POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

DEVELOPER AND FIXER SAFETY TANK

Engr. Dr Hj ZUNUWANAS BIN MOHAMAD
FARIZA BT ZAHARI
MARIANA BT ROSDI

NUR AQILA BINTI MOHD MAZLAN 08DEU14F1059
MUHAMMAD FAKHRIY HANIF BIN MOHD HARIS 08DEU14F1023
MUHAMMAD IKMAL BIN ROSLI 08DEU14F1033
PETAH NUR ALIFAH ILYANA BT ABD HALID 08DEU14F1081

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NUR AQILA BINTI MOHD MAZLAN
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PETAH NUR ALIFAH ILYANA BINTI ABD HALID

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Jabatan Kejuruteraan Elektrik

Politeknik Sultan Salahuddin Abdul Aziz Shah

DIS 2017

ENDORSEMENT

"I hereby acknowledge that I have read this report and I find that its contents meet the requirements in term of scope and quality for the award of the Diploma in Electronic Engineering (Medical)"

Signature :..

Name of Supervisor:.. DR. HJ. ZUNUWANAS BIN MOHAMAD KETUA PROGRAM IJAZAH SARJANA MUDA TEKNOLOGI KEJURUTERAAN ELEKTRONIK (ELEKTRONIK PERUBATAN) POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

Date :.. 29/3/17

DECLARATION

"We hereby declare that the work in this report is our own except for quotation and summaries which have been duly acknowledge"

Signature :...

Name : NUR AQILA BINTI MOHD MAZLAN

Registration No: 08DEU14F1059

Date : 20th March 2017

Signature :...

Name : MUHAMMAD FAKHRIY HANIF BIN MOHD HARIS

Registration No: 08DEU14F1023

Date : 20th March 2017

Signature :...

Name : MUHAMMAD IKMAL BIN ROSLI

Registration No: 08DEU14F1033

Date : 20th March 2017

Signature : ....

Name : PETAH NUR ALIFAH ILYANA BINTI ABD HALID

Registration No: 08DEU14F1081

Date : 20th March 2017

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ABSTRACT

Developer Fixer Safety Tank (DFS Tank) is oe of the safety product that can be used by the user in the Dark Room located in Imaging Department og Hospital. This product allow the to perform their work comfortable and easily. In normal Dark Room, only X-Ray Film Processor is used to produce X-Ray Film. Processing of film will cause a toxic gas which those gas is then expelled to the environment. However, the gas vapour from the waste of machine is stuck in the dark room. It will be dangerous for user when the concentrartion of toxic gas is increased. In order to produce this product, we use sensor MQ-135 and MQ-136 to detect two type of toxic gas which is when its achieve the increase of range, it will cause the fan to on and suck out the gas. For software. We use Microcontroller to guard the activity of the circuit. Eagle Cad and MpLab are important software that are used is process of designing and build the programming. This product will used the range of concentration of toxic gas in the tank as the parameter. Concept of making this project is same as those safety gas detector that are mostyly used in building. Based in the implication of our finding, we can replaced protective mask that are used during the handling of film to an air-tight casing. We build this Developer Fixer Safety Tank in order to provide good workplace for those user who are working in the Dark Room. Our recommendation for future, we want to use GSM Module that operate with Developer Fixer Safety Tank.

DEVELOPER AND FIXER SAFETY TANK

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Developer Fixer Safety Tank is develop to overcome problems that are happening to the user who are handling both Developer and Fixer chemical. As far as we know, both of the liquid are handled with un-appropriate way. Two bottle of Developer and Fixer that store liquid that have been process by the X-Ray Film Processor to produce film is not compatible to be used in the dark room as its cause a few problems such as pollution that will lead to disease.

1.2 Problem Statement

During the handling of Developer and Fixer bottle in the Dark Room, a few problems may arise. Usually, liquid that flow from the X-Ray Film Processor may overflow. Such that, caused a backflow to X-Ray Film Processor machine and the biggest impact is the failure of X-Ray Film Processor machine.

Developer and Fixer liquid is a well known liquid as it its corrosive and dangerous. To handle both of the liquid, one must wear a protective mask (FM-12) which is a bit pricey. Plus, the mask need to change between a coupled of period (Within two to three weeks). The need of using the protective mask is to avoid such disease such as asthma and difficulty in breathing.Without any filter attach to the Developer and Fixer bottle , both of the liquid expelled poisonous gas to the environment. This is why the user that are handling both liquid need to wear protective mask (FM-12)

1.3 Objective

1. To overcome bad odour that come out from both bottle (Developer and Fixer)
2. To prevent backflow of liquid to Processor Machine.
3. To provide a safe environment and ecosystem to user.

1.4 Study population

We have carried out a few researches through the internet and also from interviews. We have done a survey and research Hospital Sultanah Nora Ismail which is located in Batu Pahat, Johor. And also a few biomedical engineer from Advance Pact. Questionnaires were given to them and from the research and the opinion that we gained, it's allowed our team to begin compiling problem statements and objectives pertaining to the specific observation. And from the survey, we get a good feedback regarding our project 'Developer Fixer Safety Tank' because it can provide a safe and a healthy environment to the user as well as to the engineer.

1.5 Sample size and sampling technique

Population	Expected Probability									
	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
10	6.5	7.8	8.3	8.6	8.8	8.9	9.0	9.0	9.0	9.1
15	8.2	10.5	11.5	12.1	12.4	12.6	12.8	12.9	13.0	13.0
20	9.5	12.7	14.2	15.1	15.7	16.0	16.3	16.4	16.5	16.6
25	10.5	14.5	16.6	17.8	18.6	19.1	19.4	19.7	19.8	19.8
30	11.3	16.1	18.6	20.2	21.2	21.9	22.3	22.6	22.8	22.9
40	12.5	18.5	22.0	24.2	25.7	26.7	27.4	27.9	28.2	28.2
50	13.4	20.4	24.7	27.6	29.5	30.9	31.8	32.4	32.8	32.9
60	14.0	21.9	27.0	30.4	32.7	34.4	35.6	36.3	36.8	36.9
70	14.5	23.1	28.8	32.7	35.5	37.5	38.9	39.8	40.3	40.5
80	14.9	24.1	30.4	34.8	37.9	40.2	41.8	42.8	43.4	43.6
90	15.2	25.0	31.7	36.5	40.0	42.5	44.3	45.5	46.2	46.5
100	15.4	25.7	32.9	38.1	41.9	44.7	46.6	48.0	48.7	49.0
125	15.9	27.1	35.2	41.2	45.7	49.0	51.4	53.1	54.0	54.3
150	16.3	28.1	36.9	43.6	48.7	52.5	55.2	57.1	58.2	58.6
175	16.5	28.9	38.3	45.5	51.0	55.2	58.3	60.4	61.6	62.0
200	16.7	29.5	39.3	47.0	53.0	57.5	60.8	63.1	64.4	64.9
250	17.0	30.4	41.0	49.3	55.9	61.0	64.8	67.4	68.9	69.4
300	17.2	31.0	42.1	51.0	58.1	63.6	67.7	70.5	72.2	72.8
350	17.3	31.5	43.0	52.3	59.7	65.6	69.9	73.0	74.8	75.4
400	17.5	31.8	43.6	53.3	61.0	67.1	71.7	74.9	76.8	77.4
450	17.5	32.1	44.2	54.1	62.1	68.4	73.2	76.5	78.5	79.1
500	17.6	32.3	44.6	54.7	63.0	69.5	74.4	77.8	79.9	80.6

Table 1.5.1 Table Sample Size and Sampling Technique

Respondents from user that handle medical equipment including Medical Assistant (MA) are selected for this survey to determine our usability for our product. The first sample are 20 user from those user who are working in X-Ray Department. In this sample, a questionnaire was given to them.

The third sample are given to 5 biomedical engineer and technician from Advance Pact Sdn Bhd. In this sample, we demonstrate our product and a questionnaire was given to them.

The third sample are biomedical engineer from our polytechnic to verify the safety of the device. An electrical test was carried out to make sure the device is safe to be used and safe from any leakage current.

1.6 Significant of study

This study will be a significant endeavor in promoting good work environment in the workplace especially those are working in X-Ray Department in hospital. This study will also be beneficial to those user who are handling those medical user as well as engineer.

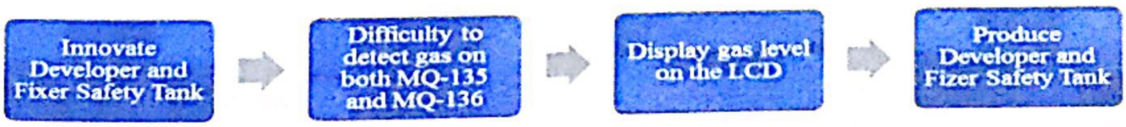


Table 1.6.1 Block Diagram of Significant of Study

1.7 Theoritical of study

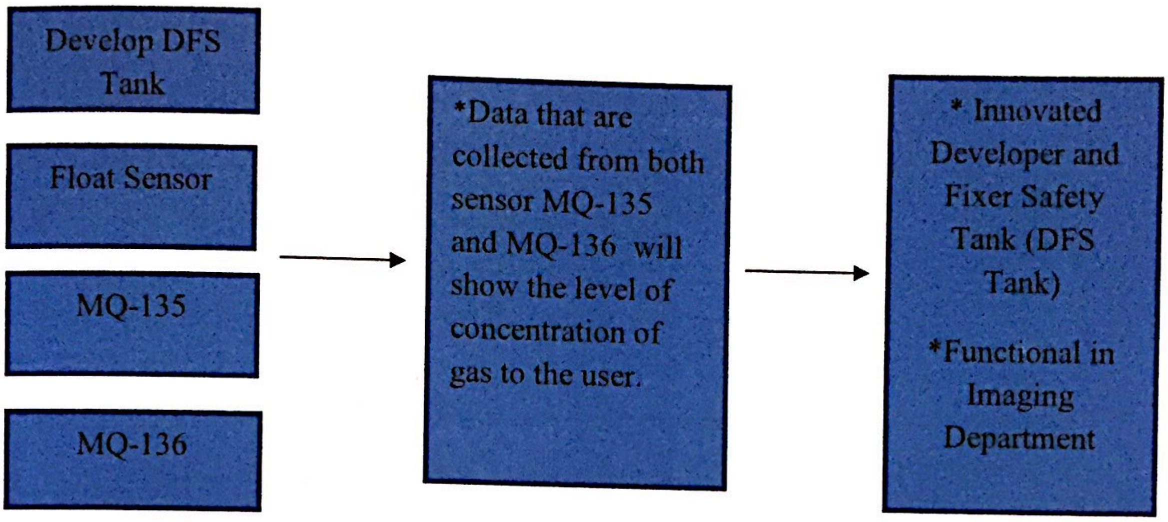


Table 1.7 Block Diagram of Theoritical of study

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction Of Literature Review

A literature review is a body of text that aims to review the critical points of current knowledge and or methodological approaches on a particular topic. Literature reviews are secondary sources, and as such, do not report any new or original experimental work.

The report that we want to be produced needed a few factor that should be taken consideration until that project implemented. To get a quality project result, we need to study about the type of material, design , components that we used, framework installation , installation method and maintenance ,level of product safety, structural strength, project size and so on that we need make it and consider the result that we get. This is all ensure that no any problems would arise during the completion or even when presenting the project.

Hence, systematic and detailed planning must be arranged for produce a complete and perfect project. First step that we need made it, was design daub (sketching) to get the real image of machine that we want to be produced. Due to this, the work design and study that we made is a continuing process and it involving problem solving activity creatively namely which is known as literature study.

2.2 Developer and Fixer Photochemical

2.2.1 Introduction

Developer and Fixer is a chemical that a very important agent in film processing prosess. Developer works to converts latent image to black metallic silver. Typically a dilute solution of acetic acid or citric acid, halts the action of the Developer. A rinse with clean water may be substituted. The Fixer makes the image permanent and light-resistant by dissolving remaining silver halide. A common Fixer is hypo, specifically ammonium thiosulfate.

Figure 2.2.1.1: Developer and Fixer Photochemical

2.2.2 Developer and Fixer Chemical Components

Developer (DEV)	Fixer (FIX)
Part A: • Hydroquinone • Diethylene Glycol • Potassium Sulphite	Part A: • Ammonium Thiosulphate • Ammonium Suplhite • Acetic Acid • Sodium Bisuplphite
Part B: • Acetic Acid • 1-Phenyl-3-Pyrazolidinone	Part B: • Aluminium Suplhate and Sulphuric Acid.
Part C: • Glutaraldehyde	NONE

Table 2.2.2.1: Developer and Fixer Chemical Components

2.2.3 Effect of main waste gas to human health

The chemical waste from the Developer and Fixer may be dangerous to the users and other people's health. For example, the waste from the Developer may produce a Sulfur Oxide,SO_2 gas that a poisonous gas [1] Then, waste from Fixer may produce Ammonia,NH_3 gas that very harmful to health and bleaching agent.

This may give negative impact to users and peoples such as:

a. Difficulty in breathing
b. Nose irritation ,throat irritation and skin irritation
c. Chemical burns and eye irritation or conjunctivitis
d. A person with Ammonia gas poisoning may also have nausea, vomiting, or a headache.
e. May cause pulmonary problems like acute wheezing attacks, chronic cough with phlegm, and asthma.

