DESIGN OF AIR-CONDITIONER CONTROLLER FOR AN AUTOMATION

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MAY 2009

"I hereby declare that I have read through this report and found that it has complied the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)"

Signature : .....

Supervisor's Name : En Kyairul Azmi Bin Baharin

Date : 8 MEI 2009

"Saya akui bahawa saya telah membaca karya ini. Pada pandangan saya karya ini adalah memadai dari skop dan kualiti untuk tujuan penganugerahan ijazah Sarjana Muda Kejuruteraan Elektrik (Kuasa Industri)

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Nama penyelia : En Kyairul Azmi Bin Baharin

Tarikh :8 MEI 2009

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree Of Bachelor In Electrical Engineering (Industrial Power)

Faculty Of Electrical Engineering

University Teknikal Malaysia Melaka

0ctober 2008

"Saya akui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya saya jelaskan sumbernya."

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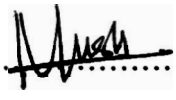
Tarikh : 8 MEI 2009

"I hereby declared that this report is a result of my own work except for the except that have been cited clearly in the references."

Signature : 

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Date : 8 MEI 2009

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ABSTRACT

The air condition controller for automation is a system designed to control the temperature of the air conditioner according to the changes of the room temperature. This project main objective is to design the control system that contributes to more effective energy consumption. In this project or thesis, the thermostat will sense the room temperature. The thermostat does this by controlling the flow of heat energy into or out of the system. Then, through the PID controller, it will increase or decrease the air conditioner temperature, which we do not to do it manually. There are also innumerable applications for this system of which most people are never aware of applications include automobiles, industry, resident and etc.In term of energy consumption, this project will lead to more efficient energy usage. It is because we only use the air conditioner according to the room temperature. In other words, we are not using the air conditioner at 20°C if the room temperature is 25°C. That the result that I hope my project will achieve at the end of this thesis.

ABSTRAK

Litar kawalan penyaman udara untuk tujuan mengautomasi adalah satu sistem yang direka untuk mengawal suhu bagi penyaman udara berdasarkan perubahan bagi suhu bilik. Objektif utama projek ini adalah mereka bentuk sistem kawalan yang menyumbang untuk penggunaan tenaga lebih berkesan. Dalam projek atau tesis ini, termostat berfungsi sebagai mengesan suhu bilik. Termostat berfungsi dengan mengawal aliran tenaga haba kepada atau daripada system.Kemudian, melalui pengawal PID, ia akan meningkatkan atau mengurangkan suhu penyaman udara yang pada kebiasaannya dilakukan secara manual. Terdapat banyak aplikasi untuk sistem ini di mana kebanyakan pengguna tidak menyedarinya termasuklah aplikasi pada kereta, industri, pemastautin dan sebagainya. Dari segi penggunaan tenaga, projek ini akan alternatif untuk penggunaan tenaga lebih efisien. Ia adalah kerana sebagai contoh kita hanya menggunakan penyaman udara berdasarkan untuk suhu bilik. Dengan kata lain, kita tidak menggunakan penyaman udara pada 20°C jika suhu bilik adalah 25°C. Saya berharap projek saya akan mencapai objektif di akhir tesis ini..

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CHAPTER 1

INTRODUCTION

1.1 Background

The air conditioning system is designed to provide a comfortable living or working environment within a specific area by controlling the surrounding at a suitable range of temperature, relative humidity, air circulation and purity of the air. For tropical weather such as in Malaysia, the use of the air conditioning system helps to create a more comfortable living environment. With the improvement and more cost efficient in manufacturing technology, the production of air conditioning unit have been made more environmentally friendly. One of the fact that lead to the design of the air conditioner controller is to improve the efficiency of energy use. Knowing that improving the efficiency of energy use will lead to a reduction in energy consumption.

The air conditioner controller was not only can reduce the energy consumption, but also can provide more comfortable and conducive environment. One of the controller type that been use in this air conditioner controller is PID controller. By using that kind of controller, the air conditioner will operate according to the room temperature. Which is mean that the air conditioner temperature will inversely proportional with the room temperature. All this process will be run

automatically. This controller will overcome all the problem faced when using the conventional air conditioner.

