Automatic Temperature and Humidity control system by using Fuzzy Logic Algorithm for Mushroom nursery

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Abstract

This research present about Automatic temperature and humidity control system by using Fuzzy Logic algorithm for mushroom nursery. Fuzzy logic is used for analysis event in micro-controller for control device in mushroom nursery. The processes of system first is get value from temperature and humidity sensor and send data to micro-controller for analysis and control appropriate temperature and humidity by Fuzzy Logic algorithm, and send signal for control Mist sprayer and Heater. Researcher designs to experiment for 3 types of mushrooms are Straw mushroom, Angel mushroom, and Oyster mushroom in mushroom nursery size 3×5×3.5 meters. The results of this experiment are temperature and humidity control system can control appropriate temperature and humidity for 3 types of mushroom that used in experiment.

Keywords; *Automatic Mushroom nursery; Temperature and humidity control system.*

I. INTRODUCTION

Because it has good taste and high nutritional value. Some of mushroom has medicine properties. Therefore demand of mushroom to consumption will increase. Generally planting mushroom by abundant material from agriculture to be raw material for plant mushroom. Thailand has appropriate environment for plant mushroom to be agriculture economy. In 1975 after Karn Cholwijarn instructor study for developing of Infected Mushroom Loaf for making high productivity to export to foreign country [1]. Currently mushrooms that are necessary for agriculture economy in Thailand have 7 type are Straw mushroom, Black mushroom, Champion, Dried Chinese mushroom, Oyster mushroom, Angel mushroom, and Abler mushroom. From Thailand department of agricultural extension survey found many investor interest to investment about plant mushroom. In domestic have mushroom productivity more than 100,000 ton so plant mushroom job will making good income for farmer. However the process to making appropriate environment for mushroom has difficult. The main factor that effect with growing of mushroom are temperature and humidity so the most of farmer solving problem by plant in close system or mushroom nursery.

In this paper present about temperature and humidity adjusting process for mushroom nursery by using Fuzzy Logic to analysis. Researcher develops Fuzzy Logic from expert experiences for making learning machine. This system use for increasing efficiency of temperature and humidity adjusting, and save human resources and man power to monitoring in mushroom nursery . The data from experiment keep by temperature and humidity sensor that setting in mushroom nursery and send data to micro-controller for run Fuzzy logic process and getting signal to output for control fan, mist sprayer, and heater for control temperature and humidity from user setting..

II. FUZZYLOGIC

Fuzzy Logic [2-6] is a popular tool to analyze class of data for making decision support. Fuzzy logic can analyze uncertainty data so making it flexible. Fuzzy logic learning by reason that is emulate human thinking method and it has features that different from Boolean logic where Fuzzy can find the answer more than 2 answers. Fig. 1, is computing structure of Fuzzy logic

- Fuzzification is the process to convert input data to fuzzy input dataset.
- Knowledge base is a part to collect data consists of two parts. The first is Rule base is a part of define control process. Rule base define by expert person design in form of Linguistic rule. And second is Database is a part of preparing data and managing data for Fuzzy logic.
- Inference Engine is analyze and detect the facts and rules for making condition or reason to solving problem. And Inference Engine is a process to interpret for searching appropriate answers.
- Defuzzification is a part to convert fuzzy input dataset to output data that are in appropriate range of answer. The last process of this part is making the measurement for analyze with new situation or new input data.

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III. THE PROPOSED TECHIQUE

In this section present about develop Fuzzy Logic to making automatic control system. Fig. 2, present the overall device that use for making temperature and humidity control system in mushroom nursery. The design process of this system is get input data from temperature and humidity sensors and analyze by Fuzzy Logic process and take 3 output signals are fan (F), mist sprayer (M), and lamp (L).

A. Automatic control system

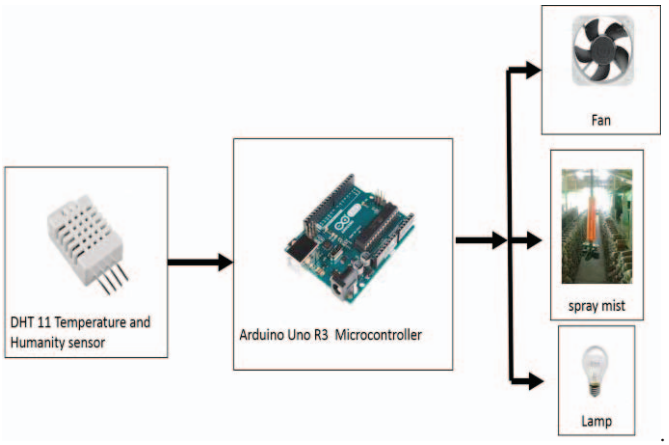

Fig. 1. Control System

In this research use Adruino Mega Uno R3 micro-controller board for develop automatic control system. And using temperature and humidity sensor (DHT11) that set around mushroom nursery keep input data. For temperature and humidity devices that use in mushroom nursery have 2 fans, Mist sprayer (8 head), and 3 lamps for making appropriate environment for mushroom.

