International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Smart Health Monitoring and Anomaly Detection Using Internet of Things (IOT)

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***Abstract*— Smart health monitoring systems, driven by IoT technology, are revolutionizing healthcare by enabling continuous and real-time monitoring of patients. In a country like India, where inadequate health supervision accounts for a significant number of premature deaths, this solution offers a timely and essential intervention. Specifically designed for elderly care, the system utilizes advanced tools to monitor vital parameters such as heart rate and body temperature, instantly notifying caregivers and healthcare providers when irregularities are detected. This real-time alert mechanism not only improves the quality and speed of medical response but also promotes preventive care through early intervention. With its intuitive design and comprehensive functionality, the system plays a vital role in enhancing healthcare outcomes for the elderly.**

I. INTRODUCTION

In the modern era of rapid technological advancement, healthcare systems are increasingly adopting innovative tools to enhance patient care. In India, where insufficient health monitoring plays a major role in premature mortality, there is a pressing demand for effective solutions. Addressing this challenge, a smart health monitoring system utilizing IoT technology has been developed to offer continuous and real-time tracking of elderly patients' vital health parameters. Tailored specifically for the elderly, the system efficiently monitors key indicators such as heart rate and body temperature, issuing instant alerts to caregivers and medical staff when any irregularities arise. By emphasizing proactive and preventive care, this solution not only accelerates response times but also facilitates timely medical interventions, thereby improving both the quality of healthcare services and the overall well-being of senior individuals.

II. LITERATURE SURVEY

Much of the research and work has been done In the field of SMART HEALTH MONITORING AND ANOMALY DETECTION USING INTERNET OF THINGS (IOT)

M. Al-Fuqaha, M. Guizani, S. A. A. K. Al-Omari (2019) – "Smart Healthcare Systems for Elderly: Opportunities and Challenges" This study examines how smart healthcare systems can benefit the elderly by utilizing IoT technologies such as wearable devices and sensors. The authors emphasize that continuous monitoring of vital signs through these tools can significantly improve health management for older adults. They also highlight the importance of designing systems that are easy to use and responsive in real time, enabling both elderly individuals and their caregivers to better handle health-related challenges.

S. Kumar, R. Sharma, P. Patel (2020) – "A Review on IoT-based Health Monitoring Systems for Elderly Care"

This review focuses on various IoT-based systems developed specifically for elderly healthcare. The authors discuss the challenges posed by chronic illnesses in aging populations and how IoT technologies can aid in more precise monitoring and timely medical interventions. The study also covers the use of wearable sensors and

automated alert systems that inform caregivers or medical staff during critical health events, thereby enhancing the safety and well-being of elderly individuals.

A. B. Lee, J. M. P. He (2021) – "Internet of Things (IoT) for Elderly Healthcare" Lee and He present a systematic review of IoT applications in elderly healthcare, concentrating on remote monitoring tools, emergency response systems, and personalized treatment options. The paper underscores the advantages of minimizing hospital visits and ensuring continuous tracking of health metrics through real-time data. It also brings attention to key barriers such as privacy concerns, security issues, and difficulties with integrating various IoT systems effectively.

S. G. Miller, J. B. Thompson, N. R. S. Sanders (2021) – "Telemedicine and Remote Patient Monitoring for Elderly"

This literature review explores the use of telemedicine and remote patient monitoring (RPM) technologies in elderly healthcare. The authors highlight how home-based systems and wearable devices help in collecting essential health data remotely, particularly in rural and underserved regions. The study evaluates the effectiveness of these technologies in managing chronic conditions and emphasizes the growing importance of remote care in modern healthcare strategies.

P. R. K. V. Sharma, R. G. Williams, T. D. Paul (2022) – "IoT-based Health Monitoring System for Elderly People"

This paper introduces a health monitoring system built with IoT capabilities tailored for elderly users. The system is designed to track various health indicators such as heart rate, temperature, blood pressure, and physical activity. The data collected is transmitted to caregivers via a mobile application, allowing for real-time oversight. The authors emphasize that timely alerts and interventions enabled by this system can help prevent medical emergencies and improve elderly health outcomes.

III. EXISTING SYSTEM

Traditional health monitoring methods usually depend on routine medical visits and stationary equipment found in clinics or hospitals. These approaches often lack real-time tracking capabilities, which can result in delayed detection of unusual health conditions.

IV. PROPOSED SYSTEM

The developed system leverages IoT technology to enable continuous, real-time tracking of essential health indicators like heart rate. It is designed to identify irregularities automatically and notify healthcare providers or caregivers immediately, allowing for swift medical response.

