A
Project Report
on

Cardiovascular Monitoring and Real-

-time Reporting

Submitted to

Sant Gadge Baba Amravati University, Amravati

Submitted in partial fulfilment of
the requirements for the Degree of
Bachelor of Engineering in
Electronics and Telecommunication Engineering

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Certificate

This is to certify that the project report entitled **"Cardiovascular Monitoring and Real Time Reporting System"** is hereby approved as a creditable study carried out and presented by

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in a manner satisfactory to warrant of its acceptance as a pre-requisite in a partial fulfillment of the requirements for the degree of Bachelor of Engineering in Electronics & Telecommunication Engineering of Sant Gadge Baba Amravati University, Amravati during the Session 2022-23.

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Abstract

Nowadays, healthcare has become one of the most substantial issues for both individuals and government due to brisk growth in human population and medical expenditure. Many patients suffer from heart problems causing some critical threats to their life; therefore, they need continuous monitoring by a traditional monitoring system such as Electrocardiographic (ECG). The proposed ECG monitoring system consists of AD8382 ECG sensor to read patient's data, Arduino Uno, ESP8266 Wi-Fi module, and IoT Blynk application. The implementation of the proposed ECG healthcare system enables the doctor to monitor the patient's remotely using IoT Blynk application installed on his smartphone for processing and visualizing the patient's ECG signal. The monitoring process can be done at anytime and anywhere without the need for the hospital.

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Acknowledgement

We would like to take this opportunity to express our heartfelt thanks to our guide Prof. V.N. Bhonge for his esteemed guidance and encouragement, especially through difficult times. His suggestions broaden our vision and guided us to succeed in this work. We are also very grateful for his guidance and comments while designing part of our project and learnt many things under his leadership. Also, we would like to thank to Dr. M. N. Tibdewal, Head of Electronics and Telecommunication Department, all teaching and non-teaching staff of EXTC Department for their encouragement and suggestions for our project.

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Abbreviations

IoT	- Internet of Things
GSM	- Global System for Mobile
WHO	- World Health Organization
ECG	- Electrocardiogram
ICU	- Intensive Care Unit
Wi-fi	- Wireless Fidelity
CVD	- Cardiovascular disease
ICSP	- In Circuit Serial Programming
USB	- Universal Serial Bus
SRAM	- Static Random Access Memory
EEPROM	- Electrically Erasable Read Only Memory
TTL	- Transistor transistor logic
PWM	- Pulse Width Modulation
SPI	- Serial Peripheral Interface
I2C	- Inter Integrated Circuit
UART	- Universal Asynchronous Receiver Transmitter
LED	- Light Emitting Diode
IC	- Integrated Circuit

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1. Introduction

Nowadays, a patient monitoring system is getting much more popular among researchers and patient guardians. This system has the capability to monitor physiological parameters from the patient's body at regular intervals. This system is responsible for collecting pulse, body temperature, and heart bit from the patient's body and sending the data into the IoT Cloud platform by using a WIFI-Module and the health condition of the patient stored in the cloud.

It enables the medical specialist or authorized person to monitor the patient's health, whereas the medical specialist or authorized person can continuously monitor the patient's condition on the cloud server.
The proposed outcome of this research is to give suitable and effective health facilities to patients.

1.1 Problem Statement

- In today's world, health problems related to the heart are very common. Cardiovascular diseases are one of the most important causes of death among men and women. It claims approximately 1 million deaths every year.
- The personal health monitoring of each individual is considered very important because of the rise in health problems in today's world. The increasing stressful lifestyle is taking a maximum toll on public health.
- In such cases the absence of the doctors, the patient cannot consult the doctors due to which emergency situations may also be created. In such cases of emergency, the doctors need total attention to the patients and the details of their vitals.

1.2 Objectives

1) Here the main objective is to design a Remote Patient Heart Monitoring System to diagnose the health condition of the patients.

2) Giving care and health assistance to the patients at critical stages with advanced medical facilities.
3) To provide cost-effective and fast responding alert mechanism.
4) To provide timely warnings to the medical staffs and doctors, so that patient get timely response.
5) To provide patients data remotely, which will allow for taking preventive measure (e.g., up on foreseeing an upcoming heart stroke) or provide immediate care (e.g., when a user falls and needs help).

1.3 IoT (Internet of Things)

A very simple definition of IoT is anything, anytime, anywhere. IoT in healthcare has played a prominent role in the redesigning of present systems with the current advancements in the field of technology associated with IoT. IoT based solutions guarantee health monitoring not only in hospitals and house environment, but also in outdoor environments.

1.4 Advantages of IoT in Healthcare

The IoT (Internet of Things) field is growing rapidly, and more people are relying on smart devices and smart building technology during their day-to-day lives. In fact, the smart building market is expected to reach $109.48 billion by 2026

With the growth of the smart building market, IoT applications and devices are evolving to meet the growing demands of a digital world. Wherever there are opportunities for innovation, forward-thinking IoT vendors are producing creative solutions to enhance comfort, convenience, security and more.

Opportunities for IoT innovation in the healthcare industry are constantly appearing and evolving. Medical facilities have unique challenges, and loT vendors are developing new ways to address those challenges.

Applications of IoT in medical care range from environmental controls and security solutions to wearable sensors and cloud-connected medical equipment. The positive impact of IoT in healthcare transforms the healthcare experience, improving patient outcomes and enhancing quality of care.

IoT start-ups are finding new implementations within healthcare and are leveraging connected sensors for better diagnoses, monitoring and guiding patient treatment. The major advantages of the IoT in healthcare are the following:

1) Reduces costs of medical treatment
2) Betters' outcomes of treatment
3) Better diseases management and reduced errors
4) Improves patient experience
5) Upgrades management of drugs.

2. Literature Review

2.1 Intelligent wireless mobile patient monitoring system. (2010 International Conference on Communication Control and Computing Technologies)

Nowadays, Heart-related diseases are on the rise. Cardiac arrest is quoted as the major contributor to the sudden and unexpected death rate in the modern stress filled lifestyle around the globe. A system that warns the person about the onset of the disease earlier automatically will be a boon to the society This is achievable by deploying advances in wireless technology to the existing patient monitoring system. This paper proposes the development of a module that provides mobility to the doctor and the patent, by adopting a simple and popular technique, detecting the abnormalities in the bio signal of the patient in advance and sending an SMS alert to the doctor through Global System for Mobile (GSM) thereby taking suitable precautionary measures thus reducing the critical level of the patient. Worldwide surveys conducted by World Health Organization (WHO) have confirmed that the heart-related diseases are on the rise Many of the cardiac-related problems are attributed to the modern lifestyles, food habits, obesity, smoking, tobacco chewing and lack of physical exercises etc. The post operative patients can develop complications once they are discharged from the hospital. In some patients, the cardiac problems may reoccur, when they start doing their routine work Hence the ECG of such patients needs to be monitored for some time after their treatment. This helps in diagnosing the improper functioning of the heart and take precautions. Some of these lives can often be saved if acute care and cardiac surgery is provided within the so-called golden hour So, the need for advice on first hand medical attention and promotion of good health by patient monitoring and follow up becomes inevitable Hence, patients who are at risk require that their cardiac health to be monitored frequently whether they are indoors or outdoors so that emergency treatment is possible. Telemedicine is widely considered to be part of the inevitable future of the modern practice of medicine [19].

