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Experiment – 8: Fuzzy Logic Controller for Washing Machine

Date: _____

1. **Aim:** Write a program of fuzzy controller for washing machine.

2. **Requirements:** Python

3. **Pre-Experiment Exercise**

3.1 Brief Theory

While using a washing machine, the person generally select the length of wash time based on the amount of clothes wish to wash and the type and degree of dirt cloths have. To automate this process, we use sensors to detect these parameters (i.e. volume of clothes, degree and type of dirt). The wash time is then determined from this data. Unfortunately, there is no easy way to formulate a precise mathematical relationship between volume of clothes and dirt and the length of wash time required. The sensor system provides external input signals into the machine from which decisions can be made. It is the controller's responsibility to make the decisions and to signal the outside world by some form of output. Because the input/output relationship is not clear, the design of a washing machine controller has not in the past lent itself to traditional methods of control design. This design problem is presented using fuzzy logic. Fuzzy logic has been used because a fuzzy logic controlled washing machine controller gives the correct wash time even though a precise model of the input/output relationship is not available.

Figure 1 shows the basic approach to the problem. The fuzzy controller takes two inputs, processes the information and outputs a wash time. The degree of dirt is determined by the transparency of the wash water. The dirtier the clothes, less transparent the water being analyzed by the sensors is. Degree of dirt determines how much dirty a cloth is. Whereas type of dirt determines the quality of dirt. Greasy cloths, for example, take longer for water transparency to reach transparency because grease is less soluble in water than other forms of dirt.

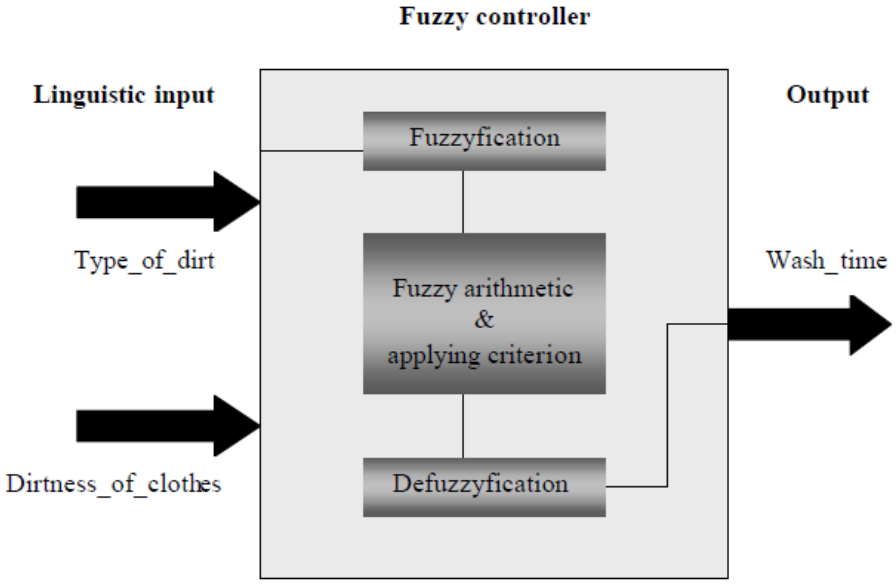

Figure 1: Basic block diagram of the process

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The range of possible values for the input and output variables are determined. These are the membership functions used to map the real world measurement values to the fuzzy values, so that the operations can be applied on them. Figure 2 shows the labels of input and output variables and their associated membership functions. Values of the input variables degree_of_dirt and type_of_dirt are normalized range -1 to 100) over the domain of optical sensor.

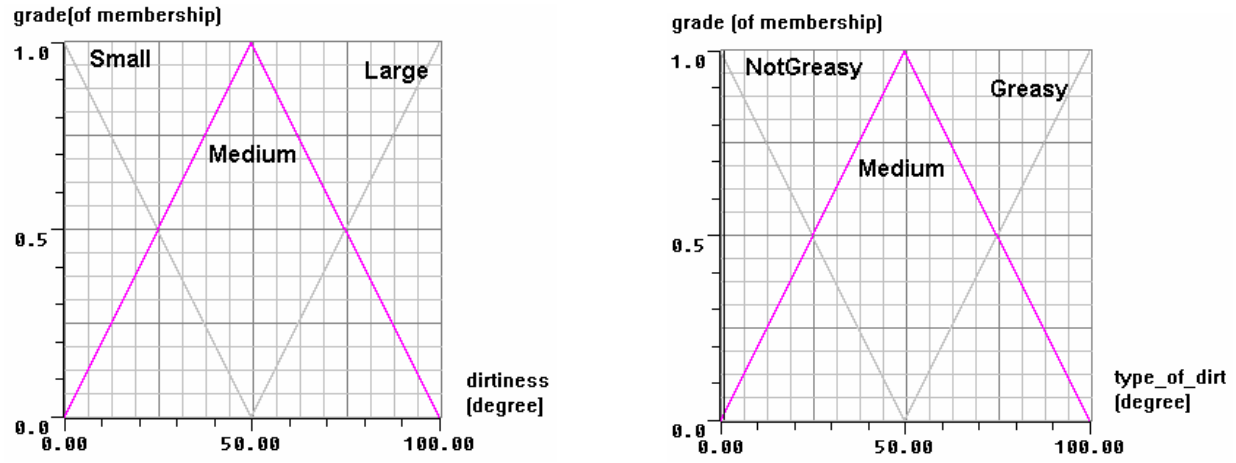

Figure 2: Membership function for dirtness_of_clothes and type_of_dirt

The decision which the fuzzy controller makes is derived from the rules which are stored in the database. These are stored in 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. The two input parameters after being read from the sensors are fuzzified as per the membership function of the respective variables. These in additions with the membership function curve are utilized to come to a solution (using some criteria). At last the crisp value of the wash_time is obtained as an answer.

4. Laboratory Exercise

4.1 Algorithm:

1. Take the two inputs, type of dirt and degree of dirtness in terms of percentages.
2. Define the membership functions for both inputs and one output (wash time)
3. Set the rules with all permutation combination of both inputs with wash time.
4. Apply the fuzzy arithmetic and defuzzyfication, find the proper output wash time.

5. Post-Experiment Exercise

5.1 Conclusion:

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