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A Review on Intelligent Health Care System Using Learning Methods

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Abstract: All organizations that are striving for healthy living must establish and maintain updated diet regimens. A health care recommendation system uses data to give medical advice. Machine Learning analyses data to predict future requests and improve healthcare management. An intelligent health care system needs to be built using machine learning and blockchain for health care recommendation systems. This paper discusses in detail the various systems for providing high quality health services. The existing systems that are discussed are Distributed Ledger Technology (DLT), swarm intelligence learning-based systems, adaptive systems, and deep learning systems. Furthermore, various techniques, advantages, disadvantages, tools used, and their accuracy are compared and contrasted. From the studies, it is clear that block chain technology with deep learning techniques provides better accuracy than other conventional methods.

Keywords: Block chain**,** deep learning, healthcare, swarm intelligence, adaptive

1. Introduction

Due to the various health hazards in human life after the COVID pandemic, it's becoming essential to have a healthcare management system in human society. It is mandatory to build a personalized diet plan for individuals and to make advanced systems that can be maintained in all organizations working to benefit from a healthy life [1-3]. A healthcare recommendation system is a computer system that can provide a piece of proper medical advice to a person based on specific given data. Our healthcare management system is dependent on the rules and regulations of hospitals and healthcare centers. Machine learning is a subpart of artificial intelligence that comes into play when the data requires classification and predictions for solving user queries [4-9].

The healthcare systems developed based on machine learning models are so complex and dynamic that there is a possibility of leaking vital and sensitive information relative to patients' exposure to data that can lead to severe damage. So, blockchain technology comes into play to reduce security risks as the decentralized approach can preserve the system's trustworthiness. So, a secure distributed machine learning model keeps privacy from being broken and works well [1, 2], [10-13].

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2. Related Work

A few of the algorithms and methodologies are required to build an intelligent system. A personalized diet recommendation system using a blockchain privacy system (BPS) with deep learning models has been proposed [1]. The Internet of Medical Things (IoMT) datasets are built by collecting data from medical institutions [2]. Researchers proposed a framework for using the Ethereum Blockchain and the X-Ray mechanism for access control. Kimovski et al. [3] have proposed a decentralizing machine learning distributed ledger to create intelligent EHR (electronic personal health records) systems that can utilize information from personal healthcare devices.

It also reduces machine learning time by up to 60% and consensus latency to below 8 seconds. Integration of two popular technologies, such as machine learning and blockchain technology, for cancer care was proposed in [4]. The smart-contract, according to Abugabah et al. 2020 [5], proposes that it manages the communication among all entities participating in the network and keeping the patients precisely updated about transactions. Kaissis et al. 2020 have discussed next generation methods for maintaining security while focusing on large datasets, especially medical images of patient diagnosis reports [6]. Potential attack vectors can be reduced by that methodology. A decentralized machine-learning approach using swarm learning is proposed. To maintain security and confidentiality, edge computing and blockchain-based peer-to-peer networking are used [7].

Body Sensor Networks (BSNs) are introduced as a driver to transform the entire medical field [8]. Hybridization of different methods seems to be a promising approach for enhancing the performance of smart healthcare. The convergence of these two technologies can give highly accurate results in terms of machine learning with the security and reliability of Blockchain Technology [9], [16], [17]. Model Chain, a new framework adapted with Blockchain technology for privacy-preserving machine learning [10], is being developed. An enhanced system is proposed for parallel model training and distribution in block chains [11]. The Adaptive Energy Efficiency (EEA) algorithm enhances energy efficiency, battery lifetime, and throughput [12]. The vast data gathered demonstrate that novel model save operational expenses for internet services and enhance the area under the curve of the model [13], [18]. Artificial intelligence-based models [14] and secure IoMT devices [15], [19] are recently gaining importance.

3. Methodology Used

The methodology section describes in detail the various existing systems, such as distributed ledger technology, swarm intelligence systems, smart adaptive systems, and deep learning-based systems.

