

# Temperature Control inside a Room Using Fuzzy Logic Method

Parmita Mondal<sup>1</sup>, Madhusree Mondal<sup>2</sup>U.G. Student, Department of Electrical Engineering, Techno India College of Technology, Rajarhat, Kolkata, India<sup>1</sup>U.G. Student, Department of Electrical Engineering, Techno India College of Technology, Rajarhat, Kolkata, India<sup>2</sup>

**ABSTRACT:** In this paper a fuzzy logic controller has been devised to make conditions adapt to a certain temperature range in the room comparing that of the environment. The fuzzy logic controller acts as a room temperature controller through which the air conditioner and the heater present in the room can be controlled. The proposed algorithm uses fuzzy logic as a controlling unit that maintains the temperature of simulated heater or the air condition to the desired point.

**KEYWORDS:** Fuzzy logic, Temperature Control, Fuzzy Inference System (FIS), Fuzzification.

## I. INTRODUCTION

Fuzzy logic is many valued logic where the attributes are real numbers lying between 0 and 1. In traditional method, 0 is considered as complete false while 1 is considered as complete truth. Thus, fuzzy logic comes into existence where partial truth is handled, ranging from complete truth to complete false. Fuzzy logic is closer to the way our brain works. Fuzzy logic is necessary for development of Artificial Intelligence, so that when the software is presented with an unfamiliar task, it can find a solution just like human beings. Fuzzy logic is almost same as human reasoning. It involves the possibilities between Digital 'YES' and 'NO'. The conversational computer understands precise inputs which is 'YES' or 1 and 'NO' or 0. Lotfi Zadeh the inventor of fuzzy logic realised that human interactions involves a range of possibilities like 'Definitely Yes', 'Possibly Yes', 'Cannot Say', 'Possibly No', 'Definitely No'. Thus, to train a software just like humans, making it efficient in solving real time problems, it was necessary to use Fuzzy Logic.

Fuzzy logic can be useful in Artificial Intelligence System, controlling water level in a tank, controlling temperature of a room, aerospace vehicle control system, route planning, image processing, testing for safety critical systems. It can be used in spell checkers where a list of probable words is given to check the misspelled word. A comparative study was done between PI controller and Fuzzy controller where the design and implementation of Fuzzy logic for level control was discussed. It was found out that Fuzzy Controllers provided more stable and improved output for level control. It requires less settling time than PI controller and removes overshoot present in PI Controller [1]. Artificial Intelligent Fuzzy Logic Controller (FLC) was used to control speed of the train. An emergency switch was introduced to override the fuzzy logic during an emergency condition. Simulation was done in MATLAB Simulink to examine the working of FLC design & the speed control is achieved accordingly [2].

Researchers from Tennessee State University developed multilevel fuzzy logic for control of turbine engines. In this system, a single input single output (SISO) system was used to control the fuel flow. A fuzzy logic was implemented on the SISO system and its performance was compared with that of the existing proportional integral (PI) controller [3]. Fuzzy model was designed to determine the maturity of fuji apples. The outcome of the fuzzy model gave the the value for the level of maturity of fuji apples, which are divided into: raw, half-ripe and ripe [4]. Professor Anish Benny and his team developed an intelligent control method using a Fuzzy Logic Controller implemented on a DC-DC converter device. The system was aimed for maximum power point tracking of a photovoltaic system under variable insolation conditions [5]. The self-tuning fuzzy PID controller was designed in controlling the position variation of electrohydraulic actuator, in Malaysia. The output of the system was compared with pole placement controller [6].

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 7, July 2018

Hardware implementation followed by software approach has been discussed for temperature control system using 8-bit microcontroller [7]. Development of fuzzy logic water bath controller has been developed by Malaysian researchers to control the liquid temperature in the water bath. In this system, fuzzy logic controlled is designed based on inputs received from thermal transducer sensor [9]. Fuzzy logic can also be implemented in Automated Car braking system where the controller has to brake the car when the car approaches an obstacle [10]. Fuzzy logic based image processing can be done for accurate and noise free edge detection and resulting edge can be enhanced using Cellular Learning Automata (CLA) [11].

