Fuzzy Logic Based Control System for Washing Machines

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Abstract
In the Indian household, washing machines are a common feature today. The most important utility that can be derived from washing machine is that, effort can be saved what had to put in brushing, agitating and washing different types of clothes who need different amount of washing time which depends directly on the type of dirt, amount of dirt and cloth quantity etc.The washing machines that are used today serves all the purpose of washing but which cloth need what amount of agitation time is an important aspect.
The work present in this paper describes the procedure that can be used to get a suitable washing time for different clothes with the help of fuzzy logic control.The procedure is based on the principle of taking inputs from sensors subjecting them to the fuzzy arithmetic and obtaining a crisp value of washing time.

Keywords
Fuzzy Logic Control, Fuzzy Inference System, Washing Machine Automation, MATLAB Software

I. Introduction

The first and the most important question is "what is fuzzy logic?" Fuzzy logic is basically a multi-valued logic that allows intermediate value to be defined between conventional evaluations like yes/no, true/false and black/white. Notions like warm cold or very cold can be formulated mathematically and processed by computers.
The term Fuzzy logic was brought forth in 1965 by a professor at the University of Berkeley, named Lofti A.Zadeh.
Now a day's Fuzzy Logic is being used in many different fields, and in many different ways. In this paper an idea is presented how fuzzy logic may be used for washing machines.

II. Problem definition

When we use washing machine, generally we select the duration of washing time based on type of dirt, degree of dirt and quantity of clothes. To automate this process, we use sensors to detect these parameters, the washing time is then determined from this data. But there is no easy way to formulate a precise mathematical relationship between amount of cloths, dirt and the duration of washing time required. Consequently, this problem is remained unsolved until very recently. Conventionally, people simply set wash time by hand and error experience. The washing was not as automatic as they could be. The sensor system provides external input system from the machine from which decision can be made. It is the controller responsibility to make the decisions. We address this design problem using fuzzy logic. Fuzzy logic has been used because of fuzzy logic controlled washing machine controller gives the correct wash time.

III. Fuzzy Model for Washing Machine

The input parameters used to solve the above mention problem are:

- The quantity of clothes
- Dirtiness of clothes

The fuzzy controller takes two inputs, processes the information and gives output as washing time. The basic structure of fuzzy logic controller for washing machine is shown in fig. 1,

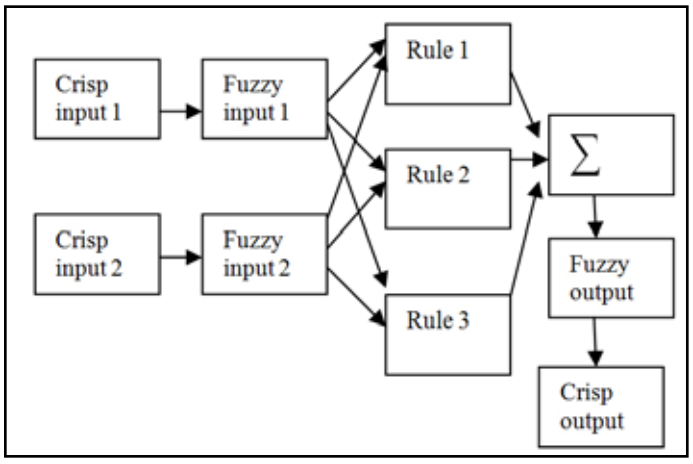

Fig. 1: Fuzzy Logic Controller for Washing Machine

IV. Membership Functions

The two crisp inputs,quantity and dirtiness vary from 0 to 10 and presented as fuzzy sets defined by their respective membership functions.Let the output;washing time be allowed to have three linguistic values less,medium and high.Similarly, let the input variable; quantity of clothes be expressed as low,average and large and dirtiness of clothes be described as being less,medium and high.The washing machine fuzzy inference system is shown in fig. 2.

