EXHIBIT 3.02

Preliminary Class
345

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IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Hotelling et al. | Attorney Docket No.: APL1P305/P3266

Application No.: 10/840,862 | Examiner: Unassigned

Filed: May 6, 2004 | Group: 2673

Title: MULTIPOINT TOUCHSCREEN

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first-class mail on August 23, 2005 in an envelope addressed to the Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.

Signed: Linda L. Pollock
Linda L. Pollock

INFORMATION DISCLOSURE STATEMENT
37 CFR §§1.56 AND 1.97(b)

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The references listed in the attached PTO Form 1449, copies of non-U.S. references are attached, may be material to examination of the above-identified patent application. Applicants submit these references in compliance with their duty of disclosure pursuant to 37 CFR §§1.56 and 1.97. The Examiner is requested to make these references of official record in this application.

This Information Disclosure Statement is not to be construed as a representation that a search has been made, that additional information material to the examination of this application does not exist, or that these references indeed constitute prior art.

This Information Disclosure Statement is: (i) filed within three (3) months of the filing date of the above-referenced application, (ii) believed to be filed before the mailing date of a first Office Action on the merits, or (iii) believed to be filed before the mailing of a first Office Action after the filing of a Request for Continued Examination under §1.114. Accordingly, it is believed that no fees are due in connection with the filing of this Information Disclosure Statement. However, if it is determined that any fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 500388 (Order No. APL1P305).

Respectfully submitted,
BEYER WEAVER & THOMAS, LLP

Quin C. Hoellwarth
Registration No. 45,738

P.O. Box 70250
Oakland, CA 94612-0250

OIPE JC131 AUG 2 5 2005 PATENT & TRADEMARK OFFICE

Form 1449 (Modified) Information Disclosure Statement By Applicant (Use Several Sheets if Necessary)	Atty Docket No. APL1P305/P3266	Application No.: 10/840,862
	Applicant: Hotelling et al.	
	Filing Date May 6, 2004	Group 2673

U.S. Patent Documents

Examiner Initial	No.	Patent No.	Date	Patentee	Class	Sub-class	Filing Date
	A1	2002/0015024 A1	02-07-02	Westerman et al.			07-31-01
	A2	3,662,105	05-09-72	Hurst et al.			05-21-70
	A3	3,798,370	03-19-74	Hurst			04-17-72
	A4	5,825,351	10-20-98	Tam			11-15-95
	A5	6,188,391 B1	02-13-01	Seely et al.			07-09-98
	A6	6,323,846 B1	11-27-01	Westerman et al.			01-25-99
	A7	6,570,557 B1	05-27-03	Westerman et al.			02-10-01
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	A11	6,856,259 B1	02-15-05	Sharp			02-06-04
	A12	6,888,536 B2	05-03-05	Westerman et al.			07-31-01

Foreign Patent or Published Foreign Patent Application

Examiner Initial	No.	Document No.	Publication Date	Country or Patent Office	Class	Sub-class	Translation Yes	Translation No
	A13							
	A14							
	A15							
	A16							
	A17							

Other Documents

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	A18	U.S. Patent Application No. 10/654,108 filed September 2, 2003.
	A19	U.S. Patent Application No. 10/789,676 filed February 27, 2004.
	A20	U.S. Patent Application No. 10/903,964 filed July 30, 2004.
	A21	U.S. Patent Application No. 11/015,978 filed December 17, 2004.
	A22	U.S. Patent Application No. 11/038,590 filed January 18, 2005.
	A23	U.S. Patent Application No. 11/048,264 filed January 31, 2005.
	A24	"Touch Technologies Overview," 2001, 3M Touch Systems, Massachusetts.
	A25	"Touchscreen Technology Choices," http://www.elotouch.com/products/detech2.asp, downloaded August 5, 2005.

	A26	Jun Rekimoto, "SmartSkin: An Infastructure for Freehand Manipulation on Interactive Surfaces," CHI 2002, April 20-25, 2002, Minneapolis, Minnesota.
	A27	"Wacom Components – Technology," http://www.wacom-components.com/english/tech.asp., downloaded October 10, 2004.
	A28	"Comparing Touch Technologies," http://www.touchscreens.com/intro-touchtypes.html, downloaded October 10, 2004.
	A29	"GlidePoint®," http://www.cirque.com/technology/technology_gp.htm, downloaded August 5, 2005.
	A30	"Captive Position Sensing," http://www.synaptics.com/technology/cps.cfm, downloaded August 5, 2005.
	A31	"How do touchscreen monitors know where you're touching?," http://electronics.howstuffworks.com/question716.htm, downloaded August 5, 2005.
	A32	"How Does a Touchscreen Work?," http://www.touchscreens.com/intro-anatomy.html, downloaded August 5, 2005.
	A33	"4-Wire Resistive Touchscreens," http://www.touchscreens.com/intro-touchtypes-4resistive.html, downloaded August 5, 2005.
	A34	"5-Wire Resistive Touchscreens," http://www.touchscreens.com/intro-touchtypes-resistive.html, downloaded August 5, 2005.
	A35	"Capacitive Touchscreens," http://www.touchscreens.com/intro-touchtypes-capacitive.html, downloaded August 5, 2005.
	A36	"PenTouch Capacitive Touchscreens," http://www.touchscreens.com/intro-touchtypes-pentouch.html, downloaded August 5, 2005.
	A37	"Surface Acoustic Wave Touchscreens," http://www.touchscreens.com/intro-touchtypes-saw.html, downloaded August 5, 2005.
	A38	"Near Field Imaging Touchscreens," http://www.touchscreens.com/intro-touchtypes-nfi.html, downloaded August 5, 2005.
	A39	"Infrared Touchscreens," http://www.touchscreens.com/intro-touchtypes-infrared.html, downloaded August 5, 2005.
	A40	"Watershed Algorithm," http://rsb.info.nih.gov/ij/plugins/watershed.html, downloaded August 5, 2005.

Examiner	Date Considered

Examiner: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

TOUCH TECHNOLOGIES *Overview*

Touch is everywhere

Touch screens are fast becoming the preferred interface between users and their personal, professional, and public access technology. The intuitiveness of touch screens combined with the space-savings, ease-of-use, and extreme durability over keyboards are just a few reasons why touch is so popular. In restaurants, bars, and casinos, touch screens are used for order entry and entertainment.

In industrial environments like assembly lines and factories, touch screens are simplifying process automation. In museums, hotel lobbies, and shopping malls touch-enabled kiosks provide easy access to information. And for children involved in educational training, touch is an instinctive way to interact with computers.

There are several types of touch screen technologies offered by various worldwide manufacturers. Each technology has its own set of characteristics and depending on your touch application, these differences may be viewed as benefits or disadvantages.

Consider the following questions. The answers to these questions will help you begin to understand your touch needs.

Activation
What type of touch activation do you need – finger only, gloved finger, or stylus input.

Options
Do you need touch buttons, drag and drop, or signature capture?

Image Clarity
Is optical clarity the most important requirement?

Space
Do you need a compact screen size?

Sealability
Will your touch screen be exposed to liquids, chemicals, or fluxtuating weather extremes.

Cost
What are your cost requirements?

Reliability
Will the touch screen have to stand up to dust, grease, or shock vibrations.

Durability
Will your touch screen be exposed to harsh environments?
Will it need to be impact resistance?

Vandal Resistant
Will the touch screen be in an unattended public environment and subject to abuse?

Power
Do you have specific power requirements or constraints?

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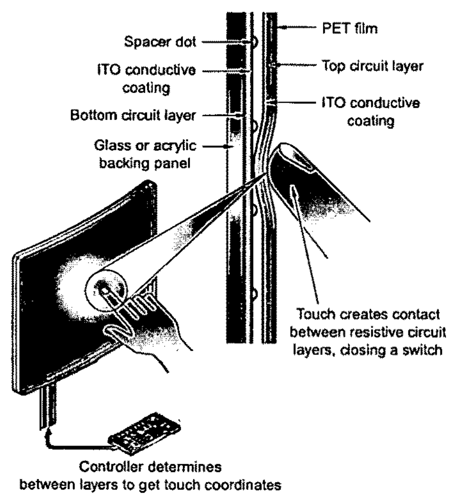
TOUCH TECHNOLOGIES *Overview*

Most touch solutions have a touch screen attached to a video display unit. The touch screen works with a controller and a software device driver to sense a touch, determine its location, and transmit the information to the computer's operating system. Touch solutions primarily use one of five technologies, each with characteristics that make it best suited for specific applications.

RESISTIVE



Resistive technology is versatile and economical for applications such as food service and retail point-of-sale, industrial process control and instrumentation, portable and handheld products, and communication devices.

Resistive touch screens have a flexible top layer and a rigid bottom layer separated by insulating dots, with the inside surface of each layer coated with a transparent conductive coating. Voltage applied to the layers produces a gradient across each layer. Pressing the flexible top sheet creates electrical contact between the resistive layers, essentially closing a switch in the circuit.

Advantages
- Value solution
- Activated by any stylus
- High touch point resolution
- Low power requirements

Disadvantages
- Reduced optical clarity
- Polyester surface can be damaged

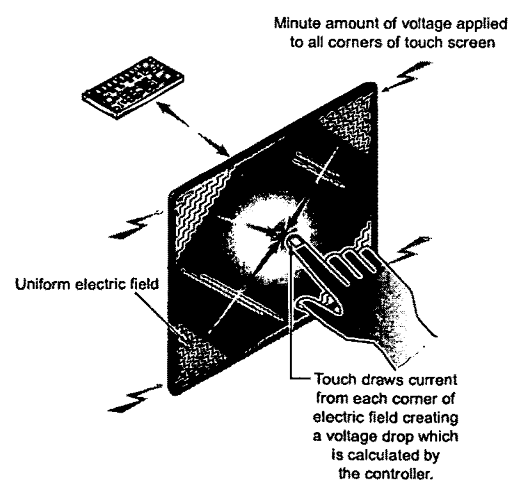
CAPACITIVE

Capacitive technology offers durability, reliability, and optical clarity. Popular applications include gaming machines, ATM installations, kiosks, industrial equipment, and point-of-sale.

Advantages
- Extremely durable
- Very accurate
- Good optical clarity
- Good resolution

Disadvantages
- Requires bare finger or capacitive stylus
- Severe scratch can affect operation within the damaged area

Capacitive touch screens are curved or flat glass substrates coated with a transparent metal oxide. A voltage is applied to the corners of the overlay creating a minute uniform electric field. A bare finger draws current from each corner of the electric field, creating a voltage drop that is measured to determine touch location.



