Fuzzy Logic based automatic Greenhouse Monitoring System using Arduino & Labview

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Abstract— Greenhouse forms an important part of the agriculture in India specially in chhattisgarh Existing system is difficult to maintain the plant growth so, there is a need of automation in greenhouse. Automatic controlling of the environmental factors such as temperature, light intensity and soil moisture using arduino board and labview is proposed in this system. These parameters play a vital role in the proper growth of crops. Here the constant temperature is maintained frequently by turning ON & OFF the light & fan. Temperature and soil moisture is controlled using arduino board and graphical user interface monitored and controlled using LabView. The purpose of this work is to design a labour free, sensor based greenhouse monitoring & controlling system which is fully automated. The output signal is generated from different sensors, which in turn sent to the for appropriate action. This results in proper growth of different plants in greenhouse. an automated environmental control system for a prototype greenhouse system using embedded systems technology. Efficiency and performance of AEC algorithm technique and the results of these has compared to one of the existing technique. He simulation result provides an exact idea for temperature, humidity, and water output for the prescribed agricultural field. The advantages of applying FLC are increasing Irrigation Efficiency, increasing the type of crop and harvest, in addition saving the electrical power. In this method the greenhouse effect using growth of different crops depend upon environment and crops growth condition. All condition set automatic using fuzzy logic all sensors are connected to arduino board and sensor value and analysis using labview and automatically take decision using fuzzy logic to control the greenhouse effect to help growth of crops and controlling fan, light and water using set of rule in fuzzy logic input of temperature humidity and soil moisture condition.

Keywords: Labview, Arduino, LIFA Tools, Fuzzy Logic Tool

I. INTRODUCTION

Tomatoes are one of the basic food crops of vegetables when most people in the world. Tomatoes growing well in warm fertile land exchange good advertising in areas exposed to direct sunlight for at least 6 hours a day. Tomato crop of choice for agriculture gardening is standard because it can grow in almost all types of land rows, plus it gives a great crop of relatively small area. Most varieties produce from 4.5 to 7 kg of fruit per leaf. Although they contain a high percentage of water has high nutritional value. as a source of energy, where many vegetables and other food crops got high benefits due to its contents of salts and vitamins and organic acids. Substantial the importance of this crop yields per unit area is still small compared to what it should have been due mainly to lack of correct methods in the cultivation of this yield. Many researchers use advanced technology in controlling environmental factors affecting mainly on the growth and the quality and quantity of agricultural crops, including tomato crop. The greenhouse is used, the weather conditions for the development of agricultural crops where work to control temperature and humidity and other environmental factors are excellently to reflect its impact on Agricultural crops [1-3]. Intelligent control system that combine sensors and actuator nodes currently are considered as one of the most significant technology in the greenhouse climate control [4-5]. Intelligent control system based on Fuzzy logic controller has great advantages in terms of cost, flexibility, autonomy and robustness as it compared to classical control system [6]. Greenhouses are used to enhance the environment condition for crops; hence, the climate control of a greenhouse (GH) requires deploying of multi types of sensors and actuators [7]. Using automatic control will highly assist of reducing energy conservation, scalability, enhance productivity process and reduce human intervention [8-11]. The important environmental factors such as Temperature, Light intensity,CO2 concentration, etc., affect the growth of crops and its development. The greenhouse system is composed of heating system, lighting system, ventilation system and automatic sprinkling system [1].

