A PROJECT REPORT ON

EVALUATING AND ANALYZING BLOCKCHAIN BASED AGRICULTURE LAND REGISTRY SYSTEM

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IN

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SUBMITTED BY

MR. SANKET BHANUSE	**EXAM NO: B190438509**
MR. RUDRANT DODMANI	**EXAM NO: B190438520**
MS. PRACHI GUND	**EXAM NO: B190438524**
MS. PRIYANKA CHAVAN	**EXAM NO: B190438512**

UNDER THE GUIDANCE OF

PROF. L. J. DEOKATE

Sinhgad Institutes

DEPARTMENT OF INFORMATION TECHNOLOGY

STES'S SINHGAD ACADEMY OF ENGINEERING

KONDHWA BK, PUNE 411048

SAVITRIBAI PHULE PUNE UNIVERSITY

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Sinhgad Institutes

CERTIFICATE

This is to certify that the project report entitles

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Submitted by

MR. SANKET BHANUSE	**EXAM NO: B190438509**
MR. RUDRANT DODMANI	**EXAM NO: B190438520**
MS. PRACHI GUND	**EXAM NO: B190438524**
MS. PRIYANKA CHAVAN	**EXAM NO: B190438512**

is a bonafide work has been carried out by them under the supervision of **Prof.L.J.Deokate** and it is approved for the partial fulfilment of the requirement of Savitribai Phule Pune University, for the award of the degree of **Bachelor of Engineering** (INFORMATION TECHNOLOGY).

Prof. L. J. Deokate	**Dr. S.S. Kulkarni**	**Dr. K. P. Patil**
Guide	**H.O.D.**	**Principal**
Department of Information Technology	Department of Information Technology	SAOE, Pune

Place: **Pune**

Date: / / 2023

External Examiner

Prof. Mrs.P.Y. Pawar

Project Coordinator

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Project Group Members:

MR. SANKET BHANUSE	**EXAM NO: B190438509**
MR. RUDRANT DODMANI	**EXAM NO: B190438520**
MS. PRACHI GUND	**EXAM NO: B190438524**
MS. PRIYANKA CHAVAN	**EXAM NO: B190438512**

ABSTRACT

Data security has become more essential than ever before because of rapid advances in Information technology. According to recent survey on higher education in India alone the count of students graduating in 2020 is around 3.66 crore. Individuals whether they choose to start job hunting or continue pursuing higher education, require various certificates for interviews and admissions during which they often find that they have lost their educational and recommendation certificates. Also, with the absence of efficient forgery prevention systems, the problem of fabricating bogus certificates, licenses and other crucial documents exists, as a solution the dissertation work proposes designing an electronic credential verification system using private blockchain setting which offers improved data privacy of sensitive information and control of user authorization resulting in reduced energy consumption, with quicker validation of transactions as compared to earlier systems implemented on open blockchain platforms. Blockchain is a non-centralized ledger which chronicles information in blocks only through authentication by all participants in the network. Thus, due to the decentralized and immutability property, the credential validating system with anti-counterfeit, verifiability and time stamp could be made that can also electronically reduce the physical loss of documents saving paper and time. However, when applying blockchain technology significant delay is incurred in processing and validating transactions in the chain making it necessary to evaluate performance of the system. The design, architecture, code-base and consensus of blockchain implementations are still being researched and optimized constantly for mainstream usage. Thus, we estimate performance of the project based on memory usage, execution time, latency and throughput and analyze performance-security trade-offs which can be used to overcome the overhead of blockchain applications.

Keywords: Blockchain, Non-centralized, Immutable, Anti-counterfeit, Consensus Algorithm, Permissioned, Performance-Security trade-offs etc.

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CHAPTER 1

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 BASIC CONCEPT

1.1.1 WORLD WIDE SCENARIO

With the revolution of the property management system in the recent years, the agricultural land registry system has been paid more considerable attention. Agricultural land registration is a topic that hardly crosses the mind of most people outside of the real estate sector, except for when they're involved in a real estate transaction themselves. Even then, it's generally considered one of the mundane administrative matters, a rubber-stamping exercise that's far less tangibly exciting than collecting the keys to a new land. In principle, agricultural land registries simply need to maintain records of land and real estate ownership, recording changes of hands as they happen over the years. It sounds like a simple enough task, but it comes with myriad challenges.

However, if someone wants to sell an older property that hasn't previously been registered, and the paper title deeds have been lost or destroyed, the process to register the property in order to sell it can become highly arduous. The seller will need to somehow prove the basis of their claim to ownership without the relevant paperwork, as well as explain how the documents came to be lost or destroyed.

These functions are supported by new digital technologies. Blockchain follows absolute privacy rules to identify users related to transactions. It is mainly used for the management of information systems to help achieve secure storage, transactions, process automation, and other applications. ML is the leading technology for performing complex analysis, intelligent judgment, and creative problem solving in healthcare

1.1.2 SCENARIO IN INDIA

In India, currently the ownership of a agricultural property is proved through presumptive land titling (RoR)-chain of documents that provide evidence of the transfer of title from person to person over the years all the way to the current owners. Registration is only recognized as an agreement between two parties for transfer of property. An important constraint is that any one of these intermediate transactions is liable to be challenged as the office of sub-registrar(SRO) is only

undertaking deed registration under the central registration act 1908 and does not verify the ownership of the land. Agricultural property fraud is also rampant in many forms in our country.

The revenue department/ Revenue & Panchayati Raj department is the custodian of the agricultural land records. They are the authority to maintain the land record details. The various other transactions related to change of ownership through sale, loan, mortgage, release of mortgage , crop updation initiated by other departments are approved by the revenue department officials and the RoR gets updated. Agricultural land records is under the jurisdiction of state laws.

1.1.3 NEED OF PROJECT

The aims of this study are:

- ✓ Propose a secure, transparent and intelligent methods in the Internate of real estate things industry using Machine learning models and blockchain technology to enhance security level and train our models to improve diagnostic, prevention, registry of land, farmers rights, customers support and equality in the real estate system.
- ✓ Creating reliable artificial intelligence models in Agricultural land registry using blockchain, which is an open network for the sharing and authorization of information. Real estate professionals will have access to the blockchain to display the medical records of the land, and AI uses a variety of proposed algorithms and decision-making capability, as well as large quantities of data.
- ✓ Apply classification of machine learning & Blockchain techniques to process the data and survey of selection methods, query strategies, applications and security. In highly secure data, Security issues are solved by using Blockchain Technology.
- ✓ To conduct assessments in effect for ascertaining the accuracy alongside performance of suggested designs and state additional studies that can be conducted so as to boost the accuracy and performance.
- ✓ To carry out tests on devised algorithms in Python on varied test pictures and consequently determine problems within the created algorithm. Assessment is to be based on success rate as well as time consumed and the algorithm's capability to functions in various circumstances.

1.1.4 PURPOSE OF STUDY

Today we have enormous amount of data available in every sector, with the advent of technology available, it is possible to provide solutions to many problems. In this project we are going to provide solutions to the problems related to land data management using Blockchain. Extracting only the relevant information from the data is possible with the use of Blockchain. This is done using trained algorithms. Once this data is stored, the next problem is Data sharing and its reliability. This is where Blockchain comes into picture. The consensus in Blockchain technology makes sure that data is legitimate and transactions are secure. Blockchain technology can potentially change agricultural land management for the better by placing farmers at the epicentre of the land regisrty system and increasing the privacy and interoperability of agricultural land data.

Generally, previous studies related to application of digital technologies in real estate domain were limited to study in one field or one country. No studies have mapped the current status of these two technologies in the real estate field. Also, there is no relative study that specifically addresses the relationship between authors, affiliations, keywords, and the hotpots of the research. In the past five years, the study of smart healthcare has attracted extensive attention from scholars of a series of disciplines, which requires us to integrate the viewpoints of scholars of different disciplines and study the status to seek deeper discoveries.

Therefore, this research proposed portraying the status of application of two types of digital technologies, Blockchain, in smart contract studies by bibliometric visualization. In this paper, we have presented a comprehensive review on the application of Blockchain techniques in the healthcare sector. We analyze the research status in terms of countries, institutions, publication volume, authors, journals, sponsors, and subject areas. In addition, this paper subdivides the main application scenarios of the prior art in the land registry field. Our research will provide Agriculture land registry with an insight to keep Blockchain technologies fully utilized. Finally, we analyze the latest research trends based on Blockchain technology in order to provide a research direction for future research.

Data is distributed and maintained by various nodes and is thus decentralized. Consequently, a block becomes validated only once authenticated by multiple parties (nodes) in the chain making it a secure system which is difficult to hack. Accordingly, a credential authentication system providing easy verification of student credentials saving paper, time and risk of physically losing the certificates is propositioned. We also further evaluate the system based on crucial blockchain parameters such as memory usage, execution time, latency to estimate and evaluate the delay incurred in the implemented system for processing and verifying transactions in the blockchain from compute intensive task of

mining which consumes huge amounts of energy and time which is the chief shortcoming of blockchain based applications.

There is a shortage of proper counterfeit detection and prevention systems, which has lead to an increase in creation of false educational credentials, diplomas, licenses, and other crucial documents which are not detected. For identifying and averting information manipulation or imitation of academic credentials to match required criterion, we propose an electronic credential verification system for confirmation of academic qualification of the person of interest by universities, companies or recruitment organizations. For this purpose, we use blockchain technology which chronicles information in unique and unchanging chunks known as blocks only after authorization by all parties in the network known as nodes.

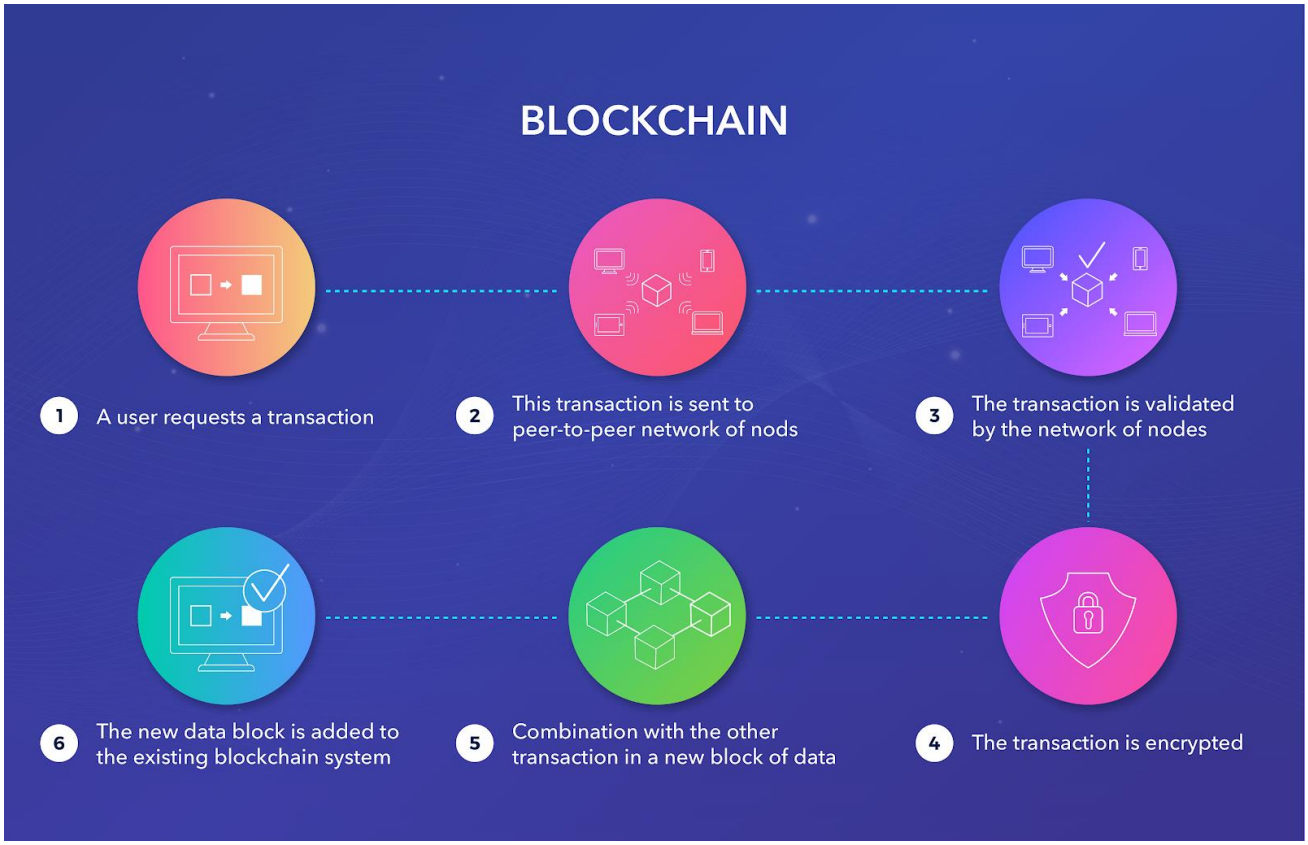

Figure 1. Blockchain in real estate: Use cases

CHAPTER 2

LITERATURE SURVEY

Chapter 2

LITERATURE SURVEY

Information systems and computerization nowadays need very faster, secure & easier data analysis techniques. It is also required to maintain efficiency and accuracy in data analysis. So Blockchain techniques have been continuously used in the data analysis & security in various fields from medicine to organization and education to energy applications. This study applies classification of Blockchain techniques to process the data and survey of selection methods, query strategies, applications and security. In highly secure data, Security issues are solved by using Blockchain Technology. Blockchain technology is rapidly gaining attention towards the Security of confidential data. The real estate industry is one of the fields of organization where high risk involves & its attracted attention of many technological organizations so this field required the security for securing their data. The Blockchain is generally used for providing the security to secure the high sensitive data. By using the Blockchain technology there are numerous opportunities for healthcare industry to achieve & gain. Such as reduced transaction costs, increased transparency for regulatory reporting, efficient healthcare data management and healthcare records universality as well as able to access data from any location. In the context of smart healthcare system blockchain may provide distinct benefits, particularly from a context-aware perspective where efficient and personalized solutions may be provided to citizens and the society. This paper provides a comprehensive survey of relationship between blockchain techniques related to agricultural land registry system. In addition, we are going to discussed several challenges can come for actually implementing secure real estate system using blockchain based Technology.

