CERTIFICATION

As the candidate’s supervisor, I have approved this project report for submission.

Name: Mr. Jumanne Ally

Signature: ________

Date: ____________

DECLARATION

I, Peter Samuel, declare to the best of my knowledge that the project presented here as partial fulfillment for the award of bachelor of engineering in electronics and telecommunication course is my original work and has not been copied from anywhere or presented elsewhere except where explicitly indicated otherwise as all sources of knowledge have been acknowledged.

CANDIDATE NAME	**SIGNATURE**	**DATE**
PETER, Samuel	___________________	_______________

ABSTRACT

Across Tanzania most of people use the liquefied petroleum gas (LPG) cylinders. In our homes we observe that LPG gas cylinders are empty without known that the cylinders will be empty, many times it happens that because of suddenly emptiness and shortage of cylinders, there is a delay in providing the gas cylinder. Main reason behind this is we inform the gas provider at the last moment when the gas is empty. The main objective was to design a system that will be used for booking and monitoring real time weight of LPG gas cylinders.

The steps and methods which were used to achieve the goals for this project was literature review different sources of information based on principles, data collection, data analysis, system design, simulation and built a prototype. The idea of this work was to present a design that senses the daily weight of the cylinder and if the weight gets low to certain value cylinder gets booked automatically and an SMS is sent to the user. Sensing unit was design perfect, everything is displayed on LCD display and SMS were sent. The proposed system was designed to meet Tanzania environment

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Special thanks to the project coordinator and all member staff in Electronics and Telecommunication Department for their valuable recommendation and support.

Also, my special thanks should go to my father Eng. Peter E.S Mkiramweni and my mother Agnes R. Shangari for their encouragement and prayers they offer to me and to my family members and class members for their support and encouragement whenever I faced problem during the preparation of this report.

Finally, I would like to extend my appreciation to all those who contributed time, concern and efforts to lend a helping allows me to gain invaluable knowledge. On top of that, their supports have led me to practice and learn more from them in order to become a good expert in the field of engineering.

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LIST OF ABBREVIATION

AC	Alternating Current
BCS	Base Station Controller
BTS	Base Transceiver Station
CBC	Cell Broadcast Centre
CCIR	Consultative Committee on Radio
CCITT	ComitéConsultatif International TéléphoniqueetTélégraphique
CEPT	European Conference of Postal and Telecommunication Administration
DC	Direct Current
EDGE	Enhanced Data Rates for GSM Evolution
EIR	Equipment Identity Register
GPRS	General Packet Radio Service
GSM	Global System for Mobile
GSMC	Gateway Mobile Switching Centre
HLR	Home Location Register
IREP	Infrared Emitting Diode
ISDN	Integrated Service Data Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
MSC	Mobile Switching Centre
MSSP	Managed Security, Service Provider
OTP ROM	One Time Programmable Read Only Memory

PCMCIA	Personal Computer Memory Card Integration Association
PCMCIA	Personal Computer Memory Card International Association
PCN	Personal Communication Network
PCS	Personal Communication Services
PLMN	Public Land Mobile Network
PSP	Parallel Slave Port
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
RAM	Random Access Memory
SIM	Subscriber Identity Module
SMS	Short Message Service
TRAU	Transcoder and Rate Adaptation Unit
UPC	Universal Product Code
USART	Universal Synchronous Asynchronous Receiver Transmitter
VLR	Visitor Location Register

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CHAPTER ONE

1.0 INTRODUCTION

This chapter will introduce the background information about the project, how broad the problem is, the main and specific objectives to be covered and the expected result if the set objectives achieved.

1.1 Background Information

Tanzania's petroleum Subsector can be divided into two activities, i.e. Upstream and downstream. Upstream activities involve exploration and production of hydrocarbons, while downstream currently includes importation, storage, and transit transportation, wholesale and retail distribution of the refined petroleum products including liquefied petroleum gas.

The main National Energy Policy 2003 addresses issues pertaining to local content, related policies in oil and gas sub-sector have all emphasized broadly on enhanced local content, without detailing on the level of participation of Tanzanian nationals and Tanzanian owned companies.

The Natural Gas Policy of 2013 came up even more precisely by anchoring itself on a principle pillar that "Natural gas resource found in Tanzania belongs to Tanzanians; and must be managed in a way that benefits the entire Tanzanian society". This strong statement and other provisions of the Natural Gas Policy are the basis of this local content policy for the oil and gas industry [1].

Tanzania has been slow to develop in terms of LP Gas growth, but Governments who provide a favorable fiscal environment for LP Gas can get fast returns on this investment through the rapid growth of LPG consumption. Tanzania LPG consumption in rural household is 4%, almost zero, whereas urban household and restaurant consumption is around 3569 metric tons (0.1 kg/capita per annum) No subsidy on LPG. The LPG industry lobbied the Tanzania government prior to the 2002 budget for relaxation of import duty and VAT and appliances under the umbrella of "Association of Tanzania Petroleum Marketing Companies" but they were not successful. Reductions in taxes and duties together with the inherent benefits of using LPG will enable it to become a more competitive fuel leading to economic growth.

1.2 Problem Statement

In our homes we observe that LPG gas cylinders are empty without known that the cylinders will be empty and we give the request for new cylinders at the office of Gas cylinder provider. Many times it happens because of suddenly emptiness and shortage of cylinders also there is a delay in providing the gas cylinders. Main reason behind this is we inform the gas provider at the last moment before the gas cylinder is totally empty.

1.3 Objectives

The objectives of this project are divided into a general and specific objective.

1.3.1 Main Objective

To design a system that will be used for booking and monitoring the real time weight, of LPG gas cylinders.

1.3.2 Specific Objectives

i. To establish the design requirements for the proposed system

ii. To design the sensing mechanism for LPG cylinder to measure the real weight for data collection of the gas cylinder.

iii. To program the microcontroller and design the automatic LPG booking system.

iv. To interface the GSM (Global System for Mobile) module, (Green and Red) led, sensing unit and display unit with the control unit.

1.4 Significance of the Project

i. It avoids the problematic situation or the trouble caused due to unavailability of gas cylinder

ii. It will be easy to use and fully automated so no human attention required.

1.5 Scope and Limitation of the Project

i. Part of the system (GSM) operates depends on network parameters so if the user is out of coverage of GSM network may not receive the SMS.

ii. The initial cost is high compared to traditional system.

1.6 Chapter Conclusion

This chapter contains the source and basic information about the project on what is the main aim of the project and the measurable factors or specifications of the project.

CHAPTER TWO

2.0 METHODOLOGY

This chapter presents the expected steps and methods to be used in order to achieve the goals of our project. The steps are shown below

i. Literature review.
ii. Data collection
iii. Data analysis.
iv. The system design
v. Simulation
vi. Prototype building and testing

2.1 Literature Review

In a literature review, different sources of information based on principles, laws and all scientific verification will be revised.

2.2 Data Collection

In a literature review, different sources of information based on principles, laws and all scientific verification will be revised.

2.3 Data Analysis

Analysis of data is a process of inspecting, cleaning, converting, and modeling data with the goal of determining useful information, suggesting conclusions, and supporting decision making

In data analysis, we have most analyzed the details on the gathered information by relating them to the scientific principles that lead to the designing conclusion.

2.4 System Design

The circuit design will base on information collected in order to meet the objective of the project.

2.5 Simulation

Different parts of this system after design will be simulated in order to observe results of each part before implementing the complete circuit.

2.6 Prototype Building and Testing

The circuit will be implemented on the board to see whether the output is as that one obtained in the simulation before install it into the Vero board or printed circuit board.

2.7 Chapter Conclusion

This chapter explains various methods or procedures which will be used to accomplish the project.

CHAPTER THREE

3.0 LITERATURE REVIEW

The literature review provides some information about reviews of existing project formed to get an idea about the project design, conception and any information that related to improving the project. With different concept and design, there are other creation and innovations of projects done by other people. Researches related to this project also covered in this part.

3.1 Common Information about LPG gas

LPG, first produced in 1910 by **Dr. Walter Snelling**, Liquefied petroleum gas or liquid petroleum gas (LPG or LP gas), also referred to as simply propane mixtures of hydrocarbon gases used as fuel in heating appliances, cooking [2].

Tanzania has been exploring for oil and gas for more than half a century. The first natural gas discovery was made on the Songo-Songo Island in 1974 followed by another one in the Mnazi Bay in 1982. In 2004 and 2006 commercial production of natural gas on the SongoSongo Island and in the Mnazi Bay commenced, respectively. From 2010, Tanzania has witnessed further exploration and discoveries of significant quantities of natural gas both on- and offshore [1]. The figure 3.1 shows the picture of LPG cylinders.

Figure 3.1 LPG cylinders.

3.2 Existing System

This part describes two major things, the present situation and some related works. The related works are the works done by various authors and different publications whose information is useful in this project.

3.2.1 Present Situation

Presently in Tanzania the system used to monitor the weight of LPG gas cylinders and the process of booking them at home is manually system and it operates as follows.

3.2.1.1 Gas Weight Checkup through Weight Scale

An alternative way to check a gas cylinder is by using a scale. Disconnect the bottle and place it on a scale, making sure the valve is firmly closed.

The tare (empty) weight of the bottle is stamped on the neck ring. The difference between the scale reading and the tare weight should indicate approximately how much gas remains in the bottle. This is done by checking that the LPG cylinder seal is intact. For example, the 15 kg cylinder, the weight of the empty cylinder (15.3*kg) is painted on its body. So in order to get the net weight of the gas, the following calculation used to get it. The figure 3.2 shows LPG weight checks up

NETT WT = (GROSS WEIGHT OF EMPTY CYLINDER AND LPG) – (EMPTY CYLINDER WEIGHT)

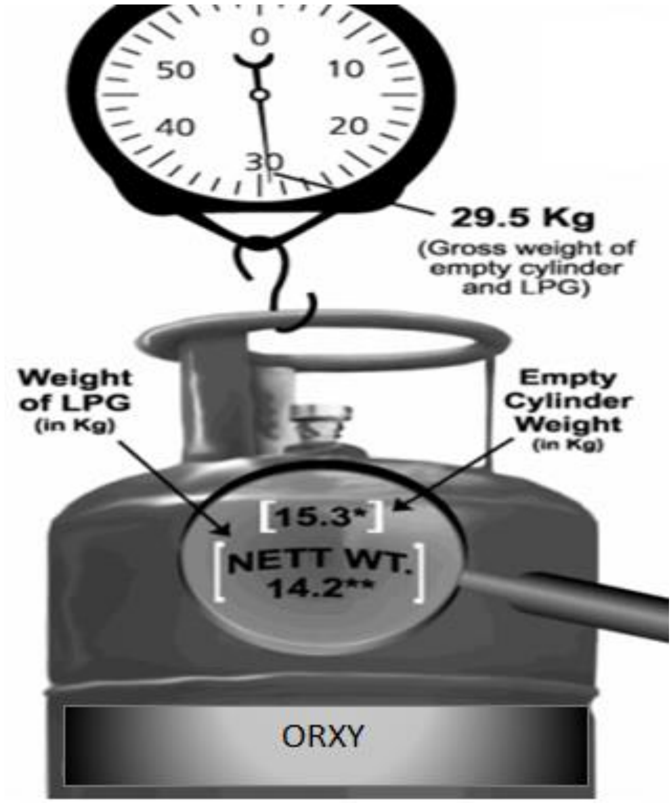

Figure 3.2 LPG weight checks up [3]

3.2.1.2 Checking the Level of Remaining Gas

LPG is stored under pressure, as a liquid, in a gas bottle. It turns back into a gas by 'boiling' into gas vapor. This happens at the very low temperature of -42°C. To boil, the liquid LPG draws heat from the steel walls of the gas bottle. This, in turn, makes the gas bottle feel colder than the ambient temperature. The gas bottle gets even colder when we are actually using the gas. Under the right conditions, when you are using gas very rapidly, ice can even form on the gas bottle. So, this was used to tell how much gas is left in a gas bottle. How? Well, by pouring hot water down the side of the gas bottle to heat the steel. The steel above the level of the gas will retain the heat longer than the steel below the level of the gas. This makes it feel warmer above and cooler below the gas level. The point at which there is any feeling that temperature change is the level of the gas inside the bottle [3].

How full is the gas bottle? It is recommended that 'Do NOT use boiling water', as it would risk scalding ourselves. The figure 3.3 shows How the gas level is checked.

i. Water from the hot water tap at home should work fine.

ii. Using care, SLOWLY to pour the hot water down one side of the gas bottle. More water is better, as it will make it easier to feel the difference in temperature.

iii. A line of condensation may appear, indicating the gas level. If not: Wait a few seconds and then run the hand down the same side of the gas bottle, where it poured the water.

iv. There are must be feeling a change of temperature at the level of the gas. If no feeling the difference, the gas bottle/cylinder may well be empty.