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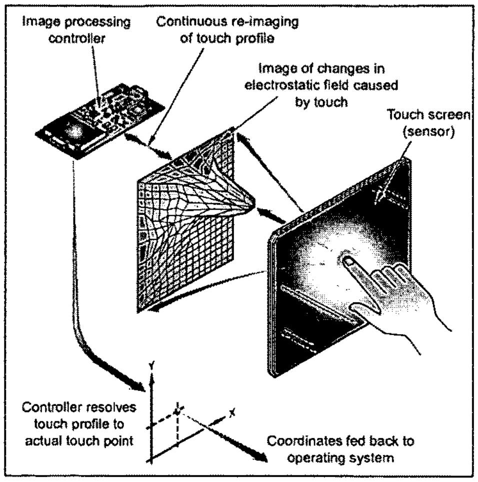
NEAR FIELD IMAGING™



Near Field Imaging, a projected capacitive technology, is extremely rugged, yet sensitive to touch, making it perfect for harsh industrial environments and unsupervised kiosks.

Near Field Imaging (NFI) touch screens consist of two laminated glass sheets with a patterned coating of transparent metal oxide between. An AC signal is applied to the patterned conductive coating, creating an electrostatic field on the surface of the screen. When a finger – gloved or ungloved – or other conductive stylus comes into contact with the sensor, the electrostatic field is disturbed.

Advantages
- Good optical clarity
- Extremely durable – scratch and debris resistant glass front
- Operates with fingers, gloves or or conductive stylus
- Accurate – even under harsh conditions

Disadvantages
- Slightly less touch resolution

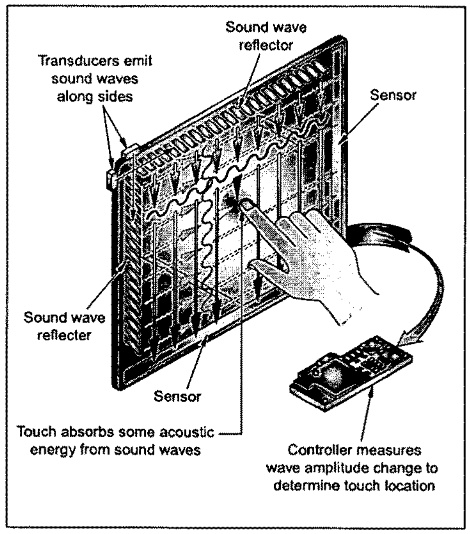
ACOUSTIC WAVE

Because of its high optical clarity and accuracy, acoustic wave technology is typically used in kiosk applications.

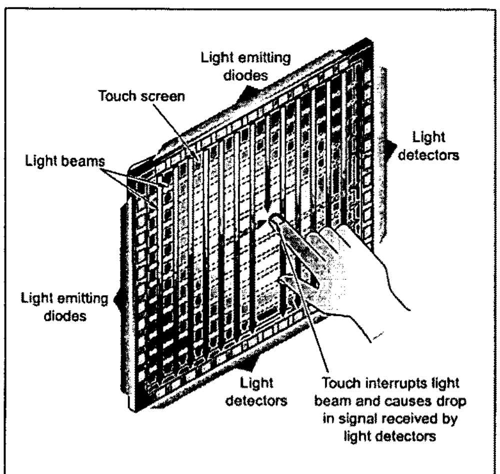
Advantages
- Good optical clarity
- Z-axis capability
- Durable glass front

Disadvantages
- Requires finger or sound absorbing stylus
- Difficult to industrialize
- Signal affected by surface liquids or other contaminants

Acoustic wave touch screens use transducers mounted at the edge of a glass overlay to emit ultrasonic sound waves along two sides. These waves are reflected across the surface of the glass and received by sensors. A finger or other soft tipped stylus absorbs some of the acoustic energy and the controller measures the amplitude change of the wave to determine touch location.



INFRARED



Infrared touch screens are primarily used for large displays, banking machines, and in military applications.

Infrared touch screens are based on light-beam interruption technology. Instead of an overlay on the surface, a frame surrounds the display. The frame has light sources, or light emitting diodes (LEDs) on one side and light detectors on the opposite side, creating an optical grid across the screen. When an object touches the screen, the invisible light beam is interrupted, causing a drop in the signal received by the photosensors.

Advantages
- 100% light transmission (not an overlay)
- Accurate

Disadvantages
- Costly
- Low reliability (MTBF for diodes)
- Parallax problems
- Accidental activation
- Low touch resolution
- No protection for display surface

3M TOUCH SOLUTIONS

Now that you've thought about the touch requirements and limitations of your application, and the advantages and disadvantages of each technology, give us your most challenging touch application and we'll give you a solution.

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Your satisfaction is our success. Purchase off-the-shelf components for quick and easy touch product development or work with our engineers to create custom solutions. You can choose from our capactive product line, known for exceptional clarity and durability, with ClearTek™ capacitive for public-use applications, and Near Field Imaging™ projected capacitive for those extremely harsh touch environments. For resistive solutions, we'll assist you in choosing from FG and PL constructions, using 4-, 5-, or 8-wire designs to help you get the best resistive product for your application.

Notice: Given the variety of factors that can affect the use and performance of a 3M Touch Systems product, including that solid state equipment has operation characteristics different from electromechanical equipment, some of which factors are uniquely within User's knowledge and control, it is essential that User evaluate the 3M Touch Systems product to determine whether it is suitable for User's particular purpose and suitable for User's method of application. 3M Touch Systems' statements, engineering/technical information, and recommendations are provided for User's convenience, but their accuracy or completeness is not warranted. 3M Touch Systems products are not specifically designed for use in medical devices as defined by United States federal law. 3M Touch Systems products should not be used in such applications without 3M Touch Systems' express written consent. User should contact its sales representative if User's opportunity involves a medical device application.

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3M

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10% post-consumer waste paper

Watershed Algorithm

Author: Christopher Mei (christopher.mei at sophia.inria.fr)

History: 2003/12/15 : First version

Requires: ImageJ 1.31p or later, which adds the ability to package plugins in JAR files

Source: Contained in Watershed_Algorithm.jar, which can be opened using a ZIP utility

Installation: Download Watershed_Algorithm.jar to the plugins folder, or subfolder, restart Imag there will be a new *Plugins/Filters/Watershed Algorithm...* command.

