Asian Journal of Electrical Sciences
ISSN: 2249-6297 (P) Vol.5 No.1, 2016, pp.1-7

DOI: https://doi.org/10.51983/ajes-2016.5.1.1971

An Intelligent Fuzzy Based Technique of Making Food Using Rice Cooker

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Abstract - **This paper aims at presenting the idea of controlling the cooking time of rice based on the type of rice and quantity of water using fuzzy logic control. The paper describes the procedure that can be used to get a suitable cooking time for different types of rice. The process is based entirely on the principle of taking non-precise inputs from the sensors, subjecting them to fuzzy arithmetic and obtaining a crisp value of the cooking time. It is quite clear from the paper itself that this method can be used in practice to further automate the rice cookers. Nevertheless, this method, though with much larger number of input parameters and further complex situations, is being used by the giants like LG and Samsung.The rice cooker features with advanced logic technology, which allows it to think for itself and make adjustments to the temperature and timing of batch of rice totally on the cooking. A spherical inner cooking pan and heating system distributes heat evenly so the rice at the bottom is the same consistency.**
Keywords: **Fuzzification, Cooker status, Fuzzy logic control**

I. INTRODUCTION

Rice cookers are a common feature today in the Indian household. The most important utility a customer can derive from a rice cooker is that he saves the effort he/she had to put in cooking. Most of the people wouldn't have noticed (but can reason out very well) that different type of rice need different amount of cooking time which depends directly on the type of water, amount of temperature, water quality etc. The rice cookers that are used today (the one not using fuzzy logic control) serves the purpose of cooking, but which rice needs what amount of time is a business which has not been dealt with properly..It'll do brown rice, white rice, even oatmeal. For nights you need not want to wait, a quick cook program will make white rice in just 15 minutes, exactly the amount of time it'll take you to make a stir fry out of all those vegetables in your crisper and that leftover rotisserie chicken.In this cooker as we set the time for cooking the cooker itself set the temperature automatically. Fuzzy logic is a form of knowledge representation suitable for notions that cannot be defined precisely, but which depend upon their contexts. Fuzzy control is based on fuzzy logic, a logical system which is closer in spirit to human thinking and natural language than traditional logical systems.

II. ARCHITECTURE

Fuzzy control is based on fuzzy logic a logical system which is closer in spirit to human thinking and natural language than traditional logical systems. Fuzzy logic control system is based on fuzzy logic provides means of linguistic control strategy based on expert knowledge into an automatic control strategy. Crisp set is defined in such a way that all individuals in a given universe can be partitioned into tow classes that those who belong to the set and those who do not belong to the set. The input variables in a fuzzy control system are in general mapped by sets of membership functions similar to this, known as "fuzzy sets". The process of converting a crisp input value to a fuzzy value is called "fuzzification".

The problem in this paper has been simplified by using only two variables. The two inputs are:

a) Type of rice
b) Water quantity

Figure 1 shows the basic block diagram of the fuzzy controller. The fuzzy controller takes two inputs (as stated for simplification), processes the information and outputs a cooking status. How to get these two inputs can be left to the sensors (optical, electrical or any type). The working of the sensors is not a matter of concern in this paper. We assume that we have these inputs at our hand. Anyway the two stated points need a bit of introduction which follows. The type of rice is determined by the user who applies it to the cooker for cooking. On the other hand, water quantity is determined by the rice cooker automatically is determined by the time of saturation, the time it takes to reach saturation. Saturation is a point, at which there is no more appreciable change in the color of the water. Type of rice determines which type of rice is to be cooked where as water quantity determines the how much water needed to cook a particular type of rice.. Thus a fairly straight forward sensor system can provide us the necessary input for our fuzzy controller.

