LAND REGISTRY SYSTEM USING BLOCKCHAIN

PROJECT REPORT

Submitted By

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to

APJ Abdul Kalam Technological University

In partial fulfilment of the requirements for the award of Degree in

MASTER OF COMPUTER APPLICATIONS

DEPARTMENT OF COMPUTER APPLICATIONS

MOHANDAS COLLEGE OF ENGINEERING & TECHNOLOGY

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DEPARTMENT OF COMPUTER APPLICATIONS
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CERTIFICATE

This is to certify that the main project report entitled **"LAND REGISTRY SYSTEM USING BLOCKCHAIN"** submitted by **SHAHINA S S** (Registration number: **MCT21MCA- 2044**) to the **APJAbdul Kalam Technological University**, in partial fulfilment of the requirements for the award of the Degree of **Master of Computer Applications,** is a bonafide record of the project work carried out by her under my/our guidance and supervision. This report, in any form, has not been submitted to any other University or Institute for any purpose.

Internal Supervisor(s) **Project Coordinator**

Head of the Department **External Examiner**

DECLARATION

I undersigned hereby declare that the main project report for "**LAND REGISTRY SYSTEM USING BLOCKCHAIN**" submitted for partial fulfilment of the requirements for the award of the degree of Master of Computer Applications from APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under the supervision of **Prof. Dr. SAJITHA A V**. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources.

I also declare that I have adhered to academic honesty and integrity ethics and have not misrepresented or fabricated any data, idea, fact, or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and or the University and can also evoke penal action from the sources which have thus not been properly cited, or from whom proper permission has not been obtained. This report has not been previously formed as the basis for the award of any degree, diploma, or similar title of any other university.

Place: Trivandrum **Submitted by**

Date: **Shahina S S**

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I am overwhelmed in all humbleness and gratefulness to acknowledge in depth all those who have helped me to put these ideas, well above the level of simplicity into something concrete. I wouldlike to express my special thanks and gratitude to our principal **Dr. S. SHEELA** and our Director **Dr. ASHALATHA THAMPURAN** for providing all the necessary facilities.

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Shahina S S

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ABSTRACT

A land registry using blockchain is a decentralized and secure system for recording land ownership and transactions. It utilizes blockchain technology, which allows for transparent and immutable record-keeping, ensuring that all transactions are recorded accurately and cannot be tampered with. This abstract proposes the development of a land registry using blockchain, which would provide a more efficient, secure, and cost-effective method for recording land ownership and transactions. This system would allow for a streamlined process for land registration, eliminating the need for intermediaries and reducing the likelihood of fraud. The use of blockchain technology would provide increased transparency and security, ensuring that land ownership records are accurate and up-to-date. Additionally, the use of smart contracts would enable automatic execution of contractual obligations, further reducing transaction costs and increasing efficiency. The proposed land registry using blockchain has the potential to revolutionize the way we record land ownership and transactions, providing a more secure, efficient, and cost-effective method for all parties involved.

1. INTRODUCTION

1.1 ABOUT LAND REGISTRY SYSTEM USING BLOCKCHAIN

The traditional method of land registry and management is often fraught with inefficiencies, delays, and the potential for fraud. However, the emergence of blockchain technology has the potential to revolutionize the way land ownership and transactions are recorded, making the process more secure, efficient, and cost-effective.

A blockchain-based land registry system has the potential to streamline the process of land registration, eliminate intermediaries, and reduce the likelihood of fraudulent transactions. In this project, we propose the development of a land registry system based on blockchain technology, which would enable transparent and immutable record-keeping, making it easier to record and transfer ownership of land as analysed in Christiaan Lemmen's "Blockchain for Land Registry and Land Transactions".

The system would leverage the benefits of blockchain technology, such as decentralized control, transparency, and immutability, to ensure that land ownership records are accurate and tamper-proof. Furthermore, the use of smart contracts would allow for the automatic execution of contractual obligations, reducing transaction costs and increasing efficiency. The proposed blockchain-based land registry system has the potential to transform the way we manage land, making it more secure, efficient, and accessible to everyone.

1.2 OBJECTIVE

The main objectives of a land registry using blockchain are to provide a secure, decentralized, transparent, efficient, and accessible system for managing land ownership records. It aims to provide an easy-to-use and accessible platform that enables all user to register, verify, and transfer land ownership records securely and efficiently. Moreover, blockchain-based land registry systems have the potential to reduce transaction costs and streamline the process of transferring ownership rights. This can lead to a more efficient and reliable system that can provide greater access to land ownership rights for more people, particularly in developing countries where traditional land registry systems are often inadequate.

1.3 SCOPE

The scope of a land registry using blockchain is significant, offering a decentralized and secure system for managing land ownership records. With the use of blockchain technology, the system can provide immutable and tamper-proof records of land transactions, eliminating intermediaries, reducing costs, and increasing efficiency. The system's scope is extensive and covers various areas such as land registration, transactions, ownership records, dispute resolution, government services, and land management. The system can be customized to meet the specific needs of different stakeholders, making it a versatile solution for managing land ownership records. The land registry using blockchain has the potential to revolutionize the way we manage land, providing a more secure, efficient, and transparent platform for managing land ownership records.

1.4 EXISTING SYSTEM

A traditional land registry system is a method of recording and managing land ownership and transactions that has been used for centuries in many parts of the world. In this system, land ownership is recorded in paper documents that are stored in a central registry maintained by the government or a designated authority.

The traditional land registry system typically includes information such as the name of the owner, a description of the land and its boundaries, any mortgages or liens on the property, and any history of ownership transfers as mentioned in by Aldo de Pape‘s “Land Titling and Registration on the Blockchain” The information in the registry is considered legally binding and serves as proof of ownership.

However, this system has some limitations, such as the potential for errors in recording information and the lack of transparency and accessibility. In recent years, many countries have been transitioning to digital land registry systems, which aim to address these issues and provide more efficient and reliable management of land ownership and transactions.

1.4.1 LIMITATIONS

- **Technical expertise:** The adoption of blockchain technology requires technical expertise, and many governments and land registries may not have the necessary knowledge to implement and maintain the system.

- **High setup costs:** Implementing a blockchain-based land registry system requires significant upfront costs, including the development and deployment of the system, as well as the necessary infrastructure to support it.

- **Legal challenges:** There may be legal challenges associated with implementing a blockchain-based land registry system, particularly around issues of property ownership and transfer, and the legal recognition of digital signatures.

- **Privacy concerns:** While blockchain technology is secure, it is also transparent, and the public nature of the system may raise privacy concerns for individuals and organizations that do not want their land ownership information publicly available.

1.5 PROPOSED SYSTEM

A proposed system for land registry using blockchain would leverage the technology's key features to create a decentralized, secure, and transparent platform for managing land ownership and transfers. The system would use smart contracts to automate the process of recording land transactions, reducing the need for intermediaries and paperwork. The use of blockchain technology would create immutable and tamper-proof records of land ownership and transfers, ensuring accuracy and trustworthiness. To ensure the integrity of the information added to the blockchain, the system would use verification processes such as digital signatures. The proposed system would also be accessible to all parties involved in a land transaction, including buyers, sellers, and government agencies, improving transparency and efficiency. Overall, the proposed system for land registry using blockchain would offer a more efficient, transparent, and secure platform for managing land ownership and transfers.

1.5.1 ADVANTAGES

The use of blockchain technology in a land registry system offers several advantages over traditional centralized systems. Here are some of the key advantages of the proposed work:

- **Security and immutability:** The decentralized and distributed nature of blockchain technology ensures that data recorded on the blockchain is immutable and tamper-proof. This means that the land registry system is less susceptible to fraud, corruption, and hacking, providing a more secure and reliable way to record and manage land ownership rights.

- **Transparency:** Blockchain technology offers complete transparency, making it easy to trace ownership and transaction history. This can help prevent disputes and provide greater transparency in land ownership rights.

- **Efficiency and cost savings:** Blockchain technology can help streamline the process of transferring ownership rights, reducing the need for intermediaries and paperwork. This can lead to significant cost savings and make the land registry system more efficient.

- **Accessibility:** Blockchain-based land registry systems can provide greater access to land ownership rights, particularly in developing countries where traditional land registry systems may be inadequate. This can help provide greater economic and social empowerment to communities.

Overall, the use of blockchain technology in a land registry system offers several advantages that can make the system more secure, transparent, efficient, and accessible to all stakeholders involved.

2. METHODOLOGY

2.1 AGILE METHODOLOGY

For my final year academic project, I implemented Agile methodology to manage the development of a Land registry system using blockchain. Agile methodology is a project management framework thatemphasizes flexibility, collaboration, and continuous improvement. This report describes the process of implementing Agile in my project and discuss the benefits, challenges, and lessons learned. Agile teams work in short cycles called sprints, with each sprint delivering a working increment of the project.

2.2 ROLES

For my final year academic project on Land registry system using blockchain, I decided to implement Agile methodology to ensure that I could work efficiently and effectively. Since I was working alone, Iadapted the roles of the team members to fit my needs.

Head of Department, Prof Sreeja K, acted as my designated Scrum master, helped to facilitate meetings and ensure that I followed the Scrum framework.

Prof. Dr. Sajitha A V, served as my product owner, providing guidance on the project goals and priorities.

2.3 IMPLEMENTATION

To begin, I defined the product vision for my Land registry system using blockchain project, which was to createa secure, user-friendly platform for peer-to-peer trading of digital assets without the need for intermediaries. Then, I created a product backlog by identifying the features and functionalities required for the platform. This included user registration and authentication, land selling and buying, transaction history and reporting.

