Robots and public libraries

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Introduction

The Fourth Industrial Revolution now includes the emergence of artificial intelligence (AI) and automated robotics (Xu *et al.*, 2018). This revolution is disrupting and changing the entire landscape of education and industry (Shahroom and Hussin, 2018). Humanoid service robots are being used in sectors of industries all over the world (Nguyen, 2020). However, how these humanoid robots might be integrated into the library sector, as well as the potential ethical–privacy–legal implications, is currently under investigation. Some academics believe that highly intelligent humanoid robots may face ethical and moral quandaries. Other issues to consider include whether humanoid robots can be considered legal persons capable of assuming legal obligations and how robots and humans can co-exist in the same environment.

Tella (2020) noted that AI in humanoid robots is already available in libraries in both developed and developing countries, which is no longer news. The robots engage in activities such as scrambling, rolling, soaring and climbing. These robots have an impact on libraries and the larger information (and social) environment in which we all live. Libraries have recently begun to provide access to robots and robot-related science technology, engineering and mathematics (STEM) education programs. Westport (Conn.) Library, for example, offers training for its two programmable humanoid small humanoid robot (NAO) robots, and the Chicago Public Library lends small, mobile Finch robots. The University of Rhode Island Libraries' AI Lab hosts weekly "robot hours", during which students learn to control and program robots. Some aspects of library work are more likely than others to benefit from robots. According to Kim (2017), libraries can use humanoid robots to greet visitors and provide directions. Libby, a robot at the University of Pretoria Libraries in South Africa, already performs such tasks.

As AI in humanoid robots improved, such as the ability to identify and re-shelve misfiled books, they became more useful for library access services. Robots can also assist with reference requests, particularly simple ones. These robots can be online chatbots (Blut *et al.*, 2021). To provide basic reference services, the University of Oklahoma Libraries is experimenting with Alexa, Amazon's virtual assistant. Similarly, readers' advisory robots can be used, and children's librarians may find reading robots useful. When robots interact directly with library patrons and staff, safety may be an issue (Villani *et al.*, 2018). Interacting with robots, on the other hand, can strengthen those bonds.

More sophisticated, versatile and autonomous robots are likely to enter our homes, workplaces and libraries as AI technology advances. Nobody knows how the widespread use of robots will affect libraries, but it will undoubtedly raise a slew of intriguing questions:

Q1. Are libraries equipped to house AI-powered humanoid robots?

Q2. Can the implementation of these robots improve reference services or pose a threat?

Artificial intelligence, robotics and libraries

The study of AI is concerned with the development of intelligent computer programs that simulate various aspects of intelligent human behaviour. The emphasis has been on representing knowledge structures that are used in human problem-solving (Amit, 2018). In other words, AI is the simulation of human intelligence processes by computer systems. Learning (the acquisition of information and the rules for using that information) and reasoning are examples of these processes (including the rules to reach approximate or definite conclusions and self-correction). Expert systems, speech recognition and machine vision are examples of AI applications. AI is a paradigm shift in how we think and make decisions (Wong *et al.*, 2020).

AI is used in a wide range of industries, including medicine, the military, commerce, education and gaming; AI systems in libraries were proposed for the first time in 1990. These intelligent library systems, which provide knowledge-based services to both library employees and visitors, benefit both (Asemi and Asemi, 2018). AI in library systems can be seen in descriptive cataloguing, subject indexing, reference services, technical services, shelf reading, collection development and information retrieval systems. To improve efficiency, many libraries are automating their operations" (Duan *et al.*, 2019).

AI is also concerned with the design, construction, operation and application of robots (Abram, 2019). A robot is essentially a machine that can carry out a complex series of actions automatically based on a computer program. It is made up of three parts: the controller, the mechanical part and the sensor. The controller is the brain, which is controlled by a computer program that sends commands to the robot's moving parts. The mechanical parts of the robot include motors, pistons, grippers, wheels and gears that allow it to lift, grab, turn and move. The sensor informs the robot about its surroundings, allowing it to determine size, shape, distance between objects

and direction (Science Trek, 2019). Robots have begun to infiltrate all places and jobs where manual labourers used to work.

The increasing use of the term "robot" to refer to any type of automation in recent years has cast doubt on how robotics and AI fit together. As it appears, there is a small overlap between the two fields: Artificially Intelligent Robots (Humanoid Robots). Scholars frequently mix up the two concepts because of this overlap. However, the power of AI in robots makes them a one-of-a-kind object, with all industries recognising the need to integrate them into their services. Tella (2020) noted that AI and robotic technology, like other disruptive technologies, have revolutionised the delivery of information services in libraries in various ways. Libraries have used robots for internal operations as well as public services, in addition to automated information storage and retrieval.

Robotics has an immediate impact on libraries and the larger information (and social) environment in which libraries and librarians of all types work (Owolabi *et al.*, 2022). The presence of robots in libraries gives librarians more time to focus on other important information service delivery to today's dynamic needs. Some of the areas where robotic technologies have been applied to library operations, according to Harisanty *et al.* (2020), include shelving and locating library materials, security, inquiries and answering of repetitive reference and directional queries, outreach and public relation (PR) via library tour and even information illiteracy instruction. Additionally, robots are useful for automated storage and retrieval systems, which have aided in the management of library space (Echedom and Okuonghae, 2021).

