Programming Pepper: What can you make a humanoid robot do?*

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***Abstract*— The UK Robotics Week provided an opportunity to engage the UK nation's schools, colleges and universities in developing skills needed to drive the UK's technological future economy. Within this contest we decided to present a series of events to introduce school children to the state-of-art of social Human-Robot Interaction (HRI) and some currently adopted social cues. The students were exposed to three different types of HRI: a video HRI, a real live HRI and HRI programming of a robot. In particular, during the programming sessions, students were focused on the implementation of emotions in HRI. Future works will use the results collected during this event to investigate the impact of human perceptions of trust and acceptability of robots in Human-Robot Interactions.**

I. INTRODUCTION

The Adaptive Systems Research Group at the University of Hertfordshire organized an event for the UK Robotics Week in 2018 to introduce school students to our robotics research (see Figure 1). The students' interacted first with the robot, and then they created behaviours for a storyteller robot. In order to provide a pleasant and interesting experience, we asked the students to apply some of the state-of-art principles used for human-robot social interactions (i.e. robot expressing emotions) to the focal points of the story.

Emotions are natural human behaviours and "they are parts of the very process of interacting with the environment."[1, page 51]. Frijda et al. also propose that emotions have direct or indirect social consequences on the individuals involved in the HRI. Exhibition of socially interactive behaviours is a key factor in human acceptance of an autonomous robot [2], [3]. In particular, a robot that is able to show emotions helps to facilitate interactions with a human [4], [5]. Humans can feel many emotions however, and Ekman [6] described in his work six universally recognised basic emotions: anger, disgust, fear, happiness, sadness and surprise. Wellman et al. [7] described how children as young as 3 years appropriately understand happiness, sadness, surprise and curiosity emotions.

From the students' prospective, the main objective of this event was to inspire school students to take an interest in robotics while having fun. During this activity, the students appreciated the practical applications and challenges of programming social robots.

From a scientific prospective, we aimed to observe and analyse the human participants' perceptions of the robots with regards to their different interactions and levels of knowledge of a robot. Our main research interest is focused on investigating how to enable safe HRI in human-centred environments. In particular, we were interested in investigating how an interactive relationship can be established and preserved between human users and their robotic companions. It is likely that humans has become acquainted with a particular robot, their expectations of robot's capabilities may vary. We hypothesise that human attitudes towards robots can change when they become more aware of the real potential and limitations of the robot.

In Human Computer Interaction, Muir and Moray [8] showed that peoples' trust in a machine was strongly affected by the machine's good performance. Indeed, trust is a key factor in the acceptance of an autonomous robot as a peer, assistant or companion in human-centred environments. It can determine humans' perceptions of the usefulness of imparted information and capabilities of a robot [9], [10], [11].

Moreover other aspects can affect peoples' perceptions of robots, including the particular embodiment of a robot [12], [13], [14], [15], and their degree of awareness of a particular robot's functionality and operation.

This work gives an overview of setup of the event, but we leave the presentation and discussion of results to a future article.

II. APPROACH

The focus of the event was both on the design of emotions for the interactive humanoid robot, and on collecting students' perceptions of the robot during three different levels of interactions by means of questionnaires.

A. Method

We collected participants' behaviours during three different levels of interactions with the SoftBank Robotics robot Pepper. Students worked with two Pepper robots for one session that lasted approximately three hours including a short break. Participants were asked to watch a video of the Pepper robot, then they were presented with two real Pepper robots, which they programmed and then tested different behaviours for the robots. In order to analyse the interactions between the human participants and the robot, at the end of each activity we asked the participants to answer a questionnaire.

Fig. 1. A class of pupils posing with two robots at the end of one of the two-days event.

B. Procedure

The event was organised as three different stages: 1) meeting the humanoid robot Pepper, 2) interacting with Pepper, and 3) programming Pepper. In the first part of the event, students watched

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a brief introductory video in which an actor interacted with the robot.

The second part of the event was focused in a closer interaction with Pepper in which students can touch the robot and use its functionalities.

Finally participants built a story combining the narrative and matching emotions. The story is a simplified version of the Hansel and Gretel story, composed by six different sentences. The custom emotions were designed and implemented by students. To achieve this goal, they used body movements, gesture, verbal and non-verbal cues. Students autonomously chose an emotion for each sentence, but we were expecting them to use the following feelings: happiness, sadness, anger, curiosity, fear and surprise.

In order to perform a future analysis of the students' interactions and their experiences with the robot, the students were presented with a short questionnaire at the end of each stage.

C. Participants

We conducted the event in a local secondary school. Participants were secondary school students in year groups 10 to 12 [min age 14, max 15, avg. age 14.76, std. dev. 0.42]. The event was conducted over two consecutive days in the school and participants were tested in their age year groups, making a grand total of 43 students [6 girls, 37 boys].

The event was approved by the Health, Science, Engineering & Technology ECDA of the University of Hertfordshire (UK) and students' parents gave their written consent.

D. Evaluation

We asked students different questions at the end of each part of the interaction about: 1) previous experiences with Pepper; 2) assessing participants' willingness to have Pepper as companion; 3) their perception of trust of Pepper; 4) their experience in programming the robot.

The questions sets were:

- Q1 Have you ever seen Pepper before today?
- Q2 If yes, where:
- Q3 Would you like to have Pepper in your home?
- Q4 Do you trust Pepper to be able to help you with your homework?
- Q5 Do you trust Pepper to wake you up in time for going to school?
- Q6 Do you trust Pepper to be able to warn you of danger, e.g. when using the Internet?
- Q7 Do you trust Pepper to help you in case of danger?
- Q8 Programming Pepper was? [very boring - very fun]
- Q9 Programming Pepper was? [very hard - very easy]
- Q10 Would you like to program Pepper again?

The first set of questions (Q1-Q2) were asked only after the video interaction, while students answered the questions Q8-Q10 only at the end of the programming phase. We repeated the sets of questions Q3-Q7 after all the interactions.

A preliminary analysis confirmed our hypothesis that participants' awareness of the robots' real potential and limitations affected their perceptions of trust in the robot.

III. CONCLUSIONS & FUTURE WORKS

The event was a success for the students and the purpose of devolving science in younger people. The teachers were very enthusiast and are looking forward to repeating the event next year, also to be involved in other activities of the Adaptive Systems Research group. All students stated they were happy about their interactions with the robots and the programming activities.

A future article will use the data collected from the questionnaires during the event to present detailed results and findings with regard to the impact of the different levels of knowledge of a robot on the students' perceptions of trust and acceptability of robots in repeated Human-Robot Interactions.

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