HEART RATE ANALYSER

MINI PROJECT REPORT (ECD 334)

submitted by

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to

APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the award of the Degree of

Bachelor of Technology

in Electronics and Communication Engineering

Department of Electronics and Communication Engineering

Mar Athanasius College of Engineering

Kothamangalam, Kerala, India 686 666

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MAR ATHANASIUS COLLEGE OF ENGINEERING KOTHAMANGALAM

CERTIFICATE

This is to certify that the **MINI PROJECT** report entitled **HEART RATE SYSTEM** submitted by **Susan Varghese (MAC20EC0107)**, **P Pranav (MAC20EC090)**, **Lakshmi G Menon (MAC20EC069)** and **Mizaj M (MAC20EC072)** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Electronics & Communication Engineering is a bonafide record of the mini project work carried out. This report in any form has not been submitted to any other University or Institute for any purpose.

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ACKNOWLEDGEMENT

It is a great pleasure to acknowledge all those who have assisted and supported us for completing our project.

First of all, we thank God Almighty for his blessings as it is only through his grace that we were able to complete our project successfully.

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We are also grateful to Dr. Thomas George, Associate Professor, Head of Electronics & Communication Engineering Department for his valuable guidance as well as timely advice which helped us a lot in the preparation of our mini project.

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TABLE OF CONTENT

ABSTRACT

Phase 1 of the mini project is about the working of a Non-Inverting Amplifier, which offer positive voltage gain, high input impedance, low output impedance, stability, linearity and compatibility with single-ended input signals. It is a simple circuit that operates by amplifying the input signals using an op-amp with positive voltage gain. It is designed using LM741IC.

Phase 2 of the mini project is Heart Rate Analyzer using STM32G431TB6 microcontroller. The rapid development of the medical field creates more and more innovations to track and access the facilities. One such innovation is the introduction of heart rate sensors. This module consists of one or more light-emitting diodes that emit light into the skin and photodetectors that detect the amount of light reflected or transmitted through the tissue and this amount changes with each heartbeat. This sensed data is then given to a microprocessor and it is transmitted via Wi-Fi module for getting an idea about one's health virtually

LIST OF FIGURES

ABBREVIATIONS

IC	-	Integrated circuits
Op-amp	-	Operational Amplifier
PCB	-	Printed circuit board
GND	-	Ground
TXD	-	Transmitter
RXD	-	Receiver
FPGA	-	Field Programmable Gate Array
HMI	-	Human Machine Interface
IOT	-	Internet Of Things
APP	-	Application

PHASE I

NON - INVERTING AMPLIFIER

CHAPTER 1

INTRODUCTION

An electronic amplifier, amplifier, or (informally) amp is an electronic device that increases the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with the larger amplitude. In this sense, an amplifier modulates the output of the power supply. The second basic configuration of an operational amplifier circuit is that of a Non-inverting Amplifier. In this configuration, the input voltage signal, (V_{in}) is applied directly to the non-inverting (+) input terminal which means that the output gain of the amplifier becomes "Positive" in value in contrast to the "Inverting Amplifier" circuit we saw in the last tutorial whose output gain is negative in value. The result of this is that the output signal is "in-phase" with the input signal. Feedback control of the non-inverting amplifier is achieved by applying a small part of the output voltage signal back to the inverting (-) input terminal via R_f - R2 voltage divider network, again producing negative feedback. This closed-loop configuration produces a non-inverting amplifier circuit with very good stability, very high input impedance.

An operational Amplifier, often called an op-amp, is a DC-coupled high-gain electronic voltage amplifier with differential inputs ad usually a single output. Typically the output of the op-amp is controlled either by negative feedback, which largely determines the magnitude of its output Voltage gain, or by positive feedback, which facilitates regenerative gain and oscillation. High input impedance at the input terminals and low output impedance are important typical characteristics.

Ideal Op-amp: The main part in an amplifier is the dependent voltage source that increases in relation to the voltage drop across Rin, thus amplifying the voltage difference between V+ and V-.

CHAPTER 2

OBJECTIVE

The primary objective of this project is to design an efficient and reliable Printed Circuit Board (PCB) layout for non-inverting amplifier circuit. The non-inverting amplifier is a fundamental analog circuit used in signal processing and amplification applications. The main focus of this PCB design is to ensure optimal signal integrity, minimal noise interference, and efficient thermal management. The PCB layout will be developed to accommodate the non-inverting amplifier's components, connections, and necessary auxiliary components, while adhering to standard design practices.

Another key objective is to ensure the proper positioning and routing of components on the PCB to achieve optimal performance and minimal signal distortion. Special attention will be given to maintaining appropriate trace widths, impedance matching, and signal isolation to prevent signal degradation and crosstalk. Careful consideration will also be given to component placement to facilitate ease of assembly, testing, and potential future modifications. Design guidelines and best practices will be followed to prevent manufacturing issues such as solder bridges, open circuits, and misalignment of components. The PCB layout will also incorporate proper spacing and clearance to avoid potential short circuits and ensure safe operation.

Overall, this project aims to deliver a well-organized, compact, and functional PCB layout for the non-inverting amplifier circuit. The final design will be thoroughly simulated and validated to ensure that it meets the desired performance specifications, including gain, bandwidth, and noise levels. By achieving these objectives, the PCB layout will enable seamless integration of the non-inverting amplifier into larger electronic systems, contribute to signal fidelity, and pave the way for potential future optimizations and enhancements to the circuit design.

CHAPTER 3

METHODOLOGY

DESIGNING

The circuit was designed according to formula.

SCHEMATIC PREPERATION

The circuit is stimulated in schematic as well as PCB format using Altium software.

PCB PREPERATION

The PCB layout is then etched onto a single clad copper plate which is further drilled in order.

SOLDERING

The components are then soldered onto their positions making sure that there is no break in Connections.

CIRCUIT IMPLEMENTATION

The circuit is then implemented by closing the switch, thus completing the circuit.

