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Remote Vital Sign Monitoring Solution

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ABSTRACT

In the era of advanced technology and connectivity, the IoT has revolutionized various realms, including healthcare. This study advances research in intelligent information systems and computer technologies, with a particular focus on the application of information technologies in healthcare. It introduces the design and development of a health monitoring system based on the Internet of Medical Things (IoMT), highlighting its role in modern medical data acquisition and patient monitoring. The system is built upon the ESP32 platform, integrated with sensors for oxygen saturation, pulse and temperature measurements. The data acquired by the ESP32 module is sent to an IoT-based cloud platform, where it is stored, visualized, and made available for subsequent analysis. The proposed computing system responds to the increasing need for continuous health surveillance, particularly for elderly patients, by offering an effective solution for remote healthcare monitoring and management. It focuses to bridge the gap among traditional healthcare and the capabilities offered by IoMT, providing real-time observations of a person's health status. The combination of the ESP32 platform with dedicated medical sensors enables efficient acquisition of critical physiological data, which is essential for detecting health abnormalities and enhancing clinical outcomes. The findings confirm the practicality and effectiveness of an IoMT-based approach for real-time health monitoring, paving the way for improved healthcare services in an increasingly interconnected environment.

Keywords:- Internet of Medical Things, computer system, IoMT, ESP32, sensors, real-time monitoring, healthcare.

1. INTRODUCTION

The swift progress of information technology, along with the widespread adoption of connected devices, has initiated a new phase of innovation, particularly within the healthcare sector. The Internet of Things (IoT) [1] has become a key enabling technology, supporting the creation of intelligent systems capable of transforming health monitoring and management practices. Within this framework, the Internet of Medical Things (IoMT) [2] emerges as a healthcare-focused extension of IoT, providing significant potential for real-time patient monitoring and remote medical care. The rapid aging of the global population has intensified the need for continuous health surveillance and personalized medical solutions. Elderly individuals often require constant observation and prompt medical intervention; however, caregivers and family members are frequently limited by professional and personal obligations, reducing their capacity to offer uninterrupted, in-person support. These challenges have been further heightened by recent quarantine measures and social distancing requirements. In parallel, modern medicine has increasingly incorporated information technologies, leading to the development of automated computer systems for medical institutions. In response to these evolving demands, there is a growing need for a dependable and efficient real-time health monitoring system that not only delivers continuous health status updates but also allows healthcare professionals to remotely access and analyze vital physiological data, thereby supporting early diagnosis. IoMT technology addresses these requirements by seamlessly combining connectivity solutions with medical devices and sensor technologies [3].

The main objective of this study is to design and develop a cost-effective and reliable IoMT-based health monitoring system (HMS). The proposed system enables real-time tracking of essential physiological parameters, such as body temperature and pulse oximetry, for individuals with chronic conditions as well as those seeking improved health management. By integrating IoT-enabled devices with data visualization platforms, the system supports remote patient monitoring by medical professionals. Ultimately, this approach aims to enhance the efficiency of patient care, reduce healthcare expenditures, and improve overall health outcomes through the effective integration of sensor and IoT technologies.

1.1 Related works

In recent years, the development of real-time health monitoring systems (HMSs), particularly those utilizing the Internet of Medical Things (IoMT), has attracted significant research interest. Numerous IoMT-based HMS

solutions have been reported in the literature, typically incorporating networks of sensors and medical devices to collect and transmit physiological data. Cloud computing serves a critical function in the storage, processing, and accessibility of health information, leading to the emergence of various cloud-based healthcare platforms capable of managing the large volumes of data generated by such systems. These platforms facilitate secure data retention and enable real-time data sharing with healthcare professionals. Researchers have investigated a wide range of IoMT architectures and sensor configurations to address diverse medical requirements. This section reviews several notable contributions to HMS research, with most studies focusing on the integration of Internet of Things technologies [4] and sensor-based solutions for remote patient monitoring [5].

