Journal of Information Systems Engineering and Management
2025, 10(31s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/ **Research Article**

Artificial Intelligence Technique in Privacy and Security of Patient Records for Healthcare Application

Dr. Mawahib Sharafeldin Adam Boush[1], *Dr Chamandeep Kaur[2], Haja Banu Shaikh Mohammed Essa[3], Zeba Khan[4]
[1&2] *Assistant Professor, Computer Science Department, College of Engineering and Computer Science, Jazan University, Saudi Arabia*
[3&4] *Department of Computer, Applied College, Jazan University, Jazan 45142, Kingdom of Saudi Arabia.*
**Corresponding author can be reached at kaur.chaman83@gmail.com*

ARTICLE INFO

Received: 18 Dec 2024

Revised: 10 Feb 2025

Accepted: 28 Feb 2025

ABSTRACT

Healthcare data analysis is increasingly critical today. Patient Healthcare Records (PHR) are essential for analyzing every detail pertaining to individual patients; therefore, the meticulous maintenance of all health information for patients is of paramount importance. A multitude of researchers are engaged in healthcare data analysis, ensuring the security and privacy of each Personal Health Record (PHR) analysis. Current methodologies predominantly utilize machine learning and artificial intelligence approaches; however, they fail to deliver precise accuracy results. Consequently, our paper introduces lightweight deep learning techniques grounded in cryptographic methods. Typically, image processing approaches include four fundamental analytical functions: pre-processing, segmentation, feature extraction, and classification methods. A Gaussian filter is employed to eradicate speckle noise seen in MRI or ultrasonic imaging of the brain. This technique involves substituting the noisy pixel, which follows a Gaussian distribution, with the average value of the adjacent or adjoining pixels. Preprocessing techniques facilitate the reduction of noise in all datasets. Our paper employs a Gaussian filter for pre-processing, utilizes principal component analysis for feature extraction, and applies enhanced homomorphic encryption through deep learning techniques to manage the datasets. Ultimately, our article evaluates its accuracy in relation to existing approaches.

Keywords: Enhanced Homo-morphic Encryption, Deep learning, Gaussian filter, PHR

1. Introduction

Our proposed methods employ a blockchain-based Internet of Things and deep learning approaches to securely maintain patient healthcare records, which is an important function in and of itself. This ensures both enhanced accuracy and privacy protection throughout the entire network.

No application can function without the internet of things. Therefore, both traffic and demand are on the rise due to the increasing necessity for these strategies. This Internet of Things is most vulnerable to DoS attacks. The elimination of these dangers, improvement of security, and increase in network performance can be achieved through the use of cryptographic homomorphic encryption techniques and the blockchain-based Internet of things. The fundamental objective of our proposed solutions is to preserve medical records by enhancing their security and privacy through the use of cryptographic methods based on the Internet of Things. Our proposed methods, which employ IoT homomorphic encryption based on the blockchain, thus provide better privacy and security performance than existing options. Results from comparing our proposed methods demonstrate that, first, blockchain-based Internet of Things–based Deep Neural Network approaches provide better network–wide accuracy and privacy protection; second, our proposed techniques, like homomorphic encryption, provide better dataset classification and accuracy.

2. Review of literature

According to Parab A.N. et.al (2020) This study lays forth a plan to analyze emotional states and stress levels using the Internet of Things (IoT), deep learning, electrodermal activity detection, and the amalgamation idea. Primarily focusing on the idea of stress level identification based on different mental states, this study presented a number of

identifications, such as emotional experience, voice recognition through the use of cutting-edge technology utilizing the Internet of Things (IoT) and deep neural networks.

In 2020, Mozafari et al. Using the Internet of Things (IoT), this article lays out the Evaluating mental stress using multiple methods Utilizing Artificial Intelligence (AI) and the SVM algorithm, this work creates a human stress level detector. Features are retrieved using the Fisher approach, and the classification procedure is handled without the PCA method. The detection and classification of multimodal emotions based on accuracy level are covered in this paper utilizing this method.

In 2019, Verma et al. In this research, we present a complete system for monitoring student stress in an Internet of Things (IoT) fog-cloud context. This research presents the implementation of a Bayesian belief network that makes use of input data classifications, Before inserting the student data into the two stages of the temporal Dynamic Bayesian network (TDBN), it separates the data into normal and abnormal categories depending on their analysis. With the use of four parameters—leaf node evidences, context, student health trait, and workload context—in this predictive model, this article aids in the proper interpretation of human emotions.

This study uses an Internet of Things (IoT) based stress detection and health monitoring system, according to Padmaja N et.al (2020). This paper demonstrates how to use various pieces of equipment to detect human stress levels; however, making accurate predictions has become more difficult in recent years. For example, patients may appear to be in good health, but they are actually suffering from stress; this issue should be treated as a chronic illness. To address this, the Internet of Things (IoT) has introduced a plethora of sensor devices, which can be used to accurately measure stress levels.

In 2019, Rachakonda L et.al. In order to detect stress levels in the IoMT, this work uses a DNN integrated edge device for stress lysis. In this study, we apply a deep neural network to a dataset consisting of three waveforms—2000, 4000, and 6000—and evaluate both the training and testing datasets using specific samples. Consequently, the improved accuracy and better categorization results are evident in the end results.

Last year, Uday S. et al. This study demonstrates how to use wearable sensors in an Internet of Things architecture for stress detection. This work introduces MATLAB visualization for further specification setup in the Internet of Things and uses sensor devices like HRV, Galvanic skin response, and electro-dermal activity to detect various forms of stress evaluation in the human body. As a result, human emotional and stress calculations are able to be detected with more precision and perfection.

