

Robot Diaries: An Interdisciplinary Collaboration to Design and Evaluate Educational Robotics

Illah Nourbakhsh, Carl DiSalvo, Emily Hamner, Tom Lauwers, , Debra Bernstein

Carnegie Mellon University and the University of Pittsburgh
I. Nourbakhsh, Newell-Simon 3115, Carnegie Mellon University, Pittsburgh PA
E. Hamner, Newell-Simon A504, Carnegie Mellon University, Pittsburgh PA
T. Lauwers, Newell-Simon A504, Carnegie Mellon University, Pittsburgh, PA
C. DiSalvo, Studio for Creative Inquiry, Carnegie Mellon University, Pittsburgh PA
D. Bernstein, UPCLOSE, University of Pittsburgh

illah@cs.cmu.edu, tlauwers@andrew.cmu.edu, etf@andrew.cmu.edu, dlb36@pitt.edu, cdisalvo@andrew.cmu.edu

ABSTRACT

In this extended abstract we present an overview of the *Robot Diaries* project for consideration for inclusion in the upcoming spring 2007 AAAI workshop on Multidisciplinary Collaboration for Socially Assistive Robots. *Robot Diaries* is an educational robotics project that brings together researchers from robotics, informal education, and design to develop and evaluate a robot platform and curriculum for middle-school girls. We believe Robot Diaries would make a worthwhile inclusion to the workshop because of its highly interdisciplinary team and emphasis on participatory design.

Author Keywords

Educational Robotics, Participatory Design, Informal Learning, Interdisciplinary Collaboration

INTRODUCTION

In order to broaden girls' engagement with technology, we are developing *Robot Diaries* as a compelling experience that is constructed from the ground up to engage a diverse group of students in creating an embodied robotic artifact that is responsive to their own interests, emotions, and activities. Specifically, a "robot diary" is a customizable robot designed to serve as a means of expression for middle school girls. Each robot is connected to an online diary/messaging system and is responsive to the diary entries/messages of its user. Girls will be able to share their entries and robot expressions with their friends through the online interface. For example, a girl could see how her friend is feeling by playing the friend's diary entry on her own robot. While the actual content of each diary entry remains secret, the emotional "gist" of the content is shared with the friend group through the actuation of the robot.

We believe that the *Robot Diaries* project will serve several educational goals. First, we believe that engaging with creative technology on an everyday level will impact girls' identity. By identity, we mean the extent to which the girls

come to view themselves as a part of a community that's interested in, competent at, and motivated to engage in technology with a mission. Specifically, we strive to increase girls' motivation and interest in technology, and give them the confidence they need to continue their technology explorations. We also believe that participating in the *Robot Diaries* project will increase girls' knowledge of both declarative and conceptual robotics content.

Once the *Robot Diary* prototype has been fully developed, we intend to study its impact by comparing participants in a *Robot Diary* community with participants in a more typical robotics community (e.g., Botball). We will look for changes in knowledge and identity for participants in each group, in order to determine if *Robot Diaries* provide a unique educational opportunity for girls. We hypothesize that we will find larger gains in knowledge and identity for participants in the *Robot Diaries* community.

DISTINCTIVE QUALITIES OF THE ROBOT DIARIES PROJECT

The *Robot Diaries* project is characterized by two distinctive qualities. The first of these qualities is the interdisciplinary team, and second is the focus on participatory design and collaborative inquiry with the middle-school girls.

Interdisciplinary Team

The *Robot Diaries* project is a result of an ongoing collaboration between the Mobile Robot Programming Lab at the Robotics Institute, Carnegie Mellon University and the University of Pittsburgh Center for Learning in Out-of-School Environments (UPCLOSE), based at the Learning Research and Development Center.

The Mobile Robot Programming Lab has recently developed TeRK, which stands for Telepresence Robot Kit, which will be used as the technical platform for the *Robot Diaries* project. The aim of TeRK is to make educational robotics fun, affordable, and accessible to a diverse community of college students, pre-college students, and all

individuals interested in robotics. Thus, the TeRK is an instantiation of the general mission of the Mobile Robot Programming Lab: to design, create, and disseminate robotics curricula and technologies that motivate young women and men to actively explore science and technology. Members of the Mobile Robot Programming Lab have backgrounds in computer science, robotics, art, and design.

UPCLOSE conceptualizes, develops, and studies informal learning. Their work explores what it means to learn and change as a result of experiences in everyday environments including museums, commercial and community settings, on the web, and at home. UPCLOSE connects academic theory and real world practice. Their research focuses on relationships between learners, mediators, environments, and experiences. Members of UPCLOSE have backgrounds in cognitive psychology, learning sciences, and entertainment technology.

Working together, the Mobile Robot Programming Lab and UPCLOSE bring a broad diversity of technical, design, and social science research knowledge to the project. Importantly, the project is not segregated based upon disciplinary boundaries. Rather, faculty, staff, and students from each group work together on a weekly basis, constructing new modes of interdisciplinary production while collaborating in research, design, and technical, activities.

