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An Iot-Enabled Wearable Framework For Remotely Continuous Health Monitoring Of Homestay Elderly Patients From Hospital

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Abstract: Health is a critical aspect of human life, and continuous health monitoring becomes especially important for aged patients who are more vulnerable to chronic illnesses and sudden medical emergencies. Traditional health assessments are often periodic and insufficient to detect real-time variations in a patient's condition. Bringing aged patients oftenly to the hospital for regular health check up and follow up is a hectic and sometimes difficulty due to incapability of aged people. It not only consumes time but also aged patient gets tired. To address this gap, a low-power Internet of Things (IoT) framework is developed for remote health state analysis and emergency localization of elderly individuals, Where the health condition is monitored in the patient's home from the hospital. The patient is treated immediately during any irregularity occurs in health conditions by refering Patient health history recorded for further treatment. The system integrates wearable sensors to measure vital parameters such as body temperature, heart rate, blood pressure, and surrounding gas levels. A Global Positioning System (GPS) module is incorporated to track the patient's location in case of emergencies. All collected data are transmitted through IoT and stored in a cloud server for real-time access by family doctors, enabling timely intervention. The proposed framework enhances patient safety, reduces response delays, and provides a scalable solution for elderly healthcare monitoring.

Index Terms – IoT, Elderly Care, Health Monitoring, Low-Power Wearable System, Remote Patient Surveillance, Emergency Localization, Cloud Computing.

I. Introduction

Health is one of the most valuable aspects of human life, and maintaining it becomes increasingly critical with advancing age. Elderly patients are more vulnerable to chronic illnesses, including cardiovascular disorders, hypertension, diabetes, and respiratory complications. In addition to these long-term health issues, sudden medical emergencies such as strokes, cardiac arrest, or falls may occur unexpectedly. In such circumstances, continuous health monitoring and immediate access to medical assistance can make the difference between life and death. Conventional healthcare systems, however, are limited in this regard because they depend largely on periodic hospital check-ups or manual monitoring, which cannot capture real-time changes in a patient's physiological state. This limitation highlights the urgent need for an advanced, efficient, and scalable solution capable of continuous remote monitoring.Recent developments in the Internet of Things (IoT) and wearable electronics have opened new possibilities in healthcare technology. IoT-enabled frameworks make it possible to continuously track patient health without requiring human intervention. Wearable sensors integrated into compact, low-power embedded systems can measure key parameters such as body temperature, heart rate, blood pressure, and exposure to harmful environmental gases. By analyzing these measurements in real time, abnormalities in the patient's health can be quickly detected. Additionally, the integration of the Global Positioning System (GPS) allows continuous location tracking, enabling caregivers or family doctors to immediately locate a patient in distress, especially in outdoor environments.The integration of IoT with cloud computing enhances the capability of healthcare monitoring systems. Data collected from sensors can be transmitted wirelessly to a secure cloud platform, where it is stored for real-time access and long-term analysis.

II. RELATED WORKS

Article[1] 'Remote Healthcare for Elderly People Using Wearables' by J. O. Olmedo-Aguirre et al. in 2022: This review surveys wearable technologies targeted at elderly care, enumerating sensors (PPG, ECG, accelerometers, temperature), communication options, and system architectures. The paper discusses usability and adoption barriers for older adults, such as comfort, battery life, and ease of use, and highlights the role of continuous monitoring for fall detection and activity recognition. Privacy and data security concerns are analyzed, especially for long-term home deployment where sensitive health data are streamed to remote platforms. The review also covers validation studies and the lack of standardized clinical validation for many consumer wearables.

Article[2]'IoT-Based Healthcare-Monitoring System towards Improving Quality of Life' by S. Abdulmalek et al. in 2022: This article presents an IoT prototype and survey of state-of-the-art IoT healthcare monitoring systems, explaining design tradeoffs between edge processing and cloud analytics. The authors describe common sensor suites (heart rate, SpO_2, blood pressure, temperature), microcontroller platforms (Arduino/ESP32 families), and network transports (Wi-Fi, LoRa, NB-IoT). Power management strategies such as duty cycling, event-driven sampling and low-power sleep modes are compared to show how battery life can be maximized in wearable devices.