The year 2021 was recorded by Raval D. The implementation of stress detection using an ANN and the IoT is detailed in this article. This study uses CNNs, or convolutional neural networks. Better accuracy and categorization of emotional states and stress detection were previously made possible by artificial intelligence within the internet of things. We are all aware that convolutional neural networks (CNNs) provide superior classification results than other techniques, and this article uses them to classify images even better.

Emotional stress state identification using genetic algorithm-based feature selection is implemented in this research by Shon D et.al (2018). Impacting electroencephalogram (EEG) signals, Utilizing the DEAP dataset, which contains a public collection of EEG signals, this research applies a genetic algorithm for feature extraction and the K closest neighbor method for dataset classification.

In 2020, Chakladar et al. This research presents an implementation of an EEG-based mental workload estimator that makes use of an evolutionary algorithm and a deep BLSTM-LSTM network. This work uses multilevel alignment to determine the accuracy value in the given input data, which is useful since the ERP and EEG are level of signal measurement used to calculate mental stress. In this work, we apply the STEW dataset, When compared to the GA and PSO feature extraction techniques, the Grey Wolf optimized method offers better optimization, which is demonstrated in this research. An evaluation of mental stress is conducted utilizing a multi-level hybrid method that makes use of both long short-term memory and bidirectional long-short term memory.

In 2017, Santhoshkumar S et al. This study demonstrates how to use cellular neural networks (CNNs) for rapid, scalable genetic algorithm-based picture segmentation. This study uses two cutting-edge methods for assessing brain stress: a genetic algorithm and a convolutional neural network (CNN). Convolutional neural networks (CNNs) identify picture recognition based on pixel value, and genetic algorithms are useful for making predictions and converting images to binary values.

Activity recognition and anomaly detection in E-health applications employing color-coded representation and lightweight CNN architectures are implemented in this study by Yatbaz et.al (2021). Due to the fact that early detection of human activity aids in the earlier identification of human mental state, human activity recognition may become increasingly important.

In 2022, Miranda L. and colleagues This study presents the results of a survey on human activity recognition using context-aware middlewares and machine learning approaches. Using context middlewares throughout the network, this paper demonstrates human body activity recognition; this method aids in both the prediction and detection of human activity recognition in its earlier stages; this paper also employs convolutional neural networks for classification techniques, resulting in improved accuracy over previous methods.
The authors of the 2021 study are Chen et al. The paper presents an AI model that integrates holistic big data with smart city data management to improve data privacy and security. By processing big data using high-processing methods, this model outperforms current approaches in terms of accuracy.

Neelakandan S et.al (2022) In this paper implements that the blockchain with deep learning enabled secured healthcare data transmission and diagnostic model, In this paper implements that the deep learning based secured data based analysis the data transmission and the diagnosis methods based on the functions of the deep learning approaches and then the feature extraction techniques can be handled by using the histogram equalization methods thus this methods of approaches provides that the enhanced accuracy and the secured data transmission when compared to the existing techniques.

Hao M et.al (2020) In this paper implements that the privacy aware and resource saving collaborative learning for healthcare in cloud computing, this paper implements that the secured privacy and protection of the healthcare data in the form of the big data analysis function, thus our paper implements that collaborative learning techniques, thus this methods of the classifications provides that the enhanced accuracy for the classification techniques when compared to the existing approaches.

Ali A et.al (2022) This paper implements that the deep learning based homomorphic secure search able encryption for keyword search in blockchain healthcare system. This paper implements that the secured and the privacy protection in the entire networking system, thus this methods are approaches provides that the homomorphic encryption in the entire network classifications approaches then this methods of approaches provides that the enhanced accuracy of the classifications when compared to the existing approaches, In normally the image processing deep learning approaches provides enhanced accuracy of the classification and the detection of the privacy techniques provides enhanced results when compared to the existing approaches.

Atiewi S et.al (2020) In this paper implements that the scalable and secure big data IoT system based on multifactor authentication and lightweight cryptography, this paper implements that the cloud computing performance and the allotment of the security and the privacy protection in the form of the hybrid clouding, public and the private clouding, thus this methods of approaches provides that the biometric analysis of the entire image processing network, thus this methods of approaches provides enhanced accuracy of the classification when compared to the existing approaches.

Sammeta N et.al (2022) In this paper implements that the Hyperledger blockchain enabled secure medical record management with deep learning based diagnosis model, this paper implements that the secured methods for the data analysis in the healthcare data our proposed methods implements that the form of the Hyperledger blockchain analysis and then the records managements are provided in the form of the function of the enhanced accuracy and the classifications functions thus this methods of approaches provides that the enhanced accuracy of the classifications when compared to the existing techniques.

Veeramakali T et.al (2021) In this paper implements that the intelligent internet of things based secure healthcare framework using blockchain technology with an optimal deep learning model, this paper implements that the intelligent approaches provides that the internet of things based on the secured healthcare based on the blockchain model approaches and the basic configurations of the deep learning approaches, in the normal statement thus that the deep learning provides that the enhanced accuracy of the classification when compared to the existing approaches.

Rahman M A et.al (2020) In this implements that the secure and provenance enhanced internet of health things framework, in the basis of blockchain managed federated learning approach, this paper implements that the federated learning approaches thus this methods of approaches when compared to the existing approaches in the form of the enhanced internet of health thigs framework, proposed that the enhanced accuracy of the classification approaches provides that the secured and the privacy enhanced data analysis. Thus this methods of approaches provides that the enhanced accuracy of classifications when compared to the existing approaches.

Kshirsagar A et.al (2021) In this paper implements that the anatomized study of security solutions for multimedia deep learning enabled authentication cryptography and information hiding in the form of the advanced security solutions for multimedia in advanced security solutions for multimedia, this paper implements that the cryptography based security and the privacy protection of the hidden data in the form of the deep learning approaches, thus this methods of approaches provides that the enhanced accuracy and the specificity classifications in the entire networks.