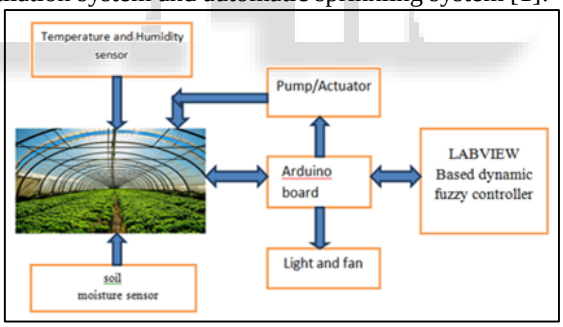

Fig. 1: Block diagram

This system is based on continuous monitoring and controlling the parameter which plays important role in green house. When the temperature reach a certain threshold value, the temperature sensor will send the information to controller, the controller will process that signal and perform appropriate actions. This system is designed in such a way that it automatically controls the different parameters such as temperature, intensity of light, soil moisture etc. This system reduces the manual overheads of monitoring different parameters and in process it reduces the percentage of the errors occurring due to the manual operations. Green houses are climate controlled. Green Houses have a variety of applications. The major application is being, off-season growing of vegetables, fruit crop and plant breeding [5].The structure of greenhouse range in size from small sheds to industrial-sized buildings. A miniature greenhouse is called as a cold frame. The interior of a greenhouse exposed to

sunlight becomes significantly warmer than the external ambient temperature and it protects its contents during cold weather. Many commercial glass greenhouses or hothouses provide high tech production facilities for vegetables and flowers. The glass greenhouses are equipped with screening installations, heating, cooling, and lighting. It may be controlled by a labview to optimize conditions for plant growth [5]. The environmental parameters temperature, moisture and smoke are sensed by sensors send signal arduino uno board and labview interface arduino though ni-visa send labview graphical user interface window and analysis the condition and send signal for output though arduino connected device.

A. Fuzzy Logic Control

Many practical control systems and processes have dynamic and complex characteristics, such as uncertainty and non-linearity. In addition, the complexity of such systems increases with the ever increasing demands for autonomy and intelligent decision making abilities. Accurate mathematical models to capture and model all these characteristics and attitudes are either not easily attainable or too complicated. The design of conventional controllers such as PID and the functionality and performance of these controllers depend on the accuracy of the models. Therefore, applying conventional controllers has revealed some limitations in controlling these systems particularly when they are applied to non-linear systems or when the circumstances surrounding a process under control are changing.

B. Different types of tuning in fuzzy logic controller

1) Tuning via Trial and Error Methods

In most cases, a nominal fuzzy controller is designed for a plant and then, based on some prior knowledge, the controller parameters are adjusted by a process of trial and error until a satisfactory performance is achieved the adjustment might include the input and output membership functions' parameters, the input and output gains or the rule-base system.

2) Tuning via Intelligent Optimization Techniques

In order to deal with the difficulties in tuning fuzzy logic controllers and find optimal values of the parameters, the use of several intelligent optimization tools has been proposed by many researchers. These tools, also known as Evolutionary Algorithms (EAs), are inspired by the functionality of intelligent biological systems, either in the way they perform a task or how they find an optimal solution to a problem.

3) Tuning via Supervisory Algorithms

These algorithms are mainly based on the observation of some of the control system signals, such as the error, the change of error, the control signal, the plant output or (a combination of them) to adjust the controller parameters. In this scheme, an upper level algorithm or a fuzzy controller acting as a system supervisor, normally called a 'supervisor controller', is added to a system to monitor the performance of another direct fuzzy controller.

4) Tuning Methods from Conventional Control Algorithms

As fuzzy logic control has its foundation in the conventional control, there are some similarities between them for example, under certain conditions .an FPID controller is equivalent to a PID controller. In both, the control output is obtained from a combination of the error, the change of error and the integral of error. The combination is linear in the case of the PID controller, while it is 'fuzzified' in the case of the FPID controller and the control strategy in the FPID controller is formulated in the form of linguistic terms.

II. LITERATURE SURVEY

Frédéric Lafont et al. proposed A model-free control strategy for an experimental greenhouse with an application to fault accommodation Agricultural greenhouses and regulating them via advanced controllers are challenging tasks since strong perturbations, like meteorological variations, have to be taken into account. This is why we are developing here a new model-free control approach and the corresponding "intelligent" controllers, where the need of a "good" model disappears. This setting, which has been introduced quite recently and is easy to implement, is already successful in many engineering domains successful model-free control strategy and its fault-tolerant capabilities will be further developed by taking advantage of technologically more advanced greenhouse systems. Let us find out here, among many other possibilities, a regulation of the CO2 rate. Further comparisons with various other feedback synthesis techniques should also be investigated. [1]

