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## **ARTIFICIAL INTELLIGENCE APPLICATIONS IN LIBRARIES IN THE CONTEXT OF DIGITAL TRANSFORMATION OF SOCIETY**

Throughout human history, obtaining information and acquiring knowledge has been a priority for people. At the same time, historically society, the demand for information has continued to increase, people have constantly made efforts to obtain, collect, develop and share information using various methods. As a result of the development of technologies, the process of obtaining information has become easier, people have managed to make their lives easier by using technology more efficiently and productively in all areas of life, and have reached previously unattainable levels in terms of obtaining information.

In the past, people sometimes wrote inscriptions on cave walls, animal skins, and parchments in order to turn their knowledge into culture and pass it on to future generations. Currently, the methods and forms of information transfer have changed. Thus, different methods and tools: cloud systems, physical servers, etc., are used for information transfer. The common feature of these tools, which differ from the past to the future, is to ensure the transmission of knowledge and culture to future generations. Today, libraries host digital resources as well as traditional materials and offer a variety of digital services to facilitate access to information by keeping up with technological developments. Along with digital services, artificial intelligence technologies have also emerged as a possible tool that can be used to make libraries more efficient. The use of artificial intelligence in libraries can facilitate the work of both library staff and users, and improve library services. It should be noted that the directions of application of artificial intelligence in libraries – solving problems and making decisions; in the areas of information discovery by voice and image identification, document cataloging, collection preparation, technical services, reference services, querying, subject indexing, determining users' information needs, database searching and document supply. As can be seen from this, artificial intelligence has the ability to perform many functions of librarianship, such as cataloging, reference services, and collection tools with applications.

**Key words:** Digital transformation, Use of Artificial Intelligence in Libraries, Expert systems, Robotic Applications, Image Recognition Applications in libraries.

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## **ЗАСТОСУВАННЯ ШТУЧНОГО ІНТЕЛЕКТУ В БІБЛІОТЕКАХ У КОНТЕКСТІ ЦИФРОВОЇ ТРАНСФОРМАЦІЇ СУСПІЛЬСТВА**

Протягом усієї історії людства отримання інформації та здобуття знань було пріоритетом для людей. Водночас історично склалося так, що потреба в інформації в суспільстві продовжувала зростати, люди постійно докладали зусиль для отримання, збору, розробки та обміну інформацією різними методами. У результаті свого розвитку технологій процес отримання інформації став легшим, люди змогли полегшити собі життя, використовуючи технології більш ефективно і продуктивно в усіх сферах життя, і вийшли на раніше недосяжний рівень в отриманні інформації.

У минулому люди іноді робили написи на стінах печер, шкурах тварин і пергаментях, щоб перетворити свої знання на культуру та передати їх майбутнім поколінням. Нині змінилися методи і форми передачі інформації. Таким чином, для передачі інформації використовуються різні методи та інструменти: хмарні системи, фізичні сервери тощо. Спільною рисою цих інструментів, що змінюються від минулого до майбутнього, є забезпечення передачі знань і культури майбутнім поколінням. Сьогодні бібліотеки зберігають цифрові ресурси, а також традиційні матеріали та пропонують різноманітні цифрові послуги для полегшення доступу до інформації, крокуючи в ногу з технологічним розвитком. Разом із цифровими послугами з'явилися також технології штучного інтелекту як можливий інструмент, який можна використовувати для підвищення ефективності діяльності бібліотек. Використання штучного інтелекту в бібліотеках може полегшити роботу як бібліотечного персоналу, так і користувачів, покращити бібліотечне обслуговування. Слід зазначити, що напрями застосування штучного інтелекту в бібліотеках – розв'язання проблем та прийняття рішень у сферах виявлення інформації за допомогою голосової ідентифікації та ідентифікації зображень, каталогізації документів, підготовки колекції, технічних послуг, довідкових послуг, запитів, предметного індексування, визначення інформаційних потреб користувачів, пошуку в базі даних та постачання документів. Як видно з цього, штучний інтелект здатний виконувати багато бібліотечних функцій, таких як каталогізація, довідкові служби та засоби колекціонування з додатками.

