



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF HVAC DAMPER TEMPERATURE  
CONTROLLER USING ARDUINO**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (ELECTRONICS & COMPUTER ENGINEERING TECHNOLOGY) (Hons.)

by

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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

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ARDUINO

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## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of the degree of Bachelor of Engineering Technology Electronic Telecommunication with Honours. The member of the supervisory is as follow:

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(MOHD. KHANAPIAH BIN NOR)

## **ABSTRAK**

Sistem pemantauan dan pengendalian HVAC adalah bahagian kecil tetapi penting dalam sebarang aplikasi perindustrian. Meningkatkan permintaan untuk penggunaan HVAC adalah motivasi utama di belakang projek ini serta bagaimana mereka menggunakan HVAC dengan cara yang tidak sesuai yang membuat orang tidak selesa. Ciri utama projek ini adalah mengenai perancangan prototaip HVAC dengan sistem kawalan dan kawalan kos efektif dan injap yang boleh dipercayai untuk mengawal aliran udara. Terdapat tiga modul utama projek. Yang pertama ialah mengawal injap / peredam (motor) yang terdiri daripada motor servo dipasang pada injap, kedudukannya yang diperlukan. Yang kedua ialah pemantauan suhu HVAC yang terdiri daripada sensor suhu Thermistor untuk merasakan suhu dan menghantar bacaan ke komputer. Dan yang ketiga adalah mengenai sistem pemantauan dan pengendalian HVAC yang boleh mengawal dan memantau dengan butang langkah.

## **ABSTRACT**

The HVAC monitoring and handling system is a small but important part of any industrial applications. Increasing the demand for HVAC use is the main motivation behind this project as well as how they use HVAC in inappropriate ways that make people uncomfortable. The main feature of the project is about planning HVAC prototypes with effective cost control and control systems and reliable valves to control airflow. There are three main modules of the project. The first is to control the valve / damper (motor) composed of servo motor mounted on the valve, its required position. The second is about HVAC temperature monitoring which consists of Thermistor temperature sensors to feel the temperature and transmit the reading to the computer. And the third is about the HVAC surveillance and handling system that can control and monitor by step button.

## **DEDICATION**

All the effort is dedicated to my beloved parents, family lecturers and friends, whose love can never be forgotten for their support, guidance and encouragement upon completing this project and report.

Special dedication to my parents

**ABD. KADIR BIN SARING**

**JURIAH BINTI MOHAMAD**

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## LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

HVAC	-	Heating, ventilation and air conditioning
PC	-	personal computer
CNC	-	numerical control computer applications
F	-	temperature
RH	-	humidity
Gpm	-	flow
AHU	-	Air Control Unit
NTC	-	Negative Temperature Co-efficient
PTC	-	Positive Temperature Co-efficient
NTC	-	Negative Temperature Co-efficient
USB	-	Universal Serial Bus
C	-	Celsius

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 PROJECT BACKGROUND**

. HVAC is a type of mechanical engineering based on the principles of thermodynamics, fluid mechanics and heat transfer. HVAC is an integral part of residential structures such as houses, apartment buildings, hotels, convenient for industrial buildings and large offices such as skyscrapers where safe and healthy regulated building conditions relate to temperature even for humidity to use fresh air from outside the house. Before the creation of this system, three elements are usually divided between three or more devices.

Control system is a system that can handle, instruct, direct or control the behavior of other devices or systems that we control the behavior or characteristics of the device or system. Mastascusa (1999) says that when controlling the system, the first known thing is the system it wants to operate and how it works. Control / damper valves are an important part of HVAC airflow control. The control valve (damper) is something that we can adjust or control airflow to get what we want desired. In this case, valve area must turn to get the airflow accordingly. So, proper airflow must be adjusted using the valve (damper) to ensure the flow of air in the right valve.

The monitoring system can be described as a set of strategies to control the course of data through an association with the various levels of administration with the specific goal of improving basic learning. The system needs to authorize the following information is subjective and clear quantitative and data interpretation to the benefit administration Monitoring applications require information such as log file path and number of threads to run. Once the application is running, it needs to know what to monitor, how to monitor and conclude. Because configuration data for monitors to what is required in other areas of the system, such as usage, configuration data can not be customized specifically for use by system monitors, but should be a common system configuration model

The monitoring system is essential for reducing electricity consumption. To reduce any, shall have to monitor the problem. For HVAC monitoring system, it can only use the temperature monitoring system for HVAC is about air conditioning. This is because if someone who works at night, so it does not require too low temperature of air-conditioning as someone who works in the morning because of the weather. In order to reduce electricity consumption as temperatures in HVAC will increase the more energy is used.

