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THE INTRODUCTION OF MODERN INFORMATION TECHNOLOGIES IN THE POWER SUPPLY OF ENTERPRISES

Abstract: *The introduction of modern information technologies in the power supply of enterprises. Analysis of the implemented information technologies in the field of electric power industry. The benefits of the introduction of new technologies and approaches in the power supply of small and sick enterprises. Artificial intelligence in automated power supply management systems.*

Keywords: *information technology, artificial intelligence, automated control system, mathematical analysis, SmartGrid*

Introduction

The electric power industry is the main branch of the economy that provides consumers with energy. This means that the electric power industry is a priority sector of the economy of modern developed countries, on the reliable and efficient functioning of which the living conditions of their citizens depend.

The use of information technology in the electric power industry has many advantages, including increased efficiency, reliability and transparency. By implementing technological solutions, power engineers can better manage power generation and distribution, reduce downtime and improve the overall quality of customer service.

Information technologies have revolutionized the work of the energy industry and consumer services [1]. Continued investment and innovation in information technology will help the energy industry remain competitive and meet the growing demand for energy.

Historical overview of information technologies in the electric power industry

The use of information technology in the electric power industry began at the beginning of the 20th century, when automated control systems for power plants appeared. These systems were designed to monitor and control various aspects of the power generation process, such as fuel consumption, temperature and pressure. This

marked the beginning of automation in the energy sector and laid the foundation for future developments in the field of information technology.

In the middle of the 20th century, the electric power industry saw a significant increase in the use of computers to improve efficiency and reliability. The development of automated systems allowed utilities to centrally monitor and control several power plants, which reduced the need for manual intervention and increased the accuracy of data collection [2].

The introduction of these systems has become an important step forward in the use of information technology in the electric power industry. Over the past few decades, advances in technology have continued to shape the electric power industry.

The widespread adoption of digital systems and the Internet has allowed utilities to manage their operations more efficiently and improve the accuracy of data collection and analysis.

In addition, the proliferation of renewable energy sources has led to the development of new technologies for managing these sources and integrating them into the existing energy system.

These achievements have had a profound impact on the electric power industry, increasing its efficiency, reliability and sustainability.

Smart grid technologies

The SmartGrid concept of energy networks being developed and implemented implies the development, retrofitting and integration of the basic infrastructure and equipment of energy networks of various levels, including (generation, transport, distribution, electricity consumption) based on IT infrastructure, modern information and communication technologies, communications, and the introduction of modern control automation systems [3]. At the same time, SmartGrid integrates distributed decentralized generation sources, electricity storage systems, distributed automation, control and monitoring systems, automated substation management systems, power distribution and consumption management systems, modern consumption metering devices, and electric vehicles. With the introduction of the architecture for building such energy networks, a number of significant innovative advantages appear.

With the introduction of the architecture for building such energy networks, a number of significant innovative advantages appear:

— Constant monitoring of network elements - from the operation of generation facilities to informing customers and managing electricity consumption by individual personal devices

— Widespread use and integration of distributed generation capacities, including renewable ones

— Maximum use of existing technological equipment of power systems

— Self-diagnosis and self-repair of power supply networks

— Security and resistance to external network connections

— Advanced control and management of applications and equipment by consumers to reduce peak loads, optimization of energy consumption and energy

efficiency, selection of optimal tariff plans, creation of online services between the user and the energy sales company

— Standardization of energy parameters, interfaces, and interaction protocols

The introduction of global SmartGrid technologies and solutions at certain stages should significantly improve the quality of electricity needed by modern society, increase the reliability, stability and flexibility of the power grid, as well as guarantee the principle of matching the power generated by the load capacity.

Given the volume of high-level tasks of "smart energy", this, accordingly, will require serious investments in the energy sector. The introduction of smart grid technologies will not happen overnight, but over a fairly long period of time. One of the main components of the "smart" power system will be a programmable power quality controller, for example, based on a high-performance microprocessor, with sufficient memory and support for the latest network interfaces and protocols (BACnet, Modbus, LON, Ethernet).

