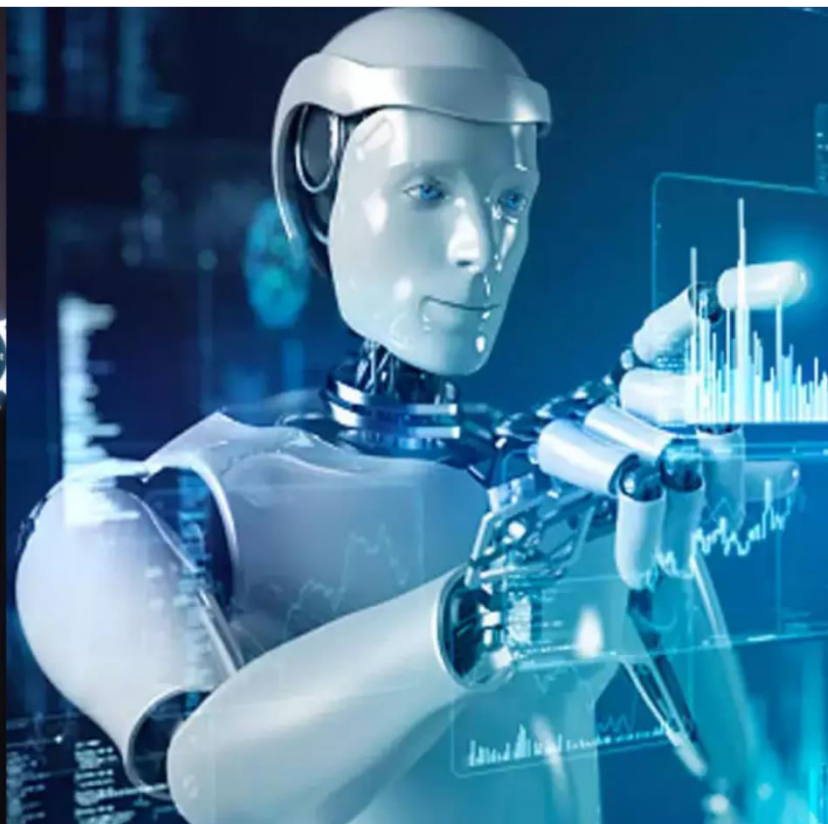




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Early Heart Attack Detection using AI and IoT

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ABSTRACT: This project proposes an IoT-based early heart attack detection system using ECG, SpO₂, and temperature sensors connected to an ESP32 microcontroller. The system continuously monitors vital cardiac parameters, processes the sensor data, and compares readings with standard health thresholds. If any abnormality is detected, an alert is instantly sent via Wi-Fi or Bluetooth to a mobile device or cloud platform, allowing real-time medical intervention. By integrating AI and IoT technologies, the system provides low-cost, portable, and continuous health monitoring, ensuring timely detection of potential heart attacks and enhancing preventive healthcare.

KEYWORDS: ECG, SpO₂, temperature sensor, ESP32, IoT, real-time monitoring, early heart attack detection, AI.

I. INTRODUCTION

Cardiovascular diseases, especially heart attacks, are a leading cause of mortality worldwide. Early detection of abnormal cardiac conditions can save lives by enabling timely intervention. The proposed project, “*Early Heart Attack Detection Using AI and IoT*”, focuses on real-time monitoring of vital body parameters such as ECG signals, pulse rate, oxygen saturation, and body temperature. Using an ESP32 microcontroller integrated with IoT technology, the system continuously processes physiological data and sends instant alerts during abnormal readings. By providing immediate notifications, the system aims to prevent severe cardiac emergencies and improve overall patient safety.

II. LITERATURE SURVEY

Recent research highlights the importance of continuous cardiac monitoring and the use of AI for predictive healthcare. Merino-Monge et al. [1] developed an ECG and PPG-based heartbeat detection system using wavelet transforms, demonstrating the feasibility of early arrhythmia detection. Qananwah et al. [2] focused on cardiac arrhythmia detection via photoplethysmography, confirming the effectiveness of non-invasive monitoring techniques. Rincón et al. [3] proposed an IoT and fog computing-based system with automatic ECG classification using deep neural networks, showing how cloud-integrated monitoring can improve cardiac patient care. Angel Nancy et al. [4] enhanced cardiovascular disease prediction using modified GRU models, highlighting the role of AI in early detection. Liu et al. [5] emphasized the predictive potential of machine learning models for cardiac arrest warning systems, proving that AI can complement real-time sensor monitoring.

The project is divided into two phases: data acquisition and processing, followed by alert generation and cloud visualization. In the first phase, ECG, SpO₂, and temperature sensors collect real-time physiological data, which is processed by the ESP32 microcontroller. Abnormal readings are immediately detected by comparing with preset medical thresholds. In the second phase, alerts are sent to the user and caregivers via IoT connectivity, while all data is visualized on a mobile application and stored in the cloud for further analysis. This approach ensures continuous monitoring, timely intervention, and improved cardiac care.