**Ключові слова:** цифрова трансформація, використання штучного інтелекту в бібліотеках, експертні системи, роботизовані програми, програми розпізнавання зображень у бібліотеках.

**Introduction.** The information age in which we live, and the level of technological and social development that has created it, is based on knowledge. The new society, in which the information that enables this development is used as raw material in all fields, is called the information society (Yeşilorman, Koç, 2014, s. 120). In today's society, where the amount of information has increased in quantity and become a large ocean, libraries, which since ancient times have been the only place where information is collected and disseminated, must take advantage of technological innovation to provide more efficient and accurate services. Especially after World War II, the rapid development of information and communication technologies and the spread of scientific innovations pushed information centers, especially libraries, to use new types of documents and communication technologies, leaving them outside the confines of traditional service institutions. Also, it is possible to quickly and accurately satisfy information needs, identify library resources, accelerate resource search time, increase the efficiency of library work, facilitate digitization of funds and improve library service, analyze user behavior and ensure digital security of libraries.

This study elaborates on the application of artificial intelligence in libraries, the dimensions of human brain and intelligence, the scope and historical development of artificial intelligence, and the content of artificial intelligence applications used in libraries in order to better understand artificial intelligence as a field. At the same time,

special emphasis is placed on analyzing the current state of artificial intelligence applications in terms of their development in the world, how they are used in libraries, and the study of library applications in in this field.

Therefore, differences emerged in the way information was recorded, the type of digital media used in addition to the print source, and the channels of information transmission (Üstün, 1994, s. 217).

**Degree of problem development.** No independent research has been conducted on the directions of application of artificial intelligence technology in libraries in Azerbaijan (Üstün, 1994). Only some researchers have recently touched on this topic in a superficial way in their scientific articles and conferences. As for world researchers, the prospective directions and application possibilities of using artificial intelligence have long been investigated as the main priority direction by experts and researchers in the field of library science in some articles (Frederick, 2016). From this point of view, associate professor of the Moscow State Institute of Cinematography V. K. Stepanov can rightfully be considered a pioneer. Thus, in 1996, he published the article "Artificial intelligence and its application possibilities in libraries" (Scardilli).

He noted in his article that at that time the elements of artificial intelligence were already included in the software products of the libraries and were used in the libraries in the form of modules. They automatically ensure compliance with the standards of bibliographic records and reporting documents (Lohani). The program itself generates the title of the bibliographic record

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depending on the number of authors (if a book has one or two authors, both are reflected; if there are three or four authors, the machine places one – the first – in the title, and the rest in the field of responsibility; five and more automatically describes the title and shows the first three authors in the field of responsibility) and additionally suggests adding the corresponding inventory number when creating an inventory book. However, this is only the first stage of introducing artificial intelligence to the world. From this, it is clear that the benefits of applying artificial intelligence to libraries have been well justified for a long time (Perez, 2018).

In the article, the scope and historical development of artificial intelligence, the content of artificial intelligence applications used in libraries are explained in detail and researched by the author. Considering all this, it is of great importance to examine the above-mentioned subject under an independent title.

**Purpose and tasks.** The main purpose of the research is to investigate the levels of application of artificial intelligence applications in the world, the current state and analyze how they are used in libraries. At the same time, it is one of the main tasks to investigate the research and library practices in this direction, to highlight the importance of the topic and to educate in order for libraries to provide more effective services in accordance with the developments in artificial intelligence and communication technology.

**Methods.** Analytical research method was generally used during the research among the sources related to the topic. Methods such as generalization, systematic approach, synthesis, comparative analysis were used in the research depending on the tasks set.

**Main part.**

### **Transformation of libraries in the context of digitalization of society**

It is known that computers were first used in libraries in the 1960s, mainly for cataloging. With the development of the Internet, online catalogs became widespread, and later, with the development of the Internet, the rapid growth of information, electronic resources and automation systems was used. At the same time, the developing web technologies have posed various challenges to libraries, such as how to present information on the Internet or to obtain reliable information, which is the main task of the library profession.

