ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 10, October 2024

Use of neural networks in decision making in intellectual energy information systems

U.O Odamov *, F.M Makhammadiev
Institute of Energy Problems of Academy of Sciences of the Republic of Uzbekistan,

ABSTRACT: The article describes the procedure for using neural networks in decision-making in intellectual energy information systems, and their work processes. A mathematical model for solving problems in artificial intelligence systems and neural networks is described. The possibilities and advantages that can be achieved by using neural networks are revealed. In the process of using neural networks, it is necessary to develop decision-making algorithms and models of artificial neural networks by using neurocomputer instruments of neurobionics. Also, the time of data processing through neural networks is reduced, which provides real-time monitoring and control in energy information systems.

KEY WORDS: Intellectual energy information systems, neural networks, artificial intelligence systems, artificial neurons, nodes, hidden layer, loads in the network.

I. INTRODUCTION

Currently, the use of neural networks in intellectual energy information systems has great potential for increasing the efficiency, stability and reliability of energy systems. However, to realize this potential, issues of data quality, interpretability and security must be addressed. Further research and development in the field of neural networks and electronic information systems will allow us to overcome these difficulties and use all the possibilities of these technologies [1-3].

It is well known that intellectual energy information systems (IEIS) are complex systems that combine developed information on energy consumption, infrastructure information and forecasting. These are key to optimizing energy systems, increasing efficiency and sustainability. In such systems, neural networks (NN) have great potential to increase the accuracy and efficiency of decision-making. Neural networks are able to analyze the complex relationships between factors affecting energy consumption and production and generate accurate predictive questions and suggestions[4-6].
At the same time, through neural networks, it can effectively analyze large amounts of data collected by intellectual energy information systems (IEIS) and obtain valuable and necessary information for decision-making. Today's modern management methods require the transition to digital transformation from all enterprises, including enterprises in the field of electric power.

In this article, the possibility of improving the performance of intelligent energy information systems (IEIS) by using neural networks to make accurate decisions about electricity consumption, network loads, connection and disconnection problems, advance forecasting of electricity consumption and their decision-making is considered.

II. THE MAIN PART. NEURAL NETWORKS.

Neural networks (NN) are a powerful machine learning tool inspired by the structure and function of the human brain. They consist of interconnected nodes called neurons that process and transmit information. Neural networks are trained on large data sets by communicating information between inputs and outputs [7-9]. Neural networks consist of "neurons" (simple processors). When a neural network processes some information, signals pass through the neurons and the connections between them. As the learning process continues, these connections change, becoming stronger or weaker, allowing the network to find the solutions it needs.
A neural network consists of artificial neurons or nodes and small programs that perform calculations. There are a lot of such nodes, so they are combined into the following layers:

- enter, place of arrival of data;
- one or more hidden data, that is, the place where calculations are made;
- exit, where sorted data is output.

Each node is connected to its neighbors, their connection is called a synapse and has a certain amount. The higher this value, the more important the connection between two nodes.

If the output of any node exceeds the specified value, that node is activated and sends data to the next layer of the network[10-12]. Otherwise, the data will not be transmitted anymore. The diagram of the neural network's operation process is presented in Figure 1.

