

Medical Images Sharing System Based on Blockchain and Smart Contract of Credit Scores

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Abstract — At present, medical images account for nearly 70% of medical diagnostic data, which is an important basis for disease diagnosis. However, medical data leakage incidents have occurred in more than 90% medical institutions, the protection of patients' medical data is of great urgency. At present, all types of medical institutions involved in the medical imaging business use the PACS to archive, manage, and use the collected medical images, but only sharing the managed video resources within the organization. This method applies only the traditional data protection strategy and cannot guarantee a stronger protection for patients' private information. And patients have no control over medical information at the time of treatment. For this reason, this paper proposes a method of secure sharing of medical images based on smart contracts of block chain and credit scores. Through a blockchain based on distributed, reliable database of recording image sharing process, we realize a cross-organizational, cross-regional, trustworthy, and supervisory medical image sharing system. And the establishment of smart contracts based on credit scores of patients and medical institutions guarantee intelligent sharing by rules and conditions. Compared with traditional PACS, the method proposed in this paper extends its scope of application on the basis of PACS, increases its robustness, and provides new ideas for more extensive, multi-level, safe and reliable medical images sharing.

Keywords—blockchain; smart contract of credit scores; distributed; medical images; security; share

I . Introduction

The concept of blockchain was first proposed by “Bitcoin: A Peer-to-Peer Electronic Cash System” proposed by Satoshi Nakamoto, it is a unique way of storing data in encrypted

currency, such as Bitcoin^[1]. The emerging blockchain can make the inter-agency medical image sharing come true. The authority shares medical images through the blockchain form a peer-to-peer distributed network in which nodes communicate directly with each other^[2], but not through the third party intermediary to save and process the data^{[3][4][5]}. So the sharing becomes more direct and efficient. All nodes in the sharing network backup and update the record of the reliable block uniformly, which ensures datum are traceable and recorded by timestamp, can not be tampered. The information produced by each node will be saved onto the block after going through the network verification of all nodes. If a node attempts to upload fraudulent data, the request will be rejected because of inconsistency of the data. So the deceit can be prevented.

II . System Design and Implementation

In the following, this paper proposes a secure medical image sharing method based on blockchain to solve the problem of cross domain sharing and patient privacy protection in medical image resource sharing. In this article, we use the ethereum to build the blockchain. There are many challenges in the process of using the blockchain, such as node need to backup the blockchain copy synchronously when joining into the shared network, the design of the data structure of the operation records, format incompatibility problem of the medical image collected by different types of equipment in different institutions. Figure 1 shows the structure of the blockchain of MedImgShr.

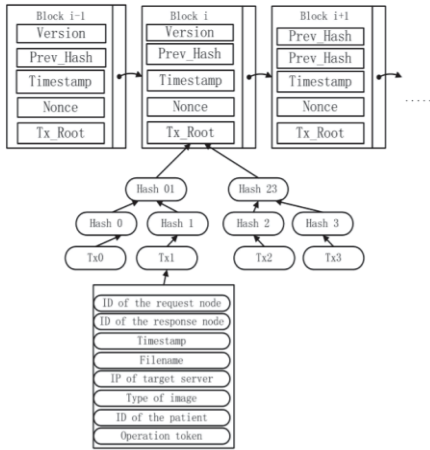


Figure 1. The structure of the blockchain of MedImgShr.

The innovation of the design is the scheme of smart contract of credit scores. When the patients or hospitals share the medical images, the credit score will change accordingly. And the credit scores will influence the operation permissions of patients and hospitals at the same time. Figure 2 is a sample of the smart contract of the credit scores.

```
function Selecting()
{
    if user.grade>=1 //the user have the permission to select medical images
    if graph.user.beSelected==true //the owner of the images allow others to select his images
    {{ if credit.integration>=0&&credit.integration<1000 //scores between 0 and 1000;select the images with lower importance and 10 images can be selected at most each time
        selecting;
    else if credit.integration>=1000&&credit.integration<10000 //scores between 1000 and 10000;select the images with higher importance and 100 images can be selected at most each time
        select; }
        increase the scores of the owner of the images; }
    else //judge the grade of the user
    if credit.dishonesty>0 //if the user has behaved deceptively, his sharing operation will be restricted
        Have no permission to control the sharing of his own images;
    else { if credit.integration>=0&&credit.integration<1000 //scores between 0 and 1000;have the permission to restrict others to share the images
        Do not allow others to select the images;
    else if credit.integration>=1000&&credit.integration<10000 //scores between 1000 to 10000;increase the credit scores and can enjoy the preferential policies when seeing the doctor in the hospital later on
        { allow others to select the images;
        increase the credit scores; }
    else if .....{}
    }} .....
```

Figure 2. The sample of the smart contract of the credit scores.

III. Prototype Evaluation

The method proposed in this paper use the block chain to solve the problem of sharing medical images across the organizations and protecting the privacy data of the patients. The main points are as follows. Firstly, the method provides a mechanism to monitor the history of automatic and immutable transactions. Secondly, different medical institutions as a network node communicate with other destination nodes directly. Thirdly, we can obtain the complete history of access to medical images through this method. Any access to medical images are well regulated.

The proposal mentioned in this paper is the first application practice of the blockchain in medical images sharing.

IV. Conclusion

The MedImgShr prototype proposes a proof-of-concept product, illustrating how decentralization through blockchain architectures and smart contract could contribute to Medical Images Sharing System. Using Ethereum smart contracts of Credit Scores to supervise intelligent sharing by rules and conditions, the MedImgShr can provide patients and hospitals with cross domain data sharing. We show an emerging style for combining smart contracts and scheme of credit scores. The continued work on the MedImgShr project infrastructure is integrating with medical images and records. Furthermore, we will release the proposed framework on GitHub as an open source platform for further research in the fall of 2018.

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