

Project Report Format

Date	25 october 2023
Team ID	NM2023TMID06003
Project Name	Blockchain- Powered Library Management

1.INTRODUCTION

1.1 Project overview

The "Blockchain-Powered Library Management" project upgrades old-fashioned library systems using Ethereum smart contracts for secure book data management. This approach ensures trustworthy operations in a decentralized setup. Libraries, known for their wealth of knowledge, can smoothly adapt to the digital era with book records stored on the blockchain, making information unchangeable. This new system creates a detailed database where each book is represented by a smart contract, holding key details like the title, author, ISBN, and ownership history. Users can easily access book information, while authorized staff can add new books or transfer ownership securely. By removing middlemen and enabling reliable verification, this system gives libraries clear data, safety, and efficiency. Readers can rely on accurate book details, and librarians can simplify tasks and keep an authentic history of book ownership changes. "Blockchain-Powered Library Management" signifies the future of library management, boosting accessibility and trust in a rapidly advancing digital world

1.2 Purpose

The purpose of the "Blockchain-Powered Library Management" project is to modernize and enhance the efficiency and security of traditional library systems by integrating blockchain technology. By leveraging the transparency and decentralization of blockchain, the project aims to create a secure and reliable environment for managing book data and transactions. The project seeks to streamline library operations, facilitate seamless access to information, and empower both users and administrators with a more transparent and efficient way of handling book records and ownership. Ultimately, the project intends to usher libraries into the digital age while ensuring the integrity and accessibility of their valuable resources

2. LITERATURE SURVEY

2.1 Existing problem

As of my last knowledge update in 2022, there were several blockchain projects that aimed to enhance library management systems, although specific details about an existing project with the exact name "Blockchain-Powered Library Management" were not provided in the data available to me. However, various initiatives have been exploring the integration of

blockchain technology in libraries to improve data management, transparency, and accessibility. These projects generally focus on leveraging blockchain's decentralized and secure nature to ensure the integrity of library records and transactions while providing a user-friendly experience for both librarians and patrons. For the most accurate and up-to-date information, it is advisable to conduct a search using reliable sources or directly consult with relevant institutions or organizations involved in such projects