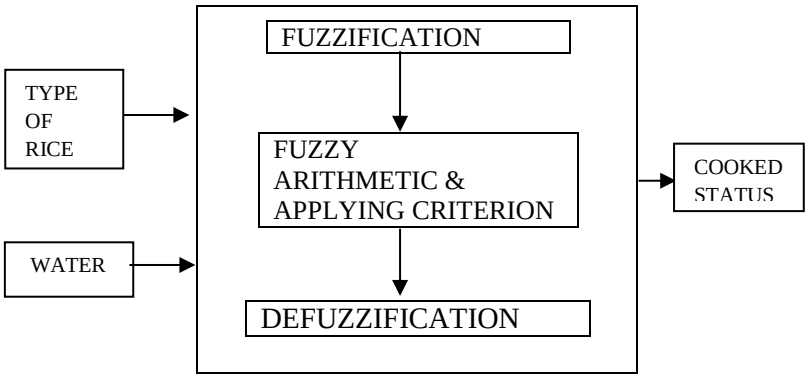

Fig.1 Basic block diagram of fuzzy controller process

III. FUZZIFICATION AND FUZZY BASED RULES

A. Fuzzification

Before the details of the fuzzy controller are dealt with, the range of possible values for the input and output variables are determined. These (in language of Fuzzy Set theory) 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 type_of_rice and water_quantity are normalized over the domain of optical sensor.

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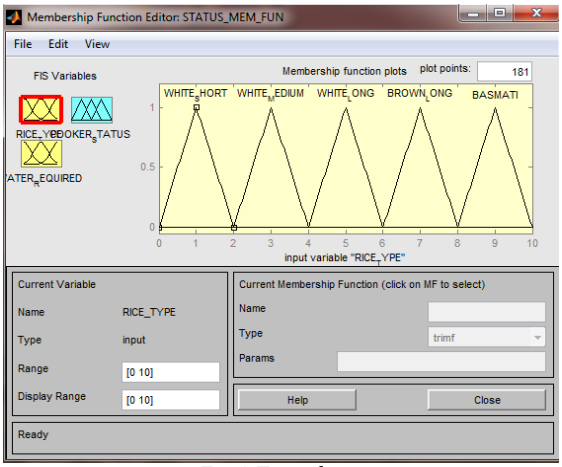

Fig. 2 Type of rice

The different types of rice applied as input for cooking are white short, white medium, white long, brown long, basmati.These are taken as linguistic variables for the input type of rice.The corresponding membership function plot for type of rice is shown in fig.2.The second input is the quantity of water required.The value of water is taken in ml(mililitre).The membership function plot for water quantity is is given in fig.3.

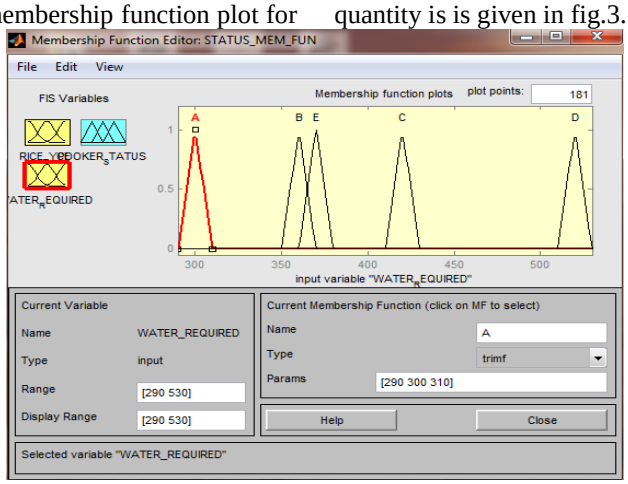

Fig.3 Water quantity

B.Fuzzy based rules

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. Rules used in this paper are derived from common sense, data taken from typical home use, and experimentation in a controlled environment.In our work we have defined 25 rules which is shown in fig. 4 below.

