

Research on the Field of Social Robotics and HRI

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Abstract

One of the most fascinating trends in recent technology is “Social Robots”, born out of human intelligence. Soft Robots will soon become a vital organ of Human civilization. Social robots are robots that are designed in such a way that they can interact with other living organisms. The detailed study of interactions between a Social robotic system and humans is crucial in developing this technology. With the progress in this field, social robots are becoming more and more intelligent. Social robots are widely used in the healthcare sector, Disease diagnosis, and many other customer services. To better understand this field of Soft Robots and HRI, we decided to summarise both of these concepts. In this paper, we bisected the topic into two parts. In the First part, we tried to explain the basic definition of “Social Robots”, elaborated their architecture, perceptions about them, then we discussed few of the recent and famous Social robots of our time with specifications, it's benefits and potential risks, and the future of Social robots. In the second part, we attempted to explain HRI and its current status, it's supervisory control, teleoperations, automated vehicles, social interactions and discussed various human factors that are required to overcome few challenges in this field. Along with that, we discussed the future scope for HRI.

Keywords: Social robots, Architecture, human interaction, supervisory control, teleoperator, telerobot

INTRODUCTION

“Social robots” is a subfield within the vast field of robotics. Robots are the autonomous machines that work under the supervision of human through a set of programs which is also created by humans, social robots are those robots which are designed in such a way through Artificial Intelligence commonly known as “AI”, that they can communicate with humans and other living beings as well. Social robots are gaining rapid popularity, because of their ability to socialize with humans. Many social robots are already in the use. Many companies like Hanson Robotics and Boston Dynamics are leading the research in the vanguard. Soft robots are embedded with features similar to that of humans or any other living being. Eyes, nose, mouth with lips everything is attached to it to normalize its appearance. They are designed in such a way that they can recognize their former users and learn from their past experiences. They is proven to be very effective especially in the field of Healthcare, but while they make our life easier they contain some drawbacks as well. This brings us to our second part of this paper “HRI” a short form used for Human-Robot Interactions. HRI is another challenging field, which is very diverse and extremely extensive. HRI is constantly improving and is becoming

more and more advance. Our main aim in this paper is to give a brief overview of the concepts involved in this rather new yet fascinating field.

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Social Robot

A machine that has implanted elements of computational intelligence that allows them to behave independently for a long period of time with human control or supervision is called robots. Social robots are a kind of robot that are usually humanoids and animaloid, that is they have human and animal-like features. They have physical

features like “eyes”, “nose” and “facial hair”. And they embedded with actuators that support expressions to make them more social. In another word, Social robots are AI-assisted robots that can interact with humans and other humans and can perform jobs like butlers and therapists. In the homes, social robots can be designed perfectly enough to become part of the family and can be developed with programs to engage with family members. A social robot may be remotely controlled, perhaps serving as a telepresence representative at a business meeting or in the home or as a companion in a healthcare facility. In other words, social robots are AI-assisted robots capable enough to communicate with people and things in the environment. Autonomous robots of these kinds are known as Smart robots, Smart robots are those robots that can copy the functioning of the human brain through data mining, pattern recognition, and natural language processing (NLP). The social interactions in soft robots are more cooperative, but the definition is not limited to this situation. But robots can also interact with minimal or no communication. The social robots must interact within the framework of social rules assigned to them. Many restaurants are in India and all over the world have started using robots as butlers, their performance is very good. Social robots must communicate with humans in an understandable natural manner and follow contextually appropriate norms [1]. Apart from spoken language processing, they must produce human-like features like smiles or frowns, whereas sound, posture, color, prosody, and movement can also enhance the quality of communication [1]. Despite facial features, the most important part of human nature is “emotions”, which is why more significant efforts have been made to develop “emotionally responsive robots” [1]. The field of social robotics is able to grasp much broader developments in AI (Artificial intelligence) and robotics, including robot control, natural language processing, improvements in machine learning, and computer perception. Various new techniques like cloud computing are used to produce a more intensive form of computations, this will enhance its capabilities. Social robots are also able to access resources such as databases and off-board sensors that will permit them to provide more difficult social support. Hence, rather than emulating forms of human-to-human interaction, we can hope that Human-robot interaction will be different than the previous one. The key elements in the pursuit of the social robot:

- *Physical*: Physical robots exposed to the physical environment
- *Reflexive*: they are of two types Fast reactive and reflexive nature to unforeseen or unanticipated events
- *Deliberative*: Computational machinery required in order to realize defined complex goals
- *Social*: It is the ability of the robots to interact with other robots for achieving future goals.