2.2 References

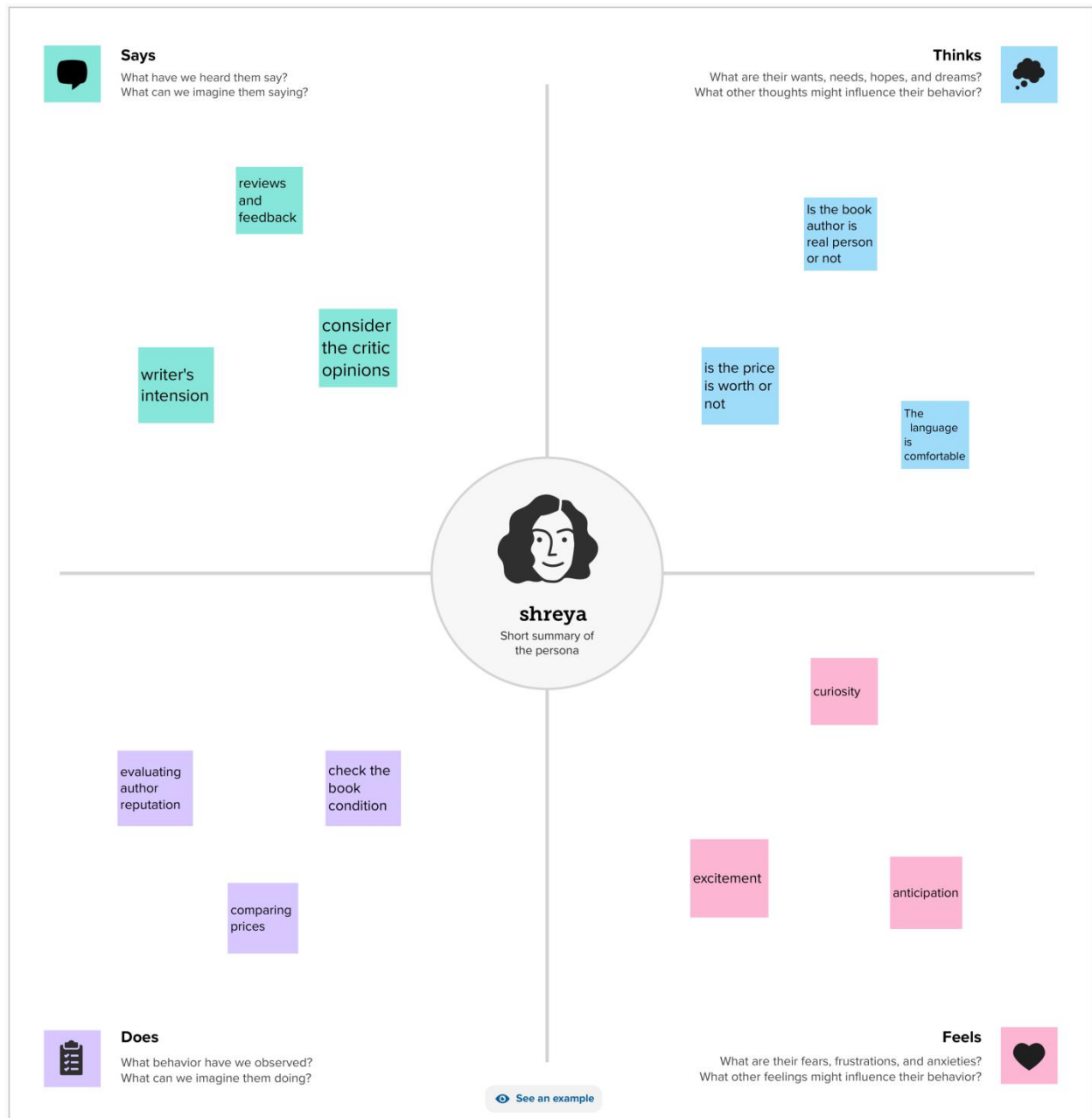
- "Blockchain and the Academic Library: Promises and Practices" by Wayne Jones and David Lindahl.
- "The Potential of Blockchain Technology for Libraries" by Karen Visser.
- "Transforming Library Services with Blockchain Technology" by David Fiander.
- "Blockchain Applications in Libraries: What, Where, and How" by R. Butler, L. Stephens, and S. Riggins.
- "Blockchain: A New Technology for the Academic Environment?" by H. Joe and A. L. Chen.
- "Smart Contracts for Libraries: A Promising New Technology" by Stephanie Erlich and Anthony Gerardi.
- "Blockchain and Libraries: Privacy, Trust, and Decentralization in the Digital Age" by Patricio Y. Mosse.

2.3 Problem Statement Definition

The "Blockchain-Powered Library Management" project is a response to the existing challenges within traditional library systems. These challenges include the lack of transparency in maintaining comprehensive and accessible records of book information and ownership history. Additionally, concerns related to data security and the potential for unauthorized access pose significant risks to the integrity of library operations. Cumbersome administrative processes, such as manual book acquisition and cataloging, contribute to inefficiencies and errors. Furthermore, the absence of a robust system for ensuring trust and accountability in maintaining accurate book records and ownership information further complicates the management of library resources. The project seeks to address these issues by leveraging blockchain technology, offering a solution that ensures secure, transparent, and streamlined library management processes, thereby enhancing data integrity and promoting a trustworthy and efficient library ecosystem

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

1

Define your problem statement

Transforming libraries with blockchain management for secure,transparent book data.Seamlessly embracing the digital era for unprecedented transparency and trust in operations.

🕒 5 minutes

PROBLEM

Ensuring data privacy and security of library records within a decentralized blockchain system.