The study presented in [6] proposes an IoMT-based architecture for monitoring elderly patients, addressing the growing demand for home-cantered diagnostic and surveillance systems. The framework emphasizes adaptive data processing across fog, edge, and cloud layers, depending on computational load and data sensitivity. Although the authors suggest promising approaches for continuous monitoring and data protection through blockchain and artificial intelligence techniques, challenges related to system usability and long-term sustainability remain insufficiently addressed, requiring further investigation before large-scale healthcare deployment.

In [7], an intelligent IoMT-enabled system for real-time patient monitoring is introduced. The proposed solution demonstrates benefits in terms of affordability, precision, portability, and responsiveness. However, the study provides limited discussion regarding the development challenges and practical constraints of the system. Addressing potential scalability and usability concerns across different healthcare environments would further clarify its real-world applicability.

The work reported in [3] reviews the implementation of IoMT-based remote health monitoring systems utilizing wearable sensors, with particular emphasis on diabetes management. The study underscores the growing importance of IoMT in future healthcare models and highlights the continuous monitoring of vital physiological parameters, including blood glucose levels.

1.2 Overall Description

The work presented in [8] proposes an IoT-enabled health monitoring system aimed at continuously observing the functional health status of elderly individuals living independently. The system integrates sensor technologies with machine learning techniques to evaluate both physiological parameters and behavioural patterns. Although the study highlights the potential for real-time health surveillance, it does not sufficiently address the practical challenges and deployment considerations associated with implementing such a solution in real-world IoT environments.

The research in [9] investigates an IoT-based health monitoring system that utilizes a wearable glove for the detection and analysis of heart rate and electroencephalogram (EEG) signals in stroke management. While the proposed approach aims to simplify healthcare workflows and reduce clinical complexity, a more detailed discussion of clinical validation and its effectiveness in stroke prevention and treatment would strengthen the study.

The study reported in [10] explores the expanding domain of IoMT and its applications in collecting health and sports-related data. It focuses on the use of temperature and acceleration sensors to capture information associated with human health and physical activity, emphasizing data modelling and analytical techniques. Although the findings are encouraging, the authors acknowledge the inherent complexity of IoMT systems and underline the need for further research to address architectural issues and ensure consistent and reliable data acquisition.

In [11], an IoT-based health monitoring system is introduced, highlighting the transformative role of IoT technologies in modern healthcare. The proposed system is capable of gathering and processing data from multiple sensors to support real-time monitoring and health condition prediction. Despite demonstrating a promising prototype, the study does not thoroughly examine potential implementation challenges, particularly those related to scalability and user acceptance. Additional research is required to overcome these limitations and enhance system reliability.

The work in [12] presents an intelligent IoT-driven system for remote health monitoring, offering features such as continuous monitoring and immediate alerts to healthcare professionals. However, the paper provides limited discussion on the challenges that may arise during large-scale deployment. Potential constraints, including sensor precision and system reliability, are not sufficiently explored.

Finally, the study in [13] introduces an IoT-based remote intelligent medical health monitoring system designed for real-time acquisition and storage of patients' physiological data. While the system demonstrates advantages in improving medical services and enabling remote patient care, further validation and real-world implementation are necessary to ensure its effectiveness and its ability to address the complex demands of remote healthcare monitoring.

2. SYSTEM STRUCTURE

The proposed health monitoring system is built around the ESP32 platform and incorporates dedicated sensors for measuring heart rate, blood oxygen saturation, and body temperature. The developed HMS represents an integrated framework that combines multiple components to support real-time physiological monitoring and data analysis. The main elements of the system include an ESP32 microcontroller, the MAX30205 temperature sensor, the MAX30102 pulse oximeter and heart rate sensor, an OLED display, an IoT cloud server, and user access devices such as a laptop, computer, or smartphone.

Careful selection of sensing devices, particularly the MAX30205 and MAX30102 sensors employed in this system, ensures accurate and dependable data collection. The MAX30205 sensor delivers high-precision body temperature measurements, which are essential for identifying fever and abnormal temperature variations. The MAX30102 sensor is utilized to monitor both pulse rate and blood oxygen saturation, making it a critical component for evaluating cardiovascular function and blood oxygen levels.