The Architecture of Social Robot

The Social Robot Architecture facilitates the development of teams of robots that may not be homogenous, both in terms of behavior and hardware. Behavioral heterogeneity is achieved by developing BDI agents of various capabilities through Agent factory, e.g., commitment adoption strategies, knowledge resources, planning facilities, etc. The use of a standard interface among the reactive layer and deliberative component (i.e., the agent-events and commands) signify that robots with sensors of different fields and actuators can be submerged into the system. For the purpose of interaction, the use of a standard interface that is the ACL Teanga, permit non-homogenous agents to co-ordinate and communicate [2]. The architecture is made of four different layers: physical, reactive, deliberative, and social:

1. *Physical*: Robots take the form of a physical thing or being
2. *Reactive*: A series of fundamental reflex behaviors are used at this level. The sensory information is worked upon and transformed resulting in clear agent-events and interacted to the deliberative level. Agent-commands are received from the deliberative layer.
3. *Deliberative*: This comprises of a Belief-Desire-Intention (BDI) architecture developed through Agent Factory [Col96] [OCC+98]. The process of perception deals with the transformation of agent events into belief and adding them to the belief set providing the agent with an up-to-date model of its current perceived situation and results in the agents' commitments are updated as per the process [2]. Commitments that were already existed are checked and those pertaining to

the current time frame changed resulting in either a communicative act being sent to the social level or a physical act being delivered to the actuators through the reactive level.

4. *Social*: agents communicate through an Agent Communication Language (ACL), called Teanga1.

Perceptions Regarding Social Robots with Respective Concerns

Generally, people possess positive perceptions regarding Social robots and are interested to engage with them, but the development in the field of social robotics have generated several concerns on the societal and ethical challenge they raise. The behavior and exterior of the robots resemble us and many representations in cultural artifacts such as film and literature may contribute to feelings of unease, and perhaps triggering anxieties about our own human nature. They may come as a threat to human dominance and may later de-humanize the world. That is why Robots are seen as a matter of concern about the broader impact of AI. A major portion of the debate on the ethics of social robots revolves around the contrast between their physical and ontological status [1]. Physical due to their ability to behavioral manifestation which can only be seen in living organisms, this leads humans to place them near boundaries of Human sociality and culture. But ontologically they belong to the family of the designed machines. But in the case of social robots, we may categorize them with machines and tools, still, we communicate with them as if they have psychological capacities similar to us. So rather than categorizing Social robots in any of the above, they should be seen as a new ontological class.

Famous Social Robots of Our Time

Pepper

Created by Softbank's robotics, it first came into the limelight when it was introduced in Tokyo on June 5, 2014, the type of this robot is "Humanoid". Pepper became popular in a very short period of time; more than 12000 pieces of this robot are already sold in Europe (Figure 1(a)). Pepper is currently used as reception in several offices, is able to identify visitors with the use of facial recognition, send alerts for meeting organizers and arrange for drinks to be made. In Japan, it is widely used in households, banks, and restaurants. Pepper can successfully interact with humans can propose games and menus in restaurants. The robot has embedded with 4 microphones, 1 HD camera in the mouth and another in the forehead, and a 3D depth sensor which is located behind its eyes. Touch sensors are located in the head and hands. 6 lasers, 2 sonars, 3 bumper sensors, and a gyroscope are located in the gyroscope. The height of this robot is 4ft, depth of 17 inches, es, and a width of 19 inches. And weight is approximately 28 kilograms and used Lithium-ion battery and size of the display is 10.1 inch. It uses the platform of NAO iq OS.

