[Geetharamani,3(9): September 2016] ISSN 2348 – 8034
DOI- 10.5281/zenodo.154679 Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

REALIZATION OF FUZZY LOGIC CONTROLLER USING VHDL IN WIRELESS NETWORK ENVIRONMENT

Dr. G. Geetharamani*[1] and P.Ramadevi[2]
*Department of Mathematics Bharathidasan Institute of Technology, Tiruchirappalli
Department of Electronics and Communication Engineering Bharathidasan Institute of Technology, Tiruchirappalli

ABSTRACT
The emerging field of wireless communication, industrial automation, consumer product applications etcetera has enhanced designing technologies using fuzzy logic controllers. Nevertheless, the involved design scheme output performance along with cost factors are mandatory for design consideration and it is not an easy to balance. So, applying fanatical fuzzy based processors to achieve the required needs is noticeable. The synthesis work based on VHDL logics is an efficient method for designing complex hardware for the applications. So it is focused in the paper which illustrates FPGA apprehension of a Fuzzy Logic Controller (FLC) using VHDL for control the output. The system is built up with major module namely fuzzification, inference, and defuzzification.

Keywords: *Fuzzy Logic Controller (FLC), fuzzification, inference, and defuzzification, VHDL, FPGA, wireless Network.*

I. INTRODUCTION

The idea of fuzzy logic was given by Lotti Zadeh nearly 30 years ago, since then numerous applications of this concept have been implemented in the every field. The human behavior can be modeled easily by fuzzy logic. The if-then rules of fuzzy inference system modeling are having maps directly to the concept, where each rule has a meaningful explanation in our sense. A fuzzy system improves the relative performance of a system. It compensates non linear errors, accelerates the response and decreases the steady state error and retains stable values in the load and environment changes.

System can process crisp or classical data such as either '0' or '1'. The vague words in languages are properly handled by conversion of terms in to linguistics fuzzy parameters which is being set in the input and output side of the system for example the word 'Session Greetings'.

To have a good control system the converted input and output control variables are associated with linguistic variables. The former is corresponding to the input parameter and the latter is associated with the output control variable. Three consecutive steps are needed; Fuzzification is the first step to apply a fuzzy inference system. Most variables are in the class of crisp or classical existing in the real world. The fuzzy variables are processed from the crisp variables and applied to fuzzy inference process to get right output. According to the objectives finally data are again converted to the original crisp variables from fuzzy parameters.

II. METHODOLOGY

Communications happen surrounded by fuzzy area as considered basic service area under propagation characteristics of the wireless communication medium. In wireless medium of IEEE standard 802.11 networks have fuzzy boundaries. The degree of fuzziness involved in the system is most desirable. In mobile communication networks having overlapping of basic service areas is allowed. In successful transitions increases the probability between basic service areas and offers the highest level of network coverage. In order to control the traffic and successful transmission Fuzzy logic controller placed in the wireless medium.

The implementation of a fuzzy logic controller using VHDL, the system is built up with major module namely fuzzification, inference, and defuzzification .

 ISSN 2348 – 8034
Impact Factor- 4.022

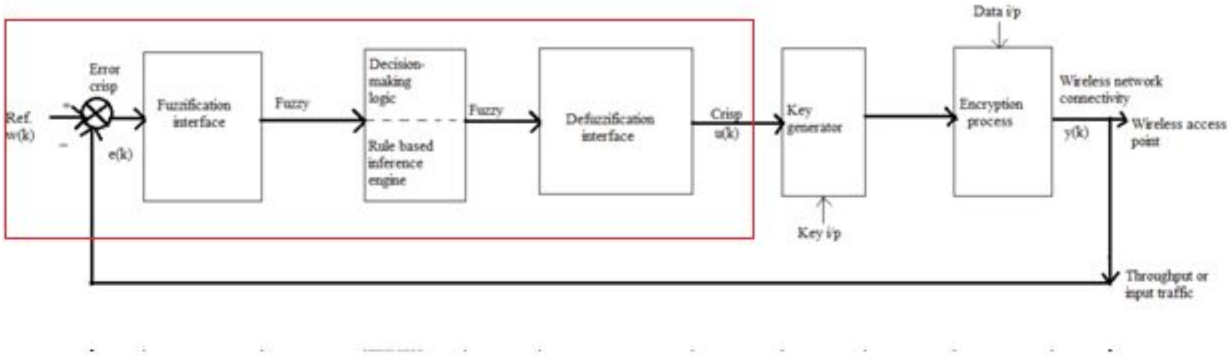

Figure – 1 Implementation of FLC in wireless medium

2.1Fuzzy Logic

The proper way to acquire exact conclusion is make available from Fuzzy logic. To take a decision a set rules of fuzzy logic and membership functions are properly processed. To achieve higher security the algorithm uses desired key length. The desired key is obtained using an artificial intelligence called FLC.

