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Virtual Heart Monitoring System Using IoT

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Abstract: *Cardiovascular disease is one of the leading causes of mortality worldwide. Early detection and diagnosis of heart conditions are essential for effective management of the disease. Heart monitoring systems have become increasingly popular, and the advent of IoT technology has provided an opportunity to develop wearable heart monitoring systems for real-time heart monitoring. In this project, we propose a heart monitoring system using the MAX30100 pulse oximeter and the ECG sensor. The system is designed to monitor heart rate, oxygen saturation level, and pulse rate. The ECG sensor detects the presence or absence of the pulse, and the MAX30100 pulse oximeter measures the oxygen saturation level and heart rate. The data collected from the sensors are transmitted wirelessly to a Blynk application through a microcontroller. The Blynk application is used to display the heart rate, oxygen saturation level, and pulse detection status*

Keywords: IOT(Internet of Things), Sensors, Micro Controllers, Heart Disease, Bluetooth module, Data Analytics, Blynk App

I. INTRODUCTION

Cardiovascular disease is a major health problem worldwide, accounting for a significant number of deaths each year. According to the World Health Organization, an estimated 17.9 million people die from cardiovascular disease each year, representing 31% of all global deaths. Early detection and diagnosis of heart conditions are crucial for effective management of the disease. Heart monitoring systems have become increasingly popular, and the advent of IoT technology has provided an opportunity to develop wearable heart monitoring systems for real-time heart monitoring.

The MAX30100 pulse oximeter and the ECG sensor are two commonly used sensors in heart monitoring systems. The MAX30100 pulse oximeter measures the oxygen saturation level and heart rate by using light to detect changes in blood flow.

The ECG sensor, on the other hand, detects the electrical activity of the heart and can be used to detect the presence or absence of the pulse. The combination of these two sensors can provide a comprehensive view of the heart's health.

In this project, we propose a heart monitoring system using the MAX30100 pulse oximeter and the ECG sensor. The system is designed to monitor heart rate, oxygen saturation level, and pulse rate. The ECG sensor detects the presence or absence of the pulse, and the MAX30100 pulse oximeter measures the oxygen saturation level and heart rate.

The data collected from the sensors are transmitted wirelessly to a Blynk application through a microcontroller. The Blynk application is used to display the heart rate, oxygen saturation level, and pulse detection status in real-time.

II. LITERATURE SURVEY

Alvee Rahman, Tahsinur Rahman, proposed an “IoT Based Patient Monitoring System Using ECG Sensor” The ECG signals by using a single lead heart monitor(AD8232) ,temperature sensor Raspberry Pi ,Arduino Uno. The data then collected and saved in the cloud using Thing Speak.And data can be accessed by the users. If there is any variation with optimal value the message is sent to the saved individual. This proposes an intelligent patient monitoring system that automaticaly screens the patient’s health condition through various sensors. The data is then processed using a Raspberry Pi and useful information is saved to the IoT cloud. Primarily the system would be extracting the bio signal, ECG using an ECG sensor.

Dr.T.Jagannada Swamy and T.N.Murthy, published an “eSmart: An IoT based Intelligent Health Monitoring and Management Systemfor Mankind”, IoT based smart health monitoring system plays a vital role in telemedicine concept for the mankind. With the help of advance communication and information technology, it has led to the Internet of

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Things (IoT) for various real world applications. Many physical devices capture transmit data, and provides data to various interoperability methods in IoT. The basic functionalities of IoT is for storage, display and communicate the information. Hence the e- Health monitoring system with IoT is adapted for distant patient monitoring on a continual basis and aggregated, analyzed the data.

KumbharPallavi,Pathan, Hameed,proposed "Patient Health Monitoring System using Raspberry PI-3". Health is one of the big challenges for humans. In the last few years the healthcare has drawn considerable amount of attention. The prime goal is to develop a reliable patient monitoring system so that the healthcare professionals can take care of the patients, who are either hospitalized or executing their normal daily life activities I their own house.

R.Alekya, Dr.Prabha, proposed "IOT based Smart Healthcare Monitoring System". Healthcare requests generally reflect close attention to IoT techniques due to cost savings, ease of interpretation, and recovery of patients personal satisfaction.This paper helps to imagine how IoT can be incorporated into complex hprocedures. The "Mobile Healthcare Management System (HMS) IOTapps that link the Internet to mobile sensors, people, clinicians, networks another Connected devices.

M.Sathya, S.Madhan, K,Jayanthi, proposed an "Design on IOT based Health monitoring and Challenges". Among the applications that Internet of Things (IoT) facilitated to the world, Healthcare applications are most important. In general, IoT has been widely used to interconnect the advanced medical resources and to offer smart and effective healthcare services to the people. The information collected in such manner, can be analyzed, aggregated and mined to do the early prediction of disease.

