Blockchain Case Study

Report

on

"A Use Case of Blockchain in Healthcare: Allergy Card"

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Blockchain for Competitive Advantage

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1. Introduction

The Blockchain was first revealed by Satoshi Nakamoto in his paper “Bitcoin: A peer-to peer Electronic cash system”. It is a technology or rather a combination of technologies which is still under development. A Blockchain is a peer-to-peer system for validating, time-stamping, and permanently storing transactions on a distributed ledger that uses cryptographic hashes to authenticate digital asset ownership and asset authenticity, and consensus algorithm to add to the ongoing integrity of the ledger's complete history. It is a system of storing data in a way that makes it impossible to change, hack or cheat the system. While blockchain was initially established for financial security purposes, nowadays it is implemented in several sectors such as- data management, digital rights management, patent management, business process engines, healthcare sectors, the Internet of Things, etc. The purpose of this report is to present the necessity of a blockchain based healthcare application to manage and access the allergy information of patients, based on the case study “A Use Case of Blockchain in Healthcare: Allergy Card” by Rhode Ghislaine Nguewo Ngassam, Roxana Ologeanu- taddiei, Jorick Lartigau and Isabelle Bourdon, which introduces a mobile-based application built on the foundations of a permissioned blockchain architecture. The report will go on to discuss the implications while looking at the benefits and challenges of implementing such an application to one of the most integral aspects of human lives.

2. Explanation of selected case study

Healthcare is an important facet in our lives. In recent years health information systems have faced several challenges in terms of counterfeit medications, medication overprescribing, accessibility, privacy and traceability of medical information. Blockchain has the potential to become a promising platform for the healthcare sector as it can ensure the secure exchange and traceability of information while respecting the regulatory framework for confidentiality and portability of healthcare data. Using Blockchain applications in the healthcare sector will open opportunities or benefits like drug recognizability, improvement and validation of medical services records and conventions for electronic health records and allergy information. It could also aid in sharing and monitoring health information where authorizations can be allowed to chosen medical services associations, clinical preliminaries in which falsely changing or adjusting information from affected parties can be annihilated. Furthermore, nationwide interoperability and misuse of doctor prescribed medications can be reduced. (Dasaklis, et al., 2018)This case study tackles one of those uncountable, crucial issues regarding healthcare information systems. It focuses on the construction of a blockchain based mobile application for sharing allergy information between patients and various healthcare professionals. As mobile phones have become an integral part of our daily lives, the use of a mobile application based on Blockchain for the healthcare sector is a reliable and easiest medium of sharing health related records and information between patients and various health professionals as well as take one more step towards the revolutionary change of the healthcare system.

3. The business problem that the Blockchain solution is attempting to solve

3.1 The problem space

In this case study the Blockchain solution is attempting to solve the difficulty of access and inaccuracy of the healthcare information system, specifically the allergy information of patients. The case study manifests a design for an application that exhibits a Blockchain based allergy card to solve real life issues such as registering, sharing and tracing information regarding drug allergies. Drug Hypersensitivity Reactions (DHRs) can be lethal and may require prolonged hospitalization if not dealt with promptly and accordingly, and can be a lifelong problem for many patients. Misinformation from patients, previous misdiagnosis, over-medication, over-prescription, poor documentation and ignorance of patient's allergy, lack of knowledge, for example- the treating physician may not be aware that the prescribed drugs are cross-reactive, failure to collect relevant information from the patients, patients forgetting their allergy or inability to recognize allergy, administering of drugs despite the awareness of allergies after a risk/benefit analysis are some of many causes of allergic reactions to drugs. (Khalil, et al., 2011) However, in most cases, the stimulus of drug allergy is inaccuracy of information and is a significant problem for the healthcare industry. This issue poses more of a threat when the patient is unconscious. Conveying this information through paper documentation in today's technology-driven world is impractical, as they can be lost or misplaced. Furthermore, accumulation of the multitude of data necessary for diagnosis in a paper-based record system is practically unachievable. This case study introduces the concept of universally available, information-based allergy cards through a Blockchain based mobile application to reduce cases of misdiagnosis caused from drug allergies.

