JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STRESS CLASSIFICATION AND VITAL SIGNS FORECASTING FOR IOT HEALTH MONITORING

[1]Sanjay C, [2]Vishnupriyan S, [3]Yogesh P, [4]Vijayakumar D

[123]Final year Engineering Students, [4]Assisstant Professor,
[1234]Department of Biomedical Engineering,
[1234]Mahendra Institute of Technology, Namakkal, Tamil Nadu, India

Abstract: The integration of IoT in healthcare has paved the way for real-time patient monitoring, offering both predictive and diagnostic advantages. This project proposes a health monitoring system designed to detect stress and forecast vital signs using wearable sensors and machine learning models. By capturing physiological data and processing it through cloud-based analytics, the system empowers proactive healthcare management. Beyond traditional health assessments, this model focuses on non-invasive data collection and intelligent interpretation. Stress classification is handled using machine learning classifiers, while time-series models like LSTM forecast health anomalies. This two-pronged approach makes the system suitable for early detection and remote patient care, especially in areas with limited medical access.

IndexTerms - IoT, Stress Detection, Wearable Sensors, Machine Learning, LSTM, Vital Signs Forecasting, Biomedical Signals, Real-Time Monitoring.

I. Introduction

Modern healthcare faces challenges in detecting chronic stress and monitoring health in real-time. The introduction of IoT devices into the biomedical space allows for continuous health tracking, which is vital in reducing emergency incidents and enhancing preventive care. This project addresses the limitations of traditional monitoring systems by providing a wearable, data-driven solution. With the use of non-intrusive sensors and cloud connectivity, the proposed system ensures not just convenience, but also timely intervention based on live data. The rise in stress-related disorders underscores the significance of such innovations in daily health management.

II. Abbreviations and Acronyms

- **ESP32** – Embedded Serial Peripheral 32-bit Microcontroller
- **LCD** – Liquid Crystal Display
- **GUI** – Graphical User Interface
- **NFC** – Near Field Communication
- **HTTP** – Hypertext Transfer Protocol
- **SSL** – Secure Sockets Layer

III. Data and Sources of Data

The system uses physiological signals such as heart rate, oxygen saturation, temperature, and sweat to assess the user's health. These data points are captured in real-time using wearable sensors, ensuring continuous monitoring without the need for medical supervision. The strength of this approach lies in its adaptability to real-world conditions. Unlike lab-based diagnostics, this model captures and evaluates health metrics dynamically, making it ideal for users in remote, high-stress, or aging populations. The integrity and accuracy of data sources are critical for reliable machine learning output.

IV. Theoretical framework

At the heart of this project is a blend of embedded systems, cloud computing, and AI. The theoretical base combines signal processing with algorithms such as SVM, Random Forest, and LSTM, which work collectively to detect stress patterns and predict future health issues. This layered framework enables dual functionality: classification and prediction. By grounding the system in proven AI methodologies, the project ensures scalability and reliability. Moreover, it bridges clinical knowledge with real-time computing, a step forward in personalized healthcare.

V. RESEARCH METHODOLOGY

The methodology begins with identifying the shortcomings of existing health monitoring systems. It then outlines the development of an improved IoT-based solution, which incorporates sensor integration, data collection, cloud processing, and predictive analytics. Subsections such as the proposed system, block diagram, and advantages detail each design decision and its technical rationale. The methodology showcases a systematic transition from concept to working prototype, emphasizing iterative development and data-driven decision-making.

VI. SYSTEM DESIGN

The design centers around the ESP32 microcontroller, which serves as the data collection and transmission unit. The sensors are interfaced with this module and continuously relay data to a cloud platform for real-time monitoring and alert generation. The architecture is modular and efficient, allowing for easy deployment and customization. The block diagram represents the system's logical flow—from sensing and processing to feedback—demonstrating how multiple components work cohesively for optimal performance.

VII. HARDWARE COMPONENTS

The system includes an ESP32 microcontroller, heart rate and temperature sensors, an LCD for display, and a buzzer for alerts. These components are chosen for their affordability, portability, and compatibility with low-power operation—ideal for wearable medical applications. The synergy between hardware modules ensures robust data capture and user interaction. For example, the buzzer alerts caregivers when stress levels exceed normal thresholds, while the LCD shows real-time vital readings. This enhances both patient awareness and intervention speed.

VIII. SOFTWARE DESCRIPTION

Software implementation is done using Arduino IDE and Embedded C for the hardware interface, while cloud connectivity and visualization use platforms like Blynk IoT. The software layer bridges the gap between raw data and actionable health insights. Machine learning algorithms are embedded in the cloud environment for classification and prediction. These models analyze physiological trends and trigger alerts. This separation of concerns—hardware logic on the edge and analytics in the cloud—makes the system scalable and future-ready.

IX. RESULTS AND DISCUSSION

Although explicit experimental results are not detailed, the system's architecture implies several expected outcomes: accurate stress classification, early detection of anomalies, and timely alerts. These outcomes contribute to improved health management and reduced medical emergencies. The discussion would ideally focus on the advantages observed during trials, such as reliability, portability, and user-friendliness. It should also consider the scope of improvement, including model accuracy and multi-sensor data fusion, for future iterations.

X. ACKNOWLEDGEMENT

Every innovation relies on collective effort. This project recognizes the support of academic guides, institutional infrastructure, and peer collaboration, all of which were crucial in shaping its execution and refinement. Special thanks should also be extended to the technical staff who assisted with sensor calibration, circuit integration, and testing, ensuring that theoretical plans translated into a functional prototype.

XI. REFERENCES

[1] Abraham G. Taye et al., 'Design of an AI-Enhanced Digital Stethoscope: Advancing Cardiovascular Diagnostics Through Smart Auscultation', arXiv, 2024.

[2] Nafiul Rashid et al., 'Stress Detection using Context-Aware Sensor Fusion from Wearable Devices', arXiv, 2023.

[3] Gideon Vos et al., 'Generalizable Machine Learning for Stress Monitoring from Wearable Devices: A Systematic Literature Review', arXiv, 2022.

[4] D. D. Kadam Patil et al., 'Design of Wireless Electronic Stethoscope Based on Zigbee', arXiv, 2012.