A PROJECT REPORT

ON

"EDUCATION RECORDS MANAGEMENT SYSTEM USING BLOCKCHAIN"

Submitted to

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY) COLLEGE OF ENGINEERING, PUNE, INDIA

In Partial Fulfillment of the Requirement for the Award of

BACHELOR'S DEGREE IN
COMPUTER SCIENCE AND BUSINESS SYSTEMS

BY

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UNDER THE GUIDANCE OF
Dr. Bindu Garg

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

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, PUNE, INDIA - 411043

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CERTIFICATE

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"Education Records Management System using Blockchain "

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is a record of Bonafede work carried out by them, in the partial fulfillment of the requirement for the award of Degree of Bachelor of Technology in Computer Science and Business Systems at Bharati Vidyapeeth (Deemed to Be University) College of Engineering, Pune, India. This work is done during academic year 2022-23

Date: **11/05/ 2023**

Signature	Signature	Signature
Prof. Dr. Bindu Garg HOD, CSBS & CSE Engineering	(Dr. Bindu Garg) Project Guide	(NAME OF THE EXTERNAL) External Examiner

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Aditya Aman
Vanshita Jain
Rohan Awsarkar
Aum Radia

ABSTRACT

New technologies are constantly attracting education professionals and education planners of all levels to make the most of them to overcome obstacles and improve the learning and teaching skills of teachers and students. Some of the improvements are: Big data, data analytics and more use of artificial intelligence.
Another emerging area of interest in the education sector is the use of blockchain technology.

Recently, blockchain technology has been attracting attention in the field of education. This is primarily due to special features including segmentation, security, reliability, and data integrity.

In this project , our current goal is that we are going to implement Blockchain on Student Management system which helps in providing security to the stored data , protects and prevents data from any sort of manipulation or tampering and and our extended goal is to makes data easy to share to genuine individuals or organization.

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Chapter 1

Introduction

Education is a powerful method or tool which is used for development. Education can be called as a strongest instrument which can eradicate poverty, improve healthcare, create peace and equality as well as improve technological reach and use for us. But sadly education - the method which has this level of importance is highly neglected for years.

If we tend to compare educational technique as a method with methods of different domains like communication, transportation, healthcare we could see a lot has evolved and it is still evolving, but in majority parts of the world education is still being carried out in the same classes with same method and same technique for storing academic records of students that were used 50 or 60 years ago. As these methods and technology are not improving and evolving, it is getting easier to find loopholes in the system and these loopholes are being used against the principles on which education system stands.

The Loopholes we are pointing at are Forging certificates issued by the institution, as these certificates are provided in physical format or in digital format, which allows forgers to forge the document very conveniently. This is a huge concern not only for the institution but also for the company's which employee students as they spend huge time and money in verification of the certificates. Another Loophole is the manipulation of academic grades or academics records, institutes tend to use databases to store various information's, these databases are password protected, and the key relies with the admin. The institution solely functions, based on its records. If someone is able to manipulate the middleman i.e., the admin, they could manipulate the database, by the changes they desire.

The solution these problem is one of the most emerging technology Blockchain. The currently used system is centralized. Implementation of Blockchain in education sector will result in great success. Even though many research has been already done in this particular field but there are some improvements & changes which can be done which we are going to propose in this paper. It follows a new methodology which will result in advancement of the blockchain technology in educational sector. And we will try to overcome the short comings we found out in currently used blockchain based solution.

Blockchain will provide a secure way to store and view these documents to avoid the problems faced in the digitalization of education industry. Blockchain technology can be used to create tamper-proof and immutable educational certificates. These certificates can be stored on a blockchain, where they are accessible to authorized parties and can be easily verified for authenticity. This can help to combat fraud and make it easier for students to share their educational credentials with potential employers or educational institutions. Additionally, blockchain-based systems can automate the process of issuing, verifying, and sharing educational certificates, making it more efficient and cost-effective for all parties involved.

Blockchain technology is decentralized means there is not central authority, the power is distributed equally. Blockchain technology is immutable which means it once a data is recorded/stored in the blockchain it cannot be changed/altered. With the help of smart contracts many small processes can be automated. This will help in increasing speed, and would save a lot of time. The data stored in the blockchain is stored cryptographically which prevents it from cyberattacks.

By using blockchain we are going to create a secure network. The organization and the students will be registered on the blockchain. Each student will be allotted a block of chains. There will be two keys used in our proposed methodology a public key and a private key. The private key will be only be made available to two parties 1) Organization 2) Students. Using the private key organization will be able to change the node, issue certificates, etc. Student will also be provided with the private key as they need to have control over their own blocks. Once the transaction is made it cannot be reversed. Students can share the public key to third parties which will allow them to view the data and can be easily verified

Thus all the problems discussed above like cyberattacks, fake certificates, misuse of power will be eliminated. We will try to make the whole process easy to use, efficient, fast, with interactive and user friendly UI.

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Chapter 2

Project Planning

Blockchain is a system for recording information in a way that makes it difficult or impossible to change, hack, or cheat the system. Blockchain is a dynamic digital transaction log and distributed across a network of computer programs on the blockchain. Each block in the series contains a number of activities, and each time a new activity occurs in a blockchain, a record of that purchase is added to each participant's book. A multi-participant shared site is known as Distributed Ledger Technology (DLT) .

Blockchain is a type of DLT where transactions are recorded with a static cryptographic signature called hash. This means that if one block in one chain is replaced, it will immediately become apparent that it has been stolen. If criminals want to damage the blockchain system, they will have to change all the chain blocks, in all the distributed versions of the chain.

In our project, we are going to develop a decentralized application (dApp) that securely stores student information and allows for easy verification by corporates. This will save time and resources, prevent forgery, and minimize the risk of tampering with documents.

The dApp will be designed to store and manage student information, including their academic records, achievements, and personal details. It will also allow corporates to access this information for verification purposes, without the need for physical documents. The dApp will be built on a blockchain network, enabling secure and transparent data management.

Key Deliverables:

1. A functional dApp that allows for easy storage and management of student information.
2. Integration of smart contracts to ensure secure data access and transfer.
3. A user-friendly interface that allows students and corporates to easily access and verify information.
4. A robust data backup and recovery system to prevent data loss.

Timeline:

Our project will be divided into 4 phases:

Phase 1 - Research and Planning (2 weeks)

- Conduct research on existing dApps and blockchain networks.
- Analyze user requirements and design a blueprint for the dApp.
- Plan the development process and finalize the project timelines.

Phase 2 - Development (12 weeks)

- Develop the dApp with necessary features and functionalities.
- Integrate smart contracts for secure data access and transfer.
- Test the dApp for any bugs or glitches.
- Ensure compliance with data privacy laws and regulations

Phase 3 - Deployment and Testing (4 weeks)

- Deploy the dApp on the blockchain network.
- Conduct system testing and user acceptance testing.
- Address any issues or bugs identified during testing.

Phase 4 - Maintenance and Support (Ongoing)

- Provide ongoing maintenance and support for the dApp.
- Continuously monitor and enhance the system to meet changing user needs.
- Address any security threats or vulnerabilities that may arise.

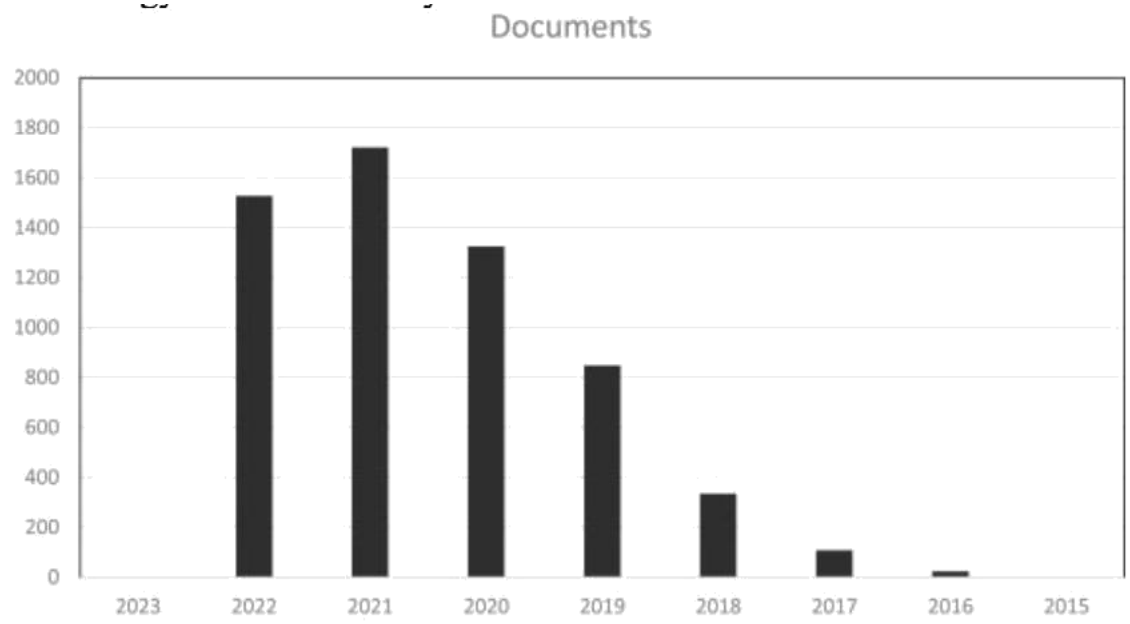
Chapter 3

Literature Survey

Many excellent research papers have already been published since Blockchain came into existence on the topic of our paper and since then, there have been incredible advancements in this technology, with its implementation in different aspects of our lives and the educational industry.

For our paper, we studied a few of them (the latest) to get to know to which extent and how blockchain has been used in the educational stream and learn from them.

In the [1] paper of 2023, Dubey, Gupta, Mikalef and Akter gave us a deep sumary of all the other research papers that been published till now and why should we focus on blockchain technology in information systems research



According to the study of these publications, peer-reviewed articles make up around 90% of them. But after carefully examining these publications, they stated that very few of them actually contribute to the theory's development and testing. The majority of research publications either describe blockchain technology in detail or concentrate on its technical aspects. Second, it is still unclear under what circumstances blockchain technology works best.

Blockchain has a lot to offer to the field of education, Christian Delgado-von-Eitzen, Luis Anido-Rifón and Manuel J. Fernández-Iglesias in their paper [2] told us that recent research and publications have demonstrated its potential in a number of initiatives through their work. Due to these features, new opportunities can be created to improve the security, trust, and effective use of academic material, as well as to issue, trade, exploit, and verify it while maintaining security.

