วารสารมหาวิทยาลัยราชภัฏสกลนคร ; 6 (12) : กรกฎาคม – ธันวาคม 2557
Sakon Nakhon Rajabhat University Journal ; 6 (12) : July – December 2014

The Demonstration Set of Temperature and Humidity Control System Fuzzy Control in the Chicken House

Chaiyos Commee [1]
Chaiyapon Thongchaisuratkrul [2]

Abstract

This paper shows the application of control techniques for chicken farm. The fuzzy controllers are applied for temperature and humidity control. The temperature fuzzy controller has two inputs and one output. A humidity fuzzy controller has three inputs and one output. There are 25 rules for temperature fuzzy controller and 25 rules for humidity fuzzy controller. A chicken's room model is constructed and used as an experimental model. Results showed that the temperature and humidity can be regulated. The step response of fuzzy logic controller and application proved that the proposed control system has good performance for the fast, exactly, stability response and robustness of disturbance.

Keywords : Fuzzy control, Temperature-humidity control, Chicken house's farm

Introduction

A closed poultry production system is a system which can be monitored for pathogenic germ to protect the chickens from injection. There are three methods of monitoring. Firstly, disinfection of persons by spraying and/or walk over disinfection solution before entering the chicken housing. Secondly, by taking a shower and where proper clothing before entering the chicken house. Finally, they must wear proper clothing and boots before entering the chicken house, shoes of the farm. Equipment and supplies must be sterilized before being brought into the chicken house, such as smoking with formaldehyde gas, spraying with disinfectant solution, ultra violet light, etc.

The animal feed must be come from the hazard analysis and critical control points (HACCP) system factories. The sanitation should be strictly concerned. The raised chicken should be the same age and sold at the same time. The chicken room in closed farming system can be designed of any

[1] Faculty of Industrial Technology, Loei Rajabhat University, Thailand
[2] Faculty of Technical Education, King Mongkut's University of Technology North Bangkok, Thailand

farm systems which are not necessarily the same. However, the farmers need to know and understand the management and the type of farms. For example, the chicken in an open farm will be stressed due to weather change. The problem of management is over density of chickens. For a closed chicken room of evaporating systems included the speed, consistency and pressure of air they were correctly calculated. The density of chicken has been calculated from the weight per area.

Since, the bird flu outbreak in 2004 has been caused the damages of farmers. They started to keep their chicken in a closed coop for a safety. This is reason for the air condition system in the farm of became very necessary. This system is the most important factor of closed farming. If can be set the optimum temperature and humidity for the chicken, they will eat more water and food which led to the more food conversion ratios, no disease, and uniformity of chicken, medium-sized farm, lower budget and especially better returns in long term.

The air condition system consists of two major components which are as follows:

1. The air ventilation is the circulation between the hot air from the chicken, carbon dioxide, ammonia from poultry farm and fresh air outside farm. The polluted air was driven out of the farm. And then the system brings the fresh air back in the farm.

2. The evaporative cooling is system for decreasing temperature of the farm. When the air passes through the cooling pad, water evaporates and the room temperature goes down.

However, there are problems of setting an environment in the chicken house as follow:

1. The temperature difference between front and back side of the farm is large value. The chicken will sick.

2. The high temperature in summer, the air will not ventilate.

3. It is difficult to decide for the best environment of farm.

In this work, the researchers have been designed and constructed the temperature controller of a chicken house using a fuzzy logic controller and a model of a chicken house for implementation with Laboratory Virtual Instrument Engineering Workbench(Lab VIEW) program to study and create a real controller for the chicken house.

Objective of research

This research is experimental research. The following objectives:

1. Construct the Demonstration Set of Temperature and Humidity Control System Fuzzy Control in the Chicken house.

2. construct control system of Temperature and Humidity Control System Fuzzy Control in the Chicken house.

Related Works

The researchers studied relevant articles as follows: "Fuzzy logic control systems; Fuzzy logic controller – part I and II" by Lee (1990). "Application of fuzzy logic to approximate reasoning using linguistic synthesis" by Mandeni (1997). "Fuzzy logic controller design: A case study" by Lucian."Fuzzy control for temperature and humidity in refrigeration systems" by M. Beeker, et al. (1994) And "Application of intelligent control techniques for temperature and humidity control in industrial workshops" by Guo, Cao, and Zheng, (2009)

Methodology of research

Procedures of the research are as follows:

1. The Proposed Fuzzy Controller Chicken House
2. Temperature-humidity control systems description
3. Design of fuzzy controller for temperature and humidity of chicken house
4. Model of fuzzy control for temperature and humidity of chicken house using Lab VIEW
5. Lab VIEW programming for the chicken house.

