IJETIE International Journal of Emerging Technology and Innovative Engineering
Volume I, Issue 4, April 2015
ISSN: 2394 - 6598
www.ijetie.org

A REVIEW ON INDUSTRIAL APPLICATIONS OF SOFT COMPUTING

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ABSTRACT
Softcomputing is broadly comprised of artificial neural network,fuzzy logic and genetic algorithm.This technique handles the uncertainty present in the real world situations appreciably hence presently much research is being done on various areas covered by softcomputing techniques.This paper focuses on the work that has been done in the field of softcomputing applications in industrial process control.

Keywords
Neural network, Fuzzy Logic, Genetic Algorithm

1. INTRODUCTION
ANN is a network formed by massive interconnections of artificial neurons which is to be first of all trained to carry out a specific task by some training algorithm which may be supervised, unsupervised or reinforcement type exactly like biological neural network. An ANN contains an input layer which receives electrical signals from outside world, number of hidden layers and an output layer of neurons where learning is done by adjusting the connection weights A neural network could be used to perform specific applications like data classification, function approximation, pattern recognition, and pattern association and detect trends which are too complex for humans or other computer techniques to notice. Other advantages of working with an ANN include adaptive learning, self organization, real time operation and fault tolerance.

The concept of Fuzzy Logic was developed by Lotfi A. Zadeh, Professor at the University of California at Berkeley. The difference between Fuzzy logic and Boolean logic is that it is very much like how a human thinks. The members of universe of discourse be present in a Fuzzy set with different membership grades over [0, 1]. It can be implemented in hardware, software or a combination of both.

GA is similar to sexual reproduction in which the genes of two parents combine to form their offspring. It is basically a search strategy which searches out the optimum solution of an optimization problem from the population of possible solutions called chromosomes. GAs are executed iteratively with three basic operators namely selection, crossover and mutation.

2. APPLICATIONS
Mansour Bazregar et al. proposed a parallel soft computing control optimization algo for uncertain dynamic systems and presented design of robust feedback controller using Lyapunov stability criterion controlling the position of continuum robot in the environment where uncertainties are present[1].The scheme used is shown in Fig.1.

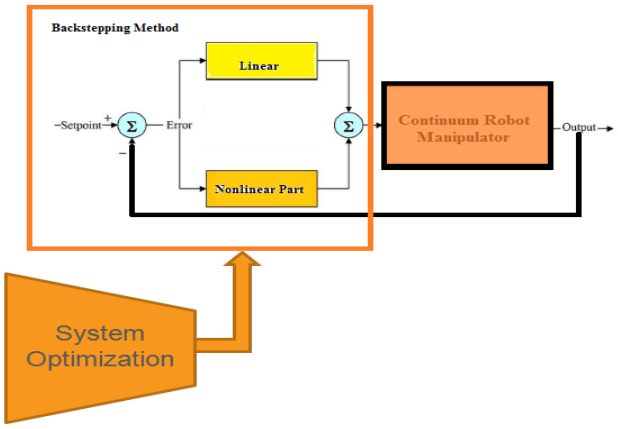

Fig.1: Backstepping Optimization Control Methodology with Application to Continuum Robot [1]

P.Melin and O.Castillo described a new method for intelligent control of nonlinear robotic dynamical system with the use of a neuro-fuzzy inference system with multiple differential equations. In this case the used parameter for the fuzzy system is the fractal

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dimension of a time series of measured values of the variables .In addition ANN was used to control robotic dynamic systems trained with Levenberg-Marquardt learning algo[2].

Dharmendra kelde et al. presented image forensic techniques which use natural properties of image to determine forgery or detect tampering [3].

Rahul et al. introduced an agent based modelling and simulation (ABMS) approach for modelling a fuzzy controller for highway entrance ramp monitoring and controlling. They designed a controller considering varying levels of congestion, a downstream control area, changing occupancy levels, upstream flows and a distributed detector array in its rule base [4].