Dinesh Singh Rana et al. a proposed a Fuzzy Logic Based Control System for Fresh Water Aquaculture: A MATLAB based Simulation Approach fuzzy control is regarded as the most widely used application we find out of fuzzy logic. We study about Fuzzy logic is an innovative technology to design solutions for multi parameter and non-linear control problems. One of the greatest advantages of fuzzy control is that it uses human experience and process information obtained from operator rather than a mathematical model for the definition of a control strategy and delivers solutions faster than conventional control design techniques. The proposed work includes a use of Data acquisition system, an interfacing device for on line parameter acquisition and analysis, fuzzy logic controller (FLC) for inferring the stress factor.The implementing the FLC in the MATLAB with the help of fuzzy logic toolbox and MATLAB programming can be utilized to control the various stress factors on the fish. This manuscript getting considers only three input parameters dissolved oxygen, temperature and conductivity. Some more such as dissolved ammonia and carbon dioxide may be included in order to get better degree of accuracy. [2]

Shalini V N et. al. praposed a method Green House Monitoring and Controlling Using Programmable Logic Controller (PLC) and LABVIEW. This system is based on continuous monitoring and controlling the parameter which plays important role in green house. When the temperature reach a certain threshold value, the temperature sensor will send the information to controller, the controller will process that signal and perform appropriate actions. This system is designed in such a way that it automatically controls the different parameters such as temperature, intensity of light, soil moisture etc. This paper we find out system reduces the manual overheads of monitoring different parameters and in process it reduces the percentage of the errors occurring due to the manual operations. Green houses are climate

controlled. We know that Green Houses have a variety of applications.

The major application is being, off-season growing of vegetables, fruit crop and plant breeding .The structure of greenhouse range in size from small sheds to industrial-sized buildings. A miniature greenhouse is called as a cold frame. The interior of a greenhouse exposed to sunlight becomes significantly warmer than the external ambient temperature and it protects its contents during cold weather. Many commercial glass greenhouses or hothouses provide high tech production facilities. We study and find out design Greenhouse Environment monitor and controlling using PLC and smoke detection using LABVIEW and develop a prototype of greenhouse environment monitor and controlling using PLC and smoke detection using LABVIEW and Verify the effectiveness of this system through testing on real time demand. [3]

Christakis Papageorgiou et. al. proposed Environmental Control of a Greenhouse System Using NI Embedded Systems Technology This paper presents the application of an automated environmental control system for a prototype greenhouse system using embedded systems technology. The prototype greenhouse system was developed and instrumented with appropriate sensors to measure various environmental variables like the temperature, the light intensity, the soil moisture, the air humidity and CO2 concentration. These measurements are provided to the control algorithm which is implemented on a embedded system and manipulates various actuators like, a heating and cooling actuator, fans, lights, irrigation system, and louvers in order to achieve the desired set-points, as specified by the user through a Human-Machine Interface implemented in LabView software. Certain aspects of the greenhouse dynamics have been modeled in Matlab/Simulink using nonlinear differential equations and the simulation model has been validated against experimental data, showing good agreement between the simulation and the experimental data. The purpose of this paper we find out is to enhance research related to the accurate environmental control of greenhouse systems in order to minimize energy and water consumption and to aim to develop a robust platform for control system design, analysis, instrumentation and embedded systems.[4]

R. G. Snyder et. al. proposed a "Environmental control of greenhouse tomatoes," The authors discuss the various functionalities of a greenhouse such as light intensity control, heating control, cooling control, air circulation control and humidity control. Various active and passive actuation devices are presented in order to achieve the desired regulation effect. A brief discussion on closed-loop (feedback) control is given, detailing some requirements on sensing environmental variables and on control algorithm implementation. Interestingly, the authors present their analysis based on the application of a greenhouse automated system for the extreme Alaskan weather. They quote: ``By optimizing light, temperature and humidity, in conjunction with the proper fertilization, watering and selection of adapted varieties, an endless array of growing opportunities await the Alaska greenhouse gardener and commercial producer''. Moving towards the more moderate Mediterranean climate, the authors in [5]

