

# Medical Image Sharing System using Hyperledger Fabric Blockchain

Jinbeom Seo<sup>1</sup>, Youngbok Cho<sup>1\*</sup>

<sup>1</sup>Department of Information Security, Daejeon University, 62 Daehak-ro Dong-gu Daejeon South Korea.

seojinbeom@naver.com, ybcho@dju.ac.kr

**Abstract**— In this paper, we use the blockchain to manage our own medical information on our own and to maintain data integrity where data can be changed without our approval. This paper proposes a system that can solve the problem of costly repetition of expensive medical imaging and make more accurate diagnosis by sharing one image with various experts.

**Keywords**— Medical Information, security, mydata, blockchain

## I. INTRODUCTION

In the era of the 4th Industrial Revolution, the key is to create new knowledge and value through the integration of various fields, and to prepare a process for establishing and executing better policies. In addition, various policies regarding the management of individual medical data such as the sharing of medical images are emerging. As in the beginning of “Mydata” in Korea, a hyper-leisure environment can be constructed and experimented in which a consortium of expensive medical imaging images can be shared with each other and used for accurate diagnosis.

## II. RELATED WORKS

### A. Blockchain Technology

Blockchain technology was proposed for a new concept of electronic money system in a paper published in 2008 by Satoshi Nakamoto. Blockchain technology consists of P2P network, distributed ledger, encryption technology, distributed consensus, and smart contract. Here, distributed consensus is used as an element for all participants to maintain a consistent ledger in the blockchain, and all users must have the same record. Due to the nature of this blockchain, all participants need to determine the suitability of the data and agree. This process is achieved through decentralized consensus, such as Proof of Work (PoW) or Proof of Stake (PoS). In addition, the smart contract was first presented by Nick Szabo.

This is a protocol for e-commerce to minimize the broker for trust in transactions and to execute specific contract terms. After the Ethereum blockchain, called the second-generation blockchain, the trading parties without an intermediary or central agency supporting such smart contracts direct trading between them is possible. Also the traded terms and results are

recorded in a distributed ledger to ensure the reliability and integrity of the transaction information.

- Public blockchain : The first blockchain is used to make transaction information open to all members over the Internet. High openness and transparency, but network expansion is difficult.
- Private blockchain : A blockchain designed to efficiently and securely handle transactions that occur within a specific company or between limited partners. Maintain decentralized structure, but increase control through limited participation

### B. Medical Image Storage Transmission System

Picture Archiving and Communications System (PACS) is a system that integrates the functions necessary to acquire and store the image information acquired through the image diagnosis device in digital state, and to transmit and retrieve the reading and medical records together. It is a system in which several components are combined and operated. Based on PACS-only software, medical equipment (including CR, DR, readout monitor, etc.), IT equipment (including server, storage, PC, monitor, network, etc.) and application software are combined. It is used after. PACS is a system in which several components are combined and operated. Based on PACS-specific software, medical equipment (including CR, DR, readout monitor, etc.), IT equipment (including servers, storage, PC, monitor, network, etc.), applications Used after the software is combined.

In addition, as a promise made for the standardization of medical images, DICOM stipulates the storage format and communication method of medical images so that medical images generated from photographing equipment can be transmitted and exchanged smoothly.

## III. MEDICAL IMAGE SHARING SYSTEM USING HYPERLEDGER FABRIC BLOCKCHAIN

By sharing medical images with each other, we can contribute to the choice of Gold Standard while developing a private blockchain system to protect personal information and medical information. Implement a private blockchain for sharing medical images. The proposed private blockchain forms a system that approves and shares medical images among members and supports certain rewards to providers. By sharing medical images freely, we provide clinician's learning

and propose a sharing system for owners to select. We also test the reliability of the blockchain voting system for sharing the medical image of the proposed system. We build and experiment with the system of blockchain safety and reliability.

### A. System design

For the experiment in the proposed paper, the system is largely composed of blockchain medical image sharing unit, data processing unit, DB processing unit, and interface unit. Medical information is stored anonymously when it is stored in the database as sensitive information. To handle anonymization, a private blockchain anonymization method is created in Hadoop as shown in <Figure 1>.