See Also: Watershed plugin by Daniel Sage
Process/Binary/Watershed command

Description: This algorithm is an implementation of the watershed immersion algorithm written Vincent and Soille (1991).

```
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    year =          "1991",
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    title =         "Watersheds in digital spaces: An efficient algc
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    journal =       "IEEE PAMI, 1991",
    volume =        "13",
    number =        "6",
    pages =         "583--598",
    annote =        "Watershed lines (e.g. the continental divide) m
                    boundaries of catchment regions in a topographic
                    The height of a point on this map can have a dir
                    correlation to its pixel intensity. WIth this an
                    the morphological operations of closing (or open
                    can be understood as smoothing the ridges (or fi
                    in the valleys). Develops a new algorithm for ob
                    the watershed lines in a graph, and then uses th
                    developing a new segmentation approach based on
                    {"}depth of immersion{"}.",
    }
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A review of Watershed algorithms can be found at :
http://www.cs.rug.nl/~roe/publications/parwshed.pdf

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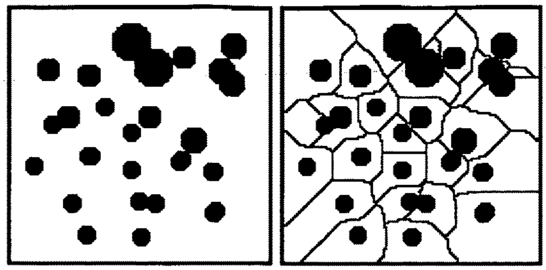

The image on the left represents the type of result obtained from the thresholding of classical images where Watershed segmentation is efficient. This could be a picture of coffee beans, blood cells, sand ...
The segmentation on the right was obtained with the following operations : invert image (*Edit/Invert*), calculate the distance transform (*Process/Binary/Distance Map*), invert result, apply Watershed.

|**Plugins** | **Home** |

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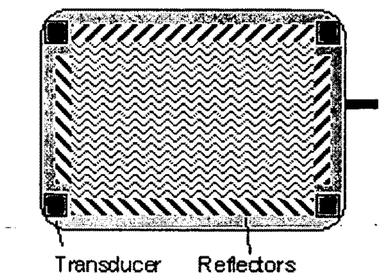
Now at: Home > Introduction > Comparing Technologies > Comparing Touch Technologies > Surface Acoustic Wave

Surface Acoustic Wave Touchscreens



Surface Acoustic Wave technology is one of the most advanced touch screen types. It is based on sending acoustic waves across a clear glass panel with a series of transducers and reflectors. When a finger touches the screen, the waves are absorbed, causing a touch event to be detected at that point.

Because the panel is all glass there are no layers that can be worn, giving this technology the highest durability factor and also the highest clarity. This technology is recommended for public information kiosks, computer based training, or other high traffic indoor environments.

Advantages

- High touch resolution
- Highest image clarity
- All glass panel, no coatings or layers that can wear out or damage

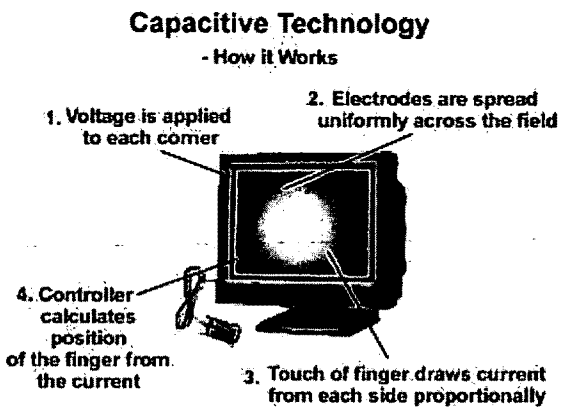
Disadvantages

- Must be touched by finger, gloved hand, or soft-tip stylus. Something hard like a pen won't work
- Not completely sealable, can be affected by large amounts of dirt, dust, and / or water in the environment.

Touchscreen Specifications

Touch Type:	Elo IntelliTouch Surface Acoustic Wave
Cable Interface:	PC Serial/COM Port or USB Port
Touch Resolution:	4096 x 4096
Activation Force:	less than 3 ounces
Light Transmission:	90%
Expected Life:	50 million touches at one point
Temperature:	Operating: -20°C to 50°C Storage: -40°C to 71°C
Humidity:	Operating: 90% RH at max 40°C, non-condensing
Chemical Resistance:	The active area of the touchscreen is resistant to all chemicals that do not affect glass, such as: Acetone, Toluene, Methyl ethyl ketone, Isopropyl alcohol, Methyl alcohol, Ethyl acetate, Ammonia-based glass cleaners, Gasoline, Kerosene, Vinegar
Regulations:	UL, CE, TUV, FCC-B
Software Drivers:	Windows XP, 2000, NT, ME, 98, 95, 3.1, DOS, Macintosh OS, Linux, Unix (3rd Party)

PenTouch Capacitive Touchscreens



The PenTouch Capacitive screen is a durable Capacitive type touchscreen with an attached pen stylus. The PenTouch screen can be set to respond to finger input only, pen input only, or both. A capacitive touch screen consists of a glass panel with a capacitive (charge storing) material coating its surface. Circuits located at corners of the screen measure the capacitance of a person touching the overlay. Frequency changes are measured to determine the X and Y coordinates of the touch event.

Capacitive type touch screens are very durable, and have a high clarity. They are used in a wide range of applications, from restaurant and POS use to industrial controls and information kiosks.

Advantages

- High touch resolution
- High image clarity
- Not affected by dirt, grease, moisture.
- Attached pen stylus for precise input

Disadvantages

- Must be touched by finger or attached pen stylus, will not work with any non-conductive input

Touchscreen Specifications

Touch Type:	3M PenTouch Capacitive
Cable Interface:	PC Serial/COM Port (9-pin) or USB Port
Touch Resolution:	1024 x 1024
Activation Force:	less than 3 ounces
Light Transmission:	88% at 550 nm wavelength (visible light spectrum)
Durability Test:	100,000,000 plus touches at one point
Temperature:	Operating: -15°C to 50°C Storage: -50°C to 85°C
Humidity:	Operating: 90% RH at max 40°C, non-condensing
Chemical Resistance:	The active area of the touchscreen is resistant to all chemicals that do not affect glass, such as: Acetone, Toluene, Methyl ethyl ketone, Isopropyl alcohol, Methyl alcohol, Ethyl acetate, Ammonia-based glass cleaners, Gasoline, Kerosene, Vinegar
Regulations:	UL, CE, TUV, FCC-B
Software Drivers:	Windows XP, 2000, NT, ME, 98, 95, 3.1, DOS, Macintosh OS, Linux, Unix (3rd Party)

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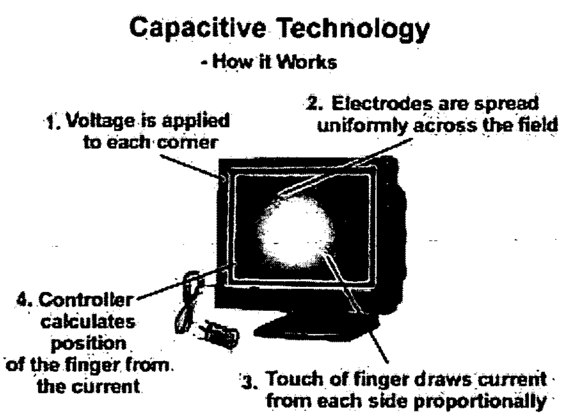
Capacitive Touchscreens



A capacitive touch screen consists of a glass panel with a capacitive (charge storing) material coating its surface. Circuits located at corners of the screen measure the capacitance of a person touching the overlay. Frequency changes are measured to determine the X and Y coordinates of the touch event.

Capacitive type touch screens are very durable, and have a high clarity. They are used in a wide range of applications, from restaurant and POS use to industrial controls and information kiosks.

Advantages

- High touch resolution
- High image clarity
- Not affected by dirt, grease, moisture.

Disadvantages

- Must be touched by finger, will not work with any non-conductive input

Touchscreen Specifications

Touch Type:	3M ClearTek Capacitive
Cable Interface:	PC Serial/COM Port (9-pin) or USB Port
Touch Resolution:	1024 x 1024
Activation Force:	less than 3 ounces
Light Transmission:	88% at 550 nm wavelength (visible light spectrum)
Durability Test:	100,000,000 plus touches at one point
Temperature:	Operating: -15°C to 50°C Storage: -50°C to 85°C
Humidity:	Operating: 90% RH at max 40°C, non-condensing
Chemical Resistance:	The active area of the touchscreen is resistant to all chemicals that do not affect glass, such as: Acetone, Toluene, Methyl ethyl ketone, Isopropyl alcohol, Methyl alcohol, Ethyl acetate, Ammonia-based glass cleaners, Gasoline, Kerosene, Vinegar
Regulations:	UL, CE, TUV, FCC-B
Software Drivers:	Windows XP, 2000, NT, ME, 98, 95, 3.1, DOS, Macintosh OS, Linux, Unix (3rd Party)

Touchscreen Technology Choices

AccuTouch Five-Wire Resistive

AccuTouch five-wire resistive technology is the workhorse of resistive touchscreens, providing unsurpassed performance. When activated with a finger, gloved hand, fingernail, or object such as a credit card, the AccuTouch touchscreen delivers a fast, accurate response every time. It is impervious to environmental conditions such as liquid spills and splashes, humidity, and washdown—the most contamination-resistant touchscreen available. AccuTouch is widely used in point-of-sale, industrial, and medical applications and is available for both flat panel and CRT solutions. Read more about AccuTouch technology.

AT4 Four-Wire Resistive

Elo TouchSystems' AT4 four-wire resistive technology is the entry-level touch solution. Its benefits include stable operation, quick touch response, input flexibility, narrow border width, less weight, and low power consumption. AT4 resistive touchscreens are ideal for industrial applications, portable medical and field automation devices, access control terminals, office equipment, home appliances, and wearable computers—almost anywhere a small display is used. Read more about AT4 technology.

CarrollTouch Infrared

CarrollTouch infrared technology is the survivor of harsh applications. It's the only technology that does not rely on an overlay or substrate to register a touch, so it's impossible to physically "wear out" the touchscreen. CarrollTouch technology combines superior optical performance with excellent gasket-sealing capabilities, so it's an excellent choice for harsh industrial and outdoor kiosk applications. Touched with a finger, gloved hand, fingernail, or stylus, it delivers a fast, accurate response every time. CarrollTouch infrared technology is available for flat panel solutions. Read more about CarrollTouch technology.

IntelliTouch Surface Wave

