GREEN HOUSE MODELLING USING FUZZY LOGIC CONTROL

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Abstract

Currently the climate computer offers many benefits and solves problems related to the regulation, monitoring and controls. Greenhouse crop production systems are located throughout the world within a wide range of climate condition. To improve understanding of complexity and dynamic behavior of greenhouse environment, the greenhouse environment model based on energy balance principle is used. A control system is presented using fuzzy controller. To increase agricultural output it is needed a system that can help the environmental conditions for optimum plant growth. Smart greenhouse allows for plants to grow optimally, because the temperature, humidity, light and pH can be controlled so that no drastic changes. Two operating modes in GUI: Cultivation mode and online selection mode. Cultivation mode works as per sensor values. In online selection mode the crop name is entered and the necessary climatic condition for the plant growth will automatically reached.

Index Terms: Greenhouse, Fuzzy Controller, Temperature, Humidity

1.Introduction

Increased demand and requirement of fresh products consumers throughout the year, led parallelly to a rapid development of agricultural greenhouse, which is today modern and quite sophisticated. Agricultural greenhouse aims to create a favorable microclimate to the requirements of the plant, necessary for its growth and development, from the surrounding weather conditions. it produces based cropping calendars, off-season products, cheap and widely available along the year.

Climate change is happening today has made farmers difficulties for increasing agricultural product. Erratic weather conditions led to the planting and harvesting cannot be determined and estimated. Farmers are difficult to predict the weather in the growing season. Mark and Davel describe an annotated bibliography on issues relating to changes in the concentrations of Earth's greenhouse gases. The areas covered include theory and numerical modelling of climate change; cycles involving carbon dioxide and other radiatively important trace gases; observations of climate change and the problems associated with those observations; paleoclimatology as it relates to previous changes in the greenhouse gases; the impacts on and interactions with managed and natural ecosystems from climate change; policy issues related to climate change and to the limitation of climate change; history of the study of the green house effect; and some other causes of climate change.

Greenhouse production systems are originally implemented in cold countries in order to extend the production season of plants and improve environmental condition. Now-a-days the greenhouse production is spread all over the world. In order to accomplish the specific environmental need of various crops, greenhouse design varies in shape, size, and glazing material. Further various types of equipments are obligatory to achieve the desired environmental conditions. The main environmental parameters controlled in greenhouse are: 1) Air temperature, 2) Airmoisture (relative humidity), 3) pH,

4) Light Intensity. Greenhouses are designed and equipped with exhaust fans, ventilators,

cooling pads, heaters and also with light supplementing system .

It is defined by its structural and functional architecture, the optical quality, thermal and mechanical coverage and the accompanying technical means. it is considered as a very confined environment where many components are exchanged between them, and in which the main factor involved in this medium is light, temperature and relative humidity . to manage the greenhouse microclimate, greenhouse growers often use methods such as passive static ventilation (opening), shade screens, evaporative cooling etc ... and occasionally the active type. these methods are less expensive but more difficult to manage and optimize. The first objective is to improve the thermal capacity of the green house(greenhouse).

This is, to characterize the behavior of the complex system that is the greenhouse with its various compartments (ground, culture, cover, indoor and outdoor environment). To develop non-stationary mathematical models usable for simulation, optimization and the establishment of laws and control of simple and effective regulation.

These models must reproduce the essential properties of the mechanisms and interactions between different compartments. They must be both specific enough to obey the dynamic and real behavior of the greenhouse system, and fairly small to be easily adaptable to the phases of the simulation. Good modulation instructions depending on the requirements of the plants to grow under shelter and outdoor climatic conditions, result in a more rational and efficient use of inputs and equip the best production performance.

In this paper, or using fuzzy logic which is a powerful way to optimize and facilitate the global management of modern greenhouse, while providing through simulation interesting and encouraging which results in an optimization of favorable state variable values for the growth and development of protected cultivation .

A. Control System Of Smart Green house

Plants can grow properly if schedule for watering is done every day. In the conventional greenhouse, watering is done manually by the owner to perform continuous scheduling watering during the day.

This being smart greenhouse that plants watering process is performed automatically in accordance with the sensor values. The greenhouse smart also uses temperature, pH, moisture and humidity sensors to maintain the condition of the plants in the green house.

The control system is Arduino controller.

1) SYSTEM ARCHITECTURE: Four sensors are used: Temperature and Humidity Sensor[DHT], Moisture Sensor, Light Sensor, pH Sensor. The controller is ATMEGA 328. Four relays are used to perform the output action. The sensor senses the values and it directly stores into ESP8266 module. Based on the values data-sheet is obtained. From those values rule set is formed using fuzzy. So when a sensor senses the value it will check the rule set and corresponding to those rules Arduino works.

