UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Development of Automatic Air Humidity and Temperature Controller with Purifying Function Controlled by Arduino

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

by

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FACULTY OF ENGINEERING TECHNOLOGY
2017

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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 **Bachelor's Degree in Electronics Engineering Technology (Industrial Electronics) with Honours**. The member of the supervisory is as follow:

……

(Ir. Nik Azran bin Ab.Hadi)

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ABSTRAK

Cuaca panas adalah masalah yang dialami oleh manusia untuk masa yang lama. Sejak itu manusia telah lama memikirkan kaedah dan cara untuk memerangi gelombang haba dari cuaca panas. Dengan kemajuan teknologi, manusia akhirnya berjaya menyelesaikan masalah ini yang telah merisaukan kita untuk masa yang lama. Teknologi moden membolehkan kami mencipta peralatan yang menghasilkan angin sejuk seperti penyaman udara, kipas dan lain-lain untuk menamatkan kesusahan kehidupan ini. Walau bagaimanapun, masalah juga akan timbul apabila alat-alat ini tidak dikawal dengan betul. Tubuh badan manusia adalah sangat sensitif dan memerlukan suhu dan kelembapan yang optimum untuk kekal sihat. Oleh itu, evolusi manusia yang seterusnya memerlukan teknologi untuk mengawal suhu dan kelembapan secara automatik dengan menggunakan penderia suhu dan kelembapan untuk mengesan dengan tepat perubahan dalam suhu persekitaran Ini membolehkan kita senang untuk mengekalkan suhu dan kelembapan yang sesuai untuk kita. Selain itu, pencemaran udara yang semakin serius telah menyebabkan kualiti udara terjejas. Oleh itu, projek ini juga bertujuan untuk membangunkan pengawal suhu dan kelembapan udara secara automatik dengan penapis untuk meningkatkan kualiti udara. Pengawal automatik ini menggunakan penderia suhu dan kelembapan untuk mendapatkan masukan data tentang perubahan suhu dan kelembapan persekitaran. Masukan data itu akan dihantar ke mikropengawal Arduino untuk menganalisis masukan data. isyarat kawalan akan dihantar kepada penggerak seperti motor, kipas dan lain-lain untuk mengekalkan suhu dan kelembapan yaag sesuai dan optimum untuk badan kita. Penapis udara juga akan ditambah dalam usaha untuk meningkatkan kualiti udara.

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ABSTRACT

Hot weather is a problem experienced by the humans for a long time. Since then, humans have yearned for a method to combat the heat wave from the hot weather. However, with the advancement of technologies, humans finally able to solve this problem that has been troubling us for a long time. Modern technology enables us to create a device that produces an artificial cool breeze such as air conditioning, air cooler, fan and others to end the unpleasantries of life. However, another problem arises when these cooling devices are not properly controlled whether it is too cold or too hot is not suitable for the human body. The human body is very delicate and always required an ideal and optimum environmental condition to stay healthy. Therefore, the next step in the evolution of air cooling technology is the automatic temperature and humidity controller that able to accurately detect the changes in the surrounding temperature and adjust accordingly to provide and maintain the ideal and optimum temperature and humidity. In addition to the increasing air pollution, the air quality has been getting worst severely due to the increasing dust particles and air impurities. The aim of this project is to develop this automatic temperature and humidity controller with a purifying function that is cost effective and efficient in improving the air quality. The controller uses temperature and humidity sensor to obtain input data which are the surrounding temperature and humidity. The input data will be sent to the Arduino microcontroller to analyze the input data based on the program developed. Control signal will be sent to the actuator which is the motor, fan and others to produce an appropriate corrective response to maintain the temperature and humidity at the set point value. In the attempt to improve air quality, the air filter will be added to the system to filter and trap the air impurities in the air.

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DEDICATION

I would like to dedicate this project to my parents, Chin See Khoon and Haw Wai Min

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ACKNOWLEDGEMENT

First of all, I would like to take this opportunity to express my utmost gratitude to my supervisor, Ir. Nik Azran bin Ab. Hadi for his guidance in helping me complete this project. He is selfless and sacrifice a lot of his time to provide and share with me his vast knowledge and information about this project. The time we spent together discussing the project helped to spark many ideas and points of improvement to make the project better. Therefore, here I am showing my appreciation to him for his guidance, support and encouragement.

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LIST OF ABBREVIATION SYMBOLS AND NOMENCLATURE

AC – Alternating Current

ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers

°C – Celsius

DC – Direct Current

GBI- Green Building Index

HEPA - High Efficiency Particulate Air

IDE - Integrated Development Environment

ISCP - In-Circuit Serial Programming

NTC - Negative Temperature Coefficient

PID – Proportional, Integral, Derivative.

