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Soft computing technique for the blockchain-enabled secure healthcare system

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ABSTRACT

A recent study demonstrates that by combining AI and Blockchain technologies, we can close several loopholes in the healthcare industry. AI systems perform better when given substantial data input that may be used to infer conclusions and make decisions. When data is acquired from a reliable, trustworthy, safe, and tenable data vault, the machine learning algorithms perform better. On the other hand, Blockchain, a dispersed information system, allows for the storage and movement of data in a manner that is cryptographically approved of by all mining nodes. The Blockchain technology, which is extremely dependable and robust and cannot be tampered with, is frequently used to securely store the sensitive personal information of patients. The outcomes of choices made using machine learning algorithms and smart agreements are frequently regarded as reliable and unquestionable. The AI and ML algorithms utilise these blockchain-secured datasets. In order to illustrate this Soft Computing Technique, we will utilise the support vector machine algorithm. Finding a hyper plane in an N-dimensional space (N is the number of features) that divides and organises the data points is the primary feature e of the support vector machine method. Finding decision boundaries that categorise the greatest distance between the data points of the two objects is our goal. By identifying margins with greater distance, we obtain stronger reinforcement, assisting subsequent data points in being confidently separated. When AI-driven systems must gather, store, and use data, a powerful and secure decentralised system like the healthcare system is created thanks to the combination of blockchain and AI.

Keywords: *Artificial intelligence (AI), Machine Learning (ML), and Blockchain.*

1. INTRODUCTION

A fault-finding characteristic of machine learning is data or observations. Additionally, the indicator can be used in pre-processing methods to enhance study conditions. The data will be obtained from many sources, including individuals all around the world, using a variety of techniques such surveys, voluntarily submitted data gathering, trails, etc. The performance, classification accuracy, and prediction quality of machine learning all improve with quality as well as quantity of data. Blockchain supports decentralised databases without compromising the reliability of the information. Users may easily access this information in a decentralised database. Blockchain technology may consist of a distributed network of connecting nodes.

1.1 Soft Computing

Soft computing is a growing management and reasoning technique that reveals the amazing capacity of the human mind to struggle and learn in the face of ambiguity and helplessness. Soft computing is dependent on a number of naturally occurring mechanisms, including inherited traits, progress and behaviour, the general data nodes, the human framework, and so on. Currently, soft computing is the primary solution when there is a requirement to manage unpredictable issues, adapt to changing circumstances, and be executed with equal processing but no numerical representation of critical thought (i.e., computation). Its extensive applications span a wide variety of fields, including diagnosing, PC vision, machine learning, anticipating, plan advancement, LSI configuration, design recognition, written by hand character improvement, and others. AI models have demonstrated their importance in a number of industries, including marketing, online commerce, transportation, and healthcare management. It is frequently used in medical services to predict and identify illnesses like disease, diabetes, and other conditions. Due to evolving demands, data has grown and information has been stored on unified servers. The unchanging quality of the data remains despite the let-down challenges that the unified server also experiences. Blockchain chooses a decentralised database above data consistency and speed. In a decentralised database, the data is effectively accessible to clients. A network of connected hubs might be transmitted using blockchain technology. Within the blockchain organisation, every hub possesses a duplicate date of a distributed record, which poses a major problem for every single trade. AI models commonly take information into consideration. Each Block has shown clear how adaptable and strong it is outside of budgetary portions.

1.2 Blockchain

Blockchain is a decentralised, distributed, open-source digital public ledger that is shared across networked peers. These peers create a singular square that houses the primary item of exchange and along which are located the client-to-client benefit exchanges. The blockchain mining centres will carry out the directives of smart agreements. A self-executing algorithm that verifies the previously listed agreement points will constitute a realistic, intelligible agreement. The blockchain mining centres execute, verify, and store data in squares rather than certifying computerised financial forms like Lit coin does. After committing an exchange to its Ethereum address and processing it in accordance with the date specified for that exchange, a practically intelligible agreement is started.