2.2 The real-time monitoring system for in-patient based on ZigBee. (2008 Second International Symposium on Intelligent Information Technology Application)

The system is made up of two sub-systems. patient physical states data acquisition and communication system based on ZigBee technology, and hospital monitoring and control center. The patient physical states data acquisition and communication system monitors the main physical parameters and movement status continuously. The information from data acquisition system is sent to hospital monitoring center by ZigBee wireless communication module The monitoring center receives the information from each patient and save them to the database, and then judges the states of the patient by fuzzy reasoning. The data from the patient can be displayed as a graph or numeric on the monitor if it is necessary, and then the doctor can diagnose the patient according to the recorded continuous data. Wireless sensor network is made up of a lot of wireless sensors based on ZigBee technology. The ZigBee technology provides a resolution for transmitting sensors' data by wireless communication. ZigBee technology can transmit data with a rate of 250kbps, and then it is enough for the physical parameters of the patient. The communication distance of ZigBee node can be over 200 meters and can be spread by add route node, and then Zigbee technology is suited to a short distance wireless sensors network. ZigBee technology owns many virtues, such as low power consumption, low cost, small size, free frequency, etc to know the physical states of in-patient, the physical parameters need to be monitored real-time the traditional medical test instrument is a large size and connected by wire often, and the patient is required to be quiet during the test. In most of the hospital, the medical instruments need to be read by doctor or nurse, and the physical parameters are tested and recorded one or two times each day, the real-time monitoring is expensive for most of the patients, and can be only acquirable for ICU by a nurse For this reason, the worsening of patient can't be found in time, and then the patient can't be helped in time For most of the patients can be monitored real-time in hospital, we should find a new method Consider that the movement of the patient is limited in hospital, we adopted the ZigBee and wireless sensors network to acquire the physical parameters of the patient[20].

2.3 Health Monitoring system using IoT (2018 International Conference on Advances in Computing and Communication Engineering (ICACCE) Health has prime importance in our day-to-day life. Sound health is necessary to do the daily work properly This project aims at developing a system which gives body temperature and heart rate using LM35 and pulse sensor respectively. These sensors are interfaced with controller Arduino uno board. Wireless data transmission done by Arduino through Wi-Fi module. ESP8266 1s used for wireless data transmission on IoT platform i.e, thing speak Data visualization is done on Thing speak. So that record of data can be stored over period of time. This data stored on web server so that it can see to who logged[21].

2.4 An IoT-Based E-Health Monitoring System Using ECG Signal (GLOBECOM 2017-2017 IEEE Global Communications Conference)

In this paper, we present an Internet of Things (IoT)-based health care system implementation scheme using Hidden Markov Model (HMM) chain and Electro Cardio Gram (ECG) sensors within the context of e-health. The scheme aims to facilitate improved monitoring and timely intervention for Cardio Vascular Diseases (CVD) patients thereby enhancing medical services for such patients As real-time monitoring of patients from different locations remains a critical challenge for IoT-based health care systems, this implementation employs patient path estimator, patient table and alert management schemes within the hospital to facilitate the localization and timely intervention for the treatment of CVD patients[22].

2.5 A Smart Patient Health Monitoring System using IoT (June 2020 Indonesian Journal of Electrical Engineering and Computer Science)

The healthcare monitoring systems has emerged as one of the most vital systems and became technology oriented from the past decade. Humans are facing a problem of unexpected death due to various illness which is because of lack of medical care to the patients at night time The primary goal was to develop a reliable patient monitoring system using IoT so that the healthcare professionals can monitor their patients, who are either hospitalized or at home using an IoT based integrated healthcare system with the view of ensuring patients are cared for better A mobile device based wireless healthcare monitoring system was developed which can provide real time online information about physiological conditions of a patient mainly consists of sensors, the

data acquisition unit, microcontroller (i.e. Arduino), and programmed with a software i.e. JAVA) The patient's temperature, heart beat rate, ECG data are monitored, displayed and stored by the system and sent to the doctor's mobile containing the application. Thus, IoT based patient monitoring system effectively monitor patient's health status and save life on time[23].

2.6 IoT Based Patient Monitoring System using ECG Sensor. (2019 International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST))

Patient monitoring is a pivotal part of the healthcare system nowadays, either at hospitals or at home. This paper proposes an intelligent patient monitoring system that automatically screens the patient's health condition through various sensors. The data Is then processed using a Raspberry Pi and useful information is saved to the IoT cloud. Primarily the system would be extracting the bio signal, ECG using an ECG sensor Through continuous monitoring and graphical representation of the patient's information, doctors/nurses/relatives can remotely check the patient's condition. Furthermore, if the condition becomes critical, a notification is sent to the doctor/nurse/relative to inform them and either party will have the opportunity to start a video call [24].

2.7 Comparison of different Research papers

Sr no	Research paper name	Authors	Year of Publication	Conclusion
1	Internet of Things (IoT) Driven U-healthcare system architecture	Yvette E. Galego, Jung-won Oh, Jinn Woo Park	2022	This paper studies the u-healthcare system with respect to the Internet of Things (IoT) perspective. .The background of Internet of Things (IoT) and its application are also discussed.
2	IoT Based Emergency Health Monitoring System	Md. Raseduzzaman Ruman Amit Barua Waladur Rahmandcxs	2021	This paper provides solution for uninterrupted health monitoring system for the patients. The professional and family member can monitor their patient from a remote location at any time.
3	IoT-Based Applications in Healthcare Devices	Bikash Pradhan, Saugat Bhattacharyya, Kunal Pal	2020	This paper represents the system for monitoring the patient's body 24/7 by using IoT. The system used in this

				paper has the capability to monitor physiological parameters from patient body at every 15 seconds.
4	An IoT based Environment Monitoring System	Mosfiqun Nahid Hassan, Mohammed Rezwanul Islam, Fahad Faisal	2020	This paper presents an IoT based framework that effectively monitors the change in an environment using sensors, microcontroller, and IoT based technology. Users can monitor temperature, humidity, detect the presence of harmful gases both in the indoor and outdoor environment using the proposed module.

Table 2.1: Comparison of different Research papers

3. Hardware

3.1 Block Diagram

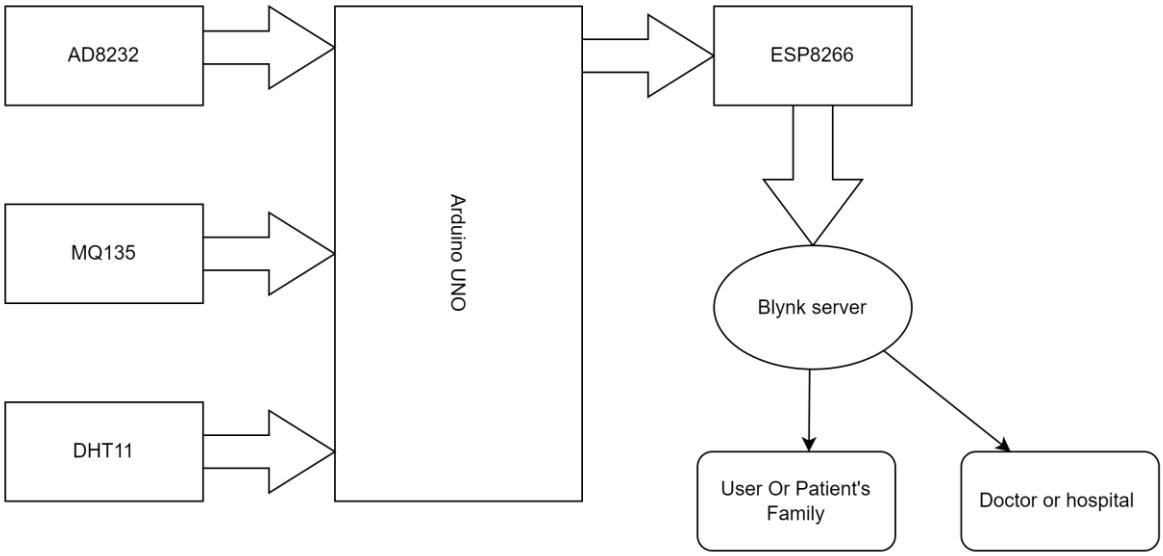


Fig. 3.1 Block diagram of project

3.2 Component Description

1. Arduino Uno
2. MQ-135 Air Quality Sensor
3. AD8232 ECG Sensor
4. DHT 11 Sensor

3.2.1 Arduino Uno

Arduino Uno is a microcontroller board based on ATmega328.This board includes digital I/O pins-14, a power jack, analog I/Ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header.

