Prototyping Social Interactions with DIY Animatronic Creatures

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Abstract
For some time now, robotics research has shifted its attention from robots that function within their own predefined space to robots that coexist with humans in the human's natural habitats. This evolution has not only driven interest in robot safety and compliance, it has also resulted in the subdomain of Social Robotics, which is concerned with natural interaction between robots and humans. In this studio, we will offer participants the chance to create their own animatronic creature using modular building blocks derived from Ono, our low-cost Do-It-Yourself social robot. In the first part, we will help participants to conceptualize a context and scenario for their social robot. Then, using craft materials (e.g. cardboard, glue, fabrics, foam, etc.) in combination with custom connectors and our animatronic modules, participants will build the physical embodiment of their creature. Finally, they are brought to life by connecting the modules to our electronics platform (Raspberry PI), which is then programmed using an easy to use library.

Keywords
Social Robotic Platform, Embodied Human-Robot Interaction, Animatronics

ACM Classification Keywords

I.2.9 Robotics, H.5.2 User Interfaces: Input devices and strategies, Prototyping

Introduction

A growing trend in robotics is that robots are no longer confined to spaces that were specifically designed for them, such as an industrial robotic arm that operates in an enclosure at a factory. Instead, robots are starting to show up in the living and working spaces of humans. Examples include Roomba [1] (a robotic vacuum cleaner), Paro [2] (a therapeutic seal-like robot for hospitals and nursing homes) and Baxter [3] (a robotic factory worker that can safely work alongside its human coworkers). Influenced by this trend, we created another social robot, named Ono [4], aimed primarily at children, with a focus on therapeutic applications such as the treatment of autism spectrum disorder. Different from other social robots in research, Ono was designed with low-cost materials and DIY techniques in mind, resulting in a low-cost, modular robot that can be produced in any common FabLab. Owing to the robot's modular construction, it can be repaired more easily, and the modules can also be recombined to quickly create radically different looking social robots. This aspect is very useful in the treatment of autism in particular, as therapeutic tools sometimes need to be adapted to fit the specific needs of each child. This approach is not only advantageous in our specific context; it also facilitates the process of building social robots for completely different applications. In this studio, we will show how our modules can be used to prototype an animatronic creature in a quick and iterative manner.

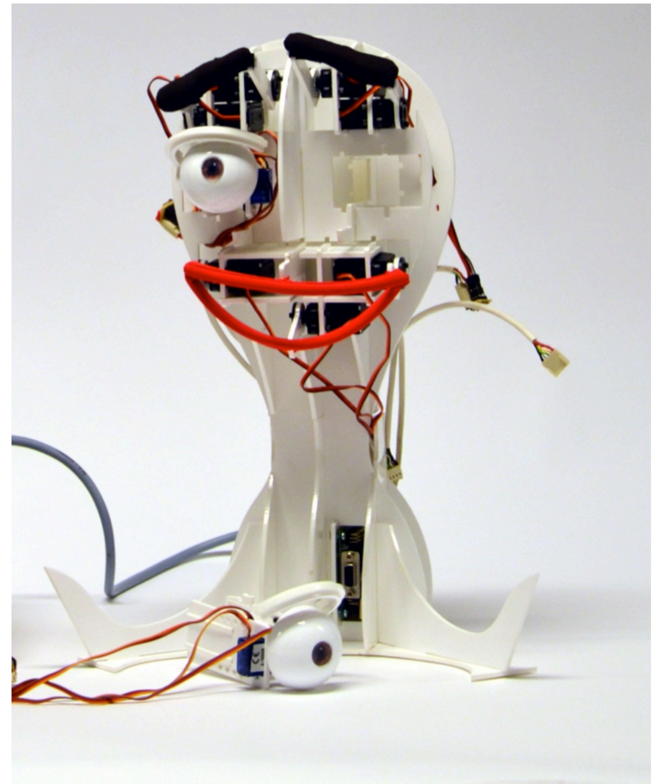

figure 1: Inside view of social robot Ono, with one eye module detached.

Studio Proposal

The goal of our studio is to enable participants to design and prototype their own robotic creature. Participants will be split up into four groups of four, and each group will build one robot. The workshop is divided into four parts:

Part 1: Concept Generation
We will start the studio session with a brief overview of social robotics. We will shortly discuss the history and inspirational examples of human-robot interaction. We will demonstrate the social robot Ono and briefly describe the design philosophy behind it. Finally, we will introduce participants to our social robotics toolkit and go over the possibilities and limitations of the kit. Participants will then be given time to come up with a concept and scenario for a new social robot.