Next, I planned the sprints based on the time required for each task in the product backlog. For example, the first sprint focused on user registration and authentication, while the second sprint focused developing front end. During each sprint, I worked on the tasks identified in the product backlog and held daily stand-up meetings to track progress and identify any obstaclesthat needed to be addressed.

At the end of each sprint, I conducted a sprint review to evaluate the progress made and identify any areas for improvement. For example, the front end connected to the blockchain feature was not working as intended, I identified the root cause of the issue and made necessary adjustments. I also held a sprint retrospective to reflect on the development process and identify ways to improve for the next sprint. For example, if I realized that I spent too much time on a particular task, I adjusted the sprint planning accordingly to better allocate time for the remaining tasks.

One of the key benefits of implementing Agile methodology in a solo project is that it can help you stay organized and on track. By breaking your project down into smaller, manageable sprints, you can focus on one task at a time and avoid feeling overwhelmed. Additionally, holding daily stand-up meetings can help you stay accountable and motivated, as you'll have to report on your progress and identify any obstacles that need to be addressed.

Another major benefit of implementing Agile methodology in a Land registry system using blockchain project is that it allows you to be flexible and adapt to changes in your project requirements. For example,if I realized that a particular feature was taking longer than expected to implement, I could adjustmy sprint planning to better allocate time for that feature. This allowed me to remain agile and ensure that I was delivering the most value to my users.

Another important aspect of implementing Agile methodology is adapting it to fit your specific needs and constraints. For example, as a solo developer, you may need to adjust the length of your sprints or the number of tasks you tackle in each sprint. You may also need to adjust your approach to accommodate any unexpected challenges or changes in your project requirements.

Overall, implementing Agile methodology in my project was a valuableexperience that allowed me to work efficiently and effectively. By following the Agile framework, I was able to continuously improve my development process and achieve my project goals.

2.4 PRODUCT BACKLOG

ID	As a…	I want to be able to…	So that	Priority	Remarks
1	Developer	Creates a user interface	User can interact with the latform	Very High	
2	Developer	Creates a smart contract for secure transactions	User can secure their payments	Very High	
3	Seller	Enter the details	User can register to the website	Very High	
4	Seller	Redirected to the seller dashboard	User can view his dashboard	Very High	
5	Seller	Enter the details	Can register to the website	Very High	
6	Buyer	Redirected to the buyer dashboard	User can view his dashboard	Very High	
7	Land Inspector	Verify buyers profile	Land inspector can verify the genuinity of the buyer	High	
8	Buyer	Request for land	Buyer can buy the land after the aproval from seller	Very High	
9	Land inspector verify the seller	Verify the seller profile	Land inspector can verify the genuinity of the seller	High	
10	Seller	Post the land details as add	Buyer can view and request for land	Very High	

ID	As a…	I want to be able to…	So that	Priority	Remarks
11	Seller	Approve the land request	Buyer can buy the land from seller	High	
12	Buyer can make the payment to seller	Make payment to the seller	Land inspector can arove the transaction	High	
13	Seller	View the land which sold is disappear from the sellers dashboard	Buyer can own the land	Very High	
14	Buyer	View the seller profile	Buyer can check weather the seller is genuine or not	Very High	
15	Seller	View the seller profile	Seller can check weather the buyer is genuine or not	Very High	
16	Buyer	Can request for more photos	Buyer can check for more land details	High	
17	Buyer	Can request for location	Buyer can check for more land details	High	
18	Buyer	Can view the legal documents	Buyer can check for more genuinity	High	
19	Land inspector	Can view sellers profile	Land inspector can check for more genuinity	High	
20	Land inspector can view the buyer profile	Can view buyers profile	Land inspector can check for more genuinity	High	

2.5 SPRINT BACKLOG

Sl.No.	USER STORY	NOT STARTED	IN PROGRESS	COMPLETED
1	Creating development environment	20/02/2023	25/02/2023	Completed
2	Downloading the required Assets	25/02/2023	25/02/2023	Completed
3	Search for the algorithms	25/02/2023	25/02/2023	Completed
4	Code for hashing	27/02/2023		Completed
5	Implement initial versions of smartcontracts	27/02/2023	01/03/2023	Completed
6	UI design	02/03/2023	05/03/2023	Completed
7	Learn about blockchain technology	06/03/2023	08/03/2023	Completed
8	Developed profile page for buyer seller and land inspector	10/03/2023	12/03/2023	Completed
9	Source code for blockchain	12/03/2023	12/03/2023	Completed
10	Connecting blockchain to front end	16/03/2023	20/03/2023	Completed
11	Testing and review	20/03/2023	21/03/2023	Completed
13	Web integration and Development	21/03/2023	25/03/2023	Completed
14	Documentation	25/03/2023	27/03/2023	Completed

2.6 FEASIBILITY STUDY

A feasibility study is a preliminary investigation or analysis conducted to evaluate the practicality, viability, and potential success of a proposed project or idea. It is typically conducted at the beginning of a project to determine if it is worthwhile, given the resources, time, and effort requiredto complete it. The main purpose of a feasibility study is to assess the technical, economic, social,and environmental aspects of a proposed project, and to identify any potential issues, risks, or challenges that may affect its success. This analysis includes gathering and evaluating data, determining project requirements, defining objectives, assessing potential benefits and drawbacks,analyzing the market, and estimating costs and financial returns A feasibility study for implementing a land registry using blockchain technology would involve assessing the technical, financial, legal, and operational aspects of the project. Here are some key considerations to keep in mind:

- Technical feasibility
- Financial feasibility
- Legal feasibility
- Operational feasibility

2.6.1 TECHNICAL FEASIBILITY

Determine the blockchain platform that will be used for the project, and assess its suitability for the requirements of the land registry. Consider the scalability, security, and performance of the blockchain platform to ensure that it can handle the expected volume of transactions and data.

- **Blockchain Infrastructure:** The blockchain infrastructure should be carefully designed and configured to ensure that it is secure, scalable, and fault-tolerant. This involves choosing the right blockchain platform, consensus algorithm, and network architecture based on the specific needs of the land registry system.

- **Smart Contract Development:** Smart contracts are self-executing computer programs that can automate the execution of contracts and agreements on the blockchain. Developing smart contracts for the land registry system requires expertise in blockchain development, programming, and contract law.

- **Data Standardization:** To ensure interoperability and data consistency, the land registry

system should use standard data formats, protocols, and APIs. This can help facilitate data sharing and integration with other systems and applications.

- **Data Security:** The land registry system should be designed to ensure that data is secure, encrypted, and tamper-proof. This involves implementing secure access controls, encryption, and cryptographic algorithms to protect sensitive data.

- **System Integration:** The land registry system should be integrated with other systems and applications such as property tax systems, GIS systems, and property management systems. This can help ensure that data is consistent and up-to-date across all systems.

- **User Experience:** The land registry system should be designed to be user-friendly and accessible to all stakeholders, including property owners, buyers, sellers, and government officials. This can help ensure that the system is widely adopted and used effectively.

- **Governance:** The land registry system should have a clear governance structure that outlines roles, responsibilities, and decision-making processes. This can help ensure that the system is managed effectively and transparently, and that issues such as disputes and data quality are resolved in a timely and fair manner.

2.6.2 FINANCIAL FEASIBILITY

Estimate the costs associated with developing and implementing the blockchain-based land registry. Determine the sources of funding, such as government grants or private investors, and assess the financial viability of the project.

- **Development Costs:** Developing a blockchain-based land registry system can be expensive, requiring specialized skills and expertise in blockchain development, smart contract programming, and data management. The cost of developing the system should be carefully estimated and budgeted for.

- **Infrastructure Costs:** In addition to development costs, the land registry system will require ongoing infrastructure costs for hosting and maintaining the blockchain network, including hardware, software, and network costs.

- **Integration Costs:** Integrating the blockchain-based land registry system with other systems and applications can also be costly, requiring additional development, testing, and deployment efforts.

- **User Adoption:** The success of the land registry system depends on user adoption, including property owners, buyers, sellers, and government officials. Promoting user adoption can require additional marketing, training, and support costs.

2.6.3 LEGAL FEASIBILITY

Analyze the legal requirements and regulations that govern land registry systems, and ensure that the blockchain-based system meets these requirements.Consider the legal implications of using blockchain technology, such as data privacy, security, and ownership.

- **Compliance with Legal Framework:** The land registry system should comply with the legal framework of the jurisdiction in which it operates. This involves understanding the legal requirements for property registration, land ownership, and transfer of title, and ensuring that the blockchain-based system meets those requirements.

- **Legal Recognition:** The land registry system should be recognized and accepted as a legally valid system for property registration and transfer of title. This may require legislative or regulatory changes to recognize blockchain-based systems as a valid method of property registration.

- **Privacy and Data Protection:** The land registry system should comply with privacy and data protection laws, including regulations related to personal data protection, data retention, and data sharing.

- **Security and Fraud Prevention:** The land registry system should be designed to prevent fraud

and ensure the integrity of the data stored on the blockchain. This involves implementing secure access controls, encryption, and cryptographic algorithms to protect sensitive data and prevent unauthorized access.

2.6.4 OPERATIONAL FEASIBILITY

Assess the organizational structure and processes needed to support the blockchain-based land registry. Identify potential challenges and risks associated with the adoption of blockchain technology, such as resistance from stakeholders or lack of technical expertise.

- **User Adoption:** The success of the land registry system depends on user adoption, including property owners, buyers, sellers, and government officials. Ensuring that the system is easy to use, user-friendly, and meets the needs of its users is critical to its success.

- **System Scalability:** The land registry system should be designed to accommodate large volumes of data and transactions. This involves ensuring that the system can handle the expected number of users, transactions, and data without compromising performance.

