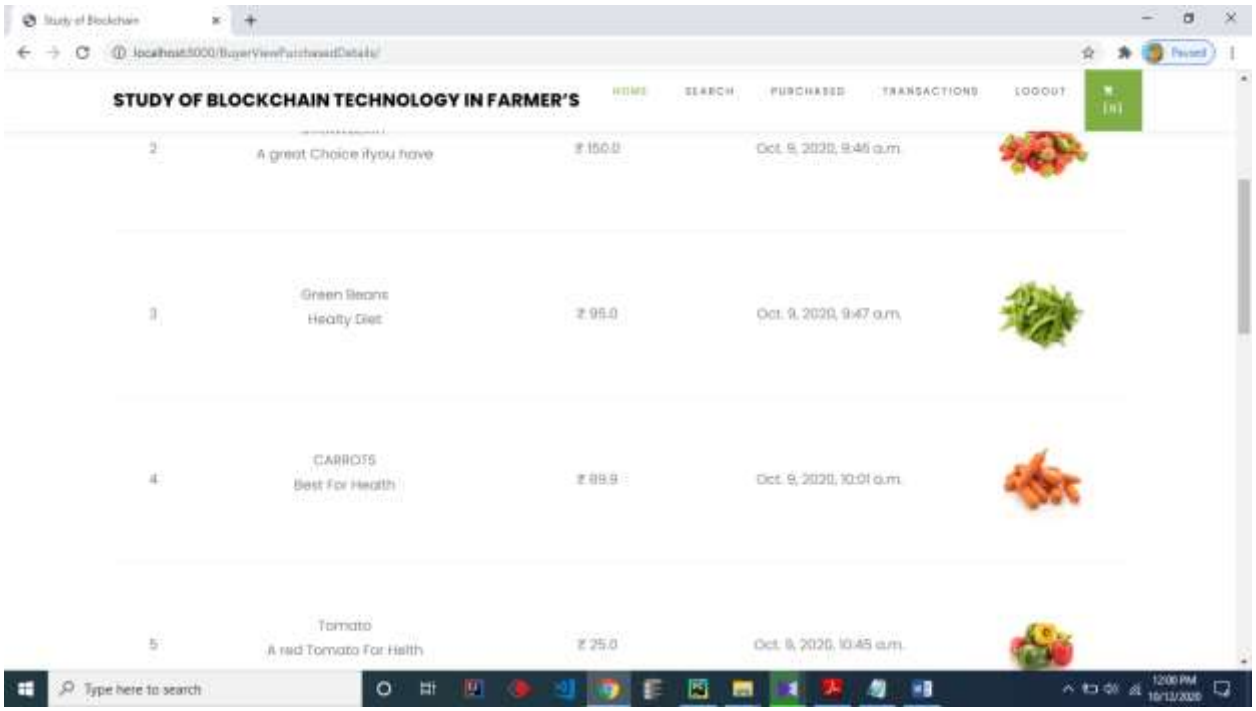

Admin View Blockchain Transaction:

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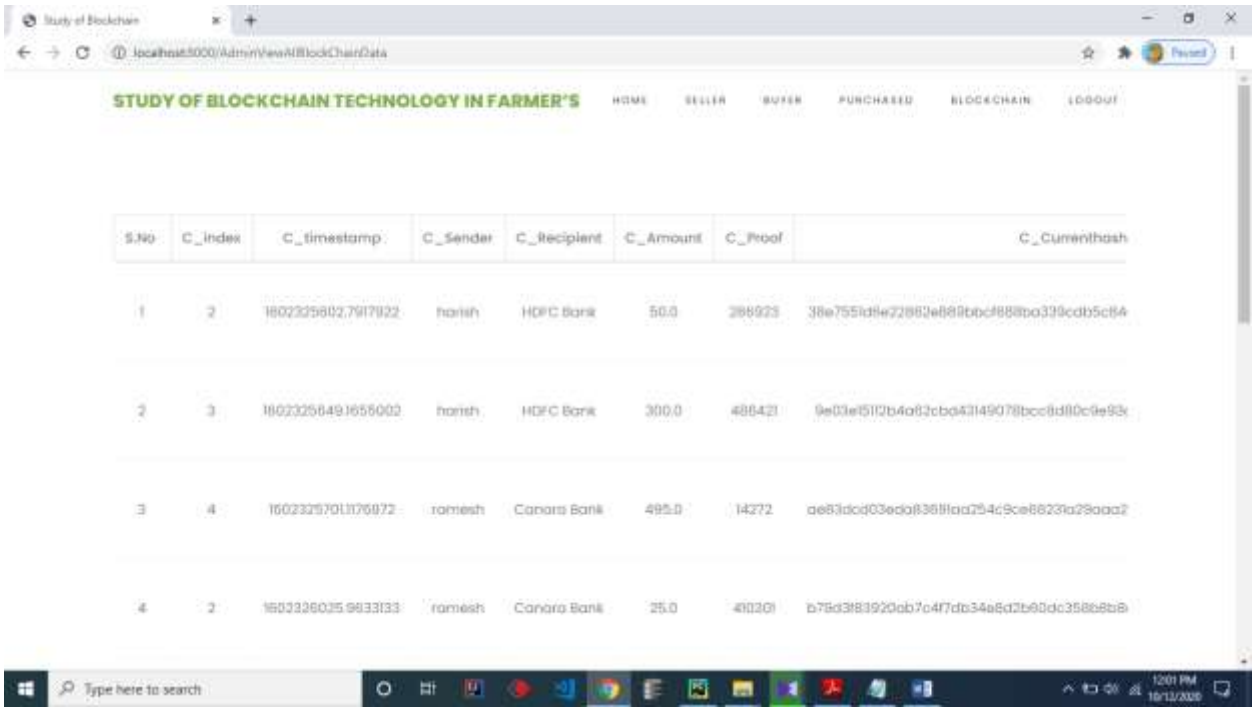

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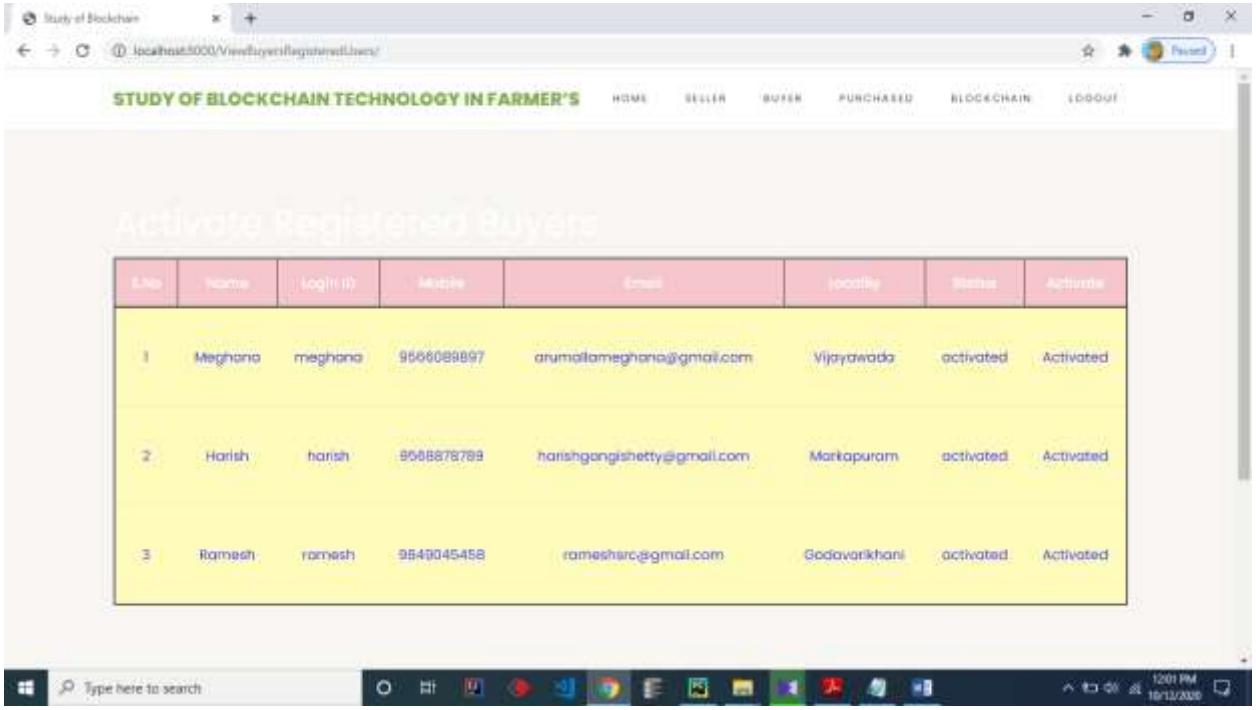
Admin Activate Buyers



