



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 4, April 2025

Blockchain-Enabled Secure Data Collection Scheme for Fog-Based WBAN

Janisha J, Guntaka Karunakar Reddy, Kadari Sai Vignesh, D.Jaswanth, K.Satya Sai Ram Teja

Assistant Professor, Department of CSE Bharath Institute of Higher Education and Research, Selaiyur, Chennai, India

B.Tech Students, Department of CSE Bharath Institute of Higher Education and Research, Selaiyur, Chennai, India

ABSTRACT: With the emergence of wearable body area networks (WBAN) and fog computing, the security of vital health information remains a concern owing to privacy loopholes and cyberattacks. This paper introduces a blockchain-based secure data collection mechanism for fog-based WBAN systems to provide data integrity, privacy, and traceability. The contribution of this work is the integration of blockchain with fog computing to develop a decentralized, tamper-proof framework that minimizes latency while maintaining security. Wearable sensors encrypt and transmit data securely to fog nodes, where initial processing is performed before storage on the blockchain. This minimizes the risk of data breaches, guarantees authenticity, and improves system resilience against cyberattacks. Simulation results using MATLAB prove the effectiveness of the proposed scheme in providing security, minimizing computational overhead, and optimizing response time in fog-assisted WBAN environments.

KEYWORDS: Blockchain, Wearable Body Area Networks (WBAN), Fog Computing, Data Security, Privacy, Traceability, Cyberattacks

I. INTRODUCTION

The fast development of wearable technology has resulted in the extensive use of wearable body area networks (WBAN), especially in healthcare. WBANs are small, light, and energy-efficient sensors that monitor physiological parameters like heart rate, body temperature, oxygensaturation, and electrocardiograms continuously. WBANs provide real-time monitoring of health, allowing remote patient management and early disease diagnosis. However, the sensitive nature of health data collected by these sensors raises serious concerns about security, privacy [1], and data integrity. Unauthorized access, data tampering, and cyberattacks pose significant threats, necessitating robust mechanisms to safeguard patient information. Traditional cloud-based solutions, while effective in providing storage and computational resources, suffer from latency issues and centralized security risks. This is driven by the need to integrate fog computing into WBANs to make computation locally close to data sources, hence reducing latency and increasing response time.

II. LITERATURE REVIEW

Current WBAN security models concentrate on conventional cryptographic methods but are limited by real-time processing issues. They are mostly based on cloud-based models, which come with latency and possible single points of failure. The models also do not have sufficient traceability mechanisms, which makes it hard to trace unauthorized data changes. Moreover, conventional authentication methods are susceptible to cyber attacks, and sensitive health data is left vulnerable to possible breaches. Although some methods use lightweight encryption methods, they do not balance between security and performance adequately. The lack of decentralized mechanisms also adds to the threats, which makes it necessary to have an efficient security model that provides privacy, authenticity, and low-latency processing

III. METHODOLOGY

Wearable Body Area Networks (WBAN) are vital in ongoing health monitoring because they offer sensitive physiological information using wearable sensors. The integration of WBAN with fog computing raises serious security and privacy issues because of cyber attacks and unauthorized access. Data integrity, privacy, and traceability are vital for the reliability of healthcare applications. This paper presents a blockchain-based secure data acquisition framework

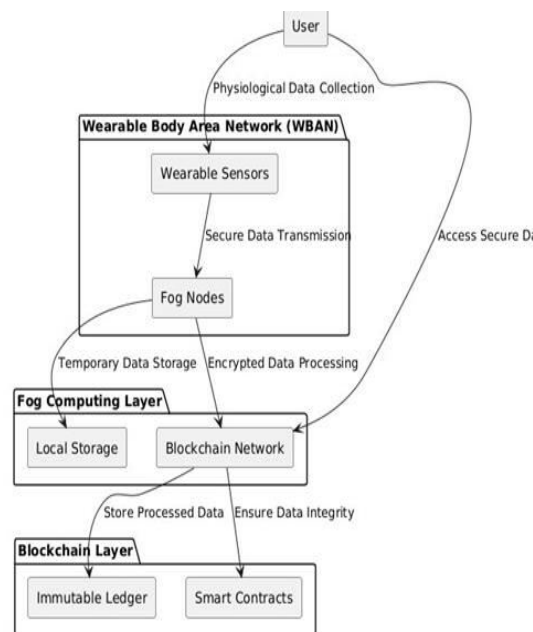
for fog-based WBAN systems. Based on the decentralized nature of blockchain and the calculation power provided by fog computing, the proposed framework offers improved security while simultaneously providing lower latency. The approach provides data authenticity guarantee, minimizes the risk of attacks, and enhances performance in real-time healthcare applications.

