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Islamic University of Technology

Department of Computer Science and Engineering

BLOCKCHAIN FOR ELECTRONIC HEALTH RECORDS

A Thesis by

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10

Submitted in Partial Fulfillment of

the Requirements

for the Degree of

Bachelor of Science in Computer Science and Engineering

May 2022



ISLAMIC UNIVERSITY OF TECHNOLOGY
ORGANISATION OF ISLAMIC COOPERATION



BLOCKCHAIN FOR ELECTRONIC HEALTH RECORDS

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

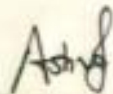
ISLAMIC UNIVERSITY OF TECHNOLOGY

MAY 2022

CERTIFICATE OF RESEARCH

The thesis titled "BLOCKCHAIN FOR ELECTRONIC HEALTH RECORDS" submitted by RADWAN MOHAMED FARAH (170041066) and ALI UMAR ATIKU (170041077) has been accepted as satisfactory in partial fulfillment of the requirement for the Degree of Bachelor of Science in Computer Science and Engineering.

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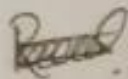
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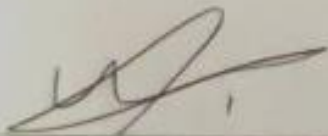
DECLARATION

I hereby declare that this thesis titled "Blockchain for Electronic Health Records" is an authentic report of our study carried out as requirement for the award of degree Bachelor of Science in Computer Science and Engineering at Islamic University of Technology, Gazipur, Dhaka, under the supervision of Assistant Prof. Asharaful Alam Khan, CSE, IUT in the year 2022. The matter embodied in this thesis has not been submitted in part or full to any other institute for award of any degree.



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All thanks is to Allah almighty, A big thanks to our lovely parent for the constant support, prayers and believing in me, this success wouldn't be achieved without each and every teacher who have taught me throughout the journey of my academic career, I couldn't be more grateful for all that you have done, the supporting root to achieving greatness. My Allah make the acquired knowledge beneficial to my humanity.

ABSTRACT

Blockchain may additionally reinvent the technique victim's electronic fitness statistics are distributed and kept via imparting more secure mechanisms for reallocate peer-to-peer (P2P). That means to help and simplicity the recognize of this give out ledger era, a strong systematic literature overview changed into manage, attending to discover the latest literature on blockchain and care realm and establish current question and open queries, coached way of the enhance of take a look at queries concerning EHR for the duration of a blockchain.

Pretty 300 scientific research revealed within the last 10 years have been researched, culminating in the construction of an up-to-date classification, question and unlocked queries recognized, and additionally the foremost important tactics, statistics types, requirements and architectures concerning using blockchain for EHR had been evaluated and referred to.

Blockchain is a noteworthy examination area for a great rhythm body and furthermore the wellbeing it offers were used by assortment of shifted organizations. Basically, the attention area stands to gain extraordinarily from blockchain innovation due to protection, secrecy and spread out. By means of the through, the digital health record (EHR) frameworks face issue concerning facts fix, respectability what's greater, the executives

In the course of this paper, we have a tendency to have a look at why blockchain innovation is wont to enhance the EHR frameworks and may reply to these troubles. We have a tendency to ask the machines might be able to use in order to implement the blockchain innovations to the EHR for research. The point of our arranged device is first off to execute blockchain innovation for EHR and second to create cozy ability of electronic statistics by way of defining granular get admission to policies for the clients of the organized system.

Besides, this machine likewise examines the quantifiability disadvantage highlighted by the commonly by means of utilization of off-chain capacity of the data. This structure offers the EHR framework the blessings of have a versatile, comfortable and essential blockchain-related answer.

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1. INTRODUCTION

The latest advent in the era has effects on all components of human life and is dynamical the approach we have a tendency to use and understand things antecedently. Much like the modifications' automation has presented in numerous opportunity district of lifestyles, it is moreover locating fresh ways wherein for development in the fitness care area. The maximum blessings that advancement in generation presents are to reinforce safety, user understanding, and alternative factors of the care sector.

Those interest were supplied by electronic fitness reports and electronic clinical file structures. However, they nonetheless face a few troubles regarding the protection of clinical data, personal possession of information, know-how integrity, etc. The answer to one's problems can be the utilization of an exact era, i.e., blockchain. This technology gives an easy, mood-proof platform for storing clinical facts and opportunity care-related facts.

