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DESIGN AND IMPLEMENTATION OF LOW POWER EDGE ENABLED EMBEDDED SYSTEM FOR REAL TIME ATRIAL FIBRILLATION DETECTION USING MULTI LEAD ECG

[1]Name of 1st P.Dhivya, 2nd T.Mahalakshmi,3rd G.Maharajan,4th V.Sathishkumar,5th V.Thirunarayanan

Assistant Professor,Final year students, Department of Biomedical Engineering
Sri Shanmugha College Of Engineering And Technology ,Salem,Tamilnadu,

Abstract : Cardiovascular diseases are a problem that causes a lot of deaths around the world. One common issue is arrhythmia, which can be very bad if it is not found early. So it is really important to keep an eye on what the heart's doing all the time. This helps find any problems at the start. Sometimes patients do not feel anything is wrong which makes it very useful to have systems that can check the heart in time. If we can find heart rhythms early we can really reduce the chance of serious problems and make patient care much better.

This project is about a system that can check the heart rhythm using ECG. The system is designed to find arrhythmia and send alerts to buzzer away if it sees anything wrong. It gets signals from the heart using sensors and looks at them all the time. If the signal does not look right the system sends an alert to the buzzer. This helps doctors or nurses act fast especially when time is very important.The system also has a collection of ECG data from about 500 patients. This data includes both abnormal heart signals. The system uses this data to compare with the real-time signals it gets. This helps make sure the system is accurate when it says there is a problem. By comparing the signals the system can not find arrhythmia but also give an idea of what is going on with the disease. This makes the analysis more helpful.All the data and results are shown in a way that's easy to understand. The system is made to work and can be used in hospitals or at home. The goal of this system is to give an affordable way to find arrhythmia early. This helps make decisions and keeps patients safe by sending alerts to buzzer and doing accurate analysis. The system is really good, at checking for arrhythmia and other heart problems. Arrhythmia is a deal and the system is designed to help with that..

INTRODUCTION

Cardiovascular health is really important these days because a lot of people are getting heart diseases. One of these diseases is arrhythmia, which's when the heart beats in a weird way it can be too fast or too slow. Cardiovascular health monitoring is crucial to detect arrhythmia. If we do not find out about arrhythmia early it can cause problems like strokes or heart failures or even something as bad as a sudden cardiac arrest.

The old ways of checking the heart with ECG machines are only used in hospitals and need doctors to watch over them all the time, which is not very practical for checking the heart over a long time. This means we need a system that can check the heart all the time and tell us if something is wrong.

So this project is about making a system that can check the heart in time and find arrhythmia. The system checks the heart signals. Tells us right away if it finds something wrong. The system gets the ECG data. Looks at it and then it compares it to other ECG data that we already have to make sure it is **correct. By looking at the** data in time and comparing it to other data we hope to make a system that is easy to use and good at finding heart problems early. This can be used in hospitals and, at home. It can help doctors find problems faster and take better care of patients. Cardiovascular health monitoring and arrhythmia detection are the goals of this system.

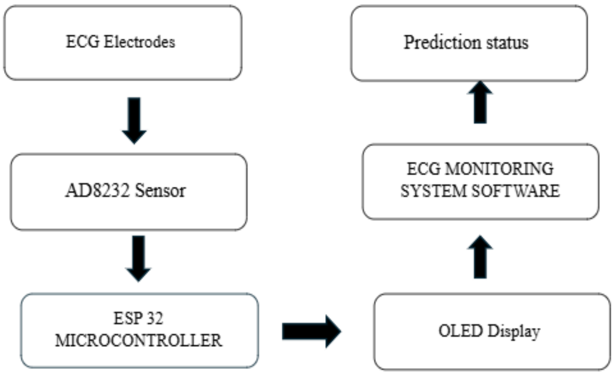
LITERATUREREVIEW

In recent years there has been an increasing amount of research into the developments in healthcare technology. This has led to the creation of systems that use ECG to detect arrhythmia. A lot of research is focused on using sensors to monitor heart activity in real time. These sensors allow us to track what is going on with the heart when people are not in the hospital.

Researchers use ECG systems with one lead or many leads to get signals from the heart. They then use techniques to process these signals like filtering and classifying them. Single-lead systems are simple. Do not cost a lot. However they are not always accurate especially when it comes to detecting arrhythmias. ECG systems with leads are better at detecting these problems.

Some systems use approaches to analyze ECG data in real time. They do this on devices or microcontrollers which helps to reduce delays and make the system more reliable. However these devices are not very powerful. It is hard to get accurate results. To solve this problem researchers try to use algorithms and design the hardware in a way that makes it work better.