Nao

Nao is a human-based or humanoid robot of compact size, due to sensors embed in it is able to perform human operations and can sense or recognize human faces (Figure 1(b)). It also created Softbank's robotics. Nao is an autonomous, programmable, medium-sized humanoid robot. of which the architecture of control and the software is customizable. NAO can walk at different speeds and at different directions including the speed of small children. The robot has the capability of performing a rich panel of movements with smoothness and precision, and a certain degree of interactive autonomy. NAO is modular, referring to actuator modules that can be used for different joints. The head of NAO can be unplugged and replaced by a more specialized one. Hands and forearms can also be changed. Nao's lower part has 11 DOF (Pelvis and legs), 25 Degrees of Freedom, upper part (Arms, trunk, and head) has 14 DOF. 2 DOFs are located at the ankles in each leg, the knee had 1 and hip have 2. The pelvis is made of 2 coupled joints mechanisms at each hip. The rotation axis of these two joints is tilted at 45° towards the body. It is a very fine replacement for a classical set of 3 active rotary joints. The rotation of the trunk along the vertical axis (YAW ROTATION) is prevented by the coupling of pelvis joints when support is provided to both legs. This is a major advantage as now only 1 motor is required to drive the pelvis instead of 3 like before, which will be cost-effective and saving

space in the lower part of the trunk. The structure helps to better distribute the power between the hip roll joint and the pelvis joint and confers a specific motion style to the NAO humanoid. 2 DOFs are located on the shoulder, 1 at the wrist, 2 at the elbow, and for hand's grasping 1 additional DOF is provided. The head is able to rotate about yaw and pitch axes. Custom-designed integrated circuits based on Microchip 16-bit ds PICs microcontrollers is embed in it. The main function is able to control bus control, sensor management, power converters, and servo control. MREs are attached with actuators.

Atlas

Developed by American Company Boston Dynamics and U.S. Défense Advanced Research Projects Agency (DARPA) is a bipedal humanoid robot. Atlas is designed to operate both outdoors and inside buildings and has whole-body dynamic balancing. Atlas is able to sense obstacles run over rough terrain autonomously or through teleoperation (Figure 1(c)). The robot is electrically powered and hydraulically actuated. The Applications of Humanoid have basically two types of Stage control problem. One is a Behavior level controller that produces outputs of high-level commands and another one is a low-level controller that generates the joint commands. The low-level controller is composed of dynamics and full-body kinematics in order to use the workspace and robust the external perturbations. Inverse kinematics via stiff joint position tracking is another way of controlling humanoid robots. Whereas inverse dynamics-based approach method has gained drastically increasing acceptance by providing compliant motions and robustness to external perturbations. The inverse Kinematic method is easier as it only needs Kinematic models which are easier to generate, whereas the previous method is highly dependent on Dynamic models of high quality. As per DARPA Robotics Challenge, ATLAS was tested on the proposed full-body controller. It has a total of 28 hydraulic actuators, back joints have 3, neck pitch has 1 and each leg and arm have 6. Their major function is to perform various functions like ladder climbing, through full-body manipulation. Atlas is capable enough to perform all eight tasks as follows:

1. Drive a utility vehicle at the site.
2. Travel dismounted across the rubble.
3. Remove debris blocking an entryway.
4. Open a door and enter a building.
5. Climbing the industrial ladder and traverse an industrial walkway.
6. Breaking concrete panel through a tool.
7. Locate then close a valve near a leaking pipe.
8. Connect a fire hose and standpipe then turn on a valve.

Sophia

Developed by Hong Kong-based Hanson Robotics Sophia is one of the most developed social robots. Sophia is the first robot ever to be granted citizenship of any nation, As of October 25, Sophia is the first robot in history to be a full citizen of a country (Figure 1(d)). Sophia has a female face, she has 2 cameras embedded in her eyes, cameras are programmed to detect faces and greet users by their names. The material used for making her skin is a special variety of silicone (Frubbet). This material is flexible enough to perform 62 facial expressions like anger, joy, sadness, amazement, annoyance, fear, etc. She possesses an electronic synthetic voice that allows her to speak. The most human-like feature of this robot is that it gains from her previous experiences and uses them for the future. Sophia becomes more and more familiar with the cultures, customs, feelings, emotions, and linguistic styles of her interlocutors.

Benefits with Social Robots

The benefits of social robots should always be placed before negative aspects. One major benefit is comfort. Comforts cFan later be again classified into two parts, Emotional and physical. Various studies have proved that the role of social robots in providing physical comfort has been demonstrated in studies that compare interventions with social robots with controls using a tablet-based avatar of the

same robot. Children always interact with robots with great interest even more than living being such as dogs. The increasing work on Human-robot interaction also understands the value of physical contact with artificial companions in providing comfort [1]. Many robots like Sony Aibo and Miro-e can also provide emotional support to people by reducing social isolation and the experience of loneliness (Figure 2(a),(b))[1]. Interactions with robots will also result in a positive consequence especially in the case of older adults and therapies.



(a) Pepper



(b) Nao



(c) Atlas



(d) Sofia

Figure 1. Some famous Social Robots of our time.



Figure 2. (a) Sony Aibo.



Figure 2. (b) Miro-e.

Risks with Social Robots

Social robots will be essential members of human society in the upcoming days. But everything has some negative consequences as well so do social robots. One of the major demerits of the social robot is cost, the cost of the robots like NAO, Atlas, and Sophia are very high. The main areas where social robots will be used are with children suffering from autism, parents, schools, or therapies, and might not have enough capital for purchasing social robots. Though cheaper versions of robots are available they won't be that effective. Children with autism would be missing out on a great opportunity. The second is that children with autism might form emotional bonds with social robots which can have serious consequences. Especially children, because children become very emotional with the thing they play. The third and the most important aspect is job loss, social robots will take over many jobs in the future and will create a few and limited for skilled people only. Jobs like therapists, Butlers, and receptionists might be human-free in the future.

Future of Social Robots

With the future, robots are becoming an integral part of the future. Automation and robots go hand in hand. Many companies like Softbank's and Boston dynamics are tiring to make new robots that are more affordable and versatile. Many Restaurants and hospitals are using social robots as butlers and receptionists. Many Hotels are using robots as the staff. But it may pose challenges to humans' jobs.

Researchers are developing more refined hardware and software, with their integration with artificial intelligence in social robots are making things more and more versatile. Many philosophers are exploring the morality of human-robot relationships. Social ecologists and social psychologists study the dynamics of relationships and examine their impact on the quality of life.

Major challenges that still remains are:

1. Consider the positive and negative potential impacts of social robots.
2. Identify potential outcomes that are plausible.
3. Develop strategies to promote positive impacts and discourage negative ones.
4. Affordability of robots among people.

Human-Robot Interaction

Human-Robot Interaction or HRI is a multidisciplinary field of study dedicated to learning, designing and evaluating artificial robotic systems to work for humans or with humans. It is presently an extensive field of research and experimentation. Interestingly, the roots of this field originated when it was presented by 20th century author *Isaac Asimov* in his novel *I, Robot* as a distinct in problem in 1941. In his work, he postulates the three laws of robotics as:

1. *A robot may not harm a person or, through inactivity, allow the person to be injured.*
2. *A robot must obey the commands given to it by its human supervisor, except if the commands would lead to injuring the supervisor hence contradicting the first law.*
3. *A robot must safeguard itself inasmuch it does not contradict its function to not harm a human and by extension it should not contradict the first and second rules.*

Although the actual concepts of HRI were much more complicated requiring years of research work, these fictional laws provided a framework for engineers and researchers to build upon. Also, HRI gives more priority to safety of humans dealing with potentially dangerous robotic systems. The solution to this problem involves approaches ranging from philosophical to practical. *Lidar* is as example where safety zones are created based on detection of human/obstacle presence in the robot's proximity to impede any contact between the machine and its operator. At first, human involvement was necessary for the operation of HRI but since the early 2000s, fully autonomous have become more common as a consequence of persistent and continuing research in this field. Such systems include simultaneous localization and mapping, natural language processing and natural language generation which all contribute to smart motion and natural communication with humans [3].

The studies in this field are expanding rapidly through various publications annually and by different research societies dedicated to technical disciplines of mechanical and electrical engineering, computer and control science, artificial intelligence and deep learning. The demands for observations on human interaction and robotic cooperation are huge. Ergonomics professional should work with engineers and scientists to better understand robot dynamics and control which will further research, design and evaluation in HRI. Study has shown that interaction between robots and humans is mostly dependent on their proximity. One such type of interaction is *Remote interaction* where the robot-human pairs are not in the same location, but are separated by space or time (for example: space rovers). The other type is *Proximate interaction* in which both are in the same location. With these two important distinctions, we can categorize the different types of robots according to the application.

HRI encompasses around four regions of application,

Supervisory Control

It is a proximate interaction involving mobile robotics. In such applications, the robot is used to perform routine functions under human supervision and have limited automation. Such robots are used in the process of manufacturing where parts need to be put in sequence on an assembly line, delivery of components to different places etc. These robots are called *Telerobots*. Telerobots are operated by humans using computer programs and designed to sense their environment and component trajectories. In case there are changes, the robots report back to the supervisor/human operator and the necessary updates in the computer program are be made.

Teleoperation

Here, remote interaction with mobile robots is involved. The robots operate in sequestered and potentially dangerous environments like in space exploration, aviation or in underwater scenarios. They perform non-routine exercises in a remote physical surrounding in accordance with continuous instructions from a remote human who control the robot's motion. These machines are called *Teleoperators*.

Automated Vehicle

This kind of robotics deals with human passengers in automatic automobiles, automatic rail travel or automatic aircraft travel.

Social Interaction

It includes the societal, perceptual and emotional aspects of human-robot interaction. In social interaction, humans and robots treat each other as companions or associates. Such an interaction is seen as proximate rather than remote. These robots are used for human aid applications like entertainment, education, Autism intervention, injury rehabilitation etc.

The current research and challenges in all of these areas is discussed in this paper. The human factors and the basic tough problems facing HRI are also discussed in the following sections.

Supervisory Control

Many types of robots are involved in performing fabrication work (Figure 3(a)). Nowadays, many manufacturing industries use artificial aid in assembly and other wide variety of works. The human component in the interactions taking place in such an environment is in a supervisory role where humans instruct the robots what function to perform, what repairs need to be made etc. In other words, telerobots are used here. One such robot is the Baxter robot developed by Rethink Robotics [6]. This robot was built in such a way so as to allow safe proximate interaction with humans (Figure 3(b)). It is compliant, humanoid structure. It has been provided with a set of eyes not for sight but to intimate to the humans what task it is presently performing.



Figure 3. (a) An industrial robot.



Figure 3. (b) A Baxter Assembly line robot.

In 2011 and 2015, some researchers in HRI were trying to enhance the interactions between human-robot pairs in industrial conditions and have shown methods in surveying people carrying out supervision of artificial agents. The survey was carried out by demarcating the limbs of the robot manipulating operators using computer vision. The data is used to deduce a strategy for close-knit cooperation with the robot where it relieves the operator of some duties which it can do better. It was found the operators preferred the robot to predict their actions rather than them having to guide the robot through the task step by step. Also, the human participants concluded that this method was better instead of a knowledgeable operator having to program the robots to do certain tasks.

Present HRI challenges in this category include industrial performance, medicinal supply systems, agriculture etc. Safety continues to be a major concern.

Teleoperation

In the early days of robotics, the demand of robots began when highly radioactive substances needed to be manipulated without putting the Human operators in danger of exposure to these toxic substances. Master-slave robotic systems which held and moved objects in all six degrees of freedom were made. In the beginning, mechanical tapes were used for controlling this mechanism which later transitioned to electromechanical servomechanisms having a feedback force. Since then, the research and experiments have led to the development of more remote robots which can be used in hazardous scenarios like space rovers (Figure 4(a)), underwater robots, drones (Unmanned aerial vehicle or UAVs) (Figure 4(b)) [6].