S,N,Singh et al. invented a hybrid system using fuzzy control technique for rural home energy management which consists of photovoltaic system, diesel generator, inverter and battery This system was declared to optimize the cost of electricity against max household loads of 36000 Wh/day[5].Block diagram of this system is shown below in Fig.2.

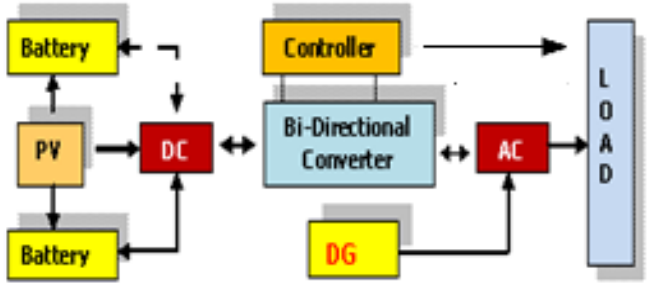

Fig.2: Power Circuit Model [5]

K.T.Sagkars et al. used soft computing methods for controlling the power in CDMA networks where the total transmission power on the uplink of a multi service DS-CDMA system was minimized. The problem of optimum allotment of power to the uplink transmitters was solved by training an ANN by TPAA (transmission power allocation algo) [6].

P.P.Bonissone and K.Goebel proposed a neuro fuzzy inference system to indicate the web break tendency in the wet end part of paper making machine [7].

Kayoed Owa et al. exploited GA and ANN techniques to design a controller for coupled tank system which gave an appreciable control performance over conventional PID controller[8] .The schematic layout of a coupled tank system is shown in Fig.3 .

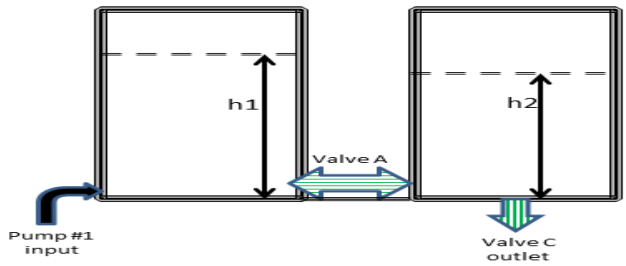

Fig.3: Schematic Layout Diagram of SISO Two-Tank Setup[8]

Faran Baig et al. proposed a fuzzy logic based elid grinding control system which is used for betterment of surface quality and metal removal rate in brittle materials. The defuzzifier is made to take four inputs namely roughness, hardness, material removal rate and tangential force. MATLAB simulation has been used to formulate the rule base for this problem [9].

Jingying Zhao et al. applied GA in the optimization design of transformer. They took the typical voltage transformer JDCF-110 as the research object [10].

M. Abbas et al presented the prototype of a control system based on Fuzzy Logic for Hydro-Electric Power Dam(as shown in Fig.4)taking water level and flow rate as input parameters and release valve control and drain valve control as output parameters with a wide range of input and output membership functions[11].

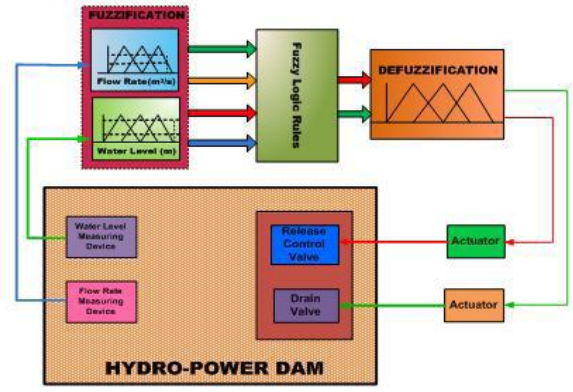

Fig.4: Block Diagram of Hydro-Electric Power Dam Fuzzy Control System [11]

Dharamniwas et al. proposed a fuzzy logic controller for the control of liquid level [12].The fuzzy controller used is shown in Fig.5