2.2 Membership set of FLC

This paper involves the enhancement of two-fish encryption algorithm with FLC in verilog HDL. The FLC structure is constructed by three main modules Fuzzification, Inference, and Defuzzification. The desired key length is selected using fuzzy logic based on wireless network connectivity.

The easy way to achieve the definite decision is through Fuzzy logic. The sets of membership and rules of fuzzy logic give a right decision. The desired length of key give higher security and it is obtained using an artificial intelligence with FLC. It uses two mapping tables and membership sets for which fifteen rules are framed.

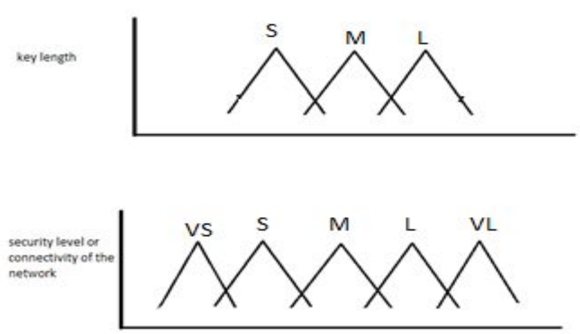

Figure 2 Membership function

X / Y	VL	L	M	S	VS

[Geetharamani,3(9): September 2016]
DOI- 10.5281/zenodo.154679
ISSN 2348 – 8034
Impact Factor- 4.022

S	L	M	M	S	S
M	L	M	M	S	S
L	L	M	M	M	S

Figure 3 Mapping Table

Where X is Network connectivity, Y is Key Length, VL is very large, L is large, M is medium, S is small, VS is very small

2.3 Fuzzy logic rules

- If key length is small and network connectivity is very large then the key length is 256.
- Else if key length is medium and network connectivity is very large then the key length is 256.
- Else if key length is large and network connectivity is very large then the key length is 256.
- Else if key length is small and network connectivity is large then the key length is 192.
- Else if key length is medium and network connectivity is large then the key length is 192.
- Else if key length is large and network connectivity is large then the key length is 192.
- If the key length is small and network connectivity is medium then the key length is 192.
- Else if the key length is medium and network connectivity is medium then the key length is 192.
- Else if the key length is large and network connectivity is medium then the key length is 192.
- Else if the key length is small and network connectivity is small then the key length is 128.
- Else if the key length is medium and the network connectivity is small then the key length is 128.
- Else if the key length is large and the network connectivity is small then the key length is 192.
- Else if the key length is small and the network connectivity is very small then the key length is 128.
- Else if the key length is medium and the network connectivity is very small then the key length is 128.
- Else if the key length is large and the network connectivity is very small then the key length is 128.

III. IMPLIMENTAION RESULTS OF SUB MODULE

ISSN 2348 – 8034
Impact Factor- 4.022

3.1 Fuzzification:

It converts conventional data or crisp data into fuzzy data or Membership Functions (MFs).

