IMPROVED SMART IRRIGATION SYSTEM USING FUZZY LOGIC

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ABSTRACT

The irrigation system is to help agriculture crop growth, landscape maintenance, reduce the effect of inadequate rainfall. Therefore the importance of irrigation system is very high. In this thesis we proposed a smart irrigation system using fuzzy logic technique by mapping the knowledge and experience of a traditional farmer. The fuzzy logic control system adapted the input such as humidity, temperature, flux, soil moisture, leaf wetness and Wind. The output for this system is the lamp, water pump and irrigation. Smart irrigation proposed system, the domain expert knowledge is gathered and is stored in the form of rule-based knowledge base. The proposed system is implemented using the features of fuzzy logic toolbox in matlab.

Keywords- Fuzzy Logic, Fuzzy Inference System, Membership Function

INTRODUCTION

Agriculture is often greatly hampered due to irregular, insufficient or uncertain rain. Proper irrigation system secures uninterrupted agriculture. A recent study found that, on average, 33 percent of the global population suffers from water scarcity in some form. Approximately 70 percent of the total volume of with water withdrawals in the in the world are a used for irrigation. Around 60 percent of the water mean to be used for irrigation is lost, either due to evapotranspiration, land runoff. Agriculture is dependent on climate conditions, mainly water presence. Due to climate conditions, many crops are wasted which results in massive lost. In order to minimize the lost, much technology advancement is being done.

Water is the basic need of life. Crops need exact amount of water, too much or too little will damage the growth of the crops. Smart irrigation system can be save up to 45 percent water during dry season, and around 80 percent of water in the rainy season. When compared to manually operated watering system.

Irrigation controller is divided roughly into two main classes:

Open loop controller: Which means there is no error feedback from the controlled object. In details the user set the time to start and the time to end. The pause intervals and the watering periods are set too. No checking is done to know whether Right Amount of water is used or not. These parameters are said pre-set of the entire session as thus:

- How long the irrigation period should be last
- How often the irrigation period should repeat itself

- How much water, that is needed in the irrigation

Closed loop controllers: These controllers are those that have a feedback combined with feed forward from the controlled object. The feedback is necessary to determine how much water needed for irrigation. The membership of an element in a fuzzy set doesn't need being complete, that's any component of a fuzzy set may also be member of another fuzzy set within the same universe. In fuzzy sets are not any sharp boundaries as there's some unclearness exist within the data. The degree of membership for sets is between zero (0) and one (1).

FUZZY LOGIC

Fuzzy logic is a part of artificial intelligence or machine learning which interprets a human action. Computers can interpret only true or false values but a human being can reason the degrees true or degree of false. Fuzzy models interpret the human actions and are also called intelligent system. Fuzzy logic is an approach to computing based on "degree of true" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based.

Fuzzy or multi-valued logic was introduced in the1930s by Jan Lukasiewicz Polish philosopher. While classical logic operates with only two values 1(true) and 0(false), Lukasiewicz, a introduced logic that extended the range of true values to all real number in the interval between 0 and. He used a number in this interval to represents the possibility that given statement was true or false.

EXISTING SYSTEM

The existing system was designed for the smart irrigation based on fuzzy logic concepts. The system accepts three input variable such as Temperature, Humidity, Illumination, sensor. The output produced by the system, provides the smart irrigation as an output variable. In the existing system the output variable is divided into only two output variable namely Lamp, Water pump. The existing system contains only 27rules in the knowledge base.

PROPOSED SYSTEM

Fuzzy logic is best applied in the fields where a great amount of uncertainty or Fuzzification exists. In our case, building an expert system by applying fuzzy ruler is a very suitable choice. In a fuzzy inference system or FIS, fuzzy set theory is applied to map inputs (or attributes) to output.

Fuzzy set,Fuzzification is the process where crisp quantities are converted to fuzzy (crisp to fuzzy) uncertainties present values we form the fuzzy values. The conversion of values is represent by membership function. Membership functions are used to associate a grade to each and every linguistic variable. In our study, we implement the Mamdani system that is depicted in Defuzzification method. Admitting centroid calculation is the most popular Defuzzification method, there are five built in method support: centriod, bisector, middle of maximum, largest of maximum, and smallest of maximum.

