POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

GLUCOSE MONITORING SYSTEM

NAME	REGISTRATION NO
INTAN SYARAFANA BINTI MD JAMAL	08DJK19F1054

JABATAN KEJURUTERAAN ELEKTRIK

SESI 2 2021/2022

POLITEKNIK

SULTAN SALAHUDDIN ABDUL AZIZ SHAH

GLUCOSE MONITORING SYSTEM

NAME	REGISTRATION NO
INTAN SYARAFANA BINTI MD JAMAL	08DJK19F1054

This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

SESI 2 2021/2022

CONFIRMATION OF THE PROJECT

The project report titled "Glucose Monitoring System" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

Checked by:

Supervisor's name : WAN MOHAD ZAMRI BIN WAN ABD RAHMAN

Supervisor's signature:

Date :

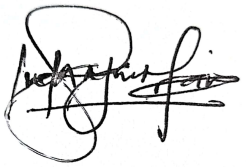
Verified by:

Project Coordinator name :

Signature of Coordinator :

Date :

“I acknowledge this work is my own work except the excerpts I have already explained to our source”

1. Signature : 

Name : **INTAN SYARAFANA BINTI MD JAMAL**

Registration Number : **08DJK19F1054**

Date : 20 / 5 / 2022

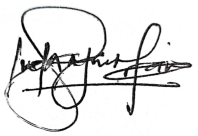
DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : GLUCOSE MONITORING SYSTEM

SESSION: 2 : 2021 2022

1.	I,	**1. INTAN SYARAFANA BINTI MD JAMAL (08DJK19F1054)**
		is a final year student of **Diploma in Electrical Engineering, Department of Electrical, Politeknik Sultan Salahuddin Abdul Aziz Shah**, which is located at **Persiaran Usahawan,40140 Shah Alam Selangor Darul Ehsan**. (Hereinafter referred to as 'the Polytechnic').
2.	I acknowledge that 'The Project above' and the intellectual property therein is the result of our original creation /creations without taking or impersonating any intellectual property from the other parties.	
3.	I agree to release the 'Project' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **Diploma in Electrical Engineering** to me.	

Made and in truth that is recognized by;



INTAN SYARAFANA BINTI MD JAMAL
(Identification card No: - 000211-11-0198)

.....
(INTAN SYARAFANA BINTI MD JAMAL)

In front of me, **WAN MOHD ZAMRI BIN WAN ABD RAHMAN** (Click here to enter text.)

)
)

.....……
(WAN MOHD ZAMRI BIN WAN ABD RAHMAN)

As a project supervisor, on the date:

ACKNOWLEDGEMENTS

I have taken efforts in this Project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly indebted to (Name of your Organization Guide) for their guidance and constant supervision as well as for providing necessary information regarding the Project & also for their support in completing the Project.

I would like to express my gratitude towards my parents & member of (Organization Name) for their kind co-operation and encouragement which help me in completion of this Project. I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my colleague in developing the Project and people who have willingly helped me out with their abilities.

ABSTRACT

Diabetes is a growing chronic disease that affect millions of people in the world. Regular monitoring of blood glucose levels in patients is necessary to keep the disease under control. Current methods of blood glucose monitoring devices are typically invasive, causing discomfort to the patients. Non-invasive glucose monitoring devices are a possible game changer for diabetic patients as it reduces discomfort and provides continuous monitoring. This manuscript presents a review of non-invasive glucose biosensors with particular focus on leading technologies available in the market, such as microwave sensing, near-infrared spectroscopy, iontophoresis, and optical methods. This paper intends to describe non-invasive blood glucose monitoring methods using various biological fluids (sweat, saliva, interstitial fluid, urine), highlighting the advantages and drawbacks in latest device development. This review also discusses future trends of glucose detection devices and how it will improve patients' quality of life. However, there continues to be several challenges related to the achievement of accurate and reliable glucose monitoring. Further technical improvements in glucose biosensors, standardization of the analytical goals for their performance, and continuously assessing and training lay users are required. This article reviews the brief history, basic principles, analytical performance, and the present status of glucose biosensors in the clinical practice.

ABSTRAK

Diabetes adalah penyakit kronik yang semakin meningkat yang menjejaskan berjuta-juta orang di dunia. Pemantauan paras glukosa darah secara berkala pada pesakit adalah perlu untuk memastikan penyakit terkawal. Kaedah semasa peranti pemantauan glukosa darah biasanya invasif, menyebabkan ketidakselesaan kepada pesakit. Peranti pemantauan glukosa bukan invasif adalah penukar permainan yang mungkin untuk pesakit diabetes kerana ia mengurangkan ketidakselesaan dan menyediakan pemantauan berterusan. Manuskrip ini membentangkan ulasan biosensor glukosa bukan invasif dengan tumpuan khusus pada teknologi terkemuka yang terdapat di pasaran, seperti penderiaan gelombang mikro, spektroskopi inframerah dekat, iontoforesis dan kaedah optik. Kertas kerja ini berhasrat untuk menerangkan kaedah pemantauan glukosa darah bukan invasif menggunakan pelbagai cecair biologi (peluh, air liur, cecair interstisial, air kencing), menonjolkan kelebihan dan kelemahan dalam pembangunan peranti terkini. Kajian ini juga membincangkan arah aliran peranti pengesan glukosa pada masa hadapan dan bagaimana ia akan meningkatkan kualiti hidup pesakit. Walau bagaimanapun, masih terdapat beberapa cabaran yang berkaitan dengan pencapaian pemantauan glukosa yang tepat dan boleh dipercayai. Penambahbaikan teknikal selanjutnya dalam biosensor glukosa, penyeragaman matlamat analisis untuk prestasi mereka, dan penilaian dan latihan berterusan pengguna awam diperlukan. Artikel ini mengkaji sejarah ringkas, prinsip asas, prestasi analisis, dan status biosensor glukosa semasa dalam amalan klinikal.