1.3 Blockchain and Artificial Intelligence

By integrating both mechanical-biological systems inside the field of medicine, several AI and Blockchain flaws are usually addressed successfully. Calculations done by artificial intelligence rely on provided input. When data is compiled from a trustworthy, safe, and significant phase or information vault, the AI computations perform better. A transmitted record called a blockchain is used by all mining nodes to exchange information that is routinely maintained and processed using cryptographic principles. Patients' sensitive personal data is routinely and securely stored inside blockchain data, which is very reliable and secure and cannot be tampered with. When intelligent agreements are used for AI calculations to make decisions and conduct an analysis, the results of those decisions are frequently believed and without question. By creating a dataset for AI and ML computations, this blockchain ensured that information is routinely used. Blockchain and AI are becoming more integrated, providing a safe decentralised framework for the sensitive data that AI-driven frameworks should collect,

store, and utilise. This idea inspires significant improvements to safeguard patient data and information as well as personal, banking and financial, trading, and legal information.

II. LITERATURE REVIEW

An overview of how combining the two technological developments of blockchain and AI will benefit the human services sector is provided by Sonali Vyas et al. The Certificate Authority will confirm its endorsement for each client using the blockchain technology. The client that will operate within the system will receive the specified character from it. Client endorsement will be automated. The client will sign the exchange and submit it to the blockchain using the enhanced authentications. A copy of the shared record will be provided to each confirmed customer. This might address the problem of getting information. The AI models will directly handle information that has the potential to be extremely reliable, and outcomes will be retrieved. Real-world data will be used to prepare the models. This can increase model production and accuracy while lowering the additional cost that must be paid for the focus location. In a sense, the records are annexed. when the transaction is recorded and impermanent. Physical entry of the crucial information will increase the likelihood of human error. This needs to be taken into account. Blockchain technology has the potential to eliminate focused authority's power.

By speculating on a radiological picture check for facts, Khaled Salah et al. sum up how machine learning computations eat up a big portion of our important time to analyse and pick a correct timing. The developers claim that by fusing blockchain and AI, it would be easier to collect patient report images with data and do a few discrete analytic operations for a patient on the blockchain. Additionally, the AI company may create usefully annotated data for handling patient reports over photographs and spread the AI conclusion output on the blockchain. On the blockchain, the outcome of the radiologists' studies might be differentiated in this manner. If the decision outcome agrees with the radiologists' judgement, the AI specialist's confidence will be high. The professional associations are combined to effectively control the definiteness of their AI figures since they are assisted for each specific purpose. In a similar vein, blockchain completes a reliable record of the entire investigation reports of both clinical centres and AI professional groups. Computer-based intelligence methods are in-depth learning calculations that extricate higher level, as information portrays through a progressive learning process and utilises information sciences and examination which can be used to close the accompanying course of activities of the treatment by examining results and blockchain can hold the record to improve social wellbeing organisations.

In the country of New Zealand, Jack Huang et al. provide a framework for a shared electronic health record. There is no uniform Electronic Health Record (EHR) structure used in this country by important healthcare organisations including emergency rooms, clinical specialties, and doctors. Due to its advantages, blockchain technology is typically a good foundation for creating a comprehensive EHR system for the country. They introduce Med Bloc, a blockchain-based secure EHR infrastructure that enables patients and healthcare providers to access and provide medical records in a completely functional yet highly safe manner. Med Bloc offers a longitudinal view on the patient's health narrative and allows patients to access their information. Med Bloc uses an encryption tool to protect clinical data and a reasonable agreement-based access control mechanism to restrict access. Med Bloc not only demonstrates how the blockchain may establish their country's first shared EHR

framework, but it also illustrates how the blockchain may potentially disrupt the whole clinical innovation field. Med Bloc may be a fully functional, individually regulated, shared EHR architecture that enables patients and healthcare providers to gainfully access and provide health records through a seductive customer administration. Patients can provide and withdraw assent anytime they choose by using careful agreements and cryptographic techniques. Healthcare providers can request assent and include records that have been securely stored on the blockchain and encoded. employing a flimsy encryption scheme. Access control procedures at Med Bloc prevent any prohibited activity from taking place.