3.1. Distributed Ledger Technology

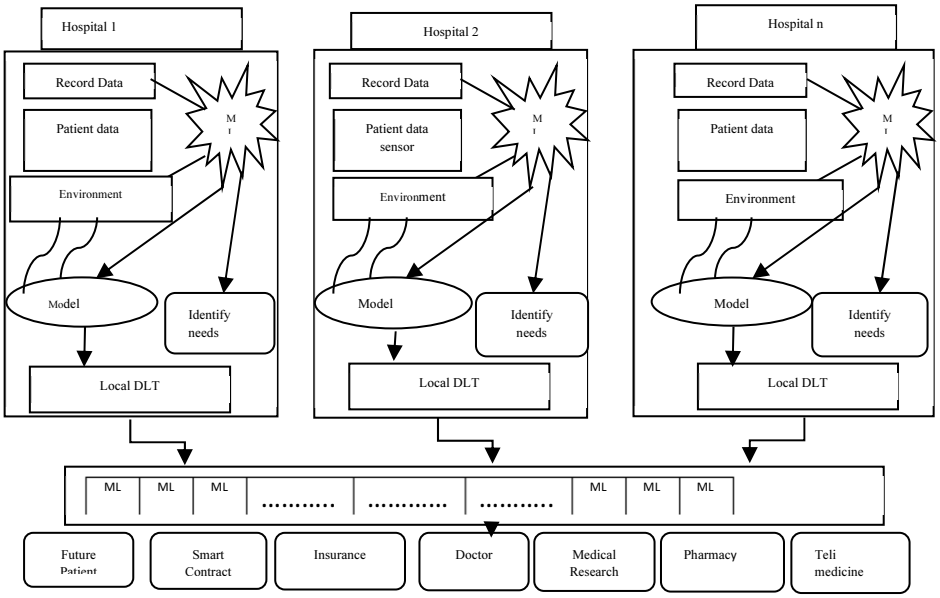

Figure 1. Distributed ledger technology

giveAccess()	requestEHR()
Input : Ethereumaddress(EA) of center's address **Steps:** 1. Restrict access to that center. 2. **If***address = address of authorized center and hashEHRmatches with patients hash value* **then** 3. Construct save changes to approve 4. Number of approve count increase to 1 5. Create notification to patient side!! 6. **Else** access failed!! 7. **End** 8. **Else** Revert state and display an error message 9. **end**	**Input :**Ethereumaddress(EA) of center's address **Steps:** 1. Restrict access to that center. 2. **If***address = address of authorized center and document hash = hashEHR***then** giveAccess() 3. **Else** give a notification alert to patient 4. **end** 5. **else** Revert state and display an error message 6. **end**

Figure 2. Pseudocode for request and response cycle

Medical institutions need to collect relevant medical data from patients and historical records. It is inputted to machine learning models using a selective algorithm. A particular institute can use its own data analysis to understand the patient's needs. The data should be stored in the form of a local DLT (Distributed Ledger Technology). Smart contracts use predefined algorithms to interact with multiple applications [3] [4] [5] such as future patients' diagnosis, medical insurance, doctors, pharmacy, telemedicine, and medical research centers as in Figure 1. The healthcare recommendation system has a wide range of applications, including disease prediction, insurance, medical research, telemedicine, pharmacy, pathology, and many others. That kind of infrastructure can be connected with the previously created decentralized platforms using smart contracts. The

two main methods that can be used are similar to the request and response cycle. A proper addressing mechanism and validation should be followed in each request as in Figure 2. Request EHR is the method used for requesting a particular dataset and access method provides access to the data to a verified person.