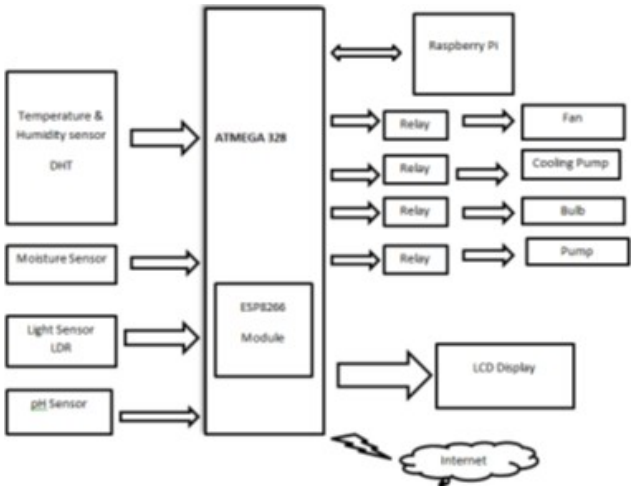

Fig. 1. Block Diagram

2) SYSTEM DESIGN AND WORKING: The proposed model aims to implement automated and efficient monitoring of Greenhouse using Fuzzy logic. Automated Greenhouse using fuzzy logic is the most important and demanding operational responsibilities. Using pH Sensor, Temperature sensor, light sensor, Moisture sensor we measure the conditions of plants in the Green house. Then the conditions is analyzed using fuzzy controller. This project shows the communication between the Microcontroller

and raspberry pi.

First the Greenhouse parameter collected using temperature sensor, pH sensor, Light sensor and Moisture Sensor of plant were collected from different types of plants. The graphical user interface (GUI) is a created in order to interact with electronic devices through graphical icons. The datas were uploaded to the cloud using Think speak server. This will allows the system to be monitored from anywhere using an internet connection. The data collected through 3 Think speak server was given as input to the fuzzy logic controller. The software implementation was done with help of the arduino controller and raspberry pi.

B. Fuzzy Logic Control

Fuzzy logic is an effective in feedback control system and easier to implement. The computational structure of fuzzy logic is composed of Fuzzification, Inference engine and Defuzzication modules. The control system implemented here is a multi input multi output system with input as error in temperature, 'error in moisture', 'error in humidity' and Ventilation rate, 'pump rate' and 'heating rate' as output variable. The Fuzzification translates the numerical values for error in each values into a linguistic value such as low, very low, zero, high and very high. A fuzzy inference engine infers fuzzy outputs by employing fuzzy implications and the rules of inference of fuzzy logic. Defuzzification takes the fuzzy output of the rules and generates the output formulated in the form of crisp numeric value used as control input to plant. The relation between input and output in the form of If-Then rules, which are based on dynamic performance of process.

Rule	If error in Temperature is	Then Ventillation rate is
Rule 1	Very Low	Very High
Rule 2	Low	High
Rule 3	Zero	Medium
Rule 4	High	Low
Rule 5	Very High	Very Low

Fig. 2. Fuzzy Rule base with Crisp Values of temperature sensor

Membership Functions

The values from data sheet are mapped in order to get membership function. Decisions given by the fuzzy controller is derived from the rules which exist in the database. These decisions are stored as a set rule. Rule-the rule is an if-then statement is intuitive and easy to understand, because only a linguistic statement. The first input is a temperature sensor with conditions of low, medium and high use trimf using the membership function types. The range values from 0 to 40 express the magnitude of the temperature in the green house.

A second input of humidity with level of membership function low, medium and high. As the humidity is high then bulb will be 'ON'.

Before testing the system user have to start training the system for that a database icon included in GUI. It consists of two modes of operation in raspberry pi. In the case on cultivation mode, we can able to see the sensor values also we must be able to plot the graph.