The ESP32-based module functions as the core controller of the system, enabling communication with the sensors through the I2C protocol and transmitting collected data to the IoT cloud server via a Wi-Fi connection. An OLED display is integrated to present real-time vital sign information in a clear and user-friendly manner, improving data visibility and accessibility for users.

The IoT cloud server serves as the central platform for data reception, storage, and processing. It securely collects data transmitted from the ESP32 module and supports analytical and visualization tools for further evaluation. The overall architecture of the proposed IoMT-based health monitoring system is illustrated in Figure 1.

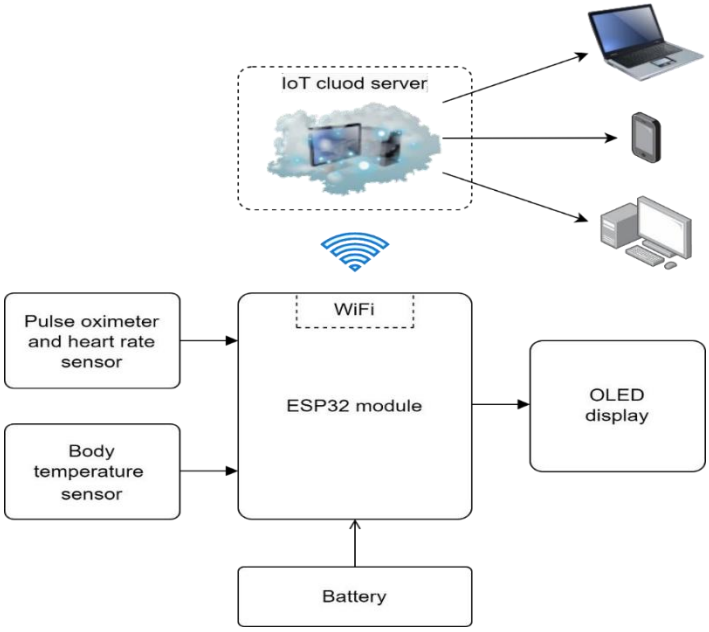

Fig -1: The proposed HMS architecture

The system operates according to the following workflow. The MAX30205 and MAX30102 sensors continuously measure essential physiological parameters, including body temperature, heart rate, and blood oxygen saturation. The collected data is transmitted to the ESP32 module through the I2C communication interface. The ESP32 processes the incoming information, presents the measured values in real time on the OLED display, and securely forwards the data to the IoT cloud server using a Wi-Fi connection.

Authorized users, including healthcare professionals and patients, can access the transmitted information through laptops, desktop computers, or smartphones via intuitive user interfaces. These devices function as monitoring terminals, enabling real-time observation of vital signs and review of health data.

2.1 System Overview and Research Background

The rapid advancement of Internet of Things (IoT) technologies has made it possible to implement continuous and real-time health monitoring solutions that enhance the quality of medical services. This study concentrates on the design and implementation of a smart health monitoring system based on the ESP32 platform, capable of tracking essential physiological parameters such as heart rate, blood oxygen saturation (SpO_2), and body temperature. The proposed system integrates sensors, including the MAX30100 pulse oximeter and temperature sensors, with an ESP32 microcontroller to enable efficient data collection and wireless communication.

Hardware Components used

Components	Specification	Sensing Unit	Display Used	Implementation
ESP32 Microcontroller	MAX30100 Sensor	Temperature Sensor	OLED Display	Breadboard
Wi-Fi Enabled	Heart Rate & SpO_2	Body Temperature	Real-time Display	Prototyping

2.2 Hardware Implementation

The hardware architecture of the proposed system is built around the ESP32 development board, which functions as the primary unit for data processing and wireless communication. The MAX30100 sensor is employed to monitor heart rate and blood oxygen saturation using photoplethysmography principles, while a temperature sensor is utilized to track body temperature. An OLED display is integrated to provide immediate visual representation of the measured parameters. During the prototyping phase, all components are connected via a breadboard to allow ease of testing and modification. The ESP32 wirelessly transmits the collected sensor data to a mobile application, enabling real-time monitoring and remote data access. This hardware configuration supports reliable performance, portability, and potential scalability for future system expansion.