TABLE OF CONTENTS

CONFIRMATION OF THE PROJECT i
DECLARATION OF ORIGINALITY AND OWNERSHIP i
ACKNOWLEDGEMENTS i
ABSTRACT i
ABSTRAK i
TABLE OF CONTENTS i
LIST OF TABLES i
LIST OF FIGURES i
LIST OF SYMBOLS i
LIST OF ABBREVIATIONS i
CHAPTER 1 1
1 INTRODUCTION 1
1.1 Introduction 1
1.2 Background Research 1
1.3 Problem Statement 1
1.4 Research Objectives 1
1.5 Scope of Research 1
1.6 Project Significance 1
1.7 Chapter Summary 1
CHAPTER 2 1
2 LITERATURE REVIEW 1
2.1 Introduction 1
2.2 Motor Skill Challenges in Autistic Children (Literature Review Topic 1) 1
2.2.1 Previous Research (Subtopic Literature Review Topic 1) 1
2.3 Control System (Literature Review Topic 2) 1
2.3.1 Microcontroller 1
2.3.2 Programmable Logic Control (PLC) 1
2.3.3 Arduino 1
2.4 Chapter Summary 1
CHAPTER 3 1
3 RESEARCH METHODOLOGY 1
3.1 Introduction 1
3.2 Project Design and Overview. 1
3.2.1 Block Diagram of the Project 1
3.2.2 Flowchart of the Project 2 1
3.2.3 Project Description 1
3.3 Project Hardware 1
3.3.1 Schematic Circuit 1
3.3.2 Description of Main Component 1
3.3.2.1 Component 1 1

3.3.2.2 Component 2 1
3.3.2.3 Component 3 1
3.3.3 Circuit Operation 1
3.4 Project Software 1
3.4.1 Flowchart of the System 1
3.4.2 Description of Flowchart 1
3.5 Prototype Development 1
3.5.1 Mechanical Design/Product Layout 1
3.6 Sustainability Element in The Design Concept 1
3.7 Chapter Summary 1
CHAPTER 4 **1**
4 RESULTS AND DISCUSSION **1**
4.1 Introduction 1
4.2 Results and Analysis 1
4.3 Discussion 1
4.4 Chapter Summary 1
CHAPTER 5 **1**
5 CONCLUSION AND RECOMMENDATIONS **1**
5.1 Introduction 1
5.2 Conclusion 1
5.3 Suggestion for Future Work 1
5.4 Chapter Summary 1
CHAPTER 6 **1**
6 PROJECT MANAGEMENT AND COSTING **1**
6.1 Introduction 1
6.2 Gant Chart and Activities of the Project 1
6.3 Milestone 1
6.4 Cost and Budgeting 1
6.5 Chapter Summary 1
REFERENCES **1**
7 APPENDICES **1**
APPENDIX A- DATA SHEET 1
APPENDIX B- PROGRAMMING 1
APPENDIX C- PROJECT MANUAL/PRODUCT CATALOGUE 1

LIST OF FIGURES

FIGURE **TITLE** **PAGE**

Figure 2.1: Block diagram of open loop and closed loop system 1

Figure 3.1: Flow chart of operation of the system 1

Figure 3.2: Circuit Diagram 1

Figure 3.3: Front view of the project 1

CHAPTER 1

1 INTRODUCTION

1.1 Introduction

Diabetes Mellitus is a major health concern in the society today both locally and worldwide [1]. According to National Diabetes Institute Malaysia, 3.6 million Malaysians suffer from diabetes in 2019. This is the highest rate of incidence in Asia and one of the highest in the world. Diabetes has been linked with other health problems, including heart disease and stroke, kidney disease, nerve damage and vision loss due to fluctuating blood sugar levels. Such complications can result in retinopathy leading to blindness, can lead to amputation of feet and legs, neuropathies (nerve disorder), cardiovascular diseases or even worst; death [2]. Diabetes Mellitus can be categorized into two major types, Type 1 and Type 2. Type 1 occurs when insulin cannot be produced in the body to control the level of blood glucose. Type 2 which is common, occurs when not enough insulin is produced or when the insulin in the body is not working efficiently [3]. Pre-diabetes is a health condition where patients have a higher level of blood glucose than normal but not high enough to be classified as diabetes.

1.2 Background Research

Glucose was first isolated in 1747 from raisins by Andreas Marggraf. The name glucose was coined in 1838 by Jean Dumas, from the greek glycos, sugar or sweet), and the structure was discovered by Emil Fischer around the turn of the century.

A variety of factors can affect glucose meter results, including **operator technique, environmental exposure, and patient factors, such as medication, oxygen therapy, anemia, hypotension, and other disease states**.

Monitoring blood sugar **helps to determine if you are meeting your glucose targets which helps to reduce the unpleasant symptoms of high and low blood sugar, and avoid long-term diabetes complications**.

1.3 Problem Statement

The glucose monitoring system used to check the glucose level for patients who are at home because it's very difficult to check out the hospital that who is doesn't have vehicle at home to check the glucose level.

In addition, the patients does not know glucose level with a short amount of time.

1.4 Research Objectives

The main objective of this Project is to get the glucose level for the patients at home immediately and at the same time, this project is to save time from the shuttle to the hospital to check up glucose level. Diabetologist can monitor glucose level and suggest the prescribed treatment according to the condition.

1.5 Scope of Research

1. This Project is focusing to Diabetics.
2. The emphasis is Elderly patients with diabetes.
3. The main controller is using Glucose monitoring system and mobile phone.

1.6 Project Significance

This project is design to diabetic patients regardless of age but it this project is focusing to elderly patients who had diabetes by using this project, it can help patients to know the glucose level quickly and easily.

1.7 Chapter Summary

This chapter tells about the introduction to the project to be produced. It also explains the problems faced by the household members as well as the scope of the project and the objectives of the project to help solve the problem more thoroughly. Hope that this project will help many people out there.

CHAPTER 2

2 LITERATURE REVIEW

2.1 Introduction

The measurement of infrared and skin sensors is an important technique used by medical personnel for diagnosing and treating a wide range of non-communicable diseases and conditions. By measuring and especially monitoring a patient's infrared, medical personnel can be alerted to the related health condition at an early stage, increasing the likelihood of successful treatment. While indirect methods of skin sensor monitoring, such as with a pressure skin’s sensor and infrared sensor, are often desired for quick pressure readings, these methods can be inaccurate by as much as 10 percent, making them undesirable for longer term blood pressure monitoring of more critical patients. Consequently, direct blood pressure monitoring methods are preferred for patients with serious or critical conditions due to their improved accuracy and easier long-term implementation. Antonio et al. [1] had developed an implemented and instrumented as an IOT system, in which all the measurements were carried out in vivo to measure the glucose level by using sensor on the hand without needed to prick the patient’s finger to obtain the blood

2.2 Glucose monitoring sytem (Literature Review Topic 1)

In this proposed system considered as two parts software application and hardware kit. In software application will h ave the ability to monitor the patient's health continuously, particularly to measure the blood glucose level.

2.2.1 Previous Research (Subtopic Literature Review Topic 1)

In this proposed system considered as two parts software application and hardware kit. In software application will have the ability to monitor the patient's health continuously, particularly to measure the blood glucose level. When the patients used this system, it will detect glucose level with led which is in three level such as level one is led green for normal glucose, level two is led yellow for alert level and level three is led red for critical level. Buzzer will sound when detection occurs. Then, LCD will display how much glucose level in patients blood and will appear which level patient is.

