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Critical Review of Robots and Humans Interaction

Henry Anthony, Maddison Luna and Joseph Penelope

Computer science Colombia University New York, USA

ABSTRACT

This article shows the critical review of robots and human interaction. A robot is a machine especially one programmable by a computer capable of carrying out a complex series of actions automatically The idea of automata originates in the mythologies of many cultures around the world. Engineers and inventors from ancient civilizations, including Ancient China,[16] Ancient Greece, and Ptolemaic Egypt, attempted to build self-operating machines, some resembling animals and humans. The growing popularity of robotic automation across a wide range of sectors looks set to continue over the next few years, as businesses look to take advantage of the many benefits it offers. Manufacturers in the UK are starting invest more in the technology in preparation for our departure from the EU, allowing them to maintain their competitive edge in the market. Naturally, not everyone has been convinced of the advantages robotic automation can deliver. There is still some cautiousness about adapting an existing production line, with some reasonable objections posed by those yet to try the technology. To address both sides of the discussion, we have put together a few brief advantages and disadvantages of using robotic automation.

Keywords: Critical, review, Robots, Humans, interaction.

INTRODUCTION

A robot is a machine especially one programmable by a computer capable of carrying out a complex series of actions automatically [1]. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed on the lines of human form, but most robots are machines designed to perform a task with no regard to their aesthetics. Human robot interaction has been a topic of both science fiction and academic speculation even before any robots existed. Because HRI depends on a knowledge of (sometimes natural) human communication, many aspects of HRI are continuations of human communications topics that are much older than robotics.

Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's Advanced Step in Innovative Mobility (ASIMO) and TOSY's TOSY Ping Pong Playing Robot (TOPIO) to industrial robots, medical operating robots, patient assist robots, dog therapy robots, collectively programmed swarm robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nano robots. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. Autonomous things are expected to proliferate in the coming decade,[2] with home robotics and the autonomous car as some of the main drivers [3].

The branch of technology that deals with the design, construction, operation, and application of robots,[4] as well as computer systems for their control, sensory feedback, and information processing is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. These robots have also created a newer branch of robotics: soft robotics. With the advances of artificial

intelligence, the autonomous robots could eventually have more proactive behaviors, planning their motion in complex unknown environments. These new capabilities keep safety as the primary issue and efficiency as secondary. To allow this new generation of robot, research is being conducted on human detection, motion planning, scene reconstruction, intelligent behavior through task planning and compliant behavior using force control (impedance or admittance control schemes).

From the time of ancient civilization there have been many accounts of user-configurable automated devices and even automata resembling animals and humans, designed primarily as entertainment. As mechanical techniques developed through the Industrial age, there appeared more practical applications such as automated machines, remote-control and wireless remote-control.

The term comes from a Czech word, robota, meaning "forced labor";[5] the word 'robot' was first used to denote a fictional humanoid in a 1920 play R.U.R. (Rossumovi Univerzální Roboti - Rossum's Universal Robots) by the Czech writer, Karel Čapek but it was Karel's brother Josef Čapek who was the word's true inventor. Electronics evolved into the driving force of development with the advent of the first electronic autonomous robots created by William Grey Walter in Bristol, England in 1948, as well as Computer Numerical Control (CNC) machine tools in the late 1940s by John T. Parsons and Frank L. Stulen. The first commercial, digital and programmable robot was built by George Devol in 1954 and was named the Unimate. It was sold to General Motors in 1961 where it was used to lift pieces of hot metal from die casting machines at the Inland Fisher Guide Plant in the West Trenton section of Ewing Township, New Jersey [6].

Robots have replaced humans in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments such as outer space or the bottom of the sea. There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising technological unemployment as they replace workers in increasing numbers of functions [7]. The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the future.

The origin of HRI as a discrete problem was stated by 20th-century author Isaac Asimov in 1941, in his novel I, Robot. He states the Three Laws of Robotics as,

- A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- A robot must obey any orders given to it by human beings, except where such orders would conflict with the First Law.
- A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

These three laws of robotics determine the idea of safe interaction. The closer the human and the robot get and the more intricate the relationship becomes, the more the risk of a human being injured rises. Nowadays in advanced societies, manufacturers employing robots solve this issue by not letting humans and robots share the workspace at any time. This is achieved by defining safe zones using lidar sensors or physical cages [8]. Thus the presence of humans is completely forbidden in the robot workspace while it is working.

