

IoT, Cloud and Blockchain Based Single Centralized Unit in Healthcare System Architecture

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Abstract - The proposed healthcare system in which each layer is an integration of IoT, Cloud Computing and Blockchain Technologies. Several researchers have tested the implementation of blockchain technology in various domains inclusive of healthcare. The hospital information systems security can be improved drastically on application of blockchain. Efficient healthcare services can be provided using communication protocols and data standardization using IoT technologies. Data interoperability reduction, patient data security, user interfaces and better connectivity are the benefits of efficient healthcare services. A great focus is laid on the healthcare industry and towards developing reliable healthcare applications by several researchers. Healthcare records by stakeholders like pharmacies, hospitals and patients without any data manipulation. These challenges can be addressed by blockchain technology. Cloud storage makes use of MySQL database for storing the patient information database and blockchain transaction hashes help in efficient and fast data search that is linked to the cloud storage files.

Keywords: Internet of Things; Cloud Storage; Blockchain technology; Patient monitoring; Data Security.

I. INTRODUCTION

The research as well as healthcare industry has been greatly impacted by these new technologies. Clinical exams and self-health tracking can be done by means of miniaturized healthcare sensors that are powered by IoT. They help in early diagnosis and treatment guidance by clinicians at remote locations without directly being in contact with the users. Blockchain based smart contracts and enterprise-distributed ledger framework can be used for monitoring the vital signs of the patient. This enables accessing medical information of patients globally at any time along with immutable and extensive history log. In comparison with the traditional patient monitoring system, the proposed system offers better monitoring, improved connectivity and enhanced data security.

II. AIM

Offering healthcare and tele-medical laboratory services by integrating Blockchain, IoT and cloud technologies in the medical environment.

III. METHODOLOGY

Data sharing is authorized by blockchain technology. A web based frontend technology is developed using JavaScript and HTML for this purpose which is used for user interface. Representational State Transfer Application Programming Interfaces (REST API) is used for providing product-centric services using blockchain network. Only authorized system users can control the IoT devices connected to the healthcare sensory module.

Fig: S.A.:- System Administrator, P.I.:- Patient Information, H.S.M.:-Healthcare Sensor Management, V.S.M.:-Vital Sign Management, T.D.:-Threshold Detection, Local Database Includes Patient Details and Hospital Staff Details Shared Database Includes Treatment Details.

Figure provides the architecture of the proposed healthcare system in which each layer is an integration of different technologies. Developers and modify the system by addition or deletion of modules using the decoupled feature without affecting the other modules or the system on whole. The proposed model comprises of four layers namely application layer, blockchain based service layer, cloud based network layer and IoT based physical layer. The IoT layer comprises of communication, data storage as well as computational healthcare devices. The cloud based network layer provides connectivity, storage, blockchain engine as well as virtualization features. The blockchain based service layer provides peer-to-peer communication (P2P), distributed ledger technology (DLT), identity management, consensus and other related services.

Digital data that is replicated, synchronized and shared are contained in the DLT. This information is distributed across the blockchain network and a ledger copy is available with every participant. The healthcare sensor information is

also stored and secured by the DLT. Any modifications in this information are reflected across the blockchain in all copies

making it more reliable and efficient.