IntelliTouch surface wave is the optical standard of touch. Its pure glass construction provides superior optical performance and makes it the most scratch-resistant technology available. It's nearly impossible to physically "wear out" this touchscreen. IntelliTouch is widely used in kiosk, gaming, and office automation applications and is available for both flat panel and CRT solutions. Read more about IntelliTouch technology.

SecureTouch Surface Wave

SecureTouch provides all the features of IntelliTouch along with tempered glass construction for superior resistance to breakage and vandalism. It's nearly impossible to physically break or "wear out" these touchscreens. SecureTouch is widely used in kiosk, gaming, and office automation applications and is available for flat panel solutions. Read more about SecureTouch technology.

iTouch Touch-on-Tube Surface Wave

For CRT-based applications, iTouch touch-on-tube technology provides superior optical and image quality. The surface wave technology is applied directly to the faceplate of the CRT, so 100% of the image's original brightness and clarity comes through. The CRT faceplate is extremely strong and resistant to scratches, breakage, and vandalism. iTouch is widely used in kiosk, gaming, and office automation applications and is available for CRT solutions. Read more about iTouch technology.

Projected Capacitive

Projected capacitive technology enables touches to be sensed through a protective layer in front of a display, allowing touchmonitors to be installed behind store windows or vandal-resistant glass. **DirectTouch** consists of a 7.8 mm sensor with tempered glass outer layer, and **ThruTouch** works through a customer-installed outer layer. The complete system resists impacts, scratches, and vandalism and is also unaffected by moisture, heat, rain, snow and ice, or harsh cleaning fluids, making it ideal for outdoor applications. The solid-state touchscreen and controller provide increased levels of reliability and longer life expectancy, resulting in a drift-free response and a low-maintenance unit that requires no recalibration. Read more about projected capacitive technology.

Surface Capacitive

Surface capacitive touchscreens provide a solution for customers who want an alternative to their capacitive options available today. Elo's narrow, patented Z-borders yield an inherently linear sensor. The transparent protective coating makes the sensor resistant to scratches and abrasions. Touch performance is unaffected by everyday abuse and mishaps such as dirt, dust, condensation, liquid spills, contaminants or cleaning solutions. Yet the surface capacitive touchscreens respond quickly and easily with excellent dragging performance. And the Elo-designed controller responds to quick, light touches, and operates drift-free even in areas of poor grounding. Read more about surface capacitive technology.

SmartSkin: An Infrastructure for Freehand Manipulation on Interactive Surfaces

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ABSTRACT
This paper introduces a new sensor architecture for making interactive surfaces that are sensitive to human hand and finger gestures. This sensor recognizes multiple hand positions and shapes and calculates the distance between the hand and the surface by using capacitive sensing and a mesh-shaped antenna. In contrast to camera-based gesture recognition systems, all sensing elements can be integrated within the surface, and this method does not suffer from lighting and occlusion problems. This paper describes the sensor architecture, as well as two working prototype systems: a table-size system and a tablet-size system. It also describes several interaction techniques that would be difficult to perform without using this architecture.

Keywords
Interactive surfaces, gesture recognition, augmented tables, two-handed interfaces, touch-sensitive interfaces.

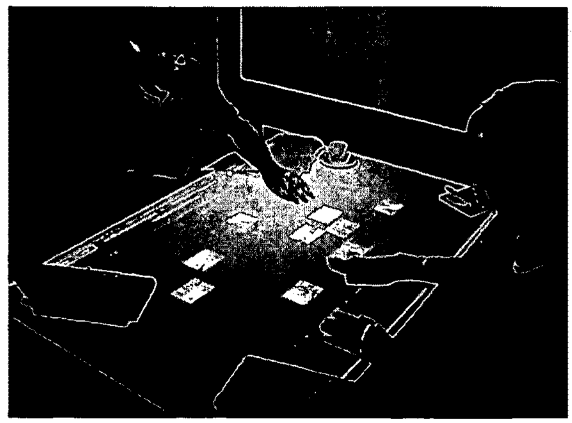

Figure 1: An interactive surface system based on the SmartSkin sensor.

INTRODUCTION
Many methods for extending computerized workspace beyond the computer screen have been developed. One goal of this research has been to turn real-world surfaces, such as tabletops or walls, into interactive surfaces [23, 21, 16, 20, 9]. The user of such a system can manipulate, share, and transfer digital information in situations not associated with PCs. For these systems to work, the user's hand positions often must be tracked and the user's gestures must be recognizable to the system. Hand-based interaction offers several advantages over traditional mouse-based interfaces, especially when it is used in conjunction with physical interactive surfaces.

While camera-based gesture recognition methods are the most commonly used (such as [24, 13, 9]), they often suffer from occlusion and lighting condition problems. To correctly capture hand images on a surface, a camera must be mounted above the table or in front of the wall. As a result, the system configuration becomes complex, making it difficult to implement the system as a portable (integrated) unit. The use of magneto-electric sensors (e.g., Polhemus [15]) is another possible sensing method, but it requires attaching a tethered magneto-electric sensor to each object being tracked.

This paper introduces a new sensing architecture, called SmartSkin, which is based on capacitive sensing (Figure 1). Our sensor accurately tracks the position of the user's hands (in two dimensions) and also calculates the distance from the hands to the surface. It is constructed by laying a mesh of transmitter/receiver electrodes (such as copper wires) on the surface. As a result, the interactive surface can be large, thin, or even flexible. The surface does not need to be flat – i.e., virtually any physical surface can interactive. By increasing the density of the sensor mesh, we can accurately determine the shape of the hand and detect the different positions of the fingers. These features enable interaction techniques that are beyond the scope of normal mouse-based interactions.

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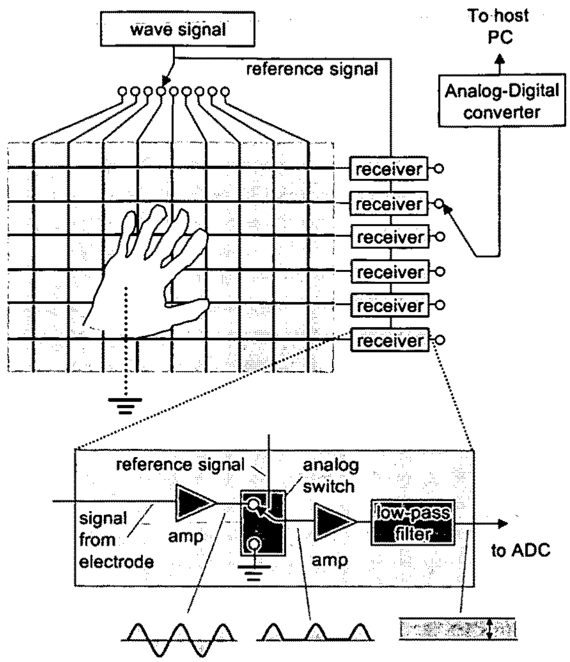

Figure 2: The SmartSkin sensor configuration: A mesh-shaped sensor grid is used to determine the hand's position and shape.

We describe the sensing principle of SmartSkin and two working systems: an interactive table system and a hand-gesture sensing tablet. We also describe new interaction techniques of these systems.

SMARTSKIN SENSOR ARCHITECTURE

Figure 2 shows the principle of operation of the SmartSkin sensor. The sensor consists of grid-shaped transmitter and receiver electrodes (copper wires). The vertical wires are transmitter electrodes, and the horizontal wires are receiver electrodes. When one of the transmitters is excited by a wave signal (of typically several hundred kilohertz), the receiver receives this wave signal because each crossing point (transmitter/receiver pairs) acts as a (very weak) capacitor. The magnitude of the received signal is proportional to the frequency and voltage of the transmitted signal, as well as to the capacitance between the two electrodes. When a conductive and grounded object approaches a crossing point, it capacitively couples to the electrodes, and drains the wave signal. As a result, the received signal amplitude becomes weak. By measuring this effect, it is possible to detect the proximity of a conductive object, such as a human hand.

The system time-dividing transmitting signal sent to each of vertical electrodes and the system independently measures values from each of receiver electrodes. These values are integrated to form two-dimensional sensor values, which we called "proximity pixels". Once these values are obtained, algorithms similar to those used in image processing, such as peak detection, connected region analysis, and template matching, can be applied to recognize gestures. As a result, the system can recognize multiple objects (e.g., hands). If the granularity of the mesh is dense, the system can recognize the shape of the objects.

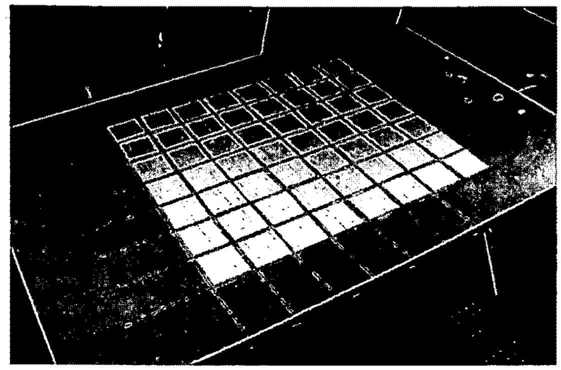

Figure 3: Interactive table with an 8 × 9 SmartSkin sensor: A sheet of plywood covers the antennas. The white squares are spacers to protect the wires from the weight of the plywood cover.

The received signal may contain noise from nearby electric circuits. To accurately measure signals only from the transmitter electrode, a technique called "lock-in amplifier" is used. This technique uses an analogue switch as a phase-sensitive detector. The transmitter signal is used as a reference signal for switching this analog switch, to enable the system to select signals that have the synchronized frequency and the phase of the transmitted signal. Normally, a control signal needs to be created by phase-locking the incoming signal, but in our case, the system can simply use the transmitted signal, because the transmitter and the receiver are both on the same circuit board. This feature greatly simplifies the entire sensor design.

We chose a mesh-shaped electrode design for our initial experiment because of its simplicity and suitability for sensing hand shapes as pixel patterns. Other layouts are possible, depending on the application requirements. For example, the density of the mesh can be adjusted. In addition, since the electrodes are simply thin copper wires, it is possible to create a very thin interactive surface such as interactive paper, which can even be flexible.