CHAPTER 4

IMPLEMENTATION

4.1 BLOCK DIAGRAM

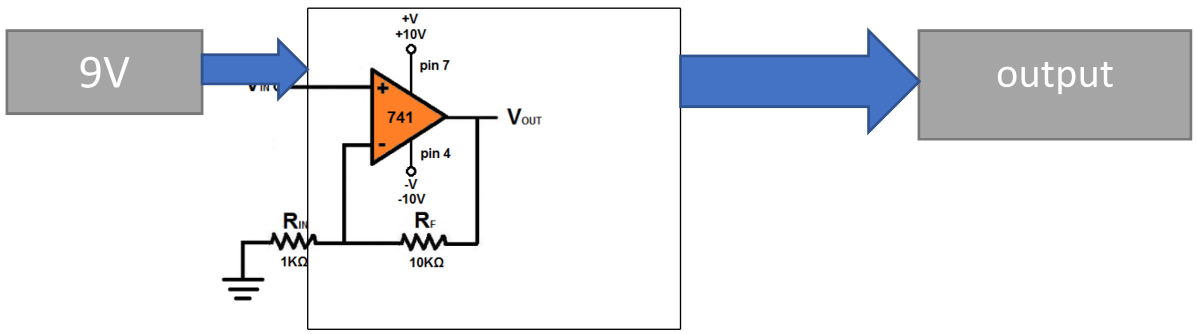

Figure 1.1 Block Diagram

4.2 DESIGN

Gain of non- inverting amplifier

Af=1+Rf/Rin

Let gain=11

11=1+Rf/Rin

Rf/Rin=10

Let Rf=100kohm

Therefore,

Rin=10kohm

4.3 COMPONENTS

1. RESISTORS

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits. The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

Figure 1.2 Resistor

2. 741 OP-AMP

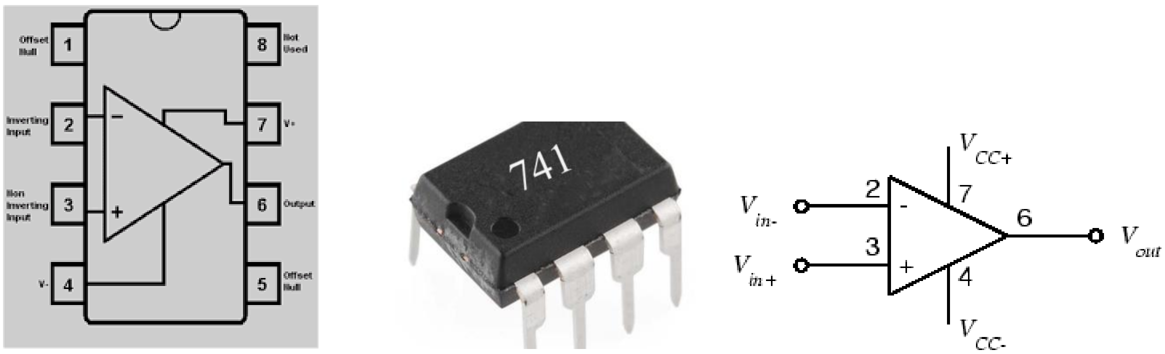

Figure 1.3 LM741 pinout

The 741 Op Amp IC is a monolithic integrated circuit, comprising of a general purpose Operational Amplifier. It was first manufactured by Fairchild semiconductors in the year 1963. The number 741 indicates that this operational amplifier IC has 7 functional pins, 4 pins capable of taking input and 1 output pin.

IC 741 Op Amp can provide high voltage gain and can be operated over a wide range of voltages, which makes it the best choice for use in integrators, summing amplifiers and general feedback applications. It also features short circuit protection and internal frequency compensation circuits built in it.

The following are the basic specifications of IC 741:

- Power Supply: Requires a Minimum voltage of 5V and can withstand up to 18V
- Input Impedance: About 2 MΩ
- Output impedance: About 75 Ω
- Voltage Gain: 200,000 for low frequencies (200 V / mV)
- Maximum Output Current: 20 mA
- Recommended Output Load: Greater than 2 KΩ
- Input Offset: Ranges between 2 mV and 6 mV
- Slew Rate: 0.5V/µS (It is the rate at which an Op-Amp can detect voltage changes).

Applications:

- It is used in regulated power supply.
- It is used in an active filter.
- It is used in ADCs and DACs to create converters that convert analog signals to binary forms and binary forms to analog signals.
- It is used to convert current to voltage and voltage to current.
- It is used in voltage comparators to compare voltage signals.
- It is used in oscillators to generate different waveforms like sinusoidal, square, triangular, etc. It is also used in Pulse Width Modulators (PWM generators).

4.4 SOFTWARE DESCRIPTION

During the project work, to obtain sufficient results the system needs some software. Software description gives the details about the software that are used.

1. ALTIUM

Altium Designer is a PCB and electronic design automation software package for printed circuit boards. Altium Designer is a powerful design package that helps simplify the design and development of electronics and printed circuit boards. Altium Designer's suite encompasses four main functional areas, including schematic capture, 3D PCB design, field-programmable gate array (FPGA) development, and release/data management. It integrates with several component distributors for access to the manufacturer's data. It also has an interactive 3D editing of the board and MCAD export to STEP. Its products are designed for use in a Microsoft Windows environment and are used in industries such as automotive, aerospace, defence, and telecommunications.

Applications:

- • It blinking circuit can be used as flashing beacon.
- • It can be used as vehicle indicator when it is broke down in the middle of the road.
- It can be used in operation theatres or offices as an indication that you are engaged in.

