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Simulationusing Matlab Rules in Neuro-fuzzy Controller Based Washing Machine

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Abstract
The general washing machine is an example of the advance washer control with a great technology. This advancement helped the household scenario very well. But we need to make it more advance from the previous one and that too by using the latest soft computing technologies. Here, the system will consist of the neuro-fuzzy and fuzzy techniques that will help the system to take its own decisions like release of water and washing powder as per need of cloth. Also the fabric detection technique will implement with the help of these techniques.The purpose of this paper is to design a simulation system of fuzzy logic controller for washing machine automatic control by using simulation package which is Fuzzy Logic Toolbox and Simulink in MATLAB software. This paper will show the simulation technique through neuro-fuzzy system in order to follow the NF controller.
Keywords- Fuzzy –controller, NF, Neuro-fuzzy logic, Washing machine, Fuzzy techniques, simulation process.

I. INTRODUCTION

Fuzzy logic is a part of artificial intelligence or machine learning which interprets a human's actions [1].Fuzzy or multi-valued logic was introduced in the 1930s by Jan Lukasiewicz, a Polish philosopher [2]. While classical logic operates with only two values 1(true) and 0(false), Lukasiewicz introduced logic that extended the range of truth values to all real numbers in the interval between 0 and 1. He used a number in this interval to represent the possibility that a given statement was true or false.

Fuzzy system was first proposed by an American professor, Lotfi A. Zadeh, in 1965 when he presented his seminal paper on "fuzzy sets"[1]. Zadeh showed that fuzzy logic unlike classical logic can realize values between false (0) and true (1). Basically, he transformed the crisp set into the continuous set. Zadeh extended the work on possibility theory into a formal system of mathematical logic, and introduced a new concept for applying natural language terms, and he became the Master of fuzzy logic. Fuzzy sets thus have movable boundaries. The elements of such sets not only represent true or false values but also represent the degree of truth or degree of falseness for each input.

II. SYSTEM OVERVIEW

A. ARCHITECTURE

At present, the washing machine has becomes an essential electrical appliance in our life. In this project we will introduce an intelligent algorithm to the system. In this, we will build a neural network fuzzy control model on the basis of the washing machine's own characteristics and some external factors.

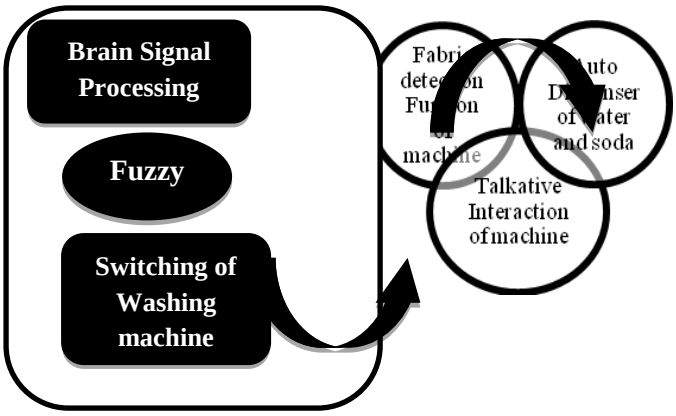

Figure 2.1: **Block diagram of Proposed**

Architecture

INTRODUCTION TO FUZZY LOGIC TOOLBOX

Fuzzy Logic Toolbox allows several things to be done, but the most important things are to be a place where a fuzzy inference system can be created or edited. These systems can be created by using graphical tools or command-line functions, or even can be automatically generated by using either clustering or adaptive neuro-fuzzy techniques.

The fuzzy system that has been accessed to Simulink can be easily tested in a simulation environment. The toolbox also allows the stand-alone C programs to be run without the need of Simulink. This is made possible by a stand- alone Fuzzy Inference Engine that reads the fuzzy systems saved from a MATLAB session.

