A Software System for Human-Robot Interaction To Collect Research Data: A HTML/Javascript Service on the Pepper Robot

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ABSTRACT

A key area in human-robot interaction research is the use of a robot to collect participant research data. However, traditional website-based data collection methods do not intergrate with the robot providing the interaction. This leaves a clear disconnect between the static delivery of a digital questionnaire and a lack context-relevant behaviours from the robot. In this paper, we present a HTML/Javascript software system to create a direct link between digital data collection and the robot that delivers it. In doing so, this system can be used to create more dynamic data collection sessions using the robot's speech, movement or presence to support the delivery of questionnaires. This system can also be used to create interactive sessions to support experimentation. We present two proposed use-case scenarios built with the system with the Pepper humanoid robot in mental health and well-being services. We present this software system to help speed up development time for user studies, lower the entry barrier for non-technical researchers who want to use social robots for data collection, and to create more systematic data collection methods for robots. Future work of the software includes increasing the repertoire of questionnaire items available to allow for more sophisticated data collection.

CCS CONCEPTS

• **Human-centered computing** → **User interface toolkits**; Interface design prototyping; • **Computer systems organization** → **External interfaces for robotics**.

KEYWORDS

Interface design, Survey toolkit, Robotics, Human-Robot Interaction

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1 INTRODUCTION

A key outcome in human-robot interaction research is the collection of data, all while using the robot to deliver the interaction. Social robots have been used to collect data from different population samples such as a clinical outpatient setting [1], educational programs for children [7] and customer feedback in retail applications [4]. In these trials, the robot delivers an interaction to collect data either before, during or after the session. This method allows for easy provision, lower cost, access to large sample sizes, and people can complete questions at their own timing and pace.

Prior to the use of social robots, digital research methods included systematic research tools and survey systems to create and maintain digital data collection, such as Google Forms, SurveyMonkey and Qualtrics. They are effective tools to automate the data collection process but they do not intergrate well with robotic platforms, instead working as an isolated solution. In other words, no exchange occurs between the survey system and robotic platform, meaning that the robot can not provide any relevant instructions, verbal prompts, actions, behaviours or overall assistance during the data collection process, making the robot no more interactive than a traditional screen-based device. User-friendly tools for working with social robots, such as block-based coding systems to create animations, dialogues and behaviours, are often not readily equipped to easily build and collect extensive questionnaire sets.

To overcome this barrier to utilize the full extent of a social robot when collecting data, we propose a template questionnaire system to capture research data in an engaging and interactive way, with full use of the robot features to enhance the session experience.

2 SOFTWARE PACKAGE

We propose a template questionnaire system for collecting research data while using the full extent of a social robot to help with data collection. The template questionnaire system was developed using HTML/JavaScript to develop complex questionnaires through the creation of simple and formulaic HTML documents that integrate with the Pepper robot to provide an integrated survey experience. This software, including a descriptive guide on its use, can be found on our Bitbucket repository[1]. For ease of use, this system is prepackaged as a Choregraphe project for NAOqi version 2.5.5, which allows it to be easily uploaded to the Pepper robot using the Choregraphe Suite[5].

[1] https://bitbucket.org/pepper_qut/survey_system/

2.1 Content Delivery

Content is delivered through a combination of dialog windows displayed on a touch screen interface attached to the robot, and spoken instructions from the robot. This flexibility provides a large number of mechanisms for designing a robot interaction that integrates with the collection of data. Different combinations and selections of elements can be combined to create robot behaviours that focus on data collection while also using different communicative features during the process, such as verbal speech, gesturing, body movements, touch, social gaze or emotion recognition [3, 6].

2.2 Common Questionnaire Elements (QE)

Here we provide a list of common questionnaire elements involved in survey-related research that can be easily created using our survey tools. Survey items that can be implemented into questionnaire-based research in a consistent and systematic format include:

(1) Date and Time: Specific times or dates. Examples: experiment date or timeline follow-back.
(2) Radio Buttons: Select one answer from a defined answer set. Examples include gender and income bracket.
(3) Checkboxes: Enter multiple answers from a defined list of responses. Examples include likes or preferences.
(4) Image Choice: Select one or more images from a defined list of images. Examples include a visual quiz or A/B testing.
(5) Dropdown: Select one answer from a dropdown list. Examples: occupation or referral method.
(6) Rating/Matrix scales: Answer one item in a row of items using the same column choices. Examples: A set of ratings from 0 to 10 for evaluation questions.
(7) Sliders: Rate a question or statement by using an interactive slider. Examples: Overall experience
(8) Single and multi-line textboxes. Examples: Contact information, email, participant code.

Importantly, by leveraging the flexibility of HTML and JavaScript, researchers are not just limited to these core elements, but are empowered to implement survey elements that are tailored to their specific research needs, such as timing questions, page timers or even mini-games. Further capability is possible by integrating additional behaviours on-board the robot that can be exposed to the survey system. For example, the ability to send survey results as a formatted document to a printer.

2.3 Data Recording

Data entered by each participant is stored on the robot by a background service running on the robot when the user concludes their interaction. This data is stored in a JSON formatted file with randomised and unique identifier. This file encodes both their responses to the questionnaire, the time in seconds taken to complete the interaction, as well as at what point the interaction ended. For purposes of completeness, the system also creates records for sessions terminated prematurely noting the time and exit point.

3 EXAMPLE USE CASE STUDIES OF ROBOT APPLICATIONS: A FOCUS ON WELL-BEING

In this section, we describe two use-case scenarios in which the Pepper humanoid robot can be used as a data collection or delivery method using the software solution in a human-robot interaction scenario. The two example use cases below have not been formally used in research trials to date.

3.1 Peppers Well-being Check-in: Data Collection

In this case, Pepper can be designed to collect the Depression, Anxiety and Stress Scale (DASS-21) by [2]. This required individuals to read each statement and select a number (0-4) that indicates how much the statement applied to them over the past week (QE6). A total score can then be calculated to indicate to what level of severity the individual resides in each category.

3.2 Peppers Well-being Technique: Experimentation

In this case, Pepper can be designed to deliver a brief emotion-regulation session. Each session commenced with the robot introducing itself, asking people to enter their name (QE8), and rate their current feeling on a series of images (QE4). They were asked to confirm they are interested to hear more information (QE2), listened to information about human emotions, and used an interactive image matrix to reveal information about emotions (Q4), followed by a slider reveal for similar emotions (QE7). Afterwards, the robot discussed emotional energy, and provided guided breathing exercise using both short and longer breaths with a visual guide (Javascript). Lastly, a final rating of their current feeling on a series of images (QE4) was provided, followed by a randomised goodbye statement.

4 RELIABILITY

This software system has been utilized as the foundation for several other field trials which used the Pepper robot to collect participant data for research purposes. To date, this software system has facilitated the collection of 347 complete experimental data points for those trials with no known errors or corruption during data entry or extraction.

5 CONCLUSION AND FUTURE WORK

In this paper, we have presented a software system that uses HTML and Javascript to assist with the design and deployment of robot experimentation with a key focus on data collection delivered by the robot. Software trials found that it was easy to use, quick to deploy and robust in practice. This emergent framework becomes a basis for further development with additional tools further developed dependant on data collection needs.

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