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Vision Aid : Multipara Monitoring

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Abstract: *Mathematical and signal-processing methods were used to obtain reliable measurements of the heartbeat pulse rate and information on oxygen concentration in the blood using short video recordings of the index finger attached to a sensor and displayed smartphone built-in camera. This project focuses on developing a wireless, multi-parameter patient monitoring system using two NodeMCU ESP8266 microcontrollers, a MAX30100 pulse oximeter, and an MLX90614 non-contact infrared temperature sensor. The system aims to provide real- time, remote monitoring of vital physiological parameters like heart rate, blood oxygen saturation, and body temperature. The system aims to provide real-time, remote monitoring of vital physiological parameters like heart rate, blood oxygen saturation, and body temperature. The hardware implementation uses two NodeMCU boards for optimal data acquisition and communication. The software component uses Arduino IDE for microcontroller programming and Firebase for cloud-based data storage and application development. The system's wireless nature and cloud-based data storage make it suitable for home health-care, telemedicine, and remote patient management. The modular design allows for future expansion, and the use of open-source platforms promotes cost-effectiveness and accessibility. The system's ability to provide continuous, real-time monitoring contributes to improved patient safety and enhanced health-care delivery.*

Keywords: multipara monitor

I. INTRODUCTION

A multipara monitor is a medical device that measure and displayed multiple physiological parameters of patient in real time it is an essential tool in health care setting such as hospitals, clinic and an home appliances a patient are device. It is use to measure record and various patient parameters such as a oxygen , body temperature and blood pressure to keep and track of patient health and provide them with quality health care. It centralizes the function of parameters measurement module, display record and output to compose a compact, portable device like a mobile phone application. This project introduced a cost effective design for multipara monitoring using a NodeMCU ESP8266, MAX30100,MLX90614 sensor for real time analysis.

II. LITERATURE REVIEW

This literature survey explores remote patient monitoring (RPM) and IoT-based healthcare solutions, focusing on specific sensors and platforms. The survey will examine the MAX30100 pulse oximeter and MLX90614 non-contact temperature sensor, the NodeMCU ESP8266 microcontroller, and the Fire-base platform. RPM systems can improve patient outcomes, reduce costs, and enhance care quality. IoT-based healthcare solutions, such as wearable sensors and smart home devices, collect real-time patient data for personalized care.

Wireless communication protocols like Wi-Fi, Bluetooth, and cellular networks are explored for home-based RPM systems and mobile applications.

IoT-based healthcare solutions are revolutionizing healthcare delivery by collecting real-time patient data, monitoring health status, and providing personalized care. Cloud computing platforms like Firebase enable secure storage and analysis of patient data. Wireless communication protocols like Wi-Fi, Bluetooth, and cellular networks are used for remote patient monitoring (RPM). Data security, privacy, and usability are crucial. Machine learning and artificial intelligence are increasingly used in remote monitoring for predictive analysis and early detection of potential health problems.

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III. METHODOLOGY

This section outlines the methodology employed in the development and evaluation of the Multipara monitor for patient The methodology encompasses a combination of hardware and software design, prototyping, testing, and user feedback integration.

This section outlines the methodology employed in the development of the multi parameter patient monitoring system. It details the steps taken from the initial design phase to the final testing and evaluation, encompassing both hardware and software aspects. The methodology emphasizes a structured and iterative approach to ensure a robust and reliable system.

Hardware Development

Component used

- NodeMCU ESP8266**:** it is a microcontroller chip is Selected for its integrated Wi-Fi, low cost, and Arduino IDE compatibility
- MAX30100 Pulse Oximeter**:** Chosen for its accuracy in measuring heart rate and SpO2.
- MLX90614 Non-Contact Temperature Sensor: Selected for its non invasive body temperature measurement capabilities.
- 5V 1A Adapter**:** Chosen to provide a reliable power source.
- LM1117-3.3V Voltage Regulator**:** Selected to provide stable
- 3.3V power to the sensors and NodeMCUs.
- 4x4 PCB: Chosen for component mounting and wiring organization

PCB Design and Fabrication:

A 4x4 PCB layout was designed using CAD software.
The PCB design included proper routing for power, ground, and I2C communication lines.
The PCB was fabricated using a professional PCB manufacturing service.

Hardware Integration:

The components were soldered onto the PCB according to the designed layout.
Proper wiring connections were made between the sensors and NodeMCUs, ensuring correct I2C communication.
The voltage regulator was integrated to provide stable 3.3V power.

Hardware Testing:

Voltage measurements were taken to verify the power supply stability.
I2C communication was tested using I2C scanner code to ensure proper sensor detection.
Sensor functionality was tested using basic Arduino code to verify data acquisition.

