

Fuzzy Logic Controller Design for Intelligent Air-Conditioning System

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Abstract—Inefficient air cooling systems may cause of wasting energy in a great amount specially in the urban area. Being the most popular cooling system, air-conditioners have been used in domestic usage as well as in industrial applications. However, the unintelligent nature of such cooling system gives rise to excess energy consumption which causes a huge problem in the current energy hungry world. In this paper, we present design of a fuzzy logic controller for the intelligent air-conditioning system. The performance of the controller is also simulated. The proposed controller has the adaptive nature to control fan and compressor speed which leads to reducing power consumption. Also, the system controls the operation mode to retain the healthy oxygen level and humid condition of the indoor environment.

Keywords—fuzzy logic controller; intelligent system; air-conditioning system.

I. INTRODUCTION

The modern world has been running after new energy sources to ensure enough energy supply of all machines and instruments run by the different form of energy. Apart from the new sources, renewable energy plays a vital role to fulfill the constant demand of energy. However, the natural resources are limited and may take a long time to reproduce the energy to alleviate the energy crisis of the world [1]. As a result, intelligent systems can be an alternative choice to cut the wastage of energy consumption from the existing electrical systems such as household appliances. For example, the air conditioner provides a comfortable environment for every individual need, especially in Malaysia, a tropical country where the temperature fluctuates between 29°C and 34°C including humidity of 70% to 90% [2]. It is usually very hot and humid throughout the year which differs from countries which have four seasons in a year. Therefore, the demand of air conditioner in Malaysia is very high. Consequently, the electricity consumption of AC systems in Malaysia has been increased from 1200 GWh in 1999 to 2200 GWh in 2009. The predicted power consumption is 3000 GWh in 2015 [2].

In a conventional air-conditioning system, temperature and humidity are regulated by a remote controller which may be a semi-automatic option. The main disadvantage of such system is setting a fixed temperature and humid condition for a long time. In other words, user seldom uses the settings option of the remote controller to change the temperature and humidity

according to the weather variation. Instead, users most often increase/decrease temperature and fan speed option which may lead to a surcharge of energy consumption. In such situation, using an intelligent controlling strategy such as fuzzy logic techniques can improve the total power saving.

Air-conditioning is the process of modifying the properties of humidity and temperature of the air in a confined room under variation of the condition. The purpose of this process is to control of these conditions may be desirable to maintain the health and comfort of the consumers. There are many types of air-conditioning systems exist such as, window air conditioning system, split air conditioning system, centralized air conditioning system and package air conditioning system. Nowadays, the air conditioner is almost integrated with every building. They contribute almost 75% of total energy consumption [3]. By using a fuzzy logic controller, the intricate effects of inputs such as humidity, temperature and oxygen level can be predicted by the artificial intelligence to make an immediate decision or action to control compressor speed, fan speed, operation mode and fin direction according to the knowledge based production rules.

Fuzzy logic controllers have been used in various types of applications including water management [4, 5], power grid management [6, 7] and solar energy management [8-10]. Although, fuzzy logic based system has been adopted in many areas of energy systems, very few systems have been designed and implemented for air-conditioning system. Recently, [11, 12] investigated fuzzy logic controller for air-conditioning system. However, there are some limitations of previous fuzzy logic controllers developed for air-conditioning system. For example, those controllers tend to solve the energy minimization problem only. Maintaining a healthy oxygen level was not addressed. In addition to the controlling fan and compressor speed, it is important to control humidity and oxygen level of the room to ensure refreshing environment.

In this paper, we develop a fuzzy logic controller program for intelligent air-conditioning system. The performance of smart system is simulated using the MATLAB Fuzzy Logic toolbox. The program is designed such that the quality of air and the power efficiency of the system are improved simultaneously. In addition to controlling excess power consumption, the system is able to maintain a healthy humidity and oxygen level in the indoor environment.