- **System Reliability:** The land registry system should be reliable, with minimal downtime and disruption. This involves ensuring that the system is designed with fault-tolerant architecture, redundancy, and backup mechanisms.

- **System Security:** The land registry system should be secure, with appropriate access controls, encryption, and cryptographic algorithms to protect sensitive data and prevent unauthorized access.

- **Interoperability:** The land registry system should be designed to work with other systems and applications, including legacy systems, to ensure seamless integration and data exchange.

3. REQUIREMENT SPECIFICATION

3.1 HARDWARE REQUIREMENTS

Processor	:	Intel(R) Core(TM) i3-1005G1 CPU @ 1.20GHz 1.19 GHz
RAM	:	2 GB or Above
Hard Disk	:	512 GB or Above
Internet	:	4Mbps or above (Wired or Wireless)
Display	:	15.5” Color Monitor
Screen Resolution	:	1366 x 768 x 60 Hz
Color Palette	:	True Color (32 bit)
Keyboard	:	PC/AT enhanced type
Mouse	:	Zenronics Zeb-Transformer-M Optical/HID

3.2 SOFTWARE REQUIREMENTS

Operating System	:	Any OS capable of running a browser (Mac, Windows, Linux)
Front-end	:	HTML 5
Back-end	:	Blockchain
Libraries	:	Flask, SQLite, Hash
Language	:	Python
IDEs	:	VS-Code
Hosting	:	FLASK

HTML 5

In a land registry system using blockchain, HTML5 can be a valuable tool for developing the user interface and frontend of the system. HTML5 can be used to design the layout, forms, and navigation menus of the system, providing features such as video, audio, and animations to enhance the user experience. HTML5 can also be used to develop a responsive design for the system, ensuring that it is accessible and user-friendly on different devices.

HTML5 can help prevent errors and ensure data accuracy by validating input data entered by users

in the land registry system. The features of HTML5 such as local storage and session storage can also be used to store data offline, ensuring that the system is accessible even when there is no internet connection.

Moreover, HTML5 can be used to integrate the frontend of the land registry system with the blockchain backend. This can involve using web3.js libraries to interact with the blockchain and display data stored in the blockchain. Interactive data visualizations for the land registry system can also be developed using HTML5 canvas and other visualization libraries.

Overall, using HTML5 in a land registry system using blockchain can enhance the user experience, improve data quality, increase functionality, and enable seamless integration with the blockchain. By leveraging the features of HTML5, developers can create a user-friendly and efficient system that meets the needs of its users.

PYTHON

Python is a popular programming language for developing land registry systems using blockchain due to several reasons. Python is known for its simplicity, readability, versatility, and a large community of developers, which makes it an excellent choice for building blockchain-based land registry systems. Here are some of the main reasons why Python is used for developing land registry systems using blockchain:

Easy to Code: Python has a simple and easy-to-understand syntax, making it an excellent choice for new developers who want to get started with blockchain development. It is also easy to read and understand, making it easier for developers to collaborate with each other.

Large Community: Python has a large and active community of developers, which means that there are plenty of resources, tutorials, and forums available for developers who need help or support. The community also regularly contributes to the development of libraries and tools that can be used in blockchain-based land registry systems.

Versatility: Python is a versatile language that can be used for a wide range of applications, including blockchain development. It can be used to develop smart contracts, create web applications, and build user interfaces. This versatility makes it an excellent choice for developing land registry systems that require a range of features and functionalities

Availability of Libraries and Tools: Python has a rich set of libraries and tools that can be used for blockchain development. These include libraries for working with blockchain platforms like Ethereum, web frameworks like Flask and Django, and data analysis libraries like Pandas and NumPy. This makes it easy for developers to create robust and efficient land registry systems using blockchain.

Overall, Python is a popular choice for developing land registry systems using blockchain due to its simplicity, readability, versatility, large community, and availability of libraries and tools.

BLOCKCHAIN

Blockchain technology can have a significant impact on the land registry system by providing a secure, transparent, and decentralized platform for recording and managing land ownership information. By using blockchain technology, land registry systems can become more efficient, accessible, and reliable.

One of the main benefits of blockchain technology in the land registry system is the security and immutability it provides. The cryptographic techniques used in blockchain can create a tamper-proof record of land ownership that cannot be altered or deleted, ensuring the authenticity and accuracy of the data.

Transparency is another key advantage of blockchain technology in the land registry system. Using a distributed ledger system, all transactions related to land ownership can be recorded and stored in a transparent and decentralized manner, reducing the risk of fraud and corruption.

Furthermore, blockchain technology can increase the efficiency of land registry systems by automating many of the tasks involved in transferring land ownership. Smart contracts can be used to verify title, record ownership changes, and release funds, reducing the need for intermediaries such as lawyers, notaries, and government officials.

Blockchain technology can also increase the accessibility of land registry data by using a decentralized network, allowing land ownership data to be accessed from anywhere in the world. This can make it easier for individuals and businesses to buy, sell, and transfer land ownership. Blockchain technology can provide a secure and transparent platform for resolving land ownership

disputes. By using blockchain technology, the process of resolving disputes can become more efficient, transparent, and trustworthy.

In summary, blockchain technology has the potential to transform the land registry system by providing a secure, transparent, and efficient platform for recording and managing land ownership information. By leveraging the benefits of blockchain, land registry systems can become more accessible, reliable, and trustworthy for all parties involved.

FLASK

Flask is a lightweight and flexible Python web framework that can be used to develop web applications, including land registry systems using blockchain. Flask provides a variety of features that can make it easier to develop and deploy a blockchain-based land registry system.

One of the main advantages of using Flask in a land registry system is its flexibility. Flask allows developers to build custom web applications quickly and efficiently by providing a range of tools and libraries to help with common web development tasks such as routing, templating, and database integration.

Flask is also well-suited for developing blockchain-based applications because of its support for RESTful APIs. RESTful APIs are a popular way to build decentralized applications that interact with blockchain networks. Flask makes it easy to build APIs that can interact with blockchain nodes and smart contracts, allowing developers to create a seamless integration between the frontend and backend of the land registry system.

Another advantage of using Flask in a land registry system is its support for testing and debugging. Flask provides a built-in testing framework that makes it easy to test individual components of the land registry system, ensuring that the system functions correctly and is free of bugs.

Finally, Flask can help with deploying a land registry system using blockchain. Flask can be easily integrated with cloud hosting platforms such as Heroku, making it easy to deploy and scale the system to meet the needs of its users.

In summary, Flask is a powerful tool for developing land registry systems using blockchain. Its flexibility, support for RESTful APIs, testing and debugging tools, and ease of deployment make it a valuable tool for building secure, efficient, and user-friendly blockchain-based land registry systems.

SQLite

SQLite is a popular choice for land registry systems using blockchain because of its lightweight and efficient database management system. It is a simple and fast system that is easy to use, making it ideal for use in blockchain-based applications. SQLite can be used to store and manage data related to land ownership, transactions, and other relevant details.

One of the main advantages of using SQLite in a land registry system is its ability to integrate with blockchain technology. SQLite can be used to store data in a decentralized and secure manner, providing an additional layer of security and immutability to the land registry system. By storing data on the blockchain using SQLite, all information is recorded in a tamper-proof ledger, ensuring the authenticity and accuracy of the data.

SQLite can also be used to query and retrieve data from the database. Developers can use SQL queries to extract data from the database and perform various tasks such as verifying land ownership, recording transactions, and resolving disputes. The flexibility and versatility of SQLite make it a popular choice for developers working on blockchain-based land registry systems.

Furthermore, SQLite can be easily integrated with other programming languages such as Python, making it easy to develop applications that interact with the database. This allows developers to create custom applications that can perform specific tasks related to the land registry system.

Overall, SQLite is a powerful tool for developing land registry systems using blockchain. Its ability to integrate with blockchain technology, its flexibility and versatility, and its ease of use make it a popular choice for developers working on blockchain-based applications.

HASH

Hash libraries are an essential component of land registry systems using blockchain. A hash function is a mathematical algorithm that can take any input data and generate a fixed-size, unique output. The output generated by a hash function is commonly known as a hash.

In a land registry system using blockchain, hash libraries can be used in various ways. One of the main uses of hash libraries is to generate a unique identifier for every transaction or block in the blockchain. This unique identifier is then stored in the blockchain, making it easy to verify the

authenticity and integrity of the data.

Hash libraries can also be used to provide an additional layer of security to the land registry system. When data is entered into the system, it can be hashed to generate a unique identifier. This identifier is then stored on the blockchain, ensuring that the data is not tampered with or modified in any way.

In addition, hash libraries can be used to perform efficient searches of data in the blockchain. By hashing the data, developers can quickly search for and retrieve specific records from the blockchain without having to search through the entire ledger.

Furthermore, hash libraries can also be used to protect sensitive information in the land registry system. By hashing sensitive data such as personal identification numbers, social security numbers, and other sensitive information, developers can ensure that this data is not exposed to unauthorized parties.Overall, hash libraries are a critical component of land registry systems using blockchain. They provide an additional layer of security, help to ensure the authenticity and integrity of the data, and facilitate efficient searches of data in the blockchain.

VS-Code

Visual Studio Code, commonly referred to as VS-Code, is an open-source and cross-platform code editor that is widely used for developing land registry systems using blockchain. This editor supports a variety of programming languages, including Python, which is commonly used in blockchain development.

One of the primary advantages of using VS-Code for developing land registry systems is its lightweight and fast nature. VS-Code provides a range of features and extensions that make it suitable for developing complex blockchain-based land registry systems. The editor also integrates with Git, which is a popular version control system used in blockchain development. This integration allows developers to easily manage and collaborate on code with other team members.

