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AI Based Seizure Detection and Alert System using Biomedical Sensors

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ABSTRACT: pileptic seizures involve sudden involuntary movements that may endanger patients without timely assistance. This project proposes a wearable seizure detection and alert system based on motion analysis. A multi-axis accelerometer continuously captures body movement data, which is processed by an embedded microcontroller. Extracted motion features such as amplitude, frequency, and intensity are evaluated using an AI-based classification model to differentiate seizure activity from normal movements. When a seizure is detected, the system immediately sends alerts to caregivers and transmits real-time GPS location data for rapid intervention. The system is non-invasive, low-cost, energy-efficient, and suitable for continuous monitoring, improving patient safety and emergency response effectiveness.

KEYWORDS: Seizure Detection, Biomedical Sensors, AI in Healthcare, EEG Signal Processing, Wearable Devices, Machine Learning Algorithms, Real-time Alert System

I. INTRODUCTION

Epilepsy is a neurological disorder that affects millions of people worldwide and is characterized by recurrent seizures. Many seizure episodes occur unexpectedly, increasing the risk of injury and delayed medical assistance.

Continuous monitoring systems can significantly reduce these risks by enabling early detection and rapid response. earable technology offers a practical solution due to its portability, comfort, and real-time sensing capability. Motion-based seizure detection has gained attention because it is non-invasive and cost-effective.

By analyzing abnormal body movements using sensors and intelligent algorithms, reliable seizure identification can be achieved, improving patient safety, independence, and overall quality of life.

II. OBJECTIVES

The primary objective of this project is to design a wearable system capable of detecting epileptic seizures in real time. The system aims to continuously monitor body movements using an accelerometer and extract meaningful motion features.

Another objective is to apply an AI-based algorithm to accurately distinguish seizure activity from normal movements. The project also seeks to provide immediate alerts to caregivers or medical personnel upon seizure detection. Additionally, integrating GPS functionality enables rapid location tracking for emergency response. Overall, the objective is to develop a low-cost, reliable, energy-efficient, and user-friendly monitoring system that enhances patient safety and timely medical intervention.

III. LITERATURE REVIEW

Title: Wearable Detection Systems for Epileptic Seizure: A Review
Author(s): A. F. Alwindawi, O. N. UÇAN, A. H. Morad
Year: 2020
Description:
This paper reviews various wearable systems developed for epileptic seizure detection. It covers sensor types such as

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accelerometers, gyroscopes, and EMG, and analyzes their ability to detect different seizure types. The study highlights methods for data acquisition, feature extraction, and processing using algorithms for real-time monitoring. It emphasizes challenges such as sensor placement, battery efficiency, false alarms, and patient comfort. Overall, the paper provides a comprehensive overview of wearable seizure monitoring technologies, enabling researchers to identify gaps and develop more effective, low-cost, and non-invasive solutions for continuous epilepsy care.

IV. PROBLEM STATEMENT

Epileptic patients often experience sudden seizures without prior warning, making continuous supervision difficult.
In many cases, seizures go unnoticed, especially when patients are alone, leading to delayed medical assistance and severe health risks.
Conventional monitoring methods rely heavily on manual observation or hospital-based equipment, which are impractical for daily use.
The absence of real-time detection and alert mechanisms increases the chances of injury, panic, and complications.
There is a critical need for a portable, automated, and reliable system that can continuously monitor patients, accurately detect seizures, and instantly notify caregivers to ensure timely intervention and improved patient safety.

V. EXISTING SYSTEM

Epileptic patients often experience sudden seizures without prior warning, making continuous supervision difficult.
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There is a critical need for a portable, automated, and reliable system that can continuously monitor patients, accurately detect seizures, and instantly notify caregivers to ensure timely intervention and improved patient safety..

VI. PROPOSED SYSTEM

The proposed system introduces a wearable seizure detection and alert solution using motion sensing technology.
A multi-axis accelerometer continuously captures body movement data, which is processed by an embedded microcontroller.

Motion features are analyzed using an AI-based algorithm to accurately identify seizure patterns. Upon detection, the system automatically sends alerts to caregivers and medical personnel while transmitting the patient's GPS location for immediate assistance.

