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# Design of Automatic Control System for Piggery Environment Based on Fuzzy Theory

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**Abstract***:* Piggery environment is to maintain an important prerequisite for the growth of healthy pigs, this paper to northern winter climate characteristics for reference, in view of the shortcomings of existing manual control, on the basis of fuzzy theory design based on fuzzy control for piggery environment automatic monitoring system. The pigsty temperature, humidity and harmful gas concentration of real-time monitoring and automatic control, and enable the growth of pigs in the best environment. Experimental results show that the proposed system has a good performance in response speed, good control effect, strong anti-interference ability, and has a certain practical application value.

**Keywords** Culture, Environment, Fuzzy control, Temperature neurons

## INTRODUCTION

On the growth and development of pig piggery environment has an important effect. With the continuous development of the aquaculture industry, the development of the intensive direction of the environment is also increasing [Guarinoa, *et. al.*, 2008]. Therefore, real-time monitoring of piggery environment, create a good growth environment is the development direction of aquaculture. In this paper, we first introduce the temperature, humidity and harmful gas concentration effect, and aiming at the problems existing in the traditional manual control, the design of the piggery environment real-time monitor and control system based on fuzzy control, and strive to realize the automatic adjustment of piggery environment, ensure pig in the environment, the best growth and development.

## EFFECTS OF ENVIRONMENT ON GROWTH AND DEVELOPMENT OF PIGS

At present, closed loop already is widely used in pig breeding process, so pig living environment of pig breeding, growth and development of have a great effect. It is very important to adopt the advanced method to carry out automatic control for large-scale, intensive pig production.

1. Temperature effect

Appropriate environmental temperature is the prerequisite for the development and reproduction of the pig. When the environmental temperature gradually increased, to reduce the heat, the activity of the pig and the amount of consumption decreased, drinking water increased, growth slowed, and even negative growth phenomenon. When the temperature is low, the heat dissipation of the pig is increased, which is to maintain the heat balance, and the consumption of the pig increases, which leads to the decrease of the feed utilization.

2. Effect of humidity

The effects of air humidity on livestock are mainly manifested in the heat dissipation. When the air is wet, the water evaporation of the pig is inhibited, which affects the body heat. On the contrary, the air humidity is small, the evaporation of the surface water of the animal is easy, and the heat of the body can be accelerated. At low temperatures, such as increased humidity in the air, it will aggravate the pig's cold; reduce the resistance of the pig.

3. Effect of harmful gas

Harmful gas in piggery is mainly refers to the ammonia, a colorless and can stimulate the taste of gas, ammonia concentration, stimulate pigs to sneeze, drooling, decreased appetite, increased the incidence of respiratory diseases, of the pig in the adverse health effects.

## DESIGN OF AUTOMATIC CONTROL SYSTEM FOR PIGGERY ENVIRONMENT

At present domestic the pigsty environment control method are still in the manual control, according to happen within the actual temperature and humidity conditions such as artificial frequent closed or open ventilation and heating system, so that piggery environment to meet the requirements. Not only increase the intensity of labor, a waste of energy, the control effect is also greatly affected. This requires the establishment of an environment automatic control system [Harper, *et. al.*, 2004], the real-time of piggery environment were detected, and ensures the stability of piggery environment by control strategy to carry on the effective control.

**Overall structure design.** Piggery environment monitoring system is mainly composed of a main control module, data collecting and detecting module and drive module output sections, as shown in Fig.1.

