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Automated Environment monitoring and control system, for agro-based industries using FIS

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ABSTRACT

The aim of this paper is to develop a automation system agro-based industries and also analyses and compare data using fuzzy logic. To design automated Monitoring and Controlling system which will monitor the analog parameters and transmit these values to the other side where they can be read and control with the set points. If these values exceed their corresponding set points, the system displays the fault indication message on the LCD with Sound alarming. The Communicate uses ZigBee to implement this application. The analog parameters like PH, Temperature and Humidity are read by the respective sensors and these values are transmitted by the transmitter section. Here Transmitter section is Slave computer. The receiver section; host computer receives these values and passes the data to the controller section. The ARM (Raspberry-Pi) controller compares these values with the fixed values and if they exceed the set points, the ARM controller displays the parameter, which actually exceeds its set point, on the LCD with Sound alarming.

Index Terms: Fuzzy logic, Fuzzy inference system, Triangular membership functions, Fuzzy editor in MATLAB ARM (Raspberry-Pi), ZigBee, Sensors.

1. Introduction

Advances in computer technology have made owning and operating agro-based industries like Greenhouse, Floriculture, Horticulture, Residential Gardening, and Landscape etc. easier than ever before. Innovations environmental control options can aid the home gardener or professional horticulturists by automatically adjusting temperature, humidity, and light intensity from within the greenhouse or from a remote location. An environmental control system will improve plant life within greenhouse by providing a constantly monitored atmosphere, producing a more uniform product.

Environmental Control Systems can:

- Adjust Temperature
- Adjust Humidity
- Control Light Intensity
- Monitor Atmosphere

Greenhouse Accessories Controlled by Environmental Control Systems:

- Fans
- Vents
- Misting Systems
- Fogging Systems
- Heating Systems
- Cooling Systems

The first stage of implementation can be as simple as an on/off switch to control circulation fans. By semi-automating a control system with a humidistat, a thermostat, or a timing device, the accessories will run only when necessary, lowering operating costs and saving energy. Fully automated systems have the option of being controlled by a semaphore or remote programming system on a PC or even through a cell phone, saving a substantial amount of time. These fully automated systems can be designed to maintain a specific set of criteria for constant plant comfort, taking into account the conditions outside the

structure that may affect the plants growing atmosphere.

In addition to common greenhouse accessories, Solar Innovations, Inc. environmental control systems can be designed to accommodate advanced features like evaporation coolers and foggers, drip systems, semaphores, remote programming, photo and light sensors, and soil sensors. The horticulturists' time can now be spent tending to plants rather than tinkering with their growing environment. Beyond the cost and time efficiency of the greenhouse control system, Mother Nature will benefit. Control systems reduce the need for chemicals to aid plant growth as the environment is more closely adjusted to create the ideal conditions and reduce energy costs and waste.

I. Analysis and comparison of data using fuzzy logic:

The growth of a crop depends on many factors such as water given to crops, soil, temperature, humidity and fertilizer etc. The Proposed study evaluates crops growth by considering above factors. The major aim of presenting paper is to analyze, how the above factors are effective to improve crops growth using fuzzy logic and how our system will make difference in it.

II. Origin of research problem:

Crop growth is mainly influenced by the surrounding environmental climatic variables and by the amount of water and fertilizers supplied by irrigation. This is the main reason why a greenhouse is ideal for cultivation, since it constitutes a closed environment in which climatic and fertirrigation variables can be controlled to allow an optimal growth and development of the crop. The climate and the fertirrigation are two independent systems with different control problems. Empirically, the requirements of water and nutrients of different crop species are known and, in fact, the first automated systems were those that controlled these variables. As the problem of greenhouse crop production is a complex issue, an extended simplification consists of supposing that plants receive the amount of water and fertilizers that they require at every moment. In this way, the problem is reduced to the control of crop growth as a function of climate environmental conditions and analysis using FIS approach.

fuzzy logic

The fuzzy logic set was introduced in 1965 as a mathematical way to represent linguistic vagueness (Zadeh, 1965). According to the fuzzy logic concept, factors and criteria can be classified without certain limits. Fuzzy logic is very useful for addressing real-world problems, which usually involve a degree of uncertainty.

The fuzzy inference system takes linguistic inputs (as stated for simplification), processes the information and outputs the performance.

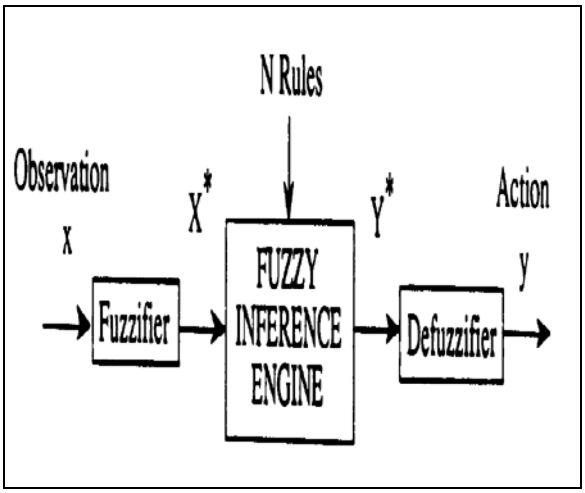

Figure 1: Block diagram of FIS

Performance Evaluation with Fuzzy Logic

Before the details of the fuzzy system are dealt with, the range of possible values for the input and output variables are determined. These (in language of Fuzzy Set theory) are the membership functions (Input variable vs. the degree of membership function) used to map the real world measurement values to the fuzzy values, so that the operations can be applied on them. The labels of input and output variables and their associated membership functions. Values of the input variables are considered in terms of percentage. The decision which the fuzzy inference system makes is derived from the rules which are stored in the database. These are stored as a set of rules. Basically the rules are 'If-Then' statements that are intuitive and easy to understand, since they are nothing but common English statements. "If" refers to Temperature, Humidity, control Light Intensity that is compared to the inputs, and "Then" refers to a Result which is the crop growth as output.