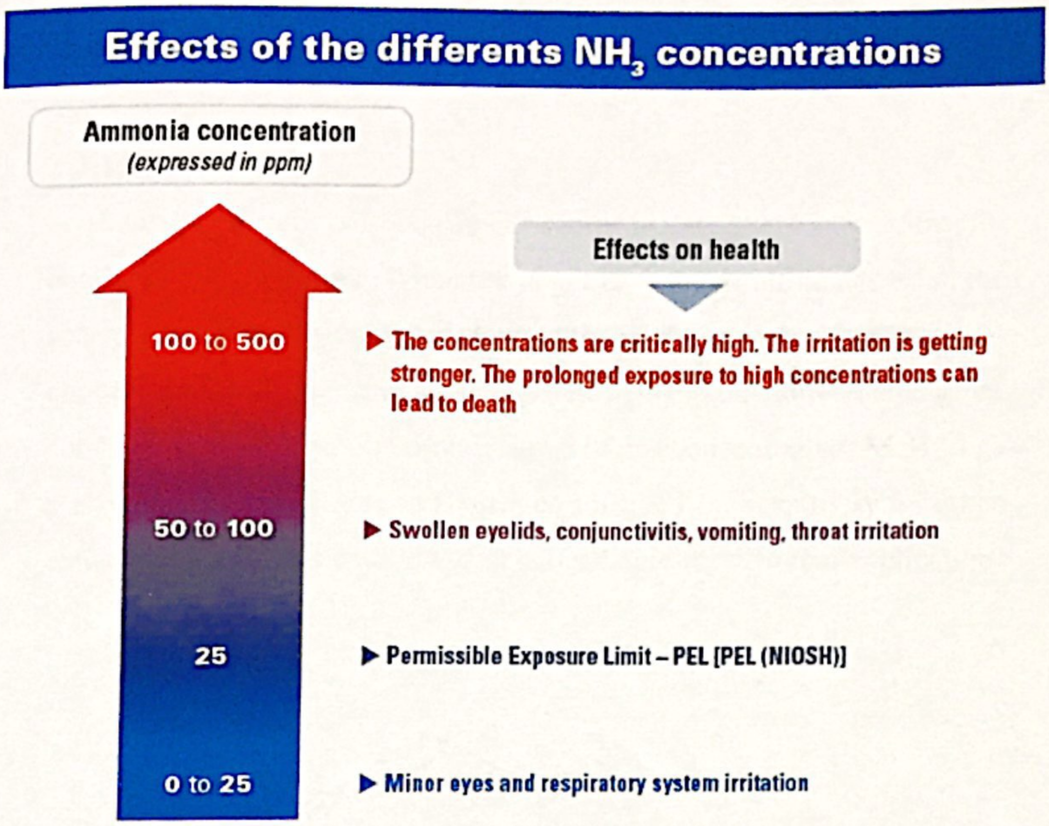


Figure 2.2.3.1: Effect of Ammonia,NH3 based on concentration to human health

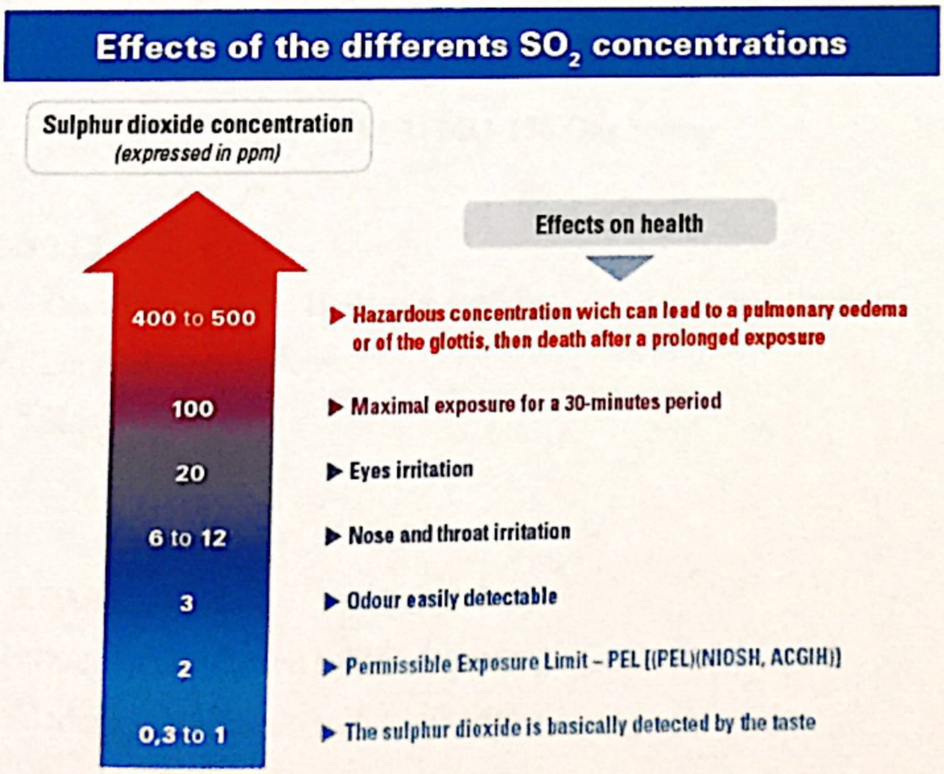


Figure 2.2.3.2: Effect of Sulfur Oxide,SO2 based on concentration to human health

2.3 MQ136 Gas Sensor

2.3.1 Introduction

Sensitive material of MQ136 gas sensor is SnO2, which with lower conductivity in clean air. When the target Hydrogen sulfide gas exist, the sensor's conductivity is higher along with the Hydrogen sulfide concentration rising. Please use simple electric circuit, convert change of conductivity to correspond output signal of gas concentration. MQ136 gas sensor has high sensitivity to Hydrogen sulfide, Low sensitivity for other combustible gas. It is with low cost and suitable for different application.

Figure 2.3.1.1: MQ-136 Gas Sensor

2.3.2 Character:

- Good sensitivity to Hydrogen sulfide
- Long life and low cost
- Simple drive circuit

2.3.3 Application:

1. Domestic Hydrogen sulfide detector
2. Industrial Hydrogen sulfide detector
3. Portable Hydrogen sulfide detector

2.3.4 Technical Data:

Model No.			**MQ136**
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			Hydrogen sulfide
Concentration			1-200ppm (Hydrogen sulfide)
Circuit	Loop Voltage	Vc	=24V DC
	Heater Voltage	VH	5.0V±0.2V AC or DC
	Load Resistance	RL	Adjustable
Character	Heater Resistance	RH	31Ω±3Ω（Room Tem.)
	Heater consumption	PH	=900mW
	Sensing Resistance	Rs	2KΩ-20KΩ(in 50ppm SO2)
	Sensitivity	S	Rs(in air)/Rs(50ppm NH3)=3
	Slope	α	=0.6(R100ppm/R50ppm H2S)
Condition	Tem. Humidity		20? ±2? ; 65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V ; VH: 5.0V±0.1V
	Preheat time		Over 48 hours

Table 2.3.4.1: Technical data for MQ-136 Gas Sensor

2.4 MQ-135 Gas Sensor

2.4.1 Introduction

Sensitive material of MQ135 gas sensor is NH3, which with lower conductivity in clean air. When the target combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benzes steam, also sensitive to smoke and other harmful gases. It is with low cost and suitable for different application.

Used for family, Surrounding environment noxious gas detection device, Apply to ammonia, aromatics, sulfur, benzene vapor, and other harmful gases/smoke, gas detection, tested concentration range: 10 to 1000ppm

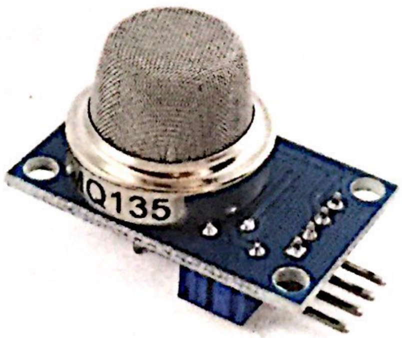


Figure 2.4.1.1: MQ-135 Gas Sensor

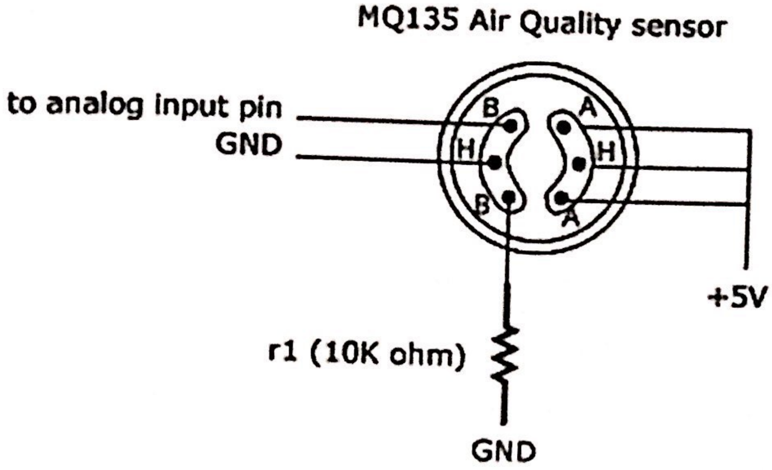


Figure 2.4.1.2: MQ-135 Gas Sensor Pins

2.4.2 Specification

- Working voltage: DC 5V
- Working Current: 150mA
- DOUT: TTL output
- AOUT: Analog output
- Preheat time: Over 20s
- Dimension: 32mm x 22m x 27mm(HIGH 27mm)

2.4.3 Character:

- Good sensitivity to Ammonia
- Long life and low cost
- Simple drive circuit

2.4.4 Application:

1.Domestic Ammonia detector

2.Industrial Ammonia detector

3.Portable Ammonia detector

2.5 The Peripheral Integrated Circuit (PIC16F877A)

2.5.1 Introduction

Microcontroller PIC16F877A is one of the PIC Micro Family microcontroller which is popular at this moment, start from beginner until all professionals. Because it is very easy using PIC16F877A and use FLASH memory technology so that can be write-erase until thousand times. The superiority this Risc Microcontroller compared to with other microcontroller 8-bit especially at a speed of and his code compression. PIC16F877A have 40 pin by 33 path of I/O.

PIC16F877A perfectly fits many uses, from automotive industries and controlling home appliances to industrial instruments, remote sensors, electrical door locks and safety devices. It is also ideal for smart cards as well as for battery supplied devices because of its low consumption. EEPROM memory makes it easier to apply microcontrollers to devices where permanent storage of various parameters is needed (codes for transmitters, motor speed, receiver frequencies, etc.). Low cost, low consumption, easy handling and flexibility make PIC16F877A applicable even in areas where microcontrollers had not previously been considered (example: timer functions, interface replacement in larger systems, coprocessor applications, etc.).In System Programmability of this chip (along with using only two pins in data transfer) makes possible the flexibility of a product, after assembling and testing have been completed. This capability can be used to create assembly-line production, to store calibration data available only after final testing, or it can be used to improve programs on finished product.

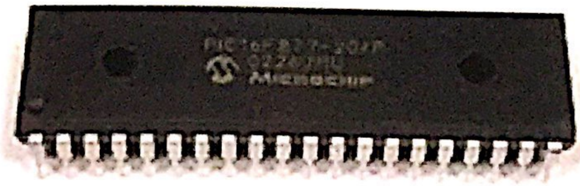
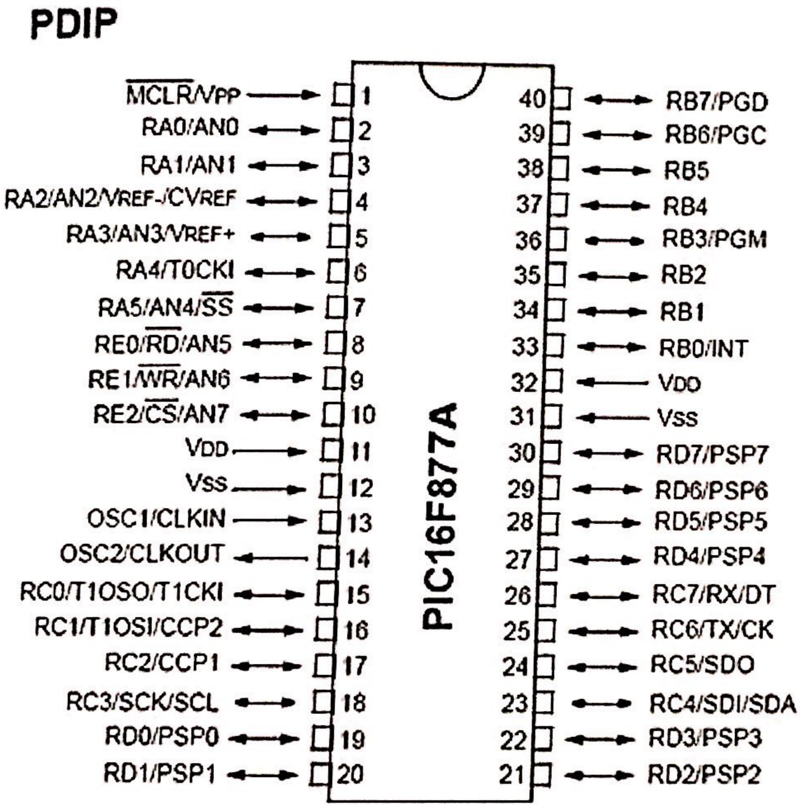


