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# METHODS FOR DETECTION OF FAULTS IN TECHNOLOGICAL MACHINES BASED ON ARTIFICIAL INTELLIGENCE

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**Abstract:**This article analyzes modern methods of fault detection in technological machines using artificial intelligence (AI) on a scientific basis. Early detection of faults and increasing production efficiency through vibration and acoustic analysis, thermal monitoring, computer vision, IoT integration and predictive maintenance systems are highlighted. The advantages of AI models, technical infrastructure requirements, practical applications and problems are systematically described.

**Keywords:**artificial intelligence, technological machine, fault detection, vibration analysis, thermal monitoring, IoT, predictive maintenance, computer vision, machine learning, production diagnostics

Digital transformation is rapidly entering all sectors of industry, including control, monitoring and maintenance systems of technological machines. In particular, the development of artificial intelligence (AI) technologies allows monitoring the technical condition of machines, early detection of faults and proactive response to faults. Complex sensor systems used in technological machines, large amounts of operational data, and analysis methods based on AI algorithms have become one of the main factors for trouble-free production. This essay analyzes advanced methods for detecting faults using artificial intelligence in technological machines, their advantages, practical applications, and prospects based on a scientific approach.

Various types of faults - mechanical, electrical, hydraulic, or software errors - can occur during the operation of technological machines. Visual inspection, operator experience, and scheduled maintenance have often been the main factors in detecting these faults using traditional methods. However, these approaches have limitations in terms of subjectivity and time.

Artificial intelligence technologies, especially machine learning (ML), deep learning (DL), artificial neural networks (ANN), and expert systems, offer modern and accurate solutions to these problems.

1. AI model based on vibration analysis: By continuously monitoring the vibration data of machines, faults can be detected early. AI algorithms study vibration signals in normal conditions and identify any unusual changes as faults.

2. Acoustic signal analysis: Mechanical faults are detected by analyzing sound signals recorded by microphones and sensors in AI models. This method is especially effective for bearings, gearboxes and other rotating parts.

3. Thermal monitoring and image analysis: By analyzing the temperature of machine parts using thermal cameras, AI programs detect overheating, heating or heat dissipation imbalances.

4. Sensor data and IoT integration: Large amounts of real-time data collected by IoT devices are processed by AI to detect changes in machine performance. This approach allows for the detection of dangerous conditions before a fault occurs.

5. Predictive maintenance with AI: AI algorithms determine the maintenance period based on the machine's operating history. This method prevents emergency failures and reduces maintenance costs.

6. Computer vision: Using cameras and image recognition software, cracks, deformations, oil leaks, and other visual defects on the surface of a machine are automatically detected. The implementation of this process by AI eliminates the human factor. Such approaches based on artificial intelligence serve to extend the service life of technological machines, increase their reliability, and reduce downtime. At the same time, economic losses resulting from the operation of a faulty machine on the production line are prevented.

The following conditions are important for the effective implementation of AI systems:

- High-precision sensors and monitoring tools;

- A constantly updated database;

- Sufficient computer resources for creating and training ML/DL models;

- Expert readiness and skills in working with systems;

- Modern software for integration (Python, TensorFlow, MATLAB, ROS, etc.).

However, there are some limitations to fault detection based on artificial intelligence. In particular, there is a possibility that the system will give false signals due to incorrectly specified model parameters, incorrect data, incorrectly processed signals, and incorrectly detected faults. Therefore, these systems must be constantly monitored and tested.

Methods for fault detection based on artificial intelligence in technological machines are playing an important role in increasing industrial efficiency, preventing emergencies, and digitizing production processes. AI-based fault detection technologies ensure the continuity of the production process and significantly reduce costs. However, for the full implementation of these technologies, a high-quality technical infrastructure, quality data and qualified personnel are required. AI-based monitoring and diagnostic tools will continue to be an integral part of future industrial systems.

**References:**


1. Karimov U.R., Tursunov B.A. Mashinalarda nosozliklarni aniqlash va diagnostika tizimlari. – Toshkent: Texnika, 2023. – 212 b.
2. Xayrullaev S.B. Sun'iy intellekt va avtomatlashtirilgan texnologik tizimlar. – Toshkent: Fan va innovatsiya, 2022. – 198 b.
3. Russell S., Norvig P. Artificial Intelligence: A Modern Approach. – 4th ed. – New York: Pearson, 2020. – 1152 p.
4. Goodfellow I., Bengio Y., Courville A. Deep Learning. – MIT Press, 2016. – 800 p.
5. IEEE Transactions on Industrial Informatics. Special Issue on AI-Based Fault Detection and Diagnosis in Industrial Systems, Vol. 19, No. 2, 2023. [Elektron resurs] https://ieeexplore.ieee.org
6. ISO 13374-1:2018. Condition monitoring and diagnostics of machines – Data processing, communication and presentation – Part 1: General guidelines. – Geneva: International Organization for Standardization, 2018. [Elektron resurs] https://www.iso.org
7. Choudhury A., Bhowmik S. AI-Enabled Predictive Maintenance and Fault Diagnosis in Industrial