1. The Proposed Fuzzy Controller Chicken House

Fuzzy logic controller

Dynamics system in the world of controller is nonlinear and changes the values of parameters on working. Thus, it is not corrected the control result, and is not created various theories as such as classical control. The designer needs to know the parameter value of system and the change of system's parameter in mathematic model that is very difficult in practice. Thus, Zadah established the theory of nonlinear system control in 1965 with the name "Fuzzy Set Theory" that the designer of controller needn't know the mathematic model of the system but it should only consider the control of basic system feature so fuzzy logics controller is easy to understand. Moreover, the fuzzy logics controller is the centre of genius men to collect their intelligent to control automatic system using the method of fuzzy control and controller's working experience. Otherwise, in nonlinear control system or any system cannot use mathematic model or any system which have been analyzed in complexity. It can easily control using technique method of fuzzy logics control. The fuzzy logic is a method of decision under the rule of program system in computer. This control has been showed the capacity as expert action in certain field and imitated control system for human thought procedure in controlling different work.

The basic principle of fuzzy logic is fuzzy set theory developed by Lotfi Zadah in 1906. The fuzzy's theory different the Boolean's theory that is the decision for zero and one. But the fuzzy theory is many values which counted from zero to one. Fuzzy logic control will work under condition of basic rule of language and then it will use the reasonable evaluation in many parts. The design of fuzzy logic controller consist of two parts using the language model which copies the skill of work and experience in control of designer in order to find the structure of fuzzy controller. The structure included membership function, logic operator, inference method and defuzzification. The fuzzy logic controller contains a number of set of parameters that can be altered to modify the controller performance. These parameters are the scaling factor for each variable, the fuzzy set representing the meaning of linguistic values and the fuzzy rules.

Above-mentioned control, some drawbacks for design of fuzzy controllers are number of rule, reliable linguistic and the experience of designer may be not allow him to control significant process changes. The method of solve problems is adaptive fuzzy controller that modifies the fuzzy rules. An approach has been applied to control the temperature and humidity of the following processes: Fuzzy control for temperature and humidity of chicken room using Lab VIEW.

2. Temperature-humidity control systems description

Thermal processes are classified the heat elimination and without heat elimination For this work, heat elimination is used as shown in figure 1.

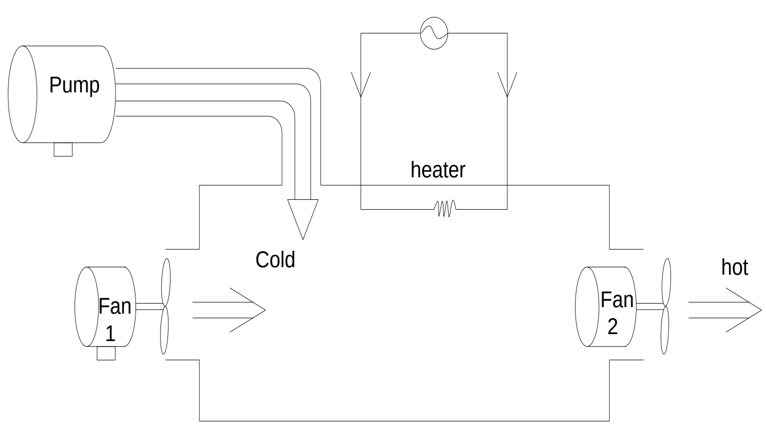

Fig. 1 the temperature and humidity control systems

The temperature and humidity control systems compose of two fans, water pump and heater. The fans were used for sucking hot air to decrease temperature. A water pump was used to inject water through the cooling pat. For the control temperature and humidity, a heater was used.

