

# Artificial Intelligence Technologies in Digital Modernization of Organizations

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**Abstract** — Currently, people in different media sources is actively discussing the negative effects of computers and robotic systems that can affect various aspects of people's lives, significantly limiting it. This article describes the terms: “machine learning”, “artificial intelligence”, “neural networks”; some prerequisites and possibilities of using artificial intelligence systems in various areas of society are considered. The detailed analysis of the necessary computing devices for solving the problems of digital transformation of organizations is presented. Concrete examples of the use of artificial intelligence systems in modern sectors of the economy, at enterprises and in institutions. This paper gives examples of the use of decision support systems based on artificial intelligence technologies in various fields. As possible computing devices for accelerating neural network operations, graphics cards, specialized neural network accelerators, and neuromorphic processors are considered. The article notes that the architecture of neural network computers is more promising than the classical one Neumann architectures currently used due to the possibility of highly parallel operation and very low energy consumption in the process of solving problems. As a result of the analysis of the technologies used, the authors substantiate the conclusion that a neural network is software and ideally suited for solving the issues of digital modernization of an organization. A neural network, learning from specific examples given by humans, is able clearly fulfill the tasks set before it and, if necessary, make decisions independently. With the introduction of artificial intelligence systems in the organization, there will be significant savings in material and labor resources as a result of reduced decision-making time.

**Keywords** — *digitalization, artificial intelligence, business process, digital transformation, organization.*

## I. INTRODUCTION

The fundamental changes have taken place in the global economy, over the past century. In the early twentieth century,

the most developed were companies in the engineering, oil, and mining industries, but nowadays IT companies have led the market capitalization rating. As a rule, these are large organizations engaged in intellectual activities that are fundamentally different from the activities of enterprises at the beginning of the last century. Researchers call these changes that have occurred on the modern market the digital transformation [1]. This process is the new business environment for enterprises based on digital technologies and digital platforms, the process of deep, Continuing Change [2].

Turning to history, during the industrial revolution in the leading states of the world in the 18th-19th centuries there was a massive transition from manual labor to machine one, from manufactory to factory.

This process was accompanied by the resistance of people who lost their jobs. It turned out that machine-related jobs was more profitable than physical, since it saved time, financial resources and the obtained results were of high quality. Enterprises with machinery-based production were more competitive. Social protests were not justified, since new technology could not always replace a person. The industrial revolution affected mainly the mechanical activity of people, but in intellectual matters, man was indispensable.

Over the past 60 years, humanity has accumulated enough knowledge for a new stage in the development of industry, which we are witnessing today. A part of the intellectual labor of man can be replaced by the labor of a machine now, which is of great benefit to production. Machine intellectual work is carried out with the help of computers that can work anywhere, anytime, when there is electricity, computers do not need to take breaks in work for sleep, food. With high-quality software, tasks will be carried out without interruptions and with a slight error, it contributes high-quality activity with

minimal cost. In this regard, for the existence and development of a modern organization, the digitalization process is inevitable and necessary [3–5].

Enterprises that already use machine intelligence instead of human labor are indebted to artificial intelligence technologies. For most people, artificial intelligence is an analogue of a person living in electronic devices, but this is not entirely true. Artificial intelligence is a term used primarily as a marketing ploy to advertise devices using trained neural networks. This software is not capable of thinking, but has significant advantages over classical programming. Earlier, when solving intellectual problems, could it not be done without a person, but now neural networks can control the work of enterprises, power plants and other objects, control cars and planes, create music and images, predict the weather, the behavior of exchange rates on the stock exchange and more. Artificial intelligence is of great use our time. Neural network – smart software that works with a huge amount of data. These data are numerical values in which any information can be presented: images, music, video, statistical information and more. That is why a neural network may be applicable for solving various problems [6, 7].

## II. METHODOLOGY

To solve the problem of analyzing the possible application of artificial intelligence technologies in various fields in the context of digital modernization of the economy, it is necessary to consider two components: software and hardware for artificial intelligence systems. To analyze the software, we considered the options for using trained artificial neural networks and artificial intelligence technologies in various fields: in working with clients; in banks; in electric power industry; in an urban environment; in the field of security; for automated processing of documents. For the analysis of hardware, specialized devices that accelerate the learning and functioning of artificial neural networks were considered.

## III. APPLICATION OF THE ARTIFICIAL INTELLIGENCE SYSTEM SOFTWARE UNDER DIGITAL TRANSFORMATION OF ORGANIZATIONS

**Artificial intelligence in working with customers.** Research has shown that artificial intelligence technologies is possible even in the areas where, it seemed, that it could not be done without a person. For example, S7 Airlines uses a neural network to communicate with customers. Specially trained software analyzed user requests and classified them by type. If the neural network was not able to solve the question independently asked by the client (suggest the best place to relax, to give information on a ticket, etc.), then speech was synthesized with a solution of the problem, otherwise the request was transmitted to the responsible persons. As a result of the introduction of this system, the need for a large staff of call center employees has decreased. This practice of using artificial intelligence has become widespread in other companies [8].

In addition, companies use special chat bots to communicate with customers, which determine the topics of questions and make up the most comprehensive answer in written form.

**Artificial intelligence in banks.** For personalized work with clients, modern financial organizations are actively using artificial intelligence. Based on data about the client, his interests, financial well-being, banks individually select advantageous offers for each client. In addition, neural networks are used to protect the interests of banks themselves. So, for example, according to the recommendations of artificial intelligence, we can understand how likely it is to pay money on a loan by a client on time [9].

**Artificial intelligence in the electric power industry.** In the electric industry, with the help of neural networks, companies forecast the generation of demand for energy resources; evaluate reliability; optimize its preventative maintenance of equipment; increase efficiency by reducing losses and preventing theft of energy resources. At the level of service provision, with the help of neural networks, the most profitable supplier is automatically selected, customers are automatically serviced, energy consumption is optimized taking into account client habits and behavior.

**Artificial intelligence in the urban environment.** Systems with neural networks are useful for controlling the rhythm of a city. At the moment, developments are underway to regulate traffic in cities. A neural network, depending on the day of the week, time of the day, holidays, traffic congestion and car crashes, can set the optimal time for traffic lights at intersections, to increase the throughput of roads [10].

**Artificial intelligence in agriculture.** Known applications of artificial intelligence systems for:

- analysis and segmentation of agricultural fields using satellite images and images from a quadrocopter;
- predicting the depth of groundwater, soil composition in agricultural areas;
- forecasting environmental dynamics;
- identification of crop diseases and pests using;
- forecasting prices for agricultural products;
- yield analysis using a multi-criteria approach.

In addition, machine vision systems are often used in soil and plant processing technology. Currently, there are combines and other agricultural machinery that works without human intervention [11].

**Artificial intelligence in the field of nutrition.** The application of intelligent systems in the field of nutrition is very diverse. We can distinguish such applications for [12]:

- Improving food recipes based on user's feedbacks;
- forecasting food demand; food classification;
- convert an image food into a recipe for its preparation.

For cafes, restaurants and other food outlets, the following applications can be distinguished:

- sales forecasting at restaurants;

- booking and forecasting the number of visits to restaurants;
- recommendations on the prospective location of the restaurant issuing;
- restaurant based on its menu analysis;
- • cost of food forecasting.

**Artificial intelligence in security.** One of the basic tasks that can be solved using neural networks is the classification of faces in images.

Specially trained software receives data from video cameras located in public places, after that it tracks all faces on these videos and photos and compares it with information in the database. So, with the help of artificial intelligence, the program finds people who are wanted. One vivid example is the fact in China, a criminal who hid for 20 years was detained with the help of artificial intelligence. The program was able to identify his face independently from the video camera at the grocery store and notify the police immediately.

**Artificial intelligence-based technologies in emergency response.**

The following systems have been developed:

- the time of serious attacks analysis;
- natural language processing in news reports;
- finding associative rules for crime analysis;
- public data on crimes investigation;
- classification, analysis and prediction of crime;
- analysis of crime trends and conditions that trigger crime;
- analysis of the ambulance location;
- Improving the response time of the ambulance;
- search for optimal routing of ambulances;
- predicting outbreaks of the disease;
- predicting and analyzing user reports of disasters;
- flood analysis and forecasting;
- analysis and forecasting of fires.

**Artificial intelligence in real estate.**

Machine learning-based software tools are also used in this area for [13]:

- issuing housing recommendations;
- issuing recommendations on cohabitants and neighbors;
- comparisons of competing hotels;
- generation and analysis of hotel reviews;
- predictions of prices for hotel rooms;
- authentication of reviews;

- finding housing according to images;
- drawing up a plan for the location of furniture and electronic appliances in the hotel.

**Artificial intelligence in the insurance industry.**

In the insurance industry, machine learning-based software is used for:

- assessment of vehicle damage;
- Forecasting waiver of insurance compensation.
- fraud forecasting;
- predictions of bankruptcy.

**The support systems based on artificial intelligence systems.** A neural network can be trained as an auxiliary make decisions product for employees of organizations who regularly that depend on a large number of factors based on big data. If the data arrays that influence the decision in a given situation are too large, human attentiveness may not be enough, therefore this task is more and more often solved with the help of a neural network. For example, machine learning can be used for tracking illegal and suspicious transactions in the tax service.

**Automated processing of documents using neural networks.** When working with documents, a neural network can be very useful, since it can save a huge amount of time. After the development of computer systems, many documents have an electronic form, but there is no rejection of paper and any electronic documents have paper copies. Transferring data from paper to computer databases is a lengthy process that requires attention. It is possible to train a neural network that will identify the necessary information in a document from a photograph or a scanned copy, translate printed and handwritten fonts into electronic text and automatically fill out databases. In government organizations, such a program is an indispensable assistant, saving workers from paperwork [14].

#### IV. APPLICATION OF HARDWARE OF ARTIFICIAL INTELLIGENCE SYSTEMS UNDER CONDITIONS OF DIGITAL TRANSFORMATION OF ORGANIZATIONS

Previously, the development of machine learning was difficult due to the low speed of solving problems (often tasks were solved in weeks) due to the lack of computing devices. Currently, the rapid development of artificial intelligence technologies is also largely due to the emergence of high-performance computing for the training and functioning of neural networks (for example, neural network processors and accelerators), that helps to obtain the result in a few seconds. The architecture of neural network computers turned out to be more promising than the classical ones used by von Neumann architectures due to the capabilities of highly parallel operation and very low energy consumption in the process of solving problems.

Currently, the following devices are widely used to implement artificial intelligence systems [15]:

1. Graphics cards. The advantages of the GPU include a large number of already written programs, ease of use.

Disadvantages – high power consumption, limited scalability, high cost of equipment, the inability to use in compact and stand-alone devices, that is, software simulation even on graphics cards, retains all the limitations of von Neumann computing architectures.

2. Specialized accelerators of neural networks, which are created either as separate solutions, and their architecture is specially designed only for modeling complex neural networks. Such is, for example, the chip of the Massachusetts Institute of Technology – Eyeriss. Its advantages include higher energy efficiency compared to solutions on graphics cards. The disadvantages include limited scalability, the ability to model only a convolutional network, low power consumption efficiency and low performance compared to neuromorphic processors.

3. Neuromorphic processors (neuroprocessors) differ from digital systems, which are combinations of processor and storage units, that, like the neurons of the human brain’s, they

contain memory distributed in the connections between elementary processors, which can be described as formal neurons or blocks from homogeneous formal neurons. Thus, the main burden on the performance of specific functions by processors rests with the system architecture, the elements of which are in turn determined by the connections between neurons (the principle of connectionism), that reflects their advantages – low energy consumption relative to classical processors and accelerators and high performance in the implementation of operations presented in the neural network logical basis.

Neurocomputers are computers of the 6th generation (Figure 1) and are considered more efficient computing devices, but only when solving problems presented in a neural network logical basis. In this regard, many companies are actively engaged in the production of neuroprocessor technology: Google, NVidia, Qualcomm, IBM, Toshiba, HumanBrainProject, KnuEdge, AnalogDevices, Texas Instruments, Darwin, Fujitsu, Eyeriss, Intel and others [16].