Article[3]'In-Home Positioning for Remote Home Health Monitoring in Older Adults' by A. Chan et al. in 2024: The study evaluates indoor localization techniques (BLE beacons, Wi-Fi RTT, UWB, sensor fusion) for clinical remote monitoring of older adults living independently. Experimental results compare localization accuracy, power consumption, and deployment complexity in real homes, showing UWB yields highest spatial precision while BLE/Wi-Fi options provide lower cost with coarser granularity. The authors investigate clinical utility by mapping in-home movement patterns to health outcomes (mobility decline, fall risk) and find that room-level detection combined with activity recognition improves clinical sensitivity.

Article[4]'Wearable Technologies for Healthy Ageing' by S. Canali et al. in 2024: This review examines the landscape of wearable devices designed to promote healthy ageing and support clinical care of elderly populations. It synthesizes evidence on sensing modalities (inertial sensors for gait/falls, PPG/ECG for cardiac monitoring, respiratory and temperature sensors) and discusses clinical endpoints measurable via wearables (fall detection, frailty markers, arrhythmia screening). The authors address engineering challenges such as miniaturization, skin-contact reliability, and robust algorithms for noisy ambulatory signals.

Article[5]'Recent Advances in Wearable Healthcare Devices' by X. Luo et al. in 2024: This paper provides a technical survey of recent material, fabrication, and algorithmic advances enabling next-generation wearable health systems. Topics include flexible/stretchable sensors, low-power analog front ends, energy harvesting strategies, and compressed sensing for data reduction. The review showcases improved signal-processing pipelines for physiological signals (artifact removal in PPG and long-term ECG), on-device inference models for anomaly detection, and connectivity stacks optimized for intermittent networks.

Article[6]'Remote Patient Monitoring Using Artificial Intelligence: Current State, Applications and Challenges' by T. Shaik et al. in 2022: This advanced review surveys AI's role in remote patient monitoring (RPM), covering signal pre-processing, feature extraction, and predictive modeling for deterioration detection. Applications include cardiovascular monitoring, respiratory disease tracking, and post-discharge surveillance. The paper analyzes clinical studies where AI models embedded in RPM reduced readmissions or provided early alerts, and it critically discusses biases, generalization, and data quality issues.

Article[7]'IoT-Based Remote Monitoring System: A New Era for Patient Care' by M. M. Hossain in 2024: This article outlines architectures for IoT remote monitoring systems emphasizing modularity between sensing, edge aggregation, and cloud analytics. Design patterns for resilience—local buffering for intermittent connectivity, priority messaging for emergencies, and adaptive sampling for power saving—are described.

III. Problem Statement

The increasing life expectancy of the global population has led to a rapid rise in the number of elderly individuals requiring continuous healthcare support. Old aged patients are more vulnerable to chronic illnesses, sudden health deterioration, and mobility limitations, which make it difficult for family doctors and caregivers to monitor their condition effectively. Traditional healthcare systems rely heavily on hospital visits or manual supervision, which are often impractical, time-consuming, and costly. Moreover, delays in detecting critical health changes may result in life-threatening situations, especially when patients live alone or in remote locations. Current monitoring methods also lack effective real-time communication and precise location tracking, limiting emergency response efficiency. Hence, there is a critical need for an IoT-enabled system that ensures timely monitoring, instant alerts, and accurate localization for aged patients.

IV. OBJECTIVES

The primary objective of this study is to design and develop an efficient IoT-based framework that continuously monitors the vital health parameters of aged patients and transmits the collected data in real time to their family doctors for clinical assessment. The system aims to integrate wearable sensors for measuring critical indicators such as body temperature, heart rate, and environmental conditions, ensuring accurate analysis of patient health status. Another key objective is to incorporate a GPS-enabled localization mechanism that helps in identifying the exact position of patients during emergencies, thereby reducing response time for medical intervention. Additionally, the study focuses on ensuring data storage in a secure cloud platform for easy accessibility and future reference.