4.5 CIRCUIT DIAGRAM

1 .SCHEMATIC DIAGRAM

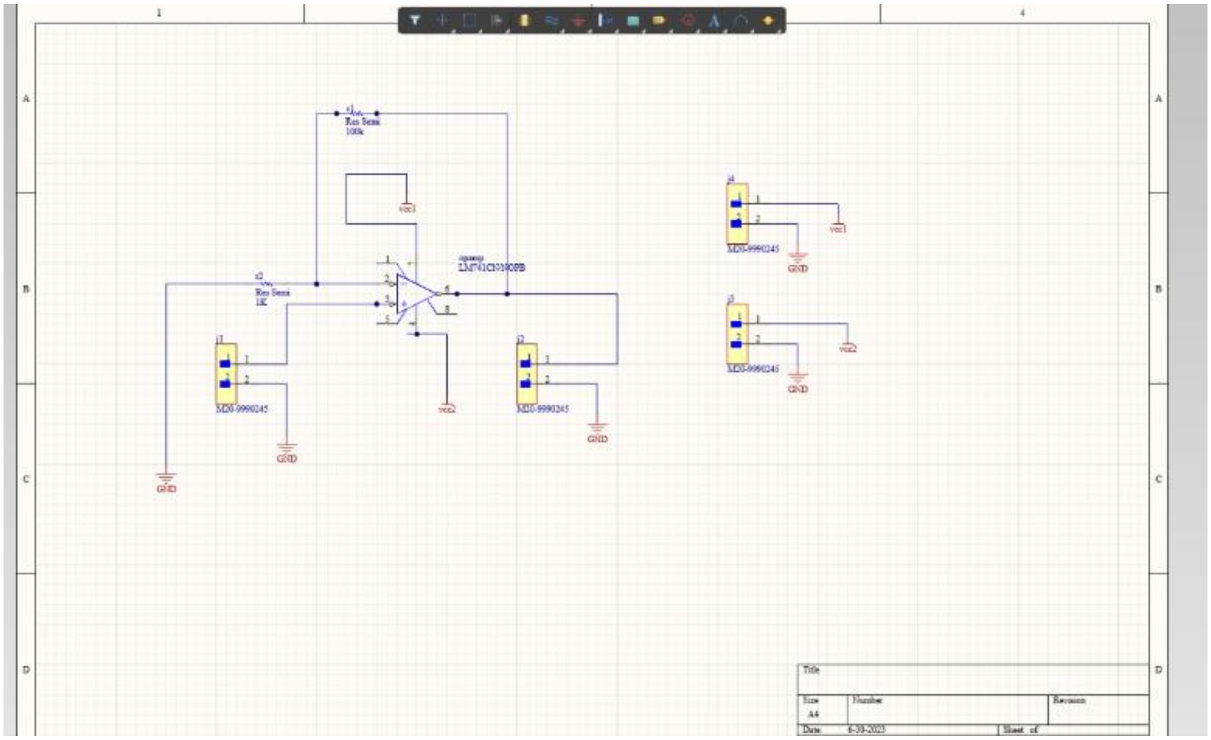

Figure 1.4 schematic diagram

2.PCB LAYOUT

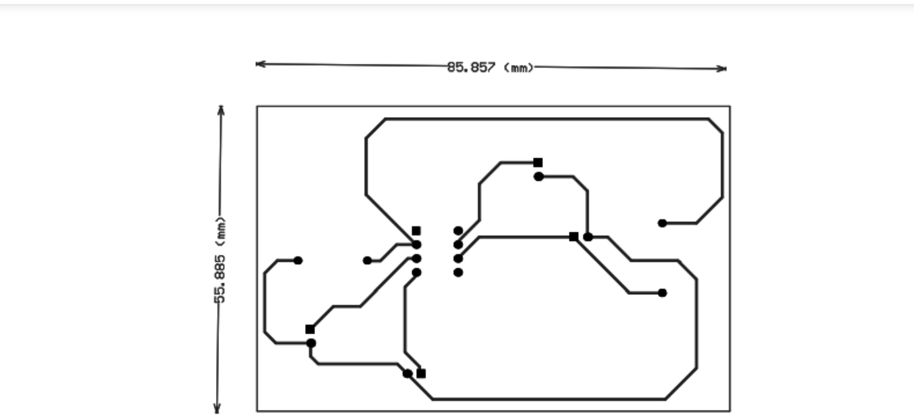

Figure 1.5 PCB layout

3. PCB BOARD

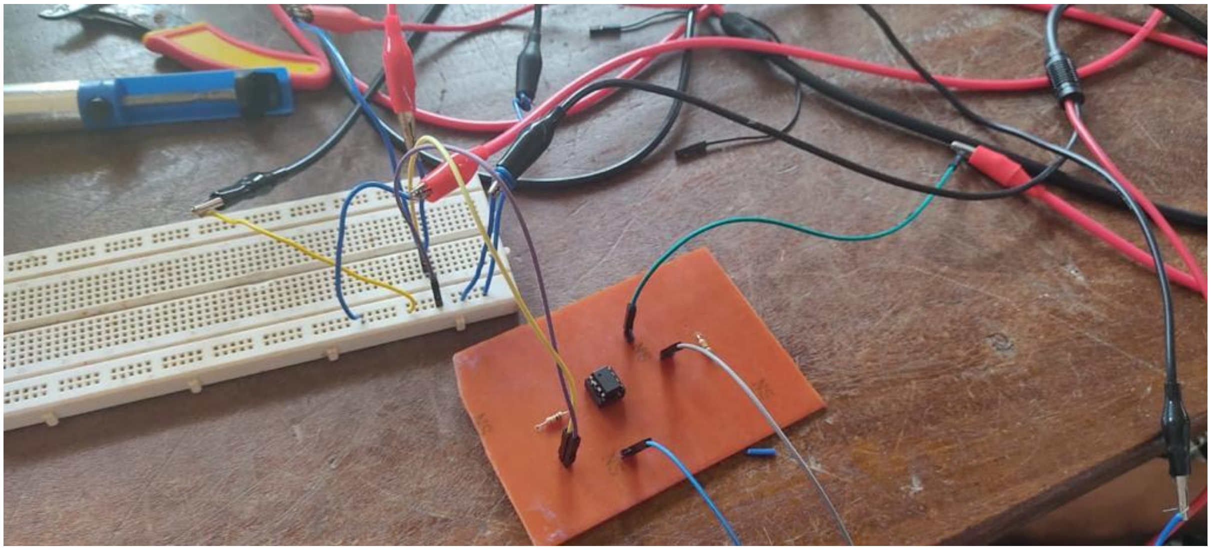

Figure1.6 PCB board

4.6 SIMULATIONS

OUTPUT

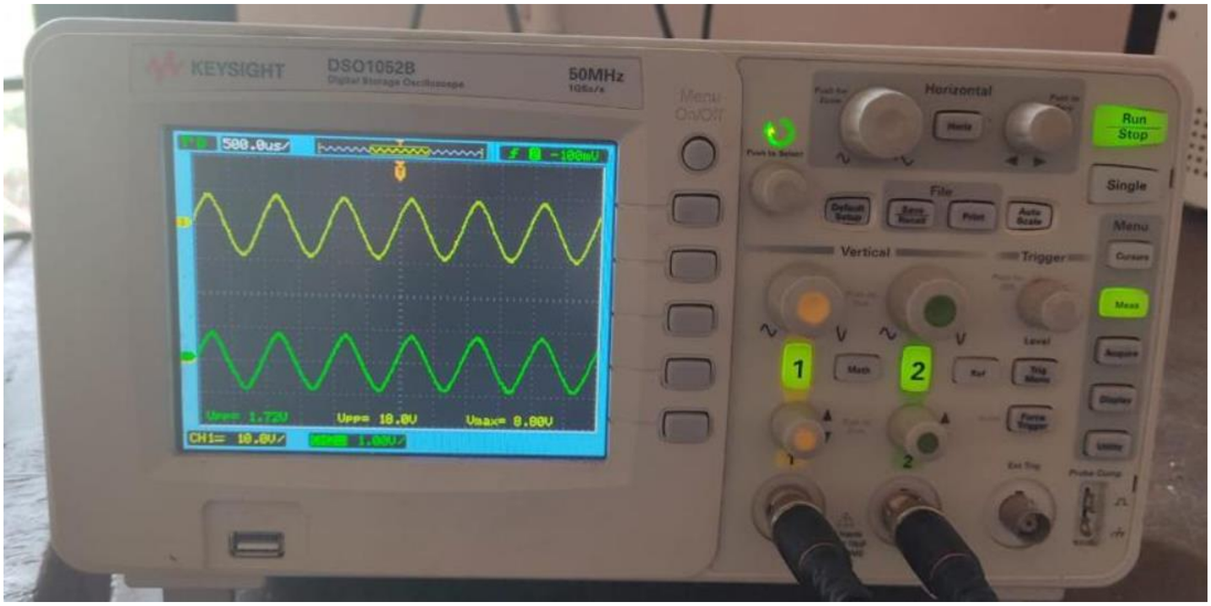

Figure 1.7 output

The non-inverting amplifier configuration using the LM741 op-amp is a commonly used circuit arrangement. It provides amplification of an input voltage while maintaining the same polarity as the input signal.

PHASE II

HEART RATE ANALYSER

CHAPTER 5
INTRODUCTION

Technological advancements have revolutionised healthcare, and heart rate monitoring has emerged as a crucial tool for assessing cardiovascular health and overall well-being. Accurate and real-time heart rate data provide essential insights for medical diagnostics, fitness tracking, and stress management. With a mission to contribute to this field, the project "Heart Rate Analyser" was initiated, aiming to design and implement a portable heart rate monitoring system that offers convenience, precision, and instant data analysis.

The primary objective of the Heart Rate Analyser project is to create a user-friendly system capable of providing precise measurements and real-time analysis. The project leverages cutting-edge technologies, non-invasive sensors, and intelligent algorithms. The STM32G431CBT6 microcontroller serves as the core processing unit, ensuring efficient data acquisition, signal processing, and communication.

Wireless connectivity plays a pivotal role in modern health monitoring systems, enabling seamless data transmission and remote access. Therefore, the project integrates the ESP8266 Wifi Module, allowing users to remotely access their heart rate data and facilitating continuous monitoring for better health management. Pulse sensor, a state-of-the-art non-invasive sensor, is central to the heart rate monitoring system. With its high sensitivity and low power consumption, it accurately captures heart rate signals using red and infrared LEDs and a photodetector, ensuring user comfort during continuous monitoring.

The project's relevance lies in its potential to empower individuals with valuable heart rate data and real-time analysis, enabling informed decisions about cardiovascular health. By providing a comprehensive heart rate monitoring solution, the project aims to enhance overall well-being and improve the quality of life for individuals.

CHAPTER 6

LITERATURE SURVEY

1. A microcontroller based automatic heart rate counting system from fingertip Mamun AL, Ahmed N, ALQahtani (JATIT)Journal OF Theory and Applied technology ISSN 1992-8645 : In this research paper heartrate signals were collected from finger or ears using IR TX-RX (Infrared Transmitter and Receiver pair) module which was amplified in order to convert them to an observable scale. A low pass filter was used to filter inherent noise.

2. Heart beat Sensing and Heart Attack Detection Using internet of things: IOT Aboobacker sidheeque, Arith Kumar, K. Sathish,(IJESCE) International Journal Of Engineering Science and Computing, April 2007 : In this research paper implementation of heartbeat monitoring and Heart attack detection system using Internet of things is shown. These days we saw increased number of heart disease and heart attack. The sensor is interfaced to a microcontroller that allows checking heart rate readings ad transmitting them over internet.