Further research and innovation are required in order to improve display and control in these robots. The robots need to be incorporated with complete circular observation at the site to which they are sent to. In faraway regions like in space research communication between the remote operator and the robot needs to be improved in order to eliminate the long delays in relaying messages or instructions. These robots are also used in surveillance, search and rescue, military strikes via drones etc. In the medical industry, telerobots are being used in some minimally evasive surgery and they provide a greater range of accuracy of the hand movements performed during the surgery. Patients with missing or amputated limbs have greater control and are able to achieve motion and manipulation with the artificial counterparts. The research in this field is important for the rehabilitation of disabled people as it will help them overcome their neurological or muscular or any other type of artificially improvable deficiency.

Automated Vehicles

Automobile manufacturers are upgrading their technologies in order to enhance the human driving experience. Some of these improvements include radar augmented cruise control, run-of-the road alarms, and vehicle to vehicle communication in order to promote driver safety in case of accident

scenarios. However, it is difficult for an artificial system to understand the complex social cues involved in driving in traffic like hand-eye signals between drivers while driving. Making an artificial intelligence-based automobile will require further research on how to train AI to understand traffic behavior and to what extent can the automobile incorporated with AI within safe limits. Present day urban planners are mulling over automated rail and highway systems but are limited in their capacity to make it a reality (Figure 5).

Artificial commercial aircrafts are included here since they are telerobots operated by supervisory pilots by utilizing the flight machinery for giving commands, changing direction and mapping locations. Similar to the human motor skills like driving, closed-loop system can be used to achieve pitch, yaw and roll on an aircraft. Speed, altitude and heading all combine to give guidance to the aircraft in order maintain a particular flight path which is like humans needing traffic lights and traffic signs for travelling from one place to another. Now, like people review weather and other conditions in order to determine their travel schedule, artificial aircrafts use map memory, knowledge of weather conditions and air traffic to navigate to a particular airport destination. Human in-loop simulations must be tested along with digital communication methods in human factors research of commercial aerial vehicles [8].



Figure 4. (a) NASA's mars exploration rover.



Figure 4. (b) A US army Drone (UAV).

Automated Highway System

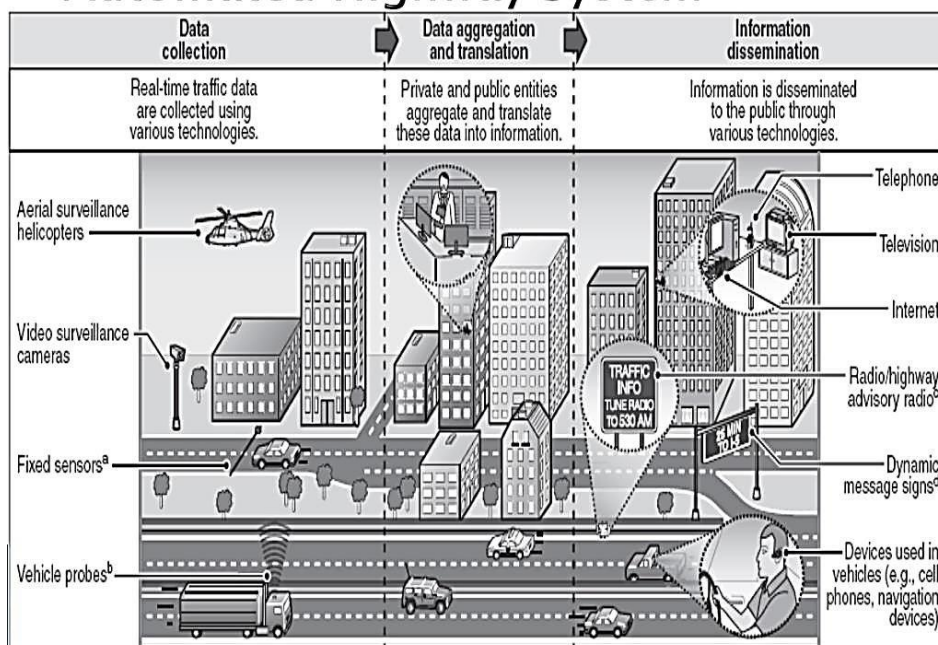


Figure 5. A computer generated model of an Automated Highway system.

