



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Development of Arduino Based Alert System for Heat, Flame
Detector and Gas Leakage**

This report is submitted in accordance with the requirement of the Universiti
Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering
Technology (Computer System) with Honours

by

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ABSTRAK

Pada masa kini, banyak kemalangan sering melibatkan kebakaran di mana ia boleh membawa kepada kerugian yang besar, di antaranya adalah disebabkan oleh kecuaiannya pengguna yang lupa untuk mematikan gas atau dapur elektrik di dapur. Selain itu, kebocoran gas sering diabaikan di mana ia boleh menyumbang kepada kehadiran bahaya. Tambahan pula, peningkatan suhu haba semasa memasak juga boleh menyebabkan kebakaran atau letupan besar. Ia adalah sangat berisiko terutamanya bagi pengguna yang jauh dari rumah mereka. Oleh itu, pembangunan amaran berdasarkan Arduino untuk api, haba, dan gas LPG direka untuk menghalang sebarang aktiviti yang boleh menyebabkan kebakaran atau bahaya kepada nyawa dan harta benda. Sistem ini membentangkan 3 tahap pengesanan unsur sensitif, yang pengesanan pertamanya melibatkan kebocoran kepekatan gas dengan menggunakan pengesanan gas. Kedua, pengesanan yang boleh mengesan haba tinggi suhu bilik dengan menggunakan pengesanan haba. Ketiga, pengesanan yang boleh mengesan kehadiran api dengan menggunakan pengesanan api. Sistem amaran ini digabungkan bersama-sama untuk membuat ia bergabung baik dan bersepadu antara satu sama lain untuk melaksanakan satu peranti projek. Apabila sistem mengesan unsur sensitif ini secara langsung memberi isyarat kepada pengguna melalui SMS dengan menggunakan modul GSM dan juga julat pengesanan (gas, haba, api) dipaparkan dalam antaramuka grafikal dengan menggunakan perisian Pemprosesan (PDE). Semua sistem amaran pengesanan ini dikawal oleh Arduino mikropengawal dan sistem ini mempunyai ciri-ciri tambahan seperti LCD, LED, dan buzer yang menunjukkan status amaran kepada pengguna.

ABSTRACT

Nowadays, many accidents often involved fires where it can lead to a great loss, which among them is caused by the carelessness of the consumer who forgets to turn off the gas or an electric stove in the kitchen. Besides, a gas leakage is often ignored somehow it can contribute to the presence of danger. Moreover, the increasing of temperature heat while cooking also can cause a fire or huge explosive. It is very risky especially for a consumer that away from their home. Thus, a development of Arduino based alert for flame, heat, and LPG gas is designed to prevent any activity which can cause a fire or harm to lives and properties. This system presents 3 section of detection of sensitive element, which the first detection involved the concentration of gas leakage by using a gas sensor. Second, detection that detected overheat of room temperature by using heat sensor. Third, detection that sensed a presence of a fire by using a flame sensor. This alert system combined together in order to make it integrated with each other to perform one project devices. When the system detected this sensitive element it directly alerts the consumer through SMS by using the GSM module and also displayed the range detection (gas, heat, flame) in the graphical user interface by used the Processing (PDE) software. All of this detection alert system was controlled by Arduino microcontroller and this system has an added features which are LCD, LED, and buzzer that indicate a warning alert status to the consumer.

DEDICATION

Every challenging work needs self-efforts as well as guidance of elders, especially those who were very close to our heart. My humble effort I dedicate to my sweet and loving

Father & Mother,

Whose affection, love, encouragement and prayers of day and night make me able to get such success and honors,

Along with all hardworking and respected

Lecturers

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TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	v
List of Table	ix
List of Figures	x
List Abbreviations, Symbols and Nomenclatures	xiii
CHAPTER 1: INTRODUCTION	1
1.1 Overview	1
1.2 Problem Statement	2
1.3 Objectives	3
1.4 Project Scope	3
1.5 Project Outline	4
CHAPTER 2: LITERATURE REVIEW	6
2.1 Introduction	6
2.2 Background	6
2.3 Related Studies	7
2.3.1 A Wireless Home Safety Gas Leakage Detection System	7
2.3.2 Development of Fire Alarm System using Raspberry Pi and Arduino Uno	9
2.4 Theory of components	11
2.4.1 Hardware	11
2.4.1.1 Sensor	12