Inputs: Data1 in: 2e Data2 In: 4c

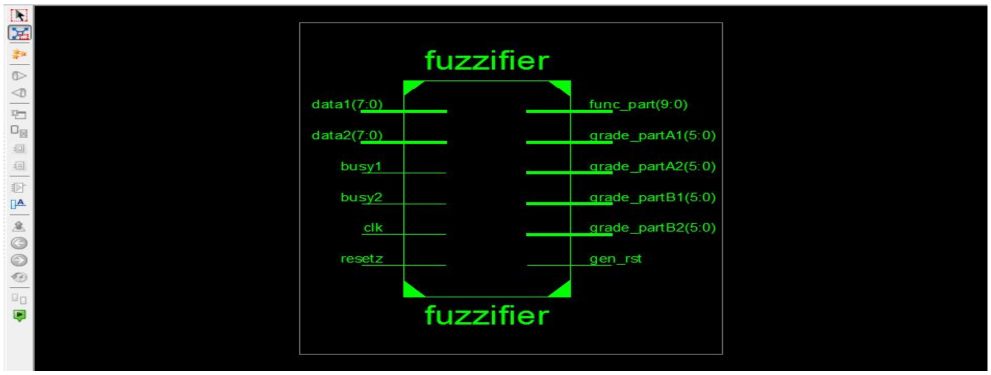

Figure 4 RTL Schematic View of fuzzifier

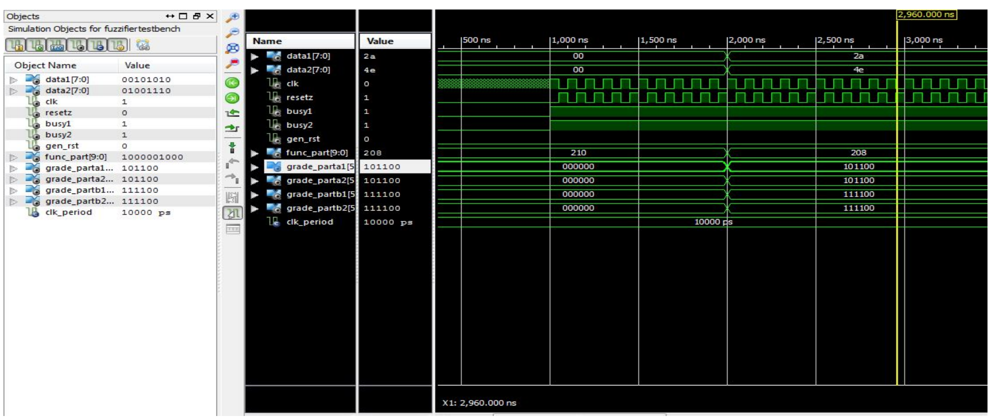

Figure 5 Simulated result of fuzzifier

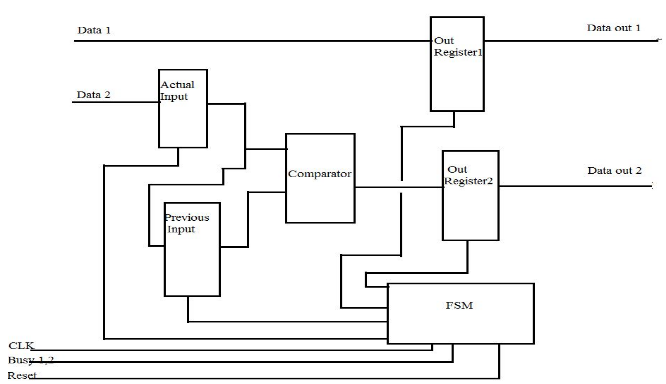

Figure 6 Digital structure of fuzzifier

3.2 Inference:

[Geetharamani,3(9): September 2016] ISSN 2348 – 8034
DOI- 10.5281/zenodo.154679 Impact Factor- 4.022

Fuzzy Inference Process is defined as combination of membership functions with the control rules to derive the fuzzy output.

