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Abstract

Human-Robot Interaction (HRI) is an interdisciplinary field that explores the communication, collaboration, and coexistence between humans and robots. As robots increasingly integrate into everyday environments—ranging from homes and schools to hospitals and workplaces—there is a growing emphasis on developing *social robots* that can interact in human-like ways. Social robots are designed not only to perform tasks but also to engage with people using verbal and non-verbal communication, emotional cues, and adaptive behaviour. This abstract provides an overview of the key challenges and developments in HRI, focusing on social robots' roles in education, healthcare, companionship, and customer service. It discusses user-centered design, ethical considerations, and the importance of trust, empathy, and cultural sensitivity in fostering meaningful and effective interactions. The paper concludes by highlighting current trends and future directions in the development of socially intelligent robots capable of understanding, responding to, and enhancing human social experience.

Keywords- Human-robot interaction, Social robots , Pros and Cons

1.Introduction

The study and design of human–robot interaction (HRI) is currently quite broad and varied. The field of HRI is rapidly evolving . Similar to specialized telerobots under human supervisory control for space and repetitive industrial activities, specialized robots under human teleoperation have demonstrated success in hazardous situations and medical applications [1].
Human–robot interaction (HRI) is often regarded as the essence of a social robot, with interaction capability being the paramount criterion for its effectiveness [1].

Numerous questions about the nature of interaction and "social behaviour" in humans and robots are raised by research on human–robot interaction (HRI)[4].

It appears that humans are especially interested in comprehending and mimicking nature in general and other people in particular. This desire has been expressed in a number of "simulacra," such as sculptures that move and speak that were created in Egypt over 2000 years ago [4].

Three components typically make up a social robot's HRI: perception, action, and a "intermediate" mechanism. Where, perception refers to a module that collects and analyzes environmental information; action refers to the actions a robot takes after receiving motor-control signals; and the intermediary mechanism is comparable to "a robot's brain," tying perception and action together to generate motor-control signals based on the findings of the perception analysis module [3].
Social robots are made to interact with people in a natural, social way. They are widely used in

education, health, quality of life, entertainment, communication, and jobs that need people to work together to get things done. The long-term objective of building social robots that are capable and competent human partners is a difficult undertaking. They must be able to interact with people in a natural way by using both spoken and nonspoken cues. To effectively support people in social and task-related situations, they will need to engage us not only cognitively but also emotionally [2].

2. Social robot can recognize four different types of signals:

- Range sensors
- Touch
- Aural
- Visual

They are gathered via laser range finders, touch sensors, cameras, and microphones, in that order. Advanced analysis of these collected features, including face detection, emotion recognition, and sound localization, is part of semantic understanding [3].

The direct (intended and unintended) effects on people who engage with social robots should be taken into account when evaluating their effectiveness. Studying the interactions of social robots and how they affect individuals engaging with them outside of the lab is becoming more and more crucial as these machines become accessible to the general public.

3.RELATED EXAMPLES

We saw interactions between the Roboceptionist and the students, employees, and visitors of Robotics Institute, as well as between the Carnegie Mellon University robot GRACE (Graduate Robot Attending a Conference) and conference participants during AAAI05 in Pittsburgh, PA. Fig.1

4.The similarities and dissimilarities between both the robots can be easily seen through the table below: [5]

Factors	**GRACE**	**Roboceptionist**
Hardware	RWI mobile bases with flat panel LCD monitors , that display animated faces .	Same as of GRACE
Human sensing ability	Using SICK laser scanner and single PTZ camera	Same as of GRACE
Movement	Fully mobile	Stationary, although the head (screen) can turn.
Interface	Touch screen interface	Relies on typed questions and comments from its interaction partners.
Communication capability	Its verbal communication capabilities are limited toward greeting and requesting directions .	Uses more sophisticated natural-languages system to answer questions.
Mode of interaction	Interactions where shorter , had only to interact briefly until she received directions.	Can respond to questions while using story -telling to foster long term interaction with

		visitors

Fig. 1 The social robots GRACE and the Roboceptionist [5].

The characteristics of human-robot interaction that arise in the less regulated real-world social contexts where they are intended to operate are not revealed by interactions with robots in the lab, where they are closely monitored and expertly guided by their designers. Therefore, it is essential to assess human-robot interactions as extracurricular, socioculturally constructed activity.

5. Social robots and examples (Aibo, Paro, iCat, Pearl)

"Social robots are embodied agents that belong to a diverse group, such as a human or robot society." They have histories (perceive and interpret the world in terms of their own experience), can identify one another and interact socially, communicate and learn from one another directly [8].

