

# Blockchain based healthcare system with Artificial Intelligence

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**Abstract**—Blockchain is not only for the financial domain anymore. It evolves to accommodate a broad range of domains and applications where trust and privacy are required for smooth transitions. As blockchain evolving, researchers are automating the blockchain tasks for better security and performance. The blockchain management system monitors specific tasks like transaction management, consensus, block security, and blockchain network security. Blockchain management system comprises of specialized engineers and blockchain software platform. This study explores the opportunity for Machine learning concepts to work with blockchain system management to automate tasks in the healthcare scenario. Reinforcement learning is used in this study to automate blockchain tasks with multiagents. Our study found that agents can be trained and perform tasks listed under the healthcare system's blockchain management system. Our study also suggests that storing and accessing data is efficient with machine learning concepts.

**Index Terms**—Blockchain, Healthcare, Machine learning, Neural Networks, Reinforcement learning

## I. INTRODUCTION

Blockchain managed to get attention for a wide range of applications. Blockchain applications range from the financial domain to online content sharing. Initially, cryptocurrencies get benefited from the blockchain [1]. However, now researchers are exploring new ways to accommodate blockchain in a broad spectrum of domains. Healthcare is one of the domains that make blockchain adaptable in health-related scenarios [2].

Blockchain is a decentralized technology with a distributed database [3]. The blockchain database is shared among the participating nodes, and nodes update periodically to reflect new changes. Blockchain is a peer-to-peer network that store transaction in blocks which are linked together to create a chain. Illegal modification in any block can be identified as block stores hash of the previous block calculated with data stored in the transactions. Chaining of blocks improve security and give characteristics of decentralization and accountability.

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Blockchain with such characteristics improves transparency among the users, thus eliminating the centralized trusted bodies to save operational costs. Likewise, healthcare can take advantage of blockchain's characteristics. Transparency and immutability can benefit healthcare organizations. Patient's data stored on the blockchain as family medical history can help doctors diagnose future possibilities and take precautionary measures in advance.

Our study explores the advantages of the machine learning concept special reinforcement learning for the healthcare sector. Authors contributed to creating a blockchain framework with reinforced multiagent to automate the healthcare sector tasks, improving blockchain performance. Section 1 provides an introduction to the article. Section 2 is a literature review, and section 3 provides information about the proposed scheme and framework. Afterward, the authors discuss the result and conclude the study.

## II. LITERATURE REVIEW

There are many intermediary parties involved in the treatment cycle of the patient. There are many intermediary parties involved in the treatment cycle of the patient. These intermediate parties are responsible for creating, maintaining, authenticating, and verifying patient healthcare data and patient data [4]. Traditionally, all involved parties either get patient health data from a centralized database or keep their local copy. Both centralized or creating own copy of database has verification and authentication issues. A centralized database can be modified, which is hard to verify if the modification is legal or not. Suppose different parties keep their local version of patient data. In that case, it is nearly impossible to reflect the change for multiple parties. In both centralized and local copy techniques, the verification cost could be time-consuming and resource-hungry [5]. Blockchain maintains their blockchain in a decentralized manner; thus, the healthcare sector can take advantage of different parties to access the same data. Estonia

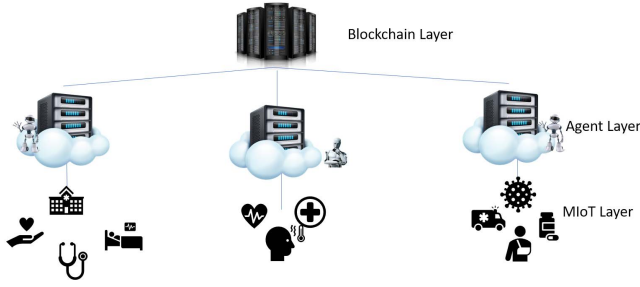


Fig. 1. Proposed Scheme for MIoT with blockchain.

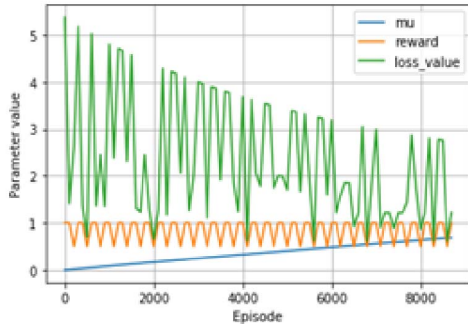


Fig. 2. Proposed Scheme for MIoT with blockchain.

was one of the first countries who introduces “Guradtime Blockchain” to store patient data [6].

Interoperability is the need of time for healthcare-related organizations. Storing, transferring, and sharing of data from multiple sites is interoperability [7]. Healthcare data stored in different locations might present problems like delays while storing and accessing the new information [8]. Data sharing is not the only problem with healthcare records; it also possesses problems like access control, user trust, and authentication [9].

### III. PROPOSED SCHEME

Figure 1: provides an overview of the scheme where the medical internet of things (MIoT) interacts with agents. Agent considers MIoT devices as a part of the environment to act. As this paper is a mere part of our study, we will only discuss agents’ learning to act on the environment. The proposed agent is named as “Blockchain agent,” which observes the input from the environment. Environment is build-up from MIoT devices, which generates the input for agents to analyze.

We created our environment in python and collected data for our blockchain agent. Blockchain agent follows the state and acts on the environment.

### IV. RESULTS AND DISCUSSION

Figure 2: shows the halfway of agent learning where we can observe that agent learning loss converges with the reward. Figure 3: provides insight into agents’ learning at the end of the episodes, where we declare that learning is finished. The agent was supposed to change into three states and take three actions on the observed data. Actions that were taken

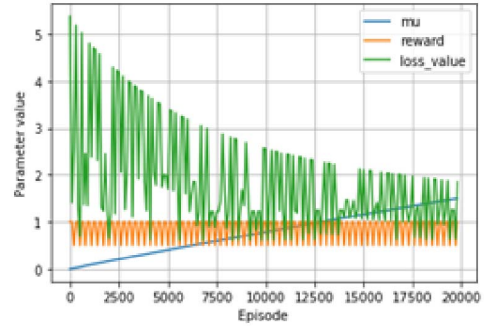


Fig. 3. Proposed Scheme for MIoT with blockchain.

are sent data to the doctor, send data to third parties, and sent data for consensus.

### V. CONCLUSION

Reinforcement learning based blockchain agent shows good learning rate. Our study shows that agents can take action on the environment according to observations. Agents can be robust and take multiple actions according to their learning. For our study we only perform three actions and agents tends to perform well. Results for learning shows that agent took 20000 episode to converge loss with reward. States are properly changed as agent act on the environment.

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