- • List Item – 1: ESP32 microcontroller for processing and Wi-Fi connectivity
- • List Item – 2: MAX30100 sensor for heart rate and SpO_2 monitoring
- • List Item – 3: Temperature sensor for body temperature measurement
- • List Item – 4: OLED display for local data visualization List Item – 1

3. EXPERIMENTAL RESULT AND DATA VISUALIZATION

The experimental results indicate that the developed health monitoring system reliably measures and presents vital physiological parameters in real time. Sensor data are continuously collected and sent to the mobile dashboard, enabling users to monitor health trends over extended periods. Visual graphs of heart rate, SpO_2, and body temperature facilitate easier interpretation of the data. The system demonstrates consistent and stable performance under standard operating conditions, confirming its effectiveness and reliability.

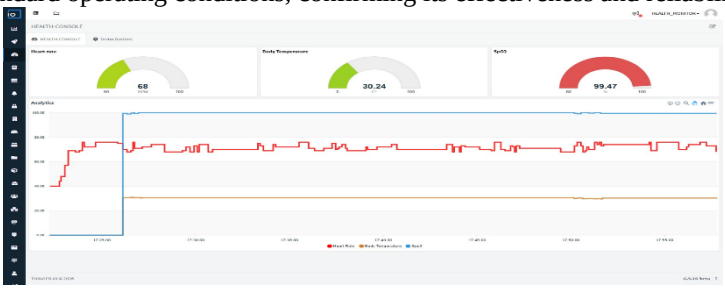

Chart -2: Model Accuracy

3.1 Mobile Application Dashboard display

The results obtained from our experiments highlight the effectiveness and practicality of the designed HMS. By leveraging IoMT and the ESP32 platform, the proposed system empowers caregivers and healthcare providers with the ability to remotely monitor patient's health parameters. This ensured timely access to health information, enabling rapid responses to changing health conditions. This is especially valuable in situations where in-person monitoring is challenging or impossible.

Fig -2: The monitoring results of the human vital health data

4. CONCLUSIONS

The proposed system provides an effective approach for managing healthcare remotely. It enables caregivers, medical professionals, and family members to monitor an individual's health status from a distance, improving the quality of care and facilitating timely interventions when needed. By operating in real time, the system can detect health irregularities and changes from baseline measurements early on. This feature is especially useful for preventing negative health outcomes and enhancing overall patient well-being. Furthermore, the system's modular design ensures flexibility and scalability, allowing it to be adapted to various healthcare environments and patient requirements. New sensors and functionalities can be easily added to address specific healthcare needs.

5. ACKNOWLEDGEMENT

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6. REFERENCES

[1] K. T. Kadhim, A. M. Alsahlany, S. M. Wadi, H. T. Kadhum, An Overview of Patient's Health Status Monitoring System Based on Internet of Things (IoT), Wireless Personal Communications, volume 114, issue 3, (2020) 2235–2262. doi:10.1007/s11277-020-07474-0.
[2] A. E. Hassanien, N. Dey, S. Borra, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications (1st. ed.), CRC Press: Boca Raton, FL, USA, 2018. doi:10.1201/9781351030380.
[3] O. AlShorman, B. AlShorman, M. Alkhassaweneh, F. Alkahtani, A review of internet of medical things (IoMT)-based remote health monitoring through wearable sensors: a case study for diabetic patients, Indonesian Journal of Electrical Engineering and Computer Science, volume 20, issue 1, (2020) 414–422.
[4] A. Palamar, M. Palamar, Fire Safety Monitoring System Based on Internet of Things, In CEUR