1.2 Problem statement

For daily usage, the air conditioner usually has been on with a certain temperature. Then the air conditioner temperature remains the same even when the room temperature was decreases. Otherwise, if want to change the air conditioner temperature, do it manually. This problem will lead to wastage of energy (electricity) because of the inanely usage of air condition.

1.3 Objective

There aim of these projects is to provide the intelligent home automation appliances. In this paper, it's focus on air conditioner. The specific objectives that will be discussed on analyze and discussion parts are as follows:

i. To design the controller for the air condition that can control the temperature of the air conditioner according to the current room temperature.
ii. To identify the most appropriate way of energy consumption.
iii. To study about the function and operation of sensors.
iv. To improve the conventional technology in air conditioner invention.

1.4 Scopes of work

The conventional air conditioner will lead to the wastage of energy (electricity). Beside the size of the air conditioner, the inanely usage of the air conditioner will cause the air conditioner not last long. Therefore, for classification

problems, the air conditioner controller for automation was introduce for a better usage compared with conventional air conditioner.

This new improvisation of the air conditioner will utilize the the data of air conditioner size, room size and type of controller that been used. Besides, the study about related project also been done.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This project is focus on the improvisation of the air conditioner. Type of controller that been used in the air conditioner was be the classification of the problem. The following study was review to gain idea in other to complete this project.

2.2 Study of related thesis.

2.2.1 Fuzzy Logic Control For Non Linear Car Air Conditioning By Mohd Fauzi Othman And Siti Marhanis Othman, (2006) University Teknologi Malaysia.

This paper is all about to study the implementation of fuzzy logic control in automobile climate control system compared to the existing state flow controller. Usually the car air conditioner use a control system such as linear piecewise linear and look up table approximations. All this type of controller can be use had a problem such as limit the control performance, costly to implement in certain applications and difficult to debug and tune. Fuzzy logic provides an alternatives solution for all problem above. It can

simply the implementation by combining multiple input into single if then statement still handling non-linearity. There are two fuzzy logic controller used in this model which is FLCBLOWER and FLCSWITCH. FLCBLOWER inputs are range of temperature different, power provided by number of passenger and the output is the blower speed. FLCSWITCH input is temperature different and the output are either switch on the heater or AC state. The concept is simple, if the temperature different is negative,meant that set temperature is less than the current temperature. Therefore, air-conditioner will be switch on. If the different is positive, it means that the set point temperature is larger than the current temperature, so the heater will turn on.

2.2.1.1 Controller design

Figure 2.0 is a *structure* of the fuzzy controller for the automobile climate control system. In this stage, the process input and output variables are also determined. A single fuzzy controller can have multiple inputs depending on the need of the control system. For FLCBLOWER, the inputs are the range of temperature difference, *a*, and the power provided by the number of passengers, *b*, and the output is blower speed proportions, *d*. Figure 2.1, Table 2.0, and Figure 2.2 describe the operation for FLCBLOWER. For FLCSWITCH, the input is the range of temperature difference, *a*, and the outputs, *c*, are switched to either *Heater* or *AC State*. T_1 is the exit temperature from both states and T_2 is the internal temperature. Figure 2.3, Table 2.1, and Figure 2.4 show the operation of FLCSWITCH.

