International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 05,
2019 ISSN: 1475-7192

Adopting Artificial Intelligence in Power Stations

[1]Sujit Kumar Dash, [2]Mihir Narayan Mohanty

Abstract--- *Power station acts as a source of supplying power to the households which is considered to be reliable. The use of power station has grown increasing based on the location, new technology developed by new generation, transmitting and distributing the energy. Artificial Intelligence has promised to solve the problems related to power station like forecasting, controlling and planning, etc. The advancements in this field helps in dealing with issues faced by the applications related to huge power generating stations with more connections so as to meet the increasing demand in the load. The application is successful in different fields related to power system engineering.*

Index Terms*— power system, artificial intelligence, electrical energy, fuzzy system*

I. INTRODUCTION

Power Systems

A power station acts as a main source for supplying electrical energy. It relates to generating, transmitting and distributing the energy to various sub stations and systems[1].

Artificial Intelligence

The intelligence that is being exhibited by machines is known as artificial intelligence. The term is concerned mainly on robots. The projects mainly focus on intelligent features and the characteristics that are involved like the ability to think, react, find meanings, generalizing them, distinguishing and learning from past experiences so that the mistakes can be rectified[2]–[5]. It basically deals with the hypothetical machine intelligence or the computer associated that helps in accomplishing intelligent and meaningful assignment which can be accomplished by humans.

Significance of AI in Power stations

The analysis of power stations is becoming more and more difficult, when it is implemented with conventional techniques. The limitations so observed are:

- Complex in nature and large amount of data for calculation.
- Increase in the computing time period and its accuracy.

The newly adopted power stations have limited itself with the increase in the consumption of energy and advancement of transmission lines and networks[6], [7]. The implementation of this, needs a less concentrated power

1,2, Department of Electronics and Communication Engineering, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswarsujitdash@soa.ac.in, mihirmohanty@soa.ac.in

Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019

supply and control methods that can only be made possible by continuously watching the system in a detailed manner. The problem can be solved using sophisticated tools as well as performing its detailed diagnosis[8], [9]. Artificial Intelligence promises to serve the purpose.

II. TECHNIQUES OF AI

II.I "Artificial Neural Networks"

The term neural deals with the neurological signals (i.e.) nervous system of the brain. It deals with the simulations that are generated by the brain signals for performing specific tasks like pattern classification, decision making, etc. It can be best described as a combination of weights and nodes which have artificial neurons and a connection is established between the input and outputs. The input signal is in the form of pattern or image and then is multiplied with the desired weights. Typically weights are strength of bonds that can be established between the layers of ANN. If the sum of the linked weights is null a bias gets added at the output end to get a non-zero value. The input to bias is always considered as unity[10], [11].

The architecture of ANN involves the following layers:

- **Input layer:** The nodes associated at the input helps in distribution of data to the other units.
- **Hidden layers:** An ANN consists of multiple hidden layers that are not visible. They help in classifying the problem of non-linearity[10]–[12].
- **Output layers:** The encoded layer in an ANN is the output layer which encodes possible values.

II.I.I Advantages of ANN

- Speed of the processor.
- No prior knowledge of system modeling
- Ability to handle situations of insufficient data.
- Fast and robust in nature.
- Ability to generalize[13], [14].

II.I.II Disadvantages of ANN

- Large size
- Less accurate results
- Limited to only task

II.I.III Implementing ANN in power stations

The problem of "production, transmission and distribution" of electricity is fed as an input to the ANN so as to retrieve suitable solution. Based on the constraints of practical generation and distribution obtained, the value of parameters can be obtained.

III SYSTEM MODELLING

AI deals with 3 techniques like expert system, fuzzy logic and ANN.

- **Expert System:** These are computer programs that include codes in a simpler manner rather than actually calculating the values of transmission. The system is flexible to modification for various programs[15], [16].
- **"Artificial Neural Network":** This network performs biological evaluations to the problems of production and distribution of energy and is fed as input to the ANN for obtaining real time solutions. The exact values further can be calculated.

Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019

- **Fuzzy logic:** This logic system uses logical calculations to prove accurate information and data. The logic also provides improved capability for modeling the set of complex issues. It is mainly useful in those areas where information is not sufficient[17]–[20].