Electronic health document EHR structures are wide used global with a pretty ninety six adoption fee among non-federal acute care hospitals inside the united states of America well timed fitness information exchange hire across tending structures well-known shows terrific edges in decreasing fitness care costs up exceptional of care and reinforcing sickness police work the place of business of the national arranger once for fitness info technology has spent a lot of money of dollars to reap pregnant utilize of EHR and ease the occasion of pelt alongside structure.

here was several achievement in reaching pelt along amongst enterprise entities like stateextensive medical institution systems inside the same cooperative association however varied varieties of pelt alongside listed in desk I motive provocation connected to information satisfactory information safety affected person seclusion and patient engagement additionally there are latest signs of transferring to patient-focused capability.

although one among the three current pelt along forms purchaser-mediated change permits patient to get admission to and manage their health information on-line to obtain an actual affected person-centric pelt alongside the patients ought to have a complete management of their

statistics like authoring tending facilities data access decisive shareable data admit the records utilize and accepting the existence cycle of the shared facts.

Digital fitness statistics (EHR) cut returned the fee of historical clinical knowledge storage. EHRs are designed to permit victims to manipulate their very possess scientific expertise. Understanding customer have restricted right of entry to EHRs. For the present, victims don't percentage their personal medical knowledge with information customers, indicating the worth given by sufferers to EHR secure and exclusive.

¹⁹ 1.1 Objectives of the Project

The main goal of this work is to grow and grasp of the plot that require station blockchain for EHR, the benefits that arise from this inclusion and the summons in that way circumstances. Also to detecting drugs that do not contain the intended active ingredients can eventually guide to end-user victim harm or flat dying.

¹⁸ 1.2 Scope of the Project

The scope of this project is to address issues with drug welfare in the fake treatment supply chain, are to do with how the drugs are at first made. The detectable of right and active pharmaceutical component during actual make is a hard system, so finding drugs that won't have the wanted mobile component can eventually guide to end-user victim damage or even died. Blockchain's newfangled attribute make it able of on condition that a basis for absolute tractability of drugs, from maker to end user, and the capability to recognize fake-drug. We want to point out the problems of drug protection by using Block chain and ciphered QR (fast reaction) code security.



Figure 1.1 Scope of the Project

1.3 Methodology

During the increase and fame of blockchain, the similar feature of its immutability and decentralization. We propose a method to track, sell and authenticate medical products: that make sure the safety of information and keep records. But it couldn't substantiate the information successfully. Related on it, we propose a key (which is password) to verify the integrity and security of data, which can give access to data.

Chapter 2

16 2. LITERATURE REVIEW

2.1 Using Blockchain for Electronic Health Records

Electronic medical information systems are plagued with cybersecurity, integrity, and management challenges. By employing off-chain record storage, this system also tackles the complex problem that blockchain technology confronts in general.

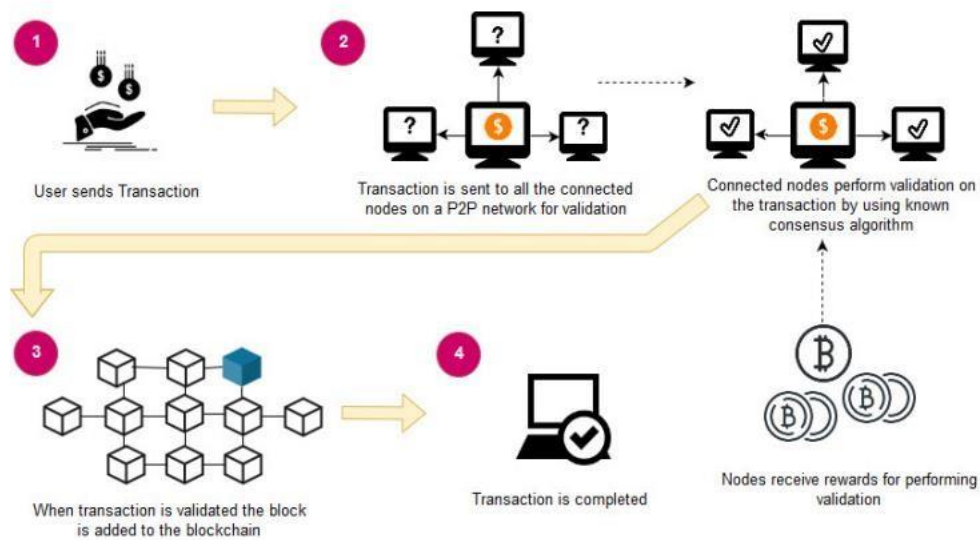


FIGURE 1. An overview of blockchain architecture.

