CROP GROWTH ACTIVITY MONITORING WITH FUZZY LOGIC

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Abstract: In this paper we have developed a Fuzzy Logic based crop activity monitoring system using Fuzzy Logic Toolbox of MATLAB-SIMULINK. Temperature and Relative Humidity are the two inputs and Crop growth activity is output of Fuzzy System. According to Fuzzy Inference Rules, the crop growth activity level is estimated using Fuzzy Logic. This is useful in designing of Control systems.

IndexTerms **- Fuzzy Logic, MATLAB-SIMULINK, Crop growth activity.**

I. INTRODUCTION

In Greenhouse control the primary focus is on maintaining the control parameters to achieve the setpoint values [1]. However it is also necessary to monitor the crop growth activity of Greenhouse crop to ensure optimum growth which in turn gives maximum yield [2]. Hence a FIS is also developed for Monitoring of Crop Growth Activity which ensures optimization of crop growth cycle of Tomato Crop grown in Greenhouse [3].

Table 1: Input and output MF's

Input 1		**Input 2**		**Output**	
Temperature		**Relative Humidity**		**Crop Growth Activity**	
MF	**Range**	**MF**	**Range**	**MF**	**Range**
Low	[0 0 10 20]	Low	[0 0 40 50]	Lagging	[0 0 0.89 0.9]
Optimum	[15 20 32 40]	Optimum	[45 50 80 90]	Optimum	[0.89 0.9 1 1]
High	[38 40 50 50]	High	[80 90 100 100]	-	-

II. FUZZY FIS DESIGNING

A Fuzzy FIS is designed by using fuzzy logic toolbox of MATLAB-SIMULINK. The input-1 is '*Temperature*' and input-2 is '*Relative Humidity*' present inside the Greenhouse. The output variable is '*Crop Growth Activity*' *of* Tomato crop. Input-1 and input-2 have three MFs each, namely '*Low*', '*Optimum*' and '*High*'. The output has two MFs '*Lagging*' and '*Optimum*'. The range of input and output are decided using Utility Theory discussed in [4]. The range of input and output MFs are as given in table 1. The Rule base used for FIS is as given in table 2[5].

Table 2: Rule base for FIS Crop Activity

Tin \ RHin	Low	Optimum	High
Low	Lagging	Lagging	Lagging
Optimum	Lagging	Optimum	Lagging
High	Lagging	Lagging	Lagging

The figure 1 shows FIS designed for monitoring crop growth activity. Figure 2, 3 and 4 shows input and output MFs used in Matlab-Simulink. Figure 5 shows rule viewer of FIS rule base.