The robots Aibo, Paro, iCat, and "nursebot" Pearl are briefly discussed next because they are the focus of most assistive social robot research that use real elderly people as participants.

5.1 Aibo (an entertainment robot developed and produced by Sony) Fig.2

Features:- It has hard plastic exterior, has programmable behaviour , wide set of sensors and actuators, sensors include - camera
- Touch sensor
- Infra red
- stereo sound.

Actuators include 4 legs ,a moveable head and a moveable tail.

Aibo is self-sufficient and mobile. It is programmed to play and engage with people, and it can locate its power source on its own. It has been widely utilized in research involving the elderly to try to evaluate the impact on stress symptoms and quality of life [6].

Fig.2 AIBO [7]

5.2 Paro (developed by the Intelligent Systems Research Institute (ISRI) of the National Institute of Advanced Industrial Science and Technology (AIST) in Japan, and is produced by Intelligent System Co., Ltd..) Fig.3

Features:- Has programmable behaviour as well as a set of sensors
Sensors include – an infra red sensor
-stereoscopic vision and hearing
-Touch screen sensor over complete body.

Actuators include –upper body motors
-eyelids
-Front paw
- hind limb motors

It is intended for older adults and was created to investigate the impact of companion robots in animal assistive therapy. Paro is not movable. It has been widely used to evaluate the impact of robot therapy in research with the elderly. Paro is a soft seal robot [6].

Fig.3 Paro [13]

6 iCat (has been developed and is produced by Philips) Fig.5

Features:- Made up of hard plastic, has cat like appearance, has a face to express emotions Fig.4

The purpose of its design is to serve as a platform for human-robot interaction research. Research usually looks into how users view the iCat as a new technology interface. The iCat is more focused on providing functional help than it is on being a companion. It is included in this study, nevertheless, because some research on the elderly usually measures acceptance while taking into account other social behaviours. As a result, the iCat has a strong connection to older people's social interactions with robots [6].

Fig.4 Some facial expressions. From left to right: happy, angry ,surprised. [14]

Fig.5 iCat [14]

5.3 Pearl (is the second generation of nursebots developed by Carnegie Mellon University)Fig.6

Features:- This mobile robot can assist senior citizens in navigating the nursing home. It can offer elderly people cognitive support and counsel, and it has an easy-to-use interface with a face [6].

Fig.6 Pearl robot [15]

Advantages of human robotic interaction and social robotics-

We are seeing increasingly complex "social" robots in real-world settings as well as in movies and television shows, thanks to advancements in artificial intelligence and engineering technology. Although we may soon have to interact with these "social robots" in our daily lives, surprisingly little is known about how we view, engage with, and accept these machines in social settings. Emphasizing the significance of this expected infiltration of machines into human society, major research organizations worldwide, such as the National Science Foundation and the European Commission, seek to enhance their role in promoting robotics development by outlining strategic visions for the incorporation of robots into all facets of society [12].

6 The global adoption of robots demonstrates how important this technology is to production. Advanced robots are still being introduced in manufacturing at a far higher rate than service robots in other industries. Nonetheless, a notable rise in these markets is the anticipated tendency [10].

7 "From 2015 to 2017, robot installations are expected to increase by 12% on average per year (CAGR): roughly 6% in the Americas and Europe, and about 16% in Asia/Australia," according to the International Federation of Robotics (IFR). The number of robot installations is still rising as a result of the automation trend. It is anticipated that the rapid rise in robots will continue, particularly in the Asian market. Fig.7 [10].

