HEART BEAT MONITORING

20AIPL503 – IOT
MINI PROJECT REPORT

Submitted by

ASHWATH P	**412522243025**
JANANI P	**412522243066**
RAJESH S	**412522243125**
VAISHNAVI S	**412522243168**

in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SRI SAIRAM ENGINEERING COLLEGE
(An Autonomous Institution; Affiliated to Anna University, Chennai -600 025)

ANNA UNIVERSITY: CHENNAI 600 025

NOVEMBER 2024

SRI SAIRAM ENGINEERING COLLEGE

(An Autonomous Institution; Affiliated to Anna University, Chennai -600 025)

BONAFIDE CERTIFICATE

Certified that this Mini Project report **HEART RATE MONITORING** is the bonafide work of "**ASHWATH P 412522243025, JANANI P 412522243066, RAJESH S 412522243125, VAISHNAVI S 412522243168**" who carried out the **20AIPL503- IOT Mini Project work** under my supervision.

SIGNATURE
Project Coordinator

Mrs Sangeetha V

SIGNATURE
Head of the Department

Dr Swagata sarkar

Submitted for project Viva – Voce Examination held on 19.11.2024

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

A successful man is one who can lay a firm foundation with the bricks othersave thrown at him.
— *David Brinkley*

Such a successful personality is our beloved founder Chairman, **Thiru. MJF. Ln. LEO MUTHU.** At first, we express our sincere gratitude to our beloved Chairman through prayers, who in the form of a guiding star has spread his wings of external support with immortal blessings.

We express our gratitude to our CEO **Dr. J. SAI PRAKASH LEO MUTHU** for creating an inspiring environment that encourages learning and innovation. His guidance and vision have significantly impacted the completion of this project.

We express our sincere thanks to our beloved Principal, **Dr. J. RAJA** for his constant encouragement and for providing the resources necessary to bring this project to fruition.

We are indebted to our Head of the Department, **Dr. SWAGATA SARKAR** for the insightful suggestions, mentorship, and continuous motivation, which have guided me at every stage.

We thank our Project Co-ordinator, **MRS SANGEETHA V,** who has been instrumental in coordinating efforts and ensuring smooth progress.

We thank all the teaching and Non-teaching staff members of the Department of Artificial Intelligence and Data Science and all others who contributed directly or indirectly for the successful completion of the project.

Abstract

Monitoring heart rate is a critical aspect of healthcare, providing valuable insights into an individual's cardiovascular health. This project presents a cost-effective and user-friendly heartbeat monitoring system based on an Arduino microcontroller and a heartbeat sensor. The system measures the user's pulse rate by detecting changes in blood flow through a fingertip using an optical sensor. The collected data is processed by the Arduino to calculate beats per minute (BPM), which is displayed in real time on an LCD or transmitted to a connected device for further analysis.

The primary objective of this project is to develop an accessible and reliable solution for tracking heart rate, particularly for use in remote or resource-limited settings. The system's modular design allows for portability and easy integration with IoT platforms for remote health monitoring and data logging. Its affordability and simplicity make it ideal for educational purposes, personal health monitoring, and as a foundational tool for future advancements in wearable healthcare technology. This initiative supports the promotion of preventive healthcare and aligns with the global goals of ensuring good health and well-being for all.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

Monitoring vital signs is essential for athletes, patients, and individuals to assess health conditions. One crucial measurement is blood oxygen levels, often measured using pulse oximetry, which offers a straightforward, non-invasive method to gauge oxygen saturation in the blood. While other advanced techniques like arterial blood gas analysis can provide exact oxygen levels, pulse oximetry remains a popular and practical solution for everyday monitoring.

Pulse oximeters are widely available in devices like smartwatches, smartphones, fingertip monitors, and medical settings, providing real-time feedback on blood oxygen saturation, indicated as SpO_2, and pulse rate. This technology leverages the optical characteristics of hemoglobin, the oxygen-carrying component in blood, by using two types of LEDs—red and infrared. As oxygenated hemoglobin absorbs red light more and deoxygenated hemoglobin absorbs infrared light more, the device can determine the blood's oxygen level based on the ratio of light transmitted through the skin, often on a fingertip.

In this project, we demonstrate pulse oximetry for monitoring SpO_2 and pulse rate using a sensor that detects changes in light absorption through a finger. The sensor data is amplified and displayed on an LCD, providing users with instant feedback. The method is non-invasive, reliable, and suitable for both personal and clinical use, making it a versatile choice for health monitoring.