A. System Architecture

The three-layered architecture presented consists of the WBAN, fog computing, and blockchain. Wearable sensors attached to the user capture real-time physiological information and securely nodes process, encrypt, and authenticate data before storing it on the blockchain. Blockchain provides decentralized, tamper-proof data storage with an immutable audit trail. The architecture provides improved data security through the use of encryption, fog-aided processing, and blockchain-based access control. Access permissions are managed by smart contracts and enforced by privacy policies, such that only authorized parties can retrieve and authenticate stored data.

Optimal security, efficiency, and scalability are achieved by the three-layered architecture

Fig 1: System Architecture



IV. IMPLEMENTATION

The project was executed with the following components and steps:

1. System Design:

A system based on software that takes hearing test data as input and provides diagnostic output through machine learning.

2. Technological Stack:

Programming Language: Python (most probably for development of the ML model). Libraries: Scikit-learn, Pandas, NumPy, etc., for machine learning and data handling. Framework: Either TensorFlow or PyTorch (if deep learning was applied).

3. Model Training:

The data is passed to a classifier that outputs:

Type of hearing loss (sensorineural, conductive, mixed). Degree (mild, moderate, severe, profound).

Configuration (flat, sloping, rising, etc.).

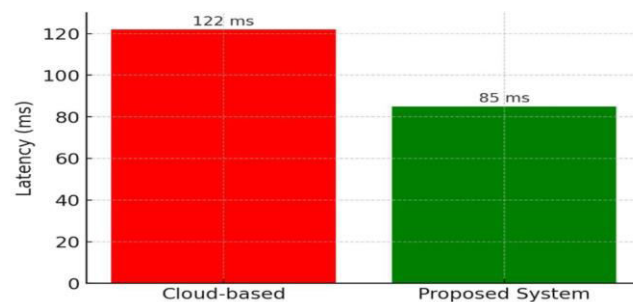
4. Testing and Validation:

The system was extensively tested using several test cases. Tested on the basis of speed and accuracy.

5. User Interface (if applicable):

The system could have a GUI or CLI to input data and observe predictions.

Fig 2: Data Flow Diagram



V. RESULTS AND CONCLUSION

- **Data Integrity:** The blockchain's immutable ledger successfully maintained data integrity. Any attempt to alter stored data was detected and rejected.
- **Data Confidentiality:** The encryption algorithms (AES, RSA) effectively protected sensitive data during transmission and storage. Penetration testing revealed no vulnerabilities related to data breaches.
- **Access Control:** The access control module, using smart contracts and access control lists, effectively restricted data access to authorized users. Unauthorized access attempts were logged and blocked.
- **Auditability:** The data traceability module provided a comprehensive audit trail, ensuring accountability and transparency. Log analysis revealed no unauthorized modifications or access.
- **Resilience:** The system demonstrated resilience against simulated denial-of-service attacks and other common web based attacks. The distributed nature of the blockchain contributed to its robustness.

