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Robots In Lecturing - The Concept Of HRI (Human –Robot Interaction)

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ABSTRACT

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. 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. Robots can also be used in giving lectures for students in an efficient way. Here we formulate some thoughts about use of robotics in education, in particular at college and university level. We argue that, although robotics is used in many universities and courses, its advantages are not necessarily as obvious as we would like to believe. There is an apparent need for analysis that would provide more convincing data supporting use of robotics for educational purposes.

Keyword- working memory, HRI

I. INTRODUCTION

Human-robot interaction has been a topic of both science fiction and academic speculation even before any robots existed. Because HRI depends on knowledge of (sometimes natural) human communication, 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,

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 any orders given to it by human beings, expect 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. Human–Robot Interaction (HRI) is a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans. Interaction by definition, requires communication between robots and humans. Communication between a human and a robot may take several forms, but these forms are largely influenced by whether the human and the robot are in close proximity to each other or not. Thus, communication and, therefore, interaction can be separated into two general categories:

1. Remote interaction — the human and the robot are not co located and are separated spatially or even temporally (for example, the Mars Rovers are separated from earth both in space and time).

2. Proximate interaction — the humans and the robots are colocated (for example, service robots may be in the same room as humans). Within these general categories, it is useful to distinguish between applications that require mobility, physical manipulation, or social interaction. Remote interaction with mobile robots is often referred to as tele-operation or supervisory control, and remote interaction with a physical manipulator is often referred to as tele- manipulation. Proximate interaction with mobile robots may take the form of a robot assistant, and proximate interaction may include a physical interaction. Social interaction includes social, emotive, and cognitive aspects of interaction. In social interaction, the humans and robots interact as peers or companions. Importantly, social interactions with robots appear to be proximate rather than remote.

II. INFORMATION EXCHANGE

Autonomy is only one of the components required to make an interaction beneficial. A second component is the manner in which information is exchanged between the human and the robot (Figure 1). Measures of the efficiency of an interaction include the interaction time required for intent and/or instructions to be communicated to the robot, the cognitive or mental workload of an interaction, the amount of situation awareness produced by the interaction (or reduced because of interruptions from the robot), and the amount of shared understanding or common ground between humans and robots There are two primary dimensions that determine the way information is exchanged between a human and a robot.

The communications medium and the format of the communications. The primary media are delineated by three of the five senses: seeing, hearing, and touch. These media are manifested in HRI as follows:

i) Visual displays, typically presented as graphical user interfaces or augmented reality interfaces
ii) Gestures, including hand and facial movements and by movement-based signaling of intent
iii) Speech and natural language, which include both auditory speech and text-based responses, and which
frequently emphasize dialog and mixed-initiative interaction
iv) Non-speech audio, frequently used in alerting and
v) Physical interaction and haptics, frequently used remotely in augmented reality or in teleoperation to
invoke a sense of presence especially in telemanipulation tasks and also frequently used proximately to promote emotional, social, and assistive exchanges.

*Fig.1 Representative types of robots. In clockwise order beginning in the upper left: **RepileeQ2** — an extremely sophisticated humanoid Robota — humanoid robots as "educational toys" ;**SonyAIBO** — a popular robot dog ; (below the AIBO) A sophisticated unmanned underwater vehicle Shakey — one of the first modern robots, courtesy of SRI International, Menlo Park; **CA Kismet** — an anthropomorphic robot with exaggerated emotion ;Raven — a mini-UAV used by the US military; **iCAT** —an emotive robot ; **iRobot_ PackBot_** — a robust ground robot used in military applications.*

III. BENEFITS OF HRI

HRI could benefit our society in multiple ways. Assistive and health-care robotics can improve the quality of life of the elderly or physically impaired people, as our aging population is growing and there is a limited human healthcare workforce available. Robots can be used in search and rescue operations to spare the lives of rescue workers in the event of natural or man-made disasters. For applications such as service robotics, the use of robots in homes, offices, museums, schools, or stores can increase the efficiency of people's work, providing new services and improving the quality of life. Education would also benefit from HRI, as robotic teacher aides could assist students and provide an enhanced learning experience for the children, leading to better results later in life. As the challenges of HRI would be solved, the market for robotic entertainment will grow and benefit significantly.

