PAPERINO: Remote Wizard-Of-Oz Puppeteering For Social Robot Behaviour Design

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Abstract

Wizard-of-Oz (WoZ) is a technique that is popular for prototyping and generating expressive movement behaviours in the field of Human-Robot Interaction (HRI). This technique often has people (usually experimenters or trained confederates) remotely pilot a robot using a control interface in order to simulate an artificially intelligent robot. Researchers often need to train themselves on the mapping of the control interface to the robots possible degrees-of-freedom, which can be confusing and time consuming. In this demo we present our remote puppeteering WoZ interface whereby a replica of the robot is able to remotely control a fully functional robot nearby. We are presenting this system using our robot Pingu, an open source social robot designed for Human-Robot Interaction labs.

Author Keywords

Wizard of Oz; WoZ; Interaction Design; Design Methods; Prototyping; Human-Robot Interaction

Introduction

The Wizard-of-Oz (WoZ) technique [3] is popular in Human-Robot Interaction (HRI) communities as a way of having a robot or other embedded system be remotely piloted (usually by the experimenter or a trained confederate) in order to perform functions such as movement, speech, navigation, gestures and other complex behaviours. This remote

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Figure 1: Left, a participant interacting with the robot, being controlled by the wizard on the right. Two video and one audio feed are transmitted to the computer in front of the wizard (right) to give them the ability to interact and react with the participant in real time.

pilot is often referred to as a *wizard*. The term WoZ may be used to describe a human being in the loop at a number of different levels, from direct motor control, through to simply triggering behaviour patterns based feasibly technologically implementable. Researchers often make the argument that although robots are (or are soon to be) advanced enough to be programmed with these behaviours, it would take them too much time and technical expertise to program a robot to do so.

One criticism levelled at those using the WoZ technique in their research is in failing to ensure repeatability of the wizards actions [3], and that this may cause the participant to be responding to the human behind the robot, rather than the robot itself. Weiss noted that this may in fact create a situation where the robot is simply acting as a proxy for a human, and that the participants actions may not reflect how they would act if it was a fully autonomous robot [8].

One approach to solve the issue of repeatability is to use WoZ as a generative design technique, rather than an ex-

perimental one. That is, researchers use Wizard-of-Oz to puppeteer a robot and act out many possible behaviours. WoZ techniques can allow dynamic experimentation that utilises the flexibility of a human in the loop to quickly iterate through many possible solutions and identify key areas for development [1]. Researchers such as Sirkin, Ju, Martelaro and Knight have used this experimental setup to design expressive behaviours for social robots [7, 2, 5, 4]. They often use this technique to design expressive behaviours for objects where a current movement paradigm has not been established, such as; ottomans, trash cans, chairs, drawers and many other new and previously unexplored robot form factors. However, these techniques have required the creation of controllers and systems to enable the wizard to remotely pilot the device. In the case of the trash barrel, a keyboard and web interface was used [6], whereas in the ottoman, a Playstation controller was used [7]. This can create a mapping problem, where a control interface may not directly match up with the form factor. Often this means that the wizard may feel constrained or require significant

Figure 2: System diagram of the Paperino Remote WoZ system.

time to train themselves to learn the interface to robot control mapping.

In addition to the WoZ technique Hoffman and Ju outline another way for designers of expressive movement to explore different possibilities for robot behaviours; *skeleton prototypes*. Skeleton prototypes involve the creation of a low fidelity mock-up of the design to evaluate the form of the design without committing to all of the details [1]. For this demo, we propose a system that combines the WoZ method with Hoffman and Ju's skeleton prototypes to build a puppet that allows exploration of expressive movement for a social robot. Zaga et al have taken a similar approach to having children design motion behaviours for a mobile robot, with the puppet robot being at a smaller scale than the functional robot [9]. Our system will consist of two same scale robots, one in a fully functional state, and the other a skeleton prototype to act as a puppeteering rig for the first. Demo participants will be able to WoZ and interact with one another by manipulating the puppet robot and seeing their behaviour mirrored into the functional robot.