3. A Heartbeat and Temperature Measuring System for Remote Health Monitoring using Wireless Body Area Network Mohammad Wajih Alam , Tanin Sultana and Mohammad Sami Alam International Journal of Bio Science and Bio-Technology Vol.8, No.1 (2016) : In this research paper, the design and development of a microcontroller based heartbeat and body temperature monitor using fingertip and temperature sensor is shown. The device involves use of optical technology to detect the flow of blood through the finger and offers the advantage of portability over conventional recording systems.

4. Heartbeat Monitoring Alert via SMS 2009 IEEE Symposium on Industrial Electronics and Applications October 4-6, 2009, Kuala Lumpur, Malaysia. Warsuzarina Mat Jubadi, Siti Faridatul Aisyah Mohd Sahak Dept. of Electronics Engineering University Tun Hussein Onn Malaysia Batu Pahat, Johor, Malaysia : In this report, it is shown that the heart rate can be measured by monitoring one's pulse using specialized medical devices such as an electrocardiograph (ECG), portable wrist strap watch, or any other commercial heart rate monitors.

CHAPTER 7

OBJECTIVE

The objective of phase 2 of the mini project is to implement a Heart Rate monitoring system using STM32G431CBT6 processor, ESP8266 and Pulse sensor. Also designing a way for users to review the heart rate data of a person with the help of a live web based app(Blynk).

The main component of the project is Heartbeat Sensor which is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heartrate and blood pressure are the basic things that we do in order to keep us healthy. In order to measure the body temperature, we use thermometers and a sphygmomanometer to monitor the Arterial Pressure or Blood Pressure. Our idea is to

design a Heart Rate Monitor System using Arduino and Heartbeat Sensor. You can find

the Principle of Heartbeat Sensor, working of the Heartbeat Sensor and Arduino based on Heart Rate Monitoring System using a practical heartbeat Sensor

Long waiting time for hospitalization or ambulatory patient monitoring/treatment, are other well-known issues for both the healthcare institutions and the patients. This project provides healthcare authorities to maximize the quality and breadth of healthcare services by controlling costs. As the population increases and demand for services increases, the ability to maintain the quality and availability of care, while effectively managing financial and human resources, is achieved by this project. The use of modern communication technology in this context is the sole decisive factor that makes such communication system successful

CHAPTER 8

METHODOLOGY

PROCEDURE

CHECKING AND PREPARING COMPONENTS

1. Select the necessary components for the project, including the STM32G431CBT6 microcontroller, ESP8266 Wi-fi Module, MAX30100 Pulse sensor, and ST Link.
2. Design the circuit layout using Altium
3. Prepare the programming code for the microcontroller to handle data acquisition and processing.
4. Simulate the circuit in software (Proteus) to verify its functionality and compatibility.
5. Burn the code onto the microcontroller IC.
6. Set up the connections on a breadboard, ensuring the +5V power supply and correct pin assignments.
7. Verify the functionality of the LCD and its response to the microcontroller inputs.
8. Observe and record the output for further analysis.
9. Design the PCB layout using Altium Design software, considering factors such as component placement and trace routing.
10. Fabricate the PCB board, including processes such as laminating, imprinting, marking, etching, drilling, and soldering.