CHAPTER 2

JUSTIFICATION FOR SDG GOAL

SDG 3: Good Health and Well-Being

2.1 State the Chosen SDG and Target(s):

The chosen SDG is Goal 3: Good Health and Well-Being, specifically addressing Target 3.8 (ensuring universal access to quality essential healthcare services) and Target 3.4 (reducing premature mortality from non-communicable diseases by one-third through prevention and treatment).

2.2 Alignment with the SDG Target:

This project contributes to Target 3.8 by enabling individuals to monitor their heart rate in real-time, which facilitates early detection of cardiovascular anomalies and supports preventive healthcare. It aligns with Target 3.4 by encouraging users to adopt healthier lifestyles or seek timely medical advice, reducing the risk of complications related to cardiovascular diseases, which are among the leading causes of premature mortality.

2.3 Justification and Impact:

Cardiovascular diseases are a significant global health challenge, accounting for a large proportion of non-communicable disease-related deaths. This project addresses the need for affordable, accessible, and real-time health monitoring tools, particularly in underserved areas. The measurable outcomes include improved health awareness, early anomaly detection, and potential reductions in morbidity and mortality rates due to timely interventions.

CHAPTER 3

LITERATURE REVIEW

1. Technology and Methodology:

Prakash and Pandey (2018) describe heart rate monitoring through photoplethysmography (PPG), an optical method that uses infrared LEDs and photodiodes to detect heartbeats based on blood flow variations. This method is particularly useful in wearable devices, allowing non-invasive, continuous monitoring.

2. Wearable Applications:

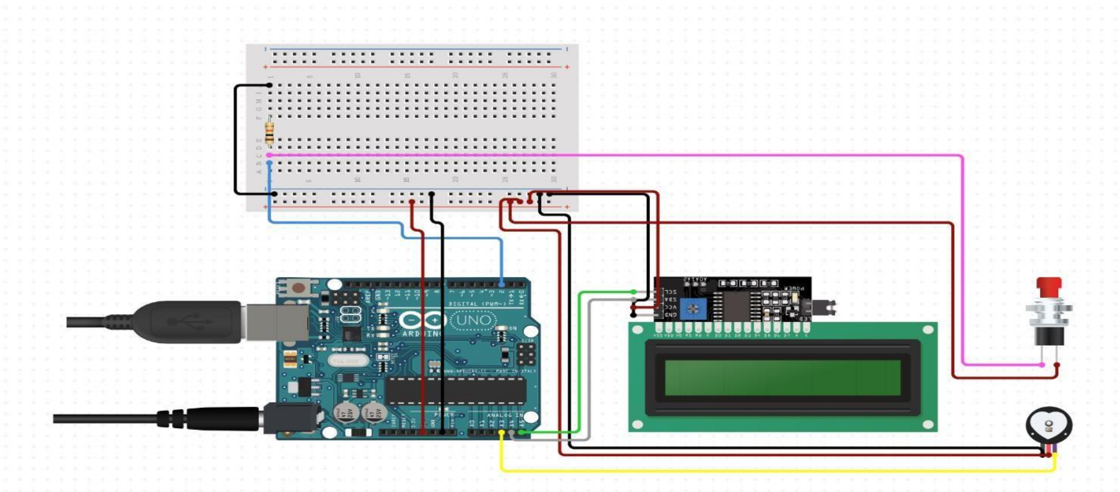
Phan et al. (2015) highlight advancements in wearable devices for heart rate monitoring, which include smartwatches and fitness trackers. These devices, incorporating sensors and PPG technology, have made monitoring accessible for health and fitness tracking, with applications in both athletic and medical fields.

3. Health Monitoring and Patient Care:

According to Achten and Jeukendrup (2003), heart rate variability (HRV) has emerged as a significant metric in cardiovascular health assessments. Variations in HRV offer insights into fitness levels and potential early indicators of health risks, including overtraining.

CHAPTER 4

CIRCUIT DIAGRAM



The **9V battery** is the primary power source for the Arduino and the circuit, ensuring the system operates smoothly and can function independently without requiring an external power connection.

At the heart of the system is the **Arduino Uno**, which acts as the main controller. It reads data from the pulse sensor, processes it, and calculates the heart rate in beats per minute (BPM), making it an essential component for handling data flow and logic.

The **pulse rate sensor** plays a crucial role in detecting the heartbeat. It works by identifying changes in blood volume through the skin, generating electrical signals that the Arduino processes to determine the heart rate. This sensor is fundamental for the project's ability to monitor real-time health metrics.