VS-Code also has a rich set of extensions available in its marketplace, including extensions for Python, Solidity, and other blockchain-related languages. These extensions provide additional features and functionalities that can make development more efficient and streamlined. The IntelliSense feature of VS-Code provides intelligent code completion, making it easier for developers to write code quickly and efficiently.

Overall, VS-Code is a popular choice for developing land registry systems using blockchain due to its cross-platform support, lightweight nature, integration with Git, rich set of extensions, and IntelliSense feature. These features make it a versatile and efficient tool for developing blockchain-based land registry systems.

3.3 FUNCTIONAL REQUIREMENTS

Contains three modules Swap and Liquidity Pool.

Seller Module

FN 1 : Registration.

Seller can register to the website.

FN 2 : Seller redirected to the dashboard.
After the login seller redirected to the sellers dashboard.

FN 3 : Seller add the land details.

Seller can add the details of the land he wants to sell.

FN 4 : Land approval.

Seller can approve or reject the land request send by the buyer.

FN 5: View profile.

Seller can view buyers profile.

Buyer Module

FN 1 : Registration.

Buyer can register to the website.

FN 2 : Buyer redirected to the dashboard.
After the login buyer redirected to the sellers dashboard.

FN 3 : Request for land.

Buyer can able to send request for a land.

FN 4 : Payment to seller.

Buyer can able to make payment to seller.

FN 5 : Request for legal documents.

Buyer can able to request for legal documents of the land.

FN 6: View profile.

Buyer can view sellers profile.

Land inspector Module

FN 1 : Registration.

Land inspector can register to the website.

FN 2 : Verify the user profile.

Land inspector can verify the seller and buyer profile.

FN 3 : View profile.

Land inspector can view sellers and buyers profile.

FN 4 : Approve the land registration.

Land inspector approves the land registration to the new owner after the verifications.

3.4 NON-FUNCTIONAL REQUIREMENTS

- Data security
- Data Privacy
- Scalability
- Performance

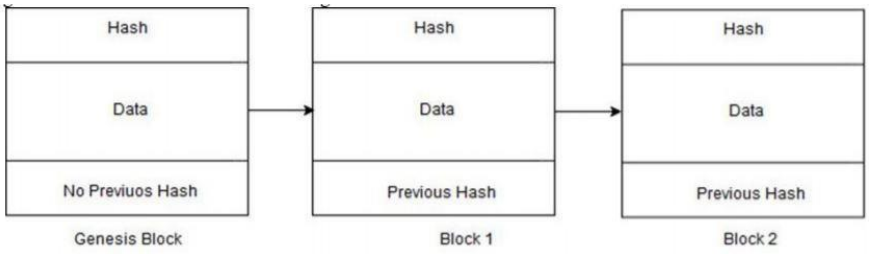
4. TECHNOLOGY

4.1 OVERVIEW

A land registry system using blockchain technology involves several different components that work together to create a secure, transparent, and decentralized platform for managing land ownership and transactions. Here is an overview of the technology used in a land registry system using blockchain:

4.2 BLOCKCHAIN

The blockchain is originally originated from Bitcoin, invented by unknown people even though some claims that it was developed by Satoshi Nakamoto. The Blockchain is a list of continuously growing records called blocks. Each Block is linked to each other and they were secured using cryptography. Blockchain has the characteristics of integrity, decentralization, Immutability, Security, Anonymity.



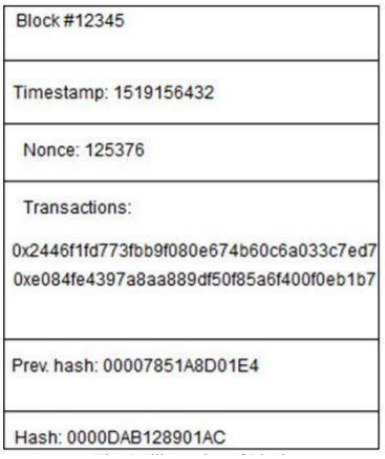


Figure 1: illustration of blockchain

4.3 PEER TO PEER

The very important part of how blockchain works are based on Peer to Peer (P2P) system. The whole blockchain is connected to all the node in the network. This means information stored on blockchain cannot be lost or destroyed, to do so have to destroy every single node on the network and that is impossible.

4.4 ALGORITHM

CONSENSUS PROTOCOL

Consensus protocol is a key component of a blockchain-based land registry system. Consensus refers to the process of achieving agreement among network participants on the state of the blockchain ledger. In other words, it is a mechanism that ensures all nodes in the network agree on the validity of a new transaction before it is added to the blockchain.In a land registry system using blockchain, the consensus protocol ensures that all parties involved in a land transaction agree on the ownership and transfer of the land. The consensus protocol is essential to maintain the integrity of the land registry system and prevent fraudulent activities.There are several consensus protocols used in blockchain-based land registry systems, including Proof of Work (PoW), Proof of Stake (PoS), and Delegated Proof of Stake (DPoS). Each consensus protocol has its advantages and disadvantages and is chosen based on the specific requirements of the land registry system.

In summary, the consensus protocol is a critical component of a blockchain-based land registry system that ensures all network participants agree on the validity of new transactions before they are added to the blockchain. The specific consensus protocol used in a land registry system depends on its requirements and can vary between different implementations.

PROOF OF WORK

Proof of Work (PoW) is one of the consensus protocols used in blockchain-based land registry systems. In PoW, network participants must solve a complex mathematical problem to add a new block to the blockchain. This process is known as mining, and participants who solve the problem first are rewarded with cryptocurrency.

In a land registry system using PoW, miners would validate and add new land transactions to the blockchain by solving complex mathematical problems. The transactions would then be added to

the blockchain as a new block, which would be linked to the previous blocks in the chain. Each block contains a unique code called a hash, which is used to verify its authenticity.

One of the advantages of PoW is its security. It is extremely difficult and resource-intensive to solve the mathematical problems required to add a new block to the blockchain, making it difficult for malicious actors to manipulate the system. However, the downside of PoW is that it is energy-intensive and requires a lot of computational power, which can result in high transaction fees and slow transaction processing times.

Overall, while PoW is a secure consensus protocol for a land registry system using blockchain, it may not be the most practical solution due to its energy consumption and scalability issues. Other consensus protocols, such as Proof of Stake (PoS) or Delegated Proof of Stake (DPoS), may be more suitable for land registry systems, depending on their specific requirements.

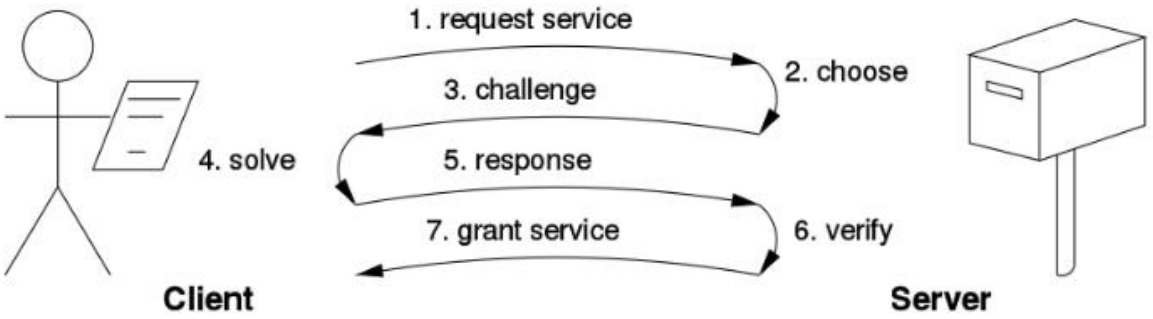


Figure 2 : proof of work

SMART CONTRACT

Smart contracts are a key feature of a blockchain-based land registry system. A smart contract is a self-executing computer program that automatically executes the terms of an agreement between parties once certain conditions are met. In a land registry system, smart contracts can be used to automate the transfer of land ownership, simplify the process of recording land transactions, and reduce the need for intermediaries.

In a land registry system using blockchain, a smart contract would contain the terms of the land transaction, including the transfer of ownership and the conditions that must be met before the transaction is executed. The smart contract would be stored on the blockchain and automatically executed once the conditions are met, such as the transfer of funds or the verification of the title deed.

Smart contracts can help reduce the risk of fraud and errors in a land registry system by automating the process of verifying and executing transactions. They can also reduce the need for intermediaries, such as lawyers or notaries, which can reduce the cost and time required to complete land transactions.

However, the use of smart contracts in a land registry system also has limitations. Smart contracts are only as reliable as the code that they are written in, and errors or bugs in the code can lead to unintended consequences. Additionally, smart contracts may not be suitable for complex land transactions that require human judgment and discretion.

Overall, smart contracts are a useful tool in a blockchain-based land registry system that can simplify and automate the process of recording land transactions. However, they should be used in conjunction with other measures, such as legal frameworks and human oversight, to ensure the integrity and reliability of the system.

