Robotic Interfaces and the Oz Paradigm

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Introduction

As the skills and intelligence of social robots increase, so does the need for a reliable interface that humans can use to interact with them. These interfaces can be part of the robot's software; thus, their responses will be autonomous and reliant on all parts of the robot to function correctly. However, this doesn't guarantee that the robot will give consistent answers and also doesn't allow for multiple robots to give equal or similar answers in a given situation. These variances can make a research study about human-robot interaction too ambiguous to get a clear conclusion. So, what can be done to guarantee consistent behavior from the robot's side of the interaction?

Design Approach

One way to make the robots' responses consistent is to make their interfaces equal and precise by establishing a Wizard of Oz Paradigm, where the robots are controlled by a hidden third party, which makes the interaction more reliable. With some robots, like Cozmo by Anki, a third-party driver is necessary because the robot cannot hear or take in verbal commands. But with other robots, like Nao by SoftBank Robotics, a third party can be preferred because the robot may not hear or understand every question or command they are given. As long as the third-party driver is hidden from study participants, a majority of them will believe that the robots are pre-programmed and will behave towards the robots as though they are autonomous [1].

Figure 1: Cozmo by Anki

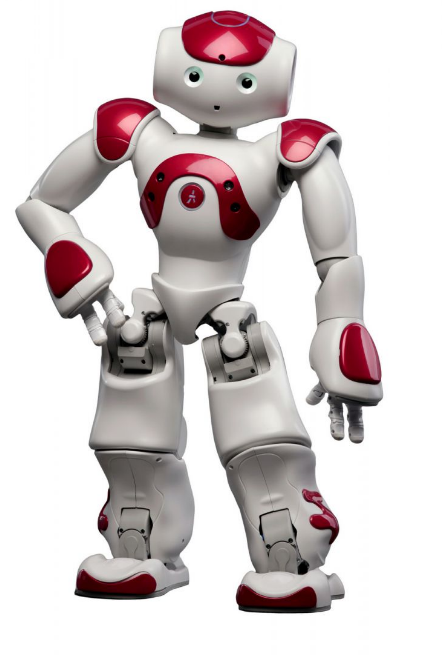

Figure 2: Nao by SoftBank Robotics

Infrastructure Approach

A future study may need multiple robots running at once or may need the robots to communicate with each other, therefore the interfaces needed to be compatible with the front end of several different robotic systems, regardless of the robot's back end structure. This could be done using the Robotic Operating System (ROS). ROS is an open source robot operating system that provides standardized access to robotics capabilities or functionalities [2]. ROS creates a controlled system that handles messages coming from the web to a robot and returns alerts when the messages are received. One of the ROS packages used with the Nao and Cozmo robots is ROSLib, the base dependency for ROS Client Libraries. ROSLib can be used with ROSBridge, which allow for ROS functions to work with non-ROS programs. In this case, the interface will be a WebSocket Server HTML file that will control the Nao robot's speech. In the HTML file, ROSLib and other required JavaScript files are imported, and then a ROS node object is created that can communicate with a ROSBridge server. Then a function can be created that uses ROSLib Topic to takes in a specific type of message that will be published to the Nao robot's speech application. Once the function is created, normal HTML components like input forms and buttons can use the function to make the Nao robot speak from a web-based interface. The same interface can be used with multiple robots, simply with changing the ROSLib Topic, making this infrastructure incredibly robust.

Conclusions

Without this web-based interface, there is no simple way to regulate a robot's behavior in a given interaction. With a third party controlling the robot's side of the conversation, studies about human-robot interaction can be much more reliant on testing the human's reaction to a social robot through an Oz Paradigm. By implementing the Oz Paradigm through a web-based server, it's easier to connect to the robots though wi-fi from an isolated location. In the future, this server can be extended by using it to connect multiple robots to one another. With multiple robots connected under a single ROS server, they could give commands to one another and complete tasks or routines as a group. This could move us towards an exponentially growing list of possibilities for social robotics in the very near future.

Citations

[1] Benjamin C. Oistad, "Colleague or Tool? Interactivity Increases Positive Perceptions of and Willingness to Interact with a Robotic Co-worker" (2016)

[2] Chis S. Crawford, "Cloud Infrastructure for Mind-Machine Interface" (2014)