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IOT Based Electro Cardiogram Machine

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Abstract: This project develops an ECG monitoring system using an ESP32 microcontroller and an ECG sensor for continuous heart rate tracking. The system transmits real-time data to ThingSpeak for visualization and sends SMS alerts to a designated guardian if an abnormal heart rate is detected. Designed to enhance patient safety and monitoring efficiency, it is particularly beneficial for individuals with chronic heart conditions, elderly patients, and those in post-operative care.

Keywords: Continuous heart rate monitoring, Real-time data visualization on ThingSpeak ,SMS alerts for abnormal heart rates, Enhanced patient safety, Integration of IoT technologies

I. INTRODUCTION

The ECG monitoring system project leverages an ESP32 microcontroller and an ECG sensor to create a comprehensive heart rate monitoring solution. This system continuously tracks the user's heart rate, providing real-time data visualization on ThingSpeak, an IoT analytics platform. In addition to this, it features an alert mechanism that sends an SMS notification to a designated guardian if an abnormal heart rate is detected.

By combining continuous monitoring, real-time data visualization, and timely alerts, this project aims to enhance patient safety and provide peace of mind to guardians. It holds significant potential for healthcare applications, especially for individuals with heart conditions or those requiring constant cardiac monitoring,

By automating the attendance management process, this system minimizes errors, saves time, and streamlines administrative tasks, ultimately contributing to a more efficient and productive environment.

II. LITERATURE PAPER

[1] Wireless ECG and cardiac monitoring systems(2021) State of the art, available commercial devices and useful electronic component The presence of cables often hinders user's free movements, alongside clinicians' routine operations. Therefore, wireless ECG systems are desirable. This paper aims at reviewing the solutions described in the literature, besides commercially available devices and electronic components useful to setup laboratory prototypes. Several systems have been developed, different in terms of the adopted technology;.

[2] Real time ECG on internet using Raspberry Pi Pallavi Patil, Kalyani Bhole. The current status of heart disease in India is alarming, with projections suggesting that by the year 2020, the population of heart patients in India will surpass all the countries. Thus, monitoring the electrical activity of heart i.e. electrocardiogram is a necessity rather than luxury. ECG machines available in hospital are rather expensive. This paper aims at charting the ECG signal using the Raspberry Pi Arm processor. The ECG signals are recorded from the patient via the AD8232 ECG module and then this data is digitized using serial ADC MCP3008.This approach has a complex design and is of high-cost design. Though the different approaches seem to be useful in their own ways but lack to have a reliable system in the long term.

[3] Design and implementation of wireless telemedicine system-electrocardiograph (2011)According to a World Health Organization (WHO) estimate, cardiovascular disease kills almost seventeen million people around the world each year, with around twenty million people at a risk of sudden heart failure.(WHO, 2004) At present, the number of Malaysians aged 60 years and above is estimated to be

[4] Design and Development Virtual ECG Machine with Problem Identification Using Labview The electrocardiogram (ECG) is a recording of the electrical activity of the heart which serves in diagnostic application. The ECG records the electrical activity that results when the heart muscle cells in the atria and ventricles contract. The ECG waveform is analyzed by the cardiologist in diagnosis various disease and condition associated with the heart. The purpose of this project is to develop a virtual ECG machine through Lab VIEW.

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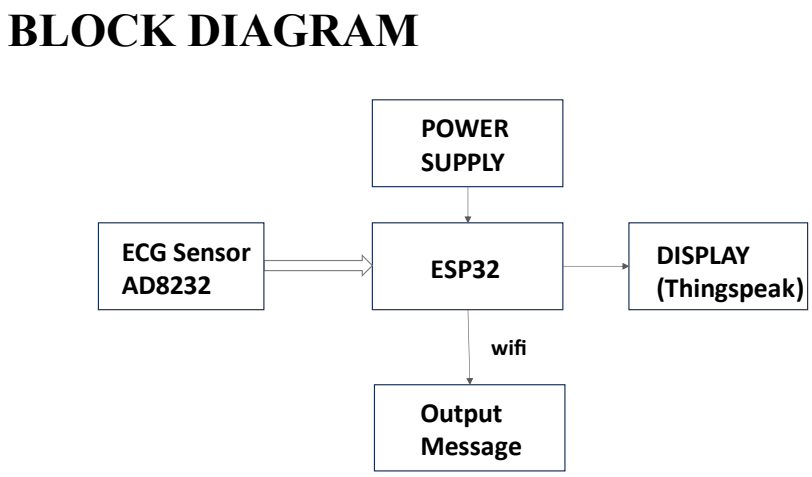
The function of this system is to identify the various heart diseases with respect to change in QRS complex, P wave, and T wave of the patient.

