

# Converging Blockchain and Machine Learning for Healthcare

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**Abstract:** The power of machine learning in understanding the patterns in data, analyzing and making decisions, has shown its importance in various sectors. Machine Learning requires reasonable amount of data to make accurate decisions. Data sharing and reliability of data is very crucial in machine learning in order to improve its accuracy. The decentralized database in Blockchain Technology emphasizes on data sharing. The consensus in Blockchain technology makes sure that data is legitimate and secured. The convergence of these two technologies can give highly accurate results in terms of machine learning with the security and reliability of Blockchain Technology. This paper gives an overview of how combining these two technologies can help in healthcare sectors.

**Keywords:** Machine Learning, Blockchain, Healthcare, Permissioned Blockchain, decentralised database

## I. INTRODUCTION

Data is a very important resource in machine learning. The data can also be used in preprocessing techniques for improving research environments [6]. The data can be gathered from interviews, questionnaire, surveys, and studies or generated electronically over the internet. The quality as well as quantity of data improves efficiency, classification and prediction rate in machine learning. Machine Learning models have proved their significance in various sectors like healthcare, transportation, e-commerce, and marketing. It can be used for prediction and detection of diseases like cancer, diabetes etc. in healthcare.

As the growing needs, the data increased and data are stored in centralized servers. The data in these centralized servers are released at a fee. This limits the quality of research. The centralised server also faces the failure issues and hence the reliability of data suffers. Blockchain comes with decentralized database without compromising on data reliability. The data is accessible to users easily in decentralized database. Blockchain technology is a distributed network of interconnected nodes [3]. All the nodes have the copy of distributed ledger which has the details of every single transaction in the Blockchain network [3]. Data can be directly fed into machine learning models. Blockchain has shown its adaptability and capability beyond financial sectors.

## II. BLOCKCHAIN AS THE BEGINNING

Blockchain Technology got recognition from Bitcoin cryptocurrency which was described in Satoshi Nakamoto's whitepaper in 2008. This can be explained as, if someone in the blockchain network initiates a transaction. The transaction will be broadcasted in the P2P network called as nodes. The nodes will validate the transaction. If the transaction gets verified, it will be combined with other valid transaction to form a block. The block is marked with previous block's hash and timestamp and will be added to the existing blockchain. The block is permanent and unaltered. It has no problem of single point of failure and there is no central server to manage the network.

## III. LITERATURE REVIEW

Blockchain Technology has gone far beyond Bitcoins. Healthcare is one of its application areas. The proposed system was based on bitcoins approach was meeting information customer's need and protecting patient's privacy [5]. In this proposal if the information customer needs to see the record of the patient then they have to pay fee with bitcoins. The disadvantage of this is misuse of patient's record and paying fees every time makes it difficult in terms of cost.

The research took a turn from Public Blockchain Network to Private Blockchain Networks. In healthcare, many parties have to access same information [12].

Gem Health Network was launched which was based on Ethereum Blockchain Technology. With this infrastructure, the information can be shared among different entities. Latest treatment information is available to prevent use of outdated information in a transparent way [12]. It also shows previous interaction between patient and all physicians.

Another research in this field was by Estonia's digital health infrastructure which was created to help insurance companies to check all the medical treatment of patient.

The Counterfeit Medicines Project based on Hyperledger Technology, was based on drug counterfeiting [5]. The drug produced was timestamp and added to the blockchain which cannot be altered [14]. This also helps in detecting the ownership transfer thereby protecting fraud [14].

*Healthbank*, on the other hand came up with an idea of Data is new Gold [5]. In this the patient's health data like heartbeat, blood pressure, sleep patterns etc. can be taken from various health apps available or from wearables or physician visit. This data was stored in Blockchain. The patient's in return will get financial benefit and data can be utilized by researchers.

#### IV. PERMISSIONED BLOCKCHAIN

The blockchain design pattern was made famous by Bitcoin but Bitcoin is an application of blockchain technology. The blockchain technology has gone far beyond. In bitcoin transactions any node can join the network without any permission. To adopt the decentralized benefits of blockchain technology, business enterprises also needed certain level of privacy. Multiple organizations can come to a common shared platform where they can exchange business information with one another in shared and secured manner. The decentralized database where transactions get recorded in append only shared ledger has many advantages in healthcare industry. In medical treatment, the complete history of patient is very important and value is added when same information is accessed by different parties [8]. The permissioned blockchain network will have following components:

- Shared Ledger

It is the append only distributed system which keeps the track of all the transactions that take place in a blockchain network. It is maintained by each peer in the blockchain network.