The wearable design ensures comfort, portability, and continuous monitoring. This system operates without invasive sensors, making it suitable for daily use.

Overall, the proposed approach enhances safety, reduces response time, and supports independent living.

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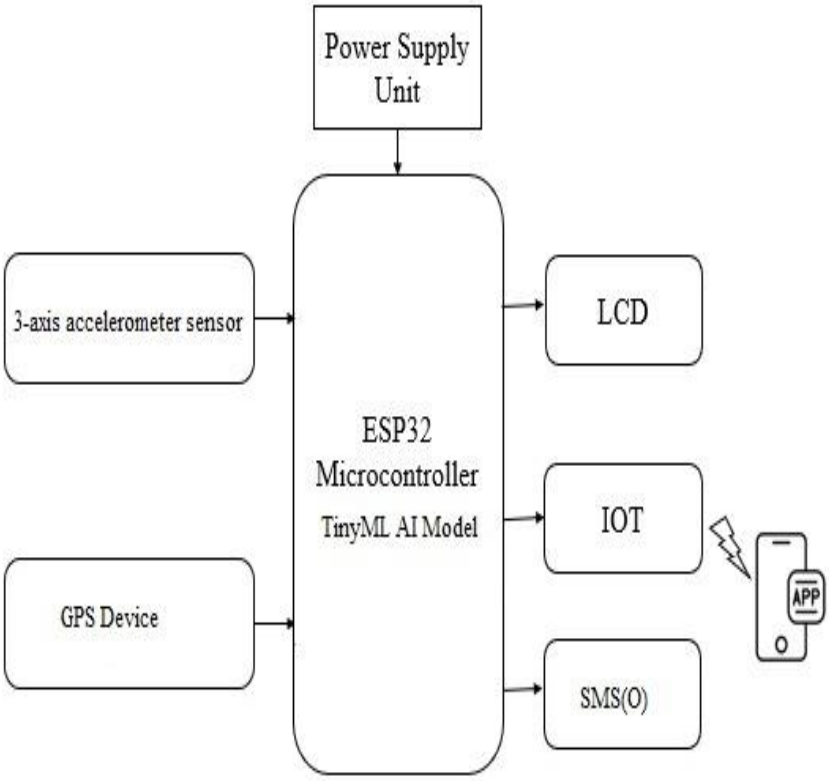
VII. BLOCK DIAGRAM

The overall working of the system can be represented using the following block diagram:



VIII. HARDWARE COMPONENTS

Power Supply Unit

The power supply unit delivers stable voltage to all components. It includes regulators and filters to ensure safe and efficient operation. The design is optimized for portability and energy efficiency.

ESP32 Microcontroller

The microcontroller acts as the brain of the system. It collects sensor data, processes signals, and manages communication between components. It supports multiple interfaces for easy integration.

Accelerometer sensor

An accelerometer sensor is a device that measures the acceleration and tilt of an object, primarily detecting changes in velocity and orientation. These sensors are widely used in various applications such as smartphones, fitness trackers, automotive systems, robotics, and industrial machinery

LCD

Liquid Crystal Display (LCD) technology has become an integral part of modern electronics, offering a reliable and efficient means of displaying information

GPS Module

GPS module is used to determine the real-time geographical location of the patient during seizure events

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IX. SOFTWARE REQUIREMENTS

The system is developed using ARDUINO IDE – Arduino Programming tools. The software handles data acquisition, signal processing, and wireless communication. Simulation tools can be used to verify system performance before implementation.

ARDUINO IDE – Arduino Programming
PROTEUS 8.13

X. CONCLUSION

The AI-based seizure detection system provides a reliable and real-time solution for monitoring epileptic patients. By combining wearable sensors, AI algorithms, and GPS alerts, it ensures quick detection and immediate assistance. Overall, it improves patient safety, reduces risks, and supports independent living.