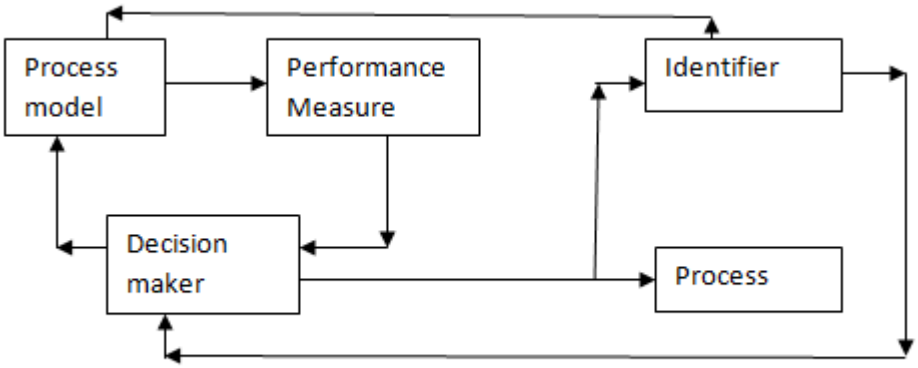

Figure 1: Fuzzy logic Controller

The fuzzy controller is used in modeling the physical components associated with the power systems. This increases the efficiency of the components in the power systems.

IV SYSTEM ARCHITECTURE OF AI IN POWER STATIONS

The practical use of AI is depicted in (fig:2). If their exists any fault in the transmission line, the activated fault detector helps in detecting the faults and feeds the same to the "fuzzy system". A 3-line current is sufficient for implementing this technique. The difference in the angles of "fault and pre-fault current" is given as input to the fuzzy control system. ANN and Expert systems are used in improving the performance of lines[21]–[23]. The sensors that are embedded in the systems are used detect the environmental conditions and provide input to the systems. Expert systems are codes/ programs that are programmed to accept the value of line currents. ANNs are trained using algorithms. After successful completion of the training the neural networks are tested and evaluated. If satisfactory results are not obtained by the neural networks, modifications are carried out in the systems by varying the quantity of hidden layers and neurons associated.

Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019

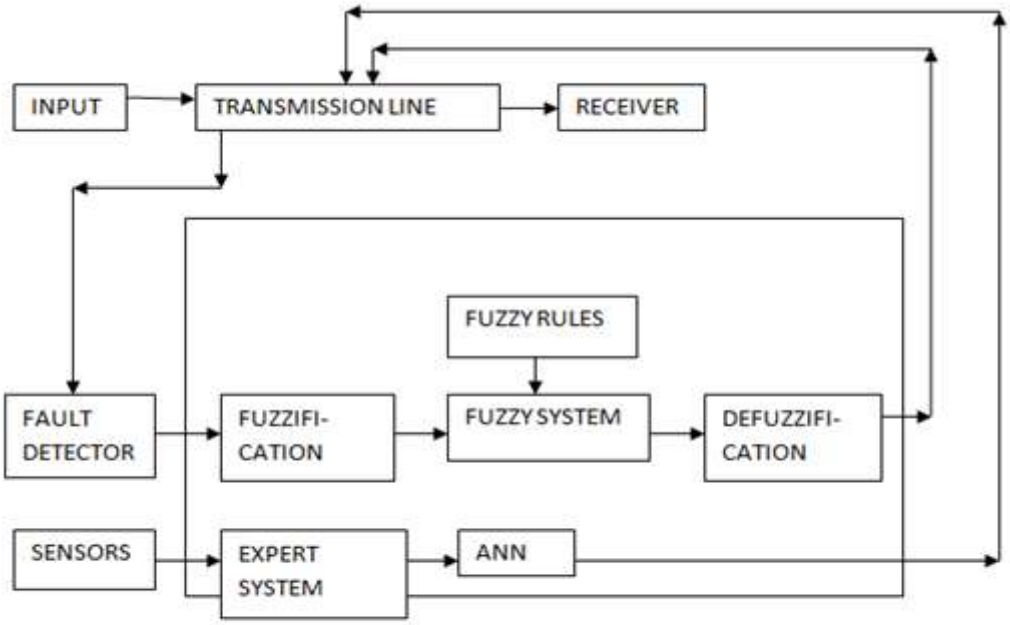

Figure 2: Practical use of AI

V RESULTS

- Human workers can be replaced with machines during operating in hazardous condition.
- Expert systems help in solving problems difficult to be solved by humans.
- The concept of working of neurons and the pattern of their interconnection is used to design smart devices for solving real world problems of classifying and recognizing patterns.
- Fuzzy logic provides maximum power, improved capability for modeling complex problems at cost effective manner.
- Diagnosing the faults.
- Forecasting the condition of load.
- Controlling power system elements like voltage, stability, power flow and load.
- Power system automation.
- Efficient