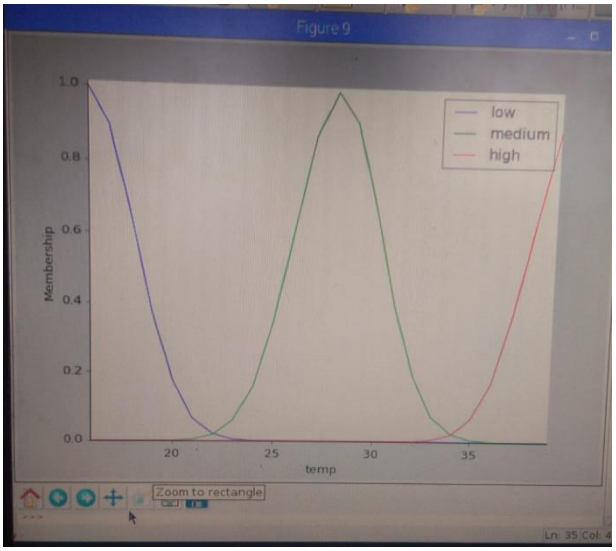

Fig. 3. Temperature as an input of Fuzzy system

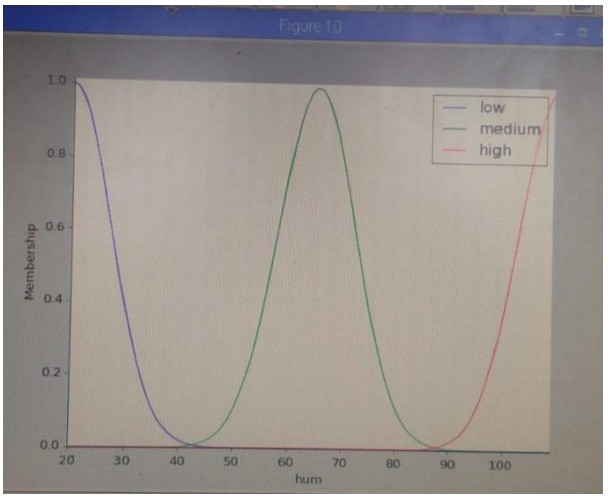

Fig. 4. Humidity as an input of fuzzy logic system

It consists of two modes of operation in raspberry pi.

Cultivation Mode

In cultivation mode, the sensor output values are given to the fuzzy logic controller. In each one minuites the sensor outputs readed by the FLC. Then it will provide the outputs based on the set of rules. So the temperature goes High more than the optimum values, then cooling pad and ventilation fan ”ON” inorder to reduce the temperature. When the water level goes low than the particular range,it will be sensed by the Moisture sensor. Thus the pump will be ”ON”. Thus the water level is maintained. When the Humidity is ”High” than the particular range, it will be sensed by the DHT. Thus the bulb will be ”ON”. The output of the fuzzy controller is given to the arduino controller and raspberry pi. So if the water level is goes to low then the pump will be on automatically. If the temperature goes high then cooling pad and ventilation fan will be on automatically. All the operations done continously.

