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Fuzzy Logic Approach with Microcontroller for Climate Controlling in Green House

S.D. Dhamakale* and S.B. Patil*

**D.Y. Patil College of Engineering and Technology, Kolhapur, (MS)*

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ABSTRACT : For Green house climate control, in now days computerized control is required. Many old systems are based on (1) ON-OFF (2) Proportional control methods, which are not so helpful. Limitations of this methods are loss of energy, labor ,productivity. To maintain a constant climate a more sophisticated system must be used. By using fuzzy logic logic programming Green House Climate Controller (GHCC) is designed. Developed fuzzy logic controller (FLC) is based on Mamadani controller & it is based on MATLAB software. Fuzzy Logic is a mathematical technique that greatly enhances the capability of classical set theory by allowing the "degree of membership" or "truth value" to range over the interval of 0 to 1. Sets in fuzzy logic systems typically describe ranges of operations and are named using linguistic adjectives such as "slow", "medium" or "fast". The degree of membership describes how "slow" or how "fast" a particular value is.

The controller formed sharply controls parameter such as temperature & humidity & intensity of green house to great extent. It achives dynamic optimization from economic view for green house model.

Keywords : Fuzzy logic, green house climate control green house model

I. INTRODUCTION

Old approach uses rules such as understand physical system & control requirements, develop a linear model of plant sensor & actutators, determine a simplified controller from control theory, develop an algorithm for the controller, simulate, debug implement the design. If the performance is not satisfactory then the system must be remodeled, the controller must be redesigned, algorithm must be rewritten & retry. If we use fuzzy logic the steps are as follow,

1. Know physical system & control requirements.

2. Design the controller using fuzzy rules

3. Simulate, debug implement the design. If the performance is not well, we only need to modify some fuzzy rules & retry. Merits of fuzzy logic: 1) Simplified design complexity. 2) Reduced hardware costs. 3) Simplified implementation. Fuzzy Logic is a very powerful concept when applied to control systems. It allows control system designers to greatly reduce the number of rules necessary to deploy a desired control strategy. It allows rules to be crafted in a very linguistic syntax. Finally, if properly designed, instabilities and hysteresis can be reduced or eliminated.

II. FUZZY LOGIC CONTROLLER

Most commercial fuzzy products are rule-based systems that receive current information in the feedback loop from the device as it operates and control the operation of a mechanical or other device. Crisp input information from the device is converted into fuzzy values for each input fuzzy set with the fuzzification block. The universe of discourse of the input variables determines the required scaling for correct per-unit operation. The scaling is very important because the fuzzy system can be retrofitted with other devices or ranges of operation by just changing the scaling of the input and output. The decision-making-logic determines how the fuzzy logic operations are performed (Sup-Min inference), and together with the knowledge base determine the outputs of each fuzzy IF-THEN rules. Those are combined and converted to crispy values with the defuzzification block. The output crisp value can be calculated by the center of gravity.

Fuzzy Logic Controller has following blocks

[1] Fuzzification interface: It measures the values of input variables & performs scale mapping that transfers the range of values of input variables into corresponding universe of discourse. Actually it does the function of fuzzification.

[2] Knowledge data base: It consists of (a) data base & (b) rule base.

[3] Here data base provides necessary definitions which are useful for defining linguistic control rules & fuzzy data manipulation in FLC .The rule base characterizes the control goals &control policy of the domain experts by means of set of linguistic control rules.

[4] Defuzzification: It performs scale mapping which converts the range of values of output variables into corresponding universe of discourse.

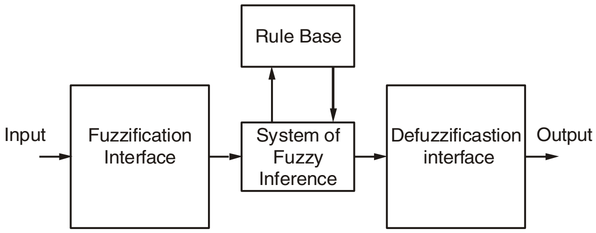

Fig. 1. Fuzzy Logic Controller.