Figure 3.3 How the gas level is checked [3]

3.2.1.3 Estimation of Gas Uses

LPG gas cylinder, checking is done manually by the gas cylinder owner either in our home or hotels or small industries by estimate the use of gas due to their experiences in the use which made them to get un-correct answers. Sometimes it happens that the gas cylinder is empty without know that gas has finished in the cylinder.

3.2.2 Limitation of Existing System

i. **Inefficient**. Due to that no real time weight data can be obtained using this manual method to know when the cylinder will be empty in order to order a full cylinder.

ii. It's not easy for the gas cylinder owner, to make checkup daily, weekly and monthly to know the status of gas remain.

iii. It is cost full due to that if the cylinders are finished to the gas provider A, you will need to go to the gas provider B who is farthest from you are placed. So booking is important.

3.3 Chapter Conclusion

This chapter contains the explanation of the various existing accessing system, their weaknesses and limitations of these systems

CHAPTER FOUR

4.0 PROPOSED SYSTEM

This chapter introduces the proposed system which is an advanced system that will overcome the limitations from all existing systems; it also explains the function of all parts of the proposed system and the principle of operation of this system.

4.1 Proposed System Block Diagram

The block diagram of the proposed system is illustrated in Figure 4.1

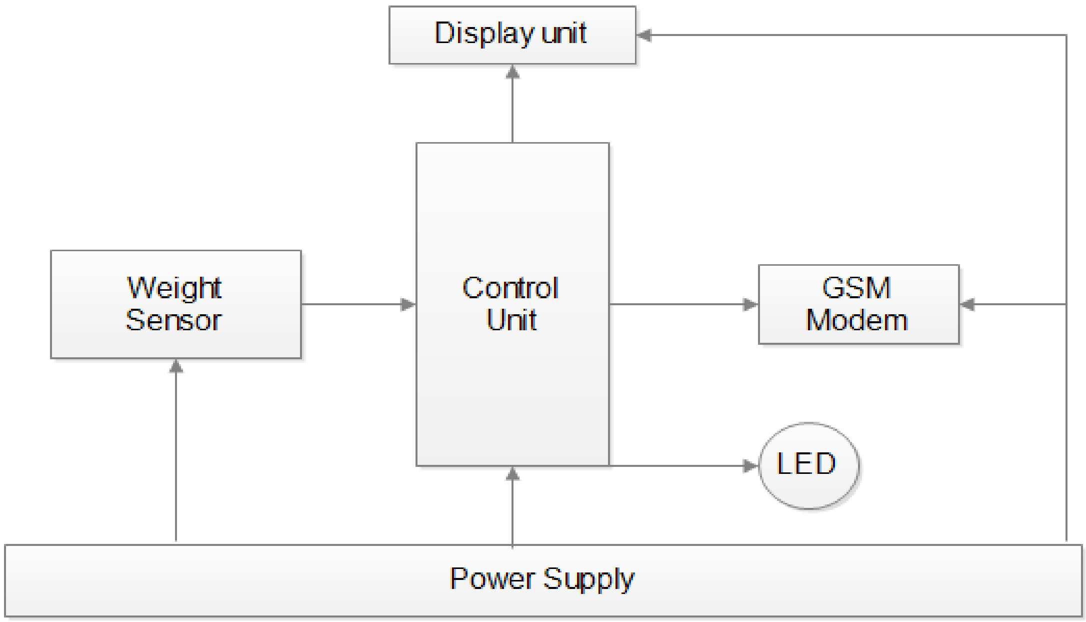

Figure 4.1 Block diagram of proposed system

4.2 Parts of Proposed System

The following are the parts of the proposed system and their functions.

4.2.1 Sensor Unit

A load cell is a transducer that is used to convert a force into an electrical signal. The most common application of this sensor is in weighing machine. Every weighing machine which shows weight has a load cell as the sensing element. This conversion is indirect and occurs in two stages. Through a mechanical organization, the force being sensed bends a strain meter. The strain meter measures the distortion (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire. A load cell usually consists of four strain meters in a Wheatstone bridge arrangement. Load cells of one strain meter or two strain gauges are also available.

The electrical signal output is typically in the order of few millivolts and needs amplification by an instrumentation amplifier before it can be used. The output of the transducer is plugged into an algorithm to calculate the force applied to the transducer. The figure 4.2 is for Load cell weight sensor cell weight sensor

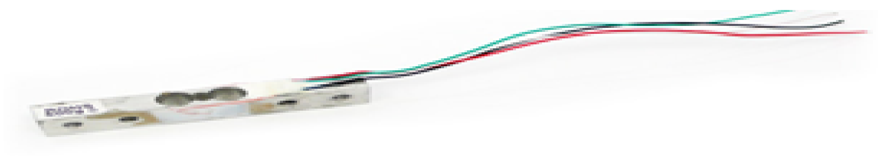

Figure 4.2 Load cell weight sensor

4.2.2 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM [4]. An efficient and fast working controller is needed to continuously sense the LPG gas and its level (weight) sensor's output. The following are the main functions of microcontroller in this project:

- **i.** It reads the input from weight sensor digitizer board which is in digital
- **ii.** Calculate the weight, which is corresponding to this digital input
- **iii.** Display these data on LCD display
- **iv.** Find out whether the weight is above the threshold weight level or below the threshold weight level
- **v.** To communicate with GSM modem to send the SMS to the owner of gas cylinder and the gas provider.

4.2.3 Power Supply

The power supply is designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A DC power supply which maintains the output voltage constant irrespective of A.C mains fluctuations or load variations is known as **“Regulated D.C Power Supply”.** For example, a 5V regulated power supply system.

4.2.4 GSM Network Architecture

Global system for mobile telecommunication (GSM) comprises the CEPT-defined standardization of the services, functional/subsystem interfaces, and protocol architecture, based on the use of worldwide standards produced by CCITT and CCIR, for a Pan-European digital land mobile system primarily intended to serve users in motor vehicles. The digital mobile radio networks, for which GSM represents the European standards, provide a powerful message signaling capability that facilitate and enhance roaming, compared to the first generation analogue systems, through automatic network location detection and registration. GSM provides terminal mobility, with personal mobility provided through the insertion of a subscriber identity module (SIM) into the GSM network (mobile station). The SIM carries the personal number assigned to the mobile user. The GSM-based cellular mobile networks are currently in widespread use in Europe. At the present time, the next generation of personal communication services (PCS) beyond GSM is also being considered. These third generation systems, known as universal personal communication networks (PCN) will be using lower power handsets to provide personal mobility for pedestrians, as well. The PCS low-power handsets are expected to eliminate the need to have different handsets for wide-area (cellular) and local (cordless) applications. The universal PCS will also provide a higher quality of personal-service mobility across the boundaries of many different networks (mobile and fixed, wide- and local-area). Many network capabilities, however, such as mobility management, user security protection, and resource allocation, addressed in GSM, are also some of the critical requirements and issues in UPC networks of the future. GSM is expected to play a major role in the specification of the standards for UPC. In the United Kingdom, PCN is already being designed and deployed with close adherence to the GSM standards other than the different operating frequencies (GSM operates at 900 MHz and the United Kingdom PCN operates at 1800 MHz). Generally, GSM may be viewed as a framework for studying the functions and issues that are specific to cellular type personal communication networks, whatever the means of implementation might be [5]. The figure 4.3 is for GSM network architecture

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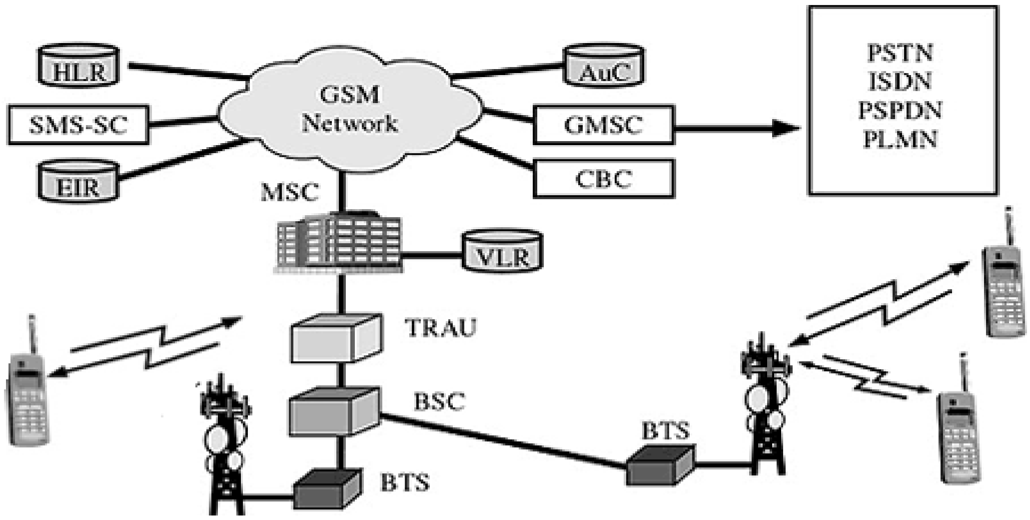

Figure 4.3 GSM network architecture

4.2.5 GSM Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate [6].

GSM modem is used for sending SMS so that user can get remote indication and used to send SMS to the user about the situation of gas cylinder. The figure 4.4 below show the GSM module/modem.

Figure 4.4 GSM module/modem

4.2.6 Display Unit

Alphanumeric is used to in a wide range of application, including a point on scale terminal, medical instrument and other application. The 16*2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. The figure 4.5 below show the LCD display.

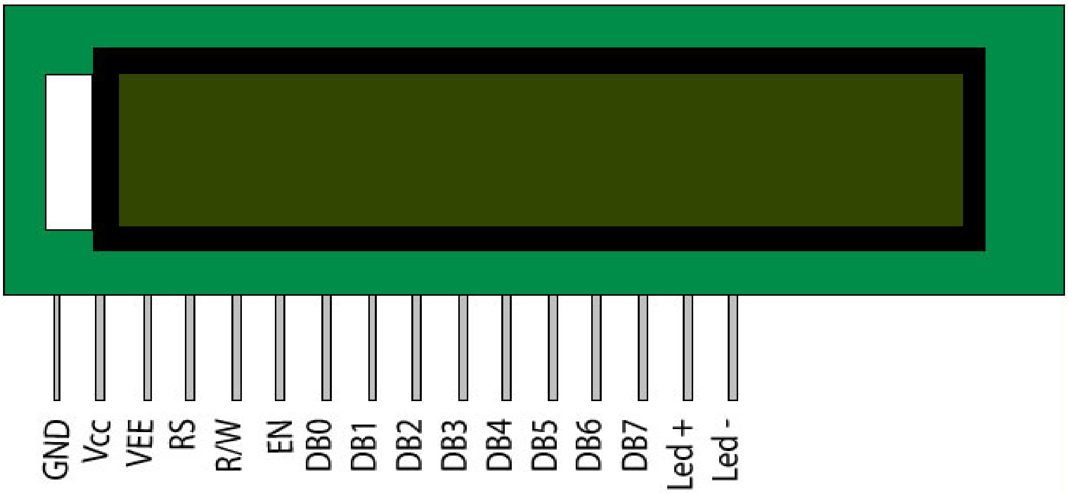

Figure 4.5 LCD display

4.2.7 Red and Green Led

This will give the status of gas weight in the cylinder, whereas green glow to show the cylinder is full and red to show the weight of gas cylinder is in critical condition.

4.3 Chapter Conclusion

This chapter contains various blocks for the proposed system, the operation of the proposed system and the explanation on each block.

CHAPTER FIVE

5.0 DATA COLLECTION

This chapter concerns with gathering data which would facilitate the accomplishment of the project. The data collected are very important as far as designing and implementation of the system is concerned.

5.1 Data Collected at Different Source

The collected data can be grouped as primary and technical data

5.2 Primary Data

Preliminary data were those data collected from residence Dar Es Salaam city, especially in NHC blocks located at Buguruni Sokoni for the aim to justify the importance of the project in the community and to justify if the users have enough understanding of using the existing system of real gas weight monitor and booking of LPG cylinders. The researchers use the questioner to archive that information from the residence. Below are the tables that show the questioner and respondent of the residence.

Qn. 1. Which kind/type LPG cylinder company are you using for cooking and boiling hot water?

The table 5.1 and 5.2 below shows the response of the interviewer and satisfaction levels.