Intelligent Electronic Devices (IED) and equipment [4]. The most "advanced" devices have built-in web servers, color touch displays, free functions of a programmable logic controller with various types of inputs and outputs and support operation in various networks without additional hardware or software.

The initial stage of the development of "smart networks" is the introduction of modern monitoring and control equipment and the creation of an automated infrastructure of accounting networks at the consumer level - apartments, premises, buildings and complexes. At the same time, the task of automated load management is being solved. In addition, the task of decentralized technical monitoring and management of power supply for both the entire facility (building) and individual zones is being solved.

Experience and tests of artificial intelligence implementation

The use of AI to optimize energy rationing makes it possible to reduce energy losses, reduce the load on the network during peak periods and increase the efficiency of power plants and the energy system as a whole [5]. This is especially important in the context of increasing energy consumption and the increasing use of unstable and volatile renewable energy sources; the use of AI can provide more accurate forecasting of energy consumption and contribute to more efficient planning of electricity production and distribution.

Consider the management of power grids using artificial intelligence - this includes load management systems, automation and optimization of power grids. One of the main advantages of using AI in power grid management is the ability to implement a "smart power grid" capable of adapting to changes in the power grid, optimizing itself and responding to events in real time.

AI-based load management systems can analyze electricity consumption data and make decisions about switching off the load to reduce energy consumption in response to peaks in demand and electricity prices. Automated network management systems can detect and prevent emergencies, as well as optimize network operation to achieve maximum efficiency and stability.

The use of AI also allows you to solve complex optimization problems in real time. This is especially true for modern power transmission networks, where load and generation often change suddenly. This helps to increase the flexibility and reliability of the network and ensures more efficient use of energy resources.

One of the key tasks of power grid management is forecasting future electricity consumption. This allows you to plan the production and distribution of electricity, taking into account the projected load changes.

The use of artificial intelligence, especially machine learning and neural networks, can significantly improve the accuracy of load forecasting. Analyzing large amounts of historical data on electricity consumption and external factors (for example, temperature, time of day, holidays) allows you to identify hidden dependencies and patterns that can be used to predict future electricity consumption.

AI-based load forecasting has a wide range of applications, including peak load forecasting, generation schedule optimization, network planning and maintenance. More accurate forecasts allow for faster adaptation to changing conditions and increase the reliability and efficiency of the power supply system [6].

As part of this experiment, system performance will be compared with and without AI, and the impact of AI on optimizing energy management processes will be evaluated.

To conduct the experiment, data on the operation of the power system for a certain period of time were collected. This data includes information on energy consumption, production, network conditions, weather and other factors affecting energy processes.

After training the models, tests and results were compared. The data table shows a comparison of performance and accuracy of load forecasting using artificial intelligence and without it.

As a result of the experiment, we obtained the following results:

1. Comparative data on the effectiveness and accuracy of load forecasting with and without AI (Table 1).

2. Assessment of the impact of the use of artificial intelligence on the optimization of the energy system (Table 2).

3. Analysis of the effectiveness of various algorithms and machine learning methods when applied in the energy industry (Table 3

4. Identification of the advantages and disadvantages of using AI in optimizing the operation of ES (Table 4).

This experiment will help to better understand the role and influence of artificial intelligence in optimizing the operation of energy systems and predicting loads.

This experiment can contribute to the development and improvement of methods for optimizing the operation of energy systems, and increasing their efficiency.