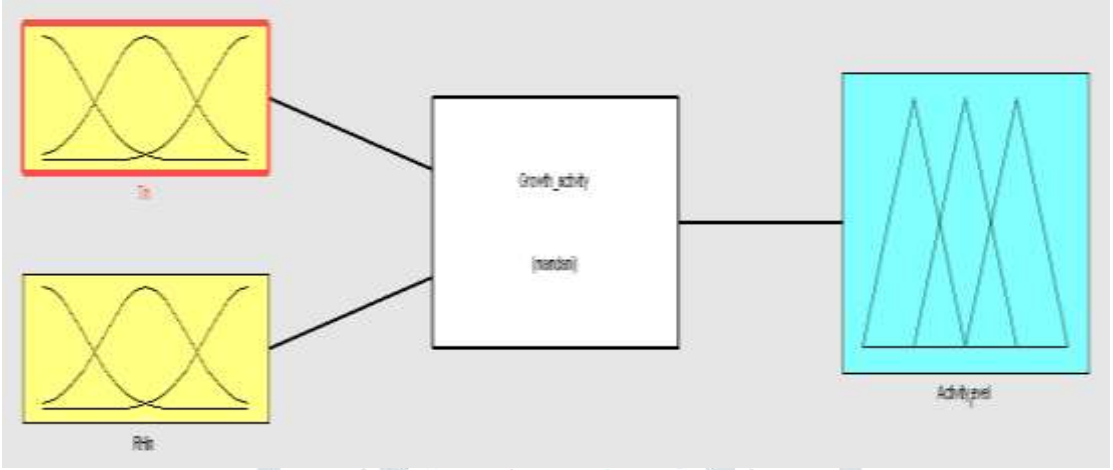

Figure 1: FIS for Monitoring crop growth activity

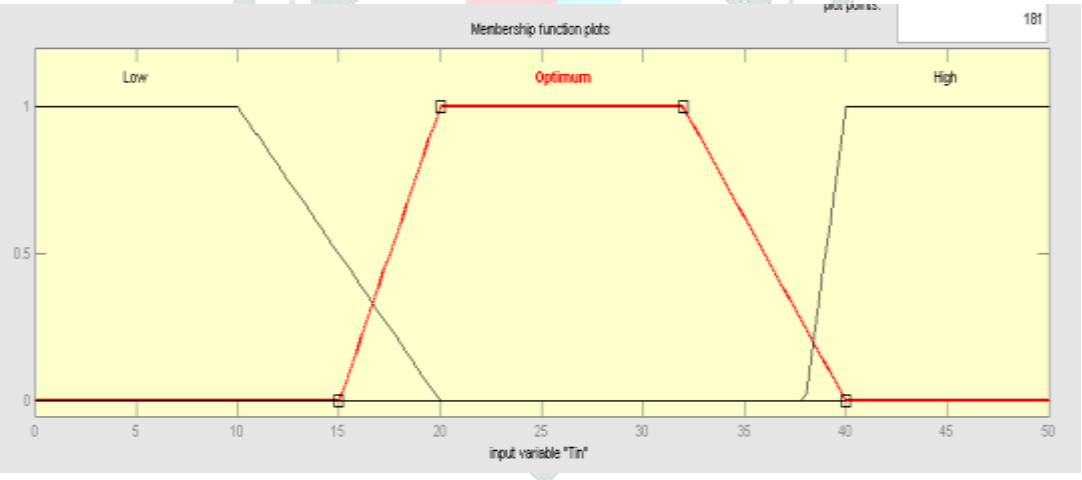

Figure 2: MF's of input variable Tin

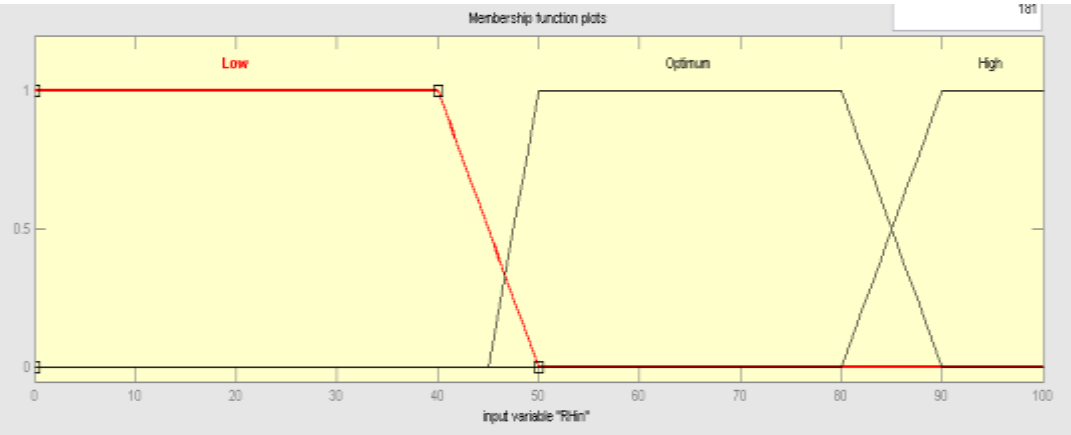

Figure 3: MF's of Input variable RHin

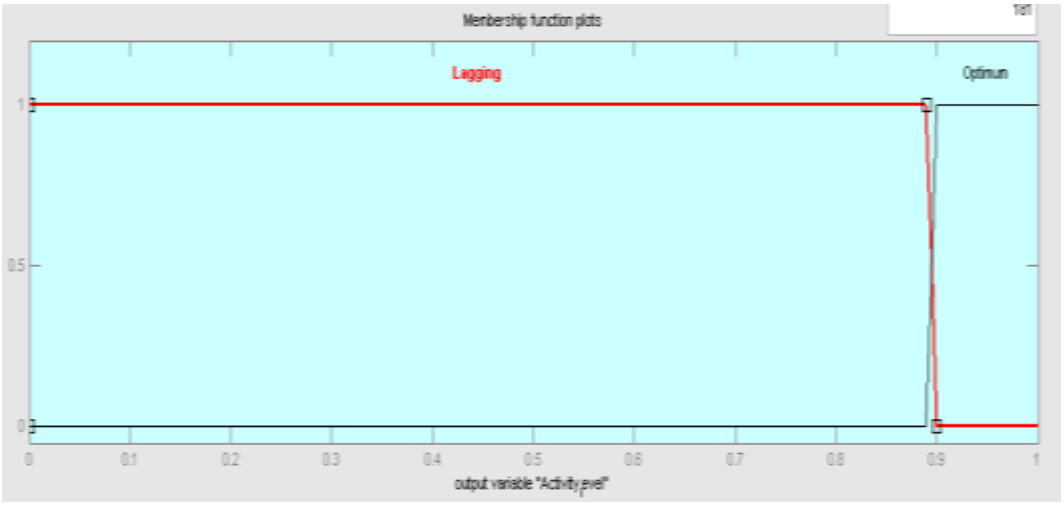

Figure 4: MF's of Output variable Activity level

Figure 5: Rule Viewer of FIS

III. SIMULATION RESULTS OF CROP GROWTH ACTIVITY FIS

After control of Greenhouse parameters the effect of these parameters can be studied by using Crop activity FIS. The simulink model to study crop activity is in figure 6.

