Issues and Techniques in Touch-Sensitive Tablet Input (Extended Summary)

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Abstract

Touch-sensitive tablets and their use in human-computer interaction are discussed. It is shown that in certain contexts such devices have some very important advantages over more common technologies (such as mice and joysticks). The analysis serves two purposes: (1) it sheds light on touch tablets, and (2) it demonstrates how other devices might be approached. Three specific distinctions between touch tablets and traditional devices are drawn. These concern: the signaling of events, multiple point sensing and the use of templates. These distinctions are reinforced, and possible uses of touch tablets are illustrated, with a simple example system. Potential enhancements to touch tablets and other input devices are discussed, as are some inherent problems. The paper concludes with recommendations for future work.

CR Categories and Subject Descriptors: I.3.1 [**Computer Graphics**]: Hardware Architecture: Input Devices. I.3.6 [**Computer Graphics**]: Methodology and Techniques: Device Independence, Ergonomics, Interaction Techniques.

General Terms: Design, Human Factors.

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1. Introduction

Much recent human-computer interaction research has focussed on problems of input [Foley, Wallace & Chan 1984; Buxton 1983; Buxton 1985] and specifically on input technologies. The standard keyboard is rapidly being supplemented by touch-screens, mice, and other technologies.

Now that the range of available devices is expanding, how does one select the best technology for a particular application? And once a technology is chosen, how can it be used most effectively? These questions are important, for as Buxton [1983] has argued, the ways in which the user physically interacts with an input device have a marked effect on the type of user interface that can be effectively supported.

In the general sense, the objective of this paper is to help in the selection process and assist in effective use of a specific class of devices. Our approach is to investigate a specific class of devices: touch-sensitive tablets. We will identify different classes of tablets, show how and where they can be used effectively, and compare them to a more common input device, the mouse. There are two intended benefits for this approach. First, the reader will acquire an understanding of touch tablet issues. Second, the reader will have a concrete example of how the technology can be investigated, and can utilize the approach as a model for investigating other technologies.

2. Touch-Sensitive Tablets

A touch-sensitive tablet (touch tablet for short) is a flat surface, usually mounted horizontally or nearly horizontally, that can sense the location of a finger pressing on it. They can vary greatly in size, from a few inches on a side to several feet on a side. The most critical requirement is that the user is not required to hold some device in the hand that is doing the touching (as is the case with traditional tablets).

We call a touch tablet, as described in the previous paragraph, a simple touch tablet. Some tablets can also sense how hard the user is pressing, in addition to the location. And some are sensitive to multiple points of contact. In this case, the user could press with several fingers, and the location (and possibly pressure) of each point of contact would be reported.

3. Properties of Touch-Sensitive Tablets

Asking "Which input device is best?" is much like asking "How long should a piece of string be?" The answer to both is: it depends on what you want to use it for. With input devices, however, we are limited in our understanding of the relationship between device properties and the demands of a specific application. We investigate touch tablets from the perspective of improving our understanding of this relationship. Our claim is that other technologies warrant similar, or even more detailed, investigation.

Touch tablets are especially well suited for a number of applications:

- They have no mechanical intermediate device (such as stylus or puck). Hence they are useful in hostile environments (e.g., classrooms, public access terminals) where such intermediate devices can get lost, stolen, or damaged.
- Having no puck to slide or get bumped, the tracking symbol "stays put" once placed, thus making them well suited for pointing tasks in environments subject to vibration or motion (e.g., factories, cockpits).
- They present no mechanical or kinesthetic restrictions on our ability to indicate more than one point at a time. That is, we can use two hands, or more than one finger simultaneously on a single tablet. (Remember, we can manually control at most two mice at a time: one in each hand. Given that we have ten fingers, it is conceivable that we may wish to indicate more than two points simultaneously.)
- Unlike joysticks and trackballs, they have a very low profile and can be integrated into other equipment such as desks and low-profile keyboards. This has potential benefits in portable systems, and, according to the Keystroke model of Card, Newell and Moran [1980], reduces homing time from the keyboard to the pointing device.
- They can be molded into one-piece constructions thus eliminating cracks and grooves where dirt can collect. This makes them well suited for very clean environments (eg. hospitals) or very dirty ones (eg., factories).
- Their simple construction, with no moving parts, leads to reliable and long-lived operation, making them suitable for environments where they will be subjected to intense use or where reliability is critical.

They do, of course, have some inherent disadvantages, which will be mentioned at the close of the summary.

We make three important distinctions between touch tablets and mice. These are:

- A touch tablet has limited ability to signal events compared to a mouse.
- The surface of a tablet can be partitioned into regions representing a collection of independent "virtual" devices. This is analogous to the partitioning of a screen into "windows" or virtual displays. Mice do not lend themselves to this mode of interaction. Conventional and touch tablets do. However, with touch tablets, physical templates can be placed over the surface to delimit the various regions. Because of their thickness and texture, they permit the operator to sense the regions to be touched, without diverting the eyes from the screen or some other visually critical task.
- Touch tablets can be made that can sense multiple points of contact. There is no analogous property for mice.

The presentation continues with a discussion of these distinctions and then uses a simple finger painting program to illustrate them in the context of a concrete example. Through the course of the example, a technique for partioning tablet surfaces into virtual devices without the use of templates is discussed and the need for pressure and multiple-point sensing abilities is shown. It is argued that these and other improvements, many of which we have demonstrated in prototype form, must be made to touch tablets if they are to realize their full potential as input devices. Finally, some inherent problems with touch tablets, such as the presence of friction and the difficulty of providing good feedback, are discussed and their impact assessed. We also suggest potential improvements to traditional devices, motivated by our experience with touch technology.

4. References

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