In paper [2] we found out that a paper of 2018 [8] by Badyal and Chowdhary, where they propose a service to issue academic credentials that recruiters can validate. The Hyperledger Fabric framework is used in the implementation, and the authors talk about a proof of concept for this project. Their technology is conceptually modelled as a DLCC (Digital Learning Chain Structure) blockchain that extends the Bitcoin architecture. The operations between students and universities are autonomously carried out using smart contracts: a grade book is queried, progress is evaluated, and bitcoin is sent to the student's account if the criteria are met. The paper also contains the findings of empirical study on the perceptions of Bitcoin and the suggested platform among students.

The paper by Siddharth Badyal and Akash Chowdhary discuss about an service (Alumni Chain) that allows university to update students records on the block ,and the student enlist a code related to the certificate in CV and recruiter could scan the code to verify the certificates.[8]

Open source version of the Linux hyperledger is used to build and deploy their proof of concept, blockchain network and this was a clear choice because of the vast set of tools that it offers that really simplifies the development process and is easily scalable.

Paper [4] has first carried out a more thorough analysis of blockchain technology, including its overview, consensus algorithms, smart contracts, and cryptography. It gave a brief history of blockchain technology before comparing the five most popular consensus algorithms with one most unique consensus algorithm. For the integrity, authentication, nonrepudiation, and payment address necessary in blockchain systems, public key cryptography, Zero-Knowledge Proof, and hash functions have been explained in detail. Following that, this paper has provided a thorough list of blockchain applications. Additional topics covered include supply chain as a common use case, Smart Dubai Office as the first application for a full government function, and rich information and comparisons of eight cryptocurrencies as the first blockchain application.

[5] was a article that talked about the promises and challenges of blockchain in educational industry, they concluded with, blockchain in and for education is a plausible forecast of an upcoming all–encompassing mega transformation yet, as a technology, it is subject to the principle of magnification and reduction, that is, “For every enhancement of some feature, perhaps never before seen, there is also a reduction of other features.”

Blockchain in education: opportunities, application and challenges by Mara- Florina Steiu [6[discussed the advantages and difficulties of using blockchain technology in education. The digitalization and decentralisation of educational credentials, as well as the promotion and motivation for lifelong learning, are the main blockchain uses in education that have been considered. Data protection regulations, such as the General Data Protection Regulation and the California Consumer Protection Act, which present obstacles for application developers, are some of the main issues discussed. Scalability issues that result from slow-speed blockchain transactions and the Scaling Trilemma are also discussed.

Two important research questions are addressed by this study. How might blockchain technology enhance student learning and educational institution performance, first? What second-order barriers exist for implementing blockchain in the education sector? In this context, this study explored some of the primary advantages of using blockchain in education, such as boosting student, business, and educational institution security and efficiency, and generally integrating greater trust and transparency into transactions in our society. The study examined blockchain applications in education with a focus on projects for certification and identity management (Digital Credentials Consortium, Open Source University, BCDiploma), as well as programmes that encourage lifelong learning (BitDegree, Odem.io). In parallel, issues related to law, scalability, data privacy and security, market adoption, and other issues were considered.

Patrick Ocheja, Friday Joseph Agbo, Brendan Flanagan and Hiroaki Ogata [7] did a bibliometric and qualitative examination of blockchain research in education in their research paper. Their bibliometric analysis provided information on the field's current situation, including the expansion of research publications and citations, author contributions, contributions from diverse research communities, co-occurrence patterns, and thematic progression. There article also demonstrated the dearth of cross-network partnerships and a blockchain-focused community in education research. Only a small number of publications offered a practical answer or even integrated with a fundamental educational system, according to their qualitative investigation using content analysis.

Additionally, they discovered that compared to other blockchain in education use cases, the use of blockchain to issue and verify academic diplomas has attracted more attention over time.

The paper by Sergio Guerreiro, Joao F. Ferreira discuss about converting an existing academic management system (FenixEdu) into Blockchain based AMS.It enables certificates to be deployed in Ethereum blockchain and paper discusses about smart contracts to support the decentralized verification of higher education certificates. It allows HEIs to register the certificates they issue in the blockchain and recruit organizations to check the authenticity and integrity of these certificates.[9]

The paper by Valentin Kuleto investigates an alternative in which HEIs are included in the blockchain network to provide the best possible sustainable education system. In terms of practical implications in HE, blockchain can be applied to MOOCs, AR, VR, Gamification, and Videoconference.[10]

The paper by Nikolaos Nousias discuss about a platform called VerDe which is a blockchain-based facility for the registration and verification of academic qualifications.[11]

The paper by Emran-Yasser discuss about an application Unichain which is an Ethereum based system to issue and manage academic certificates that can be accessed and shared among students, universities and other third parties, while keeping students’ privacy by means of time-based smart contracts .[12]

An initiative to share exam questions and protect them from being leaked is proposed and analyzed by Islam et al . Question papers are encrypted with a timestamp and trustfully stored in the blockchain with a smart contract that controls when they can be accessed. The actual blockchain technology to be applied is not specified. The authors also propose an algorithm to randomly select a question paper.[13]

[14] study analyzed the emerging blockchain technology and its potential ramifications in healthcare and financial services. The blockchain technology provides a decentralized network and is considered to have tremendous potential for use in healthcare and financial services, due to the sensitive nature of the collection and management of data. The review aimed at defining the existing state of blockchain in healthcare and financial services and the current implementations in these industries. To achieve this aim, they have taken into account numerous scholarly publications concerning healthcare and financial services and challenges. there findings indicate that blockchain technology has tremendously changed the healthcare sector and financial sector in the area of storage of data, processing of data, transaction, security, and so on based on its current implementation stage. Therefore, Blockchain technology help replaces paper-based and manual transaction processing in financial services and healthcare provides new models for electronic medical records and financial payments. It is found that blockchain technology facilitates for the improvement of quality services in the healthcare sector and various research agendas are proposed to carry out further research for patient satisfaction and comfortability.

[15] research shows that blockchain-based online course design is suitable to use a variety of teaching methods to obtain qualitative and quantitative process-based and outcome-based data, win the trust of multiple parties and enhance students' learning effectiveness. Specifically, for the discipline with strong theory and practice, we can take the index-oriented method of competence evaluation into consideration, adopt the form of research group, obtain the leadership support, and get better online course design and evaluation effect.

Bhaskar P presents in his [16] research paper an attempt to deeply explore, identify, and categorize the perceptions of academic and administrative staff toward the barriers in applying blockchain in HEIs. According to the findings in the current research, several barriers have led to the low adoption rate of blockchain in HEIs. The findings indicated 15 challenges based on the TOE framework classified into the following three perspectives: technological, organizational, and environmental. The technological challenges are as follows: (1) immaturity; (2) poor usability; (3) security issues; (4) privacy; (5) lack of scalability; (6) limited interoperability; (7) integration complexity; (8) immutability and lack of flexibility; and (9) unavailability. In the organizational context, there is (10) a lack of adequate skills; (11) financial barriers; and (12) a lack of management commitment and support. Additionally, in the environmental context, there are (13) legal issues and lack of regulatory compliance; (14) market and ecosystem readiness; and (15) sustainability concerns.

Basically in [17] research paper, Navin Duwadi tells that the use of blockchain technology in education is still in its initial phase. As a result, a review of current blockchain research in the field of education is required to identify specific research gaps that should be addressed in future research. The goal of this research was to give a thorough examination of blockchain applications in the sector of education.

The research paper from 2017 they state that block chain is a chain of blocks , a complex evolving technology with tremendous potential and less associated risk that has no intermediaries.

In recruitment process resume is asked and based on it the student is judged , there are 2 challenges of it: Information included in the CV is truth full accreditation of complex and custom learning records BC would prove the elements of a CV prepared by the user, preventing the manipulation or alteration of data scattered across a distributed system without storing

The data in a center vulnerable to attacks or violations of its integrity. It would work as a "test of intellectual work" and, going further, as a "local currency". It would be a technology that can ensure "accredited educational records faithfully combined with a negotiable Reputation system" and the first benefit is obviously a transinstitutional accreditation system (Sharples & Domingue, 2016). This is a change that will have a great impact on the education system, but will also, according to some authors, take more than 4 years to be implemented Applications:

In 2016 MIT developed a project called blockcert short and simple: users download the Blockcerts app and are offered a private pass phrase to ensure ownership; afterwards, they add credential issuers to their apps; lastly, they receive, manage, and distribute credentials BitDegree was gamified online education platform that provides users learning incentives such as tokenized scholarships for completing tech courses or reaching learning milestones on BitDegree. The BitDegree team claims that the BDG token will track educational achievement data and will reward the parties engaged within the platform (e.g., learners, course providers, community contributors).

The papers from 2021, they tell us that blcokchain is being implemented in many streams including medical, industrial, accounting, educational, etc. Blockchain has been implemented in the eductional stream before, the Roles of Blockchain Technology in the Education Sector that has been found are:

1. Helps Verify Student Records and Accreditation

2. Reduce Academic Fraud Charges

3. Distribute Online Learning

4. Protection of Copyright and Digital Rights Violations

5. Creating Better Learning Platforms

The papers talk about benefits of storing data in BC like:

• if the student is storing data on BC without having any central authority , the student can store their life long data in it .

• BC is secured , by hash function. Therefore it makes it difficult to alter the data once stored.

• The paper talks about solving money related issue by accepting blockchain based current like King’s College in New York City accept bitcoin as payment. Its not just about institution related work but a students outside learning proofs can also be stored using BC.

There are various challenges related to the BC in education:

• Integration with asset plans

Even if organization decide to use the blockchain, they need to completely redesign their previous system, or devise a way to successfully integrate the two technologies. Due to the lack of skilled developers, organizations are unable to access the required pool of blockchain talent to participate in the process.

• Growth of Blockchain:

One major blockchain technology challenge is related to network technological scalability that can complicate the adoption process, Visa, for example, is able to process more than 2000 transactions per second. However, the two major blockchain networks, Bitcoin and Ethereum, are far behind when it comes to transaction speed. While the Bitcoin blockchain can process three to seven transactions per second, Ethereum can handle up to 20 transactions per second. This lack of scalability is not such an issue in private blockchain networks but in public network.

• Blockchain has natural costs

Most blockchain technologies follow bitcoins infrastructure and use Proof of Work (PoW) as a mutually agreeable way to verify transactions. These protocols require users to solve mathematical dilemmas and require considerable computing power to verify and process the operation and security of the network.

• Lack of blockchain developers

While the demand for professional blockchain staff is growing exponentially, the blockchain environment is facing a severe shortage of adequately trained and skilled / qualified people to develop and manage the complexity of peer-to-peer networks.

In 2022 papers there were more complex topics that were discussed like Hybrid blockchain, centralised ledgers that were implemented for avoiding CFTs and BFTs. Blockchain implementation in the Fisheries supply chain.