III. METHODOLOGY

The system consists of multiple integrated modules. First, the **Sensor Data Acquisition Module** collects real-time data from ECG, SpO₂, and temperature sensors. Next, the **Signal Processing Module** filters noise and analyzes readings to detect abnormalities. The **IoT Communication Module** transmits processed data wirelessly to a cloud server or mobile application. The **Alert Module** instantly notifies users and caregivers when abnormal readings occur. Data is visualized through the **Data Storage and Visualization Module**, enabling long-term health tracking. Power efficiency is ensured

by the **Power Management Module**, which controls battery usage and activates sleep modes when idle. A data flow diagram shows the end-to-end process, from sensor input to cloud storage, mobile display, and doctor notifications.

IV. EXPERIMENTAL RESULTS

The proposed system was tested for reliability, responsiveness, and real-time monitoring capability. ECG sensors accurately detected arrhythmia and ST-segment variations, while SpO₂ sensors identified oxygen drops indicative of cardiac stress. Temperature sensors successfully tracked variations associated with heart conditions. Alerts were sent immediately to the mobile application and cloud platform upon detection of abnormal readings. Data visualization on the mobile app provided a clear overview of cardiac health, and cloud storage allowed long-term analysis. The integration of AI and IoT ensured precise monitoring, rapid alerts, and continuous preventive healthcare, demonstrating that the system is reliable, portable, and cost-effective.

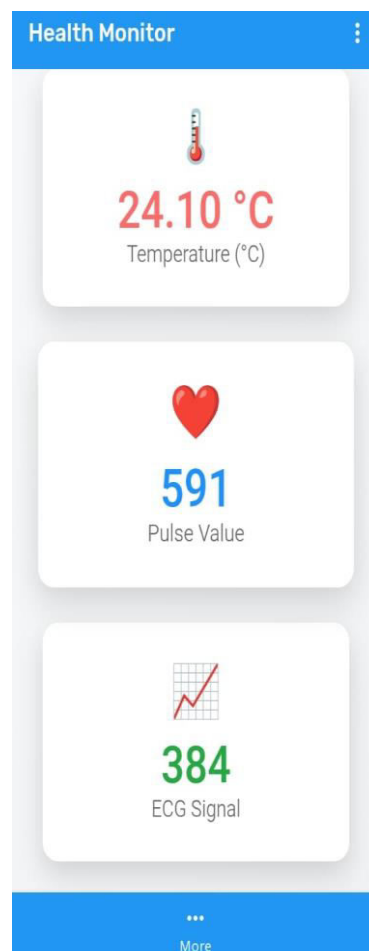


Fig.1. Integrated Physiological Sensing Module for Early Cardiac Anomaly Detection

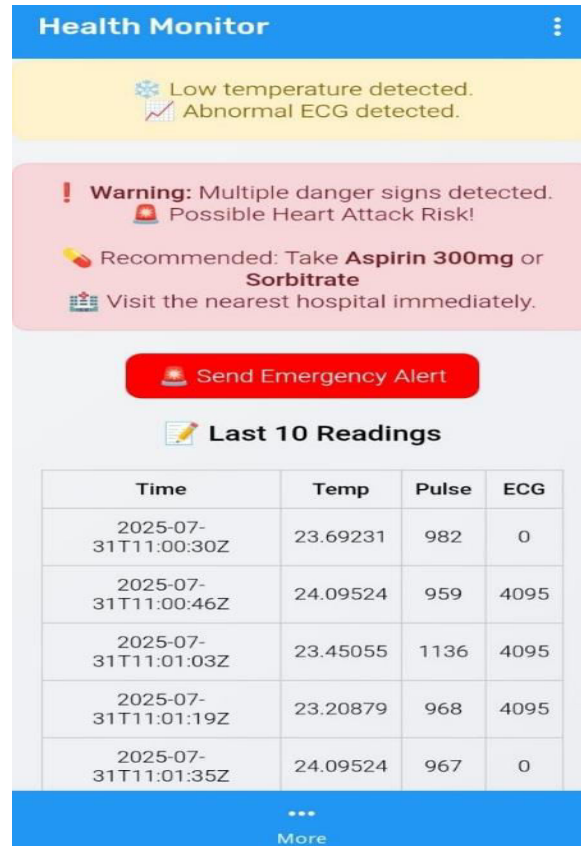


Fig.2. Real-Time Heart Rate Trend Visualization

V. CONCLUSION

This project demonstrates a compact and real-time system for early heart attack detection using ECG, SpO₂, and temperature sensors connected to an ESP32 microcontroller. By continuously monitoring vital parameters and integrating IoT connectivity, the system detects abnormal cardiac readings and instantly alerts users and caregivers. This approach enhances preventive healthcare, reduces the risk of severe cardiac events, and provides cost-effective, portable, and energy-efficient monitoring. The project illustrates the potential of AI and IoT to revolutionize early detection and rapid response in cardiac healthcare.

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