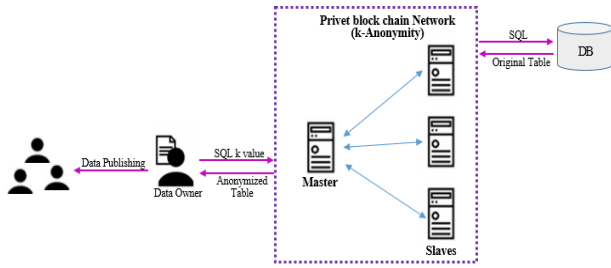


Figure 1. Proposed system blockchain diagram

The blockchain is characterized by the fact that all data is encrypted and blocks are connected in chronological order, making it impossible to modify, forge, or alter past records. The proposed method is a private blockchain-based medical image sharing system that guarantees the accuracy of image reading through voting and verifies the reliability of distributed ledger and blockchain-based online voting during development.

### B. Medical Image Pre-processing

The proposed system extracts the region of interest from the input image and extracts the outline when the x-ray image is input as shown in <Figure 2>. As a result of experimenting the pre-processing accuracy of the image pre-processing algorithm, we can see that the ROI is well extracted.

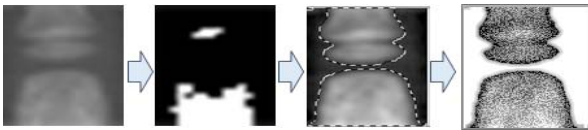


Figure 2. Medical image ROI extraction

### C. Ethereum web architecture

The online voting contract of the proposed system is a program that is delivered to user accounts on the Ethereum network and uses Solidity to form the Web and Ethereum architecture for medical image sharing. <Figure 3> shows the structure of web architecture and Ethereum architecture for medical image sharing proposed in this paper.

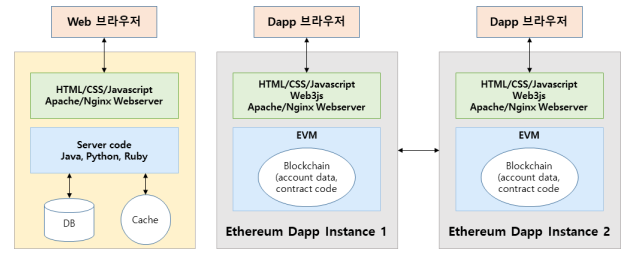


Figure 3. Web and ethereum structure for medical image sharing

The voting structure of the smart contract for sharing medical images on the Ethereum network is constructed as shown in <Figure 4>. Vote (), voteClosed () and voteCount () are configured for the voting function of the online smart contract used in the proposed medical information sharing system.

- vote (): Voting
- voteClosed (): vote confirmation function
- voteCount (): aggregate check function

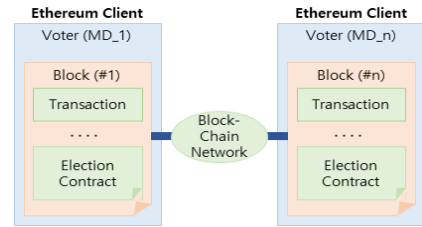


Figure 4. Voting structure for medical image sharin

## IV. EXPERIMENT AND EVALUATION

In order to evaluate the proposed model, we implemented a smart contract in the Intel (R) Core (TM) i7-8700, @ 3.2GHz and 64GB of RAM, Geforce RTX 2080 environment for medical image sharing system, and improved the safety of blockchain smart contract Experiment. We implemented the voting algorithm, set up the voters as shown in <Figure 5>, and conducted illegal voting using hackers whose credentials were not authorized and tested the results.

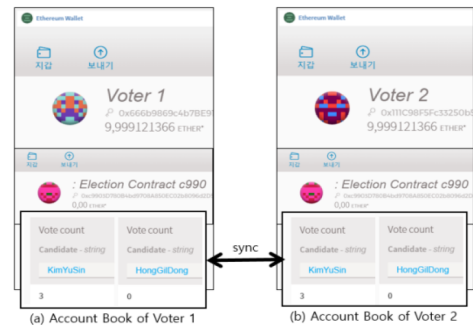


Figure 5. Illegal voting execution example

The result of experimenting that the voter cannot manipulate the vote is shown in <Figure 5>.

Experiments proved that the proposed system could not be manipulated by blockchain proof of work. If there is a threat

of illegal voting by an unidentified user (an unauthorized person or an attacker with a malicious purpose) as shown in Figure 6, only the voters who have been sent cryptocurrencies by the Election Commission will form a blockchain. Voters are not granted a vote, so voters who do not form a block with that vote contract cannot be included in the voter list. Therefore, illegal voting becomes impossible in the proposal system.

