



Touch-Sensitive Computer Terminal Update

Is the computer screen replacing the keyboard as the primary means of entering information?

By JOHN J. MARINO

Preferences in input technologies often seem to have more to do with religious fervor than scientific objectivity. One often hears unilateral claims like "mice are better than tablets" and "trackballs are useless." What is always missing from such claims is the recognition that if they are true, it is only for the performance of some specific class of tasks. The truth lies

more in the observation that every device, no matter how arcane, is likely to be the best technology for some task, and the worst for some other. What is missing from the debate is the context in which the device is to be used!

Eliminating the need for users to learn computer jargon could hardly be easier than with a touch input system. Operation requires no special skills—responses to screen queries are produced with simple hand-eye coordination. Response times improve and errors decrease when the user is

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not forced to look away from the CRT, where responses are displayed (to the keyboard, where any number of mistakes can be made).

Along with speech, pointing with the finger and drawing with the familiar pencil or pen form the foundation for our most common techniques of transmitting information. In producing an effective touch-sensitive interface between human and computer, there is a scope of issues that many refer to as ergonomics. However, the fundamental issue remains one of precisely defining and thoroughly understanding the functional needs of the users.

Application

Today, positive things are happening with touch screens. Interactive training, especially in conjunction with laser disks, is one of the hottest areas. Major companies find these interactive training systems ideal for multiple decentralized locations. These interactive training systems facilitate consistent, self-paced, and controlled learning environments—and they provide as much repetitive individual instruction as the student requires. Touch screens require no user instruction and thus complement interactive video training, which itself uses minimal training support.

Understanding the exact functionality needed by the user leads to touch screen systems at once intuitive and natural—computer systems that become secondary in nature to the user. International Treasury Systems studied the functionality needed in foreign exchange dealing and trading rooms—highly frenetic environments, where millions of dollars change hands and where each dealer enters hundreds of transactions each day. The foreign exchange dealer wants a computer system for decision support, for calculations and to capture the deal, and is not inclined to work with a keyboard or another traditional interface. With touch screens, the busy dealers interact simply by selecting choices presented on the screen—and they do so within minutes after having been introduced to the system.

Well-designed touch screen system makes good use of available graphic dynamism. At any moment in the process, these systems are dynamic enough to present only the relevant information and choices. That dynamism and the other touch screen benefits are becoming recognized and valued more widely. As manufacturers and systems integrators

begin applying touch sensitive products in other situations, and not simply as replacements for standard interface devices, we'll see many applications providing similar functionality. The most obvious advantages of touch screens stem from their use in interactive and menu-driven situations, such as in inquiry and/or response, manipulation, or control applications.

Just as both vendor and user understanding has grown, the technology has also matured and product improvements have reduced prices. The technology, the software, and the applications have gelled. Recent industry conferences and exhibits support the contention that in the near future there will be far more terminal and personal computer products introduced having touch-sensitive features than we have previously seen.

Vendors have accepted touch screens, and touch screens have finally reached an acceptable price threshold. At the Electronic Selling Show, sponsored by Touche-Ross and featuring interactive video catalogs and ordering systems, 15 of the 22 exhibited systems used touch screens. Of these, 10 used resistive membrane screens and 2 used infrared light emitting diodes (LED), predominant technologies. At the August Interactive Videodisc in Education and Training Show put on by the Society for Applied Learning Technology, all of the major exhibitors—DEC, NCR, Interactive Training Systems, Digital Techniques, Visage, New Media Concepts, Wicat, and ECA—displayed products having touch screens.

The unique advantage a touch screen brings to corporate applications is the same one that makes touch screens so effective in public kiosks and point-of-sale environments—simplicity and familiarity. Once the user is enticed to touch the screen, the learning is complete. From that point, the user interacts with the system by following the natural instinct to point at the desired choice (or menu selection). There's not even a second thought about the interaction, and users are left with a comfortable feeling that the system was made to be used just by them.