Figure 2.5.1.1: PIC16F877A



2.5.1.2: PIC16F877A Pin Diagram

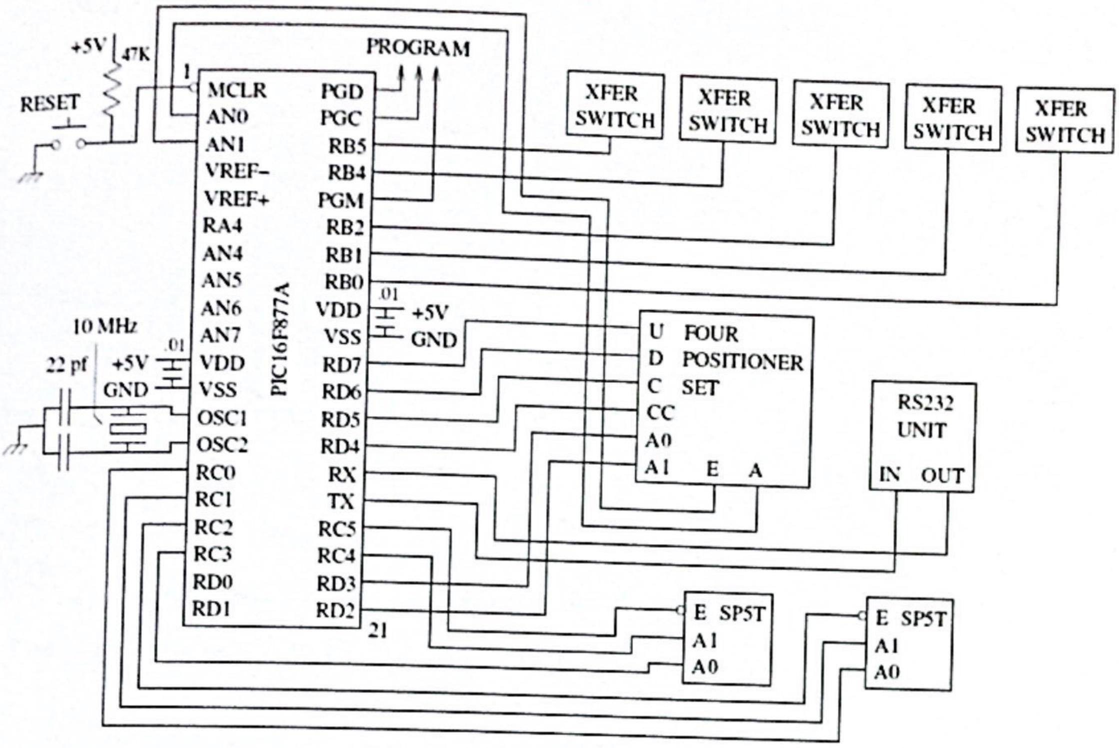


Figure 2.5.1.3: Schematic Diagram Of Microcontroller Connections

2.5.2 Benefit of PIC

a.Lower Cost:

Pic were originally create to decrease the cost of the user of it compare with the plc that weremore expensive that pic. Therefore in this project we choose pic as the brain in this project.

b.Sizes:

The pic is the smallest that other programming control that has many types of input and output pin such as 16 pin to 40 pin.

c.Communication Capability:

A pic can read and program all the input that has to program with it and easy to to program with any programmer and software.

d.Faster Respond Time:

Pic are design for high-speed and real-time applications. It can operate in real times, which mean that an even taking place in the field will result in the execution of an operation or output.

2.5.3 Characteristic of PIC

NO.	FEATURES	PIC16F877A
1.	Operating Frequency	DC – 20 MHz
2.	Resets and delays	POR, BOR (PWRT, OST)
3.	Flash Program Memory (14-bit words)	8K
4.	Data Memory (bytes)	368
5.	EEPROM Data Memory (bytes)	256
6.	Interrupts	15
7.	I/O Ports	Ports A, B, C, D, E
No.	features	Pic16f877a
8.	Timers	3
9.	Capture/Compare/PWM modules	2
10.	Serial Communications	MSSP, USART
11.	Parallel Communications	PSP
12.	10-bit Analog-to-Digital Module	8 input channels
13.	Analog Comparators	2
14.	Instruction Set	35 Instructions40-pin PDIP
15.	Packages	44-pin PLCC 44-pin TQFP 44-pin QFN

Table 2.5.3.1: Features of PIC16F877A

2.6 LCD (2 x 16 Character)

2.6.1 Introduction

Recently, a number of projects using intelligent Liquid Crystal Display (LCD) modules have been featured in EPE. Their ability to display not just numbers, but also letters, words and all manner of symbol, makes them a good deal more versatile than the familiar 7-segment light emitting diode (LED) display.

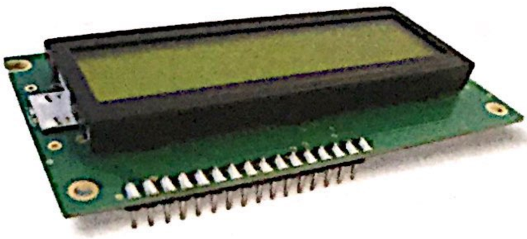


Figure 2.6.1.1: LCD (2 x 20 Characters)

2.6.2 Connections of LCD

Most LCD modules conform to a standard interface specification. A 14-pin access is provided (14 holes for solder pin insertion or for an IDC connector) having eight data lines, three control lines and three power lines. The connections are laid out in one of two common configurations, either two rows of seven pins, or a single row of 14 pins. The two layout alternatives are displayed in figure 2.5.

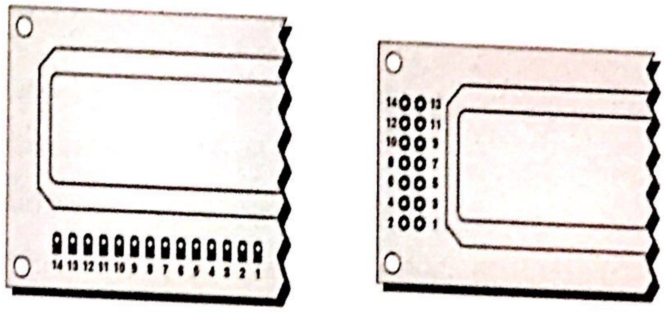


Figure 2.6.2.1: Two Layout Alternatives

2.6.3 LCD Pins

Pin No.	Name	Function
1	Vss	Ground
2	Vdd	+ve supply
3	Vee	Contrast
4	RS	Register Select
5	R/W	Read/Write
6	E	Enable
7	D0	Data bit 0
8	D1	Data bit 1
9	D2	Data bit 2
10	D3	Data bit 3
11	D4	Data bit 4
12	D5	Data bit 5
13	D6	Data bit 6
14	D7	Data bit 7

Table 2.6.3.1: Pin Outs Functions for All the LCD Types

Pins 1 and 2 are the power supply lines, Vss and Vdd .The Vdd pin should be connected to the positive supply, and Vss to the 0V supply or ground. Although the LCD module data sheet specify a 5V DC supply (at only a few milliamps), supplies of 6V and 4.5 both work well, and even 3V is sufficient for some modules. Consequently, these modules can be effectively, and economically, powered by batteries. Pin 3 is a control pin, Vee, which is used to alter the contrast of the display. Ideally, this pin should be connected to a variable voltage supply.

A preset potentiometer connected between the power supply lines, with its wiper connected to the contrast pin is suitable in many cases, but be aware that some modules may required a negative potential; as low as 7V in some cases. For absolute simplicity, connecting this pin to 0V will often suffice. Pin 4 is the Register Select (RS) line, the first of the three command control inputs. When this line is low, data bytes transferred to the display are treated as commands, and data bytes read from the display indicate its status. By setting the RS line high, character data can be transferred to and from the module.

Pin 5 is the Read/ Write (R/W) line. This line is pulled low in order to write commands or character data to the module, or pulled high to read character data or status information from its registers.

Pin 6 is the Enable (E) line. This input is used to initiate the actual transfer of commands or character data between the module and the data lines. When writing to the display, data is transferred only on the high to low transition of this signal. However, when reading from the display, data will become available shortly after the low to high transition and remain available until the signal falls low again.

Pins 7 to 14 are the eight data bus lines (D0 to D7). Data can be transferred to and from the display, either as a single 8-bit byte or as two 4-bit "nibbles". In the latter case, only the upper four data lines (D4 to D7) are used. This 4-bit mode is beneficial when using a microcontroller, as fewer input/output lines are required.

2.7 Electronic Valve

2.7.1 Introduction

Model APL-1/2-9VDC of our plastic valve line is a two-way, direct acting valve with a normally closed operating position. This means that there are two ports in which media flows, the valve will open when energized and allow media to pass through. Taking the energy away from the valve will close it and stop the flow. It works across various media such as water, air, oil or other low viscosity fluids.

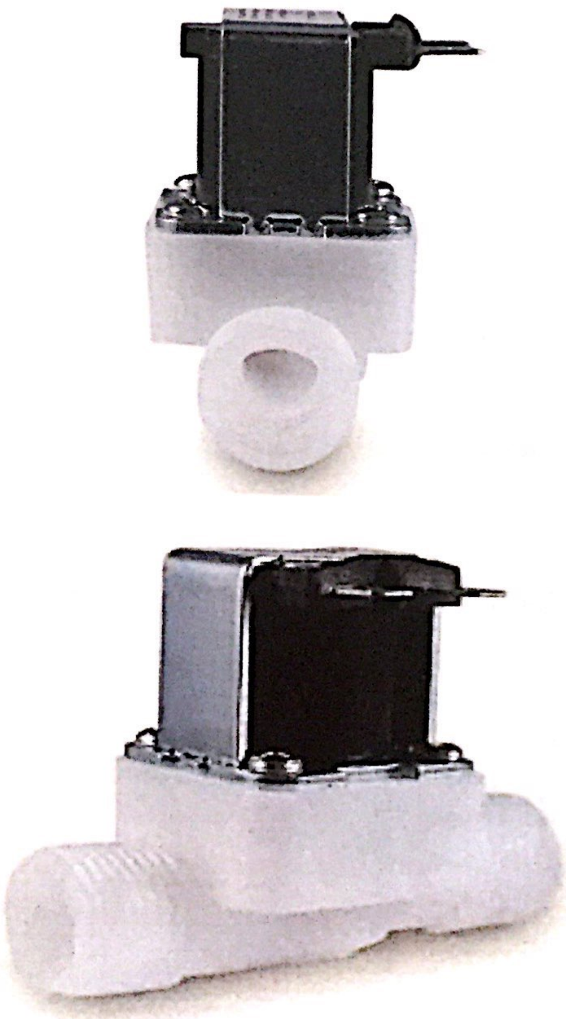


Figure 2.7.1.1: Model APL-1/2-9VDC Electronic Valve

2.7.2 Specifications

Specifications:	
Port Size	1/2" NPSM
Voltage	9V DC Coil (6 Watts)
Build Material	Plastic (POM)
Working Medium	Water – Air – Oil
Operation Mode	Normally Closed
Fluid Viscosity	Low Viscosity Fluids (below 20 cst)
Pressure Limits	3 - 115 psi (8bar)
Temperature	32 to 125° F | 0 to 50°C
Seal Material	EPDM Seal
Response Time	Fast Acting (Less than one second)

Figure 2.7.2.1: Model APL-1/2-9VDC Electronic Valve works

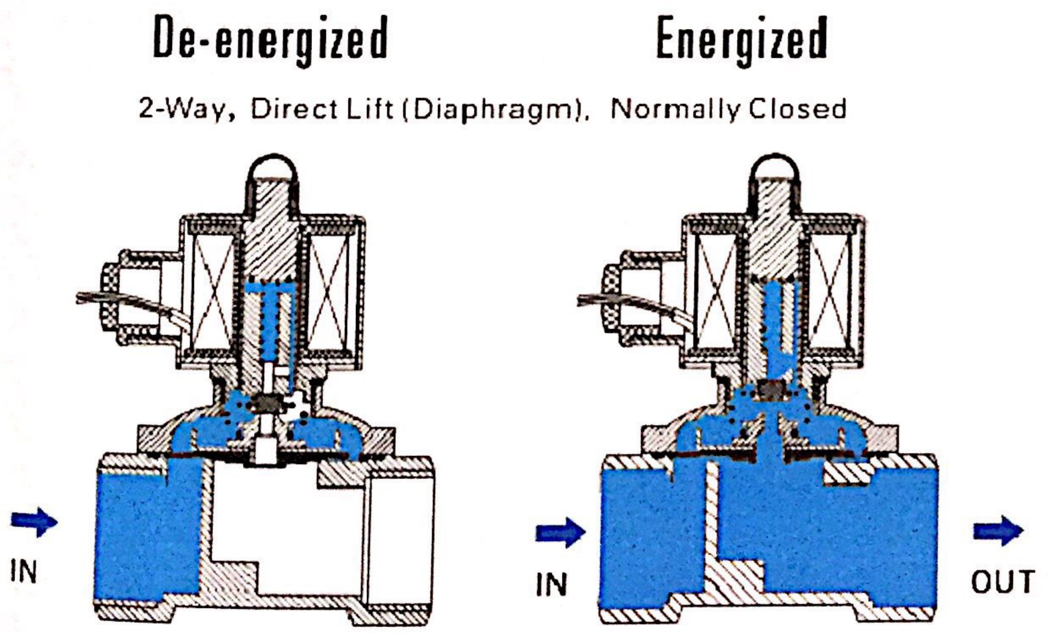


Figure 2.7.2.2 ModelAPL-1/2-9VDC Electronic Valve

The port size is 1/2" inch NPSM male threaded. It can withstand pressure up to 115 psi (8 bar) and temperatures as low as 0 C and as high as 50 C. The seal material is EPDM Rubber. This valve is capable of flowing 6.5 Gallons per minute at the max rated PSI.

This specific plastic valve has a 9 Volt DC coil with a voltage range that is -+ 10. The coil head can easily be connected with your own terminal connectors or directly soldered. Its response time is very quick; in fact, it acts in less than one second, making it a great choice for all types of applications.