V. METHODOLOGY

The system is developed using IoT-based hardware and software components to monitor essential health metrics like heart rate and body temperature in real time. It integrates sensors—such as pulse and temperature sensors—connected to a microcontroller. The data collected is displayed on an OLED screen and monitored through an Arduino-based platform programmed using Embedded C. When the system identifies abnormal readings, it activates a buzzer to signal an alert. This methodology ensures continuous tracking and immediate notification, improving response time in critical situations.

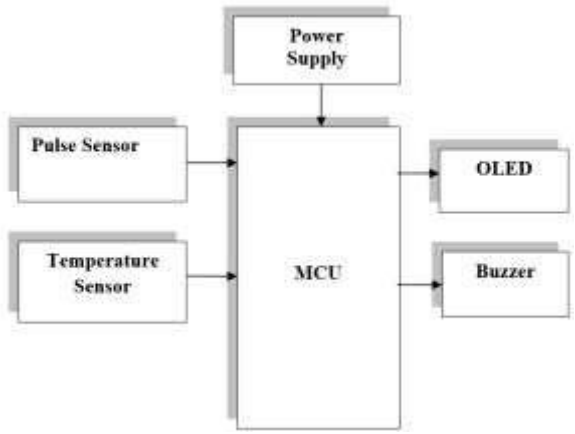


FIG 1 Block diagram of Smart health monitoring and anomaly detection using internet of things

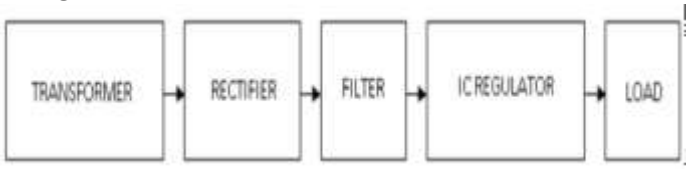
Applications

This IoT-based smart health monitoring system can be effectively applied in various healthcare settings, particularly for elderly and chronically ill patients who require continuous supervision. It is ideal for use in home healthcare, allowing family members or caregivers to track vital signs remotely and respond swiftly to health anomalies. The system can also be deployed in hospitals and assisted living facilities to enhance patient monitoring efficiency and reduce the burden on medical staff. Additionally, it holds potential in rural and remote areas where access to immediate healthcare is limited, providing timely alerts and improving the chances of early intervention during emergencies.

VI. HARDWARE DETAILS POWER SUPPLY

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.



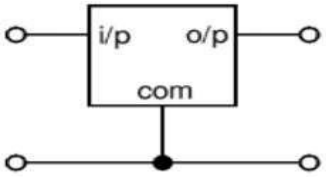
Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.

Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in India) to a safer low voltage.

Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts totens of watts.



MICROCONTROLLER

The Raspberry Pi foundation changed single-board computing when they released the Raspberry Pi computer, now they're ready to do the same for microcontrollers with the release of the brand-new Raspberry Pi Pico. This low-cost microcontroller board features a powerful new chip, the RP2040, and all the fixin's to get started with embedded electronics projects at a stress-free price.

OLED (Organic Light Emitting Diodes)

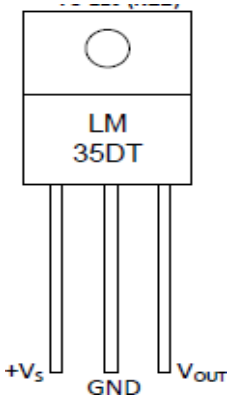
OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight).

PULSE SENSOR

The pulse sensor is a compact, low-power device designed to measure heart rate by detecting changes in light absorption due to blood flow through the skin. It uses a green LED to illuminate the skin and a photodetector to measure the reflected light, with variations indicating heartbeats. The sensor operates on 3.3 to 5V and consumes less than 4mA of current. It includes an operational amplifier and filtering components to clean and amplify the signal, making it suitable for use with microcontrollers like Arduino. Its small form factor allows it to be clipped onto a fingertip or earlobe, and it comes equipped with a three-wire interface for easy integration into wearable andhealth-monitoring applications.

TEMPERATURE SENSOR

The temperature sensor, commonly represented by models like the LM35 or LM34, is an essential component in monitoring systems that translates temperature variations into corresponding electrical signals. These sensors are known for their accuracy and linear output, typically providing 10 millivolts per degree Celsius or Fahrenheit. Operating within a wide range of temperatures, they are ideal for remote and embedded applications. The LM35, for instance, offers reliable Celsius readings without needing external calibration and can be easily integrated into circuits due to its low power consumption and straightforward three-pin configuration (Vcc, Ground, and Output). Its output is directly proportional to temperature, making it suitable for real-time data acquisition in various industrial and medical settings.