2.4.1.1.1	Flame Sensor	12
2.4.1.1.2	Gas Sensor	13
2.4.1.1.3	Heat Sensor	15
2.4.1.1.3.1	LM 35	15
2.4.1.1.3.2	DHT 22	16
2.4.1.2	Arduino Microcontroller	17
2.4.1.2.1	Arduino Mega	18
2.4.1.2.2	Arduino Due	19
2.4.1.2.3	Arduino UNO	20
2.4.1.2.3.1	Power	22
2.4.1.2.3.2	Memory	23
2.4.1.2.3.3	Input and Output	23
2.4.1.3	GSM Module	25
2.4.2	Software	26
2.4.2.1	Arduino Software (IDE)	26
2.4.2.2	Fritzing	27
2.4.2.3	Processing User Interface (GUI)	28
CHAPTER 3: METHODOLOGY		31
3.1	Introduction	31
3.2	Flowchart of Project Development	31
3.3	System Architecture	34
3.4	Development Flow of Project Hardware	35
3.4.1	Heat Detector Module Process	36

3.4.2	Gas Detector Module Process	37
3.4.3	Flame Detector Module Process	38
3.5	Costing and Budget of Project	40
 CHAPTER 4: RESULT AND DISCUSSION		41
4.1	Introduction	41
4.2	Development Phase	42
4.2.1	Implementation Program Code	42
4.2.2	Hardware Connection	47
4.2.3	Final Hardware Connection	49
4.3	Test and System Program Description	51
4.3.1	GUI Output	54
4.4	Results	55
4.4.1	Testing Phase 1 (Heat Sensor)	55
4.4.2	Testing phase 2 (Gas Sensor)	56
4.4.3	Test phase 3 (Flame Sensor)	58
4.5	Discussion	59
 CHAPTER 5: CONCLUSION AND RECOMMENDATION		61
5.1	Conclusion	61
5.2	Future Improvement	62
5.3	Commercialization Potential	62
 REFERENCES		63

APPENDICES	68
A Source code Arduino	68
B Source Code Processing	71
C Pin layout for Arduino Uno board	73
D Arduino UNO Schematic Diagram	74
E SIM900A GSM Module Hardware Specification	75

LIST OF TABLES

2.1	Power pin of Arduino UNO	23
3.1	List Component and Costing of Project	40
4.1	Pin connection of Arduino UNO and Components	48
4.2	Testing Increasing of Heat with Box A	55
4.3	Testing Increasing of Heat with Box B	56
4.4	Testing Concentration of Gas Leak with Box A	57
4.5	Testing Concentration of Gas Leak with Box B	57
4.6	Result Presence of Flame with different Distance	58

LIST OF FIGURES

2.1	The Block Diagram Transmission Module of Wireless Gas Leakage Detection System	8
2.2	The Block Diagram Receiver Module of Wireless Gas Leakage Detection System	8
2.3	A wireless Gas Leakage Detection System Prototype	9
2.4	Block Diagram of Fire Detection Development System	10
2.5	The Capture Image from a Webpage	10
2.6	IR Infrared Flame Sensor Detector	13
2.7	The Specification for Flame Sensor	13
2.8	MQ-2 Gas Sensor Module ¹	14
2.9	The Features of Specification for Gas sensor	14
2.10	Heat LM35 Sensor	15
2.11	Description Pin of Heat LM35 Detector	16
2.12	DHT 22 Humidity Sensor	16
2.13	Specification of DHT 22 Humidity Sensor	17
2.14	The Arduino Mega256 Board	18
2.15	Specifications of Arduino Mega	19
2.16	The Arduino Due Board	20
2.17	The specifications of Arduino Due	20
2.18	The Arduino Uno Board	21

2.19	The specification features of Arduino UNO	22
2.20	Schematic Pin I/O of Arduino Uno	24
2.21	The SIM900 GSM Module	25
2.22	The features of GSM Module	25
2.23	The Symbol of Arduino IDE	26
2.24	Example of Arduino IDE	27
2.25	Example Project of Fritzing Application	28
2.26	Example of Project using Processing Application.	29
2.27	Output Display of Processing Application	30
3.1	Flowchart of Project Development	32
3.2	System Block of Development Alert System for Detecting a Flame, Heat and Gas Leakage	34
3.3	Flowchart for Design Development of Heat Detector	36
3.4	Flowchart for Design Development of Gas Detector	38
3.5	Flowchart for Design Development of Flame Detector	39
4.1	The library that used in Program Code into Arduino Uno	43
4.2	Pin definitions of the Hardware	44
4.3	The condition of Gas Sensor Detection	45
4.4	The condition of LM35 Heat Sensor Detection	45
4.5	The condition of Flame Sensor Detection	46