The goal of HRI research is to define models of humans' expectations regarding robot interaction to guide robot design and algorithmic development that would allow more natural and effective interaction between humans and robots. Research ranges from how humans work with remote, tele-operated unmanned vehicles to peer-to-peer collaboration with anthropomorphic robots. Many in the field of HRI study how humans collaborate and interact and use those

studies to motivate how robots should interact with humans.

History of Robots and Human Interaction

The idea of automata originates in the mythologies of many cultures around the world. Engineers and inventors from ancient civilizations, including Ancient China,[9] Ancient Greece, and Ptolemaic Egypt, attempted to build self-operating machines, some resembling animals and humans. Early descriptions of automata include the artificial doves of Archytas, [10] the artificial birds of Mozi and Lu Ban, a "speaking" automaton by Hero of Alexandria, a washstand automaton by Philo of Byzantium, and a human automaton described in the Lie Zi. Robots are artificial agents with capacities of perception and action in the physical world often referred by researchers as workspace. Their use has been generalized in factories but nowadays they tend to be found in the most technologically advanced societies in such critical domains as search and rescue, military battle, mine and bomb detection, scientific exploration, law enforcement, entertainment and hospital care [11].

These new domains of applications imply a closer interaction with the user. The concept of closeness is to be taken in its full meaning, robots and humans share the workspace but also share goals in terms of task achievement. This close interaction needs new theoretical models, on one hand for the robotics scientists who work to improve the robots utility and on the other hand to evaluate the risks and benefits of this new "friend" for our modern society.

This research is focusing on one part towards the safest physical interaction but also on a socially correct interaction, dependent on cultural criteria. The goal is to build an intuitive, and easy communication with the robot through speech, gestures, and facial expressions.

Dautenhahn refers to friendly Human–robot interaction as "Robotiquette" defining it as the "social rules for robot behaviour (a 'robotiquette') that is comfortable and acceptable to humans"[12] The robot has to adapt itself to our way of expressing desires and orders and not the contrary. But every day environments such as homes have much more complex social rules than those implied by factories or even military environments. Thus, the robot needs perceiving and understanding capacities to build dynamic models of its surroundings. It needs to categorize objects, recognize and locate humans and further their emotions. The need for dynamic capacities pushes forward every sub-field of robotics.

Furthermore, by understanding and perceiving social cues, robots can enable collaborative scenarios with humans. For example, with the rapid rise of personal fabrication machines such as desktop 3d printers, laser cutters, etc., entering our homes, scenarios may arise where robots can collaboratively share control, co-ordinate and achieve tasks together. Industrial robots have already been integrated into industrial assembly lines and are collaboratively working with humans. The social impact of such robots have been studied [13] and has indicated that workers still treat robots and social entities, rely on social cues to understand and work together.

On the other end of HRI research the cognitive modelling of the "relationship" between human and the robots benefits the psychologists and robotic researchers the user study are often of interests on both sides. This research endeavours part of human society. For effective human – humanoid robot interaction[3] numerous communication skills[4] and related features should be implemented in the design of such artificial agents/systems.

Advantages of robots

The people should know the importance of robots to help them to determine when to use and when to not use robots, Robots can go to the planets, They can be used to explore the space, They can spy on the people in ways the people can't move and from views the humans can't reach.

Robots can go far down into the unknown places where the humans would be crushed, They can give us the information that the humans can't get, They can work