2.3 Control System (Literature Review Topic 2)

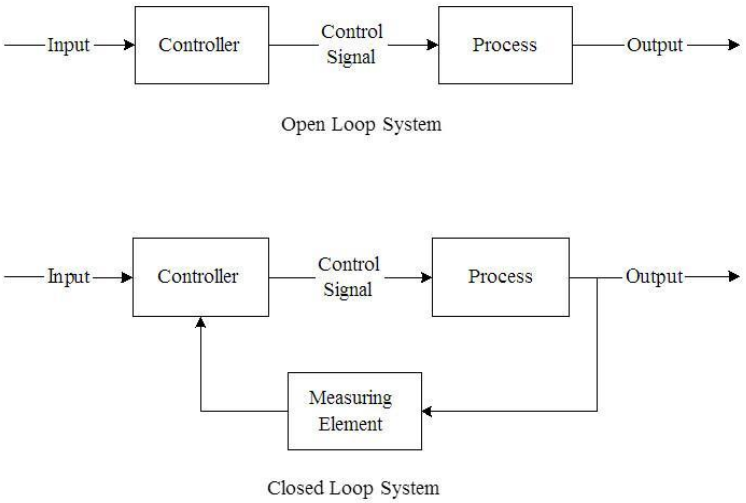


Figure 2.1: Block diagram of open loop and closed loop system

2.3.1 Microcontroller

Microcontroller is a compressed micro computer manufactured **to control the functions of embedded systems in office machines, robots, home appliances, motor vehicles, and a number of other gadgets**. A microcontroller is comprises components like - memory, peripherals and most importantly a processor.

2.3.2 INFRARED PULSE (IR) SENSOR

This pulse sensor as fits over a fingertip or toes and uses the amount of infrared light reflected by the blood circulating inside to do just that. The proposed system consists of a near infrared sensor and skin sensor. The near-infrared sensor is used to obtain the glucose level of the person. The glucose level here is obtained without capturing the blood samples from human body.

2.3.3 Arduino UNO R3

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs),6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be **integrated into a variety of electronic projects**.

2.3.4 HC - 05 BLUETOOTH MOLUDE

The RN-42 Bluetooth Module as shown in Figure 3.3, provides a reliable method for creating a wireless serial communication interface between two devices such as a microcontroller, PC, cell phone, or another module. This module can pair up with devices supporting Bluetooth SPP (Serial Port Profile) to establish a serial interface. The RN-42 Bluetooth Module is breadboard-friendly and is compatible with all 5 V and 3.3 V microcontroller platforms.

2.3.5 LCD 1602A

LCD1602, or 1602 character-type liquid crystal display, is a kind of dot matrix module to show letters, numbers, and characters and so on. It's composed of 5x7 or 5x11 dot matrix positions; each position can display one character.

2.3.6 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

2.3.7 B10K POTENTIOMETER

It is **a single turn 10k Potentiometer with a rotating knob**. These potentiometers are also commonly called as a rotary potentiometer or just POT in short. These three-terminal devices can be used to vary the resistance between 0 to 10k ohms by simply rotating the knob.

2.3.8 PROTEUS DESIGN SUITE

A proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

2.3.9 THINGSPEAK APP

ThingSpeak™ is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics. Internet of Things (IoT) describes an emerging trend where a large number of embedded devices (things) are connected to the Internet. These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend.

2.4 Chapter Summary

This chapter tells about the literature, the components used to produce this project. In this case this chapter helps to study more about the functionality of each component and its suitability. Thus, it is possible to add knowledge about the usefulness of each component.

CHAPTER 3

3 RESEARCH METHODOLOGY

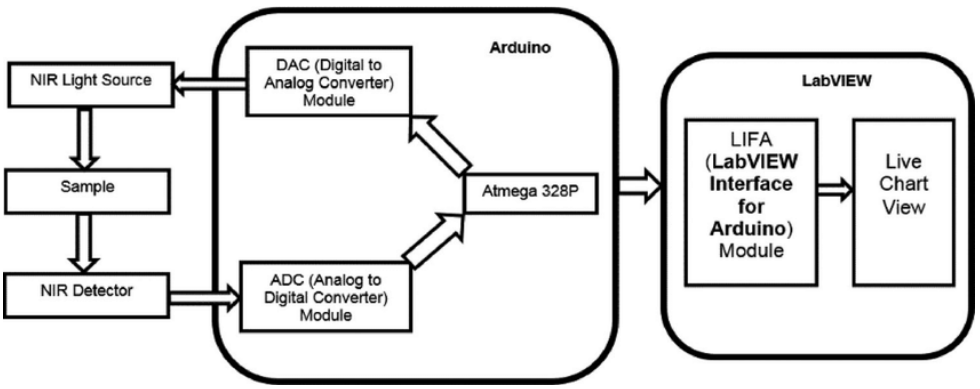
3.1 Introduction

To realize this Project as a product that ready to use with safety characteristic, a very comprehensive plan is undertaking. A step by step procedure is done so that the Project can be completed in time. This include collecting data of sample finger, design the mechanical part, circuit design testing and verification.

3.2 Project Design and Overview.

As mention in the previous chapter,due to the long term requirements of blood glucose monitoring in diabetic patients, regular self-testing and patient compliance to medication is crucial to prevent diabetes complications. Currently, diabetes patients can test the blood glucose at home with a portable electronic device (glucose meter) that measures sugar level in a small drop of blood. Continuous blood glucose monitoring is advantageous for diabetic patients as it can provide feedback on the effectiveness of the prescribed treatment. Diabetes management is a multi-pronged and some doctors may prescribe controlled diet, exercise in addition to the medication. Having regular measurements of blood sugar levels of the patients provide important information to the doctors on how well their patients are responding to the treatment plan.

3.2.1 Block Diagram of the Project




Calculating glucose level
Sending glucose level to server
Internet
Sending alert SMS to patient
Sending glucose level to the doctor

3.2.2 Flowchart of the Project 2

A flowchart is a diagram that shows step-by-step progression through a procedure or system especially using connecting lines and a set of conventional symbols. Figure 3.1 shows the flowchart of the whole system as well as an example of kitchen gas leakage detector operating system.

