Studying Coevolution between Social Robots and their Stakeholders

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ABSTRACT

For a social robot to be used in society, it should incorporate feedback from stakeholders, including users. In addition, stakeholders explore the best use of the robot and may change their thoughts about the robot. This is the process of coevolution. To study this process, we are investigating the interactions between senior citizens with limited knowledge about robots and the developers of a robot.

Keywords

Stakeholders; Harmonizing process; Coevolution

1. INTRODUCTION

When a new technology emerges, and is successfully used by society, coevolution occurs between the technology and its stakeholders. This is not just the evolution of a technology but also the evolution of the stakeholders. Users may change how they use technology, and their attitude toward the technology may also change. Similarly, change can occur in other stakeholders, such as the providers of the technology. This is also the case with social robots. For social robots to be used in society, it is important to induce a smooth coevolution between the robots and stakeholders. Therefore, we are investigating the coevolution process to gather knowledge about how to make it occur effectively. To this end, the study first focuses on how users become accustomed to social robots. We refer to this process as a harmonizing process comprising the following six steps.

[**C1**] Users grasp both the advantages and the risks of using a robot.

[**C2**] The users have a will to use the robot.

[**C3**] The users can use the robot under the initiative of the developer of the robot.

[**C4**] The users can use the robot by themselves in their own environments.

[**C5**] Unexpected use/value of the robot is discovered.

[**C6**] The users experience spreads to other people, thereby producing new users.

The definition of this harmonizing process is still preliminary and must be expanded through study. At present, we recognize that the gap between steps [C3] and [C4] is particularly significant, implying several important aspects. For example, instructional and environmental factors likely exist between these steps. In the following sections, we report on our ongoing study to investigate steps [C3] and [C4]. The target users are senior citizens who have limited prior knowledge about robots. Social robots should be designed for such users. The design process begins by presenting some known functions for seniors, such as promoting physical exercise and cognitive games. The aim of the study is to gather knowledge about the harmonizing process, particularly for steps [C3] and [C4], to more precisely define the steps.

2. METHOD

The study comprises four phases. In each phase, participant harmonization level increases through interaction with a robot. In each harmonization step, questionnaires and interviews are employed to reveal participants' anxieties related to robotics technology and the robot they interacted with, as well as to measure the users' perceptions of robots.

2.1 ROBOTS

Two social robots with different appearances and functions will be used in this study. These robots have different roles to elicit general anxiety about robotics technology. The participant interacts with only one of these robots according to instructions given by a facilitator. The participant will not interact with the other robot and thus the functions of the robot will be unknown to the participant. Therefore, one of these robots plays the role of robot technology people interact with, while the other robot represents general robotics technology people never interact with. By comparing these two robots, participants' general anxieties about robotics technology will be measured. Two humanoid robots, Nao and Pepper by SoftBank Robotics [1], will be used in the study.

2.2 TASKS

We will start from using the following three tasks.

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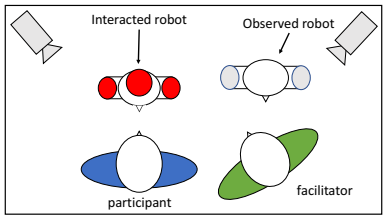

Figure 1: Test setting

2.2.1 *Introduction task*

The objective of this task is ice-breaking between the participant and the robot. The robot and the participant introduce themselves to each other in this task.

2.2.2 *Enjoyable task*

The objective of this task is to make all participants feel at ease when interacting with the robot. In this study, this task involves singing and dancing with the robot.

2.2.3 *Attractive task*

The objective of this task is to avoid the participant from becoming bored with interacting with the robot. The task should have attractive aspects for participants. In this study, participants are senior citizens. Therefore, a cognitive training game is chosen because most seniors are interested in such games.

2.3 Measurements

Two questionnaires for quantitative analysis and interviews for qualitative analysis about the participants' anxieties about robotics technology will be used. In addition, behavioral analyses will be conducted using videos taken during the trial.

2.3.1 *Questionnaires*

Many factors can disturb coevolution in the harmonization process. Negative impression toward the robot would have the most significant influence on the evolution of users in the harmonization process. In this study, the Robot Anxiety Scale [2] will be used to evaluate negative impression toward the robots. In addition, a series of questionnaires will be used to measure the users' perceptions of robots [3].

2.3.2 *Interviews*

The participants will be interviewed about the results of the questionnaires. In addition, the facilitator asks the users if they have other comments that will be not covered by the questionnaires. The participants will be interviewed multiple times. After the second interview, if the participants change their answers to the questionnaires, the facilitator asks them to explain why they had changed their answers.

3. STUDY PROCEDURE

The study comprises four phases. Through these phases, the participants proceed through the steps of the harmonization process. The test room and procedures will be designed to elicit opinions about each step of the process. In this study, the participants will be senior citizens who have never interacted with any robots. The study will be held in a place that is familiar to the participants' homes. The setting in which participants will interact with the robots is shown in Figure 1.

Phase 1 : A participant is assumed to be at step [C2]. A facilitator provides instructions about the study to the participant. Interviews are conducted in a different room.

Phase 2 : The participant enters the test room with the facilitator and meets the robots for the first time. Before the participant interacts with the robot, the participant answers questionnaires and is interviewed. Then, the facilitator provides instructions about interacting with the NAO robot relative to the three tasks described in Section 2.3. The facilitator then administers the questionnaires and conducts an interview. At this point, the participant is assumed to be at step [C2].

Phase 3 : The facilitator instructs the participant to freely use anything in the room, including both robots. The facilitator then leaves from the room. After ten minutes, the facilitator re-enters the room and conducts questionnaires and interviews. At this point, the participant is assumed to be at step [C3].

Extra : Now, the participant is assumed to be at step [C4]. The facilitator asks the participants to rent the robots and use them in their home for one day if they would like. Regardless of the answer, the facilitator asks the participants to explain their choice. If the participants decide to rent the robot, they are assumed to be at step [C5].

Finally, the participants are interviewed about the investigation procedure. Each phase in phase 1 to phase 3 takes about ten minutes respectively; however, the facilitator can adjust this time according to circumstances. Comparison between each results of questionnaire will provide requirements to proceed through the steps of the harmonization process.

4. FUTURE WORK

We are setting up this trial to clarify anxieties about robotics technology in each step of the harmonization process, and gather specific knowledge about steps [C3] and [C4] to more precisely define these steps. The results of this study are expected to bring implications to reduce user anxiety about robotics technology.

Acknowledgements

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