

An Improved Washing Machines FLC System

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Abstract- Washing time Clothing is a principal part of people's everyday life. Extraordinary garments washer can save energy, yet moreover carry on a more reasonable washing to the pieces of clothing to defer its organization life. Modified garments washer frees the customer's hands, with the objective that the customer can all the more promptly disperse a chance to achieve other work, to improve the work efficiency. Therefore, a fuzzy justification controller (FLC) based garments washer ought to be arranged. This paper presents an improved fuzzy justification based control system for garments washers. The reenactment results show that the system has a shorter washing time.

Keywords: Defuzzification, FLC, FIS, Fuzzification, Washing time and Fuzzy rules

1. INTRODUCTION

Garments washers are one in every of the foremost essential home machines discovered these days. The substance of such a machine is proportional back the work and feasibly offers cleaner pieces of clothing. To exhibit the orderliness of pieces of clothing, the garments washer makers are prodded towards a totally customized recognizing segment worked machines which may thoroughly distinguish the measure of wash load, the measure of dirtiness of the pieces of clothing and moreover the style of material inside the current wash cycle to genuinely envision the wash time required. The wash recognizing part may be a basic optical distinguishing segment used to choose the physical extent of light, experienced a glass tube, which may then be recharged to electrical signs to foresee the measure of dirtiness. Therefore, a fuzzy method of reasoning controller (FLC) based garments washer ought to be arranged.

Theory of sets is one in all the pivotal gadgets in current math. A may be an arrangement of commensurate form of undeniable things called the aspect of the set. At the point when some grouping is made like "class of high assessed vehicles" some ambiguity, caprice or vagary rises when making a decision whether a part has a spot with a class. In such form of characterizations accomplice object need not have a spot with an order there is furthermore a degree of belongingness. There comes the chance of fuzzy sets that was introduced by Lotfi A. Zadeh [1]. Fuzzy sets are furthermore observed as accomplice increase of crisp sets as they award the midway membership that isn't promising inside the crisp sets. The membership of a segment in a fuzzy set doesn't need

being done, that is any portion of a fuzzy set may moreover be individual from another fuzzy set inside a comparable universe. In fuzzy sets there are no sharp cutoff points as there's some vagary exist inside the information. The degree of membership for fuzzy sets is between zero (0) and one (1).

2. LITERATURE SURVEY

In 1965, the start of fuzzy basis was from the outset imagined by Professor Lotfi A. Zadeh [1]. Fuzzy method of reasoning is a start that helps computers in making judgments in an amazingly infers that resembles human practices. It helps trade extending effectiveness, makes the open door for the creation to be extra worthwhile and most generally it helps organizations in proficient terms. This thought had been given in one among his assessment papers under the name Fuzzy reason or Fuzzy sets [1]. It is used to watch non-direct systems that are frustrated to deal mathematically. The non-probabilistic, weaknesses issues are seen by fuzzy reason and fuzzy set theory [2]. It is noteworthy arrangement hypothesis for portraying and making control systems that gives straightforward and unconstrained technique to setup pros to realize advanced systems [3]. Fuzzy Controllers, [4] as contrary to customary controllers can utilize knowledge evoked from human decisions or human chairmen. Fuzzy Logic Controller for Gas Heater was arranged using conduct illustrating. These modules are then related by methods for fundamental VHDL to supervise valve edge [5]. The fuzzy justification controller for Liquid Level Control was arranged using MATLAB for managing valve. It is differentiated and the PID controller. In 2007, the Fuzzy Inference is used for choosing wash time using three-sided membership function [6].