A flexible application that is used for healthcare information exchange but is restricted to patients and professionals is presented by Xueping Liang et al. To keep a strategic distance from the calculating cost, they put forth a picture of interoperability but made no mention of the entrance control. It focuses on how blockchain is being used in interpersonal organisations, although it does not fully explore its benefits. Patient is meant for the Ethereum-based healthcare stockpiling system, however information security is deeply entangled with cryptographic approaches. It covers the choice of blockchain in the context of the Internet of Things. MedRec may be a framework used by executives to keep track of their knowledge of electronic medical records using smart contracts, but it creates security issues. The creation and implementation of a mobile healthcare framework for the collection, exchange, and coordination of private health information between individuals, healthcare providers, and insurance companies. The framework may be adjusted to accommodate the use of medical data for investigative reasons. Accepting blockchain development allows the system to be finished in a distributed and trust less manner. The calculation used to handle data records might simultaneously save on assurance and dependability. Then, to support the independent correspondence required by certain conditions, they obtain a channel strengthened by Hyperledger Fabric.

The authors, Jinglin Qiu et al., claim that the fusion of healthcare and smart cities has pushed the use of information and innovation in clinical and wellness practises all over the world. The inhabitants of the keen urban areas have a better quality of life because to the mixing. However, the merging has also exposed the human services sector to security issues, including the preservation of patient health data and the safety of mobile health clients in the area. However, the Blockchain project may be a potential breakthrough that will enable the medical services to address security issues in smart cities. The development of blockchain technology has promoted the safe and secure storage of patient data inside the healthcare sector. With the benefits of being decentralised, distributed, and unchangeable, blockchain has produced many excellent uses outside of the financial sector. The implementation of blockchain technology in the healthcare industry is one of the potential applications. Determining the data integrity, information interoperability, and protection challenges in present healthcare IT frameworks is the main driver of using Blockchain in medical services. Future study on the topic of smart wellness is prepared as a result. The expansion of clinical and wellbeing administrations globally is impacted by the merging of information and innovation with healthcare. Since the information isn't protected and may be accessed by others, this collaborative information sharing approach poses several challenges for the human services sector. The healthcare industry should do extensive study on the proper safety measures to be implemented in the adoption of innovation before embracing the flexible health applications. The users of health and medical applications should collaborate to ensure that the

mobile devices used by mobile health services are protected from digital risks. However, the blockchain technology's ability to provide information security and trade protection within the healthcare industry offers hopeful solutions for the problems.

III. Existing System

AI and blockchain are useful in the human services sector. The Certificate Authority will confirm its endorsement for each client using the blockchain technology. The client that will operate within the system will receive the specified character from it. Client endorsement will be automated. The client will sign the exchange and submit it to the blockchain using the enhanced authentications. Physical entry of the crucial information will increase the likelihood of human error. This needs to be taken into account. Blockchain technology has the potential to eliminate focused authority's power. Blockchain completes a reliable record of the entire investigation reports from clinical facilities and professional associations in AI. Computer- based intelligence methods are in-depth learning calculations that extricate higher level, as information portrays through a progressive learning process and utilizes information sciences and examination which can be used to close the accompanying course of activities of the treatment by examining results and blockchain can hold the record to improve social wellbeing organizations.

IV. Proposed Framework

The proposed system is used to develop a suitable architectural design to secure electronic health record systems using blockchain technology, and then applies soft computing techniques on the blockchain secured dataset. It also uses soft computing techniques to develop a suitable architectural design for a blockchain enabled secure health care system.

The suggested method has

1) AI implemented by Decentralized Blockchain system: Database built on a decentralised blockchain that will securely store data among several nodes across the globe. An authorised person who has access to such securely obtained data from the data nodes can utilise the AI on it.

2) Enhanced Data Protection: Blockchain technology offers secure data storage. Blockchain databases that are properly maintained by unique private keys. This enables AI computations to attempt security provision and progress assurance between two trustworthy parties with superior outcomes.

3) Collective Decision Making: All of the operators in a mechanical multitude biological system must cooperate in order to accomplish the multiplicity goal.

4) Decentralized Intelligence: For achieving sharp elevated options that include multiple operators to handle various mini tasks that proceed normally (for instance, if regulated learning occurs), numerous individual highly skilled AI personnel in the field

of cyber security can be combined to provide fully planned security over the fundamental systems and to resolve scheduling issues.

