A Robotic Weight Loss Coach

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Abstract

We present a rationale for studying long-term human-robot interaction and explain why new applications are necessary for this type of experimentation. The design and implementation of a robot that has been implemented is briefly described with the outline of a study that is under way.

Vision

Human-robot interaction (HRI) is now understood well enough to allow us to build useful long-term HRI systems that can function outside of the laboratory. However, little is known about how humans will respond to robots being present in their homes, offices, or other environments for extended periods of time. Most experiments thus far have been short-term, in-laboratory studies, for example, our work with several different robots (Kidd & Breazeal 2005) and (Breazeal *et al.* 2005); the work by several researchers at CMU (Kiesler & Goetz 2002) or (Gockley, Forlizzi, & Simmons 2007); and studies by Dautenhahn, et al. (Koay *et al.* 2006) or (Walters *et al.* 2007) that have informed the HRI community about narrowly focused aspects of interaction.

There are exceptions to the short-term lab work in which researchers have tried to study interaction over longer periods of time. Among the several examples, we have done work in local nursing homes (Turkle *et al.* in press) with the Paro robot (Saito *et al.* 2003). Kahn and colleagues have studied Aibos in a variety of situations (e.g. (Khan *et al.* 2006)). The PaPeRo robot from NEC has been tested in homes. The challenge with these studies is that there are not compelling applications to keep a person interested in using a robot for long periods of time – weeks, months, or even years. The most interesting robots for long-term use are currently entertainment robots such as Sony's discontinued Aibo or WowWee's RoboSapien.

In order to carry out long-term HRI studies, there must be robot systems capable of managing sustained engagement. A simple entertainment robot or a single-purpose robot such as iRobot's Roomba will not suffice for studying how people interact with a robot over time and whether results from short-term studies will be valid over longer durations. In order to carry out these long-term studies, our first step is to construct a sociable robot system that a person will have a compelling reason to interact with over time.

Figure 1: Weight loss coach prototype

Application

We are building a robotic weight loss coach that is being put into homes for an extended HRI study. Based on work we have done in the past that showed the effectiveness of a robot in engaging a user (Breazeal 2002) and engendering trust (Kidd 2003), we looked at applications where these qualities would be important and effective. We chose to work in the weight loss and maintenance area because current bariatrics research shows the need for long-term, supportive care. This care is currently provided by physicians, dietitians, and nutritionists, who guide an individual through months or years of a weight loss program that is intended to produce behavioral changes that will help the person keep off any weight that is lost. This level of support, however, is inaccessible to many people who might benefit from it. A robot, however, is capable of tirelessly providing such support.

Robot

Design and Implementation

The robot we have constructed is about half a meter tall and is intended to sit on a table or countertop. The head and eyes move and there is a small camera that allows the robot to look at the person it is interacting with using face-tracking software. As seen in Figure 1, there is also a small touch-enabled input screen on the front to allow for data entry.

Off-the-shelf PC components are used for the computation abilities (2.8GHz Pentium processor, 1GB RAM, 250GB hard drive) and an inexpensive servo controller provides motion control (the Mini SSC II from Scott Edwards Electronics) for the four hobby servos. The robot has two DOFs in the neck and two in the coupled eyes, allowing each a full range of motion. A small camera is mounted above the eyes providing a view in front of the robot to the OpenCV face tracker. Eye movement has been programmed using a simple model of human saccades so that the behavior of looking at an individual seems normal.

The support structure and shell have been designed to appear anthropomorphic. The face and body outline are suggestive of the human form, but not explicitly human. Each piece of the shell has been molded and the support structure is cut to allow us to make multiple copies of the robot to perform a long-term study with multiple users in parallel.

The software is designed to develop a relationship with a person over time using an iterative process of measuring aspects of the relationship and adapting behavior to the current goals (e.g. building trust, sustaining engagement). It does this by creating individual interactions that fit into the long-term relationship model.

Interaction

Users of the robot carry out a short conversation with the robot approximately once a day. At the beginning of the trial, they input daily goals related to diet and exercise. For example, goals might be to consume no more than 1,800 calories in a day and to get at least 30 minutes of exercise. The daily conversation consists of four parts:

- The robot greets the person and asks them to enter their diet and exercise information for the day.
- The robot provides feedback based on comparing the day's activities to the goals. (For example, "Good job meeting your goals for the day!" or "You didn't quite reach the goals you set for yourself today.")
- The robot offers advice or suggestions on something the user might do to meet his goals for the day or more general advice on diet, nutrition, or exercise.
- The robot makes "small talk," inquiring about how the user enjoys working with the system and whether they found the interaction helpful.

The interaction is based on clinical observation done in the Nutrition and Weight Management Center at Boston Medical, current research in weight loss, and research in creating engaging interactions over time.

Current Work

Multiple copies of the weight loss robot are currently being built so that we can put them into fifteen homes for an eight week study. The study has two control groups – a version of the record-keeping software that is running on the robot without the robotic interface and the traditional pen-and-paper method of record keeping – to allow us to better understand the impact of this interface over time. We are also using a variety of methods to gather data so that we can determine their utility and recommend long-term HRI research methods to other experimenters in the future.

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