2.7.3 Applications of Electronic valves

Common uses include but not limited to;

- Water Filters
- Ice Makers
- Drinking Fountains
- Washing Machines
- Dishwashers
- Dental Tools
- Fish Tanks
- Beer Brewing
- Hydroponics

2.8 12V Chemical Exhaust Fan

2.8.1 Introduction

An Exhaust Fan is any fan inside, or attached to, a case used for chemical gas waste control and may refer to fans that draw air into the case from the outside, expel chemical gas from
inside, or move air across a heat sink to cool a particular component.

Figure2.8.1.1 12V Exhaust Fan

2.8.2 Specifications

Color:	Black	Bearing Type:	Ball Or Sleeve
Material:	Plastic	Operating Temperature:	-10? -70?
Storage Temperature:	-40? -80?	Speed:	5800 RPM
Air Flow:	24.79 Cfm	Voltage:	12V
Current:	0.20A	Power:	2.40W

Table 2.8.2.1: Specifications of 12V Exhaust Fan

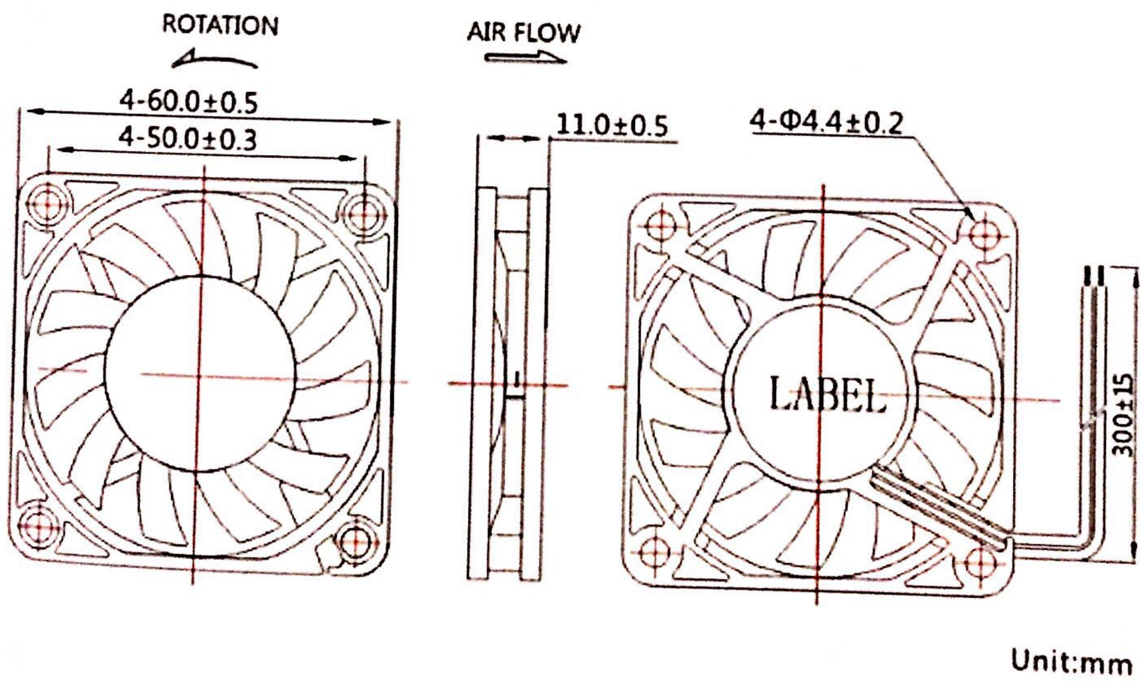
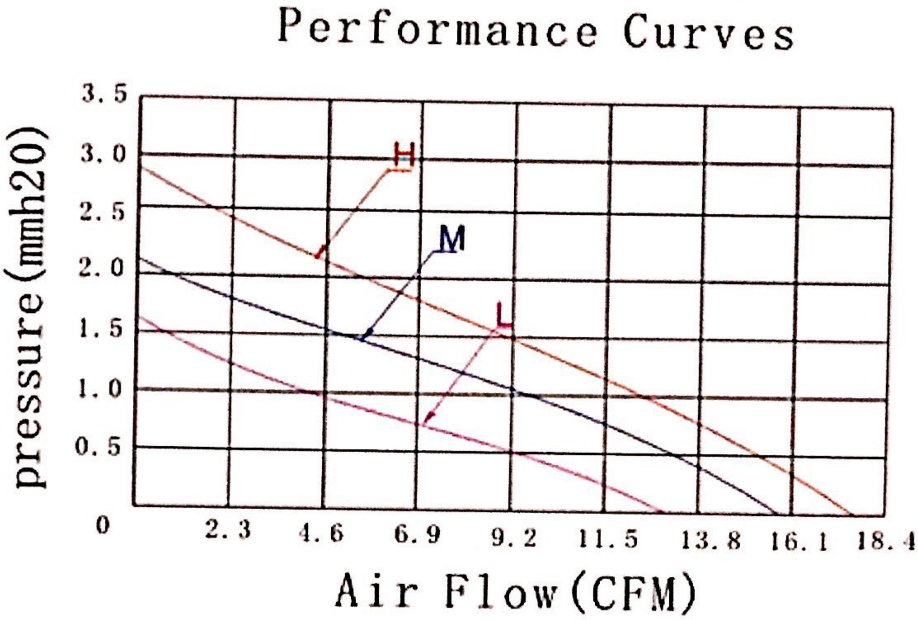


Figure 2.15: 12V Exhaust Fan Dimension



Graph 2.1: 12V Exhaust Fan Performance Graph

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will cover the details explanation of methodology that is being used to make this project complete and working well. Many methodology or findings from this field mainly generated into journal for others to take advantages and improve as upcoming studies. The method is use to achieve the objective of the project that will accomplish a perfect result. In order to evaluate this project, the methodology based on System Development Life Cycle (SDLC), generally three major step, which is planning, implementing and analysis.

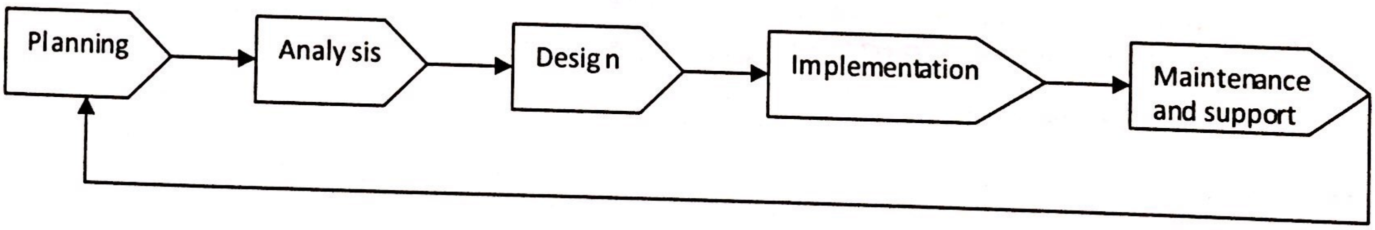


Figure 3.1.1: SLDC Phase

This final year project used three major steps to implement project starting from planning, implementing and testing. All the methods used for finding and analyzing data regarding the project related.

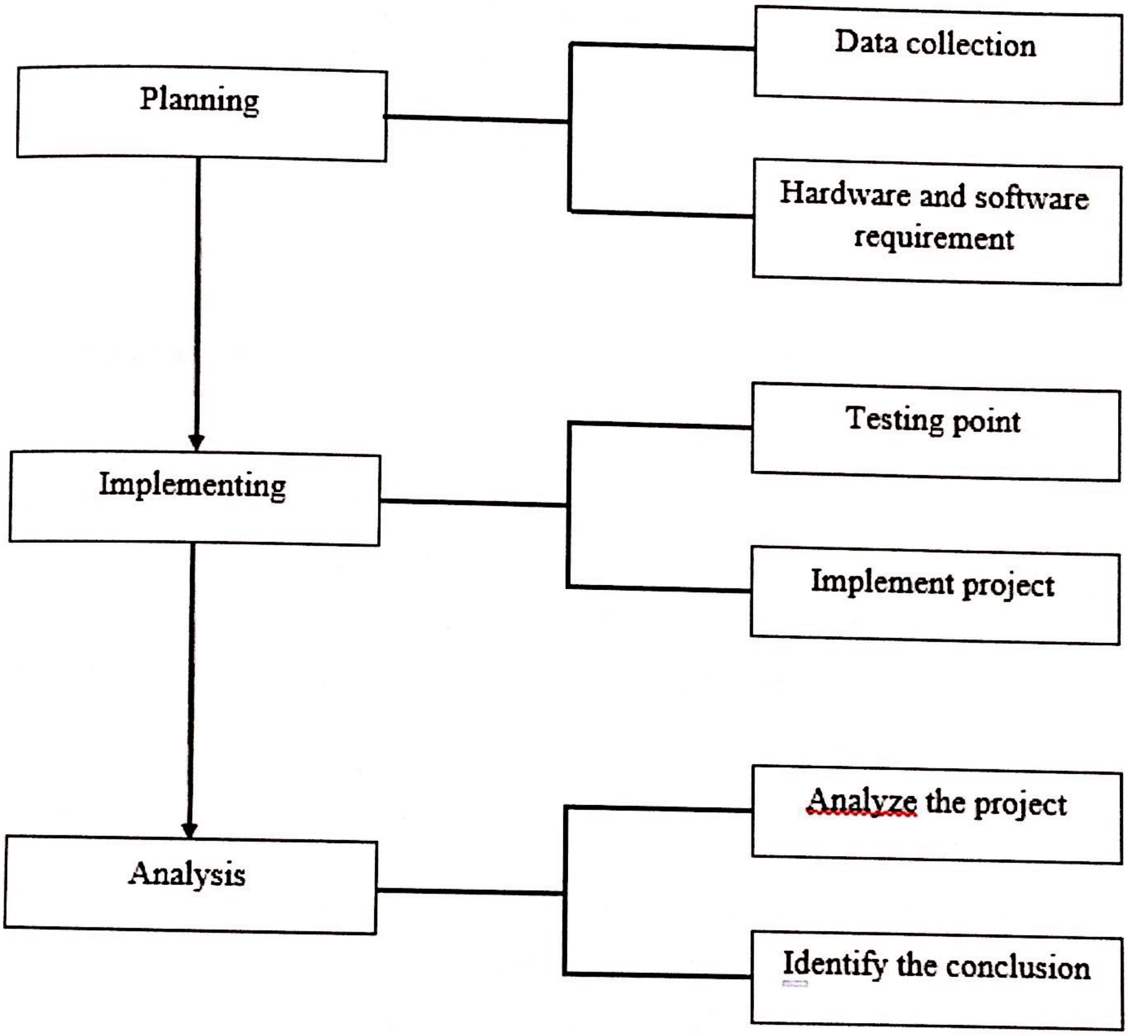


Figure 3.2.1: Steps of Methodology

3.2 Planning

To identify all the information and requirement such as hardware and software, planning must be done in the proper manner. The planning phase have two main elements namely data collection and the requirements of hardware and software.

3.2.1 Data collection

Data collection is a stage in any area of study. At this stage we planned about the projects resources and requirements, literature studies and schedule to get more information in this study. All the materials are collected from journal, texts book and research papers gathered from libraries and Internet.

Within the data collection period we have found the study about the Gas Leakage detection and Wireless Home Safety Gas Leakage detection system and do some research about the project related. Once we obtained the journal that are related with this project, we tried to find out the electronic component and other materials and some of equipment to be used.

While planning, we have done the research about the project related, which including with study about the electronic component such as MQ135 & MQ136 sensor, capacitor, resistor, LCD, transistor, electronic valve, fan and diode also delay. The study is not just for the function of the component but the types of small circuit build by each component related.