The project systems run on a circuit that can control temperature readings and can collect data in real time using software capable of analyzing data in real time. Before the software can analyze data, it must have a circuit that can control the air outlet and the device can capture data from the sensor. Then the data at the output of the sensor is converted into data that computers can understand or read. Devices that can understand is the Arduino Uno. Arduino Uno is a function to convert analog signals to digital signals. The point of this project is to create HVAC systems that can control and monitor the temperature change gradually.

## **1.2 PROBLEM STATEMENT**

The problem statement contained in this project is about control in HVAC damper where it needs to be controlled to some angle for the production of the required temperature. In addition, the resulting temperature monitoring of HVAC damper angle is also important because the issue of HVAC damper is in line with the desired output temperature. The angle required for temperature control and temperature monitoring of HVAC in universities is very important because it can influence or affect the mood of students to learn. Students need a comfortable place for learning sessions as if a very hot or too cold, it makes the place was not comfortable for students to learn. The graphical user interface was developed using Arduino . Arduino can control and monitor temperature changes through the user's own personal computer (PC).

## **1.3 OBJECTIVES**

This document proposed a design of low cost monitoring and controlling HVAC. 3 major objectives must meet in this system.

- I. To develop a prototype of HVAC temperature controlling system using low cost equipment.
- II. To produce a suitable Arduino to monitor and control the changes of the temperature.
- III. To model the prototype of HVAC damper



## **1.4 SCOPE OF PROJECT**

Several scope of project is:

- I. The hardware part of controlling HVAC temperature system will be designed and development.
- II. The software for Arduino can control HVAC damper and data analysis will be develop.
- III. The sensor part should capable to monitor temperature in real time.
- IV. The working controlling and monitoring HVAC system will be tested in related industrial application.

## **1.5 OVERVIEW OF REPORT**

This thesis has five sections, which is the first chapter, an Introduction which discusses the background of the project, the objectives, the scope of the project, which is a summary of the entire work. The second chapter will discuss some of the theoretical and literature review that have been done in this project. In this chapter, the basic theory of control, basic theory of sensor, type of sensor and the function of Arduino Uno had been discussed. The process flow of the project will be discussed in Chapter 3 which is the methodology part. The second last chapter is the results and discussions part which consists of data from Arduino. Finally, the last chapter which is Chapter 5 will conclude overall of the project and future recommendation that can improve this project.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 THE THEORY OF CONTROL SYSTEM**

The control system is a system that is often used by the people today because it can manage, command, direct or control the behavior of the device or system. It may consist of home heating controller uses a thermostat to control domestic boilers to large industrial control systems used to process or machine control Various types of applications that are around us that can be found using the control system such as rocket fire, lift transport space outside the circle of the earth, the splash of cooling water, some metal is consequently machined independently driven vehicles delivering materials to workstations in flight together both plants skims along the floor looking for a destination. This is just an illustration of the system is controlled naturally that we can make.

##### **2.1.1 Control System Definition**

The control system is the interconnection of components that make up the system configuration which provide the desired system response. The basis for the analysis based system given by the linear system theory where it considers causality of the system components. Where a controlled component or process may be represented by a block, as shown in (Figure 2.1).

The relationship between the input and output relationships states which in turn represents the process of processing the signal for input to provide the signal at the output, often with power amplification.

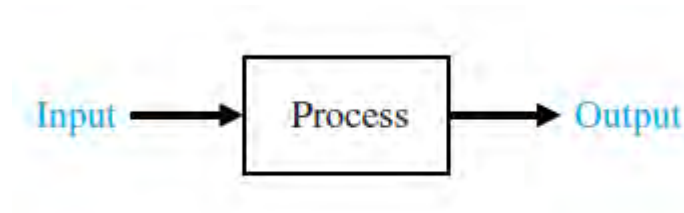


Figure 2.1. Process to be controlled.