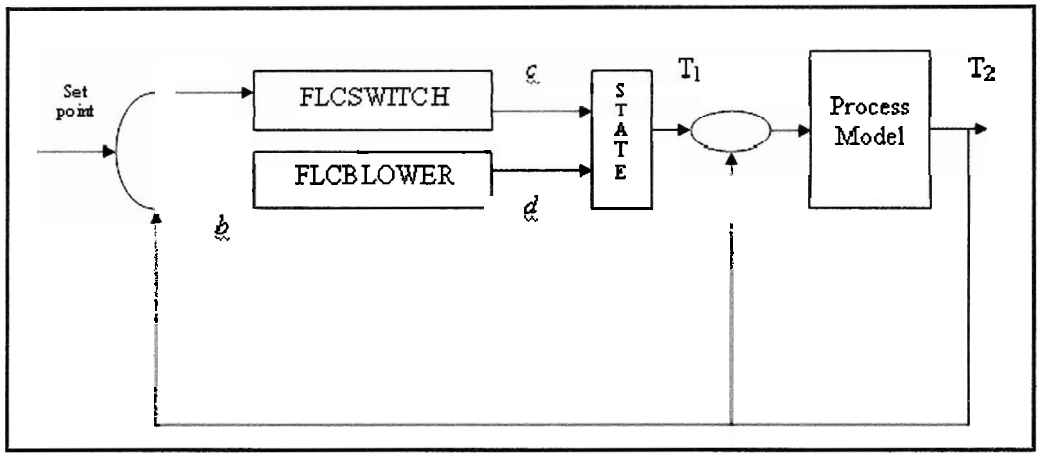
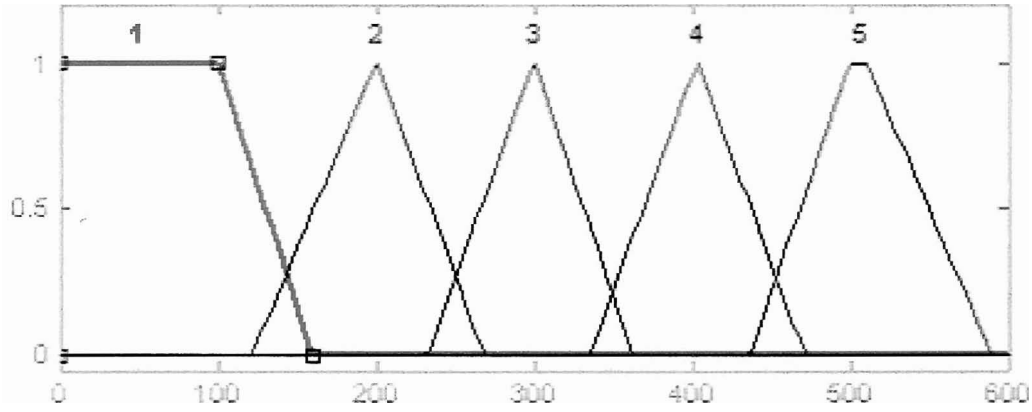
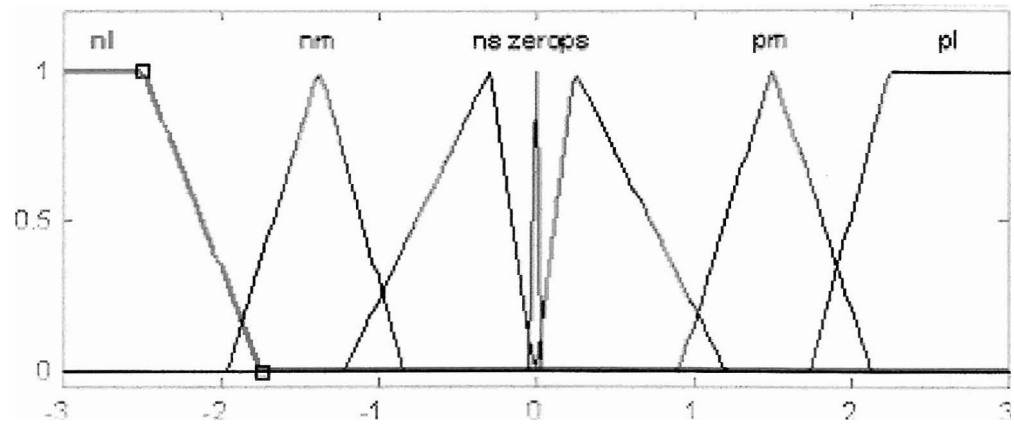