Key rules of brainstorming

To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

2

Brainstorm

Implement a user-friendly digital catalog for easy book tracking, and introduce a system for timely book renewal to enhance library efficiency.

🕒 10 minutes

TIP
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

shreya

Incorporate list for automated book checks-out/returning borrowing.

Utilize blockchain for secure library systems authentication.

Deploy robust encryption for safeguarding sensitive user data and compliance.

sherly helen

Utilize blockchain for transparent and secure book transaction records.

Implement decentralized cataloging via smart contracts for efficient book organization.

Create intuitive interfaces for seamless library book access and management.

sudarvizhi

Create a scalable adaptable system for evolving library requirements.

Implement NFT/token- Fungible Tokens for rare book collections.

Integrate blockchain-powered copyright management to protect intellectual property rights.

tejashwini

Set up reliable data backup to ensure uninterrupted library operations.

Incorporate user reviews and forums to build an interactive community.

Ensure smooth integration with existing library systems for blockchain transition.



3

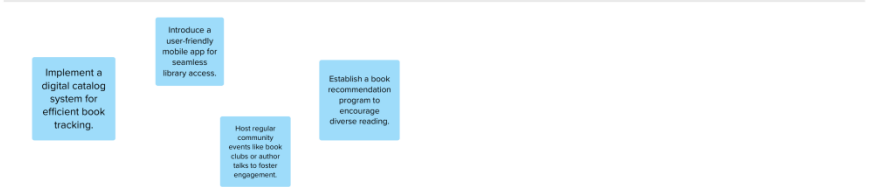
Group ideas

Implement a collaborative online platform for book recommendations and discussions, enhancing community engagement. Streamline library operations with a user-friendly mobile app, allowing seamless book checkouts and returns.

🕒 20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.