III. FOUNDATION OF FUZZY LOGIC

Fuzzy logic starts with the concept of a fuzzy set. A fuzzy set is a set without a crisp, clearly defined boundary. As we learn more and more about a system its complexity decreases and our understanding increases. It can contain elements with only a partial degree of membership.

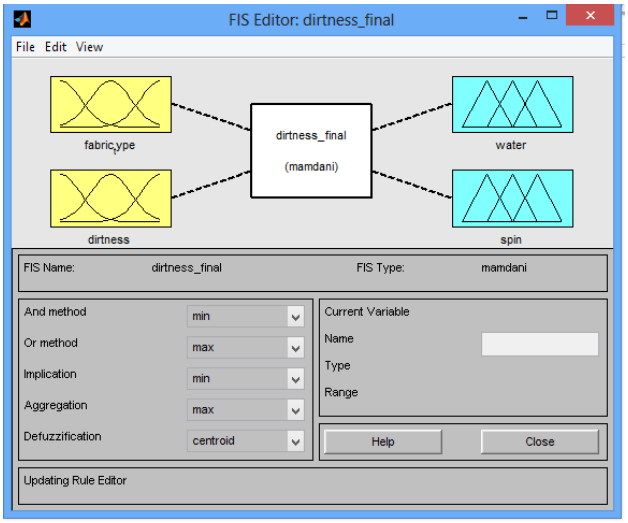

Fig3.1**: Fuzzy-Simulink Editor Window**

The process of fuzzy inference involves all of the pieces which are membership functions, fuzzy logic operators, and if-then rules. There are two types of fuzzy inference systems that can be implemented in the Fuzzy Logic. Toolbox: Mamdani-type and Sugeno-type. These two types of inference systems vary somewhat in the way outputs are determined. Thus,a set of linguistic variable has chosen and then control panel has decided.

Unlike classical set theory that classifies the elements of the set into crisp set, fuzzy set has an ability to classify elements into a continuous set using the concept of degree of membership.

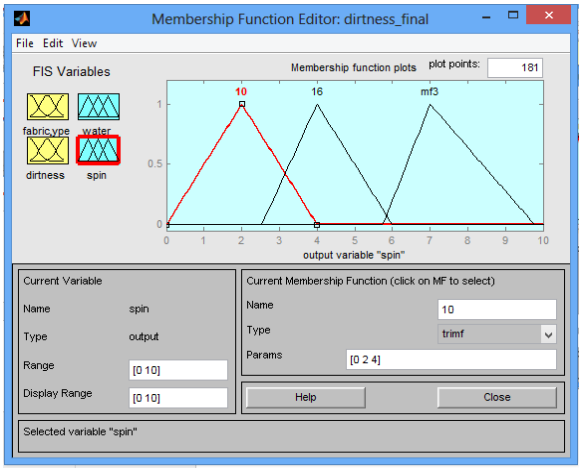

Fig3.2**: Membership Function of Fabric Type**

For systems with little complexity, hence little uncertainty, closed form mathematical expressions provide precise description of the system. As shown in fig. the membership function of one entity of the project has been shown.

The characteristic function or membership function not only gives 0 or 1 but can also give values between 0 and 1. Fuzzy logic seems to be most successful in two kinds of situations in very complex model where understanding is strictly limited or in processes where human reasoning, human perception or human decision making are involved.

A fuzzy set is a set with fuzzy boundaries. A value between 0 and 1 represents the degree of membership, also called membership value. Range of the membership function can be defined as per the requirement of the system. For this automatic washing machine control simulation system, the fuzzy boundaries can be considered according to the rules that are going to be used. The variation in the boundaries can be taken so that system can be more accurate. For systems which are little more complex, but which significant data exist, model free methods such as artificial neural network provide a powerful and robust means to reduce some uncertainty through learning.In fuzzy logic, the truth of any statement becomes a matter of degree. Any statement can be fuzzy. As the numbers of rules increased, the degree of membership will become more accurate.