Table 5.1Response of interviewer

No of interviewer	**Mihan gas**	**Lake gas**	**Oryx gas**	**Alfa gas**	**Orange gas**	**Manjis gas**
1			✓			
2			✓			
3	✓					
4	✓					
5		✓				
6			✓			
7			✓			
8			✓			
9	✓					

10		✓				
11				✓		
12			✓			
13	✓					
14	✓					
15			✓			
16			✓			
17			✓			
18			✓			
19		✓				
20				✓		
21	✓					
22			✓			
23					✓	
24	✓					
25	✓					
TOTAL	8	3	11	3	1	

Table 5.2 Satisfaction levels

	Highly satisfied	Satisfied	Neutral	Dissatisfied	Highly Dissatisfied	Total
On price of LPG cylinders	10	6	7	2	0	25
On quantity of LPG cylinders	15	7	3	0	0	25
On time delivery of LPG cylinders	3	3	5	6	8	25

5.2.1 Pearson Correlation Coefficient

The Pearson Correlation Coefficient is denoted by the symbol r. Its formula is based on the standard deviations of the x-values and the y-values [7]:

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{[n\sum X^2 - (\sum X)^2)][n\sum Y^2 - (\sum Y)^2)]}}$$

In this study researcher has used the Pearson correlation analysis to determine the relationship between:

i. Family members and LPG Utilization hours per day

ii. Family members and Refill gap between 2 cylinders.

The table 5.3 and 5.4 below shows the relation between family members and LPG utilization hours per day and a correlation result.

Table 5.3 Relation between family Members and LPG Utilization Hours per day

Family Members (X)	**No of Respondents**	**LPG Utilization Hours per Day (Y)**	**No. of Respondents**
Below 2 members	2	Below 1 hour	2
2-4 members	14	1 -2 hours	14
4-6 members	8	2-3 hours	7
Above 6 members	1	3 and above hours	2
TOTAL	25	TOTAL	25

Source: Questionnaire

Table 5.4 A Correlation result

Groups	Calculated r	Relationship
Family members and LPG utilization hours per day	0.98	Strong Positive correlation

B. Inference

From the above table clearly indicate that there is a strong positive correlation between Family members and LPG utilization hours per day. It is concluded that the LPG utilization hours per day depends on the consumption of the family, which states the increase in family members may eventually increase the consumption of LPG and vice versa.]. The table 5.5 and 5.6 below show the relationship between family members and refill gap between two cylinders and a correlation result

Table 5.5Relationship between Family Members and Refill Gap between Two Cylinders

Family Members (X)	**No of Respondents**	**Refill Gap Between Two Cylinder (Y)**	**No. Of Respondents**
Below 2 members	3	Below 31 days	4
2-4 members	12	31- 60 days	13
4-6 members	8	61- 90 days	6
Above 6 members	2	91 and above days	2
TOTAL	25	TOTAL	25

Source: Questionnaire

Table5.6 A Correlation Result

Groups	Calculated r	Relationship
Family members and LPG utilization hours per day	0.956	Strong Positive correlation

B. Inference

From the above table, it is clearly shown that there is a strong positive correlation between Family members and Refill Gap between two cylinders. It is concluded that the Refill gap between two cylinders depends on family Member, which means; the increase in family members may eventually increase the Refill of cylinders and vice versa.

5.3 Secondary Data

These are technical data collected from manufacture detail for related proposed systems used for designing work

5.3.1 Control Unit

There are various controller devices which can be used in this project; this project requires the control device which can be driven by the input of 5V supply.

The feature of these control devices is classified based on the number of inputs it can accommodate, storage capacity and bits operation [8]. The table 5.7 and 5.8 below show the PIC classifications and features.

Factors to consider:

i. The number of digital inputs, analogue inputs and outputs does the system required
ii. The size of the program memory we need.
iii. Clock frequency.
iv. The peripheral which include serial communication peripherals.
v. The power consumed by the microcontroller and its form factor that the size and characteristic of the physical package that must reside in the target design.

Table 5.7 PIC classifications

PIC	**CODE CAPACITY (In kilobyte**	**DATA STORAGE (Bytes)**	**PORT NUMBER**
18F4685[8]	96	3328	A -E
18F248[8]	16	768	A-C
18F442[8]	16	786	A-E

Table 5.8 Other features for various PICS

Features	ATMEGA32	PIC18F252	PIC16F877	PIC18F4550
Operating Frequency	DC-40MHz	DC-40MHz	DC-20MHz	DC-20MHz
Program memory	32k	32k	368	32
Data EEPROM	256	256	256	256

Timers	4	4	3	3
Serial Communication	MSSP Addressable USSRB	MSSP Addressable USSRB	MSSP USART	MSSP USART
Parallel Communication	_	PSP	PSP	PSP
Analog to digital Converter	5input Channels	8 inputs Channels	8 inputs Channels	8input Channels
Input voltage	5v	5v	-3.4to5. 5v	2 to 5.5
Comparators	2	2	2	2

5.3.2 LED

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an infrared-emitting diode (IRED) [9]. The table 5.9 below shows the led specifications.

Table 5.9 Led specifications

ITEMS	Color	Symbol	Condition	Min	Type.	Max	Unit
Forward voltage	Red	VF	I_f =20mA	1.8	2.0	2.2	V
	Green			3.0	3.2	3.4	
	Blue			3.0	3.2	3.4	

Luminous Intensity	Red	I_v	I_f =20mA	------	------	800	mcd
	Green			--------	------	4000	
	Blue			--------	-------	900	
Wavelength	Red	Δλ	I_f =20mA	620	623	625	nm
	Green			515	517.5	520	
	Red			465	466	467.5	
Light Degradation after 1000 hours	Red	-4.68% ~ -8.27%					
	Green	-11.37% ~ -15.30%					
		-8.23% ~ -16.81%					

5.3.3 Power Supply

The purpose of the power supply is to provide power to an electronic circuit. For a given amount of power, there's an inverse relationship between voltage and current. Whenever a current increase, voltage must decrease, and whenever current decrease, the voltage must increase. This simple fact, unfortunately, has an adverse effect on power supply circuits. When you connect a voltmeter to the output of the power supply, the meter itself draws an almost insignificant amount of current, so the meter reads very close to the voltage you expect to obtain from the power supply. The power supply designed to operate 250/5V, 50Hz, for appliances.

However, if you connect a circuit that draws significant current from the power supply, the voltage from the power supply will drop in proportion to the current. Depending on the nature of the circuit you're connecting to power supply, this voltage drop may or may not be a bad thing. Some circuits designed for 12VDC will work fine if only given 9VDC. But other circuits are sensitive to the input voltage, so the power supply needs to work harder to make sure it delivers the desired voltage. To maintain a steady voltage level, regardless of the amount of current drawn from a power supply, the power supply can incorporate a voltage regulator circuit. The voltage regulator monitors the current drawn by the load and increases or decreases the voltage accordingly to keep the voltage level constant [10]. The table 5.10 below shows the power supply specification.

Table 5.10 Power supply specification

No.	INPUT SPECIFICATION				
	PARAMETERS	DESCRIPTION /CONDITION	MIN	MAX	UNITS
1	Input voltage-AC	Single phase input	200	250	VAC
2	Input current -AC	Single phase input	13	15	Amp AC
3	Input frequency	AC input	50	50	Hz
OUTPUT SPECIFICATIONS					
1	Output voltages	DC out	3	5	V DC
2	Output current		1	145	mA DC
3	Output power	Output power		7000	Watt
4	Efficiency		88	100	%
5	Temperature	Operation temperature	-20	70	ºC

5.3.4 Display Unit

Alphanumeric displays are used in wide range of application including point on scale terminal, medical instrument and application. The 16×2 intelligent alphanumeric dot matrix display is capable of display 224 different characters and symbols [13]. The table 5.11 below show the technical specification of LCD.

Table 5.11 Technical Specification of LCD

Working Voltage	Symbol		
		Min	Max
Power voltage	VDD	4.5V	5.5V
Input H-level voltage	VIH	2.2V	Vdd
Input L-level voltage	VIL	-0.3V	0.6v
Output H-level voltage	VOH	2.4V	--
Output L-level voltage	VOL	--	0.4V
Supply current	Idd	2mA	--
LCD operating voltage	VLCD	3.0V	--

5.3.5 GSM Modem

A GSM modem (modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data [14]. The specification of GSM Modem includes;

i. HSDPA/UMTS 900/2100 MHz

ii. GSM/GPRS/EDGE 850/900/1800/1900 MHz

iii. Support 2Mbps (5.76 Mbps ready) HSUPA and 7.2 Mbps HSDPA services

iv. Receive diversity (UMTS 2100/1900/850 MHz)

v. Support SMS service

vi. Plug and play

The table 5.12 below show the technical specification of GSM modem

Table 5.12 Technical specification of GSM modem

Temperature range	Normal range: -10°C to +55°C (fully compliant) Storage: -40°C to +85°C
Weight	< 9g
Physical dimensions	35.0X39.0X2.9 mm (typical)
Power supply	VBAT: 3.3V to 4.2V range, 3.6V typical.
Power consumption	Off mode: < 100uA Sleep mode: < 2.0mA Idle mode: <7.0mA (average) Communication mode: 350 mA (average, GSM) Communication mode: 2000mA (Typical peak during TX slot, GSM)
Frequency bands	EGSM900 +GSM850+ DCS1800+PCS1900
Transmit power	Class 4 (2W) for EGSM900/GSM850 Class 1 (1W) for DCS1800/PCS1900
Supported SIM card	3V/1.8V SIM card. (Auto recognizes)
UART0 interface with flow control	Up to 460 kbps Full hardware flow control signals (+3.0V)
UART1 interface without flow control	2-Wire UART interface Up to 460 kbps

5.3.6 Weight Sensor

Weight sensor is a transducer that is used to convert a force into an electrical signal. The most common application of this sensor is in weighing machine. For this project the weight sensor required is that having the capability to sense weight that range from 2kg to 30kg [15] [16]. The table 5.13 below show the technical specification of gas weight sensor.

Table 5.13 Technical specification of gas weight sensor

Maximum input voltages	12V
Rated maximum load	50kg

5.4 Chapter Conclusion

This chapter contains the designing parameter which will be used in the designing of the project.

CHAPTER SIX

6.0 DATA ANALYSIS AND DESIGNING

This chapter provides detailed explanation on what was presented in chapter five. It provides critical analysis of the collected data, and then, the analyzed data will be used in the designing to come up with suitable values of components, integrated circuits, together with power supply for the entire system.

6.1 Weight Sensing Unit

6.1.1 Qualitative Analysis for Sensing Unit

Requirements for Sensing Unit (Load Cell)

i. Highly precise and linear measurements

ii. Little influence due to temperature changes.

iii. Long operating life due to lack of moving parts or any parts that generate friction.

iv. Ease in production due to small number of components.

v. Excellent fatigue characteristics.

vi. Small size compared with other types of load cells

A load cell is described as a "weight measurement device necessary for electronic scales that display weights in digits." However, load cell is not restricted to weight measurement in electronic scales. The load cell is a passive transducer or sensor which converts applied force into electrical signals. The following table 6.1 is for various types of load cell [16].

Table 6.1 Various types of load cell due to its operating principles

Types Load cell	**Operating principles**
Hydraulic load cells	Based on fluid pressure
Pneumatic load cells	Based on magnetostriction effect or piezoelectric effect
Strain gauge load cells	Based on elasticity

They are also referred to as “Load transducers”. The load cells based on strain-gauges. Hence, the term ‘load cell’ means ‘strain gauge-based load cells’.

The sensing or spring element is the main structural component of the load cell. The element is designed in such a way that it develops a strong, directly proportional to the load applied. Sensing elements are normally made of high strength alloy steels (nickel plated for environmental protection), precipitation-hardened stainless steels, heat-treated aluminum alloys, or beryllium copper alloys. The following table 6.2 is classed of load cell based on shape of spring materials [17].

Table 6.2 Classification based on shape of spring material

Shape	Applications
Column type	Tension and compression measurements.
Roberval Type (Double-beam Type, Parallel-beam Type)	Typical measurement ranges are generally between 1kg and 1 T, and are not suitable for large capacities.
Shear Type	The measurement range is generally between 100kg and 20 T.
Ring Type (Annular Type)	Intermediate capacity, ranging from 500kg to 20ton.
Diaphragm Type	Its height can be lowered and it is resistant to transverse loading.

The Load cell which is to be used is for Kitchen scale (Roberval Type (Double-beam Type, Parallel-beam Type)) i. e we can measure the weight of vegetables, fruits, etc. Available load cells are 1Kg, 3kg, 5 Kg., 10 Kg., 20 Kg., 40 Kg., 80 Kg and others. Out of these available load cells we will choose 20 Kg. Load cell as it satisfies all the requirements. We have used the load cell which is available in the local market. Load cell selected – YZC-133-20Kg. The following table 6.3 below show the wheat bridge circuit.