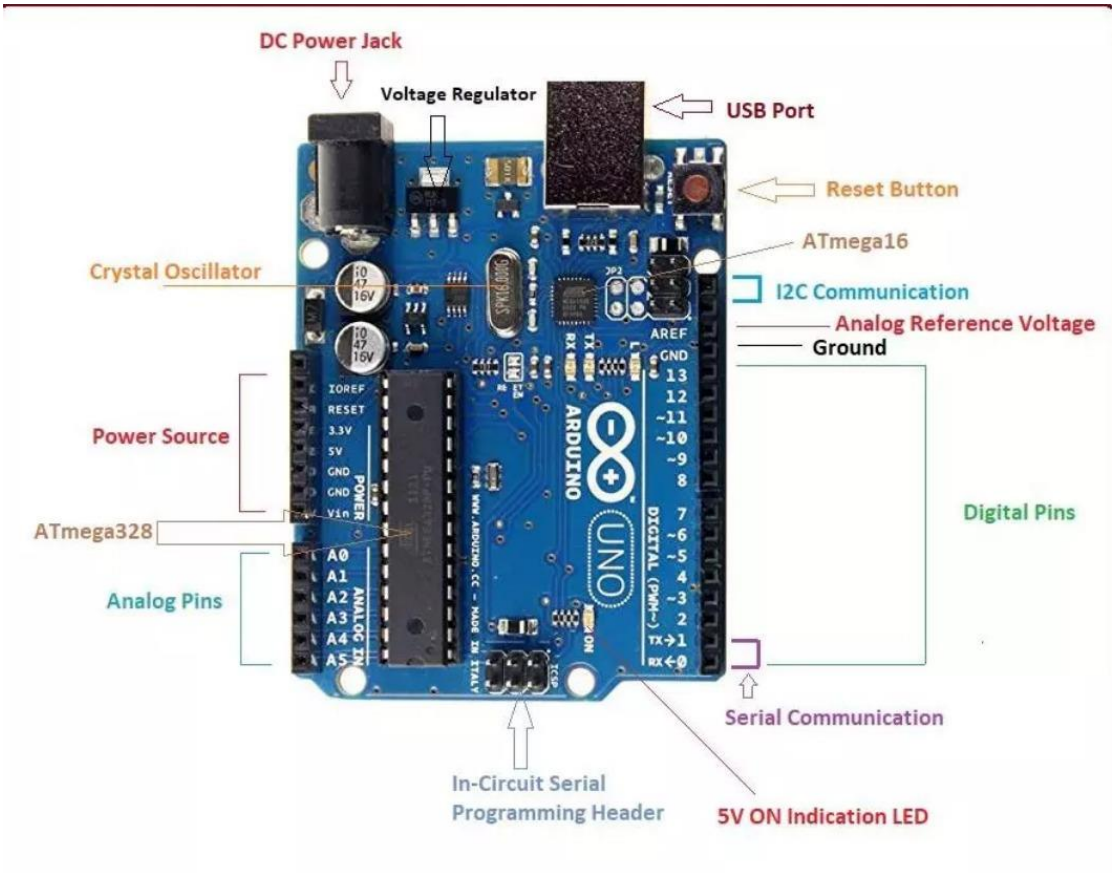


Fig.3.2 Arduino Uno

All these can support the microcontroller for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a battery.

Features of Arduino Uno

- The operating voltage is 5V
- The recommended input voltage will range from 7v to 12V
- The input voltage ranges from 6v to 20V
- Digital input/output pins are 14
- Analog I/P pins are 6

- DC Current for each input/output pin is 40 mA
- DC Current for 3.3V Pin is 50 mA
- Flash Memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK Speed is 16 MHz

Arduino Uno Pin Configuration

Power Supply

The Arduino Uno power supply can be done with the help of a USB cable or an external power supply. The external power supplies mainly include AC to DC adapter otherwise a battery. The adapter can be connected to the Arduino Uno by plugging into the power jack of the Arduino board. Similarly, **the battery** leads can be connected to the Vin pin and the GND pin of the POWER connector. The suggested voltage range will be 7 volts to 12 volts.

Input & Output

The 14 digital pins on the Arduino Uno can be used as input & output with the help of the functions like pinMode(), digitalWrite(), & Digital Read().

Pin1 (TX) & Pin0 (RX) (Serial): This pin is used to transmit & receive TTL serial data, and these are connected to the ATmega8U2 USB to TTL Serial chip equivalent pins.

Pin 2 & Pin 3 (External Interrupts): External pins can be connected to activate an interrupt over a low value, change in value.

Pins 3, 5, 6, 9, 10, & 11 (PWM): This pin gives 8-bit PWM o/p by the function of analogWrite().

SPI Pins (Pin-10 (SS), Pin-11 (MOSI), Pin-12 (MISO), Pin-13 (SCK): These pins maintain SPI-communication, even though offered by the fundamental hardware, is not presently included within the Arduino language.

Pin-13(LED): The inbuilt LED can be connected to pin-13 (digital pin). As the HIGH-value pin, the light emitting diode is activated, whenever the pin is LOW.

Pin-4 (SDA) & Pin-5 (SCL) (I2C): It supports TWI-communication with the help of the Wire library.

AREF (Reference Voltage): The reference voltage is for the analog I /P with analog Reference().

Reset Pin: This pin is used for reset (RST) the microcontroller.

Memory

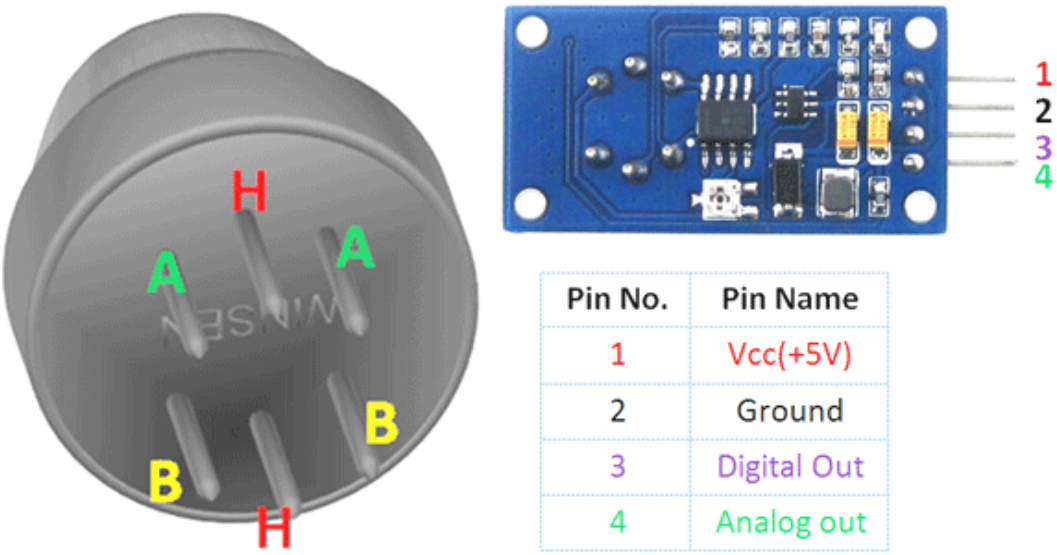
The memory of this Atmega328 Arduino microcontroller includes flash memory-32 KB for storing code, SRAM-2 KB EEPROM-1 KB.