- Peer Network

Peers will validate any transactions that are initiated by any node in the network. The validated transaction will be further added in the block.

- Membership/Certificate Authority

The user needs permission to join the network. The Certificate Authority will authenticate the users and ensures that they gets right access to ledger for the transaction they are performing.

- Smart Contract

The business logic or the software running on the ledger.

#### V. MACHINE LEARNING IN HEALTHCARE

Machine learning has been extensively used to benefit healthcare. Machine Learning can be used in identification of Treatment, give personalized suggestion to Patient, Outbreak Prediction etc.. User can get disease summary on the basis of symptoms entered [10]. Tokenization, removal of stop words and stemming are used as preprocessing. Many techniques have been done in this area which include SVM classifier, Naive Bayes and Decision Trees. The best result obtained has the accuracy percentage of 98.51%. The machine learning algorithm can also give lifestyle suggestion to Patient on the

basis of current medical situation and medical history. The machine learning models can be trained to predict future outcomes [11]. Neural Network with SVM was used to predict outbreaks of malaria in Maharashtra State. The model took rainfall, temperature, other reported cases in the area and other medical details to predict the outcome. The major hindrance in machine learning applications is data acquisition [6]. Researchers have to do a lot of struggles to get appropriate data. Lack of proper data leads to inefficient models that reduces the accuracy percentage.

#### VI. SOLUTION VIA BLOCKCHAIN AND MACHINE LEARNING

Every user in the Blockchain network will get an authorized certificate from Certificate Authority. It will going to provide identity to the user who will going to transact in the network. The identity will be digital certificate. The digital certificate will be used by the user to sign the transaction and submit it to the blockchain. The benefits of signing are:

- Authenticate the blockchain that the user performing or requesting any transaction is a legitimate user.
- Ensuring that user has rights to access the ledger for the transaction they are performing.

For instance, Patient will get certificate from the authority. The Patient can access his/her own details but will not be eligible to access the details of other patients. Patient will not be eligible to view details regarding other activities.

How blockchain can become a problem solver?

- Every authenticated user will have copy of shared ledger. This will resolve data acquisition problem. The machine learning models can be directly fed with data which will be highly reliable and results can be retrieved.
- The model(s) can be trained with real data. This will increase the efficiency and accuracy of models thereby reducing the additional cost to be paid to central authority.
- The Patient can get lifestyle advice. The model can be trained on the basis of suggestions given to other patients (by doctors) having same problems or symptoms.
- If a patient does any basic enquiry regarding his/her health, the trained model with the help of Natural Language Processing can identify the disease as well as give treatment suggestion.
- On the basis of Patients symptoms, the trained model can give clinical suggestions to doctors.
- The trained model can predict the outbreak. For instance, if Patient was undergoing any test and the reports of the

test is added in the blockchain network, the model can predict outbreak and can give suggestion to the doctor.

- vii) In healthcare sectors, we use lots of machines and equipments to perform any medical test. Every machine or part of machine has its own life span. It can also predict the need to change/remove the machine or a part of machine.

With all the above observations, blockchain seems to go well with machine learning models and can help in getting more accurate models with high efficiency rate but there are certain scenarios which need to be taken care of:

- a) The ledgers are appended only. Once the transaction is recorded cannot be altered. The details will be entered manually and there will always possibility of manual mistakes. This has to be taken care or some additional privilege is to be given to some authority.
- b) The blockchain technology keeps the history and copy of every transaction. The database size will increase which could make more difficult to handle in future.

## VII. CONCLUSION AND FUTURE SCOPE

Blockchain Technology gives great number of opportunities if utilized properly and is seen beyond bitcoin. With blockchain, the dominance of central authority could be eliminated and so the commission. Machine Learning models can directly fed with data (however the rights will be managed by central authority). This will increase the accuracy and efficiency of machine learning models and so their usability. Healthcare industry directly correlates with the life of a person. This could help patients as well as doctors. In terms of future scope the practical implementation of this model will be there. This model can be further extended for Inventory to prevent fraud.

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