SOFTWARE DEVELOPMENT

1. Develop the necessary software components for the heart rate monitoring system.
2. Program the microcontroller to acquire and process data from the MAX30100 Pulse sensor.
3. Implement intelligent algorithms to calculate heart rate values in real-time.
4. Design a user-friendly interface for data visualization and analysis.
5. Test the software modules individually and ensure their proper integration.

HARDWARE INTEGRATION AND TESTING

1. Integrate the hardware components, including the microcontroller, Wi-fi Module, and Pulse sensor, onto the PCB board.
2. Double-check the connections and power supply to ensure proper functionality.
3. Conduct thorough testing of the heart rate monitoring system, including data acquisition, signal processing, and wireless communication.
4. Calibrate the system to enhance accuracy and reliability.
5. Validate the system's performance through controlled experiments and real-world scenarios.
6. Collect and analyse the data, comparing it with established standards or reference values.

EVALUATION AND REPORTING

1. Evaluate the performance of the heart rate monitoring system based on predefined objectives and requirements.
2. Assess the accuracy, reliability, and usability of the system through comprehensive testing and analysis.
3. Document the entire process, including the design, implementation, testing, and evaluation stages.
4. Prepare a detailed project report, outlining the methodology, results, challenges encountered, and recommendations for future improvements.

CHAPTER 9

IMPLEMENTATION

9.1 BLOCK DIAGRAM

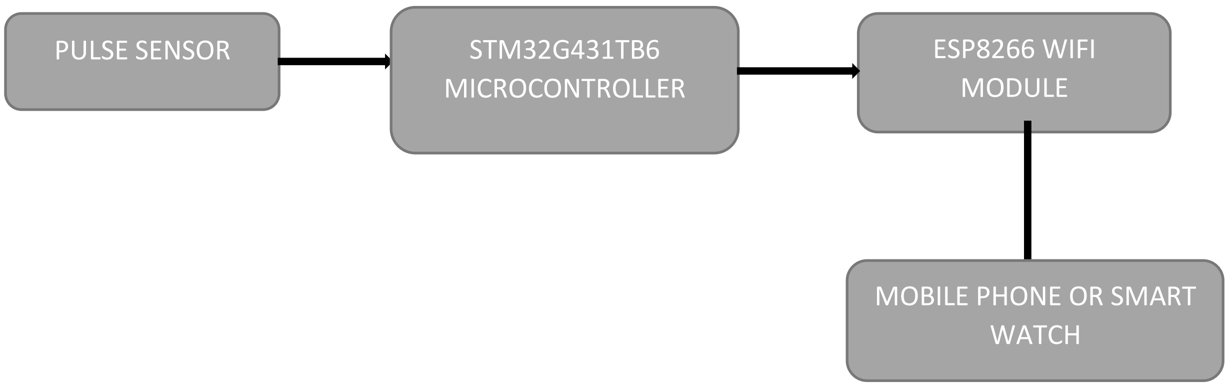

Figure 2.1 Block diagram of heart rate analyser

9.2 COMPONENTS

1. STM32G431CBT6

Figure 2.2 STM32G431CBT6 Microcontroller

The STM32G431CBT6 is a microcontroller based on the Arm Cortex-M4 core, manufactured by STMicroelectronics. It is part of the STM32G4 series of microcontrollers, which are designed for high-performance applications. The key features of STM32G431CBT6 include:

Microcontroller Core: The STM32G431CBT6 is based on the Arm Cortex-M4 core, which provides high processing power and DSP (Digital Signal Processing) capabilities.

Clock Speed: It typically operates at a maximum frequency of up to 170 MHz, allowing for swift execution of instructions.

Memory: The microcontroller includes various types of memory, such as Flash memory for program storage and SRAM for data storage.

Peripherals: It comes equipped with a wide range of peripherals, including timers, communication interfaces (UART, SPI, I2C), analog-to-digital converters (ADCs), digital-to-analog converters (DACs), and more.

Connectivity: The STM32G431CBT6 supports various communication protocols like USB, CAN, I2C, SPI, and UART.

Power Management: It features power-saving modes to reduce energy consumption in low-power applications.

The STM32G431CBT6 is commonly used in embedded systems, IoT devices, industrial automation, motor control, and other applications that require real-time processing and advanced communication capabilities.

2.ESP8266 WIFI MODULE

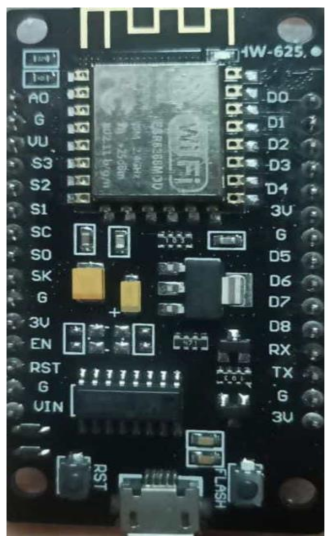

Figure 2.3 ESP8266 Wi-fi module

The ESP8266 is a popular Wi-Fi module developed by Espressif Systems. It is widely used in IoT projects due to its low cost, small size, and built-in Wi-Fi capabilities. The ESP8266 module typically includes an ESP8266 microcontroller and an integrated Wi-Fi chip. Key features of the ESP8266 module include:

Wi-Fi Connectivity: The module supports Wi-Fi connectivity, allowing devices to connect to wireless networks and communicate with other devices or servers over the internet.

Microcontroller Core: The ESP8266 integrates a low-power microcontroller, which can be programmed to perform various tasks and control connected devices.

GPIO Pins: It provides GPIO (General Purpose Input/Output) pins that allow users to interface with external sensors, actuators, or other components.

Communication Interfaces: The module includes UART, SPI, and I2C interfaces for communication with other microcontrollers or sensors.

Memory: The module typically has onboard flash memory to store firmware and web content for web server applications.

The ESP8266 is commonly used in IoT projects for home automation, smart home devices, wireless sensor networks, and Wi-Fi-enabled gadgets.