Communication

The Arduino Uno ATmega328 offers UART TTL-**serial communication**, and it is accessible on digital pins like TX (1) and RX (0). The software of an Arduino has a serial monitor that permits easy data. There are two LEDs on the board like RX & TX which will blink whenever data is being broadcasted through the USB.

3.2.2 MQ 135 Air Quality Sensor

An MQ135 air quality sensor is one type of MQ gas sensor used to detect, measure, and monitor a wide range of gases present in air like ammonia, alcohol, benzene, smoke, carbon dioxide, etc**.**



Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

Figure 3.3 MQ 135 Air Quality Sensor

Features of MQ 135 Air Quality Sensor

- Wide detecting scope
- Fast response and High sensitivity
- Stable and long life
- Operating Voltage is +5V
- Detect/Measure NH3, NOx, alcohol, Benzene, smoke, CO2, etc.
- Analog output voltage: 0V to 5V
- Digital output voltage: 0V or 5V (TTL Logic)

- Preheat duration 20 seconds
- Can be used as a Digital or analog sensor
- The Sensitivity of Digital pin can be varied using the potentiometer

Interfacing of MQ-135 Air Quality Sensor with Arduino

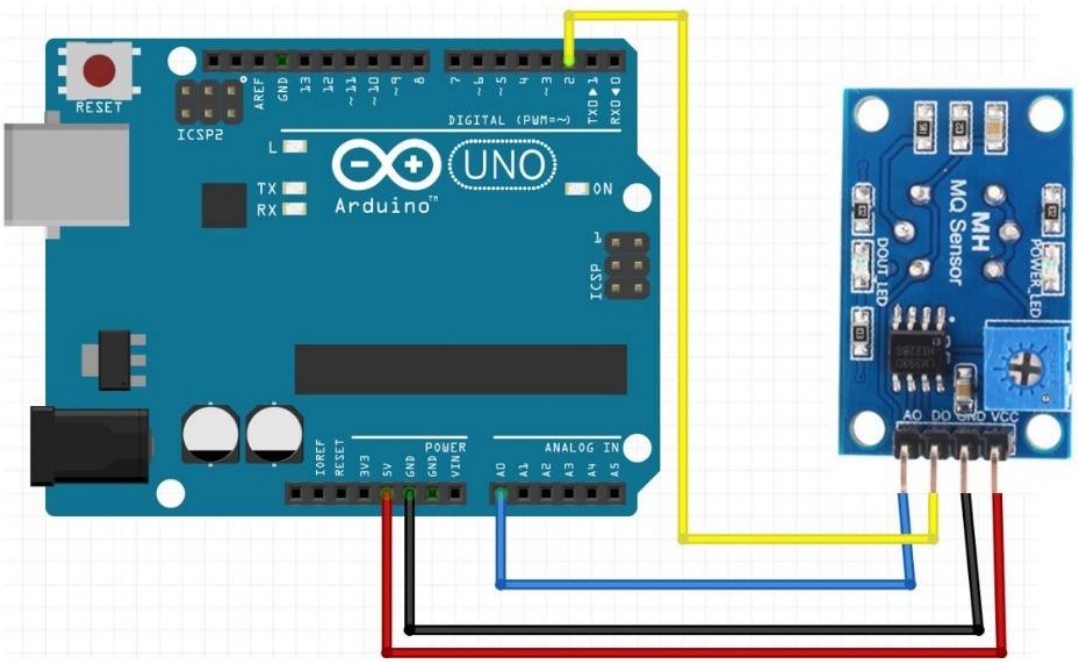


Fig 3.4 Interfacing of MQ-135

3.2.3 AD8232 ECG Sensor

The AD8232 ECG sensor is a commercial board used to calculate the electrical movement of the human heart. This action can be chart like an Electrocardiogram and the output of this is an analog reading.

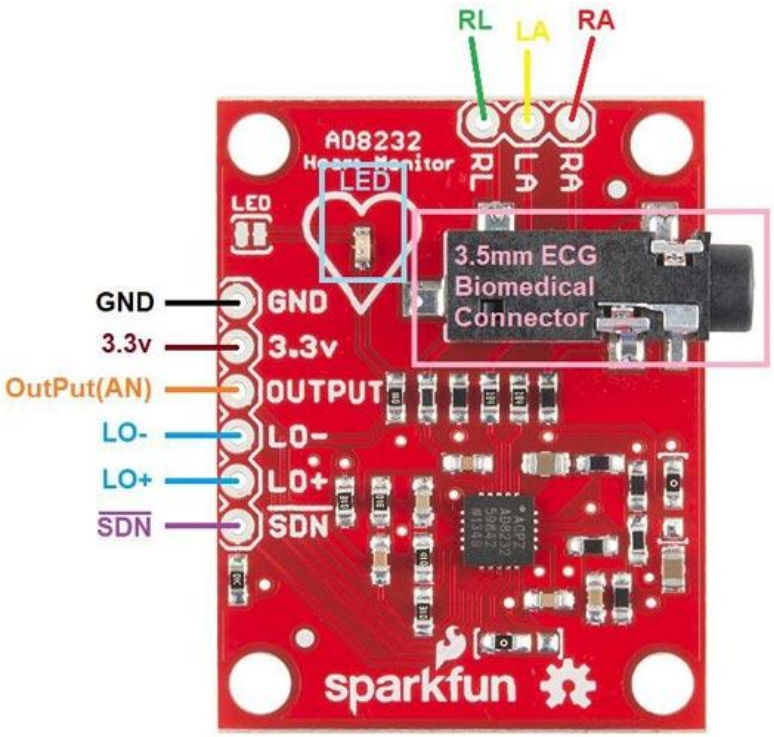


Fig 3.5 AD8232 ECG Sensor

Electrocardiograms can be very noisy, so to reduce the noise the AD8232 chip can be used. The working principle of the ECG sensor is like an operational amplifier to help in getting a clear signal from the intervals simply.

The AD8232 sensor is used for signal conditioning in ECG as well as other measurement applications of biopotential. The main purpose of this chip is to amplify, extract as well as filter biopotential signals which are small in the noisy conditions like those formed through the replacement of remote electrode as well as motion.

AD8232 Pin Configuration

The heart rate monitoring sensor like AD8232 includes the pins like SDN pin, LO+ pin, LO- pin, OUTPUT pin, 3.3V pin, and GND pin. So that we can connect this IC to development boards like Arduino by soldering pins.

Additionally, this board includes pins like the right arm (RA), left arm (LA) & right leg (RL) pins to connect custom sensors. An LED indicator in this board is used to indicate the heartbeat rhythm of humans.

The AD8232 sensor comprises a function like quick restore, used to decrease the length of long resolving tails of the HPFs. This sensor is accessible in a 4 mm × 4 mm size, and the package of this sensor is 20-lead LFCSP. It operates from −40°C -to- +85°C but the performance is specified from 0°C -to- 70°C.

