Cloud Based Real Time ECGMonitoring System

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***Abstract*——Real time Electrocardiogram (ECG) monitoring system play a vital role in healthcare, enabling continuous monitoring of cardiac activity in both clinical and ambulatory setting. This project work presents the design and implementation of a real time ECG monitoring system. This system utilizes standard gel based electrodes interfaced with AD8232 Instrumentation Amplifier. The analog output is digitized using ESP32 microcontroller. The digital datais transferred to a remote system using Wi-Fi connectivity in the remote system the ECG data is analyzed using PQR peaks of the signal the heart beat is estimated. If any abnormality is detected, then it connects to doctor through Ubidots. Then doctor can immediately analyze the patient's condition and give treatment accordingly. This helps to save the life of a patient who is in medical emergency.**

Keywords: Electrocardiogram, Gel electrodes, AD8232, Ubidots,Remote monitoring system.

I. INTRODUCTION

Nowadays cardio vascular disease patient are increased dayby day in around the world more than 0.5 millions of peopleare affected by the cardiovascular disease in 2021 because most of patient didn't get that proper treatment on a time. sowe are designing the cloud based real time Electrocardiogram monitoring system to reduce the death of the cardiac vascular disease patient by remote monitoring system, this system can be used in anywhere and anytime by using this system doctor cananalyzes the ECG signal of patient from anywhere with absence of the patient, This remote helps to rural area people where it's hard to find heart doctors, a system that shows heart tests live on a screen can let doctors far away give advice without making patients travel far to the hospital. If heart problems are caught early, it can stop people from needing to go to the hospital or get emergency help, which can cost a lot ofmoney. Doctors keep checking a person's heart ECG signals analyzing by this system, they can quickly findany problems with the heartbeat. Finding these problems early means they can help the person quickly and stop things from getting worse, which can make the patient get correct treatment at a time. The prevention can be done during the early detection of the disorder. The death rate can reduce up to 80%.

II METHODOLOGY

The AD8232 a bio-signal amplifier, is being useful for data acquisition, observing physiological signals like ECG from the body. To get correct readings, these signals frequently contain unwanted high-frequency noise, which could change the data. Hence, we design a low pass filter into the circuitry becomes essential. This filter acts as a selectively allowing through only the low-frequency components of the signal, we can clearly observe the noiseless ECG signal. ESP32 microcontroller acts as the intermediary between the sensor data and the cloud, where the handled information can be stored, analyzed, and visualized. Using MQTT, a lightweight and efficient messaging protocol perfectly matched for IoT applications the ESP32 creates a connection with Ubidots, a cloud platform widely known for its data visualization and analysis capabilities. In the field of Ubidots, the data stream is received with open arms, ready to be transformed into useful observations. The platform's used to update real time ECG signals to get loginthe platform we need username and password. Hence the doctor can analyzed ECG signals from the Ubidots platform and give the treatment to the patient immediately. IV

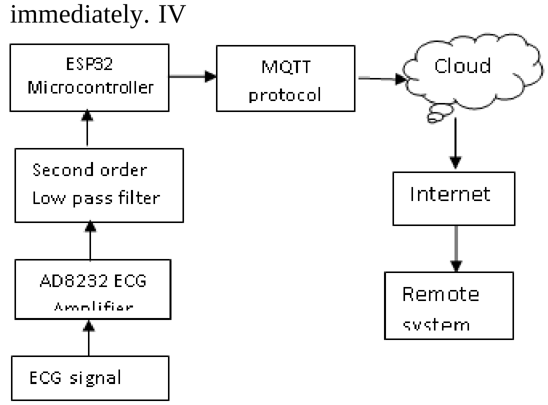

Fig 1: Block Diagram

III THE CARDIAC CYCLE

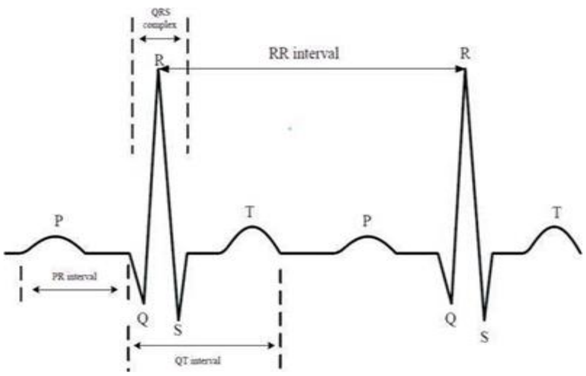

Fig 2: Standard ECG signal

P Wave: The P wave corresponds to atrial depolarization, which is the electrical activation of the atria. It signifies the spread of electrical impulses through the atria, triggering atrial contraction (atrial systole). This phase prepares the heart for ventricular filling.

