Decentralized Health Record Storage System for Individuals in Bangladesh

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Introduction

Decentralized health record storage system for individuals in Bangladesh is a platform that can store our medical documentations like prescriptions, test reports, etc and remind us what time we need to take the prescribed medication. The platform also organizes the medical documentations according to date and recent appointments, making it possible for it to be found quickly and easily. We have ensured security and privacy with the use of the Blockchain system. Blockchain is a cloud-based decentralized system that makes it difficult to hack information or cheat the system

Problem

In Bangladesh, only a few health organization stores patients health data. Even the few organizations that store medical records does not promote privacy and security, as the data are not in the patient's control and the software used rarely have proper security mechanisms. Patients can not keep track of the health record for a long time, as papers get lost or destroyed. Because of the lack of previous health records, patient face the threat of getting mistreated, which may lead to serious health issues even death.

Solution

A cloud-based decentralized system where patients can store their health records. The data will be stored encrypted following HIPAA compliance. The patient will be able to retrieve the data anytime. The doctor will be able to view this data by requesting permission for the patients when the patients are visiting their chambers.

Opportunities

We have conducted a survey on 300 people to analyze their demand for this service. We asked two questions.

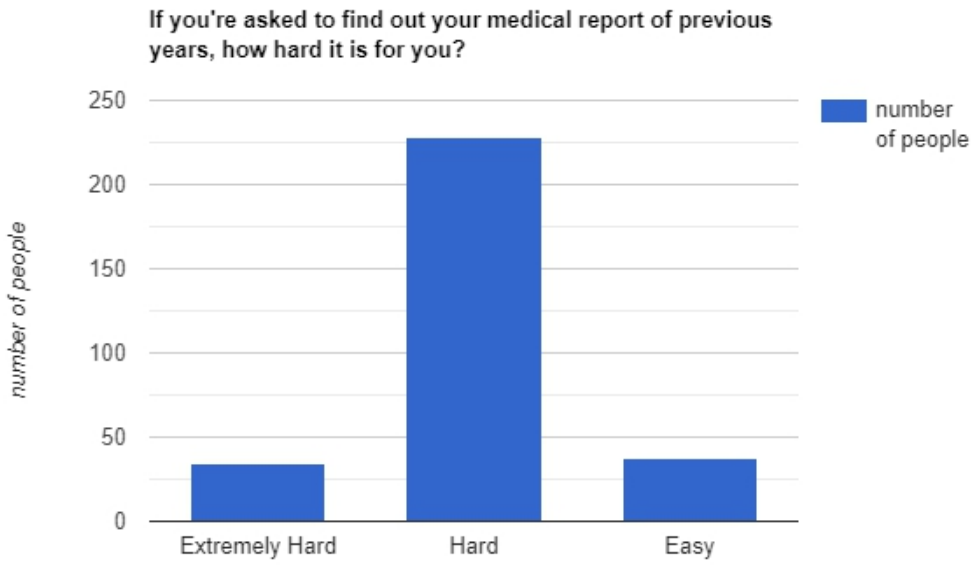

Figure 1: Bar chart showing the response of our first question

The first question was if we asked someone to find out his/her medical reports or documents, how hard would it be for him or her. **11.33%** people said this is extremely hard for them, **76%** people said it's hard and the rest of the surveyed people informed us that it's an easy task for them.

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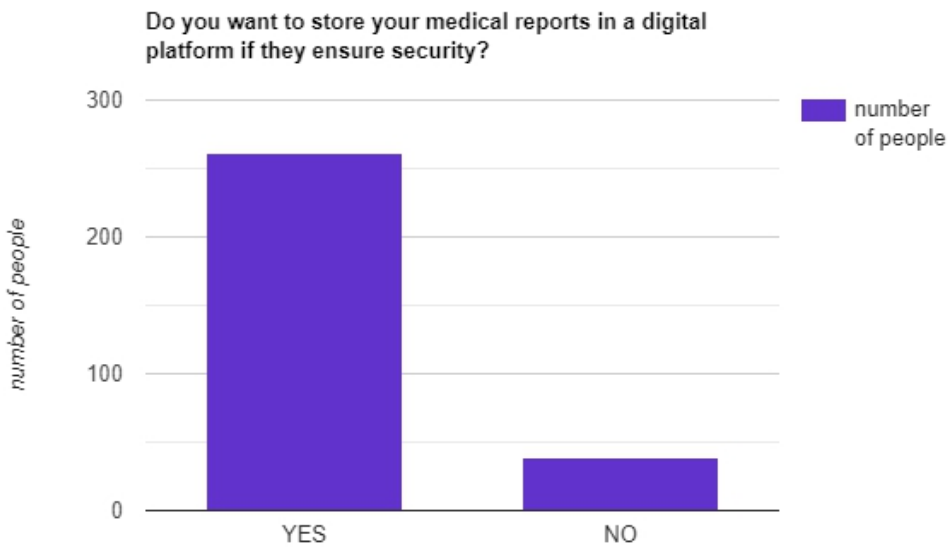