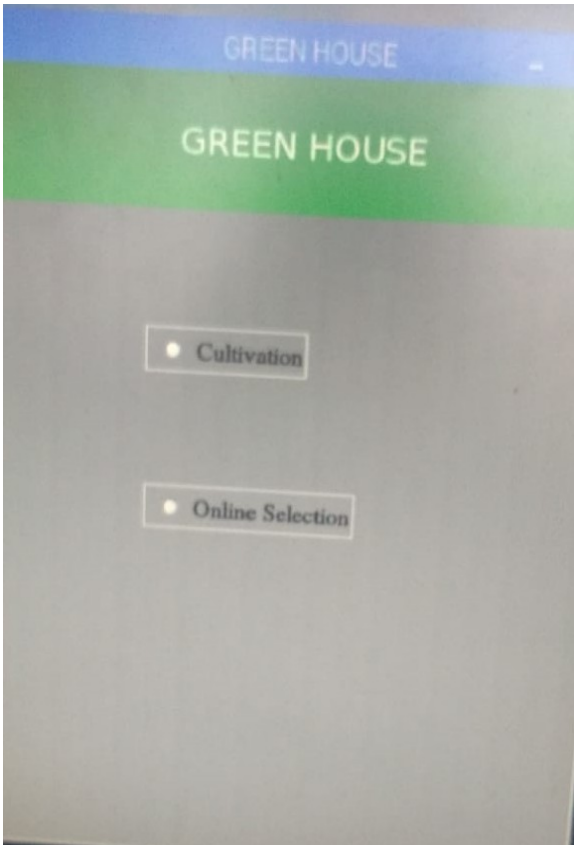

Fig. 5. Implemented GUI

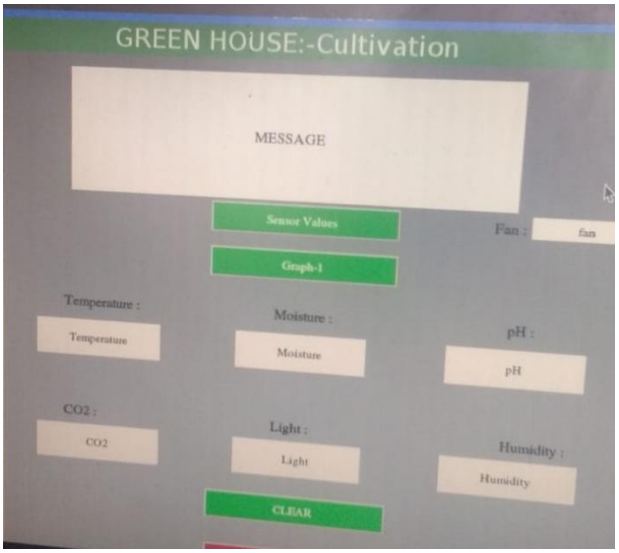

Fig. 6. Cultivation Mode

Online Selection Mode

We are not able to cultivate seasonal crops in any season. so for producing any crop at any season we must able to generate the climate conditions required for the plant growth.

This idea is implemented using online selection mode. The first thing in this mode is to collect data related to each crop. When we type the crop name automatically the temperature, moisture, humidity will be collected from the database related to that crop. Then the climate will be automatically set by the perfomance of bulb, pump, cooling pad and ventilation.

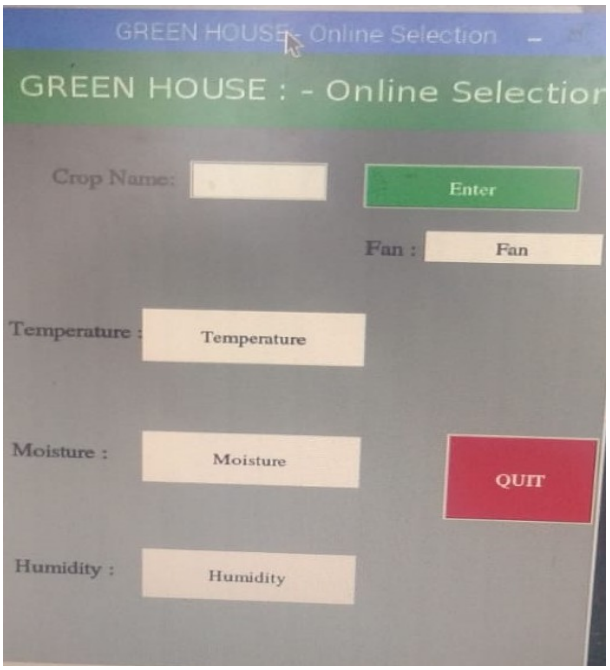

Fig. 7. Online selection Mode

II. RESULT ANDANALYSIS

The results obtained on the duration of the pump tests using fuzzy logic control then carried for watering plants in the greenhouse temperature obtained every hour can be seen in the graph.

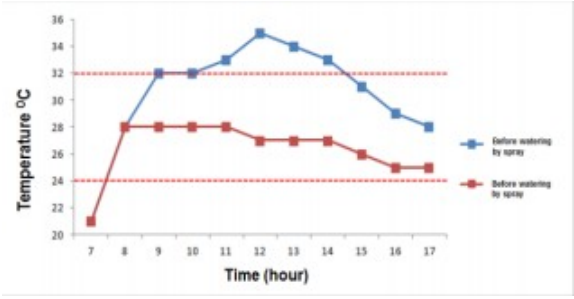

Fig. 8. The temperature before and after watering

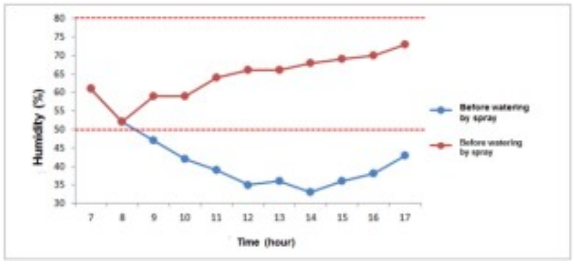

Fig. 9. Humidity inside green house before and after watering

III. CONCLUSION

This technique of fuzzy logic that has been adapted to the greenhouse to a promising future for the climate control and management of the green house. for greenhouse growers, it is a preferred approach for structuring and knowledge aggregation and as a means of identification of gaps in the understanding of mechanisms and interactions that occur in the system- greenhouse. So by using this greenhouse we are able to produce any required climate for the crop generation. This will help us to get any seasonal crops at anytime.

Fig. 10. Automated Greenhouse using Fuzzy

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