2.1 BLOCKCHAIN IN AGRICULTURAL LAND REGISTRY SYSTEM:

Today, blockchain is what the iPhone was in 2007. Revolutionary and disrupting, it can soon become a common part of day-to-day life with transparency in business operations. Blockchain has a comprehensive approach in industries which need to be protected from corruption, human error or human intervention. Agricultural Land Registry is one of the use cases that involve a lot of intermediaries to put trust in the system. The existing solutions in place are out of date. Tracking who owns which pieces of property is challenging when you have thousands of land records to maintain.

It is quite common to confront discrepancies within the paperwork such as counterfeit titles, forged documents and a complete loss of the record. Such situations lead to expensive court battles between conflicted parties. The transparent nature of blockchain can make it possible to trace how property changes hands. Blockchain's immutable, auditable and traceable features are enticing governments around the world to implement the decentralized technology in the land registry process.

Ethereum is an free open source platform which helps developers to build and deploy decentralized applications such as smart contracts and other complicated legal and financial applications . Ethereum is kind of a programmable Bitcoin where developers can use the underlying blockchain to create markets, shared ledgers, digital organizations, and other endless solutions application to a problem that need immutable data and agreements, all without the need for a moderator or realtor. Released in 2015, Ethereum is the brainchild of the prodigious Vitalik Buterin, who saw the potential uses of Bitcoin's underlying blockchain technology as the next steps in speeding the expansion of the blockchain community. Ethereum is now currently the cryptocurrency with the second highest coin market cap and is expected by some to surpass Bitcoin as both a valued investment and as the world's most popular cryptocurrency

In today's digital world, it is now possible for imposters to forge the documents and fake the title ownership with the editing software. Blockchain land registry platform will allow you to upload the title documentation to the blockchain network where signers can sign the document and other users can verify it when needed.By keeping an immutable record of transactions, blockchain can prove that you are the owner of the land title and prevent from forgery of documents.Therefore, it can be said that the blockchain land registry platform could serve as proof of ownership, existence, exchange and transaction.

There are only a few people who buy property directly. The process of loan or mortgage is comparatively slower due to administrative issues.But smart contracts can make the process simpler by automating verified transactions. With the blockchain land registry platform, you can create a digital, decentralized ID as a seller and buyer. Doing so would make ownership transfer seamless and quicker than the traditional method.As soon as the registrar confirms the transfer of land title, smart contracts trigger to update ownership for a new buyer and transaction corresponding to it gets stored on the blockchain.In this way, it is always possible to trace back the history of ownership records.

The digital certificate system will be programmed on a private blockchain network using python programming language for four virtual nodes. In the system, three groups of users are involved as shown in. Different users will be registered, they will initiate the transaction and validating will be

done with public and private key creation at the backend by the server. Educational institutes or corporate companies have access to the system, and can browse the system database, receive, access and verify student's data by providing the byte string (hash value) and password.

2.2 OBJECTIVES:

In this study we implemented a non-centralized, immutable academic credential verification system on a permissioned blockchain network. Through incorporation of key aspects of this technology the system accomplishes the following objectives:

- Saves on paper
- Cuts management costs
- Prevents document forgery
- Provides accurate and reliable information on digital certificates/documents.
- The system saves on costing because blockchain transactions don't require intermediaries, processes can be made more efficient and less expensive.
- A novel design and implementation of a digital credential verification system using IPFS (Inter-Planetary File System) developed on a private blockchain using python coding, so that the system can be further customized and advanced according to industrial requirements.
- **Analysis -** Estimate performance of the project based on memory usage, execution time, latency, throughput and analyze performance-security trade-offs which can be used to overcome the drawbacks of blockchain applications.
- **Cost savings -** This is the most obvious benefit. Because blockchain transactions don't require intermediaries, processes can be made more efficient and less expensive. **Efficiency -** Fewer users means faster turnaround as the proposed system is permissioned.
- **Enhanced Security and Control -** The proposed system is private, and custom built hence more secure due to less nodes, resulting in faster throughput, reduced memory usage and execution time also providing more regulation on key performance parameters.
- **Flexibility -** Any digital asset can use blockchain, including difficult-to-protect items like multimedia and email records.
- **Customizable -** Companies in the intellectual property field can customize the implemented verification system as per the requirement of the application to offer new services that benefit both buyers and content creators.

SR. NO	REFERENCE NAME	SEED IDEA / WORK DESCRIPTION	PROBLEM FOUND
1.	Land Registry Using Block chain Technology	In this system, users would register on the portal and can take up the role of a buyer or seller accordingly	Centralized system
2.	Smart Contract Application for Managing Land Administration System Transactions	In this system, users would register on the portal and can take up the role of a buyer or seller accordingly.	Third party involved
3.	A Survey on Blockchain and Online Land Registration	Bitcoin and different cryptocurrencies counting on blockchain technology may be disruptive however blockchain is of far broader application	Password problem
4.	Blockchain enabled Digitization of Land Registration	Use of private Blockchain	------

Table 1. Literature Survey

CHAPTER 3

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

Chapter 3

SOFTWARE REQUIREMENT SPECIFICATIONS (SRS)

A software requirements specification (SRS) is a detailed description of a software system to be developed with its functional and non-functional requirements. The SRS is developed based the agreement between customer and contractors. It may include the use cases of how user is going to interact with software system. SRS is basically an organization understanding of a customer or potential client's system and dependencies at a particular point in time prior to any actual design or development work. Software requirement specification has been developed for future reference in case of any ambiguity and misunderstanding. This document is maintained as a part of project work. This SRS will give you an explicit answer to your questions as to why this project is being developed. This Software Requirement Specification (SRS) provides a detailed analysis on the objectives of Image Restoration algorithms. The hardware and software requirements for the computer software to be developed. The requirements were determined during the analysis of present system and research papers published in this field. This section will be subject to formal/informal review. It will form the basis for ongoing development and testing of software. This section is intended to supply sufficient software and hardware requirement information to deploy this software.

Software Requirements Specification gives the information regarding software and hardware requirements for the system which have been useful for development. It also gives the operating environment needed for working of this system. The primary goal is to provide a complete and accurate list of requirements for the efficient system. This document serves as the means by which the system may be evaluated to check for quality. Design specification commences with the introduction of the design considerations and design constraints for the project. At last, the chapter presents the data flow diagrams and the UML diagrams.

3.1 SCOPE

- Blockchain land registry platform will allow you to upload the title documentation to the blockchain network where signers can sign the document and other users can verify it when needed.
- Provide soil fertility to the farmer by using cropwat tool which is used for the calculation of crop water requirements and irrigation requirements based on soil, climate and crop data.
- Doing analysis on increasing number of nodes:
    1) memory uses
    2) No. of transactions
    3) Latency
    4) execution time.

3.2 PROBLEM STATEMENT

With the lack of effective anti-forge mechanism, the problem of counterfeiting degree certificates, licenses and other crucial documents exists, as a solution we propose a digital certificate system implemented using a private blockchain network which compared to earlier open sourced systems will offer faster execution time as well as enhanced data privacy due to permissioned participants and fewer transactions compared to the earlier systems implemented using public blockchain settings, the digital certificate system based on blockchain technology would be proposed, due to the unmodifiable property of blockchain, the digital certificate with anti-counterfeit, verifiability, transparency and time stamp could be made also electronically reducing the physical loss of documents saving paper and time. However, when applying blockchain technology significant delay is incurred in processing and validating transactions in the chain making it necessary to analyze performance requirements depending on the needs of application. Thus, we estimate performance of the project based on memory usage, execution time, latency and throughput and analyze performance-security trade-offs which can be utilized to overcome the overheads and improve the performance of blockchain application.

By providing information for identity verification, individuals, students, or graduates can apply

for any certificate easily. As a result of this convenience forged degree certificates, licenses and certificates are prevalent. Consequently, educational institutes and companies cannot instantly validate the documents they receive using compute intensive blockchain systems with longer execution time for node authentication.

3.3 FEATURES

- **Accelerating the Process**

Middlemen involved in the land registry process hold information that you cannot access, or you might not have the license required to operate in a property transaction ecosystem.But the blockchain land registry platform can offer you a distributed database where anyone can record and access information without the involvement of any centralized authority.At present, the title to a property/land is just a piece of paper. You require to fill blanks in the deed, sign it, get it notarized for rubber stamping and send the documents to the government to transfer the property.The process looks too old and slow. However, creating a digital title with blockchain land registry platform can improve the process.With the blockchain's potential to prove authenticity, homeowners can transfer the land ownership legitimately to the buyer without needing third-party verification.

- **Reducing Fraud Cases**

In today's digital world, it is now possible for imposters to forge the documents and fake the title ownership with the editing software.Blockchain land registry platform will allow you to upload the title documentation to the blockchain network where signers can sign the document and other users can verify it when needed.By keeping an immutable record of transactions, blockchain can prove that you are the owner of the land title and prevent from forgery of documents.Therefore, it can be said that the blockchain land registry platform could seSrve as proof of ownership, existence, exchange and transaction.

- **Bringing Transparency with Smart Contracts**

There are only a few people who buy property directly. The process of loan or mortgage is comparatively slower due to administrative issues.But smart contracts can make the process simpler by automating verified transactions. With the *blockchain land registry* platform, you can

create a digital, decentralized ID as a seller and buyer. Doing so would make ownership transfer seamless and quicker than the traditional method.As soon as the registrar confirms the transfer of land title, smart contracts trigger to update ownership for a new buyer and transaction corresponding to it gets stored on the blockchain.In this way, it is always possible to trace back the history of ownership records.

3.4 FUNCTIONAL REQUIREMENTS

Software Requirements Specification gives the information regarding software and hardware requirements for the system which have been useful for development. It also gives the operating environment needed for working of this system. The primary goal is to provide a complete and accurate list of requirements for the efficient system. This document serves as the means by which the system may be evaluated to check for quality. Design specification commences with the introduction of the design considerations and design constraints for the project. At last, the chapter presents the data flow diagrams and the UML diagrams.

1. System should require less memory for execution than existing system.
2. System should require less amount of time for execution of transactions across all nodes on the network with minimum latency than existing system.
3. System should require less computation for execution of transactions than existing system.
4. System should be scalable for large and small number of transactions, low dimensional and high dimensional data.
5. The system should maintain a global state across all nodes on the network.

The blockchain system should provide ledger immutability, cryptographic authenticity, and tolerance against faults and attacks as core properties.

Propose a system that provides the ability to detect and track a user`s state of mind has the potential to allow a computing system to over relevant information when a user needs help {not just when the user requests help.

- **Performance**: The performance of the system will provide security by using machine learning techniques.

- **Capacity**: Capacity of project according to data it depends on dataset of project.
- **Availability**: User has allowed for login after activation of user's account. User gets result after entering the tweets as inputs given. **Security**: The system is secure because information of the user's personal details in an account is not leaked or spread anywhere.
- **Reliability**: System is reliable for maintaining the privacy and security of the sensitive information of the user.

3.4.1 REQUIREMENTS

External interface requirements specify hardware, software, or database elements with which a system or component must interface. This section provides information to ensure that the system will communicate properly with external components

3.4.1.1 HARDWARE INTERFACES

- Internet Browser: Chrome, Mozilla Firefox, Internet Explorer
- RAM : 8-16GB n more
- CPU : Intel core i3 – onwards
- Hard Disk Space :20 GB
- System: Pentium IV 2.4 GHz.
- Input device: Standard Keyboard and Mouse.
- Output device: High Resolution Monitor.

3.4.1.1 SOFTWARE INTERFACES

- Operating System Platform: Ubuntu version 14, windows and android
- Coding Languages: Python, Solidity
- Database Used: MySQL
- Software: Python version 3.7, IPFS, VMware

3. 5 NON-FUNCTIONAL REQUIREMENTS

3.5.1 PERFORMANCE REQUIREMENTS

- The prime requirement is that no error condition causes a project to exit abruptly.
- Any error occurred in any process should return an understandable error message.
- The response should be fairly fast, the action participants should not be confused at any point of time about action that is happening.
- The system performance is adequate.

3.5.2 SAFETY REQUIREMENTS

- Validation should be properly provided.
- Information transmission should be securely transmitted to server without any changes in information
- System must be executed in given flow.
- To keep this system safe care should be taken in order to avoid the theft of hardware of the system that is pc or laptop preventing unauthorized access to the system using administrator credentials or user credentials.
-

3.5.3 SECURITY REQUIREMENTS

- Administrator will have full access to Application to resolve any issues.
- Normal user can just read information but they cannot edit or modify anything except their personal information.
- The main security concern is for users account hence; proper login mechanism should be used to avoid hacking.
- System needs security of the database storage at organization side, just like many other applications. The server needs not to share any drives for networking thus avoiding data theft.