B. Fuzzifacation.

In this step researcher set 2 input variables are

- Tin is temperature input data from sensor in mushroom nursety
- Hin is humidity input data from sensor in mushroom nursery

And set 3 output sigmal variables are fan (F), mist sprayer (M), and lamp (L). In process of converting input data to fuzzy input dataset researcher design to 3 fuzzy datasets are Low, Medium, and High by using Gaussian membership function for searching member of 3 fuzzy datasets.

$$Mediumfunction(x) = \exp\left(-\frac{(x-m)^2}{2\sigma^2}\right) \quad (1)$$

When

- m is average of temperature or humidity that appropriate for plant mushroom.
- σ is standard deviation of temperature or humidity.

$$Highfunction(x) = \exp\left(-\frac{(x-m)^2}{2\sigma_1^2}\right) \quad (2)$$

When

$$\sigma_1 = m - \sigma$$

$$Low(x) = \exp\left(-\frac{(x-m)^2}{2\sigma_2^2}\right) \quad (3)$$

When

- $\sigma_2 = m - \sigma$

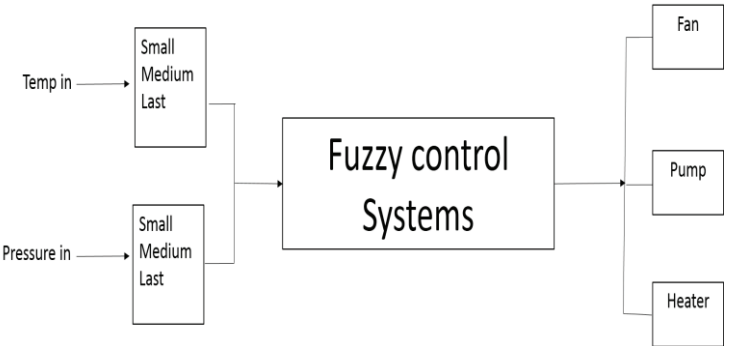

Fig 2. Overview of the proposed system.

C. Mushroom nursery

In this research use mushroom nursery width 3 meters, length 5 meters, and height 3.5 meters. Plastic is used to partition around mushroom nursery. For the roof of mushroom nursery researcher design to curve roof for good to ventilate and transport moisture. And the front and back of mushroom nursery researcher set fan via show picture in Fig 3.

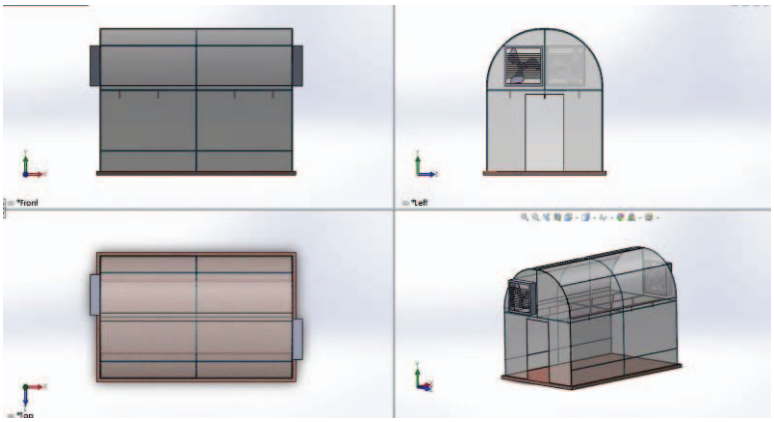

Fig 3. Mushroom nursery design 4 viewpoints

D. Output Signal.

Output signal is signal that send to control device for control degree. This process use Gaussian membership function to define member.

Fan have 2 fuzzy sets are

- F = Low means 1 fan operating.
- F = High means 2 fans operating.

Lamp have 3 fuzzy sets are

- Heat = Low means 1 lamp operating.
- Heat = Medium means 2 lamps operating.