Table 6.3 Load Cell Sensor Specification

Application	Kitchen scale
Housing Material	Aluminum Alloy
Load Cell Type	Strain Gauge
Model	YZC-133
Capacity Kg	20
Dimensions	55.25x12.7x12.7mm
Mounting Holes	M5 (Screw Size)
Cable Length	550mm
Cable Size	30 AWG (0.2mm)
Cable – no. of leads	4
Rated output mV/V	1.0 ± 0.15
Nonlinearity %	0.05
Repeatability %	0.03
Hysteresis %	0.03
Creep (5min) %	0.1
Temperature effect on sensitivity %RO/^{0}C	0.003
Temperature effect on zero %RO/^{0}C	0.02
Zero balance %RO	± 0.1
Input resistance Ω	1066± 20
Output resistance Ω	1066± 20
Insulation resistance M Ω (50V)	2000

Recommended excitation voltage V	5VDC
Compensated temperature range ^{0}C	-10~+50
Operating temperature range ^{0}C	-20~+65
Safe overloads %RO	120
Ultimate overload %RO	150

6.1.2 Quantitative Analysis of Load Cell

A Wheatstone bridge is an electrical circuit. Used in a load cell to measure an overall change in resistance. Increases sensitivity and reduces the effects of temperature [18]. The following figure 6.1 below show the wheat bridge circuit

$$V_0 = (V_{ex}\times(\frac{R_1}{R_1+R_4})) - (V_{ex}\times(\frac{R_2}{R_2+R_3}))$$

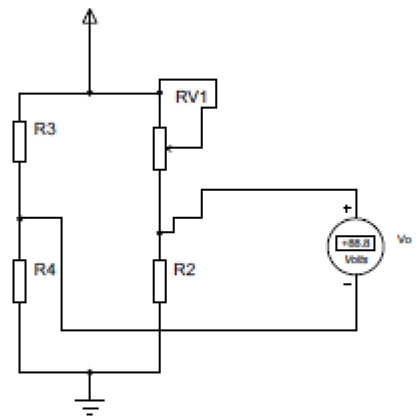

Figure 6.1 Wheatstone bridge circuit

6.1.2.1 Sensitivity of Load Cell

The sensitivity indicates the output signal in mV/V which is produced when the transducer is 100 percent loaded. To calculate the sensitivity value of the transducer, simply divide the range in units of the transducer by the full scale output value [19]

$$\textit{Sensitivity} = \frac{TransducerRange}{FullRangeOutput}$$

Transducer range = weight/normal force (F) = (mass of object) (acceleration near to surface of earth) = mg

Transducer range = 20kg × 9.8 m/s^2= 0.196 kN = 19.986437716 kg (1 N is equal to 0.101971621 kg)

Full range output = Output rate × Excitation voltage = 1mV/V × 5V = *5mV*

$$Sensitivity = \frac{Kg}{mV} = \frac{19.986437716}{5} = 3.99728\ kg/mV$$

Sensitivity of the load cell is 3.99728 *kg/mV*

6.1.2.2 Calibration

A simple formula is usually used to convert the measured mv/V output from the load cell to the measured force [20]:

Measured Force = A * Measured mV/V + B (offset)

It's important to decide what unit your measured force is - grams, kilograms, pounds, etc. This load cell has a rated output of 1.0±0.15mv/v which corresponds to the sensor's capacity of 20kg. To find A

Capacity = A * Rated Output

A = Capacity / Rated Output

A = 20 / 1.0

A = 20

Since the Offset is quite variable between individual load cells, it's necessary to calculate the offset for each sensor. Measure the output of the load cell with no force on it and note the mv/V output measured by the PhidgetBridge.

Offset = 0 - 20 * Measured Output

6.1.3 Amplifier Section

6.1.3.1 Qualitative Analysis for the Amplifier Section

Requirements for operational amplifier to amplify the mV/v signal from the load cell:-

i. Low noise differential signal acquisition
ii. High amplifier gain
iii. Wide power ranges, single supply

The following table 6.4 below show the wheat bridge circuit.

Table 6.1 Comparison for various types amplifier

LM 324 series	LM 741 IC	INA 122
Features:		
-Short Circuited Protected Outputs -True Differential Input Stage -Single Supply Operation: 3. V to 32 V -Low Input Bias Currents: 100 nA Maximum (LM324A) - Four Amplifiers Per Package - Internally Compensated	-Large input voltage range -No latch-up -High gain -Short-circuit protection -No frequency compensation required	- Low quiescent current: 60µa - Wide power supply range single supply: 2.2v to 36v dual supply: –0.9/+1.3v to ±18v -Common-mode range to (v–) –0.1v - Rail-to-rail output swing - Low offset voltage: 250µv max -Low offset drift: 3µv/°c max -Low noise: 60nv/√hz - Low input bias current: 25na max
Application:		
-Transducer Amplifiers -DC Gain Blocks -Conventional Op Amp Circuits	-Summing amplifier -Voltage follower -Integrator -Active filter -Function generator	-Portable, battery operated systems -Industrial sensor amplifier: bridge, rtd, thermocouple -Physiological amplifier: ecg, eeg, emg -Multi-channel data acquisition

The differences of voltage from the output of load cell enter to the amplifier to be amplified so that the microcontroller can read the input and process the signal to be displayed [21] [22] [23]. The type of amplifier to be used in this design is INA 122 Reason for selection:

i. High amplifier gain
ii. Availability
iii. Cost effective
iv. Easy for data acquisition

6.1.3.2 Quantitative Analysis for the Amplifier Section

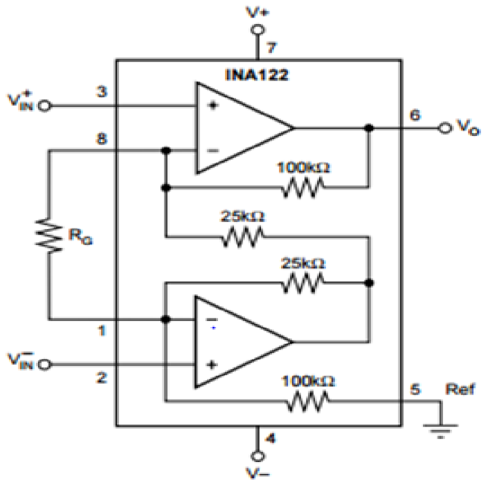

Figure 6.2 Circuit diagram of INA 122 amplifier

The figure 6.2 above show the wheat bridge circuit

The gain of the INA, 122 is set of connecting a single external resistor R_G

$$G = 5 + \frac{200\text{k}\Omega}{\text{RG}}$$

The output voltage of INA 122 is $V_o = (V_{IN}^{+} - V_{IN}^{-})\ G$

Output voltage ranges (2 to 5) V

$$\text{Gain } G = \frac{\text{Vo}}{V_{IN}^{+} - V_{IN}^{-}} = \frac{5\text{V}}{5mV} = 1000$$

To get the value of external resistor:

$$R_G = \frac{200\text{k}\Omega}{(G-5)} = \frac{200\text{k}\Omega}{(995)} = 201.005 \approx 201\ \Omega$$

6.1.3.3 Interfacing the Sensing Circuit with Amplifier Section

The weight sensing unit outputs (potential divider) which produce mill volts connected to pin 2 and 3 of INA 122 to be amplified up to volt which could read by PIC. The following figure 6.3 below shows these connections.

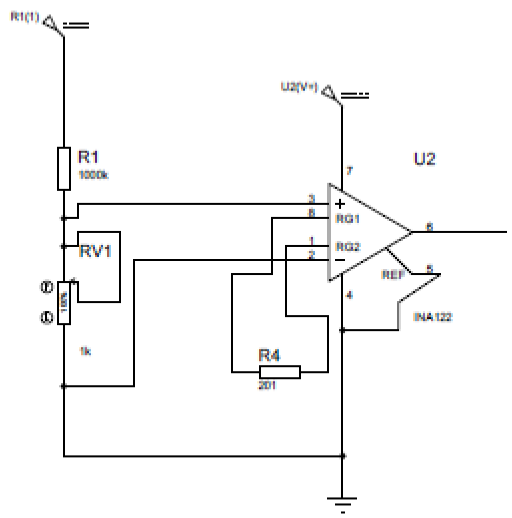

Figure 6.3 Interfacing weight sensor with amplifier section

6.2 Control Unit

6.2.1 Qualitative Analysis for Control Unit

Requirements for control unit:

i. Able to be interfaced with the list of hardware in this project from block diagram
ii. Enough memory
iii. High clock speeds
iv. Availability of development support (assemblers, compilers, debugging tools)

This is the heart of the whole system and it's responsible for execution of program instructions. This type of instruction executed by CPU includes authentic, logic, data and program branching instructions. The output from differential amplifier will be given microcontroller. We can use an 8051 microcontroller, PIC microcontroller or AVR microcontroller.

The 8051 microcontroller does not have inbuilt analog to digital converter i.e. ADC block. Hence, a separate A to D circuitry will be required along with a microcontroller, which will increase the number of components.

PIC microcontroller has inbuilt 8 bit or 10bit ADC. Hence, with the use of the PIC microcontroller, circuit will become compact [24].

6.2.2 Quantitative Analysis for Control Unit

The following table 6.4 shows the various types of PIC microcontroller.

Table 6.4 Comparison of various types of PIC microcontrollers

Parameter	**PIC 18F4520**	**PIC 16F685**	**PIC 18F452**
Operating frequency	40MHz	20MHz	40MHz
Program memory	32768 words	4096 words	32 Kbyte
Data memory	1536 bytes	256 bytes	1536 bytes
I/O ports	A, B, C, D, E	A, B, C	A, B, C, D, E
10 Bit ADC channels	12 channels	12 channels	8 channels
Number of instructions	75	35	75
Packages	40 pin DIP 44 pin PLCC 44 pin TQFP	20 pin DIP	40 pin DIP 44 pin PLCC 44 pin TQFP
Operating voltage (V)	4.0- 5.5	4.0- 5.5	4.0- 5.5
EUSART support	YES	NO	YES

From the above table information, the control unit suitable for these projects will be PIC 18F452. The following figure 6.4 shows the pin structure for PIC 18F452.

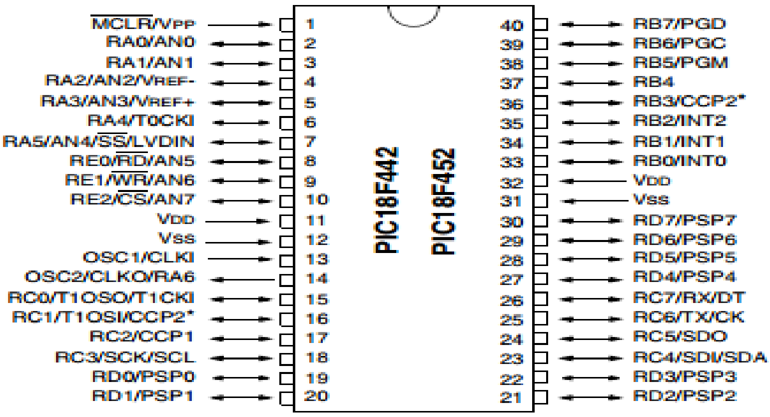

Figure 6.4 Microcontroller PIC 18F452 pin arrangement

Reason for the selection

i. Easy availability

ii. Clock frequency

iii. Enhanced USART: Addressable with RS-485, RS-232 and LIN support

iv. Compatible 10-bit Analog-to-Digital Converter module (A/D)

v. Cost effective

vi. Enough memory

The following figure 6.5 shows the Interface control unit with oscillator and reset button.

