Chapter VI
Interacting with Mobile and Pervasive Computer Systems

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ABSTRACT

In this chapter, we present existing and ongoing research within the Human-Computer Interaction group at the University of Bath into the development of novel interaction techniques. With our research, we aim to improve the way in which users interact with mobile and pervasive systems. More specifically, we present work in three broad categories of interaction: stroke interaction, kinaesthetic interaction, and text entry. Finally, we describe some of our currently ongoing work as well as planned future work.

INTRODUCTION

One of the most exciting developments in current human-computer interaction research is the shift in focus from computing on the desktop to computing in the wider world. Computational power and the interfaces to that power are moving rapidly into our streets, our vehicles, our buildings, and our pockets. The combination of mobile/wearable computing and pervasive/ubiquitous computing is generating great expectations.

We face, however, many challenges in designing human interaction with mobile and pervasive technologies. In particular, the input and output devices and methods of using them that work (at least some of the time!) with deskbound computers are often inappropriate for interaction on the street.

Physically shrinking everything including the input and output devices does not create a usable mobile computer. Instead, we need radical changes in our interaction techniques, comparable to the sea change in the 1980s from command line to graphical user interfaces. As with that development, the breakthrough we need in interaction techniques will most likely come not from relatively minor adjustments to

existing interface hardware and software but from a less predictable mixture of inspiration and experimentation. For example, Brewster and colleagues have investigated overcoming the limitations of tiny screens on mobile devices by utilising sound and gesture to augment or to replace conventional mobile device interfaces (Brewster, 2002; Brewster, Lumsden, Bell, Hall, & Tasker, 2003).

In this chapter, we present existing and ongoing research within the Human-Computer Interaction group at the University of Bath into the development of novel interaction techniques. With our research, we aim to improve the way in which users interact with mobile and pervasive systems. More specifically, we present work in three broad categories of interaction:

- Stroke interaction
- Kinaesthetic interaction
- Text entry

Finally, we describe some of our currently ongoing work as well as planned future work. Before we discuss our research, we present some existing work in the areas mentioned previously.

RELATED WORK

One of the first applications to implement stroke recognition was Sutherland's sketchpad (1963). Strokes-based interaction involves the recognition of pre-defined movement patterns of an input device (typically mouse or touch screen). The idea of mouse strokes as gestures dates back to the 1970s and pie menus (Callahan, Hopkins, Weiser, & Shneiderman, 1998). Since then, numerous applications have used similar techniques for allowing users to perform complex actions using an input device. For instance, design programs like (Zhao, 1993) allow users to perform actions on objects by performing mouse or pen strokes on the object. Recently, Web browsing applications, like Opera[1] and Mozilla Firefox,[2] have incorporated similar capabilities. There are numerous open source projects which involve the development of stroke recognition, including Mozilla, Libstroke,[3] X Scribble,[4] and WayV.[5]

Furthermore, a number of pervasive systems have been developed to date, and most have been designed for, and deployed in, specific physical locations and social situations (Harrison & Dourish, 1996) such as smart homes and living rooms, cars, labs, and offices. As each project was faced with the challenges of its own particular situation, new technologies and interaction techniques were developed, or new ways of combining existing ones. This has led to a number of technological developments, such as tracking via sensing equipment and ultra sound (Hightower & Borriello, 2001), or even motion and object tracking using cameras (Brumitt & Shafer, 2001). Furthermore, various input and output technologies have been developed including speech, gesture, tactile feedback, and kinaesthetic input (Rekimoto, 2001). Additionally, environmental parameters have been used with the help of environmental sensors, and toolkits have been developed towards this end (Dey, Abowd, & Salber, 2001). Another strand of research has focused on historical data analysis, which is not directly related to pervasive systems but has found practical applications in this area. Finally, many attempts have been made to provide an interface to these systems using tangible interfaces (Rekimoto, Ullmer, & Oba, 2001), or a metaphoric relationship between atoms and bits (Ishii & Ullmer, 1997).

Some projects have incorporated a wide range of such technologies into one system. For instance, Microsoft's EasyLiving project (Brumitt, Meyers, Krumm, Kern, & Shafer,