Technologies such as blockchain to alter EHR systems and hence provide a solution to the issue.

The application of a novel technology, such as Blockchain, could provide a solution to

these challenges. This technology promises to provide a secure, tamper-proof platform for the keeping of medical records and other healthcare data. We reviewed how distributed ledgers can be utilized for electronic health records in this study.

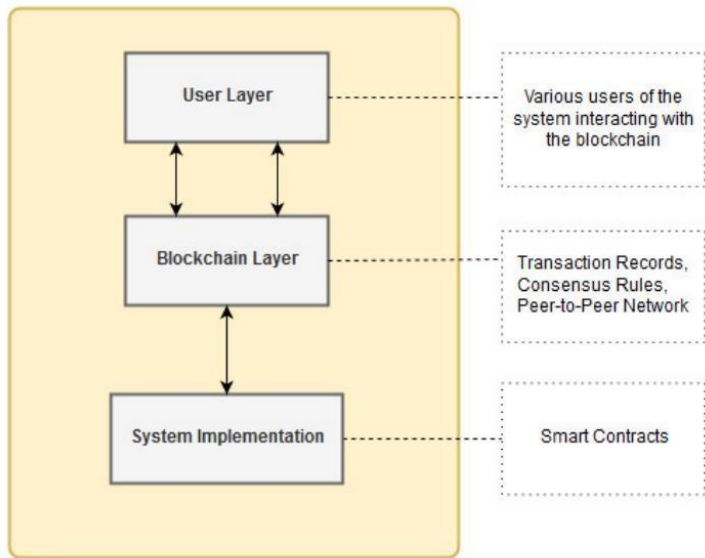


FIGURE 2. System design of proposed framework.

The system architecture that we suggest. The graphical user interface (GUI) includes all of the features that a given user has access to. The user could utilize this GUI to communicate with the platform's other layer, the blockchain layer, depending on the designated role.

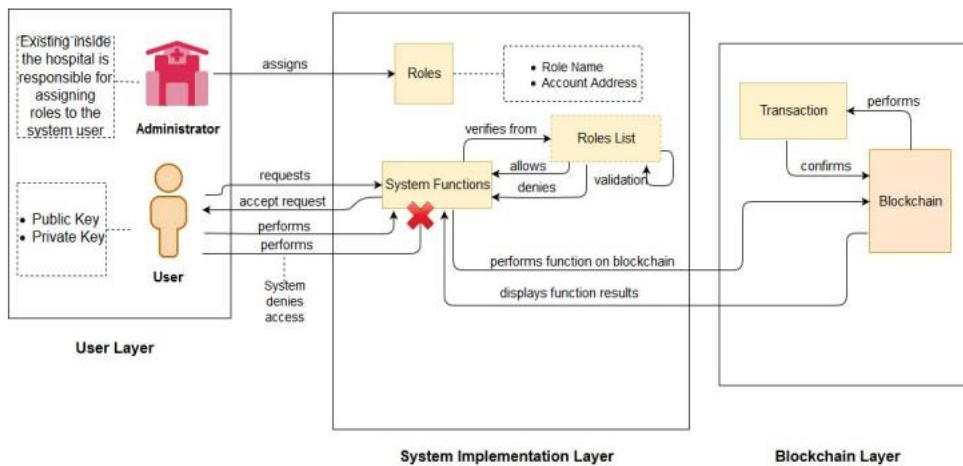
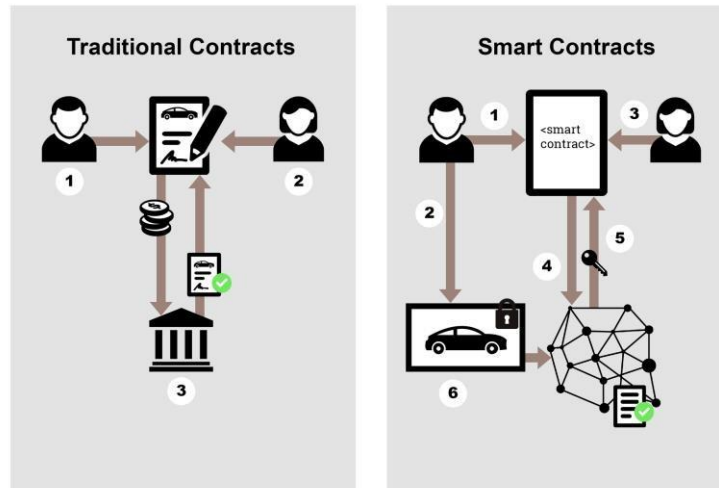


FIGURE 3. User interaction with DApp.



