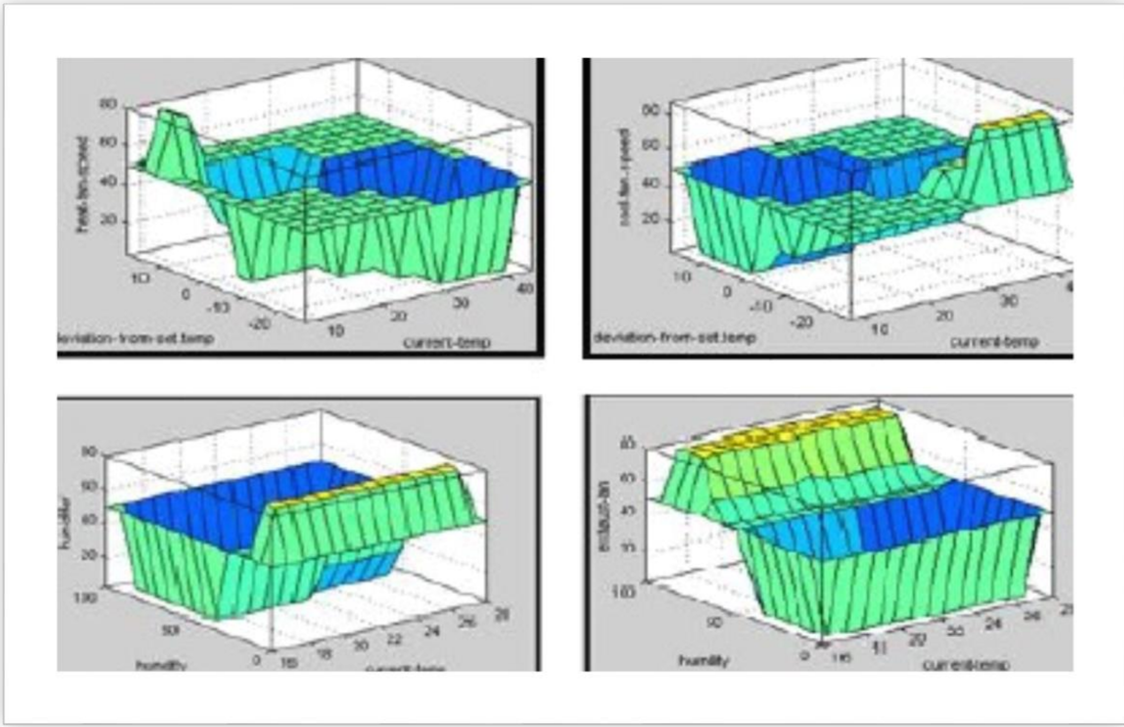

Humidity Control System

FUZZY LOGIC

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Abstract

This report describes the design of a room humidity controller using fuzzy logic. The proposed model consists of one fuzzy logic controllers to control humidity. The ideal relative humidity level for user's room temperature is preset in the system. Current humidity in % as detected by the humidity hypothetical sensor in the room serves as the input to the controller. The exhaust fan speed is controlled accordingly to maintain the correct humidity level for that temperature. This research work will increase the capability of fuzzy logic control systems in process automation with potential benefits. QtFuzzyLite-simulation is used to achieve the designed goal.

INTRODUCTION

A control system is a device, or set of devices, that manages, commands, directs or regulates the behavior of other device or systems. Industrial control systems are used in industrial production for controlling an equipment or a machine. The control system design, development and implementation need the specification of plants, machines or processes to be controlled. A control system consists of controller and plant, and requires an actuator to interface the plant and controller. The behavior and performance of a control system depend on the interaction of all the elements.

The fuzzy systems are one paradigm of CI. The contemporary technologies in the area of control and autonomous processing are benefited using fuzzy sets. One of the benefits of fuzzy control is that it can be easily implemented on a standard computer.

In contrast with traditional logic theory, where bi- nary sets have two-valued logic: true or false, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false. Fuzzy logic imitates the logic of human thought, which is much less rigid than the calculations computer generally performs. Intelligent control strategies mostly involve a large number of inputs. The objective of using fuzzy logic has been to make the computer think like people. Fuzzy logic can deal with the vagueness intrinsic to human thinking and natural language and recognize its nature is different from randomness. Using fuzzy logic algorithm, we could enable machines to understand and respond to vague human concept.

This proposed design work of room humidity controller can be used in a processing plant to maintain comfortable atmosphere in the environment. The exhaust fan dry out the air if the relative humidity is higher than the needed range. Humidity sensors used to monitor the environment of room are mounted in the room and are connected with the fuzzifiers of the fuzzy logic control system.

DESIGN ALGORITHM OF FUZZY LOGIC FOR ROOM HUMIDITY CONTROLLER

This simplified design algorithm is used to design the fuzzifier, inference engine, rule base and defuzzifier for the room air conditining system according to the control strategy of the processing plant to achieve the quantity and quality of the desire needs to maintain the room environment.

For any temperature within 18 to 26, the humidity controlling part of the proposed model performs well to maintain the comfort atmosphere of the user. The humidity comfort level is pre-defined and works perfectly within temperature range 18 to 26(C).