The control system also comprises subsystems and process control purposes to attend the output of the process. For example, the furnace produces heat as a result of fuel flow. In this process, the fuel flow is input, while the output of heat to be controlled.( Figure 2.2) shows a control system in its simplest form, where the input represents a desired output.

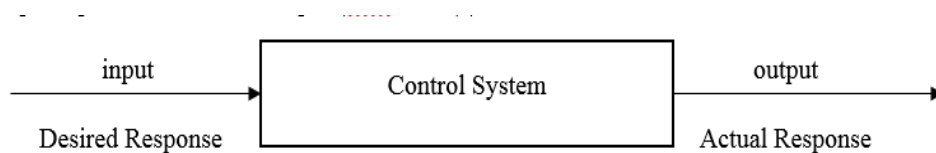


Figure 2.2: Control System

### **2.1.2 FEEDBACK CONTROL SYSTEM (Closed loop)**

The measured output quantity is called "feedback signal", and the type of control system that uses a feedback signal to both control and adjust himself called Close-loop system. By using the closed-loop system, those errors made by the disturbances can be overcome (Nise, 2011). In the closed loop control system is the feedback control system in the control system that uses the concept of open loop system as a forward path but has one or more feedback loops or the way between output and input position. Referring to "feedback", it simply means that part of the production has been restored "back" to the input to be part of an excitation system. a closed-loop system designed to achieve and maintain the desired output automatically by comparing it to the actual state. . The term 'closed loop' is also referred to as feedback control action to minimize system errors (Ogata, 2010).

It is to generate error signals which can be the difference between output and input reference. In other words, "closed loop system" is a fully automated control system where control measures depend on the problem in some way. We can see this application on traffic light system as example. In traffic lights system, in fact the computer will control the lighting sequence shown at the junction to ensure that the car does not experience an accident. In addition, the computer handles pedestrian crossings to allow pedestrians to cross the road when the button is pressed.

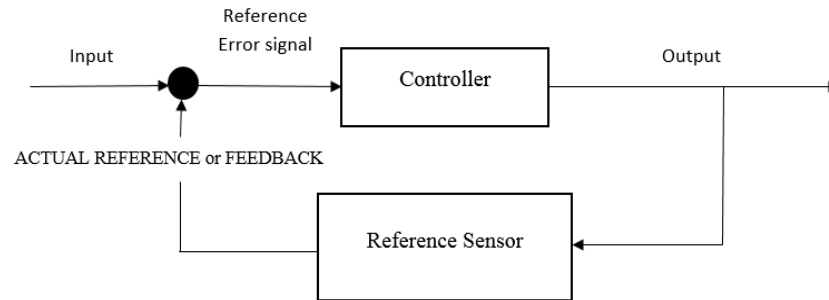


Figure 2.3: Feedback Control System Diagram

### 2.1.3 SERVO MOTOR

A DC engine is any of a class of turning electrical machines that converts electrical energy into mechanical energy. The most widely recognized examples depend on the powers delivered by attractive fields. About a wide range of DC engines have some inward component, either electromechanical or electronic, to occasionally alter the course of current stream in part of the engine.

DC engines were the main sort broadly utilized, since they could be controlled from existing direct-current lighting power dissemination frameworks. A DC engine's speed can be controlled over a wide range, utilizing either a variable supply voltage or by changing the quality of current in its field windings. Little DC engines are utilized as a part of devices, toys, and apparatuses. The general engine can work on coordinate current however is a lightweight engine utilized for versatile power apparatuses and machines. Bigger DC engines are utilized as a part of impetus of electric vehicles, lift and raises, or in drives for steel moving plants. The approach of energy hardware has made supplanting of DC engines with AC engines conceivable in numerous applications.

The immediate current (DC) engine is one of the main machines conceived to change over electrical power into mechanical power. Permanent magnet (PM) coordinate current change over electrical vitality into mechanical vitality through the cooperation of two attractive fields. One field is created by a lasting magnet gathering, the other field is delivered by an electrical current streaming in the engine windings. These two fields result in a torque which has a tendency to turn the rotor. As the rotor turns, the current in the windings is commutated to create a nonstop torque yield. The stationary electromagnetic field of the engine can likewise be wire-wound like the armature (called an injury field engine) or can be comprised of perpetual magnets (called a changeless magnet engine).