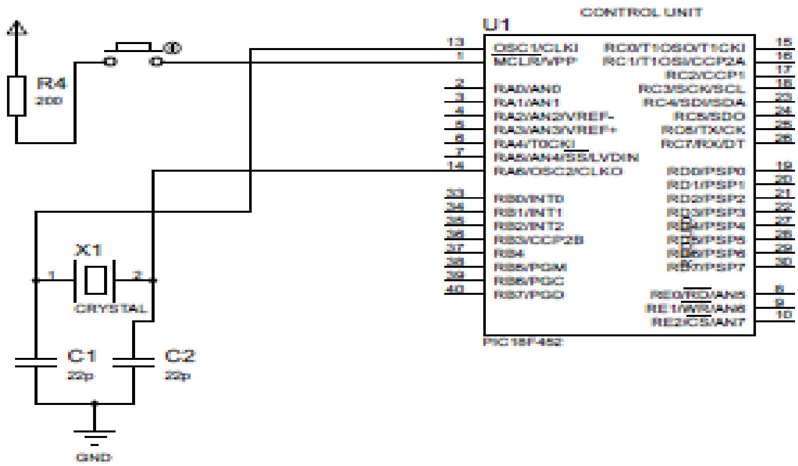

Figure 6.5 Interfacing control unit with oscillator and reset button

6.2.3 Software Design

The software part in the designed system is used for controlling all operations performed by the designed system, the following flowchart shows the sequences of operations and decisions that are performed by the control unit

6.2.3.1 Sensor Calibration

To calibrate the sensor it will need to take two measurements, by gather two samples that are known value. More points are not necessary, unless the sensor is non-linear by design. The following are the steps for calibration;

i. To collect two samples with known values

ii. To collect the values, the sensor returns**.** For no load, the sensor returned a value of 0.55. It returned a value of 1.44 when there was the 4kg load.

iii. These measurements give two sets of x, y values: (0.55, 0) and (1.44, 4). A linear function has the form $y = mx + b$, where x is the raw value (the sensor value) and y is the output (this will be our known and expected value when calibrating). To solve for m and b, these formulas used M = $\frac{Y1-Y0}{X1-X0}$ and *b*= Y_1-MX_1. The value for *m* = 4.494 and *b* = -2.471. Now we can put this function into our code with a line that would look something like this:

```
Load = (4.994 * SensorValue) - 2.471;
```

6.2.3.2 Operation Procedures for the Control Unit

The following are the operating procedures for the control program

i. Monitor the inputs: read the output voltage values from weight sensing module
ii. Compare the output voltage from weight sensing module with the threshold value. If the value from sensing circuit is greater to a threshold value, LCD to display the real weight and green led on
iii. Compare the value of output voltage of the weight sensing unit, if this value is less than two threshold values, alter massage to the LCD for a refill the cylinder, red LED on and short SMS to the phone of owner and provider for booking new cylinder
iv. Continue the monitoring these inputs.

6.2.3.3 Flow Chart

The flow chart will present the processing of data inside microcontroller and the whole signal flow from the input up to the output through it. The following figure 6.6 below is for flow chart.

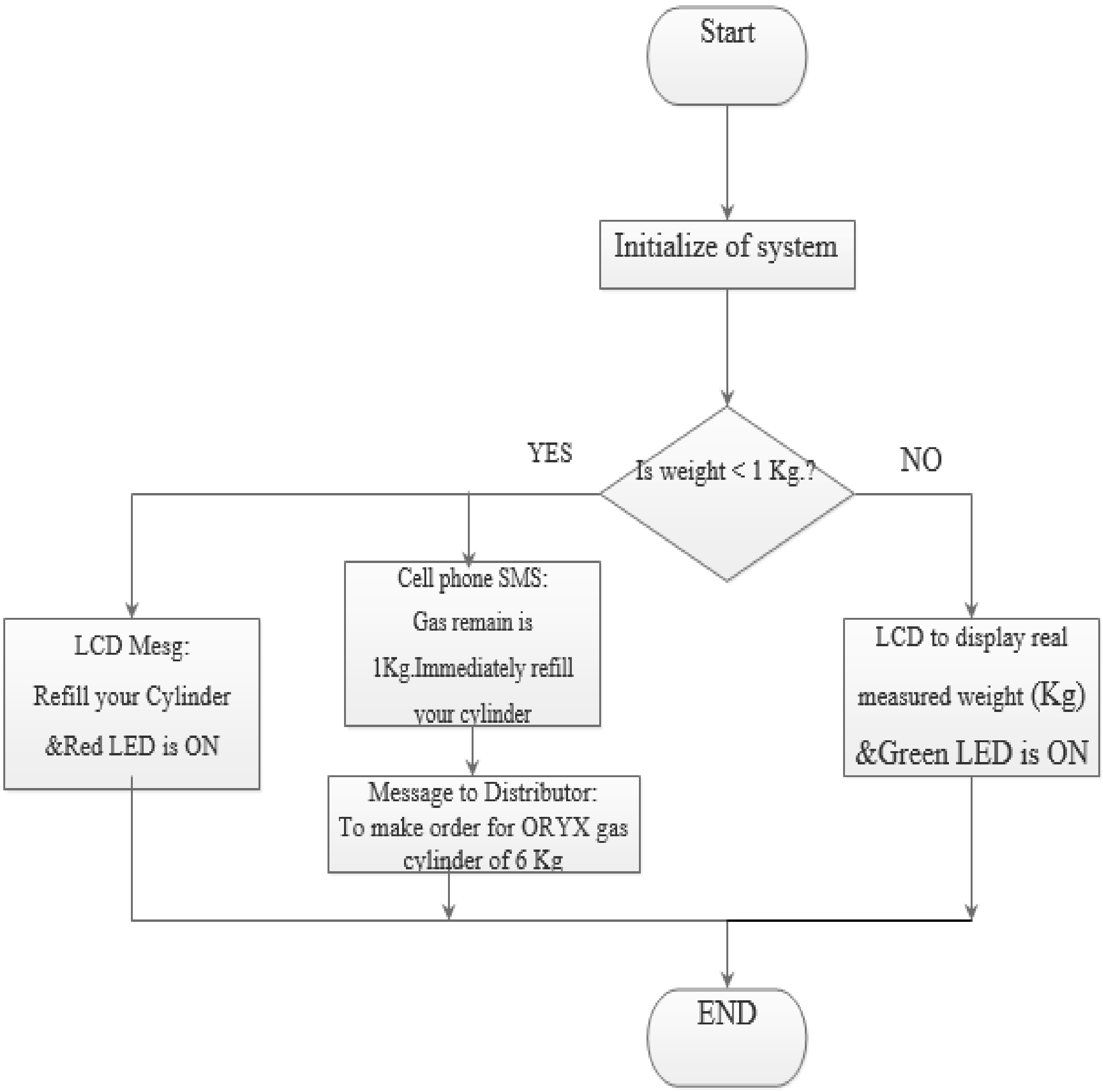

Figure 6.6 Flow chart

6.2.4 Interfacing Sensing Units to a Control Unit

The weight sensing unit outputs (potential divider) which produce mill volts connected to pin 2 and 3 of INA 122 to be amplified up to volt which could read by PIC18F452 in pin 2. The figure below shows these connections

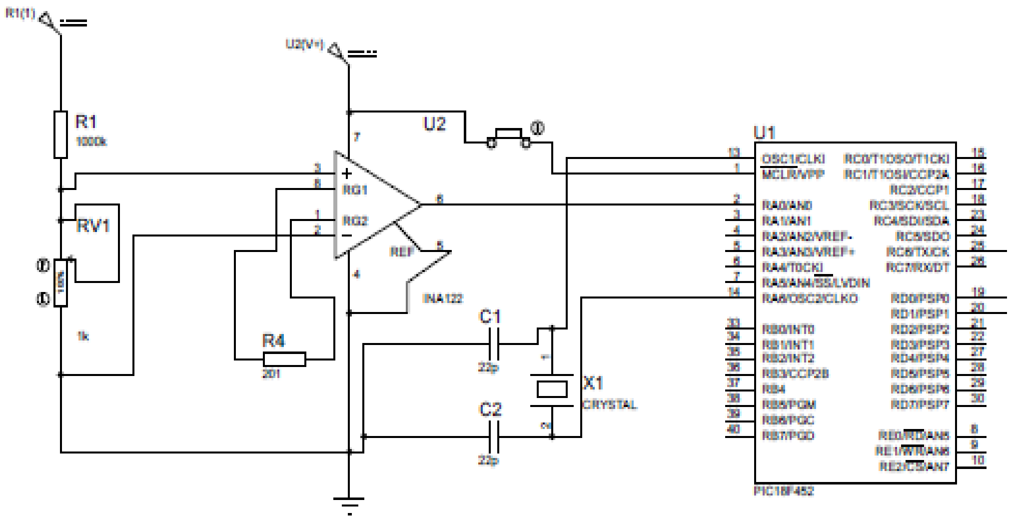

Figure 6.7 Interfacing sensing circuit with control unit

6.3 Display unit

6.3.1 Qualitative Analysis for Display Unit

There are three LCD display types [25]. The following table 6.5 below shows the comparison of three types of LCD display

Table 6.5 Comparison of three types of LCD display

	Segment LCD (or Alphanumeric LCD)	**Dot Matrix (or Character LCD)**	**Graphics LCD**
Displaying Features:	-Arabic numbers represented by 7 segments. -Arabic numbers and Roman letters represented by 14 segments. -Symbols, such as plus/minus signs, measurement units and any custom icons -Each symbol is treated as one segment.	-A number of lines of characters (1 to 4 lines of 16 to 40 characters.) -Each character is represented by 5x7 dots plus cursor (actually 5x8 dots including the cursor) - Each character block is addressed separately and can form numbers, Roman letters, character in other languages and a limited number of symbols.	-Text, graphics or any combination of the two. -Provides users with a greater degree of flexibility. -They are composed of pixels arranged in rows and columns.
Applications:	-Scientific instruments	-To display more characters than those in English alphabet.	-Applications when the user needs to have total control of

			the whole viewing area.
Advantages:	-It is easy to control and most cost-effective to develop.	-It is relatively simple to control and also inexpensive than graphic models.	-Greater degree of Flexibility
Limitation:	-Limited to displaying numbers, Roman letters and fixed symbols.	-Less degree of flexibility compares to graphic.	-Difficulty in designing the control circuitry.

In this project Dot matrix (Character) LCD 16×2 will be used as a display unit due to the following reasons:

i. Easy to interface with control unit (PIC).
ii. Will able to display the information needed for the project
iii. Availability.
iv. Inexpensive

6.3.2 Quantitative Analysis for Display Unit

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display, etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. The following table 6.6 gives an LCD Pin description.

Table 6.6 LCD Pin Description

Pin Number	Name	Function
1	Ground	Ground (0V)
2	V_{CC}	Supply voltage; 5V (4.7V – 5.3V)
3	V_{EE}	Contrast adjustment; through a variable resistor
4	Register Select	Selects command register when low; and data register when high
5	Read/write	Low to write to the registry; High to read from the register
6	Enable	Sends data to data pins when a high to low pulse is given
7	DB0	

8	DB1	8-bit data pins
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	
15	Led+	Backlight V_{CC} (5V)
16	Led-	Backlight Ground (0V)

6.3.3 Interfacing of Control Unit and Display Unit

After connection of sensing unit/module and control unit, the flawed part is display unit which shows the exact input from the sensing unit. The figure 6.8 below shows the connections from control unit to display unit.

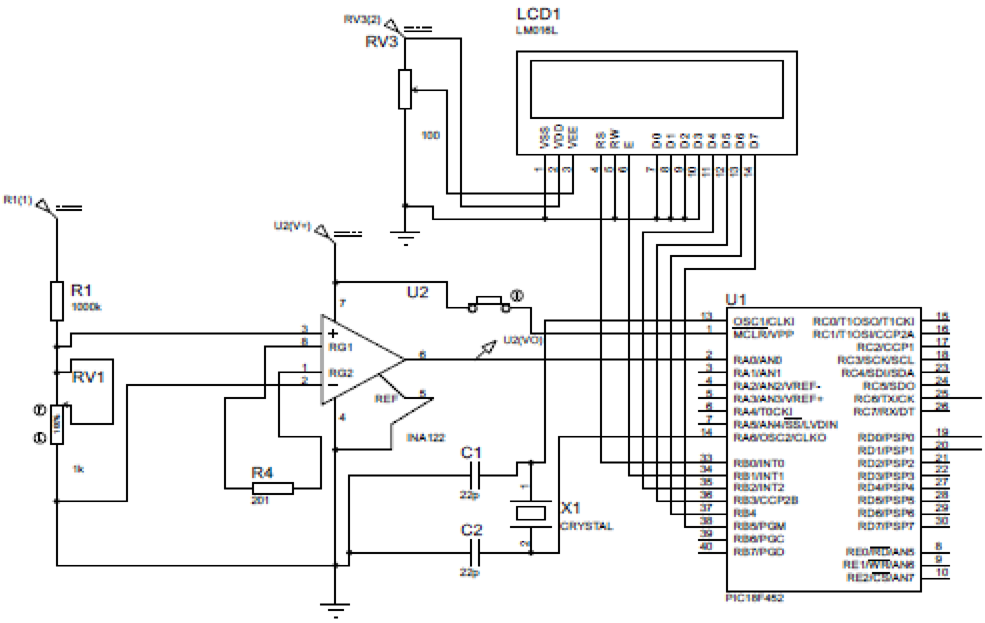

Figure 6.8 Interfacing Control with Display Unit

6.4 GSM Modem

6.4.1 Qualitative Analysis

The GSM modem is used to facilitate sending of messages. The SIM900A GSM modem will be suitable for the purpose of sending information to the user. This type of GSM modem supports SIM cards with bands used by most of the Tanzania service providers. This GSM modem has been chosen because of the following;

i. It is simple to integrate with a microcontroller.
ii. It uses simple AT commands for configuring its operations.
iii. Highly flexible plug and play quad band SIM900A GSM modem for direct and easy integration to RS232 applications.
iv. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack
v. Simple to Use and Low Cost.

6.4.2 Quantitative Analysis

The following are the functional parameters of the SIM900A GSM modem which will make it suitable for the sending SMS to gas provider and gas cylinder owner [26] [27].

6.4.2.1 General Features of SIM900A GSM Modem

i. Dual-Band 900/ 1800 MHz
ii. GPRS multi-slot class 10/8
iii. GPRS mobile station class B
iv. Compliant to GSM phase 2/2+
   – Class 4 (2 W @900 MHz)
   – Class 1 (1 W @ 1800MHz)
v. Dimensions: 24*24*3 mm
vi. Weight: 3.4g
vii. Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
viii. Supply voltage range: 3.1 ... 4.8V
ix. Low power consumption: 1.5mA (sleep mode)
x. Operation temperature: -40°C to +85 °C
xi. On board switching type power supply regulator RS232 output.

6.4.2.2 Specifications for SMS via GSM/GPRS

i. Point to point MO and MT
ii. SMS cell broadcast
iii. Text and PDU mode

6.4.2.3 Link budget and Loss calculations on the GSM network

Link budget and loss calculations are done specifically in order to analyze the signal loss factor during the propagation, and to estimate the required power in transmitter to overcome system noise of mobile phone (receiver) [28] [29]. The following table 6.7 below shows the link budget calculation in the GSM radio network;

Table 6.7 Link budget calculation

RECEIVED END		BS	MS	
RX RF-input sensitivity	dBm	-104.00	-102.00	A
Interference degrading margin	dB	3.00	3.00	B
Cable loss + connector	dB	4.00	0.00	C
Rx antenna gain	dBi	12.00	0.00	D
Isotropic power	dBm	-109.00	-99.00	E=A+B+C+D
FIELD STRENGHT	dBV/m	20.24	30.24	F=E+Z
				Z=77. 2+20*log (Freq/MHz)
TRANSMITTING END		MS	BS	
TX RF output peak power	W	2.00	6.00	
(Mean power over RF cycle)	dBm	33.00	38.00	K
Isolator+ combiner +filter	dB	0.00	3.00	L
RF peak power, combiner output	dBm	33.00	26.00	M=K-L
Cable loss + connector	dB	0.00	4.00	N
TX antenna gain	dBi	0.00	12.00	O
Peak EIRP	W	2.00	20.00	

(EIRP=ERP +2Db)	dBm	33.00	34.00	P=M-N+O
Path loss due to ant. /body loss	dBi	9.00	9.00	Q
Isotropic path loss	dB	133.00	133.00	R=P-F-Q

The following figure 6.9 below shows the connection of GSM module (as virtual terminal) with control unit.

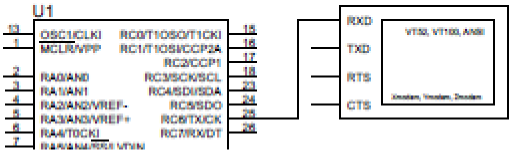

Figure 6.9 Interfacing GSM module with control unit

6.5 LED

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an infrared-emitting diode (IRED) [9] [30]. The following figure 6.10 and table 6.8 shows the connection from the control unit with LED.

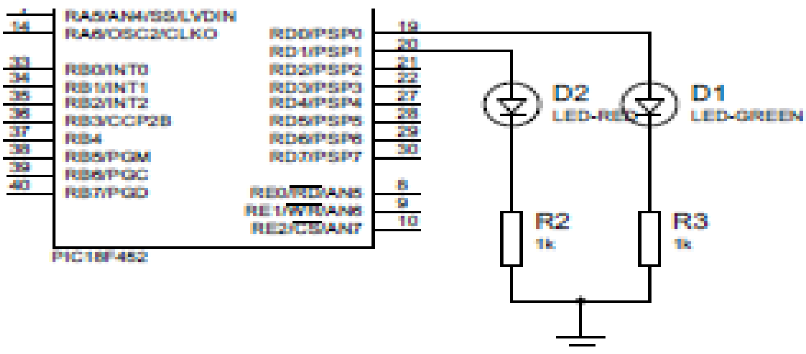

Figure 6.10 Interfacing control unit with LEDs

Table 6.8 Led specifications

ITEMS	Color	Symbol	Condition	Min	Type.	Max	Unit
Forward voltage	Red	V_f	I_f =20mA	1.8	2.0	2.2	V
	Green			3.0	3.2	3.4	
	Blue			3.0	3.2	3.4	
Luminous Intensity	Red	I_v	I_f =20mA	------	------	800	mcd
	Green			--------	------	4000	
	Blue			--------	-------	900	
Wavelength	Red	Δλ	I_f =20mA	620	623	625	nm
	Green			515	517.5	520	
	Red			465	466	467.5	
Light Degradation after 1000 hours	Red	-4.68% ~ -8.27%					
	Green	-11.37% ~ -15.30%					
		-8.23% ~ -16.81%					

6.6 Power Supply

Power supply helps in giving each block power so that the system could work correct to produce better results. The table 6.9 below shows the power budget to each component.

Table 6.9 Power budget

Component	**Voltage Requirement**	**Current requirement**	**Power Dissipation**
Load cell	5V	500mA	2500mW
PIC 18F452	5V	1.6mA	8mW

LCD 16*2 Display	5V	103mA	515mW
LED	5V	20mA	68mW
GSM MODEM	5V	1.5mA	2W
Instrumentation amplifier +VCC	5V	60uA	15nW

6.7 Overall Circuit Design

The overall circuit of the designed system is obtained after combining all individual circuits of each block. This circuit is obtained after connecting all individually designed circuits to form a single system. Figure 6.11 shows the overall circuit design of the system.

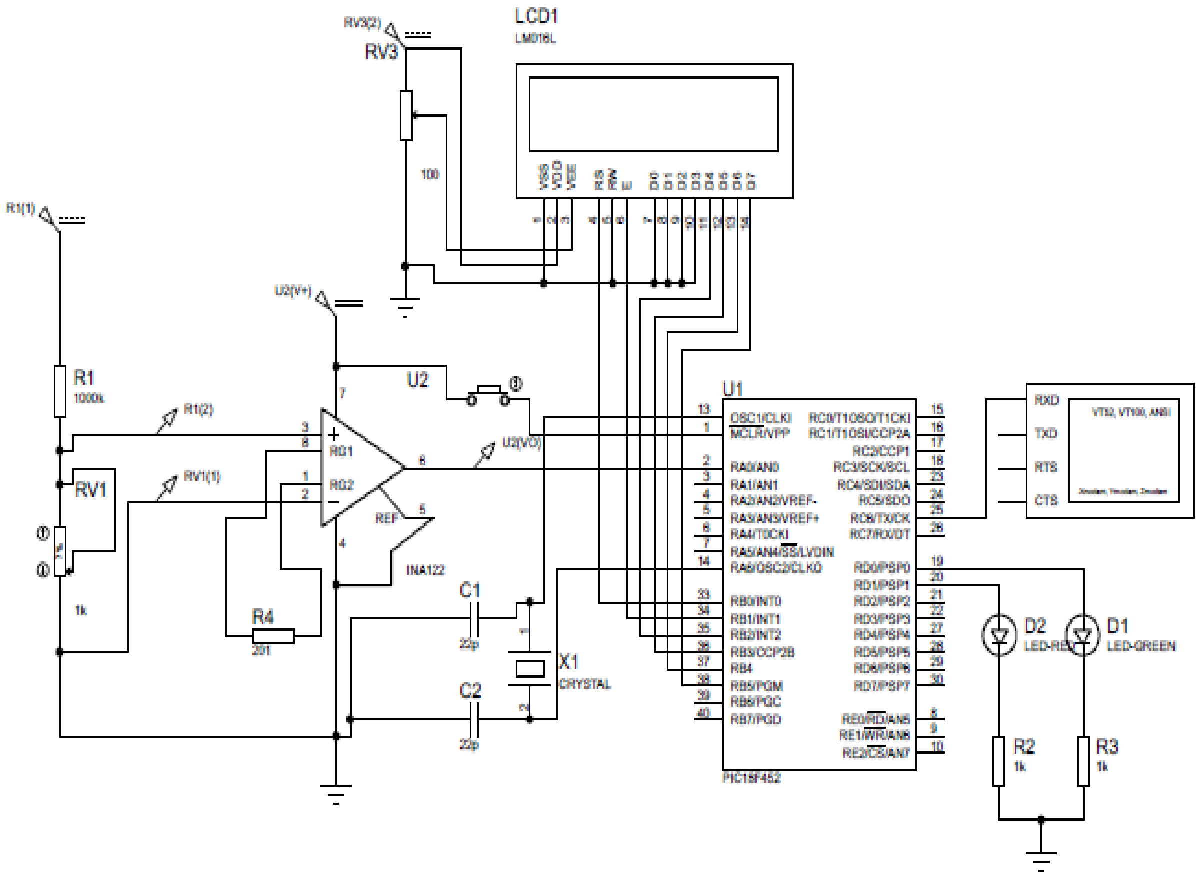

Figure 6.11 Overall circuit design

6.8 Chapter Conclusion

This chapter has described data analysis and system design. It has shown how the blocks of the proposed system have been opened and how component values have been calculated by using suitable design equations. It has also described about how different system parts have been designed and integrated to form overall system. The simulation of the designed system and its results are explained in the next chapter.

CHAPTER SEVEN

7.0 SIMULATION

7.1 Introduction

This chapter describes about the simulation of the designed system. It includes descriptions about the simulation tools used, simulation constraints, performance testing parameters and simulation testing procedures. It also presents the results and their discussions.

7.2 Simulation Software

The simulation software for this project is Proteus. The Proteus simulation tool is chosen because of the following reasons

i. It is rich in libraries of different types of electronic components and modules

ii. It performs well in different varieties of projects ranging from simple electronic circuit to complex ones

iii. In addition to simulation excellence, it offers a capability to prepare even the printed circuit board for the actual realization of the prototypes of different designed systems.

7.3 Simulation Constraints

The following are the simulation environment of the designed system.

i. The weight sensor is simulated by using potential divider because the weight sensing module is not available in the protest component library

ii. The performance parameters are measured by using a virtual terminal, Voltage and current probes available in the protest software.

7.4 Performance Testing Parameters and Procedure

In this simulation the following are the parameter to test in order to verify that the system is working as required or not.

7.4.1 Variation of Output Voltage of the Weight Sensing Circuit

The output voltage of the weight sensing unit varies as the strain gauge (variable resistor) varies in mill volts. This output voltage is due to the different voltages between the positive voltage (+V) and minus voltage (-V) from sensing circuit while the output voltage is measured by using a voltmeter or voltage probes.

7.4.2 Variation of Output Voltage from Amplifier Section

Due to that control unit cannot read the output voltage in mill volts from sensing circuit, so the signal to the control must be amplified in order for the control unit to read it. Amplifier section (instrumentation amplifier) output is measured by using a voltmeter or voltage probes.

7.4.3 Results and Discussions

The system is simulated and the performance parameters are tested to see if they agree with the wanted results. The following are the results of the simulation based on the test parameters

7.4.4 Voltage Variation for Variable Resistor in Sensing Circuit

When the variable resistor in senses circuit varied act as strain gauge, also the voltage varied which is the main parameter for the system. The table 7.1, and figure 7.1, 7.2, 7.3, 7.4, 7.5 below shows the variation of output voltage from sensing circuit and amplifier section compared with the control unit output.