In 2011, Manish Aggarwal presented the Fuzzy Logic Control for Washing Machine. It has 2 sources of information named 'Kind of Dirt' and 'Level of Dirt'. The yield was as wash time with the inference engine that offers 9 rules for the FLC [7]. In 2009, Pritesh Lohani proposed an improved controller central processor which involves 3 information sources for instance Kinds of Dirt, Dirtiness of Clothes and Mass of Clothes. The yield of the controller is Wash Time with 25 rules [8]. In 1974, the basic fuzzy reason based control attempt was done by Mamdani [9]. The maker arranged the fuzzy basis for a steam engine. After 1980, the usage of fuzzy justification based control system gets essential in garments washers, metro, vacuum cleaners, lifts and companions operations. Degrees of progress in planning recently have permitted fuzzy basis to be utilized in different fields [10]. Today, fuzzy justification has found its application in various fields like home hardware, vehicle organizations, electronic control systems, breaking systems, etc [11]. Alhanjouri and Alhaddad's garments washer takes two information var-

iables (dirt sort and level of dirtiness) to get wash time as the yield [12]. In view of fuzzy justification, neural network and its learning algorithm, the garments washer fuzzy controller is proposed [13, 14]. Kumar and Haider decide to diminish the washing time by picking dirtiness and sum as data [15]. To secure the controller yield, a Sugeno type FLC structure has been given [16]. The arrangement and execution of an autonomous room air cooler using fuzzy rule based control system for the actuators; cooler fan, water siphon and room exhaust fan. Three defuzzifiers are used to control and MATLAB-entertainment is used to achieve the arranged goal [17].

In 2015 , Olena Semenova, Andriy Semenov presented the Fuzzy Logic Control for WIMAX Network . It contain 3 information sources 'Holding up time','Queue Length','Packet Size' and the yield is as Priority i.e which group must be sent first in the wireless correspondence network. They have applied 27 rules and by arranging of these rules the relating need of transmission is gotten. [18].

In 2015 Smt.SudhaHatagar, Shri. S.V. Halase proposed the arrangement of fuzzy method of reasoning controller for Washing machine. It include 3 data 'Kind of Dirt','Dirtiness of clothes','mass of articles of clothing's .the yield of the cycle is wash time .This wash time is gotten by combining the 27 rules If-then rule reliant on fuzzy logic.[19].

3. PROPOSED DESIGN FOR FUZZY LOGIC MODELING OF WASHING MACHINE

Fuzzy basis is best applied in fields where a ton of weakness or fleeciness exists. For our circumstance, creating an expert system by applying fuzzy inference rules is a very suitable decision. In a fuzzy inference system or FIS, fuzzy set theory is applied to design sources of information (or qualities) to yields. The fuzzification cycle incorporates transforming crisp characteristics into various assessments of membership for linguistic terms of fuzzy sets. Membership functions are used to relate an assessment to every single linguistic variable. In our assessment, we complete the Mamdani system that is depicted in Figure 1 and centroid as defuzzification procedure.