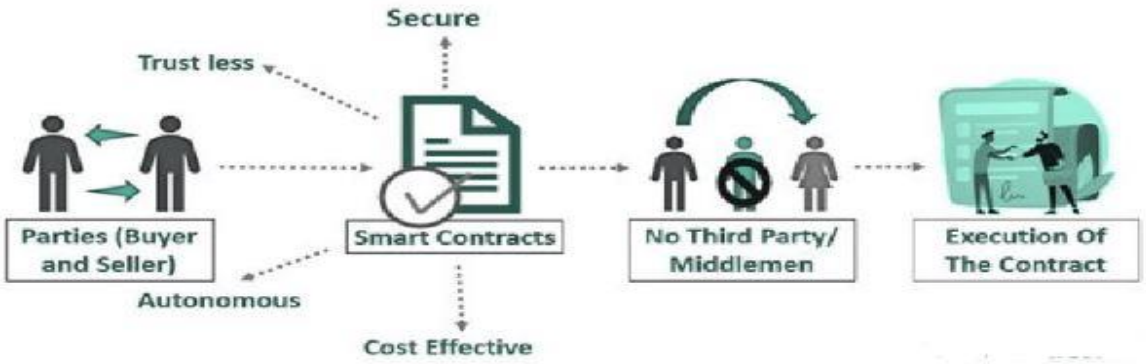
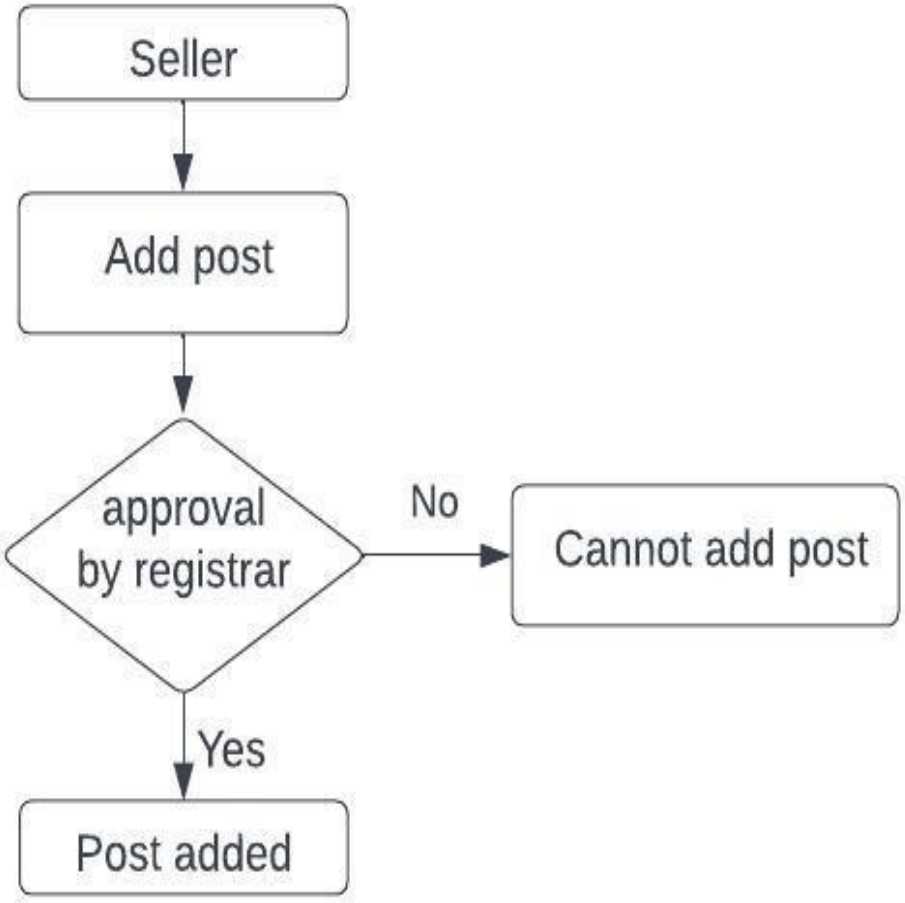


Figure 3: How smart contract works

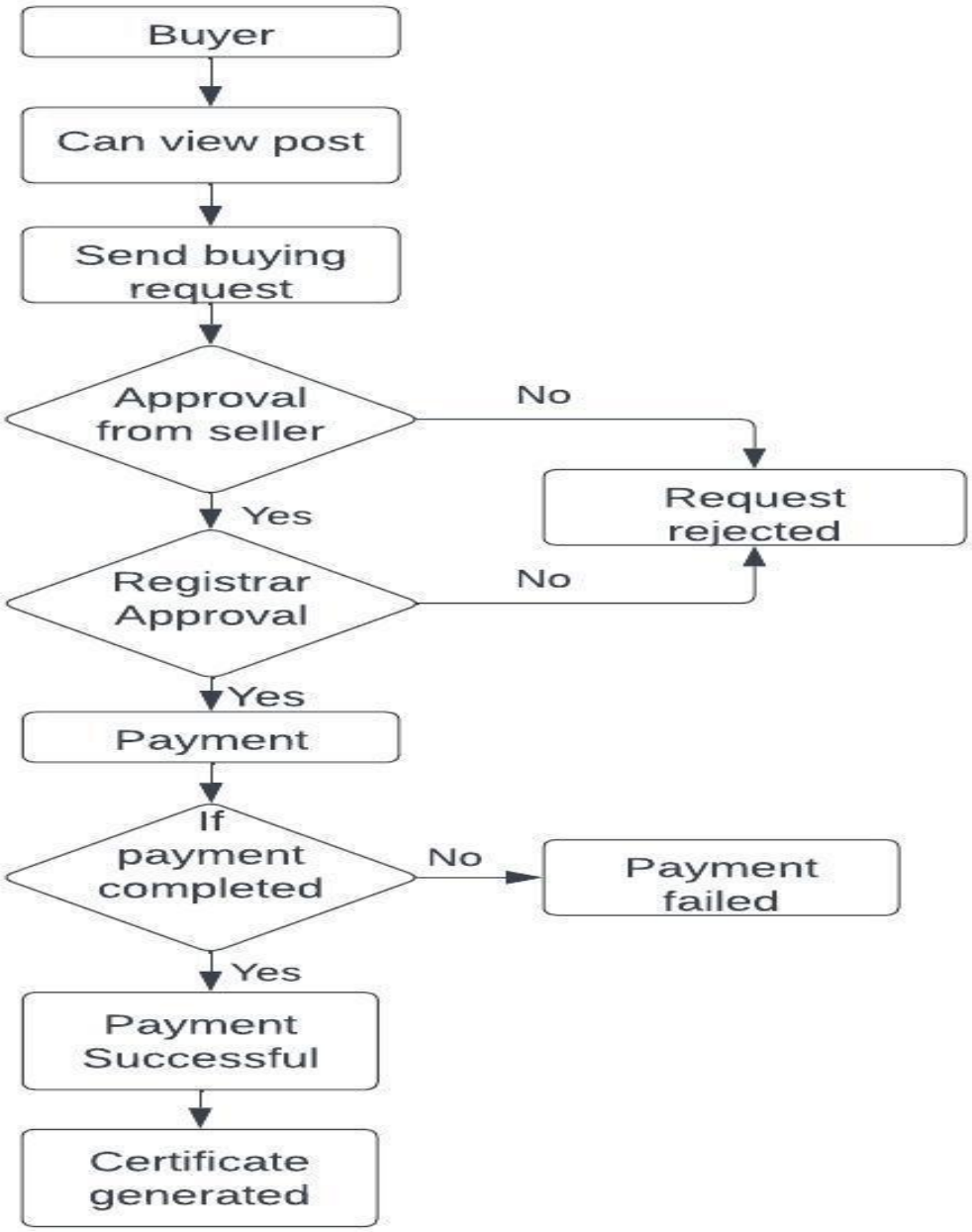
5. SYSTEM DESIGN

5.1 WORK FLOW ARCHITECTURE

FLOWCHART FOR SELLER



FLOWCHART FOR BUYER



5.2 MAJOR FUNCTIONALITY

A land registry system using blockchain technology can provide a secure, transparent, and tamper-proof record of land ownership and transactions. Here are some major functionalities of such a system:

Land registration: The land registry system can be used to register land titles and record ownership details. The blockchain technology ensures that the data is immutable and tamper-proof, thus reducing the possibility of fraud and disputes.

Land transfers: The system can facilitate the transfer of land between buyers and sellers. Once a transfer is recorded on the blockchain, it cannot be altered or deleted, providing an unalterable record of the transaction.

Smart contracts: The use of smart contracts can automate the execution of property transfers and streamline the process of buying and selling land. Smart contracts can be programmed to automatically transfer ownership when certain conditions are met, such as the payment of the purchase price.

Verification of ownership: The land registry system can provide a means to verify ownership of land, thus reducing the risk of multiple claims on the same property.

Dispute resolution: In case of any disputes related to land ownership, the blockchain-based system can provide a transparent and auditable record of all transactions related to the property, making it easier to resolve disputes.

Overall, a land registry system using blockchain technology can provide greater transparency, security, and efficiency in managing land ownership and transactions.

6. SYSTEM TESTING

6.1 TEST CASE

Test case is a document that describes an input, action, or event and an expected response to determine if a feature of an application is working correctly. A test case should contain particulars such as test case identifiers, test case, name, objectives, test conditions, input data requirements steps and expected results.

6.1.1 USER TEST CASE

Sl.No.	TEST CASE	USER	RESULT
1	User register to the website	Click on sign in button to register to the website by enetreing usre details	User register to the website.
2	User login to the website	Click on login button to login to the user profile by entering username and password	User redirected to the dashboard
3	User can edit profile	User can edit profile by clicking edit profile button	Display the edited details
4	Seller can view his adds	Seller can view his add by clicking my adds button	Seller redirected to his Add page
5	Seller can view his enquiry page	Click on “Enquiry” button to view enquiry page	User can see his enquiry page
6	Seller can reject or accept the land request	Seller can reject or accept the land request by clicking reject or accept button	The land request send by the buyer will be either accepted or rejected
7	Buyer can view Add posted by seller	After login Buyer redirected to add page	Buyer can view Adds posted by seller
8	Buyer can request for the land	Buyer can request for the land which he is interested	Request send to seller

9	Registrar accept the transaction	Registrar can be accept or reject the transaction, once he is accepted by clicking accept the button.	The transaction is added to blockchain

6.2 SYSTEM MAINTENANCE

Maintaining a land registry system using blockchain involves several steps to ensure the system is secure, efficient, and effective. Here are some steps that can be taken:

Regular software updates: Ensure that the blockchain software used for the land registry system is kept up-to-date with the latest security patches and features. This will help to prevent security breaches and other issues that could impact the system's performance.

