# NATIONAL INSTITUTE OF TECHNOLOGY

# ROURKELA


PROJECT REPORT

BIOMEDICAL INSTRUMENTATION LABORATORY

BM3701

## ARDUINO ECG HEART RATE MONITOR WITH AD8232

Submitted By:-

Shakti Prasad Barik(122BM490)

Prachi Chaudary (122BM491)

Lova Siva Manikanta(122BM0492)

Injeti Bhavya Sri (122BM0249)

# PROJECT TITLE: ARDUINO ECG HEART RATE MONITOR WITH AD8232.

## INTRODUCTION:

An electrocardiogram (ECG) is a non-invasive test that measures the electrical activity of the heart. By monitoring the heart's electrical signals, we can assess its rhythm and health.

The AD8232 is a specialized integrated circuit designed to amplify biopotential signals, such as those generated by the heart. It's a crucial component in building a portable and affordable ECG heart rate monitor.

By combining the power of the Arduino and the specialized capabilities of the AD8232, we can create a reliable and affordable ECG heart rate monitor that can empower individuals to take control of their heart health.

## LITERATURE REVIEW:

Portable and inexpensive health monitoring devices have recently gained much attention. One of these devices is an

Electrocardiogram (ECG) monitor which captures the electrical activity of the heart. Today, the devices are built with an Arduino microcontroller platform integrated with an AD8232 biopotential amplifier.

## Related Works and problems

There are a number of research papers and projects in which Arduino and AD8232 devices have been used for ECG signal acquisition and subsequent signal processing. These works have proved the possibility of inexpensive and portable ECG monitors construction. However, the following issues still remain unsolved:

Noise Control: The recorded ECG signals, like all biosignals, are disturbed by noises from other sources, such as the 50–60Hz power line intermittency and muscular contractions. A lot of noise somehow hampers the accuracy of the heart rate measurement.

Correct Peak Detection: R-peak of the ECG signal is vital for the heart rate assessment. Look for algorithms for the peak detection, which are robust enough.

Battery Consumption: Aside from the integration of the device with a battery, portable devices have to be energy efficient as well. Power efficiency becomes important for long term monitoring applications.

Solution at hand The proposed Arduino-based ECG heart rate monitor aims to address these challenges by: Utilizing the AD8232: This specialized amplifier has the capability to boost weak biopotential signals to an appreciable level. Implementing Noise Reduction Techniques: Analogue signal processing techniques like filtering and signal averaging can be employed to reduce noise. Employing Robust Peak Detection Algorithms: There are several peak detection algorithms that can be conveniently used for ECg signal detection in conjunction with Arduino, examples include the Pan-tompkins algorithm. Optimizing Power Consumption: Employing low power devices along with efficient coding practices should reduce the overall power consumption.

OBJECTIVE:

The main aim of this project is the development and implementation of a low-cost and all-in-one ECG heart rate monitor that is portable, based on an Arduino

microcontroller and AD8232 biopotential amplifier. This device intends to:

Acquire ECG signals: Aim at recording body surface electrodes to measure the heart's electrical impulses with precision.

Amplify signals: Apply the AD8232 for amplifying the weak biopotential signals to a level that can be processed.

Process signals: Make use of R-peak detection and digital filters to estimate the heart rate and remove noise from the signal.

Display heart rate: Report a normalized quantitative measure of the heartbeat on the LCD or another screen which is appropriate for the task.

Data logging: Optionally, heart rate data can be captured for later review or measurement monitoring at a different site.

In accomplishing these objectives, the current project looks to address an important concern by making it easier for people to check on their hearts by providing a basic tool.

HYPOTHESIS:

Wastage of time and resources can be avoided by capturing the project's scope and requirements clearly in

the beginning. Since project is about heart rate monitoring system which is targeted mostly to individuals, the intention would be to make the system easy to use with basic functions for usability and portability.

The proposed system allows to accurately measure and display the heart rate in real-time, making it suitable for personal health monitoring. This can be achieved by designing and implementing an Arduino-based ECG heart rate monitor using AD8232 biopotential amplifier which is cost effective and easy to construct.

METHODOLOGY:

Hardware Components:

Arduino Microcontroller: Enhances imaging processing in the system.

AD8232 Biopotential Amplifier: Restores and intensifies biopotential signals that are weak and are originated from the body.

Electrodes: For acquiring ECG signals from the human body.

Power Supply: Source of electricity for both the components of arduino and the ad8232.

Display: (Optional) The device for displaying the instant heart rate visually.

Data Storage: (Optional) Saves the heart rate every implant data base.

