



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF DYNAMIC OLFACTOMETER

FOR THE AIR ODOUR LEVEL DETECTOR

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Automation and Robotic) with Honours.

by

AZEEM AZEMIE BIN HALIMI

B071610668

940616146877

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING
TECHNOLOGY

2019

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF DYNAMIC OLFACTOMETER FOR THE AIR ODOUR
LEVEL DETECTOR

Sesi Pengajian: 2019

Saya **Azeem Azemie Bin Halimi** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.

4. **Sila tandakan (X)

SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

TIDAK
TERHAD

Yang benar,

Disahkan oleh penyelia:

.....

.....

Azeem Azemie Bin Halimi

Ts. Ahmad Muzaffar Bin Abdul Kadir

Alamat Tetap:

Cop Rasmi Penyelia

C109 APARTMENT CASMARIA,

JALAN SAMUDRA UTAMA,

TAMAN SAMUDRA,

68100 BATU CAVES,

SELANGOR

Tarikh:

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled DEVELOPMENT OF DYNAMIC OLFACTOMETER FOR THE AIR ODOUR LEVEL DETECTOR is the results of my own research except as cited in references.

Signature:

Author : Azeem Azemie Bin Halimi

Date:

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automation and Robotic) with Honours. The member of the supervisory is as follow:

Signature:

Supervisor: Ts. Ahmad Muzaffar Bin Abdul Kadir

ABSTRAK

Bumi ini dikelilingi oleh udara yang bercampuran dengan gas yang sangat penting seperti oksigen, karbon dioksida dan nitrogen. Gas-gas ini memberi manusia dan haiwan oksigen untuk sistem pernafasan berlaku. Secara umumnya, pencemaran udara dalam kehidupan seharian kita semakin teruk. Selain itu, udara persekitaran kadangkala mendapat bau yang tidak memuaskan seperti bau sampah, asap, dan gas. Untuk mengesan bau udara ini, terdapat beberapa teknologi yang dicipta oleh manusia untuk memeriksa dan mengesan bau yang dikenali sebagai "hidung elektronik". Hidung elektronik atau E-hidung adalah alat buatan olfaksi dengan pelbagai sensor gas kimia yang digunakan untuk menganalisis gas. Kaedah ini digunakan untuk mengendalikan projek ini dengan menggunakan sensor MQ-135 untuk mengesan bau dan merasakannya. Arduino NANO digunakan sebagai mikrokontroler. Projek ini akan dikendalikan oleh program yang menggunakan Arduino IDE Software dengan pengkodean C++. Seterusnya, objektif projek ini adalah untuk membuat peranti mudah alih yang dapat mengesan bau yang boleh digunakan dalam sensor bau tertentu untuk mengesan persekitaran udara, dapat mencatat data bau dalam kualiti udara dan akhirnya dapat mengumpulkan data dan melakukan perbandingan untuk analisisnya. Perkembangan peranti mudah alih ini dapat membantu manusia mengesan dengan mudah dan menjimatkan masa untuk mengukur tahap bau yang sesuai dengan udara untuk manusia bernafas.

ABSTRACT

The earth is surrounded by air, a mixture of extremely important gases such as oxygen, carbon dioxide and nitrogen. These gases provide human and animals with oxygen for respiration to occur. In general, the air pollution in our daily life that getting worst. Besides that, air environment sometimes getting an unsatisfactory of smell such as garbage smell, smoke, and gases. For detecting this air odour, there are some technology create by human to check and detect the smell which are known as "electronic nose". Electronic nose or E-nose is an artificial olfaction device with a range chemical gaseous sensor used to analyse gas. This method is applied in this project by using MQ-135 sensor to detect odour and senses it. The Arduino NANO are used as the microcontroller of the project. The project will be controlled by the program in the Arduino IDE Software with coding C++. Next, the objective in this project is to create a portable device that can detect smell to used in specific smell sensor to detect air environment, can record a data of odour in air quality and lastly can collect the data and do comparison for analysis. The development of this portable device can help people detect with easy and save time to measure the level of smell that suits the air for human to breathing.

DEDICATION

To my beloved parents,

Halimi Bin Ibrahim, my father

Noor Linda Binti Yahaya Afandi, my mother

My Supervisor,

Ts. Ahmad Muzaffar Bin Abdul Kadir

To all Lecturers,

And not forgetting to all my dear friends

Without me

ACKNOWLEDGEMENTS

Praise to Allah, with successful and smooth sailing I can finish the final year project. A very appreciative of my supervisor Ts. Ahmad Muzaffar Bin Abdul Kadir who guides me through this final year project process all the way. Without my supervisor's guidance, the process will not be as smooth as this when completing this project.

Then a very grateful one for my friends that helps make this project. The idea and improvement in my project is really helpful in the discussion with my friends. Last but not least, I am very grateful and grateful to my parents for providing moral support throughout this project making process. Their support really helps me to make this project much better by ensuring the process.