at places 24/7 without any salary and food, Plus they don't get bored.
Robots can perform the tasks faster than the humans and much more consistently and accurately, They become more common each and every day, The robotic pets can help the patients with depression and they keep them active.
Most of robots are automatic so, they can move without any human interference, They can entertain us and they can help us in certain tasks, You can send them to a dangerous environment such as the deep sea or the war-zones.
You can use robots to produce the products in the factories such as assembling the cars, They can also be used to build the parts for many products such as the plane parts, the car parts & the construction supplies.
Robots do anything which we need to be precise & accurate, New jobs are created because the people have to fix and design robots, Robots can work without sleep, So, they can work 24/7/365.
Robots can endure a hostile environment of interplanetary space, They are made that the planetary atmospheres do not affect their physical state & performance, They can replace the human beings in many areas of work, They can shoulder greater responsibilities and they can be programmed to manage themselves.
Robots can be programmed to reach the Earth's nadir, They can be used to dig for the fuels, They can be used for mining purposes, They can be harnessed for exploring the depths of oceans, They can be used to overcome the limitations that humans have.
Robots can be used in carrying out repetitive & time-consuming tasks efficiently, They are used to do dangerous tasks, They can adjust their parameters like their speed & time, They can act quickly, unaffected by the factors that affect the humans.
Robots do not require to sleep or take breaks, They are able to function without stopping, When employed to carry out dangerous tasks, the risk to the human health & safety is reduced, They can work a long time without service or maintenance and they can be more productive than the people.
Robots cannot tremble or shake as the human hands do, They can have much smaller & versatile moving parts than the people, They have performed medical surgeries because they can be faster and more precise than the people.
Robots are designed to work in harsh environments like in space, without the air, underwater & in the fire, They can be used instead of the people when the human safety is a concern, They can come in any size, Whatever size needed for any task can be created.
Robots can do the jobs that the people are unwilling to do, many robotic probes have been sent throughout the solar system to never return back to Earth, They can be stronger than the people, Robots in the warfare eliminate putting more people at risk.

Disadvantages of robots

Robots need a supply of power, The people can lose jobs in factories, They need maintenance to keep them running, It costs a lot of money to make or buy robots, The software and the equipment that you need to use with the robot cost much money.
Robots cost much money in maintenance & repair, The programs need to be updated to suit the changing requirements, the machines need to be made smarter, In case of breakdown, the cost of repair may be very high, The procedures to restore lost code or data may be time-consuming & costly.
Robots can store large amounts of data but the storage, access, retrieval is not as effective as the human brain, They can perform repetitive tasks for a long time but they do not get better with experience such as the humans do.
Robots are not able to act any different from what they are programmed to do, With the heavy application of robots, the humans may become overly dependent on the machines, losing their mental capacities, If the control of robots goes in the wrong hands, Robots may cause the destruction.
Robots are not intelligent or sentient, they can never improve the results of their

jobs outside of their predefined programming, They do not think, They do not have emotions or conscience, This limits how the robots can help & interact with people.

Robots can take the place of many humans in factories, So, the people have to find new jobs or be retrained, They can take the place of the humans in several situations, If the robots begin to replace the humans in every field, They will lead to unemployment.

Humans fear robots, Robots inspire two types of fear: firstly, that they might take over our jobs, and secondly, that they could take over the world, Robots will steal our jobs, Robots have the effect of increasing productivity rather than eliminating jobs.

Robotics become increasingly present in our everyday life, with household robots, medical, industrial, on production lines, not to mention airports, banks, and hotels, So, Robots may dominate the human species.

Applicable Areas of Robots

The application areas of human-robot interaction include robotic technologies that are used by humans for industry, medicine, and companionship, among other purposes.

Industrial Robots

This is an example of industrial collaborative robot, Sawyer, on the factory floor working alongside humans. Industrial robots have been implemented to collaborate with humans to perform industrial manufacturing tasks. While humans have the flexibility and the intelligence to consider different approaches to solve the problem, choose the best option among all choices, and then command robots to perform assigned tasks, robots are able to be more precise and more consistent in performing repetitive and dangerous work. Together, the collaboration of industrial robots and humans demonstrates that robots have the capabilities to ensure efficiency of manufacturing and assembling. However, there are persistent concerns about the safety of human-robot collaboration, since industrial robots have the ability to move heavy objects and operate often dangerous and sharp tools, quickly and with force. As a result, this presents a potential threat to the people who work in the same workspace [14].

