Advancement of Artificial Intelligence and Human-Robot Interaction

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December 3, 2017

***Abstract*—Human and Artificial Intelligence (AI) collaboration challenges society to consider the outcomes of multiple models of cognitive computing. This collaboration of man and machine is also referred to as Human-Robot Interaction (HRI)[3]. Rapid advancements in cognitive computing technology necessitate this literature review of AI and HRI, which aims to define the relevant terminology, overview AI architecture, and analyze the positive and negative implications of the expected future of HRI.**

INTRODUCTION

Day by day we are coming closer to the future where human-like robots will be something usual to have around. We need to understand how are they programmed to collaborate with us smoothly and naturally. HRI is working to introduce us to human-like robots. They are not only what we see in science fiction movies or something hidden in secret research labs. Human-like robots are very common in manufacturing and industry today. Most of these robots do not have direct interaction with humans for safety reasons. To achieve the goal in HRI, the collaboration and safety became a significant research topic since the beginning of robotics.

These Robots are not created to recreate humans or replace us. They are created to work for or with humans on an everyday basis[6].

I. UNDERSTANDING AI

A. What is AI

AI is defined as a subfield of computer science which designs computers and systems capable of performing decisions, actions, or other responses in correspondence to human cognition[5]. Other names for AI include "deep learning, cognitive computing, machine learning, and machine intelligence."[5] The Association for the Advancement of Artificial Intelligence (AAAI) defines AI as "the scientific understanding of the mechanisms underlying thought and intelligent behavior and their embodiment in machines."[5]

First mentioned by John McCarthy in 1956, the term AI is also defined as "the capability of a computer program to perform tasks or reasoning processes that we usually associate to intelligence in a human being."[2] However, as further discussed in this literature review, this association with human intelligence does not mean that machines are capable of human-level intelligence: "It is clear that this is a strange definition because it depends on what we consider being intelligent."[2] According to Francesca Rossi, it is not expected that machines will achieve human-like intelligence. [2]

B. How society sees AI

The public remains mistaken, misinformed or largely uninformed about the architecture and functionality of AI, and many people mistrust the potential abuse or uncontrollability of its widespread use [5]. Tesla engineer and SpaceX founder and CEO, Elon Musk, has warned that AI, if not stringently maintained under human control, could threaten humanity [5]. It is likely that lawmakers will stringently regulate AI and HRI expansion due to public concerns about privacy and safety [5]. The following doubts about AI are prominent: AI will reduce employment, dumb down humans, reduce privacy, facilitate bias/abuse, and eventually annihilate mankind in a Hollywood-movie-like scenario [5]

However, the concept of AI as threatening to the future of mankind distances the technology from the creator, and considers it an uncontrollable external risk. From a more optimistic standpoint, AI is meant for humans to use like any other tool, to advance the well-being of all people:

> ...AI is like a shovel or a tractor: It is a tool in the service of humans, making our lives vastly better. And given the promise that AI holds for economic growth and societal advancement, it is critical that policymakers actively support its further development and use. The cost of not developing artificial intelligence or developing it more slowly will be enormous[5].

Despite the many apprehensions regarding AI and RHI expansion, lawmakers from across the globe are well-aware of the competitive necessity of this technology for contending in the data-saturated economy of tomorrow.

II. HUMANOIDS

A. What are they?

The main objective of developing a humanoid robot is the close cooperation with humans. It is logical to create a machine with human-like intelligence which has a human-like body in order to emulate physical, cognitive, and social skills that humans do[6].

First human-like robot was created in 1973 at the Waseda University in Tokyo by Ichiro Kato. It consisted of a limb-control system, a vision system and a conversation system.[6].

First humanoid to walk out from laboratory on its own was Asimo by Honda in 1986.

Since that time the evolution of human-like robot brought us to this day where we can witness the first citizenship given to the humanoid robot.

The most advanced humanoid - Sophia: Sophia the human-like robot was designed by Hanson Robotics, and has been leading the way for AI technology – she's addressed several technology conventions, asserting that "AI is good for the world".

Sophia has a female face and is able to show emotions. She speaks English and makes jokes. Sophia can hold a reasonably intelligent conversation.

The kingdom of Saudi Arabia officially granted citizenship to the humanoid robot October, 2017[10].

B. Advantages

Several advantages keep the researchers and scientists motivated to create and interact with more and more advanced and intelligent robots.

One of the biggest use of these robots is their ability to go to another planets and explore the space in a way where human could not go for safety reasons[9].

The robot can also perform the tasks faster and can be more productive.

They do not require to sleep or take breaks.[9].

Robots can do the jobs where people could harm themselves or even put their lives in danger.

C. Disadvantages

One worry people have about humanoid robots is that they will replace jobs[6]. This situation can lead to unemployment[9].

Another disadvantage to humanoid robots could be the price. Robot costs big amount of money in build and repair. Also software and the body need to be updated to fit the changing requirements[9].

There always has to be another machine to replace the origin in case of the breakdown.

The biggest disadvantage effecting society would be our dependency on robots. People would become lazy and loose their interest in development of own intelligence as the robot will always make the smarter decisions.