Fig 1: AI/Blockchain Architecture

The following graphic provides a good illustration of how AI and blockchain technology are used for various real-time applications. These applications entail a variety of procedures, such as analysis, inspection, basic dynamic, and acceptance of test results. In order to build and predict future outcomes, clear databases may be obtained using machine learning algorithms. A machine learning algorithm that uses chart data to identify inactive elements may employ a Bayesian network, a graph database used for linking logical outcomes. A Bayesian network's direct predictions and forecast are its most crucial components. When applied to health, the goal is to provide accurate information about predictions to unrelated parties. The unchanging exchange record may be loaded with the connections between all the elements in the welfare graph database (such as physicians, specialists, clinical analysts, tranquillizer producers, patients, and so forth and their activities, which include treatment plans, medications, and admission of medications). Despite the fact that AI techniques are excellent at describing and decomposing vast datasets in the welfare sector by utilising the high patient data density from the sensors of related IoT devices, there are serious issues with reliability in terms of information collection and capacity. The danger of disclosing patient data that has been made available but is kept secure and preserved during a routine dynamic operation is also present. The combination of blockchain and machine learning offers new ideas for tailor- made medication, quadrate medicines, and wellbeing recommendations based on a patient's clinical history, hereditary ancestry, feelings of tension, topography, air quality, and previous illnesses. It also helps to increase trust in mechanical decisions.

V. Proposed Methodology

Blockchain technology will be used in the proposed system to process a publicly accessible dataset about diabetes care. This is only a rough draught. Later, this might be scaled up to widespread commercial use. We use the secured dataset and straightforward AI/ML algorithms to demonstrate efficacy.

Fig 2: Distributed Blockchain Demo

1. Distributed Blockchain

This approach uses an app that, as shown in Fig 2, builds a blockchain from the dataset that has been supplied to it. The blockchain is a cutting-edge technology that saves data securely and can spot errors and fraud. The blockchain, which is shared across several nodes as part of a shared ledger distributed blockchain network, is broken when data in the dataset is changed. The diagram illustrates how a blockchain changes when certain data is altered. By comparing the copies of the ledgers on various nodes, this will be discovered.

- A blockchain is made up of blocks that are connected to one another by hash values.
- The values of each block, including the block number, the nonce value, the block's actual data, and the hash value of the preceding block, are used to calculate the hash values.
- We can trust the blockchain by using this chain of hash-secured blocks.
- When numerous nodes/peers in a network share a blockchain ledger and each network is ensured to have a reliable ledger.
- Because any such tampering would produce a significant change in the hash values of the blocks in the blockchain, we can be certain that altering one of these ledgers cannot taint any other ledger, existing in any other node.

The ledger of the diabetic patient records that Peer A and Peer B share in Fig. 2 is shown. Three blocks from each shared ledger are discernible in this figure. The values are the same and ought

to stay that way. However, this illustration illustrates the benefit of a decentralised blockchain network. Since Block 1 is same for both ledgers in Peers A and B, Peer B, and Peer C, the computed hash value is also identical and matches for each ledger in each peer. We can observe clearly in Block 2 that the ledgers appear to have a problem. We can observe that Peer B has altered the data. The hash values change as a result of the data being altered in Peer B. The hash values of the whole blockchain are altered as a result, and the ledger in Peer B no longer matches the ledger in Peer A or any other Peer in the blockchain network. The benefit of having a blockchain-secured data store is this. Any such data manipulation will be reported, and it will guarantee the accuracy, integrity, and security of any such data.

Step 1: First, build a blockchain network. Depending on the requirements, set up several peers, such as Peers A and B.

Step 2: Configure each peer's blockchain. Blocks of information from the dataset make up the blockchain. The data will be the same across all Peers while setting up the blockchain. We save a row of data from the dataset in each block of the blockchain.

Step 3: Each block on the blockchain is made up of a number of values, including the Block Number, the Nonce value, the data that will be recorded in the block itself, and the hash value of the block before it. We set the preceding block's hash value for the first block of the blockchain to zero or any other value that is standard across all Peers. Each block's hash value is determined using the parameters listed above. This hash value is determined for each and every peer's blockchain. For matching block numbers, the hash value will be the same across all peers, i.e., the hash value for block 1 in peer A will be the same as for block 2 in peer B, and so on.