3. PULSE SENSOR

Figure 2.4 Pulse sensor

The Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino which is designed to detect and measure a person's heart rate. It uses various methods, often involving light or electrical signals, to monitor the pulsatile blood flow in the arteries caused by the heartbeat.

Components and working principles includes:

Light Source (LED): Pulse sensors that use the optical method usually incorporate a light-emitting diode (LED). This LED emits light, often in the green or red spectrum, onto the skin's surface. The emitted light penetrates the skin and interacts with the blood flowing in the arteries.

Photodetector (Photodiode): Positioned near the LED, a photodetector, often a photodiode, detects the amount of light that is either transmitted through the skin or reflected back from it. The photodiode generates an electrical signal that corresponds to the intensity of the detected light.

Blood Absorption: Blood absorbs some of the emitted light due to the presence of hemoglobin, a molecule in red blood cells that has different absorption properties at various wavelengths of light.

Fluctuations in Blood Volume: As the heart beats, blood volume in the arteries changes cyclically. During systole (contraction), the blood volume increases, leading to more light absorption. During diastole (relaxation), the blood volume decreases, resulting in less light absorption.

Signal Processing: The electrical signal produced by the photodetector is sent to a processing unit, such as a microcontroller or dedicated signal processing circuit. This unit analyses the signal for fluctuations that correspond to heartbeats.

Heart Rate Calculation: The time interval between consecutive peaks or troughs in the signal is measured. This interval represents the time between heartbeats and is used to calculate the heart rate, typically expressed in beats per minute (BPM).

Output and Display: The calculated heart rate is then presented to the user. This can be through a display on the pulse sensor itself or transmitted wirelessly to other devices like smartphones or smartwatches.

4.ST Link

Figure 2.5 ST Link

ST Link is a debugging and programming interface developed by STMicroelectronics. It is used for connecting and programming STM32 microcontrollers with a computer for software development and debugging purposes. Key features of the ST Link interface include:

Debugging: It allows developers to debug their embedded software by connecting the microcontroller to a development environment, such as an Integrated Development Environment (IDE) like STM32CubeIDE or Keil MDK.

Programming: ST Link enables users to program the microcontroller's Flash memory with the compiled firmware or software.

Serial Wire Debug (SWD) Interface: The ST Link interface typically uses the SWD protocol for communication with the microcontroller's debug and programming pins.

Virtual COM Port: Some versions of ST Link provide a virtual COM port, allowing serial communication between the microcontroller and the computer.

ST Link is commonly used by developers working with STM32 microcontrollers to flash firmware, debug code, and analyse program execution during software development and testing.

9.3 PCB SCHEMATIC

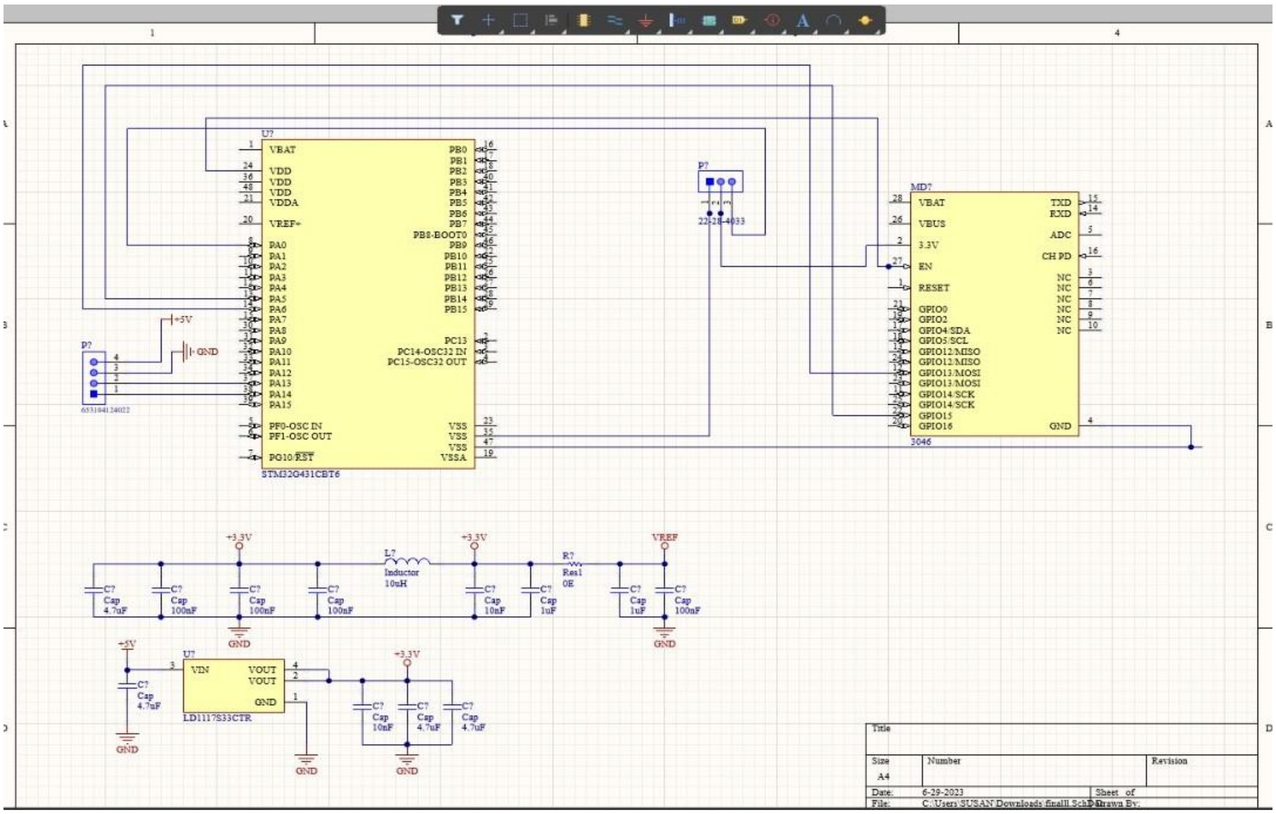

Figure 2.6 schematic diagram

9.4 SOFTWARE DESCRIPTION

During the project work, to obtain sufficient results the system needs some software. Software description gives the details about the software's that are used.

1. ALTIUM DESIGNER

Altium Designer is a PCB and electronic design automation software package for printed circuit boards. Altium Designer is a powerful design package that helps simplify the design and development of electronics and printed circuit boards. Altium Designer's suite encompasses four main functional areas, including schematic capture, 3D PCB design, field programmable gate array (FPGA) development, and release/data management. It integrates with several component distributors for access to the manufacturer's data. It also has an interactive 3D editing of the board and MCAD export to STEP. Its products are designed for use in a Microsoft Windows environment and are used in industries such as automotive, aerospace, defence, and telecommunications.