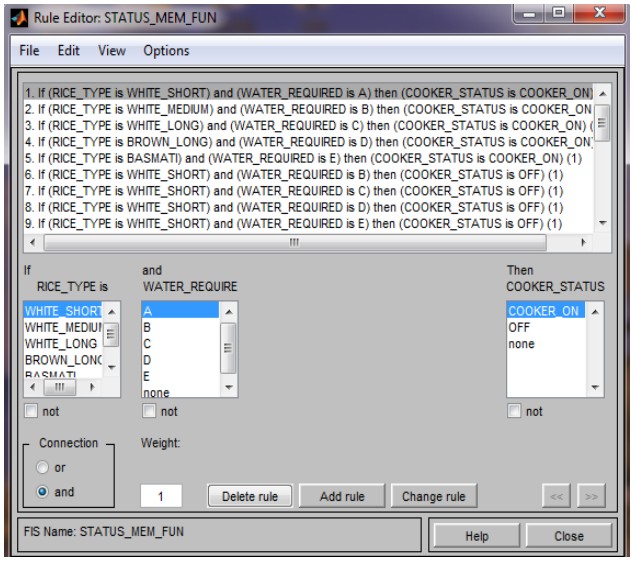

Fig.4 Fuzzy based rules

IV. EXPERIMENT

In our work we have taken different types of rice and water quantity for experimental purpose.The respective water quantity for different types of rice and rice quatity taken is as given below.

TABLE I

TYPE OF RICE	WATER QUANTITY (in ml)	RICE QUANTITY (in grams)
WHITE SHORT	360	240
WHITE MEDIUM	360	240
WHITE LONG	420	240
BROWN LONG	520	240
BASMATI	360	240

From the table it should be understood that for rice type white short water needed is 360 ml and rice quantity is 240 gms and so on.It means that if the water quantity for a particular type of rice falls below the quantity mentioned in the above table then the cooker will not start.For example for 240 gms cooking of basmati rice, minimum water required is 360 ml but if the water falls below this quantity then the cooker will not get on.The membership function plot for cooker ouput is shown in figure 5 and surface viewer is shown in figure 6 below.

A. Procedure

1. Start.
2. Add the rice and water to the cooker.
3. Set the time **tim** for cooking and it automatically set the temperature **temp** from the fuzzy sets.
4. Sensor system collects the data and sends them to the controller.
5. Fuzzy logic control system controls the controller system
6. Output: cooking is over and automatically keeps rice warm after cooking is done.
7. End.