IV. WORKING MEMORY

A. Working Memory in the Brain

Working memory is what allows you to remember what phone number the operator told you, just long enough to dial it. Working memory is what allows you to retain and use an intermediate result while solving a complex mental arithmetic problem. Working memory is what allows you to remember information that is critical to correct decision making in the current situation, discarding that information once it has served its purpose. Due to its involvement in so many aspects of mental function, working memory is a central component of almost all theories of human cognition. Working memory has been described as a system that stores a small number of "chunks" of information, protecting them from interference from other processing systems and positioning them so as to directly influence the generation of behavior. Many theories of working memory exist, but they tend to agree on several key properties. One such property is the limited capacity of the working memory system. Recent estimates of this capacity suggest that the number of "chunks" that can be stored and used by working memory is approximately four. Note that this is somewhat lower than earlier estimates which suggested a capacity of "seven plus-or-minus two" items. A second key property of working memory is that its contents are readily accessible to other cognitive processes. That is, the information may immediately influence executive or deliberative processes. This property, combined with the first, suggests that working memory may be adapted to retain only the information that is most important for influencing behavior in the current situation

B. Working Memory For Robots

The human brain includes a capacity-limited memory system devoted to the short-term retention of task relevant information. This system is called working memory. Some computational neuroscience accounts of working memory have explained it in terms of interactions between the prefrontal cortex and the mesolimbic dopamine system. Prefrontal cortex (PFC) plays an important role in working memory. Neurons in this brain region have been found to actively maintain high firing rates in the absence of stimuli, encoding relevant bits of information during delay periods. Inspired by these models, we have proposed a software toolkit for creating working memory components for robot control systems, based on the proposed mechanisms used by the brain. We report our design for this toolkit, as well as the results of a feasibility study, involving a robotic version of the delayed saccade tasks. A set of software tools for developing working memory systems that can be easily and tightly integrated into robotic control mechanisms. This set of tools, called the *Working Memory Toolkit (WMtk)*, is a software library which is general and flexible enough to be used on a variety of robotic platforms. The toolkit is written in ANSI, C++, and it consists of a set of classes and methods for constructing a working memory system that uses TD learning to select working memory contents. The temporal difference (TD) learning algorithm is a powerful method for learning to select actions based on feedback in the form of reinforcement signals:
sporadic, scalar measures of how "good" or "bad" the current situation is. The algorithm uses these sparse measures of performance quality to adjust behavior over time. The central component of this algorithm is an estimator of future reward, called the *adaptive critic*. The adaptive critic is commonly a simple artificial neural network that takes information about the current state of the animal and of the environment and maps it onto an estimate of how good or bad the current situation is. Importantly, this mapping is learned through experience. When using the WMtk, the first step involves the creation of a Working Memory object. This object is configured to hold no more than a specified number of chunks, but there is no limitation on what kind of information may be grouped into a chunk.

Chunks are not restricted to a particular data type, and the Working Memory object simply maintains untyped pointers to the chunks stored within it. When the robot encounters a new situation, its control systems are expected to generate a list of candidate chunks. For example, Object recognition systems may detect the

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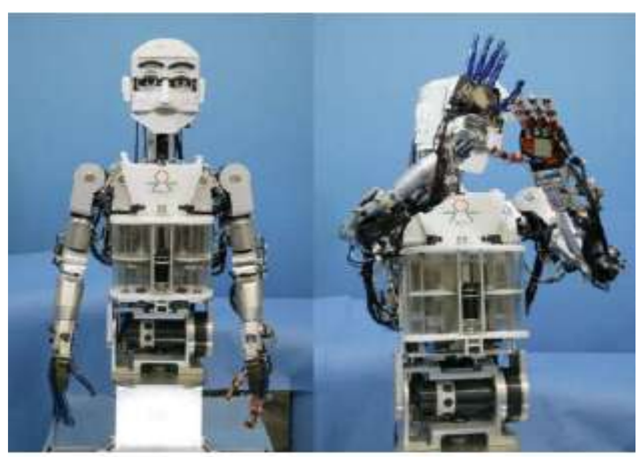
presence of a salient object, producing candidate chunks for the existence of the object, its location, and other relevant properties. Control systems may also produce candidate chunks that correspond to actions or goals, such as a desire to grasp a particular object. Importantly, candidate chunks are not automatically stored in working memory. Instead, the list of candidates is passed to the Working Memory object, which uses TD learning to decide which chunks to retain. In order to evaluate the utility of a chunk, the adaptive critic needs to be provided with real-valued features that are potentially predictive of task success and, thus, future reward.

