Inspiring Physical Activity through Play Technologies

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Abstract
Computers have traditionally been viewed as sedentary devices, promoting isolation and contributing to a high-stress, low-activity lifestyle. In this paper we describe our research directions in exertion interfaces and leisure technologies for inspiring physical activity among people with poor cardiovascular health.

Keywords
Exertion, play, computer games, health and well-being

Introduction
The average age of the world population is growing rapidly [3, 9]. Compounded by this growth is an increase in longevity, escalating instances of age-related diseases such as Alzheimer's and dementia [3]. Supporting the ability for the elderly or people with disabilities to live at home longer is of both personal and economic benefit to the individual [9]. We, along with other research groups, expect that emerging technologies can facilitate aging in place. To this end, we are building a home, rich in technology, to: help people live at home longer; connect patients to their health care providers; foster engagement with the community; enhance social interactions; and promote physical well-being.

In our project, we have research teams focusing on two user groups: Patients with physical ailments (specifically Diabetes and Cardiovascular health), and patients with cognitive impairments (specifically memory loss resulting from Alzheimer's disease).

Providing technological support for the latter group has emerged as a research direction in the HCI community. There are research groups focusing on assistive interfaces, with a specialized bi-annual conference devoted to publishing results in this research domain†.

† http://universalusability.org/

Research interest in the former group has not been as visible. For this group, we are concerned mainly with technological solutions to encourage a healthy lifestyle, by improving eating habits and encouraging physical activity. We are also concerned with monitoring and diagnostics, to both increase the user's self-awareness of the effect of their lifestyle decisions on physical well-being and increase their doctor's awareness of the patient's health situation.

Motivating Physical Activity

Technologies can be used to promote physical activity directly, by integrating with a game, by providing logging support, or by motivating the user through the accountability of a social network.

Providing logging support is an important feature of technologies designed to promote physical activities. There are examples, marketed at those who are technologically savvy and already reasonably active (e.g. the collaboration between Nike and Apple[a]). Other examples are marketed at the general user who is concerned about improving overall health and wellness (e.g. fitsense[b]). There are also technologies that motivate the user via the accountability of a social network [1]. Using physical movement/activity as input into a play technology can be direct, similar to how the Sony eyeToy[c] or Nintendo Wii[d] use physical gestures as the input. Alternatively, physical movement can be used indirectly, by accumulating over time and impacting game play in a more abstract manner [8].

In our approach, we want to consider not only how to motivate an individual, but how to keep them engaged with the technology, exceeding their own expectations by pushing past increasing fatigue and waning desire.

Our Approach

Exertion interfaces are physically difficult to use and require effort, which is contrary to guiding HCI principles. Similarly, computer games need to be somewhat challenging and frustrating to be engaging, also contrary to traditional HCI guidelines [5]. As such, traditional evaluation methods are not appropriate for investigating the success of gaming or exertion interfaces. In previous research, we developed approaches for evaluating engagement with entertainment technologies. We first explored how physiological signals respond to interaction with play technologies, and then investigated how physiological signals (e.g. heart rate, galvanic skin response, electromyography) differ between play conditions, and how body signals co-vary with subjective reports [6, 7]. Based on these results, we developed a fuzzy logic model of emotion using physiological data. The modeled emotions were evaluated with test data, and successfully compared to reported emotions [4, 5]. Using our technique, user emotion can be objectively and quantitatively analyzed over an entire experience,

Online References:
[a] http://www.nike.com/nikeplus/
[b] http://fitsense.com/
[c] http://www.eyetoy.com/
[d] http://wii.nintendo.com/

Author Biographies

Dr. Regan Mandryk is an NSERC Postdoctoral Fellow in the Faculty of Computer Science at Dalhousie University. Her multidisciplinary background merged in her Ph.D. topic on using physiological data to model a user's emotional experience when interacting with play technologies. Regan has been interested in using emerging technologies to facilitate real living, including supporting social interactions and encouraging healthy living. She is a presence in the ubiquitous gaming community, organizing 4 workshops, guest-editing a special issue of PUC, publishing a survey paper and 2 workshop papers related to ubiquitous computing techniques for play and leisure.

Dr. Jacob Slonim is a professor in the Faculty of Computer Science at Dalhousie University. As principal investigator of the awarehome project at Dalhousie University, he brings a strong research record in privacy and security to the project. His collaborations with the medical community ground his recent work on using technologies to support people living with cardiovascular problems, Diabetes, and Altzheimer's Disease.

revealing variance within and between conditions. This continuous approach has a high evaluative bandwidth.

Since our approach evaluates emotion continuously, in real-time, it can also be used to adapt the experience to keep the player engaged. Flow [2] refers to an experience state that causes deep enjoyment, due in part to the right balance between the skill of the participant and the challenge of the activity [2]. By monitoring the change in challenge along with corresponding changes in frustration and boredom, we can see when players may be in danger of leaving a flow state due to an imbalance between skill and challenge. Using this information to dynamically adjust the challenge of the activity would keep the player in a state of flow.

By this same logic, people using exertion interfaces for health and wellness need to be motivated to continue working when fatigued or bored. The desired experience state may not be due to the optimal balance between skill and challenge, but due to other factors which we intend to identify.

To understand how to sustain motivation while using an exertion interface, we are currently in the process of systematically exploring how interface, competition, and physicality impact the enjoyment and motivation of game play. Although we could take the approach of designing a game that uses physical activity as an input or motivator, we instead are taking a step back and trying to understand how competition, play, and interface can be a motivator for physical activity. Future exertion interfaces for game systems can be grounded in the results of our controlled exploration. Our experimental approach controls the amount of exertion, the realism of the interface, and the competition of the activity. Through careful experimental design and statistical analysis, we hope to isolate how each of these factors contributes to enjoyment and motivation.

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