Both internal and public access touch systems are being planned or designed by almost every major corporation, from those selling through distributors (autos, electronic parts), to those selling through catalogs (customer and product lookup) and to those needing training systems. The motivation for using touch screens in these systems stems from a desire to provide the most effective interface for the untrained

Typical Touch Screen Applications Stand Alone Terminals

DEC Touch

Printing and publishing industry

Work Stations

Data base interaction

Engineering work stations

Worldwide steel trading/brokering system

Foreign Exchange dealing & trading

Training and Simulation

GE and Singer-Link flight simulators

DEC's Interactive Video

Instructional System (IVIS)

Naval battle simulation

Interactive video disk training systems

Public Information Systems

Shopping malls

Motels

Office complexes

Banking

Interstate Traveller Welcome Centers

World's Fair pavilion

Process Control

Many examples

Interactive Sales Systems

Used in Apple retail dealerships

Used by major auto manufacturers in dealerships

Instrumentation

Test equipment

Medical instruments

Video editing system

Militarized Systems

Air Traffic Control

user and to simplify the task of those trained in specific disciplines.

The technology

Several technologies are involved behind the scenes, affecting the user-apparent simplicity of touch-sensitive screens. All of these methods are, in fact, external to the CRT tube, being placed at the outer edge or in front of the CRT screen. It is the application software that presents the appropriate menu selections, prompting the user to touch the screen when appropriate. From a matrix representation of the screen, the system determines where the screen has been touched, and that position is reported back to the application software.

From the user's viewpoint, the most pertinent difference between today's two major technologies (resistive membrane

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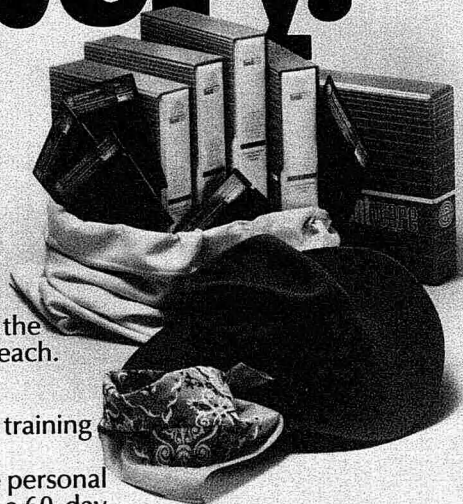
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screens and LEDs) is the response—the expected or unexpected interaction that develops as the finger triggers the system. With resistive technology, that happens as the finger touches the pointed-to area. Using infrared LEDs, that can occur when the light beam is broken, either before or after touching the screen.

The term "touch screen" was used first in 1973, when Carroll Touch introduced a touch screen product. It was an appropriate description—for the screen probably was touched where the finger pointed. But it wasn't a true touch screen: The user did not have to touch the screen, but only had to break the light beams from the infrared LEDs placed along each edge of the screen.

The LED technology is a straightforward solution to requirements that can be met by low resolution touch sensors. The sensor is triggered by the finger or stylus breaking the light path, rather than by the finger touching the CRT. This technology is often used where no fine cursor motion is needed.

With the introduction of touch-sensitive technologies by Elographics in the late 1970s, a true touch screen technology was available. The first transparent touch screen—using a resistive membrane technology invented by a founder of Elographics—was produced in 1977 under contract to the Siemens Corporation.

This resistive membrane technology offers high resolution by determining the central coordinates of the contact area. Therefore the finger can be used as a high-precision pointer. Due to the fine resolution, the sensor can be easily aligned with the raster, either mechanically, electronically, or with software.

As with any growing discipline, other hopeful participants are introducing competing technologies. They include capacitive overlays, ultrasonic arrays, matrix switches, gel overlays, and variations of the resistive membrane technology. All of these have yet to be proven as versatile or reliable as the LED and resistive membrane technologies. Together, the latter two account for better than 85 percent of the current (OEM) market sales.

Reference

1. (October 1984.) *Issues and Techniques in Touch-Sensitive Tablet Input*, W. University of Toronto.