Features and Specifications

- Operation of single supply ranges from 2V to 3.5V
- The front end is integrated fully with only lead ECG
- The virtual ground can be generated through integrated reference
- RFI filter is used internally
- The current supply is low like 170 µA
- The output is rail to rail
- Shutdown pin
- CMRR is 80 dB
- Incorporated RLD amplifier (right leg drive
- Electrode configurations are 2 or 3
- The operational amplifier is uncommitted
- It accepts half cell potential up to ±300 mV
- Three-pole adaptable LPF with adaptable gain
- The signal gain is high using DC blocking capacity
- Filter settling can be improved by quick restore
- Two-pole adaptable HPF
- 4 mm × 4 mm and 20-lead LFCSP package

Interfacing of AD8232 ECG Sensor with Arduino

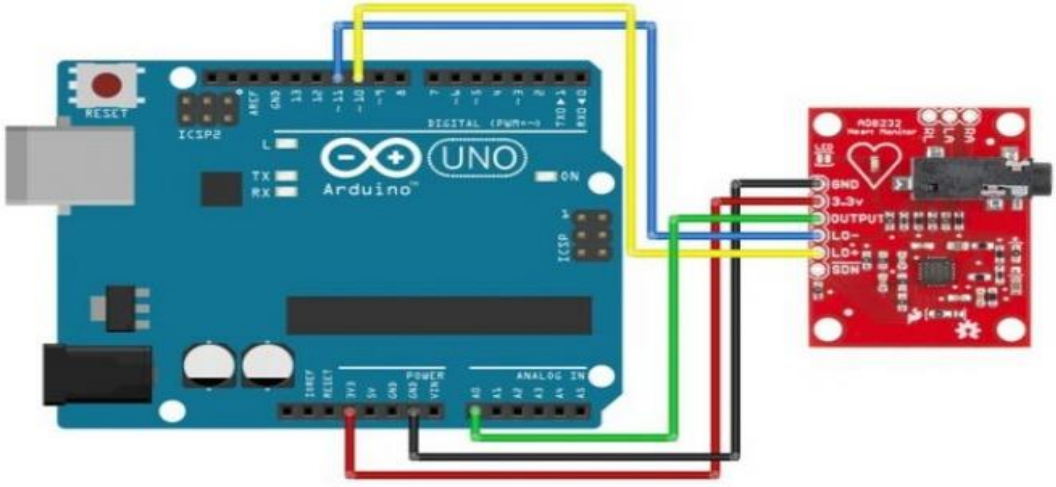


Figure 3.6 Interfacing of AD 8232

3.2.4 DHT11 Sensor

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

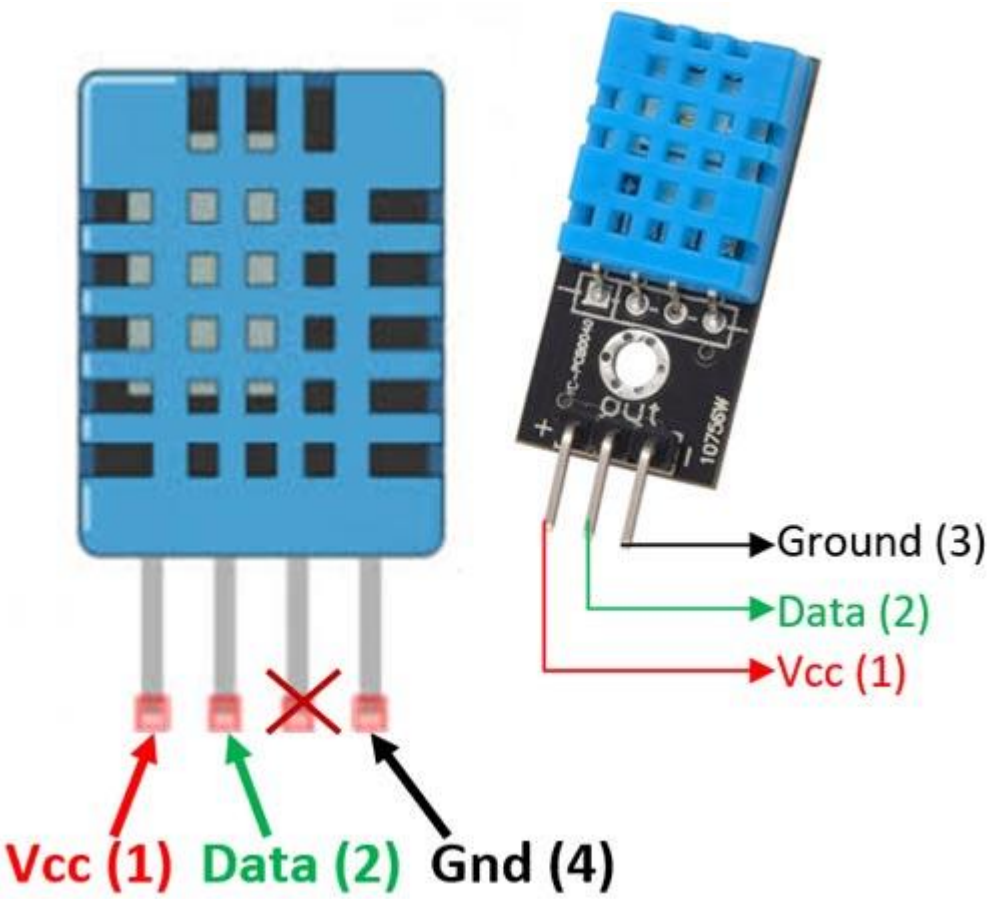


Fig 3.7 DHT11 Sensor

Features

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

Interfacing of DHT11 Sensor with Arduino

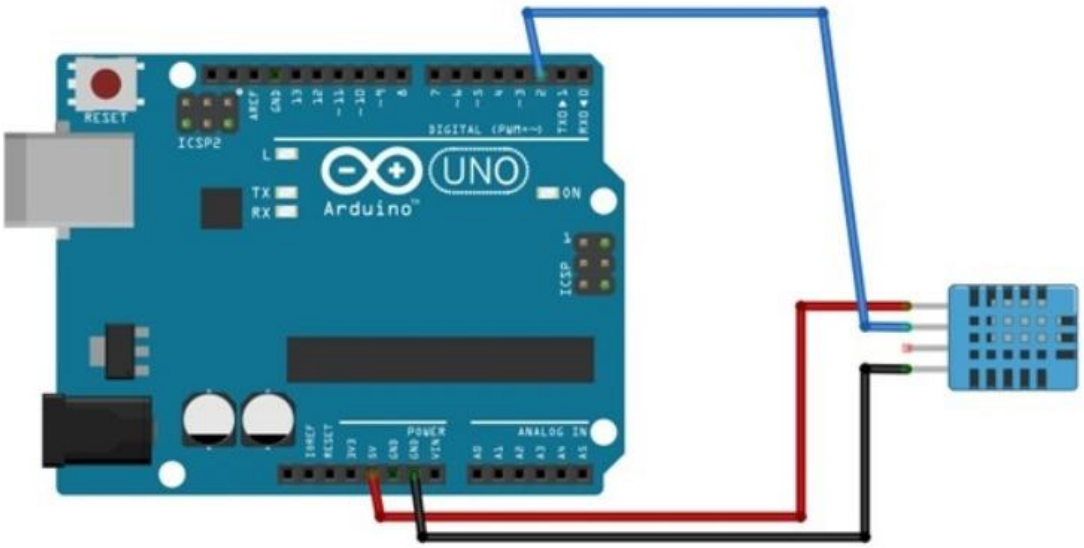


Fig 3.8 Interfacing of DHT 11

4. Blynk Platform

With Blynk, you can create smartphone applications that allow you to easily interact with microcontrollers or even full computers such as the Raspberry.

Fig 4.1 Blynk Platform

- The main focus of the Blynk platform is to make it super-easy to develop the mobile phone application.
- With Blynk, we can control an LED or a motor from our mobile phone with literally zero programming.
- You can use it to monitor the soil humidity of your vegetable garden and turn on the water, or open up your garage door, with your phone.
- You can also use it to control smart furniture that can learn from your routines, or embed IoT and AI to traditional industrial products such as a boiler, or for improving the integrity and safety of oilfields.
- Blynk is free to use for personal use and prototyping. Their business model generates profits by selling subscriptions to businesses that want to publish Blynk-powered apps for their hardware products or services.