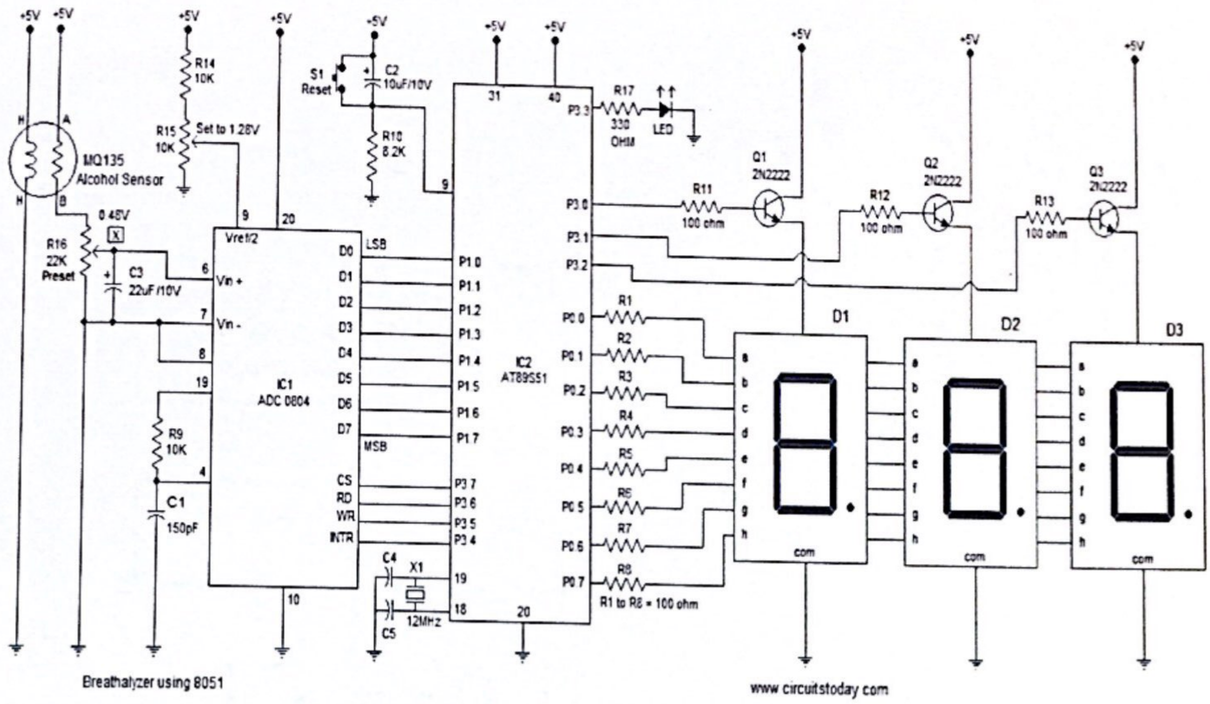
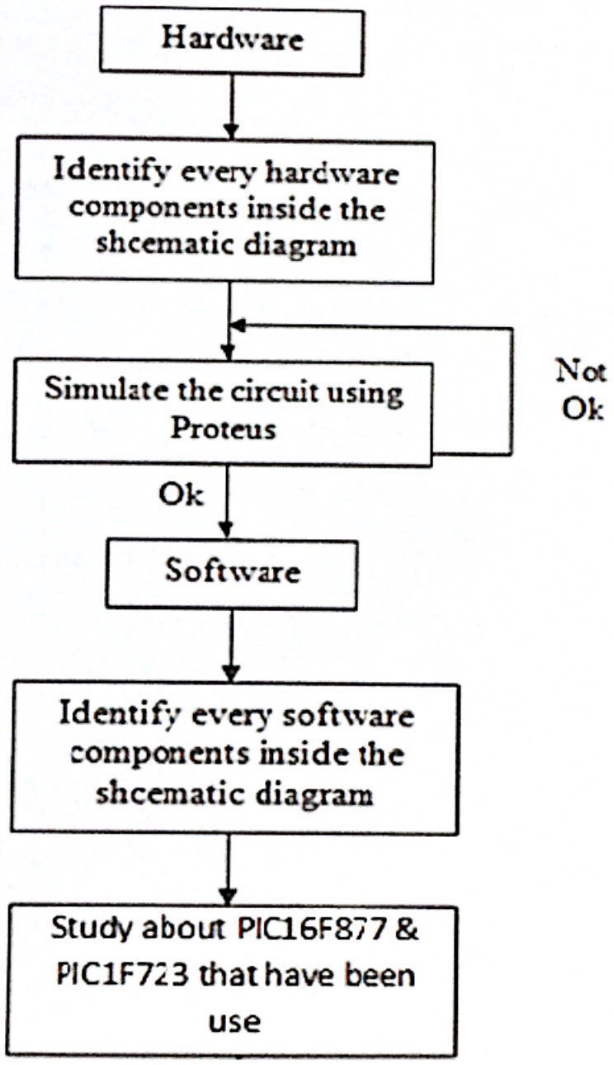


Figure 3.3 below shows the schematic diagram for gas analyze (alcohol analyze) project.

3.2.2 Requirement of Hardware and Software



Flow Chart 3.2.2.1: Hardware and Software Requirement

3.2.2.1 Hardware Requirement

Below is the list of the entire electronic components and the other material that will support to complete this project.

a. **Sensor**

- MQ 135 (detect Ammonia, NH3)
- MQ 136 (detect Hydrogen Sulfide, SnO2)
- Magnetic Sensor
- Water Leakage Sensor
-

b. **Microcontroller**

- PIC16F723
- PIC16F887A

c. **Additional part and Material**

- Fan
- Electronic valve
- Liquid Crystal Display (LCD)

3.2.2.2 Software Requirement

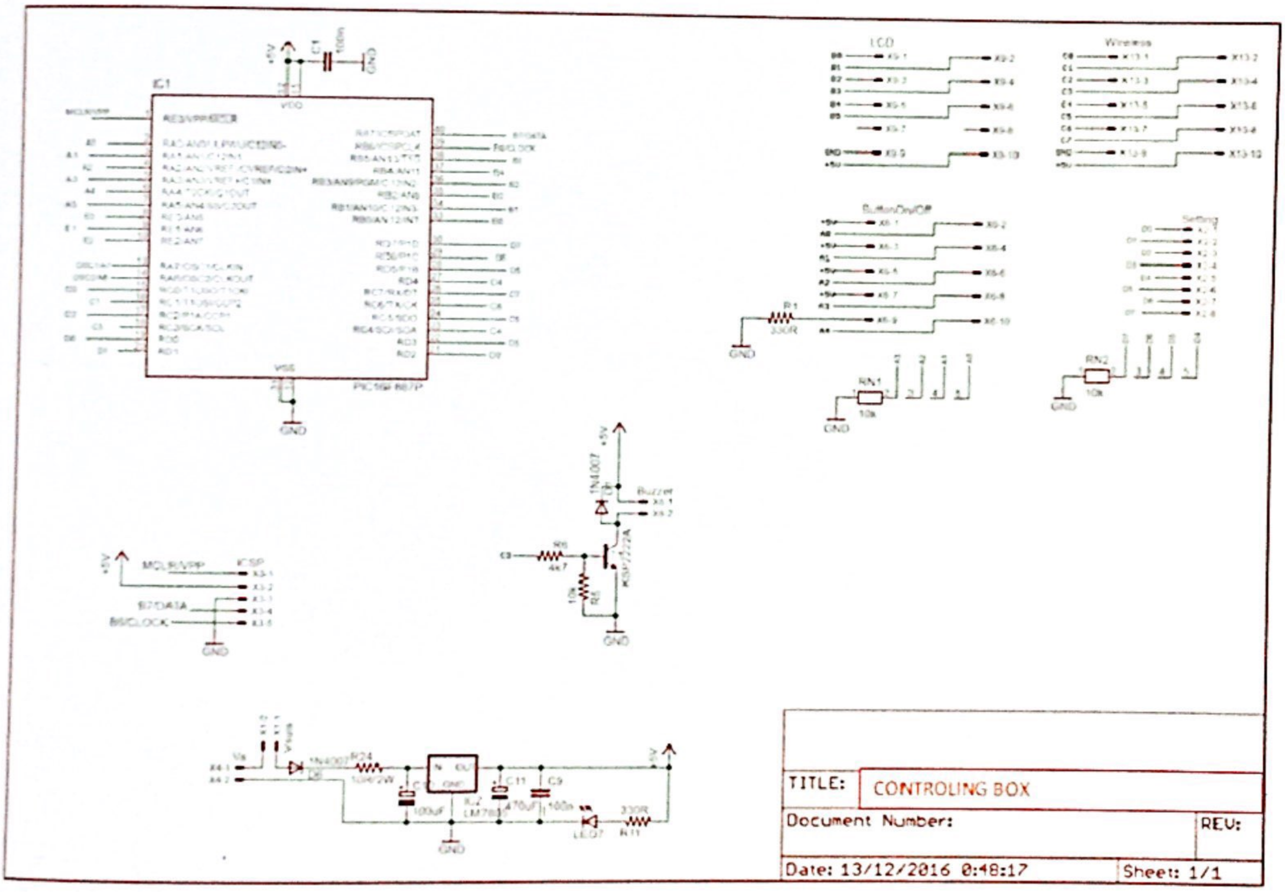
For software requirement, we have choose EagleCAD Capture CIS Software. EagleCad is a software tool suite used primarily for electronic design automation. The software is used mainly to create electronic prints for manufacturing of printed circuit boards, by electronic design engineers and electronic technicians to manufacture electronic schematics and diagrams, and for their simulation.

The name EagleCad is a portmanteau, reflecting the software's origins : Eagle + CAD, since this software can do the simulation of the schematic diagram, waveform for the output and can perform the PCB layout for the further step of this project.

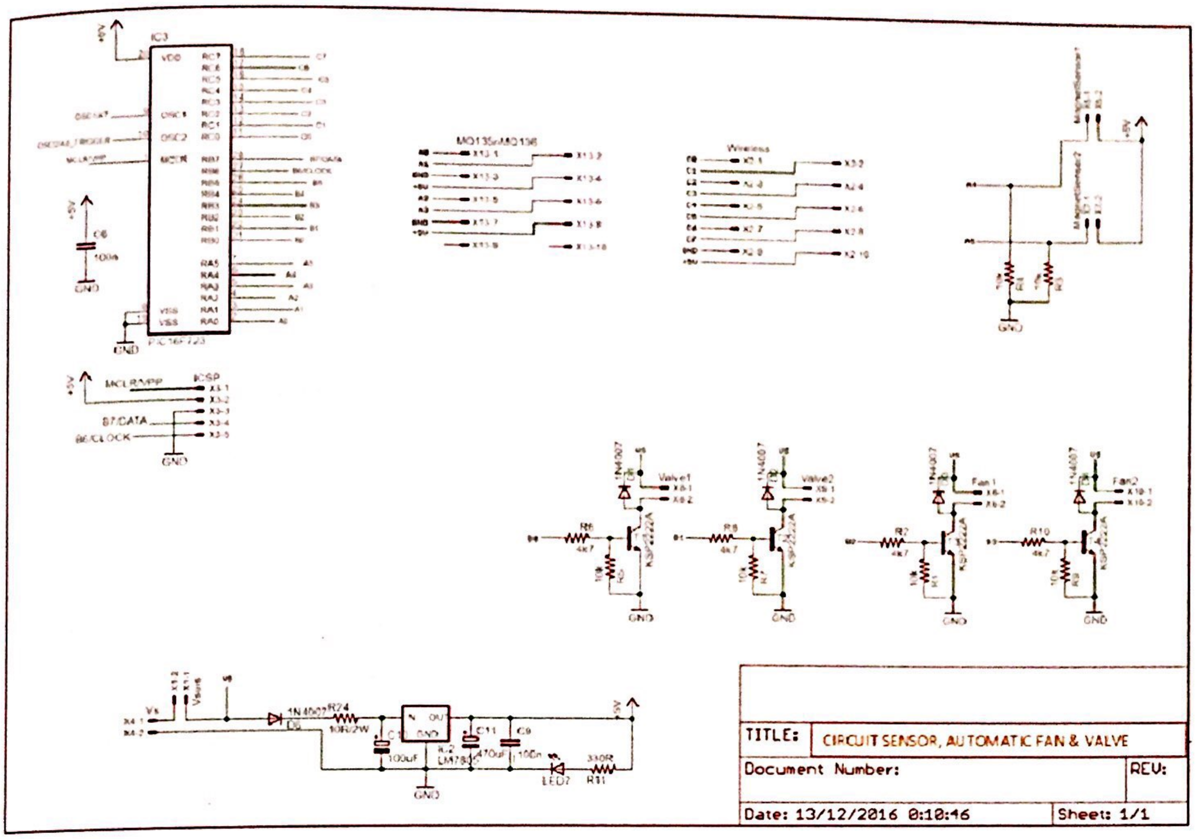
After the process of gathering all the related information about this final year project, a step of designing the circuit consist of Developer Fixer Safety Tank (DFS Tank) was done. Using the EagleCAD Capture CIS software, where several basics process of designing the circuit was done.

Controlling Circuit is the first and most important step in this electronic circuit design. The controlling circuit should be main of activities that happen on this project. It will show the output that happen from the sensor circuit.

After the transistor had been selected the circuit were then designed. Figure 3.4.a and 3.4.b shows the actual design of Developer Fixer Safety Tank (DFS Tank) that had been done using EagleCAD Capture CIS. However for the value of power supply and input/output process of obtaining the desired value is done in manually where each of the component that consist in the circuits shown below will be tuned until the desired waveform occurs.



3.2.2.2.1 Schematic Diagram: Schematic Diagram DFS Tank (Controlling Box)



3.2.2.2.2: Schematic Diagram: Schematic Diagram DFS Tank (Sensor, Valve & Fan)

3.3 Implementing

3.3.1 MQ – 136 Gas Sensor

Sensitive material of MQ136 gas sensor is SnO2, which with lower conductivity in clean air. When the target Hydrogen sulfide gas exist, the sensor's conductivity is higher along with the Hydrogen sulfide concentration rising. Please use simple electric circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ136 gas sensor has high sensitivity to Hydrogen sulfide, Low sensitivity for other combustible gas. It is with low cost and suitable for different application.

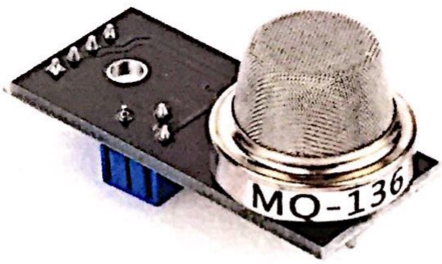


Figure 3.3.1.1: MQ-136 Gas Sensor

Character:

- Good sensitivity to Hydrogen sulfide
- Long life and low cost
- Simple drive circuit

Application:

1. Domestic Hydrogen sulfide detector
2. Industrial Hydrogen sulfide detector
3. Portable Hydrogen sulfide detector

3.3.2 MQ – 135 Gas Sensor

Sensitive material of MQ135 gas sensor is NH3, which with lower conductivity in clean air. When the target combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. To convert change of conductivity to correspond output signal of gas concentration, we use a simple electro circuit. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benzes steam, also sensitive to smoke and other harmful gases. It is low cost and suitable for different application.