Participatory Design

A second defining characteristic of the *Robot Diaries* project is that middle-school girls are true collaborators with the project team in the design, implementation, testing, and refinement of the robotic prototype and user experience. Throughout the project, the girls work together with researchers and engineers to design, build, and program robotic objects that use motion, light, color, and sound to express emotion. Engaging in this participatory design and cooperative inquiry process will give girls the opportunity to explore creative uses of technology within their peer groups [1].

We believe that involvement in the participatory design process will yield several educational benefits for girls. First, the girls will have an opportunity to learn about some of the technical aspects of robotics by observing and exploring the robotic prototypes [2]. By specifically inviting the robotics team to participate in user testing and design session with the girls, we will ensure that conversations about motors, servos and wiring will be part of the prototyping process. The girls will also be given a chance to test out different user interfaces for the robotic diary, which will necessitate conversations about how to communicate with a robot. For example, we will run several activities with the girls that highlight the ways in which software can translate diary text into commands for a robot. These activities will help girls understand the relationship between user input and robot output, as well as some of the constraints placed upon human-robot communication.

Another educational goal of the participatory design process is to expand girls' identity with respect to technology. Specifically, we believe that participating in this project will increase girls' interest, motivation, and confidence in their ability to manipulate technology in meaningful and creative ways.

RECENT AND CURRENT ACTIVITIES

We conceive of *Robot Diaries* as a long-term educational curriculum development project. Our main goal for the near term is to develop a working prototype of the *Robot Diary* and accompanying curriculum in collaboration with small groups of middle school girls. Toward these ends, we held a set of workshops with a group of middle-school girls in the summer of 2006, and we are currently in the process of recruiting participants for a second set of workshops for Fall 2006.

Throughout the project, we will be continuously collecting research data in the forms of structured interviews, ethnographic observations, and knowledge assessments (both embedded and explicit). This data will help us determine girls' level of engagement, and allow us to document the process of identity and knowledge change we believe will occur as a result of these activities.

Summer Workshops

The first phase of the project was a series of workshops held during Summer 2006. The primary purpose of the summer workshops was to engage a small group of girls in a series of participatory design activities that would lead toward the development of a working prototype of a "Robot Diary" for use in the more structured Fall sessions/study. The summer workshops allowed the team to work closely with a group of representative girls over an extended period of time in direct, "hands-on" cooperative exploration of robotic technology. This, in turn, provided four important opportunities:

- To experiment with a variety participatory design activities and discover which were most effective and compelling for middle-school girls
- To develop research themes and observational measures
- To progress the concept (both form and function) of a "Robot Diary"
- To collect initial qualitative "data" from interviews, observations, and the participatory design activities

We are currently in the process of writing up our findings from the summer workshops in a preliminary report. These will be completed and available by the spring 2007 AAAI workshop.

Fall Workshops

For Fall 2006, we are planning a ten-week workshop with girls meeting us two hours a week, as well as several one-

day, six-hour workshops. In order to bring the girls up to speed with the concepts required to be effective designers, as well as give them the confidence to offer suggestions and create, the first third of the ten week workshop will be a condensed version of this summer's workshop. The second two-thirds of the workshop will be a participatory design exercise in which the girls design robots that appeal to them emotionally, as well as offering suggestions for a software interface with which to control those robots. As such, we will introduce the girls to a robot controller, the TeRK, and allow them to take home any robots they build using the TeRK. They will test the interface at home each week, and provide us with suggestions for improvement that we will implement before the next meeting. These participatory design sessions will lead to the creation of an educational robotics product that can be used by other girls in future workshops, but we also hope to evaluate the changes in the girls' conceptions of self and technology during the session. The goals of this session are to:

- Develop and validate measures of creativity with technology.
- Develop and validate measures of change in mental model of technology (from fixed to malleable) and change in perception of self (from consumer to producer of technology)
- Develop a suite of decoration ideas and demos for the robot skeleton.

- Develop and batch produce an educational robotics product complete with hardware, software, interface, and an initial curriculum (including design activities and toolkits).

Our plans for the single day workshop are focused more on changing the girls' relationship with technology instead of designing a product with them. By condensing many of the exercises from the summer workshop and using the lessons we learned from that workshop, we will show how to create emotive robots using sound, light, and motion, as well as provide the girls enough time to create their own robots. As in the ten week workshop, we plan to measure change in the perception of self and the mental model of technology. Assuming these sessions are successful, we will package the curriculum for this workshop and disseminate it so others' can replicate it.

As with the summer workshops, we will write up a report documenting the fall workshops and findings. These should be completed and available by the spring 2007 AAAI workshop.

REFERENCES

1. Druin, A. and Hendler, J. (2000) *Robots for Kids: Exploring new technologies for learning*. New York: Morgan Kaufmann.
2. Taxen, G. (2004). Introducing participatory design in museums. *Proceedings Participatory Design Conference*, Toronto, Canada.