N. Bibi-Triki, et. al. a proposed and study the report of "Modeling, characterization and analysis of the dynamic behavior of heat transfers through polyethylene and glass walls of greenhouses," The automation of a greenhouse implies the implementation of a closed-loop (feedback) control algorithm, from the simplest on/off strategies employing thermostats to the most advanced PID and gain-scheduled controllers requiring accurate sensor measurements and algorithm development on embedded systems. The advantage of the implementation of a more advanced control algorithm is the ability to account for optimal design and operation requirements, like minimum energy control and accurate regulation in the presence of external weather disturbances and uncertainty in modeling accurately the biological processes characterizing the growth of plants. The design of an advanced control algorithm requires a good knowledge of the open-loop system dynamics, in our case, the greenhouse system. The process of acquiring knowledge and representing the open-loop dynamics of a system is called physical and mathematical modeling [6]

Didi Faouzi, et. al. submit report analysis Modeling and Simulation of Fuzzy Logic Controller for the purpose of Optimizing the Management Micro Climate of the Agricultural Greenhouseto related identified Agricultural greenhouse aims to create a favorable microclimate to the requirements of growth and development of culture, from the surrounding weather conditions, produce according to the cropping calendars fruits, vegetables and flower species out of season and widely available along the year. It is defined by its structural and functional architecture, the quality thermal, mechanical and optical of its wall, with its sealing level and the technical and technological accompanying. The greenhouse is a very confined environment, where multiple components are exchanged between key stakeholders and the factors are light, temperature and relative humidity.[7]

Asma Garrab et. al. proposed an method to An Agent Based Fuzzy Control for Smart Home Energy Management in Smart Grid Environment .Electrical Energy management in Smart Home environment is one of the main topics adopted in Smart Grid research field. In this paper, we find out a Multi-Agent System (MAS) for a Smart Home intelligent control. Such a solution was integrated in a smart meter in order to alter the shape of the residential load curve. The direct load control is based on Fuzzy Logic Control (FLC) using new fuzzy power indicator. In order to successfully implement our solution, customer acceptance of the direct load control is vital. We aim to reach a compromise among habitant comfort and electric bills in addition of satisfying technological constraints of appliances. Simulation results have proved the effectiveness of the proposed solution in energy savings. [8]

Roop Pahuja et.al. proposed a Design and Implementation of Fuzzy Temperature Control System for WSN Applications focus on application specific deployment and information processing in WSN. We find out general the design and implementation of rule based, simple, robust closed loop temperature control system using Virtual Instrumentation (VI) technology. The controller software is designed to provide optimized output to drive a heating and cooling actuator network. The self-developed software

(application program) with GUI, running on host PC, integrates and controls the operation of the hardware components to provide continuous temperature monitoring and control along with execution of add-on intelligent features. [9]

A. Hilali et.al. proposed a Control Based On the Temperature and Moisture, Using the Fuzzy Logic. design and implementation of an electronic system based on a for remote control of several experimental greenhouses. This system enables its user to consult the climatic parameters and to order the greenhouses sub-systems equipment's by SMS. The climate Sensors are packaged using the electronic circuits and the whole is being interfaced with maps of acquisitions (Arduino) via a radio frequency connection. These sensors provide information used for the control of ventilation, heating and water pumping by SMS. The acquisitions boards contain fuzzy controllers who manage the climate for local agricultural greenhouses. The procedure used in our system offers the operator an optimal control and monitoring without traveling to the place where the greenhouses are located, using his mobile phone, and being able to view at any moment the state of the greenhouse climate via the send and receive SMS function.[10]

Li Zheng et.al. proposed a practical method for tuning a PI like fuzzy controller. He proposed easier and faster tuning techniques and he employed triangular memberships function for fuzzification. He also reported a practical computer-aided tuning technique for fuzzy control. Triangular membership functions and center of gravity technique employed for fuzzification and defuzzification respectively [11,12].