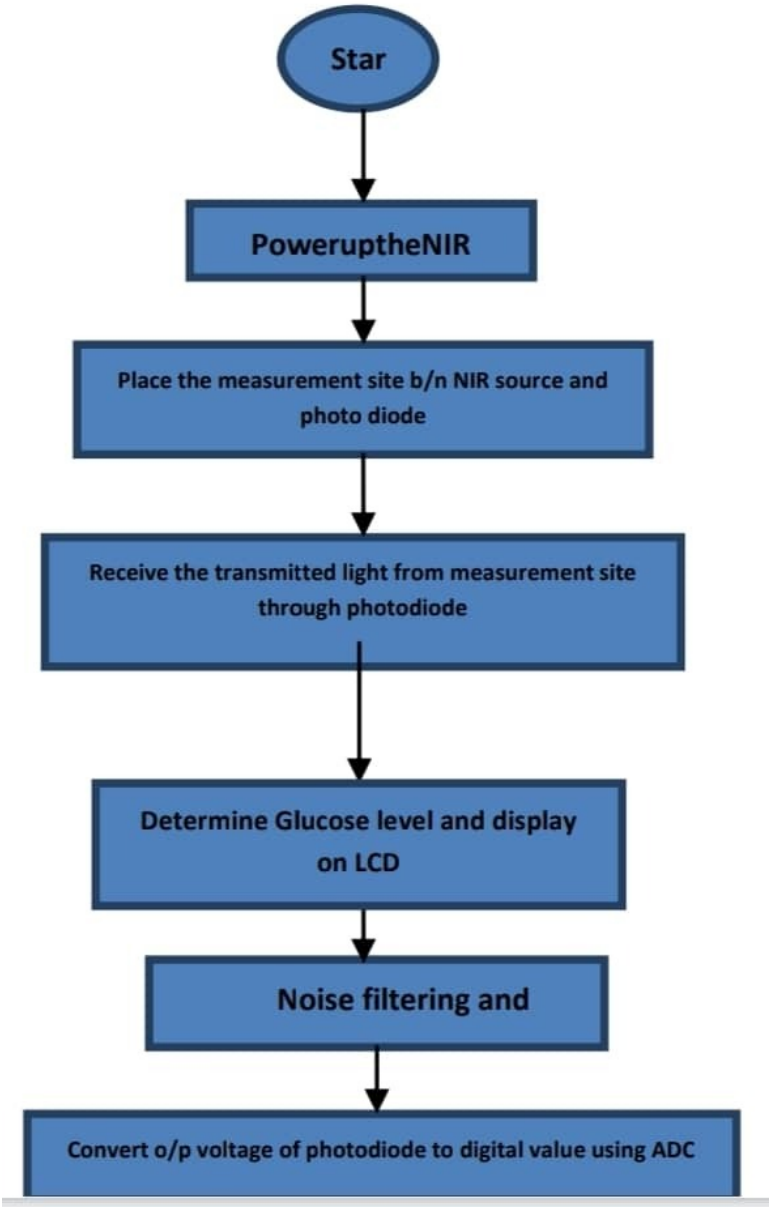


Figure 3.1: Flow chart of operation of the system

*Images may be subject to copyright

3.2.3 Project Description

This project is use Arduino UNO R3 as a microcontroller and the sensor is IR sensor to detect glucose level in blood for diabetics as ell as buzzer will sound when detect a skin or finger and led is an alert system. Thingspeak app as a platform to notify the glucose level for the patients and will appear the result to through the LCD and will send the result to the doctor.

3.3 Project Hardware

As mention in the previous chapter, the designed controller is using Arduino UNO r3 as microcontroller of the system. Then, the LED in the finger model will be blinking. The LED in the model finger is blinking randomly according to which glucose level patient is. Buzzer will sound when detect finger. LCD will appear the glucose level.

3.3.1 Schematic Circuit

Figure 3.2 shows the overall circuit diagram of this **Project Glucose Monitoring System.**

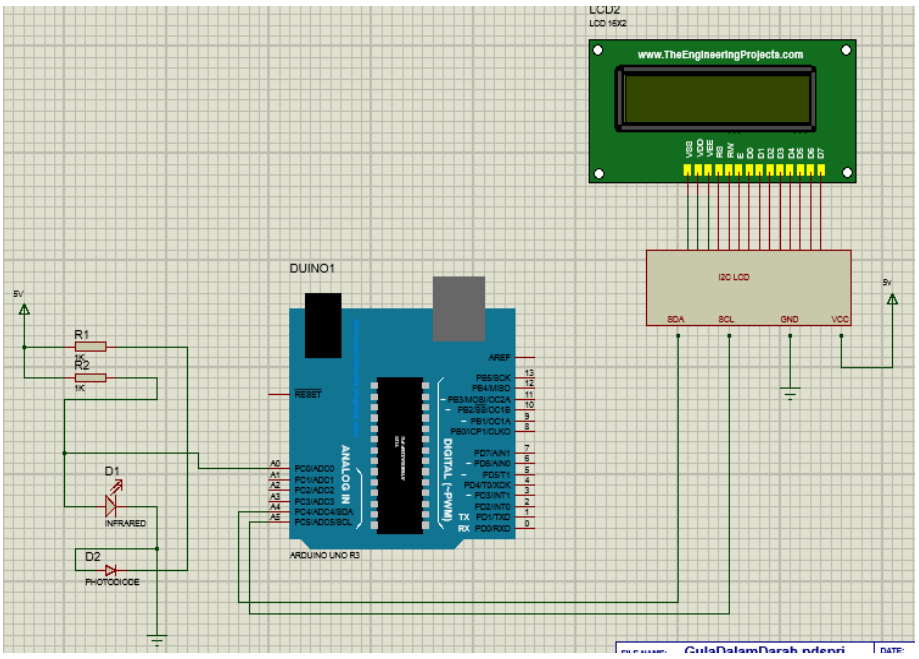


Figure 3.2: Circuit Diagram

3.3.2 Description of Main Component

Arduino UNO R3

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs),6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects.

3.3.2.1 Component 1

INFRARED PULSE (IR) SENSOR

This pulse sensor as fits over a fingertip or toes and uses the amount of infrared light reflected by the blood circulating inside to do just that. The proposed system consists of a near infrared sensor and skin sensor. The near-infrared sensor is used to obtain the glucose level of the person. The glucose level here is obtained without capturing the blood samples from human body.

3.3.2.2 Component 2

LCD 1602A

LCD1602, or 1602 character-type liquid crystal display, is a kind of dot matrix module to show letters, numbers, and characters and so on. It's composed of 5x7 or 5x11 dot matrix positions; each position can display one character.