Wireless ECG and cardiac monitoring systems: State of the art, available commercial devices and useful electronic components Wireless ElectroCardioGram (ECG) systems are employed in manifold application fields: tele-monitoring, sport applications, support to ageing people at home, fetal ECG, wearable devices and ambulatory monitoring. The presence of cables often hinders user's free movements, alongside clinicians' routine operations. Therefore, wireless ECG systems are desirable.

III. METHODOLOGY

A. BLOCK DIAGRAM



The system starts with a power supply powering the ECG Sensor AD8232 and the ESP32 microcontroller. The AD8232 measures the heart's electrical activity and sends digital signals to the ESP32. The ESP32 processes these signals to monitor the heart rate and uses its built-in Wi-Fi to send the data to ThingSpeak for visualization. If an abnormal heart rate is detected, the ESP32 sends an SMS alert to a parent number.

B. WORKING

The system begins with a power supply that provides the necessary voltage and current to the ECG Sensor AD8232 and the ESP32 microcontroller. The ECG Sensor AD8232 is responsible for capturing the electrical activity of the heart. It consists of electrodes that are attached to the body, which detect the heart's electrical signals. These analog signals are then amplified and filtered by the AD8232 to remove noise and artifacts, converting them into digital signals.

These digital signals are sent to the ESP32 microcontroller. The ESP32 processes the signals to calculate the heart rate by identifying the R-R intervals (the time between successive R-waves, or heartbeats). The microcontroller continuously monitors these intervals to determine if the heart rate is within a normal range.

The ESP32 is equipped with built-in Wi-Fi, allowing it to connect to the internet. Using this capability, the ESP32 sends the processed heart rate data to ThingSpeak, an Internet of Things (IoT) analytics platform. ThingSpeak collects the data, stores it, and provides tools to visualize it in real-time graphs and charts. This enables remote monitoring of the heart rate over time.

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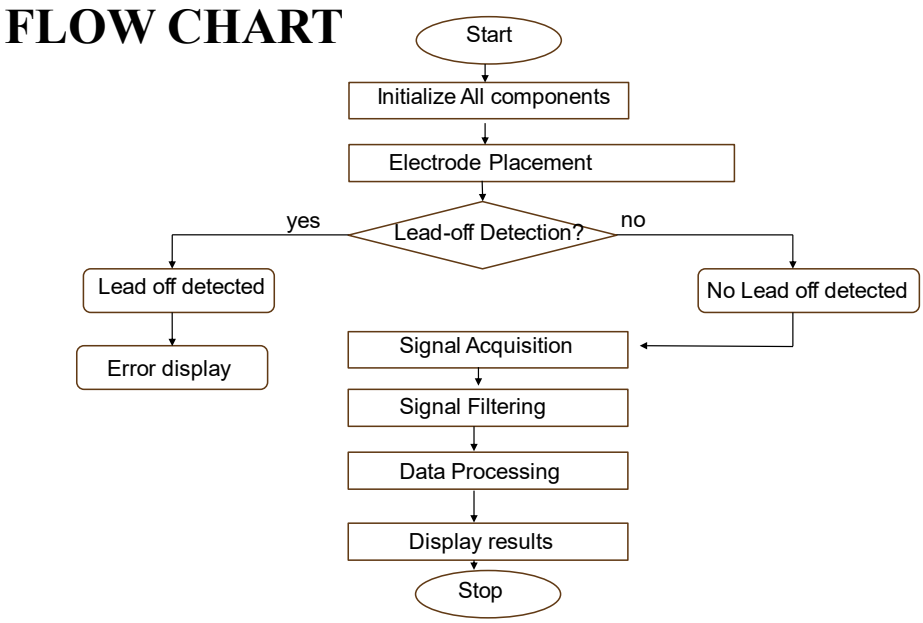
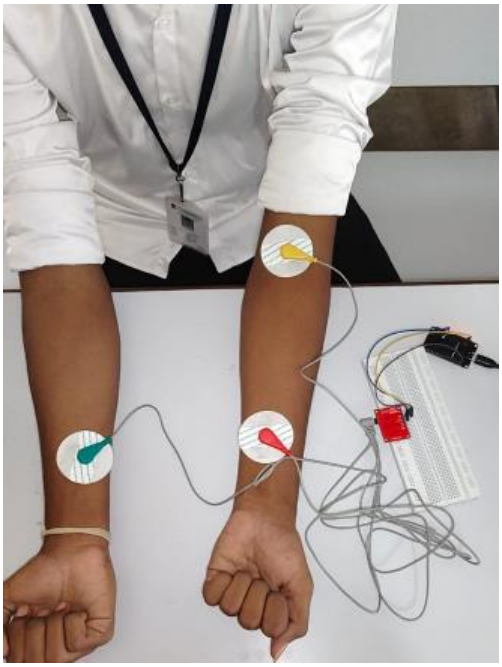
C. FLOWCHART