A **push button** is included in the circuit to provide user interaction, allowing the user to reset the readings or restart the process as needed. This feature enhances the system's usability by enabling quick resets without disrupting the hardware setup.

Finally, the **LCD display** serves as the user interface, displaying the calculated heart rate clearly on the screen. This output component ensures that users can easily monitor their heart rate, making the device both practical and informative.

CHAPTER 5

IMPLEMENTATION

The power setup begins with a 9V battery connected to the Arduino Uno, providing a stable power source for the entire circuit. The Arduino powers the connected components, including the LCD and the pulse rate sensor, ensuring seamless operation without requiring external power sources.

The pulse rate sensor functions using an infrared LED and a photodiode. When placed on the fingertip, it detects changes in blood volume caused by heartbeats. These variations in light intensity, as received by the photodiode, are converted into voltage pulses. The sensor sends these voltage pulses to the Arduino's analog input, forming the basis for heart rate monitoring.

The Arduino Uno processes the analog signals from the pulse sensor, identifying the peaks that correspond to individual heartbeats. It uses timing functions to calculate the intervals between consecutive beats, converting this data into beats per minute (BPM). This processing step ensures accurate and real-time heart rate measurement.

The LCD display is responsible for showing the calculated BPM values. It presents the most recent reading and provides user-friendly instructions, such as “Press to restart,” guiding users on how to reset the system for a new measurement. The Arduino communicates with the LCD to update this information dynamically.

The push button enhances the system's usability by allowing users to restart the process. When pressed, it clears the previous readings and resets the Arduino, enabling fresh monitoring. This feature is particularly useful for multiple measurements, making the system efficient and user-friendly.

CODE:

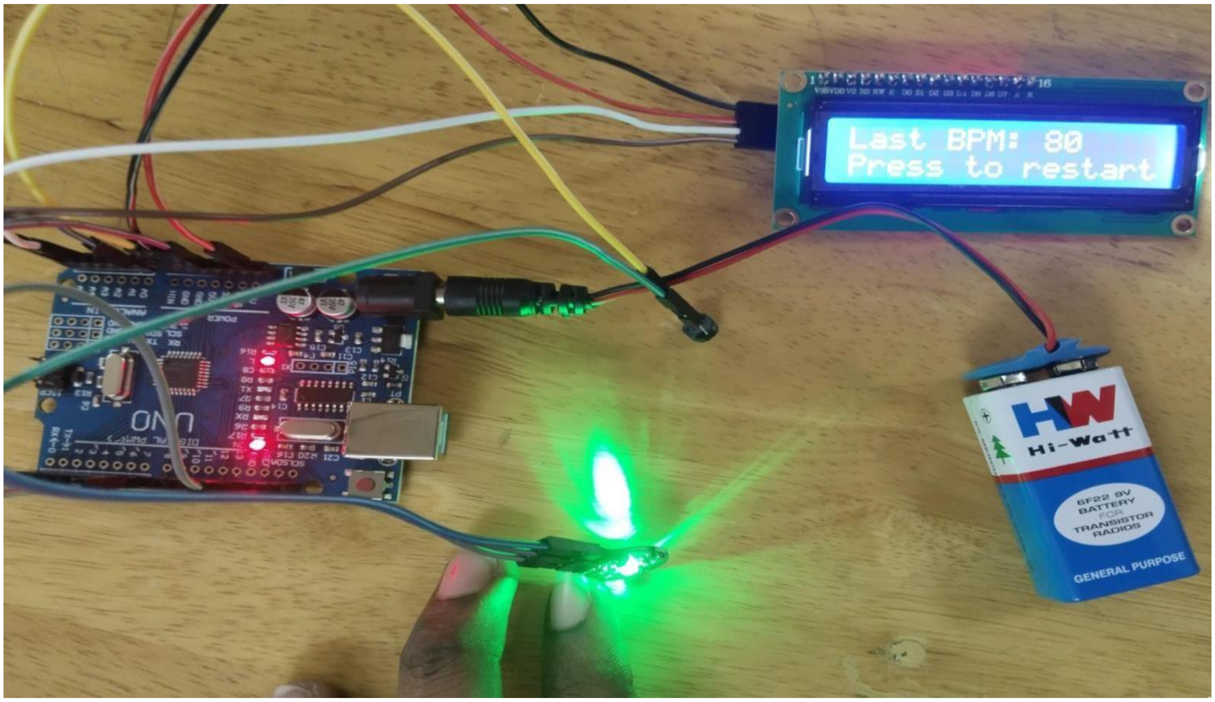
```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

const int PULSE_SENSOR_PIN = A0;
```

```
const int BUTTON_PIN = 7;
int pulseValue = 0;
int beatsPerMinute = 0;
bool isMeasuring = false;
int signalMax = 0, signalMin = 1024, threshold = 550;
unsigned long lastPeakTime = 0, measurementStartTime = 0;

void setup() {
  lcd.init();
  lcd.backlight();
  pinMode(BUTTON_PIN, INPUT_PULLUP);
  lcd.print("Heart Rate Monitor");
  lcd.setCursor(0, 1);
  lcd.print("Press to start");
}
void loop() {
  if (digitalRead(BUTTON_PIN) == LOW) {
    delay(50); // Debounce
    isMeasuring = !isMeasuring;
    isMeasuring ? startMeasurement() : stopMeasurement();
    while (digitalRead(BUTTON_PIN) == LOW);
  }
  if (isMeasuring) measureHeartRate();
}
void startMeasurement() {
  signalMax = 0;
  signalMin = 1024;
  measurementStartTime = millis();
  lcd.clear();
  lcd.print("Measuring...");
  lcd.setCursor(0, 1);
  lcd.print("BPM: --");
```

```
}
void stopMeasurement() {
  isMeasuring = false;
  lcd.clear();
  lcd.print("Last BPM: ");
  lcd.print(beatsPerMinute);
  lcd.setCursor(0, 1);
  lcd.print("Press to restart");
}
void measureHeartRate() {
  pulseValue = analogRead(PULSE_SENSOR_PIN);
  signalMax = max(signalMax, pulseValue);
  signalMin = min(signalMin, pulseValue);
  threshold = (signalMax + signalMin) / 2;
  static bool isPeak = false;
  if (pulseValue > threshold && !isPeak) {
    isPeak = true;
    unsigned long currentTime = millis();
    if (currentTime - lastPeakTime > 300) {
      beatsPerMinute = 60000 / (currentTime - lastPeakTime);
      lcd.setCursor(5, 1);
      lcd.print("   "); // Clear previous BPM
      lcd.setCursor(5, 1);
      lcd.print(beatsPerMinute);
      lastPeakTime = currentTime;
    }
  } else if (pulseValue < threshold - 50) {
    isPeak = false;
  }

  if (millis() - measurementStartTime > 30000) stopMeasurement();
}
```