Hassan J et.al (2021) In this paper implements that the lightweight proxy re- encryption approach with certificate based and incremental cryptography for fog enabled E- healthcare, this paper proposed that the certificate based incremental proxy methods in the entire networks thus this methods of approaches provides that the enhanced accuracy and the enhanced privacy protection and the security enhancement in the entire network, thus this methods of cryptography provides that the enhanced results in the form of the entire network.

Singh S et.al (2022) In this paper implements that the framework for privacy preservation of IoT healthcare data using federated learning and blockchain technology In this paper implements that the federated learning as the special types of the machine learning approaches, thus this methods of approaches provides that the enhanced accuracy and the classifications details and provides that the enhanced privacy and the security of the entire datasets thus this methods of cryptography based machine learning provides that the enhanced accuracy and the privacy protection of the healthcare data in the entire network.

Galetsi P et.al (2019) In this paper implements that the values and challenges and the future directions of big data analytics in healthcare in the form of systematic review. This paper implements that the preferred reporting items for systematic Reviews and the meta Analysis methodology in the form of the security predictions and then the main challenge of the security analysis might be handled by this approaches and finally our approaches provides enhanced accuracy when compared to the existing techniques.

Mishra K N et.al (2020) In this paper implements that the novel approach towards using big data and IoT for improving the efficiency of m-health systems in the form of the advanced computational intelligence techniques for virtual reality in healthcare, this paper provides that the analysis of the big data in the entire network and the challenges facing in the entire network and then the improvement of the analysis and also explains that the enhanced prediction of the accuracy in the entire network, And finally this paper compares with the existing approaches when compared to the existing techniques.

Vyas S et.al (2021) In this paper implements that the big data analytics and cognitive computing in smart health systems in smart health systems, this paper implements that the big data analysis and the cognitive process of the entire network in the image processing and then the prediction of the analysis in the entire network thus the enhancement of the analysis provides that the enhanced accuracy and the throughput detection in the entire network.

Rajeswari S V K R et.al (2022) In this paper implements that AI Based IoT analytics on the cloud for diabetic data management system this paper implements that the enhanced way of the accuracy prediction in the entire network thus this approach provides that the enhanced throughput and then the entire network in the substitution of the algorithm in the entire network by using the various enhanced approaches.

Dai D et.al (2021) In this paper implements that the review of artificial intelligence to enhance the security of big data systems then the state of art methodologies, application and challenges, this paper provides that the machine learning and the artificial intelligent approaches and then the convolutional neural network provides that the enhanced accuracy and the throughput power in the entire network and then final comparison of the network provides that the enhanced accuracy detection when compared to the existing approaches.

Dash S et.al (2019) In this paper implements that the big data in healthcare in the form of the management analysis and future prospects, this paper implements that the enhanced accuracy of the classification detection in the entire network in the form of the network designs in the hospital records in the form of the big data analysis in the entire

network and thus the big data analysis provides that the enhanced accuracy detection and the throughput in the entire network, And then the entire networks of the accuracy detection provides that the enhanced accuracy when compared to the existing approaches.

Smys S (2019) In this paper implements that the survey on accuracy of predictive big data analytics in healthcare this paper implements that the enhanced accuracy and the classifications prediction in the entire network thus our methods of approaches provides that the enhanced accuracy and the classifications detection of the throughput and the maximum visualization of the data classification of the entire network might been shown in the form of the given datasets [1-30].

3. Overview of Proposed approach

The figure 1 implements that the basic functions of image processing are covered in the overview of the suggested approaches, and the first approaches of the pre-processing techniques help to reduce network noise by using the ideal filter. After the pre-processing is complete, the segmentation techniques are used, and this methods of approaches provides that each and every pixel in the entire networking system is segmented. And finally, classification techniques are used, therefore our suggested methods offer improved classification accuracy as well as network-wide privacy and security protection.