Software Development

Firmware Development (Arduino IDE):
Arduino IDE was used for NodeMCU firmware development.
The ESP8266WiFi, Firebase ESP8266 Client, MAX30100
PulseOximeter, and Adafruit MLX90614 Library libraries were used.
I2C or serial communication was implemented to transfer data between the two NodeMCU's.

Firebase Integration:

A Firebase project was created, and the Realtime Database and Authentication services were enabled.
The Firebase ESP8266 Client library was used to establish a connection between the NodeMCUs and Firebase.
The database structure was designed to store patient data with timestamps and patient IDs.

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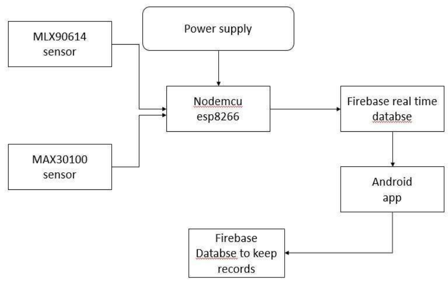
IV. DETAILS OF DESIGN, WORKING AND PROCESSES:

This section provides a comprehensive overview of the design considerations, operational workflows, and processes involved in the development of the multiparameter patient monitoring system. It elucidates the system's architecture, data low, and the rationale behind key design decisions. The design emphasizes modularity, scalability, and reliability, aiming to create a system that is both functional and adaptable to future enhancements. The working processes are streamlined to ensure efficient data acquisition, processing, and transmission.



The system uses a distributed processing model with two NodeMCU ESP8266 microcontrollers for optimal performance and reliability. It consists of three primary components: sensor nodes for physiological data, Firebase for data storage, and a mobile/web application for caregivers. The MAX30100 Pulse Oximeter is a medical device that is used to measure blood oxygen saturation levels, heart rate, and pulse strength. It uses a non-invasive method to measure oxygen saturation levels in the blood.

The 4x4 PCB was designed for efficient routing, signal interference reduction, and compact form factor. A 5V 1A adapter and LM1117-3.3V voltage regulator provide power. Sensor integration MAX30100 and MLX90614 use I2C communication protocol, with pull-up resistors for reliable communication.

A Firebase-based mobile or web application was developed for real-time data visualization, alert management, user authentication, patient profile management, and historical data analysis

MAX30100: The sensor uses PPG to measure heart rate and SpO2. The firmware initializes the sensor, configures the sampling rate, and reads the sensor data at regular intervals.

Algorithms are implemented to filter noise and improve accuracy.

MLX90614: The sensor measures body temperature using infrared thermometer. The firmware initializes the sensor, configures the measurement parameters, and reads the temperature data. Temperature compensation techniques are applied to mitigate the effects of ambient temperature.

Data Filtering: Sensor data is filtered using moving average filters or other signal processing techniques to reduce noise and improve accuracy.

Data Aggregation: The gateway NodeMCU aggregates data from both sensor nodes.

Wi-Fi Communication: The NodeMCUs establish a Wi-Fi connection to transmit data to Firebase.

Firebase Data Storage: The Firebase ESP8266 Client library is used to send sensor data to the Firebase Realtime Database. The database structure ensures efficient data storage and retrieval.

Data Transfer between NodeMCU's: I2C or Serial communication is used to send data from the sensor gathering nodeMCU to the Firebase Gateway NodeMCU.

V. RESULT

The multipara meter has been developed and evaluated focusing on its multiple parameters their recordings, diplayed in mobile application and user experience. The sensors provide an accurate sensor and the nodemcu microcontroller provides wifi and data will be displayed in the mobile without any error. The system also provides information about patients for example name, email id, and mobile no and the recording of the videos was performed by different individuals using the described smartphone. it also consist of commination links for displaying or recording a result sensor usually include biosensor and mechanical sensor

VI. FUTURE SCOP

The system can be enhanced by incorporating additional sensors for monitoring vital signs like blood pressure, ECG, and glucose levels, providing a more comprehensive view of patient health,and Machine learning algorithms can enhance predictive analytics and personalized patient care by predicting adverse events based on patient data.

Optimizing power consumption would extend the battery life of the system, making it more suitable for portable and wearable applications.User research and usability testing can enhance the application's user interface and functionality, promoting inclusivity through the incorporation of accessibility features.

VII. CONCLUSION

the development of this multi-parameter patient monitoring system has demonstrated the feasibility and potential of leveraging IoT technologies to enhance healthcare delivery. By integrating readily available components, opensource platforms, and cloud-based services, a cost-effective and reliable solution has been created for remote monitoring of vital physiological parameters. The system's ability to provide continuous, real-time monitoring of heart rate, SpO2, and body temperature has significant implications for improving patient outcomes, particularly in home healthcare, telemedicine, and elderly care settings. The results obtained from testing and evaluation demonstrate the system's accuracy, reliability, and usability, validating its potential for practical applications.

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ACTUAL SETUP: