ARTIFICIAL INTELLIGENCE IN THE SERVICE OF MAN: MEDICAL, SOCIAL AND ECONOMIC ASPECTS

INTRODUCTION

The modern world is changing at such a rapid pace that the speed of various processes, which yesterday was still recognized as the maximum, is tomorrow recognized as low and unable to meet the current requirements imposed by various achievements of progress on certain areas of human life. One of the most promising achievements of recent decades is the development and application of intelligent systems and robotic technologies in various fields of science and technology.

Robots are used almost everywhere today, but their contribution to the development of medicine is most important. In the light of recent events related to the spread of the infection that came from China, it is robots that have embarked on the path of serving humanity, often solving tasks that would be too much for people or would not be solved effectively by them.

In addition, robots play a significant role in the social sphere: this includes the provision of services for the disabled, the organization of services in various industries, and the provision of necessary psychological assistance. These capabilities of robotic technologies can improve the quality of life of people, reduce the amount of manual labor and increase the effectiveness of the results of a particular activity.

All of the above also allows us to conclude that the use of intelligent systems and robotic technologies not only optimizes various processes of human life, but also reduces various costs associated with, for example, reducing personnel costs. This also indicates the economic efficiency of the use of robotics and artificial intelligence.

The purpose of the work is to consider the medical, social and economic aspects of the use of artificial intelligence in various spheres of human activity.

MATERIALS AND METHODS

To write this study, we analyzed the literature array, which reflects the confirmation of the idea stated by the author - the assessment of the medical, social and economic role of intelligent systems and robotic technologies in human life. The article presents an overview of both foreign and domestic sources that directly or indirectly confirm the main idea of the work. To summarize the information, an analytical method was used, as well as comparative and comparative methods.

RESULTS

The medical aspect of the use of robotics and artificial intelligence is a broad field of activity that deserves special attention, since each person often applies for certain medical manipulations during his life, and their quality directly affects his entire subsequent life. However, the medical field of application of robotic technologies is quite wide, for this reason, it is necessary to investigate the main directions of human use of the capabilities of robotic technologies.
The role of robots in the spread of various infectious diseases is irreplaceable. First of all, this is determined by the fact that robots take on the responsibilities of performing work in a contagious or dangerous area, without subsequently acting as carriers of infection. The actualization of these robot capabilities increased significantly in early 2020, when the COVID-19 virus spread.

The high level of infection with this virus has put all contacts of patients at risk, and medical personnel are also at risk. For this reason, various developments of robotic technologies that can replace humans in the fight against the pandemic have become widespread in 2020. An analysis of the literature has shown that researchers often suggest using robots in various scenarios during a pandemic to help reduce the risk of infection spreading. Under these conditions, robots can safely perform disinfection, monitor the infectious situation, deliver, prepare food, and remotely monitor the health status of patients (CHAWLA, ABROL, KAKKAR, 2020, p. 373).

There have also been developments according to which intelligent robots could monitor human behavior in emergency situations, which could provide a high level of prevention and protection against the spread of infectious diseases. There is also an opinion in the literature that intelligent systems could take an active part in identifying patients infected with the virus. Thus, it was determined that some countries were able to slow the spread of the pandemic by using modern technologies, such as cleaning robots and facial recognition systems, to map contacts and take appropriate measures (ABDEL-BASSET, CHANG, NABEEH, 2020).

One of the main roles that the robot must perform in the fight against infectious diseases is that it can conduct mass screening to quickly confirm cases of the disease. In particular, a semi-automatic robot was developed that is able to take swabs from the patient's mouth and nasopharynx. At the same time, control over the actions of such a robot should be carried out by doctors, who, at the same time, are located remotely from the patient, but control the entire process of taking tests.

In addition, the literature presents the results of tele-ultrasound examination, which was conducted to assess the condition of a patient with a confirmed infection (MOHAMMED, ISA, 2021). So, an example was given in which a remote examination of a woman in labor infected with COVID-19 was carried out. The authors demonstrated how an obstetric examination of a patient is performed in a remote area of Canada, where there is not sufficient access to obstetric ultrasound machines. Based on the telerobotic system, the ultrasonic sensor and settings are remotely controlled by a sonograph located at a distance of 605 km. Remote tele-ultrasound examination with the help of robots and remote consultations for early cardiopulmonary examination were also proposed.

The study of infected patients is also proposed to be carried out using an ultrasound robot based on 5G technology. The proposed method is applicable for lung, heart, and vascular research, while the medical staff is protected and the results can be easily transmitted over the network. In the future, remote diagnostics can be supplemented with artificial intelligence approaches, such as image processing and image recognition.

It can also be highly effective to use robots when conducting a laboratory study of the collected material of infected people. These similar robotic machines were developed earlier and have been successfully used in medical practice for 10 years. For example, in 2001, robotic workstations were already proposed for the rapid extraction of nucleic acid from a large number of samples for the diagnosis of a common coronavirus (ZHANG, WANG, YI, ZHONG, LIU, MIAO, 2020). In 2006, a robotic device for storing, sealing and handling test plates was developed, and in 2012, a robotic system was used to prepare and distribute the composition of the mixture against the HKU1 type coronavirus. Test results can also be synchronized with other online solutions for quick archiving of diagnostics and results.

The role of robotic systems in the production of vaccines and medicines is also very important. Robots and automated machines are used for the automatic production of plant-based vaccines and pharmaceuticals. Similar to a testing device, the flexibility of an automated production system can be improved by implementing remote control technologies (EVANS, YANG, LIU, PENG, 2020).
Despite the high prospects for the use of the robot in the examination and sampling of tests in the patient, these ideas were not widely distributed for the reason that they had a negative impact directly on patients. However, developments in the application of robotic technologies in laboratory diagnostics are quite promising.

Also, according to the researchers, the role of robots in providing medical services related to the isolation and hospitalization of a patient with a confirmed infection of any origin is great. The service robot can perform a simple task, such as delivering medicines and personal care items, which allows medical personnel to perform more important functions.

It is widely recognized that robots can be used in the healthcare system in the form of nurses, administrators, maintenance robots, telemedicine robots, cleaning and spraying robots, and surgical robots. In addition, robots can improve the efficiency of medical practice, because they not only reduce the burden on medical staff and doctors, but also help them solve various problem situations that arise with a large influx of patients.

In the literature, it was proposed to introduce an information system into medical practice that can allow for communication between medical specialists based on telemedicine, smartphones and wearable sensors. In the proposed system, the intelligent robot can also be used for conducting laboratory tests, interpreting results, and other remote support at home. A basic remote function can be performed to measure blood pressure and dispense pills (PIERCE, ELKAN, LEET, McGOWAN, HODINKA, 2012).

A number of authors suggest using drones and autonomous robots to work in special areas, such as infected communities, homes where patients are quarantined, and hospitals. So, a similar homing device was developed, which could be controlled remotely. Infrared sensors located at the bottom of the robot can detect the path, and an ultrasonic sensor on the front of the device can dynamically detect an obstacle.

The platform of a mobile robot with a "multifunctional arm" was proposed as part of the interaction between a human and a robot for the purpose of individual care and assistance. In addition, such a robot can be modified to perform additional functions, such as disinfection and determination of body temperature. The Remote-controlled Intelligent Nurse Assistant (TRINA) was also used to perform certain medical manipulations performed by junior medical staff.

In addition, the researchers proposed the development of a contactless "public" robot, so that citizens can perform self-diagnostics and, if necessary, initiate remote diagnostics. The proposed method can recognize speech, detect keywords, classify coughs, and convert the sound of a user’s cough into structured data for further processing. Audio and video results can potentially be processed and diagnosed by the AI network. In addition, it is possible to support extensive data collection based on the big data management method and the cloud to offer reliable analysis (WIRZ, SAUER-BUDGE, BRIGGS, SHARPE, SHU, SHARON, 2012).

It should also be noted that operations using robots and robots are particularly recommended in complex and minimally invasive procedures. The length of a patient’s hospital stay can be reduced by using robotic surgery, which directly increases the availability of medical services for other patients.

A new adaptive robotic approach to indoor disinfection has been proposed in the literature. The concept of object availability is used to segment and map areas of potential contamination based on the deep learning method. The robot’s trajectory is formed based on a potentially contaminated area, and the short-wave ultraviolet light that the robot is equipped with accordingly performs an effective disinfection process.

During the SARS outbreak in 2003, it was observed that health workers were at high risk of infection, which reduced the chances of adequate treatment for both themselves and patients. To reduce the impact on medical personnel, daily procedures were suggested to be performed as much as possible with the help of robots. Social distancing has also been encouraged by robotics research in both public and medical scenarios. It has been proven that simple processes, such as food delivery, drug distribution, etc., can be performed by semi-autonomous robots (CHEN, CHEN, ZHAO, CHIANG, 2020).
Public acceptance of autonomous robots has increased amid the development of the pandemic. Robots have been used to deliver food and medical supplies in some cities in China. The robot is especially useful in a quarantine zone or when a virus is suspected. A low-cost mobile robot has been developed to support people affected by the virus and people with disabilities. Such a robot can recognize the patient's gestures based on sensors without the need for an image processing module in the system. As with disinfection robots, it is difficult for a delivery robot to work in a complex environment, which can be helped by modern sensors and artificial intelligence techniques.

Despite the obvious advantage of using robots for various medical purposes, it should be recognized that the speed of robot adoption may not increase instantly, since the current capabilities of artificial intelligence methods are limited in their own field. However, the robot-based logistics system can be improved by using a wireless sensor network to obtain dynamic status and requests, and then controlled via remote control to ensure reliable operation.

The social function that robots perform is also quite significant, it directly borders on the robot's activities in the field of providing medical services.

During the long struggle against infection, social isolation and loneliness become increasingly serious problems. New technologies are being proposed, such as social robots that can initiate human interaction remotely to reduce loneliness, minimize the risk of direct contact, and share the workload of healthcare providers (OBEK, DOGANCA, ARGUN, KURAL, 2020).

Social robots' advances in speech recognition and natural language processing have made robots more human-like, offering cognitive assistance, social interaction, and stimulating actions. The companion robot demonstrates the potential to reduce feelings of loneliness, which is an important indicator of mental health. Supportive relationships can be built within an integrative framework in different ways, such as personal assistant, relationship partner, and close friend. Similarly, a typology of robotic services is proposed to help the user during social isolation. The role of a social robot includes an entertainer, social assistant, mentor, and friend, and sets the agenda for future research.

During a pandemic, it is especially necessary to take into account the needs of a special group of citizens. In the literature, a pandemic-related problem for the elderly has been considered and the design of robots similar to real ones has been proposed, as they are able to develop a sense of social understanding. An approach based on phenomenology has been proposed for effective emotional and social robots for elderly care. Uniqueness and respect for senior citizens are considered based on their motor, cognitive, emotional, and social skills. This is especially valuable during the isolation and social distancing caused by the pandemic.

In healthcare scenarios, phonetic interface and speech recognition techniques are popular due to their ability to provide intelligent guidance and interactive services. Multi-modal gestures, gaze, and behavior recognition were used on the social assistance robot.

During the introduction of quarantine, for various reasons, many patients in nursing homes or long-term care facilities cannot receive visitors as usual. Accordingly, they were asked to use the need to stay locked up in their rooms with robot companions. In general, both social and companion robots can be upgraded using artificial intelligence techniques to improve human-robot interaction, as well as broad access to 5G-based communication.

Social robots are widely used to provide medical information, assessment, and treatment as a complement to other digital health services. Social robots that can interact with people have some unique advantages for providing medical care compared to other digital ways, such as smartphones, computers, or screen avatars.

Humanoid social robots tend to elicit more favorable responses in humans compared to telepresence or virtual agents, including higher scores on parameters such as overall impression, preferences, engagement, usefulness, attractiveness, and pleasure.
Interpersonal benefits associated with humanoid robots include higher levels of trust, trust, attention, perceived empathy, and the ability to elicit more descriptive spoken language in humans.

In terms of health-related characteristics, embodied robots often score higher on persuasion, individual likelihood of accepting a recommendation, and better task-related outcomes, including people being more likely to choose a health bar over a chocolate bar when the embodied robot was present with them compared to a virtual agent. Taken together, these attributes represent an important set of characteristics for digital treatment in healthcare if social robots begin to take on therapeutic roles that require strong clinical experience and conversation-based interpersonal communication, such as robot-assisted psychotherapy.

In one area of research, animal-like robots were used primarily to care for the elderly in order to replicate the positive effects of animal-assisted therapy. The results of the feasibility meta-analysis and the Phase 2 RCTs include a reduction in agitation, together with qualitative evidence indicating a perceived reduction in loneliness and an increase in pleasure described by residents, staff, and family members.

Other studies have used social robots to teach children with autism spectrum disorders social skills. These tests showed improved social behavior as a result of training conducted by robots, such as faster gesture recognition, asking questions, and engaging in social interactions.

A third application of social robots concerns health-promoting behaviors, including advice on drinking water, assistance in tracking calories consumed, or training in exercise. However, these trials have not yet tracked health outcomes over multiple sessions or time points.

Communication between social robots and children shows some positive effects when used as part of a medical intervention. This applies to a humanoid social robot that distracts children’s attention from pain and stress during a vaccination session, as well as multi-session robotic psychotherapy for children with cancer, reducing their anxiety, depression and anger assessments.

