RobotsFor.Me and Robots For You

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Abstract
Interactive Machine Learning (IML) and Human-Robot Interaction (HRI) are rapidly expanding fields that focuses on allowing non-expert users to naturally and effectively interact and teach robots. The importance of conducting extensive user studies has become a fundamental component of this work; however, due to the nature of robotics research, such studies often become expensive, time consuming, and limited to constrained demographics. In this work we present the Robot Management System, a novel framework for bringing robotic experiments to the Web through a project known as RobotsFor.Me. We present a description of our open source system and describe the potential this and similar systems have for contributing to IML.

Author Keywords
Web Robotics, HRI User Studies, Remote Users, Crowdsourcing

ACM Classification Keywords
I.2.9 [Robotics]: Operator interfaces.; H.5.3 [Group and Organization Interfaces]: Web-based interaction.

General Terms
Design, Experimentation

Introduction

Integration of user studies into the design, development and evaluation of new Interactive Machine Learning (IML) and Human-Robot Interaction (HRI) techniques has been shown to result in more usable methods [2], whereas development of algorithms in isolation risks biasing useability towards expert users. Although user studies are shown to be effective, they are subject to limitations due to safety, robot durability, or high cost. Due to this, researchers are typically limited to using a single robotic platform for a given study and conducting user studies requires bringing human subjects in one at a time. Such studies take days to weeks to perform and are limited to relatively small numbers of participants. Furthermore, the typical research cycle progresses through the stages of method formulation, implementation, user study, and presentation of results, which integrates user studies only at the culmination of a project, leaving little time for the integration of lessons learned back into the final product.

Our work seeks to address several of the above limitations by introducing a web-based framework for HRI and IML experimentation. Recent projects have explored web-based robot control [1]; however, unlike past efforts, our work focuses on bringing research-grade robots into the homes of non-expert users. With this, we introduce the Robot Management System (RMS), a web-based framework designed to dramatically reduce the overhead of running remote user studies that involve control of the robot.

RMS and RobotsFor.Me

The Robot Management System (RMS) is an open-source[1] framework that allows researchers quickly and easily install, configure, and deploy a secure and stable remote lab system. The framework is designed in a robot, lab, and interface independent manner. At its core, RMS is a custom content management system written in PHP backed by a MySQL database. Its main goal is to keep track of different ROS (Robot Operating System) enabled robotic environments, interfaces, users, and research studies with little need of additional programming by researchers. By doing so, such a system enables researchers to focus on the goals of their research without needing to spend countless hours testing and implementing a custom web solution.

The RMS was developed with the following goals in mind:

- Robot and interface independent design
- Support for easy creation and management of new widgets and interfaces
- Secure user authentication and authorization
- Creation, management, logging, and analysis of multi-condition user studies
- Website content management

Once the system itself is deployed, researchers can choose from existing interfaces, or create their own custom web interface such as the one depicted in Figure 1. RMS provides a customizable browser interface for robot control, integrated support for testing of multiple study conditions, and support for both simulated and physical environments. Through these capabilities, RMS enables any online user across the globe to participate in user studies by observing the actions of a robot through camera feeds and providing control commands through keyboard and mouse.

Using this system, we have deployed an instance of the RMS in a project called RobotsFor.Me. By using a RobotsFor.Me, we are able to develop, prototype, and run preliminary tests on learning algorithms, interfaces, or

[1] Documentation and code are available at ros.org/wiki/rms

other methodologies in a rapid development cycle that was previously unfeasible. Such a system has gone through an initial study to prove its validity as a form of conductiong such research [3].

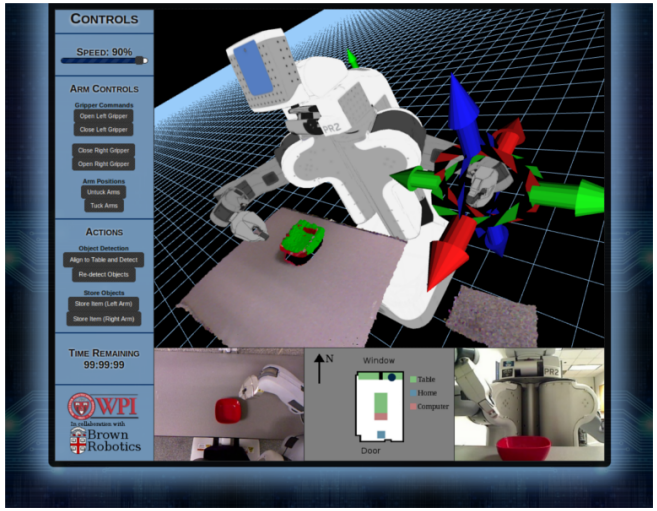

Figure 1: An Example Web Interface using the RMS.

Robots For You

To progress IML in robotics, it is necessary to make professional grade robots and research available to the masses. Due to costs, expertises levels, and safety concerns associated with current state-of-the-art robotic platforms, using the web to conduct such studies makes logical sense. RobotsFor.Me sits as only one example of a system that aims to allow naive users to gain access to robots and participate in research studies.The efforts put into the development of the RMS allow researchers to deploy similar systems with a fraction of the overhead that was previously required. Furthermore, by allowing users access to robotic simulation environments, experiments can be in parallel and reduce the risk of naive users damaging the robot or its surroundings.

We note that the presented framework can not replace face-to-face interactions, and therefore will have limited application in some areas of research, such as proxemics or physical HRI. Instead, we envision RMS, RobotsFor.Me, and similar projects contributing to research in areas such as shared autonomy, learning from demonstration, and interfaces for teleoperation, by enabling evaluation at unprecedented scale through the web.

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