PROTOTYPE 1: AN INTERACTIVE TABLE

Based on the principle described above, we developed two interactive surfaces: a table-size system that can track multiple hand positions, and a smaller (and more accurate) system that uses a finer electrode layout.

The table system is constructed by attaching sensor elements to a wooden table. A mesh-like antenna, made of polyurethane-coated 0.5 mm-thick copper wire, is laid on the tabletop. The number of grid cells is 8×9, and each grid cell is 10×10 cm. The entire mesh covers an 80×90 cm area of the tabletop

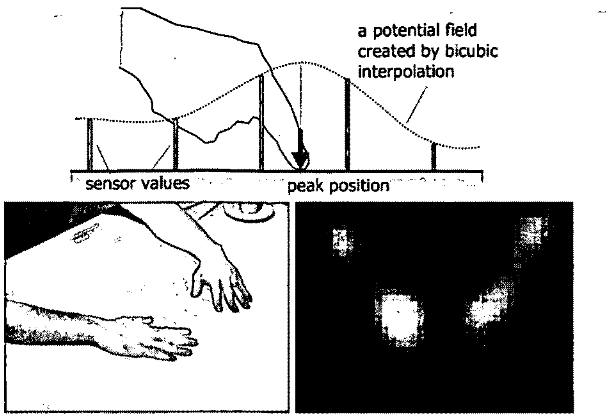

Figure 4: top: A bicubic interpolation method is used to detect the peak of the potential field created by hand proximity. bottom: arms on a table and a corresponding potential field.

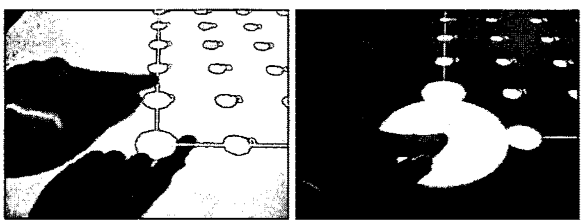

Figure 5: Relationship between distance between hand and sensor and sensed values. The diameter of the circle represents the amplitude of the sensed value.

(Figure 3). A plywood board covers the antennas. A signal transmitter / receiver circuit is attached to the side of the table. Two Atmel AVR microprocessors control this circuit. One microprocessor generates square-wave signals (400 KHz) with firmware that directly controls the I/O port, and the other microprocessor with a built-in A/D converter measures the values of the received signals and transmits them to the host computer. A projector is used to display information on the table. The current implementation is capable of processing 8×9 sensor values 30 times per second.

When the user's hand is placed within 5-10 cm from the table, the system recognizes the effect of the capacitance change. A potential field is created when the hand is in the proximity to the table surface. To accurately determine the hand position, which is the peak of the potential field, a bicubic interpolation method is used to analyze the sensed data (Figure 4). By using this interpolation, the position of the hand can be determined by finding the peak on the interpolated curve. The precision of this calculated position is much finer than the size of a grid cell. The current implementation has an accuracy of 1 cm, while the size of a grid cell is 10 cm.

As for the distance estimation, although there is no way to directly measure the precise distance between the hand and the table surface, we can estimate relative distance. Figure 5 shows the relationship between the hand position and obtained A/D-converted values. Our system enables detecting various levels of hand proximity, which is difficult to do with other technologies such as computer vision.

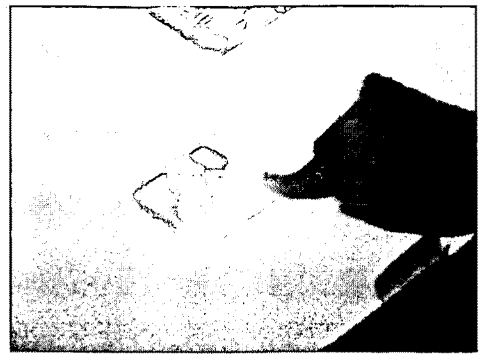

Figure 6: Mouse emulation by using calculated hand position. The distance between the hand and the surface is used to determine button-press and button-release states.

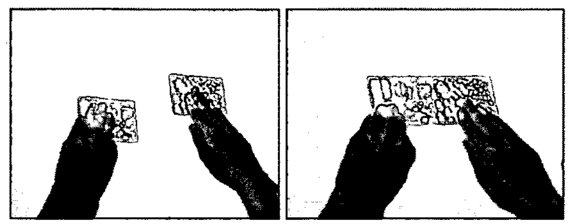

Figure 7: Two-handed operation is used to concatenate two objects.

Since each point on the grid can independently measure the proximity of an object, the system can simultaneously track more than one hand. This feature is important because many table-based applications are used by more than one user.

Interaction techniques

We studied two types of basic interaction techniques for this platform. One is 2D-position control with distance measurement, and the other uses a sensor potential field as input.

Mouse emulation with distance measurement The first interaction technique is the simple emulation of a mouse-like interface. The estimated 2D position is used to emulate moving the mouse cursor, and the hand-surface distance is used to emulate pressing the mouse button. A threshold value of the distance is used to distinguish between pressed and released states that the user can activate "mouse press" by touching the table surface with the palm, and move the cursor without pressing the mouse button by touching the table surface with the fingers. Normally, touch-sensitive panels cannot distinguish between these two states, and many interaction techniques developed for the mouse (such as "mouse over") cannot be used. In contrast, an interactive table with a SmartSkin sensor can emulate most mouse-based interfaces. Figure 6 shows how the user "drags" a displayed object.

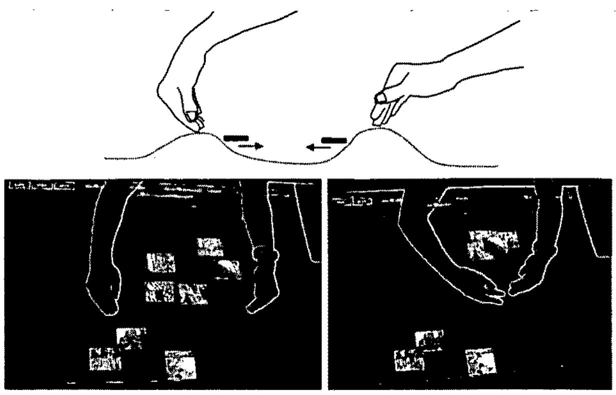

Figure 8: Shape-based object manipulation. The potential field created by the hand's proximity to the table is used to move objects. The user can use both hands or even entire arms to manipulate objects.

A notable advantage of SmartSkin over traditional mouse-based systems is its natural support for multiple-hand, multiple-user operations. Two or more users can simultaneously interact with the surface at the same time. The multiple-hand capability can also be used to enhance object manipulation. For example, a user can independently move objects with one hand. He or she can also "concatenate" two objects by using both hands, as shown in Figure 7, or can take objects apart in the same manner.

Shape-based manipulation The other interaction technique, which we call "shape-based manipulatio", does not explicitly use the 2-D position of the hand. Instead, a potential field created by sensor inputs is used to move objects. As the hand approaches the table surface, each intersection of the sensor grid measures the capacitance between itself and the hand. By using this field, various rules of object manipulation can be defined. For example, an object that "descend" to a lower potential area repels from the human hand. By changing the hand's position around the object, the direction and speed of the object's motion can be controlled.

We implemented this interface and observed how users tried to control objects. Overall, the reaction to the interface was quite encouraging. The people were quickly able to use this interface even though they did not fully understand the underlying dynamics. Many users naturally used two hands, or even arms. For example, to move a group of objects, one can sweep the table surface with one's arm. Two arms can be used to "trap" and move objects (Figure 8).

PROTOTYPE 2: A GESTURE-RECOGNITION PAD

The table prototype demonstrates that this sensor configuration can be used to create interactive surfaces for manipulating virtual objects. Using a sensor with a finer grid pitch we should be able to determine the position and shape of the hand more accurately. In addition, if the sensor can sense more than one finger position, several new interaction techniques are possible. For example, a 3D-modeling system often requires manipulation of multiple control points such as curve control points. Normally, a user of traditional mouse-based interfaces has to sequentially change these control points one by one. However, it would be more efficient and more intuitive if the user could control many points simultaneously.

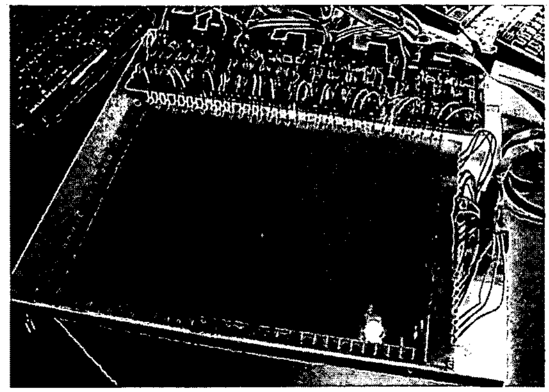

Figure 9: A gesture-recognition pad made up of a 32×24 grid mesh. A sheet of plastic insulating film covers Sensor electrodes.

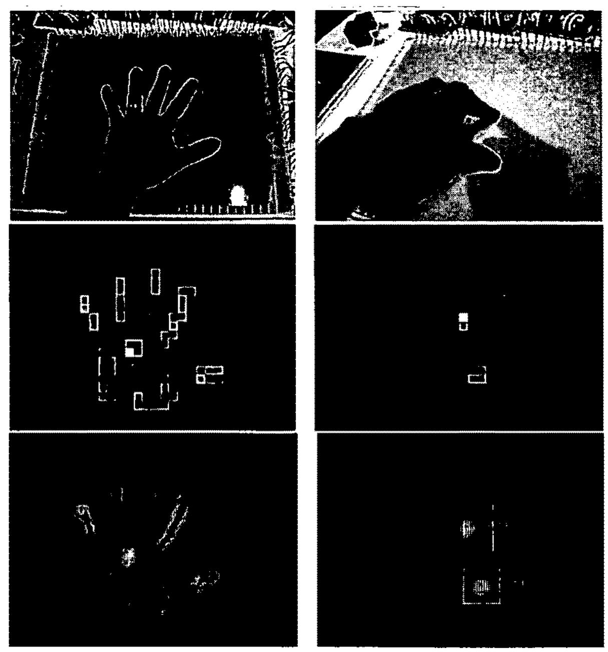

Figure 10: Gestures and corresponding sensor values. (top: a hand on the sensor mesh, middle: raw input values, bottom: after bicubic interpolation)

The second prototype uses a finer mesh pitch compared to that of the table version (the number of grid cells is 32 × 24, and each grid is 1 × 1 cm). A printed circuit board is used for the grid electrodes (Figure 9). The prototype uses the bicubic interpolation algorithm of the interactive table sys-

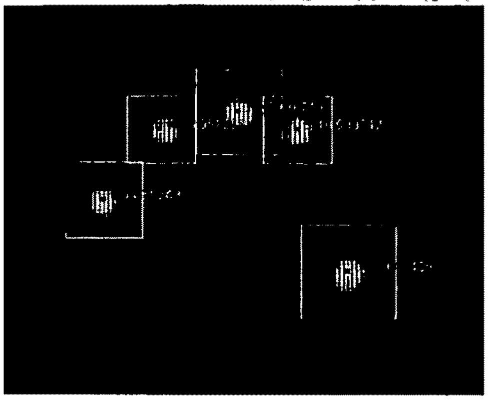

Figure 11: Fingertip detection.

Figure 12: Examples of uses of multiple-finger interfaces: left: curve editing. right: a map browsing system. The user can use one finger for panning, or two or more fingers for simultaneous panning and scaling.

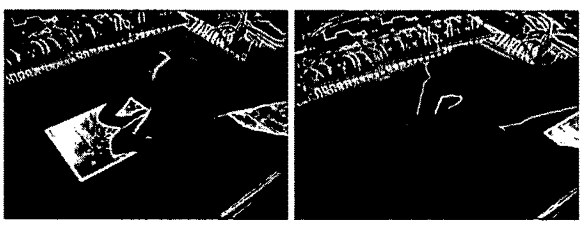

Figure 13: Two-finger gestures can be used to "pick-up" objects.

tem, and it can determine the human hand shape as shown in Figure 10. The peak detection algorithm can also be used, and in this case, the algorithm can track multiple positions of the fingertips, not just one position of the hand (Figure 11).

Interactions by using fingers and hand gestures

We studied three possible types of interaction for this platform. The first one is (multiple) finger tracking. Here, the user simultaneously controls several points by moving his or her fingertips. The second is using hand or finger shape as input, and the third is identifying and tracking physical objects other than the user's hands.

A typical example of a situation in which the multi-finger interface is useful is diagram manipulation. A user can simultaneously move and rotate a displayed pictogram on the surface with two fingers. If three or more fingers are used, the system automatically uses a least-squares method to find

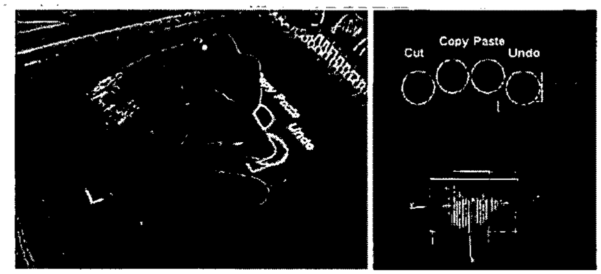

Figure 14: A palm is used to trigger a corresponding action (opening menu items). The user then taps on one of these menu items.

Figure 15: The "capacitance tag": a conductive pattern attached at the bottom of an object is used to identify this object.

the motion (consisting of moving, rotating, and scaling) that best satisfies the constraints given by the fingers.

Another simple example is the expression of attributes during manipulation. For example, the user normally drags a scroll bar with one finger, but to increase the scrolling ratio, he or she could use two or more fingers.