CHAPTER 4

PROPOSED SYSTEM ARCHITECTURE

Chapter 4

PROPOSED SYSTEM ARCHITECTURE

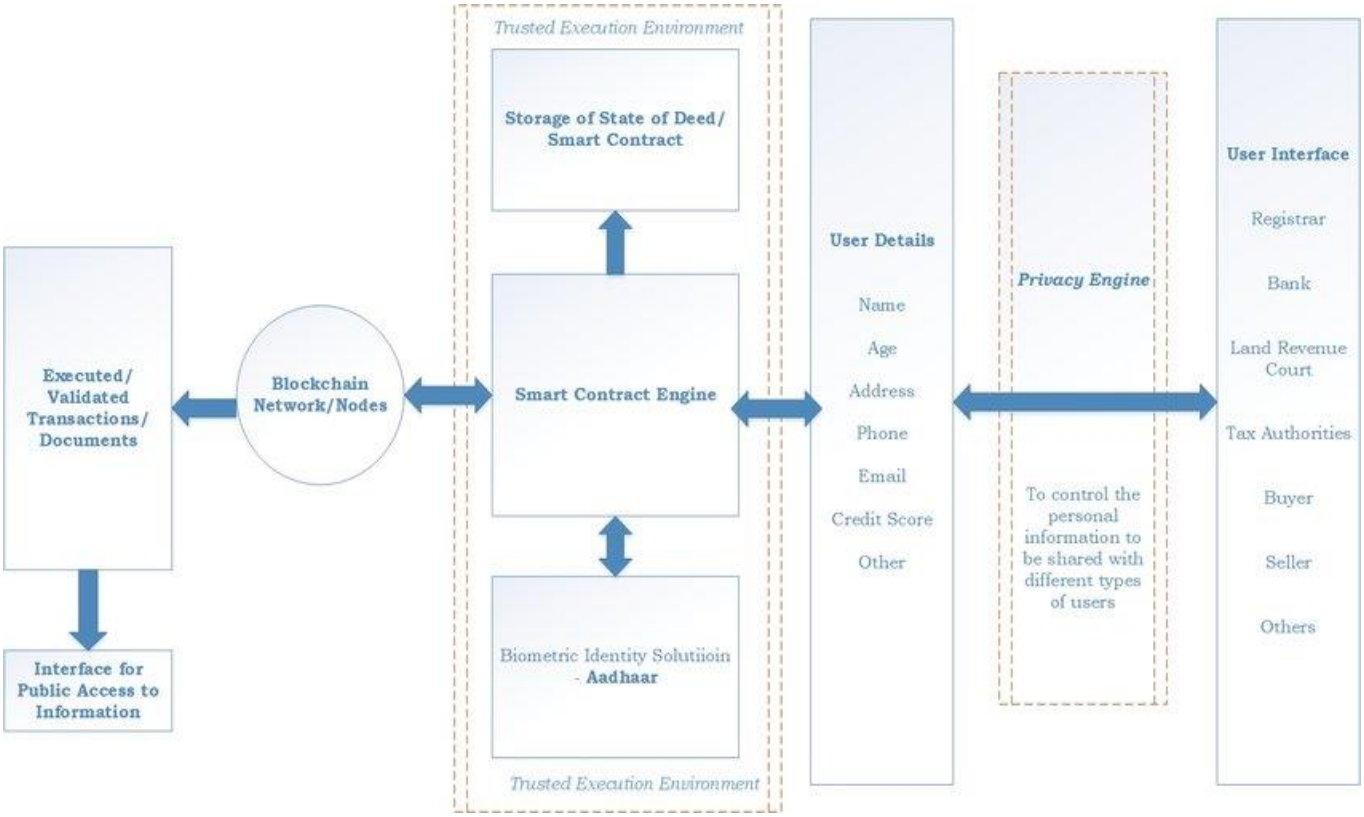

Figure 2. Proposed System Architecture Diagram

4.1 SOFTWARE QUALITY ATTRIBUTES

Ease of Use requirement address the factor that constitute the capacity of software to be understand, learned and used by its intended user.

- **Usability**: The system should be user friendly and self-explanatory. Proposed system is Flexible, Robust, and easily Testable.

- **Accuracy**: The system will give accurate results related to query.
- **Openness**: The system should be extensible to guarantee that it is useful for community system.
- **Usability**: The proposed system will helpful to the hospital network in maintaining the security and transparency between the patients and doctors. This system will also be very helpful for the patients in order to predict the disease early.
- **Reliability**: The system should have accurate results regarding the prediction of disease.

CHAPTER 5

SYSTEM DESIGN

Chapter 5

SYSTEM DESIGN

5.1 ER DIAGRAM

ER model stands for an Entity-Relationship model. It is a high-level data model. This model is used to define the data elements and relationship for a specified system. It develops a conceptual design for the database. It also develops a very simple and easy to design view of data. In ER modeling, the database structure is portrayed as a diagram called an entity-relationship diagram.

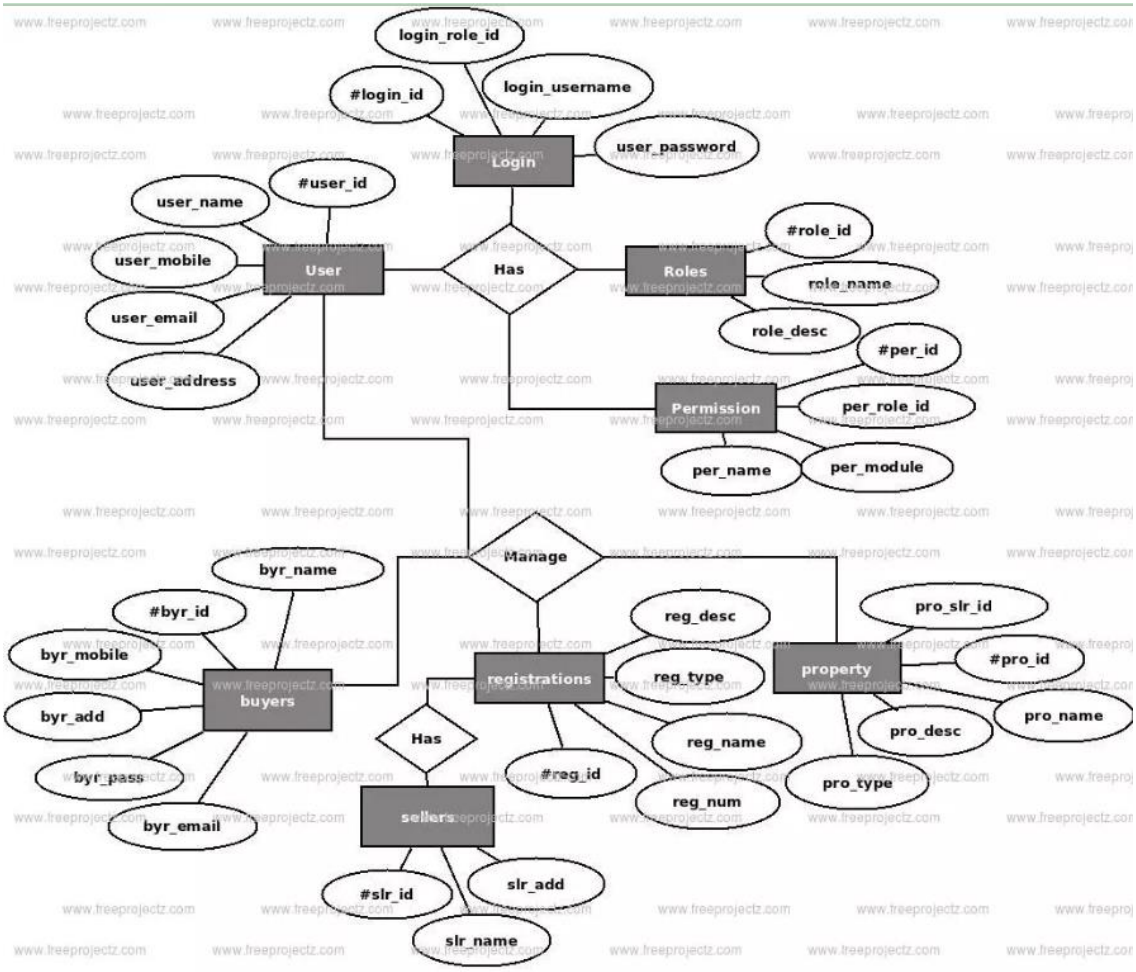

Figure 3. ER-Diagram for Proposed System

5.2 DFD'S (LEVEL 0)

In Software engineering DFD (data flow diagram) can be drawn to represent the system of different levels of abstraction. Higher-level DFDs are partitioned into low levels-hacking more information and functional elements. Data Flow Diagrams (DFD) are graphical representations of a system that illustrate the flow of data within the system. DFDs can be divided into different levels, which provide varying degrees of detail about the system

5.2.1 LEVEL 0 DFD:

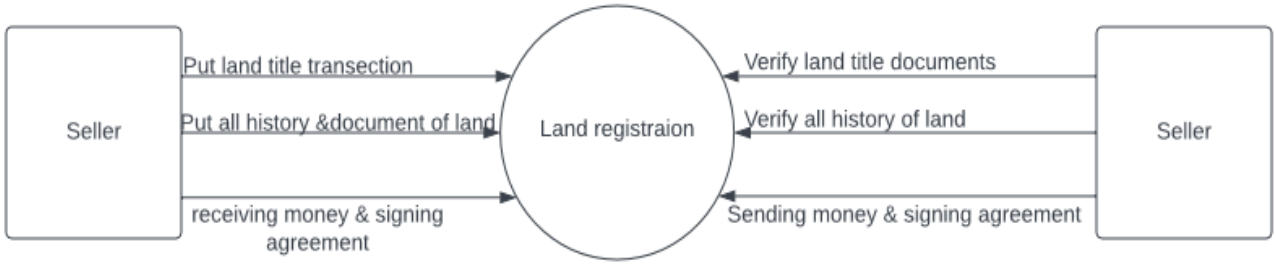

Figure 4. DFD Level-0

5.3 UML DIAGRAMS

5.3.1 USE-CASE DIAGRAM

A use case diagram is used to represent the dynamic behaviour of a system. It encapsulates the system's functionality by incorporating use cases, actors, and their relationships. It models the tasks, services, and functions required by a system/subsystem of an application. It depicts the high-level functionality of a system and also tells how the user handles a system. Use case illustrates a unit of functionality provided by the system. The main purpose of the use- case diagram is to help development teams visualize the functional requirements of a system, including the relationship of "actors" to essential processes, as well as the relationships among different use cases. Use-case diagrams generally show groups of use cases, either all use cases for the complete system, or a breakout of a particular group of use cases with related functionality to Show a use case on a use-case diagram, you draw an oval in the middle of the diagram and put the name of the use case in

the centre of, or below, the oval. To draw an actor (indicating a system user) on a use-case diagram, you draw a stick person to the left or right of your diagram. Following diagram shows the relationships of the user or actors with the use cases which are shown in an oval shape. The main purpose of a use case diagram is to portray the dynamic aspect of a system. It accumulates the system's requirement, which includes both internal as well as external influences. It invokes persons, use cases, and several things that invoke the actors and elements accountable for the implementation of use case diagrams. It represents how an entity from the external environment can interact with a part of the system. Depicts use case diagram of the proposed system. It explains the interaction of the users with the different use case and its involvement.

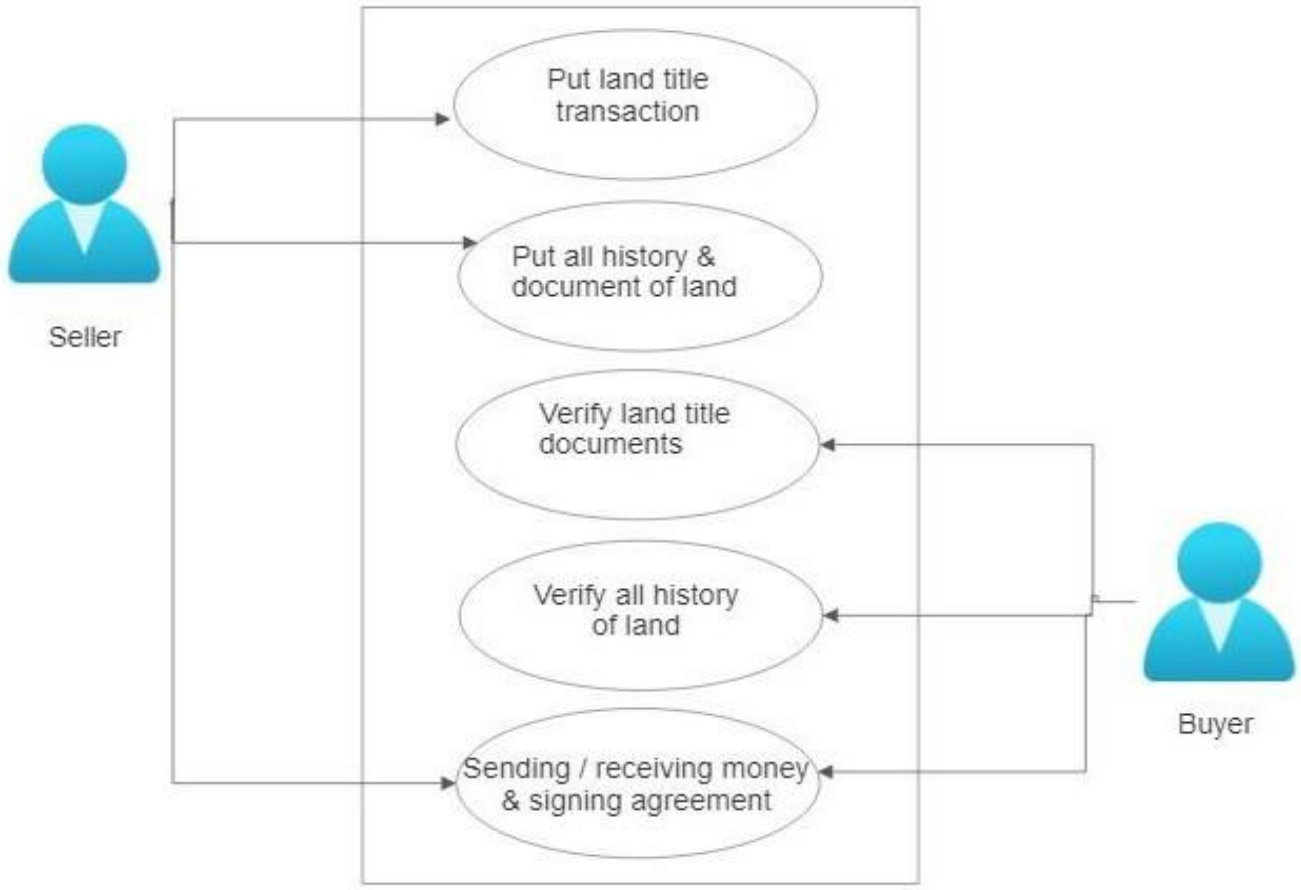

Figure 5. Use-Case Diagram

5.3.2 CLASS DIAGRAM

In software engineering, a class diagram in the Unified Modelling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application. Class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modelling of object oriented systems because they are the only UML diagrams, which can be mapped directly with object-oriented languages.

Class diagram shows a collection of classes, interfaces, associations, collaborations, and constraints. It is also known as a structural diagram.