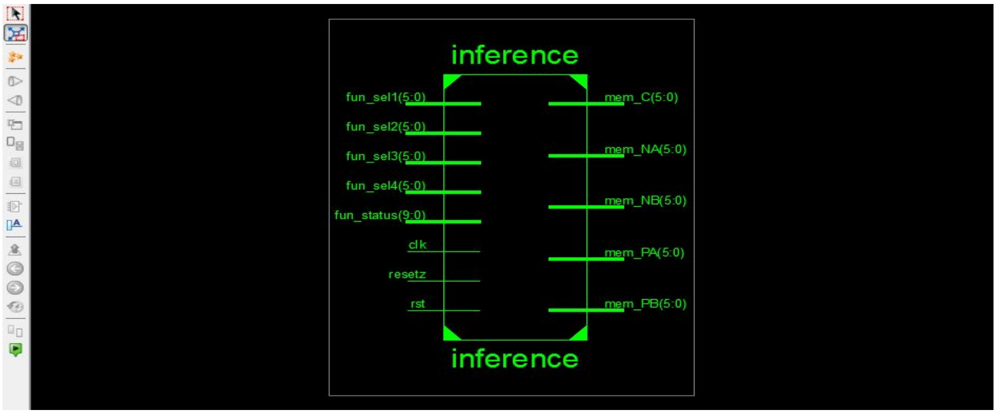

Figure 7 RTL Schematic View of inference

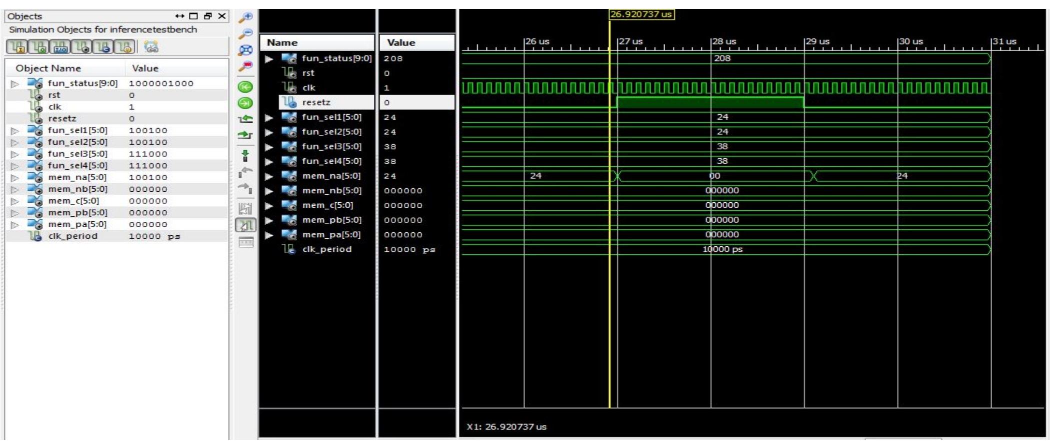

Figure 8 Simulated result of inference

3.3 Defuzzifier

Defuzzification is described according to the available input and its corresponding output data it is calculated using different methods and the values are placed as look up tables. The data required is picked up from the look up table based on the application of the current input.

Mem1[5:0] :23
Mem2[5:0] :34
Mem3[5:0] :00
Mem4[5:0] :00
Mem5[5:0] :00

[Geetharamani,3(9): September 2016] ISSN 2348 – 8034
DOI- 10.5281/zenodo.154679 Impact Factor- 4.022

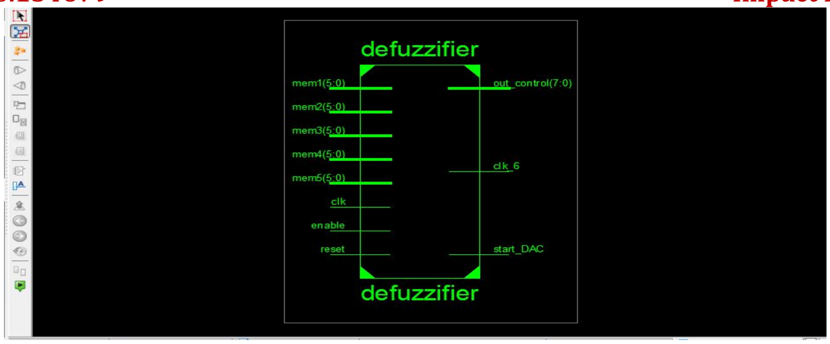

Figure 9 RTL Schematic View of defuzzifier

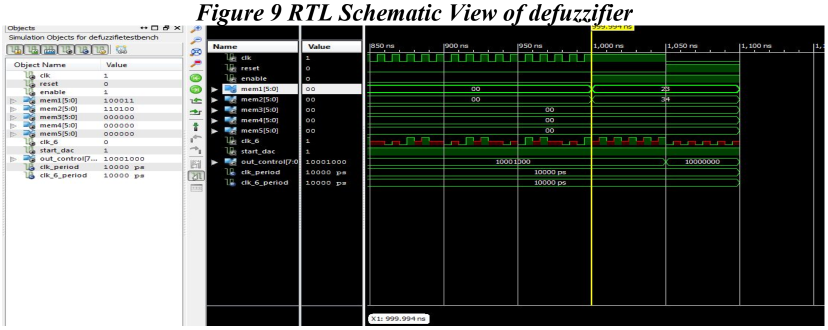

Figure 10 Simulated result of defuzzifier

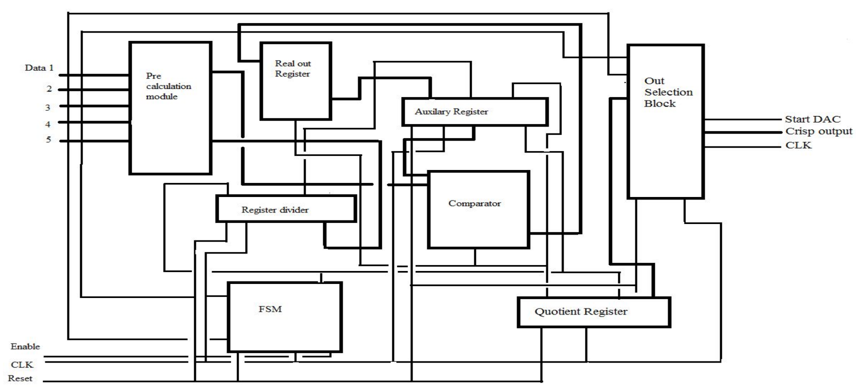

Figure 11 Digital architecture of defuzzifier

IV. IMPLIMENTAION RESULT OF MAIN MODULE(FLC)

In implementation, three consecutive steps are needed, which are: Fuzzification, fuzzy inference and defuzzification. Fuzzification is applied to a fuzzy inference system. Most variables existing in the real world are crisp or classical variables. To get the required output obtained by applying proper fuzzy inferences in the system with the conversion of crisp variable to fuzzy variables and again it has been changed according to the particular desired objectives.
Inputs: Data1 in : 2e Data2 in :4c