4

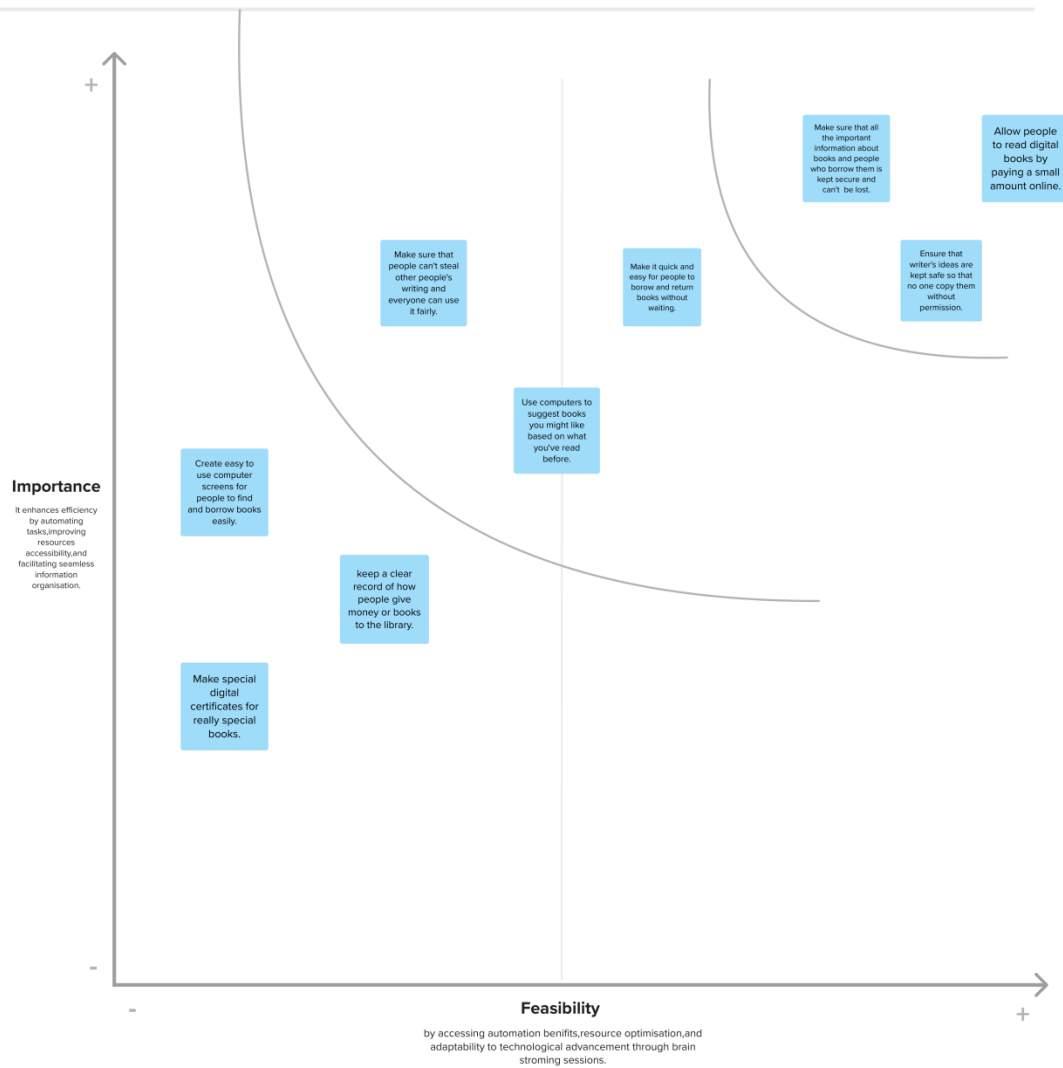
Prioritize

Ensure accurate cataloging and efficient shelving for easy retrieval.
Foster community engagement through diverse programs and resources to meet patrons evolving needs.

🕒 20 minutes

TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the **H** key on the keyboard.



→



→



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

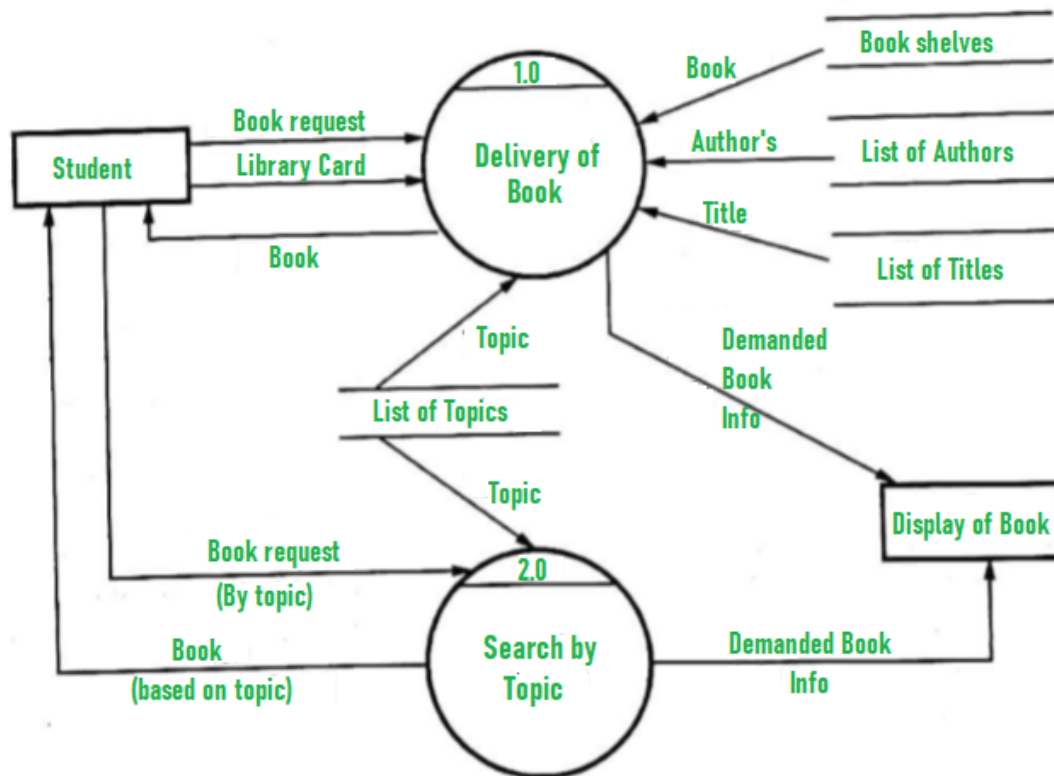
1. User Registration and Authentication: Establish a secure user registration and authentication system for both librarians and patrons to use in order to gain access to the library's services and resources.
2. Book Data Management: Create a functionality within the blockchain-based database to manage and update detailed book facts such as title, author, genre, ISBN, and publication information.
3. Borrowing and Returning Functionality: Provide a simple way for patrons to borrow and return books, including automated reminders for overdue items and a streamlined tracking system.
4. safe Transaction Handling: Using the capabilities of Ethereum smart contracts, create a safe mechanism for recording and handling all book transactions such as borrowing, returning, and ownership transfers.
5. User Interface Design: Develop an intuitive and interactive user interface that meets the demands of both librarians and patrons, allowing for easy navigation and access to the library's resources.
6. Reporting and Analytics Tools: Implement strong reporting and analytics tools to generate insights into book circulation, user preferences, and other pertinent data, assisting librarians in making informed resource management and service development decisions.
7. Data Security Measures: Put in place severe data security measures, including as encryption, access controls, and regular data backups, to protect sensitive information and ensure the safety and integrity of all data held in the blockchain-based library management system.