REFERENCES

1. F. Alwindawi, O. N. UÇAN and A. H. Morad, "Wearable Detection Systems for Epileptic Seizure: A Review," Al-Khwarizmi Eng. J., vol. 16, no. 2, pp. 1–13, Jun. 2020, doi: 10.22153/kej.2020.03.001.
2. W. Li, G. Wang, X. Lei, D. Sheng, T. Yu and G. Wang, "Seizure detection based on wearable devices: A review of device, mechanism, and algorithm," Acta Neurol. Scand., vol. 146, no. 6, pp. 723–731, Dec. 2022, doi: 10.1111/ane.13716.
3. S. Aziz et al., "Wearable Artificial Intelligence for Epilepsy: Scoping Review," J. Med. Internet Res., vol. 27, p. e73593, Oct. 2025, doi: 10.2196/73593.
4. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor &Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
5. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2
6. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
7. S.Tamilselvi, R.Prakash, C.Nagarajan,"Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
8. S.Tamilselvi, R.Prakash, C.Nagarajan," Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epsr.2025.112428
9. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
10. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- *Acta Electrotechnica et Informatica Journal* , Vol.13 (2), pp.18-31,April-June.2013, DOI: 10.2478/aeei-2013-0025.
11. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- *Springer, Frontiers of Electrical and Electronic Engineering*, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
12. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- *Iranian Journal of Electrical & Electronic Engineering*, Vol.8 (3), pp.259-267, September 2012.
13. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007

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14. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: https://doi.org/10.1590/1517-7076-RMAT-2024-0721
15. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
16. 4. G. J. M. Pereira et al., "Tonic-clonic seizure detection using accelerometry-based wearable sensors: A prospective, video-EEG controlled study," Seizure, vol. 65, pp. 48–54, Feb. 2019, doi: 10.1016/j.seizure.2018.12.024.
17. X. Zhang *, X. Qiu, M. Z. Gao and J. Yang, "Seizure detection using the wristband accelerometer, gyroscope, and surface electromyogram signals based on in-hospital and out-of-hospital dataset," Seizure, vol. 127, pp. 127–134, Apr. 2025, doi: 10.1016/j.seizure.2025.03.016.
18. Kiran, A., Rubini, P., & Kumar, S. S. (2025). Comprehensive review of privacy, utility and fairness offered by synthetic data. *IEEE Access.*
19. Gopinathan, V. R. (2024). Real-Time Financial Risk Intelligence Using Secure-by-Design AI in SAP-Enabled Cloud Digital Banking. *International Journal of Computer Technology and Electronics Communication, 7(6), 9837-9845.*
20. Udayakumar, R., Elankavi, R., Vimal, R., & Sugumar, R. (2023). Improved Particle Swarm Optimization with Deep Learning-Based Municipal Solid Waste Management in Smart Cities. *Environmental & Social Management Journal, 17(4).*
21. Anand, L. (2023). An Intelligent AI and ML–Driven Cloud Security Framework for Financial Workflows and Wastewater Analytics. *International Journal of Humanities and Information Technology, 5(02), 87-94.*
22. Soundappan, S. J. (2020). Big Data Analytics in Healthcare: Applications for Pandemic Forecasting. *International Journal of Advanced Research in Computer Science & Technology, 3(1), 2248-2253.*
23. Rajasekar, M. (2024). Real-Time Predictive DevOps Intelligence for Risk-Aware Digital Business Processes in Cloud and SAP Ecosystems. *International Journal of Advanced Research in Computer Science & Technology, 7(4), 10713-10718.*
24. Poornima, G., & Anand, L. (2024, May). Novel AI Multimodal Approach for Combating Against Pulmonary Carcinoma. In 2024 5th International Conference for Emerging Technology (INCET) (pp. 1-6). IEEE.
25. Prabha, P. S., & Rengarajan, A. (2025). Adaptive Cloud Resource Allocation Using Attention-Driven Deep Reinforcement Learning. *Engineering, Technology & Applied Science Research, 15(6), 29334-29340.*
26. Jagadeesh, S., & Sugumar, R. (2017). A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences, 9(5), 243-248.*
27. Varma, K. K., & Anand, L. (2025, March). Deep Learning Driven Proactive Auto Scaler for High-Quality Cloud Services. In International Conference on Computing and Communication Systems for Industrial Applications (pp. 329-338). Singapore: Springer Nature Singapore.
28. Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS, 19(11), 3841-3855.
29. Poornima, G., & Anand, L. (2025). Medical image fusion model using CT and MRI images based on dual scale weighted fusion based residual attention network with encoder-decoder architecture. Biomedical Signal Processing and Control, 108, 107932.
30. Archana, R., & Anand, L. (2025). Residual u-net with Self-Attention based deep convolutional adaptive capsule network for liver cancer segmentation and classification. Biomedical Signal Processing and Control, 105, 107665.Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII Transactions on Internet and Information Systems, 19(11), 3841-3855.*
31. Rengarajan, A. (2025). Cloud-Based AI-Driven Threat Detection Framework for Smart Grid Cybersecurity. *International Journal of Future Innovative Science and Technology, 8(6), 16065.*
32. Murugeshwari, B., Sudharson, K., Panimalar, S. P., Shanmugapriya, M., & Abinaya, M. (2020). SAFE–Secure Authentication in Federated Environment using CEG Key code.
33. Raj A. A., & Sugumar, R. (2023). Early Detection of COVID-19 with Impact on Cardiovascular Complications using CNN Utilising Pre-Processed Chest X-Ray Images. *2023 International Conference on Applied Intelligence and Sustainable Computing (ICAISC), IEEE.*
34. Jagadeesh, S., & Sugumar, R. (2017). A Comparative study on Artificial Bee Colony with modified ABC algorithm. European Journal of Applied Sciences, 9(5), 243-248.

