A Study on Mamdani Fuzzy Logic to Implement the Programs of Washing Machine

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Abstract: Fuzzy set is set with the ambiguity of elements regarding their belongingness. In the washing machine, the dirtiness of clothes, the amount of washing powder, etc. are fuzzy terms. These are operated through fuzzy logic systems. But the operations on the inputs are most important for suitable output. Quality of washing powder is an essential input variable to the current existing inputs like dirtiness, types of clothes, etc. This study will focus on the proposed operations on the system of MAMDANI in fuzzy logic for washing machine.

Introduction:

Fuzzy logic uses the reasoning process, which imitates the way human beings think and comprehend things. Fuzzy logic management opens the way for the automation of reasoning processes to model the user expert expertise in a computer program [1]. The fuzzy logic of rice cooker is used to calculate time to cook based on rice and water quality. In the case of air quality, fuzzy logic is appended based on room temperature and humidity to determine the compressor speed, fan speed, fan direction and way of operation [12]. The fuzzy logic of medical applications is used to modulate the inclination of the body so that patients with extended bed rest can change the cardiovascular (HR) or systolic or diastolic blood pressure variables [13].

Washing machines are one of today's most frequent kitchen appliances. Controllers with conventional, additive, integral and differential control [PID] have proved to be less able such that advanced logically programmers are more efficient than conventional methods in the control of complex systems.

It is vital that this machine reduces workload and provides cleaner clothes efficiently. The washing machine manufacturers intend to prove the cleanliness of the apparel with a fully automatic sensor operating a machine that can totally sensitize the quantity of washing, garment dirt and material form during the current washing cycle in order to predict the appropriate washing time directly. The washing sensor can be used to measure the physical amount of light that is passing into a glass tube, which can then be transformed into electrical signals to calculate the amount of dirt [10].

The owners of laundry machines faced the dilemma of choosing the amount of laundry time depending on clothes, soil, fabric dirt and clothing quantity. It is very difficult for most people to select which cloth requires how long to wash. The benefit of efficiency, simplicity and reduced costs is that these problems are completely solved by automated washing machines based on fluid logic.

This paper addressed the new growth of Fuzzy-based washing machines, supplying machines with the potential also to learn from the experience, memorize and modify programmes to reduce operating expenses.

Conventional washing machines require professional and manual user intervention [2]. Human information is grasped by the Mamdani process to automate the washing machine using fuzzy logic. The system has four stages, which are linguistic vector fuzzification, rule evolution, rule aggregation and Defuzzification. The following should be used for washing machines based on fuzzy logic: high performance, lower running time and the ease of use of devices [3]. Fuzzy's logical control system outweighs PID, and conventional system control recognizes to its low cost of installation and high reliability of operation.

Fuzzy Logic: Professor Lotfi A. Zadeh University of California, Berkeley, first designed the idea of Fuzzy Logic in 1965. Fuzzy logic is an influential theory for the explanation and development of control systems that offer design

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engineers a simple, intuitive method of integrating complex systems. Inputs with several degrees at more than one point at a time are allowed by fuzzy logic systems, which enable the engineers to define them more naturally.

Fuzzy Logic Controllers and their Applications: Fuzzy Controllers can use information obtained from human decisions or from human operator structures relative to classical controllers. Gas heater's Fuzzy Logically Controller was developed with behavioural modelling and linked to 'Valve Angle' by structural VHDL.

MATLAB for control of the "Valve" and the compared PID controller was used to construct the flush logic controller for Liquid Level Control. The findings show that the foggy logic controller decreased overheads and steady-state errors substantially.

For the 2007 wash time, the Fuzzy Inference was used. In this configuration MF was used in three ways; the Fuzzy Controller's input was adjusting the turbidity; the output was washing time. Pritesh Lohani proposed in 2009 the "Microchip for Washing Machine Improved Controller" which consists of three LI's, i.e. Dirt, clothes and clothing mass and LO wash time with 25 rules styles. LO wash time with 25 rules. Manish Aggarwal suggested in 2011, the Fuzzy Washing Machine Logic Regulation with two types of inputs Dirt and separate amounts of dirt and the inference machine performance was Wash Time, setting out 9 FLC rules. By using the Fuzzy interface unit, the input-output relationship is calculated.