V. SYSTEM ARCHITECTURE

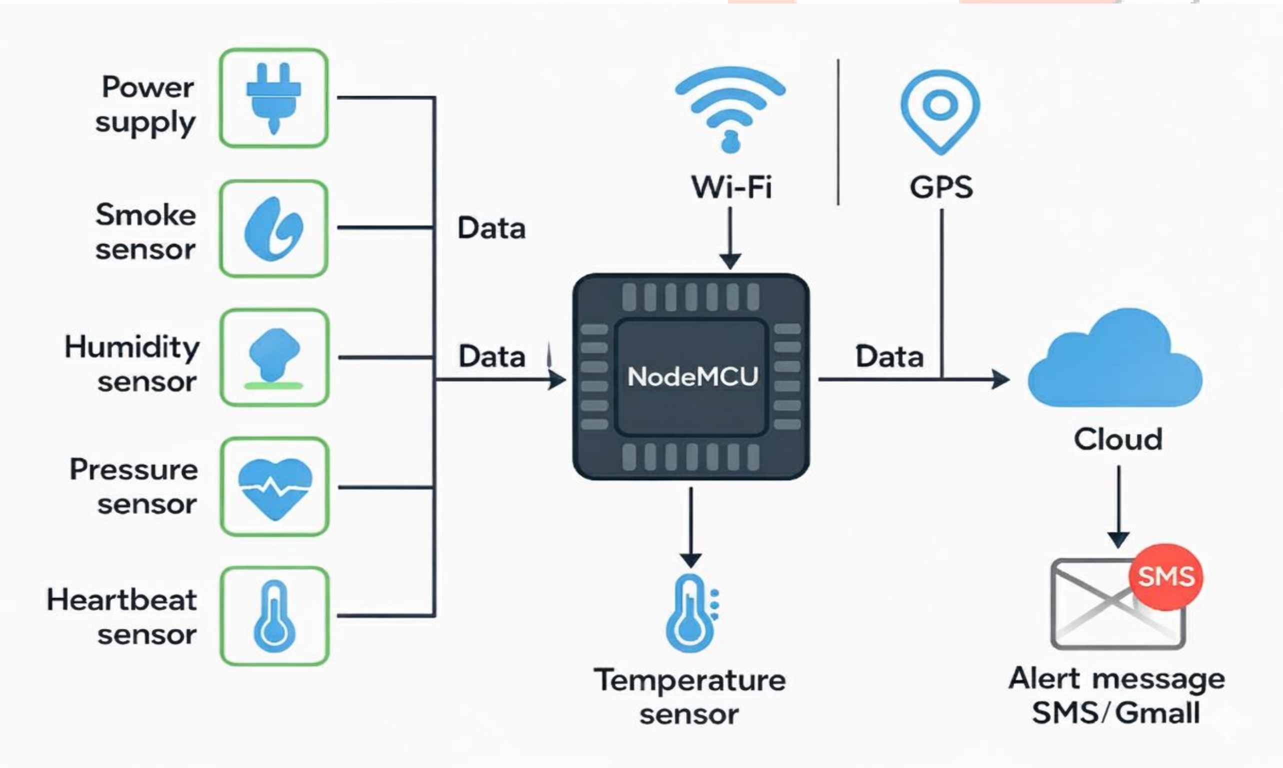

Fig 1:System Architecture

From Figure 1 illustrates the system architecture of the proposed IoT-based health monitoring framework designed for aged patients. The architecture integrates multiple sensors connected to a NodeMCU microcontroller, which serves as the central processing unit. The power supply ensures uninterrupted operation of the system, while a set of sensors continuously monitors vital and environmental parameters. The smoke sensor detects the presence of harmful gases, the humidity sensor measures surrounding humidity levels, and the pressure sensor captures pressure variations that could impact patient health. Additionally, a heartbeat sensor is employed to track pulse rate, and a temperature sensor records body temperature. These collected data values are transmitted to the NodeMCU for processing. The NodeMCU is equipped with Wi-Fi capability, allowing real-time transmission of information to cloud storage. Simultaneously, a GPS module is integrated to capture the exact location of the patient, ensuring rapid localization during emergencies. The cloud platform securely stores all monitored data, enabling family doctors and caregivers to remotely access and review patient health status. Furthermore, the system is configured to generate automated alert messages via SMS or email whenever abnormal health conditions are detected, thereby ensuring immediate intervention. This architecture emphasizes continuous monitoring, real-time reporting, and reliable communication, making it highly suitable for supporting aged patients in maintaining safety and timely healthcare assistance.