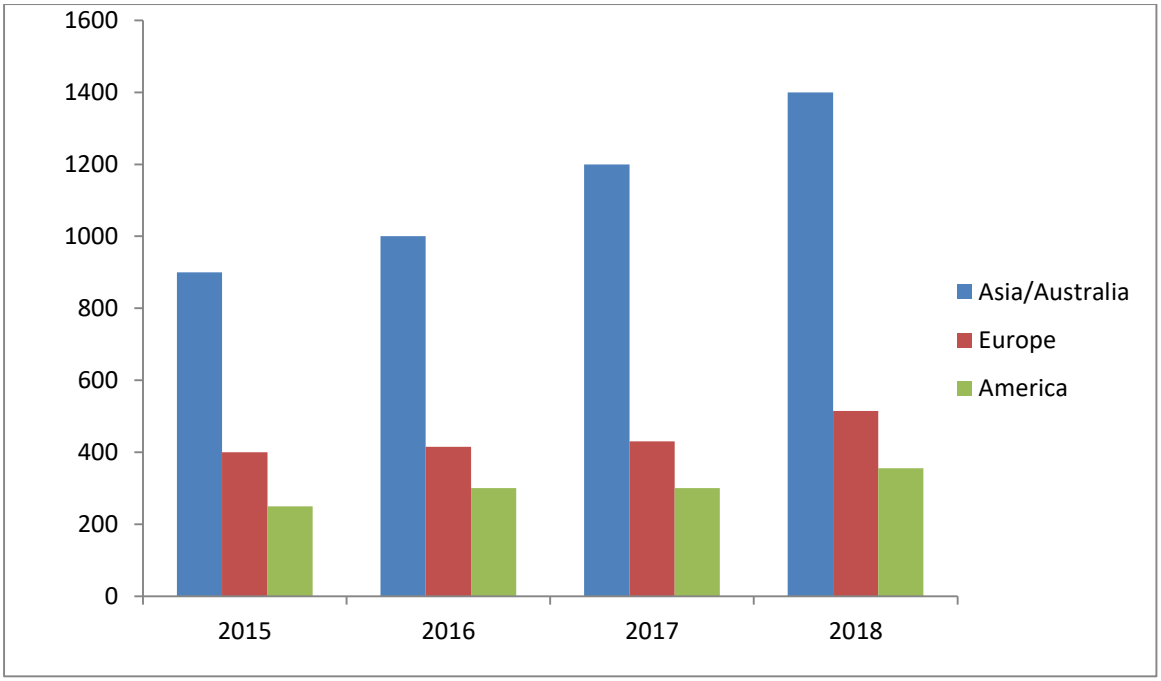

Fig.7

- Robots designed to help in assisted living facilities, robots that track a patient's physical and mental health, and robots that improve social learning for people with conditions that may affect their communication effectiveness are all examples of research in the healthcare application area [11].

- The impact of a social robot in an educational setting was assessed in various research. These research typically involved young children as subjects, and the robots were designed to increase their attention span so they could remember more knowledge during a single lesson [11].

8. Limitations of Human Robotics Interaction and Social Robotics–

Some of the disagreements on whether or not deception is an element of social robotics stem from disagreements regarding whether or not the deceiver's intention is always included.
For examples- the Paro, a fur-covered, seal-like robot that is employed to treat elderly patients .They contend that since it can offer comfort without requiring a purposefully created false idea that the robot is a real seal, there is no deceit in its use.
We disagree and contend that our intentions may be deceptive. The makers of the Paro robot had no intention of giving the impression that it was a real seal. Instead, they aimed to design a therapeutic item that offered people some stress alleviation and a pet-like experience. However, it might be argued that its appearance and behaviour give some people the false impression that it is sentient or intelligent [9].

Attachment formation is even more likely to occur when the robots are adorable humanoids or hairy robot pets. For vulnerable adults, such as those suffering from dementia or other cognitive impairments, such emotional ties may have detrimental effects. In order to concentrate their feelings and attention on the robot, they can decide to disregard their interactions with other people [9].

Friends, family, and caregivers in general may start to feel that a robot companion or pet is meeting the social and attachment needs of an elderly person, leading them to spend less time with them [9].

Similar to children, an elderly person who thinks of a robot as a friend may divulge information to it that they would like not to be shared with others. They may also heed its advise, but it may not always be suitable for their circumstances [9].

Could a robot distinguish between a child using scissors to pry dangerously into the appliance and a child picking them up for a craft project? Of course, the robot's creator could have foreseen certain risky scenarios, but the actual world is full of unforeseen and unpredictable events that could have detrimental effects [9].

9. Conclusion

Designing and researching autonomous robots that are anticipated to interact socially with humans is the focus of the rapidly expanding discipline of social robotics. In the near future, social robots will carry out tasks in our daily lives, and research on interaction-oriented robots has been inspired by recent advancements in robotics. These robots differ from conventional task-oriented robots, which carry out specific tasks in a restricted range of applications. Robots that are interaction-oriented are made to engage with people, communicate with them, and take part in human civilizations [16]. Similar to how a coin has two sides, social and HRI robots are useful in some aspects of our life and can help humans by making their jobs easier, but they can also cause people to become estranged from their loved ones and environment. These days, people look for work that requires less effort, yet when we rely on robots to do a task, we are sacrificing our ability to do it.
To prove that social robots can be used more effectively in daily life, more research is needed. Despite these encouraging outcomes, there are still unanswered questions, and a database for these kinds of circumstances can be created by testing a wide range of scenarios. This includes many other possibilities that need to be considered in addition to the effective usage of a robot companion in an office setting. Overall, the findings show that a social robot can exhibit behavior that significantly improves the robot's overall user experience, even when the robot is not actively carrying out a particular task [17].

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