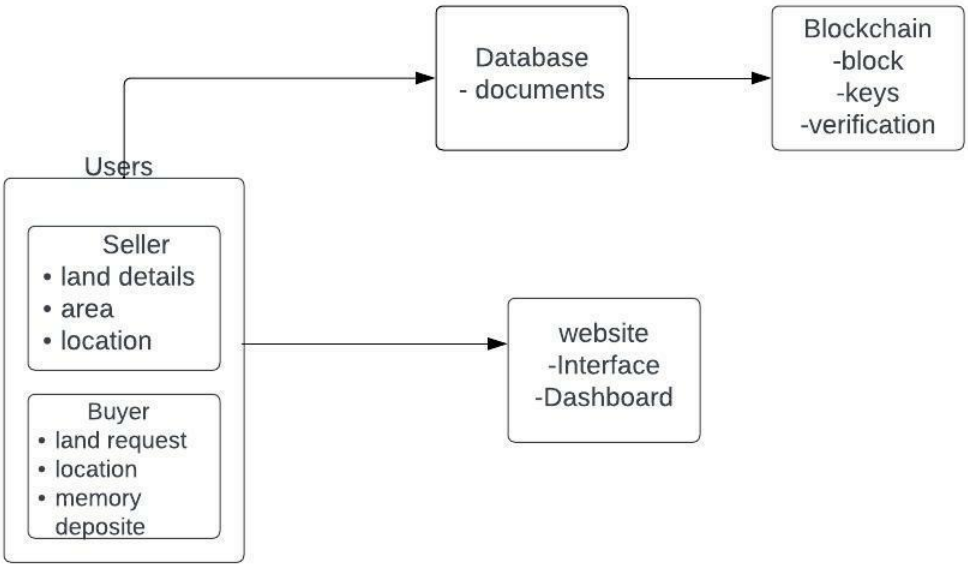

Figure 6. Class Diagram

5.3.3 SEQUENCE DIAGRAM

Sequence diagrams can be used to explore the logic of a complex operation, function, or procedure. They are called sequence diagrams because sequential nature is shown via ordering of messages. First message starts at the top and the last message ends at bottom. The important aspect of a sequence diagram is that it is time-ordered. This means that the exact sequence of the interactions between the objects is represented step by step. Different objects in the sequence diagram interact with each other by passing "messages". Above Sequence diagram shows that how the interaction between object is represented step by step.

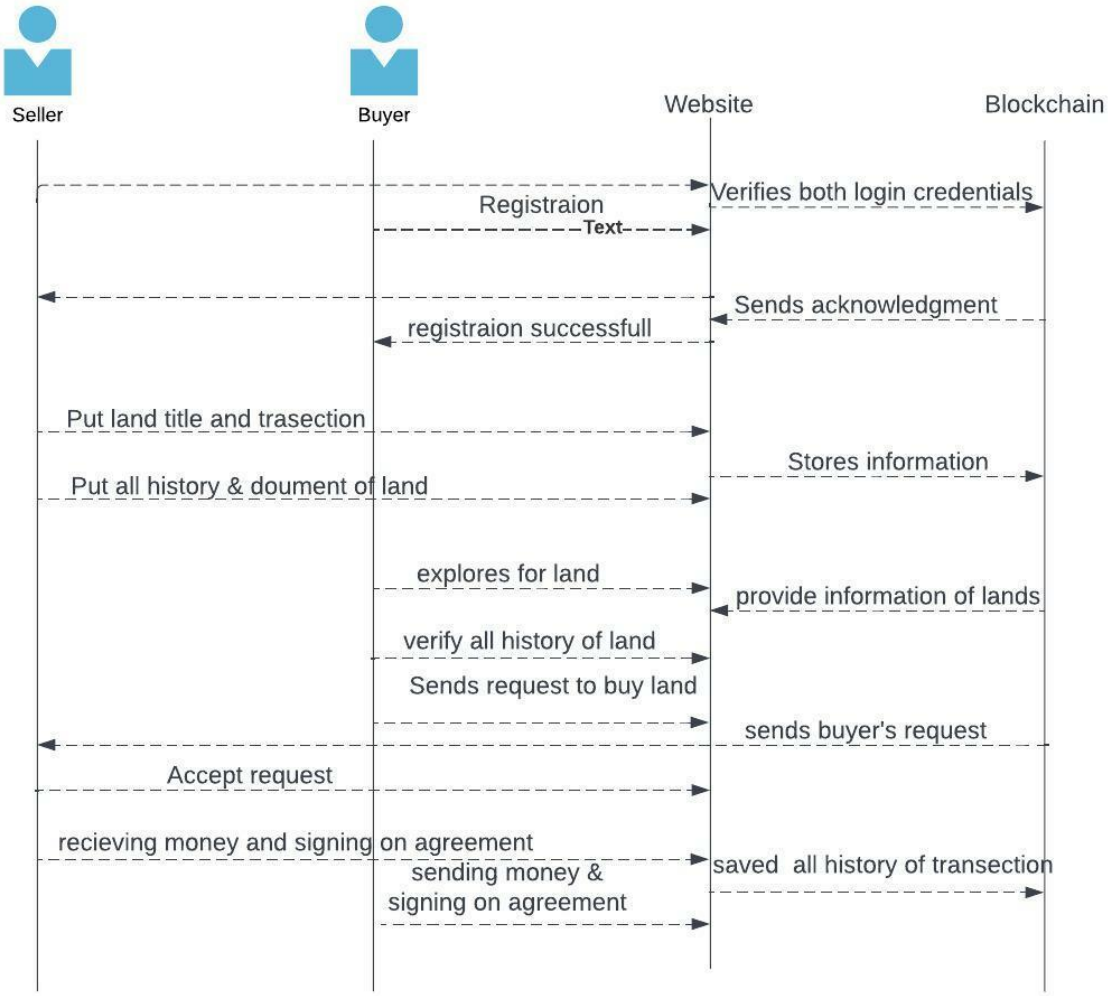

Figure 7. Sequence Diagram

5.3.4 ACTIVITY DIAGRAM

Activity diagram is typically used for business process modelling, for modelling the logic captured by a single use case, or for visualizing the detailed logic of a business rule. Complicated process flows in the system are captured in the activity diagram. Similar to a state diagram, an activity diagram also consists of activities, actions, transitions, initial and final states, and guard conditions. However, difference is state diagrams are in context of simulation while activity gives detail view of business logic. Activity diagrams are "less technical" in appearance, compared to sequence diagrams, and business-minded people tend to understand them more quickly. Activity diagram is another important diagram in UML to describe the dynamic aspects of the system. Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc The basic purposes of activity diagrams is similar to other four diagrams. It captures the dynamic behavior of the system. Other four diagrams are used to show the message flow from one object to another but activity diagram is used to show message flow from one activity to another. Activity diagram is an important behavioral diagram which describe dynamic aspects of the system. Activity diagram is essentially an advanced version of flow chart modeling the flow from one activity to another activity in the proposed system.

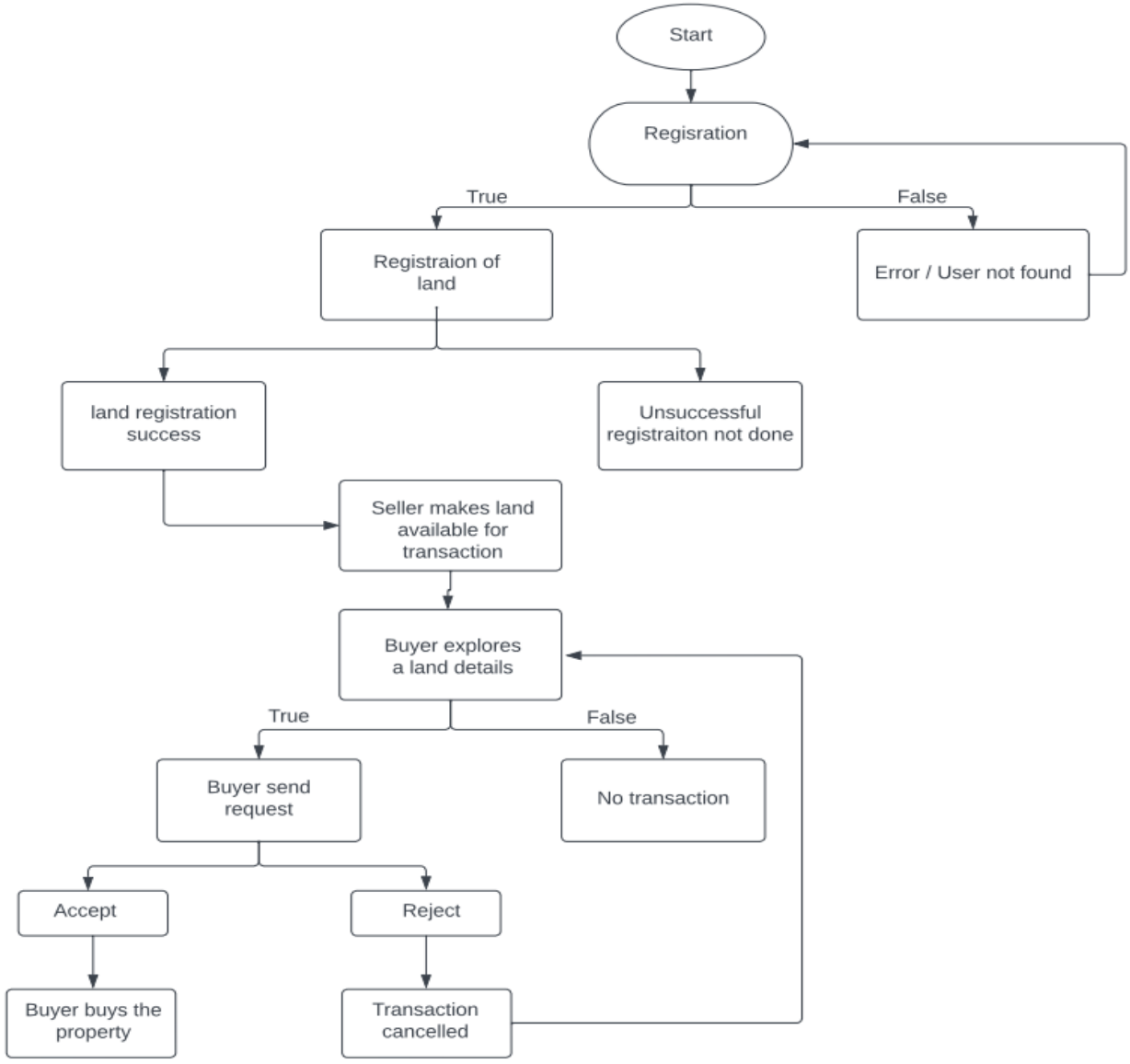

Figure 8. Activity Diagram

5.3.5 ARCHITECTURE DIAGRAM

Architecture diagramming is the process of creating visual representations of software system components. In a software system, the term architecture refers to various functions, their implementations, and their interactions with each other. As software is inherently abstract, architecture diagrams visually illustrate the various data movements within the system. They also highlight how the software interacts with the environment around it. An architecture diagram is a visual representation of all the elements that make up part, or all, of a system. Above all, it helps

the engineers, designers, stakeholders — and anyone else involved in the project — understand a system or app's layout. Architecture diagrams typically depict the sequential order of events in a project. They include various symbols that describe what is happening at any given moment in the process. They provide a visual representation that allows us to comprehend the structure of a system, such as a process, a procedure, a method, or a database. They depict the components of the system in terms of the relationship between the parts and the purpose of each part.

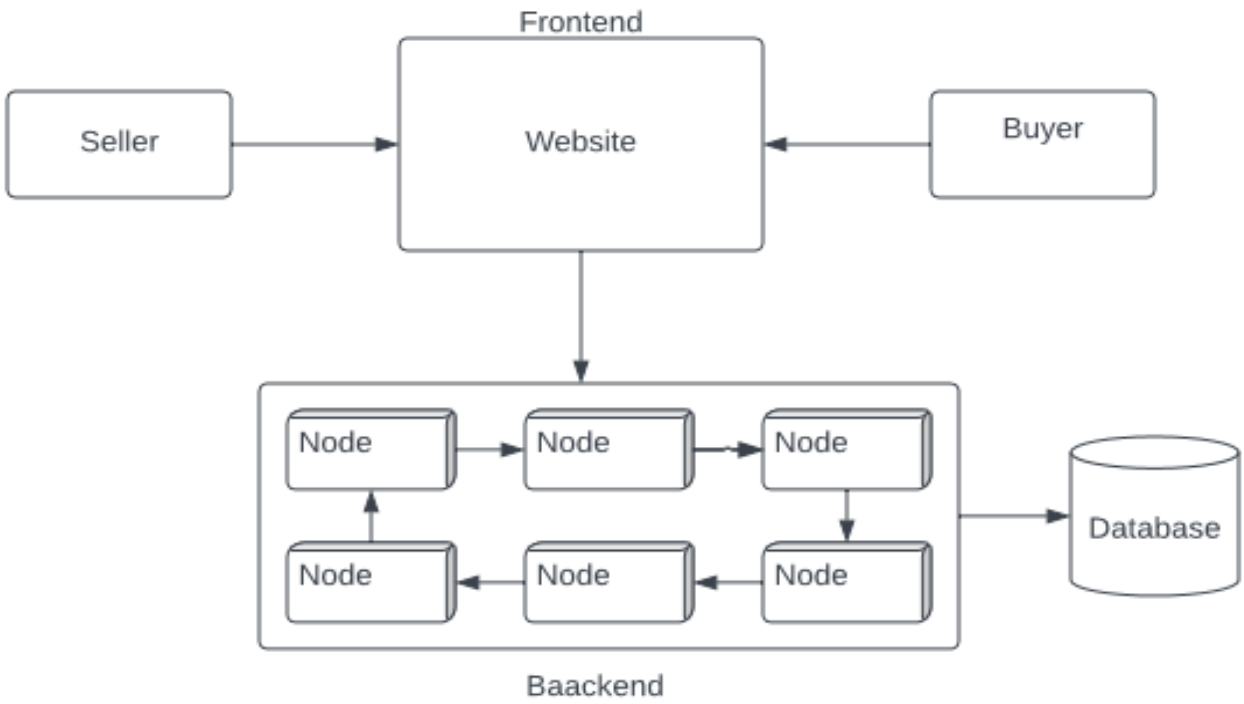

Figure 9. Architecture Diagram

5.3.6 FLOW DIAGRAM

A flow diagram is a visualization of a sequence of actions, movements within a system and/or decision points. They're a detailed explanation of each step in a process, no matter the level of complexity of that process. Flow diagrams, also known as flowcharts, are powerful tools for optimizing the paths - or flow - of people, objects or information through a system or procedure. The connectors and symbols work together to create a visual representation of the direction of movement and what's needed to make that movement happen. The development

process needs clear status of system requirement. This system requirement is defined based on problem statement, literature review and the capability of related hardware and software.