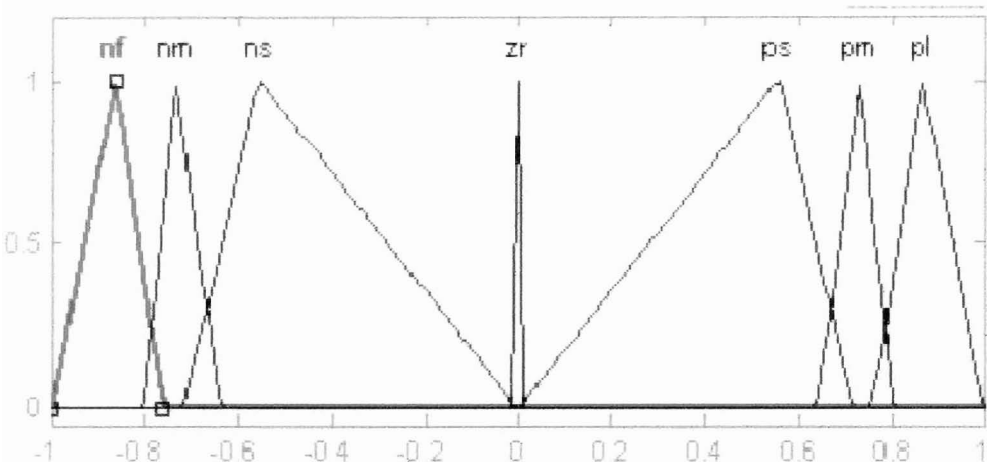
Figure 2.0 Configuration of fuzzy logic control automobile climate control system



(a)



(b)



(c)

Figure 2.1. Membership function for FLCBLOWER (a) Input : Heat (*n*) (b) Input : temperature difference (c) Output: blower speed

Type	Number	Quantization level
Input 1: Heat (*N*)	5	- 1 (Very small) - 2 (Small) - 3 (Medium) - 4 (Large) - 5 (Very large)
Input 2: Temperature difference	7	- Negative large (NL) - Negative medium (NM) - Negative small (NS) - Zero (ZR) - Positive small (PS) - Positive medium (PM) - Positive large (PL)
Output: Blower speed	7	- Negative fast (NF) - Negative medium (NM) - Negative slow (NS) - Zero (ZR) - Positive slow (PS) - Positive medium (PM) - Positive fast (PF)

Table 2.0 : Quantization for FLCBLOWER

TD\N	VS	S	M	L	VL
NL	PS	PS	PM	PM	PF
NM	PS	PS	PS	PM	PM
NS	PS	PS	PS	PS	PS
ZR	ZR	ZR	ZR	ZR	ZR
PS	NS	NS	PS	NS	NS
PM	NS	NS	PS	NM	NM
PL	NS	NS	PM	NM	NF

Figure 2.2. Rule base for FLCBLOWER

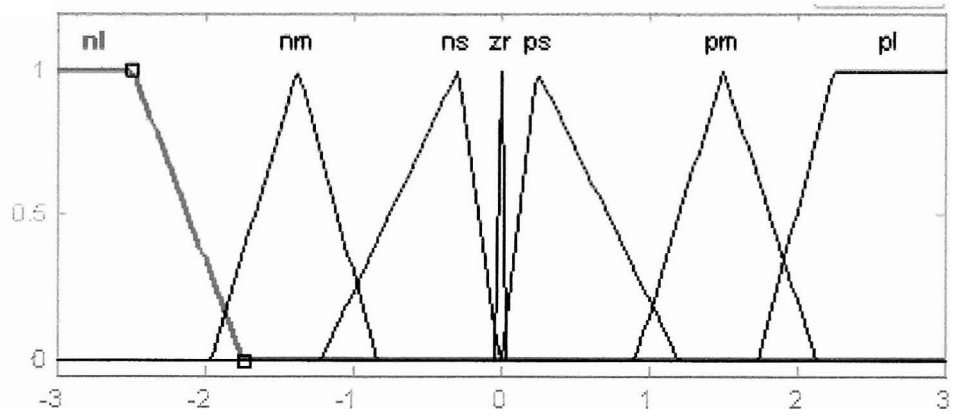


Figure 2.3. Membership function for FLCSWITCH

Type	Number	Quantization level
Input 1: Temperature difference	7	- Negative large (NL) - Negative medium (NM) - Negative small (NS) - Zero (ZR) - Positive small (PS) - Positive medium (PM) - Positive large (PL)
Output 1: Switch AC	2	- on (ONE) - off (ZERO)
Output 2: Switch HEATER	2	- on (ONE) - off (ZERO)

Table 2.1. Quantization for FLCSWITCH

TD\N	Switch AC	Switch Heater
NL	on	off
NM	on	off
NS	on	off
ZR	off	off
PS	off	on
PM	off	on
PL	off	on

Figure 2.4. Rule base for FLCSWITCH

2.2.2 Microcontroller Based Temperature Controller-Implementation Of Fuzzy Logic By Prof S D Markande, Prof P M Joshi, And Dr S K Katti, (2002) Rajashi Shau College Of Engineering.