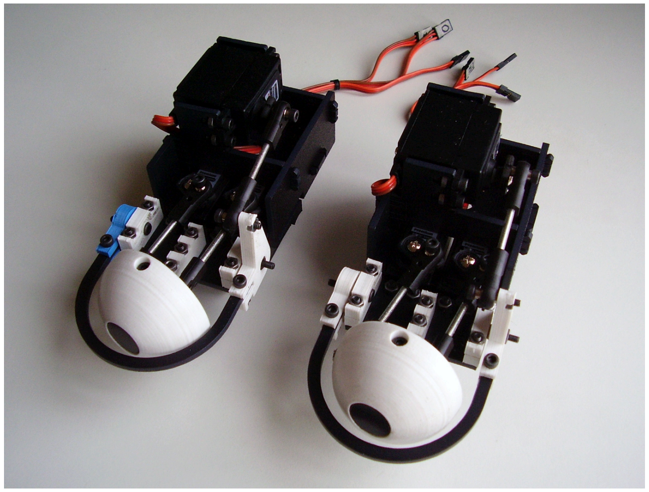

figure 2: The eye modules of the toolkit.

Part 2: Embodiment
In the second phase, we will give participants the tools and materials to turn their chosen concept into a working prototype. We will provide (1) our toolkit, which contains modules for eyes, eyebrows, mouth and neck and (2) craft materials to create the shape of the robot. The craft materials include , cardboard plates (2 mm and 5 mm), foam sheets, hot-melt glue, double-sided tape, fabrics, ... We chose these materials because they allow quick design iterations with minimal effort.

Part 3: Creating Interaction
Once the embodiment of the robot has been built, we will provide each group with a set of electronics to bring the creatures to life. Our platform consists of a Raspberry Pi with a custom add-on board. This add-on board allows the Raspberry Pi to control RC servos (used by the different modules) as well as to read analog and digital inputs. Because the Raspberry Pi is an embedded computer (as opposed to a microcontroller), interpreted languages can be used. For this workshop, we will use the Python programming language, so participants will need to be familiar with it. As part of our platform, we will use a Python module (API) to interface with the hardware.

Part 4: Demos and Reflections
When every team has completed their animatronic prototype, groups will be given the opportunity to demonstrate their robot to their peers. A short movie of each human-robot interaction scenario will be recorded. We will stimulate discussion to see what participants thought of during the design process and to find out if our lo-fi prototyping approach could be useful in other researchers' work.

Required Prior Skills
Part 3 of our studio requires some basic programming experience in order to use our platform to the fullest. We will use Python in our studio session, though knowledge of other languages is also relevant. We will try to divide the groups so that each group has at least one person has some experience with programming.

Additionally the course organizers will offer support to all teams that need help to program their envisioned interaction.

We will use simple, low threshold prototyping techniques throughout the session, so some affinity with craft techniques is helpful, though not necessary.

Studio Topics to be covered

In the process of prototyping social interactions with robots, participants will be introduced to a number of different concepts. The topics covered in our studio include:

1. Introduction to social robotics, with a special focus on embodiment.
2. Quick, low-fidelity prototyping techniques.
3. How to use our modular system for social robots.
4. Design strategies for the creation of "hackable" toolkits.
5. How to use the Python programming language on Raspberry Pi to program basic interations.

Studio Learning Goals

The main aim of our studio is to introduce participants to social robotics through a hands-on approach. It is our goal to demonstrate a quick and practical way to prototype social interactions with robots, and we think this approach could be useful for other technologies as well. We feel that there is a large overlap between social robotics and tangible interaction, and as such the topics covered in this studio should be of interest to the TEI conference's audience.

Studio Supporting Web Documents

A main overview of the Ono project is available at [5]. Source files of social robot Ono can be found on GitHub [6], source files of the modules and the electronics platform will be uploaded to GitHub at a later time. Pictures and videos of the robots built and interactions during the workshop will be made available online after the conference's end.

References

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[5] Social Robot Ono http://www.industrialdesigncenter.be/ono.

[6] cesarvandevelde/Ono2 - GitHub https://github.com/cesarvandevelde/Ono2.