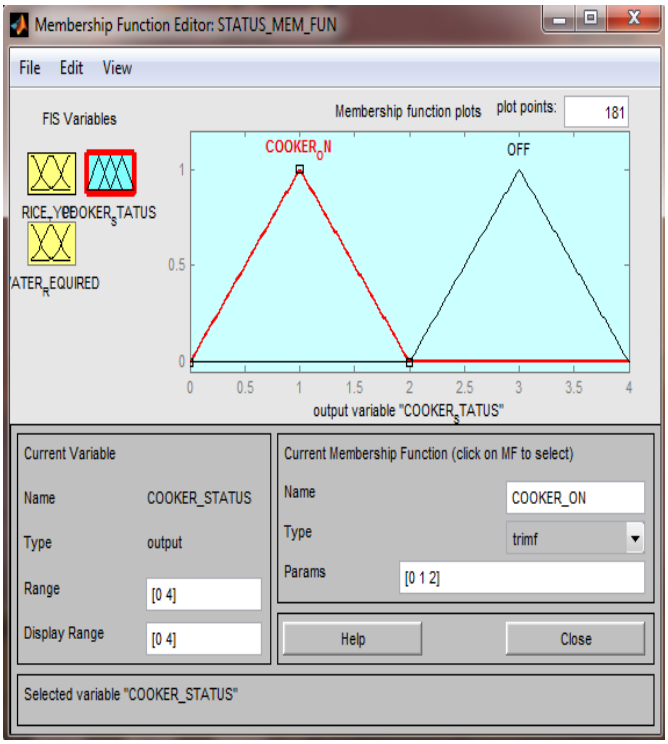

Fig.5 Cooker status

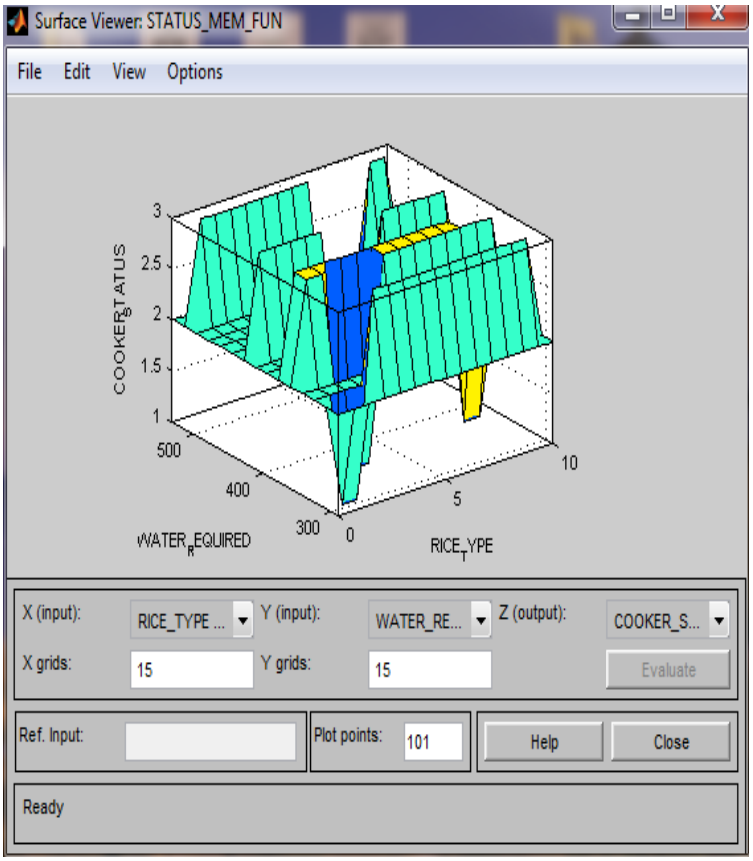

Fig.6 Surface Viewer

V. TROUBLESHOOTING

Troubleshooting occurs in some worst condition where there may be a chance of the rice is not cooked according to our need.There are three cases of such type and are as follows

1. Musty
2. Undercooked
3. Frequently burnt

If the rice is musty then for 240 gms of rice,reduce the water 30 to 60 ml.similarly for undercooked rice(too chewy or dry),add 30 to 60 ml of water and if the rice is frequently burnt then reduce the cooking time.