Now the traditional librarian profession has been replaced by a kind of expertise in Internet and digital systems (Asiye, 2018, s. 173).

In today's competitive business environment, many businesses are faced with the challenges of large amounts of information in making operational decisions to improve efficiency. Thus, many manufacturing systems are not prepared to manage large databases due to the lack of intelligent tools. In 2011, Industry 4.0 was introduced to the public at a trade show held in Hanover, Germany, which was presented to the public as a new concept and symbolized the beginning of the 4th industrial revolution. Hence "Industry 4.0." the concept was adopted as a strategy to be implemented in order to compete with contemporaries in producing the products and services of the future. The Fourth Industrial Revolution is different from the other three industrial phases.

This attribute is the growing mass of freely available information on the Internet. With this revolution, not only the industrial and manufacturing sector, but also the service sector underwent a technological transformation. In fact, the difference of this revolution, unlike previous industrial stages, in the context of increased production and information abundance with the current level of technological development is the transition of the main workforce from humans to robots.

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Artificial intelligence technology, which took its first steps in the middle of the last century and continued to develop in the following years, is now on its way to becoming a transformative revolution spanning all fields and industries. Today, in an era of rapid technological development, artificial intelligence, which is widely used in all fields, especially in industry and business, provides both fast service and more efficient methods of protecting information in the face of information abundance (Frederick, 2016).

### **Application of artificial intelligence technologies in libraries**

Although it seems impossible for the industry and service sector to resist this new wave (robots and artificial intelligence changing the existing concept of work and corporate activity), these enterprises need to adapt to modern technologies in order to keep up with the demands of modern times. Artificial intelligence is fundamentally changing all areas of activity – industry, agriculture, transportation and logistics, energy, telecommunications, financial sector, health care, trade, education, etc. Artificial intelligence is also changing the way we do business (Gade, 2017).

One thing that should be emphasized is that in the conditions of the information revolution, when the difference between the physical and cyber world is erased, while the role and functions of libraries in the new revolution are being discussed, there are opinions that there will be no need for them. for libraries in the future. Because the information needed by individuals and businesses will be included in the environment, and the requested information will be received through the Internet of Things. However, in the future, libraries will become places that serve many important functions and will be physically more useful in the future (Frederick, 2016, s. 10–11). If some of these features are mentioned:

- When conducting research on documents that cannot be digitized, you will need to seek the assistance of a librarian;
- The role of librarians in the process of data creation and knowledge management will be taken into account.

The theory of artificial intelligence offers various principles, techniques, methods and systems related to the creation and provision of digital libraries to users.

As can be seen from the above, the theory of artificial intelligence will cause great changes in the field of library and information services. With the development of artificial intelligence techniques, libraries will make complex decisions and assessments with fewer errors. In this context, libraries will not only ease the manual labor of employees, but will also be chosen as more efficient institutions in today's world, where obtaining reliable information is becoming increasingly difficult (Dent, 2009). At the same time, dependence on information literacy will

decrease as artificial intelligence prevails in the context of solving many problems.

Artificial intelligence expert systems that imitate human cognitive behavior, natural language processing, image recognition, intelligent agents, robotics, etc. have areas of application. These applications of artificial intelligence technology are most effectively used in: cataloging, classification, information retrieval, technical services, periodicals and many other library services (Herron, 2007).

### **Application of expert systems in libraries**

Expert systems, one of the applications of artificial intelligence, are a technology that allows librarians and users to gain many positive benefits in library services.

The knowledge base of expert systems contains all the necessary information and rules that library specialists use to make decisions. Using this information, the system can perform an evaluation process using an inference algorithm and make better decisions than even a librarian. Because the knowledge base of an expert system includes the experience of the best group of experts. Such a specialist can provide effective service by imitating the decisions and statements of the librarian (Asemi, 2018, s. 143).

In the context of reference services, the library provides many benefits to users, such as searching, directing users to resources, answering users' online questions, and providing advisory services (Su S.-F., 1995, s. 219).

According to researcher Richardson (1989), the potential advantages and disadvantages of applying expert systems to the library reference system as a whole are explained as follows (Davies, 1997, s. 94).