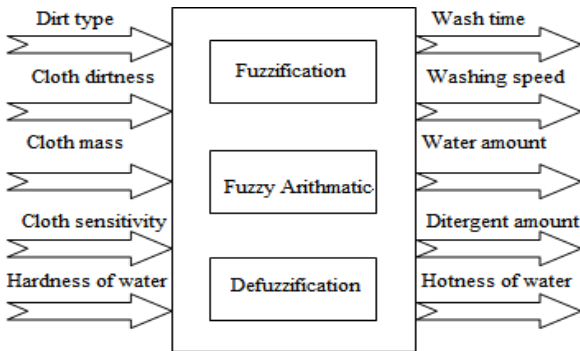


Figure 1: Planned Fuzzy Logic Controller

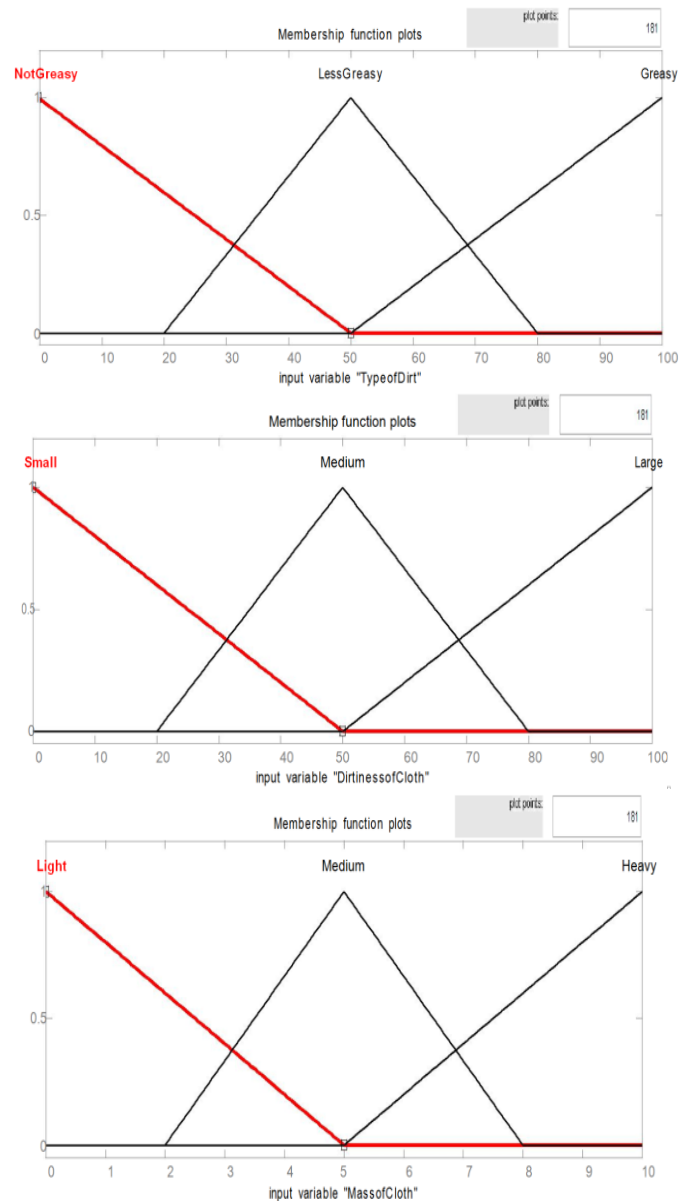
After we present our five information elements and five yield factors as underneath, we choose membership functions for every factor for our fuzzy system and their looking at fuzzy memberships as presented in Figure 2 and Figure 3 independently.

Input Parameters:

1. Water Hardness
2. Type of Dirt
3. Mass of Cloth
4. Dirtiness of Cloth
5. Sensitivity of Cloth

Output Parameters:

1. Wash Speed
2. Wash Time
3. Amount of Water
4. Water Hotness
5. Amount of Detergent



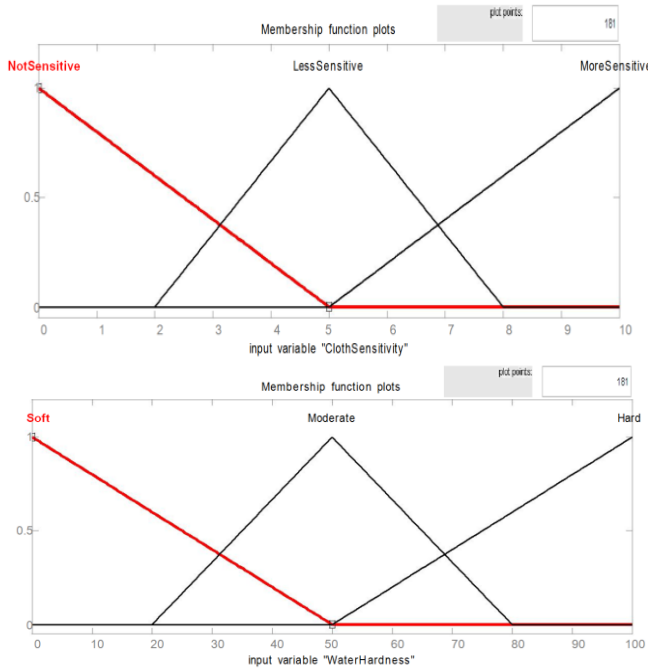


Figure 2. Fuzzy logic input membership functions

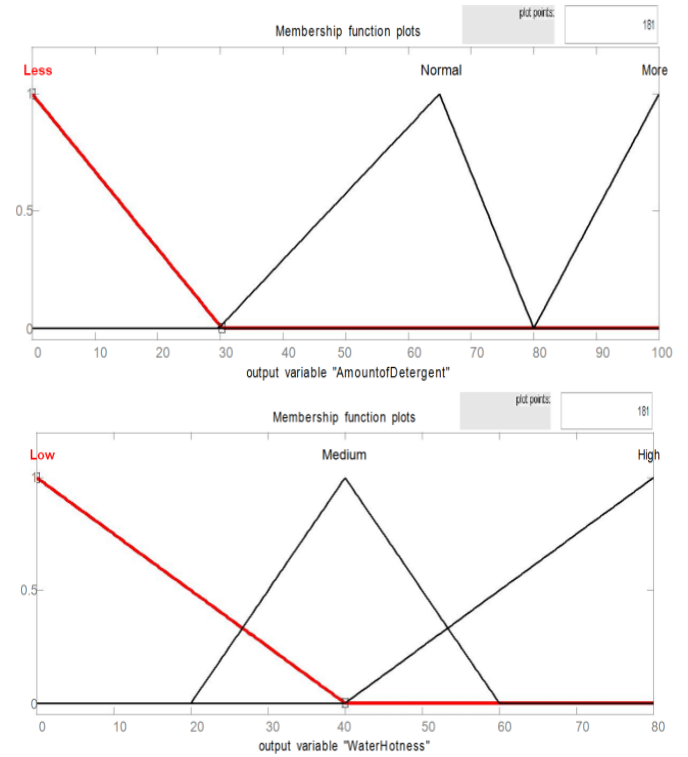


Figure 3. Fuzzy logic output membership functions

To apply fuzzy method of reasoning to garments washer, it is essential to develop fuzzy basis rules., After choosing the membership functions, a total of 27 rules have been set okay with portraying relationship among the limits. The rules gained can be examined viewing IF and thereafter verbalizations as showed up in underneath.

Fuzzy Rules:

Rule 1

In case (TypeofDirt is Greasy) or (DirtinessofCloth is Large) or (MassofCloth is Heavy) or (SensitivityofCloth is MoreSensitive) or (WaterHardness is Hard) by then (WashTime is Long)(WashSpeed is Medium)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

Rule 2

In case (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is NotSensitive) and (WaterHardness is Soft) by then (WashTime is VeryShort)(WashSpeed is VeryShort)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 3

In case (TypeofDirt is LessGreasy) and (DirtinessofCloth is Medium) and (MassofCloth is Medium) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Medium)(WashSpeed is Medium)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

Rule 4

In case (TypeofDirt is NotGreasy) or (DirtinessofCloth is Small) or (MassofCloth is Light) or (SensitivityofCloth is

NotSensitive) or (WaterHardness is Soft) by then (WashTime is Short)(WashSpeed is Medium)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Low) (1)

Rule 5

In case (TypeofDirt is Greasy) and (DirtinessofCloth is Large) and (MassofCloth is Heavy) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Hard) by then (WashTime is VeryLong)(WashSpeed is VeryLong)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 6

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is NotSensitive) and (WaterHardness is Moderate) by then (WashTime is VeryShort)(WashSpeed is VeryShort)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 7

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is NotSensitive) and (WaterHardness is Hard) by then (WashTime is VeryShort)(WashSpeed is Short)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 8

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Soft) by then (WashTime is VeryShort)(WashSpeed is VeryShort)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 9

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is VeryShort)(WashSpeed is VeryShort)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 10

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Hard) by then (WashTime is Short)(WashSpeed is Short)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 11

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Soft) by then (WashTime is VeryShort)(WashSpeed is VeryShort)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 12