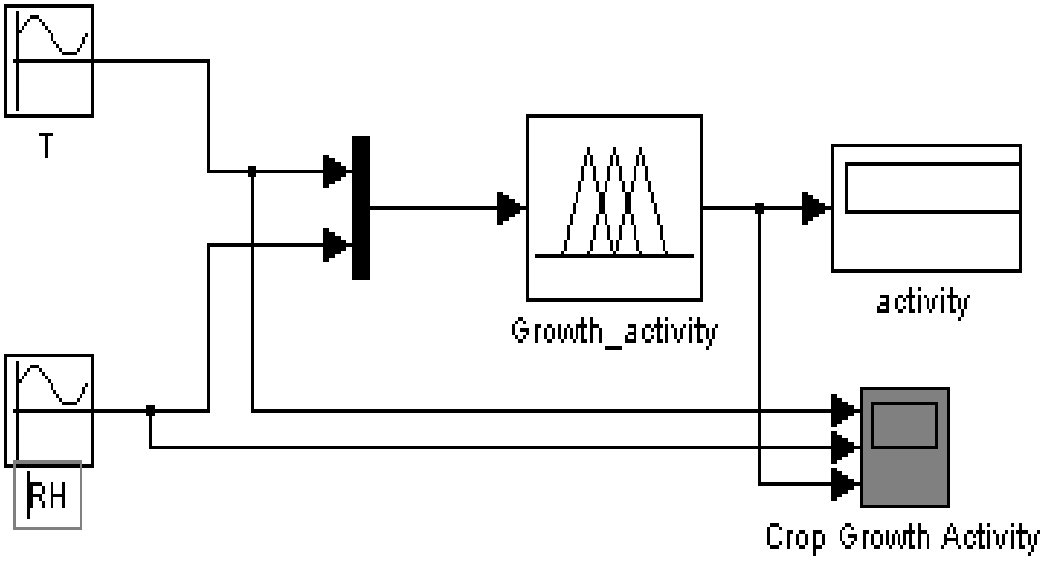

Figure 6: Simulink model to study Crop activity

In this model input given to FLC are the present temperature and humidity inside the Greenhouse and Crop growth activity is an output. When climate parameters are within suitable range the activity is optimum, otherwise the crop lags in growth. The model is tested for variuos input conditions and results are obtained. Figure 7 and 8 shows the Simulation results.