4.1 Blynk Smartphone App

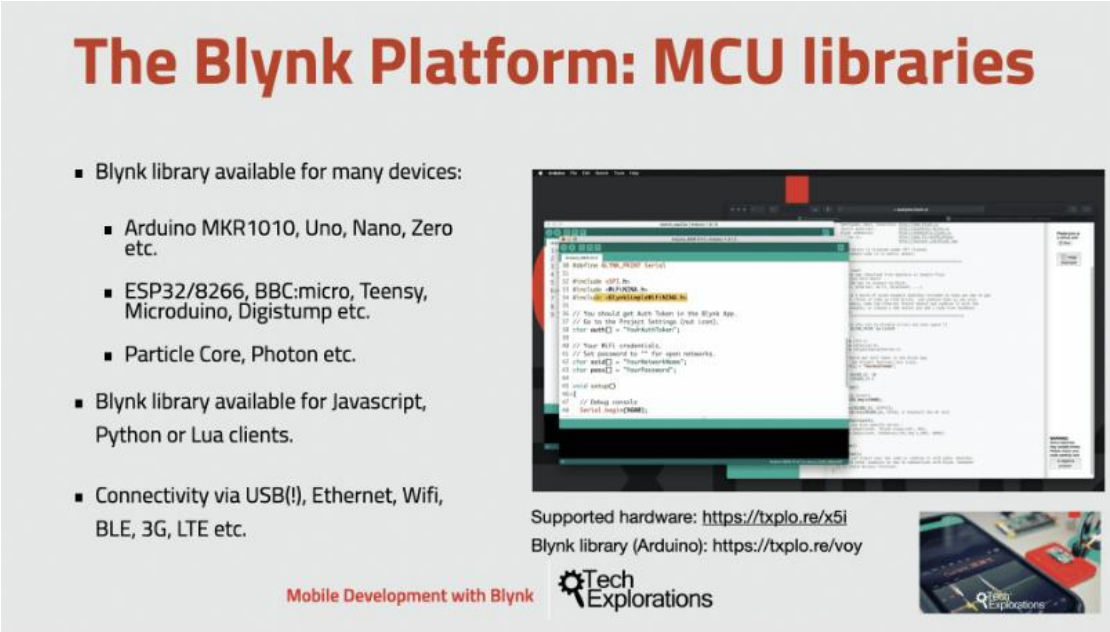
- The Blynk app is an app editor.
- It allows us to create one or more projects.

Fig 4.2 Blynk Smartphone App

- Each project can contain graphical widgets, like virtual LEDs, buttons, value displays and even a text terminal, and can interact with one or more devices.
- With the help of the Blynk library, it is possible to control Arduino or ESP 32 pins directly from your phone, without having to write any code at all.
- It is also possible to share a project with friends and even customers so that they can access the connected devices but not be able to modify the project. Imagine a scenario where you build a smartphone application where you can control lights, window blinds and room temperature from your phone. You can share the project with other family members so that they can also access the functionality.

4.2 Blynk Microcontroller Libraries

Blynk platform supports large range of devices. The support is implemented by means of a Blynk library that targets a device and connectivity type combination.



- For example, if you want to use your Arduino Uno with an Ethernet Shield, you would use the library "BlynkSimpleEthernet" which contains the Blynk firmware plus the required connectivity support.
- Blynk also supports clients that are not a microcontroller. You can write client code is JavaScript, Python or Lua thanks to the available Blynk libraries for these languages.

4.3 Blynk Server

- Unlike IoT platform such as IFTTT, Twilio, and even AdaFruit IO, we can host a private instance of the full Blynk server and connect your smartphone Blynk app to it.
- The Blynk Cloud server is an excellent choice for most projects, as it is always there, ready to use. However, as you will see, the Cloud Blynk server has imposed limitations. Some limitations are due to the topology of the server: depending on your geographical location, the server may be in a different

continent, which makes communications between the app, the devices and the server slow due to the amount of time it takes packets to travel across the Internet.

- Another imposed limitation is that in the Cloud server, you can only use a small number of widgets. Blynk is using the concept of "energy" to implement a pricing system for its widgets. In the Cloud server you may start a new project with 1000 energy units. An LED widget may cost you 200 units, leaving 800 units for other widgets.
- On a private server, you can set your own energy limits. You can configure your server to allocate 100,000 energy units to new users. It's totally up to you.

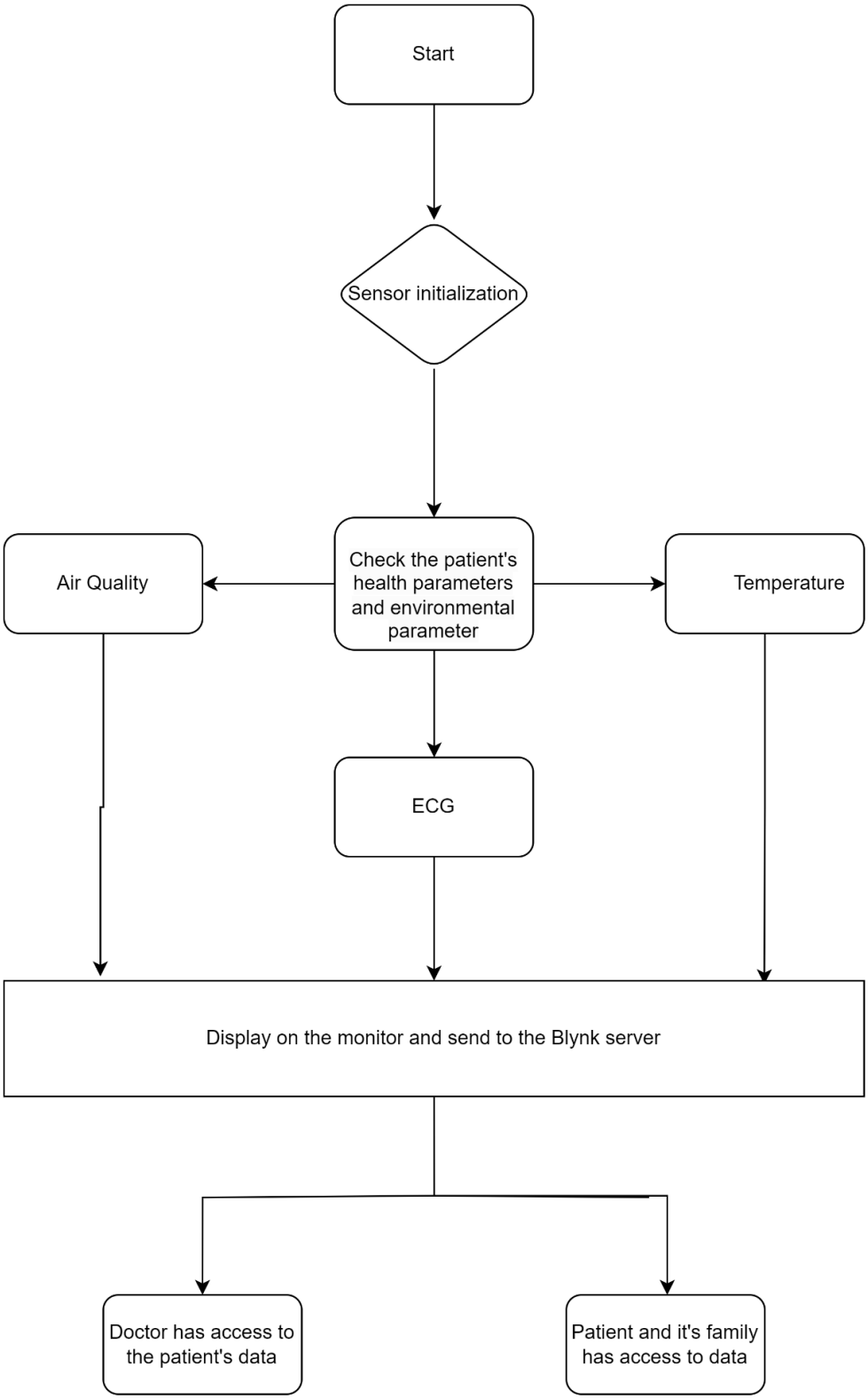
- **Benefits of Blynk Server**

- Essentially unlimited energy units, so that you can build any Blynk application you can think of.
- Minimal latency, which is useful when your application is used in a limited geographic area and responsiveness is important.
- Total control of your data. You can keep your own backups of your Private server, migrate your server to a new host, implement whichever security mechanisms you wish, and finely control your users