Figure 12 shows a map browsing system. The user scrolls the map by sliding a finger along the sensor surface. The scrolling speed increases with the number of fingers in contact with the surface. If the user touches the surface with two or more fingers, by changing the distance from the fingers to the surface, he/she can control the map scale. Simultaneous control of scrolling and zooming is intuitive, because the user feels as if his or her fingers are fixed to the map's surface.

Other possibilities we have explored include gesture commands. For example, two fingers moving toward the center of an object represent a "picking up" action (Figure 13), while a similar outward motion represents a "dropping" action. There are probably many other actions or functions representable by multi-finger gestures, for example, those based on the geographical relations between tapped fingers.

An example of using a hand shape as input is shown in Figure 14. In this example, the user places a hand on the surface, its shape is recognized by the system, and a corresponding action, in this case, "showing menu item", is triggered. The action is selected by template matching. The system first lists up connected regions (a group of sensor values that are connected), and then calculates the values of correlation between the stored templates. The system selects the region with the highest correlation value, and if this value exceeds a predetermined threshold value, the corresponding action is activated. In Figure 14, the user first touches the surface with his/her palm, then selects one of the displayed menu items.

Capacitance tags

While exploring several hand-based interaction techniques, we also found a way to make the SmartSkin sensor interact with objects besides than the hand. This feature can support graspable / tangible user interfaces [2, 8].

The principle of this method, called "capacitance tags", is shown in Figure 15. The capacitance tag block is made of a dielectric material such as wood or plastic. Some parts of this tag block are coated with a conductive material such as copper film. These conductive areas are connected to each other (by a copper wire, for example). This wire also connects the conductive areas at the bottom and at the top of the block.

When this block is placed on the SmartSkin surface, the sensor does not detect the capacitance change because the block is ungrounded. However, when a user grasps it (and touches the conductive area at the top), all the conductive areas become grounded, and areas corresponding to the conductive parts coated at the bottom of the block can be detected. Since the geometrical relationship (e.g., the distance between conductive areas) is predetermined, the system can distinguish these patterns from other patterns created when the user moves his/her hands or fingers. Essentially, the combination of conductive areas works like a barcode. In addition, the geometry of the patterns indicates the position and orientation of the tag block. Simultaneous object identification and position tracking is a key technology for many post-GUI user interface systems (such as [21, 22, 16]), and this method should be a new solution for such systems.

Another advantage of this capacitance tag method is its ability to support simultaneous hand gestures. For example, a user places a capacitance tag block on an interactive surface, and then issues a "data transfer" command by hand-dragging the displayed object toward the block.

DISCUSSIONS

Design Issues

Most computers now use mice as input devices. With a mouse, the user controls one 2D position on the screen, and uses various interaction techniques, such as clicking or dragging. Although the mouse is a popular input device, its 'way' of interaction is different from the way manipulate objects in our daily lives. In the real world, we often use multiple fingers or both hands to manipulate a physical object. We control several points on the object's surface by touching, not by using "one position of the cursor" as in GUI systems. Consequently, with mouse-based interfaces, we have to unnaturally decompose some tasks into primitive operations.

In addition, our ability to interact with the physical environment is not limited to the control of multiple points. Hands and fingers can also create various phenomena, such as pressure. As a result, interaction becomes more subtle and analogue.

Related work

Capacitive sensing for human-computer interaction The idea of using capacitive sensing in the field of human-computer interfaces has a long history. Probably the earliest example is a musical instrument invented by Theremin in the early 20th century, on which a player can control the pitch and volume by changing the distance between the hand and the antenna. Other examples include a "radio drum" [11], which is also an electric musical instrument, and Lee et al.'s multi-finger touch panel, which has a sub-divided touch-sensitive surface [10].

Zimerrman et al.'s work [26] pioneered the sensing of an electric field as a method for hand tracking and data communication (e.g., "personal area network" [25]). Although there has been a lot of research in this area, interaction techniques, like the ones described in this paper, have not been studied extensively. Our other contributions to this field are the new electrode design that enables accurate and scalable interactive surfaces, and the creation of tagged physical objects that can be used in combination with hand gestures.

Hinkely et al. showed how a simple touch sensor (which is also based on a simple capacitive sensor) can enhance existing input devices such as a mouse or a trackball [6].

Vision-based gesture recognition There have been a number of studies on using computer vision for human gesture recognition [7]. However, achieving robust and accurate gesture recognition in unconditioned environments, such as the home or office, is still difficult. The EnhancedDesk [9] uses a thermo-infrared camera mounted above the table to extract the shape of the hand from the background. In contrast to these vision-based approaches, our solution does not rely on the use of external cameras, and all the necessary sensors are embedded in the surface. As a result, our technology offers more design flexibility when we implement systems.

Other types of vision-based systems include HoloWall [13] and Motion Processor [14]. Both systems use a video camera with an optical infrared filter for recognition, and infrared lights are used to illuminate objects in front of the camera. While Motion Processor directly uses this infrared reflection, HoloWall uses a diffuser surface to eliminate the background image. "Barehand" [19] is an interaction technique for a large interactive wall. It enables recognizing hand shapes by using a sensor similar to that of HoloWall, and it uses the shapes to trigger corresponding actions. Using infrared reflection, the system can detect not only the shape of the hand, but also its distance from the camera. As a result, gestures that cannot be recognized by other vision-based systems, such as moving a finger vertically over a surface (i.e., tapping), can be detected. However, like other vision-based systems, these systems also require the use of external cameras and lights, and thus they cannot be integrated into a single unit.

Bimanual interfaces Various types of bimanual (two-handed) interfaces (for example, see [1, 5, 17] and [4] for physiological analysis of these interfaces) have been studied. With such an interface, the user normally holds two input devices (e.g., a trackball and a mouse), and controls two positions on the screen. For example, the user of ToolGlasses [1] controls the tool-palette location with his/her non-dominant hand, while the cursor position is controlled by the user's dominant hand. Some bimanual systems [5, 17] provide higher-degree-of-freedom control by using motion- or rotation-sensitive input devices. With the SmartSkin sensor, the user can also control more than two points at the same time, and the shape of the arm or hand can be used as input. This is another approach to achieving higher-degree-of-freedom manipulation.

In contrast to two-handed interfaces, interaction techniques that are based on the use of multiple fingers have not been well explored. DualTouch [12] uses a normal touch panel to detect the position of tow fingers. Its resistive touch panel gives the middle position between two fingers when two positions are pressed, and assuming that the position of one finger is known (i.e., fixed to the initial position), the position of the other finger can be calculated. DualTouch can perform various interaction techniques such as "tapping and dragging", but due to this assumption of the initial position, most multiple-finger interfaces described in this paper are not possible.

CONCLUSION AND DIRECTIONS FOR FUTURE WORK

Our new sensing architecture can turn a wide variety of physical surfaces into interactive surfaces. It can track the position and shape of hands and fingers, as well as measure their distance from the surface. We have developed two working interactive surface systems based on this technology: a table and a tablet, and have studied various interaction techniques for them.

