

# *Synopsis of*

## Operational Amplifier Based ECG Board

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## Abstract:

This paper provides the synopsis of our final year project that is based on the topic- OPAMP based ECG board. The following parts of the paper discuss about the problem statement, which is a basic technical stack along with the workflow chart followed by the motivation behind choosing this project. The paper concludes with the novelty of the project and some of the references that are being used for this project.

## Problem Statement:

The purpose of this project is to develop an OPAMP based ECG board by developing it, we can contribute to improving healthcare outcomes, advancing technology, and enhancing knowledge in biomedical engineering as well as in Electronics field. An ECG's job is to amplify the small signal measured from the heart as well as to filter outside and internal noise. The amplification is mainly implemented through a differential amplifier whereas filtering is completed through common and differential mode filtering. There is also the Right Leg Drive circuit which cancels noise and maintains the common mode voltage.

## Literature Survey/Basic Technological Idea:

Heart diseases are becoming a big issue for the last few decades and many people die because of certain health problems. Therefore, heart disease cannot be taken lightly. By analyzing or monitoring the ECG signal at the initial stage this disease can be prevented. So we present this project, i.e ECG Monitoring with **AD8232 ECG Sensor & ESP32 with ECG Graph**.

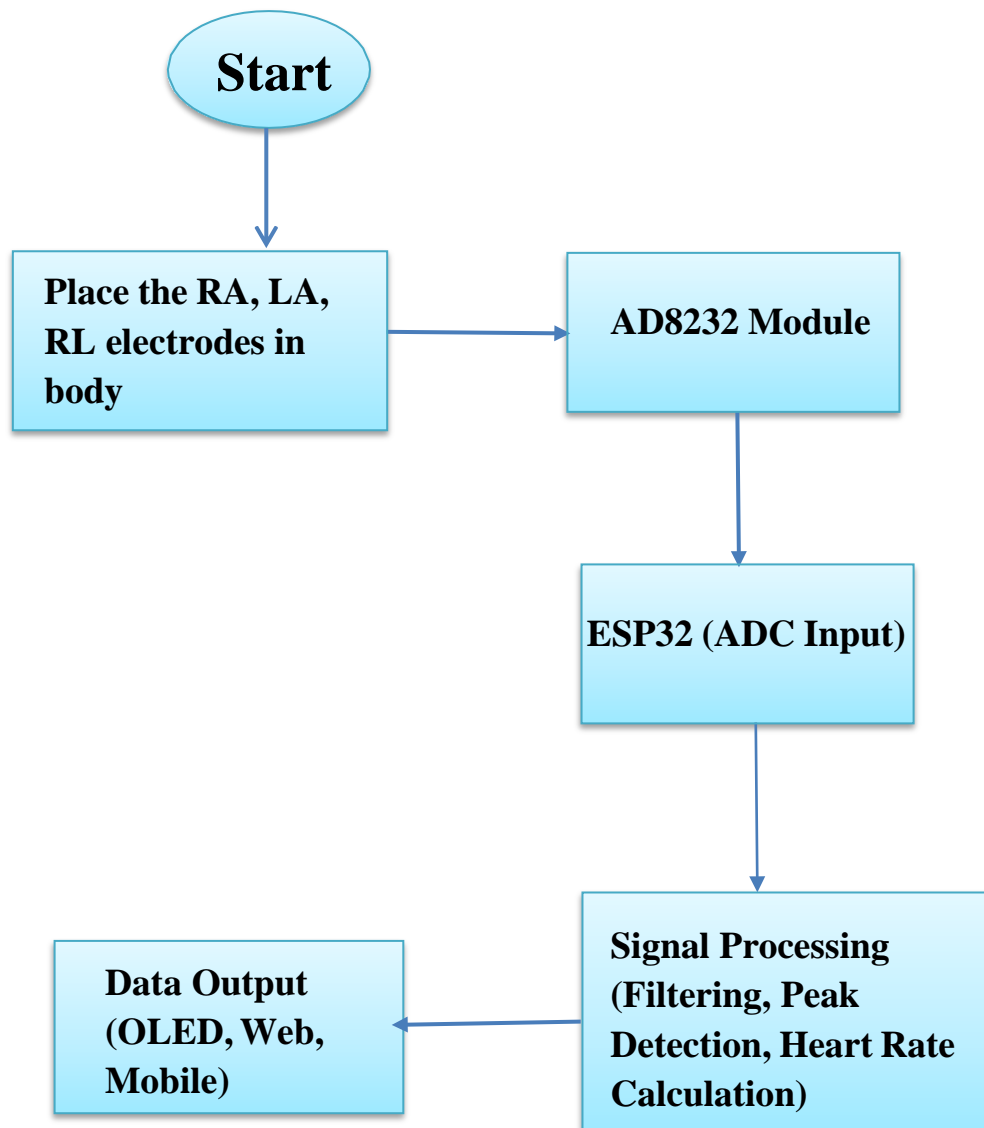
The **AD8232** is a neat little chip used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram. Electrocardiography is used to help diagnose various heart conditions.