PLC – Programmable logic controller

PTC - Positive Temperature Coefficient

PWM - Pulse Width Modulation

RH – Relative Humidity

RTD - Resistance Temperature Detector

UART - Universal Asynchronous Receiver/Transmitter

USB - Universal Serial Bus

UV – Ultraviolet

VOC- Volatile Organic Components

WHO- World Health Organization

μm – Micrometer

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CHAPTER 1
INTRODUCTION

1.0 Introduction

Malaysia being an equatorial country, experience a tropical rainforest climate whereby it is hot and humid throughout the whole year. Through the advancement of technologies, countless methods and devices such as air conditioning, fan, air cooler and others had been utilized to help combat the heat wave from this hot weather. However, even though these devices are able to help us keep cool, they still do not provide the ideal and optimum temperature and humidity that is suitable for the human body. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) define this as thermal comfort whereby the body and the mind express satisfaction with the thermal environment. According to the research done by the World Health Organization (WHO), the optimum thermal condition have been internationally standardized until around 18°C to 21°C for people living in a house or building (Tiew, Si Yee 2012). However, due to geographical differences, this standard is not the same for all countries. The Green Building Index (GBI) stated that thermal comfort level that has been determined to be in the range of 23°C-26°C with an average relative humidity of 50% – 70%, which comply with the Uniform Building By Law which stated that the room temperature should be maintained at 24 °C (Tiew, Si Yee, 2012). Ir Ahmad Izdihar proposed that the indoor room temperature should be maintained in the range of 23℃ - 27℃ and the relative humidity in the range of 55% - 70% in the UBBL 2012 Amendments on EE Bylaw 38A and MS1525:2014.

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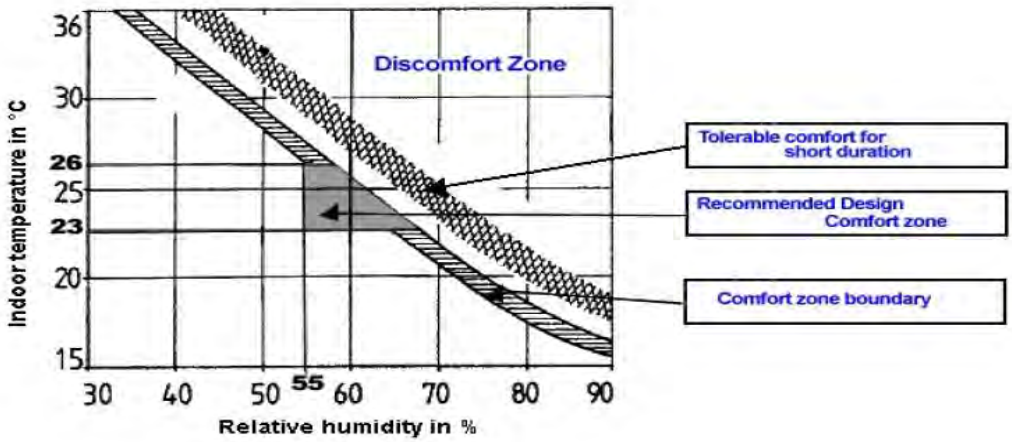

Figure 1.1: Graph of suitable thermal comfort zone (Temperature vs Humidity).
(L.Tan. (2008))

Therefore, this project aims to create an automatic temperature and humidity controller using sensors that can help to regulate the temperature and humidity automatically and accurately. Temperature and humidity control nowadays still needed to be manually adjusted by human power based on the comfort level of the individual. The development of this automatic temperature and humidity controller eliminates the need of constantly watching on the device to self-control the temperature and humidity of the system manually. Besides that, with the rise of global warming phenomenon throughout the world, an accurate temperature and humidity control system is highly needed to adapt to the increasing heat wave and the constant fluctuation of climate. Furthermore, in addition to that, various pollution of the nature contributes to the increasing air pollutant and harmful gaseous that are detrimental to human health. Hence, this project has taken consideration of this problem to incorporate an air filtration system into the temperature and humidity controller in order to improve the air quality in an attempt to create a clean and healthy environment.

This temperature and humidity control system is basically an assembly of the temperature and humidity sensor to collect input data and a series of actuator such as DC motor and fan to produce an appropriate response based on the control signal

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sent from the microcontroller after analyzing and processing the input data. It is a feedback system with a control loop, including sensors, control algorithms and actuators and is arranged in such a way as to regulate the variables which is the temperature and humidity at a set point. When the temperature and humidity exceeds or fall below the set point, control signal will be sent to the actuator to regulate the humidity and temperature until it returns back the set point value.

1.1 Problem Analysis

Temperature and humidity control system of the current cooling system mostly are controlled manually based on the individual comfort that may vary from one person to another. This is highly not accurate as each person's comfort zone are different from one another. Therefore, problems may arise as the temperature and humidity is not accurately controlled to provide a standardized ideal and optimum temperature and humidity for everyone. Besides that, constant fluctuation of the weather makes it difficult to constantly maintain an ideal and optimum temperature and humidity for the thermal comfort of the people.