• During the epidemic, educational institutions jumped on the digitising bandwagon. As a result of the revolutionary nature of blockchain technology, this industry may see a dramatic shift having:

1. Intelligent Agreements for Courses and Assignments

2. Certifications, Report Cards, And Documentation

3. Streamlining the Payments of Fee

4. Universal Admittance and Lower Expense

• Hybrid blockchain databases are decentralized systems that have three key components, namely,

(1) a shared database that uses a storage engine such as MySQL, MongoDB, Redis, among others,

(2) a shared ledger replicated via a consensus mechanism such as Kafka (CFT) and Tendermint (BFT), among others, and

(3) a user interface (API) that usually supports a simple key-value (KV) store with put and get operation.

From studying various paper we conclude that these paper are basically based and made on what is block chain , what are the application of block chain ,what are its advantage and what are the disadavantage .

These paper do not talk much about implementation of the application , they at last state various disadvantage because of which implementation could not take place . These paper also state that may be in future it may get implemented .

The applications are mentioned only of MIT and startup, which can also be in for experimentation nothing full proof has been implemented .

Chapter 4

Requirement Analysis

Creating a blockchain is no joke, no person could just one day become a master of blockchain developing skill. There are set of skills that a person must acquire to build a blockchain. These skills are:

- **Data Structure-**

Data Structure is the first essential skill that a Blockchain programmer should have. For the advancement and deployment of systems, blockchain engineers must engage with the data structures skill promptly. The entire Blockchain system is made up of data structures. Moreover, we can also say that a block is indeed a data structure.

With encapsulated data structures and a public ledger acting as a blockchain, a block behaves like a group of transactional activities connected to an open ledger.

Data structures are one of the most important blockchain skills because they help you understand the basic behavior of blocks, the most important element in blockchain.

In blockchain platforms, some blocks consist of headers. Well, this header is much smaller than the block. Knowledge of data structures helps build a solid foundation for grasping complex topics more quickly and effectively.

Let's see how data structures work in blockchain.

According to the structure of the blockchain, the unit of information collected within the block can be represented by any type of value. It could be property, a part of a corporation, a computerized proof of ownership, an electoral vote, or something else entirely. Information is encrypted and stored in blocks. The encrypted identities of senders and recipients are also stored in the digital encryption block. For example, a seller's and a buyer's assets are in the league of e-commerce operations. In a blockchain, each block appears to have a hash that is responsible for defining the block and its contents. Any change in the block will change the hash. As a result, hashes typically identify block changes. Blocks, by contrast, contain the hash of the previous block. Imagine a blockchain with 3 blocks.

The 3rd block has the hash of the 2nd block, and the 2nd block has the hash of his 1st block. Changing a block can change the hash of that particular block and make the whole chain wrong. Hash functions are great tools for determining changes in information within a block.

- **Smart contract-**

For a budding professional, Smart contract alongside other blockchain skills is a very challenging approach. Blockchain newbies should be aware that smart contracts have been a popular concept in the industry since the birth of Ethereum. Practically all blockchain platforms strive to take advantage of smart contracts.

Smart contracts enable the exchange of goods and services and avoid the use of middlemen. Smart contracts are primarily executed when all parties involved in the transaction have fulfilled their contractual obligations. The decentralized structure of blockchain contributes to the productivity of smart contracts.

Let's see how smart contracts work on the blockchain.

A basic “if/when…then…” line is injected into a program on the blockchain to make smart contracts work. Activities are executed by a computer system when pre-configured conditions are met and verified. These activities may also include forwarding payments to the appropriate parties, authenticating vehicles, providing alerts, or issuing tickets. Make the payment and the blockchain will be fixed. This means that the operation cannot be changed and the results are visible only to users who have been granted access.

A smart contract can require a lot of specs to convince parties that an operation will be performed correctly. Members should be aware of how their activities and related data are represented on the blockchain, and provide those activities to determine "if/when...then..." criteria and consider possible Investigate exceptions and design a mechanism to handle the issue so that the clause can be enforced.

Let's see how it secures our transactions. Blockchain transaction data is encrypted. It is difficult to break through them. However, one of the main purposes of using smart contracts is their supreme security. Additionally, every transaction in the decentralized network is linked to previous and subsequent entries, requiring cybercriminals to change the chain and change the data entirely. Programmers can then code smart contracts. However, companies using blockchain for commerce are gradually adopting frameworks, web applications and other digital tools to facilitate smart contracts.

- **Server**

Choose a cloud service provider:
There are several cloud service providers available, including Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform. Choose a provider that best suits your application's needs, budget, and technical requirements.

Provision servers:
Once you have chosen a cloud service provider, you need to provision servers for your application. You can use virtual private servers (VPS) or containers. VPS are isolated virtual machines that run on a physical server, while containers are lightweight, standalone executable packages that run on top of an operating system kernel. Provision servers based on your application's resource needs and expected traffic.

Install and configure the operating system:
Install and configure the operating system (OS) on the server. Choose an OS that is compatible with your application and cloud provider. Common choices include Ubuntu, CentOS, and Debian. Configure the server with the required software, such as a web server (e.g., Apache, Nginx), database (e.g., MySQL, PostgreSQL), and programming language (e.g., PHP, Python).

- **Hash Calculator**

A hash calculator is a tool that is used to calculate the cryptographic hash of a file or message. A cryptographic hash function is a mathematical algorithm that takes input data of arbitrary size and produces a fixed-sized output, called a hash value or checksum.

The hash value is a unique digital fingerprint of the input data, and any changes made to the input data will result in a different hash value.In this project we are using SHA-256 algorithm , the calculator take a pdf file and converts it into a hash value .

- **Front End**

In web development, the front-end, also known as the client-side, refers to the user interface and interactions of a website or web application that are visible to the user. It is the part of the application that runs in the user's web browser and is responsible for rendering the HTML, CSS, and JavaScript code that make up the website or web application.

The front-end typically consists of three main components:

HTML (Hypertext Markup Language): This is the foundation of the front-end and is used to structure and define the content of a webpage.

CSS (Cascading Style Sheets): This is used to style and layout the HTML elements to create visually appealing and responsive web pages.

JavaScript: This is used to add interactivity and dynamic behaviour to the webpage, such as user input validation, animations, and dynamic content updates..

- **Ethereum**

Ethereum is a decentralized, open-source blockchain platform that enables developers to build and deploy decentralized applications (dApps). One of the key features of Ethereum is its ability to store and execute smart contracts, which are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. Smart contracts are stored on the Ethereum blockchain and are executed automatically when specific conditions are met.

Ethereum can be used to store data in several ways. One way is through the use of smart contracts. Smart contracts can include data storage functionality, allowing developers to store data on the blockchain in a secure and tamper-proof manner. This data can be accessed by anyone with permission to view it, making it ideal for use cases where transparency and immutability are important.

Another way to store data on the Ethereum blockchain is through the use of decentralized applications (dApps). DApps are built on top of the Ethereum blockchain and can include data storage functionality through the use of smart contracts or other storage mechanisms such as IPFS (InterPlanetary File System). By storing data on a decentralized network, data can be made more secure and resilient to attacks or data loss.

Chapter 5

System Design

Components of blockchain architecture
The main components of blockchain architecture are:

- Node – a computer in the blockchain architecture (each node has an independent copy of the entire blockchain ledger)
- Transaction – A record verified by blockchain participants that serves as a near-perfect confirmation of the authenticity of a financial transaction or contract.
- Block - a sealed compartment containing:

  1) the native hash code that identifies the block,
  2) the hash code of the previous block in the block sequence, and
  3) a sequence of timestamped transactions.
- Chain — ordered sequence of blocks
- Miner – a node that validates blocks before adding them to the blockchain structure
- Consensus (protocol) – a set of rules and agreements for conducting blockchain operations

Decentralized blockchain applications are built like any other traditional software product. Development requires functional specifications, UI/UX design, and architectural planning. It is essential to define application functionality, set user roles, and consider system flows and interactions between users.
To build your own blockchain architecture, you should consider:

- Infrastructure for applications hosted in defined environments within one or more organizations
- Tasks and objectives for which this blockchain solution was designed
- There are several open source solutions that can be used to create private blockchain architectures.

A blockchain solution can bring all these parties together in a peer-to-peer (P2P) network that eliminates all risks and builds a transparent system. All network participants have access to synchronized data from a common immutable ledger, allowing them to track gold movements from mining to selling to end-users in the form of gemstones. A blockchain ledger contains the sequence of all activities taking place. (B. Mining, Processing and Distribution.0

Each party in the network typically maintains its own copy of the blockchain. This is synchronized with the intelligent protocol and technology layers of the blockchain network. For multiple users, there are Membership Service Providers (MSPs) that grant access to specific users on their network. All transactions along the way are stored in a ledger (e.g. diamond image, data about where the diamond was mined, colour and serial number, information about where the diamond was cut, cleaned, sold, etc.).

After the blockchain network is set up, the next step is to agree on the type of business transactions happening inside the blockchain architecture.

Our project is like any other blockchain with all the basic elements and basic architecture just the difference is the working of the Proof of Work.

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In the literary review we read that previous papers wrote that finding out who will be doing the proof of work in a network of students in a institution which is saving the information of every student in the blockchains is hard to decide. But we have come up with the solution that all the students of a particular batch are going to make sure that no one tempers with the documents cause all of the students will be approving addition or changing of a block in blockchain.

This will make the decentralized control over the documents of different students, taking the major control from the administrative team of the institution. Even these documents can directly be verified by sharing the public key of your blockchain in your resume where the person interested to verify your qualification can directly check it.

Chapter 6

Implementation

A step-by-step guide to the implementation process for this project :

1. Choose a Blockchain Network:
The first step is to choose a blockchain network for our dApp. We have chosen to use any Ethereum blockchain network.

2. Design the Architecture:
The next step is to design the architecture for our dApp. We need to decide on the data structure, smart contracts, and user interface. We will use Solidity programming languagefor smart contracts.

3. Develop the Smart Contracts:
After designing the architecture, we need to develop smart contracts for our dApp. We will write smart contracts for storing and managing student information, such as academic records and personal details. We will also create smart contracts for data access and transfer.

4. Develop the User Interface:
We will develop the user interface for our dApp. The user interface will enable students and corporates to access and verify information easily. We will use modern web development technologies such as ReactJS, AngularJS, or VueJS for this purpose.

5. Integrate the Smart Contracts and User Interface:
We will integrate the smart contracts and user interface to create a functional dApp. We will test the dApp for any bugs or glitches and address them accordingly.

6. Deploy the dApp on the Blockchain Network:
Once the dApp is developed and tested, we will deploy it on the chosen blockchain network. We will ensure compliance with data privacy laws and regulations.

7. Conduct System Testing and User Acceptance Testing:
We will conduct system testing and user acceptance testing to ensure the dApp is functioning correctly and meets user requirements.