2.2⁷ Electronic Health Record Sharing Scheme with Searchable Attribute-Based Encryption on Blockchain

The Internet systems' tractor trailer issue can be solved using blockchain technology, while also allowing free access to and sharing of data. It not only addresses the issue of Searching for data storage in a moderately manner servers, but it also addresses the issue due to a lack of blockchain disk space. All of the solutions listed above rely recovery from data centres, even though most internet server admins are dishonest and suspicious.

The current Recovery of medical information on the blockchain lacks detailed solutions for data owners and data users. This paper proposes a system for exchanging electronic medical record depending on more for each blockchains search query to address the issue of shady doctors downloading forged electronic health information and a half-truthful check of online storage systems





2.3⁹ A Patient -Centric Health Information Exchange Framework Using Blockchain Technology

May be prevented if indeed the target matching problem was solved via blockchain. To reduce the risk of a data leak, the consensus mechanism will monitor and enforce the rules in each

blockchain adapter. Disruptive technologies, such as blockchain, may give viable solutions by using blockchain capabilities in light of these hurdles and problems.

For the patient matching problem, this solution is somewhat more reliable and effective than the present MPI-matching mechanism. After final decryption, any modification to the information, although if started by the medical institution partner, would lead in incompatible passwords and alerts. 100% of the operations were accepted, as the secured queried data was kept in the requesting facility' databases.

2.4 A Patient -Centric Health Information Exchange Framework Using Blockchain Technology

Mismatching could be avoided by using the patient matching problem can be solved utilizing  blockchain technology. To reduce  the risk  of a  data leak, the The consensus mechanism will keep track of everything. And enforce every blockchain adapter's regulations.

Because on these obstacles and issues, Blockchain and other similar technologies may be able to help. Viable fix by leveraging blockchain features. This method is safer and cheaper than MPI-matching. Technique now in use

After final decryption, any modification to the data, even if started by the medical institution adapter, can lead in incompatible codes and security alerts. 100% of the interactions got accepted, as all encoded requested information was kept in the requesting institution' databases.

2.5 Electronic health records in a Blockchain: A systematic review

The Blockchain architecture shall assist call this issues by helping the building of integration quality and necessary that mark seclusion and allow the fix interchange of information across systems. The volume of a blockchain is a topic that is currently being researched, and it has been demonstrated to be a major bottleneck also for chains that contain simple data.

Transferable information. Blockchain might be used as a method and distribution mechanism for data exchange, allowing telehealth and accuracy healthcare to cooperate on medical choices. As a result, researchers were able to create a category and identify open subjects that need to be explored further, all of which represent problems that have arisen in recent history.

²⁴Chapter 3

3. PROBLEM DEFINITION

3.1 Problem Statement

Blockchain uses a hash function to verify authenticity. Securing data that is text and convertible to 32 length is possible. Our objective of our project is to lay foundation for an overview of what's to become of a trusted system of the distribution and traceability of medical products. Also, a provision of immutable records.