Air cooling system like the air conditioning is ubiquitous in tropical countries such as Malaysia. With the rise of various global environmental problem such as global warming, the dependence on such cooling system increase in tandem with the increasing intensity of the heat wave from the hot climate. Without a proper control system, the usage of air the cooling system will not be regulated. This contributes to the increase of energy consumption of the household, which will be reflected on their monthly electricity bills.

The advancement of technologies contributed to the increasing air pollution with the emission from cars, release of chemical gaseous, and many others. This severity of the air pollution causes the deterioration of the air quality in both indoor and outdoor. These air pollutants may be poisonous and are detrimental to human health. Continuous exposure to these air pollutants, although not poisonous, will increase the chance of having health problems. Elderly, children and people with respiratory diseases will suffer a higher risk due to the air pollution. Besides that, the

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trend of having household pets will also affect the indoor air quality as they produce certain odor and the body hair may cause severe allergy to certain people

1.2 Objectives

The main objectives of this project are:

1. To develop an automatic temperature and humidity control system with sensors that will be able to accurately detect temperature and humidity without being affected by the constant fluctuation of the weather to maintain a constant and ideal temperature and humidity.

2. To save energy by controlling the ON and OFF state of the actuators according to the changes in temperature and humidity with accurate temperature and humidity control.

3. To improve the indoor air quality through an air filtration system that is specializes in filtering common air pollutant.

1.3 Scope of Work

The project focus on the development of the automatic temperature and humidity controller with a series of air filtration system. The project compromises of three major parts which are;

1. Detection System

   The temperature and humidity sensors are used to collect input data and detect the changes in the surrounding temperature and humidity.

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2. Control system

   The control system consist of a microcontroller that will analyze the input data from the sensor using certain algorithms and produce a control signal to the corresponding actuator

3. Feedback System

   The actuator such as the motor will produce an appropriate response to regulate the temperature and humidity based on the control signal sent from the microcontroller.

1.3.1 K- Chart

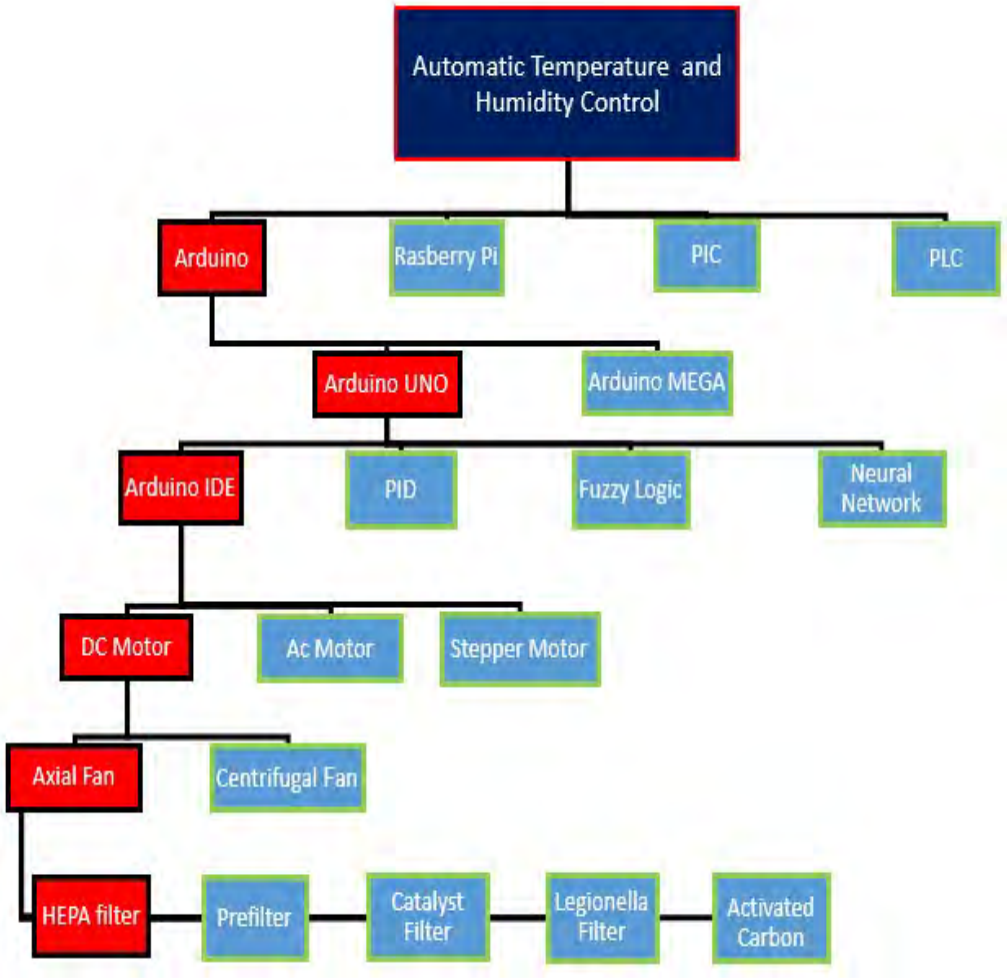

Figure 1.2: K-Chart.

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