

A Platform for Education in ‘Interaction Design for Adaptive Robots’

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Abstract

This paper introduces an educational software platform for a small teddy-bear-like robot, RobotPHONE. Utilizing back-drivability of the three joints (totally 6 DOFs) of the robot, the platform enables the robot to learn correspondences between gestures (posed by a human teacher) and voice (given by a human). Because the motion and the voice can be symmetrically produced and recognized, the robot would be an ideal tool for the research and education in learning and development.

1. A teddy-bear-like robot, RobotPHONE

In these days, there are some robots with which we can conduct researches into building artificial systems that develop. Among them AIBO [1] is famous for its high performance and a powerful software development kit. Although the price of AIBO is reasonable, it is still costly for educational use.

We thus selected RobotPHONE [2,3] for educational use in one of our classes for graduate students that aims ‘interaction design for adaptive robots’. The RobotPHONE has three joints with angle sensors: two for two shoulders and one for a neck, and each joint has two degrees of freedom (Fig. 1). It also has a microphone and a speaker. It is connected to a computer with a USB connection, and audio input/output connections. We can provide a robot for each student or for each small group of students because of its economy price, US\$180.



Figure 1: RobotPHONE used in our platform. It has three joints, a microphone and a speaker in the body.

2. An educational software platform for the robot

Based on a software development kit, RobotPHONE-SDK [4], we built a software platform for educational use in our institute. The platform consists of 1) RobotPHONE wrapper library, 2) a text-to-speech synthesizer, and 3) a speech recognition engine, Julius (Fig. 2).

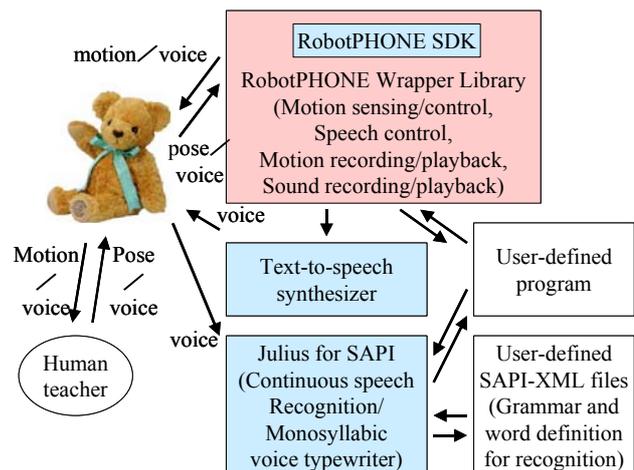


Figure 2: The configuration of the software platform. The motion and the voice can be symmetrically produced and recognized

RobotPHONE Wrapper Library includes RobotPHONE SDK, and it takes charge of motion sensing/control, speech control, motion recording/playback, and sound recording/playback.

Julius [5] is an open-source large vocabulary continuous speech recognition engine, and it can be used also as a grammar-based recognition parser of small vocabulary, or as a monosyllabic voice typewriter.

3. Sample programs provided for the students

We provided three kinds of sample programs for the students for their convenience: 1) The first sample program learns how to respond to voice given by a human teacher by supervised learning. One can teach the robot how to respond to voice by posing it, taking its hands. For example, one calls the robot's name, and then holds its hand and raise it. One can also teach how to respond by voice. 2) The second program learns appropriate actions under given situations by reinforcement learning. For example, when one says 'bye-bye' to the robot, it gradually learns to respond with saying 'bye-bye' and a wave from rewards given by voice. 3) The third sample program learns names of poses from examples with a k-nearest neighbors algorithm.

4. Interaction designs by the students

We gave students an assignment of interaction design between a RobotPHONE and a human. The students were divided into 14 groups, and each group designed interaction and wrote an interactive program using the software platform. Each group gave a demonstration at an exhibition on the 31st May, so we are going to show a video of the exhibition at the workshop. Some photographs of the demonstration are shown in Fig. 3. We also plan to give a demonstration with a RobotPHONE at the workshop.

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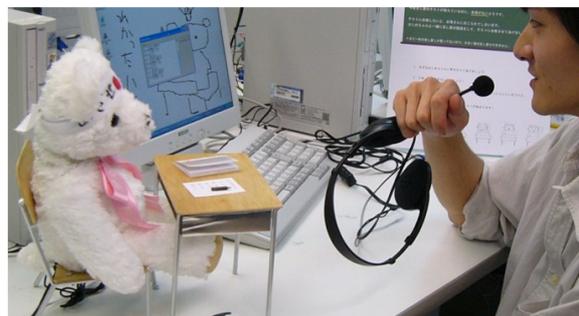


Figure 3: Some photographs of interactive demonstrations by the students.

References

- [1] <http://www.sony.net/Products/aibo/>
- [2] <http://www.iwaya.co.jp/Files/phone-e.html>
- [3] Sekiguchi, D., Inami, M. and Tachi, S. (2001). RobotPHONE: RUI for Interpersonal Communication. *CHI2001 Extended Abstracts*, pp. 277-278.
- [4] <http://www.star.t.u-tokyo.ac.jp/~dairoku/mm/index.php?Contest%2FDownloads> (in Japanese)
- [5] <http://julius.sourceforge.jp/en/julius.html>