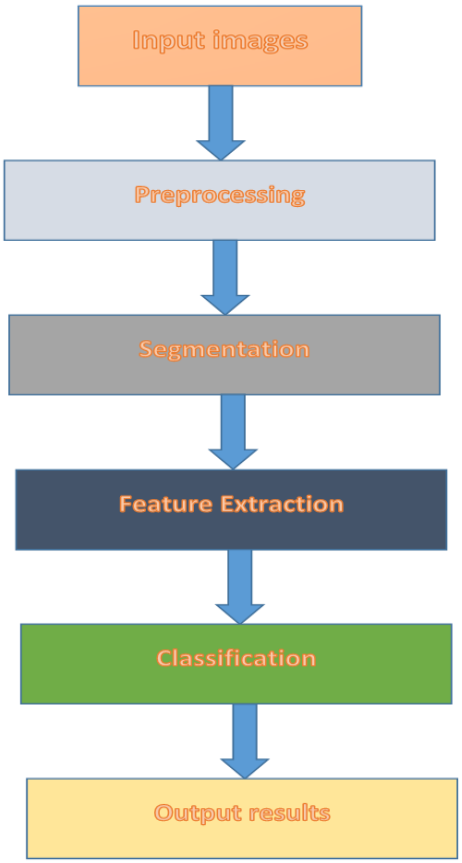

Figure 1 Overview of the proposed approach

4. Proposed methods

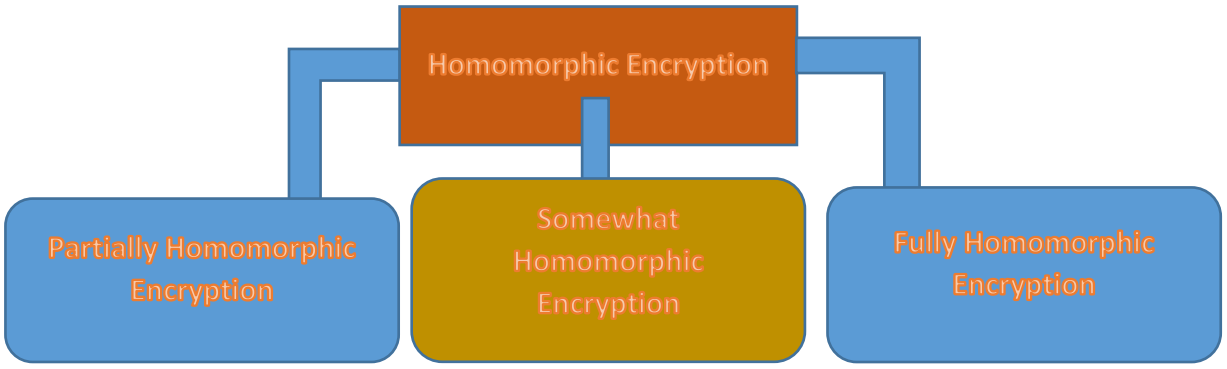

Figure 2 Classification of Homomorphic Encryption

The figure 2 implements that the classification of homomorphic Encryption thus the classification approaches contains that the partially homomorphic Encryption, somewhat homomorphic encryption and the fully homomorphic encryption, thus this methods of approaches provides that the enhanced accuracy of classifications and the prediction of the perfect data analysis in the entire network thus this methods of approaches provides that the enhanced way of classification and the determination of the enhanced approaches and then the way of determination can be compared in the form of the machine learning and the other approaches as shown in the existing methods [31-35].

5. Challenges and issues

The figure 3 implements that the comparative analysis of differential privacy and security approaches in the form of our enhanced techniques of our proposed approaches thus our above figure implements that the existing approaches like trusted executive environment and the differential privacy, the secured multiparty competition and finally our proposed methods homomorphic encryption and then the enhanced homomorphic methods based on the cryptography approaches provides that the enhanced accuracy and the privacy and then the security detection in the entire network, thus our proposed approaches provides the most secured approaches when compared to the other approaches like existing approaches [36-40].

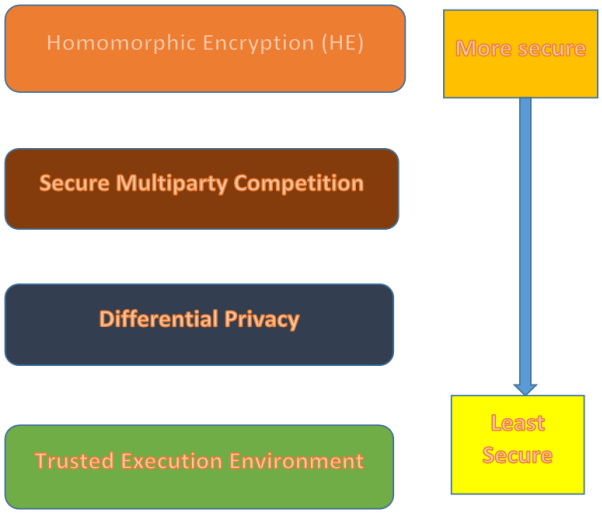

Figure 3 Comparative analysis of differential privacy and security Approaches

Our proposed methods consists of the different form of the methodology and the security approaches in the entire network thus this methods of approaches consists of the three major layers of the techniques namely the IoT enabled layer, Blockchain edge layer and the user layer.

Our proposed methodology comprises the Registration phase, Verification phase, Validation phase, and Blockchain Creation phase. Initially, the method entails the early registration of the complete datasets, utilizing zero-knowledge

proof protocols. Following the initial registration, the Verification phase occurs, which involves a light node analyzing the input datasets. Subsequently, the Validation and Blockchain Creation phase ensues, during which the registered data is integrated into the blockchain, ensuring the meticulous maintenance of our healthcare datasets. The work is ultimately registered [41-45].

6. Proposed blockchain model in IoT using Deep learning

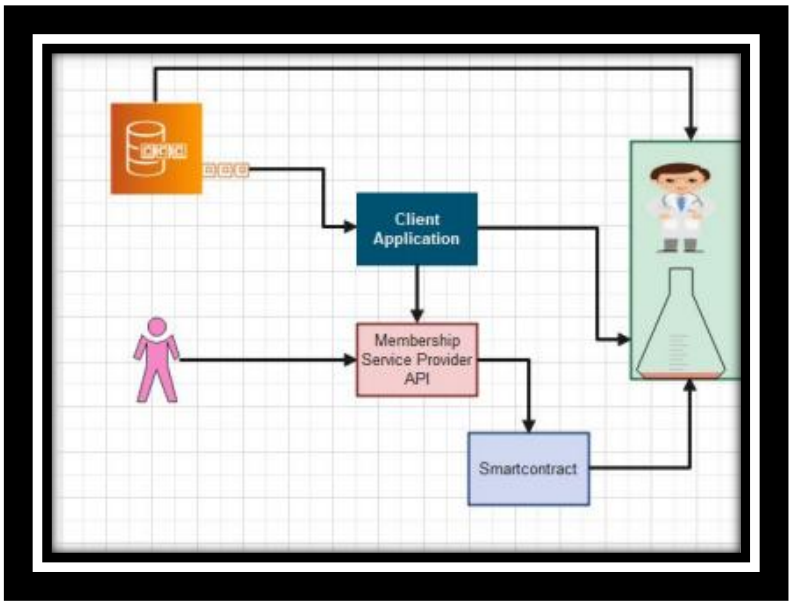

Figure 4 Transactions of EHR through Blockchain based healthcare

The figure 4 implements that the transactions of the Electronic health records through Blockchain based healthcare, We are all know that Internet of things plays the vital role in the form of the all applications thus this methods of approaches are suffered by the Denial of services attacks thus this types of attacks can be reduced by using the blockchain based healthcare. After the complete detection of the entire attacks thus our entire datasets provides that the enhanced accuracy and the privacy protection in the entire network.