3. Design of fuzzy controller for temperature and humidity of chicken house

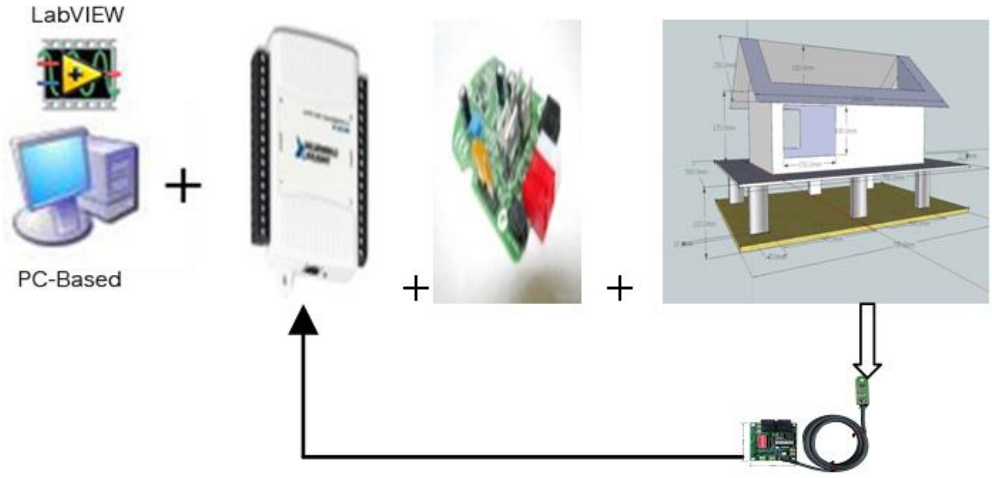

Fig.2 design of Fuzzy controller for temperature and humidity of chicken house

The major of device for Design of Fuzzy controller for temperature and Humidity of chicken house consist of Lab VIEW program base on computer, data acquisition (DAQ. NI 6008), pulse with moss (PWM), model of fuzzy control, and temperature and humidity sensor.

The Lab VIEW program base on computer was used for run on the computer to fuzzy control. And then sends control signal to the DAQ NI 6008 for processing and inference signal for sent to the buffer circuit. The buffer circuit by pulse with moss (PWM) wear used drive fans. water pump and heater for temperature and humidity controlled room. A temperature and humidity sensor was used the detection of temperature and humidity error to send feed back to the DAQ for run again and will work to close loop system to get the response when they need accurately and quickly.

3.1 Structure of control system

Figure 3 shows the feedback control system with the fuzzy controller and the process. The fuzzy controller consists of a fuzzy temperature controller and a fuzzy humidity controller. The inputs of the fuzzy temperature controller are the temperature error (E–temp) and change in temperature error (De–E temp). The inputs of the fuzzy humidity controller are the humidity error (E–Hu) and change in error (De–E Hu). The outputs of the fuzzy controller were used for heater and fans (Temp–out).

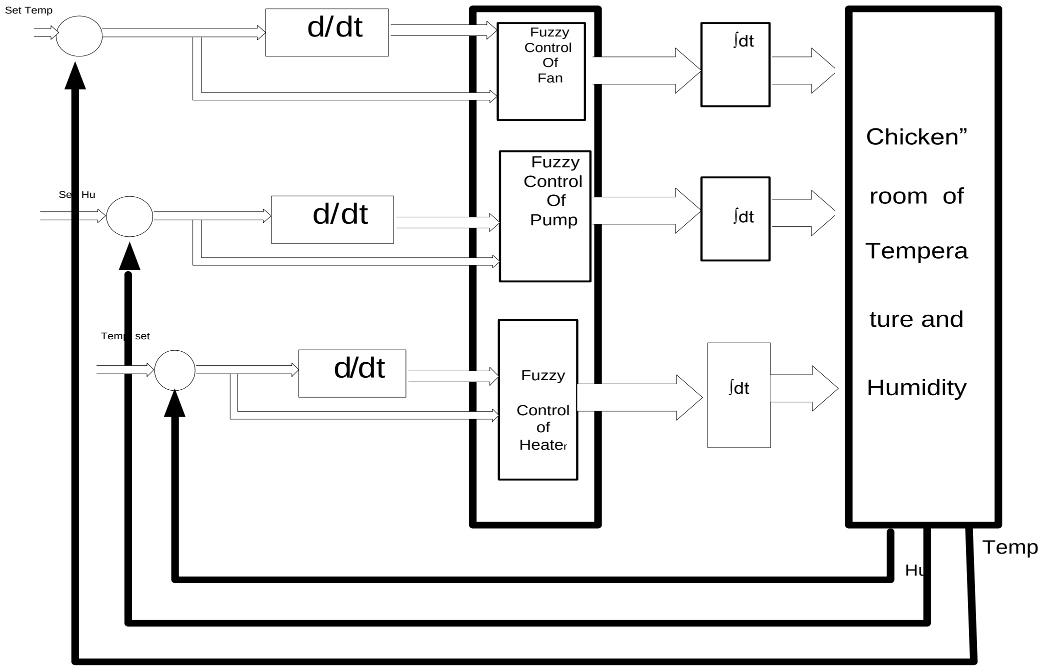

Fig. 3 Control system with fuzzy control

The fuzzy controller has six fuzzy variables (six inputs and three outputs) which were defined:

E-temp is defined form the difference between the value of set point and the present temperature value)

De-E temp is changing of temperature error which was defined form the difference between present value of E-temp and last value

De-E hu is changing of humidity error which was defined form before value

Temp-out is output value for driving the fans and a heater powers

Hu-out is output value for driving a pump power

The values of the input variables are converted by fuzzification variables linguistic in terms of five respective and three linear membership functions. The output values of temp-out form defuzzification were used for driving electrical power of the fans, a heater (Temp-out) and a pump (Hu-out). For both of controllers, the MAX – MIN inference method and the Centre-of-Area (CoA) defuzzification method were used. The controller was designed using Lab VIEW tool kid.

3.2 Fuzzy Temperature Controller

The fuzzy temperature controller is designed like a PI fuzzy controller. This means that the inputs and outputs are equivalent to traditional PI controller Figure 4 shows the membership functions of the two inputs (E-Temp, De-E temp) and the output (Temp-out). The values of the variable input and output are scales to interval (–10 to 10). Table 1 shows the fuzzy rules of the rule base. The control law for the temperature controller are required.

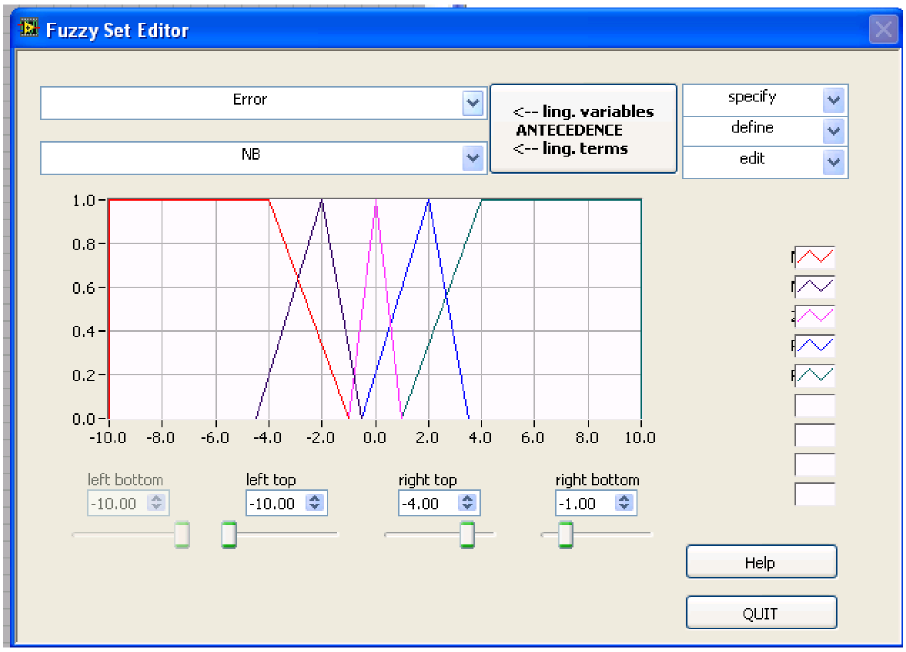

Fig. 4 membership function definitions for the fuzzy temperature controller

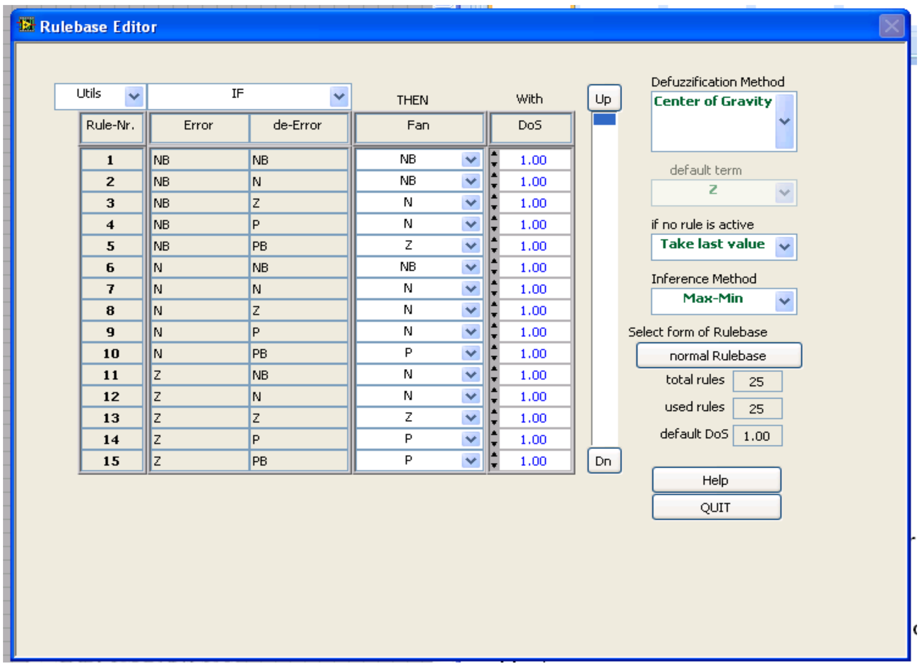

Fig. 5 rule base for the fuzzy temperature controller

Table 1 Fuzzy rules for temperature controller

Temp–out		E–temp				
		Nb	ns	zo	ps	pb
de–E temp	nb	zo	ns	ns	nb	nb
	ns	ps	zo	ns	ns	nb
	zo	ps	ps	zo	ns	ns
	ps	pb	ps	ps	zo	ns
	pb	pb	pb	ps	ps	zo

3.3 Fuzzy humidity controller

Figure 6 shows the membership functions for the fuzzy humidity controller of the humidity error (E–Hu) and changing of humidity error (de–E Hu). The outputs of humidity controller were used for pump power (Hu–out).

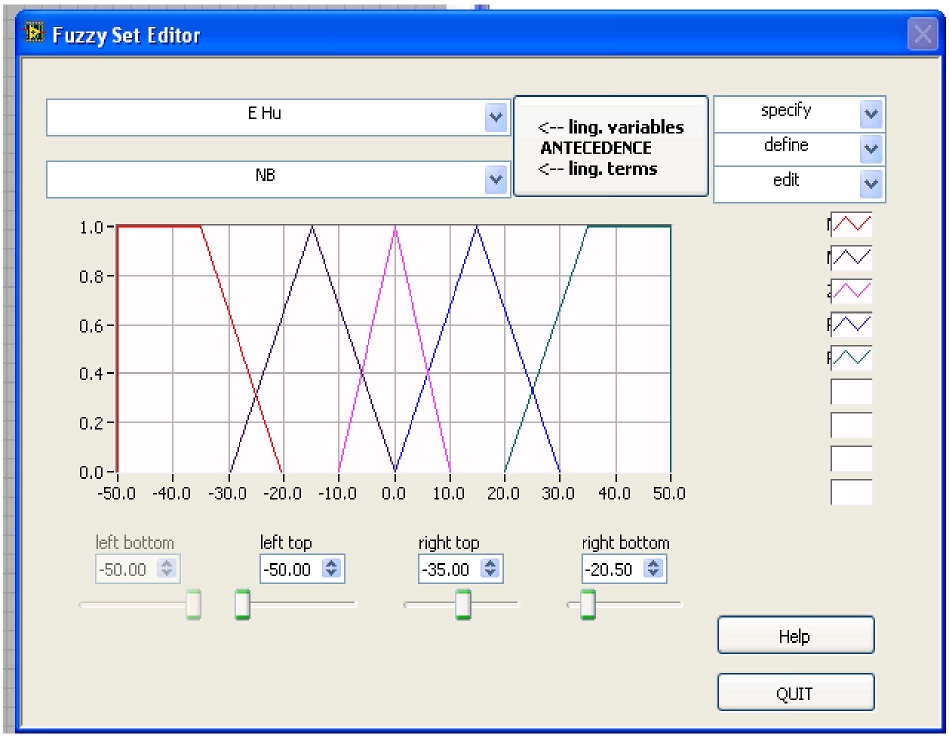

Fig. 6 membership function definitions for the humidity controller

วารสารมหาวิทยาลัยราชภัฏสกลนคร ; 6 (12) : กรกฎาคม – ธันวาคม 2557
Sakon Nakhon Rajabhat University Journal ; 6 (12) : July – December 2014