TABLE OF CONTENTS

	PAGE
TABLE OF CONTENTS	x
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
LIST OF APPENDICES	xvii
LIST OF SYMBOLS	xviii
LIST OF ABBREVIATIONS	xix
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Objective	2
1.3 Statement of the purpose	3
1.4 Problem Statement	3
1.5 Scope	5
CHAPTER 2 LITERATURE REVIEW	6
2.1 Types of Gases	6
2.1.1 Carbon Dioxide (CO ₂)	6
2.1.2 Smoke	7
2.1.3 LPG	7
2.1.4 Garbage Smell	8

2.1.5	Perfume	8
2.2	Types of Sensor (Smell Sensor)	9
2.2.1	MQ-135	9
2.2.2	MQ-2	10
2.2.3	MQ-4	11
2.2.4	MQ-8	12
2.2.5	MQ-9	13
2.2.6	Structure of MQ sensor	14
2.3	Types of LCD output	16
2.3.1	OLED	16
2.3.2	LCD	17
2.4	Types of controller	18
2.4.1	Arduino	18
2.4.2	Raspberry Pi	23
2.5	Types of fan	25
2.6	Temperature Sensor	26
CHAPTER 3 METHODOLOGY		27
3.1	Flow Chart of Project	28
3.1.1	Flow chart overall project	25
3.1.2	Flow chart of the operation project	30
3.2	Circuit in this project	33

3.2.1	Design of Circuit	34
3.3	Hardware Development	37
3.3.1	Rechargeable Battery	38
3.3.2	MQ Sensor	39
3.3.3	Arduino Microcontroller	45
3.3.4	Hinges	47
3.4	Software Development	48
3.4.1	Proteus	48
3.4.2	Arduino IDE Software	52
3.4.3	SolidWorks	54
3.5	Project Design	55
3.5.1	Nasal Ranger Olfactometer	55
3.5.2	Design of Project	56
3.6	Coding	58
3.6.1	Level Odour (CO ₂)	58
3.6.2	Calibration	59
3.6.3	Range and Condition	59
3.6.4	Voltage indicator	61
CHAPTER 4	RESULT	63
4.1	Voltage versus PPM	63
4.2	Hardware and the model of the project	68
4.3	Experimental	70

CHAPTER 5	CONCLUSION	76
5.1	Introduction	76
5.2	Summary Research	76
5.3	Problem encountered during the process	77
5.4	Achievement of the project objective	78
5.5	Improvement for the future work	78
	REFERENCES	79
	APPENDIX	

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1:	Comparison of MQ sensor	13
Table 4.1:	Voltage and PPM result in all condition	64
Table 4.2:	An experiment by using MQ-135 sensor	70
Table 4.3:	An experiment by using MQ-8 sensor	71
Table 4.4:	An experiment by using MQ-9 sensor	72
Table 4.5:	An experiment by using MQ-4 sensor	73
Table 4.6:	An experiment by using MQ-2 sensor	74

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1:	MQ sensor module	14
Figure 2.2:	OLED Display	16
Figure 2.3:	LCD Display	17
Figure 2.4:	Arduino UNO (R3)	19
Figure 2.5:	LilyPad Arduino Board	20
Figure 2.6:	RedBoard Arduino Board	20
Figure 2.7:	Arduino Mega (R3) Board	22
Figure 2.8:	Arduino Leonardo Board	21
Figure 2.9:	Arduino Shields	22
Figure 2.10:	Raspberry Pi Model	24
Figure 2.11:	5V DC fan and 12V DC fan	25
Figure 2.12:	Temperature sensor with humidity sensor	26
Figure 3.1:	Flow Chart Overall Project	28
Figure 3.2:	Flow Chart of The Operation Project	30
Figure 3.3:	Simulation and actual circuit project	34
Figure 3.4:	Simulation and actual circuit project (fan)	35
Figure 3.5:	Simulation and actual circuit project (main body)	36
Figure 3.6:	Simulation circuit using Proteus Software	37

Figure 3.7:	Assemble hardware component following the simulation circuit	37
Figure 3.8:	9V Rechargeable Battery	38
Figure 3.9:	MQ sensor with pin	39
Figure 3.10:	Connection Pin A and B	40
Figure 3.11:	Sensitivity Characteristics of MQ-135	42
Figure 3.12:	Graft data form MQ sensor	44
Figure 3.13:	Arduino UNO	45
Figure 3.14:	Arduino NANO	46
Figure 3.15:	Hinges	47
Figure 3.16:	Proteus 8 CAD connected software	48
Figure 3.17:	Open schematic capture	49
Figure 3.18:	The defaults of schematic capture	49
Figure 3.19:	Insert the component	50
Figure 3.20:	Key in the component name	50
Figure 3.21:	Selected Arduino with Gas Sensor	51
Figure 3.22:	Completing the circuit diagram	51
Figure 3.23:	Arduino IDE software	52
Figure 3.24:	Coding sketch	53
Figure 3.25:	Starting page for SolidWork software	54
Figure 3.26:	Given the choice of three files to start	54
Figure 3.27:	Inhalation by using nasal ranger and direction of the nasal ranger	55
Figure 3.28:	Draft design for the device	56
Figure 3.29:	New design main body and holder	57