III. BLOCK DIAGRAM

Temperature, Humidity & intensity are analog in nature These signals will be converted into digital signals by using on chip A/D converter .The sensor outputs are applied to ADC (on chip) of microcontroller (LP2148) which is programmed to work as a Fuzzy Logic (FLC).LCD display will show current as well as modified values of humidity, temperature and intensity.

We can control above parameters by using actuators such as fan, sprinkler. Temperature, humidity, intensity are analog in nature. These signals will be applied to A/D converter, which converts analog signals into digital, which in turn will be analyzed by microcontroller. If temperature is greater than threshold then corresponding relay and actuator will be turned and corresponding parameter will be monitored and controlled.

The LPC2148 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal perfomance penalty. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. A blend of serial communications interfaces ranging from a USB 2.0 Full Speed device, multiple UARTs, SPI, SSP to I2Cs, and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial application.

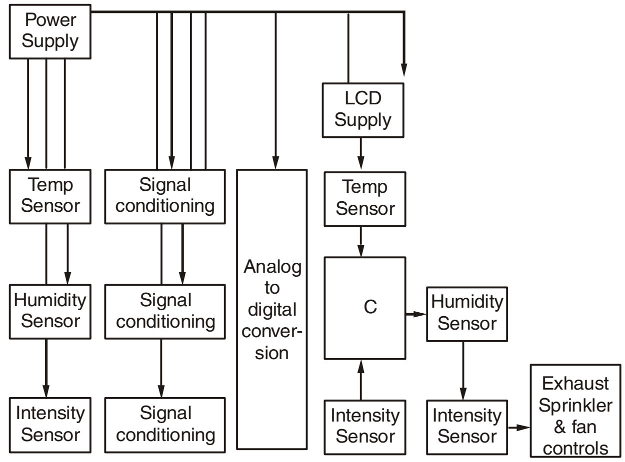

Fig. 2. Block Diagram.

IV. WORKING OF INFERENCE SYSTEM:

Fuzzy inference system consists of a fuzzification interface, a rule base, a database, a decision-making unit, and finally a defuzzification interface.– a rule base containing a number of fuzzy IF–THEN rules;

– a database which defines the membership functions of the fuzzy sets used in the fuzzy rules;

– a decision-making unit which performs the inference operations on the rules;

– a interface which transforms the crisp fuzzification inputs into degrees of match with linguistic values; and

– a defuzzification interface which transforms the fuzzy results of the inference into a crisp output.

The working of FIS is as follows. The crisp input is converted in to fuzzy by using fuzzification method. After fuzzification the rule base is formed. The rule base and the database are jointly referred to as the knowledge base. Defuzzification is used to convert fuzzy value to the real world value which is the output. The steps of fuzzy reasoning (inference operations upon fuzzy IF–THEN rules) performed by FISs are:

[1] Compare the input variables with the membership functions on the antecedent part to obtain the membership values of each linguistic label. (this step is often called fuzzification.)

[2] Combine (through a specific *t*-norm operator, usually multiplication or min) the membership values on the premise part to get firing strength (weight) of each rule.

[3] Generate the qualified consequents (either fuzzy or crisp) or each rule depending on the firing strength.

[4] Aggregate the qualified consequents to produce a crisp output.

V. MAMDANI'S FUZZY INFERENCE METHOD

Mamdani type inference, as defined it for the Fuzzy Logic Toolbox, expects the output membership functions to be fuzzy sets. After the aggregation process, there is a fuzzy set for each output variable that needs defuzzification. It is possible, and in many cases much more efficient, to use a single spike as the output membership function rather than a distributed fuzzy set. This is sometimes known as a *singleton* output membership function, and it can be thought of as a pre-defuzzified fuzzy set. It enhances the efficiency of the defuzzification process because it greatly simplifies the computation required by the more general Mamdani method, which finds the centroid of a two-dimensional function.

To compute the output of this FIS given the inputs, six steps has to be followed

[1] Determining a set of fuzzy rules.

[2] Fuzzifying the inputs using the input membership functions.