When we look at all the research that has been done it is clear that we need a system that can do a things. It needs to be able to get ECG data in time process it efficiently and detect arrhythmia reliably. It should be able to do all this without needing a lot of help. This project is trying to fill these gaps by combining real-time monitoring with an approach. This approach compares the ECG data to a dataset that already exists. The goal is to make the detection more accurate while keeping the system simple, portable and affordable. This would make it useful, for both hospitals and remote healthcare



Existing Model Diagram

HARDWARE COMPONENTS :

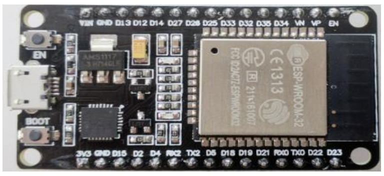


FIGURE 1.1: ESP 32

ESP32 is a microcontroller with built-in Wi-Fi and Bluetooth capabilities .It operates at 3.3V and has a high-speed dual-core processor. It includes multiple ADC pins for reading analog signals like ECG.

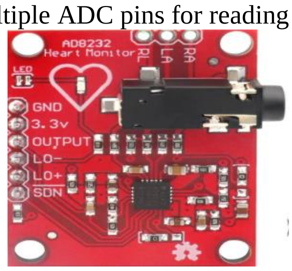


FIGURE 1.2:AD8232 SENSOR

AD8232 is a low-power analog designed for ECG signal acquisition. It amplifies and filters weak heart bio-signals from the body. Operates at 3.3V and provides analog output. Commonly used for portable and wearable heart monitoring system

FIGURE1.3:ECG LEAD SCABLE

Three electrodes used to capture electrical signals from the body. RA (Right Arm), LA (Left Arm), RL(Right Leg – ground/reference).Helps in forming a complete ECG signal circuit. Placed on the body to detect heart activity.

Buzzer:

A buzzer is an electronic audio signal device usually found in embedded systems to produce sounds and alert and when abnormal ECG signals are detected. Helps in giving immediate warning to the user or caregiver without needing to check the display

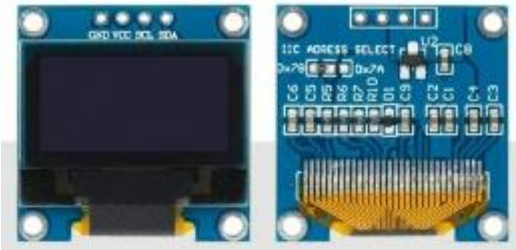


FIGURE 1.4:OLED DISPLAY

A compact display module used to visualize ECG waveform and heart rate In real time . Typically has 128×64 resolution with low power consumption. Communicates using I2C protocol (SDA, SCL pins).Provides clear visualization of real-time data.it provides fast response time making it suitable for continuously updating the signals like ECG waveforms**.**

SOFTWARE COMPONENTS

Figure 1:1 ARDUINO IDE

Arduino IDE

Arduino IDE: An easy to use, powerful environment designed as an Integrated Development Environment (IDE)for creating, compiling and uploading programs to the Arduino platform and other compatibly designed board. The programming interface can be accomplished through either C or C++, making the IDE a sufficient way for both novice and experienced programmers to produce embedded applications on multiple platforms; and can be accomplished by utilizing the user interface components: text editor, compiler, and serial monitor. Therefore, this allows for creating programs that target your hardware devices, all from one location using this IDE.

Figure 2.2: ESP 32 programing code for ECG

A highly efficient C++ library used on the ESP32 to serialize the analog ECG readings into JSON payloads before transmitting them to the server.WiFi. (ESP32 Built-in): Used to establish and maintain a connection between the ESP32 and the local Wi-Fi network.

Google Antigravity

Figure 2.3:Antigravity Software

Recommended environments for developing the Python backend, training the machine learning models, and building the frontend

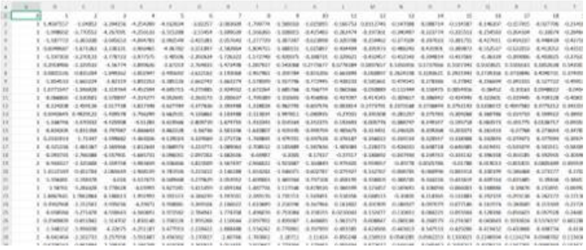
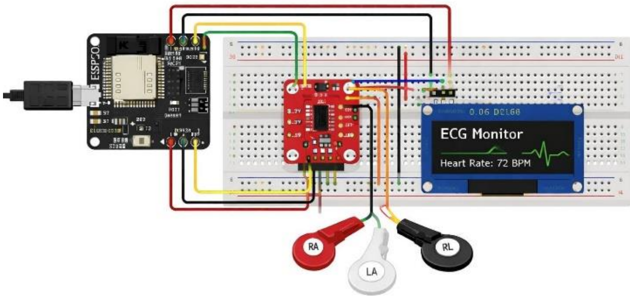