QRS Complex: The QRS complex represents ventricular depolarization, the electrical activation of the ventricles. It consists of three distinct waves:

Q Wave: Represents the initial downward deflection following the P wave, indicating the onset of ventricular depolarization.

R Wave: Represents the main upward deflection in the QRS complex, reflecting rapid ventricular depolarization.

S Wave: Represents the subsequent downward deflection, signifying the completion of ventricular depolarization.

Together, the QRS complex corresponds to the spreadof electrical impulses through the ventricles, leading to ventricular contraction (ventricular systole). This phaseis crucial for pumping blood out of the heart to the restof the body.

IV COMPONENTS USED

A. ESP32

The ESP32 is a powerful microcontroller widely used in IoT applications, including real-time ECG monitoring systems. It transfer the ECG signal from AD8232 ECG amplifier to the specified cloud without wireless connection between them.

Fig 3: ESP32 Microcontroller

B. AD8232 ECG Amplifier

The AD8232 ECG amplifier is an integrated analog front-end for single-lead ECG monitoring. It is designed to extract ECG signal from gel electrodes which was placed to human body it amplify, and filter small bio potential signals in the presence of noisy conditions.

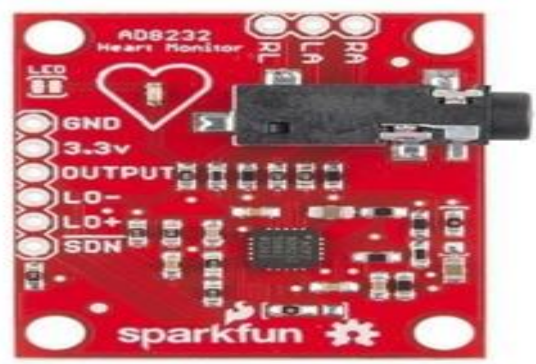

Fig 4:AD8232 ECG Amplifier

C. Low pass filter

A low pass filter is an electronic circuit that allows signals with frequencies lower than a specified cutoff frequency to pass through while attenuating signals with frequencies higher than the cutoff. It's commonly used to remove high-frequency noise from signals. For biomedical application we design the second order low pass filter of cut off frequency 200Hz to get noise less ECG signal.

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D. Ubidots

Ubidots is a cloud-based IoT platform that provides tools for collecting, analyzing, and visualizing data from connected devices. we uploaded the ECG signal to this cloud so, we can visualize ECG signal from anywhere and anytime by login trough this cloud using username and password.

E. MQTT Protocol

MQTT (Message Queuing Telemetry Transport) isa lightweight messaging protocol designed for efficient communication between devices in constrained environments, particularly in the Internet of Things (IoT). It allows publish-subscribe architecture for the Ubidot platform. where devices publish messages to the subscribe to receive messages. MQTT operates over TCP/IP, so it does not loss the packet of data.

Consider

$f=1/2\pi RC$

C1 & C2 = 0.01uf

R1 = R2 = $1/2\pi fc$

$R1=R2=1/2*\pi*200*0.01*10^{-6}$

V-RESULT

The real-time ECG monitoring system using the ESP32 and AD8232 allows for continuous monitoring of the user's heart activity. The system captures ECG signals from the AD8232, processes them using the ESP32, and transmits the data over Wi-Fi to a cloud platform for visualization and analysis. This setup enables remote monitoring and early detection of any abnormal heart activities, contributing to better healthcare management.