3.2 Is Blockchain the right solution to the problem?

Healthcare industries aim to provide the best service and care for the patients. However, due to the lack of access to and inaccuracy of information, it has become difficult for them to maintain the continuity of efficient and effective care-based service. Analyzing the issue, we can come to the conclusion that the perfect system for maintaining such information must have the following characteristics: it has to be decentralized so that all affected parties (patients and healthcare professionals) can have access to the complete database while maintaining privacy of individuals; the information needs to be chronological and immutable; the system needs to be divided into different access levels, where the doctors are able to validate the information declared by the patients. Considering the problem space, a permissioned blockchain is the perfect solution, addressing all the needs of an efficient, patient-empowered allergy card, which maintains the privacy of individuals. The solution mentioned in the case study is a permissioned Blockchain-based application, called PikcioChain. This application would help all concerned parties to keep record of exact and updated information about their needs and there would be less cases of data legacy. The case study describes a blockchain process which regards drug allergies and potential sources of allergy information allowing them to share information to ensure safety of patients. By using this specific blockchain solution, patients can easily report about allergic reactions as soon as they occur and enable the health care professionals to directly validate information in the blockchain and share the information when it's necessary by granting access to identified users. Additionally, the physicians will have quick access to their patient's allergy information, in detail. (Ngassam, et al., 2020)

3.3 How does the application solve the problem?

PikcioChain fulfills the requirements of a fully functional digital allergy documentation. It gives power to patients to report their allergic reactions promptly and according to access levels, physicians have the added functionality that allows them to validate the declared information, in order to weed out the misinterpretations of allergic reactions by the patients. The application works by implementing a decentralized P2P network to communicate data between doctors and patients. The data travels through a chain of trusted contacts chosen as intermediaries, by the patients themselves, which forms a concentric ring of trust in order to deal with the lack of confidentiality in P2P networks. To allow for reliable access to information, each user is authenticated via a Trusted Identification System (TIS). Users are certified by validated third-parties to ensure integrity and data security. Furthermore, it addresses the privacy concerns by encrypting data and due to the nature of architecture of a permissioned blockchain, it is inherently secure.
The proposed mobile device-based application would maintain information or data related to healthcare through the following process:
There should be a user profile for patients and physicians including their identification. There is a sign in/ sign up option for the users and that could be possible by user verified code. There is an option for a patient for reporting about his problem and access for information history. There is another option for patients and physicians for holding their information in the device. Patients can grant access to identified healthcare professionals in his or her information in response to requests sent by the physicians. Then the physician can report a reaction to the medication if he or she has access to the patient's files. Doctors can validate prescription or information based on the history of the patient or different tests. Each patient has the opportunity to manage a trusted third-party account and the other patient can be a third party with verified identifications. In case of emergency or unconsciousness of the patients the law provides a solution for trusted third parties or the physician to get access in the patient file provided that the access is truly justified by an emergency. In the case of a patient being unconscious, trusted contacts, chosen by the patients beforehand, can access the information if need be.

4. Limitations of using the application

Despite the perceived advantages of using the application, PikcioChain, as a digital allergy card, there are some major drawbacks. Limitations of the application are as follows:

No interoperability: Patients using the application would need to maintain different record keeping methods for other health-related data, as the application only keeps record of allergy information. Doctors using the application would only have access to the allergy information of data of their patients and would need to access other information about the patient via other means. (Ngassam, et al., 2020)

Identification of the users: Authentication of the users is a major requirement for the integrity of the data in the blockchain. However, this is accomplished by third-party services which uses centralized database, thus potentially compromising the integrity of the identification of the users. A case of compromised identity would prove to be severe in the case of a doctor’s identity being stolen. (Ngassam, et al., 2020)

Immutability of blockchain: Once validated, the data entered is practically immutable. (Hofmann, et al., 2017) Thus, any misdiagnosis or wrongly validated reports cannot be changed and remains in the blockchain permanently, which may cause further misdiagnosis of other patients.

Empowering patients: The application empowers patients in updating their allergy information and this could prove to be problematic as patients often tend to misinterpret adverse drug reactions with allergic reactions to drugs, which might lead to future misdiagnosis. (Ngassam, et al., 2020)

Lack of proper confidentiality: Even though the data is passed through trusted nodes, the trusted entities might have malicious intent or might be an imposter and thus, the communication between the doctors and their patients should be accessible exclusively by them.