Current-Humidity

Relative Humidity is the percentage of water vapors the air is holding, in relation to the amount it is capable of holding at a given temperature. The Proper Indoor Humidity that gives comfortable atmosphere depends on temperatures, as indicated here:

If Outdoor Temperature Is:	Relative Humidity That Should Be Maintained
30’C	56%
27’C	54%
25’C	50.5%
22’C	45%
20’C	43.5%
17’C	40%

The most recent advancement in humidification is a humidifier that automatically delivers the optimum RH without periodic homeowner adjustment. The humidification part is designed in this model in such a way that the user does not have to set any particular humidity. The comfort feeling humidity level within user settable temperature range (18-26C) is pre-set here. from 18 C to 22C the ideal comfort RH level is taken as 45%. And from 23-26C the ideal RH level is taken as 50-54%.

MEMBERSHIP FUNCTIONS	RANGE (%)
DRY	0-21
NOT_TOO_DRY	20-43
EE_SUITABLE	42-48
SUITABLE	46-54
NOT_TOO_WET	53-75
WET	70-100

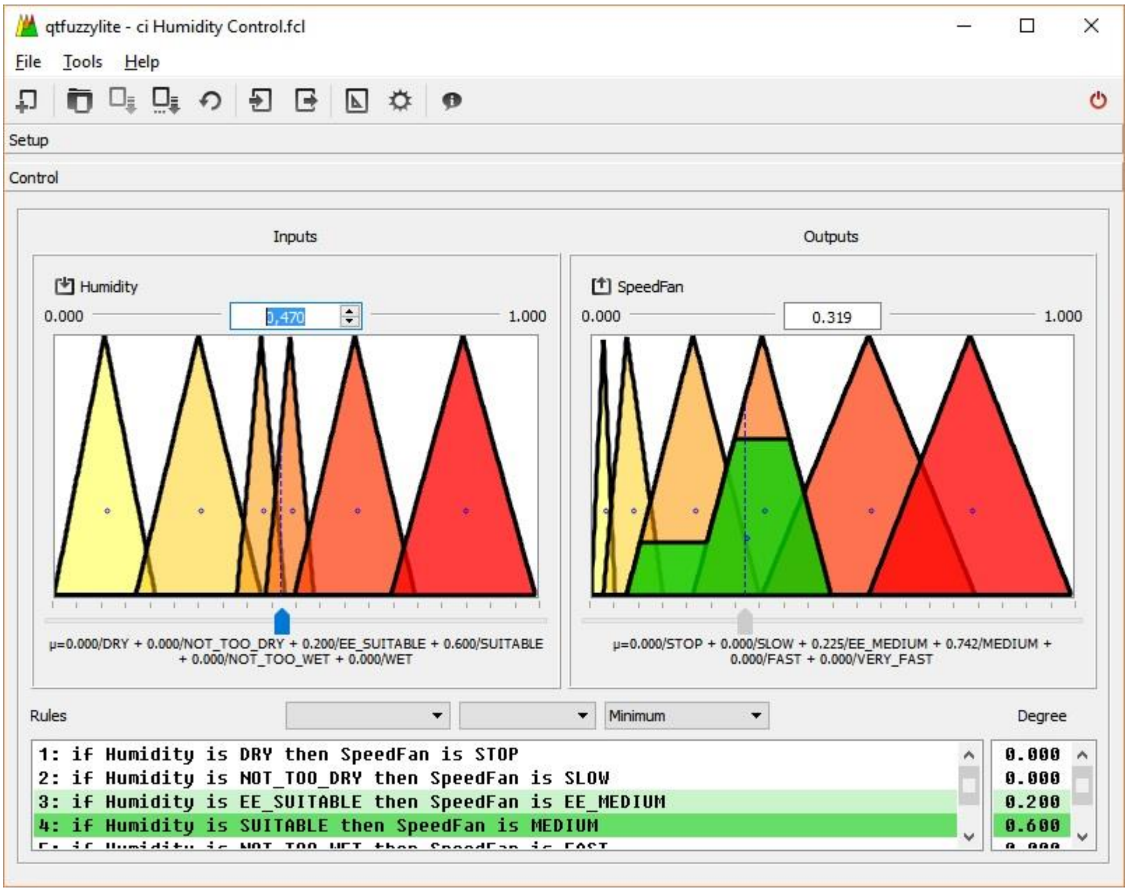
Membership functions for humidity system fan speed:

MEMBERSHIP FUNCTIONS	RANGE (%)
STOP	0-5
SLOW	2.5-15
EE_MEDIUM	7.4-35
MEDIUM	21.2-50
FAST	35.6-80
VERY_FAST	57.8-100

Fuzzification

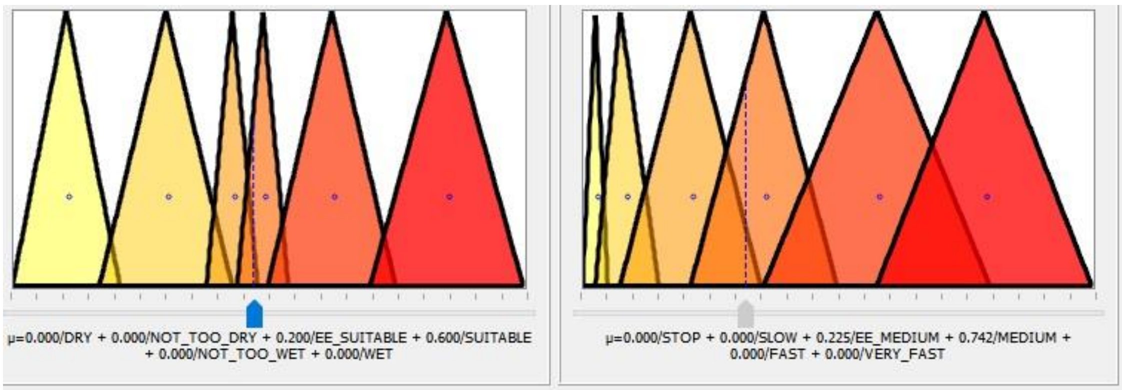
We select two random values of input variables from first fuzzy logic controller to demonstrate how fuzzification is done in both the fuzzy logic controller used in this system.

In the fuzzy logic controller, the signal value of current humidity = 46% intersects with fuzzy variables "EE_MEDIUM" and "MEDIUM", where "MEDIUM" is taken as the first fuzzy variable SpeedFan[0] and "EE_MEDIUM" is the second fuzzy variable, SpeedFan[1] as the next image suggests.



Deffuzifier

In this system, one defuzzifier control the actuators the exhaust-fan-speed. The defuzzification process provides the crisp value outputs after estimating its inputs. But as we are citing an example of how the defuzzification is done, we select the defuzzifier in correspondence to the current humidity levels. So the input is given to each of the defuzzifier, six values of SpeedFan1, SpeedFan2, SpeedFan3, SpeedFan4, SpeedFan5, SpeedFan6 from the outputs of inference engine and , six values of Rule1, Rule2, Rule3, Rule4, Rule5, Rule6 from the rule selector . Each defuzzifier estimates the crisp value output according to the center of average (C.O.A) method using the mathematical expression Σ Rule[i]*SpeedFan[i] /ΣSpeedFan[i] , where $i = 1$ to 6. Each. output variable membership function plot consists of six functions with similar range values for simplification.



CONCLUSION

The algorithmic design approach makes the system efficient and absolutely under control. The analysis clearly maps out advantage of fuzzy logic in dealing with problems that are difficult to study analytically yet are easy to solve intuitively in terms of linguistic variables. In case of the Air-Conditioning system, fuzzy logic helped solve a complex problem without getting involved in intricate relationships between physical variables. Intuitive knowledge about input and output parameters was enough to design an optimally performing system. The utility of the proposed system in processing plants is being carried out and in future it will help to design the advanced control system for the various industrial applications in environment monitoring and management systems.

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APPEDICIES

This is the Fuzzy Control Language program that represents the humidity controller.

```
FUNCTION_BLOCK ciHumidityControl

VAR_INPUT
  Humidity: REAL;
END_VAR

VAR_OUTPUT
  SpeedFan: REAL;
END_VAR

FUZZIFY Humidity
  ENABLED : TRUE;
  RANGE := (0.000 .. 1.000);
  TERM DRY := Triangle 0.000 0.105 0.210;
  TERM NOT_TOO_DRY := Triangle 0.170 0.300 0.430;
  TERM EE_SUITABLE := Triangle 0.380 0.430 0.480;
  TERM SUITABLE := Triangle 0.440 0.490 0.540;
  TERM NOT_TOO_WET := Triangle 0.500 0.625 0.750;
  TERM WET := Triangle 0.700 0.850 1.000;
END_FUZZIFY

DEFUZZIFY SpeedFan
  ENABLED : TRUE;
```

```
  RANGE := (0.000 .. 1.000);
  TERM STOP := Triangle 0.000 0.025 0.050;
  TERM SLOW := Triangle 0.025 0.074 0.150;
  TERM EE_MEDIUM := Triangle 0.074 0.212 0.350;
  TERM MEDIUM := Triangle 0.212 0.356 0.500;
  TERM FAST := Triangle 0.356 0.578 0.800;
  TERM VERY_FAST := Triangle 0.578 0.789 1.000;
  METHOD : COG;
  ACCU : MAX;
  DEFAULT := nan;
END_DEFUZZIFY

RULEBLOCK
  ENABLED : TRUE;
  ACT : MIN;
  RULE 1 : if Humidity is DRY then SpeedFan is STOP
  RULE 2 : if Humidity is NOT_TOO_DRY then SpeedFan is SLOW
  RULE 3 : if Humidity is EE_SUITABLE then SpeedFan is EE_MEDIUM
  RULE 4 : if Humidity is SUITABLE then SpeedFan is MEDIUM
  RULE 5 : if Humidity is NOT_TOO_WET then SpeedFan is FAST
  RULE 6 : if Humidity is WET then SpeedFan is VERY_FAST
END_RULEBLOCK

END_FUNCTION_BLOCK
```