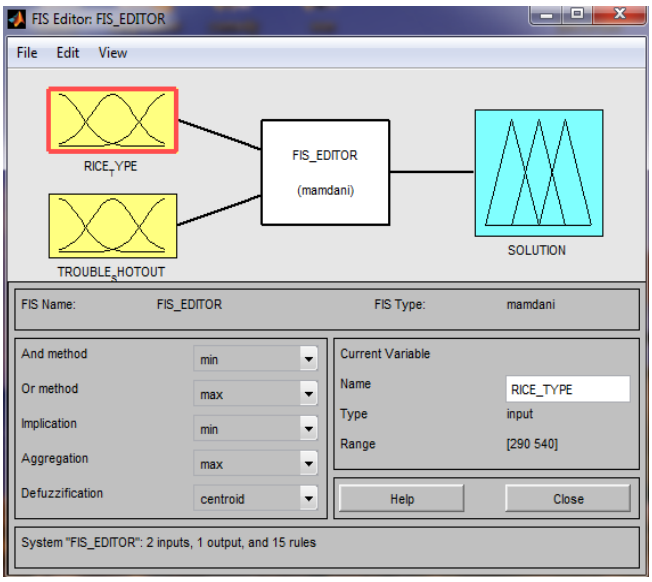

Fig.7 Troubleshooting

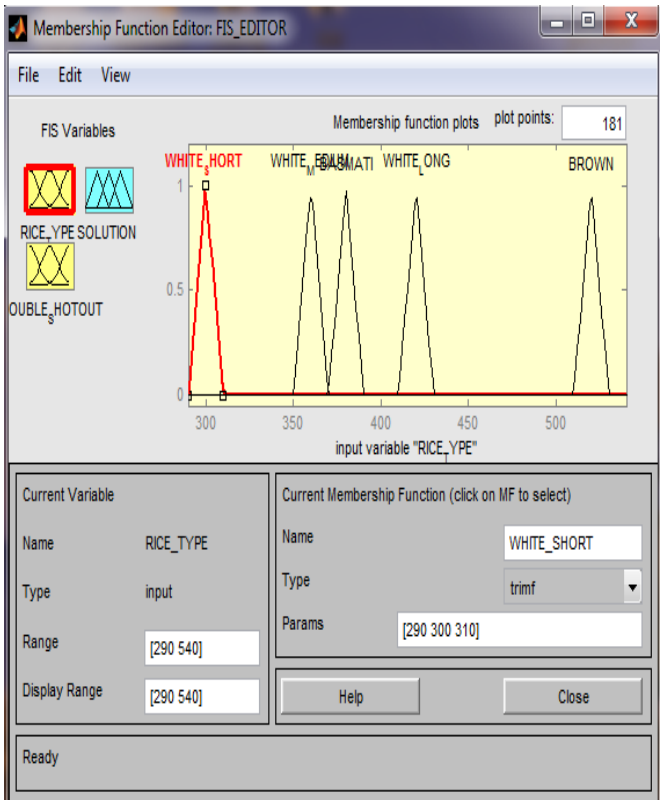

Fig.8 Type of rice

Accordingly the membership function plots for different inputs changes when troubleshooting occurs.figure 8 is the plot for type of rice,figure 9 and 10 are the plot for types of troubleshooting and its solution respectively.

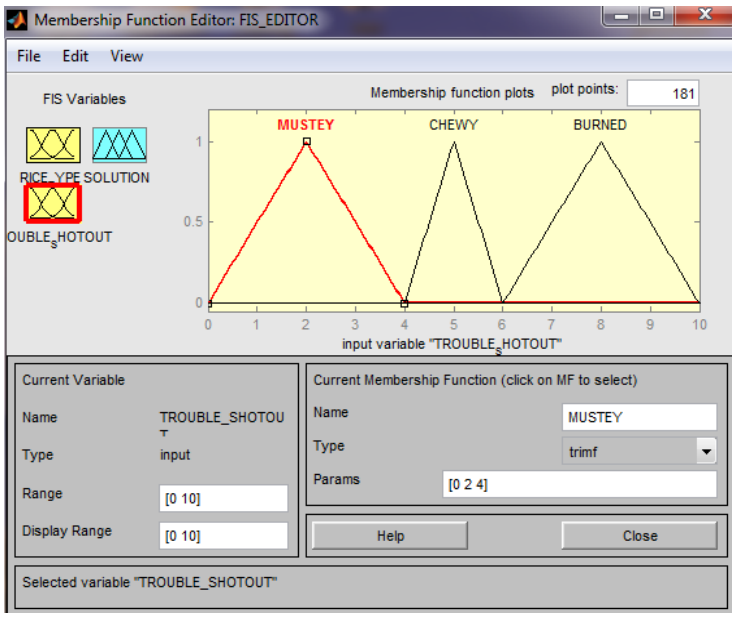

Fig.9 Types of troubleshooting

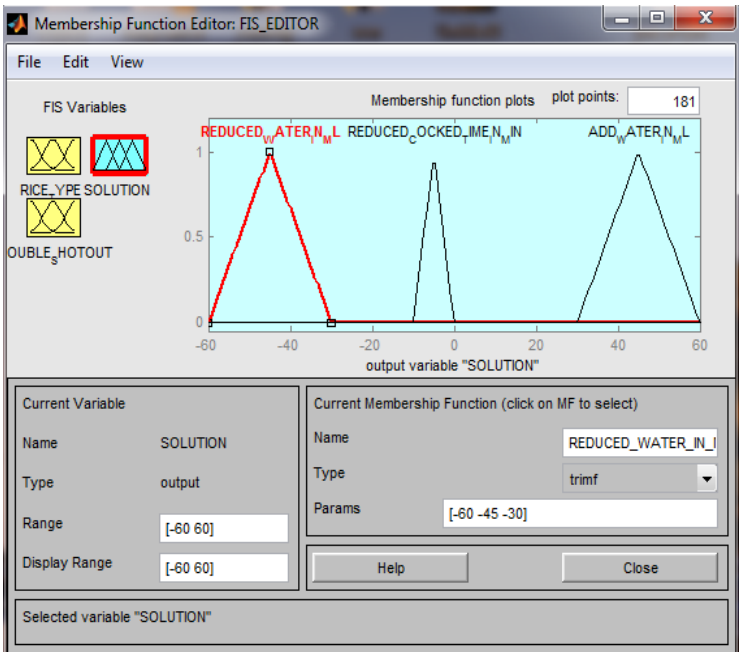

Fig.10 Solution

A. Fuzzy rules for troubleshooting

When troubleshooting occurs or the rice cooking state changes,the corresponding fuzzy rules are also changed which are given in the figure 10 below.