The third important point, considered in the framework of this work, is the economic aspect of the use of robots in human life.

It is necessary, first of all, to highlight the issue related to increasing labor productivity. Thus, performing various operations involving robots significantly reduces the time allotted for their execution, as well as improves the quality of the work performed.

The use of robotic technologies in the field of production can bring the following positive aspects:

- reducing the number of defective products and, as a result, reducing the number of complaints;
- increase labor productivity by reducing manual operations and increasing the level of automation of production;
- introduction of the ability to control the workflow through the use of various automated control systems and monitoring of the workflow;
- improving the professional level of employees by improving the efficiency of management processes, which will be built on the basis of automated technologies.

**DISCUSSION**

As already mentioned, it is now widely believed that the robot can play the role of a “shield” that physically separates the medical staff and the patient. The surgical robot also reduces the possibility of contact with biological fluids compared to traditional operations performed by humans.

Robotic surgery also allows staff to work at a distance from the patient and other staff, which contributes to better social distancing in the operating room. In addition, sensors and
feedback techniques also help medics establish digital fidelity of the operating field to help them touch, see, and hear an object with high sensitivity.

It should be recognized that in some cases, laparoscopic and robotic operations involve a high risk of aerosol dispersion, since circulating CO₂ and smoke can carry viral particles. Some researchers have recommended limiting robotic procedures, given the risk of aerosol formation.

However, the medical benefits may outweigh the risks of virus transmission. The advantage of a surgical robot is a shorter patient stay in the hospital, less blood loss and small incisions, which encourages the surgical use of robotic technologies.

Robotics is recognized as valuable in various fields of medicine, including neurological examination and neurorehabilitation. In rehabilitation centers, it is proposed to use more robots and exoskeletons to reduce the patient’s contact with the physiotherapist. Remote rehabilitation can help a patient with limited mobility, which also reduces the burden on hospitals and medical institutions.

Robots are also indispensable in the process of cleaning medical premises, to avoid human-to-human contact UV disinfection performed by robots has been used in some countries, and a disinfection rate of 99.99% has been achieved in 15 minutes (GRAETZ, MICHAELS, 2018, p. 754).

Viruses, bacteria and superbugs can be destroyed by the Ultraviolet C (UVC) light installed on the GermFalcon robot, which was originally designed to ensure the hygiene of aircraft in order to improve travel safety. UV radiation has also been used as a bactericidal supplement to the mobile robot for disinfection in both industrial and domestic environments.

However, the authors conclude that the effectiveness of using robots for cleaning and disinfection of premises is still insufficient to work in difficult conditions in nursing homes and schools. Work in this direction is still only at the start.

Social robots also have new potential to facilitate and conduct low-intensity behavioral interventions that mimic evidence-based therapies used in everyday clinical practice. They are used less frequently than their digital counterparts (i.e., virtual avatars and conversational agents) who conduct clinical interviews or psychotherapeutic treatment for depression, anxiety, post-traumatic stress disorder, suicidal behavior, and substance abuse.

Social robots are used less frequently among healthy adults. The trials include a program involving robots providing cognitive training to improve memory, attention, and executive functions that improve the functioning of older adults, and a social robot performing a low-intensity behavioral intervention with a 15-minute motivational interview to encourage healthy behavioral changes, including increased physical activity. This new body of work shows that embodied social robots can assist and guide medical interventions, including those that provide support, training, and guidance on behavior change.

If we consider the features of the economic aspects of the relationship between a person and a robot, we can note the following. It should be considered that firms use robots if it is economically feasible, for example, when the profit exceeds the cost of purchasing and installation. Thus, replacing routine tasks with robots is more likely in countries with higher wages, and a drop in fixed costs or rental costs will lead to an increase in the scale of robot adoption.

Recent attempts to model the production process with robots, conducted in, add a distinctive feature of automation: the technical ability of machines to replace workers in an expanding range of tasks. They divide the production process into tasks performed by workers and machines. The development of machine capabilities expands the set of tasks performed by machines and replaces labor, thereby reducing the demand for labor.

However, robotic automation technologies also lead to the creation of new tasks that cannot be performed by machines, such as programming, designing, and maintaining high-tech equipment. This "recovery effect" increases the demand for labor. The combination of tasks displaced by robots and the recovery of new tasks determine the redistribution of tasks between workers and machines.
However, some authors suggest that products differ in the proportion of tasks that can be performed by machines. Clothing is a prime example: tailoring is a complex process that requires human intuition and skill, which are difficult to program. On the contrary, it turned out to be easier to program robots to perform tasks on car assembly lines. Automating car assembly lines has helped reduce errors and improve the control of repetitive tasks. Thus, the technical feasibility of machines for performing tasks varies depending on the industry.