Professor Asif Khan and his team has discussed an approach of medical image processing using fuzzy logic contributing to solve medical problems in diagnosis and visualization [15]. Researchers from Korea have demonstrated a Fuzzy Logic Controller which maintains the constant temperature of refrigerator, improving the efficiency of it [25]. It is found out that Fuzzy logic is way more advantageous than that of traditional controllers. In traditional controllers, detailed physical properties of the controllers have to be known. Here most systems are too complex, thus needing idealization and conditions in which they work are fairly constricted within a range. Fuzzy logic, on the other hand does not need much knowledge of the system. The system does not need to be idealized for implementing Fuzzy logic on it. The outcome will be more robust because of wide range of variability in the inputs.

## II. METHODOLOGY

The process of changing a specific value into fuzzy value using different fuzzifiers or membership functions is said to be Fuzzification. Defuzzification is the process in which these fuzzified values are changed into crisp logical output by using rule based training. The Fuzzy Inference System (FIS) implements both of them.

It typically has three parts-

1. Input,
2. FIS editor, and
3. Output.

The Input has different membership function which converts crisp inputs into fuzzified form. These fuzzified inputs are sent to the FIS editor and rules are set according to the given conditions to get the de-fuzzified crisp output.

We have taken into consideration six input parameters, fuzzified it using membership functions, then added the required conditions to establish the rules and procured the required temperature inside the room as output.

The six input parameters are:

1. Cloud content (0 to 8 oktas),
2. Humidity (0 to 100 percent),
3. Temperature outside (0 to 40 degree Celsius),
4. Rainfall (0 to 100 percent),
5. Pressure (990 to 1030 bars), and
6. Wind (0 to 360 degrees).

These parameters are used to control the temperature inside a room with proper calibration. Thus, in this way the model of the temperature control system is developed by training the input parameters using rule based system as shown in Fig 5.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 7, July 2018

The schematic diagram of the algorithm for this research is shown in fig1. and the input and output parameters are defined in fig2.

The entire algorithm is implemented using MATLAB R2017a.

### III. EXPERIMENTAL RESULTS

Fig3. shows the graph of the output variable 'temperature inside the room' with the membership functions- low, medium and high, each defined for a specific range. Fig 4. shows the graph of the membership function of input parameter- cloud content and Fig7. depicts the surface viewer which is a 3D structure with cloud content in the X axis, humidity in the Y axis and temperature inside the room in the Z axis.