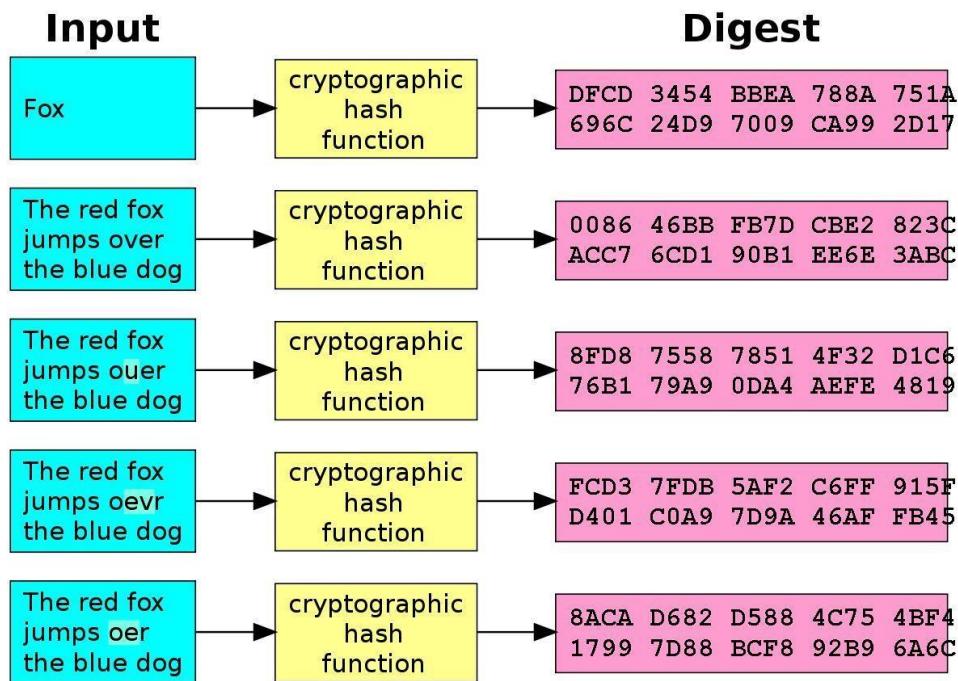


Figure 3.1 The Input and Digest Procedure

3.2 Existing System

The goal of our current framework is to first implement blockchain creation for EHR, and then to provide secure storage of digital information for users of the current framework by utilizing system granular access controls. They were on hand to improve the safety of the patients by preventing errors and collecting data. Furthermore.

With the aid of the system, we hope to resolve the above-mentioned records spatiality and records breaches negative aspects. The authors underline the fact that measurability is a significant disadvantage of blockchain, which, in conjunction with lightning, bitcoin money, and bitcoin gold, addresses measurability difficulties.

They exist in order to combine the measurability provided by the underlying Hadoop data with the decentralization provided by the blockchain age. There is a scalable decision for scientific documents on the block chain. The main goal of this is to look into transforming into a style that meets with the desires of the office of the national organizer for fitness information generation (on).

emphasized that it may be useful for establishing identification systems, decision terminology utilized in her structures, and security challenges linked with those structures, which is why the authors chose block chain technology for their current framework. The confirmation of the form being submitted inside the machine is any additional income available via the device.

In contrast to prior responses, our current system tries to address the issue of measurability by abusing ifs' off-chain scaling mechanism. Furthermore, ethereal is used to implement the existing framework in its entirety. As previously stated, the purpose of this current architecture is to create a localized device for digital fitness data that is tamper-proof, secure, and private using blockchain technology.

Users who are most likely patients, doctors, management, and nursing staff are all part of the current framework. Because they need varying degrees of authority on the device, they were granted a granular right of entry.

3.3 Proposed System

As blockchain is booming and rising now. It's also the go-to for a trustless system. We proposed a method to distribute medical products. That way it ensures the decentralization of the system and grantees a third party then can be trusted.

But for that user to register itself. Use that Data for login credentials. After registration and login, we use RSA to encrypt the data. So basically, the RSA algorithm is AN asymmetric cryptographic framework that permits public-key encryption and is widely utilized for encoding of email and distinctive advanced exchanges over the web.

It's essentially useful for sending information over AN uncertain organization very much like the web. Then generated image information is stored on the IPFS server and ales we store share hash and transaction hash in the database.

After generating a shared image, if the user wants to upload some documents, then those documents are also encrypted and stored on server IPFS is brief for inter planetary.

