

RECENT TRENDS IN AI-DRIVEN SENTIMENT ANALYSIS, HEALTHCARE APPLICATIONS, AND WIRELESS COMMUNICATION NETWORKS

Samya Das¹, Dr. Sanchita Saha², Dr. Ankan Bhattacharya³, Achyut Mitra⁴, Asit Kumar Nayek⁵

¹Computer Science and Engineering, Jadavpur University, Kolkata, India.

²Computer Science and Engineering, Techno International New Town, Kolkata, India.

³Electronics and Communication Engineering, Hooghly Engineering & Technology College, Kolkata, India.

⁴Computer Science and Engineering, JIS University, Kolkata, India.

⁵Computer Science and Engineering, Haldia Institute of Technology, Kolkata, India.

Email address: samyadas2107@gmail.com (Samya Das), sanchita.cse2007@gmail.com (Dr. Sanchita Saha), ankan@hete.ac.in (Dr. Ankan Bhattacharya), achyutmitra683@gmail.com (Achyut Mitra), asit.nayek@gmail.com (Asit Kumar Nayek).

Abstract: Sentiment analysis provides healthcare providers to understand patient emotions, feedback, and behavioral patterns from textual and speech data. Simultaneously, wireless communication networks such as 5G, 6G, Wireless Sensor Networks (WSNs), Internet of Medical Things (IoMT), and Wireless Body Area Networks (WBANs) facilitate real-time healthcare monitoring and remote medical services. This paper reviews recent trends, advancements, challenges, and future directions in AI-driven sentiment analysis integrated with healthcare applications and wireless communication systems. The study highlights emerging technologies including federated learning, explainable AI, edge intelligence, and emotional AI for next-generation smart healthcare systems.

Keywords: Artificial Intelligence, Sentiment Analysis, Healthcare Applications, Wireless Networks, IoMT, Deep Learning, 5G/6G, Explainable AI.

1. Introduction

Healthcare systems have underwent a revolution thanks to the quick training of artificial intelligence (AI), which has made intelligent diagnosis, patient monitoring, emotion detection, and individualized treatment promising[1,2,8]. Understanding patient thoughts, feelings, and healthcare experiences through textual and voice-based interactions is made possible by sentiment analysis, a subfield of natural language processing (NLP)[3,4,9,23]. In order to enable real-time medical data transfer, modern healthcare infrastructures depend more and more on wireless communication technologies including Wireless Sensor Networks (WSNs), the Internet of Medical Things (IoMT), and fifth/sixth-generation (5G/6G) networks[16,17]. Improved patient care, remote monitoring, lower latency, and intelligent decision-making are all made possible by the combination of AI-driven analytics with wireless healthcare systems[7,8,14]. A thorough examination of current developments in wireless communication networks, healthcare applications, and AI-driven sentiment analysis is presented below.

2. Related Work

Sentiment analysis involves recognizing and understanding the emotions, opinions, and attitudes taken in textual or spoken data. In the medical field, it is vital for grasping patient experiences and enhancing healthcare services[18,26]. It is commonly utilized to evaluate patient feedback, track mental health conditions, identify emotional states, aid clinical decision-making, and improve interactions with healthcare chatbots[22,23].

The Models like BERT, BioBERT, and ClinicalBERT have an important role in sentiment analysis, healthcare[5,6]. Long Short-Term Memory networks and Convolutional Neural Networks are also useful to recognize emotional patterns and derive significant insights from healthcare data[20,23]. Generative AI and Large Language Models (LLMs) have enhanced systems' capabilities to understand patient perspectives, feelings, and clinical stories with greater precision[16].

Sentiment analysis has discovered various key uses in healthcare[12]. It is frequently utilized to identify indications of depression and anxiety by examining patient dialogues, social media entries, and written replies[18]. In telemedicine systems, analyzing feedback allows physicians and healthcare facilities to comprehend patient experiences and enhance online consultations [16].

3. Theory/Calculation

AI-based healthcare applications are widely used for disease prediction, helping doctors identify potential health risks at an early stage[14]. Personalized treatment systems are another major application, as they help design treatment plans according to an individual patient's medical history and condition[18]. We create a health map to monitor the disease[19].

The Internet of Medical Things combines healthcare devices, sensors, and communication technologies to support continuous monitoring and management of patient health[1]. It is also widely used in smart ambulances, telemedicine services, and emergency healthcare response systems, where quick access to patient information can improve treatment and decision-making[8].

