DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING
UNIVERSITY OF MORATUWA

Group Project Report

EN1093 - Laboratory Practice

Portable Heart Rate Monitor

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1 Abstract

The proposed project measures the heart rate of a person using optical sensors. The optical sensor detects the variation of blood volume at the fingertip. In our project the sensor will be an infrared light emitting diode (IR LED) which will be on the same side of the finger. The underlying principle is that the intensity of the reflected infrared light varies on the blood volume at an instance of the fingertip, which changes proportionately to each cardiac cycle. The lighting condition in the environment is very important to avoid distortion in the signal so we have taken the following measures,

• To design a special enclosure to cover the optical sensor for accurate measurements

• To use a band filter to remove unnecessary wavelengths.

Based on the refined output signal, we used an Atmel microcontroller to calculate and display the heart rate through the segment display.

2 Acknowledgement

We would like to express our gratitude to our supervisor Mr.Asanka Rathnayake for giving us technical advice and guidance.
Our sincere thanks goes to Mr.Thilina Sameera Ambagahawaththa for the inspiration and advice given to us to compile this report in LaTeX.

We pay our gratitude to all the lecturers, instructors and other academic staff who intimately welcomed us to share their knowledge and experiences. We are very grateful to the personal who are in charge of laboratories for allowing us to use the laboratories when needed and supported to solve the technical problems.

Contents

3 Introduction

This is a simple report template with the UCT logo. Feel free to use/modify it to suit your needs. Variables that need to be altered have been commented to make modifications easier. For example if you need to change the university logo, look for the comment `% University Logo` in this file and then make appropriate modifications in that line. A Table of Contents and a bibliography have also been implemented. To add entries to your bibliography, simply edit `biblist.bib` in the root folder and then use the `\cite{...}` command in `main.tex` [3]. The Table of Contents will be updated automatically. I hope that you find this template both visually appealing and useful.
— Linus

3.1 PPG

4 Methodology

4.1 Sensor

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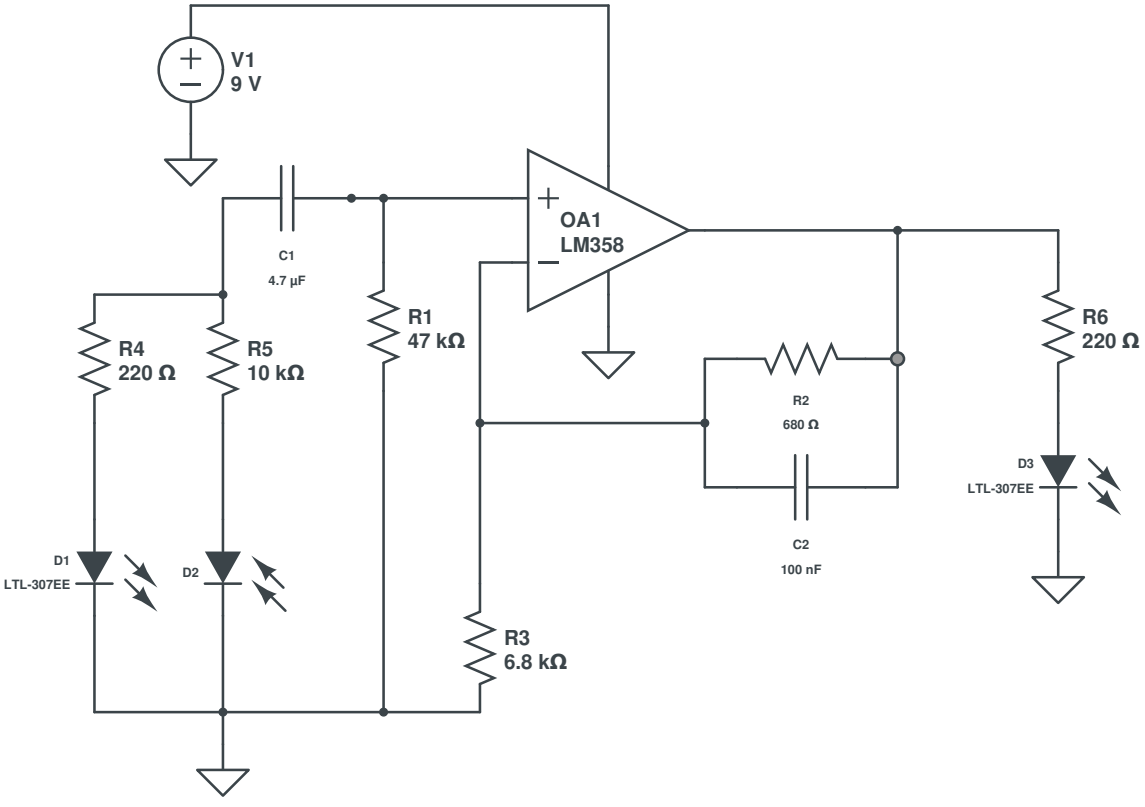
4.2 Amplifier and Filter