3.3.2.3 Component 3

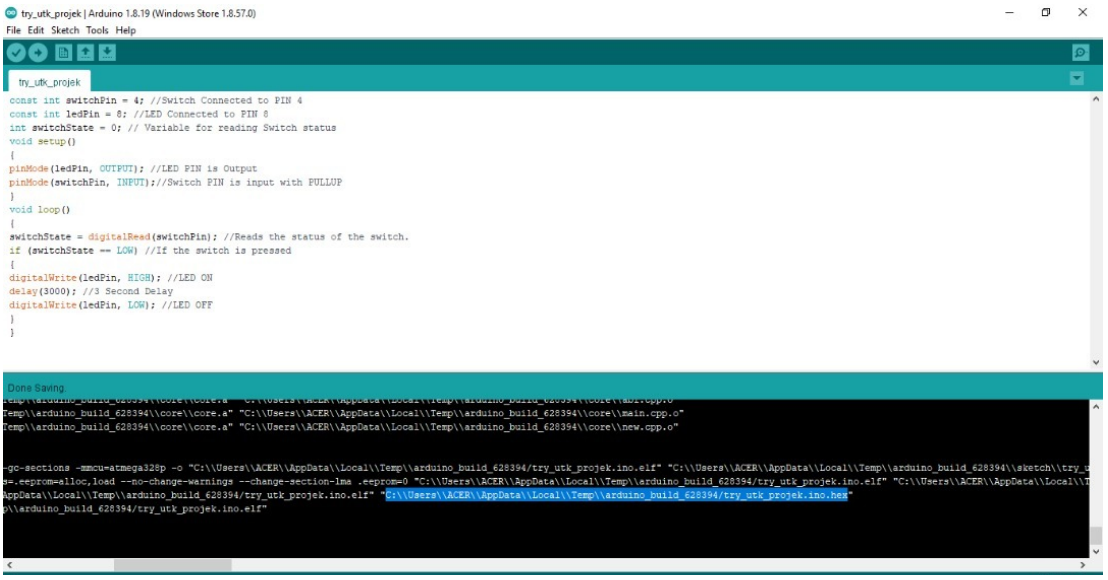
B10K POTENTIOMETER

It is **a single turn 10k Potentiometer with a rotating knob**. These potentiometers are also commonly called as a rotary potentiometer or just POT in short. These three-terminal devices can be used to vary the resistance between 0 to 10k ohms by simply rotating the knob.

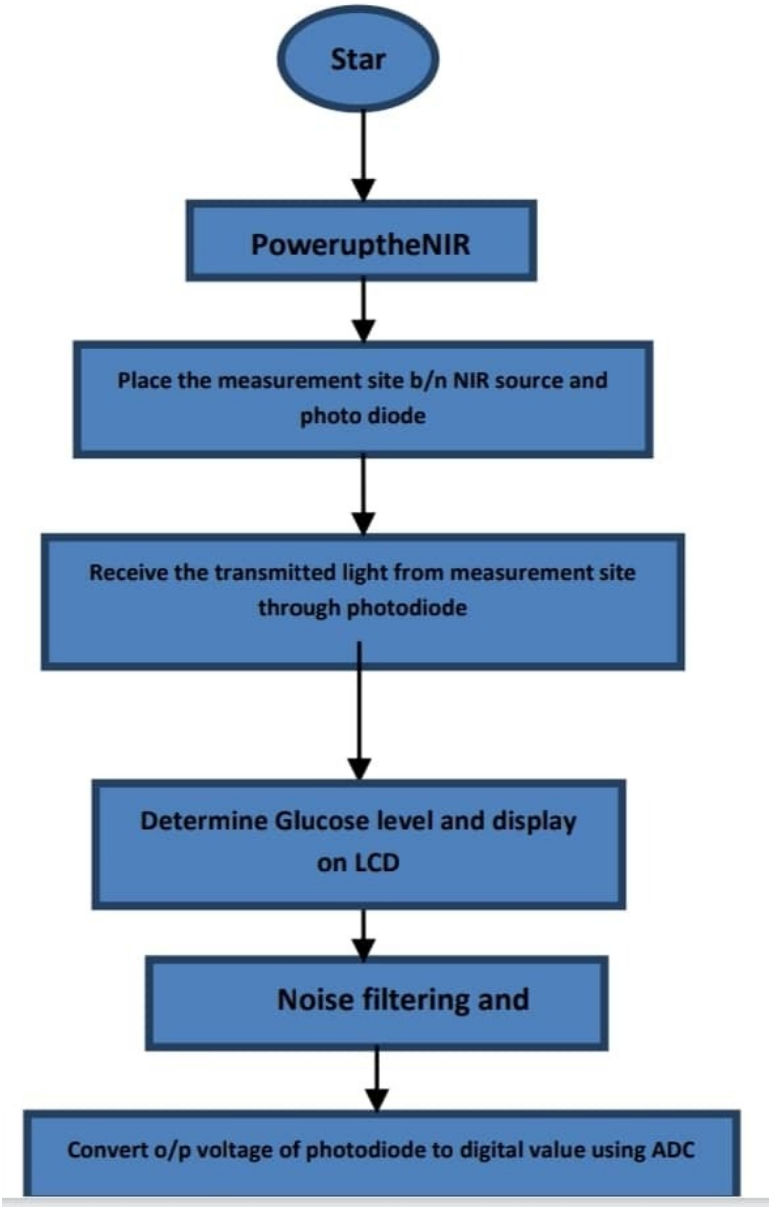
3.3.3 Circuit Operation

When the system is turn on, the Arduino will carry out the operation, and on the output, the LCD display will appear the glucose level. Next, when the patients want to know which level they are, led will blink that shows which level. When the buzzer sounds through the current sensor detect glucose and finger, the result will displayed on the LCD display. Regarding the use of Thingspeak app, the doctor need to know the glucose level from their patients that use this proposed system from home.

3.4 Project Software



3.4.1 Flowchart of the System



3.4.2 Description of Flowchart

When the system is turn on, the Arduino will carry out the operation, and on the output, the LCD display will appear the glucose level. Next, when the patients want to know which level they are, led will blink that shows which level. When the buzzer sounds through the current sensor detect glucose and finger, the result will displayed on the LCD display. Regarding the use of Thingspeak app, the doctor need to know the glucose level from their patients that use this proposed system from home.

3.5 Prototype Development

3.5.1 Mechanical Design/Product Layout

Figure 3.3 shows the design of the Glucose Monitoring System with an Arduino hardware, IR sensor, LCD display, potentiometer, resistor and circuit.