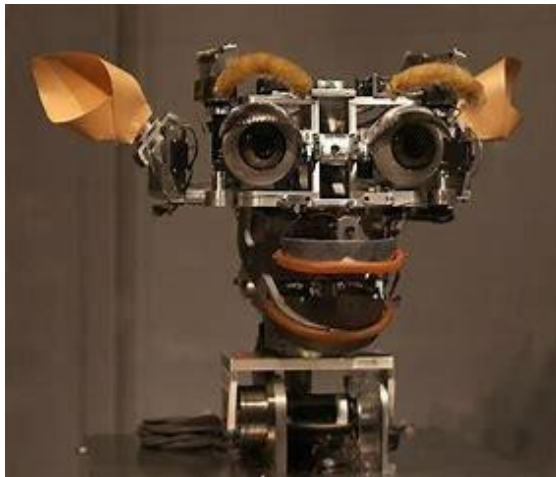


Figure 6. (a) MIT's Kismet.

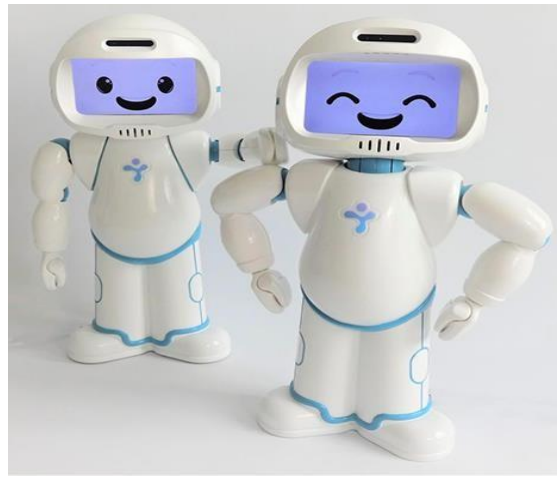


Figure 6. (b) QTROBOT-An interactive social robot for children affected by autism.

Social Interactions

The Massachusetts Institute of Technology (MIT), contributed significantly to social robotics research in the late 1990s with its Kismet robot head. It can understand and create facial gestures pertaining to emotion (Figure 6(a)). It uses the computer processed face and voice of a human subject and makes the suitable facial signals in return. Although we can ask how it counts as social intelligence, it is a step forward to further intellectual debates regarding its nature. Evidence shows that robots like kismet interact with young children efficiently but questions can be raised on whether they lessen or increase imagination in children.

Interactive toys with artificial speech recognition and decision-making capabilities are being produced by toy manufacturers. One example of this type of robots is the barbie doll designed by Mattel. It is capable of making regular interesting conversation with children owing to its speech and language recognition and it's to the internet via the server. Interactive robots are especially useful in healthcare of autism afflicted children and elderly people (Figure 6(b)) [8]. Here, a major dilemma is whether the patients will fully trust a robot to aid their rehabilitation process. Much work is still required in human factors research to integrate social robots into the healthcare industry.

Human Factors Research Reuirements to Combat the Complex Problems of Human Robot Intetaction

Function Analysis

One important attribute of human factors research is the differentiation of tasks between humans and robots. The study on what tasks a human or a machine can perform best individually was established but needs more work. Small sensors, AI, deep learning and high frequency communication have led to the progress of social machines. From an Ergonomics point of view if one takes the example of aiding the elderly and handicapped people, human caretakers injure their backs while doing this work while robots may be designed to lead the patients safely and gently from place to place. However, challenges do arise in task planning and modelling of such machines in duration, spaciousness, impetus, energy and price [16]. Also, previous tests show the corporeal form of the robot is best decided by what task it will perform rather than trying to make it more humanoid which does not make proper sense.