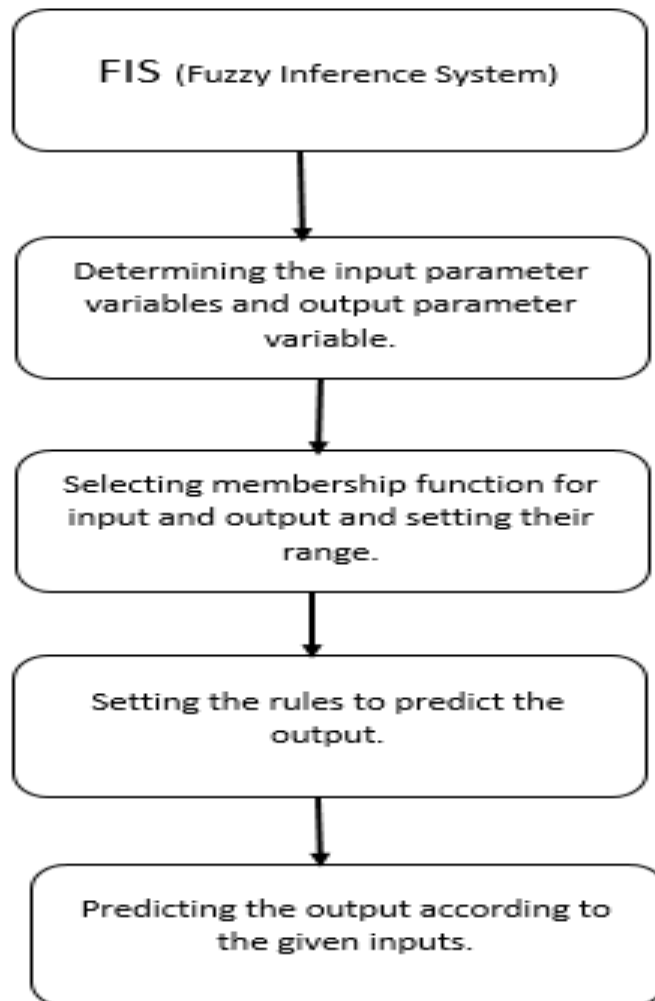


Fig 1: Schematic diagram of FIS algorithm

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 7, July 2018

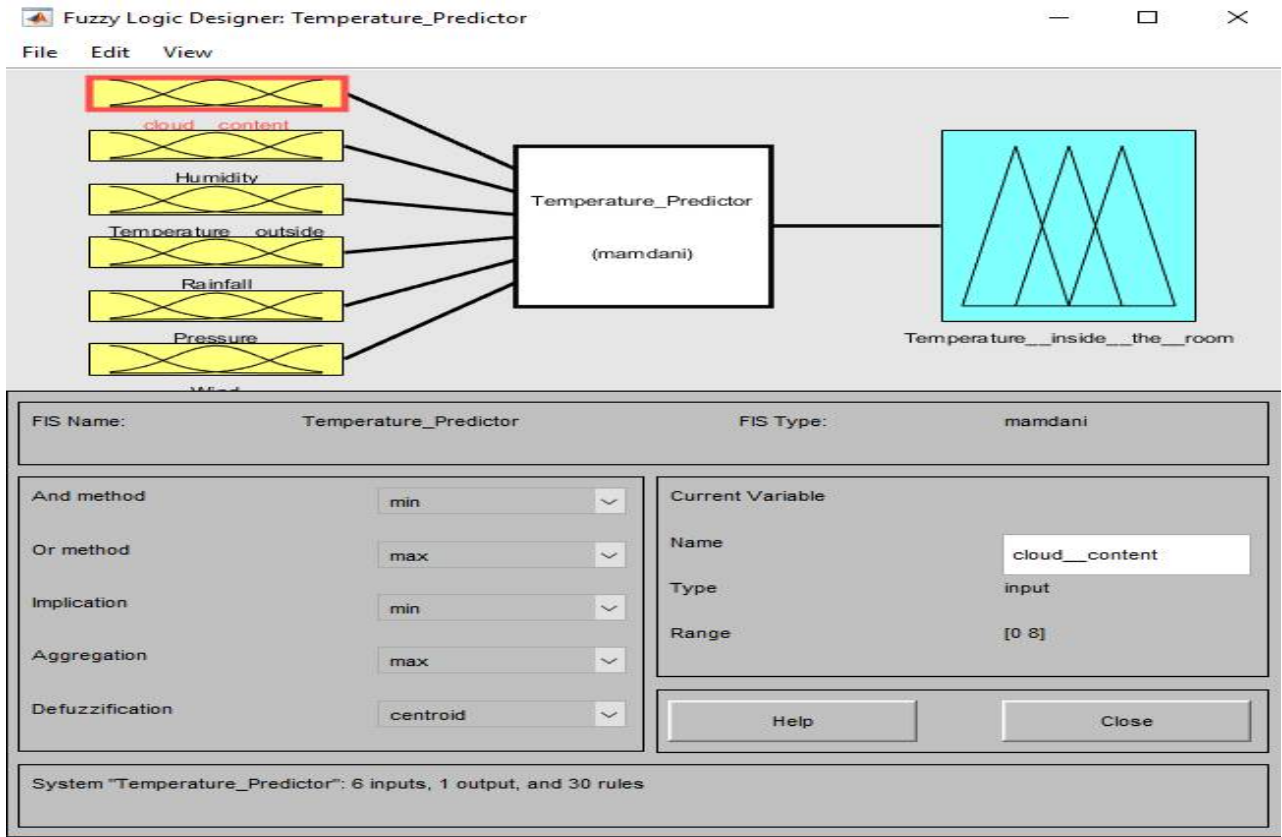


Fig2. FIS algorithm showing the input and output parameters.