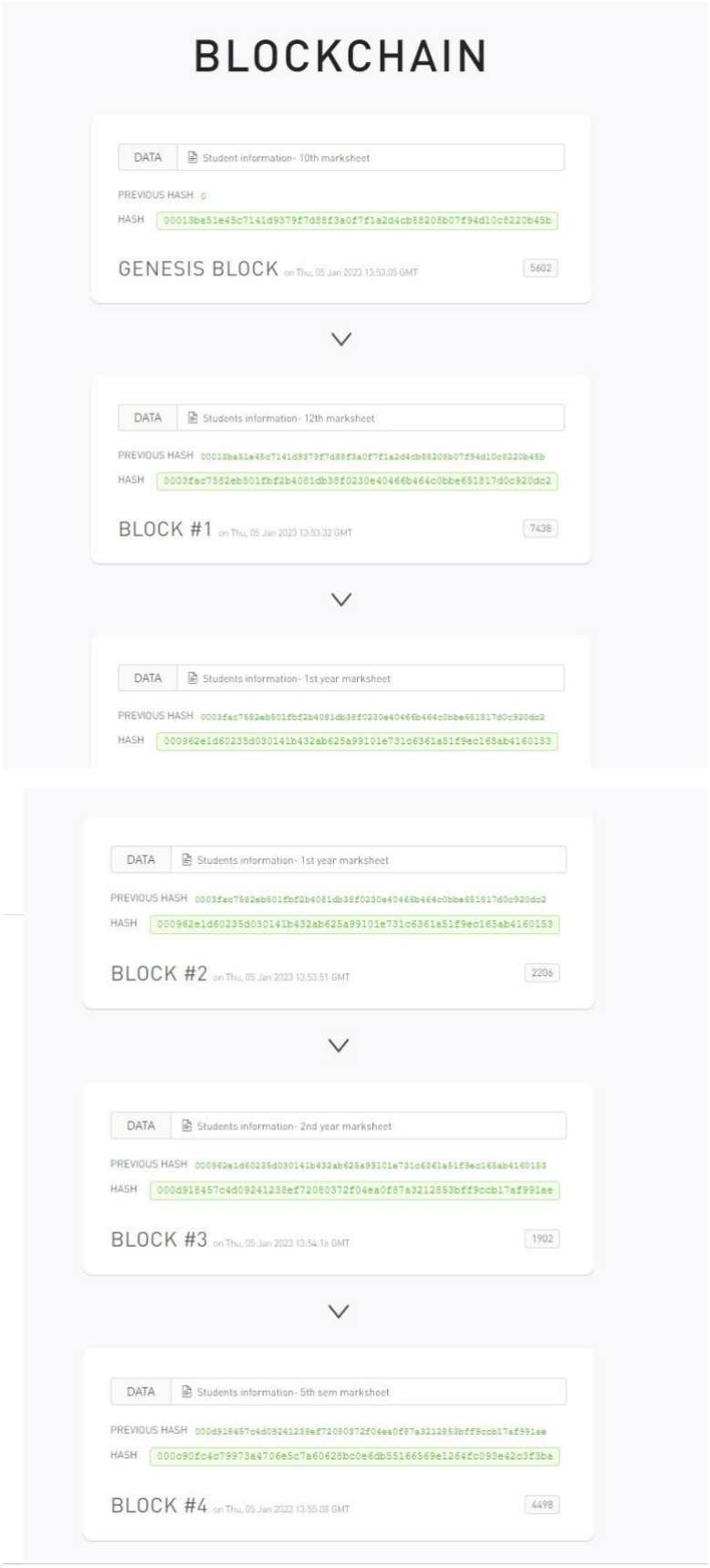
8. Provide Ongoing Maintenance and Support:
We will provide ongoing maintenance and support for the dApp. We will monitor the system for threats or vulnerabilities and address them accordingly. We will also continuously enhance the system to meet changing user needs.

Chapter 7
System Testing

We just tested with a very basic of saving a single students information till now in the form of blocks. In this blockchain a student's 10th marksheet, 12th marksheet, 1st and 2nd year college marksheet, plus the 5th semester marksheet has been saved in blocks of a single chain likewise many other student's information and important documents will be saved in different blocks of different accounts of students in a network of the institution in which there are going to be thousands of accounts of forming hundreds of networks according to the batch year.

6.1 Test Cases and Test Results

Block Number	Information Stored	Hash Generated	Previous hash
b-0	10th Class Marksheet (School)	00013ba51e45c7141d9379f7d88f3a0f7f1a2d4cb88208b07f94d10c8220b45b	-
b-1	12th Class Marksheet (School)	0003fac7582eb501fbf2b4081db38f0230e40466b464c0bbe651817d0c920dc2	00013ba51e45c7141d9379f7d88f3a0f7f1a2d4cb88208b07f94d10c8220b45b
b-2	1st year college marksheet	000962e1d60235d030141b432ab625a99101e731c6361a51f9ec165ab4160153	0003fac7582eb501fbf2b4081db38f0230e40466b464c0bbe651817d0c920dc2
b-3	2nd year college marksheet	000d918457c4d09241238ef72080372f04ea0f87a3212853bff9ccb17af991ae	000962e1d60235d030141b432ab625a99101e731c6361a51f9ec165ab4160153
b-4	5th semester college marksheet	000c90fc4c79973a4706e5c7a60628bc0e6db55166569e1264fc093e42c3f3ba	000d918457c4d09241238ef72080372f04ea0f87a3212853bff9ccb17af991ae


BLOCKCHAIN
DATA
Student information- 10th marksheet
PREVIOUS HASH 0
HASH
00013ba51e45c7141d9379f7d88f3a0f7f1a2d4cb88208b07f94d10c8220b45b
GENESIS BLOCK on Thu, 05 Jan 2023 13:53:05 GMT
5602
DATA
Students information- 12th marksheet
PREVIOUS HASH 00013ba51e45c7141d9379f7d88f3a0f7f1a2d4cb88208b07f94d10c8220b45b
HASH
0003fac7582eb501fbf2b4081db38f0230e40466b464c0bbe651817d0c920dc2
BLOCK #1 on Thu, 05 Jan 2023 13:53:32 GMT
7438
DATA
Students information- 1st year marksheet
PREVIOUS HASH 0003fac7582eb501fbf2b4081db38f0230e40466b464c0bbe651817d0c920dc2
HASH
000962e1d60235d030141b432ab625a99101e731c6361a51f9ec165ab4160153
DATA
Students information- 1st year marksheet
PREVIOUS HASH 0003fac7582eb501fbf2b4081db38f0230e40466b464c0bbe651817d0c920dc2
HASH
000962e1d60235d030141b432ab625a99101e731c6361a51f9ec165ab4160153
BLOCK #2 on Thu, 05 Jan 2023 13:53:51 GMT
2206
DATA
Students information- 2nd year marksheet
PREVIOUS HASH 000962e1d60235d030141b432ab625a99101e731c6361a51f9ec165ab4160153
HASH
000d918457c4d09241238ef72080372f04ea0f87a3212853bff9ccb17af991ae
BLOCK #3 on Thu, 05 Jan 2023 13:54:16 GMT
1902
DATA
Students information- 5th sem marksheet
PREVIOUS HASH 000d918457c4d09241238ef72080372f04ea0f87a3212853bff9ccb17af991ae
HASH
000c90fc4c79973a4706e5c7a60628bc0e6db55166569e1264fc093e42c3f3ba
BLOCK #4 on Thu, 05 Jan 2023 13:55:08 GMT
4498

Chapter 8

Screenshot of Project

Self Made Blockchain

Code:

```
import hashlib
def hashGenerator(data):
   result= hashlib.sha256(data.encode())
   return result.hexdigest()
class Block:
   def __init__(self,hash,data,prev_hash):
      self.data=data
      self.hash=hash
      self.prev_hash=prev_hash
class Blockchain:
   def __init__(self):
     hashLast=hashGenerator('gen_last')
     hashStart=hashGenerator('gen_hash')
     genesis=Block('gen-data',hashStart.hashLast)
     self.chain=[genesis]
     def add_block(self,data):
        prev_hash=self.chain[-1]
        hash=hashGenerator(data+prev_hash)
        block=Block(data,hash,prev_hash)
        self.chain.append(block)
bc=Blockchain()
bc.add_block('1')
bc.add_block('2')
bc.add_block('3')

for block in bc.chain:
   print(block.__dict__)
```

Output:

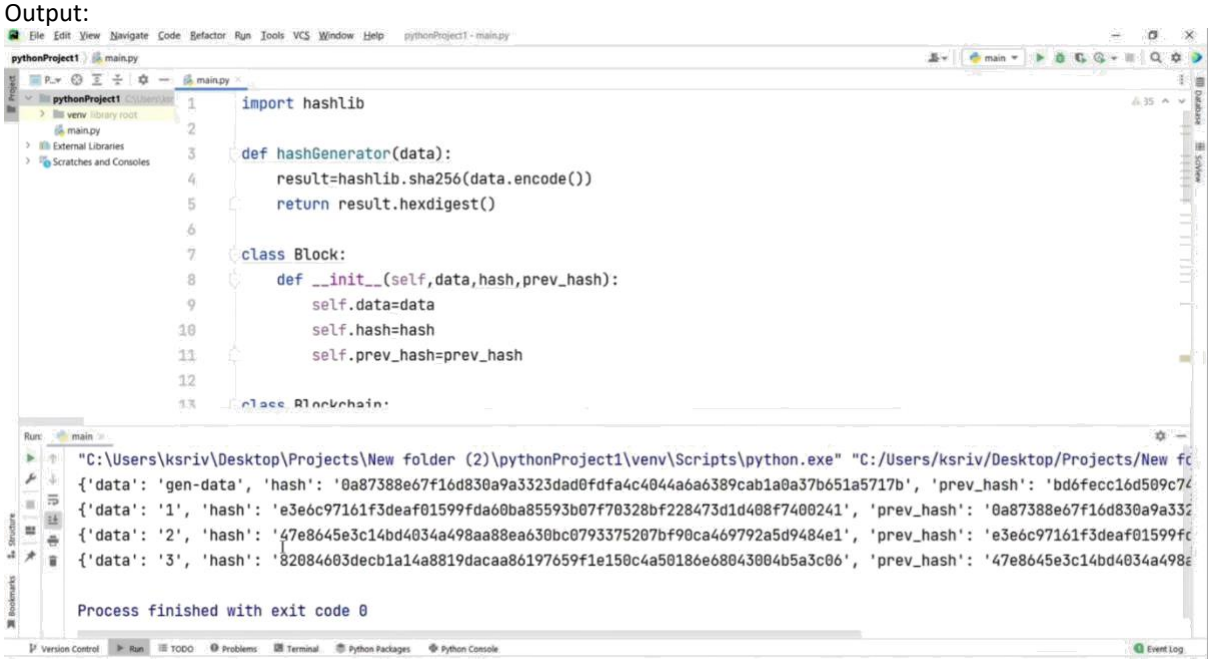


Fig. output1

Smart Contracts:

1) To save data in the blockchain

```
pragma solidity ^0.8.0;

contract StudentRegistry {
    struct Student {
        string name;
        uint age;
        string course;
        bool isEnrolled;
    }

    mapping(address => Student) private students;
    address[] private studentAddresses;

    event StudentRegistered(address indexed studentAddress, string name, uint age, string course);
    event StudentUpdated(address indexed studentAddress, string name, uint age, string course);
    event StudentRemoved(address indexed studentAddress);

    function registerStudent(address _studentAddress, string memory _name, uint _age, string memory _course) public {
        require(!students[_studentAddress].isEnrolled, "Student already registered.");

        Student memory newStudent = Student(_name, _age, _course, true);
        students[_studentAddress] = newStudent;
        studentAddresses.push(_studentAddress);

        emit StudentRegistered(_studentAddress, _name, _age, _course);
    }

    function updateStudent(address _studentAddress, string memory _name, uint _age, string memory _course) public {
        require(students[_studentAddress].isEnrolled, "Student not found.");

        Student storage updatedStudent = students[_studentAddress];
        updatedStudent.name = _name;
        updatedStudent.age = _age;
        updatedStudent.course = _course;
        emit StudentUpdated(_studentAddress, _name, _age, _course);
    }

    function removeStudent(address _studentAddress) public {
        require(students[_studentAddress].isEnrolled, "Student not found.");

        delete students[_studentAddress];
        for (uint i = 0; i < studentAddresses.length; i++) {
            if (studentAddresses[i] == _studentAddress) {
                studentAddresses[i] = studentAddresses[studentAddresses.length - 1];
                studentAddresses.pop();
                break;
            }
        }
        emit StudentRemoved(_studentAddress);
    }
    function getStudent(address _studentAddress) public view returns (string memory, uint, string
```

```
memory, bool) {
    Student memory student = students[_studentAddress];
        require(student.isEnrolled, "Student not found.");
        return (student.name, student.age, student.course, student.isEnrolled);
    }
    function getAllStudents() public view returns (address[] memory) {
        return studentAddresses;
    }
}
```

2) Giving access to who can modify the blocks

```
pragma solidity ^0.8.0;

contract StudentData {
    address public owner;
    mapping(address => bool) public students;

    constructor() {
        owner = msg.sender;
    }

    modifier onlyOwner() {
        require(msg.sender == owner, "Only contract owner can call this function");
        _;
    }

    modifier onlyStudents() {
        require(students[msg.sender] == true, "Only students can call this function");
        _;
    }

    function addStudent(address _student) public onlyOwner {
        students[_student] = true;
    }

    function uploadData() public onlyStudents {
        // Upload data logic here
    }
}
```

3) Adding student details

```
pragma solidity ^0.8.0;
contract StudentList {
 address public teacher;

constructor() {
teacher = msg.sender;
}
struct Student {
string name;
uint age;
bool exists;
}
mapping(address => Student) public students;
modifier onlyTeacher() {
 require(msg.sender == teacher, "Only the teacher can perform this action");
  _;
 }
```

```
17. function addStudent(address _address, string memory _name, uint _age) public onlyTeacher {
18.  require(!students[_address].exists, "Student already exists");
19. students[_address] = Student(_name, _age, true);
20. }
21. }
```

4) Uploading documents

```
1.  pragma solidity ^0.8.0;
2.
3.  contract DocumentStorage {
4.      mapping(address => bytes32) public documents;
5.
6.      function uploadDocument(bytes32 _hash) public {
7.          require(documents[msg.sender] == 0, "Document already uploaded");
8.          documents[msg.sender] = _hash;
9.      }
10. }
11.
```

Chapter 9

Advantages, Disadvantages Application of Work

Application of Work:

- **Student self-study data :**

If student data such as data, skills learned, etc., is stored by Blockchain and is not a central administrator such as a university, the student may be able to store that data for life and to own and manage it effectively. This, in turn, proves that the information provided in their resume is accurate and puts loyalty to employers.

- **Improving the safety and efficiency of educational institutions and students:**

Blockchain has the potential to ensure the identity, privacy, and security of student data. With its consistency and hash function, Blockchain provides security and legitimacy. As a result, students are unable to change their previous academic data stored in Blockchain, which is much easier in the case of paper records. You can verify the privacy of data by not keeping it instead of using hash. Or you can encrypt data before saving it to Blockchain.

- **A combination of trust and openness between job seekers and employers:**

By using Blockchain, students are able to adjust their debt such as grades, degrees, and certificates, thus reassuring employers that job applicants have the necessary skills for the job. This helps employers find the best match for the job seeker they have applied for. This is especially true with distributed ledger technology.

- **Increasing efficiency in existing business processes:**

University of Blockchain university diplomas are visual documents or records of all academic achievements throughout one's life. This is a major advantage of Blockchain in education. This flexible transcript, which is a lifetime value, reduces CV fraud and reduces overhead related data verification across all sectors of the industry.

- **Produces a new market for digital goods:**

Blockchain has been used for the student payment process, which is another important area. Simplifying the payment process is another matter that requires a lot of staff including students, parents, financial institutions, scholarships, governments, and educational institutions. It is expected that cryptocurrencies will play a major role in this area in the future as a student payment method. Many institutions such as King’s College in New York City accept bitcoin as payment.

Advantages:

Immutability: Blockchain supports immutability, meaning it is impossible to erase or replace recorded data. Therefore, the blockchain prevents data tampering within the network. Traditional data do not exhibit immutability. The conventional database uses CRUD (create, read, update and delete) at the primary level to ensure proper application operation, and the CRUD model enables easy erasing and replacing of data. Such data can be prone to manipulation by rogue administrators or third-party hacks.

Transparency: Blockchain is decentralized, meaning any network member can verify data recorded into the blockchain. Therefore, the public can trust the network. On the other hand, a traditional database is centralized and does not support transparency. Users cannot verify information whenever they want, and the administration makes a selected set of data public. Still, however, individuals cannot verify the data.

Censorship: Blockchain technology is free from censorship since it does not have control of any single party. Therefore, no single authority (including governments) can interrupt the operation of the network. Meanwhile, traditional databases have central authorities regulating the operation of the network, and the authority can exercise censorship. For instance, banks can suspend users' accounts.

Traceability: Blockchain creates an irreversible audit trail, allowing easy tracing of changes on the network. The traditional database is neither transparent nor immutable; hence, no permanent trail is guaranteed.

Trust: Blockchain creates trust between different entities where trust is either non-existent or unproven. As a result, these entities are willing to engage in business dealings that involve transactions or data sharing that they may not have otherwise done .The enablement of trust is one blockchain's most cited benefits.

Leasing blockchain storage : Organizations wanting to lease storage from a blockchain-based storage network would use a service provider such as Storj or Sia. There are a number of advantages to this approach compared with centralized storage in an on-premises or cloud-based data center.

Disadvantage:

Speed and performance. Blockchain is considerably slower than the traditional database because blockchain technology carries out more operations. First, it performs signature verification, which involves signing transactions cryptographically. Blockchain also relies on a consensus mechanism to validate transactions. Some consensus mechanisms, such as proof of work, have a low transaction throughput. Finally, there is redundancy, where the network requires each node to play a crucial role in verifying and storing each transaction.

High implementation cost. Blockchain is costlier compared to a traditional database. Additionally, businesses need proper planning and execution to integrate blockchain into their process. Just as this technology represents low costs for users, unfortunately, *it also implies high implementation costs for companies*, which delays its mass adoption and implementation.

Data modification. Blockchain technology does not allow easy modification of data once recorded, and it requires rewriting the codes in all of the blocks, which is time-consuming and expensive. The downside of this feature is that it is hard to correct a mistake or make any necessary adjustments.

SCALABILITY Blockchains are not scalable as their counterpart centralized system. Huge scale implementation of blockchain system can be a tough challenge . In simple words, the more people or nodes join the network, the chances of slowing down is more. Other aspects of technology will be required in order to adopt blockchain in wider aspect. The chances of slowing down are higher as more people or nodes join the network.

Time-Consuming: To add the next block in the chain miners need to compute values many times so this is a time-consuming process and needs to be speed up to be used for industrial purposes. Also it is couple years old technology so not much improvements are seen in this field.

Chapter 10

Conclusion and Future Scope

Over the past five years, various blockchain-based solutions for education have been proposed. Higher education can pave the way to better jobs and a higher standard of living. For this reason, many people want to pursue a bachelor's degree. Scammers are investigating these methods of forging diplomas, the data of which is permanently lost due to unforeseen circumstances. Security issues and the phenomenon of illegal distribution of digital educational resources seriously undermine the rights and interests of digital educational resource owners. Therefore, from a technical point of view, there is an urgent need to provide a reliable and functional digital educational resource authentication method for realizing authentication of digital educational resource property information. Currently, authentication methods based on centralized authorities are easy to falsify and fraudulent, and it is difficult to guarantee the safety of educational resource information in educational service transactions. We propose a solution to solve such problems. It is a plan to register the academic background of undergraduate students on the blockchain. It then authenticates the certificate so that it can be verified by a third party, making it free from fraud and potential fraud. The system proposed in this study comprehensively protects the rights and interests of owners of digital educational resources.

It is recognized that blockchain technology brings many benefits when implemented in education. We show that blockchain technology has the potential to solve these problems through properties such as security, transparency, and immutability. Blockchain technology can help overcome the shortcomings of current solutions, whether paper-based or digital. A detailed analysis was then conducted on blockchain-based projects in higher education. We proposed a blockchain-based authentication system for digital educational resources that uses the decentralized, tamper-proof capabilities of blockchain technology to store the information of digital educational resources.

By resolving the issue of trust and credibility among key actors in the higher education system at national and international levels, this solution will revitalize the developmental role of the higher education system and make sustainable development justified. has the potential to be Moreover, the proposed blockchain platform is not only innovative in the domestic context, but can also be extended to an international solution to the eternal problem of certificate verification. There is a force pushing higher education to the fore as a driving force in international efforts to transition to a digital world. A blockchain-based solution for education allows users to verify authenticated certificates. These solutions have increased trust between educational institutions and employers, allowing them to hire credible and qualified employees. Compared to traditional authentication methods, blockchain-based authentication methods guarantee that resource ownership information cannot be tampered with. Using Python, known for its simplicity, we created a blockchain containing data such as hash functions, previous block hashes, and unique block values.

Our current project uses a network of 10 accounts automatically created by Ganache, each with his 100 of his Ethereum already stored. A smart contract is then written in node.js using Truffle framework functions. Every time an account makes a transaction, it is sent to individual account holders to provide proof of work (PoW), with the majority deciding whether to add the block to the chain. Once approved, the transaction is accepted on-chain as a block on that account's blockchain. The advantage of the proposed model is that all information required for certificate verification and authentication is hosted on the blockchain itself. There is absolutely no need for potential employers to contact the university to verify the certificate.