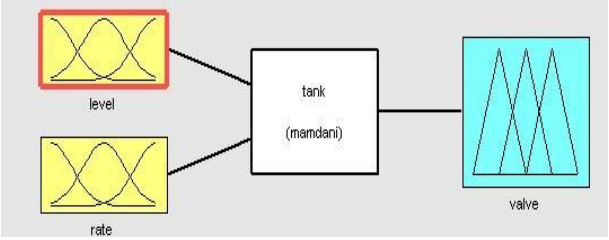

Fig.5:- Mamdani Type Fuzzy Controller[12]

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P. Singhala et al. gave the design of a low cost temperature control system using fuzzy logic where the Fuzzy controller calculates error between set point value and current value which is considered as input function of fuzzy logic. The fuzzification process calculates it membership. The Defuzzification process is made to calculate the PWM actual value for heater and fan which is output of the temperature control system [13].This scheme is shown in the Fig.6

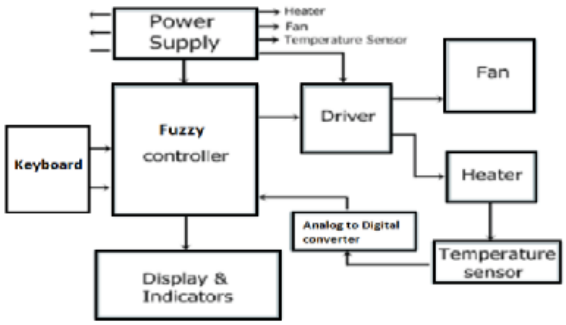

Fig .6: Block Diagram of Temperature Control System[13]

N.Virkhare and R.W. Jasutka proposed the prototype of a washing machine based on neuro-fuzzy controller. The machine proved to be smart in the sense that it takes its own decisions like release of water and washing powder as per need of cloth [14].

Ritu Shakya et al. presented a comparative study of conventional PD controller, PID controller and fuzzy logic controller for flowing fluids using MATLAB and simulink. This study resulted in small overshoot and fast response in case of fuzzy controller as compared to PID and PD controllers [15].The step responses obtained for comparative study are shown in Fig.7(a),7(b) and 7(c).

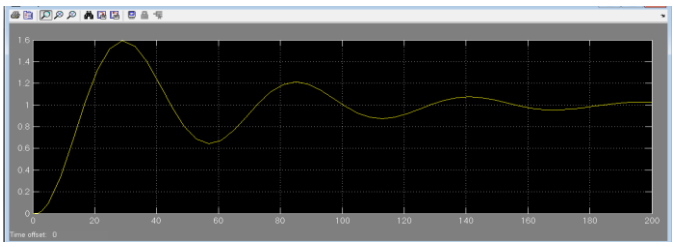

Fig.7 (a): Step Response of PD Controller [15]

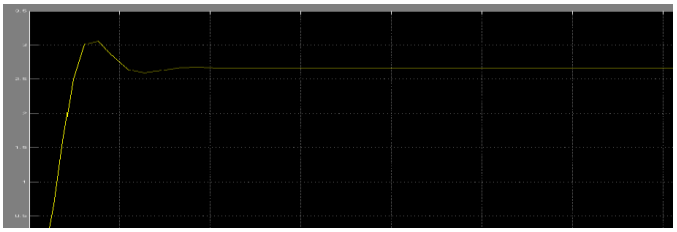

Fig.7 (b): Step Response of PID Controller [15]

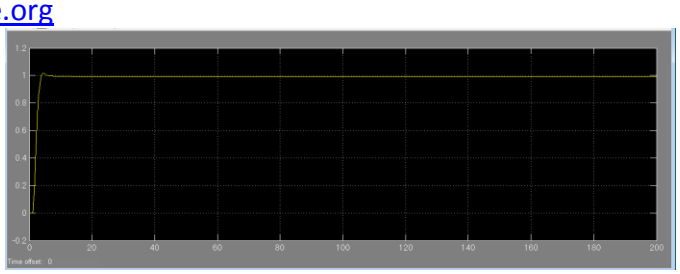

Fig.7(c): Step Response of Fuzzy Controller [15]

M.Saleem Khan and K.Benkrid presented the model of a supervisory time control discrete event (DEV) system using fuzzy logic for multi-dimensional control and supervision in industrial application of a processing plant [16].