- Heat = High means 3 lamps operating.

Mist Sprayer have 3 fuzzy sets are

- M = Low means 4 heads of mist sprayer operating.
- M = Medium means 6 heads of mist sprayer operating.
- M = High means 8 heads of mist sprayer operating.

E. Rule base

From rule base that use in Fuzzy Logic is designed by Mr.Sarawuth Mala who is entrepreneur and expert of plant mushroom in mushroom nursery. Researcher design system by getting 2 inputs and process in Fuzzy Logic and get 3 degree for control Fan, Mist sprayer, and Lamp.

Table 1.Rue Base

(Input)		**Output**		
T_{in}	H_{in}	***F***	***M***	***L***
Low	Low	off	Medium	High
Low	Meduim	off	Low	High
Low	High	off	off	medium
Meduim	Low	off	off	High
Meduim	Meduim	off	off	off
Meduim	High	Low	off	Low
High	Low	High	Low	off
High	Meduim	High	off	off
High	High	High	off	off

IV. CONCLUTION

Researcher experiment this system in 6 mushroom nurseries consists of 2 Straw mushroom nurseries, 2 Angel mushroom nurseries, 2 Oyster mushroom nurseries. Researcher design experiment by set automatic control for 1 mushroom nursery and use human control this system by manually 1 mushroom nursery. This experiment spends 3 months since first step to plant mushroom to get productivity of mushroom.

Efficiency to control temperature in mushroom nursery.

When compare automatic control system with human control can conclude that automatic control system continuous to control temperature better than human control.

Fig. 4, present temperature control results of straw mushroom plant by automatic system compare with human control devices. In experiment show system good temperature control in range 24.7 to 28.2 Celsius. And human can control in range 26 to 32.8 Celsius so this experiment researcher set appropriate temperature for straw mushroom in range 24 to 28 Celsius.

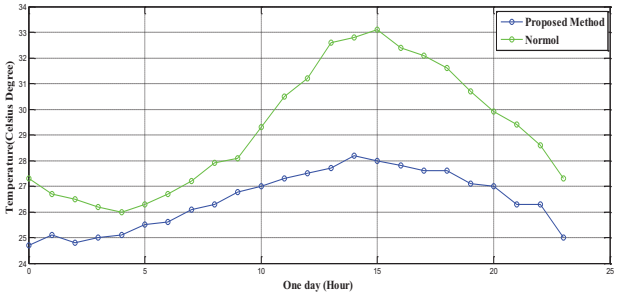

Fig 4. Temperature in straw mushroom nursery 1 day

Fig.5 , present temperature control results of oyster mushroom plant by automatic system compare with human control devices. In experiment show system good temperature control in range 26 to 32 Celsius. And human can control in range 26 to 33.1 Celsius so this experiment researcher set appropriate temperature for oyster mushroom in range 24 to 32 Celsius.

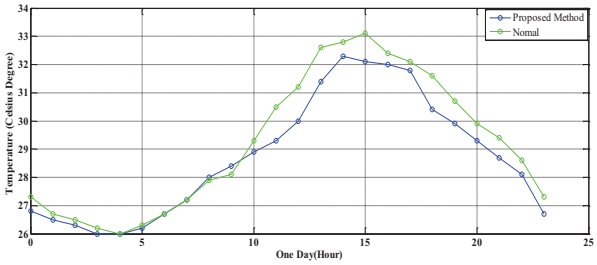

Fig 5. Temperature in oyster mushroom nursery 1 day

Fig.6 , present temperature control results of angel mushroom plant by automatic system compare with human control devices. In experiment show system good temperature control in range 26.1 to 32.2 Celsius. And human can control in range 24.7 to 33.4 Celsius so this experiment researcher set appropriate temperature for angel mushroom in range 24 to 32 Celsius.

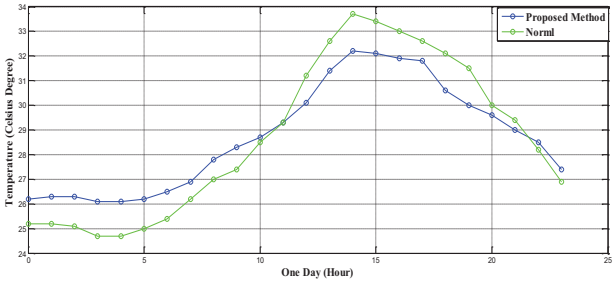

Fig 6. Temperature in angel mushroom nursery 1 day

Efficiency to control humidity in mushroom nursery.