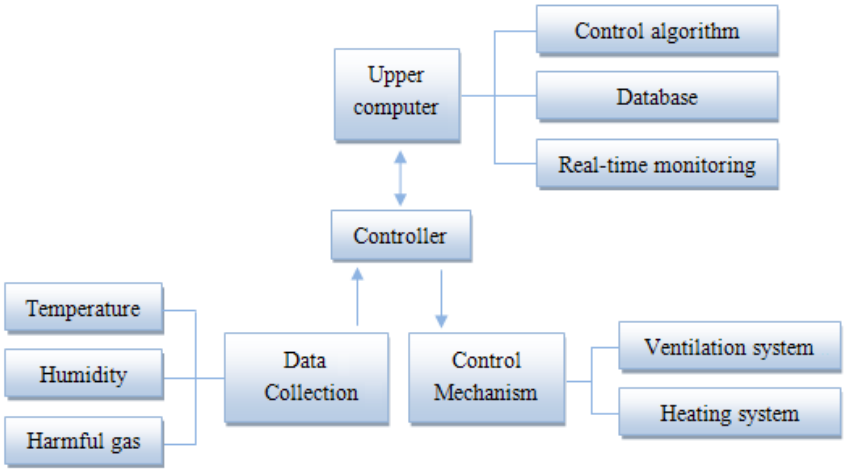


Fig.1 Environmental control system structure diagram

1. Master control module: also known as the central processing unit. The main function of this module is to deal with the digital signal which is collected by the sensor, and then sends out the control signal to the actuator.
2. Data acquisition module: changes with temperature and humidity sensor detection in piggery environmental parameters, and the acquisition result are transmitted to the controller.
3. Output drive module: the controller compares the collected data with the setting value, sends out the control signal, transmits the control signal to the executing agency, and adjusts the environmental parameters.

**Control algorithm analysis.** Piggery environment has the characteristics of multi variable, nonlinear, delay, and between the variables still exist certain coupling relationship, it is difficult to establish accurate mathematical model. In this paper, fuzzy control algorithm is applied to the pigsty environment monitoring system, the system input variables of fuzzy processing as the controller input and according to the fuzzy control rule for fuzzy reasoning generated fuzzy control, the solution of fuzzy operation, turning it into a parameter to control the actuator can be used to. Fuzzy controller structure is shown in figure 2.

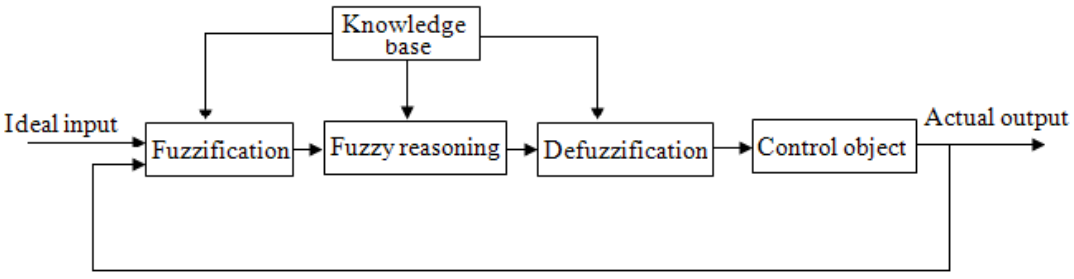


Fig.2 Structure of fuzzy controller

Take two fuzzy controllers are respectively the pigsty environment control, one is the changes in humidity and ammonia concentration as input, fan open a number as the output of fuzzy controller. The second is the temperature change and temperature change rate as input, the pump speed as the output of fuzzy controller.

**Fuzzy rules.** For the controller 1, ammonia concentration deviation is A basic domain of [-4. 4], relative humidity deviation H basic theory domain [-20%, 20%], the fuzzy subset of {NB NS ZO PS, PB}, said represent {negative big, negative small, zero, positive small, positive big}. [Jeonghwan, *et. al.*, 2004] Fan open a number N based on field theory [1, 2, 3, and 4]. Fuzzy subset of {ZO, PS, PM, PB, PVB} said, representing {zero, positive small, positive medium, positive big, positive very big}. According to the coupling relationship among the parameters, a fuzzy control rule table is established, as shown in Table 1.

Tab.1 Fuzzy control rule table

| N | | H | | | | |
|---|---|---|---|---|---|---|
| | | NB | NS | ZO | PS | PB |
| A | NB | ZO | PS | PM | PB | PVB |
| | NS | ZO | ZO | PM | PVB | PVB |
| | ZO | PM | PM | PB | PVB | PVB |
| | PS | PVB | PVB | PVB | PVB | PVB |
| | PB | PVB | PVB | PVB | PVB | PVB |

The controller 2, if in piggery temperature is low and the decline speed, you should rapidly improve the control voltage of the inverter and the pump motor speed operation. If the temperature inside the house is high and rising, it should quickly reduce the control voltage of the inverter, so that the motor speed of the pump motor. Take the basic field in the theory of temperature error E∈[-6. 6], the rate of change of the temperature deviation EC basic domain [- 2, 2], pump speed deviation ΔV of the basic domain of [-1.6, 1.6]. Fuzzy subset of {NB NS ZO PS, PB}, said represent {negative big, negative small, zero, positive small, positive big}. A fuzzy control rule table is established, as shown in Table 2.