4.6	AT command at GSM module	46
4.7	Simulation at the breadboard in Fritzing Software	49
4.8	Real Hardware Connection at the Breadboard	49
4.9	The Final Process of Hardware Connection	50
4.10	Data serial monitor if NO Increasing of Heat	51
4.11	Data at serial monitor for Increasing of Heat	51
4.12	LED Yellow ON – Increasing Heat	51
4.13	Data serial monitor if NO Gas Leaking	52
4.14	Data at serial monitor for Gas Leaking	52
4.15	LED Orange ON – Gas Leaking	52
4.16	Data serial monitor if NO Flame Detected	53
4.17	Data at serial monitor for Flame Detected	53
4.18	LED Red ON – Flame Detected	53
4.19	Output of Interface	54
4.20	Code used to Connected the Arduino IDE and GUI	54
4.21	Analyses testing using Box A	57
4.22	Analyses testing using Box B	58
4.23	Analyze Flame Sensor with Different Distance	59

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

3D	-	Three Dimensional
AC	-	Alternative Current
AO	-	Analog Output
AT	-	ATtension
AVR	-	Automatic Voltage Regulator
CPU	-	Central Processing Unit
DAC	-	Digital-Analogue-Converter
DC	-	Direct Current
DO	-	Digital Output
IDE	-	Integrated Development Environment
EEPROM	-	Erasable Programmable Read-Only Memory
FTDI	-	Future Technology Devices International
GND	-	Ground
GPRS	-	General Packet Radio Service
GSM	-	Global System for Mobile Communication
GUI	-	Graphical User Interface
Hz	-	Hertz
ICSP	-	In Circuit Serial Programming

IDE	-	Integrated Development Environment
IR	-	Infrared
KB	-	Kilobyte
KHz	-	KiloHertz
LCD	-	Liquid Crystal Display
LED	-	Light Emitted diode
LPG	-	Liquid Petroleum Gas
mA	-	Milliampere
MHZ	-	Megahertz
MYR	-	Malaysian Ringgit
OS	-	Operating System
PDE	-	Processing Development Environment
PSM	-	Projek Sarjana Muda
RF	-	Radio Frequency
RFID	-	Radio frequency identification
RX	-	Receive
SIM	-	Subscriber Identity Module
SMS	-	Short Message Service
SPI	-	Serial Peripheral Interface
SRAM	-	Static Random Access Memory
TX	-	Transmit
TTL	-	Transistor-Transistor Logic

UART	-	Universal Asynchronous Receiver/Transmitter
USB	-	Universal Serial Bus
UV	-	Ultraviolet
V	-	Voltage
VCC	-	Collect Supply Voltage

CHAPTER 1

INTRODUCTION

1.1 Overview

In the terms of electronic devices, the sensor is defined as a device that accepts and reacts to a signal or stimulus. The operation of the sensor is reacting to receive the input physical property and converting it to an electrical signal to make it compatible with electronic circuits. In this decade, it is normal for every household to have a fire alarm detector along with advances in rapid technology. The development of alarm systems technology brings to the invention of a gas sensor, heat sensor and flame sensor that give many benefits to human life especially cases that related to a fire. Furthermore, most explosion cases happen that caused by improper handling, accidental damage of gas installations or release of gas installation that proposed for natural gas in the household. In order of that, the concentration of gas leakage should detect by a gas detector about 5% which it is far lower of explosion limit. (*Rrp 2008*)

In other countries, various types of a gas alarm system which can be bought with a cheaper price but most of the devices are not based on any quality standard. That is because the technology of other kitchen appliance like an electric stove was no longer use a natural gas as an energy source and due to the latest technology of kitchen cooktop an electric stove like the induction cooktop. It is increasingly well among consumers because of green technology that provides a momentum based on speed, safety, and efficiency. This may lead to an issue of gas detector capability which is an outdated technology. Thus, a study was conducted to solve the problem by making a development system of Arduino based alert system for flame, heat detector, and gas leakage. It is a

system development that detects a gas leakage and presence of fire through any increasing of heat changes by sending an alert message to the consumer. (Jacob Fraden, 2004)

