

ASSIGNMENT #3

CSBC1020 – Blockchain Applications for Industry FALL '21

Submitted by :

Gazi Mohammed Ashab Hossain
Student ID: 219019231

Submitted to :

Victor Li

Submitted on :

14.11.2021

The healthcare system requires constant data handling and security. Accessing health care services across various hospitals or clinics for diagnosis and treatment has become quite widespread. Especially for patients with chronic conditions like cancer; due to greater specialization of health care services and high levels of patient mobility.

What are the problems in current healthcare data management?

Physicians/doctors can make timely decisions about a patient's condition if they have access to accurate information about the patient's medical history. This is known as EHR or Electronic Health Records.

These records are mostly shared among various medical institutions via fax or mail; due to a lack of systematic infrastructure. This makes the whole process time-consuming (sometimes takes days and months) and resource-draining. On top of that, since access to EHR data could prove to be the difference between life and death for an individual, such a non-automated system could indirectly be responsible for an individual's untimely demise.

Ecosystems for Health Information Exchange (HIE) are currently responsible for EHR data to be shared efficiently, accurately and securely. But HIEs have limited adoption and scalability, with many regional networks still isolated. It also lacks standard architecture resulting in failure to ensure proper security and access control for patients once data are shared. While a centralized system like HIE is easier to maintain, it has a single point of failure and could be a performance bottleneck in real-world deployments. Hence, end users (doctors, patients) have naturally raised concerns over privacy and security when dealing with a centralized authority with access to highly sensitive information.

Why was blockchain technology chosen to address the problems?

ACTION-EHR system was created with blockchain technology to address the current EHR data issues.

ACTION-EHR's goal was to develop a patient-centric system that facilitates security, trustable management, sharing, and aggregation of EHR data. It would allow patients to manage their own medical records across numerous hospitals or clinics. Such a system would ensure privacy and promise security with respect to the requirements for EHR data management, where access control can be specified by the patient.

Blockchain, as we know, is a peer-to-peer distributed ledger system that maintains a shared, immutable, and transparent append-only record of all network transactions that happen on the network. Data is stored and timestamped in blocks, in the form of transactions, digitally signed by the network participants. A hash function is applied to the contents of a block to form a unique block identifier which is stored in the subsequent block – forming a chain.

As we can see, blockchain offers a unique solution to the EHR data management problems. Each hospital will provide a node with EHR data to form the network of blocks. These blocks will only store metadata and the actual data will be encrypted and stored off-chain, complying with relevant protocols. The UI will be a simple web-based interface which is user-friendly. The participants can initiate EHR sharing transactions through this UI.

This makes applying blockchain for ACTION-EHR an ideal and achievable solution.

Why do you think that a Hyperledger blockchain framework was chosen to build ACTION-EHR - a prototype of a patient-centric blockchain-based EHR data management system? Why not use Ethereum?

To understand why Hyperledger blockchain framework was used instead of Ethereum, we have to first understand the basic comparisons between them.

Purpose: Ethereum is used for generalized B2C (Business-to-customer) applications. When on the other hand, Hyperledger is preferred when there's a specialized B2B (Business-to-business) purpose; where entities can implement a block according to their business requirements. Since ACTION-EHR is a specialized enterprise level system, Hyperledger was the preferred option.

Confidentiality: On Ethereum, every transaction made is visible to the network. This wouldn't be ideal for an environment where sharing sensitive information is one of the use cases. Hence using Hyperledger for ACTION-EHR makes more sense.

Peer Role: Each peer in Ethereum has a role, which implies that numerous nodes must participate in order for a transaction to be completed. Hyperledger on the other hand, does not require each peer in the network to be informed to complete a transaction.

Operation Mode: In Ethereum, the operation mode is public; meaning anyone can join the network and no permission is needed. This directly contradicts the data-security and privacy principle of ACTION-EHR. Hyperledger is a private blockchain by design; implying that only authorized or permissioned participants can access the network. In other words, the network is restricted to a predetermined group of individuals who have been given permission.

For an enterprise level system such as ACTION-EHR where data security is invaluable, Hyperledger blockchain is the optimal alternative.

Limitations:

Application of a new technology lacking proper government rules and regulations in a highly regulated medical data environment was always going to be challenging. In the event of a caregiver failing to access the records of an unconscious patient due to some technical issue, more robust and 'break-glass' mechanisms for these situations has to be considered.

Moreover, an immutable log of data means no individual can really delete their information from the system. This principle already contradicts the patients right "to be forgotten" as per Data Protection Regulation in Europe.

REFERENCES

[1] CSBC 1020 – Course Module 3 and 4

[2] A. Dubovitskaya¹, F. Baig³, Z. Xu⁴, R. Shukla³, P. S. Zambani³, A. Swaminathan³, M. M. Jahangir³, K. Chowdhry³, R. Lachhani³, N. Idnani³, M. Schumacher⁵, K. Aberer⁶, S. D. Stoller³, S. Ryu⁴, F. Wang³, 1S. of I. Technology, and C. A. A. Dubovitskaya, “Action-EHR: Patient-centric blockchain-based electronic health record data management for cancer care,” Journal of Medical Internet Research. [Online]. Available: <https://www.jmir.org/2020/8/e13598/>. [Accessed: 12-Nov-2021].

[3] N. Srivastava, “Ethereum vs. Hyperledger: A comprehensive guide,” Blockchain Certifications, 20-Feb-2021. [Online]. Available: <https://www.blockchain-council.org/ethereum/ethereum-vs-hyperledger-a-comprehensive-guide/>. [Accessed: 12-Nov-2021].

[4] “Hyperledger vs Ethereum: Key differences and comparison,” Edureka, 22-May-2019. [Online]. Available: <https://www.edureka.co/blog/hyperledger-vs-ethereum/#confidentiality>. [Accessed: 12-Nov-2021].