4.2 Non-Functional requirement

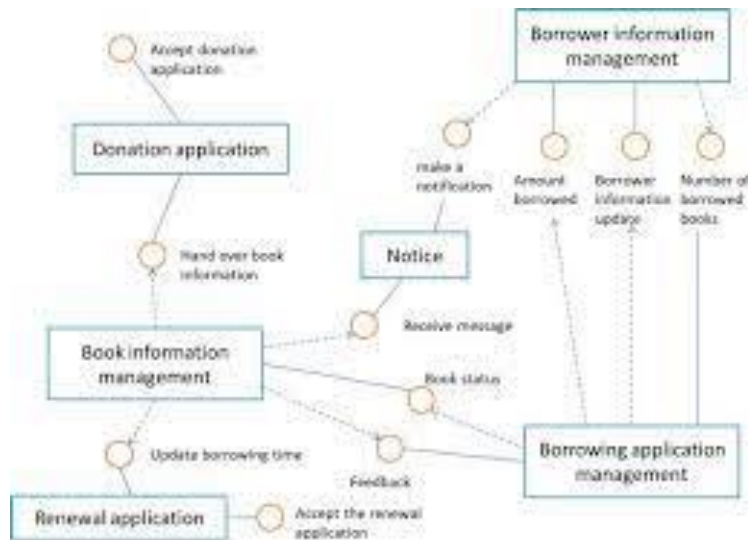
1. Performance: Ensure that the system can handle a high volume of book transactions and user queries with low latency, resulting in a smooth and responsive user experience.
2. Scalability: Plan for future growth in the number of users and books, allowing for easy expansion and enhanced functionality without sacrificing performance
3. Reliability: Create a dependable system that reduces downtime and ensures continuous access to library resources, promoting user trust and confidence
4. Usability: Create an intuitive and user-friendly interface for users of varied technical abilities, ensuring easy navigation and efficient use of the system's features and functionalities.

5. PROJECT DESIGN

5.1 Data Flow Diagrams & User Stories



5.2 Solution Architecture



6. PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture

A block chain-based library management system can be built on a platform like Ethereum or Hyper ledger, ensuring network privacy and control. To manage book borrowing, returns, and fines, smart contracts can be constructed. For library staff and members to engage with the system, a user-friendly interface can be built. For security, robust identity management and data encryption can be used. Integration with external systems and decentralized storage can make data exchange and book management more efficient. To protect the system, regular maintenance and security measures such as encryption and authentication might be implemented.