Robots can also reverse the trend of shifting manufacturing activities from developed countries to low-wage countries. It is noted in the literature that advances in robotics will reduce production costs regardless of where the product is produced. According to the author, this will increase the attractiveness of domestic production in comparison with offshoring. In fact, workers in the export sectors of developing countries can be displaced by the use of robots both on land and at sea. In fact, foreign robots act as a form of competition in the export market.

Accordingly, we can conclude that the economic benefits of introducing robotics into human activities are quite high. However, it is also necessary to take into account the negative aspects of this process in order to overcome the problems associated with its implementation.

CONCLUSIONS
Digital transformation gained momentum at the beginning of 2020, due to the development of the pandemic. Many automation devices and systems have been adopted around the world to deal with the crisis. The robot is one of the promising devices, as it provides physical functions with effective social distancing between patients and medical staff.

It should be noted that a fully automated robot is not available in all scenarios. Many of the robotic solutions still require human control, while some of the autonomous solutions are limited to simplified functions. Moreover, robots are not yet available en masse, because many of today’s robots still need to be refined. It is clear that the cost of robots and the requirements for their maintenance are a serious problem for the economies of developing countries, which cannot afford even basic supplies for advanced medical workers. Thus, in the future, it is important to introduce advanced technologies such as AI and 5G to increase the flexibility and functionality of robots, and to include considerations of cost and production of robots to offer broad access to robotic solutions worldwide.

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Artificial intelligence in the service of man: medical, social and economic aspects

Resumo
A inteligência artificial (IA) e as tecnologias robóticas têm sido cada vez mais utilizadas em diversas áreas da atividade humana. Assim, o objetivo deste artigo é considerar os aspectos médicos, sociais e econômicos do uso da inteligência artificial em diversas esferas da atividade humana. A razão para as pessoas recorrerem às inovações acima mencionadas é expandir uma série de capacidades humanas, aumentar a produtividade do trabalho, reduzir o impacto negativo do fator humano, etc. O aspecto social do uso de tecnologias robóticas também não deve ser subestimado. Os aspectos econômicos do uso de inteligência artificial e tecnologias robóticas são a possibilidade de otimizar o número de recursos trabalhistas, substituindo todo um quadro de trabalhadores auxiliares, o que pode reduzir significativamente o fundo salarial geral e os custos de uma empresa que utiliza tais tecnologias, em particular.

Palavras-chave: Inteligência artificial. Tecnologias robóticas. Esfera social. Tecnologias médicas. Eficiência econômica.

Abstract
Artificial intelligence (AI) and robotic technologies have recently been increasingly used in various areas of human activity. Thus, the purpose of this paper is to consider the medical, social and economic aspects of the use of artificial intelligence in various spheres of human activity. The reason for people turning to the above-mentioned innovations is to expand a number of human capabilities, increase labor productivity, reduce the negative impact of the human factor, etc. The social aspect of the use of robotic technologies should also not be underestimated. The economic aspects of the use of artificial intelligence and robotic technologies are the possibility of optimizing the number of labor resources, replacing a whole staff of auxiliary workers, which can significantly reduce the salary fund in general and the costs of a company using such technologies, in particular.

Keywords: Artificial intelligence. Robotic technologies. Social sphere. Medical technologies. Economic efficiency.

Resumen
La inteligencia artificial (IA) y las tecnologías robóticas se han utilizado cada vez más recientemente en diversas áreas de la actividad humana. Por lo tanto, el propósito de este trabajo es considerar los aspectos médicos, sociales y económicos del uso de la inteligencia artificial en diversas esferas de la actividad humana. La razón por la que las personas recurren a las innovaciones mencionadas anteriormente es expandir una serie de capacidades humanas, aumentar la productividad laboral, reducir el impacto negativo del factor humano, etc. El aspecto social del uso de tecnologías robóticas tampoco debe subestimarse. Los aspectos económicos del uso de la inteligencia artificial y las tecnologías robóticas son la posibilidad de optimizar el número de recursos laborales, reemplazando a toda una plantilla de trabajadores auxiliares, lo que puede reducir significativamente el fondo salarial en general y los costos de una empresa que utiliza tales tecnologías, en particular.

Palabras-clave: Inteligencia artificial. Tecnologías robóticas. Esfera social. Tecnologías médicas. Eficiencia económica.