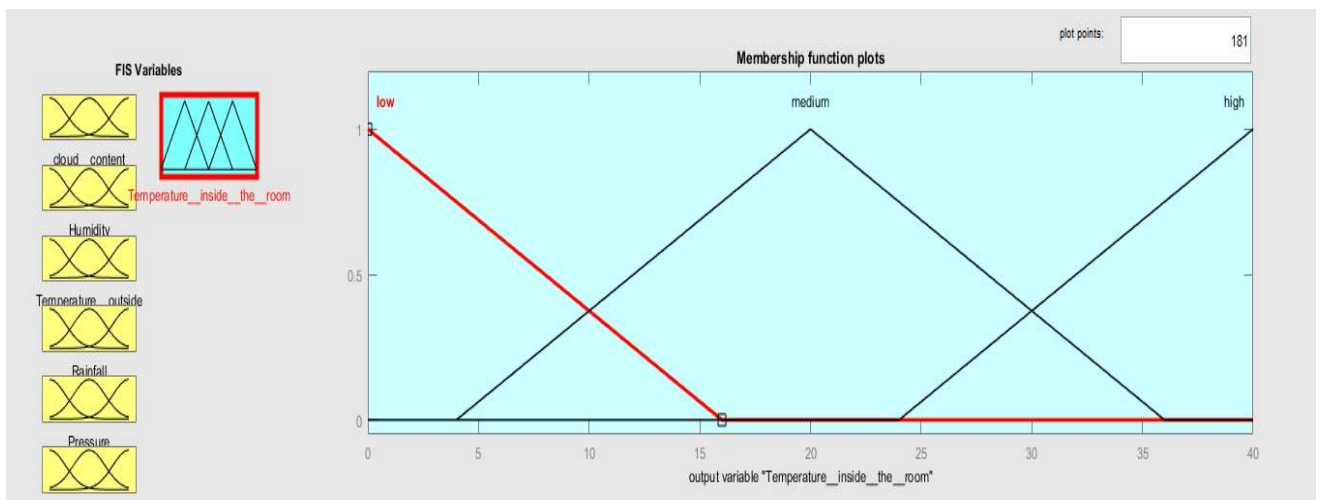


Fig3. Graph of the output variable membership function.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 7, July 2018

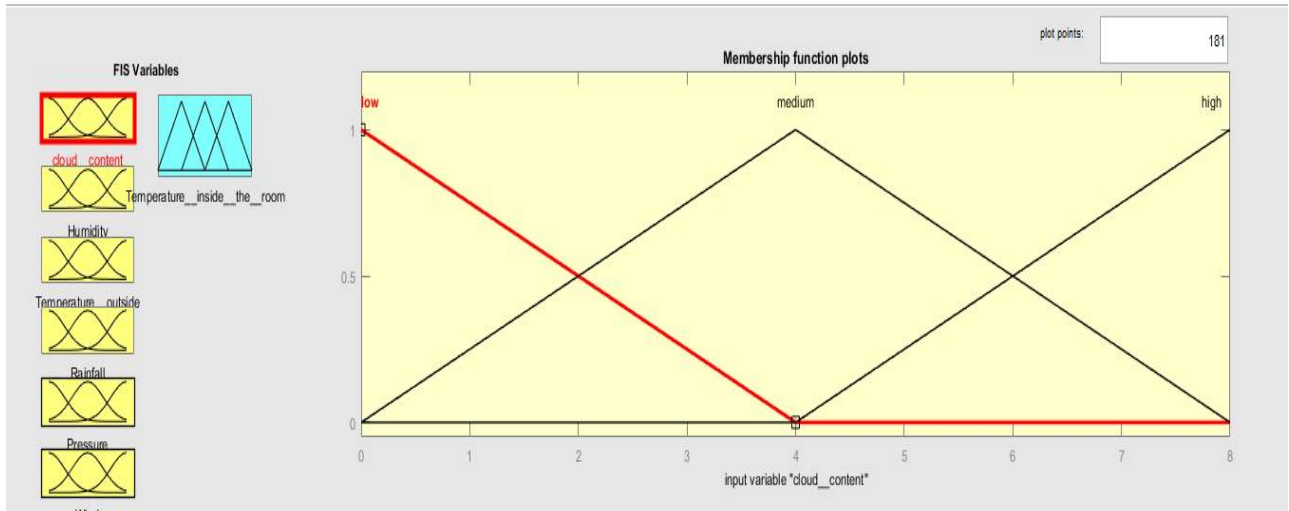


Fig4. Graph of the membership function of input variable (Cloud content).