Step 4: Let's simulate a data breach by altering the information in Block 2 on Peer B. The block's hash value changes when data manipulation is done, and it is no longer compatible with the matching hash value in any other block. This is the first sign that the data on the blockchain network may have been altered. The "prior hash value" of the next block will change when the hash value of the tampered block changes, changing the hash value of the subsequent blocks in the peer as a result. This is the second indication indicating the information in the blockchain network has been altered.

2. SVM Algorithm

SVM, also known as the support vector machine, is a tool that may be used for both classification and regression problems. However, it's often employed in categorization aims. The goal of the support vector machine technique is to identify a decision boundary that unambiguously classifies the information nodes in an N-dimensional space (N being the number of characteristics). Different hyper planes can be utilised to distinguish between two different kinds of information nodes. Our goal is to locate a plane with the greatest distance, or the greatest distance between the two information nodes. Increasing the coverage margin that offers enough distinction to enable more reliable identification of possible information nodes.

To train the model to identify diabetes based on the stated features or characteristics, the SVM method is applied to the diabetes dataset. To establish the hyper plane, we took into account 8 factors: the number of pregnancies, blood sugar levels, blood pressure, skin thickness, insulin levels, body mass index (BMI), function of diabetes in the family, and age.

The accuracy of the dataset and algorithm used is 73.95%. Since the dataset is certified to be safe due to its inclusion in the distributed blockchain network, we can be sure of both its uniqueness and security.

3. Blockchain Network

The architecture of how the blockchain may be created for the purpose of storing patient data in a network that can be accessed by any healthcare providers or dataset owners is shown in the figure below. All user authentication and authorizations for read/write access on the blockchain network are handled by the network administrator. With the help of this architecture, users may choose who gets access to their data while maintaining their privacy. Healthcare providers may be confident that the data they get from the blockchain network is accurate and error-free.

VI Advantages:

Fig 3: Blockchain Network

1. The benefit of having a data repository with blockchain security.
2. Any such data manipulation will be reported, and it will guarantee the accuracy, integrity, and security of any such data.
3. Boost accuracy
4. Since all data on the blockchain is publicly available, simulated intelligence is the only method to give customers privacy and security.

VII. RESULT AND ANALYSIS:

The frequency graph, precision, and recall scores were used to base the trial findings.

6.1 Accuracy scores

It is evident from the implementation that the accuracy scores from the SVM are around 73.958 and the precision average score is 0.74.

Fig 4: Accuracy Scores

According to the data, which was protected by a blockchain network, 69 persons were determined to have tested positive for diabetes, while 123 people were categorised as having the disease.

Figure 5: Frequency Graph

The suggested technique may be applied to projects like

1. Based on the symptoms noticed everywhere in the world, it may be used to anticipate new illnesses (endemic or pandemic).
2. Based on the symptoms, it may be utilised to create a treatment plan and prescribe medications.

3. Any patient can use it to avoid overdosing on or abusing prescribed medications.
4. It may be used to monitor a user's individual health information and offer recommendations or diagnoses.

VIII. Conclusion and future scope

Blockchain can manage decentralised commercial hubs and coordination points for many AI subsystems, such as information, computation, and registration power. These will foster the growth and use of simulated intelligence to a remarkable degree. Blockchain will also make it possible for artificial intelligence to make decisions that are simpler, more rational, and more trustworthy. Simulated intelligence is the means by which clients are provided with privacy and protection because all information on the blockchain is openly available.

Blockchain can facilitate information exchange since it provides transparency and accountability over who may access client information when and how. As clients regain ownership over their information thanks to blockchain, they will feel more comfortable sharing it with others and knowing that it will be used correctly to improve customization or for other noble purposes. Access to

(huge, anonymous) health information and cases allowed specialists and researchers to more quickly discover cures for infections and advance better clinical models and treatment ideals. Particularly for patients with rare diseases, new expectations would emerge as doctors had access to comparable examples from around the world.
Information can be legally cared for by machine learning models (anyway the rights will be overseen by a focal power). This will increase the accuracy and efficacy of machine learning models, increasing their use. The human services sector has a clear connection to a person's life. Just like specialists, patients could benefit from this.

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