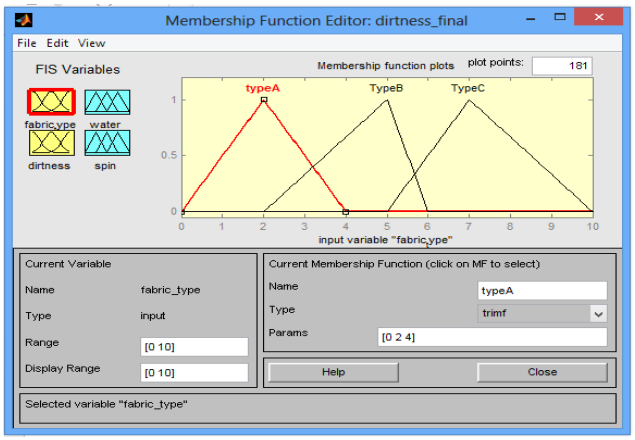

Fig3.3**: Membership Function of NO. Of Spins**

The idea of the fuzzy set is in contrast with classical or crisp sets because members of a crisp set would not be members unless their membership was full or complete in the set. Fuzziness can be measured in terms of the degree of fuzziness of a set of elements. It is a mathematical tool that describes the ability, vagueness, randomness, undecided, chaos and inaccuracy of a relation between crisp events, entities or sets. A membership function (MF) is a curve that defines how each point in the input space is mapped to a membership value between 0 and 1.

IV. WATER DETERGENT RULES AND SIMULINK

The input space is sometimes referred to as the universe of discourse. The only condition a membership function must satisfy is that it must come in between 0 and 1.

The function itself can be an arbitrary curve whose shape we can define as a function that suits us from the point of view of simplicity, convenience, speed, and efficiency.

A classical set might be expressed as

$$A = \{x \mid x > 6\}$$

A fuzzy set is an extension of a classical set. This set is normally defined as a collection of elements or objects which can be finite or infinite. If X is the universe of discourse and its elements are denoted by x, then a fuzzy set A in X is defined as a set of ordered pairs.

$$A = \{x, \mu A(x) \mid x\ X\}$$

μA(x) is called the membership function of x in A. The membership function maps each element of X to a membership value between 0 and 1. The Fuzzy Logic Toolbox includes different membership function types. These functions are built from several basic functions which are piecewise linear functions, the Gaussian distribution function, the sigmoid curve, quadratic and cubic polynomial curves. Like in below fig. 4.1 the curve is sigmoid in nature.

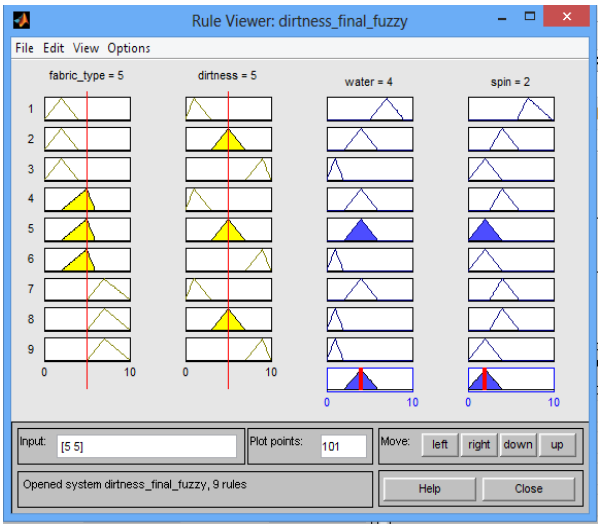

Fig 4.1:**Membership Function of Water**

There is a very wide selection to choose from these membership functions. Membership function can be created in Fuzzy Logic Toolbox. A membership function associated with a given fuzzy set maps an input value to its appropriate membership value.