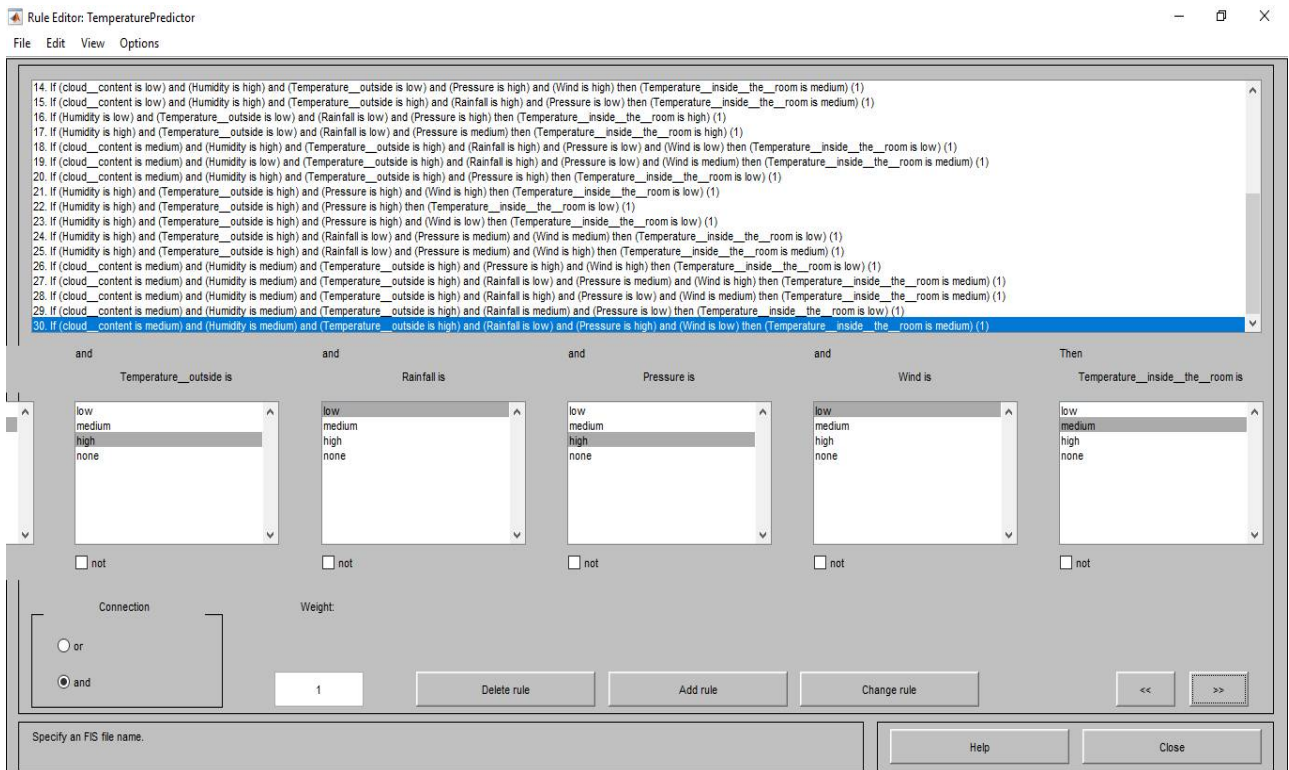


Fig5. Rule based training.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 7, July 2018



Fig6. Knowledge base.