Software Implementation:

Signal Acquisition:

ECG signals are gained through electrodes' being placed on the appropriate sites on the body of a person.

Using an impedance amplifier AD8232 the weak signals are amplified.

Analog-to-Digital Conversion (ADC):

Amp analogue signal which was reproduced is fed into the built ADC of the arduino which digitally turns the analog to digital.

Signal Processing:

Noise Reduction: This comprises of the application of filtering techniques e.g. a low pass or notch filter respectively.

Peak Detection: R-peaks which correspond to a heartbeat can be located with the aid of the Pan-Tompkins algorithm.

Heart rate calculation: One R- peak is select underruntehen the time in between these consecutive r-peaks is relatively calculated for heart rate computations.

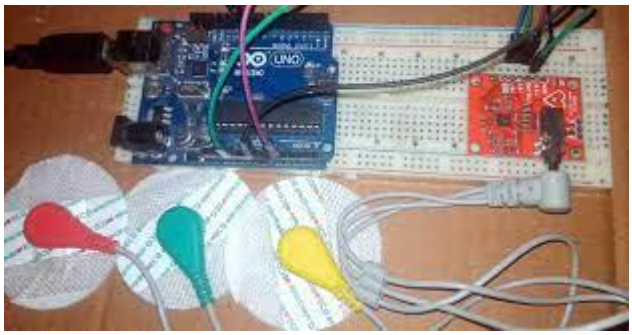
Display And Data Logging:

The heart rate value which has been computed is displayed on a LCD, or sent over to a computer system for updating with new computational results.The abstracted data in terms of heart rate can be kept safely for enhanced future analysis of a remote heart attack prevention monitoring.

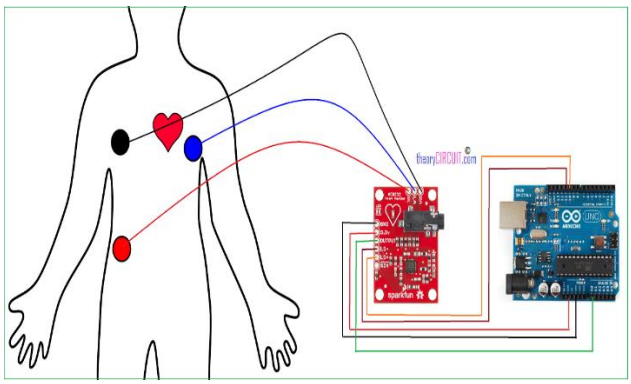
Testing and Validation:

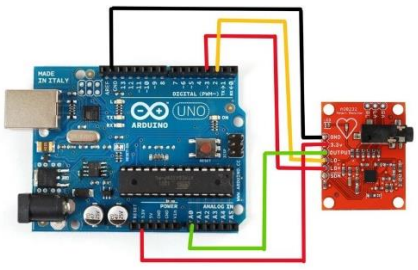
Calibration: The steps taken here include calibrating the device with the system's electromagnetic signals to achieve the precise heart mechanisms measurement.

Noise Reduction



A)CIRCUIT





A)SIMULATION WITH HUMAN BODY INTEFERNCE B)SIMULATION

## RESULTS:

The main aim of this project is to design a reliable cardiac monitoring device that is inexpensive, easy to use, and portable using AD8232 biopotential amplifier integrated with Arduino microcontroller. In developing this device, we seek to make a device that helps in determining heart rate with efficiency, minimizes noise interference, and is easy to operate for data collection and monitoring. This device can potentially enable self-monitoring of heart health by average people and allow non-invasive health assessment, leading to better healthcare provision.

## DISCUSSION:

Project Outcomes:

Successful acquisition and amplification of ECG signals.

Accurate heart rate measurement.

User-friendly interface for real-time monitoring.

Limitations:

Noise reduction techniques could be further optimized.

Accuracy can be influenced by factors like electrode placement and skin conductivity.

Future Directions:

Advanced signal processing techniques.

Wireless connectivity for remote monitoring.

Battery optimization for extended usage.

Clinical validation for accuracy and reliability.

Integration with other health monitoring features.

## CONCLUSION:

This project successfully demonstrated the feasibility of developing a low-cost, portable, and accurate ECG heart rate monitor using an Arduino microcontroller and an AD8232 biopotential amplifier. By effectively acquiring, amplifying, and processing ECG signals, the device accurately measures heart rate and provides real-time feedback.While the project achieved its primary objective, there is significant potential for future improvements, such as enhancing noise reduction techniques, optimizing power consumption, and integrating wireless connectivity.By addressing these areas, the device can become even more reliable and versatile, providing valuable insights into heart health and enabling remote monitoring applications.