In the current literature, there are limited inputs. This study analyzes the input variables and suggests that the quality of washing powder may be included in the current system.

Fuzzy Logic System in the Existing Washing Machines:

The architecture of fuzzy controllers consists of a set of the so-called linguistic input variable. The inputs are the dirtiness of clothing, fabric type, dirt type, and textile volume in this automated washing machine. During the input step, the sensor information is mapped to the required membership function and actual values of the variable known as the Fuzzification mechanism. After this variable is processed in the form of IF-THEN and the results of each rule are generated. The product of the rules is translated back to the production stage, also known as Defuzzification.

Mamdani method with triangular membership feature is the washing machine deduction method used to construct a control scheme. The fuzzy inference method in a Mamdani style is conducted in four steps following input variable fuzzification, Ruler assessment (Inferior engine), aggregation of rules (composition) performances and defuzzation (Rosyara, Vromman and Duveiller, 2008) to get the result.

I. Fuzzification:

Take the crisp inputs, the dirtiness in clothes, dirtiness types, fabric length, textile types, quality of washing powder to decide how much these inputs are part of any of the related fuzzy sets. The inference engine will be generated after learning the membership of each input variable and output variable.

II. Operations

The above-mentioned inputs are rendered and added to the context to the fuzzy rules at this point. Since the AND operator has many antecedents, the single number that is the product is related to and obtained.

III. Defuzzification:

The findings are combined to provide a sharp response which means that Defuzzification is considered the actual washing speed, washing time, water consumption and water temperature of the law. The method of Defuzzification used is the centroid technique where the vertical line splits the sum into two equal masses, called the centre of gravity (COG). Can be expressed as mathematically. Compared to the traditional approach, Fuzzy logic provides a radically new way to work with a control structure. These methods rely on what the control system can do, not how it operates. Fuzzy reasoning demonstrates what an expert or seasoned worker can do. The concentration of the control system is intended to overcome the problem rather than to model the system mathematically. The engineered washer makes the consumer simpler, more productive, less costly and more effective, which is challenging to accomplish when using typical washing machines.

Washing Powder as Additional Input in the Proposed System:

The traditional system of the washing machine is built with the inputs as dirtiness amount, types of dirtiness, types of clothes, etc. But the quality of washing powder is also an essential factor. This study recommends that the input variable as washing powder will change the washing time significantly. In Figure 1, the number of input variables is 5, and that of the output variable is 3. The variables are shown as follows.

Input variables	Output variables
Dirtiness	Washing Time
Types of cloths	Water Intake
Types of dirtiness	
Fabric Amount	Water Temperature
Quality of Washing Powder	