Fuzzy Set of Output variable

Table 1:

Linguistic Expression	Symbols
Low Crop growth	LG
Medium Crop growth	MG
High Crop growth	HG

Fuzzy Set of Input variables

Table 2:

Linguistic Expression	Symbols
Low Humidity	LH
Medium Humidity	MH
High Humidity	HH
Low Light intensity	LL
Medium Light intensity	ML
High Light intensity	HL
Low Temperature	LT
Medium Temperature	MT
High Temperature	HT

IV .Review of Research and Development in the Subject International and National status

Web is changing the way we take measurements and distribute results. Many options exist for publishing reports, sharing data and remotely controlling applications. We can incorporate the web into many aspects of farming. The system is also typically suited for India as well as other developing nations where farming is a major source of income and needs continues attention.

V. Significance of the study

A Dynamic Environment: Greenhouse environments present unique challenges to good control. Temperature changes occur rapidly and vary widely depending on solar radiation levels, outside temperatures and humidity levels, wind speed and direction, the amount of plant material in the greenhouse, watering routines, etc. Proper control of this dynamic environment is indeed challenging, but the benefits of good control far exceed the costs. Ultimately, the objective of any greenhouse system is to reduce the input cost per unit of production and maintain or increase the quality of production. While some investments affect the input cost and/or quality of one or two specific tasks (i.e. transplanters, soil handling equipment, etc.), a well-integrated environment system will have a positive effect on virtually every function in a facility. Even a small percentage of improvement in several areas will yield substantial improvements overall. Growers that own Integrated Control Systems report experiencing many real benefits resulting from improved control.

Higher Energy Efficiency: Better equipment coordination and more accurate control can reduce heating fuel and electrical costs. Savings vary depending on how well you already manage your environment and the controls you purchase.
Better Labor Efficiency: Automated controls increase the productivity of workers by enabling them to attend to more valuable tasks. Increased output reduces the pressure for more labor.

Improved Management Effectiveness: Perhaps the most important function of good control systems is the additional information available to managers and growers, enabling them to make better management decisions and spend more time managing the process instead of being or doing the process.

Reduced Water Use: With the modern irrigation control capabilities in many systems water application is more precise, and timelier. Growers report reduced overall water use and runoff of as much as 70% with the most effective irrigation controls.

Reduced Fertilizer Use: Constant monitoring and control provides higher accuracy that, when combined with efficient water use, can substantially reduce fertilizer application and improve its effectiveness.

Reduced Chemical Use: More precise control of temperatures and more effective use of DIF and other growth regulating temperature regimens reduce the need for growth regulators. Better management of humidity, irrigation, and temperature also helps reduce plant stress and diseases and, consequently, the need for fungicides and other chemicals.

Reduced Pesticide Use: Greenhouses with better climate control and precise irrigation produce healthier plants. Healthier plants are less susceptible to disease and insect infestation. Growers report noticeable reductions in insect populations and pesticide use in well-controlled environments.

Improved Plant Quality & Uniformity: Less disease, more effective irrigation and fertilization, improved grower information and management all combine to increase the health and uniformity of plants. Uniform crops are easier to handle and market.

Reduced Equipment Wear & Tear: Poor control over-taxes equipment by over-cycling and increasing operation hours. Good control allows more precise management of the equipment. Continuous monitoring and alarms alert growers to pending breakdowns and other problems earlier, before more serious consequences occur.

Less Plant Loss from Failures: Good data logging and graphing of greenhouse conditions and sophisticated

early warning alarm systems help reduce losses from catastrophic failures

Methodology:

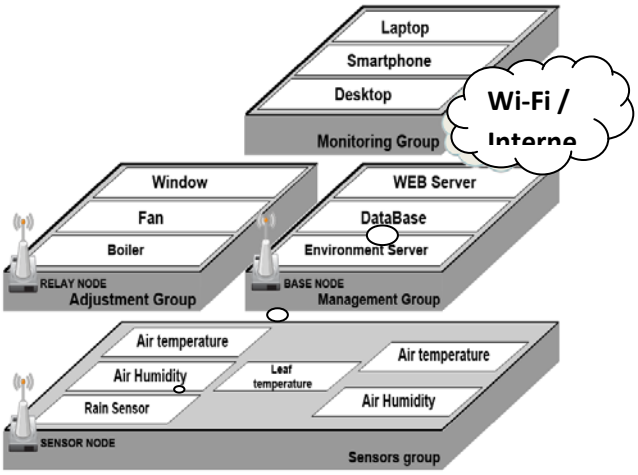

Figure 2:

VI. Conclusion

India is an agriculture–oriented country. For the quality and Productivity improvement of greenhouse and open field crops, it is necessary to measure and control several interacting physical variables. These tasks can only be accomplished by 'control systems with built in software'. Erecting greenhouse is expensive. Automation machinery is imported in India hence it is expensive. Many farmers cannot adopt the greenhouse technology due to its high cost. Our system highlights about the approach to control the environment in Greenhouse. The greenhouse controller senses the changes in the temperatures (Dry temperature, Wet temperature), humidity, soil moisture etc. through input sensors and processes to take control action. Real time monitoring provides reliable, timely information of crop and soil status, important in taking decisions for crop production improvement. Evaluation of agricultural production systems is a time consuming and difficult process because it means performing visits to selected crop fields to be able to measure and register certain physical, chemical and biological characteristics of the cultivated areas and analysis of all input parameters using fuzzy approach.

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