T. H. Lee et al. reported position control for wheeled mobile robots using fuzzy logic controller, the FLC employed triangular member ship function for fuzzification and center of gravity technique for defuzzification[13], Mohamadien and Stonier developed a method to tune and optimize the membership functions of the FLC by using genetic algorithms [14].

III. PROBLEM IDENTIFICATION

Agricultural greenhouse is largely answered in the agricultural sphere to produce same vegetable fruit to all weather condition and climate change, despite the shortcomings it has, including overheating during the day and night cooling which sometimes results in the thermal inversion mainly due to its low inertia. The glasshouse dressed chapel is relatively more efficient than the conventional tunnel greenhouse. Its proliferation on the ground is more or less timid because of its relatively high cost Agricultural greenhouse aims to create a favorable microclimate to the requirements of growth and development of culture, from the surrounding weather conditions, produce according to the cropping calendars fruits, vegetables and flower species out of season and widely available along the year. It is defined by its structural and functional architecture, the quality thermal, mechanical and optical of its wall, with its sealing level and the technical and technological accompanying. There are so many technology to maintain the green house condition to facing to same problem:-

The model of the system was implemented using MATLAB-Simulink tool-box for the analysis of thermal behavior of greenhouse. It is fast to implement and allows for the verification of installation of adequate and efficient systems. Secondly the performance FLC was evaluated and has shown good control over output. To improve behavior of such FLC it is necessary to use some optimization methods like Genetic Algorithm.[2]

The objective of offer to farmers a control system for greenhouses that will be automatically performing remotely via GSM, which can meet their needs.
The system is controlled by a master that is currently a privileged tool for data acquisition. This system has multiple benefits, namely the power of execution, the availability of Interfaces of control and monitoring, and also the level of data storage capacity.

IV. PROPOSED METHODOLOGY

This proposed method a design dynamic fuzzy logic controller for green house using labview. This approach based on agriculture information of tomato crops to control precisely the greenhouse climate of temperature, humidity, irrigation, ventilation CO2 and lighting autonomously. The main focus is to show the efficiency of adopting of Fuzzy logic arduino to labview Inference system to build intelligent coordinator that keeps the green house parameters at the desired set values. This research shows several issues which has been addressed such as greenhouse control system design based on Fuzzy logic and inference system for tomato crop, deceasing power consumption within actuating nodes connected to a heater, humidifier and fan devices based on arduino uno board and interfacing to labview software

A. Design of System Labview Interface to arduino.

LabVIEW is a kind of program developing environment, which is developed by National Instruments (NI) and is similar to the environment of C and BASIC. But the difference between LabVIEW and other computer language is: other computer language uses the language based on text to generate code, however LabVIEW used the graphical editing language G to program. The program generated is a kind form of block diagram, and the operation and upgrading of products are more convenient. The design of system interface. Lab VIEW software is used for simulation. The programming language used in LabVIEW is dataflow programming language.

B. Design Greenhouse Climate Control of Tomoto Crop

First of all to design GH climate control based on fuzzy inference; Life cycle of a tomato plant should be study and analysis, Environmental requirements affecting the crop, and design Fuzzy inferences.

1) Life Cycle of a Tomato Plant

Evolving tomato plant through stages to produce fruits of safe for consumption or marketing and these stages are as follows:-

Germinating stage can split into multiple separate stages of germination process is standard but in fact overlapping phases with each rows, these stages are stage water absorption and digestion of nutrients and germination stage. At this stage the seed absorbs water, which increases

the moisture content of the seed rows, then turn such complex food carbohydrates, fats and proteins stored in the endosperm Simple materials and transmitted to the embryo axis growth points. Providing developmental stages take their shape gesture and begin the emergence of leaves and reproduction. Vegetative growth stage with increased nutrients and environmental factors help from heat and humidity & lighting continues vegetative growth of tomatoes and continue with this stage of plant water consumption on the rise.