Tab.2 Fuzzy control rule table

| ΔV | | EC | | | | |
|---|---|---|---|---|---|---|
| | | NB | NS | ZO | PS | PB |
| E | NB | PB | PB | PS | PS | PS |
| | NS | PB | PB | PS | ZO | NS |
| | ZO | PS | PS | ZO | NS | NS |
| | PS | PS | ZO | NS | NS | NB |
| | PB | NS | NS | NB | NB | NB |

## EXPERIMENT

Experiment of environmental monitoring on a pig farm pig, long and cold winter time in the area, larger temperature difference between day and night. In pig house placement of temperature sensor, [Amold, *et. al.*, 2002] humidity sensor and ammonia concentration sensor, each 5, were placed in the four corners and the center position and for measurement of indoor temperature, humidity and ammonia concentration. The initial temperature of the room is 18°C, the controller setting temperature is 22°C, the setting value of the humidity is 60%, the ammonia concentration is 8ppm, the test time is 24 hours, and the test results are compared with the manual control. The test results are shown in Figure 3-5.

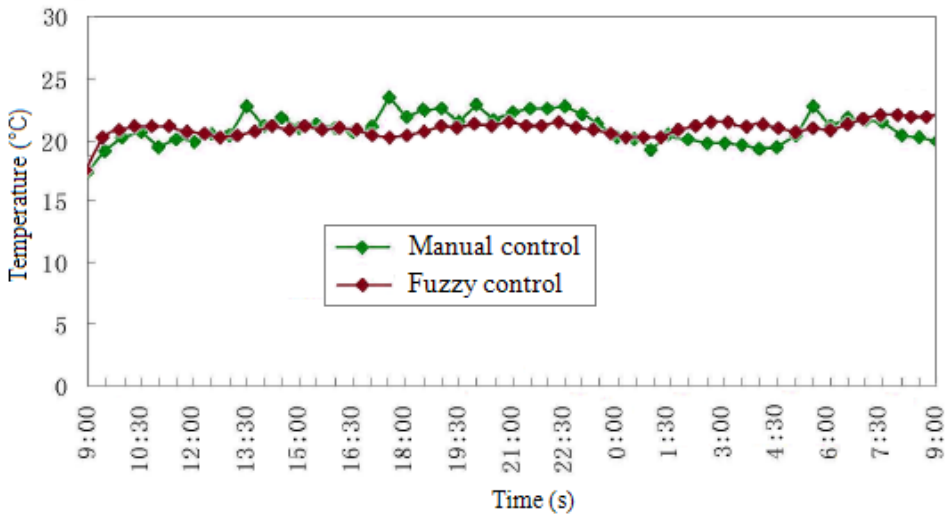


