A Study Report on Fuzzy Logic Application for Washing Machine

S PETRICIA LEEMA ROSELINE
Christ College – Pune

Dr R MOHAN
College of Military Engineering - Pune

*Abstract–*In our everyday life, Washing Machines play a vital role in household appliances, which are mostly used in all houses across the world. In some way, washing machines make our lives easier. A short review is provided in Fuzzy logic for Washing Machines. This review paper focused only on the Fuzzy washing Machines. It reviews the scenarios for the implementation of three phases, which are fuzzification, inference (rule based), defuzzification. This study report tells the number of inputs-outputs and simulated model using MATLAB with various Fuzzy Rules. The authors have proposed various designs of fuzzy logic controllers for washing machines, which have different linguistic numbers of input variables and numbers of output variables.

Keywords --Fuzzy Logic Controller (FLC), fuzzification, inference, defuzzification, linguistic variables.

I. INTRODUCTION

In the year 1965, theconcept of fuzzy logic was first introduced by Professor Lotfi A. Zadeh at University of California, Berkeley [1]. Fuzzy logic system is the multivalued control system for powerful mathematical designs which provide simple designs to implement very complex systems [2]. Before the development of fuzzy washing machines, there wereconventional method of manually operatedand semi-automated ones.After introducing fuzzy logic, rapid changesin the washing machine controllers were fully automated.This paper is about the study of the various types of fuzzy logic washing machines designed by different authors. The papers collected from various conferences, proceedings, and journals. MATLAB software is used to achieve the simulation designed goal.

Fuzzy Logic

Fuzzy logic is an approach based on human natural linguisticto formalize the imprecise reasoning into if-thenrule-based system. Ambiguous reasoning to embody the human ability into control system under uncertainty. It uses multivalued approach to mathematical formulation. In fuzzy logic all truths values are real numbers, between 0 and 1, which means,"degree of truth" or approximate.

Fuzzy logic washing machines help us clean our clothes automatically. All fuzzy logic machines do all our daily chores. There are many parameters, as these washing machines use detergent, water, time consumption and automatic decision making to run themselves.
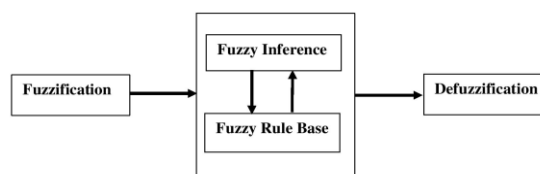
Structure of a fuzzy logic

Figure1. Structure of Fuzzy Logic System

Washing Machine: Principle

To know the functions of washing machine we must know its components. The components are Motor, Agitator, water pump, Sensor for door safety, Detergent drawer, controller, drain tube, mechanical programmer, and valve for inlet control of water.

II. LITERATURE REVIEW

DESCRIPTION OF SOME OF THEM IS AS FOLLOWS:

Muhammad Riazet al.[4].The results are thoroughly verified by TOPSIS technique of MCDM. This paper compares hard water and soft water. The study says that Hard water detergent consumption and wash time is longerwhereas soft water reduces the quantity of detergent and, economically power consumption. There are 5 inputs and 2 outputs, and its inference has 576 rules. Defuzzification is done using the Centroid method. The conclusion says choosing high temperature and soft water, amount of detergent and washing time can be saved up to 70 percent.

Sweta Gautam, Rohit Miri and S R Tandan[5]inputs are Amount of Dirtiness, Mass of Clothes and number of cycle to clean up the clothes are used to calculatetheoutputs. Calculation is done in python language with five if-then rules. The algorithm leads to saving the electricity and time.

Reference [6]This paper analyse the performance of Fuzzy Based Washing Machine**,** there are three output and five input variables fuzzy logic controller to calculaterinse time, wash time and spin time. Hardware Implementation of proposed FLCs using VERILOG in ISE environment for Xilinx Spartan 3E.

Reference [7]Design of Washing Machine using Fuzzy Logic Controller (FLC) is shown in the figure.
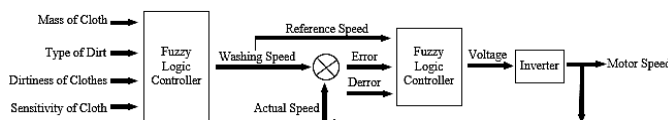

Figure 2: Proposed system

Mamdani Method is used to implement proposed inference system. In this method the implication function used is min-max that implies a rule and centroid method for defuzzification. In phase1, If-Then Rule base has 81 rules and in phase2 has 125 rules. The various parameters can determine the applicable washing speed. The results of the washing speedcan enter the next control system to steady the motor speed regardless of any changes in load.