Useful for family surrounding too as it can detect noxious gas in the environment. If this sensor is applied, it can detect ammonia, aromatics, sulfur, benzene vapor, and other harmful gases/smoke, gas detection, tested with concentration range: 10 to 1000ppm

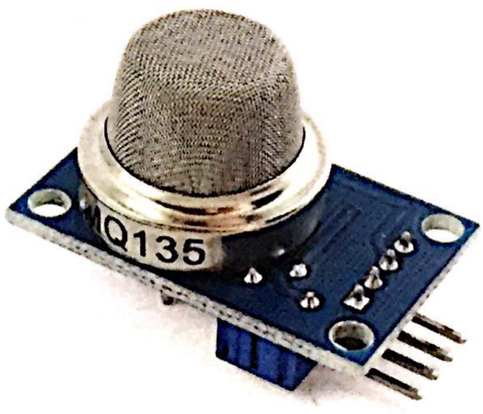


Figure 3.3.2.1 : MQ-135 Gas Sensor

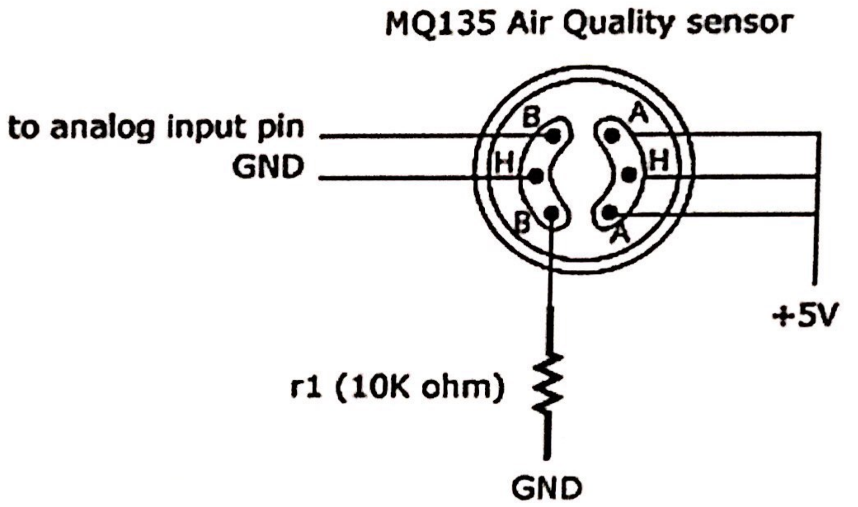


Figure 3.3.2.2: MQ-135 Gas Sensor Pins

Character:

- Good sensitivity to Ammonia
- Long life and low cost
- Simple drive circuit

Application:

1. Domestic Ammonia detector

2. Industrial Ammonia detector

3. Portable Ammonia detector

3.3.3 PIC16F877A

Microcontroller PIC16F877A is one of the PIC Micro Family microcontroller which is popular at this moment, start from beginner until all professionals. Because it is very easy using PIC16F877A and use FLASH memory technology so that can be write-erase until thousand times. The superiority this Risc Microcontroller compared to with other microcontroller 8-bit especially at a speed of and his code compression. PIC16F877A have 40 pin by 33 path of I/O.

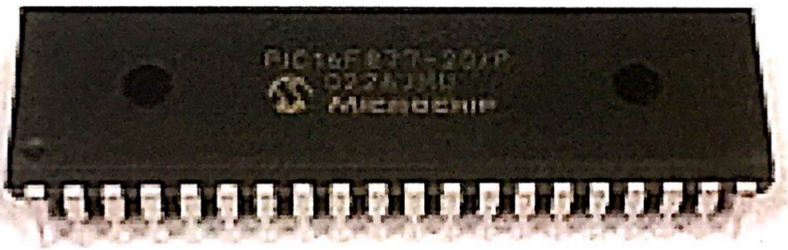


Figure 3.3.3.1 PIC16F877A

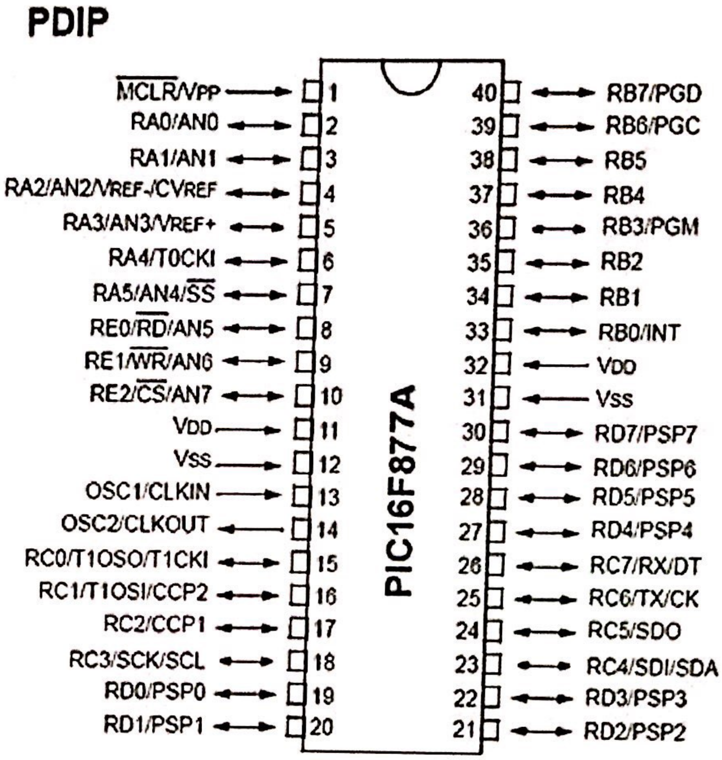


Figure 3.3.3.2: PIC16F877A Pin Diagram

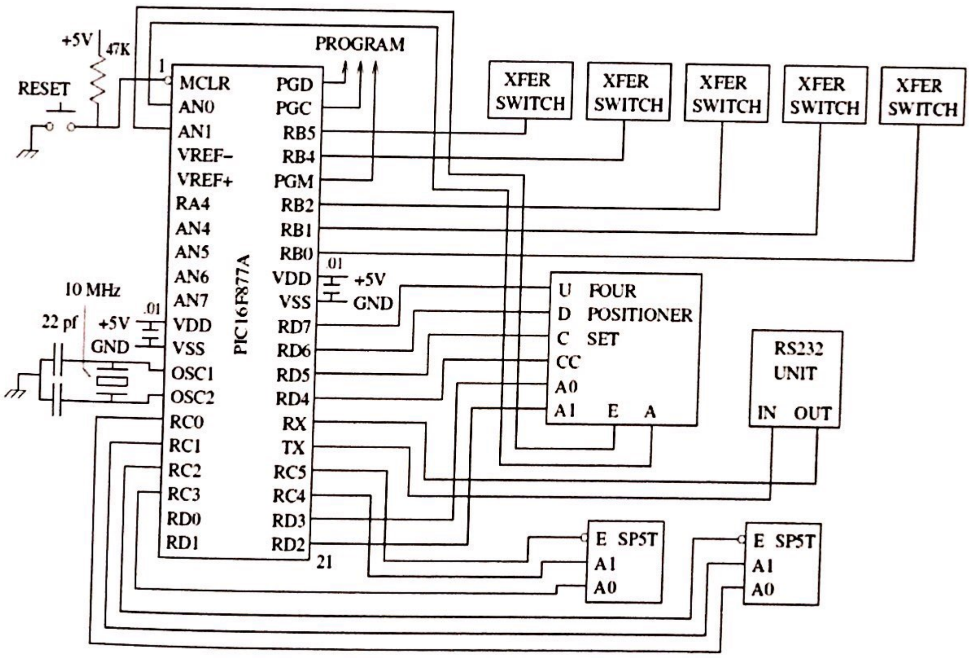


Figure 3.3.3.3: Schematic Diagram Of Microcontroller Connections

NO.	FEATURES	PIC16F877A
1.	Operating Frequency	DC – 20 MHz
2.	Resets and delays	POR, BOR (PWRT, OST)
3.	Flash Program Memory (14-bit words)	8K
4.	Data Memory (bytes)	368
5.	EEPROM Data Memory (bytes)	256
6.	Interrupts	15
7.	I/O Ports	Ports A, B, C, D, E
No.	features	Pic16f877a
8.	Timers	3
9.	Capture/Compare/PWM modules	2
10.	Serial Communications	MSSP, USART
11.	Parallel Communications	PSP
12.	10-bit Analog-to-Digital Module	8 input channels
13.	Analog Comparators	2
14.	Instruction Set	35 Instructions40-pin PDIP
15.	Packages	44-pin PLCC 44-pin TQFP 44-pin QFN

Table 3.3.3.1: Features of PIC16F877A

Model APL-1/2-9VDC of our plastic valve line is a two-way, direct acting valve with a normally closed operating position. This means that there are two ports in which media flows, the valve will open when energized and allow media to pass through. Taking the energy away from the valve will close it and stop the flow. It works across various media such as water, air, oil or other low viscosity fluids.

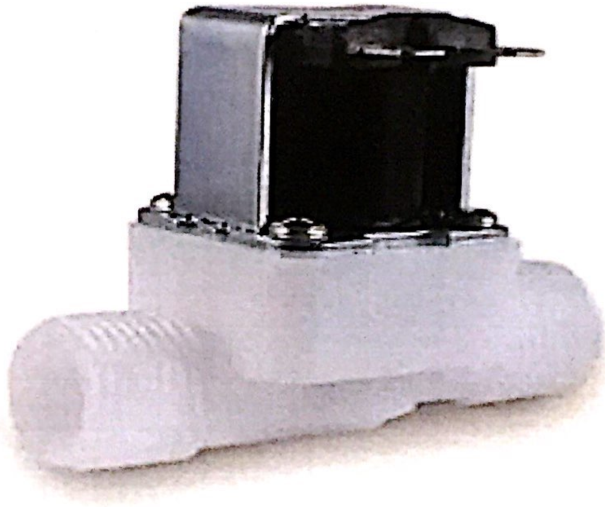


Figure 3.4.1 : Model APL-1/2-9VDC Electronic Valve

3.3.4 Project Testing

Simulation

After the process of designing circuit using EagleCAD Capture System, the simulation of the circuit process is followed. By using the same software, EagleCAD Capture CIS performed the result of simulation. Several simulation characteristics that can be observed by using this software are such as the output waveform and also the characteristics of the project. Since this project use the power supply AC/DC, so DC Volt value for input power, so the simulation result is performed straight-line form.

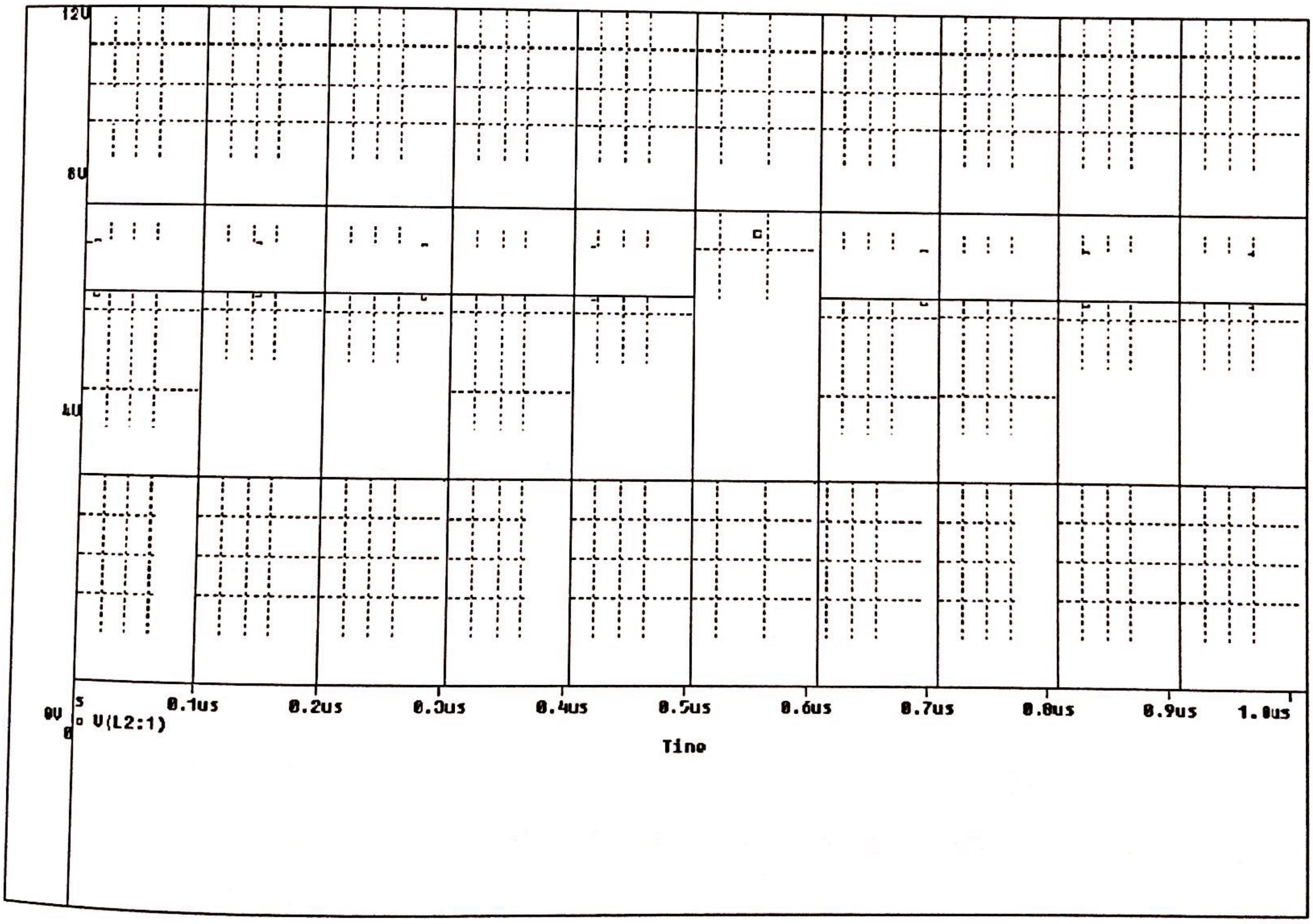


Figure 3.3.4.1: Simulation Result by EagleCAD

3.3.5 Layout design

After the process of designing the schematic circuits is done,we then proceed our project to the designing of the layout where it requires several steps until the layout can be done properly.The procedures of performing the layout design are stated as below:

- Annotate the circuit of FM Telephone Transmitter.
- Run the Design Rule Check (DRC).
  - From this stage the circuit will check whether it is successfully done and error will alert if anything was failed.
- Netlist process.
  - The netlist process is done due to link the schematic circuits to the layout footprint. In this part of process will creating a file of *.mnl*
- Creating the circuit layout process.
  - In this process the circuit's file of *.mnl* is needed to be import. Next, all the footprint needs to be link to each of the component that is includes inside the circuits.
- Rearrangement of the circuit.
  - By doing this the size of the circuit can be minimized. While doing the arrangement, the setting of the circuit also must be done where the size of drilling, size of tracks, which layer is going to be used; as for this circuit design the single layer will be used.
- After all the process had been done the circuit then will be route in automatically and so on it then will be checked again using the design rule check.