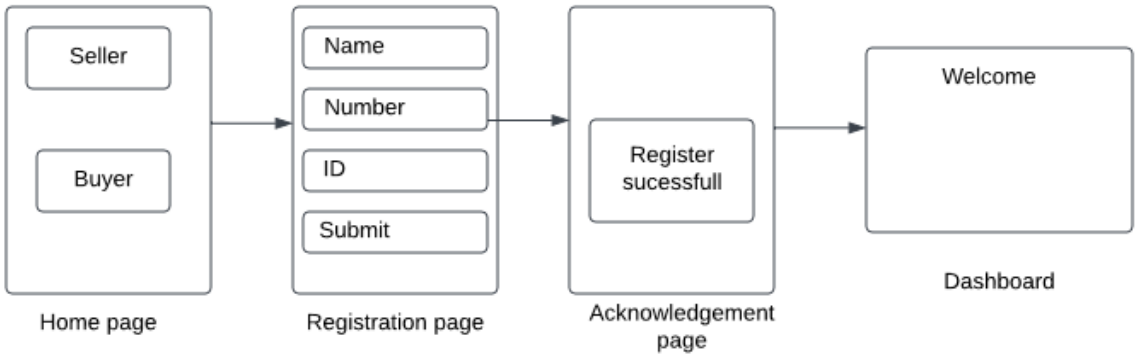

Figure 10. Flow Diagram

CHAPTER 6

PROJECT PLAN

Chapter 6

PROJECT PLAN

6.1 PROJECT ESTIMATES

6.1.1 EFFORT ESTIMATE TIMETABLE

TASK	EFFORT WEEKS	DELIVERABLES	MILESTONES
Analysis of existing systems & comparison with proposed one	4 weeks	-	-
Literature survey	1 week	-	-
Designing & planning	2 weeks	-	-
System flow	1 week	-	-
Designing modules & its deliverables	2 weeks	Modules: Design Document	-
Implementation	7 weeks	Primary System	-
Testing	4 weeks	Test Reports	Formal
Documentation	2 weeks	Complete Project Report	Formal

Table 2. Effort Estimate Timetable

6.1.2 PROJECT DESCRIPTION

PHASE	TASK	DESCRIPTION
Phase 1	Analysis	Analyse the information given in the IEEE paper.
Phase 2	Literature survey	Collect raw data and elaborate on literature surveys.
Phase 3	Design	Assign the module and design the process flow control.
Phase 4	Implementation	Implement the code for all the modules and integrate all the modules.
Phase 5	Testing	Test the code and overall process weather the process works properly.
Phase 6	Documentation	Prepare the document for this project with conclusion and future enhancement.

Table 3. Project Schedule

6.2 RISK MANAGEMENT

6.2.1 OVERVIEW OF RISK MITIGATION, MONITORING, MANAGEMENT RISK MANAGEMENT ORGANIZATIONAL ROLE

Each member of the organization will undertake risk management. The development team will consistently be monitoring their progress and project status as to identify present and future risks as quickly and accurately as possible. With this said, the members who are not directly involved with the implementation of the product will also need to keep their eyes open for any possible risks that the development team did not spot. The responsibility of risk management falls on each member of the organization.

6.2.2 BUSINESS IMPACT RISK

Amount and quality of documentation that must be produced and delivered to customer the customer will be supplied with a complete online help file and user's manual for the application. Coincidentally, the customer will have access to all development documents for the application, as the customer will also be grading the project.

- Governmental constraints in the construction of the product none known.
- Costs associated with late delivery Late delivery will prevent the customer from issuing a letter of acceptance for the product, which will result in an incomplete grade for the course for all members of the organization.
- Costs associated with a defective product Unknown at this time

6.2.3 CUSTOMER RELATED RISKS

- Have you worked with the customer in the past? Yes, all team members have completed at least one project for the customer, though none of them have been to the magnitude of the current project.
- Does the customer have a solid idea of what is required? Yes, the customer has access to both the System Requirements Specification, and the Software Requirements Specification.
- Will the customer agree to spend time in formal requirements gathering meetings to identify project scope? Unknown. While the customer will likely participate if asked, the inquiry has not yet been made.

6.2.4 PROCESS RISKS

- Does senior management support a written policy statement that emphasizes the importance of a standard process for software development?
- Has your organization developed a written description of the software process to be used on this project?
- Are staff members willing to use the software process? Yes. The software process was agreed upon before development work began.
- Is the software process used for other products?

6.2.5 TECHNICAL ISSUES

- Are facilitated application specification techniques used to aid in communication between the customer and the developer? The development team will hold frequent meetings directly with the customer. No formal meetings are held (all informal). During these meetings the software is discussed and notes are taken for future review.
- Are specific methods used for software analysis? Special methods will be used to analyse the software progress and quality. These are a series of tests and reviews to ensure the software is up to speed.
- Do you use a specific method for data and architectural design? Data and architectural design will be mostly object oriented. This allows for a higher degree data encapsulation and modularity of code.

6.2.6 TECHNOLOGY RISK

- Is the technology to be built new to your organization? No
- Does the software interface with new or unproven hardware? No
- Is a specialized user interface demanded by the product requirements? Yes.

6.2.7 DEVELOPMENT ENVIRONMENT RISKS

Is a software project management tool available? No. No software tools are to be used. Due to the existing deadline, the development team felt it would be more productive to begin implementing the project than trying to learn new software tools. After the completion of the project software tools may be implemented for future projects.

6.3 TIME-LINE CHART

6.3.1 WORK TASK 1: ANALYSIS PHASE

Work Task 1: Analysis Phase

Work Task	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12
1.1	■											
1.2		■										
1.3.1			■	■								
1.3.2					■							
1.3.3						■						
1.4							■	■				
1.5									■			
1.6										■		
1.7											■	
1.8												■

Table 4. Analysis Phase

6.3.2 DESIGN PHASE

Work Task 2: Design Phase

Work Task	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20	Wk 21	Wk 22	Wk 23	Wk 24
2.1	■	■	■									
2.2				■	■	■						
2.3							■	■	■	■	■	■

Table 5. Design Phase

6.3.3 CODING, DEPLOYMENT AND DOCUMENTATION PHASE

Work Task 3: Coding, Deployment and Documentation Phase

Work Task	Wk 25	Wk 26	Wk 27	Wk 28	Wk 29	Wk 30	Wk 31	Wk 32	Wk 33	Wk 34	Wk 35	Wk 36
3.1	■	■										
3.2			■	■	■							
4.1						■						
4.2							■					
4.3								■	■			
5										■		
6											■	■

Table 6. Coding Deployment and Documentation Phase

CHAPTER 7

IMPLEMENTATION

Chapter 7

IMPLEMENTATION

As Blockchain is a network of decentralized distributed database. The project flow of the system for ‘n’ number of nodes developed in this study is as follows:

1. We have created a Private Blockchain system for storing e-certificates using python of four virtual nodes.
2. First when the user logs in, a node will be registered with corresponding cryptographic key creation at the backend.
3. Then consensus will occur using proof of work using smart contracts by checking if the private key matches with the public key, that is the nodes on the network agree on the same state of a blockchain making it a self-scrutinizing ecosystem while ensuring that every block in the chain is valid as well as keeping participants incentivized.
4. In the Background python script will be running to maintain and update Blocks in self node and other nodes.
5. Create a Block (Certificate update)
    a. Login
    b. Select Document (IPFS Hash).
    c. Upload (New Block Creation and gets encrypted with IPFS Hash and block gets stored).
6. We have used the Inter-Planetary File System (IPFS) which is a non-centralized document sharing mechanism. To save data IPFS uses a dispersed hash table. Using the hash, we can ask the client who has the content located at that hash and we download the content directly from the member that has the same data or document.
7. We use the file sharing databased for storage as it is content-addressed where we upload files into the network, and these files are shared among entities using hash of the requested file which is an identifier distinctly and permanently linked to the information content itself. As a result, any change to the data will not be permitted as it will change the file location.
8. A private IPFS network behaves the same as the public network except participants are

only able to communicate with other nodes inside that same network. This means that only those members in the private network will be able to see things like content announcements / content requests.

9. When you add any content on IPFS network, the data is segregated into small parts of 256Kb. Each part is identified with its own hash. These chunks of data are then distributed to various nodes on network which have their hash closest to client-Id.

Flow of Implementation:

The entire blockchain project development consists of three major components −

1. Seller
2. Buyer
3. Blockchain

The major components of the system are implemented with the help of nine modules – developing client class, generation of private and public keys, defining the transaction class, creating genesis block, defining sign transaction method, developing the block class, creating blockchain, developing the mining function and adding block. This section sequentially gives an overview of the implementation of these modules

7.1 ALGORITHM

7.1.1 BLOCKCHAIN

- Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An asset can be tangible (a house, car, cash, land) or intangible (intellectual property, patents, copyrights, branding). Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for all involved.
- Business runs on information. The faster it's received and the more accurate it is, the better. Blockchain is ideal for delivering that information because it provides immediate, shared and completely transparent information stored on an immutable ledger that can be accessed only by permissioned network members.

- A blockchain network can track orders, payments, accounts, production and much more. And because members share a single view of the truth, you can see all details of a transaction end to end, giving you greater confidence, as well as new efficiencies and opportunities.

➢ **Key elements of a blockchain**

1. **Distributed ledger technology**

   All network participants have access to the distributed ledger and its immutable record of transactions. With this shared ledger, transactions are recorded only once, eliminating the duplication of effort that's typical of traditional business networks.

2. **Immutable records**

   No participant can change or tamper with a transaction after it's been recorded to the shared ledger. If a transaction record includes an error, a new transaction must be added to reverse the error, and both transactions are then visible.

3. **Smart contracts**

   To speed transactions, a set of rules — called a smart contract — is stored on the blockchain and executed automatically. A smart contract can define conditions for corporate bond transfers, include terms for travel insurance to be paid and much more.

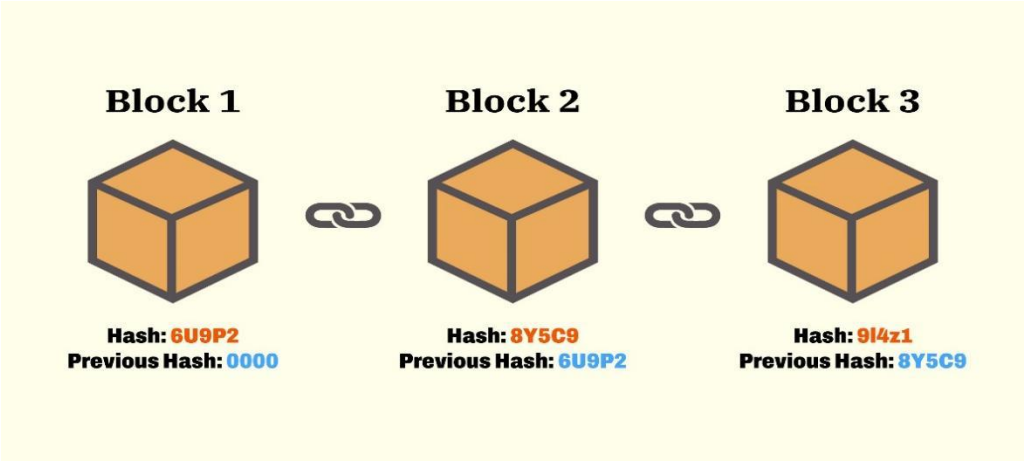

Figure 11. Blockchain Networking Diagram

- **How blockchain works**

1. **As each transaction occurs, it is recorded as a "block" of data**

   Those transactions show the movement of an asset that can be tangible (a product) or intangible (intellectual). The data block can record the information of your choice: who, what, when, where, how much and even the condition — such as the temperature of a food shipment.

2. **Each block is connected to the ones before and after it**

   These blocks form a chain of data as an asset moves from place to place or ownership changes hands. The blocks confirm the exact time and sequence of transactions, and the blocks link securely together to prevent any block from being altered or a block being inserted between two existing blocks.

3. **Transactions are blocked together in an irreversible chain: a blockchain**

   Each additional block strengthens the verification of the previous block and hence the entire blockchain. This renders the blockchain tamper-evident, delivering the key strength of immutability. This removes the possibility of tampering by a malicious actor — and builds a ledger of transactions you and other network members can trust.

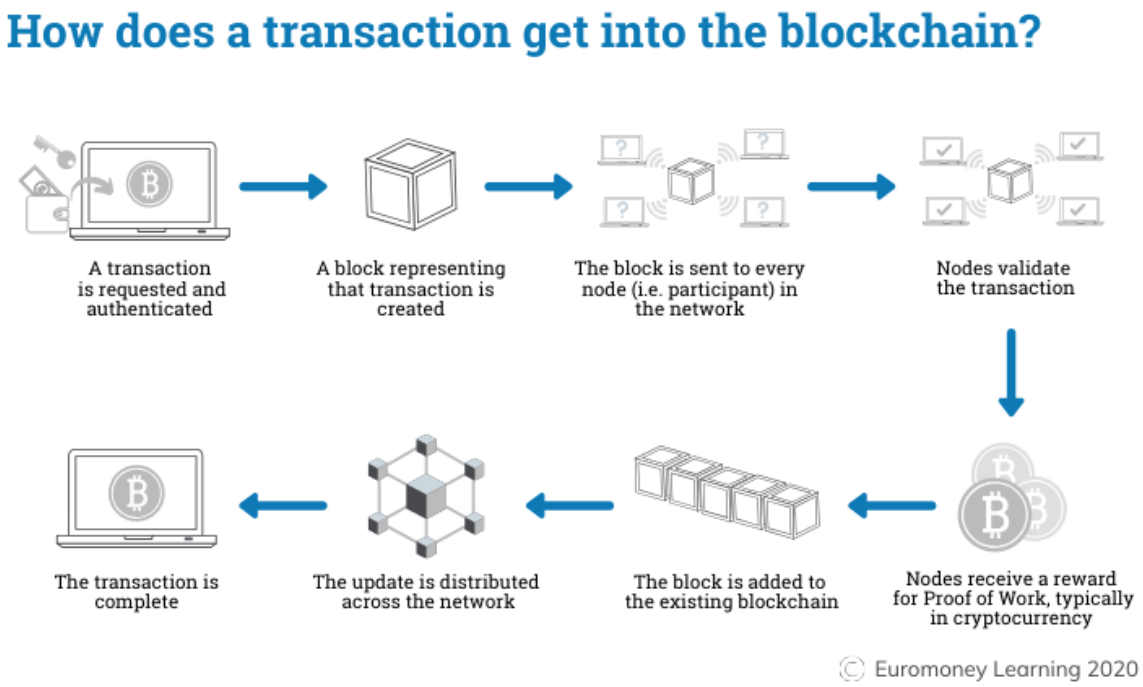

Figure 12. Working of Blockchain

7.1.2 BENEFITS OF BLOCKCHAIN

1. **Greater trust**

With blockchain, as a member of a members-only network, you can rest assured that you are receiving accurate and timely data, and that your confidential blockchain records will be shared only with network members to whom you have specifically granted access.

