

# Human Robot Interaction

Thummodarage Ruvishantha

University of Auckland

Auckland New Zealand

Rthu009@aucklanduni.ac.nz

4658651

## ABSTRACT

It is interesting to explore the world of robotic research to understand the complex work and issues that are being dealt with researches around the world. This paper discusses current achievements in robotics by scientists and big corporations it also explore the effect that robots may have on the society and also look into the ethical issues that may arise with this new domain of Human Robot Interaction. I will look at how scientist achieve anthropomorphism by creating more realistic interactions between humans and robots to deceive humans into believing robots can actually understand the humans.

## INTRODUCTION

With ever increasing population levels it is important for us to keep up with consumer demand for products and services. Jobs in the areas of factory production lines, medical care and service industry require skilled labour intensive task to be done in a repeated manner. Robots are used in such areas to undertake such tasks. Even though the cost of initial setup is far more expensive than humans long term results shows that robots are more effective at saving time and money. Currently most production line robots are preprogrammed to work on given tasks at specified time. However robots are becoming increasingly more autonomous as we move towards new age of artificial intelligence. This new domain technological learning sets the path for entirely new form of interaction between humans and robots. We call this Human Robot Interaction HRI. The study of how humans interact with robots has gained more attention over past few years. "The fundamental goal of HRI is to develop principles and algorithms for robot systems that make them capable of direct, safe and effective interaction with humans." [1]

## BEGINNING OF HRI RESEARCH

In 1921 play named R.U.R by Karel Capek introduced the word "robot" to the English language. The play starts off in a factory where they produce these human like machines in a shape of androids. They work for people and as the story

progress they eventually turn evil and work to destroy the human race. In the 1950's, Isaac Asimov explored this concept of human robot interaction in his book I, Robot [2]. Long after novels, movies and plays simple features of androids/robots came into existence. Soon after that people began to explore the roles and responsibilities of robots. Isaac Asimov has proposed the original benchmark for HRI.

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

Although the current systems are not advanced enough to apply above laws directly, it has constructed a way point to which researches can implicitly apply to build their robots. Star Wars series by George Lucas feature two main robot characters. One of the robots appears more human (C3PO) and other one is more of a can shaped object (R2D2). Both interacts and communicate with humans effectively through various hand gestures and beeps. They represent human like characteristics which helped the audience to relate and recognize them as anthropomorphic subjects. Even though C3PO appeared more human, often people preferred the can shaped robot (R2D2). This is not because of its shape but it's human like behavior such as determination and courage.

## REAL WORLD ROBOTS IN ACTION.

Having a robot nanny or a robot servant that listen to us and understand human language is still a science fiction dream. Current prototypes are still mastering how to stand up without falling and walking at speeds of normal human being.

AIBO (Artificial Intelligent Robot) developed by Sony is a robotic pet dog that can walk, recognize spoken commands and learn new behaviors. Its design won the highest design award that discussed by Japan. After the success of Aibo Sony announced QRIO (Quest for curiosity) a bipedal robot which designed exclusively for entertainment and learning. It was the first bipedal robot capable of running and in 2005 it entered into the Guinness World Records for this achievement.

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After the discontinuation of QRIO in 2006 a new robot emerged. NAO is an autonomous, programmable humanoid robot developed by Aldebaran Robotics. Its 58cm tall and is capable of performing simple dance steps, speech and other more complex movements. NAO managed to replace AIBO (Sony's robot dog) in the Robot Soccer World Cup. NAO and ASIMO by Honda are the most advanced bipedal robots that are available to consumer market today.

Many of the care/helper robots in research are getting closer and closer to looking more like humans rather than machines. Some of the elderly care robots present a monitor with animated human face to communicate with elderly and to build better relationships with them.

### **RESEARCH CHALLENGES**

Research field of Human Robot Interaction consists of long list of challenges. Here I will discuss some of the major research challenges involved in HRI.