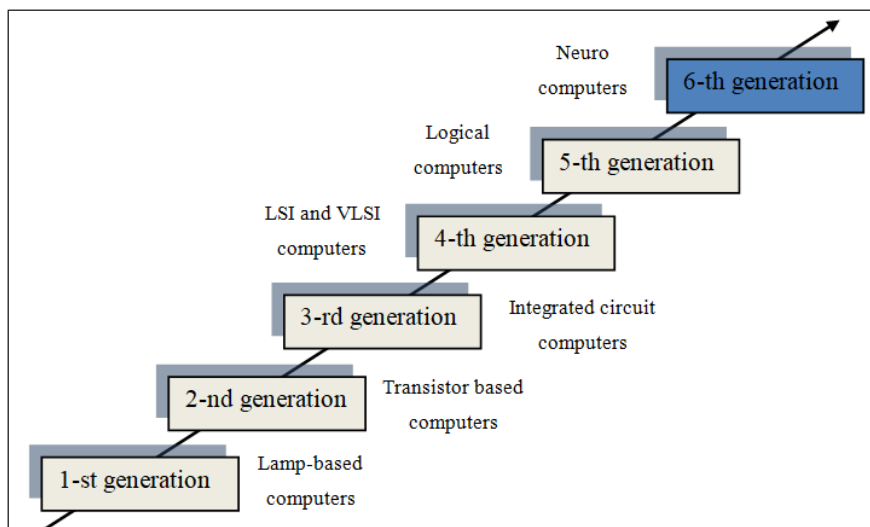


Fig. 1. Computer evolution

In 2013, Qualcomm introduced its prototype Zeroth processor, which simulates the properties of the human brain’s, including the property of self-learning in the process. In 2015, the company released the eponymous computing platform for object recognition.

In 2014, IBM Research introduced the TrueNorth chip from one million digital neurons and 256 million synapses, which are part of 4,096 synaptic cores. At the opportunity demonstration, the chip recognized the video from the intersection of cars, cyclists from the intersection at a speed of 100 times faster and consuming 1000 less energy than existing computing devices built on the basis of von Neumann architecture.

KnuEdge Inc. developed the KnuPath Hermosa processor, which consists of 256 processor cores, 64 programmable DMA modules, 72 MB of internal memory, 34 watts of power consumption. The processor has 16 bi-directional I / O channels, which allows for throughput of the RAM subsystem up to 320 Gb / s. In 2016, the company introduced the

KnuVerse program, which can recognize and identify the voice.

For example, since 2016, in mobile devices there have been used neuromorphic technologies, Samsung uses the FinFET Exynos 8890 chip in its Galaxy S7 and S7 Edge smartphones. Its main feature is the M1 core, which has a neural network built in. Apple has built its own Neural Engine in the A11 processor core.

In the framework of the Human Brain Project, aimed to create an “artificial brain”, a neuromorphic chip containing 384 digital neurons and 100 thousand synapses was developed at the University of Heidelberg (Germany). It also used a SpiNNaker board with 48 nodes and 864 ARM processor cores, which is capable of real-time mathematical modeling in processes occurring in the brain of a bee (University of Manchester).

In 2016, NVidia introduced the NVidia Jetson TX1 modular computer based on its own NVidia Maxwell

architecture, which has 256 NVidia CUDA cores and a 64-bit central processor with functions for implementing artificial intelligence systems to support deep learning, machine vision and GPU computing.

In 2017, Intel introduced the neuromorphic core of Loihi, which has 130 thousand digital neurons and 130 thousand synapses [210]. Google has developed its neural chip TPU (Tensor Processing Unit) and uses it in data centers for its own Internet services. In China, a Darwin chip (Neural Processing Unit Darwin) is implemented, in which 2048 digital neurons, more than 4 million synapses and more than 15 types of synaptic delays are implemented.

As for Russian companies, neurochips based on their own nucleus produce by the Modul Scientific and Technical Center [4], and they are also developing the Elvis Research Center and the Advanced Research Foundation of the Moscow Institute of Physics and Technology in the same field. Plans for the creation of a domestic neuroprocessor are presented in detail in the roadmap of the Neuronet industry union.

## V. RESULT

The main results of the scientific research include:

1. The application options for trained artificial neural networks and artificial intelligence technologies in various fields are considered: working with clients; banks; electric power industry; an urban environment; the field of security; real estate; the field of insurance; the field of nutrition and agriculture; to deal with emergency situations; for automatical processing of documents.

2. The specialized devices that accelerate the training and / or functioning of artificial neural networks are considered: graphic cards; specialized neural network accelerators; neurocomputers.

## VI. CONCLUSION

Scientific research into the use of neural networks indicates that the software is able to determine hidden patterns in different types of information (images, music, video, databases, etc.) and on this basis to analyze and make decisions independently. On the whole, the neural network solves most of the tasks assigned to it, surpassing human capabilities in many respects. Therefore, when making specific requests it is advisable to use it to create models for digital modernization of targeted state and non-state enterprises and institutions, municipalities, cities and even countries.

The existing problem of insufficient speed of artificial intelligence systems can be solved using specialized high-performance computing equipment, for example, neuroprocessor devices.

Thus, it can be said that a neural network – modern software and specialized hardware – is ideally suited for the task of digital transformation of organizations, clearly and according to the scheme, fulfilling tasks, making rational decisions, saving time and resources.

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