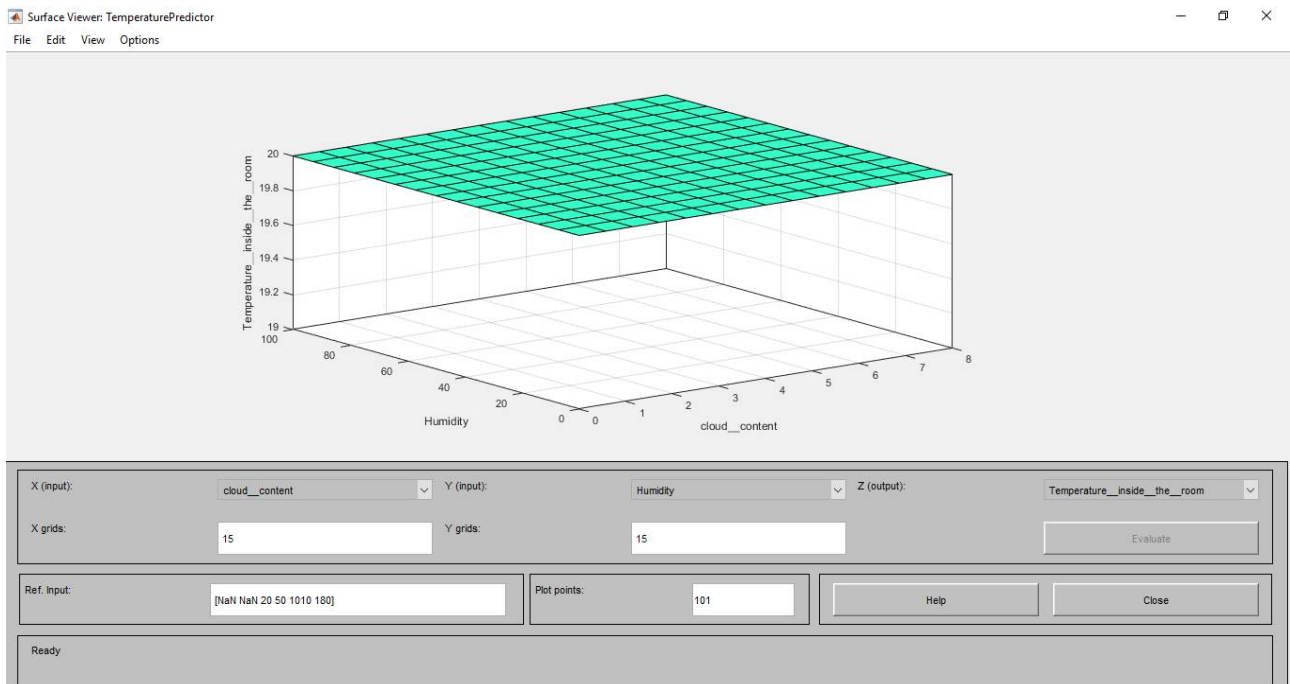


Fig7. Surface Viewer.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 7, July 2018

## IV. CONCLUSION

In this paper, an attempt has been made to devise a temperature controller using the fuzzy logic. The initial results obtained from this study are very encouraging, even with a very small amount of input and output parameters. Though the present investigation shows a promising future of Fuzzy Inference System (FIS) for this kind of automation applications, but actual challenge lies on real time implementation of FIS.

