Passive Tangibles and Considerations for User Interface Description Languages

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ABSTRACT
This position paper outlines some challenges facing the development of user interface description languages (UIDL) for emerging post-WIMP interaction styles. In particular, it proposes the term *passive tangible interfaces* for a new subset of tangible interfaces that feature passive physical tokens and a non-continuous link to a digital system. It then describes difficulties in modeling passive tangibles using common UIDL techniques.

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INTRODUCTION

There is little that is standard about emerging post-WIMP interaction styles. Designers and researchers, in an effort to create the previously unimagined, have struck out in a thousand different directions and truly pioneered a new generation of human computer interaction. This creativity is both exhilarating and important for the HCI community, but it may be many years before post-WIMP technology and interaction techniques settle into standardized systems that are widely used beyond research laboratories.

As post-WIMP interfaces mature, standardization will become increasingly important. This includes standardization of technology, interaction convention, and of the tools available to interface designers. In particular, design tools such as user interface description languages (UIDL) will play a critical role, in part because the task of designing interaction will necessarily include the collaboration of many disciplines such as computer science, graphical design, industrial design, and electrical engineering. However, despite the need for post-WIMP UIDLs, it is important to remember that we are still in the early, creative phases of this next generation of interaction. As such, it would be unproductive and restricting to attempt to overly-standardize the conventions and languages of next-generation interaction. This is not to say that we shouldn't begin to make an effort. Rather, we should remember to remain flexible and to put more emphasis on describing the tasks, goals, and actions of the user than on any particular emerging interaction technology.

A case in point is tangible interaction. One of the major revelations of the First International Conference on Tangible and Embedded Interaction is that we lack a suitable definition for tangible interaction. Ten years ago, Ishii and Ullmer proposed that tangible interfaces "will augment the real physical world by coupling digital information to everyday physical objects and environments" [2]. However, this definition does not encompass all the features of tangible interfaces developed since that time. For example, BodyBug [3] is an interactive, motion-sensitive object inspired by full-body movements of modern dance. In this system there is no coupling of digital information in the sense that Ishii and Ullmer imply, yet the interface has clear tangible attributes. This is just one example of the way in which tangible interaction is continually evolving, ten years after its conception. As we attempt to formalize our descriptions of post-WIMP interaction, I believe it is important not to inadvertently exclude this sort of creative work.

This position paper will further illustrate this point by introducing the concept of *passive tangible interfaces* and highlighting some of the challenges and requirements for a UIDL in this space.

PASSIVE TANGIBLE INTERFACES

I propose the term *passive tangible interface* to describe a collection of passive physical components with a non-continuous link to an online system. With such systems, users work in offline settings to create physical models that represent such things as computer programs. Often the physical components are inexpensive to produce and make use of passive sensor technology such as computer vision fiducials or RFID tags. Passive tangibles seem best suited for certain kinds of iterative tasks that involve cycles of design, testing, and revision. End user computer programming is an obvious example of this sort of task. Other application domains might include creating models of workflow, process control, or simulations that don't require continuous interaction.

Passive tangibles are distinct from interfaces such as Illuminating Light [5], which feature inexpensive physical components used to interact with real-time computer simulations. Passive tangibles are also distinct from interfaces such as McNerney's Tangible Programming Bricks [4] in which active electronic components are embedded in the physical elements of the interface. While passive tangible interfaces sacrifice some of the real-time interactivity of online (or active) tangible system, they also offer a number of appealing advantages. Foremost, passive tangible systems represent an affordable, robust, and portable alternative to active tangible systems. This makes them ideal for use in educational settings where cost is always a factor and technology that is not dependable tends to gather dust in the corner. Passive tangible systems may also give interaction designers greater freedom to choose materials and forms that make sense for an application rather than the technology used to implement it.

Figure 1. Tern Tangible Programming Console at the Museum of Science, Boston

One example of a passive tangible system is Tern[1], a tangible programming language we are developing for a robotics exhibit at the Museum of Science in Boston. In this case, the physical components of the interface are nothing more than wooden blocks shaped like jigsaw puzzle pieces with circular barcode-like symbols printed on them. Visitors to the exhibit create programs to control a robot by connecting the blocks together and pressing a *Run My Program* button. The exhibit uses a digital camera to capture high-resolution still images of visitors' programs, which it then converts into digital instructions for the robot. Visitors might create and test one or two programs per minute. Otherwise, the interface is offline.

UIDL CHALLENGES

There are several challenges involved in adapting UIDLs for use with passive tangible systems. One problem is the use of state-based or event-response description formats. For example, with the Tern interface there are only two states: the authoring state (where the user constructs programs) and the observing state (where the user watches the robot act out a program). However, these two states can be active simultaneously, and this description does little to elucidate the system. Likewise, the user event/system response model is largely inapplicable. From the event/response model, Tern is very simple: the user presses a compile button, and the system responds by transmitting the user's program to a robot. The problem is that almost all of the meaningful interaction—groups of users learning and leveraging the physical syntax to construct programs and revising algorithms after observing the robot's actions—is lost in this description. A final problem is that much of the user interaction is unpredictable and idiosyncratic because of the richness of interacting with the physical world. For example, a user might choose to *comment* a physical computer program by sticking post-it notes next to meaningful blocks.

CONCLUSION

The task of formally describing post-WIMP interaction is daunting but worthwhile. In the process of developing description languages, it is important to focus on user tasks, goals, and actions, rather than on specific technologies or interaction paradigms. This is both because the extent post-WIMP interaction is still actively being defined and because new approaches to interaction will introduce surprising new challenges for formal descriptions.

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