3.2. Swarm Intelligence System

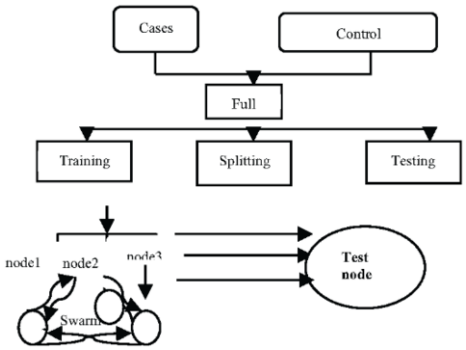

Figure 3. Swarm intelligence approach

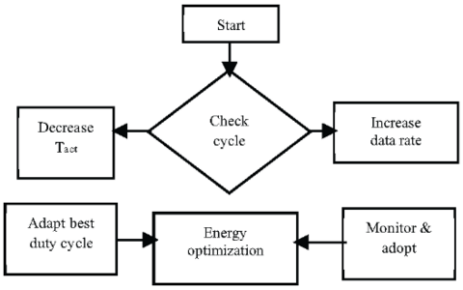

Figure 4. Smart adaptive method

Swarm learning prediction approach, also as described in Figure 3. In this particular approach, individual nodes can be used for storing medical data and are connected using swarm networks. The network is constructed based on blockchain technology. Each time a new node is added to that network, the smart contract should synchronize that particular node with all the previous blocks on the local servers. At every node, the SL model is categorized into two layers, such as middle and application layer. The middle layer contains all kinds of dataset models required for that application, whereas the application layer is constructed with the machine learning methods. An SLL neural network consists of one input layer, eight hidden layers, and one output layer. The input layer uses a rectified linear unit function, whereas the output layer uses a sigmoid function. The model is trained with Adam optimization to compute the loss between the actual and predicted class.

3.3. Smart Adaptive System

A health care model based on ML and BCT with a smart energy adaptive method is very useful for health care monitoring devices [8]. The adaptive duty-cycle optimization algorithm optimizes the active time by taking into account the power levels as shown in Figure 4. Active time relies on the number of bits (W) and symbol rate (Rs). The bit stream must be transferred during the wearable device's selected short active time period in order to minimize energy loss. In addition to the fundamental methodologies (ML and BCT) utilized for the analysis of medical data and ensuring security, they may also be employed in healthcare monitoring systems to increase the efficiency of those systems.

3.4. Deep Learning System

A deep learning and blockchain-based algorithmic approach are proposed for enhancing security as in Figure 5[2]. As in algorithm 1, Hyperledger address validation is checked by registering it in the blockchain and verifying it with trusted resources. The system

initializes a deep learning model to analyses the medical data as in algorithm 2. The proper outcome of that particular health care recommendation system assures confidentiality of the data.

Algorithm 1	Algorithm 2
Input: Electronic Health record 1: Register Data 2: Key Generation 3: User Verification 4: Request user data 5: If verified Hyperledger Blockchain transfer 6: Initialization of the Deep learning Model 7: Go to Algorithm 2 8: Detect malicious 9: else 10: Registration and add to the database 11: Update the Normal and Malicious entries 13: Updation in Blockchain	**Input**: Dataset D 1. Split Dataset D into Subset S 2. For i=1 to S 3. Training the data 4. For i=0 to S 5. Split the Augmented data to subset 7. For i=1 to N 8. Batch_Training of the samples 9. Train CNN model 10. Batch_Validation of the samples 11. Validate CNN model 12. Test the trained model 13. Return CNN

Figure 5. Deep learning method

4. Results and Discussions

Table 1 shows the comparison between various healthcare systems along with the advantages, disadvantages, tools used, dataset, performance and accuracy.

Table 1: Comparison of various existing health care recommendation system techniques

S. No	Techniques Used	Advantag-es	Disadvant-ages	Tools Used	Dataset	Performa-nce	Accura cy
1	Blockchain [2]	Automatio n	Needs further tuning	Kaggle, CNN	x-rays	Alert	99.87%
2	Decentralzed Telemedicine [5]	Data integrity	Legal regulation	Solidity Support vector machine,	Tele-medicine centers	Record verification	98.81%
3	Federated ML [6]	Secure implementa tion	much more infrastructu res	SMPC,Ho momorphic encryption, CNN	Medical images	Confidence intervals	94%
4	Swarm learning[7]	Detection accuracy is high	Implement ation is time consuming	Keras API,	GSE1017 05, 107104, 112087	Accuracy, sensitivity, specificity	98%
5	Adaptive optimization [8]	Energy optimised	Installation problems	MATLAB	Body postures scenario	Detection rate	93.31%

5. Conclusion and Future Work

Dietary practices need to be established and kept up to date if an organization is serious about promoting healthy lifestyles. A recommendation system for health care makes use

of data in order to provide medical guidance. Machine learning is the process of using data to make predictions about the future in order to enhance healthcare management. This article presents an in-depth discussion of the numerous learning-based systems that are available for delivering high-quality medical services. When applied to the development of health care recommendation systems, machine learning and blockchain can help create an intelligent health care system. From the studies, it is inferred that deep learning methods provide better accuracy in comparison to the existing methods.

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