1.2 Problem Statement

The LPG is a mixture hydrocarbon gases that used as a fuel in many applications such as homes, hostels, industry, automobiles and vehicles because it produces less smoke, produces less soot, and does not cause any harm to the surrounding environment. The natural gas is another types of fuel that are widely used in homes. Both of this gases is burned to generate a clean energy, but there is a serious issue about their leakage in the air. This gases is heavier than air and it does not disperse easily where it can cause an explosion when a gas leak in the air and the number of deaths has increased since the past few years, due to the explosion of LPG gas issue. Besides, the carelessness of consumer also contributes to the presence of danger. For example, in a situation where the housewife is suddenly busy doing something else while cooking and she forgets to turn off the gas in the kitchen stoves.

Next, the logistic problem such as less maintenance of gas pipeline, which also can lead the leakage of gas to a danger level of an explosive where the gas pipeline should be inspected at least once every three months. Furthermore, the use of electric stoves also contributes the danger of fire, because as everyone knows, electric stoves do not use a natural gas but electric energy as an energy source for cooking. So, in a situation if the consumer forgets to turn off the switch button of electric stoves it will cause the room temperature overheat and an increase of the heat dramatically where it also contributed to energy waste and electric bill increased. Lastly, for a situation where fire has occurred in the restaurant or house that were no people around it. This proposed system also sends an alert SMS directly to the user and displayed the range detection of sensitive elements (gas, heat, flame) in the graphical user interface by used the Processing (PDE) software. Thus, to avoid this problem cause from the fire, the alert system should distinguish and prevent this accident of fire from occurring.

1.3 Objective

The objectives of this project are:

- I. To study how the 3 features of sensor convert from sensitive element to electrical signal.
- II. To develop an integrated LPG leakage, heat and flame detector alert system based on Arduino microcontroller.
- III. To analyse the performance and functionality of the project system.

1.4 Scope of Project

The scope of this project is to understand the basic concepts of Arduino by doing a research and study in detail the operation of Arduino. This Arduino board was a microcontroller that acts as a program core in this system project and runs this system by implementing a C++ language as a platform for the program. Besides that, study the operation of combination three sensors that used in this project which is the gas sensor, heat sensor and flame sensor for a better understanding. This project also sends an alert by SMS through the GSM module and displayed the range of detection in the graphical user interface by used the Processing (PDE) software if have a presence of increasing heat, gas leakage and occurrences of fire.

Furthermore, this project needs to build and construct as a circuit by using the Frizzing application. Next, gather all the electronic components that will be used in this project by connecting it all into the Arduino board like the gas sensor, flame sensor, heat sensor, GSM, buzzer and others electronic parts. Moreover, prepare the case of flame, heat detector, and LPG gas leakage then makes a testing especially the hardware part where the circuit needs to be tested in the breadboard. It is to avoid and detect any misconduct or an error before making in a strip board. Lastly, make an analysis by executed the program code design in Arduino for verifying its functionality and reliability with the three detectors to obtain the desired result. Both hardware and software part have

to ensure no error and any improvements that can be added in this project and write a report that explains all the process in this project.

1.5 Project Outline

This report contains five chapter that explains detail about the development of Arduino based on an alert system for a heat, flame detector and gas leakage. The chapters included as follows:

Chapter 1: Introduction

Chapter one introduces the general understanding of detector based on an alert system that detects any presence of flame or fire, increasing of heat temperature and leak of gas that can cause a danger and a huge explosive. Where it gathered all the steps and method to gaining the successful of this project. It also provides an overview and problem statement that need to be solved in this study. Besides that, it also includes the goals or objectives, the scope of a project in carrying out the research and the contribution of this study.

Chapter 2: Literature Review

Chapter two introduces the literature review, which summarizes the whole literature and sources like journals, books, articles, and periodicals. The related theory of the study and the previous outcomes based on some related sources are written down in this chapter.

Chapter 3: Methodology

In chapter three, it covers for methodology part which it will briefly explain both of the hardware and software operations through the designing flowchart. Also, a detailed description of the methodology of the project flow includes the suitable microcontroller and detector used and how to implement the program by using simulation software.

Chapter 4: Result and Discussion

Chapter four presents and discusses experimental results and data analysis of this research project.

Chapter 5: Conclusion and Recommendation

In chapter five, the major findings have been agreed or disagreed to the objective are concluded. The discussions, conclusions, appendix, references and some attachment will be included together. Finally, the recommendations are suggested for the further improvement of the project development.