3.3.6 Project Board Circuit (PCB)

When EagleCAD Capture CIS Software did the process of designing the electronic circuit diagram, the process of produce project board circuit (PCB) is followed. The layout diagram circuit from EagleCAD Capture CIS Software was sent to Eaching Process and after that to Drill Process.

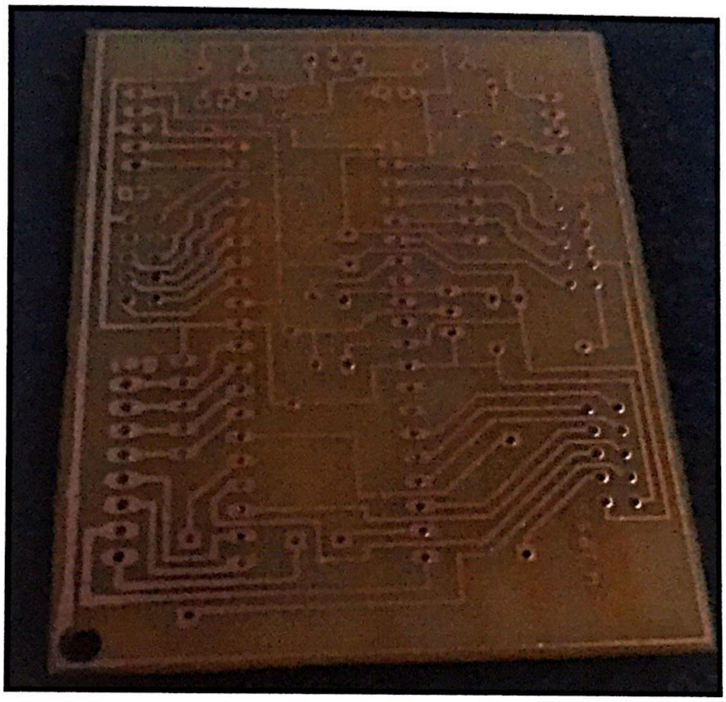


Figure 3.3.6.1 : PCB that is finished Etching and Drill Process

3.3.7 Components

The components for this project are based on the circuit diagram where all the components are bought mostly at electronic component shop at Jalan Pasar, Pudu. We also bought those component through website

3.3.8 Construction

i. When mounting components parts to the PCB, we used the parts-placement diagram as a guidance.

ii. Install the components, the board is so tight that some components must be mounted vertically.

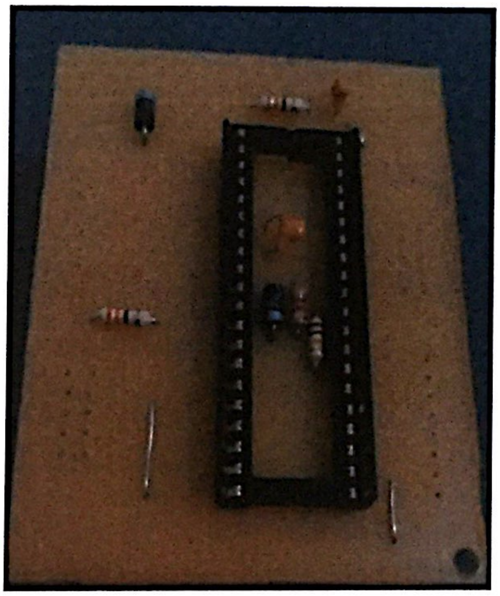


Figure 3.3.8.1 Components Installation Process

iii. After installing the components, we proceed the next step with soldering process.

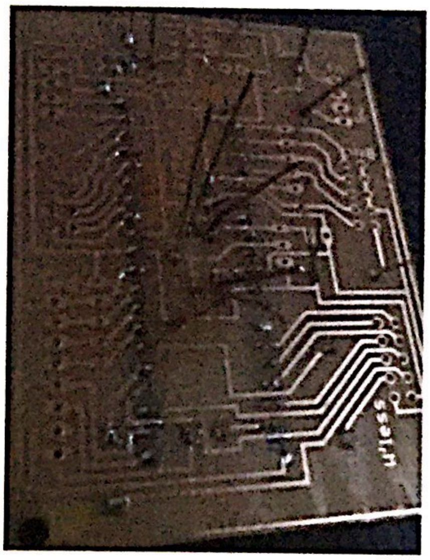


Figure 3.9 Soldering Process

3.3.9 Checking

After parts of mounting the components at PCB finished, we need to check the continuity track of the circuit. This part of job is to ensure that the operation of this circuit will run smoothly.

The tools related with the checking parts is multimeter and the continuity checking involve with every circuit tracks and the point of soldering. By using the buzzer multimeter, it's will alert the failed continuity. The failed continuity will recover with the soldering again the lake of components related.

Testing Circuit

The procedure of testing the circuit is by checking the input through out the whole circuit. This procedure is to check the input source is reached to all of components. By doing this activity, the LCD will light up to show that it is connected to the circuit without any result display.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

Result and discussion is a research to get the analysis information about the project. In this chapter we will discusses on the result, findings and the assessment from the analysis conducted in this project.

After the development of the Developer Fixer Safety Tank (DFS Tank), this project will be analysed to measure the effectiveness and to ensure the objectives of the project successfully achieved. Throughout the analysis stage, strengths and weakness of the Developer Fixer Safety Tank (DFS Tank) is identified.

Generally, there are three aspects stressed in the analysis, which are the behaviour, ability and sensitivities of the DFS Tank.

4.2 Parts per Million (ppm)

Parts per Million is a way of expressing very dilute concentrations of substances. Just as per cent means out of a hundred, so parts per million or ppm means out of a million. Usually describes the concentration of something in water or soil. One ppm is equivalent to 1 milligram of something per liter of water (mg/l) or 1 milligram of something per kilogram soil (mg/kg).

4.3 Parts per Million (ppm) by Volume or Mole in Air

In air pollution literature ppm applied to a gas, always means parts per million by volume or by mole. These are identical for an ideal gas, and practically identical for most gases of air pollution interest at 1 atm. Another way of expressing this value is parts per million volume (ppmv).

One part per million (by volume) is equal to a volume of a given gas mixed in a million volumes of air:

$$1\ \text{ppm} = \frac{1\ \text{gas volume}}{10^6\ \text{air volumes}}$$

A micro liter volume of gas in one liter of air would therefore be equal to 1 ppm:

$$1\ \text{ppm} = \frac{1\ \mu\text{L gas}}{1\ \text{L air}}$$

There is more ways on how to express gas concentrations in metric units, i.e. $\mu g/m^3$. Although expressing gaseous concentrations in $\mu g/m^3$ units, has the advantage of metric expression, it has the disadvantage of being greatly influenced by changes in temperature and pressure. Additionally, because of difference in molecular weight, comparisons of concentrations of different gases are difficult. To convert parts per million (ppmv) to a metric expression like $\mu g/m^3$, the density of the concerning gas is needed. The density of gas can be calculated by the Law of Avogadro's, which says: equal volumes of gases, at the same temperature and pressure, contain the same number of molecules. This law implies that 1 mole of gas at STP a volume of 22.71108 liters (dm^3) enfolds, also mentioned as the molar volume of ideal gas. Standard Temperature and Pressure (STP) is defined as a condition of 100.00 kPa (1 bar) and 273.15 K (0°C), which is a standard of **IUPAC**. The amount of moles of the concerning gas can be calculated with the molecular weight.

$$1\ ppm = \frac{V_m}{M} \frac{1\ \mu g\ gas}{1\ L\ air}$$

Where:

V_m =	**standard molar volume of ideal gas (at 1 bar and 273.15 K)**	**[22.71108 L/mol]**
M =	molecular weight of gas	[g/mol]

Table 4.3.1: Table Parts per Million (ppm)

For converting ppm by mole, the same equation can be used. This can be made clear by the following notation:

$$1\ \text{ppm} = \frac{1\ \mu\text{mole gas}}{1\text{mole air}} = \frac{V_m}{M}\,\frac{1\ \mu\text{g gas}}{1\ \text{L air}}$$

By checking the dimensions of the most right part of the equation, there will be found a dimensionless value, like the concentration in ppm is.

To calculate the concentration in metric dimensions, with other temperature and pressure conditions the Ideal Gas Law comes in handy. The volume (V) divided by the number of molecules (n) represents the molar volume (V_n) of the gas with a temperature (T) and pressure (P).

$$V_n = V/n = R\,\frac{T}{P}$$

Where:

V_n =	**specific molar volume of ideal gas (at pressure *P* and temperature *T*)**	**[L/mol]**
V =	volume of the gas	[m^3]
n =	amount of molecules	[mol]
R =	universal gas law constant [3]	[8.314510 J K^{-1} mol^{-1}] or [m^3 Pa K^{-1} mol^{-1}]
T =	Temperature	[K]
P =	Pressure	[Pa]

Table 4.3.2: Table Parts per Million (ppm)

With this equation it comes clear that the percentage notation by ppm is much more useful, because the independency of the temperature and pressure.

4.4 Evaluation Test Parts per Million (ppm) Calculation using Law of Avogadro's

The density of gas can be calculated by the Law of Avogadro's, which says: equal volumes of gases, at the same temperature and pressure, contain the same number of molecules. This law implies that 1 mole of gas at STP a volume of 22.71108 liters (dm^3) enfolds, also mentioned as the molar volume of ideal gas. Standard Temperature and Pressure (STP) is defined as a condition of 100.00 kPa (1 bar) and 273.15 K ($0^{\circ}C$), which is a standard of **IUPAC**. The amount of moles of the concerning gas can be calculated with the molecular weight.

$$1 \text{ ppm} = \frac{V_m}{M} \frac{1\,\mu g \text{ gas}}{1 \text{ L air}}$$

Where:

V_m =	**standard molar volume of ideal gas (at 1 bar and 273.15 K)**	**[22.71108 L/mol]**
M =	molecular weight of gas	[g/mol]

Table 4.4.1: Table Parts per Million (ppm)

4.4.1 Parts per Million (ppm) for Ammonia, NH_3

- **Molecular Weight, M = 17.03 g/mol**

- **ppm**

ppm	Volume / Mole	Weight
1 ppm	**0.75 mg/m^3**	**1.29 mg/m^3**
5 ppm	**3.75 mg/m^3**	**6.46 mg/m^3**
10 ppm	**7.50 mg/m^3**	**12.90 mg/m^3**
15 ppm	**11.20 mg/m^3**	**19.40 mg/m^3**
20 ppm	**15.00 mg/m^3**	**25.90 mg/m^3**
25 ppm	**18.70 mg/m^3**	**32.30 mg/m^3**

Table 4.4.1.1 Parts per Million (ppm) for Ammonia, NH_3

- **mg/m^3**

mg/m^3	Volume / Mole	Weight
1 mg/m^3	**1.33 ppm**	**0.73 ppm**
5 mg/m^3	**6.67 ppm**	**3.87 ppm**
10 mg/m^3	**13.34 ppm**	**7.73 ppm**
15 mg/m^3	**20.00 ppm**	**11.60 ppm**
20 mg/m^3	**26.67 ppm**	**15.50 ppm**
25 mg/m^3	**33.34 ppm**	**19.30 ppm**

Table 4.4.1.2 Parts per Million (ppm) for Ammonia, NH_3

4.4.2 Parts per Million (ppm) for Hydrogen Sulfide, H2S

- **Molecular Weight, M = 34.08 g/mol**
  - **ppm**

ppm	Volume / Mole	Weight
1 ppm	1.50 mg/m³	1.29 mg/m³
5 ppm	7.50 mg/m³	6.46 mg/m³
10 ppm	15.00 mg/m³	12.90 mg/m³
15 ppm	22.50 mg/m³	19.40 mg/m³
20 ppm	30.00 mg/m³	25.90 mg/m³
25 ppm	37.50 mg/m³	32.30 mg/m³