5. Software Aspects

5.1 Flowchart

This is a flowchart of our project: -



5.2 Program

5.2.1 Program for interfacing of AD8232 ECG sensor with Arduino

```
/*
 * VARIABLES
 * Count: variable to hold count of rr peaks detected in 10 seconds
 * Flag: variable that prevents multiple rr peak detections in a single heatbeat
 * Hr: HeartRate (initialised to 72)
 * Hrv: Heart Rate variability (takes 10-15 seconds to stabilise)
 * instance1: instance when heart beat first time
 * Interval: interval between second beat and first beat
 * Timer: variable to hold the time after which hr is calculated
 * Value: raw sensor value of output pin
 */
long instance1=0, timer;
double hrv =0, hr = 72, interval = 0;
int value = 0, count = 0;
bool flag = 0;
#define shutdown_pin 10
#define threshold 100 // to identify R peak
#define timer_value 10000 // 10 seconds timer to calculate hr
void setup() {
  Serial.begin(9600);
  pinMode(8, INPUT); // Setup for leads off detection LO +
  pinMode(9, INPUT); // Setup for leads off detection LO -
}
void loop() {
  if((digitalRead(8) == 1)||(digitalRead(9) == 1)){
    Serial.println("leads off!");
    digitalWrite(shutdown_pin, LOW); //standby mode
    instance1 = micros();
    timer = millis();
  }
  else {
```

```
  digitalWrite(shutdown_pin, HIGH); //normal mode
  value = analogRead(A0);
  value = map(value, 250, 400, 0, 100); //to flatten the ecg values a bit
  if((value > threshold) && (!flag)) {
    count++;
    Serial.println("in");
    flag = 1;
    interval = micros() - instance1; //RR interval
    instance1 = micros();
  }
  else if((value < threshold)) {
    flag = 0;
  }
  if ((millis() - timer) > 10000) {
    hr = count*6;
    timer = millis();
    count = 0;
  }
  hrv = hr/60 - interval/1000000;
  Serial.print(hr);
  Serial.print(",");
  Serial.print(hrv);
  Serial.print(",");
  Serial.println(value);
  delay(1);
 }
}
```

5.2.2 Program for interfacing MLX90614 sensor with Arduino

```
#include <Wire.h>
#include <Adafruit_MLX90614.h>
Adafruit_MLX90614 mlx = Adafruit_MLX90614();
void setup() {
  mlx.begin();
   Serial.begin(115200);
  Serial.print("Emissivity = "); Serial.println(mlx.readEmissivity());
  Serial.println("================================================");
}
void loop() {
    while (!Serial);
  Serial.println("Adafruit MLX90614 test");
  if (!mlx.begin()) {
    Serial.println("Error connecting 8to MLX sensor. Check wiring.");
    while (1);
  };
 Serial.print("Ambient ");
 Serial.print(mlx.readAmbientTempC());
 Serial.print(" C");
 Serial.print("Target  ");
 Serial.print(mlx.readObjectTempC());
 Serial.print(" C");
 delay(100);
}
```

5.2.3 Program for interfacing of MQ135 sensor with Arduino

```
int sensorValue;
int digitalValue;
void setup()
{
  Serial.begin(9600); // sets the serial port to 9600
  pinMode(13, OUTPUT);
  pinMode(2, INPUT);
}
void loop()
{
  sensorValue = analogRead(A0); // read analog input pin 0
  digitalValue = digitalRead(2);
  if (sensorValue > 400)
  {
    digitalWrite(13, HIGH);
  }
  else
    digitalWrite(13, LOW);
  Serial.println(sensorValue, DEC); // prints the value read
  Serial.println(digitalValue, DEC);
  delay(1000); // wait 100ms for next reading
}
```

6.Advantages and Applications

6.1 Advantages:

- **Remote monitoring:** Real-time monitoring via connected IoT devices and smart alerts can diagnose illnesses, treat diseases and save lives in case of a medical emergency.
- **Prevention:** Smart sensors analyses health conditions, lifestyle choices and the environment and recommend preventative measures, which will reduce the occurrence of diseases and acute states.
- **Reduction of healthcare costs:** IoT reduces costly visits to doctors and hospital admissions and makes testing more affordable.
- **Medical data accessibility:** Accessibility of electronic medical records allow patients to receive quality care and help healthcare providers make the right medical decisions and prevent complications.
- **Improved treatment management:** IoT devices help track the administration of drugs and the response to the treatment and reduce medical error.
- **Improved healthcare management:** Using IoT devices, healthcare authorities can get valuable information about equipment and staff effectiveness and use it to suggest innovations.
- **Research:** Since IoT devices are able to collect and analyze a massive amount of data, they have a high potential for medical research purposes.

6.2 Applications

- Adjust medication dosing or treatment regularly to improve outcomes.
- Automate and respond to alerts while identifying worrisome trends or readings.
- Minimize associated hospitalizations by performing timely interventions as soon as message alerts indicate a problem.
- Monitor a patient's progress and adherence to the treatment program.
- Prioritize attention and resources on patients that need more support.
- Provide a holistic and comprehensive outlook of an individual's health.

- Reduce manual data collection and data entry, providing more for data analysis improve clinical decisions.

