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AI-Powered Robots for Libraries: Exploratory Questions

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Abstract:

With recent developments in machine learning, a subfield of artificial intelligence (AI), it seems no longer extraordinary to think that we will be soon living in the world with many robots. While the term, 'a robot' conjures up the image of a humanoid machine, a robot can take many forms ranging from a drone, an autonomous vehicle, to a therapeutic baby seal-bot. But what counts as a robot, and what kind of robots should we expect to see at libraries?

AI has made it possible to make a robot intelligent and autonomous in performing tasks not only mechanical but also cognitive, such as driving, natural language processing, translation, and face recognition. The capability of AI-powered robots far exceeds that of other simpler and less sophisticated machines. How we will be interacting with these robots once they came to be in the world with us is an interesting question. Humans have a strong tendency to anthropomorphize creatures and objects they interact with, many of which are less complex than a robot. This suggests that we will be quite susceptible to projecting motives, emotions, and other human traits onto robots. For this reason, the adoption of robots raises unique concerns regarding their safety, morality, their impact on social relationships and norms, and their potential to be used as a means for manipulation and deception.

This paper explores these concerns related to the adoption of robots. It also discusses what kind of robots we may come to see at libraries in the near future, what kind of human-robot interactions may take place at libraries, and what type of human-robot relationship may facilitate or impede a library robot's involvement in our information-seeking activities.

Keywords: artificial intelligence, human-robot relationship, morality, safety, manipulation

1. What Counts as a Robot?

With recent rapid developments in machine learning, a subfield of artificial intelligence (AI), it is no longer extraordinary to think that we will be soon living in the world with many robots around us.[1] The term 'a robot' often conjures up the image of a humanoid machine. But a robot can take many forms ranging from a drone and an autonomous vehicle to a therapeutic baby seal-bot.[2] Since robotics is an established discipline, it is often assumed that roboticists have an agreed upon definition of a robot. However, this is not the case. Does a robot need to look like a human? Does it have to have a physical body? Does it have to be smart? Surprisingly enough, what counts as a robot is not an entirely settled topic.

When loosely used, the term, 'robot,' may refer to anything that can be programmed to move, no matter how simple it is. Sometimes, even software designed to automate tasks is called a bot. But in most cases in which we refer to something as a 'robot,' we want to distinguish it from a piece of software or a typical machine. George Bekey proposes an intuitive and reasonable working definition of a robot, which I will adopt in this paper. He defines a robot as "a machine, situated in the world, that senses, thinks, and acts."[3] This means that a robot must have the capability to take in sensory input from the surroundings, process it for a cognitive task, and act upon the physical world.[4] This requires a robot to be equipped with sensors, some cognitive capability to process the input from the environment and to determine the response or an action, and actuators, which allow it to physically act upon the environment.

In this definition, it is not necessary for a robot to take a human form. But a robot must be embodied, able to sense the surroundings, and act on the physical world. Consequently, a piece of software cannot be a robot. Nor does a machine that lacks the sensing capability, a certain level of cognitive processing capability, or the ability to perform its tasks autonomously up to a certain degree.

AI has made it possible to make a robot intelligent and autonomous in performing tasks not only mechanical but also cognitive. Such cognitive tasks include driving, natural language processing, translation, and face recognition. The capability of AI-powered robots far exceeds that of other simpler and less sophisticated machines. Unlike humans and some other living beings, robots do not have consciousness, desire, or motives. Their intelligence comes from a program, not from internal mental states. But humans have a strong tendency to anthropomorphize a variety of objects they interact with, many of which are less complex than a robot. This suggests that we will be quite susceptible to projecting motives, emotions, and other human traits onto robots. As such, the adoption of robots raises interesting and unique concerns regarding their safety, morality, the robot's impact on social relationships and norms, and their potential to be used as a means for manipulation and deception.

In this paper, I will explore these concerns in the hope of facilitating more discussion and research regarding robots for libraries. At a time when libraries may soon adopt robots more widely, it is important to understand these general concerns related to the adoption of robots. I will also briefly discuss what kind of robots we may come to see at libraries in the near future, what kind of human-robot interactions may take place at libraries, and what type of human-robot relationship may facilitate or impede a library robot's involvement in our information-seeking activities.

2. General Concerns about the Adoption of Robots

As an embodied and intelligent autonomous agent in the world, a robot's capability far exceeds that of other simpler and less sophisticated machines. As such, robots will no doubt bring many benefits. But their adoption also raises concerns regarding their safety, morality, their impact on social norms, and their potential to be used as a means to deceive or manipulate people.

