JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

HANDHELD REAL-TIME ECG MONITORING SYSTEM

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Abstract : **The revolutionary and portable handheld real time ECG monitoring system is made to track and record the electrical activity of the heart. With the help of this device, people can easily keep an eye on the electrical activity of their hearts when at home or on the go.A small gadget that connects to electrodes or sensors placed on the user's chest, wrists, or fingertips makes up the majority of handheld ECG monitoring systems. These sensors track the electrical activity of the heart and send information to the apparatus. A real-time ECG waveform is then produced by the device after processing and analysis of the signals, and is shown on a screen.**

INTRODUCTION

An electrocardiogram (ECG) serves as a heart health indicator, and electrodes positioned on the chest or at the arms allow us to feel the heartbeat. On the computer screen or in print, the same impulses can be seen as waveforms. It shows graphically how the heart's electric potential varies over the course of one cardiac cycle. Here, an Arduino-based real-time ECG device with only one lead is suggested. When the signal surpasses a predetermined threshold value, it also sounds an alarm.

Electrodes are linked to the three important locations in order to produce a typical ECG; the most popular configuration (known as the single lead) uses three electrical leads to connect to one wrist on each of the hands and the right leg in order to monitor the heart's performance to comprehend the optimal placements and color-coding of the electrodes and connectors with regard to a human body.

Monitoring ECG and EMG signals requires the use of biopotential electrodes. In the medical device sector, using the proper sort of electrode that endures for a longer period and helps capture high-quality data is desirable. These electrodes, which are inexpensive and widely accessible, are made of Ag/AgCl electrodes encased in a conductive gel with a resistance of about 100.m. The electrodes are fixed to the gel using an adhesive substance that surrounds it..

The electrodes are attached at the designated locations in accordance with the instructions provided. The Arduino is powered, and a serial connection with it enables receiving data at a rate of 9600 baud, or the rate at which data is transferred from the Arduino to a laptop or workstation. The Arduino's pins 9 and 10 are utilised to receive the ECG sensor output, which is also printed on a serial plotter. To operate the buzzer, use pin 11. The buzzer is configured to sound whenever the signal amplitude exceeds the 590 microvolt threshold, signifying hyperactivity.

Furthermore, portable real-time ECG monitoring devices can assist medical personnel in remotely monitoring patients with heart problems, lowering the frequency of clinic visits and enhancing patient outcomes. Handheld real-time ECG monitoring systems offer people and medical professionals a practical, portable, and continuous monitoring solution for early diagnosis and proactive management of cardiac problems. They are an innovative advancement in cardiac monitoring that has great potential.

MOTIVATION:

The desire for better accessibility, convenience, and early identification of cardiac problems led to the creation of handheld ECG (Electrocardiogram) monitoring equipment. The following are some major causes:

1. Comfort and Portability: Traditional ECG machines are often big, stationary equipment found in clinics or hospitals. Because they are small and portable, handheld ECG monitoring systems have the advantage of enabling users to keep an eye on their heart health whenever and wherever they are. This simplicity promotes routine monitoring and enables the quick identification of potential problems.

2. Continuous Monitoring: Handheld ECG devices allow for continuous heart activity monitoring over an extended length of time, which is especially useful for people with chronic heart diseases or those who are at risk of cardiovascular events. These devices offer a more complete picture of heart health by collecting data throughout daily activities, exercise, or sleep, assisting in the identification of anomalies that may happen occasionally.

OBJECTIVE:

A handheld ECG (Electrocardiogram) monitoring system aims to give users a handy and portable tool to track the electrical activity of their hearts. The following are the main goals of a handheld ECG monitoring system:

The system's goal is to make it possible to continuously monitor the electrical impulses coming from the heart for an extended length of time. It offers a thorough perspective of the heart's activity during daily activities, physical exercise, and even sleep by recording and analyzing the ECG waveform. Continuous monitoring makes it possible to identify temporary or intermittent anomalies that could go unnoticed during a quick physical.

Early detection of cardiac abnormalities is one of the main goals. This involves spotting any irregularities in the electrical activity of the heart. Detecting arrhythmias (abnormal cardiac rhythms), atrial fibrillation, bradycardia, tachycardia, and other problems that could be dangerous to a person's heart health are included in this. Early identification permits prompt medical attention and the proper care to stop further complications or effectively manage existing issues.