R1 = R2 = 80kΩ

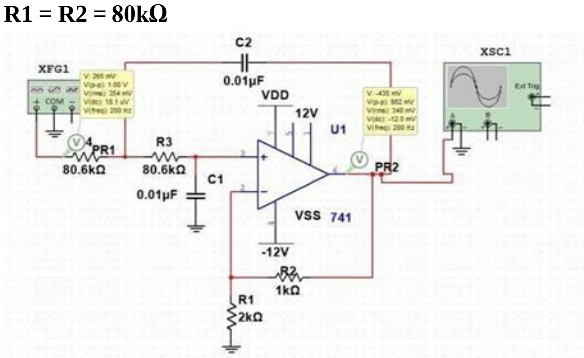

Fig 5: Second order Butterworth low passes Filter for cut off frequency 200Hz

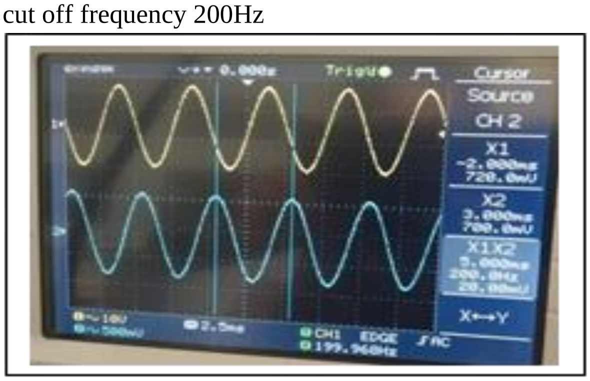

Fig 6: low pass filter signal

Fig 7: Sub-1 ECG signal Acquisition

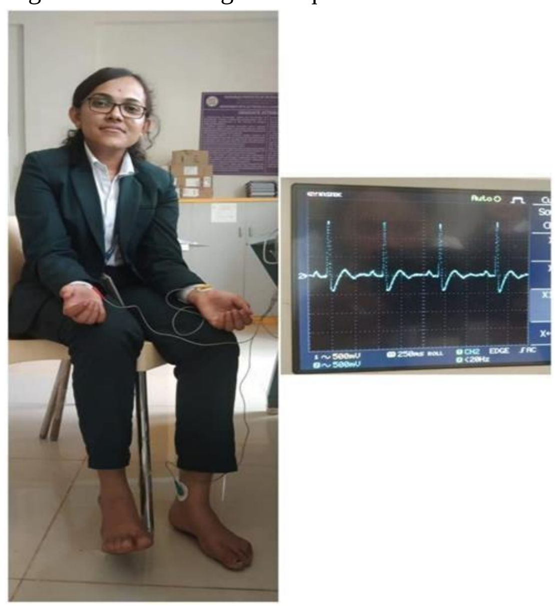

Fig 8: Sub-2 ECG signal Acquisition

Fig 10: Sub 4 ECG signal Acquisition

Table 1: Heart Beat Calculated from ECG

SL. NO	Subject	PQR interval	Heart beat perminute
1	Kavya M M	0.70sec	85
2	Tejashwini S	0.69sec	86
3	Vidyashree H M	0.71sec	84
4	Rakshitha G	0.69sec	86

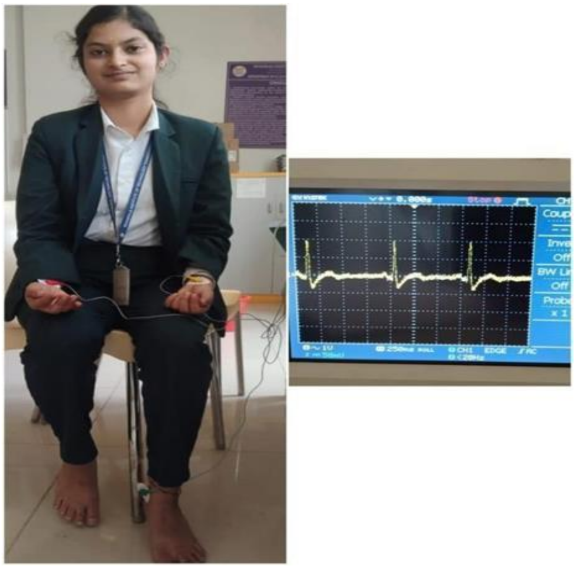

Fig 9: Sub 3 ECG signal Acquisition

VI - CONCLUSION

With the help of AD8232 ECG Amplifier the ECG signal was acquired successfully from the subjects using gel electrodes. The noise present in the signal was removed using a second order Butterworth low pass filter with a cut off frequency of 200Hz.This signal was uploaded to Ubidot platform using ESP32 microcontroller which has in built WI-FI and Bluetooth modules. In Ubidot we can visualize ECG signal from anywhere and anytime through user login and password process. This platform will help doctors to analyze the ECG signal of the patients and they can give immediate treatment based on the severity. Hence this Cloud based system will certainly help the patients to get instant information from the doctors with suitable treatment and life of the patients can be saved

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