This work is still at an early stage and may develop in several directions. For example, interaction using multiple fingers and shapes is a very new area of human-computer interaction, and the interaction techniques described in this paper are just a few examples. More research is needed, in particular, focusing on careful usability evaluation.

Apart from investigating different types of interaction techniques, we are also interested in the following research directions.

Using a non-flat surface as an interaction medium: Places of interaction are not limited to a tabletop. Armrests or table edges, for example, can be good places for interaction, but have not been studied well as places for input devices. Placing SmartSkin sensors on the surface of 'pet' robots, such as Sony's AIBO, is another possibility. The robot would behave more naturally when interacting with humans. Similarly, if a game pad were "aware" of how the user grasps it, the game software could infer the user's emotions from this information.

Combination with tactile feedback: Currently, a SmartSkin user can receive only visual feedback, but if SmartSkin could make the surface vibrate by using a transducer or a piezo actuator, the user could "feel" as if he/she were manipulating a real object (the combination of a touch panel and tactile feedback is also described by Fukumoto [3]). [1]

Use of transparent electrodes: A transparent SmartSkin sensor can be obtained by using Indium-Tin Oxide (ITO) or a conductive polymer. This sensor can be mounted in front of a flat panel display or on a rear-projection screen. Because most of today's flat panel displays rely on active-matrix and transparent electrodes, they can be integrated with SmartSkin electrodes. This possibility suggests that in the future, display devices that will be interactive from the beginning, and will not require "retrofitting" sensor elements into them.

We also want to make transparent tagged objects by combining transparent conductive materials with the use of capacitance tags as shown in Figure 15. This technology will enable creating interface systems such as "DataTiles" [18], a user can interact with the computer via the use of tagged physical objects and hand gestures.

Data communication between the sensor surface and other objects: Because the SmartSkin sensor uses a wave signal controlled by software, it is possible to encode this signal with data. For example, location information can be transmitted from a SmartSkin table, and a digital device such as a PDA or a cellular phone on the table can recognize this information and trigger various context-aware applications. The table could also encode and transmit a "secret key" to mobile devices on the table, and these devices can establish a secure network with this key.

ACKNOWLEDGEMENTS

We thank our colleagues at Sony Computer Science Laboratories for the initial exploration of ideas described in this paper. We also thank Shigeru Tajima for the valuable technical advice, Takaaki Ishizawa and Asako Toda for their contribution to the implementation of the prototype system. We also would like to thank Toshi Doi and Mario Tokoro for their continuing support of our research.

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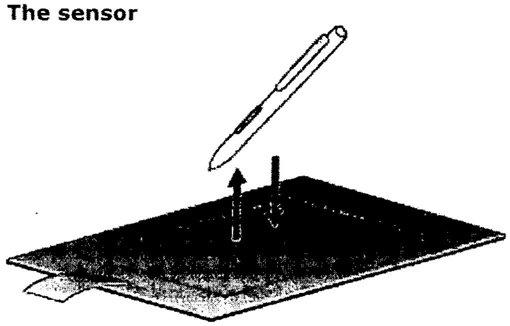
Technology

WACOM patented its EMR (Electro-Magnetic Resonance) send and position sensing technology over 14 years ago. We also call it the Electro-Magnetic Send and Receive method, as we will explain below. WACOM has recently invested in re-branding it's EMR Send and Receive method and renamed it Penabled®. Penabled® by WACOM is the new technology brand for our novel EMR technology, and it is identical in terms of the core technology we have being using over the last decade and a half.

How it's made
A component-less printed circuit board where the copper tracks provide a multitude of over-lapping antenna coils in both the x and y directions. The p.c.b. is manufactured from glass epoxy or PET film. Underneath the sensor is a magnetic reflector used to enhance and shield the magnetic field. The sensor is placed underneath and penetrates the display. Hence there is no transmission loss of the display, and also since the sensor is embedded behind the display it is not prone to damage.

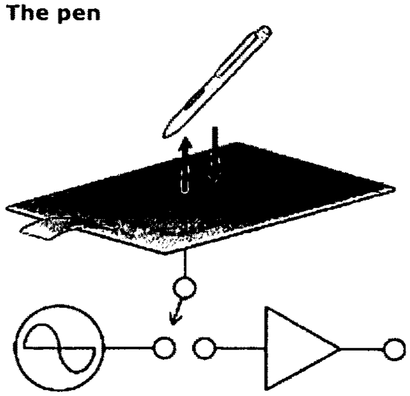
How it works

The sensor



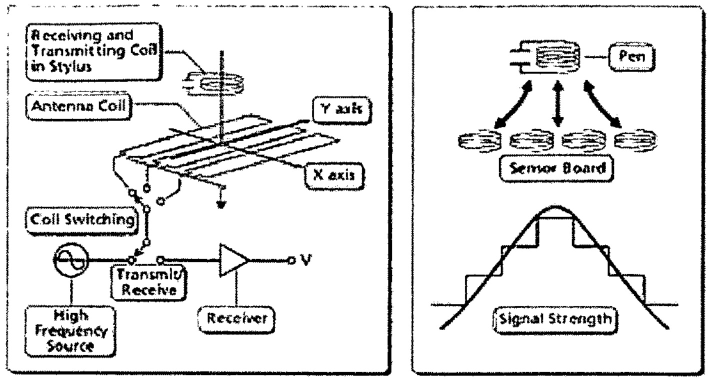
Each antenna coil is energized in turn. This generates a close coupled field in the h-domain at a very low energy level (< -25dbuA) and resonant frequency.

The pen



This energy couples with a tank circuit which is located in the pen. The pen is battery-less. It is the simplest type of EMR pen, and contains just an inductor & capacitor in its simplest embodiment. The inductance and capacitance values of the tank circuit are selected to match the resonant frequency of the antenna coil.

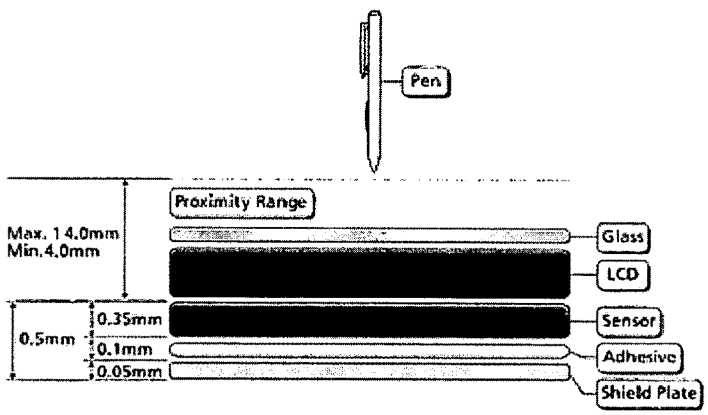
Getting the position



The coupled energy resonates with the tank circuit and reflects back towards the sensor board by forming a shaped h-domain field at the tip of the pen.

As this happens the same antenna coil is switched to receive this reflected energy and provide an analogue signal. This process is repeated in rapid succession with all antenna coils.

All of this analogue data is then collected and converted into digital signals that can be post-processed to give x, y and z position information.

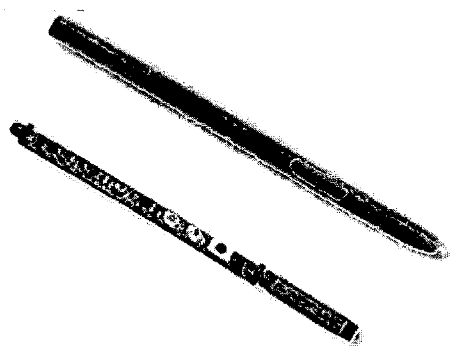


The pen has to be a maximum of 14mm from the sensor surface for it to be acquired. The sensor can track the pen in 3 dimensions as it hovers above it. The sensor only detects a "pen down" signal when pressure is applied to the pen tip.

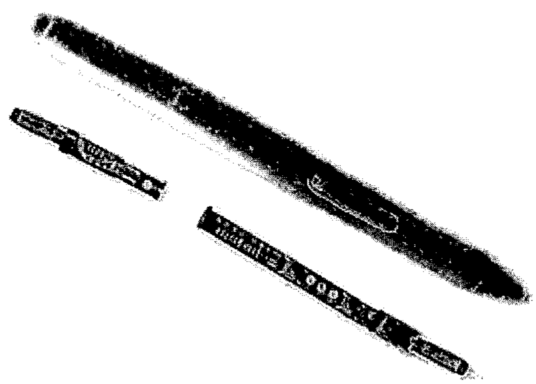
Additional data

Pressure

Depending on the technology in the pen we can also provide varying levels of pressure up to 1024. There are two main systems we employ. One uses a change in the phase angle part of the inductance at the pen tip. The other uses the same philosophy but on the capacitance part.



The MP-200-00 or "Slim Pen" above, uses inductive change and gives up to 256 levels of pressure. By using this method the pen diameter can be as thin as 5 mm.

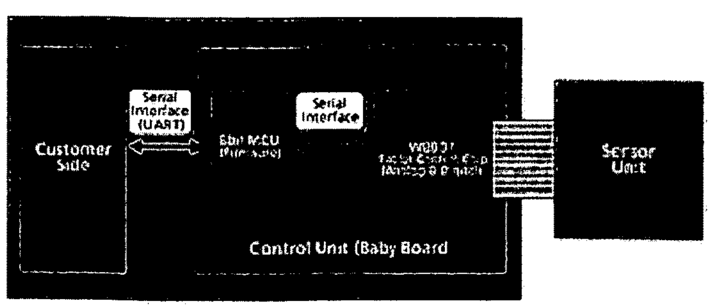


The UP-813E uses capacitive change by virtue of another proprietary WACOM component, the "C-Switch". This allows up to 1024 levels of pressure.

Other functions
Also by having a switch in the pen to alter slightly the resonance frequency, you can detect additional tools such as a side-switch or eraser.

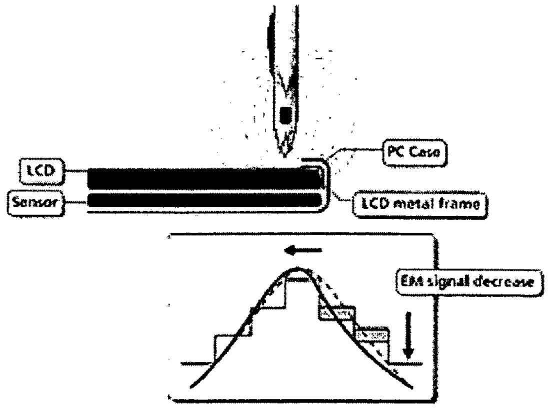
Another unique feature of our EMR technology is the ability to detect pen tilt up to 50 degrees in any direction.

Wher does the data go?

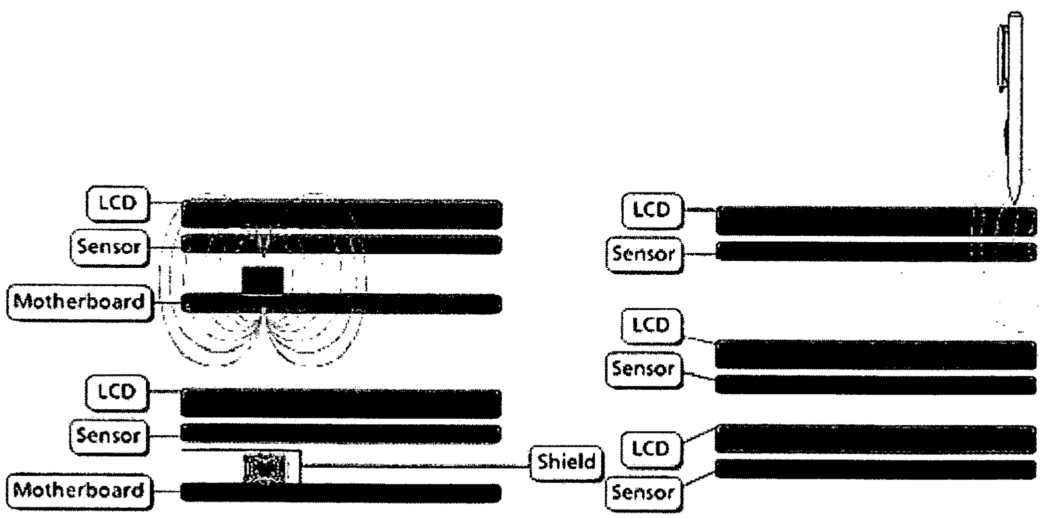


Once the raw data is gathered from the sensor board, by our custom W8001 ASIC it is relayed to a low cost standard 8-bit MCU by a synchronous serial interface. Calculations are then performed using complex algorithms developed by us over many years. A significant amount of these algorithms are based on our undisclosed proprietary know-how. These calculations transform the raw data into x, y, z, pressure, and tilt data.

We also perform error correction calculations to counteract distortions in the electromagnetic field caused by external influences.



Distortions can occur especially at the edge of the sensor when combined with an LCD, because many LCD's have metal frames around them.



Also inductive components, such as switching transformers used in backlights and DC-DC convertors.

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This corrected data is then transferred to the host microprocessor through either an asynchronous serial interface (e.g. UART) or a synchronous serial interface (e.g. SSI, SPI, I2C). This data can then be read by the pen driver resident in the host OS.

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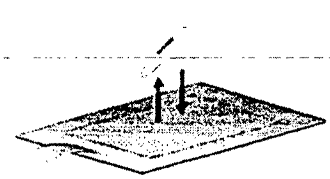

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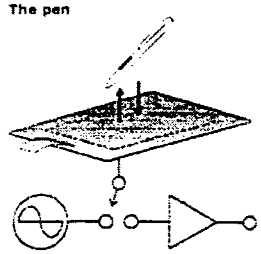

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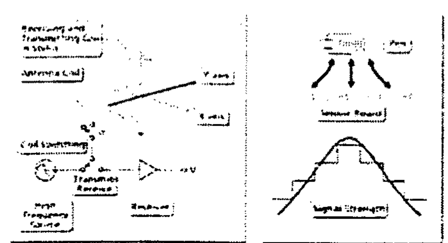

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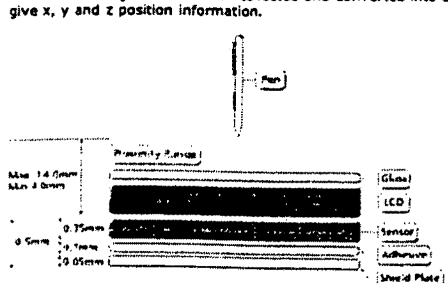

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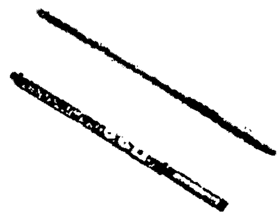

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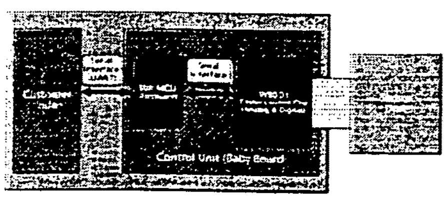

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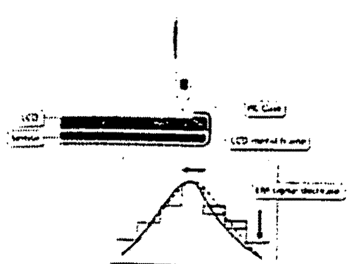

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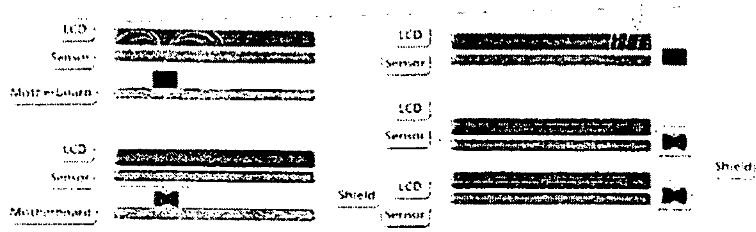

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We offer touchscreen products with several of the most widely used touchscreen technologies. Each type of screen has unique characteristics that can make it a better choice for certain applications. Follow the links below for information on the different touch technologies that we offer and recommend. Please contact us if you have any questions or would like assistance selecting a touch technology for your application.

4-Wire Resistive Touchscreens
4-Wire Resistive touchscreen technology is used in the touch add-ons that we offer for PC monitors and notebooks. It is a reliable and affordable technology that is widely used by individuals and in less demanding workplace applications. It is pressure sensitive so it responds to any input device, including finger, gloved hand, or pen stylus. Follow this link for more information.