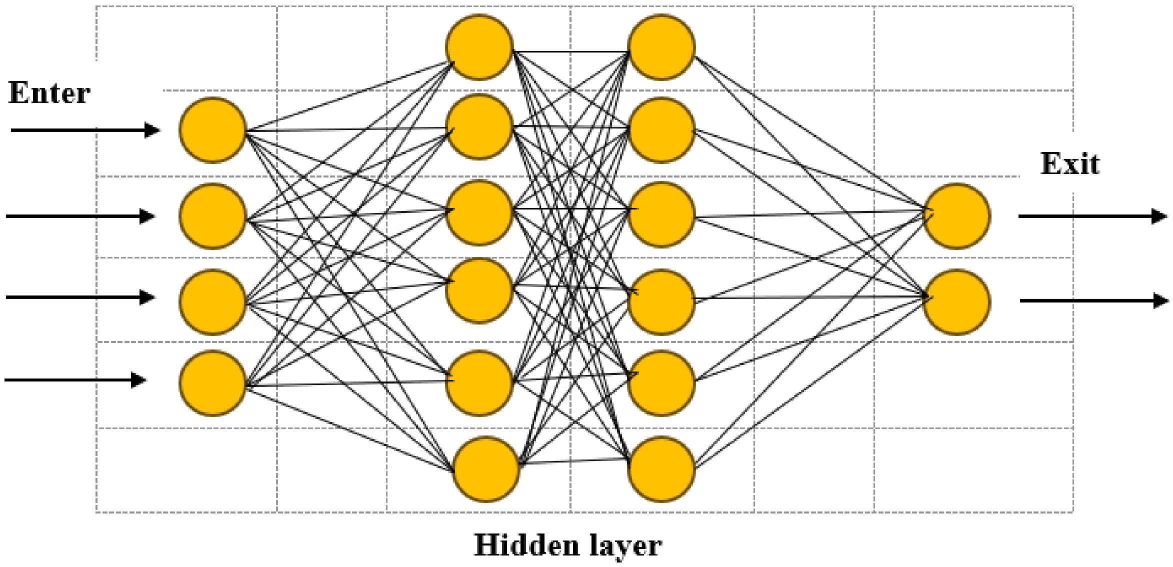

Fig. 1. Scheme of operation of a neural network

From Figure 1, it is known that all the information received from the enter node is delivered to all the nodes in the hidden layer, because they are interconnected, in the hidden layer, the data is processed again and again, and after the necessary information is determined, it is delivered to the exit nodes.

III. PART OF SCIENTIFIC RESEARCH

Let's consider the model as an example of the problem of collecting data on electricity consumption in energy systems. To solve this class of problems in artificial intelligence systems and neural networks, it is necessary to describe them as a mathematical model[13-14]:
X - a set of objects describing data on electricity consumption according to selected parameters;
Y - a set of answers to the selected electricity consumption data;
$X \rightarrow Y$ is an unknown relation artificial intelligence that the system looks for;

The following set is given: $\{x_1, x_2, \ldots x_n\} \in X$ is sampling for artificial intelligence training system;
$y_i = y(x_i), i=1,2...n$ - known answers previously used in the control system according to energy system enterprises:
Must find: $X \rightarrow Y$ An algorithm for finding a function that approximates y over the entire set x.
Vectors $(f_1(x),\ldots f_i(x))$ – property description of object x.
In this case, the "objects-characteristics" matrix will have the following form:

$$F=||f_i(x_i)_i||_{nxl} = \begin{pmatrix} f_{1(x_1)} \cdots f_{l(x_i)} \\ \cdots \quad \cdots \quad \cdots \\ f_{n(x_n)} \cdots f_{l(x_{ni})} \end{pmatrix}$$

In this case, the predicative model uses a parametric family of functions.

$$A=\{a(x)=g(x,\theta) \mid \theta \in \theta\},$$

Here $g(x,\theta)\ x\ \theta \rightarrow Y$ - defined function; θ is a defined vector of parameters with many real parameter values.

For example, if for simplicity we take a linear model with a vector of parameters $\theta =(\theta_1, \ldots \theta_n), \theta=R^n$ then $Y=\{-1\ +1\}$ for classification (classification) into at least two classes, it will look like this.

$$g(x,\theta) = \text{sign}\sum_{j=1}^{i} \theta_j f_j(x)$$

Currently, it is very convenient to use such a model, however, it has its own difficulties.

When making decisions in intellectual energy information systems, neural networks work as follows:
Training: Neural networks are trained on large data sets by making connections between inputs and outputs.
Data pattern recognition: Neural networks can recognize any shapes and forms in data, even if they are complex, that is, not obvious to humans.
Forecasting: Based on the acquired knowledge, neural networks can predict future events or values based on existing data.

The following examples of what can be achieved by using neural networks in decision-making in these intellectual energy information systems[15]:
• the neural network can forecast the demand for electricity based on historical data, meteorological conditions and other factors;
• neural network can optimize energy distribution in networks, minimize losses and increase efficiency;
• the neural network can analyze energy consumption data and manage network loads, which prevents data from accumulating in the network;
• analysis of performance data of neural network equipment, can identify faults and errors and give early warning about possible problems;
• a neural network can predict the energy production of solar panels and wind turbines, thereby optimizing the operation of renewable energy generating equipment.

IV. DISCUSSION

The following advantages can be gained by using neural networks in decision making in intellectual energy information systems.

1. The neural network can analyze the complex relationship between the factors affecting energy consumption and production and create accurate supply and demand forecasts, with high quality forecasting accuracy.
2. Neural network can quickly learn new information and adapt to changing conditions, which allows them to stay relevant in dynamic power systems.
3. Neural networks and intellectual energy can extract and process information necessary for effective analysis and decision-making of large volumes of data generated by information systems.

4. A neural network can detect anomalies in energy consumption data, report possible problems in the system, and allow you to quickly respond to them.