Fig.3 Temperature contrast curve

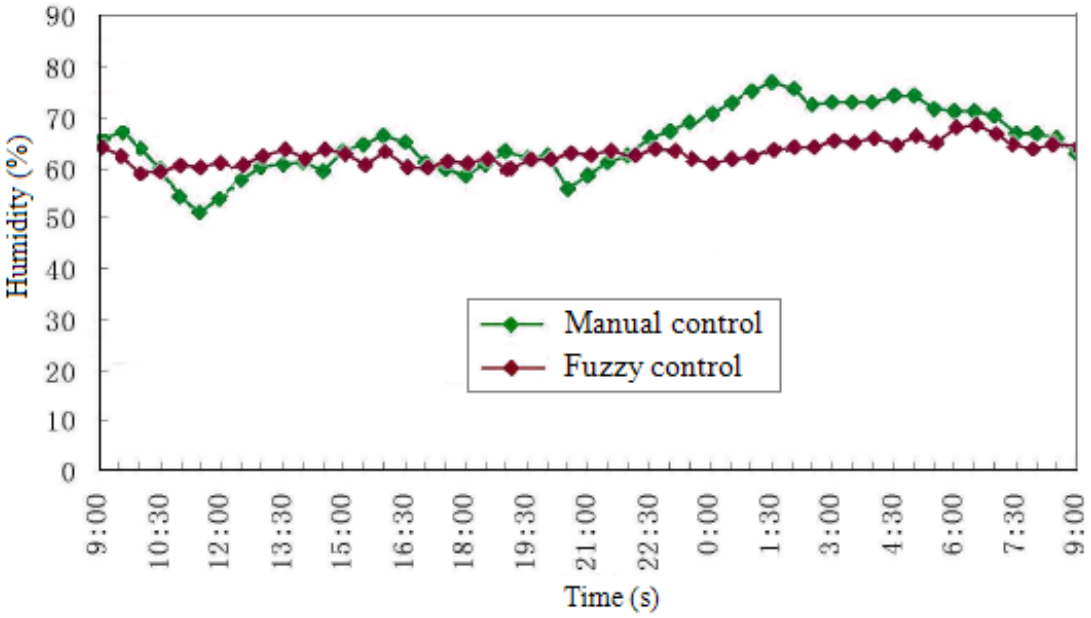


Fig.4 Humidity contrast curve

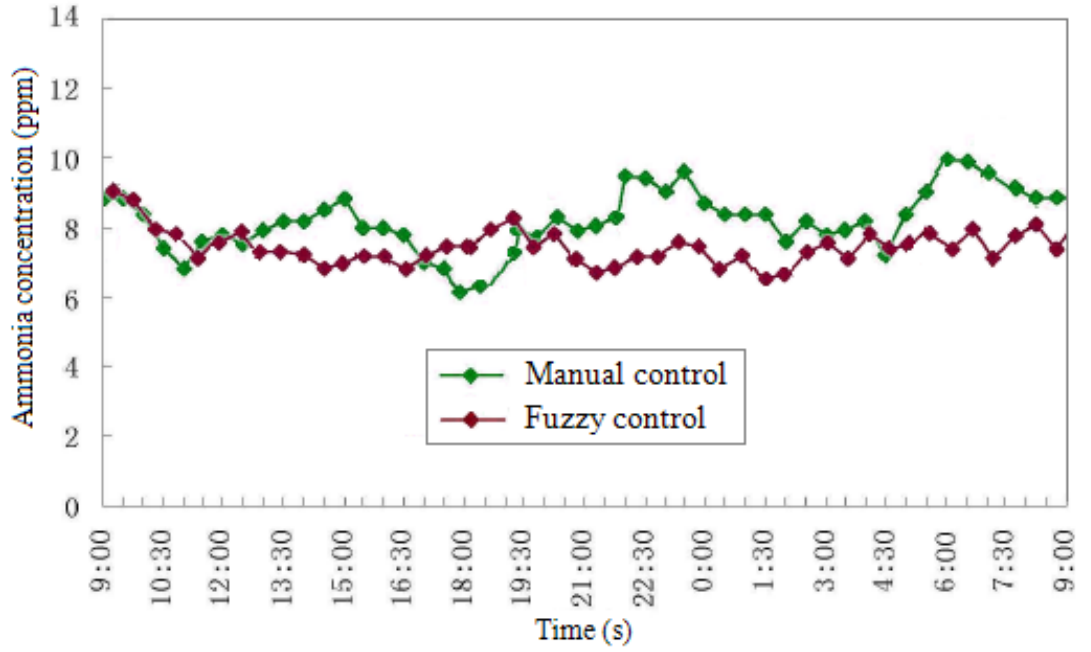


Fig.5 Ammonia concentration contrast curve

From the figure can be seen, compared with the traditional manual control, using fuzzy control in piggery environmental changes smoothly, and always maintain within the scope of the provisions, small external interference, has good control effect.

## CONCLUSION

Aiming at the shortcomings of the traditional control mode, the design of automatic monitoring system for piggery environment based on fuzzy control technology. Through the real-time detection of the piggery temperature, [Bin, *et. al.*, 2008] humidity and ammonia concentration, the fan and pump operation control, so as to ensure piggery environment are always in the best state. Experimental results show that the system has good control effect, fast response speed, and has a certain application value.

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