At Your Fingertips

We use touch screens everywhere: tourist kiosks, automatic teller machines, point-of-sale terminals, industrial controls. Half a dozen vendors, plus in-house departments at major manufacturers, produced $800 million worth in 2000. The market is growing because the interfaces are easy-to-use, durable and inexpensive.

Touch screens employ one of three physics principles for detecting the point of touch. Pressing a “resistive” design with a finger or other stylus raises a voltage. In “capacitive” models, a finger draws a minute current (this method is often used for cursor pads on notebook computers). In other designs, a finger or stylus interrupts a standing pattern of acoustic waves or infrared lights that blanket the surface.

Resistive screens are the oldest, most widely used and least expensive, and they work with any stylus (finger, pen). Capacitive screens must be touched by a finger or an electrically grounded stylus to conduct current. Wave screens are the newest and most expensive. Surface acoustic wave screens must be touched by a finger or a soft stylus such as a pencil eraser to absorb energy; infrared screens work with any stylus.

The different technologies may be used in the same applications, although pros and cons lead to prevalent combinations: resistive screens for industrial controls and Palm Pilots; capacitive screens for slot machines; wave screens for ATMs and indoor kiosks.

Most people are unaware of the type of screen they are using. But tricks can help you tell, according to Frank Shen of Elo TouchSystems in Fremont, Calif., the largest U.S. maker. Push the screen lightly with your fingernail (not your skin). If it responds, it could be resistive or infrared. In this case, place two separated fingers against the screen at the same time. If the cursor moves beneath one finger, the unit is infrared (software registers the first touch); if the cursor moves between the fingers, it is resistive (the points are averaged). If the unit does not respond to your fingernail, again place two separated fingers against it. If the cursor moves beneath one finger, the unit is acoustic wave; if the cursor moves between the fingers, it is capacitive.

- Mark Fischetti

RESISTIVE
A glass panel that lies against a cathode-ray tube (CRT) or liquid-crystal display (LCD) is coated with a conductive material. Tiny polyester spacer dots separate it from a polyester cover sheet, which has a conductive metal coating on its inside surface. A controller applies a small voltage gradient across the x-axis of the panel and the y-axis of the cover sheet. When a stylus presses the conductive layers together, the control electronics detect its x- and y-coordinates.
BUTTERFLIES AND CHADS The U.S. presidential recount fiasco might have been avoided if Florida had used common touch-screen voting machines instead of confusing paper butterfly ballots and unreliable poke-through chads. Several manufacturers aim to modernize the state. Global Election Systems released a report in December 2000 that said wryly, “The election has created numerous new opportunities for voting-system sales.” The company already supplies 850 jurisdictions nationwide. The name of its product? AccuVote.

DOLPHINS Biologist Ken Marten of Sea Life Park Hawaii is using the first underwater, infrared touch screen [made by Carroll Touch] and a Macintosh G4 computer to create a cross-species language. The computer generates dolphin-like whistles and clicks. The park’s dolphins touch images with their rostrums [noses]. When a dolphin mimics the computer sound for “up” and then swims upward, a bit of language is born. The dolphins get no food rewards, only recorded sounds and video they find intellectually stimulating.

TOUCH TV Bill Colwell, an engineer at Elo TouchSystems, developed the first touch screen in 1977. The key to commercializing the resistive design was a subsequent Elo patent for polyester “dots” that separated the screen’s layers [see diagram on opposite page]. The company unveiled the technology on 33 televisions at the 1982 World’s Fair in Knoxville, Tenn.

CAPACITIVE
A glass sheet is coated on both sides with a conductive material. The outer surface is covered with a scratch-resistant coating. Electrodes around the panel’s edge distribute a low-voltage field uniformly across the outer conductive layer. The inner layer provides shielding and noise reduction.

When a finger touches the screen, it causes a capacitive coupling with the voltage and draws a minute current. The electrodes measure the current flow from the corners, and a controller determines the finger’s coordinates.

SURFACE ACOUSTIC WAVE (AND INFRARED)
The screen is an uncoated glass panel. Transducers in the corners convert a signal from a controller into ultrasonic waves on the glass surface. Reflectors on the edges create a standing wave pattern. When a soft stylus touches the screen, it absorbs part of the wave. The transducers sense the attenuation, and the controller determines the stylus’s coordinates.

On infrared screens, tiny light-emitting diodes and phototransistors on the edges set up a standing grid of invisible infrared light; a stylus obstructs the beam.