This work is in the area of soft computing (Fuzzy Logic) which is an advanced area of computation, which can be applied for control of complex systems wherein mathematical model is not available. Therefore an attempt has been made, to control the temperature of a water bath using Fuzzy Logic Controller. This controller is designed and fabricated (a prototype) using a new microcontroller PIC 16C74 with advanced RISC architecture from MICROCHIP. Suitable fuzzy rule base for the system has been prepared and implemented to control the temperature. In this a minimum hardware was required due to the capabilities of the processor. It is observed that the response of the Fuzzy Logic Controller is faster than the conventional PID Controller.

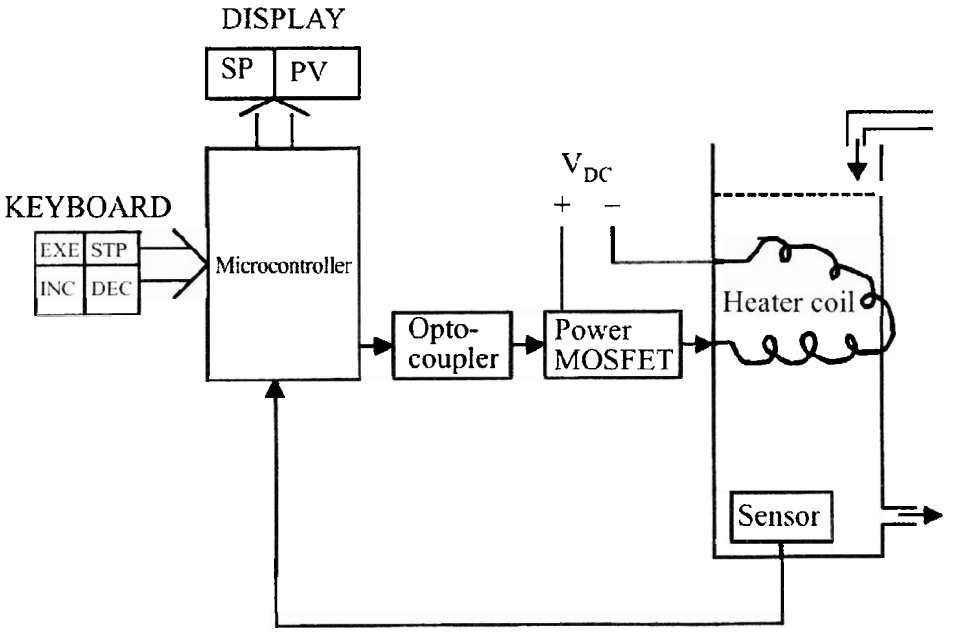


Figure 2.5 Block diagram of the FLC temperature control system for Controlling the temperature of a water bath

2.2.2.1 Description of The Process

The block diagram of the FLC Temperature Control System is shown in Figure 2.5. The block diagram shows the flow of the process. The function of each block is discussed below.

i. Water Bath

This is a container with suitable inlet and outlet and stores water. The temperature of this water is to be kept constant at desired value.

ii. Temperature Sensor

This is used for the measurement of the process variable, the temperature of the water inside the bath. The output of the sensor, which is proportional to the temperature, is fed back to the microcontroller for initiating necessary steps for taking proper control action

iii. Microcontroller with Display and Keyboard Interfaces

It is the heart of the system. It accepts the analog output of the temperature sensor and processes it further for getting the actual temperature value in digital form.

The microcontroller is provided with a keyboard interface, which is used to select the controller mode and to input the set point. It allows for the operations such as increment, decrement, execute and stop required by the user.

The display interface enables to display the set point and the actual temperature of the water.

The microcontroller calculates the error and change in error.

Then depending on the control mode selected, it uses either Fuzzy or PID algorithms from the software to generate the control signal. This control signal is in the form of PWM output.