III. Advancement in Human and Robot collaboration

Along with apprehensions about widespread usage of robots, three major challenges have been identified for HRI: communication, joint action, and human-aware execution, all of which rely on the robot having a "symbolic belief state," "prior common-sense knowledge," and a mental knowledge model of human agents[5]. Through "symbolic grounding,"[5] HRI must be able to reflect, acquire, and alter or update symbolic belief states to make decisions execute actions "with respect to the state of the world and the task at hand."[5] These functions and capabilities are centered on theory of mind[5]. The architecture of HRI is such that the development of robot capability requires the collaboration of man and machine, working complimentary to each other, with humans providing many examples for the robot to observe and assimilate.[2]

Highly invested proponents of AI, such as IBM, are working diligently to maneuver public perception towards trust in cognitive computing systems. According to the Vice President for the Government and Regulatory Affairs at IBM, the "Rise of the Machines" scenarios are not possible: "These scenarios have something in common: they oversimplify and misrepresent an important and broader set of transformative technologies that hold great promise for business and society."[1] IBM Watson, an AI built to improve business data management systems, and designed to work collaboratively with human input and interaction, is a real example of RHI already in action.

RHI, conceived as a complimentary collaboration of man and machine, is meant to enhance human intelligence, not supersede it.[1] The term "intelligence" is, of course, differentiated between computer and human intelligence, although the overlap of imagery and terminology can cause confusion for the public: "To be sure… 'intelligence' can vary greatly, and the term does not automatically imply human-level intelligence. Indeed, your dryer is intelligent if it shuts off when it senses your clothes are dry."[5] Some other examples of "intelligent" computing tasks include playing chess, performing a medical diagnosis, driving a car in traffic, writing a new mathematical theorem or even creating art[2].

Despite accelerating advancements in AI and HRI, there will always remain tasks which are easier for humans to perform, such as image identification[2]. Nevertheless, AI and HRI are becoming increasingly beneficiary as the extension of data volume accelerates, resulting in a type of "cognitive overload."[1] For that reason, AI is also defined by its decision-making capability "when there is uncertainty or vagueness, or too much information to handle."[2] Navigating the vast amounts of data will require human input.

To manage such immense amounts of information, IBM envisions the widespread implementation of a network of cognitive computing systems called the Internet of Things being navigated with the assistance of HRI.[1] IBM's vice president for cognitive computing claims that, in the future, professionals will customarily use HRI in daily tasks: "This is nothing to be fearful of; it is an evolution, and I think it is going to be much better for the world."[5]

Conversely, critics of HRI expansion claim that a reliance on AI will reduce human skills.[5] Automated driving systems will decrease or eliminate the amount of time that people practice driving, and automated medical diagnosis systems may decrease doctors' abilities to correctly diagnosis patients without robot assistance; however, according to proponents of HRI, decreases in skill levels without HRI will be vastly outweighed by the statistically significant error reduction with

HRI[5]:

> Since most car accidents are due to human fault, it is estimated that the adoption of self-driving cars will save about half of the lives that are usually lost in car accidents, which totals around 40,000 each year in the US. Some of us may be reluctant to hand over the wheel to an AI system, but very soon we may wonder why we did not do it sooner![2]

A. Social Robots

The types of AI designed to mimic and interact with humans (such as the IBM Watson) are called "social robots."[3] In the current context, robot cognition is modeled after human cognition to facilitate the interaction, and make it more comfortable for humans. Robot decisions and actions are designed to be "both legible to and in coordination with humans."[3] Social robots are designed to assimilate human thought and behavior, and to learn and make decisions based on interaction with humans. We can see few examples of successful human and social robot collaboration today. Most of them are used in therapy, like Zeno. It is a new generation robot designed to help children with autism. Zeno builds a bridge between an adult and an autistic child. Robots like Zeno help kids to learn reading, story telling, social interaction and most important, they comfort children in communication with doctors or other scary situations. Another advanced therapy robot called Paro is a seal robot. It is used mainly in nursing homes. Paro is very cute looking robot and responsive to human touch. Researchers found that Paro increases interaction between people in nursing homes and also works as a calming medication to reduce stress and anger.

B. Future

Policymakers have acknowledged the potential and have begun planning for the impact of AI and HRI expansion into private and public use. A briefing by the European Parliament appeared particularly optimistic about the possible outcomes of AI and HRI expansion: "The ability of AI systems to transform vast amounts of complex, ambiguous information into insight has the potential to reveal long-held secrets and help solve some of the world's most enduring problems."[3] The phrase "long-held secrets" implies that knowledge about the world which was previously incomprehensible to mankind will be revealed through HRI.

The U.S. National Science and Technology Council likewise noted the powerful potential of AI and HRI, claiming that this transformative technology will "revolutionize how we live, work, learn, discover, and communicate."[4] The US plans to make long-term investments in AI research, and develop methods for implanting HRI effectively and efficiently.[4] The US strategy also focuses on ensuring the security of cognitive computing systems:

> Before AI systems are in widespread use, assurance is needed that the systems will operate safely and securely, in a controlled, well-defined, and well-understood manner. Further progress in research is needed to address this challenge of creating AI systems that are reliable, dependable, and trustworthy.[4]

The European Parliament also emphasized the importance of ethics and public trust in AI, which will require cognitive computing systems to be accountable, reliable, and programed with "ethics modules."[2]

CONCLUSION

This literature considered the significant current and future impacts of AI and RHI. Machine-man collaboration is expected to change almost every aspect of society, and this challenges society to implement AI and RHI in an efficient and ethical manner. Researchers along with society have multiple questions and concerns about the future filled with AI. The progress is being made every day and today is the future shown in science fiction movies.

According to Musk, the billionaire and inventor, who gave the world Tesla cars - artificial intelligence is a "fundamental risk to the existence of human civilization."[10]

Every new technology we can relate to fire discovery by human 2 million years ago. It will not get dangerous if we understand how to use it with sense, and while we are trying to understand the collaboration between us and technology, scientists all over the world are competing to recreate the human race in metal, plastic and silicone.

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