III. SYSTEM REQUIREMENTS AND SPECIFICATION

Heart Beat Sensor

Fig. 1 Heart Beat Sensor

Heart beat sensor is used to measure the pulse rate of heart in digital outputLED is used to detect the heart rate. The normal heart beat range is 78 bpm. This provides a direct output digital signal.

Esp8266

Fig. 2 Esp8266

ESP32 is one of the main IoT learning tools. This ofers a full Linux system on a small platform at avery lowprice. ESP32 connects device sensors and actuators through GPIO pins. ESP32 and IoT merge to be a new technology for creativity in the healthcare system. ESP32 is designed extremely with integrated antenna switches, RF-balun, control amplifcation, low- noise amplifer, and flters as well as power management modules. EPS32 can communicate with other Wi-Fi and Bluetooth devices via its SPI/SDIO, or I2C/UART interfacesprovides the advantages of a PC to the domain of sensor network .

ECG Sensor

This is the reason why I am presenting you with this great IoT project. In this project, I will show you how you can interface AD8232 ECG Sensor with Board and monitor the ECG Wave form on Serial Plotter Screen. Similarly, you can send the ECG waveform over the IoT Cloud platform and monitor the signal online from any part of the world using the PC or simply using the Smart phone.

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Fig. 3 ECG Sensor System Requirements And Specification

Hardware Requirement

- MAX30100 Pulse Oximeter
- ESP8266 (NODEMCU 1.0)
- ECG Sensor

Software Requirement

- Operating System : Windows 64-bit
- Technology :C++
- IDE :Arduino IDE
- Version :Arduino 2.0 and above
- Software: Blynk App

IV. DESIGN AND METHODOLGY

- Design and Development of Heart Monitoring System: The first step in the methodology is to design and develop a heart monitoring system that integrates the MAX30100 pulse oximeter and ECG sensor. The heart monitoring system will be designed to be non-invasive, portable, and comfortable for the user. The system will also be optimized for low-power consumption.
- Calibration of Heart Monitoring System and dht11: Once the heart monitoring system is developed, it will be calibrated to ensure accurate and reliable readings. The calibration process will involve comparing the readings from the heart monitoring system with readings from a professional medical device to ensure that the heart monitoring system provides accurate and reliable readings.
- Utilize the User-Friendly Mobile Application already exist: The heart monitoring system will be integrated with a user-friendly mobile application that can receive the heart rate, oxygen saturation level, and pulse rate data wirelessly and display it in a clear and understandable format. The mobile application will be designed to be easy to use and require minimal technical expertise, making it accessible to a wider range of users.
- Testing of Heart Monitoring System: The heart monitoring system will be tested in a real-world setting to evaluate its performance and usability. The testing process will involve recruiting participants with cardiovascular disease to use the heart monitoring system in their home setting for a period. The participants will be asked to provide feedback on the usability and performance of the heart monitoring system.
- Feasibility of Integration with Existing Healthcare Systems: The feasibility of integrating the heart monitoring system with existing healthcare systems for remote patient monitoring will be assessed. The heart monitoring system will be evaluated for its ability to transmit data wirelessly to healthcare providers and to integrate with electronic health records.
- Dissemination of Results: The findings of the project will be published in academic journals and presented at relevant conferences to share the results with the scientific community.

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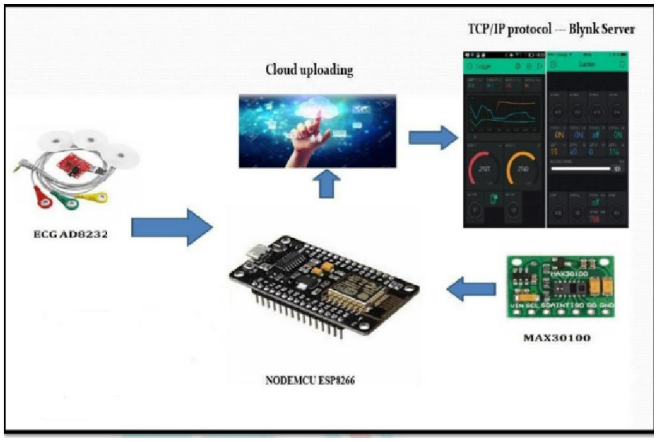

Fig. 4 Block diagram of the Heart Monitoring System

V. IMPLEMENTATION

The heart monitoring system using the MAX30100 pulse oximeter and ECG sensor is designed around the ESP8266 microcontroller and uses Wi-Fi to transmit data wirelessly. The circuit diagram for the heart monitoring system is as follows:

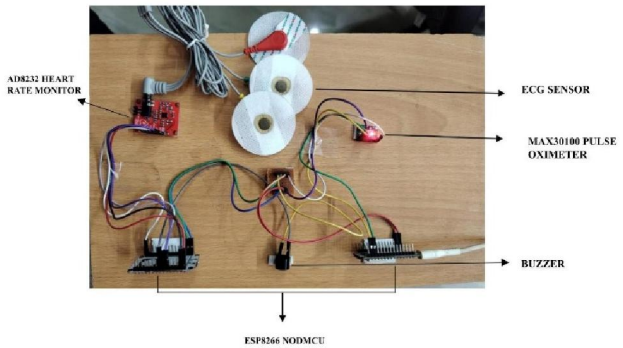

Fig. 5 Circuit Implementation

The circuit diagram for the heart monitoring system consists of four main components: the MAX30100 pulse oximeter, the ECG sensor, the ESP8266 microcontroller, and the Wi-Fi module. Each of these components is described in more detail below.

MAX30100 Pulse Oximeter:

The MAX30100 pulse oximeter is a sensor that measures the oxygen saturation level and heart rate of a person's blood by shining light through the skin and measuring the amount of light that is absorbed. The MAX30100 pulse oximeter communicates with the ESP8266 microcontroller through the I2C interface. The SDA and SCL pins of the MAX30100 are connected to the corresponding pins of the ESP8266.

ECG Sensor:

The ECG sensor measures the electrical activity of the heart using electrodes that are placed on the chest of the user. The ECG sensor communicates with the ESP8266 microcontroller through the analog pins of the ESP8266. The analog signal from the ECG sensor is amplified and filtered by an instrumentation amplifier and an active low-pass filter before being sampled by the ESP8266 analog-to-digital converter (ADC).

ESP32 Microcontroller:

The ESP32 microcontroller is the brain of the heart monitoring system, responsible for processing the data from the MAX30100 pulse oximeter and ECG sensor and transmitting it wirelessly using Wi-Fi. The ESP32 microcontroller is

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programmed using the Arduino IDE, and uses the ESP-IDF framework to communicate with the Wi-Fi module. The ESP8266 microcontroller also controls the OLED display that displays the heart rate, oxygen saturation level, and pulse rate data.

The work flow of data in the heart monitoring system is as follows:

- The MAX30100 pulse oximeter and ECG sensor detect the heart rate, oxygen saturation level, and pulse rate of the user.
- The data from the MAX30100 pulse oximeter and ECG sensor is sent to the microcontroller for processing.
- The microcontroller calculates the heart rate and oxygen saturation level, and determines whether a pulse is detected or not.
- The microcontroller sends the heart rate, oxygen saturation level, and pulse detection status data wirelessly to the mobile application.
- The mobile application receives the heart rate, oxygen saturation level, and pulse detection status data in real-time and displays it to the user.

VI. FUTURE ENHANCEMENT

Wearable Devices: Integration with advanced wearable devices, such as smartwatches or fitness trackers, could provide continuous monitoring of vital signs, including heart rate, blood pressure, and ECG data. These devices can transmit real-time data to the monitoring system

Artificial Intelligence and Machine Learning: Implementing AI and machine learning algorithms can improve the accuracy of detecting cardiac anomalies. These algorithms can analyze the collected data, identify patterns, and provide early warnings for potential heart conditions or emergencies.

Integration with Electronic Health Records (EHR): Integrating the virtual heart monitoring system with existing electronic health records allows healthcare providers to have a comprehensive view of a patient's health history. This integration enables better decision-making and facilitates a more holistic approach to patient care.

VII. ACKNOWLEDGEMENT

We'd like to express our gratefulness to SJC Institute of Technology, our council, we express our sincere thanks toDr. G T RAJU, Principle SJCIT, Chickballapur for furnishing us with excellent structure to complete the design. We express whole hearted gratefulness toDr. MANJUNATHA KUMAR B H, who's the reputed Tank of Computer Science Department. We wish to admit his help in making our task easy by furnishing us with his precious help and stimulant. It's our pleasure to thank our design Guide Prof. Manjunatha S, Assistant professor, Department of Computer Science and Engineering, SJCIT for his guidance stimulant and precious suggestion from the morning of the design work till the completion without which this design work would not have been fulfilled. We express our sincere thanks to Project coordinator Prof. Shrinath G M, SJCIT, Assistant professor, Department of Computer Science and Engineering, for furnishing us with excellence structure to complete design.

VIII. CONCLUSION

In this phase we have used hardware setup and Blynk application involves integrating the hardware components and developing system. The System would provide real-time monitoring of heart rate ,Blood oxygen saturation level and ECG data and would be accessible through Blynk application.

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