WSN networks play an important role in applications such as environmental monitoring, patient data collection, emergency healthcare services, and smart hospital management[23]. Sensors placed in different locations can gather real-time health information and transmit it for analysis and medical response[25]. With the integration of Artificial Intelligence, the performance of WSNs has improved significantly[26]. 5G and emerging 6G communication networks are transforming the healthcare sector by providing massive device connectivity[17]. The study discussed on application of latest communication technology for healthcare system [22].

4. Experimental Method/Procedure/Design

The proposed architecture combines AI-driven sentiment analysis, wireless communication technologies, IoMT healthcare devices, edge and cloud intelligence, and smart healthcare applications into a unified healthcare framework. Figure 1. shown the Proposed Architecture Diagram.

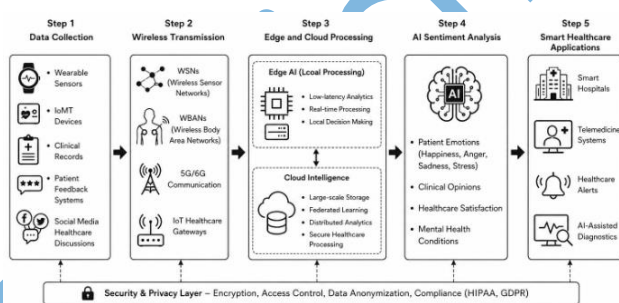


Figure 1. Proposed Architecture Diagram

Step 1: Data Collection

Healthcare data is collected from multiple sources, including wearable sensors and IoMT devices for real-time health monitoring, clinical records for medical history and diagnosis, patient feedback systems.

Step 2: Wireless Transmission

The dataset is transmitted using advanced wireless technologies.

Step 3: Edge and Cloud Processing

Edge AI needed for supporting real-time analysis and rapid clinical decision-making. Cloud computing complements this by providing scalable storage, distributed analytics.

Step 4: AI Sentiment Analysis

Artificial Intelligence (AI) models analyze healthcare data to support patient care and clinical decision-making.

Step 5: Smart Healthcare Applications

The processed healthcare information supports various advanced applications, including smart hospitals, telemedicine, real-time healthcare alerts, and AI-assisted diagnostics.

5. Results and Discussion

Emotional AI is a developing field of artificial intelligence that aims to comprehend and analyze human emotions using advanced technologies. Edge Intelligence involves utilizing AI computation near the data generation source rather than depending solely on centralized cloud infrastructures. Blockchain technology is gaining significance in healthcare as it ensures secure and transparent handling of medical data. AI-native 6G networks signify the upcoming evolution of smart communication systems intended to facilitate sophisticated healthcare applications.

Despite rapid advancements in AI-powered healthcare, several challenges remain, including data privacy and cybersecurity, AI bias and lack of interpretability, scalability, high energy consumption, unreliable wireless connectivity, ethical concerns such as patient consent and fairness, and limited or imbalanced healthcare datasets. Addressing these issues is essential for developing secure, reliable, and trustworthy intelligent healthcare systems.

6. Conclusion and Future Scope

AI-driven sentiment analysis and wireless technologies are transforming healthcare by enabling intelligent diagnosis, real-time connectivity, and patient-centric services. Emerging technologies such as edge AI, explainable AI, federated learning, and blockchain further enhance smart healthcare despite challenges in privacy, security, and scalability.

Future research in intelligent healthcare will focus on developing explainable and trustworthy AI, energy-efficient wireless healthcare networks, Quantum AI for advanced medical analytics, intelligent edge computing for low-latency

services, and real-time multimodal sentiment analysis. AI-native 6G healthcare systems and privacy-preserving federated learning will further enhance secure, scalable, and intelligent healthcare applications while protecting patient data.

References

1. Jana, R.K., Maity, S. and Maiti, S., 2022, May. An empirical study of sentiment and behavioural analysis using homophily effect in social network. In 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS) (pp. 1508-1515). IEEE. <https://ieeexplore.ieee.org/document/9788407>
2. Jana, R.K. and Maity, S., 2022. An Accuracy based Comparative Study on Different Techniques and challenges for Sentiment Analysis. Pervasive Computing and Social Networking: Proceedings of ICPCSN 2022, pp.601-619. https://link.springer.com/chapter/10.1007/978-981-19-2840-6_46
3. Radha, K., Dharmpal, S., Saikat, M. and Hrithik, P., 2023. Perception Analysis of Social Network Tweets Using a Genetic Algorithm Based Approach s. Journal of Software Engineering Tools &Technology Trends, 10(02), pp.27-38. <https://research-reels.com/publication/perception-analysis-of-social-network-tweetsusing-a-genetic-algorithm-based-approach/>
4. AI Tools for the Software Development of Real-Time Communication Systems, S. Reshma (Dayananda Sagar University, India), Varsha Goyal (Amity University, India), R. Kokila (Dayananda Sagar University, India), K. Vibha (SRM Institute of Science and Technology, India), and S. Indirani (SRM Institute of Science and Technology, India).
5. Fundamentals of AI and communication networks: Applications in human social activities MK Mahto, G Rajavikram - Intelligent Networks, 2024 - taylorfrancis.com.
6. Jana, R.K., Singh, D., Maity, S. and Paul, H., 2024. A Hybrid Approach to Analyse the Public Sentiment on Covid-19 Tweets. Indian Journal of Science and Technology, 17(7), pp.610-616. DOI: 10.17485/IJST/v17i7.3017.
7. Jana, R.K., Singh, D. and Maity, S., 2024. Modified firefly algorithm and different approaches for sentiment analysis. The Scientific Temper, 15(01), pp.1745-1754. <https://scientifictemper.com/index.php/tst/article/view/969>.
8. Jana, R.K., Singh, D., Maity, S., Paul, H., Mallick, A., Ghatak, S., Mallik, S. and Wang, M., 2024. Public perception analysis on COVID-19 tweets using hybridised method. International Journal of Computational Biology and Drug Design, 16(1), pp.19-41.DOI: 10.1504/IJCBD.2024.139485.
9. Data-driven analytics leveraging artificial intelligence in the era of COVID-19: an insightful review of recent developments A Majeed, SO Hwang - Symmetry, 2021 - mdpi.com.
10. Das, S., Nag, S. and Jana, R.,2025. A Multimodal Systematic Review of Stress Detection in University Students Based on Machine Learning and Physiological Measures.<https://www.jisuniversity.ac.in/multimodal-systematic-review-of-stress-detection-in-university-students-based-on-machine-learning-and-physiological-measures.php>.
11. B. Pradhan, S. Das, D. S. Roy, S. Routray, F. Benedetto and R. H. Jhaveri, "An AI-Assisted Smart Healthcare System Using 5G Communication," in IEEE Access, vol. 11, pp. 108339-108355, 2023, doi: 10.1109/ACCESS.2023.3317174.
12. Aneesh Bose , Deblina Pal , Radhakrishna Jana, "Population Health Tracking System: Analyzing Health Data for Effective Healthcare Planning" International Journal of Computer Sciences and Engineering Vol.11, Special Issue.1, pp.323-330, November 2023
13. Nirbhay Mishra Prottyusha Chatterjee, Akash Barman, Debashish Dey,Aditya Dutta,Radha Krishna Jana,Dharmpal singh, Sudipta Dutta, "Unlocking the Future: Leveraging Big Data Analytics for Predictive Healthcare Insights", International Journal of Computer Sciences and Engineering,Vol.11, Special Issue.1, pp.114-119, November 2023.
14. Atin Bera, Arya Bhattacharyya, Radhakrishna Jana,Sudipta Kumar Dutta, "A Simplified Review of Cloud Computing in the Healthcare System",International Journal of Computer Sciences and Engineering Vol.11, Special Issue.1, pp.290-295, November 2023.
15. Arpan Kumar Chall, Anapeksha Das, Asmi Mondal,Radhakrishna Jana, "Wellness Management Guided by Voice Input, Featuring an Intelligent AI Health Assistant Named: Raie",International Journal of Computer Sciences and Engineering Vol.11, Special Issue.1, pp.169-176, November 2023 .
16. Abhisar Paul, Diganta Biswas, Radha Krishna Jana, "Utilizing an Implicit Health Analysis Integrated Simulation for Hospital-Nurse Staffing Strategy," International Journal of Computer Sciences and Engineering, Vol.11, Issue.01, pp.127-133, 2023.
17. U. Chaudhary, M. Furqan Ali, A. Kumar, A. Sharma and D. K. Nalin Jayakody, "Unleashing the Power of Wireless Communication in Healthcare by Empowering Patient Care and Connectivity: A Comprehensive Survey," in IEEE Access, vol. 13, pp. 117239-117299, 2025, doi:

10.1109/ACCESS.2025.3578344.

18. Asit Kumar Nayek, Radha Krishna Jana, Arpan Adhikary, "An improved algorithm with Multifactor Authentication Scheme for Telecare Medical Information System (TMIS)", International Journal of Computer Sciences and Engineering Vol.11, Special Issue.1, pp.107-113, November 2023.