FUTURE SCOPE

Other foreign universities are also expected to join the platform in the future. This contributes to a more synergistic relationship between higher education systems in different countries. In future work, we plan to improve the developed user interface to make it more intuitive and easier to use. For future work, the proposed model will be implemented and adopted by selected educational institutions

The proposed model is applicable to the issuance and verification of cross-ownership certificates required for important industries such as food, oil and automotive. The review process should also demonstrate a high degree of transparency and credibility. Institutions are required to keep student evaluation records for a significant period of time. This data is used not only to verify student academic achievement, but also for further analysis to introduce more effective and fruitful reforms. The review process should also demonstrate a high degree of transparency and credibility. Introduced an online test system that realized blockchain. In this application, candidates register for the exam themselves and pay the exam fee. This ensures that only authenticated users can take this exam. The second process logs in and pastes the transaction hash to start checking. Once the exam is completed, all smart contract data is sent directly and securely to the exam center on the blockchain network. Exam data such as questions, answers, transaction amounts and timestamps will be integrated into the smart contract. This smart contract is ultimately sent as proof to both the user and the testing center.

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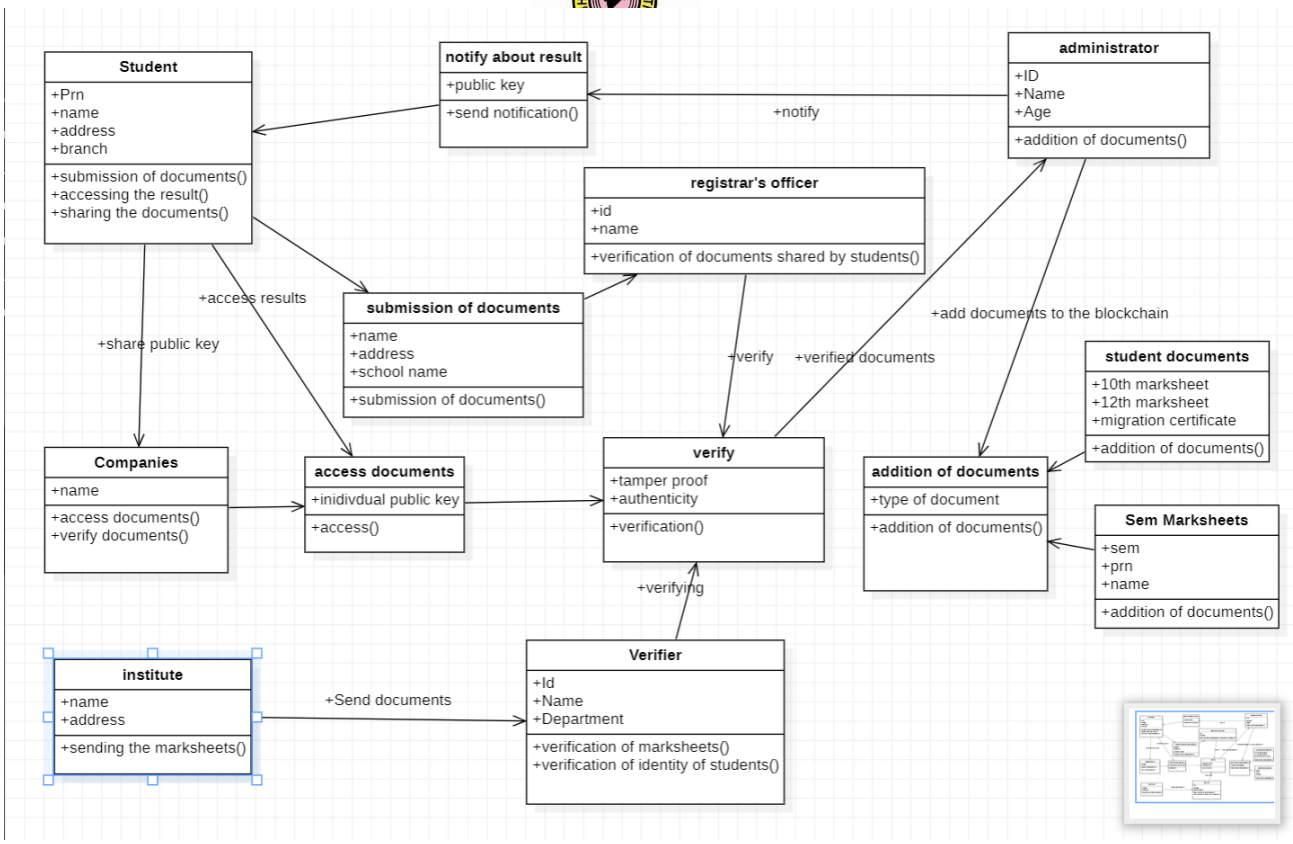