## REFERENCES

- [1] Poonam N. Lamkhade, B.J.Parvat, C.B.Kadu, "Design and Implementation of Fuzzy Logic Controller for Level Control", 2015 International Conference on Energy Systems and Applications (ICESA 2015)
- [2] Ajeesh K.P, Ashis. R, Mary HelnaMuttath, Nidheesh.K.Chandran, Sreedevi C.R, Praveen R.P, "A Novel Fuzzy Logic Controller Based Automatic Caution Order System for Indian Railways", 2012 IEEE International Conference on Advanced Communication Control and Computing Technologies (ICACCCT)
- [3] Charles D. McCurry, Richard Mgamma, and Saleh Zein-Sabatto, "Fuzzy Decision-making in Turbine Engine Controls", Southeastcon, IEEE 2009.
- [4] EviDewi Sri Mulyani, Susanto, Jeni Poniman, "Classification of Maturity level of Fuji Apple Fruit With Fuzzy Logic Method", Cyber and IT Service Management (CITSM), 2017 5th International Conference
- [5] Shilpa Sreekumar, Anish Benny, "Fuzzy Logic Controller Based Maximum Power Point Tracking of Photovoltaic System Using Boost Converter ", Computing, Communications and Networking Technologies (ICCCNT),2013 Fourth International Conference
- [6] Ramli Adnan, MazidahTajjudin, Norlela Ishak, Hashimah Ismail, MohdHezriFazalulRahiman, "Self-tuning Fuzzy PID Controller for ElectroHydraulic Cylinder", 2011 IEEE 7th International Colloquium on Signal Processing and its Applications
- [7] G.S. Nhivekar, S.S. Nirmale, R.R. Mudholker, "Implementation of fuzzy logic control algorithm in embedded microcomputers for dedicated application", International Journal of Engineering, Science and Technology Vol. 3, No. 4, 2011, pp. 276-283
- [8] U.Yolac, T.Yalcinoz, "Comparison of Fuzzy Logic and PID Controllers for TCSC using MATLAB", Universities Power Engineering Conference, UPEC 2004, 39th International Conference
- [9] NorhaslindaHasim, MohdZamzuri Ab Rashid, MohdShahrieelMohd Aras, Anuar Mohamed Kassim, Dr Shahrum Shah Abdullah, "Development of Fuzzy Logic Water Bath Temperature Controller using MATLAB", 2012 IEEE International Conference on Control System, Computing and Engineering
- [10] SachinHirulkar, Manish Damle, Vishal Rathee, BhalchandraHardas, "Design of Automatic Car Breaking System Using Fuzzy Logic and PID controller", 2014 International Conference on Electronic Systems, Signal Processing and Computing Technologies
- [11] Dhiraj Kumar Patel, Prof. Sagar A. More, "Edge Detection Technique by Fuzzy Logic and Cellular Learning Automata using Fuzzy Image Processing", 2013 International Conference on Computer Communication and Informatics (ICCCI -2013)
- [12] Essa Anas, "Edge Detection Techniques Using Fuzzy Logic", 2016 3rd International Conference on Signal Processing and Integrated Networks (SPIN)
- [13] Alexey Saenko, Galina Polte and Victor Musalimov, "Image Enhancement and Image Quality Analysis using Fuzzy Logic Techniques", Communications (COMM), 2012 9th International Conference
- [14] Mozammel Chowdhury, Junbin Gao, Rafiqul Islam, "Fuzzy Logic Based Filtering for Image De-noising", Fuzzy Systems (FUZZ-IEEE), 2016 IEEE International Conference
- [15] Asif Khan, Jian-Ping Li, Riaz Ahmed Shaikh, "Medical Image Processing Using Fuzzy Logic", Wavelet Active Media Technology and Information Processing (ICCWAMTIP), 2015 12th International Computer Conference
- [16] Mario I. Chacon, Luis Aguilar, Abdi Delgado, "Definition and applications of a Fuzzy Image Processing scheme", Digital Signal Processing Workshop, 2002 and the 2nd Signal Processing Education Workshop. Proceedings of 2002 IEEE 10th International Conference
- [17] Ching-Yu Tyan, Paul.P Wang, "Image Processing - Enhancement, Filtering and Edge Detection Using the Fuzzy Logic Approach", Fuzzy Systems, 1993, Second IEEE International Conference
- [18] N.Pappa, S.Rama Krishnan, "Autotuning of Fuzzy Inference System with RL", Proceedings of the 2007 American Control Conference
- [19] T.K Sai, K.A. Reddy, "Fuzzy Applications in a Power Station", International Journal on Soft Computing (IJSC) Vol.6, No. 2, May 2015
- [20] C.B. Kadu, D.V. Sakhare, "Improved Inverse Response of Boiler Drum Level using Fuzzy Self Adaptive PID Controller", International Journal of Engineering Trends and Technology (IJETT) – Volume 19 Number 3
- [21] R. R. Sonawane, P. G. Medewar, R. K. Munje, "Fuzzy Logic based Boiler drum level control with GUI", Proceedings of International Conference on Computing, Communication and Energy Systems (ICCCES-16)
- [22] Ravi Kumar Sahu, Sachin Tyagi, Suresh Chandra Gupta, "A Nobel Design of Monitoring and Control of a Boiler Drum Level by Fuzzy PID Adaptive Controller Using Labview", International Journal of Scientific Research Engineering & Technology (IJSRET) ISSN: 2278-0882 EATHD-2015 Conference Proceeding
- [23] P. Singhala, D. N. Shah, B. Patel, "Temperature Control using Fuzzy Logic", International Journal of Instrumentation and Control Systems (IJICS) Vol.4, No.1
- [24] Isizoh A. N, Okide S. O, Anazia A.E, Ogu C.D, "Temperature Control System Using Fuzzy Logic Technique", (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Vol. 1, No. 3, 2012
- [25] Byung-joon Choi, Sang-wan Han, Suk-kyo Hong, "Refrigerator Temperature Control Using Fuzzy Logic and Neural Network", Industrial Electronics, 1998 Proceedings, ISIE '98, IEEE International Symposium.