Digital Experience and the Physical World

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Abstract: This paper outlines my interests in user experience design for pervasive computing which revolve around three main themes: how to design physical spaces as interfaces, how to design control systems that do not fall apart when a user wants to do something out of the "ordinary", and how to better understand the emotional and psychological meanings of the term "experience" when mediated through technological artifacts and environments.

1 Introduction

The design of user experiences in pervasive computing environments is a difficult endeavor not only because of the technical hardships involved in designing, developing and implementing them, but also because the design methods used many times come from the areas of screen based user experience design. Granted, much of the methodologies used (i.e. user centered design) can have a beneficial effect on the usability of such environments, but they do not assure a successful experience for the people interacting with them. This can occur for a number of reasons: On the one hand a pervasive environment might not be focused on achieving a specific and measurable task, but more on creating a number of ambient or even emotional user experiences. On the other hand, many pervasive environments utilize interaction technologies and methods that have not reached maturity yet. Thus, much research currently explores methods and algorithms for extracting usable information from visual fields, or enhancing the usability and effectiveness of voice input, or on ways to enable un-tethered operation of equipment and spaces using wireless devices.

My work in this field revolves around the following themes[1]:

- The Room as an Interface.
- Control systems for reactive spaces.
- An exploration of technology based user experience.

[1] I am a newcomer to the field having focused earlier on screen based user interaction models, and interactive video [4, 5]

2 The Room as an Interface

In an effort to create reactive environments we are looking for ways to enable the users to interact with the environment in an unhindered and an un-tethered fashion. Forcing users to push buttons, type commands, or move and press mice is not beneficial for the user experience we are looking to create. A number of interaction methods have been studied over the years, with most of them falling into one of the following categories: a. wireless physical extensions to existing interfaces [1] b. voice recognition [9], c. wireless networking based solutions [8, 10] and d. vision based capture and processing [6, 7]. Although pragmatic in many ways, the use of wireless physical extensions such as remote controls or PDA based remote interfaces suffer in our opinion from the problems already inherent in existing screen based user interfaces: many times these objects are too cumbersome or complicated to use for many users in many scenarios. Granted that usability improvements can be made, but we believe that the ultimate goal is to get away from a model that places a computer interface between the user and the actions they want to perform. As for voice recognition based interaction, although there is no question that it will become an important dimension in the future of pervasive user experiences, it still seems to be a few years away from exhibiting effective and natural usability- unfortunately the technology is still fraught with recognition errors and still forces the user to sometimes speak in unnatural ways. Wireless networking based solutions, such as those envisioned by Weiser [10] have much promise too, but necessitate the construction of complicated infrastructures to enable them. We have decided to focus on visual capture and processing as our technology of choice. Although it too has a number of inherent limitations, we think that it offers a way to quickly implement interaction models and test them. We think that it is important to use rapid prototyping at this stage because, as in all interaction design projects, many errors of design will be made, identified and fixed along the way.

The model we have chosen to focus on using such vision techniques is the use of physical hotspots in a reactive space. We are in the process of creating a “friendly room” test bed which will enable teachers to more effectively teach a large audience. In this room the teacher is able to control all services (from lighting to all parts of the AV “podium”) in an unhindered fashion from wherever they are using a simple laser and pointing at physical icons representing the available services. The use of a laser pointer per se is not new [6, 7], nor is the use of control systems in the background [3], but the use of physical hotpots in the room, coupled with the intelligent control system, enables the user to operate things by simply pointing at them. We are not interested in trying to use the laser pointer as a replacement for the mouse, but as a simple control object to operate the services in the room. Initial tests with users have been very positive; with all of them reporting to have had a very positive experience while using the system (even though they all reported that using the laser pointer was more difficult than using the mouse, as has been reported in other studies). This project has brought us to think about the following elements that pertain to the design of an effective reactive room:

2.1 The development of a Language for Physical Hotspots

When designing such a room, every part of it, from floor to ceiling, from door to window, from book to computer, from light to projector, are candidates to become interaction hotspots. This means that any object in a room can serve as an interface object for activating various elements and services in the room. Using this method, a user can activate a service (i.e. lights, sound, projector, etc) by pointing at the provider or the controller of the service (a light fixture, an audio speaker, a projector, etc) or some surrogate (i.e. a physical icon or other physical objects placed in the room). But where should these objects be placed in order to create an easy to use interface? Screen based interface design has generated a standard in the various GUI window systems. In room interface design a number of other things must be taken into consideration.

- **Line of Sight:** the lecturer must have a clear line of sight to the objects at all times if they are to be useful. Lecturers should not have to turn their backs to their audience. As a result, some interface objects might need to be placed in more than one place in the room.
- **Target Size:** Fitt's law is especially important since a wireless laser pointer has more degrees of freedom than a mouse. Add to that the human physique which finds it close to impossible to aim in a steady fashion without wiggling, and you conclude that the target must be relatively large
- **Statelessness and Accidental Operation:** Because of the laser pointer's characteristics, a room interface must take into account a larger amount of accidental operation when compared to a computer interface. Since a regular pointer is stateless, various interaction methods have been developed to pass state information to the system. These have taken on the forms of dwelling over a target (time based) or moving the dot in a pre-specified way (gesture based)[2]
- **Context:** Physical interface objects should be organized in the room according to the possible usage contexts. Thus, lighting control should be where one would expect to find it, higher up than other elements. A door control should be placed near the door it controls, and VCR controls should be grouped, etc.

3 Control Systems for Reactive Environments

Many projects have focused on developing the software infrastructure for pervasive computing environments. One area that interests us is the level of intelligence that such systems should contain, or in other words, just how intelligent should such systems be? Do they need to identify the context or can they be guided by predefined scripts? Our initial system uses predefined scripts to manage all aspects of the room,

[2] Some projects have created state-full pointers by adding hardware and wireless capabilities to pass the state to the system [2]

including what to do when the user switches from one scenario to another (i.e. pauses a movie in order to open a power point presentation). Such scripting can create successful user experiences as long as the user actions can be matched to the predefined scenarios. When user actions do not fit them things can start to break down. This can be solved somewhat by the use of manual overrides, but we are interested in exploring ways to enable a graduated flow of experience from fitting a scenario to falling outside one, and being gently nudged back in.

4 An Exploration of Technology Based User Experience

Over the years we have concluded that interface and interaction design methodologies can only take us part of the way to the creation of successful experiences. Because of this I am participating in co-developing and co-teaching[3] a course for graduate students called Texperience: Technology base Experience. This course, given at the Bezalel Academy of Art and Design in Jerusalem teaches student artists, visual designers, architects, movie makers, and industrial designers a series of technologies (electronics, microcontroller programming, sensors, actuators, serial communications, digital media integration and programming) in order to enable them to develop "experiential" projects. These can revolve around more specific issues such as how to give an object the capability to "express" itself, and develops into broader issues, such as ways to create experiences for participants in different contexts or spaces. The course, currently in version 1.0, has already raised a number of questions for us as teachers and designers. For example, what are the dimensions of human experience that we want or need to affect? How do the various technologies available to us affect the experience of those that interact with them? Is there a difference between the capabilities of different media in their power to elicit different experiences?

Figure 1: Texperience exercises at the Bezalel Academy of Art and Design

[3] I am developing and teaching this course with Hila Dar and Ezri Tarazi at the Master of Design program at the Bezalel Academy of Art and Design. Ezri Tarazi heads the program.

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