V.I. CONCLUSION

The paper aims to solve the issue of power production, transmission and distribution using a smarter way of operation like AI. Artificial Intelligence has promised to solve the problems related to power station like forecasting, controlling and planning, etc. The advancements in this field helps in dealing with issues faced by the applications related to huge power generating stations with more connections so as to meet the increasing demand in the load. Conventional techniques cannot satisfy these issues. This will further lead to high operating and maintenance costs. Researchers are being carried out to utilize AI for power applications. These advances increases the efficiency of the system.

Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019

REFERENCES

[1] J. Lee, H. Davari, J. Singh, and V. Pandhare, 'Industrial Artificial Intelligence for industry 4.0-based manufacturing systems', Manuf. Lett., 2018.
[2] Y. Bengio, 'Learning deep architectures for AI', Found. Trends Mach. Learn., 2009.
[3] 'Scaling Learning Algorithms toward AI', in Large-Scale Kernel Machines, 2019.
[4] J. Gao, M. Galley, and L. Li, 'Neural approaches to conversational AI', in ACL 2018 - 56th Annual Meeting of the Association for Computational Linguistics, Proceedings of the Conference Tutorial Abstracts, 2018.
[5] N. Ford, 'Understanding AI', Innovations in Pharmaceutical Technology. 2018.
[6] Z. Li, S. Wang, and H. Xin, 'Toward artificial intelligence in catalysis', Nat. Catal., vol. 1, no. 9, pp. 641–642, 2018.
[7] Y. he Pan, 'Special issue on artificial intelligence 2.0', Frontiers of Information Technology and Electronic Engineering, vol. 18, no. 1, 2017.
[8] W. Xu, 'Toward human-centered AI: A perspective from human-computer interaction', Interactions, vol. 26, no. 4, pp. 42–46, 2019.
[9] S. Lemaignan, M. Warnier, A. Sisbot, and R. Alami, 'Human-Robot Interaction: Tackling the AI Challenges', Artif. Intell., 2014.
[10] M. Majumder, 'Artificial Neural Network', 2015.
[11] P. M. Buscema, G. Massini, M. Breda, W. A. Lodwick, F. Newman, and M. Asadi-Zeydabadi, 'Artificial neural networks', in Studies in Systems, Decision and Control, 2018.
[12] E. Corchado, M. Graña, V. Snásel, and M. Wozniak, 'Hybrid artificial intelligence systems', Neural Network World, 2010.
[13] K. T. Islam and R. G. Raj, 'Using an Artificial Neural Network', Sensors (Switzerland), vol. 17, no. 4, pp. 14–16, 2017.
[14] M. Turcanik, 'Network routing by artificial neural network', in 2012 Military Communications and Information Systems Conference, MCC 2012, 2012, pp. 256–260.
[15] B. Ruiz-Mezcua, A. Garcia-Crespo, J. L. Lopez-Cuadrado, and I. Gonzalez-Carrasco, 'An expert system development tool for non AI experts', Expert Syst. Appl., 2011.
[16] 'Fundamentals of expert system', Springer Ser. Mater. Sci., 2015.
[17] L. A. Zadeh, 'Fuzzy logic', in Computational Complexity: Theory, Techniques, and Applications, 2013.
[18] T. J. Ross, Fuzzy Logic with Engineering Applications: Third Edition. 2010.
[19] J. K. Williams, 'Introduction to fuzzy logic', in Artificial Intelligence Methods in the Environmental Sciences, 2009.
[20] L. A. Zadeh and R. A. Aliev, 'Introduction to Fuzzy Logic Control', in Fuzzy Logic Theory and Applications, 2018.
[21] C. Darab, R. Tarnovan, A. Turcu, and C. Martineac, 'Artificial Intelligence Techniques for Fault Location and Detection in Distributed Generation Power Systems', 2019, pp. 1–4.
[22] 'ARTIFICIAL INTELLIGENCE IN POWER SYSTEMS', Int. J. Recent Trends Eng. Res., vol. 4, no. 4, pp. 262–267, 2018.
[23] A. A. Bittencourt, M. R. De Carvalho, and J. G. Rolim, 'Adaptive strategies in power systems protection using artificial intelligence techniques', in 2009 15th International Conference on Intelligent System Applications to Power Systems, ISAP '09, 2009.

Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019