Backups and disaster recovery plans: Have regular backups of the system data to avoid any data loss or corruption. Additionally, create a disaster recovery plan in case of any unforeseen circumstances, such as natural disasters, that could cause damage to the system.

Continuous monitoring: Keep a close eye on the system to detect any abnormal behavior, such as suspicious transactions or unusual network traffic, that could indicate a security breach or other issues. Use tools like intrusion detection systems and security information and event management (SIEM) to aid in monitoring.

Regular system audits: Conduct regular audits to ensure that the system is functioning properly and meeting the required security standards. This could involve penetration testing, vulnerability assessments, and other security tests.

Training and awareness: Provide regular training and awareness to system users on how to use the system securely and avoid any potential security risks. This could include things like strong password policies, two-factor authentication, and data protection guidelines.

6.2.1 MAINTENANCE SCHEDULE

- Regular maintenance activities will be scheduled and communicated to the team, with clear timelines and responsibilities assigned.
- Ad-hoc maintenance activities will be addressed on a case-by-case basis, with the issue triage process followed to prioritize and resolve them.

6.2.2 IMPLEMENTATION PLAN

MAINTENANCE TASK	FREQUENCY	RESPONSIBLE PARTY
Test and verify smart contract functionality	Monthly	Developer
Monitor system logs and error messages	Daily	System Admin
Regularly update smart contracts	Quarterly	Developer
Backup blockchain data and system logs	Weekly	System Admin
Monitor transaction fees and gas prices	Daily	System Admin
Monitor network security and vulnerabilities	Daily	System Admin

Note: For this project, I was solely responsible for both development and system administration tasks.

7. CONCLUSION

In summary, a land registry system using blockchain technology offers a secure, transparent, and tamper-proof way of recording land ownership and transactions. By leveraging the benefits of blockchain, such as immutability, decentralization, and smart contracts, it can provide a more efficient, trustworthy, and accessible system for managing land ownership. While there may be challenges in implementing such a system, the potential benefits of reducing fraud, streamlining the buying and selling process, and providing an auditable record in case of disputes make it a promising area for further exploration and development. Overall, a blockchain-based land registry system has the potential to transform the way we manage land ownership and transactions, offering a more transparent and efficient solution for land registry management.

8. FUTURE ENHANCEMENT

There are several potential future enhancements that can be made to a land registry system using blockchain technology:

Integration with other systems: Integrating the land registry system with other relevant systems such as property tax and planning authorities can further enhance its functionality and streamline processes.

Interoperability: Developing standards for interoperability between different land registry systems can help create a more connected and efficient ecosystem for land ownership and management.

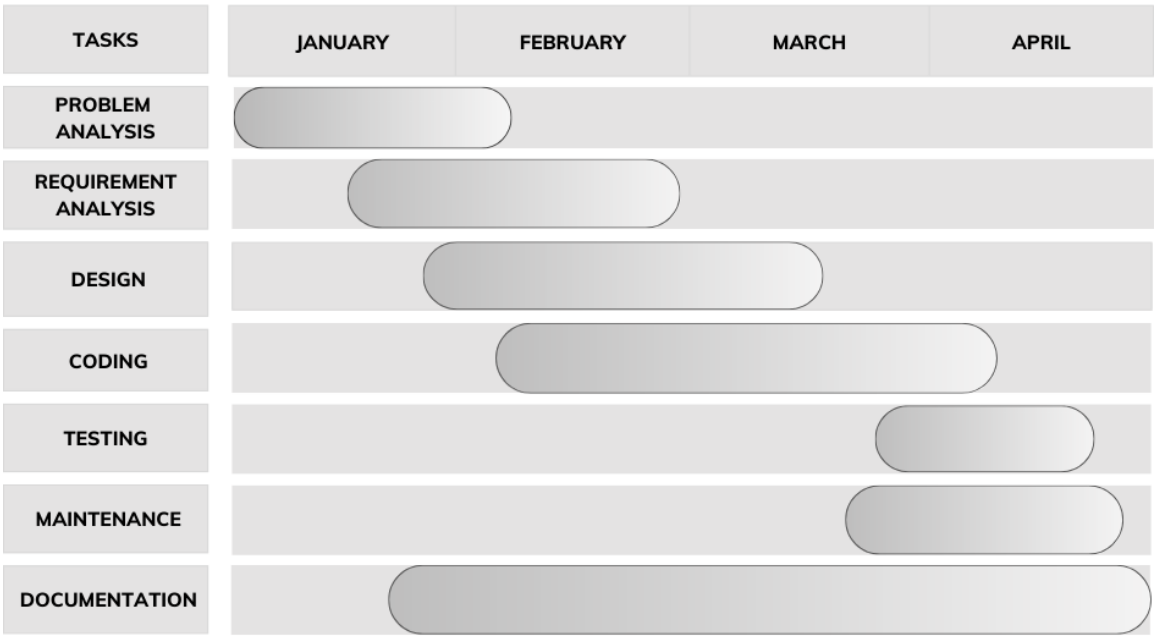
Expansion to other industries: The use of blockchain technology can be expanded to other industries beyond land registry, such as supply chain management and finance, to create a more interconnected and efficient ecosystem.

Use of Artificial Intelligence (AI): The use of AI can help automate processes such as identity verification and property valuation, further streamlining the land registry process.

Overall, the future of land registry systems using blockchain technology is promising, with many potential enhancements that can further improve their functionality, efficiency, and security. By leveraging emerging technologies such as AI blockchain networks, land registry systems can become more robust, transparent, and trustworthy, providing a more efficient and accessible way of managing land ownership and transactions.