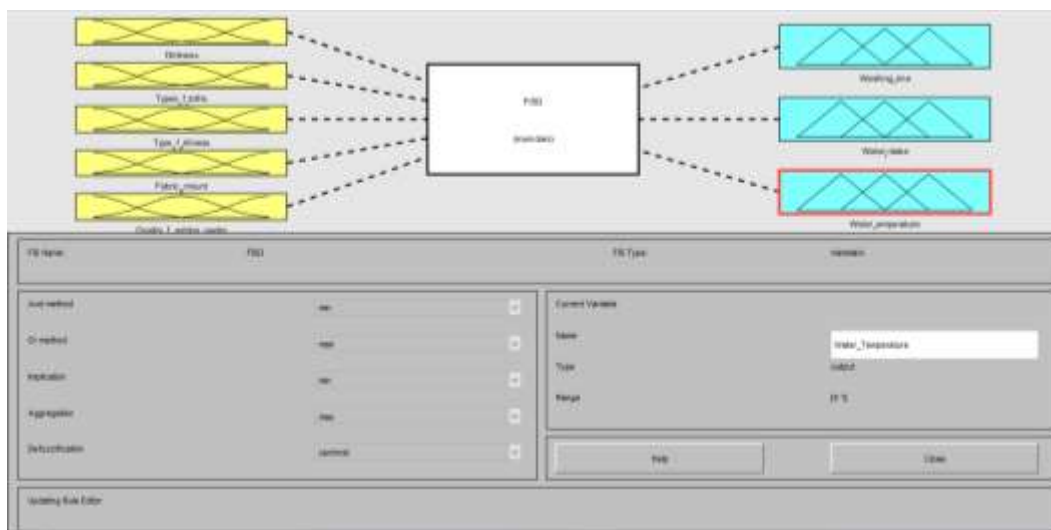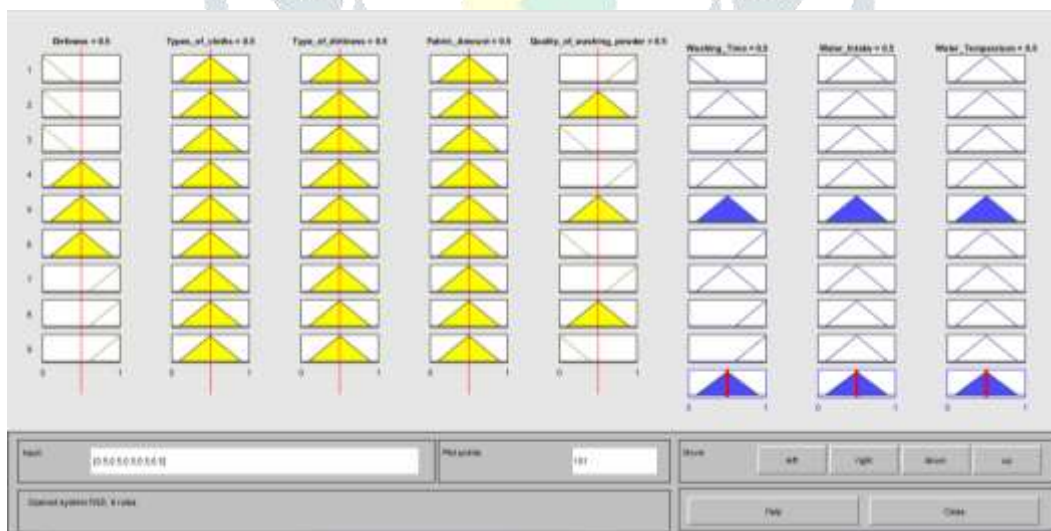Table 1: Proposed input-output variables

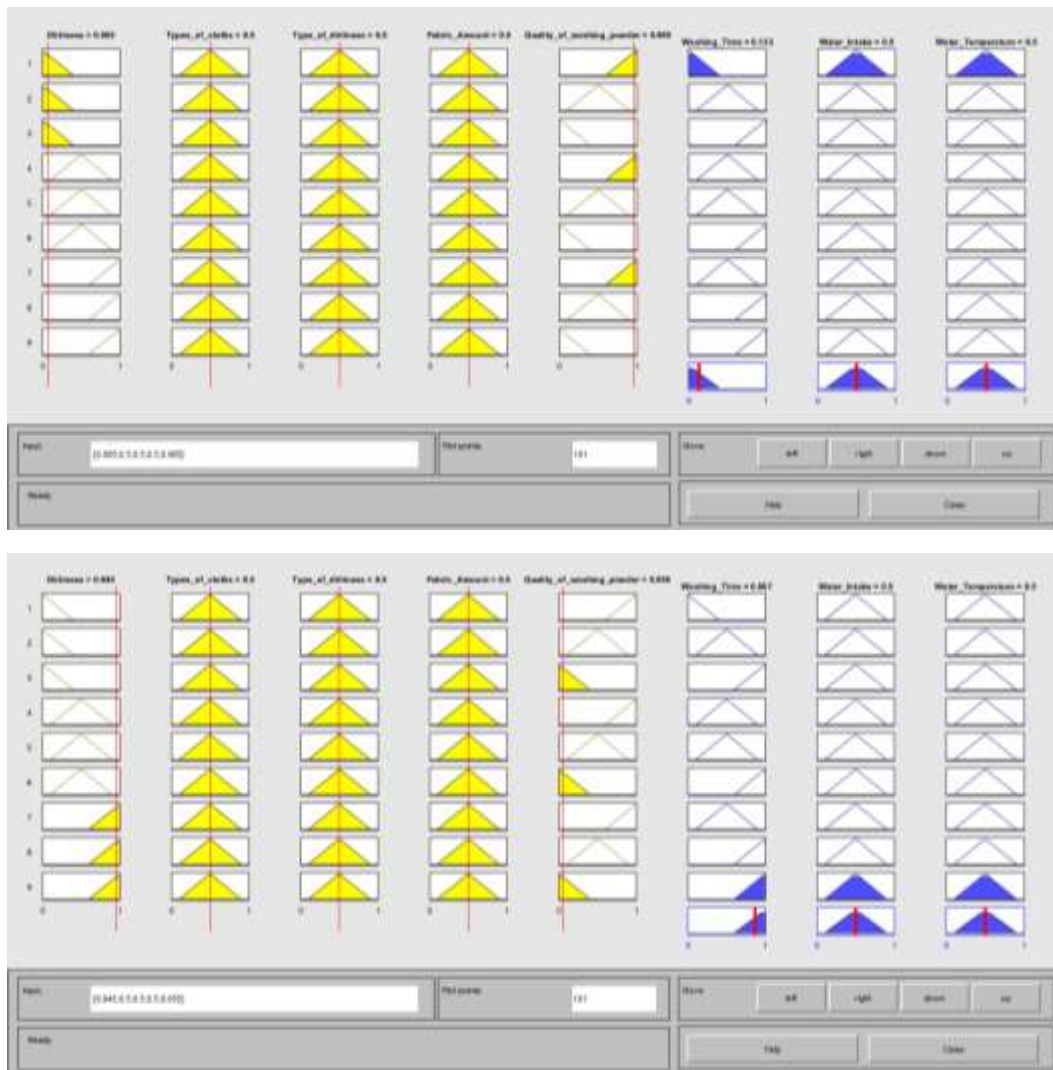Figure 1: MAMDANI fuzzy inference system with proposed input-output variables