Activating Sellers:

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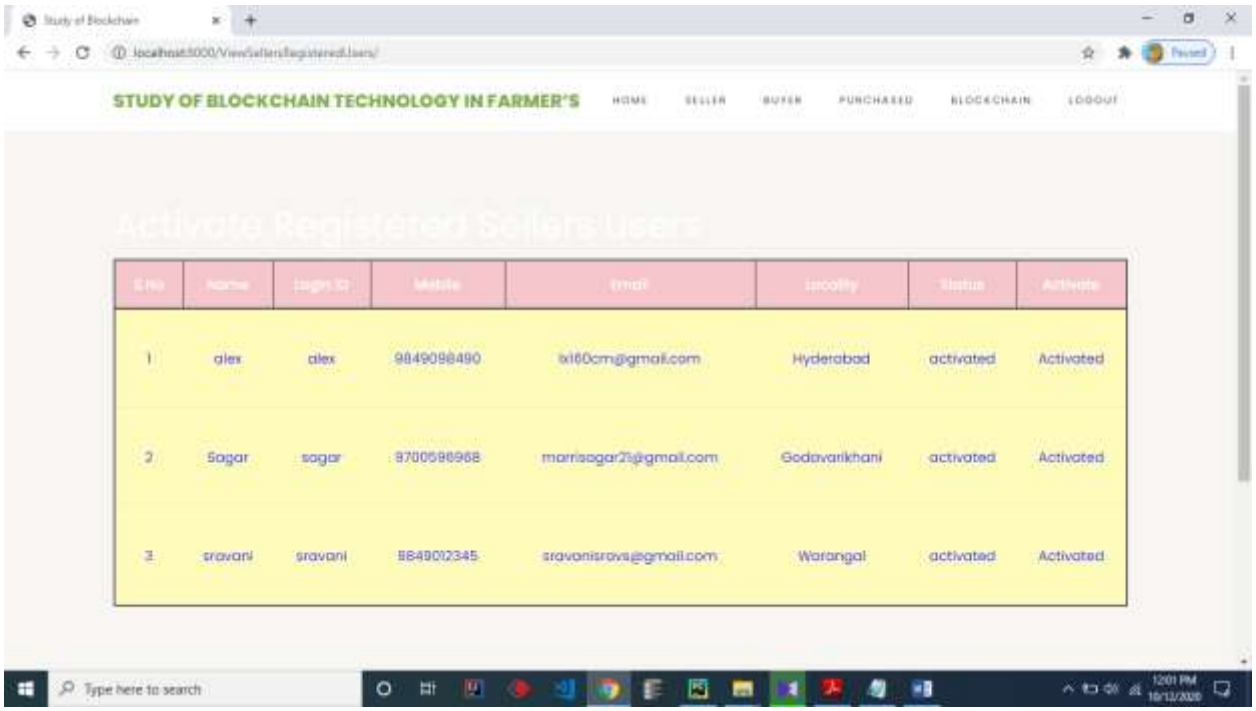

VIII. CONCLUSION

The Blockchain-Based Agricultural Marketplace System provides a secure, transparent, and efficient solution for modern agricultural trading. By integrating blockchain technology with a Django-based web application, the system addresses key challenges such as lack of transparency, data insecurity, and dependency on intermediaries.The system enables direct interaction between farmers and buyers, ensuring fair pricing and improved accessibility. The implementation of blockchain ensures that all transactions are recorded immutably, reducing the risk of fraud and enhancing trust among users. Research confirms that blockchain significantly improves trust, traceability, and efficiency in agriculture .

The system also provides a user-friendly interface, making it accessible to users with minimal technical knowledge. Features such as product search, cart management, and secure transactions enhance usability and functionality.Despite its advantages, the system has certain limitations, such as reliance on simulated blockchain mechanisms and lack of real-time payment integration. Future enhancements may include integration with real blockchain platforms, smart contracts, and IoT-based agricultural monitoring systems.

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In conclusion, the proposed system demonstrates the potential of combining blockchain and web technologies to transform agricultural marketplaces. It provides a reliable and scalable solution that can be extended to other domains requiring secure and transparent transactions.

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