T.K.Das and Y.Das discussed the design of a fuzzy logic based room temperature and humidity controller containing two separate controllers for controlling temperature and humidity by controlling the humidifier and exhaust fan speed to maintain correct humidity level for the specified temperature [17].

Tukaram R. Kumbhar et al. presented FPGA implementation of a Fuzzy Logic Controller using VHDL for temperature control.The system is shown in Fig.8. They compared its functionality and output with the models based on C and Matlab for different input conditions [18].

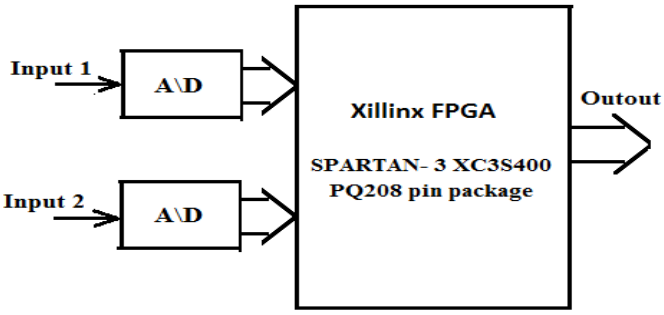

Fig.8: FLC system [18]

O.P Verma and H. Gupta designed a water bath temperature controller based on fuzzy logic [19].The model used is shown in Fig.9.

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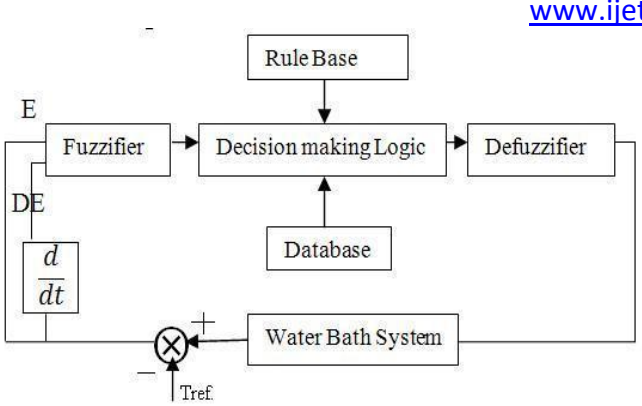

Fig .9: Fuzzy controller model [19]

M. R. Sarmasti Emami focussed on the applications of fuzzy logic in various chemical processes like combustion process, separation process, in PH control, furnace control, and reactor control, detection of chemical agents and in chemical kinetics [20].

3. CONCLUSION

In this paper we have reviewed various real world problems using soft computing techniques and found that the results given by these techniques are much more effective as compared to conventional techniques. New advancements are being done very rapidly in this area and the number of soft computing industrial and commercial products is increasing day by day. Thereby, soft computing has proven to be a major area of research.

REFERENCES

[1] M. Bazregar, F. Piltan, A. Nabaee and M. M Ebrahimi," Parallel Soft Computing Control Optimization Algorithm for Uncertainty Dynamic System", International Journal of Advanced Science and Technology vol. 51, February, 2013.

[2] P.Melin and O. Castillo," Soft Computing for Intelligent Control of Nonlinear Dynamical Systems", International Journal of Computational Cognition vol. 2, no. 1, March 2004, pp. 45–78.

[3] D.Kelde, D.Nagde ,R.Patel and P. Pawar ," Information Forensic Application using Soft Computing Techniques", International Journal of Computer Science and Information Technologies, vol. 4 (1) , 2013,pp. 69 – 72.

[4] R.Misra, A.Patel and R.Singh, "Highway Entrance Ramp Monitoring and Control Using Soft Computing Techniques", International Journal on Recent and Innovation Trends in Computing and Communication ,vol.1, issue -4 ,pp. 332 – 334.