Diagram: class diagram of the system

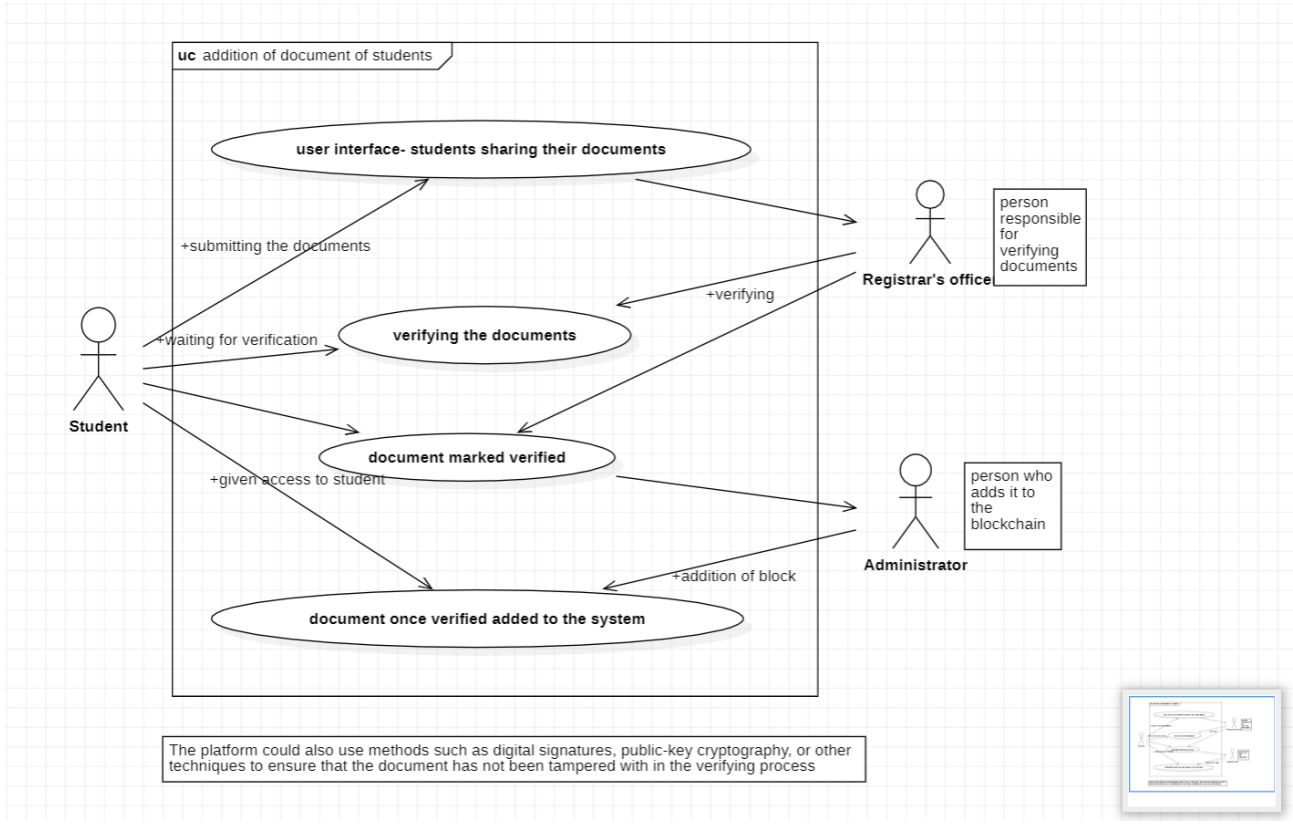
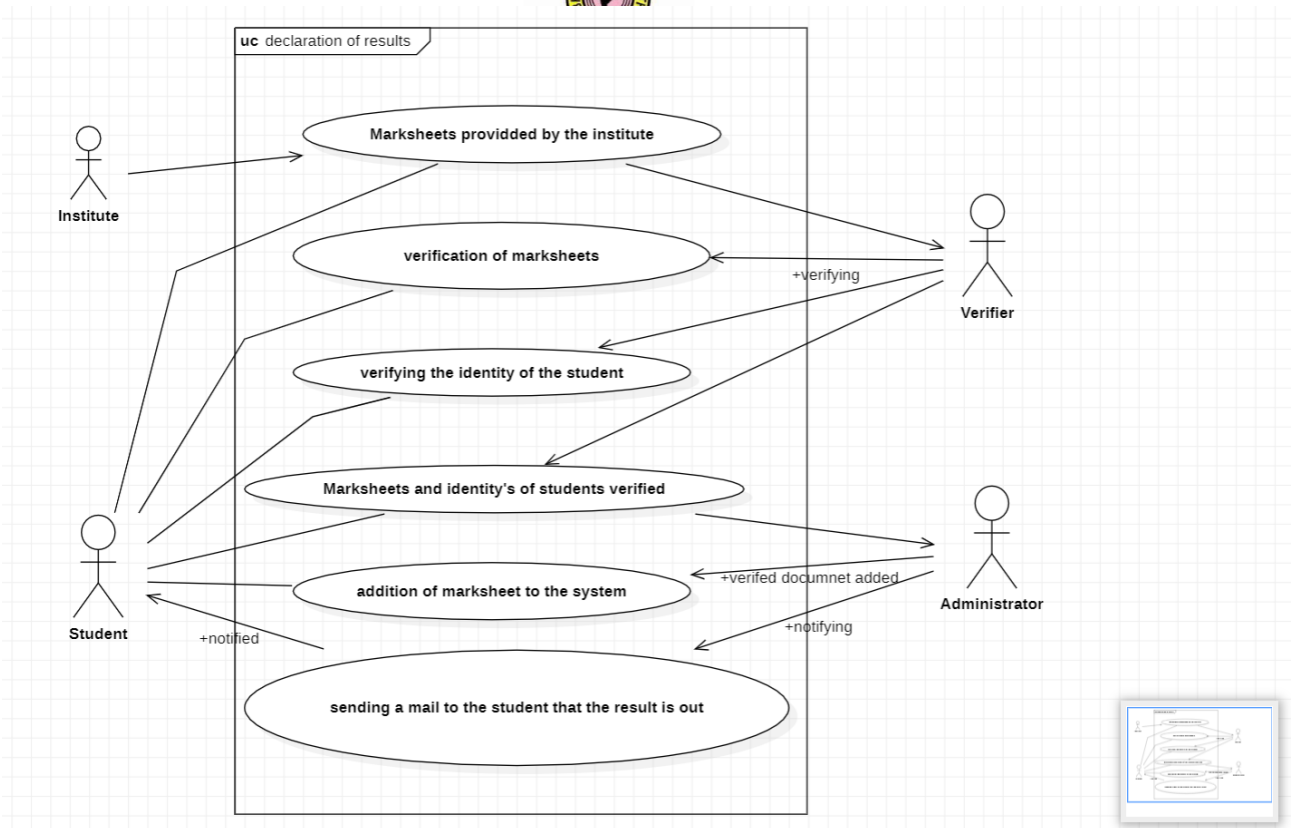
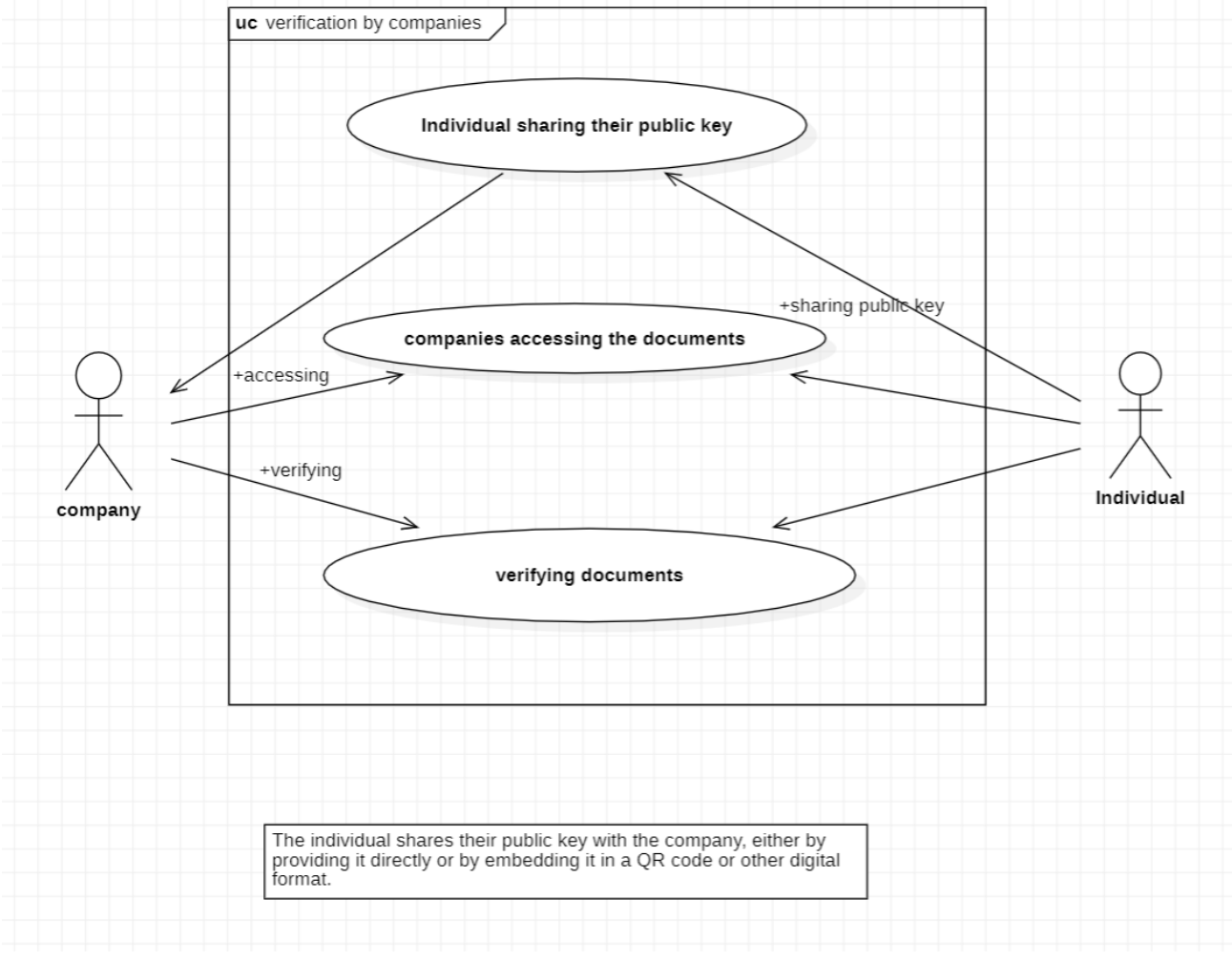
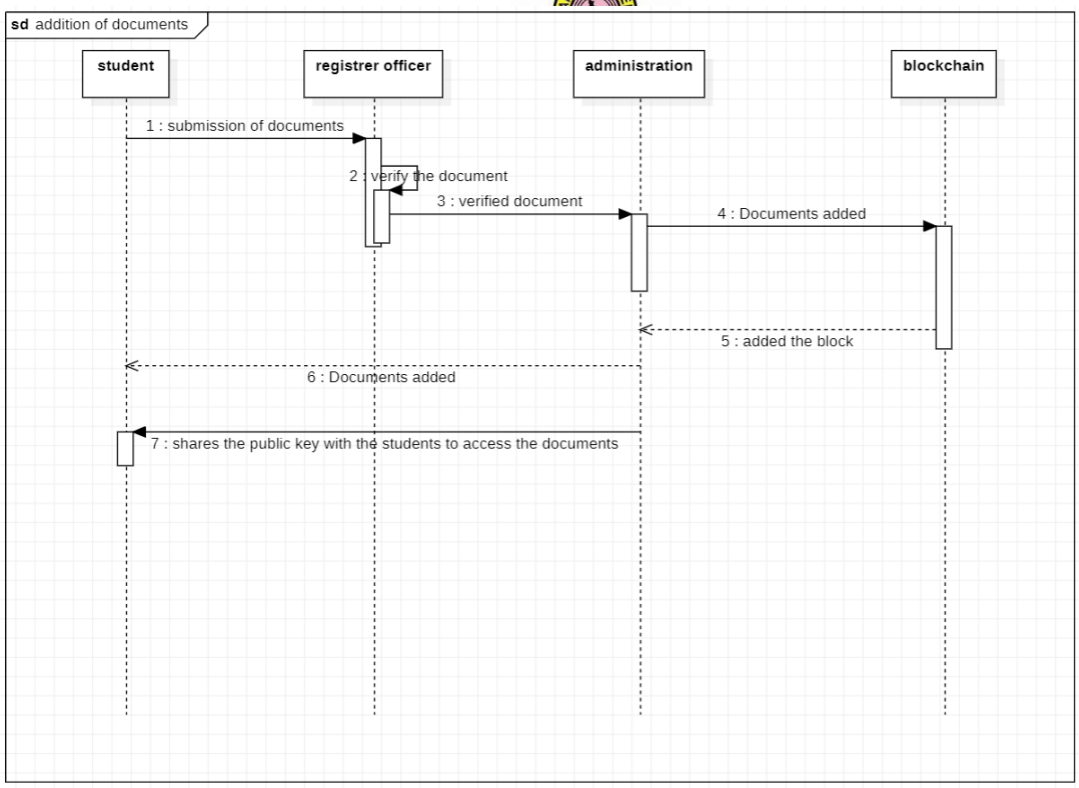


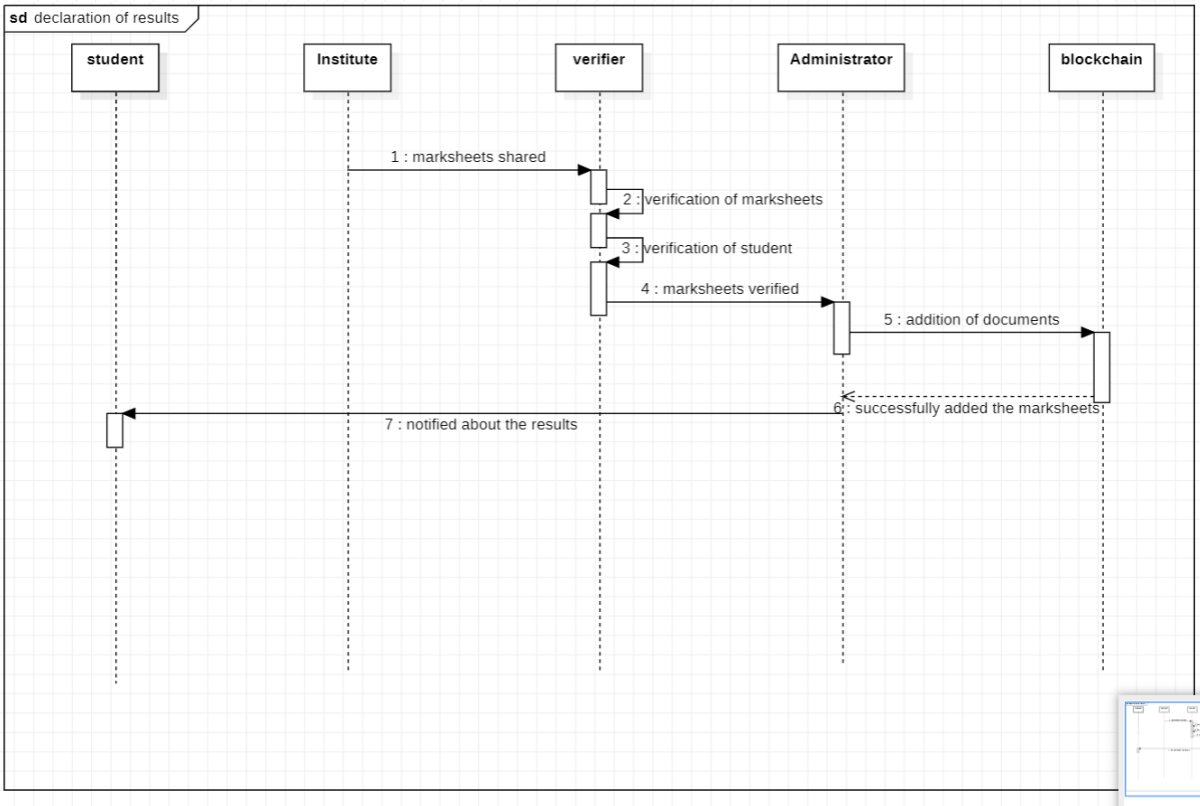
Diagram: use diagrams of the system





The individual shares their public key with the company, either by providing it directly or by embedding it in a QR code or other digital format.