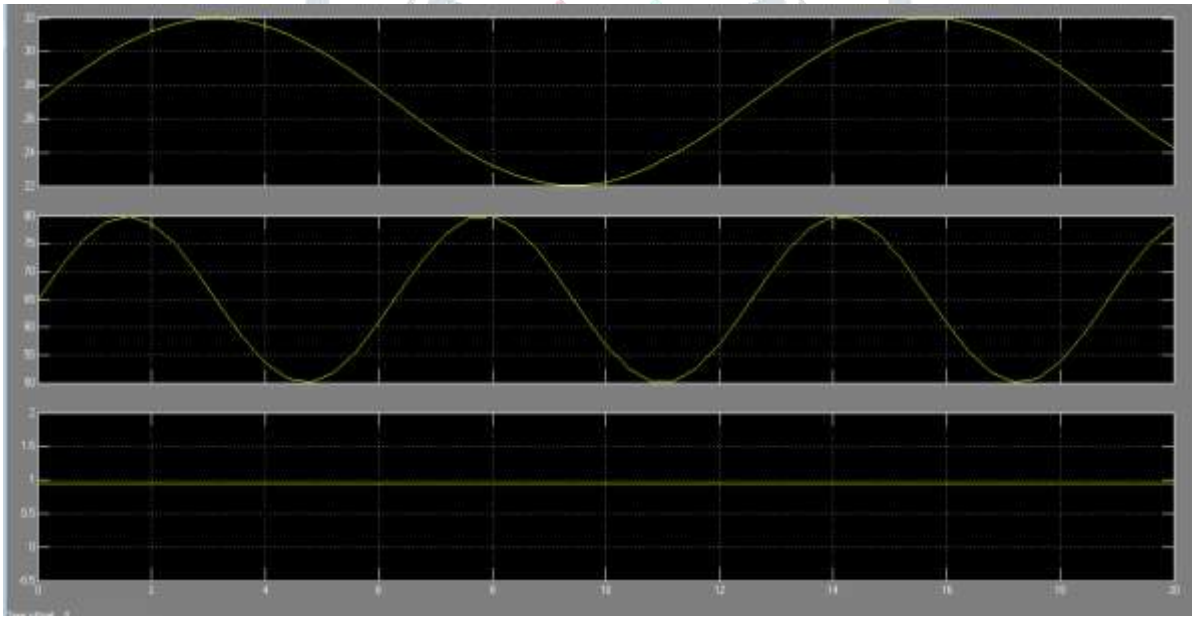

Figure 7: Scope data of Simulink model

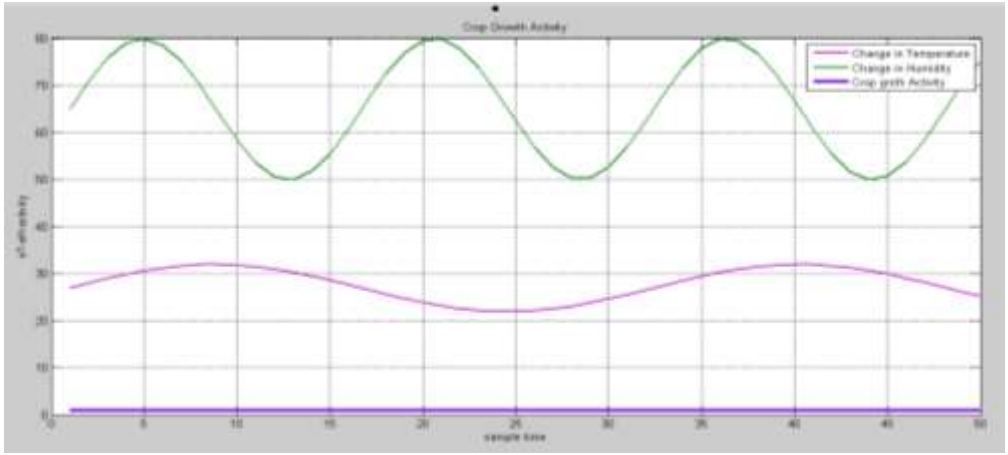

Figure 8: Crop growth activity response for changes in Temperature and Humidity

IV. CONCLUSION

The simulation results of Fuzzy Model of Crop activity can estimate suitable range of climate parameters and provide possible control mechanism which can be implemented in Control system used in Greenhouse to produce favorable climate.

REFERENCES:

[1] J. C. Bakker, "Greenhouse Climate Control - An integrated approach", Wageningen, 1995.

[2] F. B. Salisbury, C. W. Ross, "Plant Physiology", CBS Publication, New Delhi, 1986.

[3] More, Jagtap, Ranpise, "Green House Technology", Continental Publication, Pune, 2002.

[4] A. H. El-Attal,"Decision Model for Hydroponic Tomato Production (TODMOD) Using Utility Theory", Ph. D. Thesis, 1995.

[5] A. Kaur and V.Chopra, "Fuzzy Model for Optimizing Strategic Decisions using Matlab" *application note* on Anu books, pp. 270-280, 2011.