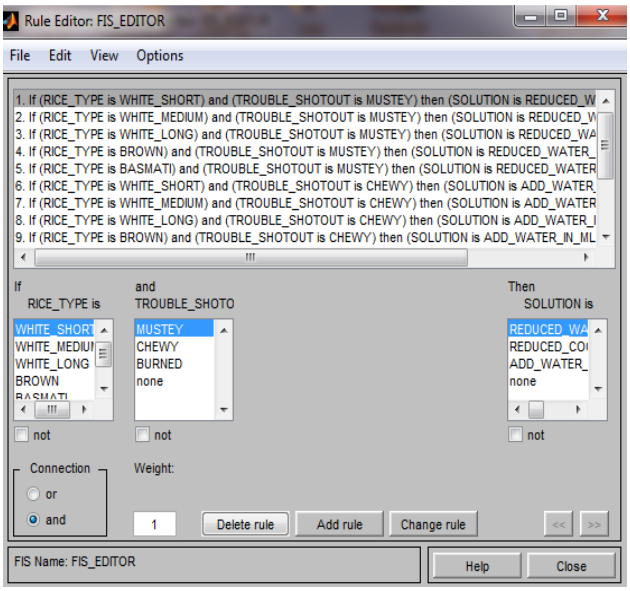

Fig.11 Fuzzy rules for troubleshooting

VI. RESULTS AND DISCUSSIONS

The sensors sense the input values and using the above model the inputs are fuzzyfied and then by using simple if-else rules and other simple fuzzy set operations the output fuzzy function is obtained and using the criteria the output value for wash time is obtained. Figure 6 shows the response surface of the input output relations as determined by FIU. FIU stands for Fuzzy Interface Unit. This is the fundamental unit in which the application interface encodes controller information. The results (the above plot) shows the way the machine will response in different conditions. This is quite convincing and appropriate.

VII. CONCLUSION AND FUTURE WORK

By the use of fuzzy logic control we have been able to obtain a cooking time for different type of riceand for different quantity of water. The conventional method required the human interruption to decide upon what should be the cook time for different rice types. In other words this situation analysis ability has been incorporated in the cooker which makes the cooker much more automatic and intelligent which represents the decisiontaking power of the new arrangement. Though the analysis in this paper has been very crude, but this clearly depicts the advantage of adding the fuzzy logic controller in the conventional rice cooker.A more fully automatic rice cooking technique is straight forward to design using fuzzy logic technology.Moreover, the design process mimics human intuition, which adds to the ease of development and future maintenance.

REFERENCES

[1] L. A. Zadeh, “Fuzzy sets,” *Inf. Control*, vol. 8, pp. 338–353, 1965.
[2] E. H. Mamdani, “Application of fuzzy algorithms for control of simple dynamic plant,” *Proc. IEEE*, vol. 121, no. 12, pp. 1585–1588, 1974.
[3] E. H. Mamdani and S. Assilian, “An experiment in linguistic synthesis with a fuzzy logic controller,” *Int. J. Man-Mach. Stud.*, vol. 7, pp. 1– 13, 1975.
[4] E.H.Mamdani, “Advances in the linguistic synthesis of fuzzy controllers,” *Int. J. Man-Mach. Stud.*, vol. 8, pp. 669–679, 1976.
[5] E. H. Mamdani, Application of Fuzzy algorithms for Control of Simple Dynamic Plant, *Proc. IEE* 121, 1974, pp. 1585–1588.
[6] T. Takagi and M. Sugeno, Fuzzy Identification of Systems and Its Applications to Modeling and Control, *IEEE Trans. Syst., Man, and Cybern.* SMC-15, 1985, pp. 116–132.
[7] N. Yubazaki, J. Yi and K. Hirota, SIRMs (Single Input Rule Modules) Connected Fuzzy Inference Model, *Journal of Advanced Computational Intelligence and Intelligent Informatics* 1, 1997, pp. 23–30