BUZZER

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, house hold appliances such as a microwave oven, or game shows.

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed,

and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

VI. SOFTWARE DETAILS

The software aspect of the system primarily utilizes MicroPython, a lightweight version of Python 3 tailored for microcontrollers like the Raspberry Pi Pico. It enables direct hardware control through an interactive shell and built-in file system. Programming is done using the Thonny IDE, which is beginner-friendly and supports features such as code completion, debugging, and real-time variable tracking. Thonny simplifies the development process by offering a clean interface and seamless integration with MicroPython. It allows users to upload, test, and debug code efficiently, making it ideal for embedded system projects that involve sensor data collection and hardware interaction..

VII. CONCLUSION

The Internet of Things (IoT) offers numerous advantages for transforming medical care, including cost reduction, improved efficiency, greater accuracy, and enhanced performance. Its integration has paved the way for advanced automation in healthcare systems. This document serves as a foundational resource for future professionals in the field, offering a comprehensive overview of IoT-based health-monitoring technologies. It systematically explores current research, highlighting the impact and benefits of these systems. Additionally, it covers the role of wearable IoT devices in healthcare, categorizes various health-monitoring sensors, and addresses critical concerns such as security, privacy, and quality of service. The study also outlines existing challenges and suggests potential directions for future development.

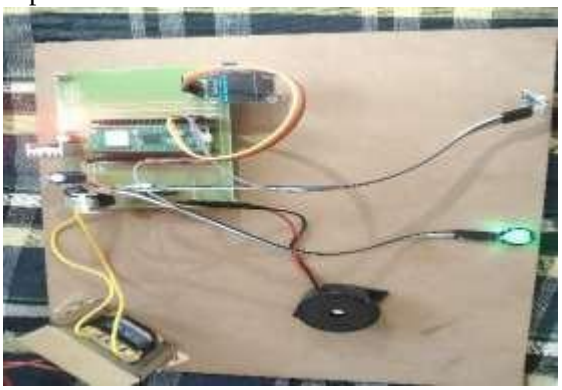


FIG 2 Prototype of The System

ACKNOWLEDGEMENT

We express our deepest gratitude to **Mr. M. Shravan Kumar Reddy**, whose invaluable guidance, expertise, and encouragement played a pivotal role in the successful completion of this research. Their insights and constructive feedback have greatly enhanced the quality of this work**.** Finally, we acknowledge the contributions of family and friends for their unwavering motivation and understanding throughout this journey. This work would not have been possible without their encouragement and belief in our vision.

We are immensely grateful to G.Praveena Reddy, Project Coordinator, and our entire faculty for their ceaseless encouragement and unwavering support, which have served as the driving force behind the completion of this project.

Our sincere thanks extend to Dr. S. P. Yadav, Head of the Department of Electronics and Communication Engineering, whose invaluable suggestions have greatly contributed to the success of this endeavor, serving as a constant source of inspiration.

We also extend our gratitude to Dr.K.Venkata Rao, Principal, for his continuous support and valuable guidance throughout this journey.
We acknowledge with deep appreciation the support and encouragement received from Dr. H.S. Saini, Managing Director of Guru Nanak Group of Institutions, whose unwavering belief in our abilities has been a source of motivation.

Additionally, we express our gratitude to our parents, friends, and all those who have provided encouragement and support along the way. Their belief in us has been a driving force behind our efforts.

Lastly, we extend our thanks to all other staff members, both teaching and non-teaching, for their timely assistance and contributions, which have facilitated the progress of this project.

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[2] **Alekya et al. (2021)** reviewed recent advancements in smart healthcare monitoring using IoT, summarizing developments and identifying potential areas for future research.
[3] **Naveen, Sharma, and Nair (2019)** proposed a secure IoT-based health monitoring framework, presenting their work at the IEEE International Conference on Electrical, Computer, and Communication Technologies in Coimbatore.
[4] **Rathi et al. (2021)** explored the integration of edge artificial intelligence with IoT in developing a health monitoring system designed for smart cities, focusing on performance and real-time analytics.
[5] **Alshamrani (2022)** provided insights into the convergence of IoT and AI for remote health monitoring, discussing system designs, implementations, and emerging trends in this domain.
[6] **Gera et al. (2021)** presented an IoT-based automated healthcare monitoring solution tailored for smart urban environments, showcasing it at the ICCMC conference in Erode, India.