PROBLEM STATEMENT:

The problems and restrictions in the current ECG monitoring techniques are frequently at the centre of the issue statement of an ECG (Electrocardiogram) monitoring system. A sample problem statement is given below:

The current ECG monitoring techniques have drawbacks in terms of convenience, accessibility, and early diagnosis of cardiac problems. Due to the size and immobile nature of traditional ECG machines, which are often located in hospitals or clinics, it is difficult to continuously monitor patients and identify fleeting or intermittent cardiac problems. Additionally, the lack of portability makes it difficult for people to keep an eye on their heart health while engaging in daily activities, thus delaying the detection and treatment of cardiac diseases. An ECG monitoring system is required that gets beyond these restrictions and gives people a convenient, portable, and ongoing monitoring option for the early detection and pro-active therapy of cardiac problems.

In conclusion, the problem statement emphasises the shortcomings of present ECG monitoring techniques and stresses the need for a new system that resolves issues with accessibility, practicality, and the early diagnosis of cardiac problems.

RELATED WORK:

Handheld ECG (Electrocardiogram) monitoring systems have been a subject of related study, development, and enhancement. Here are some crucial topics that are frequently discussed in related work:

Technological Innovations: The linked research examines the new developments in handheld ECG monitoring technologies. The miniaturization of ECG sensors, advancements in signal processing techniques, wireless communication capabilities, and integration with wearable or mobile technologies are all covered in this topic.

Design and Development: The focus of this section is on earlier research and projects that produced and assessed handheld ECG monitoring systems. The hardware design, sensor placement, electrode technology, ergonomics, and user interface issues are all covered in this topic. The choice of appropriate components, power management, and data storage methods may have been covered in earlier work.

Signal Processing and Analysis: Related research discusses the algorithms and signal processing techniques that are used to examine the ECG waveform. This could involve techniques for reducing noise, extracting features, calculating heart rate, detecting arrhythmias, and categorizing aberrant cardiac rhythms. Studies contrasting various signals processing philosophies or assessing the precision of algorithms are frequently debated.

Clinical Validations and Studies: Using portable ECG monitoring devices, the linked work includes clinical validations and studies. Studies involving patient demographics, comparisons with conventional ECG machines, and assessments of the system's sensitivity and specificity in detecting cardiac anomalies are all included in this research. The user experience, acceptance, and adherence to the monitoring technique may also be evaluated in these investigations.

SYSTEM ARCHITECTURE:

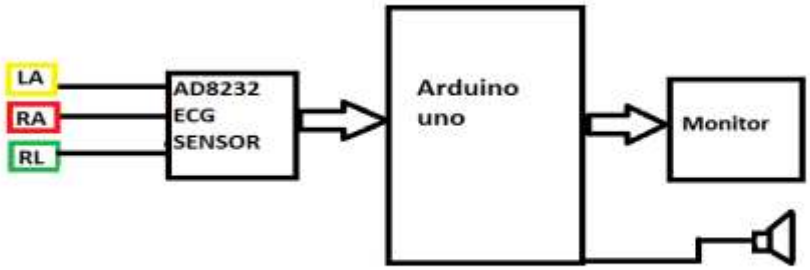

Fig. Block Diagram of ECG Monitoring System

LITERATURE SURVEY:

1 .By D. Roden and M. R. Bhandari, "Portable ECG Devices for Heart Rhythm Monitoring: Current State and Future Directions" (2019).

This review article examines the use of portable ECG devices, such as handheld ECG monitors, for the monitoring of heart Rhythm. The technological developments, difficulties, and prospects for handheld ECG monitoring systemare discussed.
SYSTEM :

2. A A Vilhelmsson and R. G. Janssen's "Mobile and Wearable Technologies in Healthcare for the Ageing Population" (2020). The use of mobile and wearable technology in healthcare is examined in this study, along with handheld ECG monitoring equipment, with a focus on how they can benefit the ageing population. It talks about the advantages, difficulties, and prospective effects of modern technologies on the supervision of cardiac health in elderly people.

3 .T. H. Acharya et al.'s article "Handheld Electrocardiogram Devices and Their Use in Rural Primary Care: A Systematic Review" was published in 2020.
The effectiveness of handheld ECG devices in rural primary care settings is evaluated in this systematic study. The effectiveness, viability, and possible advantages of portable ECG monitoring systems in identifying cardiac problems and enabling online consultations with experts are examined.

