BLOCKCHAIN AND ITS APPLICATIONS IN SECURE HEALTHCARE COMMUNICATION *

Dillon Tate
Master's Student
University of Kentucky
Lexington, Kentucky
dillon.tate@uky.edu

ABSTRACT

As a relatively new technology, Blockchain's applications is still being explored in many fields. Its usage for the secure storage of data makes it an ideal candidate to update the modern healthcare communication system. Currently, hospitals in the United States have no good way to securely communicate important patient data between facilities. Using Python and Hyperledger Iroha, this project looks into the applications of Blockchain to manage access to healthcare data and improve healthcare for patients and providers.

***K*eywords** Blockchain · Healthcare · Communication Systems · Hyperledger Iroha · Python

1 Introduction

Blockchain and its applications is the focus of a lot of attention recently. As the world weathers the effects of COVID and its variants it is useful to look at available technologies to see how it can help our infrastructure manage. One of the most important aspects of the healthcare system is the communication and storage of health information. The goal of this study is to determine how blockchain can be used to help facilitate reliable and secure communication in the healthcare system. Currently, many hospitals in the United States do not have methods in place to transfer patient records electronically. One method currently used is to give patients CD's holding their data to take with them. This requires healthcare facilities to have patients keep track of their health information, which could get lost or damaged. For important data such as X-rays, this could require the new facility to take another scan, costing both the patient and the hospital time and money. A blockchain based access system to store scans and electronic health records (EHR) would allow hospitals to reliably and effectively communicate important data without risking it being lost in transit.

2 Related Works

Blockchain has already been identified as a field of study for healthcare data. KitChain, a system built to manage pharmaceutical supply chains using smart contract, was built using Golang and Hyperledger Fabric[1]. Blockchain is also a foundation for MyClininc, a project using Hyperledger to "schedule appointments, review medical reports and request further investigations or assistance"[2]. MyClinic is primarily used for online conferences with healthcare providers, and does not store or manage healthcare data. Another blockchain project in healthcare is Verified.me, a Canadian digital identity network that uses Hyperledger Fabric to allow consumers to dictate who their data should be shared with[3].

3 Methodology

When looking into current system options for implementing blockchain there are a variety of options including Etherium and Hyperledger. For a healthcare system it is important to be able to verify the authenticity of all participants. As

* *Citation*: **Tate, Dillon. Blockchain and its Applications in Secure Healthcare Communication. Pages.... DOI:000000/11111.**

a permissioned blockchain system, Hyperledger lends itself best to the task of creating this private ledger. Two choices studied from the available Hyperledger implementations were Hyperledger Fabric and Hyperledger Iroha. While Hyperledger Fabric does have some related implementations, it is a more complex structure. For this project, Hyperledger Iroha was chosen for its use of C++ language and simplified commands for smart contracts and permission-only use. Hyperledger claims it as the only ledger that has a robust permission system that can be set for all commands, queries, and joining the network. Additionally, Hyperledger Iroha has a supported python library which makes it convenient to test and implement.

3.1 Data Structure

This project utilizes a private ledger that is split into different roles. These three roles have different accesses and are split into patients, healthcare workers, and administrators. Administrators have access to the whole system, and should include limited trusted individuals. Healthcare workers include physicians, nurses, and other healthcare staff who may need access to patient data. This role can only be added by administrators to ensure only verified healthcare workers are added to the blockchain. This role will most likely be used by the hospital staff who enter the data rather than each doctor individually. Patients are individuals who are entered into the system by healthcare workers or administrators and may have health information attached to their account. Patients can only access their own data or give access to their data to other accounts. All of these roles are under the hospital domain. When implemented across multiple healthcare offices, each healthcare facility may have a unique domain created by an administrator. Each role is only given access to the minimal commands and data they need.

Since the goal of this project is to keep the storage and transferring of healthcare data secure, it is important to investigate the best way to identify patient records. Some patients may have the same name, which could cause confusion or errors if each account was based solely on patient names. To protect against this, patient accounts should be identified by a unique username rather than their actual name. This unique identification of patients prevents anyone from looking up the account of a patient by knowing name. It also protects patient identities if a malicious user were to gain access to the blockchain.

Due to the nature of blockchain, the actual health records will not be stored on the ledger. Each health record will be stored in a separate database, and referenced in the blockchain using a unique ID. This ID can be found on the blockchain by users with the correct permissions and can be used to query the actual health records which may be an EHR, an X-ray, an MRI, or any other type of health record. Without this ID, a user cannot access the desired health record from the database.

4 Results

After the private ledger was setup, the domain, assets, and roles were successfully created with the appropriate permissions utilizing a test admin role and appropriate commands. Each user is given a public and private key upon account creation which they use to sign their queries and commands. The blockchain was first tested using the built-in command line interface of Hyperledger Iroha. After this demonstration, the python interface was created to connect and interact with the blockchain. Modules were created to create new roles, users, domains, and modify account information. Each of these modules has been tested and implemented in the python program.

5 Conclusion

In conclusion, blockchain presents a promising solution to the current communication issues plaguing healthcare facilities. Utilizing this type of system, patients will not have to keep track of their own health data. Instead, EHR and other health information can be quickly and securely transmitted over large distances. This eliminates the risks of having patients carry their own health records or from having to retake scans and tests at each healthcare facility. It also allows healthcare facilities to access patient information in an emergency and for the easy transfer of EHR when a patient goes to a new location.

5.1 Next Steps

This research demonstrates the feasibility of blockchain for healthcare data access management. Using this work as a foundation, it can be developed into a working system for patients and healthcare providers to utilize. To accomplish this, a graphical user interface (GUI) must be created to allow simple and guided transactions to occur rather than using built-in commands as is currently done for faster testing. Additionally, a database for patient data should be simulated to allow for testing the upload and download of information using created keys for each unique document.

Acknowledgments

This project was supported by Dr. Cody Bumgardner at the University of Kentucky.

Documentation

Documentation for the discussed Hyperledger projects can be found here. [4] [5] [6]

References

[1] Kitchain, 2022. Last accessed 27 April 2022.
[2] Myclinic, 2022. Last accessed 27 April 2022.
[3] Verified.Me. What is verified.me and how does it work?, 2022. Last accessed 27 April 2022.
[4] Hyperledger. Hyperledger fabric read the documentation, 2020. Last accessed 17 February 2022.
[5] Hyperledger. Hyperledger iroha read the documentation, 2020. Last accessed 17 February 2022.
[6] Hyperledger. Hyperledger iroha use cases, 2020. Last accessed 17 February 2022.