Table 2 Fuzzy rules for humidity controller

Hum-out		E-Hu				
		nb	ns	zo	ps	pb
de-E Hu	nb	zo	ns	ns	nb	nb
	ns	ps	zo	ns	ns	nb
	zo	ps	ps	zo	ns	ns
	ps	pb	ps	ps	zo	ns
	pb	pb	pb	ps	ps	zo

4. Model of fuzzy control for temperature and humidity of chicken house using Lab VIEW

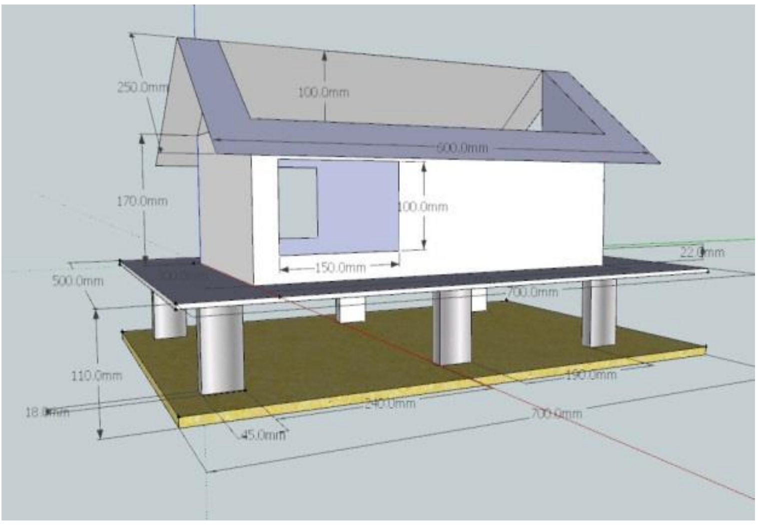

Fig. 7 structure of chicken room farm model

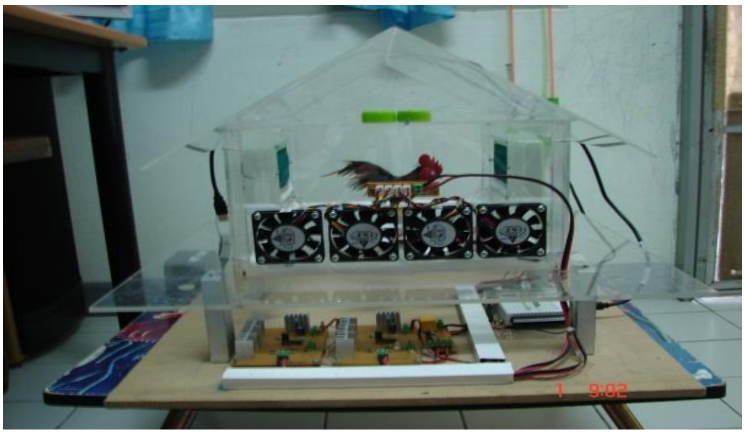

Fig. 8 chicken room farm model

5. Lab VIEW programming for the chicken house.

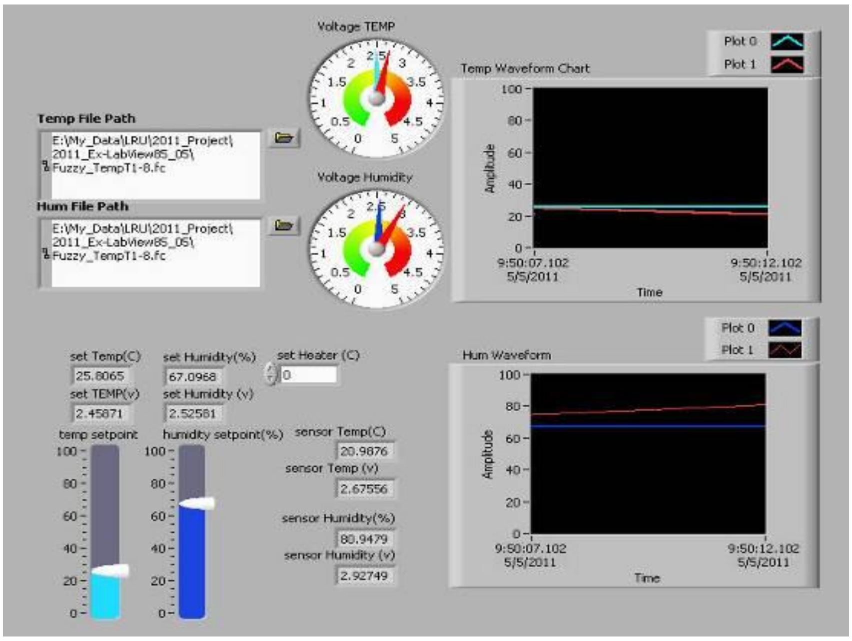

Fig. 9 front panel of program

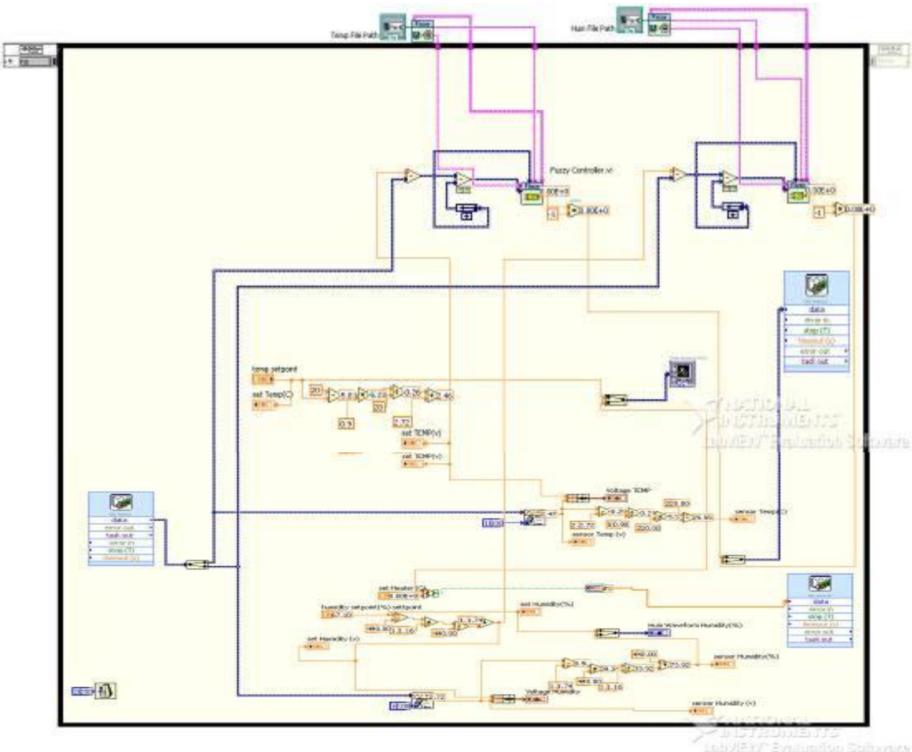

Fig. 10 block diagram of program

The Experimental Results

The experimental results of the fuzzy control for temperature and humidity of chicken house using Lab VIEW are shown in Fig. 11. From Fig. 11, illustrates the temperature and moisture controls at the set points of 28 degree Celsius temperature and 80 percent moisture (red line). It shows that the responses move toward the set points rapidly when the differences are high, and move slower when the differences get lower until there are no differences. Afterward, the system keeps the responses at the set points level.