#### **Real World Perception.**

Being aware of the surrounding world is the most important factor in robotics. Without this the robot cannot move, communicate successfully or appear more like human. Humans have more sensory inputs far more than what available for most of the robots. Main inputs for robots include vision and speech. Both present major challenges for research in real-time data processing. Vision system of robots should be able to process human facial expressions and gestures. In order to navigate through tough terrains it also needs to be able to locate and recognized objects around it. Researchers are still challenged by developing better dialog systems between robots and humans. It is even more challenging to gain a better understanding from the vast array of data presented to the individual robots through linguistic and visual sensors. These sensory information needs to be processed within milliseconds to gain seamless interaction between human and the robot.

Kismet is a robotic head designed to interact with humans similar to a toddler. Its interactions and other movements require careful calculations to be made using the data from its sensory devices. These data must be calculated parallel using high power systems in order produce high quality interactions between the both subjects. Similarly ASIMO is a humanoid robot designed by Honda as a helper bot for people. It uses a combination of audio and visual inputs to generate physical movements and speech in real time. Unlike Kismet processing required for these types of interactions all must be done inside the self-contained robot body.

Robot vision system is a highly complex structure which depends on light. Outside lab conditions system faces many different lighting conditions and several different types of ambient colors which can cause poor judgments when it is interacting with humans.

Furthermore some sensors in robots may be able to observe and detect the world around it much better than humans. GSR is a method for detecting human emotions using a galvanometer. This method combined with blood pressure monitors can be adapted for robots to gain better judgement of human emotions and feelings.

### **ROBOTS IN THE FIELD OF ASSISTIVE SERVICE.**

Gecko Systems International Corp.'s illustrated its plans to develop caregiver robot for elderly. This robot is designed to follow an elderly person around their home while detecting their vital signs and reporting this information back to the monitoring system. It is also able to communicate with the subject and deliver their medicine at specified prescribed time intervals. Company suggests that this system can also be applied to the childcare sector.

PaPeRo is a similar robot that allows remote monitoring of children. Parent or other care givers are able to monitor and control their child remotely just by using a device such as a mobile phone or a computer.

In addition to care robots efforts have been made to develop robot pet companions for children and elderly. A good early example of this is Paro. Paro is a therapeutic robotic seal who helps elderly to be more active and share emotions. It is able to recognize words and responds to touch events. The pet robot AIBO went one step further to implement movements and express six different emotions. AIBO contributed largely in robot companion research. Due to its programmable nature, scientists and researchers were able to fine tune its behaviors to achieve better human robot interactions between children and elderly.

Some research work has been done to achieve to gain better level of realism by experiments with stored interaction patterns without AI. However this method gained less popularity over the years. Even though people initially liked the robot after few hours they figure out this pre stored interaction patterns and being to lose interest on the subject.

### **ANTHROPOMORPHISM AND DECEPTION**

Most of the robots we have discussed earlier contained features that persuaded society to interact and form relationships with them Oxford dictionary define anthropomorphism as "the attribution of human characteristics or behavior to a god, animal, or object" Many of ongoing projects aimed at increasing the level of anthropomorphism between humans and robots. Robot being sensitive to touch has a significant effect on the level of believability. Tanaka et al [2] reported that "Children were more interested in the quest for curiosity (QRIO) robot that inhabited their nursery when they discovered that patting it on the head caused it to giggle". [3]

Another method to improve anthropomorphism was to adapt recognition for spoken language. iRobi can respond and react to over 1000 voice commands, However and all

of these robots only creates an illusion of understanding the human being no actual level of intelligence present here.

Recognizing faces to identify and distinguish people can improve the interaction between two parties. Robots can store individual's information to generate future conversations more easily. Ability to recognize individual's facial expression helps to strengthen the relationship between subjects.

Improvements in the areas of touch sensitivity, language processing and gesture recognition will perform to strengthen the believability and the illusion of anthropomorphic subjects and be able to maintain them for longer periods of time.

This raises a question whether creating illusions to deceive elderly and children to form relationship should be considered as both unethical and deceptive?

Robert Sparrow argued that this is the case where "Any beneficial effects of deceiving the elderly person into believing that the robot pet is something with which they could have a relationship"[3] Does this make it acceptable to conclude all illusion of machines are unethical? I think it is too extreme to do so.