Reference [8]This paper talks about the Design of a Smart Washing Machine using fuzzy logic. The main objective in this paper is to save electricity unit and time, conserve water, reduce detergent amount, and overall money. The fabric load inputs consist of the fabric types, weight, and amount of dirt. The output parameter includes washing time taken, temperature, water level, agitation, and detergent. For the program analyzing and controller part Fuzzy Tech MCU-51 Edition was used, which supports all 80C51 Microcontrollers and 8051.

Reference [9]The proposed Fuzzy Washing Machine focused on the Construction of Detergent box three linguistic variable inputs and three Linguistic variable Outputs are used. The design has three main parts, these parts consists of construction of Detergent box, AC Motor Driver Circuit, and Water Level sensor.
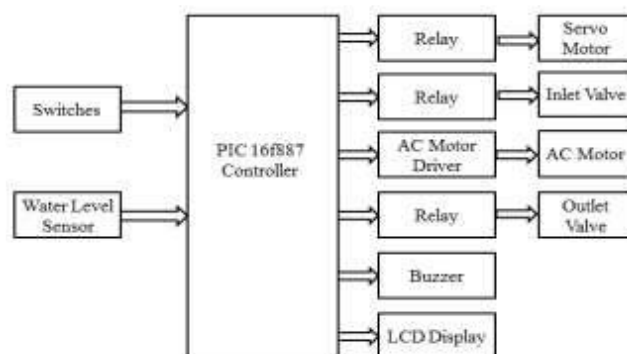
Fig 3. Block Diagram of the System

Figure3 shows the simulated Hardware implementation. In this proposed model the processing time of washing machine and amount of water is not accurate, depends on the types of clothesit may change. Therefore, this research will get correct processing time of washing machine and automatically fill the water and detergent.

Reference [10]To find out the Quality of Wash this simulated model is used. This model has 3 input parameters and five output parameters. This model is implemented in MATLAB by Mamdani-centroid defuzzification method. Surface viewer shows the wash quality with the help of 27 rules.

Reference [11] The combination of Neural Network and Fuzzy Logic was introduced to detect the type of laundry. This study uses linguistic variables of four inputs and calculates spin time as a single output. Based on the input, fuzzy calculates the spin time, Neuro is used for automatic detection of clothes type. There are Nine rules[11][12][24][27] are implemented to automate the washing machine and ability to make decision.

III. SUMMARY

The following table summarizes several rules based on the number of inputs and outputs. This table covers more than twelve research papers on Fuzzy Logic Washing Machine.

Paper Title	No. of Input Linguistic Variable	No. of Output Variables	No. of Rules
[4] Impact of Water Hardness in Instinctive Laundry System Based on Fuzzy Logic Controller	5	2	576
[5] Washing Machine Controller Using Fuzzy Logic Technique	2	1	5
[6] Performance Analysis of Fuzzy Based Washing Machine	5	3	8
[7] Design and Simulation of Washing Machine using Fuzzy Logic Controller (FLC)	Phase1: 4	1	81
	Phase2: 3	1	125
[8] Application of Fuzzy Logic in Design of Smart Washing	3	5	10

Machine			
[9] Operation System of Washing Machine with Fuzzy Logic Control System and Construction of Detergent box	3	3	9
[10] Washing machine using fuzzy logic controller to provide wash quality	3	5	27
[11] Neuro-Fuzzy Controller Based Washing Machine	4	1	9
[12] Fuzzy Logic Based Control System for Washing Machine	2	1	9
[15] Implementation of Washing Machine System Via Utilization of Fuzzy Logic Algorithms	4	5	10
[24] Implementation of Fuzzy Based Washing Machine	2	2	9
[25] Three Input – One Output Fuzzy logic control of Washing Machine	3	1	27
[27] Mathematical comparison of defuzzification of fuzzy logic controller for smart washing machine	2	1	9

Table 1: Summary Report

IV. CONCLUSION

Only a few are covered and there is more yet to be learned, so that means this paper is just presenting just an overview on fuzzy logic and its application in washing machine. By implementing fuzzy logic, washing machines are possible to make better and a more efficient design technique. Thus, these fuzzy logic washing machines have great contributions in home appliances. Fuzzy logic washing machines, therefore, do help us indeed.

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