FIGURE 2.4: ECG DATAS

FIGURE 2.5: ECG SOFTWARE

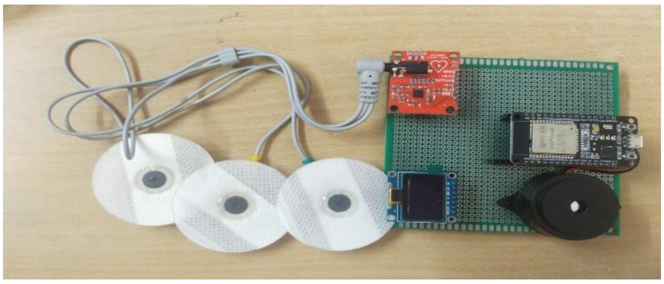
PROPOSED SYSTEM :

Existing Circuit Diagram



The new ECG monitoring system is an portable thing that can get and show heart signals in real time. It uses three electrodes. Right Arm, Left Arm and Right Leg. To catch the hearts electrical activity. These small signals from the body go into the AD8232 ECG sensor module, which makes them stronger and clearer by removing extra noise. The cleaned up signal then goes to the ESP32 microcontroller, which's the main brain of the system. It changes the signal from analog to digital using a built-in part. Looks at it to figure out the heart rate and find simple problems. The results show up on a screen, which displays the ECG waveform and heart rate as it happens power the system with a USB cable, which makes it easy to use and good for watching someones heart all the time. It is small. Does not cost a lot so it is great for people to use at home or in wearable devices. Also the ESP32 allows it to connect to things without wires so it can be used for remote monitoring storing data and working with mobile apps in the future. In all this ECG monitoring system is a good way to keep an eye, on someones heart outside of a hospital, which helps find heart problems early and take better care of patients. The ECG monitoring system is very useful for the ECG monitoring system to work well

OPERATINGPRINCIPLE:



Final output of The Existing System

The operating system of the proposed ECG monitoring device does things at the same time. It gets the ECG signals in time processes them compares them to known patterns and sends alerts if needed. The ECG signals are first taken from the patient using electrodes on the arm left arm and right leg. These signals go through the AD8232 sensor to make them stronger and remove noise. The sensor helps to clean up the signal. Then it is changed into a digital format by the ESP32 microcontroller. The ESP32 microcontroller looks at the signal to find important details like the heart rate and shape of the waveform. At the time the system software looks at a database of about 500 ECG examples that were stored beforehand. The current ECG signal is compared to these examples to see if it matches any known patterns. This is done using methods to check for abnormal heart rhythms.

If the system finds a pattern it immediately sends an alert through a buzzer or a notification on the screen. The OLED display shows the ECG waveform, the heart rate in beats per minute and whether a disease was detected.The combination of the hardware and software in the system allows for monitoring, early detection of problems and reliable support, for diagnosis.

Reference

[1.] 2022, Chen J.et al, Edge2Analysis: A Novel AIoT Platform for Atrial Fibrillation Recognition and Detection.

[2.] 2022, Rahman M.A. et al., Deep Learning Method for Detecting Atrial Fibrillation Using ECG Features.

[3.] 2022, Oh S.L. et al., Detection of Atrial Fibrillation from Wearable Sensors Using Deep Learning.

[4.] 2022, Bacevicius J.B. et al, Wearable Six-Lead ECG Device for Atrial Fibrillation Detection.

[5.] 2023, Xie J. et al., Automated Identification of Atrial Fibrillation from ECG Using ResNet.

[6.] 2023, Mazzenga F. et al., MUSE: Multi-lead ECG for Remote AI Based Atrial Fibrillation Detection.

[7.] 2024, Akter M. et al., An Embedded System for Real-Time Atrial Fibrillation Diagnosis Using ECG Data.

[8.] 2024, Ben-Moshe N. et al., RawECGNet: Deep Learning for Atrial Fibrillation Detection.

[9.] 2025, Sharma R. et al., Low Power Edge-Based Embedded System for Real-Time Atrial Fibrillation Detection Using Multi-Lead ECG.

[10.] 2025, Lee H. et al., Energy Efficient Deep Learning Model for Real-Time Atrial Fibrillation Detection on Edge Devices.

[11.] 2026, Rantula O.A. et al., Deep Neural Network for Wearable ECG Data in Atrial Fibrillation Detection.