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35. Selvi, G. V., Anbarasan, A. B., Murthy, B. A., & Prabavathy, S. (2023). An Application Oriented Integrated Unequal Clustering Algorithm for Wireless Sensor Network. In *Underwater Vehicle Control and Communication Systems Based on Machine Learning Techniques* (pp. 140-154). CRC Press.
36. Sruthi, R. S., Ananya, S., & Murugeshwari, B. (2010). Web Based Virtual Control System Laboratory and On-Line Temperature Control of Electrophoresis Equipment using LabVIEW. *International Journal of Computer Applications, 975, 8887.*
37. Vimal Raja, G. (2021). Mining Customer Sentiments from Financial Feedback and Reviews using Data Mining Algorithms. *International Journal of Innovative Research in Computer and Communication Engineering, 9(12), 14705-14710.*
38. MATHEW, A. R. (2025). Neurosecurity and Brain-Computer Interfaces.
39. Soundappan, S. J. (2024). AI-Driven Customer Intelligence in Enterprise Lakehouse Systems Sentiment Mining Governance-Aware Analytics and Real-Time Data Synchronization. International Journal of Advanced Engineering Science and Information Technology (IJAESIT), 7(5), 14905.
40. Mathew, A. (2025). Human–AI Collaboration in Security Operations: Measuring Alert Trust, Automation Bias, and Analyst Upskilling in AI-Augmented SOC Environments. International Journal of Computer Technology and Electronics Communication, 8(5), 11375-11380.
41. Soundappan, S. J. (2022). AI-Based Fault Detection and Isolation for Reliability in Modern Power Systems. International Journal of Research Publications in Engineering, Technology and Management (IJRPETM), 5(4), 7106-7110.
42. Poornima, G., & Anand, L. (2024, April). Effective Machine Learning Methods for the Detection of Pulmonary Carcinoma. In 2024 Ninth International Conference on Science Technology Engineering and Mathematics (ICONSTEM) (pp. 1-7). IEEE.Garg, V. K., Soundappan, S. J., & Kaur, E. M. (2020). Enhancement in intrusion detection system for WLAN using genetic algorithms. *South Asian Research Journal of Engineering and Technology, 2(6), 62–64.*
43. Rengarajan, A., Jayakumar, C., & Sugumar, R. (2012). Optimization Of Recent Attacks Using Internet Protocol. National Journal of System and Information Technology, 5(1), 8.
44. Mathew, A. (2024). AI TRiSM: Trust, Risk, and Security Management in Cybersecurity. Cybersecurity, 4(3), 84-90.
45. Mathew, A. (2025). Deep seek vs. ChatGPT: A deep dive into AI Language mastery. Int J Multidisciplinary Res, 7(1), 1-5.