[3] Combining the fuzzified inputs according to the fuzzy rules to establish a rule strength.

[4] Finding the consequence of the rule by combining the rule strength and the output membership function.

[5] Combining the consequences to get an output distribution .

[6] Defuzzifying the output distribution.

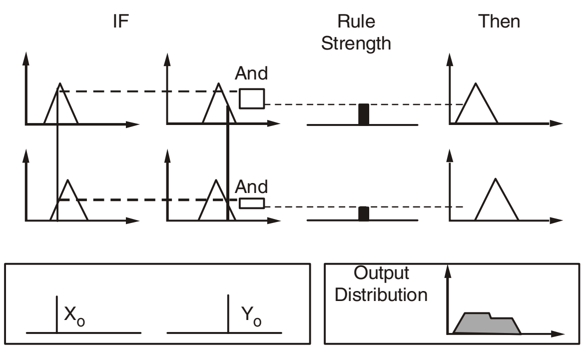

Figure 3. Rule Strength Determination.

VI. RESULTS:

Figures below shows results obtained. It shows relationship how one can adjust the o/p devices connected to monitor and control. By looking at the analysis it is possible to control and monitor temperature, humidity, intensity with the help of fan and sprinkler.

VII. CONCLUSION

LPC 2148 effectively works as a Fuzzy Logic Controller for green house climate control.

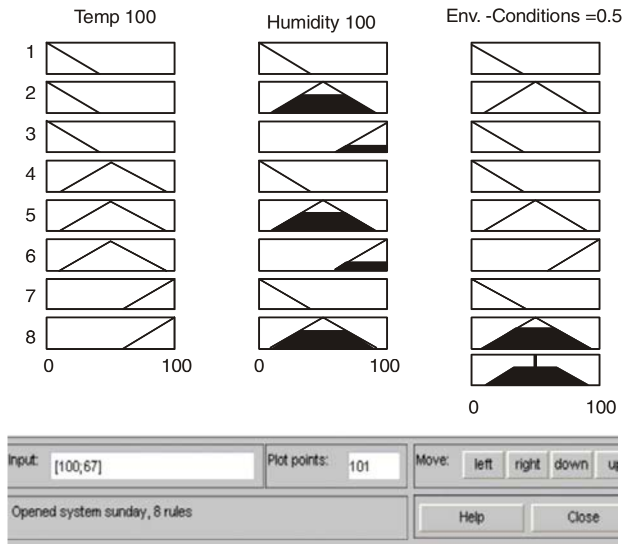

Fig. 4. Result [1].

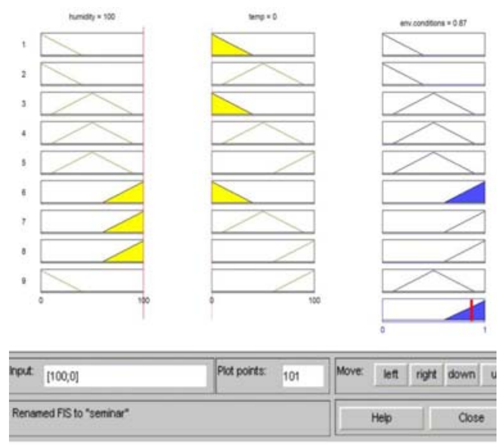

Fig. 5. Result [2].

ACKNOWLEGEMENT

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REFERENCE

[1] Environmental Informatics Archives, Volume 2 (2004) EIA04-070 ISEIS Publication #002 © 2004 ISEIS - International Society for Environmental Information Sciences A Fuzzy Inference System Approach for Greenhouse Climate Control Sriraman and R. V. Mayorga Faculty of Engineering, University of Regina, Canada.

[2] Greenhouse Climate Models: An Overview Jo sé Boaventura Cunha, @utad.ptUTAD – Universidade de Trás-os- Montes e Alto Douro, Dep. CE5001-911 Vila Real, Portugal.

[3] The Fuzzy Inference System Translator (FIST) and Micro-Controller Growth Chamber Temperature and Humidity Bill Taylor, Elena Leyderman, James Vredenburg. .