System Description

Two robots are built; one fully functional and one puppeteering robot. Each robot features 3 degrees of freedom with the same ranges of motion using Dynamixel motors. Using Python and the pypot libraries compliant mode, we link one's behaviour to another. This makes it so that the puppet robot is easy to manipulate and transmits its coordinates to the functional robot. Using live video and audio feeds, the wizard is able to manipulate the puppet robot in real time, responding to the user with dynamic interactions. A full system diagram can be seen in fig 2. Both robots will be prototypes of the Pingu robot developed in house and will be controlled using a single Raspberry Pi Model 3 B+.

Demo Description

The two robots will be placed on opposite ends of a table, with a divider placed between them. Two demo participants will sit at each end of the table so that they are only able to see one robot. The wizard, who controls the puppet robot, will have a screen next to their robot showing the view from the webcam in the functional robot. Participants will be invited to explore different behaviours and scenarios, and be given the opportunity to be both the wizard and the participant. The wizard will be given a list of behaviours that they can either choose to enact or to enact one that they generate themselves. Among others, the list of behaviours will feature;

- How would the robot show that it has something to share?
- How would the robot show that it is happy or sad?

Relevance To CSCW

We see many opportunities for systems like this to have a large impact to the CSCW community, a community featuring people with broad skillsets that may not be experts in

technical robot development. With systems such as this researchers, experts and layusers are all able to explore the expressive potential of a robots form factor, a key aspect in using motion as a communicative function [1]. Code will be provided as part of the robots source code, available at <https://github.com/riglab/spyderbot>.

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REFERENCES

1. Guy Hoffman and Wendy Ju. 2014. Designing Robots With Movement in Mind. *Journal of Human-Robot Interaction* 3, 1 (2014), 89. DOI : <http://dx.doi.org/10.5898/JHRI.3.1.Hoffman>
2. Wendy Ju and Leila Takayama. 2009. Approachability: How people interpret automatic door movement as gesture. *International Journal of Design* 3, 2 (2009), 1–10.
3. J. F. Kelley. 1984. An iterative design methodology for user-friendly natural language office information applications. *ACM Transactions on Information Systems* 2, 1 (1984), 26–41. DOI : <http://dx.doi.org/10.1145/357417.357420>
4. Heather Knight, Timothy Lee, Brittany Hallawell, and Wendy Ju. 2017. I get it already! the influence of ChairBot motion gestures on bystander response. *RO-MAN 2017 - 26th IEEE International Symposium on Robot and Human Interactive Communication* 2017-Janua (2017), 443–448. DOI : <http://dx.doi.org/10.1109/ROMAN.2017.8172340>
5. Nikolas Martelaro and Wendy Ju. 2017. WoZ Way: Enabling real-time remote interaction prototyping & observation in on-road vehicles. In *Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. ACM, 21–24.
6. Brian Ka-Jun Mok, David Sirkin, Srinath Sibi, David Bryan Miller, and Wendy Ju. 2015. Understanding driver-automated vehicle interactions through Wizard of Oz design improvisation. (2015).
7. David Sirkin, Brian Mok, Stephen Yang, and Wendy Ju. 2015. Mechanical Ottoman: How Robotic Furniture Offers and Withdraws Support. *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction* (2015), 11–18. DOI : <http://dx.doi.org/10.1145/2696454.2696461>
8. Astrid Weiss, Judith Igelsböck, Sylvain Calinon, Aude Billard, and Manfred Tscheligi. 2009. Teaching a humanoid: a user study with HOAP-3 on learning by demonstration. *IEEE International Symposium on Robot and Human Interactive Communication* (2009), 147–152. <http://www.calinon.ch/papers/Weiss-RoMan2009.pdf>
9. Cristina Zaga and Vanessa Evers. 2017. Towards Co-designing Minimal Robot Behaviors with Children : What Children Can Teach Robots Towards Co-designing Minimal Robot Behaviors with Children : What Children Can Teach Robots. May (2017), 1–4.