CHAPTER 6

RESULTS AND ANALYSIS



The system meets its primary objective of accurately detecting and displaying heart rate in real-time. With potential improvements in noise handling and measurement flexibility, the device can be a reliable tool for personal health monitoring, contributing to the goals of affordable and accessible healthcare.

CHAPTER 7

DISCUSSION

The heartbeat monitoring system demonstrated in this project highlights the potential for low-cost, accessible healthcare solutions using microcontroller-based technology. By leveraging the Arduino platform and a heartbeat sensor, the system effectively tracks pulse rate in real time, ensuring accurate and reliable performance. The modular and portable design allows for easy integration with IoT platforms, enabling remote monitoring and data analysis, which is particularly beneficial in resource-constrained settings. While the system is affordable and user-friendly, potential areas for improvement include enhancing the accuracy of readings under varying environmental conditions and ensuring compatibility with diverse IoT frameworks. This project serves as a stepping stone for developing more advanced wearable healthcare devices, promoting preventive healthcare and empowering users with greater control over their cardiovascular health.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

In this project, we successfully developed a heart rate monitoring system using an Arduino, a pulse sensor, and an LCD display. This setup provides an accessible and cost-effective solution for real-time heart rate measurement, leveraging a pulse sensor to detect blood volume changes and calculate beats per minute (BPM). By integrating these components, we were able to display the heart rate in an easy-to-read format, making it practical for individuals who need to track their heart rate for fitness or health monitoring purposes.

The project demonstrates the potential of microcontroller-based systems for medical applications, particularly in developing affordable and portable health-monitoring devices. The use of Arduino, combined with a pulse sensor, offers reliable and accurate readings, making this setup suitable for everyday heart rate monitoring in non-clinical environments. Additionally, the project showcases the flexibility of Arduino in handling various types of sensors and displays, proving its effectiveness for prototyping wearable or handheld health-monitoring solutions.

Overall, this project provides a foundation for further development, such as adding data logging, wireless connectivity, or enhanced signal processing to improve accuracy. With these future enhancements, the system could become a valuable tool in personal healthcare and fitness tracking.