(a) Safety

It goes without saying that a robot must be thoroughly tested for its safety before being deployed. This is particularly important because a robot may autonomously perform not just one but a variety of tasks in many different environments. How can a robot be designed to ensure that it would not harm humans either by accident or while trying to achieve its goal? Will a robot be able to handle unforeseen consequences? While a robot may be much more sophisticated than a simple machine, it is still a machine. A kill switch that enables the user to quickly and easily power off a robot and an override option for the user to take control when needed should be part of the design in case of malfunction.

Also, depending on its function, a robot can come equipped with a varying degree of autonomy and technical sophistication. Some may be fully autonomous and be intervened by humans only when people decide to do so. Others may require a human review and approval process before executing the planned action. These different control options are known as a 'human-on-the-loop' and a 'human-in-the-loop' system.[5] How a robot is to be configured will depend on the specific type of task that it is supposed to perform and the risks associated with the given task. The safety concern efficiency and the cost-savings to be gained from a robot's autonomy will need to be weighed and balanced with each another.

(b) Morality

The moral and ethical dimension of machine intelligence is an issue that we must give careful and serious consideration before we adopt and deploy robots widely. If machine learning techniques drive today's artificial intelligence (AI) technology to the degree that AI systems can partly or fully automate human decision-making, to what use should we put those systems and how much control should we allow them? This is an important question since AI-powered robots are likely to be adopted in a wide range of areas from healthcare to the military.

The most frequently discussed example in the discussion of machine morality is an autonomous vehicle and *the trolley problem*. *The trolley problem* is a thought-experiment in philosophy first introduced by Philippa Foot in 1967.[6] It describes a scenario in which a runaway trolley barrels down a track where there are five unsuspecting people. Suppose that you are standing next to the lever. When pulled, the lever switches the trolley onto a different track, on which there is only one person. Those who are on either track will be killed if the trolley heads down in that direction. Should you pull the lever to minimize the number of lives that will be lost?

The trolley problem has been a mere theoretical issue for a long time. Due to the lack of time, people will simply act out of instinct rather than from any clear deliberation or decision, in a real-life situation. But, with the self-driving car, *the trolley problem* becomes a matter of programming a required decision-making process in advance into an autonomous machine. A

machine does not panic or hesitate. It will simply follow and execute the given instruction as swiftly as it can. Engineers now have an opportunity to program a self-driving car to act always morally whenever an unfortunate case such as *the trolley problem* transpires. The question of whether an autonomous trolley should swerve to the track where there are a smaller number of people, however, remains unresolved.

Since military robots can take human lives, they present the problem of programming morality into a machine in an even more compelling manner. There are many different types of military robots. Some identify and dispose explosive devices. Others perform scouting tasks. There are also military drones and sentry robots that are capable of automatic targeting and shooting enemies. Automated defense systems, such as Goalkeeper CIWS and Aegis, protect a military ship by automatically surveilling, detecting, and destroying incoming threats. While many military robots are remotely controlled by their human operators, some of them already come equipped with the capacity to engage in military actions without a human operator being involved in the process.[7]

These autonomous military robots generate a greater physical and psychological distance from killing. This will desensitize us to harming and killing other human beings. For this reason, they can potentially make killing easier for us to perpetrate. It also poses the grave moral risk of surrendering the life-and-death decisions required on the battlefield to an AI-powered robot.[8] Countries and terrorist groups may also become more inclined to initiate an armed conflict, believing that it is likely to bring fewer casualties, only to increase overall violence in the world as a result.

How to program morality into a robot has started gaining attention among researchers and engineers. But the solution appears still elusive. In order to address the issue of machine morality and an artificial moral agent, we will need to first determine what level of autonomy and ethical sensitivity a robot is equipped with and to consider what level of machine morality may be feasible and appropriate for the given robot.[9] Not every robot may need the capability of being a fully moral agent. But the impact of having robots as another social agent in our world should be given a thorough examination. Considering their embodied nature and high level of autonomy, we should start investigating how our relationship may and should look like with these robots as the members of our society.

(c) The Human-Robot Relationship and Its Impact on Social Norms

People have a strong tendency to anthropomorphize creatures and objects, with which they interact. With robots acting intelligently and autonomously in the physical world, people are even more likely to attribute motives, emotions, and other human traits as if they were living beings. It has been pointed out that such anthropomorphizing can be beneficial to the robot user if it helps the robot to fulfill its intended use.[10] Suppose that a trauma victim finds psychological support from *Paro*, the baby seal robot, by treating it like a real pet. Its function as a social companion will be enhanced by this type of user behavior. Similarly, if children with the autistic spectrum disorder see the NAO robot as a social companion and friend and this makes it easier for the NAO robot to engage them, then that would facilitate the intended use of the robot.[11]

But projecting human qualities onto a robot can be harmful to the robot user and impede its intended function. For example, soldiers who treat a military ordnance disposal robot as if it were their pet or friend may act recklessly to save the robot from doing its job.[12] This would

not only make the robot an ineffective tool but also create unanticipated danger to the robot user.