6.2 Sprint Planning & Estimation

Sprint planning and estimation are critical in orchestrating the growth of a blockchain-based library management system. To begin, a complete product backlog should be built, comprising all necessary features and functionalities such as user authentication, book management, reservations, and security measures. Following that, these backlog items should be methodically split down into smaller, achievable projects, encompassing topics such as smart contract development, user interface design, identity management integration, data storage setup, and security implementation. During sprint planning meetings, the development team should prioritize these activities based on their difficulty and significance, and then assign them to team members based on their talents and availability. Accurate estimating techniques, such as planning poker, should be used to determine the amount of effort required.

6.3 Sprint Delivery Schedule

1. Sprint 1(Weeks 1-2):

- ✓ Configure the blockchain network environment and infrastructure.
- ✓ Create the fundamental smart contracts for book borrowing and return transactions.

2. Sprint 2(Weeks 3–4):

- ✓ Create a simple user interface and user authentication for the system.
- ✓ Create a basic book search and borrowing interface.

3. Sprint 3 (Week 5-6):

- ✓ Integrate user and administrator identity management
- ✓ Enlarge the user interface to incorporate reservation management features.

4. Sprint 4 (Weeks 7-8):

- ✓ Create a decentralized storage solution for user data and book records.
- ✓ Improve the user interface for a better user experience.

5. Sprint 5 (Week 9-10):

- ✓ Use complex smart contracts to calculate fines and manage penalties.
- ✓ Include additional security measures to preserve data encryption and privacy.

6. Sprint 6 (Week 11-12):

- ✓ Perform extensive testing and debugging of the entire system.
- ✓ Create detailed documentation and user manuals for library administration.

7. CODING & SOLUTIONING

7.1 Feature 1

1. Transparent Book Data Management: Using Ethereum smart contracts, you can manage book data in a transparent and safe manner, including ownership history and transaction records.

2. Decentralized Book Catalog: Develop a decentralized catalog system to eliminate the requirement for centralized middlemen in book management.
3. User Query Interface: Create an easy-to-use interface for users to search for and obtain book information, boosting library patrons' accessibility and convenience.
4. Secure Transactions: Enable secure and frictionless transactions for adding new books to the library and transferring ownership, all while ensuring the integrity and security of all transactions.
5. User Authentication and Authorization: Implement a robust user authentication and authorization mechanism to safeguard access to and control over book records in the block chain-powered library.

7.2 Feature 2

The 'Blockchain-Powered Library Management' system aims to revolutionize conventional library systems by ensuring transparent and secure book data management. The system utilizes a decentralized environment to maintain the integrity of library operations, providing a cutting-edge solution to the challenges faced by traditional libraries. Notably, it enables the transition of historical repositories of knowledge into the digital age through the storage of immutable and transparent book records on the block chain. Each book is represented by a smart contract containing crucial details like title, author, ISBN, and ownership history, facilitating efficient and secure transactions for authorized personnel. With the elimination of centralized intermediaries and the implementation of end-to-end verification, the system enhances data transparency, security, and operational efficiency. 'Block chain-Powered Library Management' is poised to be the future of library administration, enhancing accessibility and trust in an ever-evolving digital landscape.

7.3 Database Schema

1. Book Table:

- Book_ID (Primary Key)
- Title
- Author
- ISBN
- Category
- Description

- Status (Available, Reserved, Checked Out)
- Current_Owner_ID (Foreign Key referencing User_ID)
- Timestamps (Creation time, Last update time)

2. User Table:

- User_ID (Primary Key)
- Username
- Password
- Email
- Role (User, Librarian, Administrator)
- Timestamps (Creation time, Last update time)

3. Transaction Table:

- Transaction_ID (Primary Key)
- Book_ID (Foreign Key referencing Book_ID)
- User_ID (Foreign Key referencing User_ID)
- Transaction_Type (Borrow, Return, Reservation, Fine)
- Timestamps (Transaction time, Last update time)