So the advantages are:

- Human factors can provide services at any time when the librarian is unsuitable or unavailable;
- Users with disabilities may be offered an independent option;
- Users who cannot access the bibliography or have limited capabilities may be offered an independent option;
- Staff can get rid of annoying, repetitive, boring questions;
- They can play an important role in the learning process of students and professionals;
- They can help identify current bibliographic research tools needed.

In addition to the above, the system also has negative sides. To:

- Lack of human factor;
- Adequate infrastructure and equipment must be provided;
- There may be a potential occupational safety hazard;
- There is a possibility that the librarian will lose existing skills during the basic inquiry process;
- Creation and operation of an expert system requires personnel and large capital investments (Gade, 2017).

Artificial intelligence, which arose with the development of computer science and influences all sciences using computer systems, has made the creation of smart libraries capable of imitating the thoughts and behavior of librarians possible for more than 50 years, and with the development of technology has expanded the scope of services (Herron, 2007, p. 139–144).

Ideas about using smart systems instead of classical systems in libraries originated in 1990. In today's world, where more and more information is digitized, libraries need to use more and more new technologies to provide the most effective service to users. In this sense, intelligent agent technology, a rapidly growing area of research, is a promising application (Lohani, 2007, p. 139).

Smart library systems use artificial intelligence technologies to provide information services to their users and staff. Cataloging, indexing, reference, technical service, provision of documents and documents, issuance, etc. in libraries. Artificial intelligence applications can be used in many service areas (Asemi, 2018, s. 1443).

Amazon's cloud-based voice service Alexa and Apple's digital assistant Siri are intelligent agent programs designed to make people's lives easier by providing information and taking actions on demand. These technologies have become indispensable, according to information professionals who shared their experiences and explained to the library community how they can benefit from devices like Alex and Siri (Scardilli).

Libraries with programmers through staff or support channels can actively use voice-enabled intelligent agents in the library service process. Smart agents provide users with a variety of support options using the features they have (Dent, 2013, p. 119).

- Builds library catalog searching habits.
- Event scheduling can be done in libraries by connecting your device to the scheduling system.

- Their small size and low cost make it possible to place several devices in the library and at the same time make it possible to implement more bibliographic services for users, possibly even after-hours services.

- Provides search and access to local and international resources.
- You can search the library's online databases.
- It can sort and prioritize search results.
- It can serve users with virtual bibliography training based on the users' request.
- Maintains compatibility between library technologies, tools and portable devices such as personal digital assistants (PDAs), mobile phones.

Can provide relevant information services by sending personalized notifications to users to introduce relevant new resources and services.

- Considering the structure of the library, it is possible to search for educational literature in the form of electronic resources.

Intelligent agent technology can be effectively used in many library activities, such as electronic information services, collection gathering, library resource classification, catalog searching, circulation and bibliographic services, and event planning. It acts as an assistant for users and librarians. Considering that intelligent agents fit within a library's budget, they appear to be more cost effective than many technological equipment or systems.

### **Robots applications in libraries**

Mechanical systems, computer technology and software applications, which are developing more and more every year, have created the conditions for robotization. Robotic systems have entered human life more than ever before. In fact, these systems are widely used in many commercial, social, cultural and public spheres. Libraries are institutions that benefit from robotic applications in serving users (Nicola, 2017).

The need of librarians for library services, information resource management, especially high-volume and repetitive operations, has decreased due to robotic applications. These systems, using tools such as software, sensors, barcode reader, GPS, robotic arm, enable the registration of resources in the library and the process of transporting books quickly (Gade, 2017, s. 255).

As the number of information resources increases, manual management of libraries becomes an increasingly complex and time-consuming task.

To overcome these problems, library assistant robots used to collect and arrange information resources in the Library will avoid wasting time and effort.

Each user's library card is checked against the library database, and access rights to resources are determined through authentication.

- The process of returning a book to the user is carried out directly. If he wants to receive a publication, he enters the title of the book into the library database and determines the password for the desired book.

- The user sends the book number to the mobile robotic arm wirelessly and opens a new transaction window.

