



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND FABRICATE THE FIRE PREVENTION SYSTEM  
MODULE USING ARDUINO**

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Bachelor of Mechanical Engineering Technology (Refrigeration System and Air  
Conditioning) with Honours.

2019

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Design And Fabricate The Module Of Fire Prevention System Using Arduino**

SESI PENGAJIAN: **2019/2020 Semester 2**

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**DESIGN AND FABRICATE THE FIRE PREVENTION SYSTEM  
MODULE USING ARDUINO**

**ONG THIAN CHYE**

**This report submitted of the fulfilment of the requirements for the Bachelor of  
Mechanical Engineering Technology (Refrigerant and Air-Conditioning) with Honors**


**Faculty of Mechanical and Manufacturing Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2019**

## DECLARATION

I declare that this thesis entitled "Design and Fabricate the module of Fire Prevention System Using Arduino" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature : 

Name: Ong Tian Chye

Date: 16 December 2019

## **APPROVAL**

This report is submitted to the Faculty of Mechanical and Manufacturing of Engineering Technology of UTeM as partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology ((Refrigeration System and Air Conditioning) with Honours. The member of the supervisory is as follow:

Signature: \_\_\_\_\_

Supervisor Name: Muhammad Nur Bin Othman

Date:

## **DEDICATION**

This thesis is dedicated to my family, my supervisor and my friend, who always has the support and helping me to complete my thesis and project. Besides that, also willing to use their time to share their knowledge with me. All the knowledge could overcome my problem and enable me to complete my studies and make me more confident in achieving my dreams.

## **ABSTRACT**

This report presents the design and fabrication of fire prevention system modules using Arduino. The cause of fire is that the fire extinguisher system is not working perfectly or the fire extinguisher system is not too advance. Because of the fire burning, many of the facilities, property, and lives of people were lost in the incident. Furthermore, fires can also cause job loss, threaten the stability of the country's economy and even cause loss to an individual or an agency. In the event of a fire, the existing system will only be able to extinguish the fire and provide an internal warning. Because of this, fire alerts are not reach to people who have property if the person is not at the situation. Thus, the fire prevention system module using Arduino was developed. The goal of this project is to build a system that can send long-distance alerts in the situation of a fire. The system uses two sensors, namely, fire sensor and smoke sensor. The two sensors need to be integrated with the Arduino Uno board so that the Arduino Uno can control the PC fan and damper. The A6 GSM module is also used because it can send messages to smartphones when the sensor detects an object. Finally, the system is able to detect fire and smoke. The damper closes when the detector sense an object. When an object is detected, the message is sent to the smartphone.

## ABSTRAK

*Laporan ini membentangkan tentang menghasilkan reka bentuk dan fabrikat modul sistem pencegahan kebakaran menggunakan Arduino. Punca kebakaran adalah sistem alat memadam api tidak berfungsi dengan sempurna atau sistem alat pemadam api tidak cukup canggih. Oleh kerana pembakaran berlaku, kebanyakan kemudahan, harta, dan nyawa manusia pon terkorban dalam kejadian. Seterusnya, kebakaran juga mampu menyebabkan kehilangan pekerjaan, mengugat kestabilan ekonomi negara dan juga menyebabkan kerugian kepada seseorang individu atau sesuatu agensi. Apabila berlaku kebakaran, sistem yang sedia ada hanya mampu memadam api dan memberi amaran dalaman sahaja. Disebabkan itu, amaran kebakaran tidak disampaikan pada orang memiliki hartanya jika orang tersebut tidak di tempat kejadian. Maka, modul sistem pencegahan kebakaran menggunakan Arduino dihasilkan. Maklumat projek ini adalah membina sebuah sistem yang boleh menghantar amaran berjalak jauh apabila berlaku kebakaran. Sistem ini menggunakan dua pengesan, iaitu, pengesan api dan pengesan asap. Dua pengesan tersebut perlu bergabung dengan Arduino uno board supaya Arduino uno mampu mengawal motor dan alat penghadang api. A6 GSM model juga digunakan kerana boleh mengantar mesej kepada smartphome. Akhir sekali, sistem ini mampu mengesan api dan asap. Alat penghadang api tutup apabila pengesan menggesan sesuatu objek. Apabila objek dikesan, mesej akan hantar ke telefon pintar.*



## **ACKNOWLEDGEMENT**

Firstly, I would like to express my sincere gratitude to my supervisor Encik Muhammad Nur Bin Othman for the continuous support me along doing my Bachelor final year project and also his patience, motivation, and immense knowledge. His guidance helped me in all the time of doing this project to let me complete this project. I also could not have imagined having a better supervisor and mentor for my Degree study at University Teknikal Malaysia Melaka.