This issue of unethical and deceptiveness is not a straight forward concept. Humans are able to deceive them self in order to perceive something as real. "I know very well that this is just an inanimate object, but nonetheless I act as if I believe that this is a living being." [4] Often people refer to inanimate object like cars and computers as him or her. And children enjoy make believe play "When children play make-believe and let's pretend games, they absolutely know it is pretend... Real play is a conscious activity. Ask a child who is playing with a doll what they are doing and they may tell you matter-of-factly they are going to the shops or that the doll is sick, but they will also tell you that they are playing."

Often children and adults with Alzheimer's disease are unable to distinguish between living creature and robots. Therefore designing robots which capable of resembling human like features can be seen as unethical form of deception. This could also means that any object resembles human or animal like appearance could also be seen as deception. Comparing a doll or a puppet to a deceptive object can be considered too extreme.

### **CONSEQUENCES FOR ROBOTS AND THE ELDERLY**

Taking previous issues into account it is better for us to focus on the ethical perspective of this issue. Both children and adults require careful attention from society and they both have lower level of understanding about the underlying technology and strong desire for social contact.

Rather than helping, having a CareBot can raise the anxiety levels of elderly. They might become attached to the robot so that they think they have to take care of the robot even

with the cost of their health. "Observers and relatives of a confused old person looking after a robot pet might see it as depriving their relative of dignity and infantilizing them".[4] A similar situation has been examined with treatments such as of doll therapy. Adults with Alzheimer's disease are given dolls to act as a real life parent. However ethical issues have been raised claiming doll therapy infantilizes the elderly. Also studies shows dementia patients believe dolls are real children and put dolls interest before their own.

Another negative effect can be where relatives might get too comfortable knowing their elders being looked after by robots and they choose to spend less time with the elderly. Opposite could also happen when elderly choose to interact with the robot instead of socializing with others.

On the other hand positive outcome of having a CareRobot is similar to having animal-assisted therapy. "Elderly dementia patients have also shown positive outcomes, including increased communication as a result of sessions with an AIBO" [5]

### **GENERAL BENCHMARKS**

#### **Robot Evaluation**

It is important for us to evaluate robots in order to get a general idea about the capabilities of the robot.

**Safety:** This benchmark which determines how safe the robot as well as how safe it can make the life of its user. A robot has to be designed with safety in mind. Just like every other machine it too can harm its users and possibly cause death. A situation where a large care bot losing its balance and suddenly falling onto an elderly person could happen and it will seriously damage the health of him/her.

**Scalability:** Currently almost all of the robots have been tested around lab conditions. It is important for us to construct robots that can work around schools, hospitals and other outdoor environments. As well as considering the environment factor it is important to decide in which domain this robot can be used in. If it is highly a domain specific design it is not very scalable.

#### **Social Interaction Evaluation**

One of the key aspects of human robot interactions was to design robots that can carry out given tasks to best of its ability. Following sections help us to categorize robots with their abilities to impress humans and carry out well defined tasks.

**Autonomy:** When carrying out certain tasks it is best to have degree of autonomy embedded in robots. It can speed up applications for HRI without any inputs from the user. In some cases autonomy can have negative or undesirable effect on medical applications and some other applications.

**Imitation:** Artificial Intelligence systems can be tested by studying the interactions between a human and a robot to

determine whether a robot is successful in deceiving the human within a certain time frame. Total Turing Test is a common method developed by Alan Turing for determining Imitation abilities of robots. Study has shown that robot's personality can effect a person's compliance with that robot where more serious personality gained more compliance compared with playful type.

The HRI system can be evaluated in many different levels. Each new innovation and breakthrough contributes to the already long list of evaluations in HRI. However in this paper I will not go any further to break down each and every method here.

### **CONCLUSION**

It is a fact that baby boomers are slowly getting older and reaching over 60. As the world population grows it is important for us to take care of humans who are in need. Robots can improve our life and relieving humans on some of these tasks. However in order to achieve full capabilities of such robots large advancements on technology must occur. Future research efforts are promising this in near future and we will see more ASIMO like robotic subjects being available for the general public in near future.

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