The typical heart rate of a person is between 50-150Bpm



4.3 Microcontroller

```
/*  Group 7 | UoM | ENTC 17Batch */
#ifndef F_CPU
#define F_CPU 16000000UL // 16 MHz clock speed
#endif
#define D0 eS_PORTD0
#define D1 eS_PORTD1
#define D2 eS_PORTD2
#define D3 eS_PORTD3
#define D4 eS_PORTD4
#define D5 eS_PORTD5
#define D6 eS_PORTD6
#define D7 eS_PORTD7
#define RS eS_PORTC6
#define EN eS_PORTC7

#include <avr/io.h>
#include <util/delay.h>x
#include "stdlib.h"
#include "string.h"
#include "lcd.h"

char disp[16]="0000000000000001";
char result[8] = "00000001";

void lcd_disp(char arr[],int r,int c,char w[]){
   if(w=="clear")Lcd8_Clear();
   Lcd8_Set_Cursor(r,c);
   Lcd8_Write_String(arr);
}

void ADC_Init(){
   DDRA=0x0;        /* Make ADC port as input */
   ADCSRA = 0x87;      /* Enable ADC, fr/128 */
   ADMUX = 0x40;       /* Vref: Avcc, ADC channel: 0 */


int ADC_Read(char channel){
   int Ain,AinLow;

   ADMUX=ADMUX|(channel & 0x0f); /* Set input channel to read */
```

```
    ADCSRA |= (1<<ADSC);  /* Start conversion */
    while((ADCSRA&(1<<ADIF))==0); /* Monitor end of conversion
        interrupt */
    _delay_us(10);
    AinLow = (int)ADCL;   /* Read lower byte*/
    Ain = (int)ADCH*256;  /* Read higher 2 bits and
                Multiply with weight */
    Ain = Ain + AinLow;
    return(Ain);       /* Return digital value*/
}



int main(void){


    DDRD = 0xFF; // #
    DDRC = 0xFF; //for lcd
    DDRA = 0x00; //Analog input


    ADC_Init();

    Lcd8_Init(); //Initializing the LCD screen
    lcd_disp("Starting Pulse ~)",1,0,"");
    lcd_disp("Meter",2,0,"");

    _delay_ms(3000);

    int i;

    for(i=0;i>=0;i++){

        char temp[11]="Analog - ";
        char val[4]; // 0 - 255 value


        itoa(ADC_Read(0),val,10);

        strcat(temp,val);

        lcd_disp(temp,1,0,"clear");
        _delay_ms(300);
```

```
        }


    }
```

Based on this [1] and this datasheet [2]

4.4 Calibration and Ambient Lighting conditions

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4.5 Noise Filtering

4.5.1 Calculations

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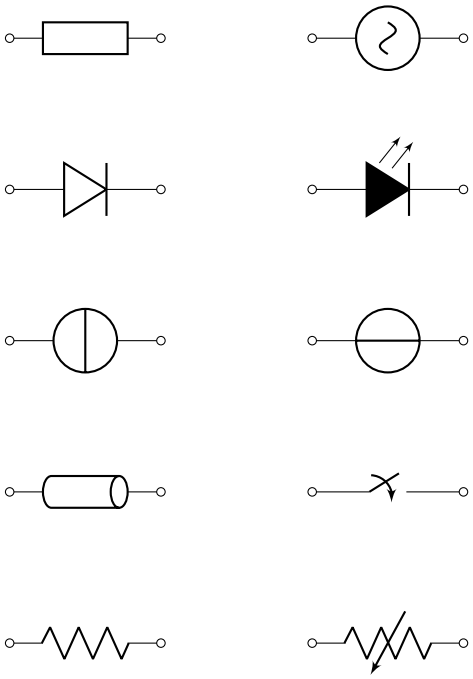
5 Enclosure and PCB Design

6 Implementation and Results



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7 Online Materials

The project has been opensourced on Github. All the diagrams,schematics, PCB designs can be found through this repository. https://github.com/ramithuh/Pulse-Sensor.

8 Conclusion

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