9. RESULTS

9.1 GANTT CHART



9.2 SCREENSHOTS

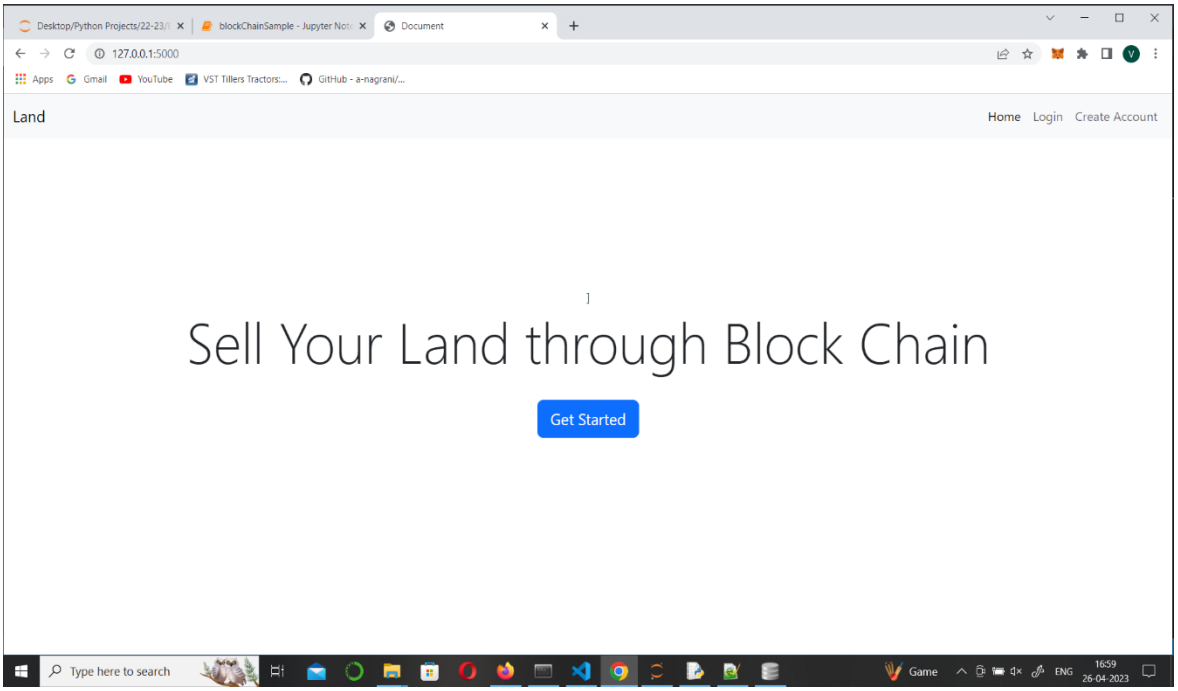


Figure 4: Home page

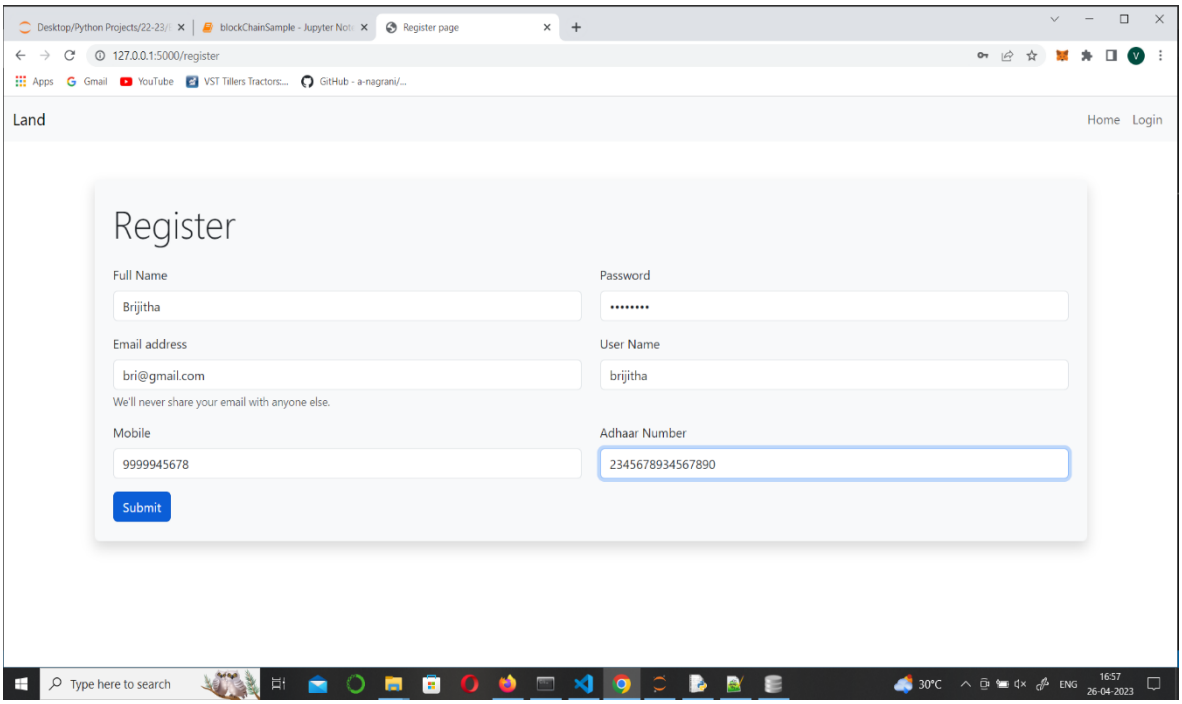


Figure 5: Registration page

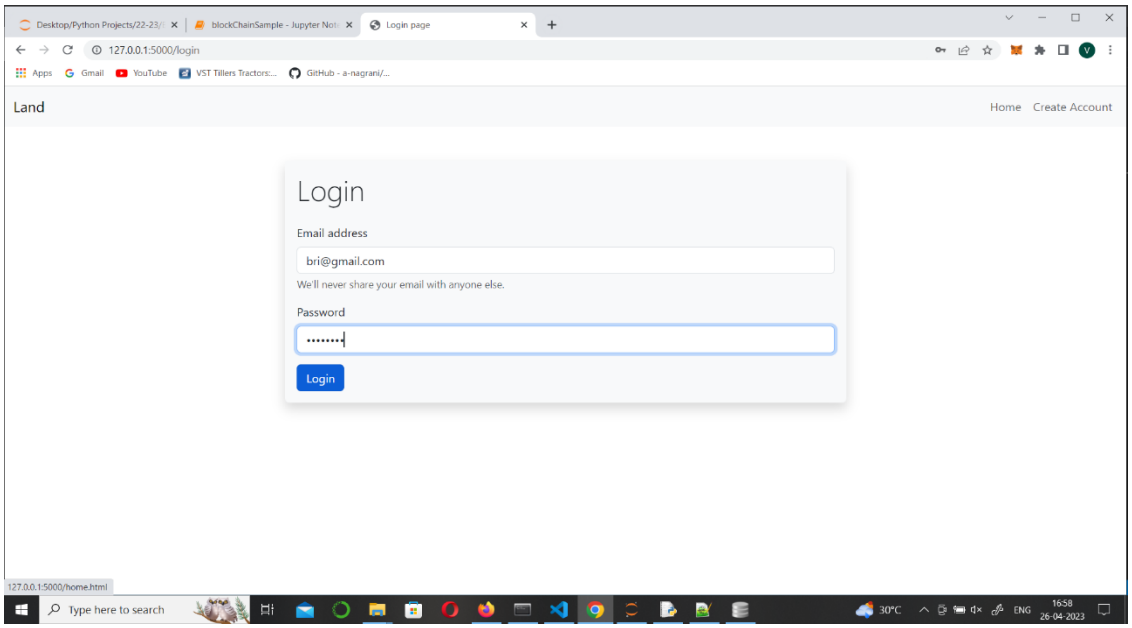


Figure 6: Login page

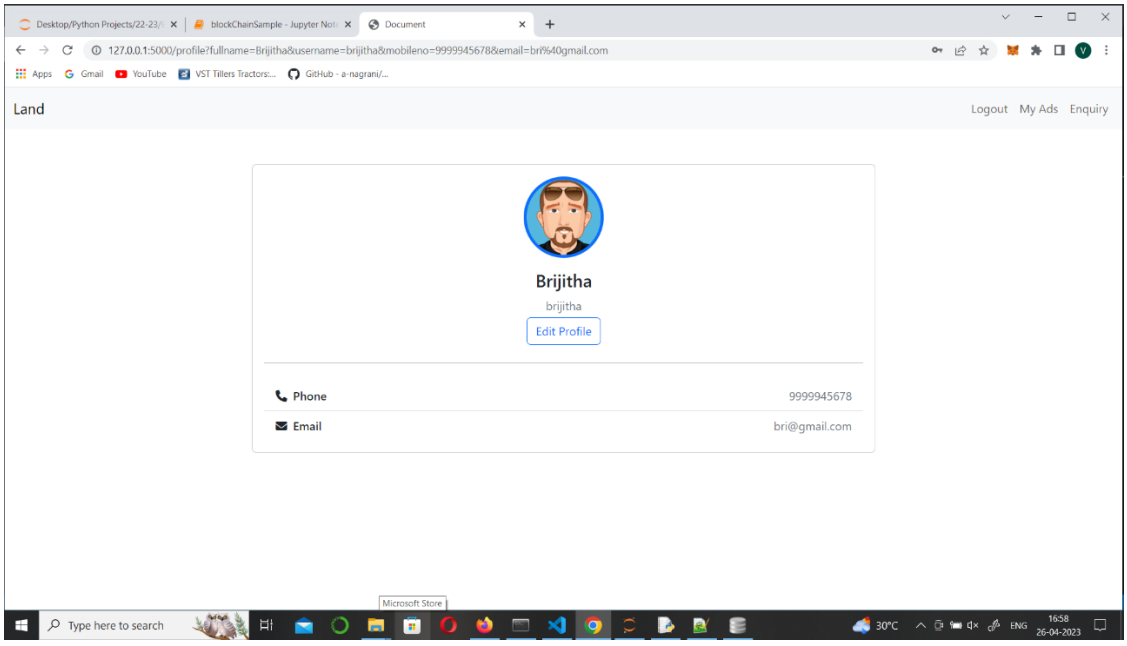


Figure 7: Profile page

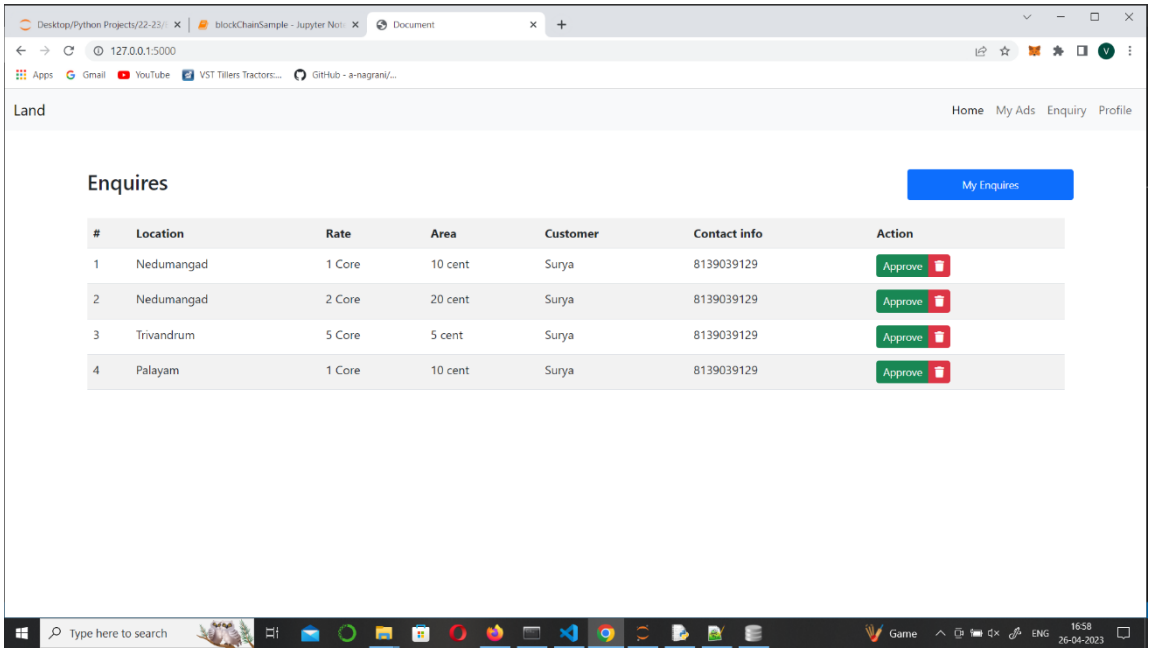


Figure 8: Enquiry page

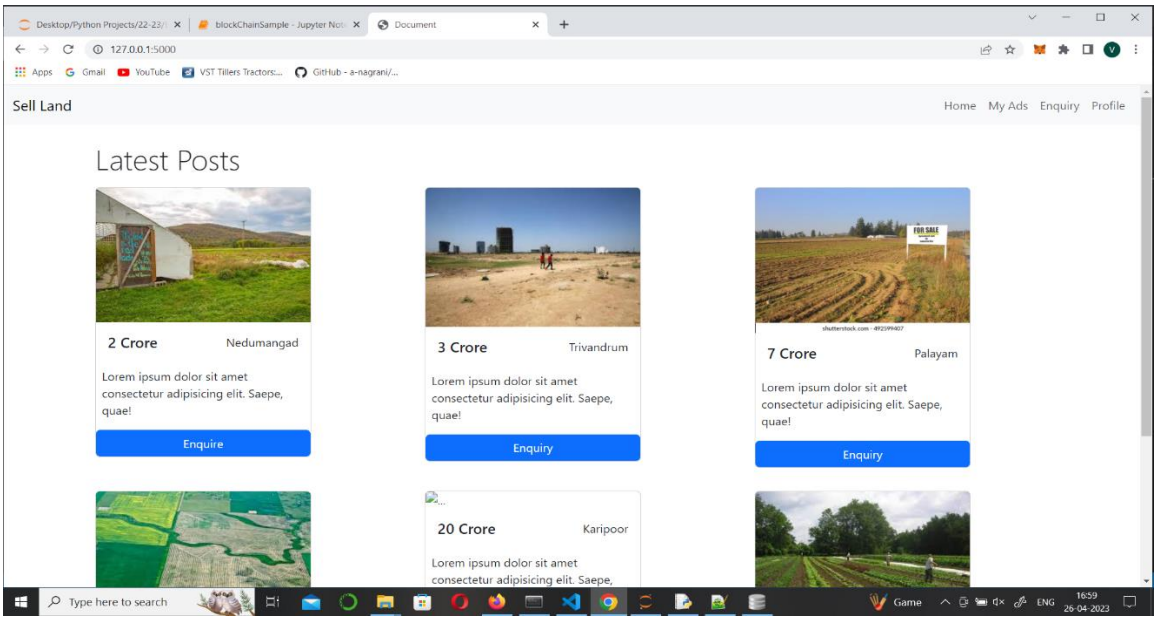


Figure 9: Sellers dashboard

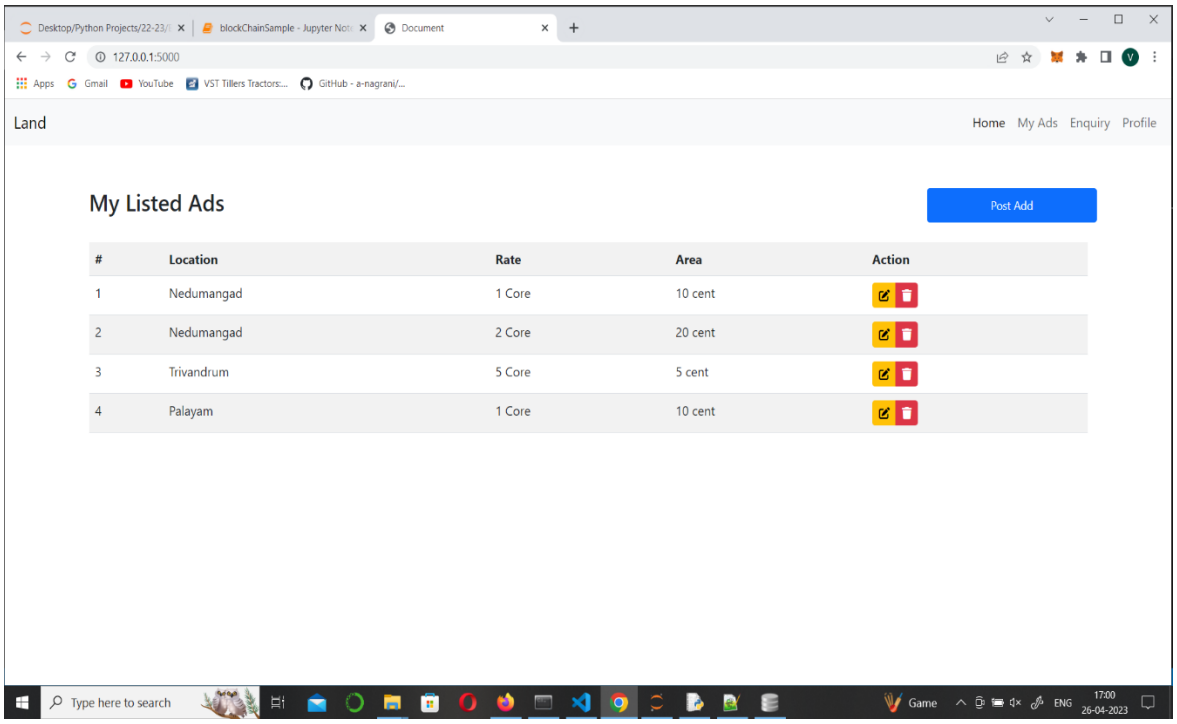


Figure 10: Sellers add list

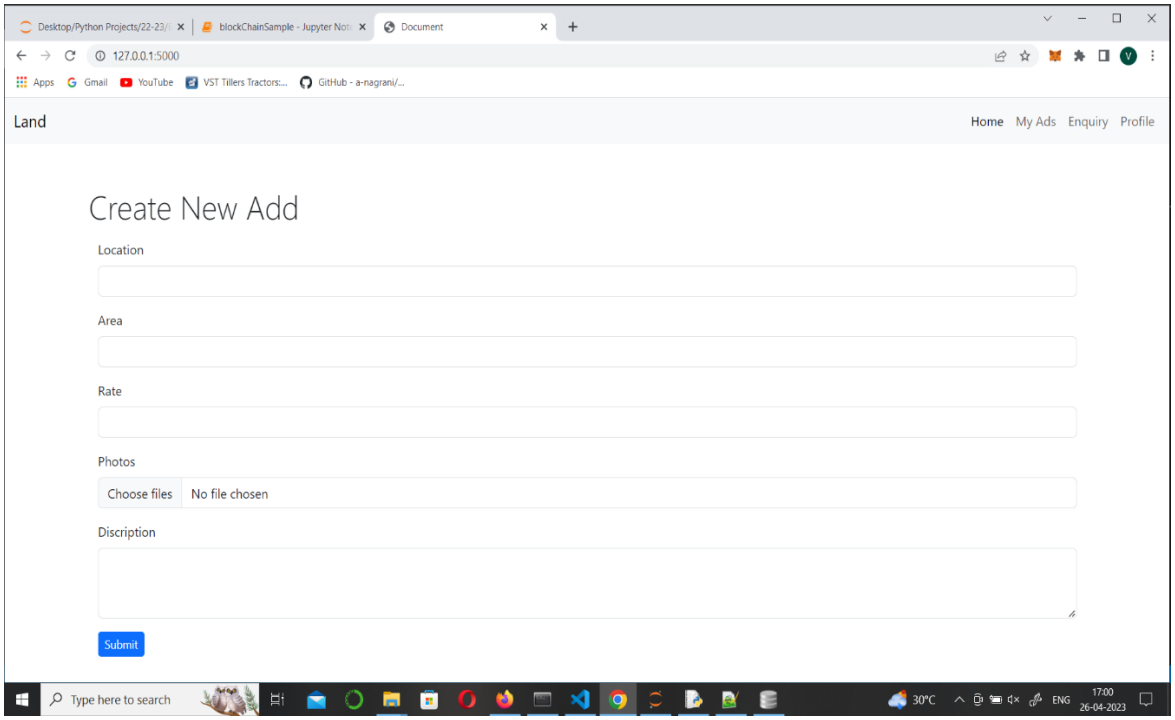


Figure 11: Creating add

9.3 PROJECT LOG

Date : 12 / 01 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Search about blockchain projects

Date : 17 / 01 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Research about land registration process

Date : 23 / 01 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Prof. Sreeja K (HOD) Approved Project Topic

Date : 23 / 01 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Abstract Submitted

Date : 24 / 01 / 2023

Place : Mohandas College of Engineering & TechnologyDuty

Executed : Started learning about blockchain technology

Date : 02 / 02 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Continue learning about blockchain technology

Date : 09 / 02 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Started designing GUI

Date : 01 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Started creating documentation

Date : 02 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Started working on smart contract

Date : 03 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Learned about Hashing

Date : 08 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Error occurred in hasing code

Date : 16 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Started frontend design

Date : 17 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Working on Hashing code

Date : 21 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Hashing code completed