7.RESULTS

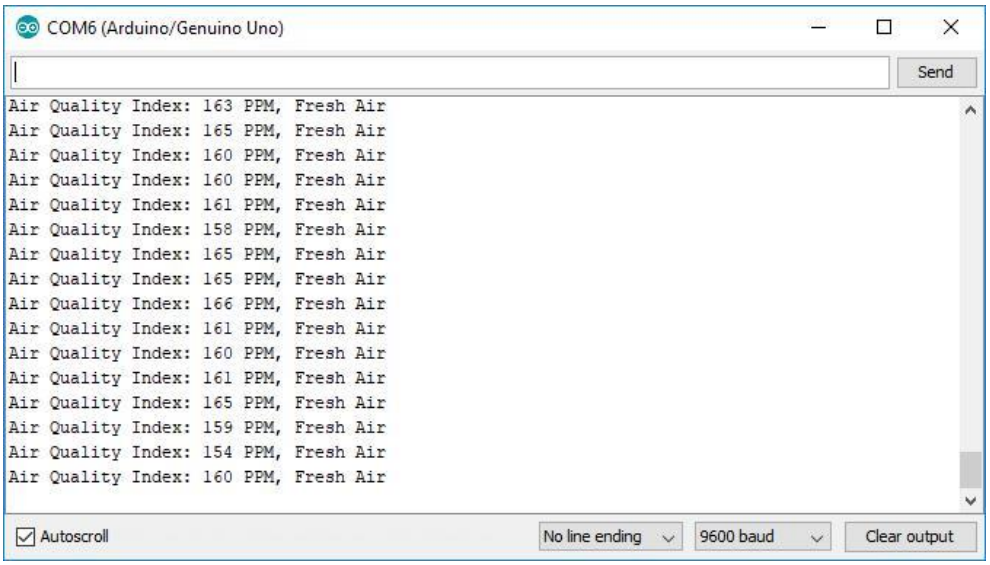


Fig. 7.1 Values of MQ135 on serial monitor

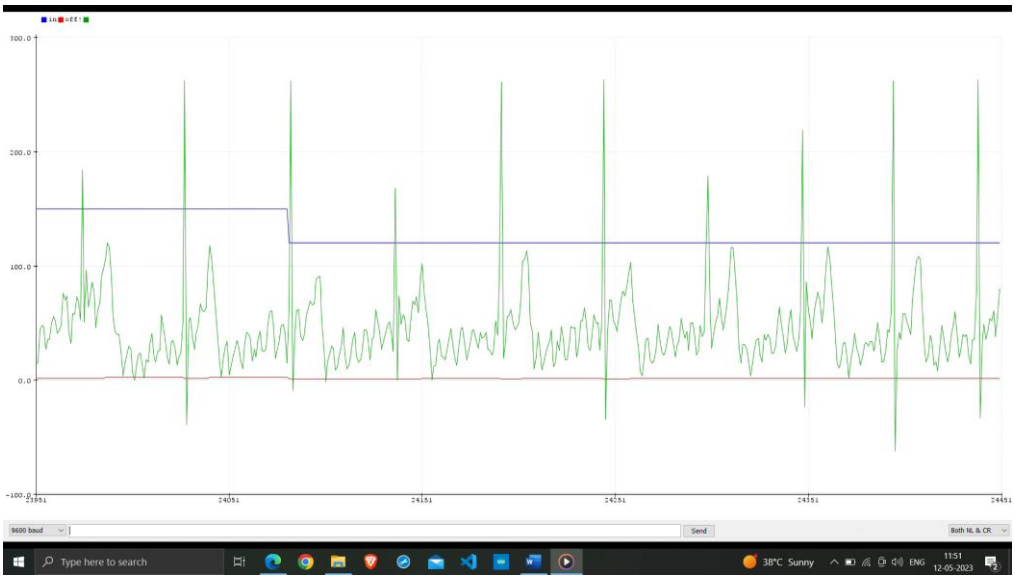


Fig 7.2 Values of AD8232 on serial monitor

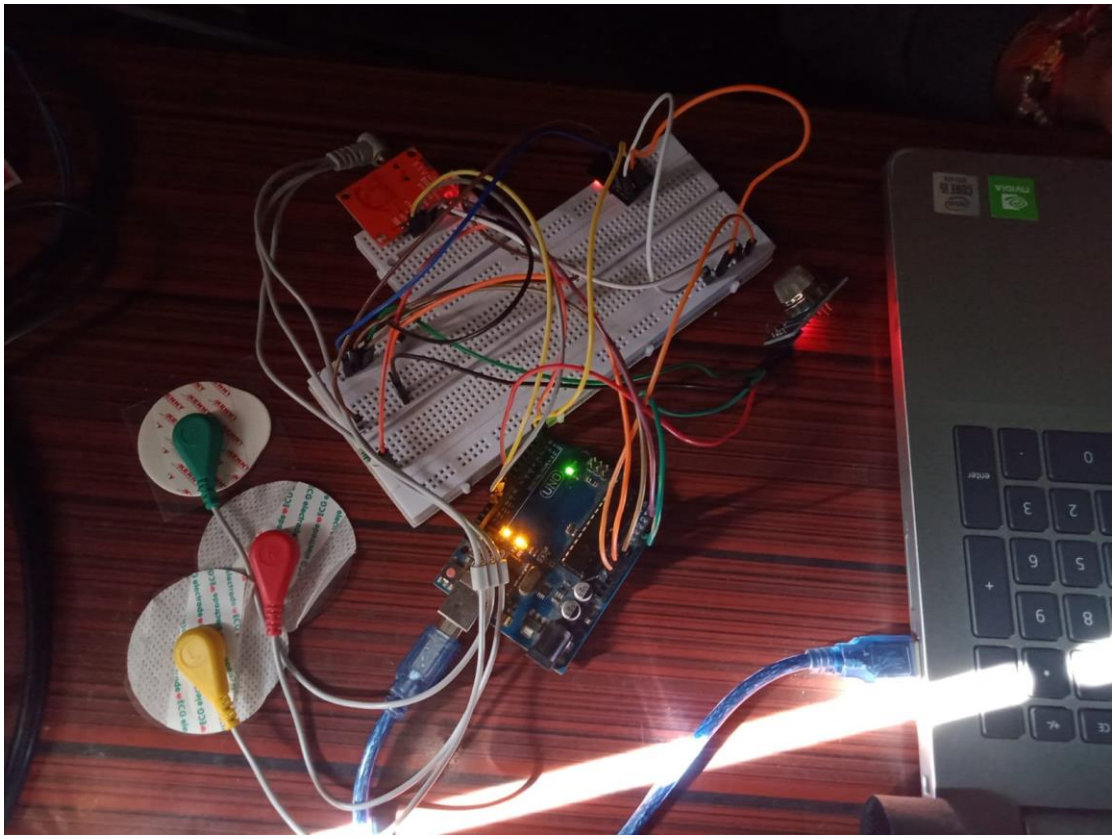


Fig 7.3 Final Hardware image

8. Conclusion

The main objective of the project was successfully achieved. All the individual modules like Heartbeat detection module, fall detection module etc. and remote viewing module gave out the intended results.

The designed system modules can further be optimized and produced to a final single circuit. More important fact that came up during project design is that all the circuit components used in the remote health detection system are available easily with the development in the integrated circuit industry, Micro Electro Mechanical Systems (MEMs) and microcontrollers have become affordable, have increased processing speeds, miniaturized and power efficient. This has led to increased development of embedded systems that the healthcare specialists are adopting. These embedded systems have also been adopted in the Smartphone technology. And with increased internet penetration in most developing countries through mobile phones, and with use of Internet of things (IoT) will become adopted at a faster rate. The Remote Health Care system utilizes these concepts to come up with a system for better quality of life for people in society.

From an engineering perspective, the project has seen concepts acquired through the computer science and embedded study period being practically applied.

9.FUTURE SCOPE

As we all know, the future scope of the patient health monitoring via internet connectivity is emerging day by day because it helps in the camps also like when a disaster takes place then in the rescue camps the medical team is unable to take the big or huge or large machines so this portable kit will be helpful. The bioelectronics is making its place in the field of electronics or engineering as well as in the field of medical science.

IoT healthcare is the most emerging field in the medical area. This project is mainly for elderly person who is alone at home. It is also helpful for senior citizens living alone or with 1 or 2 members. This is really helpful when relatives or members of the family have to go out for some unavoidable reasons. Multi challenged person can use thus project. Disabled patients who find difficulty to go to doctors on regular bass or for patients who need continuous monitoring from the doctor [3] IOT tracking proves really useful when we need to record, monitor and keep track of changes in the health parameters of the patient. In Internet of Things based patient monitoring system, we can have the database of the health parameters. Thus helps the doctor to easily find the changes in the health parameters or history of the patient while suggesting the treatment or medicine for patient Hospital stays are reduced due to remote patient monitoring Hospital visits for regular check-ups are also minimized Patient health parameters are stored in the cloud. So, it is more beneficial than maintaining the records in printed paper in separated files or in digital computer, laptops, pen drives or specific memory location. In such cases there may be a chance of losing the data. Whereas in case of IOT, the data is stored in the cloud and has minimal chance of data loss , Cure can be provided at starting stage Notification to doctor is sent in case of critical conditions even though the patient is unable to provide any details

As we all know, the future scope of the patient health monitoring via internet connectivity is emerging day by day because it helps in the camps also like when a disaster takes place then in the rescue camps the medical team is unable to take the big or huge or large machines so this portable kit will be helpful. The bioelectronics is making its place in the field of electronics or engineering as well as in the field of medical science.

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