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Moderate) by then

(WashTime is Short)(WashSpeed is Short)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 13

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Hard) by then (WashTime is Short)(WashSpeed is Medium)(AmountofWater is Less)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

Rule 14

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Medium) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Soft) by then (WashTime is Short)(WashSpeed is Medium)(AmountofWater is Less)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

Rule 15

If (TypeofDirt is NotGreasy) and (DirtinessofCloth is Medium) and (MassofCloth is Medium) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Medium)(WashSpeed is Long)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

Rule 16

If (TypeofDirt is LessGreasy) and (DirtinessofCloth is Medium) and (MassofCloth is Medium) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Medium)(WashSpeed is Long)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

Rule 17

If (TypeofDirt is LessGreasy) and (DirtinessofCloth is Medium) and (MassofCloth is Heavy) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Long)(WashSpeed is Long)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 18

If (TypeofDirt is Greasy) and (DirtinessofCloth is Medium) and (MassofCloth is Medium) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Hard) by then (WashTime is Long)(WashSpeed is Long)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 19

If (TypeofDirt is Greasy) and (DirtinessofCloth is Medium) and (MassofCloth is Heavy) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Hard) by then (WashTime is VeryLong)(WashSpeed is Long)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 20

If (TypeofDirt is Greasy) and (DirtinessofCloth is Large) and (MassofCloth is Medium) and (SensitivityofCloth is MoreSensitive) and (WaterHardness is Hard) by then (WashTime is VeryLong)(WashSpeed is

VeryLong)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 21

If (TypeofDirt is LessGreasy) and (DirtinessofCloth is Large) and (MassofCloth is Medium) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Long)(WashSpeed is Long)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 22

If (TypeofDirt is Greasy) and (DirtinessofCloth is Small) and (MassofCloth is Heavy) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Hard) by then (WashTime is Long)(WashSpeed is Long)(AmountofWater is More)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 23

If (TypeofDirt is Greasy) and (DirtinessofCloth is Large) and (MassofCloth is Light) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Hard) by then (WashTime is Long)(WashSpeed is Long)(AmountofWater is Normal)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 24

If (TypeofDirt is Greasy) and (DirtinessofCloth is Large) and (MassofCloth is Heavy) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Soft) by then (WashTime is Long)(WashSpeed is Long)(AmountofWater is Normal)(AmountofDetergent is More)(WaterHotness is High) (1)

Rule 25

If (TypeofDirt is LessGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Light) and (SensitivityofCloth is NotSensitive) and (WaterHardness is Moderate) by then (WashTime is VeryShort)(WashSpeed is VeryShort)(AmountofWater is Less)(AmountofDetergent is Less)(WaterHotness is Low) (1)

Rule 26

If (TypeofDirt is LessGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Medium) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Short)(WashSpeed is Medium)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Low) (1)

Rule 27

If (TypeofDirt is LessGreasy) and (DirtinessofCloth is Small) and (MassofCloth is Heavy) and (SensitivityofCloth is LessSensitive) and (WaterHardness is Moderate) by then (WashTime is Medium)(WashSpeed is Long)(AmountofWater is Normal)(AmountofDetergent is Normal)(WaterHotness is Medium) (1)