7. Deep learning model

The deep learning approaches in the blockchain based IoT helps to leveraging the whole network and it completely reduces the issues in the entire network and then it provides the exchange of the key function in the entire enhanced techniques. Thus our proposed approaches in the deep learning help to provides the better efficiency in the functions of the accuracy detection in the entire network.

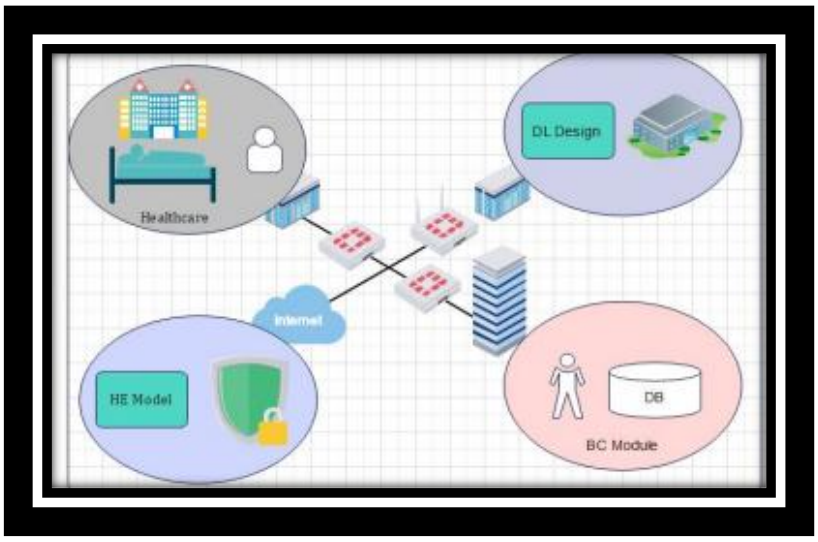

Figure 5 Flowchart for Blockchain based IoT

The figure 5 implements that the flowchart for blockchain based Internet of things, thus this flowchart contains healthcare datasets given through the Deep learning approaches and then it connects to the HE model with the proper connection of the internet.

The figure 6 implements that the proposed homomorphic encryption in the basic concept functions of the entire network, thus our proposed methods are implemented in the basic concept of the deep learning and the blockchain based IoT system, thus the given dataset are entered and then registered and also completed the verification process then the entire networking processes can be takes places. The homo morphic functions are also considered as the function of the cryptography analysis thus this methods takes places in the function of the encryption and the decryption of the data. The datasets explanation are provided in the form of the DoS attacks removes methods [16].