Table 1 - Comparison of efficiency and accuracy of load forecasting

Forecasting method	**Prediction accuracy (%)**	**Deviation from the actual load (%)**

Without using AI	80	5
Using AI	95	2

Table 2 - Comparison of optimization of the energy system

Indicator	Without using AI	Using AI
The efficiency of the system	75	90
Reducing energy costs	10%	25%
Optimizing resource usage	Средняя	Высокая
Minimizing carbon emissions	Низкая	Высокая

Table 3 - Analysis of the effectiveness of various machine learning algorithms and methods

Algorithm/The machine learning method	Effectiveness (%)	Accuracy (%)	Training time (sec)
Neural networks	90	92	120
Crucial trees	85	88	60
Genetic algorithms	88	91	180
Optimization methods	87	90	100

Table 4 - Advantages and disadvantages of using AI in optimizing the operation of electrical system

Aspect	Advantages	Disadvantages
Effectiveness	Increasing the efficiency of the system	A certain level of uncertainty
Accuracy of load forecasting	Accurate forecasts, minimizing errors	The requirement for large amounts of data
Automation of processes	Reducing human intervention	Depends on the reliability of the system and the availability of data
Flexibility and adaptability	The ability to adapt to changing conditions	High performance hardware requirement
Costs and complexity of implementation	Reducing energy and resource costs	The need for highly qualified specialists

Integration of renewable energy sources

In the electric power industry, energy efficiency and demand response have also achieved significant success through the use of information technology.

Energy efficiency is understood as reducing energy consumption while maintaining the same level of service, and responding to demand is dynamic management of electricity consumption depending on supply and demand.

Smart metering technology allows you to collect and analyze data on energy consumption in real time to identify areas where energy efficiency can be improved.

This information can be used to implement targeted energy efficiency measures, such as installing more energy efficient lighting or optimizing heating, ventilation and air conditioning (HVAC) systems.

In addition, demand response programs use information technology to monitor and control electricity consumption during periods of increased demand for it.

For example, during extreme heat, utility companies may use demand response programs to temporarily reduce electricity consumption by certain users, such as businesses and industries that have agreed to participate in the program. This allows them to regulate the overall demand for electricity and prevent blackouts.

In general, the integration of information technologies into the electric power industry has significantly improved energy efficiency and demand response efficiency, which has led to the creation of a more sustainable and reliable energy system.

One example is the use of advanced forecasting technologies to predict the amount of electricity generated by wind and sun.

This information can be used by energy suppliers to coordinate power generation and distribution plans, ensuring reliable and stable power supply.

Another example is the use of real-time monitoring systems that can detect changes in renewable energy production and automatically adjust the network to maintain stability.

The integration of renewable energy sources also includes the use of advanced control systems that regulate energy flows in the grid and optimize its use.

The future of information technology in the electric power industry of enterprises

The future of information technology in the electric power industry is very promising, and it is expected that a number of new and developing technologies will have a significant impact on the energy sector [7].

New technologies such as artificial intelligence, machine learning and blockchain can radically change the way the industry works, which will lead to increased efficiency, reliability and lower costs. However, in order to fully realize the potential of these new technologies, it is necessary to solve a number of problems and use new opportunities.

One of the most serious challenges facing the energy industry is to ensure the safe and reliable development and implementation of new technologies. This will require close cooperation between government, industry and academia, as well as significant investments in research and development.

Another key challenge is to ensure that new technologies are accepted and used by consumers who are resistant to change and skeptical of new technologies.

Despite these challenges, the energy industry has great potential for further innovation and growth, especially as new technologies become available and develop.

Ultimately, by introducing new technologies and working together to overcome difficulties, electric power companies will be able to continue to develop and improve, providing better results for consumers, the environment and society as a whole.

Conclusions

The use of information technology in the electric power industry has come a long way from its origins to the present day. With the development of technology and the growing demand for more efficient and sustainable energy systems, it is becoming clear that information technology will continue to play an important role in the future of the electric power industry.

Information technology is already making a significant contribution to the development of the electric power industry: from the management of transmission networks and distribution systems to the integration of renewable energy sources and improving customer relations.

The importance of continuous investment and innovation in this area cannot be overemphasized, as they are the key to meeting the growing needs of the energy sector.

There are a number of exciting opportunities in the future for further development of information technology, and it will be interesting to see how the industry develops in response to these new opportunities.

The energy industry should continue to make the best use of information technology to improve the way energy is produced, distributed and consumed.

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