19. Sonia Thakur, Ritaja Bhattacharya, Bidisha Debnath, Radha Krishna Jana, Hrithik Paul, "Novel Approach of Health Heatmap Design for Public Health Emergencies: A Covid-19 Perspective", Journal of Computer Science and Engineering in Innovations and Research, Vol.-1, Issue- 1, July 2024.

20. Ghosh, D., Mukhopadhyay, A. and Jana, R.K., 2025. Ambulance booking and tracking website. Drug Discovery and Telemedicine: Through Artificial Intelligence, Computer Vision, and IoT, p.183.

21. Nayek, A.K., Jana, R.K. and Adhikary, A., Enhanced multifactor authentication scheme for telecare medical information system (TMIS). In Transformative Technologies (pp. 129-139). CRC Press.

22. AI-Driven Information and Communication Technologies, Services, and Applications for Next-Generation Healthcare System Vijayakumar Ponnusamy, A. Vasuki, J. Christopher Clement, P. Eswaran. <https://doi.org/10.1002/9781119762010>.

23. Souvik Sikdar, Samya Das, Soham Dey, Radha Krishna Jana, "IoT Home Guard: Enhancing Security for Smart Home Privacy and Protection", International Journal of Computer Sciences and Engineering Vol.11, Special Issue.1, pp.301-309, November 2023.

24. Sanjoy Paul, Radha Krishna Jana, "CDMA Technique & Its Special Function in Network Technology", IJCST Vol. 3, Issue 1, Jan. - Mar Ch 2012.

25. Pijush barui, Radha Krishna Jana, "An Approach to Identify a Malicious Node Based on Shared Key Establishment in Ad Hoc Network" International Journal of Computer Science and Technology (IJCST), IJCST Vol. 2 Issue 1, APRIL - JUNE, 2012 - ISSN: 0976-8491 (online), 2229-4333 (Print).

26. Ambulance booking and tracking website, Debangshu Ghosh, Arundhuti Mukhopadhyay, Radha Krishna Jana.

Samya Das is currently pursuing his B.E. in Computer Science and Engineering from Jadavpur University, Kolkata. He has completed his Diploma in Computer Science and Technology from The Calcutta Technical School in 2024. His main research interests include Artificial Intelligence and Machine Learning, Computational Thinking, IoT Security, Smart Home Automation, Recommendation Systems, and Generative AI. He has worked on research involving problem-solving techniques in computational thinking, IoT-based smart home security, and music recommendation systems. He has also received a **Best Paper Award at RAICCIT 2023** for his work on an intelligent smart home automation system using IoT.



Ankan Bhattacharya obtained his Ph.D. from National Institute of Technology, Durgapur, India. His areas of teaching and research are Antenna Engineering, Computational Electromagnetics, Electronic Circuits and Systems, Signal Processing, Microwave Devices and Wireless Communication Technologies. He is the Editor/Reviewer of many National/International Journals of repute. Dr. Bhattacharya is the Series Editor of Modern Aspects of Computing, Devices and Communication Engineering, Chapman and Hall/CRC, Routledge, Taylor & Francis Group.



Mr. Asit Kumar Nayek received M.Tech from Jadavpur University, Kolkata, and B.Tech from West Bengal University of Technology (Now, MAKAUT, WB, India). He is qualified in NET and SET in Computer Science and Applications. He is pursuing his Ph.D. at Moulana Abul Kalam Azad University of Technology (erstwhile W.B. University of Technology), Haringhata, Kolkata, India. Presently, he is working as Assistant Professor in the department of Computer Science & Engineering (AI & ML) at Haldia Institute of Technology, India. He has over 13 years of teaching and 4 years of administrative experience in different organizations. He has authored few journals and book chapters. He successfully completed two sponsored projects that are related to IoT based device development and improvising predictive models in AI. His area of interests include computer hardware development, IoT design for different applications and Artificial Intelligence. He is a Senior Member, IEEE.



Dr. Sanchita Saha is an Assistant Professor in the Department of Computer Science and Engineering at Techno International New Town, Kolkata, India. She received her Ph.D. in Computer Science and Engineering from the Central Institute of Technology (CIT), Kokrajhar. Her research interests include Federated Learning, Artificial Intelligence, Information Security, Privacy-Preserving Machine Learning, and Internet of Things (IoT). She has published numerous research papers in reputed international journals with high impact factors, international conferences, and book chapters. She is a member of the Institution of Engineers (India).