Flower stage the plant water consumption peak during this stage. stage of fruiting: So the process of fertilization must have strobe lighting and humidity around 50-70% plus optimal temperature is 25-29 ºC currently emerging fruits begin to be the optimal temperature for holding fruits are 18-20 ºC worse either optimal temperature that ripen in the fruit is 28 Co and no Rosary off well in temperature less than 10 Co and maturity period of the fruit around 50-70 days after vaccination and at one stage Fruiting irrigation amounts begin to decline.

2) Environmental Requirements Affecting the Crop

Proper soil crop often tomato can be grows in various types of land but it thrive in the land of light free of salts and alkaline then decrease the crop after increasing the rate of salinity, as well as soil salinity increases lead to increased incidence of benimatoda Complexity of the roots as well as lead to increased incidence of fungal. There foreknowledge of what type of soil used in green house, in addition to calculate the applicability of soil water retention before the second irrigation. Effect of optical length: length of photoperiod effect on tomato plants blossom to neutral is standard but a great effect on vegetation as plant growth decreases significantly decreased if Plants were exposed for less than eight hours daily light advertising as plant growth decreases as well when exposed to daily lighting periods of (17) an hour or more.

C. Environmental Control of Greenhouse Systems

The environmental control of a greenhouse implies the regulation of day and night air temperatures, the relative humidity and the carbon dioxide levels to ensure optimal plant growth. Heat, water vapor and carbon dioxide are transferred in and out of the greenhouse space in order to maintain the set-points of temperature, relative humidity and carbon dioxide concentration using the sensor DH11 andMQ2 connection to arduino board and show the value in labview graphical user interface. Heat is transferred by conduction, convection and radiation and various mass transfer processes are also occurring utilizing fans and louvers resulting in complex flows that involve both heat and mass transfer the functionality of an automated according to set a rule in fuzzy logic base greenhouse such as light intensity control, heating control, cooling control, air circulation control and humidity control using actuator devices connect to achieve the desired regulation effect. A brief discussion on closed-loop (feedback) control is given, detailing some requirements on sensing environmental variables and on control algorithm implementation. Interestingly. To provide optimizing light, temperature and humidity, in conjunction with the proper fertilization, watering and selection of adapted varieties in proposed methodology provide indicative set-point values for these variables that favor plant growth and based on the climograph information for a given location, they determine the levels of cooling or heating required to maintain these set-point values. The climograph contains information regarding the mean solar radiation and mean air temperature for a given location all around the every sesion in the year. It constitutes the starting point in identifying the actuator requirements for an fuzzy logic based automated greenhouse system. Special attention is given to energy efficiency and sustainability. We are focus on providing favorable conditions for plant growth during the hot periods of the Mediterranean climate while using energy efficient processes like ventilation, shading, evaporative cooling and effective insulation to design for the production of tomatoes.

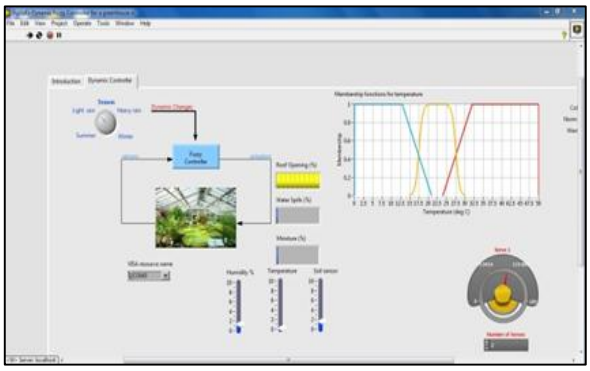

Fig. 2: Front panel of labview to fuzzy logic based environment control

D. Dynamic Fuzzy Logic controller design

We provide good harvest of tomatoes must provide the right environment to grow this plant. It is obvious that the tomato plant requires the aforementioned growth stages to different environmental factors therefore a control unit for climatic conditions control within greenhouse based on fuzzy controller of tomatoes crop. To ensure proper design and operation of greenhouse of tomatoes crop control system, several parameters should be considered Where these parameters is entered into the controller starts with soil type and vulnerability to retain water into irrigation date, time (day/night), plant growth stage, deep roots, portability Plant water retention, ambient humidity and temperature relative humidity. To design the Fuzzy Logic Controller (FLC) in labview open control and simulation module depend upon input variable(temperature, humidity and soil moisture sensor) and same process to fuzzification according to variable to output(electric roof, water spills and moisture content on greenhouse effected area)