Table 7.1 Sensing circuit output, amplifier output and control unit output

Sensing circuit output(mV)	Amplifier output (V)	Control unit output (Kg)
2.603	2.2576	1
2.854	2.3436	2
3.1045	2.411	3
3.504	2.4943	4
4.057	2.579	5
4.794	2.654	6

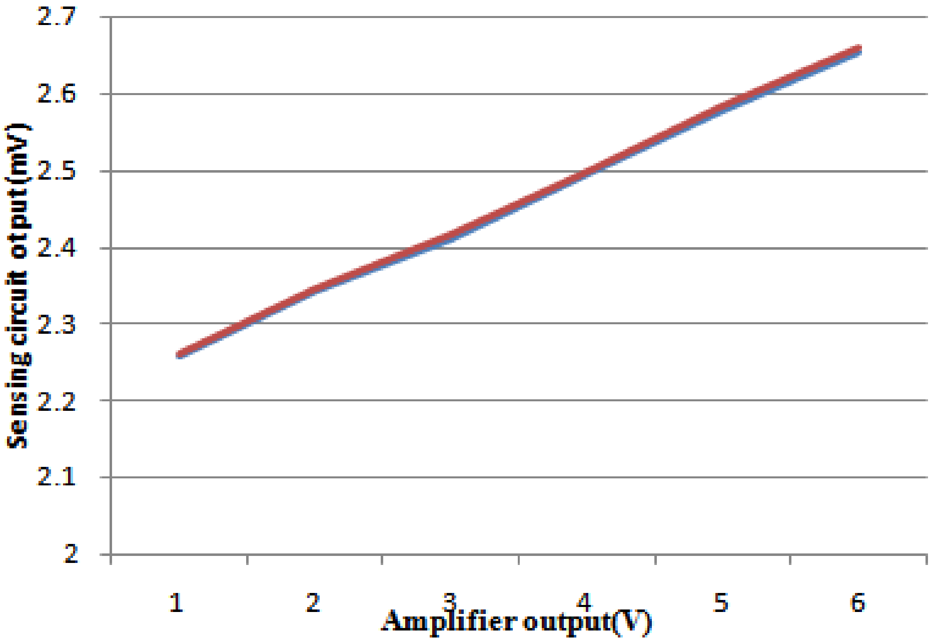

Figure 7.1 Graph of sensing circuit output against amplifier output

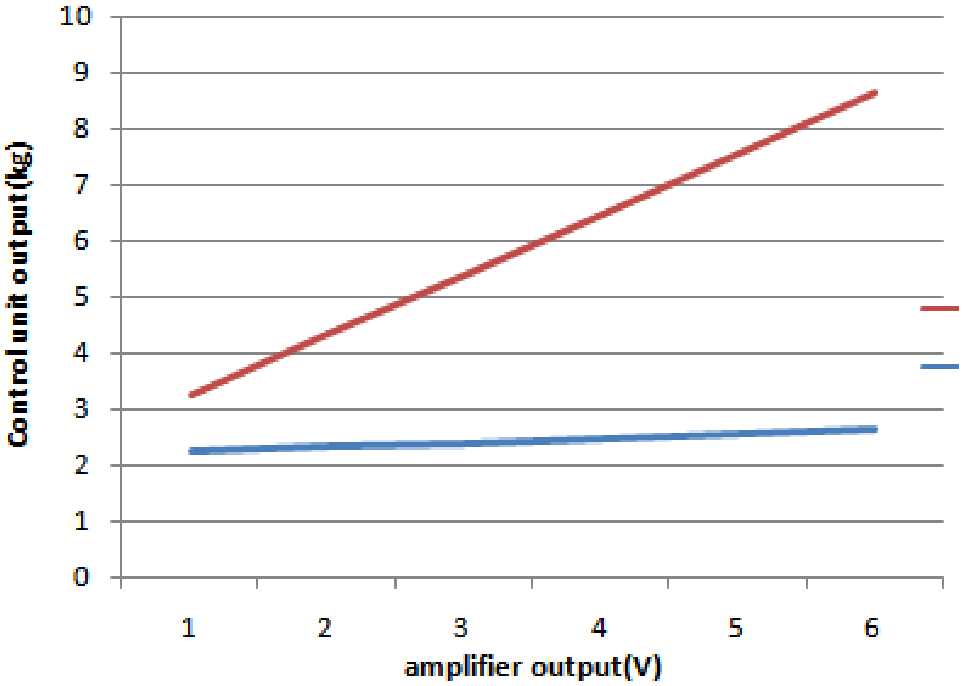

Figure 7.2 Graph of control unit output against amplifier output

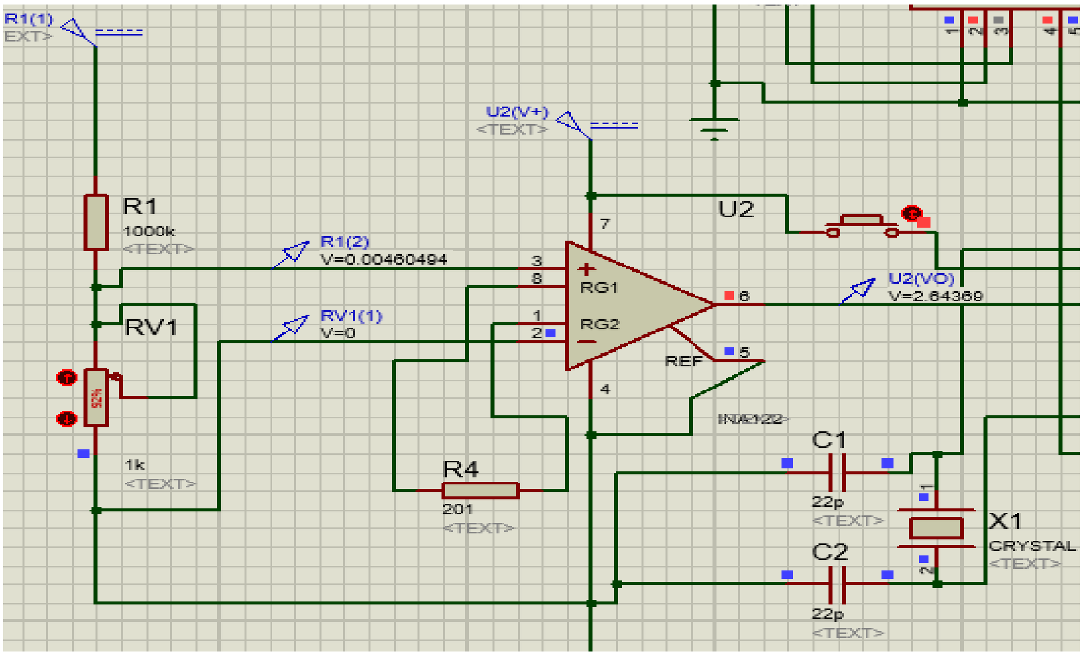

Figure 7.3 Simulation of sensing part and amplifier

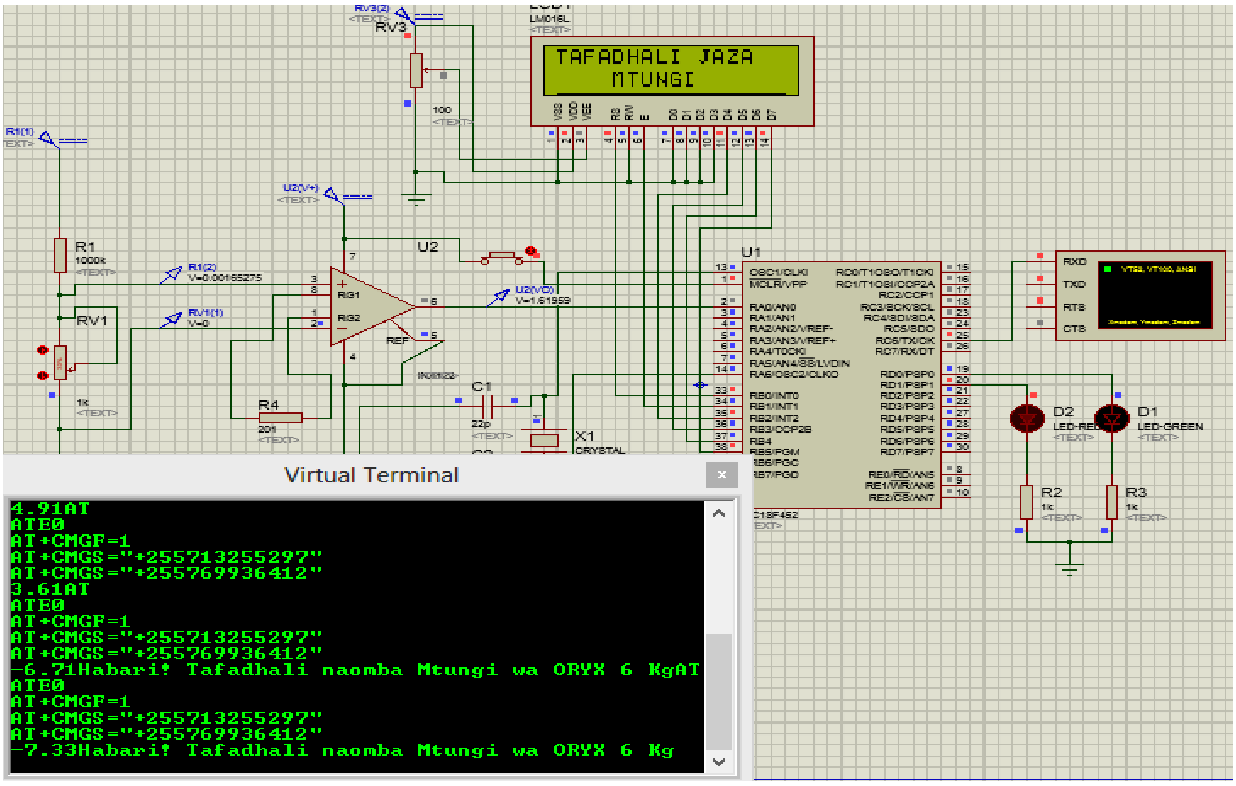

Figure 7.4 Overall circuit simulation 1

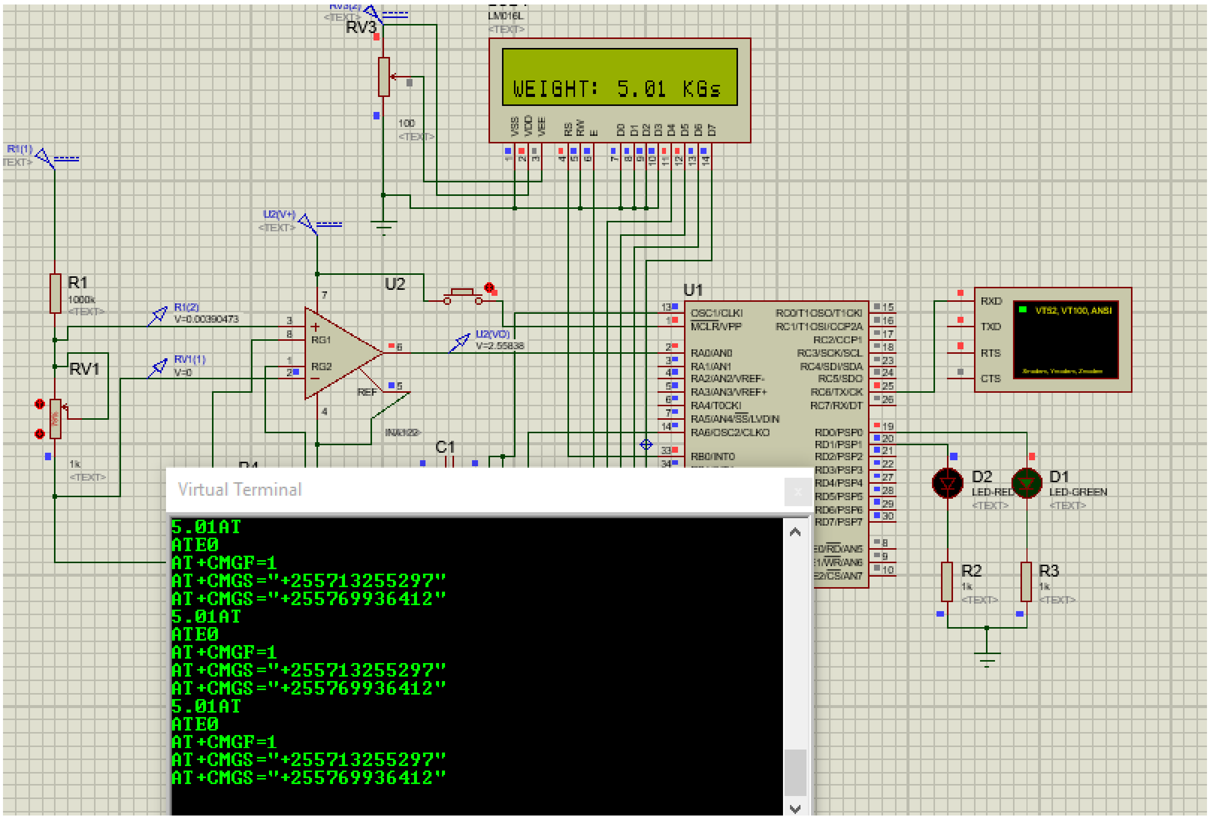

Figure 7.5 Overall circuit simulation 2

7.5 Overall Simulation Results Discussion

Based on the simulation results, the overall system performance is good because the performance parameters agree with the design requirements for all of the system designed as described in the specific objectives.

7.6 Chapter Conclusion

This chapter has described about the simulation of the designed system. This includes descriptions about the simulation tools used, simulation constraints, performance testing parameters and performance testing procedures. It has also presented the results and their discussions. From the simulation results the prototype has to be built in order to see if the simulation results agree with the results from the actual working prototype. The next chapter gives the details on how the prototype is realized

CHAPTER EIGHT

8.0 PROTOTYPE IMPLEMENTATION

8.1 Introduction

This chapter gives the details about the implementation of the design to realization of the prototype. It also describes about performance testing parameters, testing procedures, results and discussions of the overall performance of the prototype itself.