Despite the advantages mentioned above, intellectual energy information systems depend on the accuracy of forecasts and decision-making and directly on the quality of data. Neural networks must ensure the reliability and completeness of data in order to process them efficiently. Neural networks are, as a rule, "black boxes", which makes it difficult to understand their operation and interpret the results obtained [16].

Neural networks can be vulnerable to external attacks and manipulations, so it is necessary to ensure their security and protection against unauthorized access to the system.

V. CONCLUSION

The use of neural networks in decision-making in intellectual energy information systems is a powerful tool for increasing the efficiency, stability and reliability of energy systems. Their application opens up new opportunities for optimizing the operation of power plants, managing network loads, adjusting the supply of energy from renewable energy sources to the grid, and solving other energy-related problems.

However, to realize these opportunities, issues of data quality, interpretability, and security must be addressed. The use of neural networks in decision-making in intellectual energy information systems requires further research and development in this field. In the process of applying neural networks, it is necessary to develop decision-making algorithms and models of artificial neural networks by using neurobionics neurocomputer instruments. It leads to the creation of probabilistic neural system and general regression neural network algorithms based on single-layer artificial neural networks and multi-layer artificial neural networks. As a result, the accuracy of the algorithms is increased, which made it possible to improve the iterative efficiency in the decision-making process. Also, data processing time through neural networks has been reduced, which provides real-time monitoring and control.

REFERENCES

[1]. Komashinsky V. I., Smirnov D. A. Neural networks and their application in control and communication systems. Moscow: Goryachaya Liniya – Telecom, 2003
[2]. Osovsky S. Neural networks for processing information. - M.: Finance and statistics, 2004. - 344p
[3]. Melikhova O.A., Melikhova Z.A. Using the apparatus of fuzzy mathematics in modeling decision support systems // Bulletin of SFedU. Technical sciences. - Taganrog: Publishing house of TTI SFedU, 2012, No. 7 (132). - P. 113-118.
[4]. Melikhova O.A., Rudenko E.G.., Loginov O.A. Intellectual decision support systems: analysis, problems, prospects // Scientific discussion: innovations in the modern world. – M., Publishing house “International center of science and education”, 2015. No. 3-4 (35). - P. 166-170.
[5]. Voroysky, F. S. Informatics: an introduction to modern information and telecommunication technologies in terms and facts: a new systematized explanatory dictionary / F. S. Voroysky. - 3rd ed., revised and enlarged. - M.: FIZMATLIT, 2003. - 760 p.
[6]. Gaydamakin, N. A. Automated information systems, databases and data banks: a tutorial / N. A. Gaidamakin. -M.: Gelios ARV, 2002. - 367 p.
[7]. Danilevsky Y.G. Information technology in industry / Y. G. Danilevsky, I. A. Petukhov, V. S. Shibanov. -L. : Mechanical engineering, 1988. – 283 p.
[8]. Khaikin S. Neural networks. Complete course. M.: Williams M, 2006.1104 p.
[9]. Callan R. Basic concepts of neural networks. Moscow: Williams M, 2001. 291 p.
[10]. 10. Voropai N.I., Stennikov V.A., Senderov S.M. Integrated intelligent systems in the energy sector of Russia. In the book: System research in energy: methodology and results / Ed. by A.A. Makarov and N.I. Voropai. Moscow: INEI RAS.2018. P. 87-101.
[11]. Bushuev V.V. Intelligent (cognitive) forecasting and management in energy // In the book: System research in energy: methodology and results / Ed. A.A. Makarov and N.I. Voropai. Moscow: INEI RAS.2018. P. 102-112.
[12]. Khrennikov A.Y., Lyubarsky Y.A. Using elements of artificial intelligence: computer support for operational decisions in intelligent energy networks. Moscow: Litres. 2021. 140 p.
[13]. Massel L.V., Massel A.G. Intelligent computing in research of energy development directions // Bulletin of Tomsk Polytechnic University. 2012. Vol. 321. No. 5. Management, computing engineering and informatics. P. 135-14.
[14]. Nesterenko V.D. Management of infocommunication networks. St. Petersburg: Polytechnic, 2007.
[15]. 15. Mirzaeva M., Sobirov M.A. Estimates of Efficiency and Control Methods ofCommunication Network Functioning. “International Journal of Advanced Trends in Computer198Science and Engineering” (IJATCSE) ISSN: 2278-3091, Volume 9, Issue-4, July – August 2020.–P.5736-5740.
[16]. Mirzaeva M. Study of neural networks in telecommunication systems. International2021. Tashkent, 2022. -P.3