Figure 2: Bar chart showing the response of our second question

Our second question was on whether they want to store their medical report in a digital platform if they ensure security. **87%** of people answered positively and supported the need for such software. The rest were skeptical and expressed their unwillingness to store in a digital medium.

From this report, we can conclude that the majority of the people find it effective and are willing to accept similar services. This will be helpful for them. As our idea is innovative and there are not many competitors available in the market with similar services, There is opportunity for us to fill in the gap and provide some much needed services. It will help people to store their medical reports for further use.

Actors

- Patients: Will upload records and use tokens for discounts and other advantages
- Doctors: Will hand out digital prescriptions to patients, will view patient's previous records with their permission
- Pharmacies: Will sell medicine and advertise their products
- Researchers: Request and access patients data with permission (Patient will be awarded)
- Organization: Will post advertisements and give tokens to patients
- Insurance Companies: Will post advertisements

Monetization

The monetization scopes of our proposed platform is as below -

Advertisements: Health care organizations, pharmacies, insurance companies, or other healthcare-related institutes will be able to post ads to promote their product in exchange for tokens.

Patients reward: Patients will be rewarded token when they will add data, review doctors or organizations (hospital, labs, doctors, pharmacies, etc)

Medicine sell: Pharmacies will be able to sell medicine with patients in exchange for tokens.

Research: Research institutes will be able to request patients' data for research purposes in exchange for tokens.

Token Exchange: Actors will be able to purchase/sell tokens via token exchange.

Miners: Miners will be rewarded tokens for mining data.

Hardware sell: Miners will be able to buy mining hardware in exchange for money.

Lab tests: Patients will be able to do lab tests in exchange for tokens.

Prototype: Technical Details

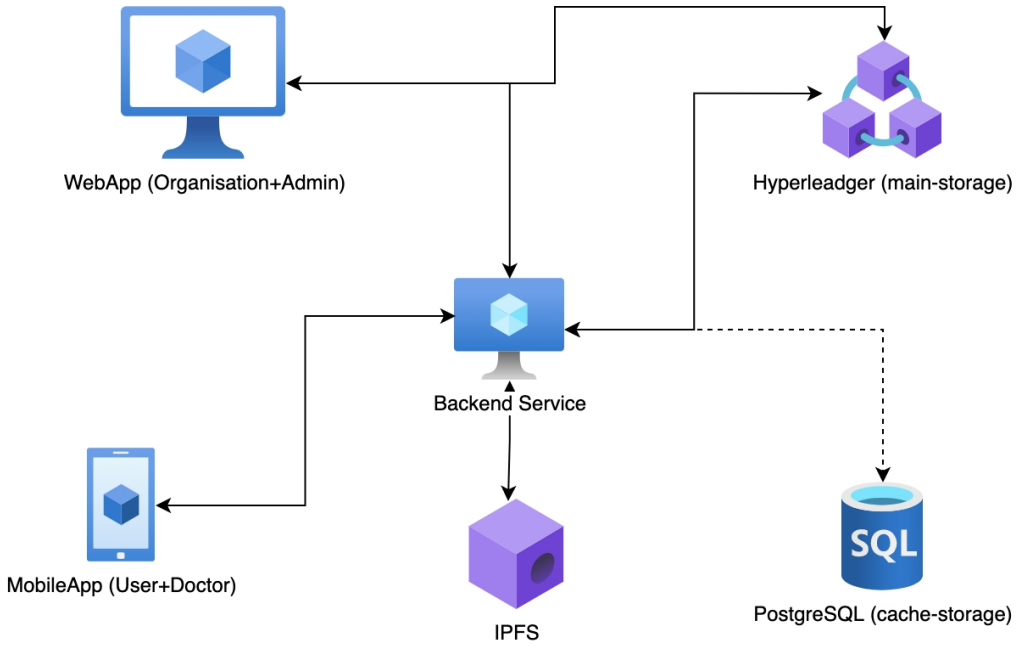

Figure 3: Bird's Eye view of the architecture

Figure 3 presents the high level architecture of our platform. Organizations and the administrators of our platform will manage the back-end operations from a web application and a mobile application will be available for the patients and doctors. The files uploaded will use the IPFS system to secure the file uploading process, and using the back-end services, it will be stored in the blockchain system.

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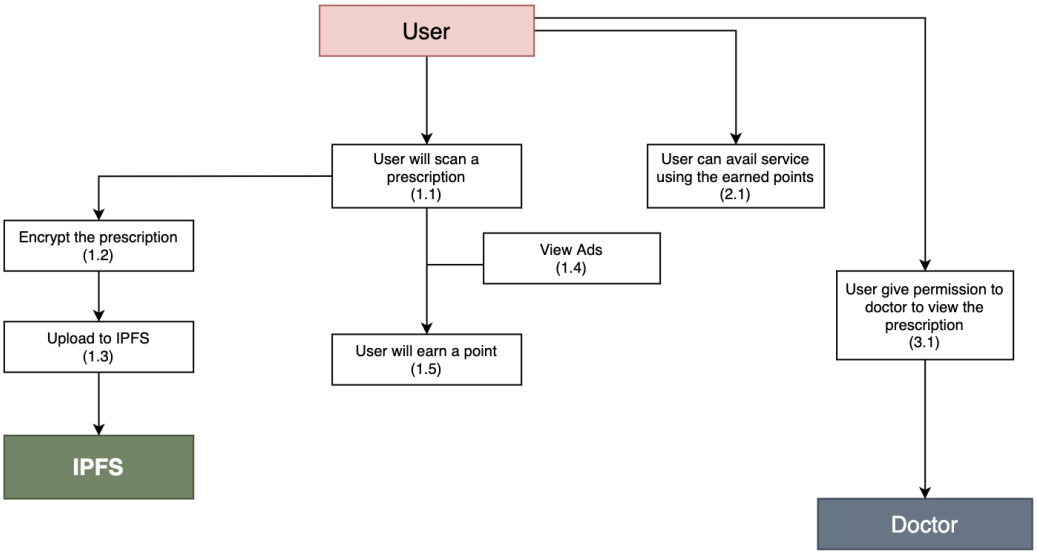

Figure 4: User flow

Our user flow is as explained in figure 4 and figure 5 shows the entities.

Figure 5: Entities

Prototype: Privacy and Security Risks

Privacy:

- Does the solution address data privacy and identity privacy?
  A: We will use Hyperledger which is an enterprise-grade blockchain framework. We will use the Hyperledger channel to keep data & identity private.

- Will data unintentionally have leaked to unauthorized parties?
  A: No. As per the Hyperledger channel, there is no way to data leakage. Also, it maintains data privacy strictly.

Crypto-security:

- How does it address key management?
  A: Hyperledger has a standard and proven key management system.

Access Control:

- Does the system have controls for who can access specific parts of the system?
  A: Yes, as Hyperledger is a private blockchain and has a strong access control management system, we can ensure who has access to which data.

Prototype: Adherence to decentralized application design

- How are transactions verified? More precisely, what is the setup of the consensus?
  A: Participating organizations will be the one that orders and the peers.
- What is stored on-chain and off-chain?
  A: User-specific data is stored in the blockchain. Few data are being maintained off-chain to do analytic and query related works. Blob data like files are stored in IPFS (encrypted).
- How is data stored?
  A: On-chain data is stored within the blockchain and off-chain data is stored in PostgreSQL.

Prototype: Governance & trust

Our prototype handles governance and trust for decentralized application design

Network Membership Governance — how to ensure effective network operations, including on-boarding and off-boarding of participants, permissions, support services, risks, and equitable costs distributed fairly based on participants' activities?

- Member on-boarding/off-boarding - Member on-boarding and off-boarding will be handled by the Hyperledger Membership service provider.
- Data ownership structure - Each User and Organization will be connected to each separate channel and data ownership will belong to them.
- Permission structure - Only the registered Users/Organization will be allowed to participate.

Why Blockchain ?

As medical documents are sensitive and classified, we must ensure security and privacy. Blockchain technology gives us the opportunity to ensure both with its unique structure. As we know, there are two types of key in blockchain technology, private and public. The data each client uploads is encrypted with the private key, and stored there. It is impossible to decrypt the data without knowing the private key. No one can extract the private key and fetch the data from the blockchain, not even the database administrators.It ensures absolute confidentiality without maintaining extra precautions.