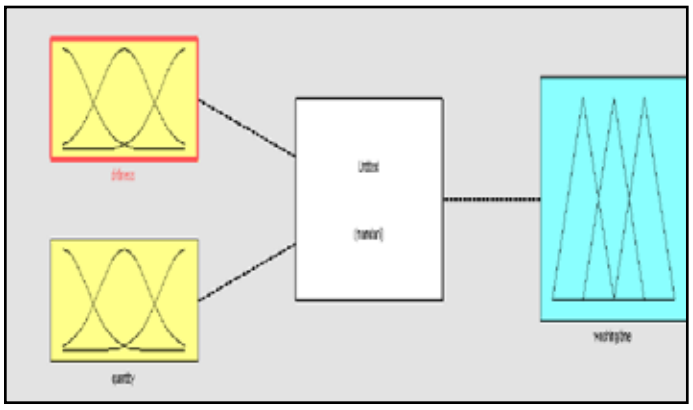

Fig. 2: Washing Machine Fuzzy Inference System

The parameter used to define memebership function of dirtiness less,medium and high are [0 0 4],[1 5 9] and [6 10 10]. Similarly Membership function for quantity low,average and large are [0 0 4],[1 5 9], and [6 10 10]. MF for washing time less, medium and high are [0 0 20],[10 25 40] and [35 50 50].

The membership functions of quantity and dirtiness of clothes shown in fig. 3(a) and fig. 3(b).

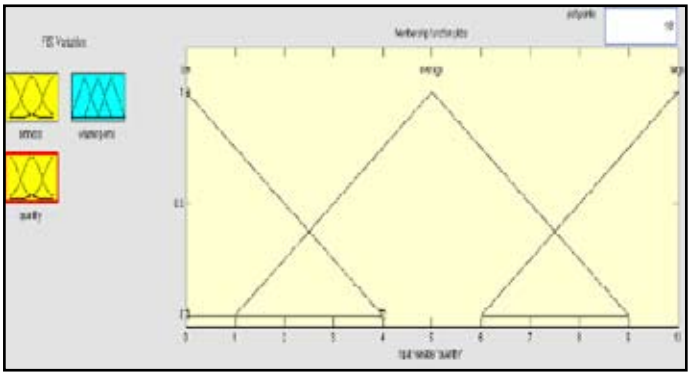

Fig. 3(a): Membership Function of Quantity of Clothes

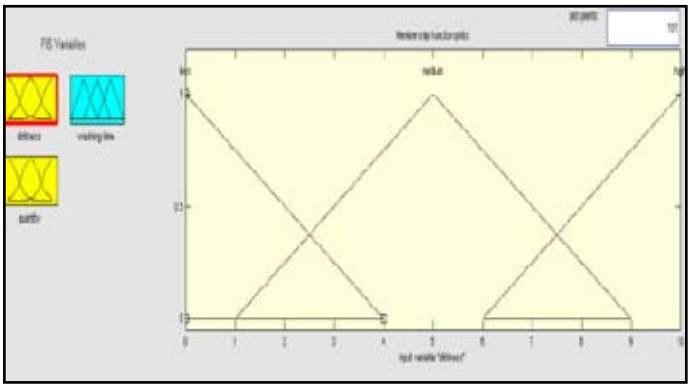

Fig. 3(b): Membership Function of Dirtiness of Clothes

V. Details About the Rules Applied

The decision which the fuzzy controller makes is derived from the rules which are stored in the database.These are stored in the set of rules.Basically the rules are if-rhen statements that are intuitive and easy to understand, since they are nothing but common English statements.The set of rules used here to derive the output are:

1. if(dirtiness is less) and (quantity is low) then (washing-time is less).
2. if(dirtiness is less) and (quantity is average) then (washing-time is less).
3. if (dirtiness is less) and (quantity is large) then (washing-time is medium).
4. if (dirtiness is medium) and (quantity is low) then (washing-time is less).
5. if (dirtiness is medium) and (quantity is average) then (washing- time is medium).
6. if dirtiness is medium) and (quantity is large) then (washing-time is high).
7. if (dirtiness is high) and (quantity is low) then (washing-time is medium).
8. if (dirtiness is high) and (quantity is medium) then (washing-time is high).
9. if(dirtiness is less) and (quantity is high) then (washing- time is high).

The rules too hav been defined in imprecise sense and hence they too are not crisp but fuzzy values.The two input parameters after being read from the sensors are fuzzified as per the membership functon of the respective variables.At last the crisp value of washing time is obtain as a answer.