Every new technological advancement is likely to have some limitations, and PikcioChain is no different. Through proper evaluation and further developments based on the results, hopefully the issues would be resolved to further the cause of healthcare information management.

5. Cyber-security implications

PikcioChain uses a permissioned blockchain based on a P2P network. A permissioned blockchain implements a tightly controlled network, and in this case, it is consisted of certified users with a certain amount of trust among them. Since only authorized users are enabled to create nodes, it is difficult for malicious users to take control of the network.

The distributed, decentralized nature of the blockchain architecture makes it practically impossible for a hacker to compromise data and furthermore, the data stored in the blocks are encrypted via classic cryptographic methods. (Ngassam, et al., 2020)

Even though the permissioned blockchain feature provides for some inherent security, it is not completely immune to cyber threats.

Blockchain nodes are generally considered to be immutable. However, this is true for published blocks only. Given that a block is unvalidated, it is vulnerable to various kinds of attacks. A blockchain platform is also vulnerable to Denial-of-Service attacks.

In addition to the possibility of having malicious users infiltrating the concentric circle of trust in the permissioned P2P network, verified users can also act maliciously. For example- an approved trusted node might betray the trust of the user and compromise the users' sensitive data. (Yaga, et al., 2019)

6. Benefits and challenges of adopting the blockchain solution & Compare and Contrast

The digitization or the implementation of healthcare information management using mobile-based applications is not a novel idea. In fact, hundreds of established alternatives to the blockchain solution could be found with some basic research. For example, applications based on Electronic Health Records (EHR) and Electronic Medical Records (EMR) are becoming widely popular and there are a wide variety of applications available for the service. AdvancedMD, Meditab, Epic are some examples of the popular mobile applications for these purposes. The benefits of using a

mobile based EHR or EMR includes- faster and efficient documentation of health records, scheduling and automated alerts for upcoming medical events, voice-assisted note taking, online prescription, patient participation, etc. (Green, 2018). However, EHR systems pose major complications when it comes to real life implications. According to nurses, EHR systems created barriers to creating documentations and different applications has different user interfaces. A lack of standardization and huge number of established EHR applications creates an issue regarding interoperability. Furthermore, in a study, EHR systems have been voted as not being user-friendly, which could pose a huge threat in case of life-threatening scenarios (CARRINGTON & EFFKEN, 2011) Additionally, and most importantly, the database of these systems being centralized poses cyber-security threats to the highly sensitive medical information of the patients.

The PikcioChain application solves only one issue regarding healthcare information management, developing a mobile-based application for reporting, sharing and tracing drug allergy information, in contrast to EHR applications having an all-in-one solution when it comes to healthcare information. However, the unique selling points of the PikcioChain application are the implementation of a permissioned blockchain, its patient-empowered system, user authentication process and its "easy-to-use" user interface. The use of a permissioned blockchain along with a user authentication system provides the essential security and data confidentiality when storing sensitive data such as healthcare information. Its patient-empowered system allows the patients to promptly declare any allergic reactions and communicate with doctors via a trusted secure network as soon as a reaction occurs. User assessments are performed to enhance usability and provide necessary functionalities for the users. The need for interoperability between healthcare information systems and user identification are results of these assessments and are subject to further improvement. (Ngassam, et al., 2020)

The implementation of a blockchain based solution into a crucial platform like healthcare could be hindered by a number of challenges, such as the scalability of a world-wide blockchain might be infeasible and could be highly cost inefficient to maintain in terms of computing power required (Kumar, et al., 2018). Regardless, the opportunities and benefits promised by blockchain deserves further research in resolving the issues in implementation of such a system.

7. Conclusion

The demand for a decentralized and distributed healthcare system is increasing resulting from a need of improvement in the existing healthcare services. The report identified the problem space in today's world regarding the conveying of allergy information between affected parties and discussed possible solutions to the problems based on the case study "A Use Case of Blockchain in Healthcare: Allergy Card". A blockchain solution methodology is discussed and limitations to the solution are identified. Cyber-security implications regarding implementation of the solution are further discussed. Finally, the report suggested alternative methods of dealing with the problem at hand and contrasted the benefits and challenges in implementation of both the methods and discussed opportunities for further research on the blockchain solution.

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