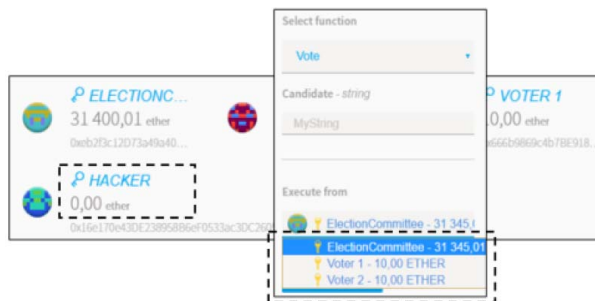


Figure 6. Example of an unacceptable low-resolution image

Experimental results show that Figure 6 does not include illegal voters. Therefore, the experiment proved that the proposed system is safe. The proposed paper utilizes Hyperledger blockchain technology for medical image sharing system to guarantee data integrity. Future research is required to secure reliability.

#### ACKNOWLEDGMENT

This research was supported by the Daejeon University Research Grants (2019)

#### REFERENCES

- [1] D. Nie, R. Trullo, J. Lian, C. Petitjean, S. Ruan, Q. Wang and D. Shen, D, "Medical Image Synthesis With Context-Aware Generative Adversarial Networks." in *Proceedings of the International Conference on Medical Image Computing and Computer-Assisted Intervention*, pp. 417-425, 2017.
- [2] L.S., Sankar, M. Sindhu and M. Sethumadhavan, "Survey of Consensus Protocols On Block Chain Applications.", in *Proceedings of 4<sup>th</sup> International Conference on Advanced Computing and Communication Systems (ICACCS2017)*, pp. 1-5.
- [3] D. H. Yang, J. K. Park, H. K. Sung and S. H. Sung, "Trend analysis of clinical studies published in the journal of pediatrics of Korean medicine," *the Journal of Pediatrics of Korean Medicine*, vol. 32, No. 4, pp. 141-162, 2018.
- [4] Y.B. Cho, "Automated Roi Detection In Left Hand X-Ray Images Using Cnn and RNN", in *the International Journal of Grid and Distributed Computing*, Vol. 11, No. 7, pp.81-91, 2018.
- [5] T. D. Bui, K.I. Lee and J. Shin, "Incorporated Region Detection and Classification Using Deep Convolutional Networks for Bone Age Assessment", *the Journal of Artificial Intelligence in Medicine*, Vol. 97, No. 6, pp.1-8, 2019.
- [6] M.A. Abbas , and J.P. Hong , "Survey on Physical Layer Security in Downlink Networks", *Journal of Information and Communication Convergence Engineering*, vol. 15, no. 1, pp. 14-20, Mar 2017.
- [7] *FLEXChip Signal Processor (MC68175/D)*, Motorola, 1996.

- [8] A. Suryadibrata , and K.B. Kim , "Ganglion Cyst Region Extraction from Ultrasound Images Using Possibilistic C-Means Clustering Method", *Journal of Information and Communication Convergence Engineering*, vol. 15, no. 1, pp. 49-52, Mar 2017. J. Padhye, V. Firoiu, and D. Towsley, "A stochastic model of TCP Reno congestion avoidance and control," Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.
- [9] Y.B. Cho, S.H. Woo, S.H. Lee and C.S. Han, "CUDA based Medical Image High Speed Processing Algorithm," in *Proc. 2017 International Conference on Future Information & Communication Engineering (ICFICE 2017)*, vol 9, no1, pp. 213-216, 2017..
- [10] S. Chen, B. Mulgrew, and P. M. Grant, "A clustering technique for digital communications channel equalization using radial basis function networks," *IEEE Trans. Neural Networks*, vol. 4, pp. 570-578, July 1993.



**Youngbok Cho** (M'2018) was born in Chungnam, Korea in 1974. She received M.S. and Ph.D from Department of computer science, Chungbuk National University, in 2006 and 2012 respectively. Also She received Ph.D from Department of medical, Chungbuk National University, in 2019 respectively. She is currently working in the department of information security, Daejeon University. Her research interest includes also include network security, medical information security and medical image processing.



**Jinbeom Seo** was born in Cheongju, Korea in 1996. He is currently studying as an undergraduate at Daejeon University. His major is Information security. His research interests also include network security and deep learning.