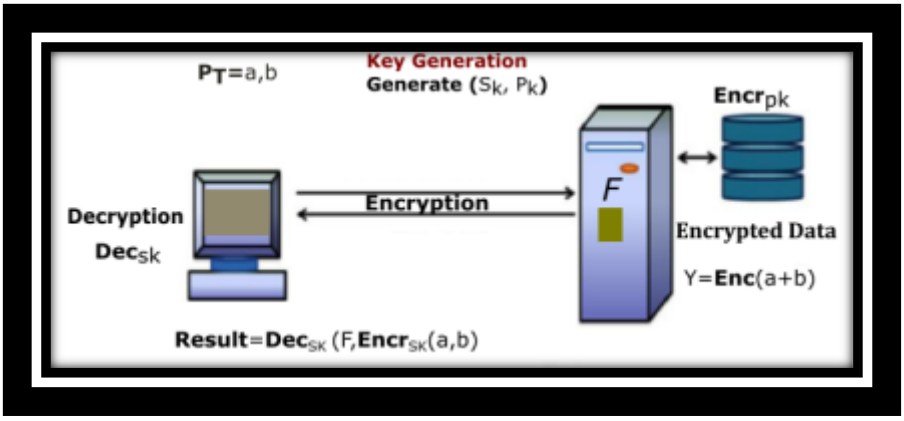

Figure 6. Proposed Homomorphic Encryption

8. Comparison analysis and results

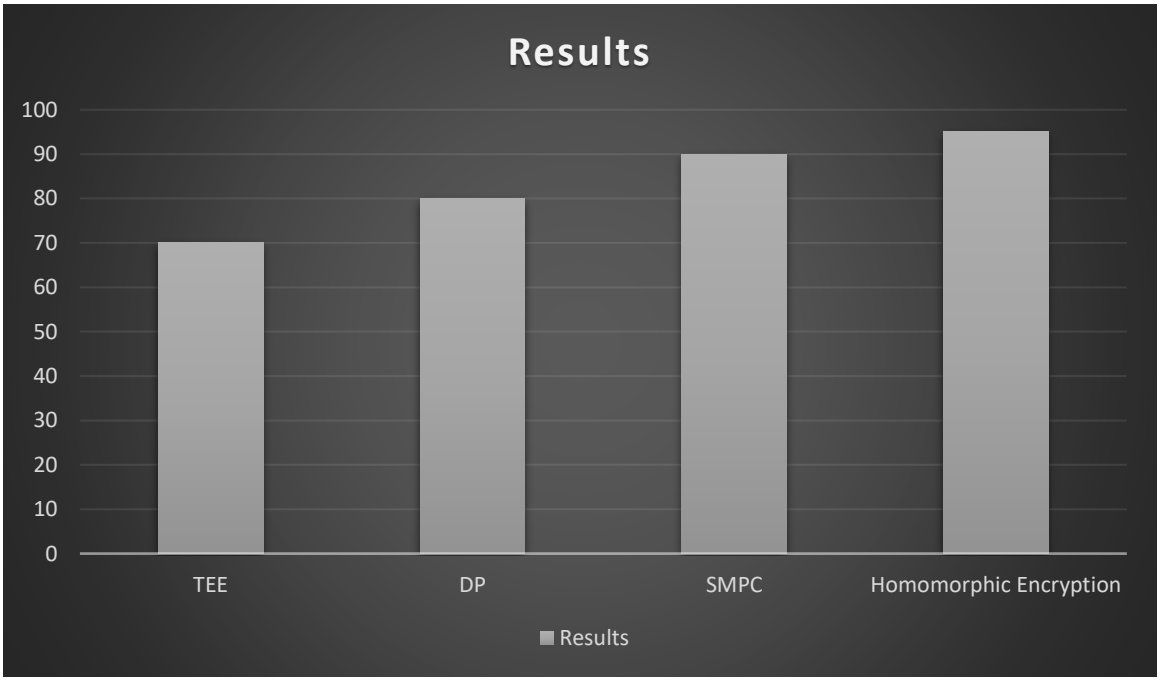

Figure 7 Results

The figure 7 implements that the comparison analysis results of our proposed approaches thus our proposed methods like homomorphic encryption provides that the enhanced accuracy and the classifications of the datasets and then the blockchain Internet of Things based Deep neural approaches provides that the enhanced accuracy and the privacy protection in the entire network.

9. Conclusion and future work

Our proposed methods provides that the high datasets of function can be analyzed by using the form of the healthcare data thus this methods of approaches can be predicted by using the enhanced Homomorphic encryption network, thus this homomorphic encryption classifications functions can be takes places in the form of the blockchain based Internet of things and the deep learning models and thus this techniques are predicted in the various form of approaches in the way of profiling the data and the pattern analysis can be takes places and finally the datasets gives the exact reaction and the predicted data and finally the deep learning takes places. Thus our future approaches works with the form of the genetic algorithm techniques.

Data availability statement:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding:

This research was supported by the Researchers Supporting Program (TUMA-Project-2021-27) Almaarefa University, Riyadh , Saudi Arabia.

References

[1] Parab, A. N., Savla, D. V., Gala, J. P., & Kekre, K. Y. (2020, November). Stress and Emotion Analysis using IoT and Deep Learning. In *2020 4th International Conference on Electronics, Communication and Aerospace Technology (ICECA)* (pp. 708-713). IEEE.

[2] Mozafari, M., Firouzi, F., & Farahani, B. (2020, September). Towards iot-enabled multimodal mental stress monitoring. In *2020 International Conference on Omni-layer Intelligent Systems (COINS)* (pp. 1-8). IEEE.

[3] Changala, R., Aarif, M., Halambi, B., Dhane, M. M., Rao, V. S., & Raj, I. I. (2024, June). Integration of Adaptive Neuro-Fuzzy Systems in Mobile Commerce Strategy: Enhancing Customer Relationship Management through Personalized Recommendations. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)* (pp. 1-6). IEEE.

[4] Padmaja, N., Anusha, A., Manaswi, D. V. S., & Kumar, B. S. (2020). IOT Based Stress Detection and Health Monitoring System. *Helix-The Scientific Explorer| Peer Reviewed Bimonthly International Journal*, *10*(02), 161-167.

[5] Rachakonda, L., Mohanty, S. P., Kougianos, E., & Sundaravadivel, P. (2019). Stress-Lysis: A DNN-integrated edge device for stress level detection in the IoMT. *IEEE Transactions on Consumer Electronics*, *65*(4), 474-483.

[6] Uday, S., Jyotsna, C., & Amudha, J. (2018, April). Detection of stress using wearable sensors in IoT platform. In *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)* (pp. 492-498). IEEE.

[7] Raval, D. (2021). Stress Detection using Convolutional Neural Network and Internet of Things. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(12), 975-978.

[8] Matharu, H., Pasha, Z., Aarif, M., Natrayan, L., Kaliappan, S., & Raj, I. I. (2024, June). Developing an AI-Driven Personalization Engine for Real-Time Content Marketing in E-commerce Platforms. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)* (pp. 1-6). IEEE.

[9] Chakladar, D. D., Dey, S., Roy, P. P., & Dogra, D. P. (2020). EEG-based mental workload estimation using deep BLSTM-LSTM network and evolutionary algorithm. *Biomedical Signal Processing and Control*, *60*, 101989.

[10] SanthoshKumar, S., Vignesh, J., Rangarajan, L. R., Narayanan, V. S., Rangarajan, K. M., & Venkatkrishna, A. L. (2007, November). A fast time scale genetic algorithm based image segmentation using cellular neural networks (CNN). In *2007 IEEE International Conference on Signal Processing and Communications* (pp. 908-911). IEEE.

[11] Dash, C., Ansari, M. S. A., Kaur, C., El-Ebiary, Y. A. B., Algani, Y. M. A., & Bala, B. K. (2025, March). Cloud computing visualization for resources allocation in distribution systems. In *AIP Conference Proceedings* (Vol. 3137, No. 1). AIP Publishing.

[12] Miranda, L., Viterbo, J., & Bernardini, F. (2022). A survey on the use of machine learning methods in context-aware middlewares for human activity recognition. *Artificial Intelligence Review*, *55*(4), 3369-3400.

[13] Chen, J., Ramanathan, L., & Alazab, M. (2021). Holistic big data integrated artificial intelligent modeling to improve privacy and security in data management of smart cities. *Microprocessors and Microsystems*, *81*, 103722.