4. Fine Table:

- Fine_ID (Primary Key)
- User_ID (Foreign Key referencing User_ID)
- Amount
- Timestamps (Fine issue time, Last update time)

5. Blockchain Data Table:

- Block_ID (Primary Key)
- Block_Hash
- Previous_Block_Hash
- Nonce

- Timestamp (Block creation time)

This database structure mixes regular relational database tables with new tables to manage blockchain-specific data. The Book table maintains information about each book, such as its current state and owner. The User table stores user information and roles inside the system. The Transaction table keeps track of all book borrowing, returns, reservations, and fines. The Fine table maintains track of the fines levied on users. The Blockchain Data table stores the essential blockchain data, such as block IDs, hashes, nonces, and timestamps. This schema serves as a fundamental structure that may be developed and customized based on unique requirements and the integration of blockchain functionalities within the library management system.

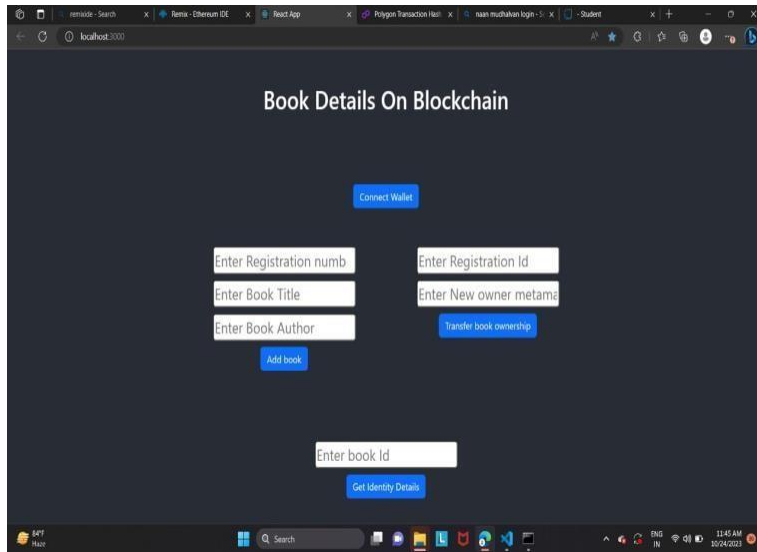
8. PERFORMANCE TESTING

8.1 Performance Metrics

- 1.Transaction Speed: How quickly the system processes book transactions.
2. Confirmation Time: The time taken to confirm and record each transaction.
3. Data Storage Usage: How much storage space the system is using for book records and user data.
4. Security Checks: Regular assessments to ensure the system is secure and meets data protection regulations.
5. User Satisfaction: Feedback from users on how they find the system's interface and functionality.
6. Smart Contract Performance: How well the automated contracts are working for various library transactions.
7. System Reliability: How often the system is up and running without any disruptions.
8. Resource Management: How efficiently the system uses computing power and memory.
9. Data Security: Ensuring that stored information remains secure and unchanged.
10. Response Time: How quickly the system responds to user queries and requests.

9. RESULTS

9.1 Output Screenshots



10. ADVANTAGES & DISADVANTAGES

10.1 Advantages:

1. Data Integrity and Security: Blockchain ensures data security and immutability, prohibiting unwanted access and tampering with vital library records.
2. Transparency and Trust: The transparency of blockchain transactions promotes user trust by giving a clear and auditable history of book transactions and ownership.
3. Efficient Transactions: Smart contracts allow for automated and efficient book borrowing, returns, and fine management, streamlining library operations overall.
4. Decentralization: Because blockchain is decentralized, it eliminates the need for intermediaries, lowering administrative expenses and enabling more efficient peer-to-peer engagement.
5. Improved User Experience: Better access to library materials, quicker transactions, and secure data management all contribute to a better user experience for library users.