After we introduction our six input variables and one output variable as below, we determine membership function for each variable for our fuzzy system and their corresponding fuzzy system and their corresponding fuzzy memberships.

Input parameters that are used by the system are

1. Temperature
2. Humidity
3. Illumination
4. Soil moisture
5. Leaf wetness
6. Wind

Table1: Membership function input variables of the Temperature

INPUT VARIABLE	RANGE	FUZZY SETS
TEMPERATURE	0-30	LOW
	30-40	MEDIUM
	40-100	HIGH

Table2: Membership function inputs variables as Humidity

INPUT VARIABLE	RANGE	FUZZY SETS
HUMIDITY	0-35	DRY
	35-70	NORMAL
	70-100	MOIST

Table3: Membership function to the input variable as Illumination

INPUT VARIABLE	RANGE	FUZZY SETS
ILLUMINATION	0-160	DARK
	160-340	NORMAL
	340-500	BRIGHT

Table4: Membership function to the input variable as Soil moisture

INPUT VARIABLE	RANGE	FUZZY SETS
SOILMOISTURE	0-12	SATURATED
	6-24	ADEQUATELYWET
	18-36	NORMAL
	30-60	DRY

Table 5: Membership function to the input variable as Leaf wetness

INPUT VARIABLE	RANGE	FUZZY SETS
LEAF WETNESS	0-300	WILTING
	200-500	NORMAL
	400-700	FROST
	600-900	DEW

Table 6: Membership function to the input variable as Wind

INPUT VARIABLE	RANGE	FUZZY SETS
WIND	0-3	MINIMUM
	3-6	OPTIMUM
	6-9	MAXIMUM

Output variable

The output variable refers to the presence of Lamp, Water pump, Irrigation, in the proposed system the output variable is divided into following:

Table 7: Membership function for output variable of Lamp

OUTPUT VARIABLE	RANGE	FUZZY SETS
LAMP	0-150	LOW
	150-300	MEDIUM
	300-500	HIGH

Table 8: Membership function output variable as Water pump

OUTPUT VARIABLE	RANGE	FUZZY SETS
WATER PUMP	0-150	OFF
	150-400	ON

Table 9: Membership function to the output variable for Irrigation

OUTPUT VARIABLE	RANGE	FUZZY SETS
IRRIGATION	75-85	SPRINKLER
	80-90	DRIP

Sample rules:

1.If(Temperature is high)and(Humidity is normal)and(Illumination is dark)and(Soil moisture is normal)and(Leaf wetness is dew)and(Wind is maximum)then(Lamp is high)(Water pump is on)(Irrigation is drip irrigation)(1)

2.If(Temperature is low)and(Humidity is dry)and(Illumination is dark)and(soil moisture is saturated)and(Leaf wetness is wilting)and(Wind is minimum)then(Lamp is low)(Water pump is off)(Irrigation is sprinkler irrigation)(1)

3.If (Temperature is high)and(Humidity is normal)and(Illumination is normal)and(Soil moisture is adequately wet)and(Leaf wetness is normal)and(Wind is optimum)then(Lamp is low)Water pump is off)Irrigation is sprinkler irrigation)(1)

4.If (Temperature is low)and(Humidity is dry)and(Illumination is bright)and(Soil moisture is adequately wet)and(Leaf wetness is frost)and(Wind is maximum)then(Lamp is low)Water pump is off)(Irrigation is drip irrigation)(1)

5.If (Temperature is low)and(Humidity is dry)and(Illumination is normal)and(Soil moisture is adequately)and(Leaf wetness is dew)and(Wind is maximum)then(Lamp is high)Water pump is on)(Irrigation is sprinkler irrigation)(1)

6.If(Temperature is high)and(humidity is dry)and(Illumination is normal)and(Soil moisture is saturated)and(Leaf wetness is frost)and(Wind is optimum)then(Lamp is medium)Water pump is on)Irrigation is sprinkler irrigation)(1)

RESULT AND DISCUSSION

This work has been carried out MATLAB R2013a simulation tool by varying input and output variables. The centroid method is used for Defuzzification. The proposed system to analyze

the data received and to check with the threshold values temperature, humidity, illumination, soil moisture, leaf wetness, wind velocity and the corresponding crisp outputs of the fuzzy logic on the values lamp, water pump, and irrigation. The developed system for the proposed work was tested under different input condition and provided good results in terms of accuracy and has a wide scope o being established.