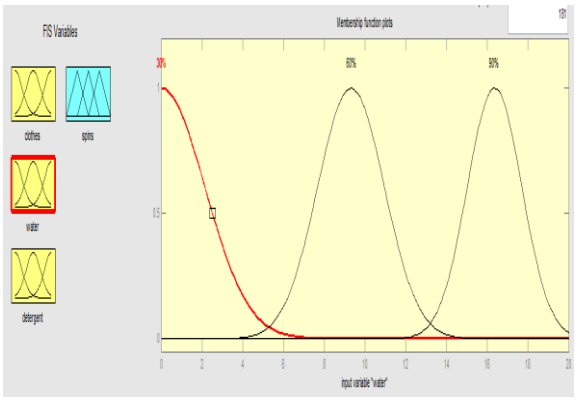

Fig 4.2: **Fuzzy Rules Viewer Window**

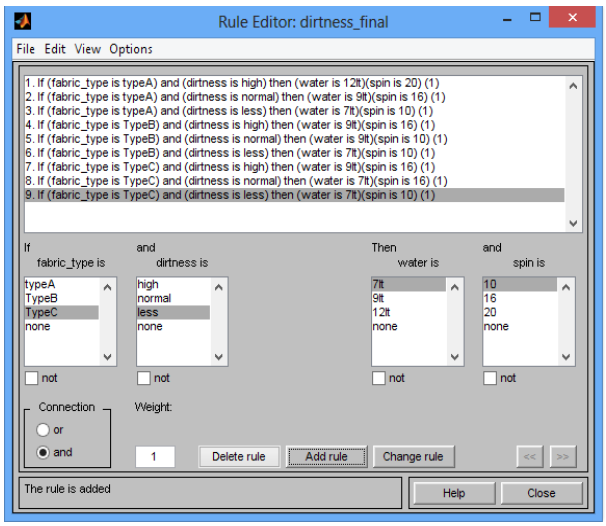

Fig 4.3: **Rule Window**

With the help of the trained network the outcomes comes in the form of rules and thus as per the training, the whole procedure circumferences.

Graphical Output:

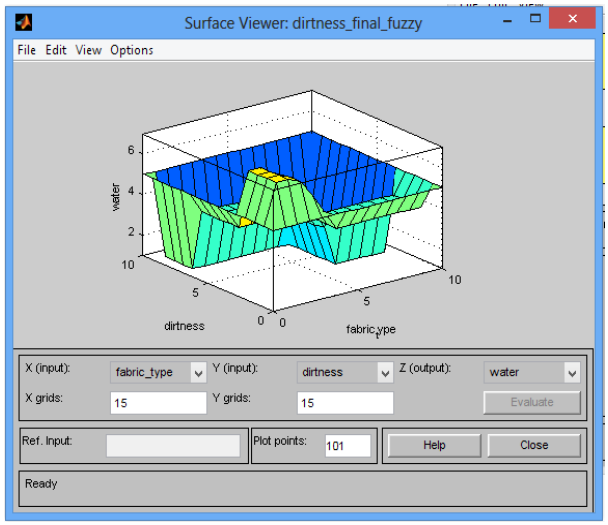

Fig 4.4:**Surface View of the Rules**

V. CONCLUSION

The advance washing machines have sensor network in it in order to automate the system. This system gives advancement to the technology so as to the science. A more fully automatic washing machine is straightforward to design using fuzzy logic technology. Increasing the controller work that controls only the wash time of a washing machine, to design process can be extended to other control variables such as water level and spin speed. The formulation and implementation of membership functions and rules is similar to that shown for wash time.

Full "Fuzzy Logic" automatic control system includes the fabric detection, washing time, and washing speed. The general use of fuzzy in the system will implement in the machine that will control the spins of drum as well as the water and washing powder dispensers. Many other product maker and industries used the fuzzy techniques in their own way. There are various applications developed using this technology but the combination of neural and fuzzy is new in this area. This combination will give rise to a new contribution to the science and technology. This combination of fuzzy and neural network will used to detect the fabric type that will the most advance system and the contribution towards the system.

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