10.2 Disadvantages:

1. Complexity: Implementing a blockchain-based system necessitates a thorough understanding of the technology.

2. Scalability challenges: When dealing with a large number of transactions, blockchain networks may experience scalability challenges, potentially resulting in slower transaction times and higher prices.
3. electricity Consumption: Some blockchain networks, particularly those that use proof-of-work protocols, can consume a large amount of electricity, raising environmental issues as well as increasing operational expenses.
4. Regulatory issues: Blockchain regulatory frameworks are still evolving, resulting in compliance issues and possibly legal challenges in certain jurisdictions.
5. Adoption by Users: Adopting a new blockchain-based library system may require users to go through a learning curve, which may result in early resistance and the need for substantial user training.

11 .CONCLUSION

Finally, the incorporation of a blockchain-based library management system represents a big step forward in the transformation of traditional library operations. Libraries can assure the security, openness, and efficiency of their book management systems by leveraging the potential of blockchain technology. The implementation of Ethereum smart contracts and decentralized data storage enables smooth and safe transactions, providing librarians and patrons with a reliable and user-friendly platform. Despite the potential difficulties and obstacles of implementing blockchain technologies, the benefits of greater data integrity, quicker transactions, and improved user experience highlight the worth of taking this creative approach. As the digital landscape evolves, embracing a blockchain-powered system paves the way for a more accessible, safe, and trustworthy library environment, laying the groundwork for a more accessible, secure, and trustworthy library environment.

12. FUTURE SCOPE

1. Integration of AI for personalized recommendations and data analysis.
2. Enhanced interoperability for seamless data exchange between libraries.
3. NFT implementation for rare collection authentication and trading.
4. Blockchain-based digital lending platforms for expanded digital offerings.
5. Advanced data privacy solutions for enhanced user data protection.

6. Integration with AR and VR for immersive learning experiences.

7. Blockchain-based publishing solutions for transparent royalty distribution and copyright management.

13.APPENDIX

13.1. Source Code

```
// SPDX-License-Identifier: MIT
```

```
pragma solidity ^0.8.0;
```

```
contract BookRegistry {
```

```
    address public owner;
```

```
    constructor() {
```

```
        owner = msg.sender;
```

```
    }
```

```
    modifier onlyOwner() {
```

```
        require(msg.sender == owner, "Only the owner can perform this action");
```

```
        _;
```

```
    }
```

```
    struct Book {
```

```
        string title;
```

```
        string author;
```

```
        address currentOwner;
```

```
}
```

```
mapping(uint256 => Book) public books;
```

```
uint256 public bookCount;
```

```
event BookAdded(uint256 indexed bookId, string title, string author, address indexed owner);
```

```
event OwnershipTransferred(uint256 indexed bookId, address indexed previousOwner,  
address indexed newOwner);
```

```
function addBook(uint256 registration, string memory _title, string memory _author)  
external onlyOwner {
```

```
    books[registration] = Book(_title, _author, owner);
```

```
    bookCount++;
```

```
    emit BookAdded(registration, _title, _author, owner);
```

```
}
```

```
function transferOwnership(uint256 registrationId, address _newOwner) external {
```

```
    require(_newOwner != address(0), "Invalid address");
```

```
    require(_newOwner != books[registrationId].currentOwner, "The new owner is the same as  
the current owner");
```

```
    require(msg.sender == books[registrationId].currentOwner, "Only the current owner can  
transfer ownership");
```

```
    address previousOwner = books[registrationId].currentOwner;
```

```
    books[registrationId].currentOwner = _newOwner;
```

```
        emit OwnershipTransferred(registrationId, previousOwner, _newOwner);
    }

    function getBookDetails(uint256 registrationId) external view returns (string memory, string
memory, address) {

        Book memory book = books[registrationId];

        return (book.title, book.author, book.currentOwner);
    }
}
```

13.2. GitHub link

<https://github.com/shre2003/Naan-mudhalvan>

Project Demo Link

https://drive.google.com/file/d/1YS-iUGlcYzTd9FIY3KKh-14VO7bEEdFm/view?usp=drive_link