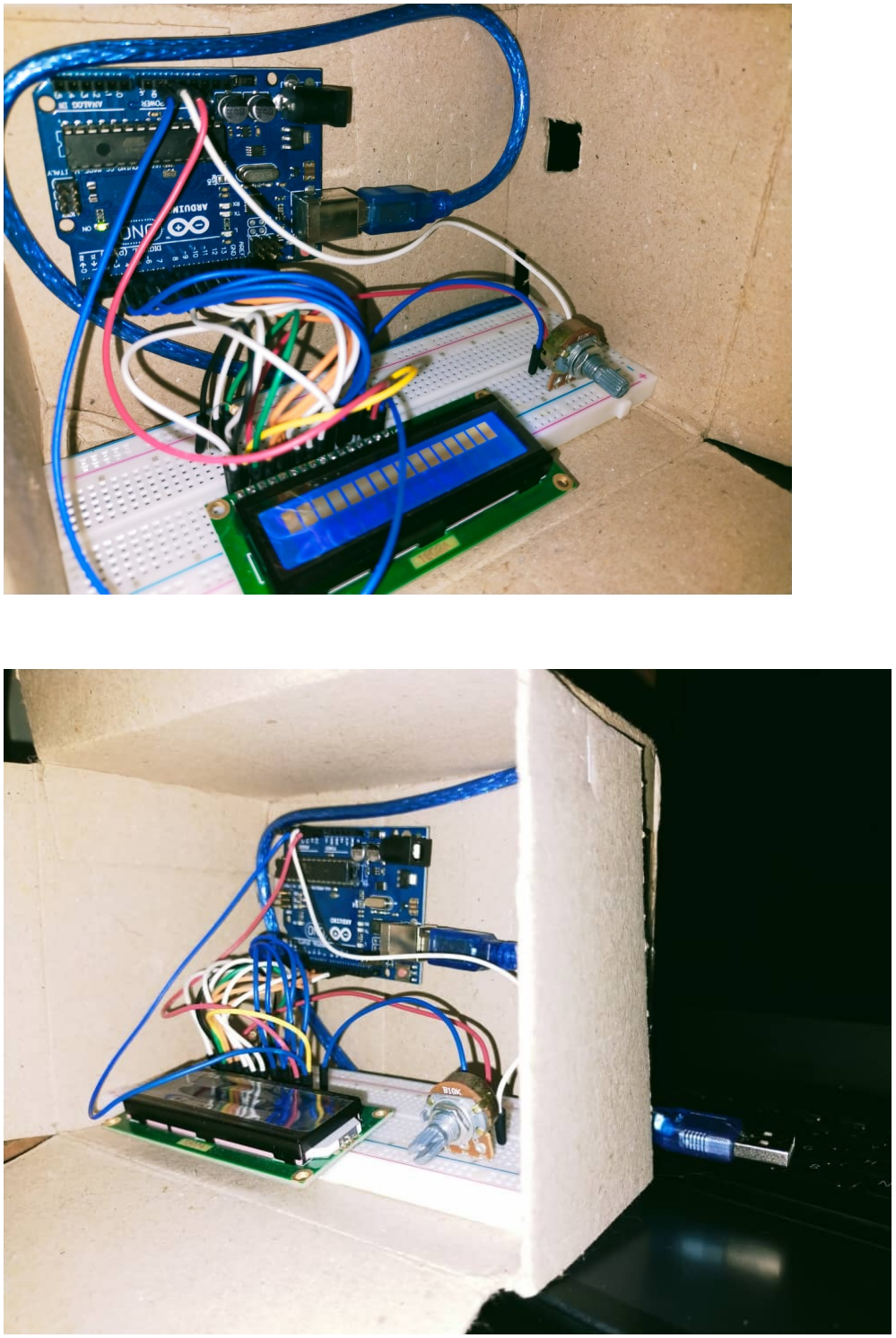


Figure 3.3: Front view of the Project

3.6 **Sustainability Element in The Design Concept**

In this proposed system considered as two parts software application and hardware kit. In software application will have the ability to monitor the patient's

health continuously, particularly to measure the blood glucose level. When the patients used this system, it will detect glucose level with led which is in three level such as level one is led green for normal glucose, level two is led yellow for alert level and level three is led red for critical level. Buzzer will sound when detection occurs. Then, LCD will display how much glucose level in patients blood and will appear which level patient is.

3.7 Chapter Summary

This project is use Arduino UNO R3 as a microcontroller and the sensor is IR sensor to detect glucose level in blood for diabetics as ell as buzzer will sound when detect a skin or finger and led is an alert system. Thingspeak app as a platform to notify the glucose level for the patients and will appear the result to through the LCD and will send the result to the doctor.