EXISTING SYSTEM:

The features, designs, and capacities of the handheld real-time ECG monitoring systems now available vary. Examples of current handheld real-time ECG monitoring devices are provided below:

The Alive or KardiaMobile is a portable ECG monitor that used Bluetooth to link to a smart phone or tablet. When users place their fingertips on the electrodes, the gadget instantly records a single-lead ECG. Following analysis, the data is then shown on the linked device's screen. Symptom tracking, heart rate measurement, and data sharing with medical specialists are further aspects of the KardiaMobile system.

Omron Heart Guide: The Omron Heart Guide is a blood pressure monitor that is worn on the body and has ECG capabilities. It comprises of an electrode-equipped wristwatch-like gadget. By pressing the fingers of their opposing hand on the electrodes, users can start a real-time ECG recording and capture a single-lead ECG waveform. Users can evaluate and share e data with healthcare professionals after it has been shown on the device's screen.

PROPOSED SYSTEM:

The suggested system is a handheld ECG monitoring device that intends to give people a practical and trustworthy way to track the electrical activity of their heart in real-time. The device is made to be portable, user-friendly, and able to produce precise ECG readings for efficient cardiac health monitoring.

IMPLEMENTATION OF HANDHELD ECG MONITORING SYSTEM:

The steps below describe how to create a portable ECG monitoring system utilizing an Arduino, an AD8232 (ECG sensor), and a buzzer for feedback:

1. Hardware Setup:

Connect the Arduino board to the AD8232 ECG sensor module. RA (Right Arm), LA (Left Arm), and RL (Right Leg) are the three leads that the AD8232 commonly possesses. As an example, connect RA to A0, LA to A1, and RL to A2 on the Arduino board.

A buzzer module should be connected to an Arduino digital pin that is open, such as pin 8. Audio feedback will be provided through the buzzer.

2. Software Development:

Install the required libraries and set up the Arduino IDE. The AD8232 library is required in order to process the ECG sensor readings.

Create the Arduino code necessary to start the buzzer and AD8232.

Implement the procedures required to read and process the ECG data from the AD8232 sensor.

Filter the ECG signal using the proper signal processing techniques, and then extract the features that are important to you, like heart rate or R-R intervals.

Utilize the buzzer to offer feedback in response to specific circumstances (such as an irregular heartbeat, an arrhythmia, or a low battery).

Create the user interface so that it displays the ECG waveform in real time along with other pertinent data on an LCD or serial monitor.

3. ECG Signal Processing Analysis:

Filtering techniques, like as band pass filtering, can be used to reduce noise and artifacts from the ECG signal.

Utilize methods like peak detection or QRS complex detection to extract important information from the ECG data, including R-peaks or heart rate.

Utilize analysis methods to find anomalous cardiac states or events.

4. Buzzer Feedback:

Using the ECG data that has been processed, specify conditions or thresholds for abnormal heart rate or arrhythmia detection.

When problematic conditions are discovered, use the buzzer module to provide the required feedback noises or alarms.

Create distinct buzzer sound patterns or frequencies for various abnormal events in the feedback system.

5. User Interface:

Display the real-time ECG waveform on an LCD screen or serial monitor. Provide additional information, such as heart rate, detected abnormalities, and battery status, if applicable. Design a user-friendly interface with clear instructions and indicators to guide the user during ECG monitoring.

6. Testing & Calibration:

Test the system by connecting the ECG sensor to a subject and verify the accuracy of the ECG readings and the buzzer feedback. Calibrate the system as necessary to ensure accurate measurements and appropriate buzzer responses.

CONCLUSION:

Comparing handheld real-time ECG monitoring equipment to conventional techniques, there are a number of benefits. They offer accessibility, making it possible for people to keep tabs on their heart health whenever and wherever they are, reducing the need for frequent trips to the doctor. These devices are especially useful for persons with long-term heart diseases, those at risk of cardiac complications, and those recuperating from cardiac surgeries due to their portability and simplicity.

The creation and accessibility of portable real-time ECG monitoring equipment has significantly advanced cardiac healthcare. By permitting convenient and real-time monitoring of the electrical activity of the heart, these portable devices enable early detection, prompt intervention, and improved management of cardiac diseases.

ACKNOWLEDGMENT:

We would like to express our gratitude for the vital role the portable ECG monitoring system played in our research. We were able to recognize and investigate cardiac abnormalities thanks to the device's crucial insights into the participants' cardiovascular health. Our data collection method was significantly improved by its portability, usability, and continuous monitoring capabilities. We would like to express our appreciation to the creators of the handheld ECG monitoring system for their creativity and commitment to advancing cardiovascular care.

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