8.2 Printed Circuit Board Construction

The layouts of the printed circuit boards for the designed system were prepared. Figure 8.1Illustrate the PCB layout of the designed system.

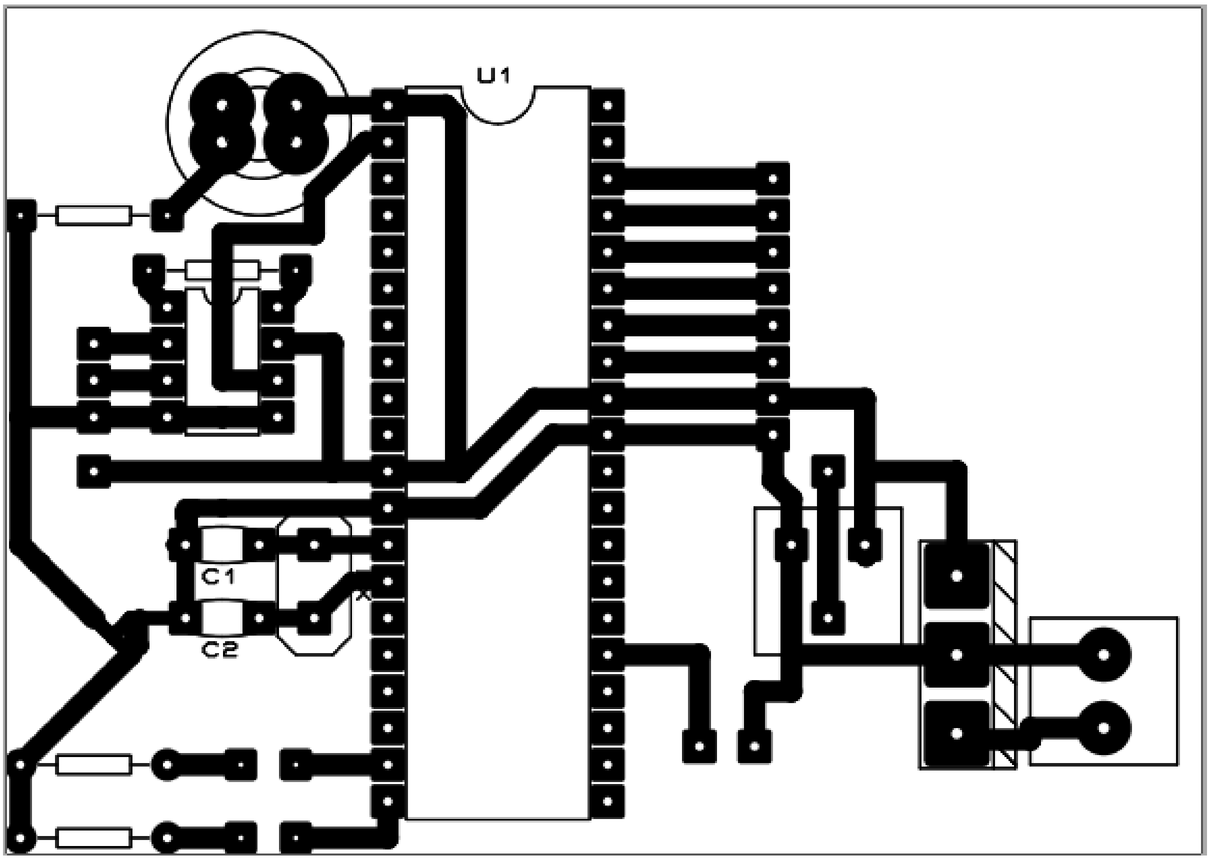

Figure 8.1 PCB layout for designed system

8.3 Component Mounting and Connections

After the preparations of the PCB the components are mounted to their respective places, the image in figure shows the mounted components and their connections. Figure8.2 shows component mounted on a PCB.

Figure 8.2 Components mounting on PCB

8.4 Overall Working Prototype

Figure 8.3 shows the complete diagram of the working prototype. This prototype is obtained after mounting components and solder them in their respective places and integrating them into a single entity.

Figure 8.3 Working Prototype

8.5 Prototype Performance Test

The following are the performance testing parameters of the prototype

i. Voltage variation from the weight sensing unit.
ii. Voltage variation from the instrumentation amplifier.

8.6 Prototype Performance testing tools and Procedures

The performance testing is done by using different Instruments, these instruments are used to measure the output voltage. The Meter was used to measure voltages at different test points. The system was switched on and the measurement of the performance testing variable is done by using the respective tools

8.7 Results

The tables 8.1,8.2, show the results of the measurements from a working prototype

Table 8.1 Output voltage from weight sensing unit compare with input load

Weight (Kg)	Weight sensor output (mV)
0	0.03
1	0.05
2	0.07
3	0.10
4	1.2
5	1.4

The results in Table 8.1 shows the results for output voltages measured from weight sensing unit (load cell). Based on the design requirements, the results in the table agree with the required output of load cell.

Table 8.2 Amplifier output with load

Weight (Kg)	Amplifier output (V)
0	0.55
1	0.77
2	1
3	1.25
4	1.44
5	1.68

The results in Table 8.2 shows the results for voltage measured from amplifier section. Based on the design requirements, the results in the table agree with the required voltage which control unit reads.

8.8 Results Discussions

The results show that the implemented prototype performance is quite good as the specific objectives has been achieved. Not only the weight sensing circuit (load cell) also the amplifier section amplified the millivolt to the volt which control unit was read and sent SMS to the GSM and LCD displayed the weight which are also suitable to measure LPG weight cylinder.

8.9 Chapter Conclusion

This chapter explains the prototype implementation and testing. The results from prototype shows that all the specific objectives have been achieved and hence the main objective of the project. This implies that the prototype implemented is expected to perform well. The next chapter concludes the project, it gives the overall summary of what have been done and achieved throughout the project.

CHAPTER NINE

9.0 CONCLUSION AND RECOMMENDATION

9.1 Introduction

This is the last chapter in this report. It gives out the overall summary of the project done. It includes conclusion and recommendations about the project.

9.2 Conclusion

This report has provided all basic information concerning the existence of the problem and the procedures towards solving it. Using these procedures, the system has been designed and realized in hardware part. Moreover, the system has been tested and appeared to give the expected results. Considering these results obtained after prototype testing, the overall performance of the designed system is good. Therefore, it can be concluded that the designed system is expected to solve the existing problem.

This project will be relevant to homes, hotels, and industries with easy control of the uses of LPG gas in order without thinking that the cylinder gas will be empty without knowing and to help with gas booking automatically to the gas provider.

9.3 Recommendation

For the productions of precise and high quality automated LPG booking system, other methods can also be used in order to produce a system which could be used for booking LPG cylinder from different cylinder providers because the designed system is only for booking into only one gas provider. Some of these methods can be based on software and other digital methods. Moreover, the system can be further modified to measure the amount of gas remaining in the cylinder and to booking new cylinders by using different sensors or weighing mechanisms and sending the notification to the cylinder owner and cylinder providers about the status of the gas through other wireless networks.

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Appendix A

A.1 Microcontroller Program

```
// LCD module connections

sbit LCD_RS at RB0_bit;

sbit LCD_EN at RB1_bit;

sbit LCD_D4 at RB2_bit;

sbit LCD_D5 at RB3_bit;

sbit LCD_D6 at RB4_bit;

sbit LCD_D7 at RB5_bit;

sbit LCD_RS_Direction at TRISB0_bit;

sbit LCD_EN_Direction at TRISB1_bit;

sbit LCD_D4_Direction at TRISB2_bit;

sbit LCD_D5_Direction at TRISB3_bit;

sbit LCD_D6_Direction at TRISB4_bit;

sbit LCD_D7_Direction at TRISB5_bit;

// End LCD module connections

/////////// GSM Module declarations

char AT[]="AT";   // To initialize mode

char noecho[]="ATE0";   // To stop echo

char mode_text[]="AT+CMGF=1";   // to set text mode

char char_mode[]="AT+CSCS=\"GSM\"";   // to set character mode

char param[]="AT+CSMP=17,167,0,0";   // set the parameter of character
```

```
char mobile_no1[]="AT+CMGS=\"+255713255297\"";    //use to set receinpent number and
        mesg

char mobile_no2[]="AT+CMGS=\"+255769936412\"";    //use to set receinpent number and
        mesg

char terminator=0x1A;     // chartacter form of control + z terminator character

char mesg1[]="GESI IMEISHA";   // mesg we want to send

char mesg2[]="Habari! Tafadhali naomba Mtungi wa ORYX 6 Kg";   // mesg we want to send

/////////////

int adc_rd;

float adc_val;

float wt;

float ww;

float load;

char finaltxt[8];

float quant=5.0/1024;

  void send_to_modem(char *s)   //function to write anything serially

{

while(*s)

UART1_WRITE(*s++);

UART1_WRITE(0X0D);

}

void send_to_modem1(char *s)

{
```

```
while(*s)
UART1_WRITE(*s++);
}
void send_sms()
{
}
void main()
{
//char res[5];
PORTD=0;
TRISD=0;
PORTA=1;
TRISA=1;
PORTC=0xFF;
TRISC=0xFF;
ADCON1=0Xc0;
ADC_Init();
LCD_Init();
lcd_cmd(_LCD_CLEAR);
lcd_cmd(_LCD_CURSOR_OFF);
while(1)
{
adc_rd=ADC_Read(0);
```

```
adc_val=adc_rd*quant;

wt=(adc_val-0.361)/0.079;

ww=wt-22.75;

sprintf(finaltxt,"%1.2f",ww);

lcd_cmd(_LCD_CLEAR);

Lcd_Out(1,1,"LPG");

Lcd_Out(1,5,"WEIGHT");

Lcd_Out(1,12,"SCALE");

Delay_ms(100);

lcd_cmd(_LCD_CLEAR);

Lcd_Out(2,1,"WEIGHT: ");

Lcd_Out(2,9,finaltxt);

Lcd_Out(2,14,"KGs");

Delay_ms(100);

send_to_modem1(finaltxt);

delay_ms(100);

uart1_write(terminator);

delay_ms(100);

if (ww<1)

{

PORTD.F0=0;

delay_ms(100);

PORTD.F1=1;
```

```
delay_ms(100);
lcd_cmd(_LCD_CLEAR);
Lcd_Out(1,1,"TAFADHALI");
Lcd_Out(1,11,"JAZA");
Lcd_Out(2,5,"MTUNGI");
Delay_ms(100);
send_to_modem1(mesg2);
delay_ms(100);
uart1_write(terminator);
delay_ms(1000);
}
else
{
PORTD.F0=1;
delay_ms(100);
PORTD.F1=0;
delay_ms(100);
}
UART1_INIT(9600);
send_to_modem(AT);
delay_ms(100);
send_to_modem(noecho);
delay_ms(100);
```

```
send_to_modem(mode_text);

delay_ms(100);

send_to_modem(mobile_no1);

delay_ms(100);

send_sms();

send_to_modem(mobile_no2);

delay_ms(100);

send_sms();

}

}
```

Appendix B

B.1 Cost Estimates

Table9.1Cost Estimates

PARTICULAR	QUANTITY	COST (Tsh)	TOTAL COST(Tsh)
Sensing unit	1	35,000/=	35,000/=
Controller unit	1	40,000/=	40,000/=
GSM module	1	120,000/=	120,000/]
LED	2	5,000/=	10,000/=
Electronic keypad	1	20,000/=	20,000/]
Power supply	1	20,000/=	20,000/=
Display unit	1	15,000/=	15,000/=
Stationary services		50,000/=	50,000/=
Internet bundle	5GB per month	20,000/=	20,000/=
Transport cost		5,000/=	5,000/=
Electronic components			100000/=
TOTAL			345,000/=

Appendix C

C.1 Gantt Chart of Senior Project 1

Table9.2 Senior Project 1 time frame

	Weeks														
Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	■	■	■												
B				■	■										
C						■	■	■							
D	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
E									■	■	■				
F												■	■		
G														■	■

KEY

A – Selection of project title

B – Title defending

C – Problem statement and methodology

D – Literature review

E – Data collection

F – Proof reading of project report and submission

G – Presentation

Appendix D

D.1 Gantt Chart of Senior Project 2

Table 9.3 Senior Project 2 time frame

ACTIVITIES															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**16**
A	■	■													
B			■	■											
C					■	■	■								
D								■	■	■					
E											■	■	■	■	
F	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	DURATION OF PROJECT IN WEEKS														

KEY:

A. Data analysis

B. Design the circuit and simulation of the design circuit

C. Data analysis

D. Building of circuit and testing of prototype

E. Project report writing

F. Literature review