Advantages:

• Easily accessible to any document in the project from the projects panel. All of the project documents are displayed to reflect the design structure.

• Can easily move back and forth between the schematic and the PCB. For example, tasks such as moving design changes from the schematic to the board, or from the board back to the schematic, are quick and non-intrusive.

• Schematic can be added to a PCB component class easily and can be repositioned and aligned, or flipped to the other side of the board.

• It allows flicking back and forth from a 2D view of the board to a highly realistic 3D view. Whenever a mistake is detected, we can immediately switch to the schematic to edit and automatically update the PCB.

2. ARDUINO IDE

The Arduino software (IDE) is an open source software, which is used to programme the Arduino boards, and is an integrated development environment, developed by arduino.cc. Allow to write and upload code to Arduino boards. And it consist of many libraries and a set of examples of mini projects. Arduino software (IDE) is compatible with different operating systems (Windows, Linux, Mac OS X), and supports the programming languages (C/C++)The Arduino software is easy to use for beginners, or advanced users. It uses to get started with electronics programming and robotics, and build interactive prototypes. So Arduino software is a tool to develop new things. and create new electronic projects, by Anyone (children, hobbyists, engineers, programmers, … etc).

Advantages:

Simple and Beginner-Friendly: The Arduino IDE provides a user-friendly interface, making it accessible to beginners with little or no programming experience. It offers a simplified programming language based on C/C++ and provides a library of pre-written code examples that users can leverage.

Open-Source: Arduino IDE is an open-source software, which means the source code is available for modification and customization. This openness encourages community contributions, and users can extend the functionality of the IDE according to their needs.

Built-in Serial Monitor: The IDE includes a built-in Serial Monitor tool, which allows users to send and receive data between the Arduino board and the computer. It is handy for debugging and monitoring the communication between the microcontroller and other devices.

Cost-Effective: Arduino boards are affordable, and the IDE is free to download and use. This makes Arduino a cost-effective solution for hobbyists, students, and professionals who want to develop projects without investing heavily in development tools.

3 BLYNK APPLICATION

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and Node MCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets**.** Blynk is a comprehensive software suite that enables the prototyping, deployment, and remote management of connected electronic devices at any scale. Whether it's personal IoT projects or commercial connected products in the millions, Blynk empowers users to connect their hardware to the cloud and create iOS, Android, and web applications, analyze real-time and historical data from devices, remotely control them from anywhere, receive important notifications, and much more.

Advantages:

Real-Time Control and Monitoring: The Blynk app enables real-time control and monitoring of devices connected to the platform. Users can interact with their devices, view sensor data, and control actuators from anywhere in the world as long as they have an internet connection

Cross-Platform Compatibility: Blynk supports both iOS and Android platforms, ensuring that users can create apps that work seamlessly across different devices. This allows for broader compatibility and a larger user base.

Data Visualization: Blynk provides powerful data visualization tools, such as graphs and history displays, allowing users to analyse and interpret sensor data easily. This feature is valuable for monitoring trends, identifying patterns, and making data-driven decisions**.**

CHAPTER 10

OBSERVATIONS AND RESULTS

We were able to interface the heart rate sensor with stm32 microcontroller and the data is displayed on a web based application like Blynk via Esp8266.