- Once the robot receives the book number, it starts checking the tags of each book one by one using Radio Frequency Identification (RFID).

- The manipulator notifies the user if the book is not found on the shelf or is lost. If the resource requested by the user and the barcode number of the book scanned by the RFID scanner match, the book is picked up by the robotic arm and delivered to the user (Rathinasabapathy, 2008).

The library robot appears to provide a flow of resources that users are searching for or want to return to the library collection, preventing users and librarians from wasting time between shelves.

This program will also be very convenient for older and disabled users and will allow these disadvantaged populations to use the library more frequently and effectively. Instead of having to deal with misplaced or lost books, the librarian will be more productive and efficient.

In addition to organizing shelves and searching for resources, robots can also perform security and security functions in libraries. Thus, it is envisaged that the robots, programmed according to the work schedule, can monitor the library building and alert security personnel or librarians if any problems arise, as well as check the cleanliness and order of the tables before closing the library (Su S.-F., 1995).

#### **Applications for image recognition in libraries**

Computer automatic image recognition systems are used in situations where human perception cannot identify characters or automate and speed up the recognition process. For example, speech recognition, human face recognition, retina recognition, fingerprint recognition, text

recognition, image recognition, etc. are examples of common object recognition applications. Pattern recognition, that is, the process of assigning objects or events to the appropriate category or class, occurs in the process of recognition in three main stages. These steps include feature extraction, feature selection, and classification (Perez, 2018).

Image recognition is an information service in libraries, document processing, language translation, electronic resource, office automation, human-machine communication, information retrieval, etc. It is used for this and has important research areas in many applications (Cheng, 1996, s. 97).

To facilitate document indexing and the development of digital libraries using digital technologies, it is necessary to know the structure and methods of analyzing document descriptions to identify areas of interest (Nicola, 2017, s. 1905).

It is important to analyze data features in the context of document processing with image recognition. In fact, the effectiveness of the method often depends on the quality of the features identified by the expert, and not on the type of classification used in the recognition process. Image recognition is also widely used in the translation process. There is a large amount of textual information available on the Internet in many languages. In this data, optical character recognition can deeply identify and read text embedded in images. In optical character recognition, text, words, and character strings in a document must be divided into correct segments before they can be recognized. It then takes the document description file as input and performs the translation.

Important for libraries from a security and user graphics perspective, biometric identification refers to physiological or behavioral characteristics that confirm a person's identity. Facial recognition, fingerprint recognition, voice recognition, signature recognition, etc. Many image recognition programs provide security for both building and library equipment as well as library print collections (Rathinasabapathy, 2008, s. 182–183).

The system can control access to protected or confidential documents. The system identifies the face in the database and shows the matching face as a secure recording through the camera, but takes a snapshot of the suspicious situation and sends it as an email notification. Using these recognition programs, libraries can automatically track users both in protected sensitive areas and in

areas where authorized outside access is prohibited and where sensitive documents such as rare artifacts are located. In addition, it detects people or situations that pose a security risk in the library and alerts those in charge.

**Conclusion.** A paradigm shift in the field of practical application of artificial intelligence is currently taking place in the globalized world. As a result of its development and convergence with the Internet of Things, cloud computing, mobile technologies, robotics, "Big data" analytics, and social media over the last decade, artificial intelligence has reached a critical point where it will strengthen and expand every technology-based service and application.

In the end, I would like to emphasize one thing that the application of artificial intelligence technology will significantly improve the quality of relations between authors, publishers, librarians

and end users of document products, will create conditions for the availability of only actively requested literature in libraries, will free bookstores from the destruction of unsolicited printed products, the general level of reading culture will rise rapidly. Although our country is not on the list of leading countries in terms of the use of artificial intelligence, one of the fields of artificial intelligence widely used in practice – fuzzy logic – was founded by the world-famous Azerbaijani scientist Lotfi Zadeh. However, we can say with a great sense of regret that even though almost none of these applications mentioned above are currently found in our libraries, in the near future there will be ample opportunities for the application of this type of smart systems in our libraries, and the development and implementation of programs in this direction will begin. Because the social and technological conditions are almost ready to start.

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