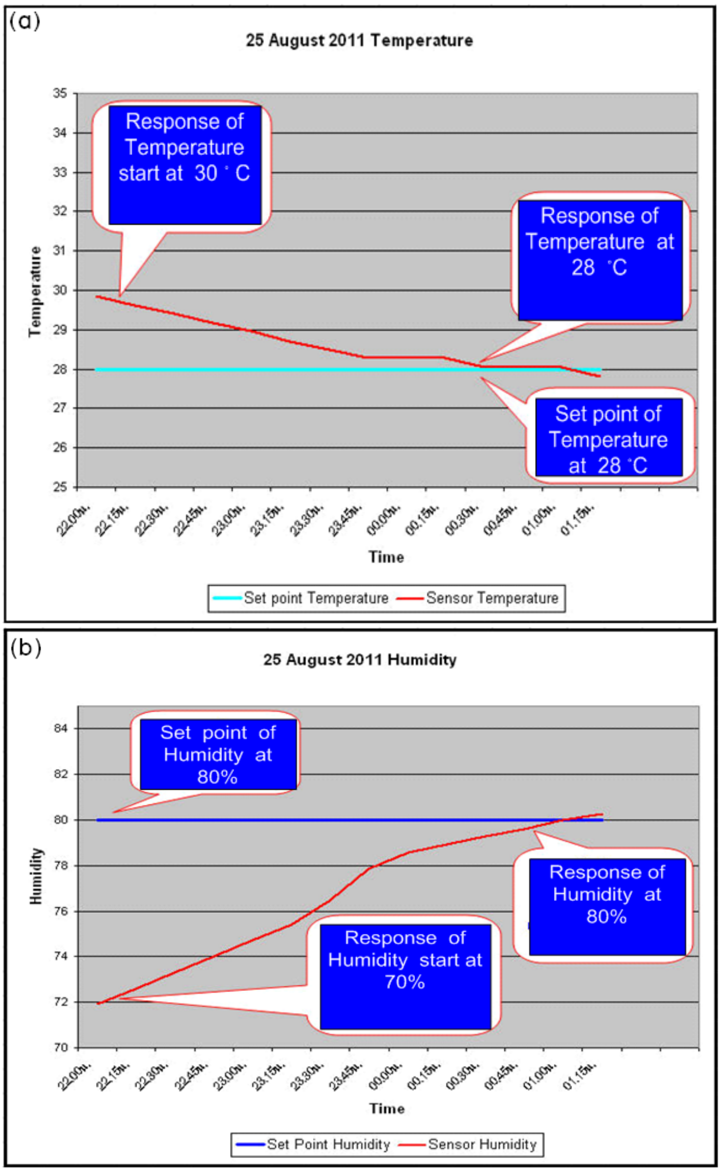

Fig. 11 the step response of fuzzy logic controller for (a) temperature and (b) humidity

Conclusion

The Fuzzy controller of temperature and humidity in chicken farm were described in the control design the thermodynamic coupling of temperature on relative humidity which were considered using the temperature error as additional input for the fuzzy humidity controller. The reimplementation of chicken farm model is based on Lab VIEW program. This controller is not needed the object's mathematic model. But it can be applied to base on the basic fuzzy control algorithm. The application results proved that the control system has good performance in rapid response and robustness disturbance. The experimental results were consistent with the research of Guo, Cao, and Zheng (2009) Research on Application of Intelligent Control Techniques for Temperature–Humidity Control in Industrial Workshops by analyzing the difference of an air conditioning control system used in industrial workshops and buildings, Mastacan, et al. (1994) Research on Fuzzy Logic controller design : A case study and Pratumsuwan, Thongchai and Tonsriwong (2011) Research on Electro-Hydraulic Position Control Using Fuzzy Logic Based On Lab VIEW presents implement in position control of the Electro-Hydraulic Servo System (EHSS) using Fuzzy Logic Controller (FLC) based on LabVIEW, etc.

References

Beeker, M. , Oestreieh, D. , Hasse, H. and Litz, L. (1994). Fuzzy control for temperature and humidity in refrigeration systems. **IEEE**. pp. 1607-1612.

Guo, Y., Cao, D. and Zheng, G. (2009). **Application of intelligent control techniques for temperature and humidity control in industrial workshops**. In Proceeding 2nd International Symposium on Intelligent Information Technology and Security Informatics. Moscow, pp. 192-194.

Lee, C.C. (1990). Fuzzy logic control systems; Fuzzy logic controller – part I and II. **IEEE Transaction on Systems, Man, and Cybernetics**. 20(2), pp. 404-435.

Mandeni, E.H. (1977). Application of fuzzy logic to Approximate reasoning using linguistic synthesis. **IEEE transaction on computers.** C-26 (12), pp. 1181-1191.

Mastacan, L. et al. (1994). Fuzzy logic controller design: A case study. **IEEE Transaction on Systems**. pp. 233-238.

Pratumsuwan,P.,Thongchai, S. and Tonsriwong, S.. (2011). **Electro-Hydraulic PositionControl Using Fuzzy Logic Based On LabVIEW.**