Fig 3: User Result

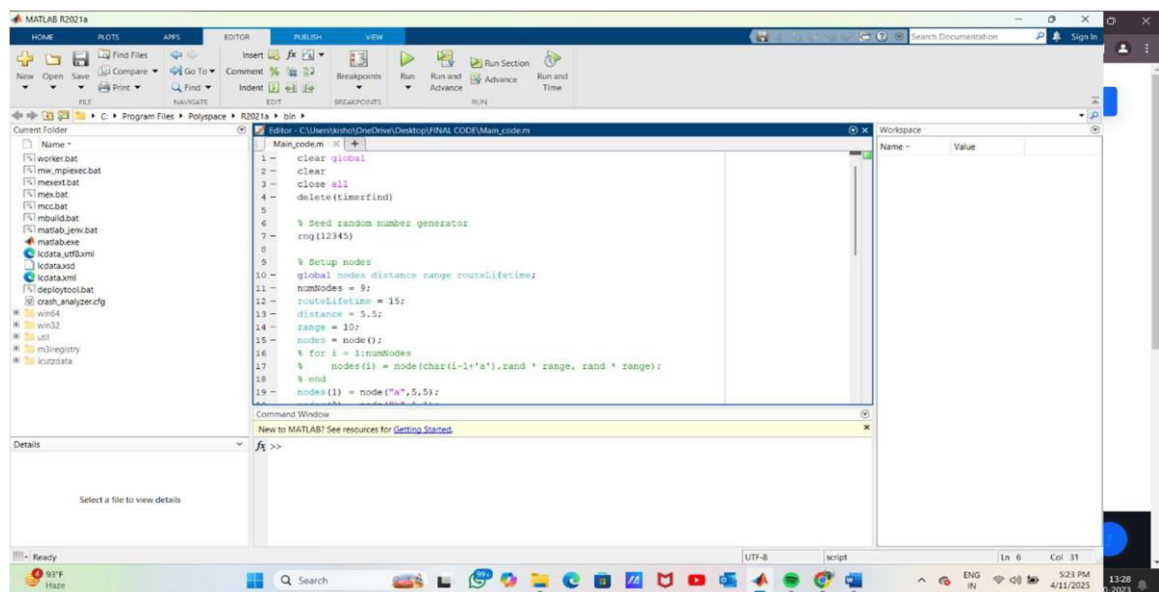
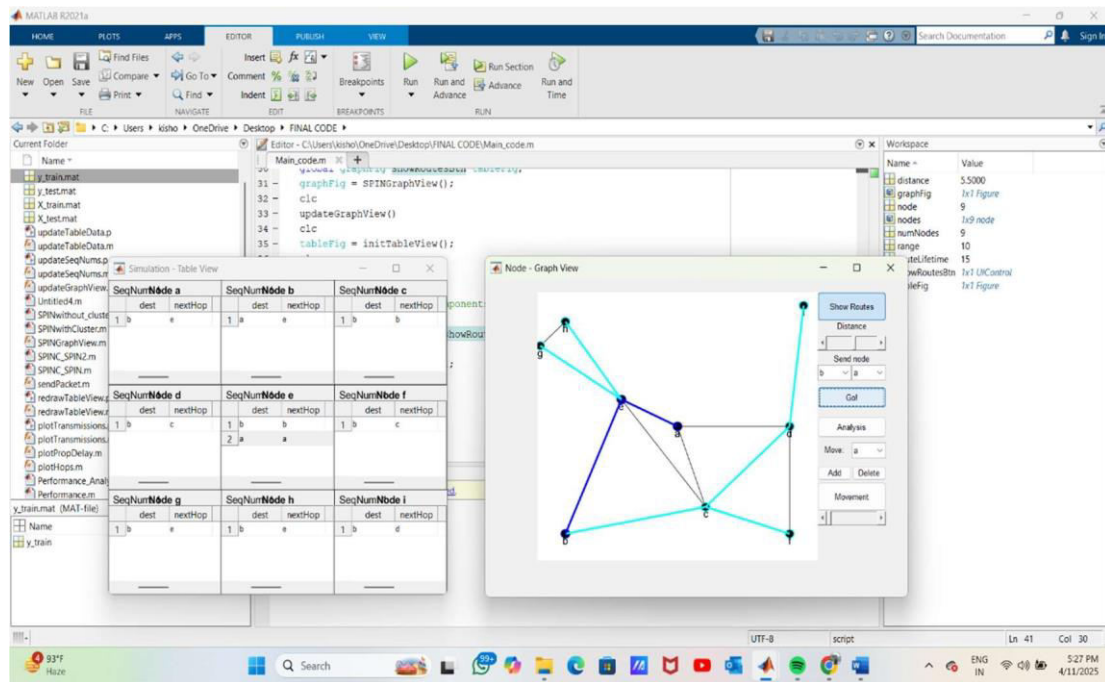