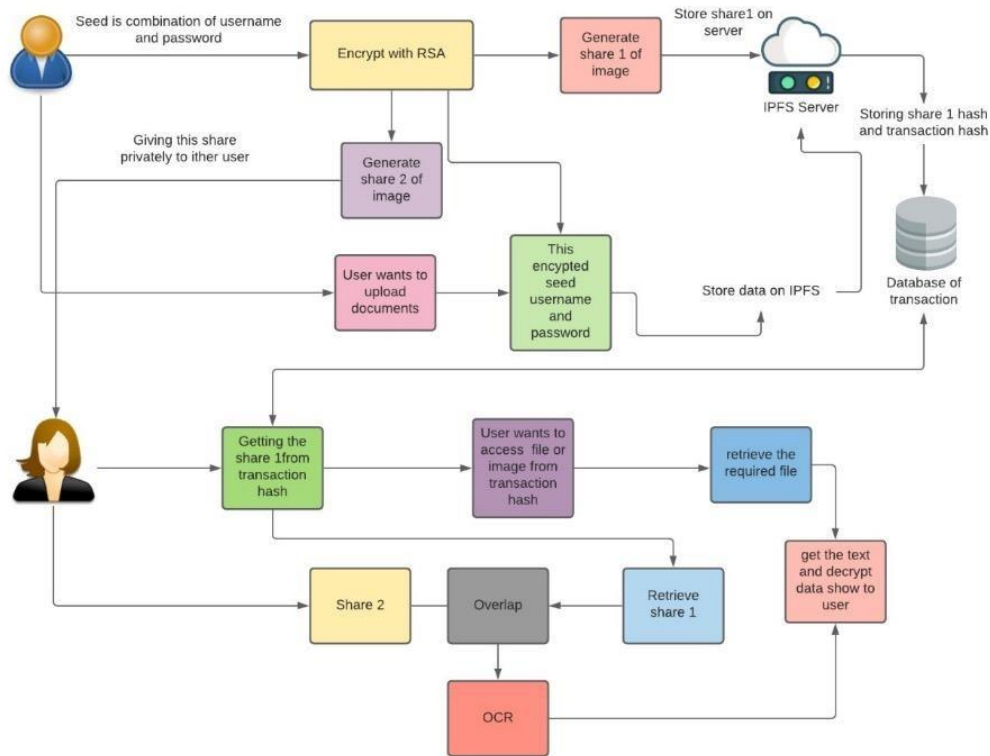


Figure 0.2 proposed system

Chapter 4

4. REQUIREMENT AND TECHNOLOGY USED

4.1 Requirements

- A fully functional computer
- Internet
- Web browser

4.2 Technologies used

- Python, Solidity, JavaScript
- Ganache
- Anaconda, Spider
- Remix IDE
- Ren mask

4.2.1 Ganache

Is it necessary to rapidly construct Ethereum or Smart contracts distributed applications with a personal block chain? Ganache may be used at any point in the development process, allowing you to create, publish, and evaluate your dApps in a safe and predictable environment.

4.2.2 Anaconda

Is a Python and R language distribution focused at making management system to ensure and deployment in scientific computing easier (information science, machine learning applications, large-scale data processing, predictive analytics, and so on).

4.2.3 Apache Tomcat server

It's an open and free Java servlet container that supports a variety of Java Enterprise Specs, including as the Web API, Java-Server Websites, and, of obviously, the Java Servlet.

The full name of Tomcat is "Apache Tomcat," and it has been initially released in 1998 in an open, participative environment. It began as the following information for the original JavaServer Pages and Java Servlet APIs.

Although it is not officially the standard version for each of these platforms, it is still the preferred option for consumers.

4.2.4 Eclipse:

The Eclipse IDE (integrated development environment) is a great tool for Java developers. Eclipse is one of the most popular IDEs, with roughly one million monthly downloads in 2020. Eclipse plug-ins are software packages that can be introduced to the program.

Eclipse distributions that come pre-packaged have a standardized set of functionality. The Eclipse IDE for Java Developers is designed to aid in the creation of standard Java applications. It supports the build technologies Maven and Gradle, and the Git version control system.

4.2.5 Remix IDE:

A robust free software application for dynamically writing Solidity contracts from your computer. It's written in JavaScript and works in both the web and natively and on the desktop. Among other things, the Remix IDE offers components for analyzing, troubleshooting, and distributing decentralized applications.

Chapter 5

5. REQUIREMENT GATHERING AND ANALYSIS PHASE

5.1 Life Cycle of Software Development

The entire project took three months to complete. The Waterfall model was used to efficiently design and construct a cost-effective model.

5.2 Phase of Obtaining and Analyzing Requirements

This phase began when we organized groups and modularized the project at the start of the project. Important considerations included:

- Projection of objectives
- Assemble requirements and gauge them
- Examine coding language
- Define coding strategies
- Examine potential risks
- Arrange approaches to problems □ Analyse the economic viability

5.3 Feasibility Study

The information is open to everyone healthcare departments like the lab, hospital and clinic, bank etc. This system can be used without the assistance of specialists the requirement is the knowledge of web surfing. It provides viable online services.

5.4 Technical Feasibility

Point of view must be examined. The feasibility is to be slashed on outline design with requirements concerning input, output, programs and procedures. That leads to what type of equipment/method required for developing system.

5.5 Economic Feasibility

The evolving system's cost and utility should be explained. Guidelines for focusing attention on a task that will produce the best outcomes as rapidly as feasible. Another of the elements is that determines the cost of creating the system is its growth.

Even during initial report, many of the most crucial accounting questions. are as follows:

- The costs investigate the entire system.
- The hardware and software expenses.
- The advantages in terms of lower expenses or less costly mistakes.

There are no charges related to hand on process. Proposed since it was created as section of the plan activity. Furthermore, the system works since all of the assets are in play. Is economically viable for development.