The Rule base diagram is shown in fig. 4.

Fig. 4: The Rule Base Diagram

VI. Results

The execution of rules is done by using MATLAB. The sensors sense the input values and using the above model the inputs are fuzzified and then by using simple if-then rules the output fuzzy function is obtained. The membership function of output washing time is shown in fig. 5.

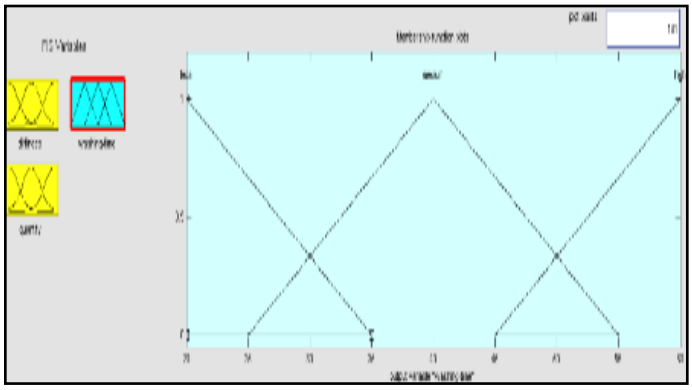

Fig. 5: Membership Function of Washing Time

The Surface view Diagram is shown in fig. 6.

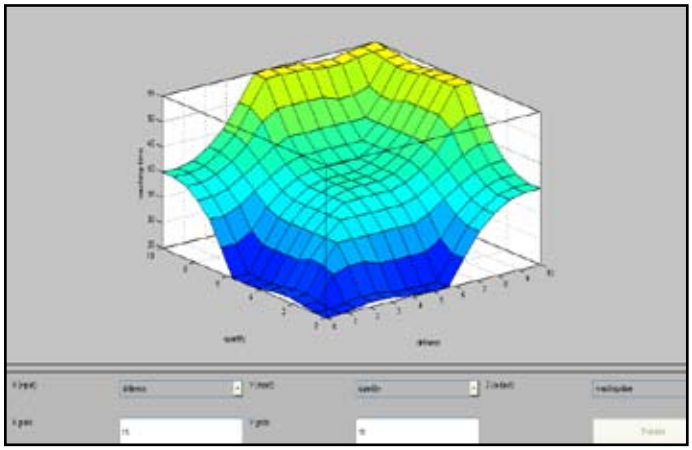

Fig. 6: Surface View Diagram

The rule view diagram is shown in fig. 7.

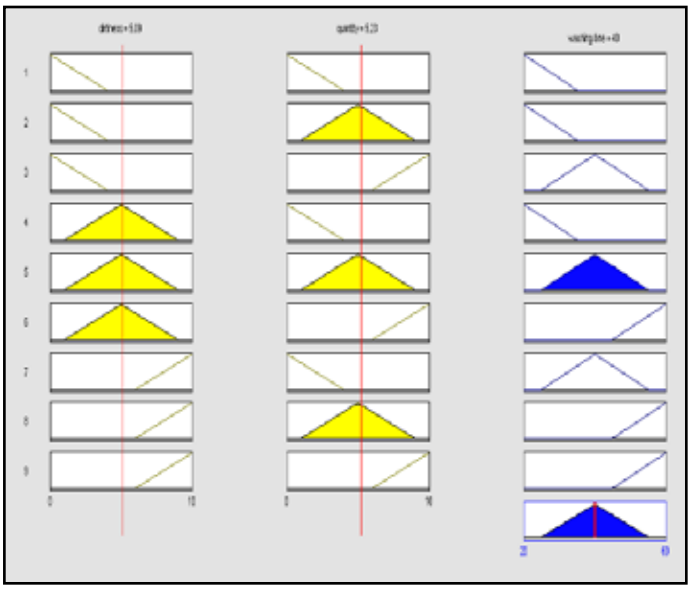

Fig. 7: Rule View Diagram

VII. Conclusion

By the use of fuzzy logic control we hav been able to obtain a wash time for different degree of dirt and quantity of clothes. The conventional method required to human interaction to decide upon what should be the wash time for different clothes. In other words this situation analysis ability has been incorporated in machine which makes the machine much more automatic and the decision taking power of the new arrangement

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