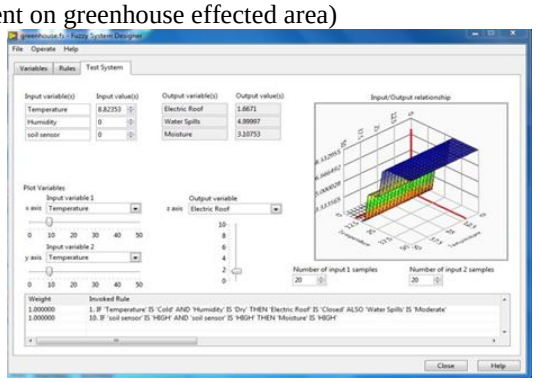

Fig. 3: Fuzzy logic system design test panel to condition monitoring

1) Greenhouse temperature regulation

The greenhouse air temperature is regulated by a cascaded PID controller architecture. There exist two inner PID controllers manipulating the PWM signals to the heating elements and the cooling Peltiers respectively in order to maintain the desired air temperatures within the heating and cooling actuators.

There also exist two outer PID controllers that manipulate the PWM signals of the fans for the heating and cooling actuators respectively. The outer PID controllers react to the error signal between the desired and actual greenhouse temperature in order to induce the flow of the right proportion of hot and cold air into the greenhouse.

2) Regulation of light intensity

There exists capacity for a control system to regulate the light intensity in the greenhouse. The control system receives an input from the light sensor and manipulates the actuator (Halogen Lights) in order to achieve the desired set-point of light intensity. This system can also operate on Manual Mode, with the user varying directly the intensity of the halogen lights.

3) Regulation of soil moisture

There exists capacity for a control system to regulate soil moisture content. The measurement is provided by an electrical conductivity sensor that relates the conductivity of the soil to the soil moisture. On Automatic Mode the controller controls the Actuator (Water Pump) but on Manual Mode the user will be able control the actuator directly and supply the desired amount of water to the plants.

4) Monitoring of other environmental conditions

Besides the regulation of the greenhouse air temperature, light intensity and soil moisture, the system monitors and displays the following environmental conditions:

- Relative Humidity inside the Greenhouse.
- Relative Humidity of the Environment.
- CO2 concentration inside the Greenhouse.

Each environmental condition is displayed in the form of a real-time graph using the LabView front panel application.

5) Electric Roofs

The greenhouse has an electric roofs is open and closed according to input data. The reason for an automated electric roofs is to ensure the electric roof remains closed so that heat losses are minimized and the temperature control system has smaller external disturbances to cope.

V. RESULT

The simulation result provides an exact idea for temperature, humidity, and water output for the prescribed agricultural field(show in fig.06). The advantages of applying and find FLC are increasing Irrigation Efficiency, increasing the type of crop and harvest, in addition saving the electrical power.

In this method the greenhouse effect using growth of different crops depend upon environment and crops growth condition. All condition set for tomoto crop automatic using fuzzy logic all sensors are connected to arduino board and sensor value and analysis using labview and automatically take decision using fuzzy logic to control the greenhouse effect to help growth of crops and controlling fan, light and water using set of rule in fuzzy logic input of temperature humidity and soil moisture condition