[5] S. N. Singh, V. N. Tigga and S. Mishra," Rural Home Energy Management by Soft Computing Fuzzy Control Models for a Photovoltaic System in India", vol. 2 (3) , March 2010.

[6] K.Tsagkaris, P.Demestichas, A.Vasilakos and M.Theologou, "Power Control in CDMA networks based on soft computing methods", Springer, February 2005, vol. 9, issue- 2, pp 81-87.

[7] P.P.Bonissone and K.Goebel,"When will it break? A Hybrid Soft Computing Model to Predict Time-to-Break Margins in Paper Machines" Proceedings of SPIE 47th Annual Meeting, International Symposium on Optical Science and Technology, vol. 4787, 2002, pp. 53-64.

[8] K.Owa1, S.Sharma and R.Sutton, " Nonlinear Model Predictive Control Strategy Based on Soft Computing Approaches and Real Time Implementation on a Coupled-Tank System", International Journal of Advanced Research in Computer Science and Software Engineering vol.3, issue -5, May 2013.

[9] F.Baig et al.,"Design and Simulation of Fuzzy Logic Based Elid Grinding Control System", International Journal of Advanced Technology & Engineering Research.

[10] J. Zhao ,F. Yao ,H.Wang, Y.Mi and Y.Wang,"Research on Application of Genetic Algorithm in Optimization Design of Transformer",Electric Utility Deregulation and Restructuring and PowerTechnologies,4th International Conference(IEEE),2011,pp. 955 - 958.

[11] M. Abbas, M. Saleem Khan and N. Ali,"Fuzzy Logic Based Hydro-Electric Power Dam Control System", International Journal of Scientific & Engineering Research ,vol. 2, issue- 6, June-2011.

[12] D. A. Ahmad, V. Redhu and U. Gupta,"Liquid Level Control by Using Fuzzy Logic Controller", International Journal of Advances in Engineering & Technology, July 2012.

[13] P. Singhala, D. N. Shah, B. Patel," Temperature Control using Fuzzy Logic", International Journal of Instrumentation and Control Systems ,vol.4, no.1, January 2014.

[14] N.Virkhare and R.W. Jasutka, "Neuro-Fuzzy Controller Based Washing Machine", International Journal of Engineering Science Invention, vol.3, issue -1, January. 2014, pp. 48-51.

[15] R.Shakya, K.Rajanwal, S.Patel and S.Dinkar,"Design and Simulation of PD, PID and Fuzzy Logic Controller for Industrial

Application", International Journal of Information and Computation Technology ,vol.4, no. 4 ,2014, pp. 363-368.

[16] M.Saleem Khan and K.Benkrid,"Multi-Dimensional Supervisory Fuzzy Logic Time Control DEV Processing System for

[17] Industrial Applications", Proceedings of the International Multi Conference of Engineers and Computer Scientists 2009, vol .2,

March 18 - 20, 2009.

[18] T.K.Das and Y.Das,"Design of a Room Temperature and Humidity Controller Using Fuzzy Logic", American Journal of Engineering Research vol. 2, issue-11, pp. 86-97.

[19] T.R. Kumbhar, S.S. Nirmale and R. R. Mudholkar,"FPGA Implementation of Fuzzy Logic Controller for Temperature Control",International Journal of Computer Applications, vol.62,no.20, January 2013.

[20] O.P Verma and H. Gupta, "Fuzzy Logic Based Water Bath Temperature Control System",International Journal of Advanced Research in Computer Science and Software Engineering",vol.2, issue- 4, April 2012.

[21] M.R.S.Emami,"Fuzzy Logic Applications in Chemical Processes",The Journal of Mathematics and Computer Science ,vol .1 no.4 ,2010,pp. 339-348.

[22] Y.T. Yu, M.F. Lau, "A comparison of MC/DC, MUMCUT and several other coverage criteria for logical decisions", Journal of Systems and Software, 2005, in press.

[23] Spector, A. Z. 1989. Achieving application requirements. In Distributed Systems, S. Mullender