Medical Robots

Researchers from University at Texas demonstrated a rehabilitation robot in helping hand movements. A rehabilitation robot is an example of a robot-aided system implemented in health care. This type of robot would aid stroke survivors or individuals with neurological impairment to recover their hand and finger movements. In the past few decades, the idea of how human and robot interact with each other is one factor that has been widely considered in the design of rehabilitation robots. For instance, human-robot interaction plays an important role in designing exoskeleton rehabilitation robots since the exoskeleton system makes direct contact with humans' body [15].

Companion Robot

Nursing robots are aimed to provide assistance to elderly people who may have faced a decline in physical and cognitive function, and, consequently, developed psychosocial issues [16]. By assisting in daily physical activities, physical assistance from the robots would allow the elderly to have a sense of autonomy and feel that they are still able to take care of themselves and stay in their own homes. [17]

This is an exhibition at the Science Museum, London that demonstrates the robots for Autism children as their toys in hopes for helping autism children to pick up social cues from the facial expression [18].

Social Robots

Over the past decade, human-robot interaction has shown promising outcomes in autism intervention. Children with autism spectrum disorders (ASD) are more likely to connect with robots than humans, and using social robots is considered to be a beneficial approach to help these children with ASD. However, social robots that are used to intervene in children's ASD are not viewed as viable treatment by clinical communities

because the study of using social robots in ASD intervention, often, does not follow standard research protocol. In addition, the outcome of the research could not demonstrate a consistent positive effect that could be considered as evidence-based practice (EBP) based on the clinical systematic evaluation. As a result, the researchers have started to establish guidelines which suggest how to conduct studies with robot-mediated intervention and hence produce reliable data that could be treated as EBP that would allow clinicians to choose to use robots in ASD intervention.

Automatic Driving

A specific example of human-robot interaction is the human-vehicle interaction in automated driving. The goal of human-vehicle cooperation is to ensure safety, security, and comfort in automated driving systems. The continued improvement in this system and the progress in advancements towards highly and fully automated vehicles aim to make the driving experience safer and more efficient in which humans do not need to intervene in the driving process when there is an unexpected driving condition such as a pedestrian walking across the street when it is not supposed to [2]. This drone is an example of UAV that could be used to locate a missing person in the mountain for example.

Search and Rescue

Unmanned Aerial Vehicles (UAV) and Unmanned Underwater Vehicles (UUV) have the potential to assist search and rescue work in wilderness areas, such as locating a missing person remotely from the evidence that they left in surrounding areas. The system integrates autonomy and information, such as coverage maps, GPS information and quality search video, to support humans performing the search and rescue work efficiently in the given limited time. The project "Moonwalk" is aimed to simulate the manned mission to Mars and to test the robot-astronaut cooperation in an analogue environment.

Space Exploration

Humans have been working on achieving the next breakthrough in space exploration, such as a manned mission to Mars [5]. This challenge identified the need for developing planetary rovers that are able to assist astronauts and support their operations during their mission. The collaboration between rovers, unmanned aerial vehicles, and humans enables leveraging capabilities from all sides and optimizes task performance

The ideal balance between robots and humans

The automation of employment aims to optimize human resource management. This is completely in contrast to the fear of being replaced by technological advancements. Today the challenge is to create the perfect hybrid between humans and robots.

This is called the ´creative economy´ because creative jobs require the use of cognitive abilities that only humans possess. Artificial Intelligence research has shown that there are cognitive functions of humans that are impossible to replicate. Automation, robotics and Artificial Intelligence then, once applied to everyday life, will give birth to new categories of employment.

The application of intelligent technologies, robots, automated systems, computer programs, and mathematical algorithms require human automation, and vice versa, Creativity is the key.

CONCLUSION

Without a doubt, robots are here to stay, and they are only becoming smarter. Disruptive technologies have transformed the way we work in many areas: administrative tasks, customer service, along with the banking, transportation, tourism industries, E-commerce, and municipal services, among others. Today we speak of the hybridization between robots and humans—neither can exist without the other. When banks first installed ATMs, employees were not left without tasks. Instead, their function was redefined, so that they could focus on more complex, customized tasks. When E-commerce was born, along with accounting and administrative software, it did not cause brick and mortar stores to

close. Self-driving vehicles are not used by themselves, robots do not apply biomedicine without the guidance of doctors, and these examples repeat across all industries

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