Table 4.4.2.1 Parts per Million (ppm) for Hydrogen Sulfide, HS2

  - **mg/m³**

mg/m³	Volume / Mole	Weight
1 mg/m³	0.67 ppm	0.73 ppm
5 mg/m³	3.33 ppm	3.87 ppm
10 mg/m³	6.66 ppm	7.73 ppm
15 mg/m³	10.00 ppm	11.60 ppm
20 mg/m³	13.33 ppm	15.50 ppm
25 mg/m³	16.66 ppm	19.30 ppm

Table 4.4.2.2 Parts per Million (ppm) for Hydrogen Sulphide, HS2

4.5 Parts per Million (ppm) After Diffuse

4.5.1 Parts per Million (ppm) for Ammonia, NH3 per Time (second)

- **Molecular Weight, M = 17.03 g/mol**

- **ppm**

Time	ppm	Volume / Mole	Weight
1 second	26 ppm	19.50 mg/m^3	33.60 mg/m^3
5 second	21 ppm	15.70 mg/m^3	27.20 mg/m^3
10 second	17 ppm	12.70 mg/m^3	22.00 mg/m^3
15 second	13 ppm	9.75 mg/m^3	16.80 mg/m^3
20 second	10 ppm	7.50 mg/m^3	12.90 mg/m^3
25 second	9 ppm	6.75 mg/m^3	11.60 mg/m^3

Table 4.5.1.1: Parts per Million (ppm) for Ammonia, NH3

(AFTER DIFFUSE)

4.5.2 Parts per Million (ppm) for Hydrogen Sulfide, $H2S$ per Time (second)

➢ **Molecular Weight, M = 34.08 g/mol**

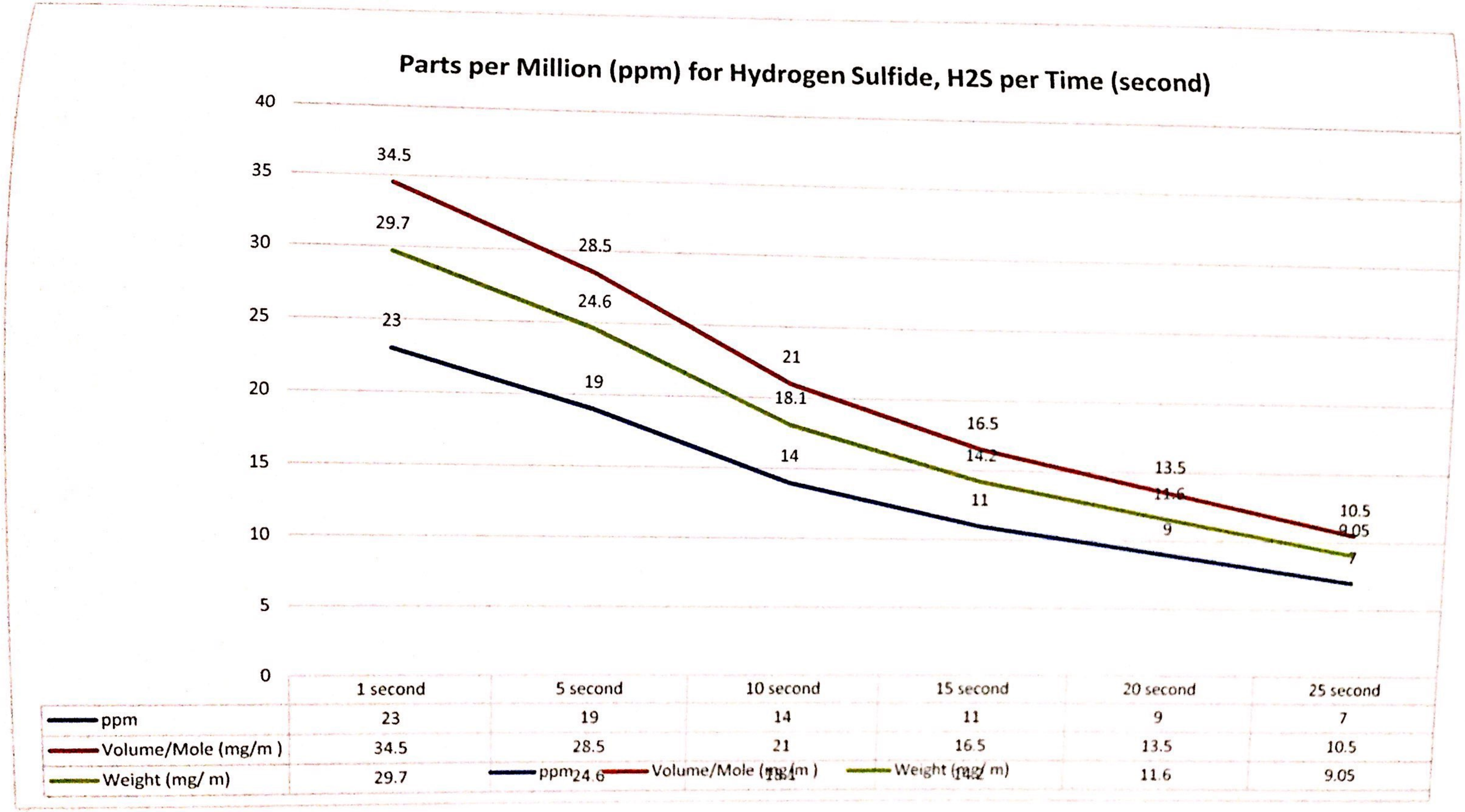
- **ppm**

Time	ppm	Volume / Mole	Weight
1 second	23 ppm	34.50 mg/m^3	29.70 mg/m^3
5 second	19 ppm	28.50 mg/m^3	24.60 mg/m^3
10 second	14 ppm	21.00 mg/m^3	18.10 mg/m^3
15 second	11 ppm	16.50 mg/m^3	14.20 mg/m^3
20 second	9 ppm	13.50 mg/m^3	11.60 mg/m^3
25 second	7 ppm	10.50 mg/m^3	9.05 mg/m^3

Table 4.4.2.2 Parts per Million (ppm) for Hydrogen Sulphide, HS2

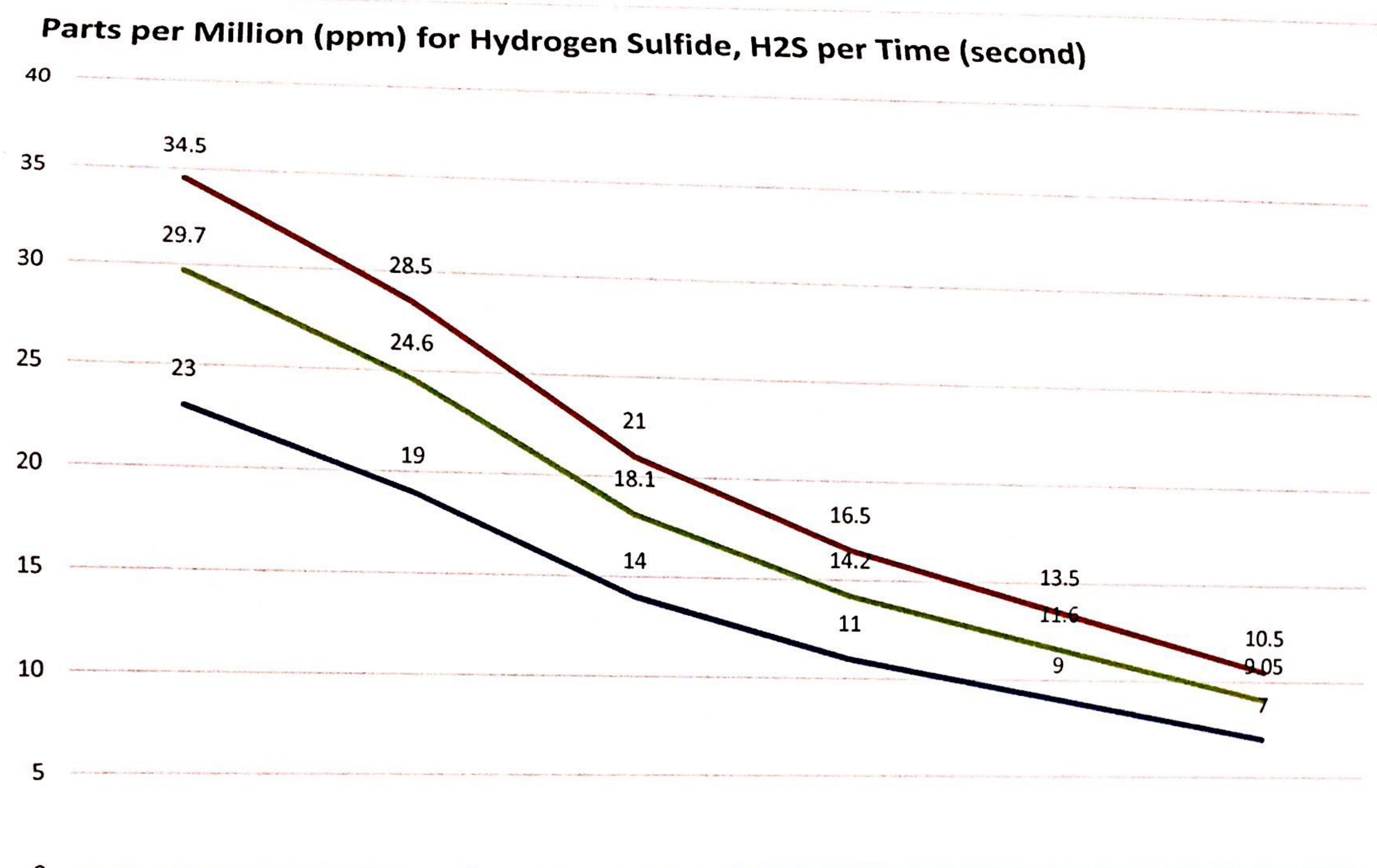
(AFTER DIFFUSE)

4.6 Relationship Between ppm and Time



	1 second	5 second	10 second	15 second	20 second	25 second
ppm	23	19	14	11	9	7
Volume/Mole (mg/m)	34.5	28.5	21	16.5	13.5	10.5
Weight (mg/ m)	29.7	24.6	18.1	14.2	11.6	9.05

4.6.1 Graph ammonia ppm over time (Refer 4.5.1)



	1 second	5 second	10 second	15 second	20 second	25 second
ppm	23	19	14	11	9	7
Volume/Mole (mg/m)	34.5	28.5	21	16.5	13.5	10.5
Weight (mg/ m)	29.7	24.6	18.1	14.2	11.6	9.05

4.6.2 Graph Hydrogen Sulfide PPM over time (Refer 4.5.2)

CHAPTER 5
DISCUSSION

5.0 DISCUSSION

During the whole two(2) semester our group has been working really hard to make this project is a success. All problem that comes we'll face it together with our group members. We manage to produce good teamwork between us in handling managing all works and problems.

Other than that, during the process of making and building a circuit for the device, we involved into too many problems. We as an electrical student, we're don't really the experience in handling electronic components such as arduino nano, bluetooth module, and etc. So when we tried ourselves to connect the circuit with the components, we often blown out the component away.Not only that it cost us our time, since we need to redo the circuit so many times, but this incident also cost us our money, we need to keep buying those components that blown out.

So in order to prevent any blown out happened again, we decided to asked opinions from the experienced one. From their suggestion, we used a more suitable material and tools to ensure there will be no more blown out happened to the other materials.

Next is, we happened to have a problem with the spring that need to be used for the device. The spring that we used is 5lbs which Is about 7.3 kg precisely. We have problem to search the exact spring for the device and it took us about more than a week to search for it, but at the end we managed to hadjndle the problem pretty well.

Next is, we happened to have a problem with the sensor. As to measure the parameter, we need to have a suitable environment which the sensor can detect the reaction of the concentration of liquid. As per advice, we test the sensor with smoke as it can detect smoke but with different parameter.

Next is regarding the design for the casing of the device. At first we decided to use an glass as what we know glass is pretty durable and can overcome corrosive liquid. However, after doing survey we find out glass is pretty expensive compares to Perspex. Perspex can be pretty strong against pressure and not really expensive. Though it have many disadvantage compare to glass but it sure worth too.

As for the conclusion, we as a group did face all the problems that arise since the beginning of the semester until the end that we managed to finish the project. This project would not be here without all the hard works from every one from the group, friends and the lecturer that have been always supervise us in many ways.

5.2 SUGGESTION

Once the project is done, we did some questionnaire around Hospital Sultanah Nora Ismail. According to the krejcie and morgan sample size table, we decided to do a questionnaire to 20 people including x-ray staff, engineer and technician. Most of them gave us positive and excellent feedback regarding our project but there are still some comments and suggestion that they gave for us to improve our project.

One of the suggestion that we get from biomedical engineer of Hospital Sultanah Nora Ismail. En Muhammad Arif Bin Mohd Dan suggest us to connect the Developer and Fixer Safety Tank (DFS Tank) with a GMS Module. By using GMS Module, user and technician are able to detect the leakage and damage by message that are send by the machine.

Another suggestion is also from a technician , En Abdul Ghaffar suggest a device which apply wireless concept. Which can provide a compact and wire-less machine.

Lastly, would be a suggestion from a biomedical student. She suggest us to use a design of product which more compact and interesting. We do agree to her suggestion, perspex might be not very compact and interesting. Maybe in the future we could think of other design that could be more attractive and compact according to the liking of both users and engineers.

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[2] world journal of pharmaceutical research, ssn 2277-7107 (page 6-7)

[3] Detection of Ammonia in Exhaled Human Breath Sneha Mardikar *(Instrumentation and control Engineering, Cummins College of Engineering, Pune, India)* Page *(semua)*