Date : 22 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Started creating code for blockchain

Date : 23 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Working on blockchain coding

Date : 25 / 03 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Working on blockchain coding

Date : 03 / 04 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Connection error occur while connecting to front end

Date : 08 / 04 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Working on connecting error

Date : 11 / 04 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Completed Blockchain coding

Date : 14 / 04 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Started testing modules

Date : 20 / 04 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Completed testing module

Date : 24 / 04 / 2023

Place : Mohandas College of Engineering & Technology

Duty Executed : Completed Documentation

10. BIBILIOGRAPHY

1. "Blockchain for Land Registry and Land Transactions" by Christiaan Lemmen and John J. Dean (2018)
2. "Blockchain for Land Registration: A Survey and a Prototype" by Hongwei Wang et al. (2020)
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4. "Land Titling and Registration on the Blockchain" by Aldo de Pape et al. (2019)

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5. "Blockchain for Land Registry and Land Transactions" by Christiaan Lemmen and John J. Dean (2018)
6. "Design and Implementation of a Blockchain-Based Land Registry System" by Isaac A. Osunmakinde and Olusegun Folorunso (2019)
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13. "The Application of Blockchain in Land Registration: A Review" by Jiayu Han et al. (2019)
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Github Repository

Shahina S S. (2023).Land registry system using blockchain.Github.

Retrieved May 12 , 2023, from " https://github.com/ShahinaSabeela/Land-registry-system-using-blockchain "