TtrainingMachines and Ppreventing Involuntary Outcomes

Human operators can instruct an artificial hand to move but to guide its movement, at what time to move, avoid of certain movements etc., one has to use symbols rather than communication in analog form. Huge leaps in computerized speech recognition (e.g., Amazon's Alexa) has made it easier to instruct machines to do tasks but this creates a prospect for involuntary outcomes. One can use real-

time virtual simulations to combat this hazard since it provides a way to visualize what the machine might do when given the said command before getting on with the task. Essentially, one can “look ahead” by extrapolating the ongoing process and create model simulations [16].

Interfacing

There has been the idea of intelligent machines and people having intellectual models for each other for quite some time. Computer algorithms can see human activity, save this data as models, and perform analysis and forecasting. Serious challenges are encountered while interfacing the human-robot internal models when attempts are made to elicit human visualizations on purpose of robots and integrating them with the artificial robotic model of organization and prevention of contradictions. Experimentation in the areas of visual, speech and language recognition has implied that AI can replicate the initial 90% of human abilities but replicating the remaining part is extremely difficult since the human consciousness is made up of vastly different and wide variety of life experiences [16]. Robotics research has always been about ultimately about creating an artificial organism in our image. Now, if it can be realized or not is yet to be seen.

Education

Till date learning has been through texts or attending lectures at schools or colleges which can be tiresome for those who have lack of interest in such education or for people with learning disabilities. Communicating with physically present teachers has always increased the efficacy of education. Robots will revolutionize the teaching profession and learning in the coming time by enhancing the joy in education, using live physical demonstrations of concepts for deeper understanding or by giving appropriate responses in the form of remarks on students' works and opinions. The research on Humans and robots teaching each other is fascinating. The challenge here is to determine at what rate can humans consume information from robot teachers across different ages, different disabilities or different cultures. Artificial learning in the whole world should not be centralized since people arise from many different regions in the world with varying backgrounds. Local researchers must focus on the needs of their particular region and collaborate with researchers from all the other different regions to carry this field forward.

Life, Concerns and Human Principles

In popular culture, robots have been shown to be antagonistic machines trying to combat the human race at all costs. Movies like the *2001: A Space Odyssey*, *Terminator* series, *Ex-Machina* etc., depict the dangers of artificial intelligence. The idea of autonomous robots seems to scare people and these fictional scenarios are depicted widely in society. Although these are for entertainment, such scenarios are not entirely realistic. With the invention of any technology, there are pros and cons that arrive with them. In case of robots there are many public concerns like will they serve us or will we serve them, will they make us unemployed, will they instead of spying for us go rogue, will they kill us instead of our enemies and so on. This is why creators of such technologies and human factors scientists are more aware of the falsities and possibilities than general society. They can think rationally, come to proper conclusions about the technology being safe for humanity or not and only then will they sanction the use of such devices. Results of experimentation should steer public debate and discussion nor unwarranted fears elicited by fictional scenarios. The crux of the discussion is this: if we could potentially automate anything, which facets of human society should we do it to and to which it should not be done to.

CONCLUSION

Social Robots will soon become an integral part of our future society. Social robots can interact with then people very easily this the main reason they are becoming trendy in the healthcare and Education sector although the research and studies show that social robots can help people across the lifespan but they have a few potential risks as well. HRI is a rapidly evolving field. Robots under human controls have proven successful in the field of medical and hazardous situations. The field of

this “social robotics” is a rather new field. It investigates unconventional materials and morphologies of autonomous systems for social robots. The field of social robotics is new, and it holds great potential but also challenges many of the assumptions, models, materials, tools, and techniques used in traditional robotics for decades. The traditional processes of design and manufacturing cannot be used when we seek to create machines with and mechanical properties and complexities that human features. New design processes, new material concepts, and new simulation algorithms are required to overcome these challenges. However, with time and advancement in technologies, we are overcoming these challenges. Revealing a new world of robotic systems far richer than today.

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