Besides my supervisor, I very thank my fellow friend for the give an idea and helping me, for the sleepless nights we were working together with each other before deadlines, and for all the fun we have had in the last four years at University.

Last but not least, I would like to thank my family for supporting me spiritually throughout writing this thesis and my life in general.

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## LIST OF ABBREVIATIONS

HVAC	-	Heating, Ventilation, and Air Conditioning
PV	-	Photovoltaic
LED	-	Light Emitting Diode
AHU	-	Air Handling Unit
IR	-	Infrared
ASIC	-	Application Specific Integrated Circuit
A/D	-	Analog / Digital
s	-	second
UV	-	Ultraviolet
°C	-	Celsius
CPU	-	Central Processing Unit
IC	-	Integrated Circuit
I/O	-	Input / Output
ICSP	-	In-Circuit Serial Programming
PWM	-	Pulse Width Modulation
UART	-	Universal Asynchronous Receiver Transmitter
TTL	-	Transistor-Transistor Logic
IDE	-	Integrated Development Environment
VESDA	-	Very Early Smoke Detection Apparatus
CAD	-	Computer-Aided Design
CFD	-	Computational Fluid Dynamics
PH12	-	Nylon powder
GSM	-	Global System for Mobile Communications
GPRS	-	General Packet Radio Service
IoT	-	Internet of Things
m/s	-	Meter per second

## CHAPTER 1

### INTRODUCTION

#### 1.0 INTRODUCTION

Based on the fire safety of ventilation systems, the most significant is to protect lives and valuable assets and to ensure great working conditions for the rescue team. A fire must be constrained before it forms into a debacle. Most to protect lives, yet additionally, huge qualities might be lost. The prerequisites for individual safety and the crisis reaction limit are all-around firmly connected to the danger of the fire spreading and stability of the structure. Strategically, this means that in case of a fire, persons must be able away from hazard by themselves or with help from the rescue team. In the structures, particularly stock, contain a measure of flammable material. Right fire security of ventilation systems can prevent heat and smoke from spreading through the ventilation systems. For instance, a too early destabilization of the building occurs, a breakdown can cause a debacle danger of a critical size. Fire safety in ventilation plants is along these lines vital in present-day structures by (Units et al. n.d.).

The fire prevention system is used to prevent the fire. (Seventh Edition - December 2015 2015) Stated that the fire prevention system is to provide an environment for occupants that is reasonably safe from fire and products of combustion. Next, to provide a reasonable level of building usability and property protection from the effects of fire and products of combustion. (Cao and Xue 2013) Stated that high performance of fire prevention system can solve many problems related with prior art system. Fire prevention

system is using the combination of chemical or wet material to extinguishing. Nowadays, a lot of fire prevention system has already applied to every multilevel building or factories. Fire prevention system has many types, which is a fire alarm, fire damper, fire sprinkler, and smoke detector. All of the fire prevention systems has its function.

In this project, the module of fire prevention is to fabricate. This project is a part of a Heating, ventilation, and air conditioning (HVAC) system to prevent the safety of human firm the fire and product combustion. This module has controlled by the Arduino UNO board. The flame sensor uses to detect the fire. Arduino UNO board will have programmed by using Arduino software. C programming was used.

This project using fire damper, a flame sensor for fire prevention system. (Selection 1998) Stated that dampers in HVAC system direct the progression of air either by balancing or two-position control. They are regularly associated with actuators by linkages and work because of pneumatic, electric, or electronic control signal. In principle, the use of dampers in HVAC system intently parallels that of control valves. The fire damper is used to reduce the fire through the building air distribution system based on author (Grondzik and Furst 2000). Damper use to control the airflow, either to balance the airflow throughout the order or to adjust airflow in response to change building load according to the author (Grondzik and Furst 2000). It can slow down the fire to get next level, especially at the multilevel building. Then the flame sensor uses to detect the spark fire.