These examples suggest that those who create a robot should consider what type of relationship the robot is supposed to form with its user for optimal functioning. They also illustrate the need for robot users to be aware of the fact that a robot may be designed to elicit anthropomorphic projection to perform its function.

The human-robot relationship is an area of studies ripe for further research and deeper exploration. As more robots get to be used in a personal environment, such as homes and care facilities, and to play a social role such as a companion and a caretaker, more people are likely to treat them as social agents either consciously or unconsciously. This means that regardless of the robot's lack of consciousness and human-like mental states, robot users will come to display a degree of expectation that their robots should behave as another social actor, following and acting according to social norms. We do not yet have robots sophisticated enough to behave as if they were a fully versatile social agent. However, even if they could, robots are not humans. As such, they cannot really reciprocate in the same way other human social agents would, expecting the social norms to be followed and holding others responsible when such an expectation is not met.

Does this mean that we should then strictly treat robots as tools at all times? Should we try to actively prevent robot users from developing any emotional attachment to their robots even when it facilitates the robot's intended use? These are not easy questions. It is also to be noted that the way people treat robots can affect how they treat other people or other living beings. This is why the human-robot relationship will eventually affect our social norms.

(d) Trust, Deception, and Manipulation

While a robot may seem like a person in that it has its own body and acts intelligently and autonomously, a robot is a product manufactured to fulfill a certain function. Robot manufacturers are those who decide on a robot's function, which subsequently determines the specifications of a robot's physical and cognitive processing parts. In the previous section about the human-robot relationship, I suggested that either consciously or unconsciously, people will come to regard a robot as a social agent in our world. What is important to note is that robots are designed by robot manufacturers, who seek to maximize their profit. For this reason, robot manufacturers are likely to take advantage of people's tendency to anthropomorphize robots.

Suppose that a human user gets attached to its care robot, and the robot manufacturer charges an unreasonably high amount of fee for the robot's software upgrade.[13] The human user is likely to succumb to it. Similarly, a human user of a companion robot, with which she or he has formed an emotional bond, will have a hard time refusing a suggestion from the robot to buy something if the robot - that is, its software - tries to persuade the user to do so. If a robot user confides his or her private matters in a therapy robot and if that personal data are not protected properly, the robot manufacturer may use that information to influence the user to purchase certain products, which the user wouldn't have considered otherwise.

In both cases, it is to be noted that manipulation and deception come not from a robot itself but from humans, i.e., the robot-manufacturing businesses that are run by humans. It is not a new phenomenon that companies try to make more profit by deceiving or manipulating consumers. But manipulation and deception through a robot are particularly pernicious because

it preys on people's natural inclination of caring about other social agents. The society operates because the majority of social agents follow and act upon certain social norms, treat one another with decency and respect, and trust that others will do the same. If the robot design does not take this natural human inclination and social norms into consideration, the robot manufacturers' business tactics that exploit the human-robot relationship for profit can seriously undermine overall trust in our society.

One may argue that training people to regard robots as mere tools and encouraging them to stop projecting human-like qualities onto those robots can be a solution. But the issue is not quite that simple. Suppose that we reinforce the fact that robots are inanimate objects to the public. This may lead to the mistreatment of robots. Imagine some people physically hit or kick a robot, use verbally abusive language, vandalize, and treat it like a slave.[14] Most of us would find this type of behavior disturbing and objectionable. The problem is not that such treatment would hurt robots either psychologically or physically. The real issue is that such abusive behavior should not be tolerated among social agents, who are expected to live and work together in harmony, respecting each other's role in the world.

Even if a robot does not have mental states or consciousness, its unique traits allow it to perform the role of a social agent in our society. In this sense, perhaps the robot's social role, rather than its physical characteristics, may be a more significant factor in deciding how we should treat robots. Of course, this does not mean that anthropomorphizing robots should be always encouraged. It simply means that we have to pay greater attention to how we can continue to uphold and strengthen important social values when a robot enters our world as another social agent.

3. Robots for Libraries

So far, I have outlined some general concerns about the adoption of robots in four categories: (a) safety, (b) morality, (c) the impact of robots on social relationships and norms, and (d) their potential as a means for manipulation and deception. Now, in this section, I would like to briefly discuss the likely robot adoption at libraries.