VI. EXPERIMENTAL RESULTS

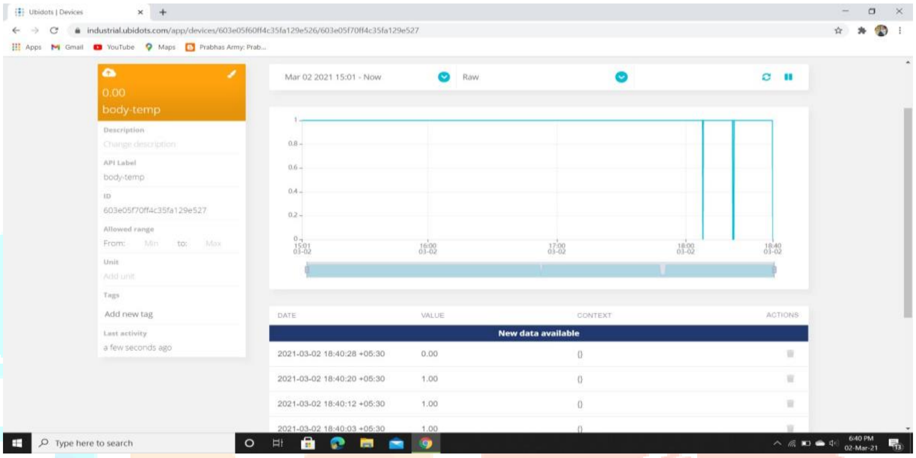

Fig 2:Graphical Representation of Body-Temperature

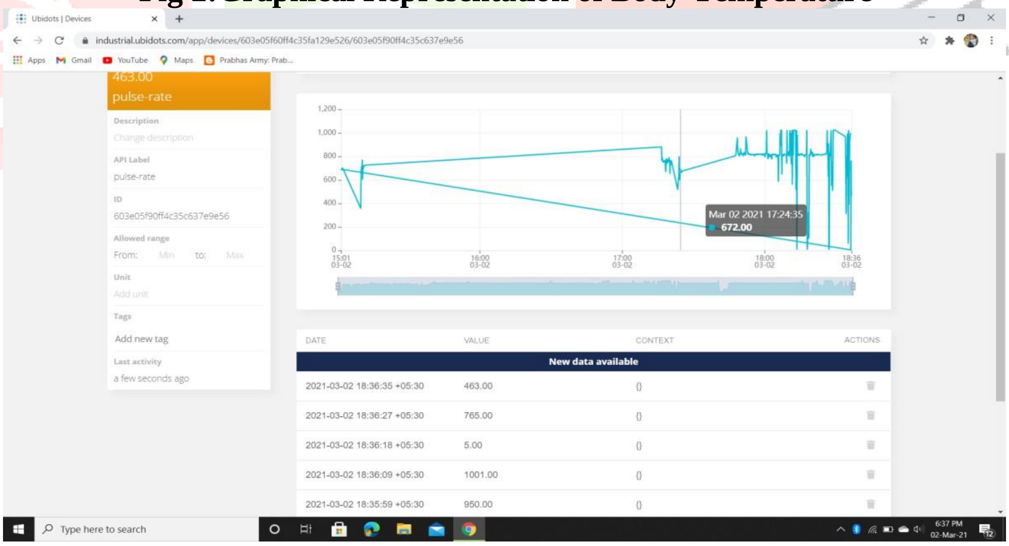

Fig 2:Graphical Representation of Pulse

VII. CONCLUSION

In this research, an IoT-based framework for continuous health monitoring and emergency localization of aged patients was successfully developed, addressing the limitations of conventional healthcare systems that rely heavily on manual supervision and hospital visits. By integrating sensors such as temperature, heartbeat, pressure, humidity, and smoke detectors with the NodeMCU microcontroller, the system ensured real-time collection of vital and environmental parameters. These data were transmitted through Wi-Fi to a secure cloud platform, while GPS functionality enabled accurate localization of patients during emergencies. Automated alerts via SMS and email were incorporated to notify family doctors or caregivers of abnormal conditions, thereby reducing response time and enhancing patient safety. The methodology emphasized low-power operation, real-time monitoring, and cloud-based data storage, ensuring reliability and scalability. Tools developed within the system included sensor integration modules, cloud communication interfaces, and an automated alerting mechanism, all of which contributed to improving patient care. Compared to existing systems limited by short-range communication and lack of comprehensive monitoring, this framework demonstrated superior efficiency, wider coverage, and better integration with healthcare services. The findings highlight the system's potential to minimize health risks, reduce emergency delays, and improve the overall quality of life for elderly patients, making it a valuable advancement in digital healthcare solutions.

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