10.1 OUTPUT

1 Output for a heart rate of 78bp

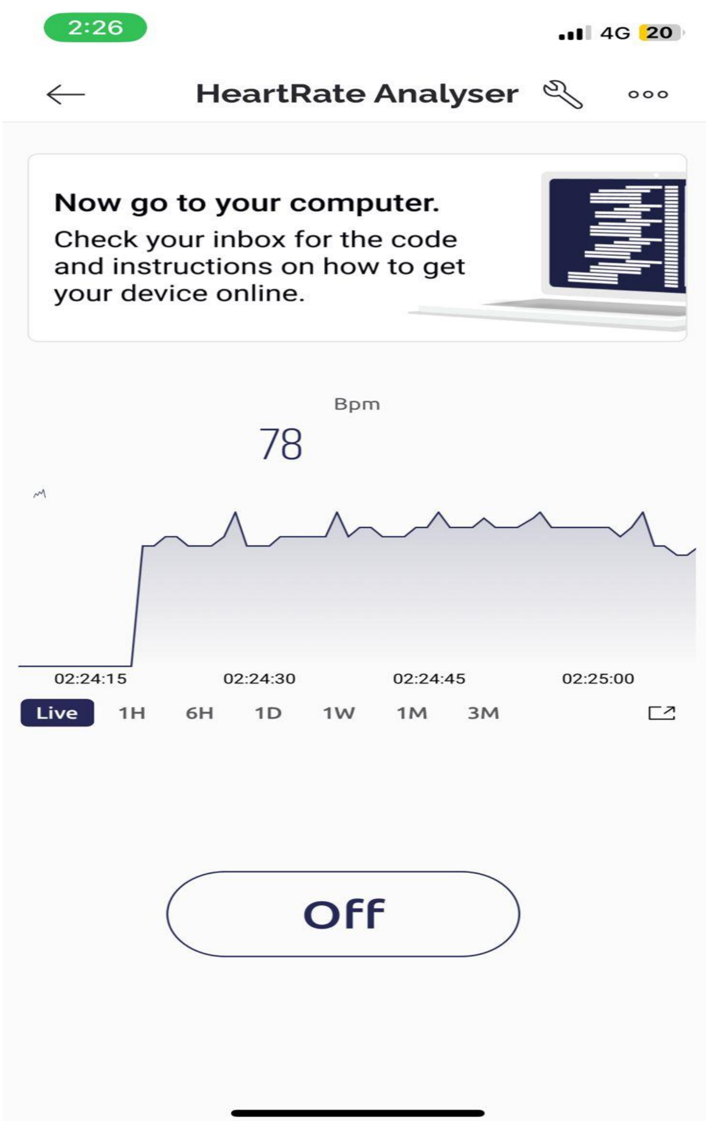

Figure 2.7 output for 78bpm

2.Output for a heartrate of 96 bpm

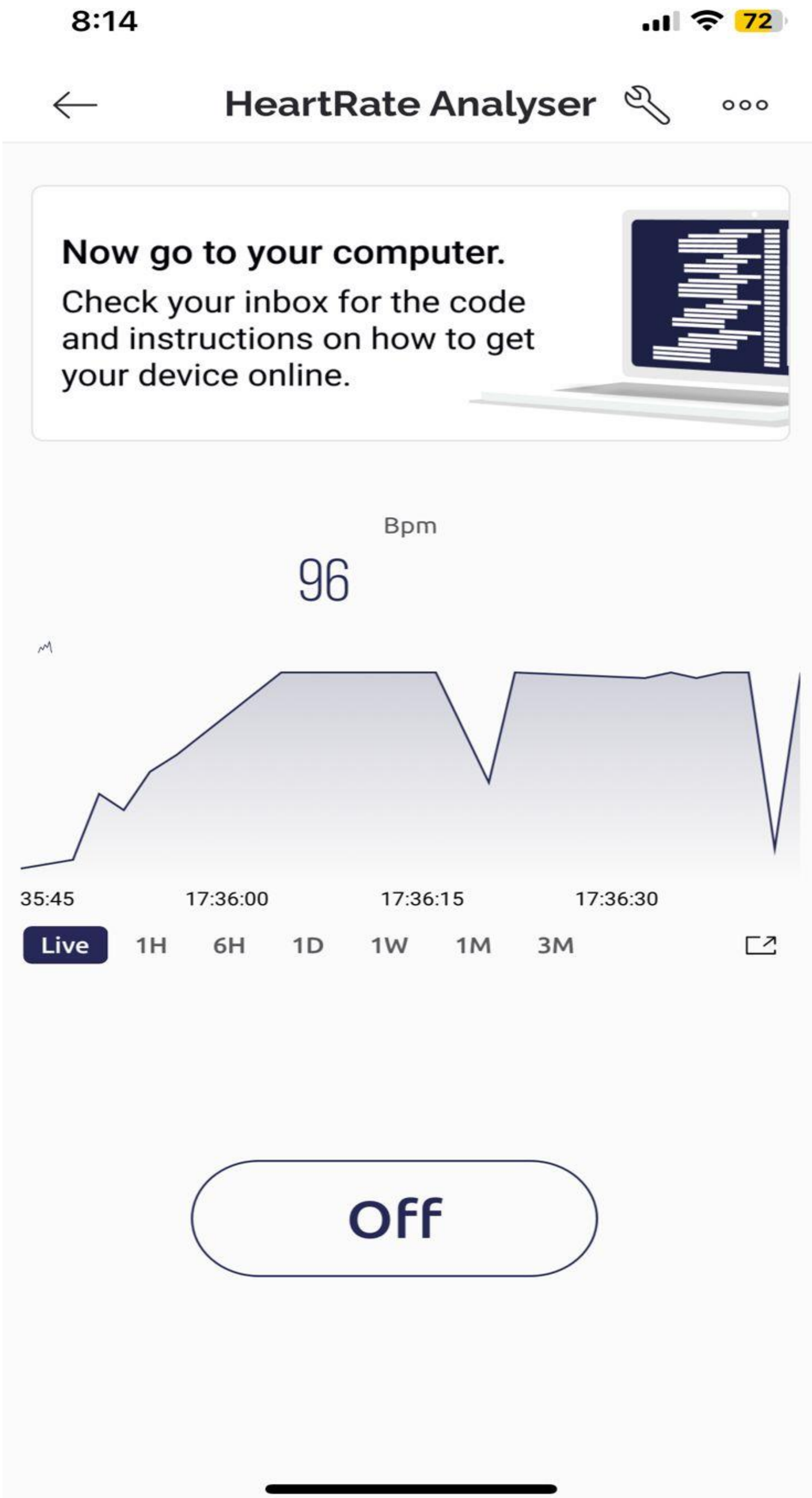

Figure 2.8 output for 96bpm

10.2 RESULT

The mini project phase-1 and phse-2 has been completed successfully with proper references and various aspects of the topic have been explored.

During phase-1, Non Inverting Amplifier circuit was designed on Altium and etched on single sided PCB manually. It functioned as it should and output was verified using DSO.

In phase-2, STM32G431CBT6 microcontroller Board was designed using Altium and printed on double sided PCB. Sensors for the project was brought and tested. STM32cubeIDE was used to test the microcontroller board. Necessary connections were made and microcontroller was programmed using Arduino IDE. Prototype worked as per the requirement and it displays a waveform showing variation of heart rate for a time interval. After proper debugging of the program, the system worked perfectly. The corresponding results are given in above sections.

CHAPTER 11

FUTURE SCOPE

• EEG, ECG and other health parameters can also be monitored.

• Continuous monitoring and future diagnosis can be performed via the same system (TELEMEDICINE).

• More than a single patient at different places can be monitored using single system

CHAPTER 12

CONCLUSION

Biomedical engineering is the application of engineering principles and techniques to the medical field. It combines the design and problem solving skills of engineering with medical and biological sciences to improve patient's health care and the quality of life of individuals. A medical device is intended for use in the diagnosis of disease, or in the cure, treatment, or prevention of diseases. Here heart rate is monitored using a sensor and this parameter is transmitted and displayed in a distant location using a web based app. This project will eventually reduce man power in the very near future.

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APPENDIX

CODE

Code for STM32Microcontroller

```
#include <SoftwareSerial.h>
SoftwareSerial espSerial(A5,A6);
const int sensorPin = A0;
const int threshold =550;
void setup()
 {
 Serial.begin(115200);
  espSerial.begin(115200);
  pinMode(A5,OUTPUT);
  pinMode(A6,OUTPUT);
  }
void loop()
 {
  int count=0;
  for (int i=0;i<200;i++){
  int sensorValue = analogRead(sensorPin);
  if(sensorValue>threshold)
{
count++;
  }
  }
  int bp=(count/10*6);
  count=0;
```

```
 espSerial.println(bp);
}
```

Code for ESP8266

```
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <SoftwareSerial.h>
char auth[] = "nil1wwUsr2sNPzXRqjY7L84TOy7YCZHY";
char ssid[] = "iPhone X";
char pass[] = "qwer1234";
const int RX = 13;   // GPIO13 as RX
const int TX = 15;   // GPIO15 as TX
SoftwareSerial mySerial(RX, TX);
void setup()
 {
  Serial.begin(115200);
  mySerial.begin(115200);
  Blynk.begin(auth, ssid, pass);
}
void loop()
 {
  Blynk.run();
  int bp = mySerial.parseInt();
  Blynk.virtualWrite(V0, bp);
  Serial.println(bp);
 }
```