[14] Nimma, D., Kaur, C., Chhabra, G., Selvi, V., Tyagi, D., & Balakumar, A. (2024, December). Optimizing Mobile Advertising with Reinforcement Learning and Deep Neural Networks. In *2024 International Conference on Artificial Intelligence and Quantum Computation-Based Sensor Application (ICAIQSA)* (pp. 1-6). IEEE.

[15] Hao, M., Li, H., Xu, G., Liu, Z., & Chen, Z. (2020, June). Privacy-aware and resource-saving collaborative learning for healthcare in cloud computing. In *ICC 2020-2020 IEEE International Conference on Communications (ICC)* (pp. 1-6). IEEE.

[16] Ali, A., Pasha, M. F., Ali, J., Fang, O. H., Masud, M., Jurcut, A. D., & Alzain, M. A. (2022). Deep Learning Based Homomorphic Secure Search-Able Encryption for Keyword Search in Blockchain Healthcare System: A Novel Approach to Cryptography. *Sensors*, *22*(2), 528.

[17] D'Souza, M., Kaur, C., Bisht, A. S., Nimma, D., Dhanalakshmi, G., & Faizal, M. M. (2024, December). Hybrid Deep Learning Framework for Dynamic and Energy-Efficient Workload Migration in Cloud Computing Environments. In *2024 International Conference on Communication, Control, and Intelligent Systems (CCIS)* (pp. 1-6). IEEE.

[18] Sammeta, N., & Parthiban, L. (2022). Hyperledger blockchain enabled secure medical record management with deep learning-based diagnosis model. *Complex & Intelligent Systems*, *8*(1), 625-640.

[19] Kaur, C., Al Ansari, M. S., Rana, N., Haralayya, B., Rajkumari, Y., & Gayathri, K. C. (2024). A Study Analyzing the Major Determinants of Implementing Internet of Things (IoT) Tools in Delivering Better Healthcare Services Using Regression Analysis. In *Advanced Technologies for Realizing Sustainable Development Goals: 5G, AI, Big Data, Blockchain, and Industry 4.0 Application* (pp. 270-282). Bentham Science Publishers.

[20] Rahman, M. A., Hossain, M. S., Islam, M. S., Alrajeh, N. A., & Muhammad, G. (2020). Secure and provenance enhanced internet of health things framework: A blockchain managed federated learning approach. *Ieee Access*, *8*, 205071-205087.

[21] Changala, R., Kaur, C., Satapathy, N. R., Vuyyuru, V. A., Santosh, K., & Valavan, M. P. (2024, July). Healthcare Data Management Optimization Using LSTM and GAN-Based Predictive Modeling: Towards Effective Health Service Delivery. In *2024 International Conference on Data Science and Network Security (ICDSNS)* (pp. 1-6). IEEE.

[22] Hassan, J., Shehzad, D., Ullah, I., Algarni, F., Aftab, M. U., Asghar Khan, M., & Uddin, M. I. (2021). A lightweight proxy Re-encryption approach with certificate-based and incremental cryptography for fog-enabled E-healthcare. *Security and Communication Networks*, *2021*.

[23] Changala, R., Misba, M., Kaur, C., Vuyyuru, V. A., & RK, A. (2024, July). Enhancing Early Heart Disease Prediction through Optimized CNN-GRU Algorithms: Advanced Techniques and Applications. In *2024 Third International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT)* (pp. 1-5). IEEE.

[24] Galetsi, P., Katsaliaki, K., & Kumar, S. (2019). Values, challenges and future directions of big data analytics in healthcare: A systematic review. *Social science & medicine*, *241*, 112533.

[25] Mishra, K. N., & Chakraborty, C. (2020). A novel approach towards using big data and IoT for improving the efficiency of m-health systems. In *Advanced computational intelligence techniques for virtual reality in healthcare* (pp. 123-139). Springer, Cham.

[26] Praveena, K., Misba, M., Kaur, C., Al Ansari, M. S., Vuyyuru, V. A., & Muthuperumal, S. (2024, July). Hybrid MLP-GRU Federated Learning Framework for Industrial Predictive Maintenance. In *2024 Third International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT)* (pp. 1-8). IEEE.

[27] Rajeswari, S. V. K. R., & Ponnusamy, V. (2022). AI-Based IoT analytics on the cloud for diabetic data management system. In *Integrating AI in IoT Analytics on the Cloud for Healthcare Applications* (pp. 143-161). IGI Global.

[28] Dai, D., & Boroomand, S. (2021). A review of artificial intelligence to enhance the security of big data systems: state-of-art, methodologies, applications, and challenges. *Archives of Computational Methods in Engineering*, 1-19.

[29] Kaur, C., Al Ansari, M. S., Dwivedi, V. K., & Suganthi, D. (2024). Implementation of a Neuro-Fuzzy-Based Classifier for the Detection of Types 1 and 2 Diabetes. *Advances in Fuzzy-Based Internet of Medical Things (IoMT)*, 163-178.

[30] Smys, S. (2019). Survey on accuracy of predictive big data analytics in heapplthcare. *Journal of Information Technology*, *1*(02), 77-86.

[31] Suresh Kumar, K., Nayak, C. K., Kaur, C., & Sedky, A. H. (2024). Using IoT to Evaluate the Effectiveness of Online Interactive Tools in Healthcare. *Advances in Fuzzy-Based Internet of Medical Things (IoMT)*, 239-253.

[32] S Rahamat Basha, Chhavi Sharma, Farrukh Sayeed, AN Arularasan, PV Pramila, Santaji Krishna Shinde, Bhasker Pant, A Rajaram, Alazar Yeshitla, "Implementation of Reliability Antecedent Forwarding Technique Using Straddling Path Recovery in Manet," Wireless Communications & Mobile Computing (Online), vol. 2022, 2022.

