DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING
UNIVERSITY OF MORATUWA

Group Project Report

EN1093 - Laboratory Practice

Portable Heart Rate Monitor

Authors:	*Registration Number:*
K.K. Herath	170213V
H.M.U.D Herath	170215U
R.U. Hettiarachchi	170221T
M.N. Hettiaratchchi	170222X

This is submitted as a partial fulfillment for the module EN1093

December 29, 2018

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

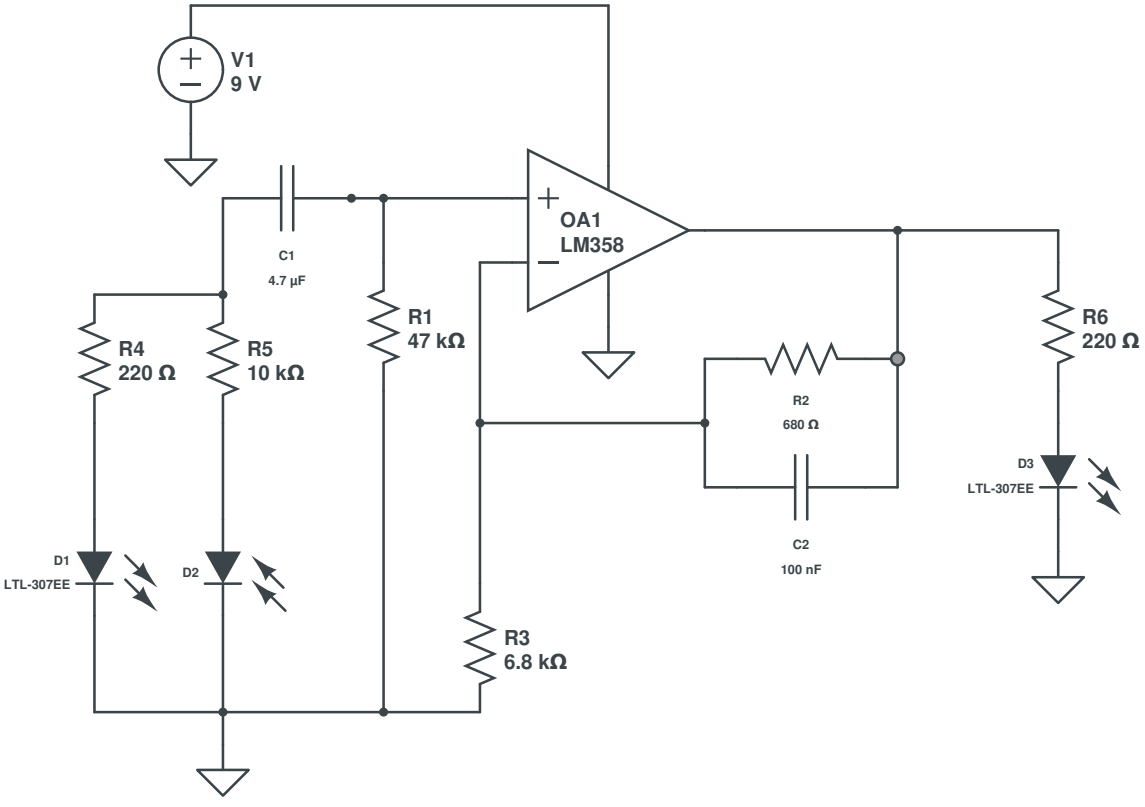
4 Methodology

4.1 Sensor

Cras egestas ipsum a nisl. Vivamus varius dolor ut dolor. Fusce vel enim. Pellentesque accumsan ligula et eros. Cras id lacus non tortor facilisis facilisis. Etiam nisl elit, cursus sed, fringilla in, congue nec, urna. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Integer at turpis. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Duis fringilla, ligula sed porta fringilla, ligula wisi commodo felis, ut adipiscing felis dui in enim. Suspendisse malesuada ultrices ante. Pellentesque scelerisque augue sit amet urna. Nulla volutpat aliquet tortor. Cras aliquam, tellus at aliquet pellentesque, justo sapien commodo leo, id rhoncus sapien quam at erat. Nulla commodo, wisi eget sollicitudin pretium, orci orci aliquam orci, ut cursus turpis justo et lacus. Nulla vel tortor. Quisque erat elit, viverra sit amet, sagittis eget, porta sit amet, lacus.