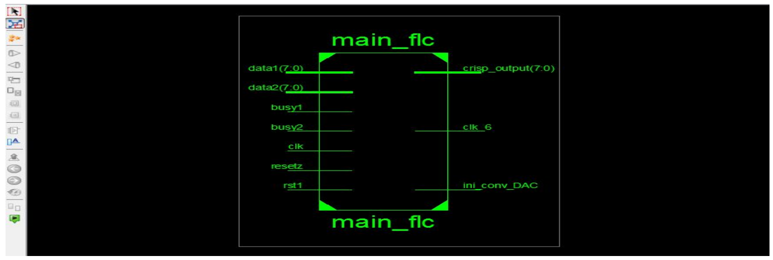

Figure 12 RTL Schematic View of main FLC

Figure 13 Simulated result of main FLC

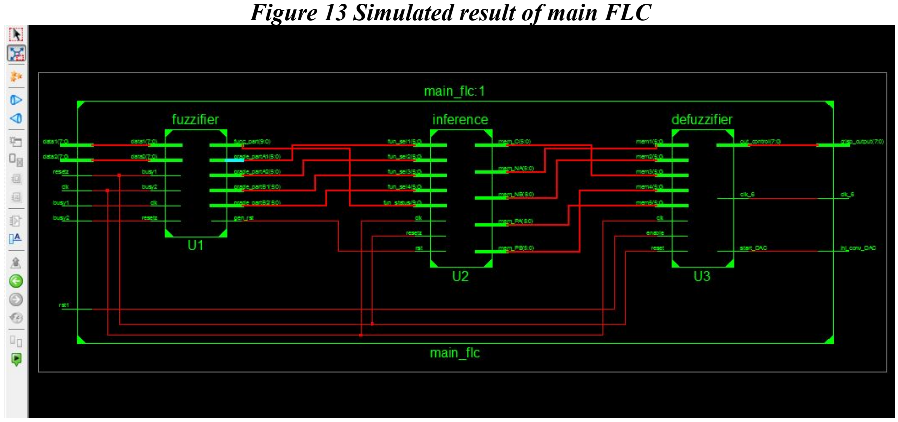

Figure 14 RTL Schematic view of internal structure of main FLC

V. CONCLUSIONS

The efficient design of Fuzzy Logic controller is obtained from the implementation of FPGA realized fuzzy logic controller in VHDL. After de normalization VHDL output is used to control the desired value regardless of changes in the load or environment.

REFERENCES

1. *Fuzzy Logic: An Introduction [online] http://www.seattlerobotics.org*
2. *Europe Gets into Fuzzy Logic" ,Electronics Engineering Times, 1991*
3. *"Fuzzy Sets and Applications: Selected Papers by L.A. Zadeh", ed. R.R.*
4. *Yage et al. (John Wiley, New York,1987).*
   "U.S. Loses Focus on Fuzzy Logic" (Machine Design, June 21, 1990).
5. *P.B.Khedkar, R.M.Nagarale 'Fuzzy controller for Load Frequency Control' IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 10, Issue 4 Ver. III (July – Aug. 2015), PP 41-47 www.iosrjournals.org DOI: 10.9790/1676-10434147 www.iosrjournals.org 41 | Page*
6. *Dr.S.S.Dhenakaran, N.Kavinilavu ' A New Method for Encryption Using Fuzzy Set Theory'*

International Journal of Engineering Trends and Technology Volume3Issue3- 2012 ISSN: 2231-5381 http://www.internationaljournalssrg.org Page 320

7. *Tukaram R. Kumbhar, Sunil S. Nirmale, R. R. Mudholkar 'FPGA Implementation of Fuzzy Logic Controller for Temperature Control' International Journal of Computer Applications (0975 – 8887) Volume 62– No.20, January 2013*
8. *Robert Full´er, 'OWA Operators in Decision Making' rfuller@ra.abo.fi, http://www.abo.fi/ rfuller/robert.html.*