When compare automatic control system with human control can conclude that automatic control system has efficiency to control humidity better than human control.

Fig. 7, present humidity control results of straw mushroom plant by automatic system compare with human control devices. In experiment show system good humidity control in range 65 to 69 %. And human can control in range 50 to 85 % so this experiment researcher set appropriate humidity for straw mushroom in range 60 to 70 %.

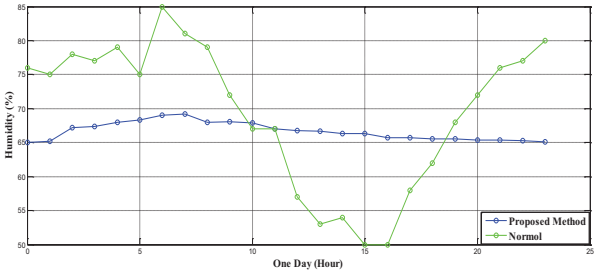

Fig 7. Humidity in straw mushroom nursery 1 day

Fig. 8, present humidity control results of oyster mushroom plant by automatic system compare with human control devices. In experiment show system good humidity control in range 70 to 87 %. And human can control in range 50 to 94 % so this experiment researcher set appropriate humidity for oyster mushroom in range 70 to 85 %.

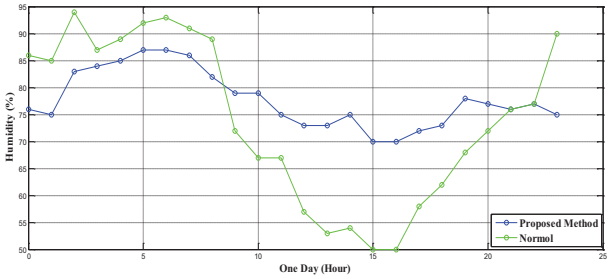

Fig 8. Humidity in oyster mushroom nursery 1 day

Fig. 9, present humidity control results of angel mushroom plant by automatic system compare with human control devices. In experiment show system good humidity control in range 72 to 86 %. And human can control in range 53 to 94 % so this experiment researcher set appropriate humidity for angel mushroom in range 70 to 85 %.

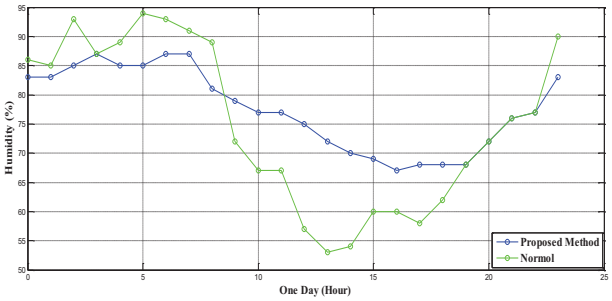

Fig 9. Humidity in angel mushroom nursery 1 day

This research show that automatic control system by using Fuzzy Logic has ability to control temperature and humidity. And automatic control system has good control when compare with human manually control. Therefore this system can represent with human control for decrease man power or human resources.

REFERENCES

[1] Manthana I, Panamas T, and Supattra S. Study on Mushroom Production Status of Farmers in Pak Chong Sub-district, Chom Bueng District, Ratchaburi Province. Journal of Agricultural Extension and Communication.2013; Vol.9 No.2 47 – 57.

[2] Juan L. TKNN: An Improved KNN Algorithm Based on Tree Structure. In: The 7th International Conference on Computational Intelligence and Security (CIS), 2011, Page No. 1390-1394.

[3] Kriesel D. A Brief Introduction to Neural Networks, 2007, Page No. 37-124.

[4] Lina L, Huijuan Q, and Jia L.The Research of Alphabet Identification Based on Genetic BP Neural Network.In: 2012 4th International Conference on Intelligent Human-Machine Systems and Cybernetics, 2012, Page No. 25-28.

[5] Liu H, Zhang S, Zhao J, Zhao X, and Mo Y.A New Classification Algorithm Using Mutual Nearest Neighbors.In: The 9th International Conference on Grid and Cooperative Computing (GCC), 2010, Page No. 52-57.

[6] Petrudi J, Hossein S, Pirouz M, and Pirouz. B.Application of fuzzy logic for performance evaluation of academic students.In:Fuzzy Systems (IFSC), 2013 13th Iranian Conference on, 2013, Page No. 1-5.