Table10: Input Data

Inputs / S. No	Temperature	Humidity	Illumination	Soil moisture	Leaf wetness	Wind
1	70	45	120	25	750	8
2	20	30	100	10	200	2
3	60	50	230	20	350	4
4	20	15	400	22	500	7
5	15	20	260	10	800	8
6	55	20	270	10	20	5

Table 11: Result

Output / S. No	Lamp	Water pump	Irrigation	Result		
				Lamp	Water pump	Irrigation
1	397.9	271.3	85.06	High	on	Drip Irrigation
2	75.8	75.7	79.9	Low	off	Sprinkler Irrigation
3	76.014	76.070	79.829	Low	off	Sprinkler Irrigation
4	75.64	75.61	85.03	Low	off	Drip Irrigation
5	398	272	79.8	High	on	Sprinkler Irrigation
6	225.9	272.2	79.9	Medium	on	Sprinkler Irrigation

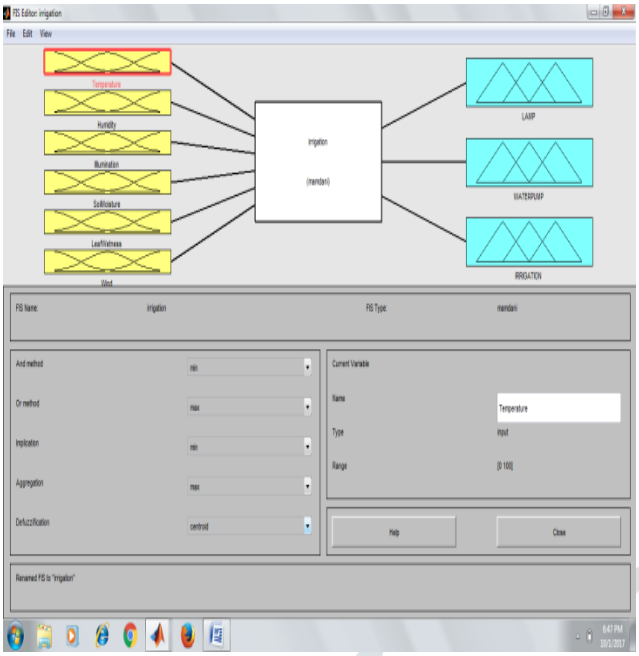

Figure 1 MATLAB Fuzzy Inference System (FIS)Editor (Mamdani model) helps the user to choose the input and output values ranges