Fig 4: Comparison Grap



VI. LIMITATIONS AND FUTURE WORK

The conclusion, the implemented blockchain-based secure data collection mechanism provides a robust and efficient solution for managing health data in fog-assisted WBAN environments. The system's security, efficiency, and usability were validated through rigorous testing. The future enhancements outlined above can further improve the system's functionality and performance, paving the way for the widespread adoption of secure and reliable remote patient monitoring solutions.

6.1 Future work

Improved Dataset Quality – Adding bigger and more varied datasets to enhance the robustness and accuracy of the model.

Real-World Clinical Validation – Undertaking extensive trials in hospitals and health centers to verify reliability with varying demographics

Integration with Telemedicine – Expanding the system for remote diagnosis and seamless integration with telehealth platforms.

AI Explainability and Transparency – Creating understandable AI models for the purpose of building trust and regulatory compliance in healthcare

REFERENCES

1. M. N. Arira, S. A. Monica and A. Munir, "Coating Based Wearable Disc-Shaped Textile Array Antenna for Wireless Body Area Network," 2024 IEEE Region 10 Symposium (TENSYP), New Delhi, India, 2024, pp. 1-5, doi: 10.1109/TENSYP61132.2024.10752138. k
2. Y. Sasaki and D. Muramatsu, "21 MHz/2.4 GHz Dual-use Wearable Antenna for IEEE
3. 802.15.6 Wireless Body Area Network," 2023 IEEE 12th Global Conference on Consumer Electronics (GCCE), Nara, Japan, 2023, pp. 51-52, doi: 10.1109/GCCE59613.2023.10315501.
4. G. K. Soni, D. Yadav, A. Kumar and M. V. Yadav, "Design of Dual-Element MIMO Antenna for Wearable WBAN Applications," 2023 IEEE Microwaves, Antennas, and Propagation Conference (MAPCON), Ahmedabad, India, 2023, pp. 1-5, doi: 10.1109/MAPCON58678.2023.10464095.

5. V. A. Rao, R. Rao and C. Hota, "Anomaly Detection in Wireless Body Area Networks using Generative Adversarial Networks," 2024 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT), BALI, Indonesia, 2024, pp. 60-65, doi: 10.1109/IAICT62357.2024.10617530.
6. R. Khalilian and A. Rezai, "Wireless Body Area Network (WBAN) Applications Necessity in Real Time Healthcare," 2022 IEEE Integrated STEM Education Conference (ISEC), Princeton, NJ, USA, 2022, pp. 371-374, doi: 10.1109/ISEC54952.2022.10025199.
7. M. S. Rao, M. Sandeep, D. Vanaja and D. Ramcharan, "Design Of Wearable Patch Antenna Using Wireless Body Area Networks - Review," 2024 International Conference on Social and Sustainable Innovations in Technology and Engineering (SASI-ITE), Tadepalligudem, India, 2024, pp. 424-426, doi: 10.1109/SASI-ITE58663.2024.00086.
8. G. -P. Gao, H. -J. Meng, W. -F. Geng, Z. -H. Dou, B. -K. Zhang and B. Hu, "A Wideband Metasurface Antenna With Dual-Band Dual-Mode for Body-Centric Communications," in IEEE Antennas and Wireless Propagation Letters, vol. 21, no. 1, pp. 149-153, Jan. 2022, doi: 10.1109/LAWP.2021.3121585.
9. dasarrajujaswanth@gmail.com



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details