Figure 3.30:	Range of CO2 level	58
Figure 3.31:	Coding of calculation for CO2raw, CO2comp, and CO2now	59
Figure 3.32:	Condition of smell detection range	60
Figure 3.33:	Coding for display voltage indicator	61
Figure 3.33:	Assembling the Arduino, OLED, and MQ sensor on breadboard	54
Figure 4.1:	The detection of sensor by voltage and ppm reading	64
Figure 4.2:	Starting operation graft in good condition	65
Figure 4.3:	Graft in moderate condition	65
Figure 4.4:	Graft in bad condition	66
Figure 4.5:	Maximum graft in sickness condition	66
Figure 4.6:	Power supply using battery li on	68
Figure 4.7:	Main circuit using Arduino Nano connected with MQ sensor	68
Figure 4.8:	Overall body and project done assemble	69
Figure 4.9:	MQ-135 respond	70
Figure 4.10:	MQ-8 respond	71
Figure 4.11:	MQ-9 respond	72
Figure 4.12:	MQ-4 respond	73
Figure 4.13:	MQ-2 respond	74

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
-----------------	--------------	-------------

LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
l	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

PPM	Part Per Million
USB	Universal Serial Bus
E-nose	Electronic Nose

LIST OF PUBLICATION

INTRODUCTION

INTRODUCTION

This chapter is mainly concerned with the title of the research, the Development of The Dynamic Olfactometer, the background information, scale and the purpose of this study for air odour level detectors.

1.1 BACKGROUND

Electrochemical is an artificial olfaction device with a range chemical gaseous sensor, sampling system and algorithm used to analyse gas, steam or odour as a classification pattern. Simply put, it consists of chemical gas sensors housed in a device with the purpose of recognizing, identifying and comparing odours using a pattern. The lungs add smells to the epithelium layer in human smells, while the e-nose uses a pump. Filters and concentrations in the human nose are hair, membranes and mucus. In comparison, the filtration in the e-nose model is provided by the inlet sampling system. The human epithet represents millions of sensing cells interacting with fragrances, while the e-Nose uses sensors interacting differently with fragrances. In humans the chemical reaction to smells is converted into electronic nerve pulses much like the chemical sensor of the nose reacts to electric signals with odour.

Olfactometric techniques can be divided into two olfactometry which is indirect (static) or direct (dynamic). Dynamic olfactometry is now a common and widespread method of odour concentration quantification (Munoz et al., 2010). Furthermore, the olfactometric analysis requiring the participation of a panel of experts has the disadvantage for dynamic olfactometry

because of the need to travel with the proband to the odour scene is very expensive. In addition, the presence of test persons at the site may have an impact on their answers to collect data.

Field olfactometry may be used in combination with laboratory-based methods in some instances. For example, in laboratory, air samples from odour sources can be collected and analysed to quantify the rate of source emission, while odour transport in the area by field olfactometric methods can be evaluated (Henry et al., 2011). For the confident measurement of the smell is using in some places that most common to be checking the air quality such as at property lines and at locations in the neighbouring community. Field olfactometry can be used as a proactive monitoring or enforcement tool (Nicell, 2009). For real-time analysis, the field olfactometers are excellent, but are limited because of insufficient dilution, accessibility of panellists to odours, replication and duration of the sampling (Traube et al., 2011).

1.2 OBJECTIVE

Based on objectives such as the following:

- Create a portable device that can checking odour quality
- Can be used in specific smell sensor to detect air depends on sensor capable
- Used to record a data of odour in air quality
- Collect the data and do comparison for analysis

1.3 STATEMENT OF THE PURPOSE

The aim of this project is to make it easy to use low-cost and higher-performance chemical sensors. As the pattern recognition and classification algorithms progressed. At the same time, these technologies were joined together with low-power Arduino microprocessors, enabling devices to be portable. The MQ sensor has been the core structure of this equipment and a few types of it with a different classified, also in this project is to design & develop of a smell detector using Arduino concept. This device has been designed and developed by the MQ sensor as the core structure, and a few types of MQ with a different classification are also involved with this project.

1.4 PROBLEM STATEMENT

- No method of finding an air quality level
- The design of the device such as air intake needs to be improved on how an air can detect the sensor.
- Need to make the flexibility and versatile device for user
- Choose the best sensor types, power and display for this project
- To convert and chemical substance to electrical output

The problem statement is to create the portable product that can be portable to detect the quality of the air level, because in Malaysia don't have own olfactometers device which is hard to get such device and finding the suitable method of specific in monitoring air quality level. With this product it will be easier to solve the problem about some smell that disturbing in some places such as neighbouring and workplace.