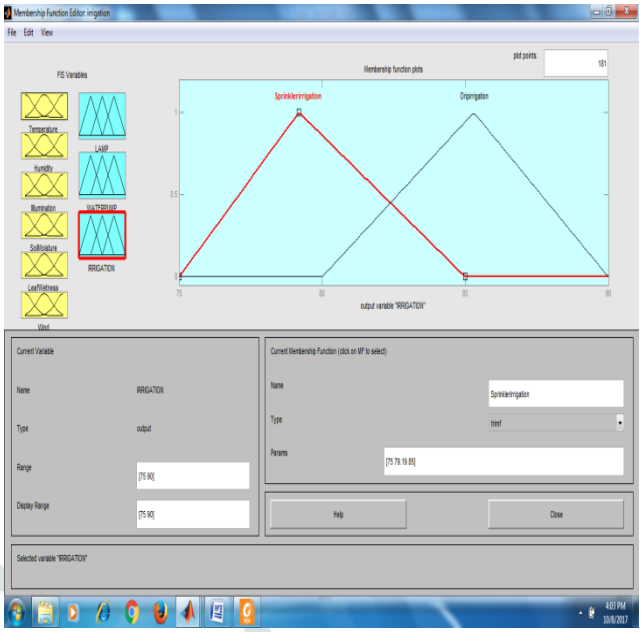

Figure 3 Membership function for output variable

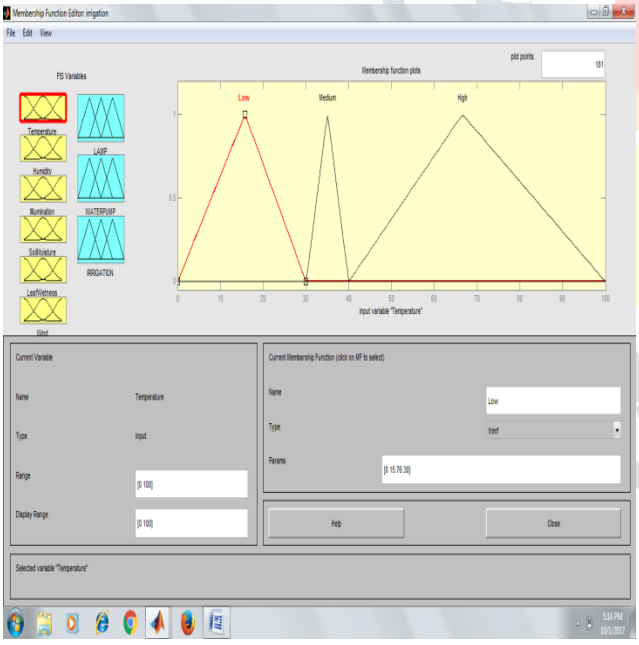

Figure 2 Membership functions for input variable

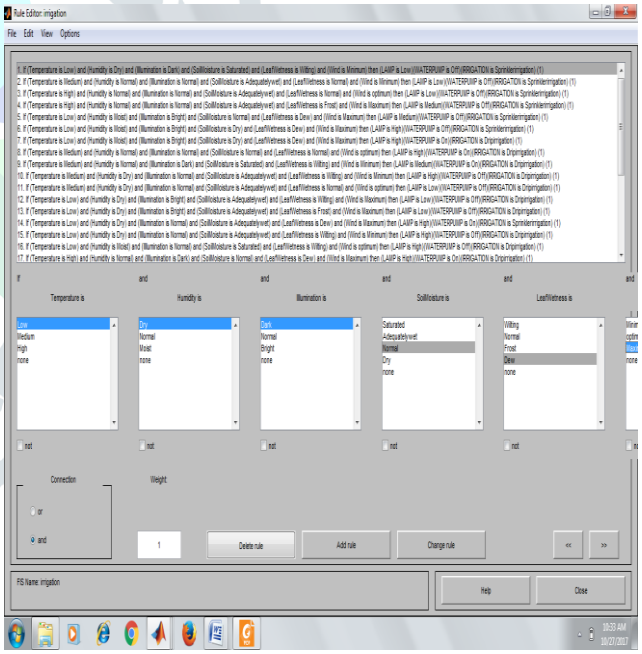

Figure 4 Fuzzy Rules Editor helps to design rules for smart irrigation

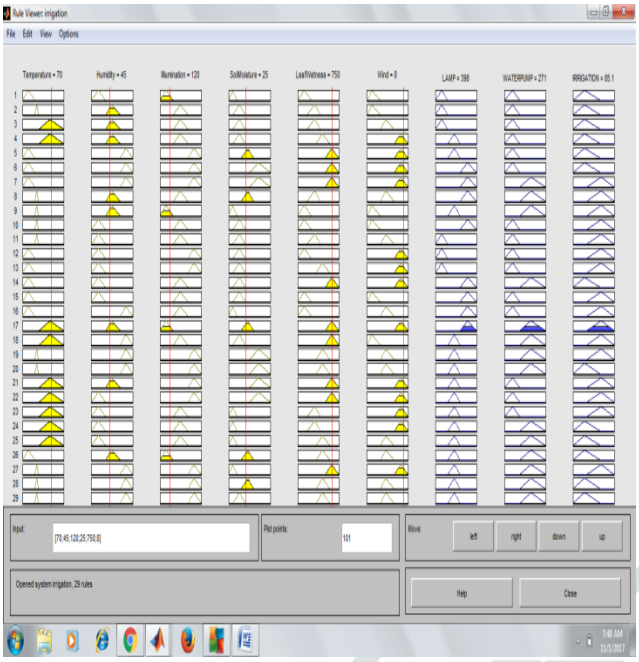

Figure 5 Rule viewer for generating rules

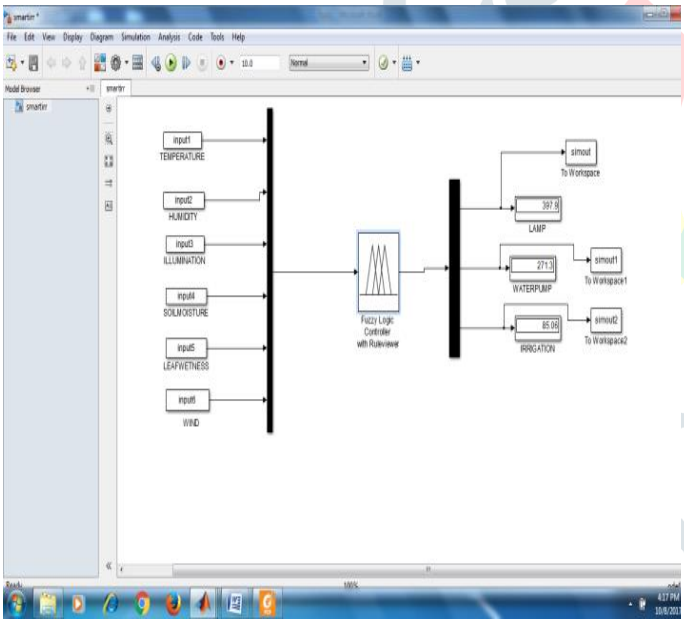

Figure 6 Simulation output for Smart irrigation

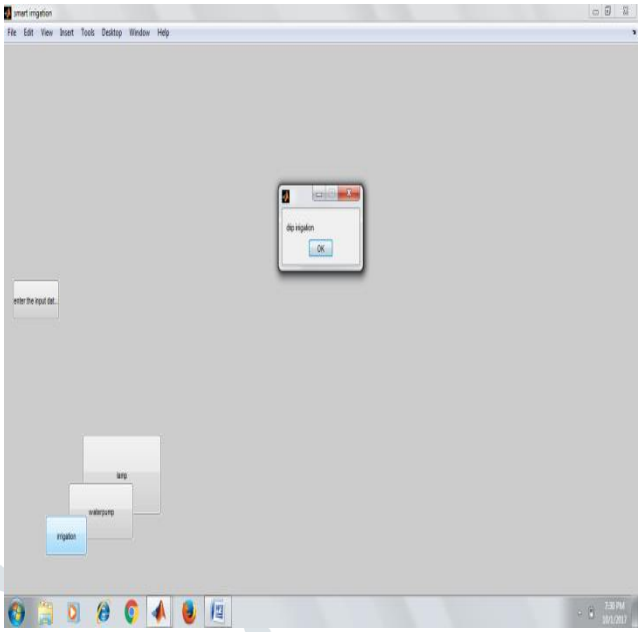

Figure 7 Smart irrigation the output for irrigation as Drip irrigation

DISCUSSION

The developed system yields a good result and serves as an improved smart irrigation system and it is simple and easy to implement. With the help of this system, it is possible to know the type of irrigation best. The proposed irrigation process system serves useful for farmer and improve Global food production. The smart irrigation system implemented is feasible and cost effective for optimization water resources for agriculture production.

CONCLUSION AND FUTUREWORK

Smart irrigation system is the most important concern in the domain of agriculture. The proposed system is designed to improve smart irrigation system using fuzzy logic. The fuzzy logic controller system had more ability as compared with other system. Fuzzy rules are simple therefore making the system attractive to

use by all types of agriculture. The proposed system is help to increasing the irrigation efficiency, reduction of labour cost, saving water and electricity.

With the improvement of computer technologies, especially those without any premises or human subjective, fuzzy logic can be applied in many areas. This thesis presents fuzzy logic controllers of Mamdani type. Efficiency and productivity can increases with precision grows larger and farms become smarter and additional condition. The result of this work reveals how a smart irrigation will respond different conditions. In future to increase the efficiency of proposed system we can make use of Neuro-fuzzy system and also increase the number of inputs or using Clustering technique.

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