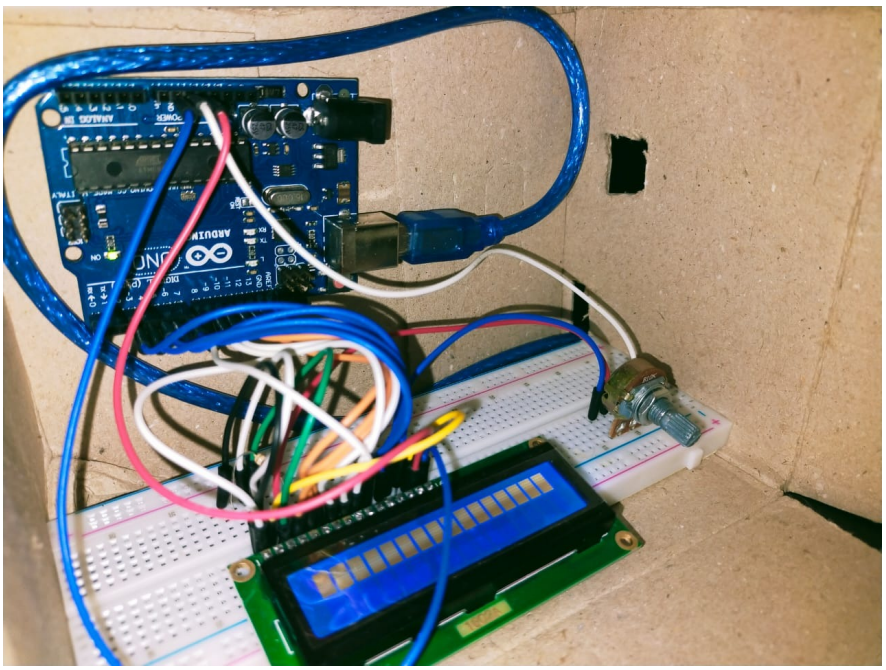
CHAPTER 4

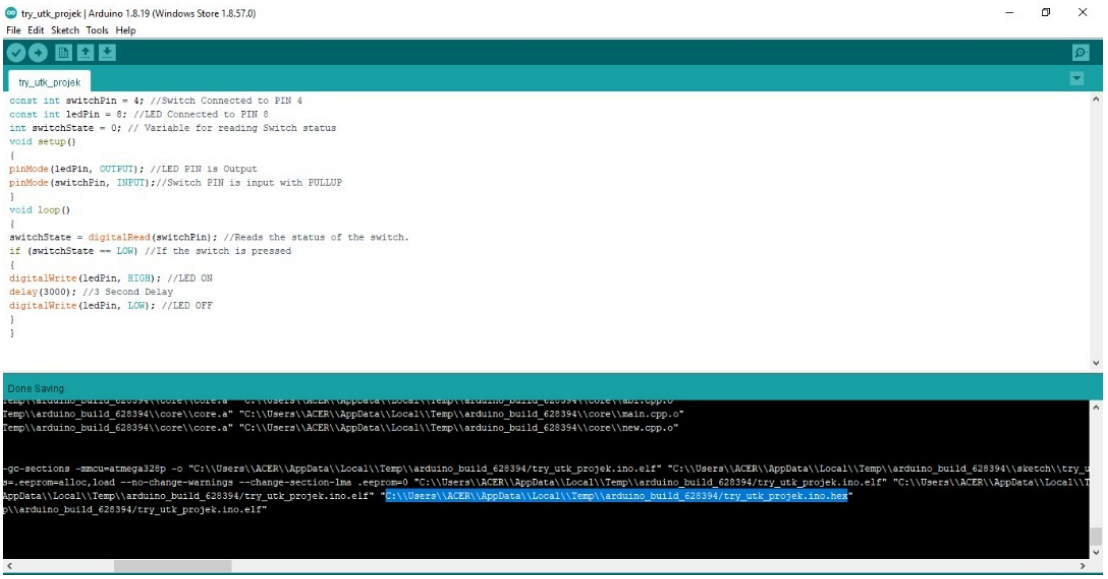
4 RESULTS AND DISCUSSION

4.1 Introduction

Glucose monitoring in diabetic patients, regular self-testing and patient compliance to medication is crucial to prevent diabetes complications. Currently, diabetes patients can test the blood glucose at home with a portable electronic device (glucose meter) that measures sugar level in a small drop of blood. Then, this project is done to use for the patients who needs at home.

4.2 Results and Analysis





4.3 Discussion

In software application will have the ability to monitor the patient's health continuously, particularly to measure the blood glucose level. When the patients used this system, it will detect glucose level with led which is in three level such as level one is led green for normal glucose, level two is led yellow for alert level and level three is led red for critical level. Buzzer will sound when detection occurs. Then, LCD will display how much glucose level in patients blood and will appear which level patient is.

4.4 **Chapter Summary**

This proposed system is shows the results considered as two parts software application and hardware kit. In software application will h ave the ability to monitor the patient's health continuously, particularly to measure the blood glucose level.

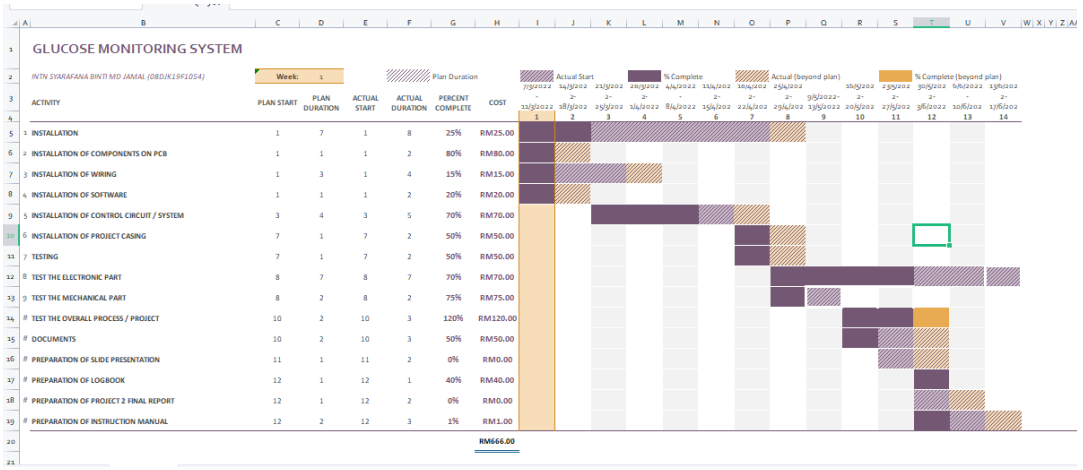
CHAPTER 5

5 PROJECT MANAGEMENT AND COSTING

5.1 Introduction

The project involves the costs of purchasing components and materials for its implementation which is involves the cost of Arduino hardware, sensors, circuit and LCD display and other equipment. All these components are purchased through the online purchase method to facilitate as well as save costs. Financial resources for this project are self -funded with some basic components and materials procured in the project laboratory. Based on the projected cost is estimated at RM150 below. The development cost is still feasible with a period of 10 months. It is feasible and achievable based on the investigation conducted.

5.2 Gant Chart and Activities of the Project



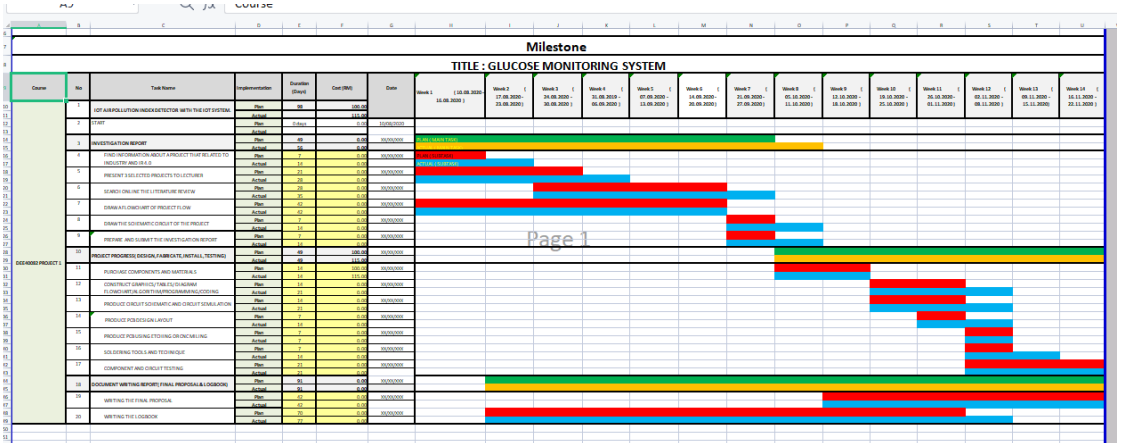
GLUCOSE MONITORING SYSTEM

INTN SYARAFANA BINTI MD JAMAL (08DJK19F1054)

Week: 1

	ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE	COST
1	INSTALLATION	1	7	1	8	25%	RM25.00
2	INSTALLATION OF COMPONENTS ON PCB	1	1	1	2	80%	RM80.00
3	INSTALLATION OF WIRING	1	3	1	4	15%	RM15.00
4	INSTALLATION OF SOFTWARE	1	1	1	2	20%	RM20.00
5	INSTALLATION OF CONTROL CIRCUIT / SYSTEM	3	4	3	5	70%	RM70.00
6	INSTALLATION OF PROJECT CASING	7	1	7	2	50%	RM50.00
7	TESTING	7	1	7	2	50%	RM50.00
8	TEST THE ELECTRONIC PART	8	7	8	7	70%	RM70.00
9	TEST THE MECHANICAL PART	8	2	8	2	75%	RM75.00
#	TEST THE OVERALL PROCESS / PROJECT	10	2	10	3	120%	RM120.00
#	DOCUMENTS	10	2	10	3	50%	RM50.00
#	PREPARATION OF SLIDE PRESENTATION	11	1	11	2	0%	RM0.00
#	PREPARATION OF LOGBOOK	12	1	12	1	40%	RM40.00
#	PREPARATION OF PROJECT 2 FINAL REPORT	12	1	12	2	0%	RM0.00
#	PREPARATION OF INSTRUCTION MANUAL	12	2	12	3	1%	RM1.00
							RM666.00

5.3 Milestone



5.4 Cost and Budgeting

1. **Cost and Budgeting**
2.