5.6 Behavioral Feasibility

This covers the following inquiries:

- Will there be enough? User support?
- Is the proposed system harmful?

When designed and installed, the project would be advantageous since it meets the objectives. All behavioral factors are carefully studied, and the project is determined to be behaviorally feasible.

5.7 Process of Risk Analysis

Regardless of the prevention tactics used, potential dangers from within and outside the business must be evaluated. Although it is difficult to predict the exact nature of prospective disasters or their consequences, it is useful to conduct a full risk assessment of all hazards that could realistically occur to the company. The goals of business recovery planning, regardless of the type of threat, are to safeguard the safety of customers, employees, and other persons during and after a disaster.

It is necessary to evaluate the proportional likelihood of a calamity occurring. The following items should be considered when estimating the likelihood of a certain disaster: geographical nearness to significant power generators, rivers and lakes, and airfields, extent of ease of access to inner amenities, background of local electric utilities in supplying reliable service, background of the town's receptivity to natural hazard, location close to main roads that transfer toxic materials and flammable goods. Natural, technical, and human risks are examples of potential exposures.

Consider the followings: Internal and external flooding, Natural dangers include internal and external wildfires, earthquakes, wind gusts, ice and snow showers, volcanic activity, tornadoes, hurricanes, diseases, tidal waves, and typhoons.

5.8 Threats

Power outages, HVAC and air conditioning difficulties, CPU malfunctions or breakdowns, application programs problems, business applications failings, internet missteps, chemical spills, and radioactive fallout are all examples of technical dangers.

All sites and equipment should be included in the risk assessment. To assess the threat's possibility, rather of attempting to compute exact probabilities for each calamity, a broad relational scoring system of severe, moderate, and lower can be used.

A vulnerability assessment should also determine the impact of each sort of potential danger on certain firm operations or departments. A Vulnerability Assessment Worksheet (PDF Format) can aid in the speeding up of the procedure. The roles or departments will vary depending on the type of organization. All potential risks should be identified and measured in the planning process, as well as the impact on the business if they occur.

To accomplish so, every area should be investigated separately. The main computer system is the most dangerous, and it's far from the only one. Even in the most automated businesses, some sections might not have been computerized or mechanized at all. In entirely automated departments, important papers including such law documents, Computer information, and programs saved on diskettes, as well as related documents for data entry, are kept outside the system.

A level of impact is as follows: 0 = Operations are not impacted or disrupted. 1= Significant impact; operations may be halted for up to 8 hours. 2= Damage to equipment and/or facilities, resulting in an 8-48-hour stoppage in operations; 3= Significant machinery and/or building damage, resulting in a 48-hour stoppage in operations.

The assumptions that can be employed throughout the risk assessment process are as follows:

- Even effect evaluations Depending on the circumstances, the ratings for each facility may range from 1 to 3, as well as the rankings should reflect the expected, probable, or concept used to describe on each place.
- Every potential threat should be "targeted" to the rated institution.
- While one possible hazard may cause others (for instance, a storm can cause tornadoes), there should be no expectation of a domino effect.
- If the threat's conclusion does not need migrating to a new place, the effect must be rated as a "2."

- The risk assessment should be carried out by the facility. To analyze potential hazards, a weighted point grading system can be utilized.

5.8.1 Functional Requirements

- Technical knowledge and fundamental skills are required.
- The system must be capable of matching needed settings.
- Data structure to understand about Blockchain's complexity.
- The system should show live tweets as well as news articles from Twitter and news websites.

25

5.8.2 Non-functional requirements

- The accuracy of the data will determine the product's reliability.
- The site is user-friendly so that customers can easily view and use it.
- CPU and memory use should be reduced.

5.9 Future Modifications

Assuring compatibility between multiple blockchain systems is critical, and it should be considered as one of the possible future work paths. Furthermore, we intend to integrate the component for money into the framework that also stands we'd want to have some help with this. A few issues, such as deciding how much a patient should pay for a doctor's consultation on this blockchain-based localized system. We'd also need to lay down specific norms and rules that adhere to the ideals of the health-care industry.