Since the WMtk does not limit the structure of chunks, however, it cannot automatically extract meaningful features from the candidate chunks for this purpose. Thus, the WMtk requires the system designer to specify a function that maps any chunk onto a vector of features to be used by the adaptive critic to assess the value of the chunk. So, the robots can be more effective in the working memory of brain. The utility of that working memory can be used in the lecturing the students also which in turn will provide so many advantages. The robots are strong enough in emotional expression also.

V. EFFECTIVE EMOTIONAL EXPRESSION

Many researchers have developed the robots with effective emotional expression and are utilized in the educational system in an effective manner. The NAO robot enables rapid prototyping of social behaviors, such as emotions, without having to struggle with lowlevel. technical details. Based on psychological research on human expression of emotions and perception of emotional stimuli we created eight different expressional designs for the emotions Anger, Sadness, Fear and Joy, consisting of Body Movements, Sounds and Eye Colors, using the robotic platform NAO.



(a) Neutral (b) Disgust

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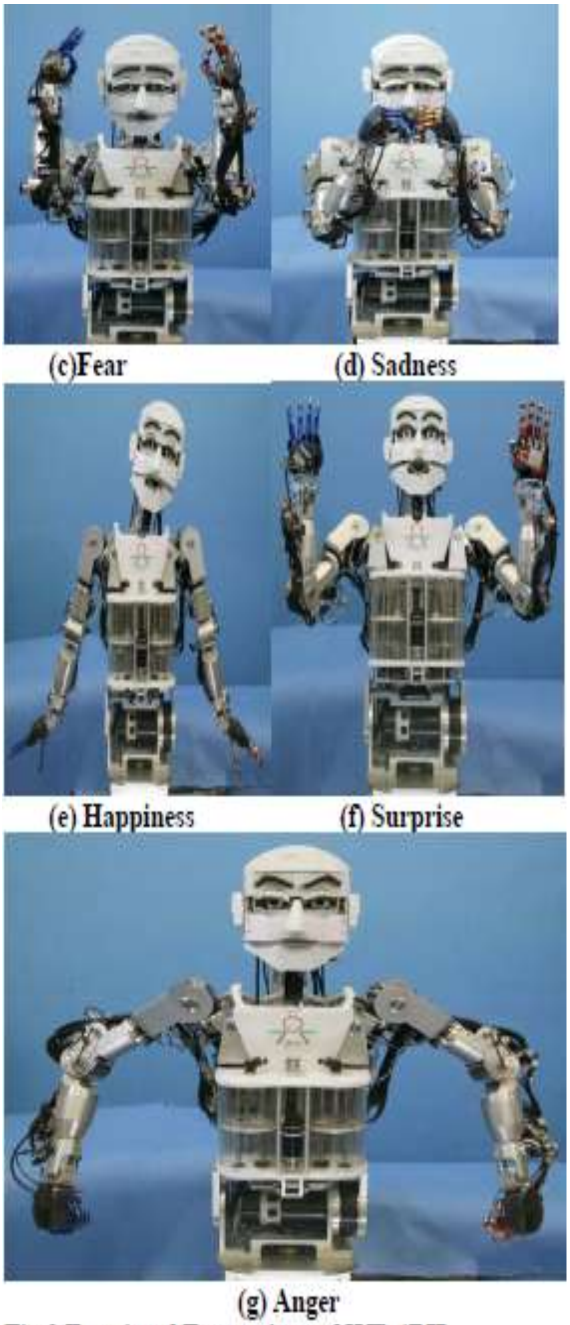

Fig 3 Emotional Expressions of WE-4RII

Fig 4 Humanoid robots

VI. CONCLUSION

Human–robot interaction is a growing field of research and application. The field includes many challenging problems and has the potential to produce solutions with positive social impact. Its interdisciplinary nature requires that researchers in the field understand their research within a broader context. Thus, the effective working memory of robots or humanoid robots can be used in education system also for giving effective lectures. The humanoid robots used under the practical course section will really help a lot for the absence of the human presence. A unified treatment of HRIrelated problems, identifies key themes, and discusses challenge problems that are likely to shape the field in the near future.

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