No.	Component and materials	The unit price	Quantity	Total
1	Arduino UNO set	RM 32.00	1	RM 32.00
2	IR sensor	RM 7.00	1	RM 7.00
3	LCD 1602	RM 15.00	1	RM 15.00
4	Potentiometer	RM 6.00	1	RM 6.00
5	Other materials	RM 60	-	RM 60
			Total :	**RM 120.00**

5.5 Chapter Summary

In this proposed system, all components had to buy online. All activity is an actual plan and complete task is done by testing all equipment for the system. These project will give the users benefits because it will appear the results on the LCD display which one is the level for the patients.

REFERENCES

[1] J. J. Crosbie, J. Burns, R. A. Ouvrier, Pressure characteristics in painful pes cavus feet resulting from Charcot–Marie–Tooth disease, Gait & Posture, 28 (2008) 545–551.

[2] D. D. L. Rodriguez, J. Assal, Biofeedback can reduce foot pressure to a safe level and without causing new at-risk zones in patients with diabetes and peripheral neuropathy, Diabetes Metab. Res. Rev., 29 (2013) 139–144.

[3] A. Nagel, F. Fernholz, C. Kibele, D. Rosenbaum, Long distance running increases plantar pressures beneath the metatarsal heads: A barefoot walking investigation of 200 marathon runners, Gait & Posture, 27 (2008) 152–155.

[4] Tekscan Inc., Pressure mapping, force measurement & tactile sensors,

www.tekscan.com/products-solutions/systems/f-scan-system,accessed:16 April 2015.

[5] Novel, The pedar system – The quality in-shoe dynamic pressure measuring system, http://www.novel.de/novelcontent/pedar, accessed: 16 April 2015.

[6] Moticon GmbH, Mission: Sensing foot dynamics, http://www.moticon.de/products/product-home, accessed: 16 April 2015.

[7] Orpyx Medical Technologies Inc., Monitor pressure underfoot with the Surrosense RXTM, http://orpyx.com/pages/surrosense-rx, accessed:16 Apri 2015.

[8] A. M. Tan, F. K. Fuss, Y. Weizman, Y. Woudstra, O. Troynikov, Design of low cost smart insole for real time measurement of plantar pressure, Procedia Technology (2015) in print.

6 APPENDICES

APPENDIX A- DATA SHEET

APPENDIX B- PROGRAMMING

```
const int switchPin = 4; //Switch Connected to PIN 4
const int ledPin = 8; //LED Connected to PIN 8
int switchState = 0; // Variable for reading Switch status
void setup()
{
pinMode(ledPin, OUTPUT); //LED PIN is Output
pinMode(switchPin, INPUT);//Switch PIN is input with PULLUP
}
void loop()
{
switchState = digitalRead(switchPin); //Reads the status of the switch.
if (switchState == LOW) //If the switch is pressed
{
digitalWrite(ledPin, HIGH); //LED ON
delay(3000); //3 Second Delay
digitalWrite(ledPin, LOW); //LED OFF
}
}
```

```
#include <p18f4550.h>

/* V E C T O R  R E M A P P I N G ***************/

extern void _startup (void);        // See c018i.c in your C18 compiler dir
#pragma code _RESET_INTERRUPT_VECTOR = 0x000800
void _reset (void)
{
   _asm goto _startup _endasm
}
#pragma code

#pragma code _HIGH_INTERRUPT_VECTOR = 0x000808
void _high_ISR (void)
{
   ;
}

#pragma code _LOW_INTERRUPT_VECTOR = 0x000818
void _low_ISR (void)
{
   ;
}
#pragma code

//=================USER PROGRAM=====================================

#include <delays.h>

#define data_port PORTD
#define rs_pin PORTAbits.RA2
#define e_pin PORTAbits.RA3

void lcd_setup(void);
void lcd_cmd(unsigned char value);
void lcd_data(unsigned char value);
```

```
void main(void)
{
 lcd_setup();
 lcd_cmd(0x80);                                  //Set DDRAM Address
 lcd_data('B');
 lcd_data('O');
 lcd_data('L');
 lcd_data('E');
 lcd_data('H');
 while(1);                                       //loop here
}

void lcd_setup(void)
{
 TRISD = 0;                                                          //Configured PORTD as Output
 TRISAbits.TRISA2 = 0;          //PORTA2 as output -> RS pin
 TRISAbits.TRISA3 = 0;          //PORTA3 as outpur -> E pin
 ADCON0bits.ADON=0;                      //ADC OFF
 ADCON1=0b00001101;                      //AN0 and AN1 are configured as ADC pins
 e_pin = 0;                                                  //prepare to enable idle low
 Delay1KTCYx(50);                        //Delay 10ms
 lcd_cmd(0x38);                                  //Function Set : LCD 2 lines, 5x7 dot
 Delay1KTCYx(50);                        //Delay 10ms
 lcd_cmd(0x0E);                                  //display on, cursor on
 lcd_cmd(0x01);                                  //clear LCD
 lcd_cmd(0x06);                                  //shift cursor right
}

void lcd_cmd(unsigned char value)
{
 data_port = value;                      //COMMAND SET
 rs_pin = 0;                                                         //command mode
 e_pin = 1;                                                  //enable in active state
   Delay1KTCYx(5);                       //delay 1ms
 e_pin = 0;                                                  //strobe enable pin
```

```
   Delay1KTCYx(25);                    //delay 5ms for execution time
}

void lcd_data(unsigned char value)
{
 data_port = value;                    //DISPLAY DATA
 rs_pin = 1;                                                    //Data Mode
 e_pin = 1;                                                  //enable in active state
   Delay1KTCYx(5);                     //delay 1ms
 e_pin = 0;                                                  //strobe enable pin
   Delay1KTCYx(25);                    //delay 5ms for execution time
}
```