This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or **Electrocardiogram** and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

### **The advantages of making an op-amp based ECG (Electrocardiogram) include:**

1. High gain: Op-amps can amplify weak heart signals, making it easier to detect and analyse.
  2. Low noise: Op-amps can filter out noise and interference, providing a clearer signal.
  3. High input impedance: Op-amps won't load down the electrodes, ensuring accurate signal capture.
  4. Differential amplification: Op-amps can amplify the difference between two signals, reducing common-mode noise.
  5. Flexibility: Op-amps can be configured for various gain settings and filter types.
  6. Low power consumption: Op-amps are energy-efficient, suitable for battery-powered devices.
  7. Cost-effective: Op-amps are widely available and relatively inexpensive.
  8. Simple design: Op-amp based ECG circuits can be designed with minimal components.
- These advantages make op-amp based ECGs suitable for portable, wearable, or implantable devices.

# Work Flow/Process Flow



# Motivation behind This Project:

Our primary focus is preventing heart disease by analyzing or monitoring ECG signals. An ECG (electrocardiogram) records the heart's electrical activity, helping diagnose conditions like arrhythmias, heart attacks, pacemaker function, and heart failure. The ECG waveform is analyzed to assess cardiac health. Key components include the P wave, which represents atrial contraction; the QRS complex, which begins with a small downward Q wave, peaks with an R wave, and ends with a downward S wave, indicating ventricular depolarization and contraction; and the T wave, a smaller upward deflection representing ventricular repolarization. By studying these waveform components, we can monitor heart function and detect abnormalities.

## **Medical uses of ECG**

An electrocardiogram can be a useful way to find out whether your high blood pressure has caused any damage to your heart or blood vessels. Because of this, you may be asked to have an ECG when you are first diagnosed with high blood pressure.

Some of the things an ECG reading can detect are:

- 1. cholesterol clogging up your heart's blood supply.**
- 2. a heart attack in the past.**
- 3. enlargement of one side of the heart.**
- 4. abnormal heart rhythms.**

So The main objectives of making an OPAMP based ECG project are:

- 5. Design and develop a low-cost ECG device:** Create a cost-effective ECG solution using open-source hardware and software.
- 6. Improve accessibility:** Make ECG technology more accessible to people in resource-constrained areas or those who cannot afford commercial ECG devices.

## Novel contribution :-

1. Ultimately our goal is to develop a 5 lead ecg module with instrumentation amplifier.
2. This will be cheap and more accurate than 3 lead ecg and will become handy in remote places where immediate standard ecg facility are not available.
3. Other than that the SpO2 facility will give a clear indication of the patient condition.

## References:

- I. A precision low-level DAS/ECG Cardiometer Demo Board, a Texas Instruments technical presentation created by John Brown.
- II. Analog Fundamentals of the ECG Signal Chain, a Texas Instruments technical presentation prepared by Matthew Hann.
- III. ECE 445 Biopotential amplifiers prepared by Professor Andrew Mason
- IV. INA333 data sheet