[33] Rathish, C. R., and A. Rajaram. "Hierarchical Load Balanced Routing Protocol for Wireless Sensor Networks." International Journal of Applied Engineering Research 10.7 (2015): 16521-16534.

[34] D. N. V. S. L. S. Indira, Rajendra Kumar Ganiya, P. Ashok Babu, A. Jasmine Xavier, L. Kavisankar, S. Hemalatha, V. Senthilkumar, T. Kavitha, A. Rajaram, Karthik Annam, Alazar Yeshitla, "Improved Artificial Neural Network with State Order Dataset Estimation for Brain Cancer Cell Diagnosis", BioMed Research International, vol. 2022, 10 pages, 2022.

[35] P. Ganesh, G. B. S. R. Naidu, Korla Swaroopa, R. Rahul, Ahmad Almadhor, C. Senthilkumar, Durgaprasad Gangodkar, A. Rajaram, Alazar Yeshitla, "Implementation of Hidden Node Detection Scheme for Self-Organization of Data Packet", Wireless Communications and Mobile Computing, vol. 2022, 9 pages, 2022. https://doi.org/10.1155/2022/1332373.

[36] Rajaram and K. Sathiyaraj, "An improved optimization technique for energy harvesting system with grid connected power for green house management," Journal of Electrical Engineering & Technology, vol. 2022, pp. 1-13, 2022.

[37] M. Dinesh, C Arvind, S.S Sreeja Mole, C.S. Subash Kumar, P. Chandra Sekar, K. Somasundaram, K. Srihari, S. Chandragandhi, Venkatesa Prabhu Sundramurthy, "An Energy Efficient Architecture for Furnace Monitor and Control in Foundry Based on Industry 4.0 Using IoT", Scientific Programming, vol. 2022, Article ID 1128717, 8 pages, 2022. https://doi.org/10.1155/2022/1128717.

[38] S Kannan, A Rajaram, "Enhanced Stable Path Routing Approach for Improving Packet Delivery in MANET," Journal of Computational and Theoretical Nanoscience, vol. 4, no. 9, pp. 4545-4552, 2017.

[39] RP Prem Anand, A Rajaram. "Effective timer count scheduling with spectator routing using stifle restriction algorithm in manet," IOP Conference Series: Materials Science and Engineering, vol. 994, no. 1, pp. 012031, 2022.

[40] Rathish, C. R., and A. Rajaram. "Efficient path reassessment based on node probability in wireless sensor network." International Journal of Control Theory and Applications 34.2016 (2016): 817-832.

[41] Kumar, K. Vinoth, and A. Rajaram. "Energy efficient and node mobility based data replication algorithm for MANET." (2019).

[42] Raghuveer, K., Gongada, T. N., Nimma, D., Aarif, M., Samudrala, K., & Bala, B. K. (2024, October). Enhancing Fraud Detection in Online E-Commerce Transactions through Deep Learning Auto encoder Model. In *2024 International Conference on Intelligent Systems and Advanced Applications (ICISAA)* (pp. 1-6). IEEE.

[43] Balavivekanandhan, A., Gummadi, A., Aarif, M., Bhasin, N. K., Gulati, K., & Raj, I. I. (2024, July). Creating A Resilient Blockchain Framework To Enhance The Efficiency And Security Of Data Management Within Internet Of Things Networks. In *2024 Third International Conference on Smart Technologies and Systems for Next Generation Computing (ICSTSN)* (pp. 1-6). IEEE.

[44] CR Rathish, A Rajaram, "Sweeping inclusive connectivity based routing in wireless sensor networks," ARPN Journal of Engineering and Applied Sciences, vol. 3, no. 5. pp. 1752-1760, 2018.

[45] K. Mahalakshmi, K. Kousalya, Himanshu Shekhar, Aby K. Thomas, L. Bhagyalakshmi, Sanjay Kumar Suman, S. Chandragandhi, Prashant Bachanna, K. Srihari, Venkatesa Prabhu Sundramurthy, "Public Auditing Scheme for Integrity Verification in Distributed Cloud Storage System", Scientific Programming, vol. 2021, Article ID 8533995, 5 pages, 2021. https://doi.org/10.1155/2021/8533995.

[46] Nimma, D., Aarif, M., Pokhriyal, S., Murugan, R., Rao, V. S., & Bala, B. K. (2024, December). Artificial Intelligence Strategies for Optimizing Native Advertising with Deep Learning. In *2024 International*

Conference on Artificial Intelligence and Quantum Computation-Based Sensor Application (ICAIQSA) (pp. 1-6). IEEE.

[47] Aarif, M., Anjum, A., Sharma, T., Arikrishnan, A., Rao, V. S., & Balakumar, A. (2024, July). Implementing Fuzzy Logic in Cognitive Sensor Networks for Environmental Monitoring. In *2024 Third International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT)* (pp. 1-6). IEEE.

[48] J. Divakaran, Somashekhar Malipatil, Tareeq Zaid, M. Pushpalatha, Vilaskumar Patil, C. Arvind, T. Joby Titus, K. Srihari, M. Ragul Vignesh, Baswaraj Gadgay, Venkatesa Prabhu Sundramurthy, "Technical Study on 5G Using Soft Computing Methods", Scientific Programming, vol. 2022, Article ID 1570604, 7 pages, 2022. https://doi.org/10.1155/2022/1570604.

[49] S. Shitharth, Pratiksha Meshram, Pravin R. Kshirsagar, Hariprasath Manoharan, Vineet Tirth, Venkatesa Prabhu Sundramurthy, "Impact of Big Data Analysis on Nanosensors for Applied Sciences Using Neural Networks", Journal of Nanomaterials, vol. 2021, Article ID 4927607, 9 pages, 2021. https://doi.org/10.1155/2021/4927607.