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

Suspendisse eu nunc. Aliquam dignissim urna sit amet mauris. Cras commodo, urna ut porttitor venenatis, arcu metus sodales risus, vitae gravida sapien ligula in est. Donec vulputate sollicitudin wisi. Donec vehicula, est id interdum ornare, nibh tellus consectetuer justo, a ultrices felis erat at lectus. In est massa, malesuada non, suscipit at, ullamcorper eu, elit. Nam nulla lacus, bibendum sit amet, sagittis sed, tempor eget, libero. Praesent ligula. Suspendisse nulla. Etiam diam. Nulla ante diam, vestibulum et, aliquet ac, imperdiet vitae, urna. Fusce tincidunt lacus vel elit. Maecenas dictum, tortor non euismod bibendum, pede nibh pretium tellus, at dignissim leo eros eget pede. Nulla venenatis eleifend eros. Aenean ut odio dignissim augue rutrum faucibus. Fusce posuere, tellus eget viverra mattis, erat tellus porta mi, at facilisis sem nibh non urna. Phasellus quis turpis quis mauris suscipit vulputate. Sed interdum lacus non velit. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae;

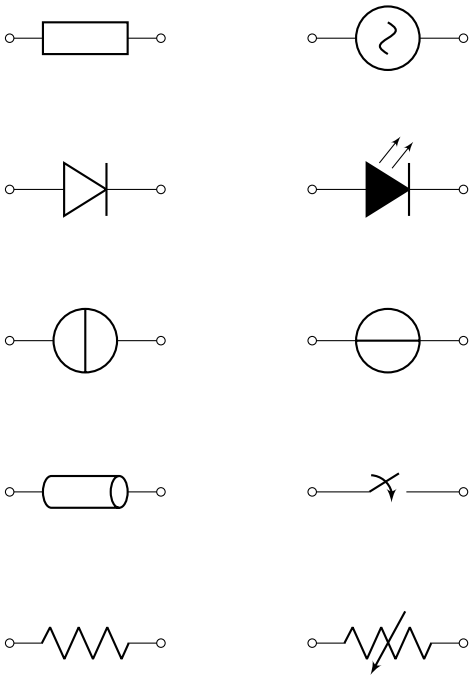
4.5 Noise Filtering

4.5.1 Calculations

Donec et nisl id sapien blandit mattis. Aenean dictum odio sit amet risus. Morbi purus. Nulla a est sit amet purus venenatis iaculis. Vivamus viverra purus vel magna. Donec in justo sed odio malesuada dapibus. Nunc ultrices aliquam nunc. Vivamus facilisis pellentesque velit. Nulla nunc velit, vulputate dapibus, vulputate id, mattis ac, justo. Nam mattis elit dapibus purus. Quisque enim risus, congue non, elementum ut, mattis quis, sem. Quisque elit.

5 Enclosure and PCB Design

6 Implementation and Results



Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

7 Conclusion

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

8 Online Materials

The project has been opensourced on Github. All the diagrams, schematics, PCB designs can be found through our repository.

https://github.com/ramithuh/Pulse-Sensor.

References

[1] Analog readings with avr. https://maker.pro/custom/tutorial/how-to-take-analog-readings-with-an-avr-microcontroller. Accessed: 2018-12-28.

[2] Atmega32 datasheet. http://ww1.microchip.com/downloads/en/devicedoc/doc2503.pdf. Accessed: 2018-11-02.

[3] Photoplethysmogram - wikipedia article. https://en.wikipedia.org/wiki/Photoplethysmogram. Accessed: 2018-10-12.