Robots are not new at libraries.[15] Many large libraries implemented a robotic system that stores and retrieves books, media, and other types of library materials.[16] *AuRoSS*, an autonomous robotic shelf scanning system developed in Singapore, self-navigates through libraries at night, scans RFID tags in books, and produces reports on missing and out-of-sequence books.[17] Some libraries also started acquiring and providing access to robots. Westport Public Library provides robot training classes for its two Nao robots.[18] Chicago Public Library lends *Finch* robots, so that library users learn how to program them.[19] San Diego Public Library held a Robot Day event to educate the public about the impact of robots on society and formed a weekly Robotics Club, where people can learn and practice building robots.[20] There are now many more libraries that offer a robotics program or support a robotics club. These efforts nicely align with libraries' interests in providing more support and outreach in STEM education and can fit well in a library makerspace.

It is important to note that here, the term, 'a robot,' is being quite liberally applied and does not follow a stricter definition, such as the one put forth by George Bekey, mentioned

earlier in this paper. In such a case, anything that can be programmed to move may be called a robot, no matter how simple it is.

None of the robots adopted at libraries so far, however, except perhaps the Nao robot, is particularly advanced or powered by the machine learning techniques of AI, to warrant the concerns that I outlined in the previous section. It would be silly to discuss the safety and morality of a Finch robot or worry about the impact of a book retrieval robot system on our social norms or its potential to be used as a means of manipulation or deception. Still, these robots have already made inroads into libraries. With recent rapid developments in AI, they are likely to get equipped with more sophisticated sensors, actuators, and cognitive processing capability. This will allow them to act in a more autonomous and versatile manner in the near future. With this in mind, here are several areas of library services and operation, where we may see the early adoption of robots.

(i) One of the most basic function that a robot can perform at a library would be greeting library visitors and answering directional questions. One can easily imagine a small Nao or a Pepper robot being deployed for this purpose.[21] The library of the University of Pretoria in South Africa has already a robot named 'Libby' playing this role.[22]

(ii) The library's access services may be another area, in which robots may come in handy. I have previously mentioned that there is already a robot, AuRoSS, developed to identify misfiled books in the library shelves. With more advanced robotics technology, robots like AuRoSS may soon be able to not only identify but also re-shelve misfiled books into correct places.

(iii) Reference could be an area for robots in libraries. With enough data and the natural language processing capability, robots will be able to answer simple reference questions. The Oklahoma University Libraries are experimenting with Alexa, a virtual assistant used in Amazon's smart speaker, to see if the library's reference service can be expanded through it.[23]

(iv) Robots may be able to provide the basic readers' advisory service and point to the location of a book that a library user wants to check out. These services do not have to be delivered by a robot and can be provided as an applicaiton on a smartphone or a computer. But a robot has the potential to add more interaction to this service and perhaps to bring better user experience along with it.

(v) For children's' librarians, a reading robot could be a useful assistant. There is already a reading robot developed for this purpose. 'Luka,' a small AI-powered robot, can read aloud picture books put in front of it.[24] Researchers at the University of Wisconsin-Madison in the United States also built a reading companion robot, named 'Minnie.' Minnie guides and interacts with middle school students and can react or make comments about the story that they are reading.[25]

Now, with these kinds of robots at libraries, what kind of human-robot interactions may take place between library patrons and library robots? These robots are likely to play the role of an assistant and a companion that help library users with accomplishing a variety of tasks. For this reason, the relationship between those robots and library patrons is likely to be positive and friendly. In certain types of library robots, such as a reading companion robot or a reference service robot, a certain level of bonding between library patrons and those robots may facilitate

the robot's intended use. If library patrons treat these robots strictly as a tool and interact with them only as such, that is likely to result in those robots' full capacity and function being under-utilized.

Would this mean that libraries should encourage library patrons to form a bond with a library robot? How would the general concerns in the adoption of robots described above apply to library robots? A library is to be a space that is safe to all library users both mentally and physically, strives to provide the public with free and equal access to information, empowers people through knowledge, protects people's intellectual freedom, and helps them exercise their right to pursue information and knowledge privately without being monitored or surveilled by a third party. In order to help the library achieve this mission, library robots, particularly those that will be involved in library patrons' information-seeking activities, may be required to follow stricter guidelines than robots deployed in other areas are. But perhaps such stricter guidelines would be beneficial to all robots in general.

While there are some robots already being introduced to libraries, more sophisticated, versatile, and autonomous robots are likely to enter our homes, workplaces, and libraries as the AI technology advances. Neither our society nor libraries yet fully understand how the wide adoption of robots would affect us. But it is clear that as a new type of social agent, robots will generate a lot of interesting questions, which are perhaps more about us, humans, than robots.

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