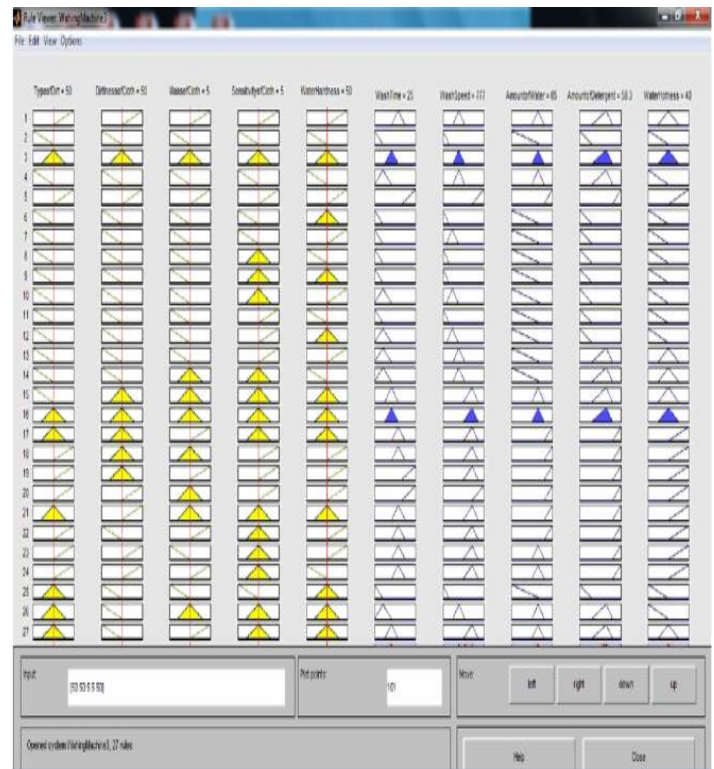


Figure 4. The outcome and Fuzzy logic rules

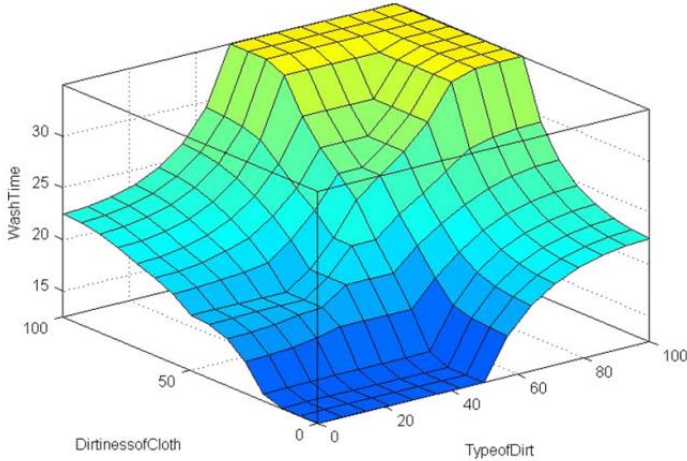


Figure 5: Dirtiness of Cloth and Type of Dirt affects the Wash Time

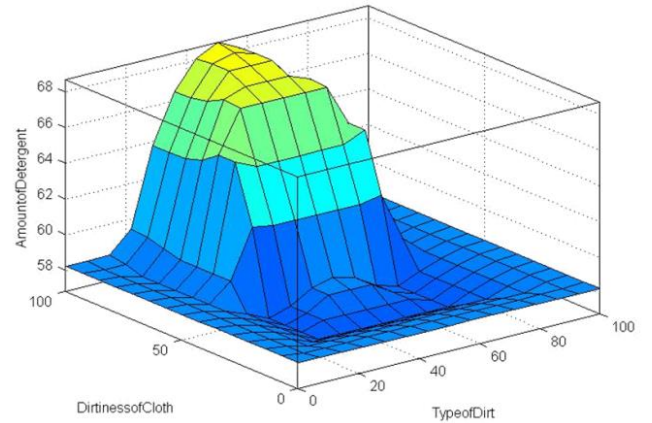


Figure 8: Dirtiness of Cloth and Type of Dirt affects the Amount of Detergent

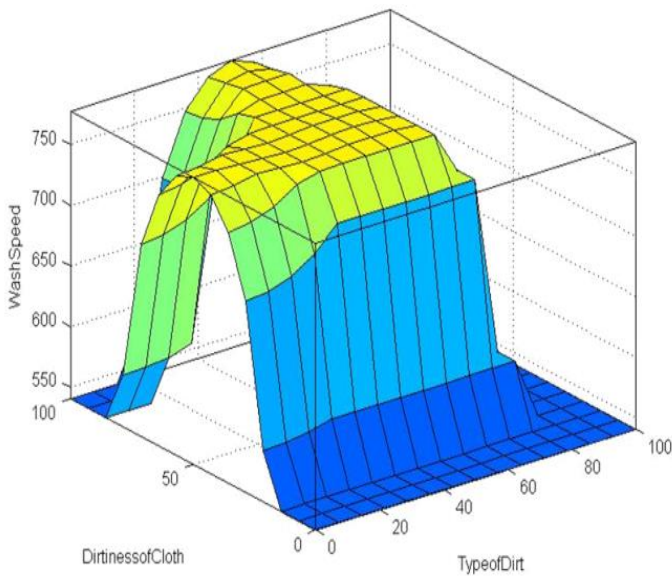


Figure 6: Dirtiness of Cloth and Type of Dirt affects the Wash Speed

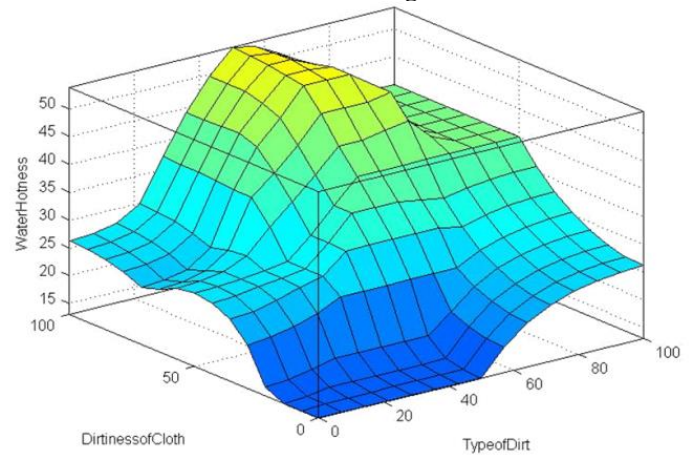


Figure 9: Dirtiness of Cloth and Type of Dirt affects the Water Hardness

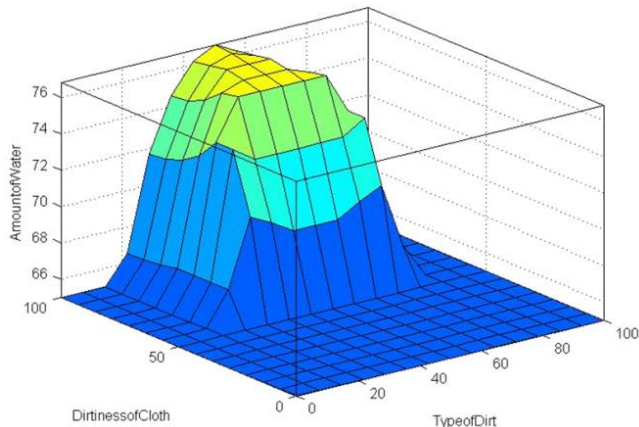


Figure 7: Dirtiness of Cloth and Type of Dirt affects the Amount of Water

The path toward changing over the fuzzy yield is called defuzzification. This work uses centroid technique for defuzzification. It will in general be conveyed as

$$\begin{aligned} \text{Wash Time} &= \bar{X} \text{ (Centroid)} = \\ &= \frac{\sum_1^N x\mu(x)}{\sum_1^N \mu(x)} \\ &= \frac{\sum_1^{12} x\mu(x)}{\sum_1^{12} \mu(x)} \end{aligned}$$

Where n is the number of output members
= 25 minutes.

4. CONCLUSION

This paper presents fuzzy reason controllers of Mamdani type. The eventual outcomes of this work reveal the way how a garments washer will respond in different conditions. For example, if we take all information limits regards (Dirtiness of Cloth, Type of Dirt, Mass of Cloth, Water Hardness and Sensitivity of Cloth) as 50, the yield limit wash time is 25 minutes. MATLAB/Fuzzy justification instrument compartment is used to show this examination.

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