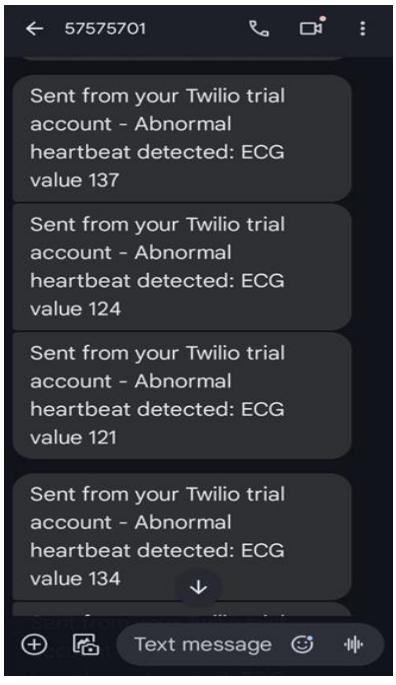


The ECG machine project starts with the initialization of all components, including the ECG sensor and ESP32. Once initialized, the user places the ECG electrodes on the patient's body at the correct positions. The system then checks for proper electrode attachment through lead-off detection. If the electrodes are not properly attached (lead-off detected), an error message is displayed indicating the issue. Once proper attachment is confirmed, the system begins signal acquisition, collecting the heart rate signal from the electrodes. This acquired signal undergoes filtering to remove any noise or artifacts. The filtered signal is then processed to extract heart rate and other relevant parameters. Finally, the processed data is displayed on the system, and if required, sent to ThingSpeak for further analysis or visualization.

IV. RESULTS

The prototype of the proposed system is shown in Figure





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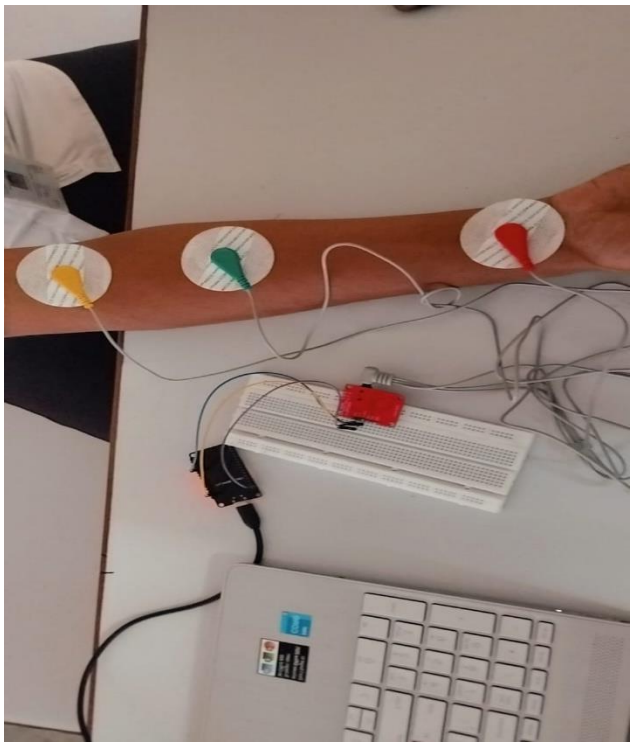

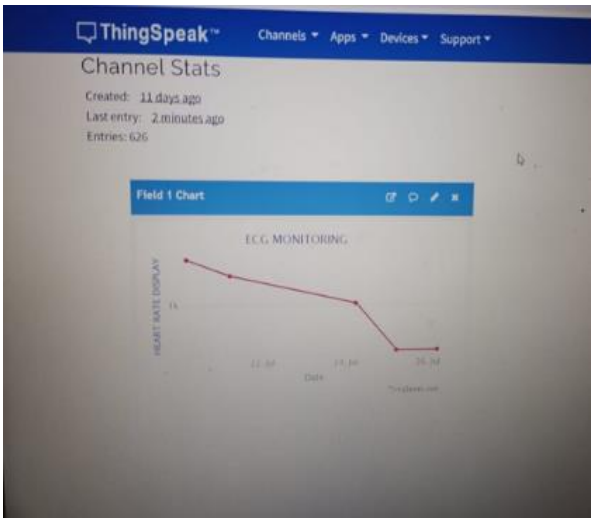

V. APPLICATIONS

1.Personal Health Monitoring
2.Remote Patient Monitoring
3. Home Healthcare
4.Education
5. Emergency Response
6. Preventive Healthcare

REFERENCES

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[3]. Developing an Affordable IoT-Based ECG Monitoring System Using ESP32: This paper presents a low-cost ECG monitoring system using ESP32 and the Ubidots platform, aimed at continuous heart monitoring and real-time data analysis【26†source】.

[4]. IOT-Based ECG Monitoring System with GSM Module: This paper describes a system that uses the ESP32 and a GSM module for real-time ECG data transmission and alerts, focusing on remote healthcare applications【26†source