2. **Greater security**

Consensus on data accuracy is required from all network members, and all validated transactions are immutable because they are recorded permanently. No one, not even a system administrator, can delete a transaction.

3. **More efficiencies**

With a distributed ledger that is shared among members of a network, time-wasting record reconciliations are eliminated. And to speed transactions, a set of rules — called a smart contract — can be stored on the blockchain and executed automatically.

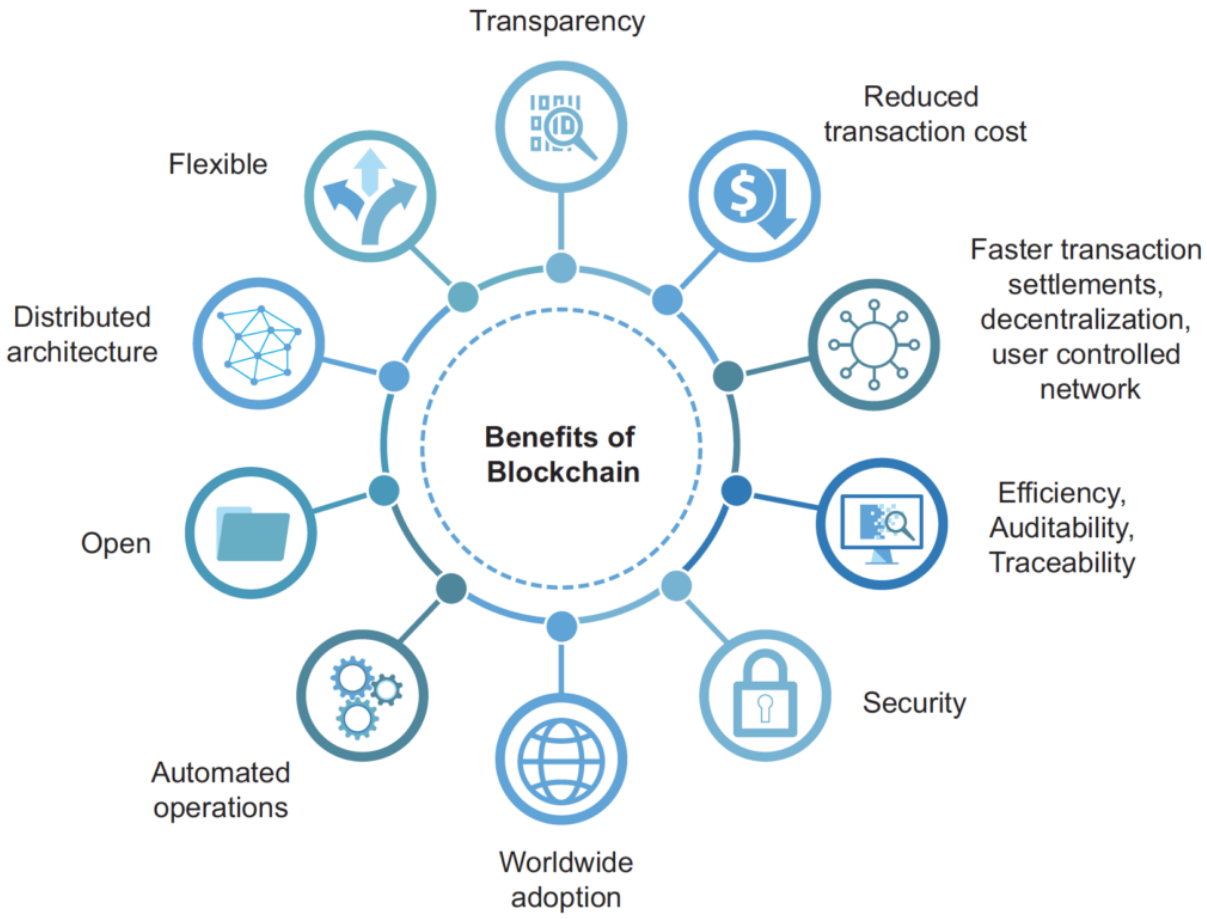

Figure 13. Benefits of Blockchain

7.2 CODING

Blockchain :

```
package Blockchain;
import java.sql.Connection;
import java.sql.ResultSet;
import java.sql.Statement;
import java.util.ArrayList;
public class Blockchain1 {
        public static ArrayList<Block> blockchain1 = new ArrayList<Block>();
        public static int difficulty = 5;
      public static String Previsblk="";
      public static int Blockchaindata(String data,Connection con,int id,String database)
      {
        try {
        String PrevHash=GetPreviousHash1(con);
        Dbconn.PrevHash1=PrevHash;
        blockchain1=GetChain1(con);
                        // if genasis
        int size=blockchain1.size();
        if(PrevHash=="0")
        {
        blockchain1.add(new Block(data, "0"));}
        else
        {
        blockchain1.add(new Block(data, PrevHash));
        }
        System.out.println("System Mine the Current Transaction Block ");
        blockchain1.get(size).mineBlock1(difficulty);
        // validation block chain
        if(isChainValid1(con)){
```

```
   System.out.println(" BlockChain Valid "+id);
    Dbconn.blockchain1msg=1;
    String msg="Valid";
    Block.blocklist.put(id, msg);
    }
    else
    {
                Dbconn.blockchain1msg=0;
                String msg="InValid";
         Block.blocklist.put(id, msg);
        System.out.println("Blockchain is Invalid "+id);
    }
    } catch (Exception e) {
                            }
    return Dbconn.blockchain1msg;
}
    public static ArrayList<Block> GetChain1(Connection con) throws Exception
{
    String previous="0";
    ArrayList<Block> wholeTransactionChain = new ArrayList<Block>();
    Statement stat = (Statement) con.createStatement();
    stat.executeQuery("select * from transhash");
    ResultSet rs = stat.getResultSet();
    int i=0;
    while (rs.next()) {
        if(i==0)
        wholeTransactionChain.add(new Block(rs.getString(2), "0"));
        else {
        wholeTransactionChain.add(new Block(rs.getString(2), previous));}
        previous=rs.getString(3);
        i++;
```

```
            }
            return wholeTransactionChain;
        }
      public static ArrayList<String> GetChainConsensus1(Connection  con) throws Exception
        {
            ArrayList<String> wholeTransactionChain = new ArrayList<>();
            Statement stat = (Statement) con.createStatement();
            stat.executeQuery("select * from transhash");
            ResultSet rs = stat.getResultSet();
             while (rs.next()) {
                wholeTransactionChain.add(rs.getString(2)+","+rs.getString(3)+","+rs.getString(4));
            }
            return wholeTransactionChain;
        }
       // its give the state it is a genasis block or not
public static String GetPreviousHash1(Connection con)
{
            String finalhash="0";
           try
           {
            Statement stat = (Statement) con.createStatement();
            stat.executeQuery("select * from transhash");
            ResultSet rs = stat.getResultSet();
            while (rs.next()) {
              finalhash= rs.getString(3);
             }
             }
catch(Exception ex)
{
}
   return finalhash;
```

```
}
// This is the strategy of consus algorithm, and its applicable for n nodes
      public static Boolean isChainValid1(Connection  con) throws Exception {
                ArrayList<String> CompleteList =new ArrayList<>();
            int flag=0;
            String hashTarget = new String(new char[difficulty]).replace('\0', '0');
            CompleteList =GetChainConsensus1(con);
            for(int startpoint=0; startpoint<CompleteList.size(); startpoint++)
            {
            String [] parts= CompleteList.get(startpoint).toString().split(",");
            String Chash=parts[2];
            if(startpoint==0) Previsblk=parts[1];
            else {
              if(!Previsblk.equals(Chash))
              {
                 flag=1;
                 System.out.println("Chash=>"+Chash);
                // break;
              }
             }

                 if(!parts[1].substring(0, difficulty).equals(hashTarget)) {
                                 System.out.println("This block hasn't been mined");
                                 flag=1; break;
                           }
           Previsblk=parts[1];
            }
                 if(flag==1)
            return false;
           else
              return true;
```

```
        }
}
```

Chain Consensus :

```
package Blockchain;

import java.sql.Connection;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.sql.Statement;
import java.util.Map.Entry;


public class ChainConsensus {

   public static int block1, block2, block3, block4;
   public static String T_id1, T_id2, T_id3, T_id4;
   public static int Node2 = 0, Node3 = 0, FP = 0, Node4 = 0, Node1 = 0, num = 0;

   public static void Consensus(String data, Connection con,int id,String database) {
      try {

         block1 = Blockchain1.Blockchaindata(data, con,id,database);
         //System.out.println(id+"\tData=>"+block1);

      } catch (Exception e) {

      }
   }

   public static void main(String[] args) {
```

```
//                  Consensus("String plaindata");
    }
}
```

Frontend :

```
package com.activity;
import java.io.IOException;
import java.io.PrintWriter;
import java.sql.Connection;
import java.sql.ResultSet;
import java.sql.Statement;

import javax.servlet.RequestDispatcher;
import javax.servlet.ServletException;
import javax.servlet.annotation.WebServlet;

import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import javax.servlet.http.HttpSession;

import com.connection.Dbconn;

/**
 * Servlet implementation class Login
 */
@WebServlet("/Login")
public class Login extends HttpServlet {
        private static final long serialVersionUID = 1L;
//         public static  int hitCount;
    /**
```

```
     * @see HttpServlet#HttpServlet()
     */
    public Login() {
        super();

        //
    }
    public void init() {
        // Reset hit counter.

     }
            /**
             * @see HttpServlet#doGet(HttpServletRequest request, HttpServletResponse response)
             */
            protected void doGet(HttpServletRequest request, HttpServletResponse response) throws
ServletException, IOException {
                        //
                        response.setContentType("text/html");
        PrintWriter out=response.getWriter();

        HttpSession session=request.getSession();
        session.invalidate();

        out.println("<script type=\"text/javascript\">");
                        out.println("alert('You are successfully logged out!');");
                        out.println("</script>");
        request.getRequestDispatcher("LoginPage.jsp").include(request, response);
        out.close();
            }

            /**
```

```
     * @see HttpServlet#doPost(HttpServletRequest request, HttpServletResponse response)
     */
    protected void doPost(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException {
        //
        HttpSession session=request.getSession(true);
        PrintWriter pw=response.getWriter();
        System.out.println("Login Servlet");
        String username=request.getParameter("username");
        String Password=request.getParameter("password");
        System.out.println("Email-ID=>"+username);
        System.out.println("Password=>"+Password);
        String uname = request.getParameter("rdo1");
        if(uname.equals("AdminInfo"))
        {
            if(username.equals("admin@gmail.com")&&Password.equals("admin"))
            {
                pw.println("<html><script>alert('Login
Successfully');</script><body>");
                pw.println("");
                pw.println("</body></html>");
                    RequestDispatcher rd = request
                            .getRequestDispatcher("/AdminProfile.jsp");
                rd.include(request, response);
            }
            else
            {
                pw.println("<html><script>alert('Incorrect Username or
Password.....');</script><body>");
                pw.println("");
                pw.println("</body></html>");
```

```
                    RequestDispatcher rd = request
                            .getRequestDispatcher("/LoginPage.jsp");
                    rd.include(request, response);
                }


            }
            else
            {
                Connection con;
                try
                {
                    con = Dbconn.conn();
                    Statement stRegister=con.createStatement();
                    ResultSet rsLogin;
                    rsLogin=stRegister.executeQuery("select * from userregistration
where Uemail='" +username+ "' and Upassword='"+Password+"'");
                    if(rsLogin.next())
                    {
                        session.setAttribute("name", rsLogin.getString(1));
                        session.setAttribute("email", username);
                        RequestDispatcher rd =
request.getRequestDispatcher("/UserHome.jsp");
                        rd.include(request, response);

                    }
                    else
                    {
                        pw.println("<script> alert(' Wrong UserName and
Password');</script>");
```

```
                                        RequestDispatcher rd =
request.getRequestDispatcher("/LoginPage.jsp");
                                                rd.include(request, response);

                        }
                }
                catch(Exception e)
                {
                        pw.println("<script> alert(' Unexpected Error');</script>");
                        RequestDispatcher rd =
request.getRequestDispatcher("/LoginPage.jsp");
                        rd.include(request, response);
                        e.printStackTrace();
                }

        }

    }

}
```

7.3 RESULT

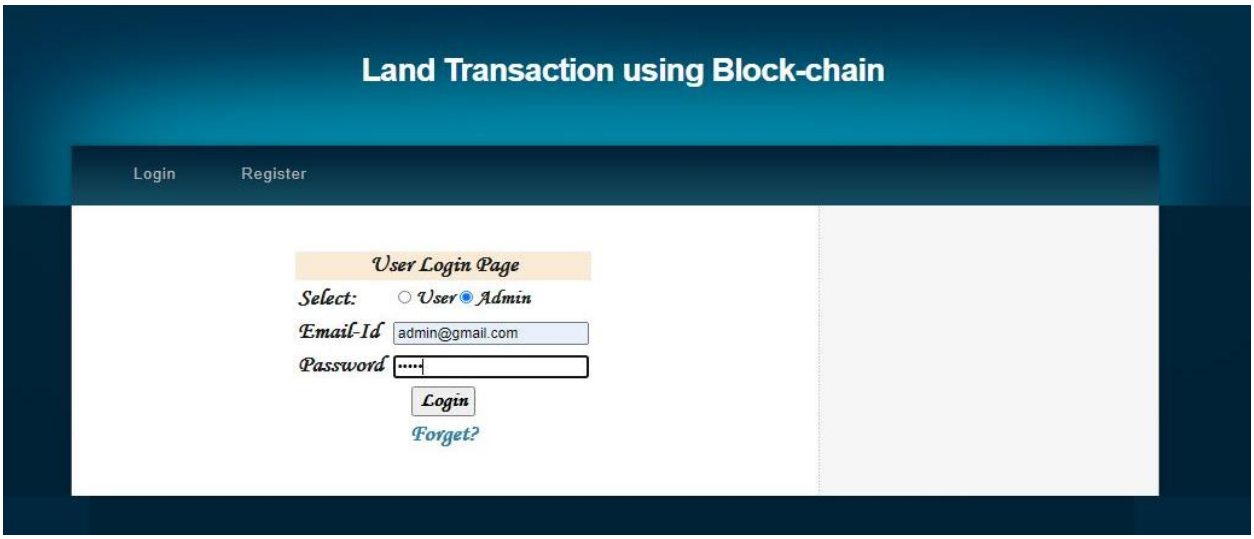

Figure 14. Output 1

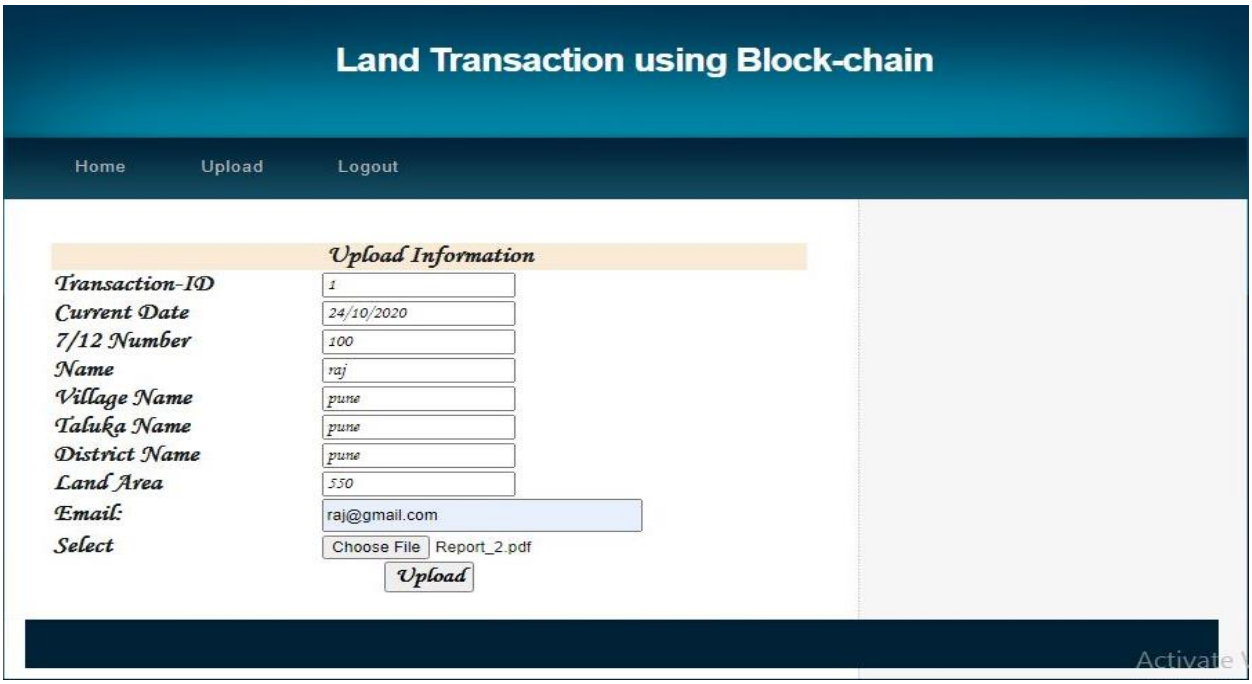

Figure 15. Output 2

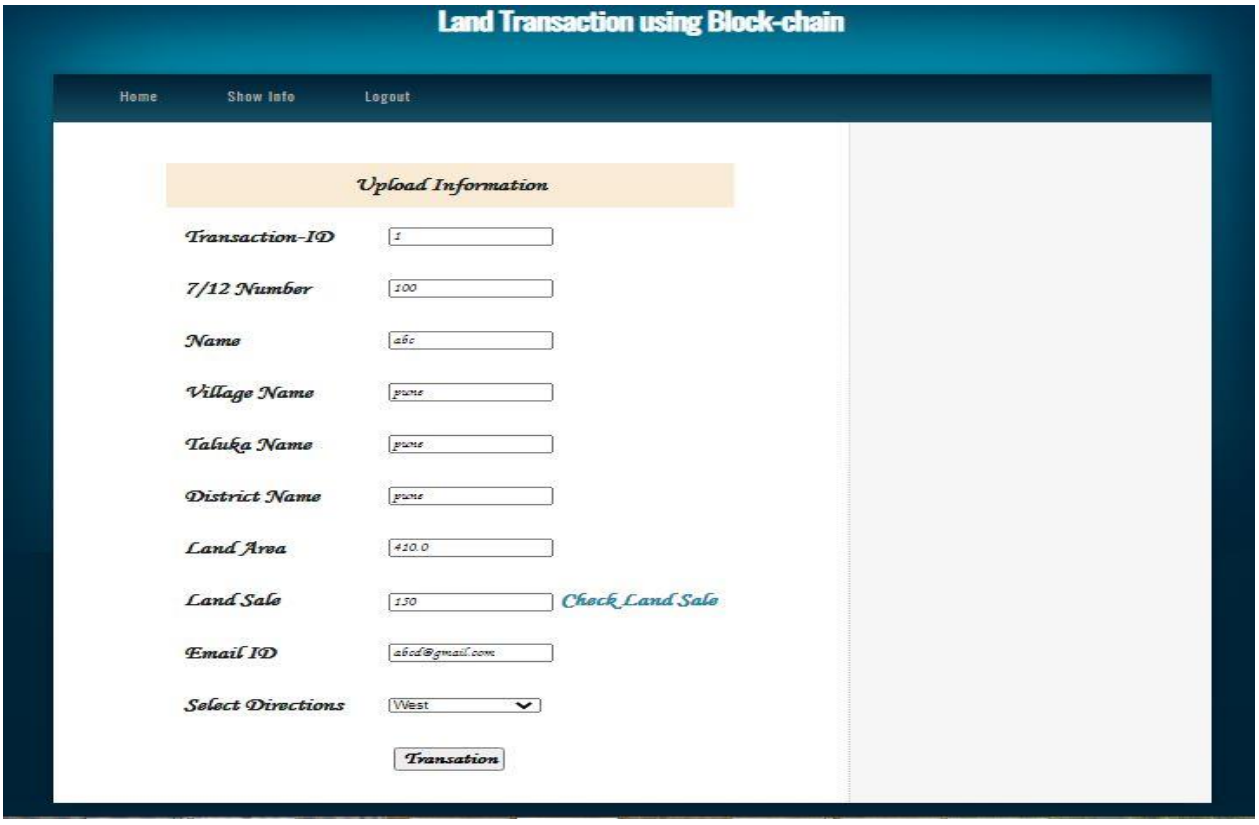

Figure 16. Output 3

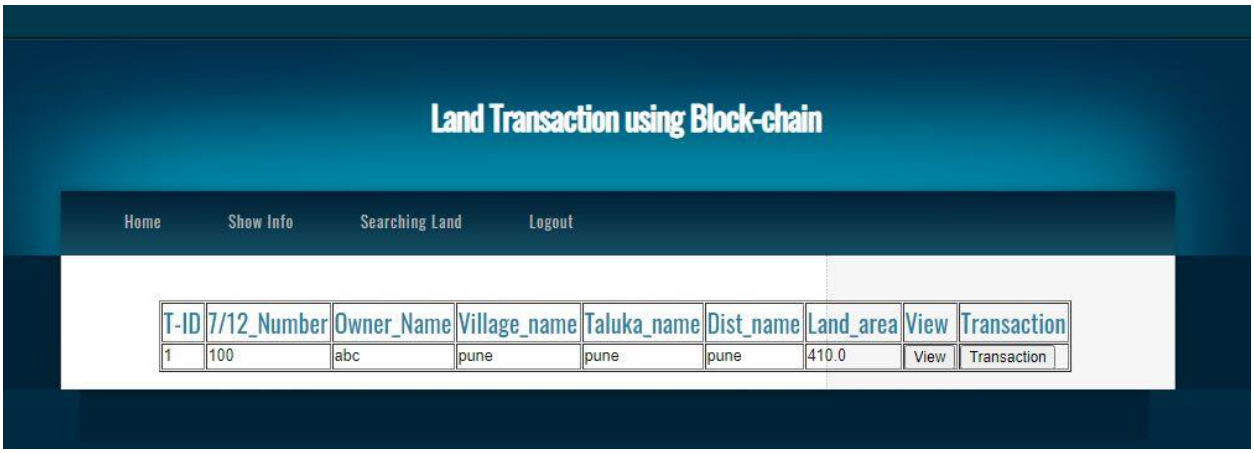

Figure 17. Output 4

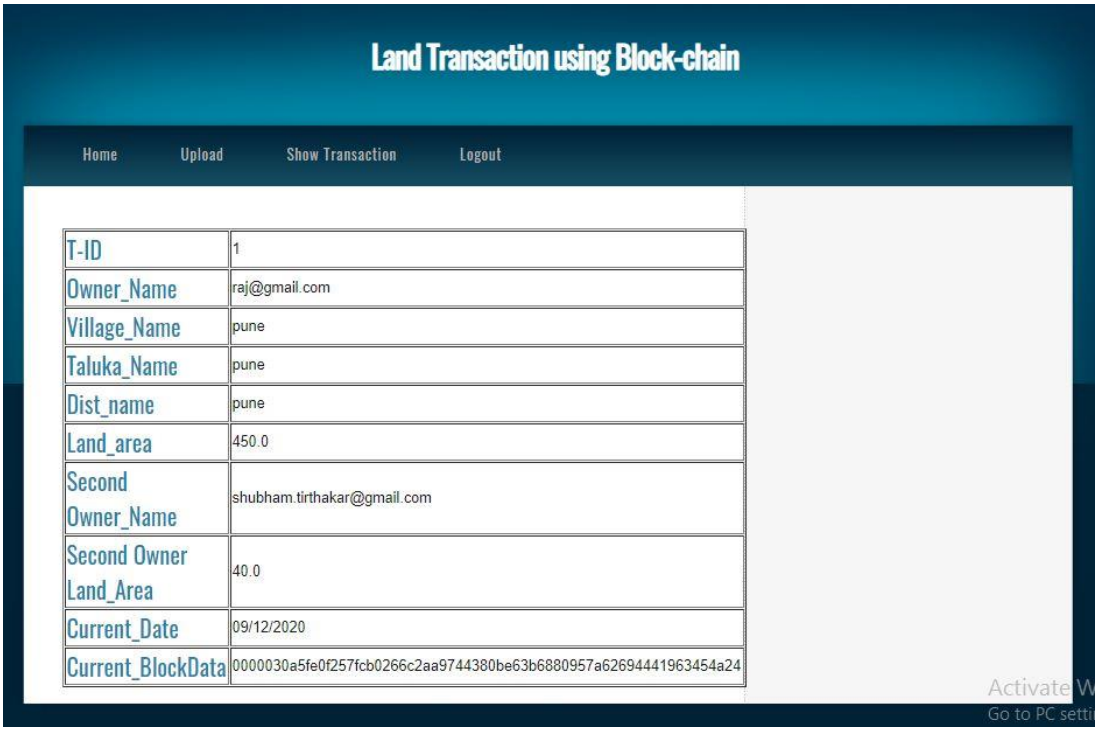

Figure 18. Output 5

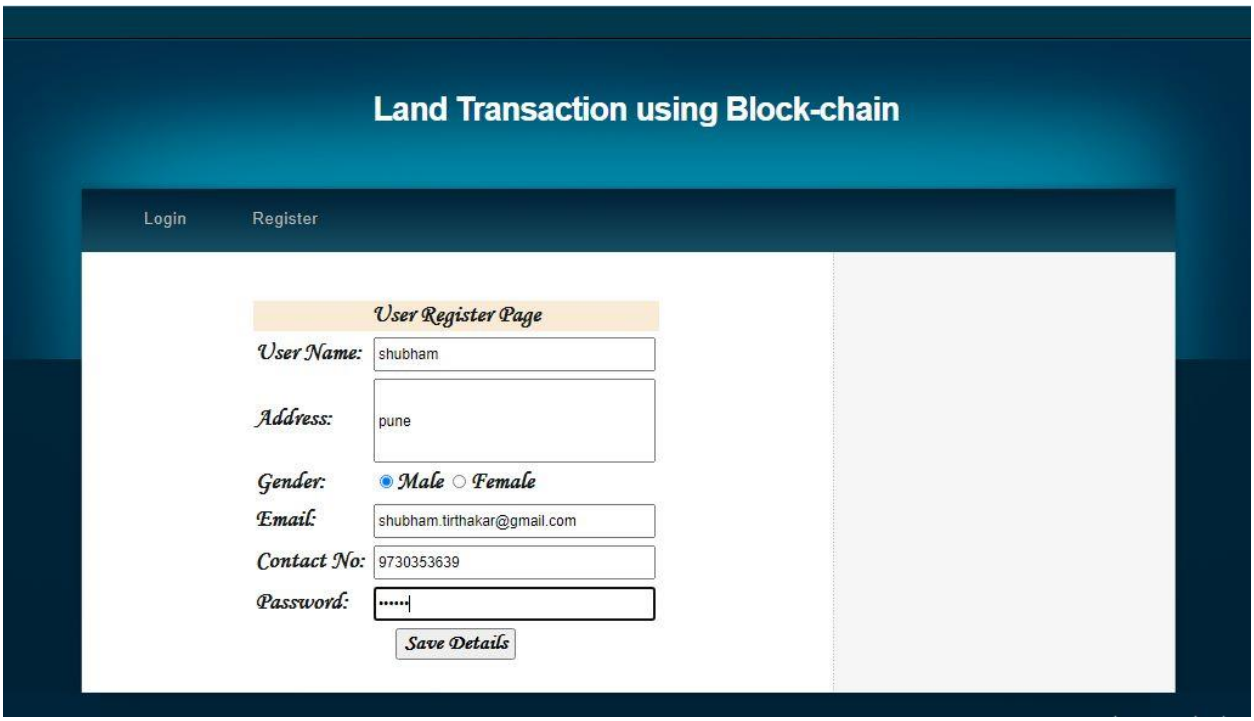

Figure 19. Output 6

Figure 20. Output 7

CHAPTER 8

TESTING

Chapter 8

TESTING

8.1 TESTING PRINCIPLES

This section explains about the basics testing principles, testing objectives, different phases of testing such as unit testing, integration testing, system testing. The test cases for the currently implemented system that is “electronic credentials verification system” is been explained below.

8.2 SOFTWARE TESTING

Software testing is an investigation done to ensure the participants with information regarding the quality of the system or service that is under testing. Software testing can also give an objective, individual perspective of the software to enable the business to appreciate and conceive the risks involved in implementation. The techniques for testing consist, but are not limited to, the process of running any software with the purpose of finding bugs or other defects. Software testing may be defined as a procedure to validate and verify that any software program/product:

1. Qualifies the prerequisites that guided its design and development.
2. Functions as expected.
3. Can be executed with the same properties.
4. Qualifies the necessities of owners.

Software testing, based on the testing methodology deployed, can be executed at any instance within the development cycle. But, much of the test effort traditionally happens after the prerequisites have been specified and the coding procedure has been finished. However, in the fast approach much of the test effort is, conversely, ongoing. As such, the methodology of testing revolves around the software development methodology used, Various software development cycles will perform the test effort at different stages in the development procedure. Latest development models often deploy test driven development and place a major chunk of testing in the hands of the developer, before it eventually reaches a formal team of testers. In traditional

approach, much of the test execution happens after the requirements have been specified and the coding procedure has finished.

8.3 PHASES OF SOFTWARE TESTING

Tests are frequently sorted according to where they are included within the software development cycle or by the extent of specificity of the test. The main layers during the development procedure are unit, integration, and system testing that can be differentiated by the test target without specifying any process model. Other test levels are grouped as per the test objective

8.3.1 UNIT TESTING

The foremost test in the development procedure is the unit test. The source code is usually subdivided into modules, which in turn are subdivided into tiny units called units. Each unit has unique behavior. The test done carried out on these units is referred to as unit test. Unit test is dependent upon the language on which the project is created. Unit tests guarantee that each different pathway of the project executes correctly as per the specifications that are documented and contains clearly specified inputs and expected outcomes.

The principal reasons of unit testing are to:

1. Verify the functionalities of the module under test
2. Find undiscovered errors
3. Ensure quality of software
4. Test the lowest level entity Unit testing is also called as white box testing and tries to ensure: I. Independent paths are exercised at least once. II. Logical decisions are exercised for both true and false paths. III. Loops are executed at their boundaries and within operational bounds.

8.3.2 SYSTEM TESTING

Several modules constitute a project. If the project is long-term project, several developers write the modules. Once all the modules are integrated, several errors may arise. The testing done at this stage is called system test. System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

8.4 KEY TYPES OF TESTING IN BLOCKCHAIN APPLICATION

1. API Testing: In API testing, we check that the interaction between applications in the blockchain ecosystem is as expected
2. Node Testing: All the blocks on the network should be tested individually to ensure proper coordination.
3. Functional Testing: In Functional Testing, we evaluate the work of various functional parts of the Blockchain (e.g., smart contracts). Below are the components that can be tested as part of functional Testing: 1) Block Size and Chain Size 2) Adding a Block 3) Data Transmission
4. Performance Testing: Details like network latency based on block size, network size, expected transaction size, and how long a query takes to return the output with the specialized authentication protocol
5. Security Testing: In this, we ensure that the application is vulnerable to attacks and Systems can protect the data and is capable of handling malicious attacks, etc.
6. Integration Testing: In Integration testing, we ensure that all the components of the application are integrated properly and performing the actions appropriately
7. Smart Contract Testing: Smart Contract testing is about performing detailed functional testing of business logic and process.

8.5 STEPS FOR TESTING THE BLOCKCHAIN APPLICATION

a. Initiation Phase: In this phase, we understand the blockchain architecture: and analyze the business and functional requirements based on which we describe the testing strategy for testing the application.
b. Design Phase: In this phase, we describe the test cases with proper steps, create test data from the previous environments and configure testing environment for the proposed system
c. Testing Phase: In this step, we conduct key testing types required for smooth functioning of the permissioned blockchain application listed above.
d. Report Phase: This report contains the details of testing of the implanted system, test data, and summary of the vulnerabilities found in the system

Test Case ID	Test Case Description	Expected Result	Actual Result	Result
TC01 Initiating Application	System initialization	When User runs and opens the application, the system should be available for use	As Expected	Pass
TC02 Admin Login	To verify that the administrator should login with the correct details.	The admin should be Registered and the page after admin login	As Expected	Pass

		should be displayed.		
TC03 Seller Login	To verify that the User (seller) should login with the correct details	The user should be Registered and the page after seller logging in, of upload land details should be displayed.	As Expected	Pass
TC04 Buyer Login	To verify that the User (buyer) should login with the correct details	The user should be Registered and the page after buyer logging in, of view page of land details should be displayed.	As Expected	Pass
TC 05 Message Seller	After receiving all land details is buyer bu land send message	Message should be send to seller	As expected	Pass
TC 06 Message receive	Message receive by buyer or owner	Message should be receive by real owner or valid user	As expected	Pass
TC 07 Land Ownership exchange	After confirmation of both seller and buyer the	Transfer of ownership should be done	As expected	Pass

	agreement will signed and ownership transferred			
TC 08 Final land title details	Land details document with land owner(old & new)	Report should contain all land owner's names and details	As Expected	Pass

Table 7. Test Cases

CHAPTER 9

ANALYSIS

Chapter 9

ANALYSIS

This section depicts the results of analysis conducted on the proposed system with respect to transaction rate for key blockchain parameters such as memory usage, execution time, latency and throughput with respect to varying number of virtual nodes in the non-centralized network.

Key Parameters	Value
Number of nodes (n)	4
Memory usage	6.5 GB
Number of Transactions (N)	16 tx
Execution time to transfer file	25 seconds
Latency	2 seconds
Throughput	0.5 tx/sec

Table 7. results of analysis

9.1 GRAPHS FOR ANALYSIS

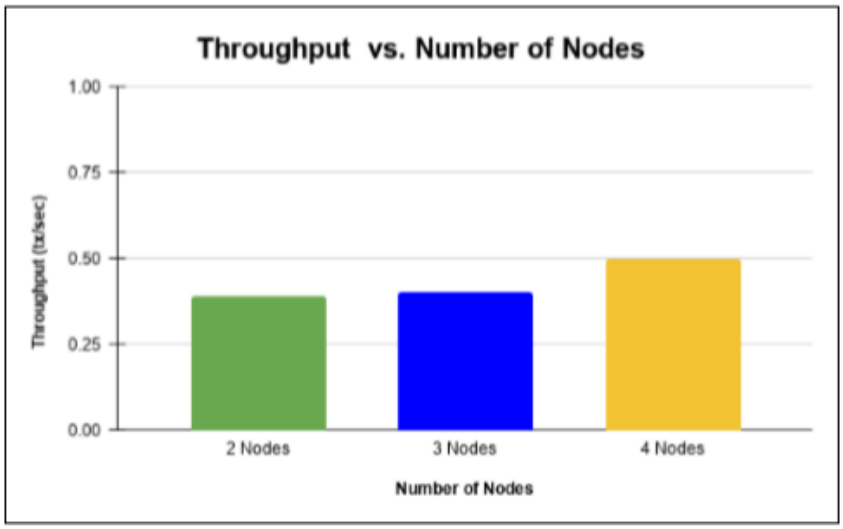

Figure 21. Throughput vs Number of Nodes Graph

The graph shows the plot of throughput across the network for varying number of nodes. Throughput denotes valid or confirmed blocks across all the nodes of the network. From the graph, we can see that throughput does vary not vary much with more nodes that Srepresents the network size

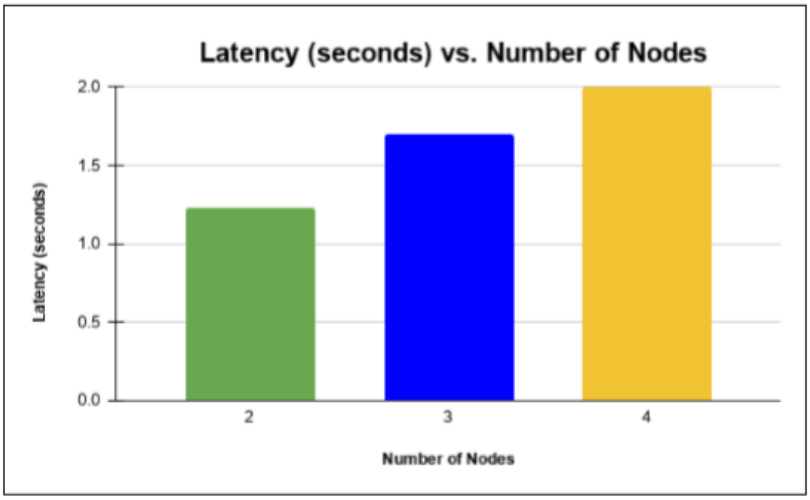

Figure 22. Latencyt vs Number of Nodes Graph

The graph shows the plot of latency across the network for varying number of nodes. It is the response time per transaction calculated by dividing the sum of response time of all transactions per unit time with number of transactions across the network. It is observed from the graph that there is a slight change in latency because with increase in the number of nodes the transaction rate also increases. When there are four nodes the transaction is confirmed after 2 seconds and takes 0.5 seconds for 2 nodes respectively.

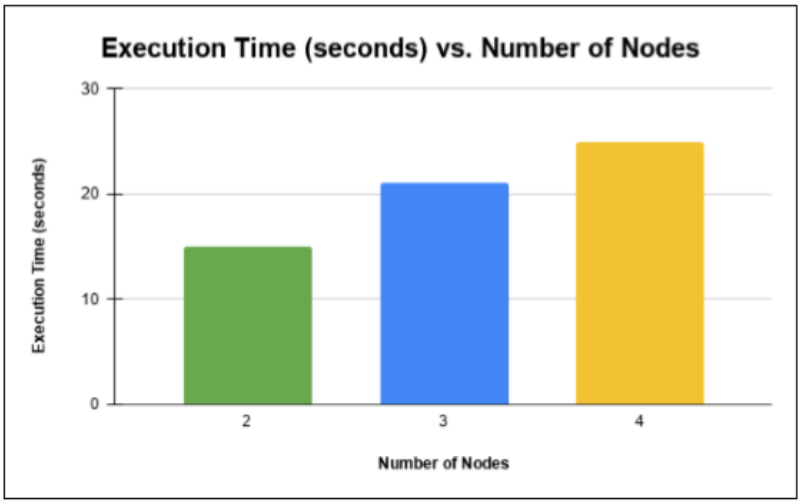

Figure 23. Execution Time vs Number of Nodes Graph

The graph shows the plot of execution time across the network for varying amounts of nodes. Execution time is the time required for a transaction to initiate and finish successfully. From the graph, it is observed that the execution rime increases with rise in nodes as the time required for consensus among the participants also increases.

CHAPTER 10

CONCLUSION AND FUTURE SCOPE

Chapter 10

CONCLUSION & FUTURE SCOPE

10.1 CONCLSION

The evaluation and analysis of a blockchain-based agriculture land registry system reveal several significant advantages and potential challenges. Overall, the utilization of blockchain technology in agriculture land registries has the potential to revolutionize the sector by enhancing transparency, efficiency, and security. One of the key benefits of a blockchain-based land registry system is the transparency it offers. By utilizing distributed ledger technology, all transactions and changes made to land ownership records are recorded and stored in a decentralized manner, accessible to all authorized participants. This transparency reduces the risk of fraudulent activities and disputes, as the immutable nature of blockchain ensures the integrity of the data. Furthermore, the efficiency of land registry processes can be greatly improved through blockchain implementation. The elimination of manual paperwork and intermediaries streamlines the transfer of land ownership, reducing administrative burdens and costs. Smart contracts, a feature of blockchain technology, enable the automation of various aspects, such as verifying ownership, transferring titles, and executing payments, thereby expediting the entire process.

10.1 FUTURE SCOPE

The future scope for evaluating and analyzing a blockchain-based agriculture land registry system is promising. Here are some potential areas of focus:

1. Efficiency and Transparency: Evaluate how the blockchain technology improves the efficiency and transparency of the land registry system. Explore the extent to which blockchain eliminates the need for intermediaries, reduces paperwork, and automates processes, thereby increasing efficiency and reducing the scope for fraud.
2. Security and Data Integrity: Analyze the security aspects of the blockchain-based land registry system. Assess how the distributed ledger technology ensures data integrity, prevents tampering, and provides a robust system for recording and verifying land ownership and transactions.

3. Interoperability and Standardization: Evaluate the potential for interoperability and standardization of blockchain-based land registry systems across different jurisdictions. Explore how blockchain can facilitate seamless integration with existing land administration systems and promote uniformity in land registration processes.
4. Smart Contracts and Automation: Investigate the use of smart contracts in the agriculture land registry system. Assess how automated execution of agreements and the enforcement of predefined conditions can streamline land transactions, such as lease agreements, sale contracts, and property transfers.
5. Data Accessibility and Governance: Examine the accessibility of land registry data stored on the blockchain. Analyze the mechanisms in place to ensure appropriate access rights, data privacy, and data governance. Evaluate how the blockchain system can facilitate secure data sharing and provide controlled access to relevant stakeholders.
6. Scalability and Performance: Assess the scalability and performance of the blockchain-based land registry system. Explore the system's capacity to handle a large number of land transactions, especially in regions with high land market activity, and analyze the associated network requirements, such as transaction speed, storage capacity, and consensus algorithms.
7. Adoption Challenges and User Experience: Identify potential challenges to the adoption of blockchain-based land registry systems. Evaluate the user experience, training needs, and infrastructure requirements for implementing and maintaining the system. Assess the readiness of stakeholders, including government agencies, landowners, farmers, and other participants, to embrace the technology.
8. Economic Impact and Benefits: Examine the economic impact and benefits of implementing a blockchain-based land registry system in the agricultural sector. Analyze how the system can enhance land market liquidity, facilitate access to credit, improve land valuation, and enable efficient resource allocation in agriculture.
9. Case Studies and Pilots: Investigate existing case studies and pilots of blockchain-based land registry systems in agriculture. Analyze their outcomes, challenges, and lessons learned to derive insights and recommendations for future implementations.
10. Regulatory and Legal Framework: Assess the regulatory and legal framework required to support blockchain-based land registry systems. Analyze the compatibility of blockchain

technology with existing land laws and regulations, and propose any necessary amendments or guidelines to ensure legal validity and enforceability.

Overall, evaluating and analyzing a blockchain-based agriculture land registry system involves assessing the technology's impact on efficiency, transparency, security, interoperability, automation, data governance, scalability, adoption challenges, economic benefits, legal implications, and lessons learned from existing implementations. Such an analysis can provide valuable insights for policymakers, land administrators, and stakeholders involved in the agriculture sector.

CHAPTER 11

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Chapter 8

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