In recent years, the increased desire for access to knowledge has aided the growth of societies, and libraries are the primary source of this access. The rapid advancement of computer technology and software applications, particularly AI in humanoid robots, has necessitated a proportionate supply of the same technologies for libraries, resulting in a paradigm shift in the format and dynamics of information and knowledge (El Kadiri *et al.*, 2016). Libraries may become obsolete in the 21st century if they do not begin to harness new technology and improve their information and service delivery. Robots come in a variety of shapes and sizes, and they serve a variety of functions. It is difficult to define the purpose of a specific robot and its categories because each robot has its distinct feature and varies in size, shape, colour and components. An attempt has been made to categorise various types of robots based on their areas of application. Examples of robotic services relevant to libraries follow.

Shelf reading robots can locate missing or out-of-sequence books on the shelves. Cox (2021) explained that after the library closes, robots can autonomously scan the print collection by detecting radio frequency identifier (RFID) tags embedded in the books. Shelf-reading robots use a self-localization algorithm to analyze the digital data collected against the library's collection database to identify books that are mis-shelved missing which is about 5% of the library collection. Most importantly, it addresses the perennial customer complaint of not being able to locate a book in the library. The item locations collected from the daily scan are integrated with the library catalogue.

Fernandes *et al.* (2021) proposed a line follower delivery robot that follows a pre-determined path to deliver books to users. Robots can also be used to take inventory of the library using RFID and barcode technology (BomblePranit & Dipika, 2015). Tay (2014) investigated robotic applications for the easy and efficient delivery of newspapers, journals, books and brochures, among other things, at the Temasek Polytechnic Library.

Chatbots consists of a user interface, usually a website or a messaging platform that can receive textual input and pass it on a natural language processing (NLP) layer that attempts to break down phrases into entities and intents of the query. A chatbot is more of a user interface, typically a website or messaging platform, that can receive textual input and pass it on to an NLP layer, which attempts to break down phrases into entities and query intents (Alli, 2019). Once the intent has been determined, a response is generated by using the relevant knowledge base and, in some cases, an external Web service for more complex requests. Chatbots can be easily created on various platforms and targeted to a wide range of users with little effort. Chatbots can help users search for books on a library's website, send out reminders when a book is due, direct users to relevant library resources, answer simple information requests and refer more complex reference questions to librarians.

Humanoid robots

Humanoid robots, also known as "social robots", are the next generation of robots that can perceive their surroundings, recognise faces, read emotions and communicate with humans, according to Nguyen (2020). According to Schaffhauser (2019), a "humanoid" is a human-like robot that can converse, dance, tell a story and teach children and adults to code. Humanoid robots can also be used for outreach and public relations by acting as library greeters or concierges. According to Schaffhauser (2019), the robot can locate the source of a sound and move towards it; it can perform face recognition for gender, age and mood; it can detect breath; and it can change the lights in its eyes and ears. When a person touches a head sensor, the robot can go to sleep or wake up. The robot has been programmed to give itself a name, explain where it came from, what the weather forecast is and when the robot or various library users celebrate their birthdays.

Certain people, such as library staff, can also be recognised by the robot. They are human-like robots that strike up a conversation, dance or tell a story. It is a robot used in public libraries to teach kids and adults coding and library instructions, among other job duties. These robots resemble humans in appearance. The Roanoke County Public Library, for example, has a Pepper robot (Jones, 2018). This type of robot is capable of responding to various types of library queries. *Telepresence* enables the librarian and the student to see each other and allows students to approach a librarian with a question they might otherwise be too embarrassed to ask.

Children and young adults will soon have robotics as part of their working lives, so it is the responsibility of the libraries to make sure that all children have opportunities to interact with robots in several programs, using different types of robots to keep up with a range of skills, and a range of coding opportunities that libraries offer. Makerspaces in libraries can host a robotics club and teach children

how to code with robots. In libraries, robots are used to browse printed materials in real time via a Web interface. The user will activate the system, which will then launch a robot to retrieve the requested item (OkpokwasiliNonyelum, 2019). The robot will deliver this item to another robotic system, which will open it and turn the pages automatically, as well as lead students to the appropriate bookshelves and retrieve newspapers from any time and date (Norwin, 2020).

For children, robots can help in teaching coding classes, telling stories and helping out with show and tell sessions. Robots are also believed to have a positive influence on autistic children for instance (Nguyen, 2019). Robots can make kids more confident, with this they can develop affection, love it and want to interact with it. This leads to a new learning experience because many participants speak a second language and they have great fun practising English with the robot. But the thing is, robot does not understand their accent, so they must adjust their voice to be understood. The robots can encourage English as a second language for students to prectice their English. A good example is Pepper, a new member of the crew at Carroll County Public Library in Maryland, who is a "humanoid", a human-like robot, who can strike up a conversation, dance or tell a story. The humans around Pepper control "her" actions using Choregraphe, a drag-and-drop interface (Schaffhauser, 2019). Nguyen (2019) explained that Humanoid robots are made to perform a series of activities in the libraries which include attracting people, entertaining them and encouraging them to join the library community.

Das and Islam (2021) proposed using an expert system in the reference section to help patrons find answers to specific questions in the recommended sources. With the help of the system, students can learn how to reference. A library-enabled expert system can help you solve problems in a variety of areas. Most will focus on narrow domains, with a focus on local issues. Schreur (2020) proposed a robotics system in the library for effective book delivery to patrons.

Concluding remarks

Public libraries should develop a strategic plan for new and emerging technology like humanoid robots in partnership with their parent institutions/organisations. They should also work more closely with other stakeholders, such as universities and robotics centres with roboticists. To take advantage of direct support, public libraries and local government councils should enhance their partnerships with robot vendors. Library management boards and librarians should maintain open lines of communication, especially when it comes to issues with humanoid robots. Humanoid robots in libraries are still a work in progress for the community and other stakeholders; therefore, more efforts should be intensified to let them go around all the libraries globally.

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