sd addition of documents
student
registrer officer
administration
blockchain
1 : submission of documents
2 : verify the document
3 : verified document
4 : Documents added
5 : added the block
6 : Documents added
7 : shares the public key with the students to access the documents


sd declaration of results
student
Institute
verifier
Administrator
blockchain
1 : marksheets shared
2 : verification of marksheets
3 : verification of student
4 : marksheets verified
5 : addition of documents
6 : successfully added the marksheets
7 : notified about the results

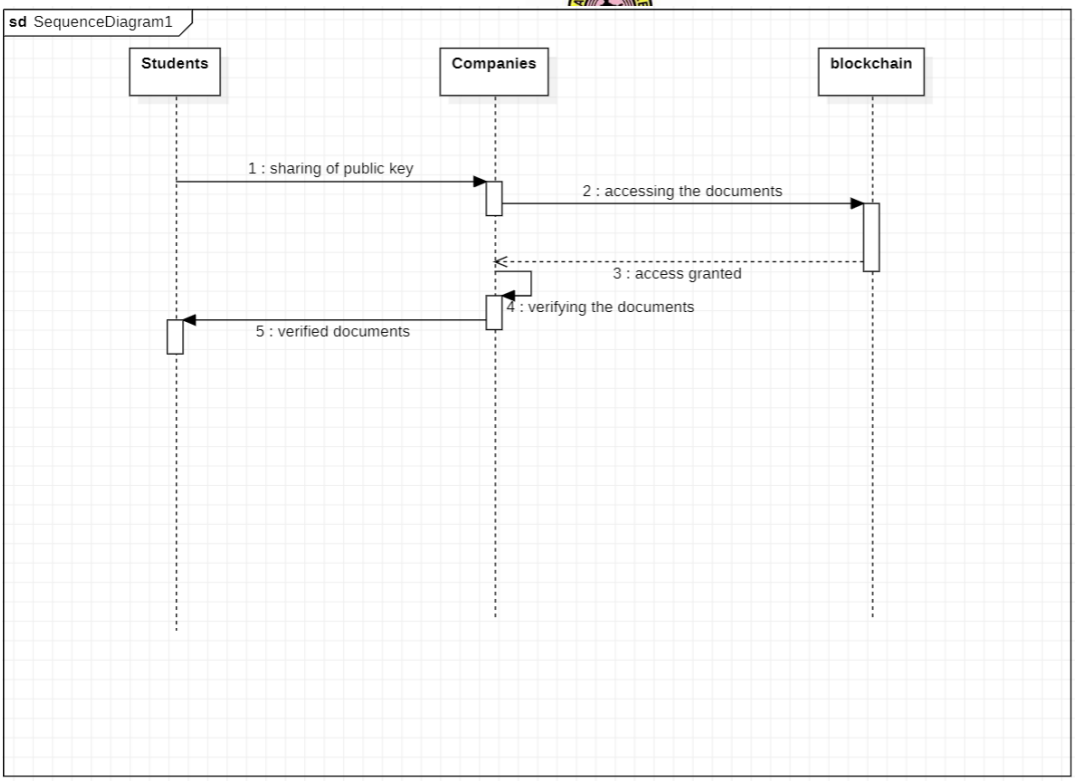
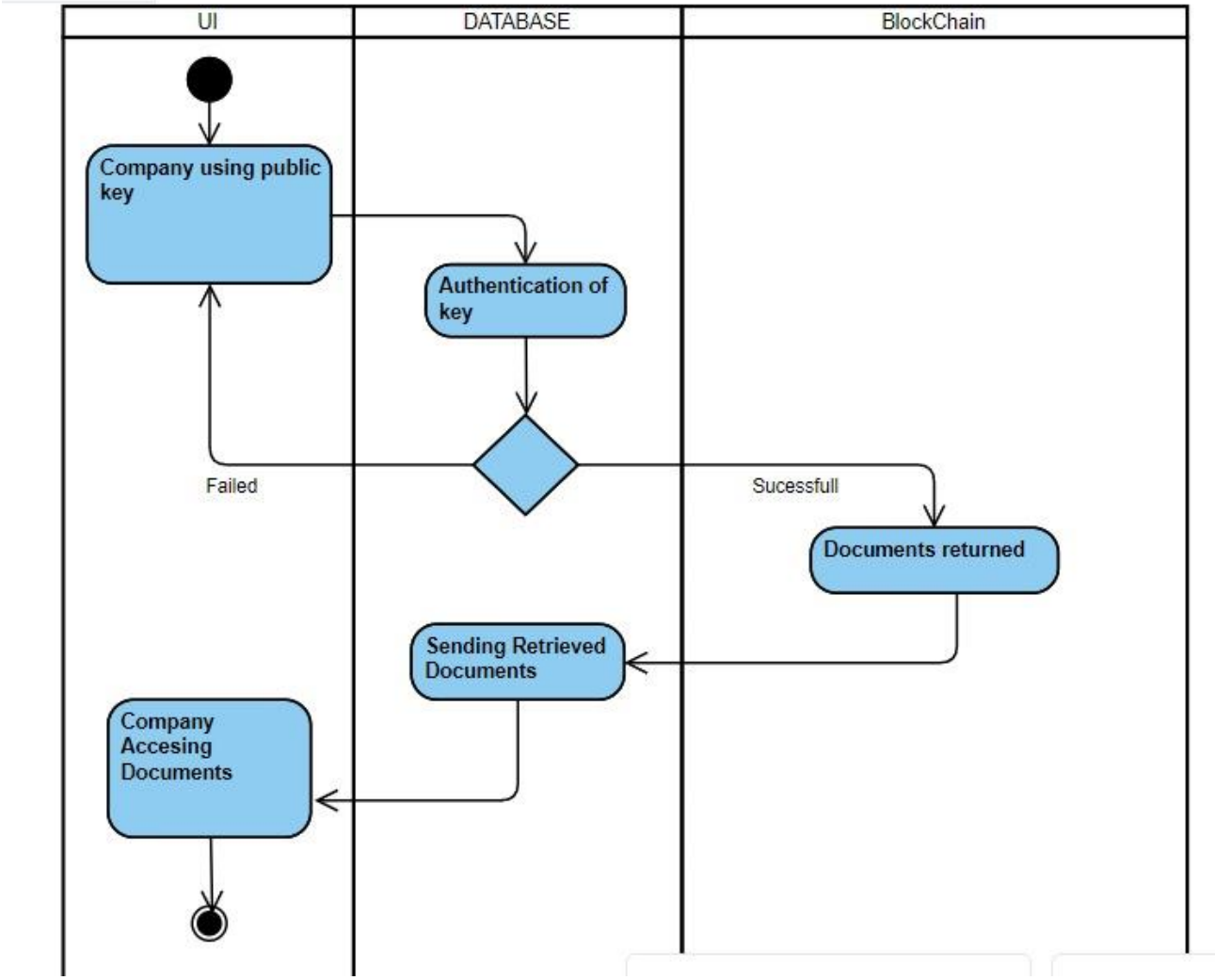
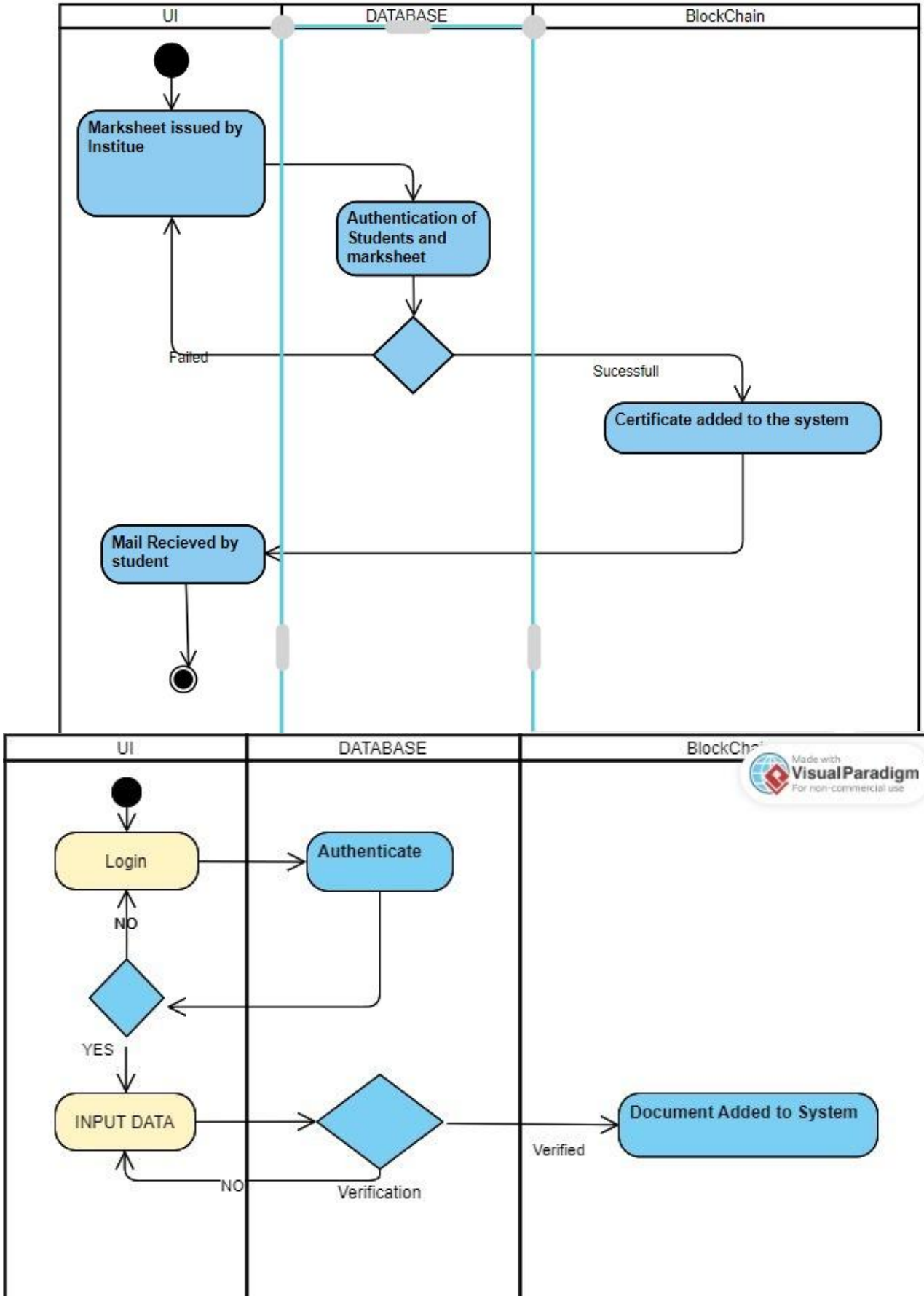


Diagram: sequence diagrams of the system





Diagrams: Activity digrams of the system