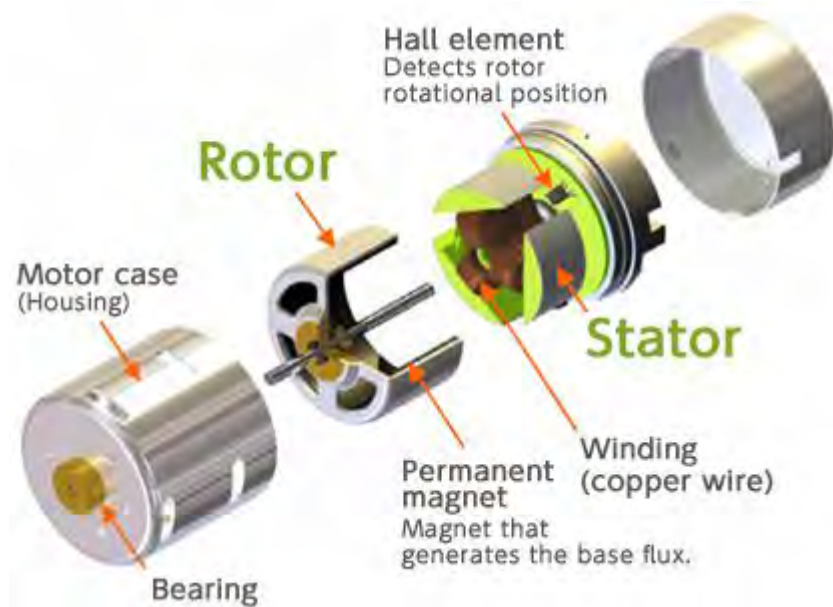


Figure 2.4: Dc motor structure

## **2.2 FUNDAMENTAL OF HVAC CONTROL**

HVAC is about physical phenomena and the control of temperature (f), humidity (% RH), flow (gpm), pressures (static channels) and air quality cold by HVAC. Sistem system is used to provide heating and cooling to the building , HVAC systems have become industry standards required for construction of new buildings. because the temperature is much easier to measure and building occupants can detect dry bulb temperature, it is the preferred choice as the control. maintaining the temperature and space of the room at a comfortable level. to control or set point value. Before the creation of this system, the three elements were usually split between three or more devices.

### **2.2.1 HVAC System**

The objective of the HVAC system is to ensure that the environment for human is safe and comfortable for human. Safety is primarily associated with Closed Air Quality, which means that indoor air must have sufficient oxygen supply and harmful toxic gas. Comfort is of course based on human perception, which can change according to the limit.

The air conditioning system works in principle when fluid can be compressed, it can "throw away" the heat it has contained in it, and when it grows it absorbs heat from its surroundings. Therefore, in turn compresses and releases liquids, can make it "absorb" heat from the building and release it outside

This system has three basic components: central crop, distribution system and heat rejection. The filtering center, also known as a cooling plant, contains a core system. This is a part that actually compresses the fluid to produce heat.

The distribution system works to circulate the "coolness" produced by air conditioning that can be dispersed throughout the building, which must be transported to the air inside the building. This is due to the fact that it is difficult to move all the air inside the building to the center of the plant, the AC planner can be used to move colder to other liquids, such as water, which then can be distributed to the units on each floor which in turn can cool the air. The equipment is called or (AHU) Air Control Unit. It can extract cold water from the plant's coolant and can cool the air into it. It's basically a tool of big fan and heat exchanger, where every cold water passes through the air. Cold water is pumped into the entire building through a protected pipeline.

The system on the distribution either distributes the coolness or collects heat from the building in two different ways to discuss the same thing, and releases the heat temperature to the air conditioning temperature which then should push into the outer atmosphere. This work has been done by the rejection unit. It can be distinguished from two types, cold air and also cold water system. cooling air on the heat system will continue to air. Therefore the air should be placed on the terrace or in places where a large amount of air is able to remove all heat. On cold water systems, heat will be transferred from the coolant to the quantity of water and then taken to the roof of the building, where heat will move upward to the atmosphere. This air cooling system has used a lot of energy but it does not use water. Cold water has been using a lot of water quantities, but it can reduce energy and even easier. Therefore, using water cooling system is easy to use.