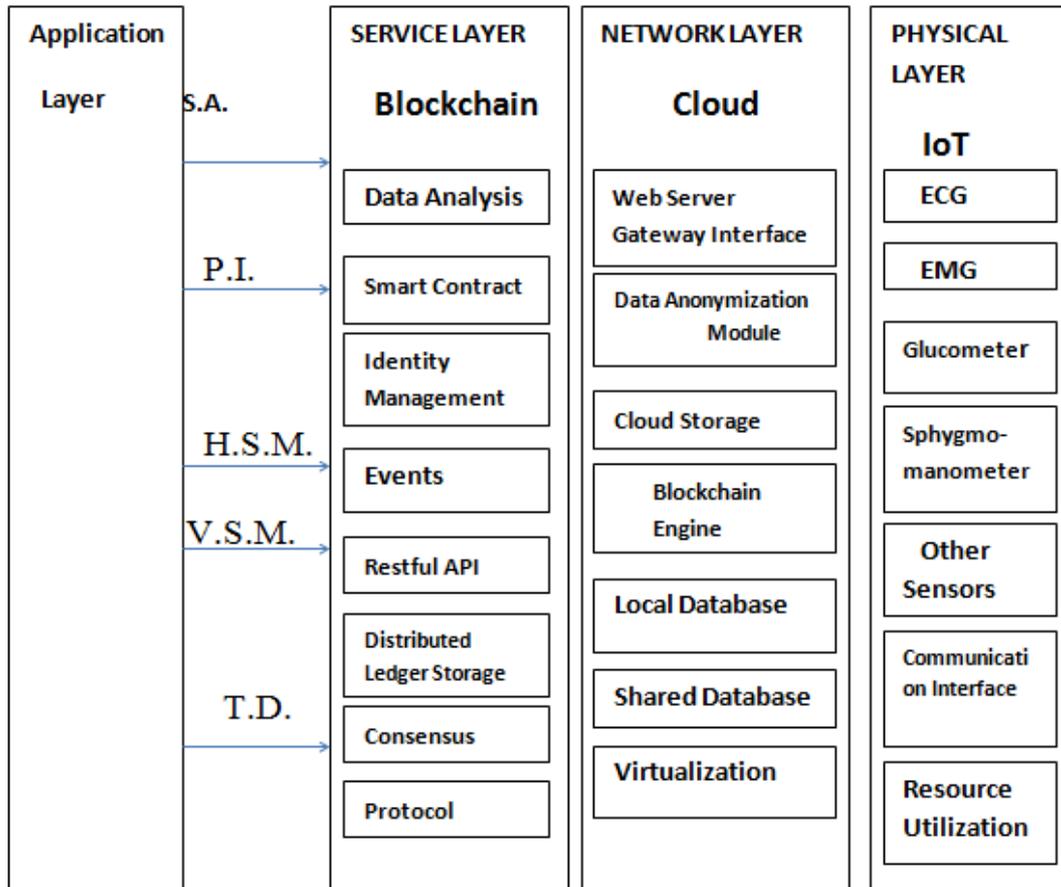


Figure 1: IoT, Cloud and Blockchain based single centralized unit in healthcare system architecture

Smart contract code helps in modifying, accessing and managing the ledger via external client applications. The information regarding addition of new blocks in the ledger is notified through event management. The blockchain platform is accessed through certain applications and the blockchain network is managed by several services in the application programming interface (API). The assets and resources of the user are shared securely and communicated using blockchain technology. Asymmetric ciphers, consensus algorithms and P2P networks are used for blockchain based communication. Healthcare devices can be managed and controlled as well as visualization of vital signs is made possible with the user interface of the application layer as represented in Figure.

Irreversible and traceable actions are performed in the virtual healthcare system. Smart contract coding and development offers a distribution certificate that is decentralized. Laboratory tests, Computed Tomography (CT) scans, blood test and such tests are analysed disease identification. Authorization and sharing of these files are done by open architecture of blockchain technology. Cloud

storage makes use of MySQL database for storing the patient information database and blockchain transaction hashes help in efficient and fast data search that is linked to the cloud storage files. Flexibility is provided to the user to perform operations with the healthcare sensors such as using nasal airflow sensor for reading rate of airflow or ECG sensor for reading heart rate. Body temperature sensor, EMG sensor, sphygmomanometer sensor, ECG sensor and other sensor based on the patient requirements can be included in the system. The business network domain model and roles of each participant in it can be defined by authorization and authentication of the participants through the Access Control Language (ACL).

IV. CONCLUSION

In this paper, IoT, Blockchain and Cloud technologies are integrated in the medical environment for offering healthcare and tele-medical laboratory services. The vital signs and physiological parameters are sensed and transmitted to provide meaningful, transparent and safe medical assistance to

patients. This decentralized platform makes use of Ethereum hybrid network certification system which offers lesser response time and cost when compared to other approaches. The public test instances, robustness and system capabilities are improved along with scalability benefits. Communication is established between the IoT nodes, server and blockchain network in the healthcare domain. The users can interact with the blockchain platform by means of a front-end web application. Various metrics are used for analyzing the performance of the proposed system. Along with the reduction of latency, the overall throughput of the system is increased significantly using this architecture. This system can be tested using various IoT frameworks for its interoperability as a future direction.

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