Chapter 6

DESIGN & IMPLEMENTATION

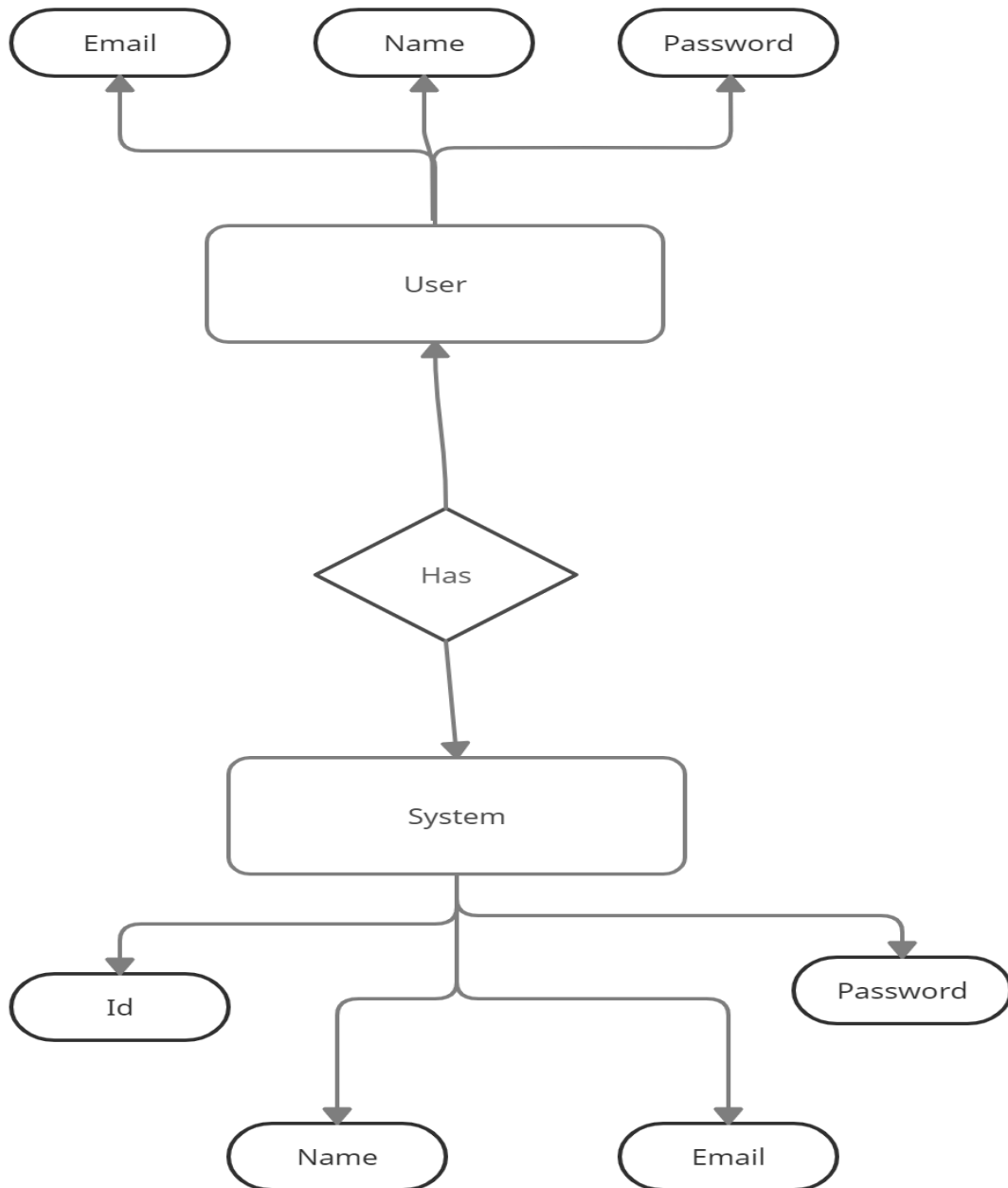


Figure 0.1 Overall design and implementation

7. CONCLUSION & FUTURE MODIFICATIONS

7.1 Conclusion

In medical services, a conveyed record will be viewed as a common unchanging and straightforward history of the multitude of activities performed by eHealth clients; these activities typify characterizing access the executive's strategies and sharing, getting to, and

changing the information. This work presents the arranging of the structure for the genuine information sharing case for radiation medication and furthermore the execution of a picture that guarantees protection, security, comfort, and granular access the executives over touchy patient information. The philosophy is general and could be basically reached out to help various kinds of patient consideration.

7.2 Future Modification

Assuring compatibility between multiple blockchain systems is critical, and it should be considered as one of the possible future work paths. Furthermore, we intend to integrate the payment module into the existing framework. For this, we'd like to have a few issues, such as deciding how much a patient should pay for a doctor's consultation on this blockchain-based localized system. We'd also need to lay down specific norms and rules that adhere to the ideals of the health-care industry.

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