## **1.1 PROBLEM STATEMENT**

Fire prevention system is a part of the HVAC system. Fire prevention is very important in building. Mehta and Reddy 2015 also stated that the fire prevention system is the most important thing to control the safety and functionality of factories, multilevel building, hotel, and many more. Every place has a deal with hazard which can harm human

life, asset, and so on. From the Mehta and Reddy 2015 also stated that all of the places are always bare to hazard, such as fire, electric sort, explosive which can cause and harm the life of human, property, and surrounding. Without the fire prevention system, it may lose many lives of human and people. Currently, the ventilation module was created to test the wind tunnel that stated by the author (Sacht et al. 2016). The module placed on different position of the window to check the wind speed. Next, the prototype of an expert system was developed to perform calculations associated with the development of fire in buildings, evacuation of people, fire service interventions and structural safety. This system is work on a web developed by SGSP that mentioned by the author (Tofiło et al. 2013). Furthermore, photovoltaic (PV) module fire reaction was created. It used to test the fire hazard (Manzini et al. 2015). Based on the all module was created before, it is not used to prevent the fire and safety; it only uses to test and study. Next, all of the module created; it cannot communicate with the smartphone. Besides that, the existing fire prevention system is costly and need a large area to install the system. So, fire prevention module is to fabricate. It only uses for learn and to understand how was that system work and can function like a real system that was applied on industries, multi-story building or any place related to fire and also can send a message to a smartphone.

## **1.2 OBJECTIVES**

From this project, it created using the Arduino board to receive the signal from the sensor and send the information to the control panel. There are few objective as shows:

- Design the fire and smoke detection system using Arduino.
- Analyse the assembly of fire smoke detection system and ducting module.
- Able to send message to smartphone when sensor detect an object.

### **1.3 SCOPE OF PROJECT**

The scope of the project included the following areas:

The scope of this project is to fabricate the module of the fire prevention system. The ducting material is use nylon powder (PH12) and will print out by 3D printer and the acrylic material used to create the casing. The rectangular duct creates to let the airflow flow to the outlet. The pc fan is used to produce airflow. The whole system is run with Arduino UNO Board, flame sensor and smoke sensor. The sensor is used to detect the fire and smoke. The damper has used for fire prevention system and control the airflow. The buzzer uses as an alarm system, and the LED light is used to show the signal when the sensor detects the fire or smoke. A6 GSM module uses to send a message to the smartphone. This module of the fire prevention system only uses to test and understand how it functions. Lastly, this fire prevention system module cannot detect wide range, smoke rejection, and fire extinguishers.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 INTRODUCTION**

In this chapter, is to discuss the component and the theories are related to this project. A lot of journals, article, website, and the book was studied to get more information about this project. To complete this project, knowledge and handwork skill are required.

#### **2.1 HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM**

In the early 1900s, Dr Willis H. Carrier has created air conditioning, or more specifically, heating, ventilating, air conditioning, and refrigeration (HVAC&R) based on author (S. K. Wang 2001). Author (S. K. Wang 2001) also stated that air conditioning is a process from heating and cooling that performs many operations simultaneously. It provides the air, delivers it, and send it to the conditioned space. It provides heat and cooling from its central plant or rooftop units. It also controls and maintains the temperature, humidity, air movement, air cleanliness, sound level, and pressure differential in a space within predetermined according to the author (S. K. Wang 2001). Author (S. K. Wang 2001) and (Systems 2012) stated that the aim of the heating, ventilating, and air conditioning (HVAC) system is to produce and maintain a comfortable environment within a building. HVAC system not only provides air conditioning on structure, but also on vehicle, aeroplane, and ships. Based on the type of transportation above, each has its air conditioning system. From the Heating, Ventilation and Air

Conditioning system have any kind which is AHU, split unit, Unitary based system, chilled water system, all air system, all water system, and many more.

### **2.1.1 FIRE SAFETY OF VENTILATION SYSTEM**

Fire safety is an important contribution to feeling safe, and an important criterion for the choice of building materials was mentioned by (Östman, Brandon, and Frantzich 2017). A façade is the part of a structure that structures the essential warm boundary with its condition. It speaks to the most significant factor for the determination of the feeling of warm comfort, daylighting and ventilation and amount of energy required for the heating and cooling of the situation (Sacht et al. 2016). The ventilation effect base on The places of window openings is significant parameters for the investigation of the adequacy of wind-driven cross-ventilation in structures. Next, ventilation altogether impacts on a few significant human reactions and speed of indoor air is characterized by elements, for example, physiological comfort, type of structure and use. In such a building, a natural ventilation system is not suitable for applications when a fire occurs. The mechanical ventilation system has not been indicated as a vital establishment for such structures in the pertinent plan determinations. Then, a hybrid ventilation system can effectively confine smoke (Z. Wang et al. 2019).

Marketed fire safety system exists with fire control boards or servers, which make a move consequently after a holding time reliant on this verity of the alarm (Lee et al. 2013). The parameters of fire safety of ventilation system control the longitudinal velocity of the air, smoke control, smoke detection, fire detection that mentioned by the author (Barbato et al. 2014).