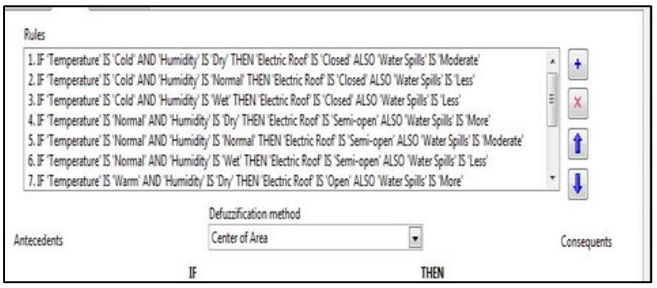

Fig. 4: Fuzzy logic based system condition and rules design

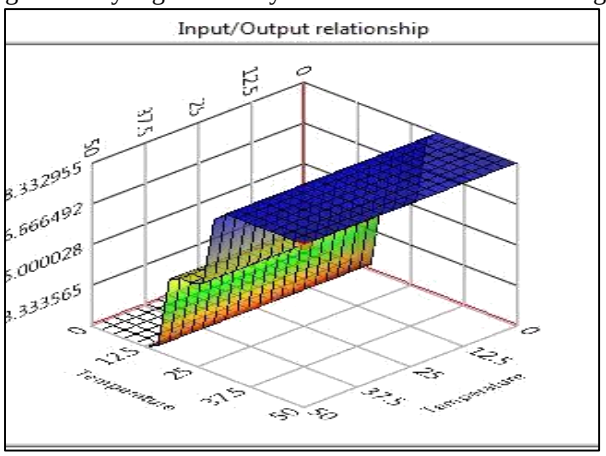

Fig. 5: Fuzzy logic based input output relationship design

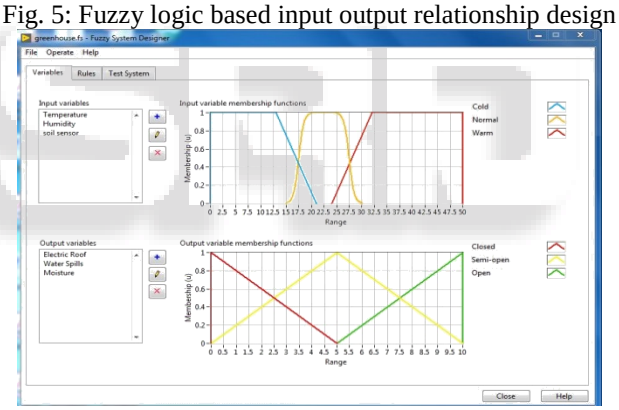

Fig. 6: Fuzzy logic based system designer I/O membership function

Temperature degree: in this proposed method we find out tomato is summer vegetable crops and temperature of 25-30 degrees Celsius is the appropriate degree of tomato seed germination for 6 days while for germination to 14 day at 15 degrees Celsius and the temperature of the vegetative growth and maturation of fruits varies between 25-30 degrees Celsius day while the temperature of the flowers and the Decade range from 15-25 °C day, and temperatures less than 15 °C to configure a wide dark green leaves and stems are thick while at low temperature of 10 degrees Celsius no growth depends upon the fruits of tomato and Low temperature less than 12 degrees Celsius due to the death of pollen which leads to incomplete pollination and fertilization of the flowers. Night temperature also plays an important role on growth and flowering and fertilization does not occur, and therefore not nodes of flowers are present when night temperatures below 13° C. The moisture almost vegetable crops depend on the type of moisture, so this parameter has been considered.

VI. CONCLUSION AND FUTURE SCOPE

A greenhouse temperature and humidity control algorithm based on direct Fuzzy logic controller were designed, tested and implemented. Several actuators and sensors are installed and connected to an acquisition and control system based on personal computer and a data acquisition card. The overall tests indicated that the fuzzy controller worked satisfactory but at the expense of actuators frequent activity. This research has successfully showed that LabVIEW and Fuzzy Logic controller can be applied to develop a system for monitoring climate parameters under greenhouse. Using a computer system can cause some difficulties for the producer inexperienced with computers. But the developed system has advantages that the designed program is user-friendly and the results could be easy to analyze by the user, as the front panel is a graphical user interface. The use of fuzzy logic requires however, the knowledge of a human expert to create an algorithm that mimics his/her expertise and thinking.

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