Figure 2: Results of the proposed system

Dirtiness	Quality of powder	Washing Time
0.065	0.965	0.133
0954	0.965	0.5
0.954	0.055	0.867

Table 2: Results of proposed systems

The results of Table 2 shows the stability of the proposed system. The higher the quality implies lower the washing time provided out inputs are fixed as mid-value.
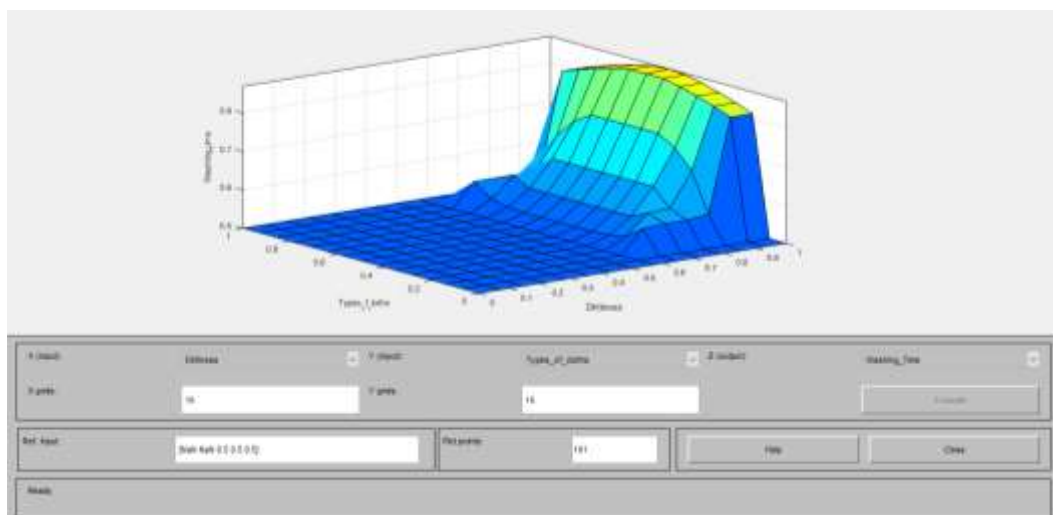

Figure 3: The surface view of the proposed FIS system.

Conclusion: This study analyses that washing powder may be taken as an input variable of the current systems of the washing machine using fuzzy logic. The future studies should focus on the operations of the MAMDANI FIS. The major drawback is the system does not capture the falsity of the cloth's dirtiness. Thus some times longer washing time is required for fewer dirt clothes. Neutrosophic fuzzy logic will be best to handle such scenarios.

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