5-Wire Resistive Touchscreens
We offer 5-Wire Resistive touchscreen technology with the CRT and LCD touch monitors that we offer. It is a durable and accurate technology that is widely used in demanding workplace applications such as point-of-sale systems, industrial controls, and medical systems. It is pressure sensitive so it responds to any input device, including finger, gloved hand, or pen stylus. Follow this link for more information.

Capacitive Touchscreens
We offer Capacitive touchscreen technology with the CRT and LCD touch monitors that we offer. It is a durable technology that is used in a wide range of applications including point-of-sale systems, industrial controls, and public information kiosks. It has a higher clarity than Resistive technology, but it only responds to finger contact and will not work with a gloved hand or pen stylus. Follow this link for more information.

PenTouch Capacitive Touchscreens
We offer PenTouch Capacitive touchscreen technology with the CRT and LCD touch monitors that we offer. This screen combines durable Capacitive technology with a tethered pen stylus. The screen can be set to respond to finger input only, pen input only, or both. The pen stylus is a good choice for signature capture, on-screen annotations, or for applications requiring precise input. Follow this link for more information.

Surface Acoustic Wave Touchscreens
We offer Surface Acoustice Wave touchscreen technology with the CRT and LCD touch monitors that we offer. It is a very durable screen that is widely used in applications such as computer based training and information kiosk displays. The SAW screen is a good choice for applications where image clarity is important, but it may not perform well in extremely dirty or dusty environments. Responds to finger or soft rubber tipped stylus. Follow this link for more information.

Near Field Imaging Touchscreens

We offer Near Field Imaging touchscreen technology as one of the custom LCD touch monitor solutions that we can provide. It is an extremely durable screen that is suited for use in industrial control systems and other harsh environments. The NFI type screen is not affected by most surface contaminants or scratches. Responds to finger or gloved hand. Follow this link for more information.

Infrared Touchscreens
We offer Infrared touchscreen technology with the Plasma display solutions that we offer. This is the only type of touch technology that we have available for large displays such as 42-inch Plasma screens. It is a durable technology that offers high image clarity. Responds to any input device or stylus. Follow this link for more information.

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Comfortable to operate.

Simple to understand.

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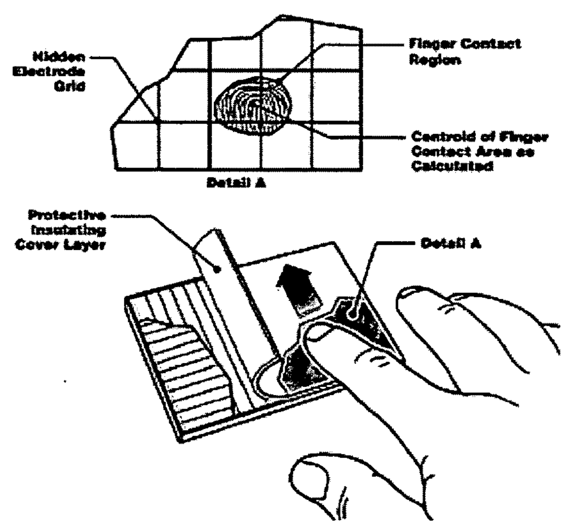
Requires no maintenance.



Cirque's original GlidePoint technology can be found in laptops, keyboards, PDAs and countless more computing devices all over the world. It provides complete navigation control of any graphical interface, packed in a space-saving, low-friction, extremely durable touchpad.

Based upon a mutual balanced capacitance design, the touchpad is mounted onto a Printed Circuit Board (PCB) where the user's finger glides. Below the electrically-insulating surface lies a sophisticated sensor system which responds to the most precise finger movements. This allows for a wide range of capacitance while providing the ability to detect small imbalances.

GlidePoint sensor dimensions can vary greatly. At any size, it will maintain excellent resolution and tracking capability, providing unparalleled flexibility in product designs. Additionally, GlidePoint technology can detect grounded and ungrounded objects, and distinguish between the two types because of the balanced capacitive method. This eliminates interference between the user and the interface.

About GlideSensor™

A variation on GlidePoint technology, GlideSensor products typically consist of a thin, polyester or plastic flexible printed sensor array and a separate rigid PCB controller assembly (see product example). This unique two-part design allows it to be readily integrated into a variety of OEM products, particularly those that require isolation from harsh environments (such as marine applications, public kiosks, phones).

GlideSensor is not limited to flat, solid-surface use; it can be mounted onto screens and contours, and can even sense through irregular surfaces and wide gaps. Plus, it can be mounted

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Cirque's Sales Team guide you through tl of touch input.

Custom Options.
Take advantage of o We'll custom-design suit your needs.

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underneath nonconductive surfaces, eliminating the need for a bezel opening and providing a completely sealed interface system.

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Capacitive Position Sensing

Synaptics is a world leader in capacitive touch sensing technology. This technology is at the industry-standard TouchPad products. Since the introduction of the TouchPad, we have exp technology in a variety of directions including pen sensors, force sensors, and flexible touch

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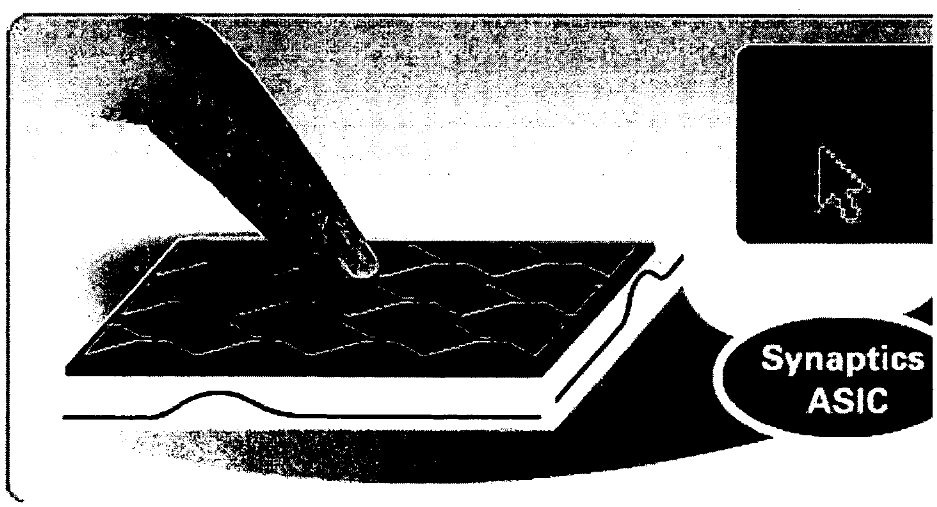
How the TouchPad Works

Synaptics TouchPad devices work by sensing an electrical property called capacitance. Wh electrically conductive objects come near to each other without touching, their electric fields form capacitance. The surface of a TouchPad sensor is an array of conductive metal electrc by a protective insulating layer. The human finger is also an electrical conductor, and when finger on a TouchPad, a tiny capacitance forms between your finger and the metal electrode TouchPad. The insulating layer protects the TouchPad sensor from wear by preventing you actually touching the sensor, and is textured to help your finger move smoothly across the s



The TouchPad sensor's sensitive analog electronics measure the amount of capacitance in electrodes. By sensing when the capacitance increases, the TouchPad can tell when your fi touching. By measuring which electrodes have the most capacitance, the TouchPad can als finger to an accuracy of better than 1/1000th of an inch. The capacitive sensing ASIC chip ir proprietary microprocessor that computes the finger's position and speed and reports them computer in the form of cursor motion.

On a PC, the TouchPad can work with any mouse driver, but it works best with the Synaptic driver. When used with the Synaptics driver, the TouchPad reports not just the mouse-like n finger, but also the absolute position of the finger on the TouchPad surface as well as the ar pressure. The driver uses this extra information to enhance the user interface in a variety of example, if the finger moves up and down along the right-hand edge of the pad, the driver a patented Virtual Scrolling feature.

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In addition, a general purpose TouchPad Application Programming Interface (API) is availat Customer Support-Developer's Support section of the web site, which allows adaptation of c into other products. The underlying capacitive technology in the TouchPad can be develope variety of devices, such as cell phones, MP3 players, PDAs, touchscreens, and remote cont Synaptics capacitive sensing technology has been used to provide 2D cursor control, 1D sc functionality, and replace electrical switches in many types of electronic devices.

Synaptics' capacitive sensing technology has numerous advantages over competing techno membrane switches and resistive sensors. Its solid-state construction makes it extraordinari because our capacitive sensor is so versatile, it can be made extremely thin, lightweight, fle: transparent. The proprietary microprocessor makes it possible to build custom capacitive so special applications.

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Transparent Capacitive Position Sensing

The versatility of Synaptics' transparent capacitive sensing technology makes it suitable for applications, including PCs, cell phones, and touch screens, which require transparent, and even flexible sensors.

Synaptics' transparent capacitive sensors provide all the functionality and performance of S TouchPad devices for both small and large touch screen applications. Compared to resistiv screens, Synaptics capacitive sensors offer superior durability and higher light transmissivit stays brighter and clearer, while consuming less power.

Our transparent capacitive position sensing technology operates in a manner very similar to capacitive sensing technology. To capacitively locate a finger, sense wires are formed usin conductors. Most commonly, indium tin oxide (ITO) is used, and can be placed over polyest polycarbonate, glass or any viewable surface.

Our two-dimensional transparent capacitive position sensing technology utilizes a grid of the accurately locate the X, Y and "pressure" of a finger on a sensor. Typically, ITO-coated PET form arrays of wires. This provides a strong, simple, and flexible sensor that can be placed i display. (Figure 1)

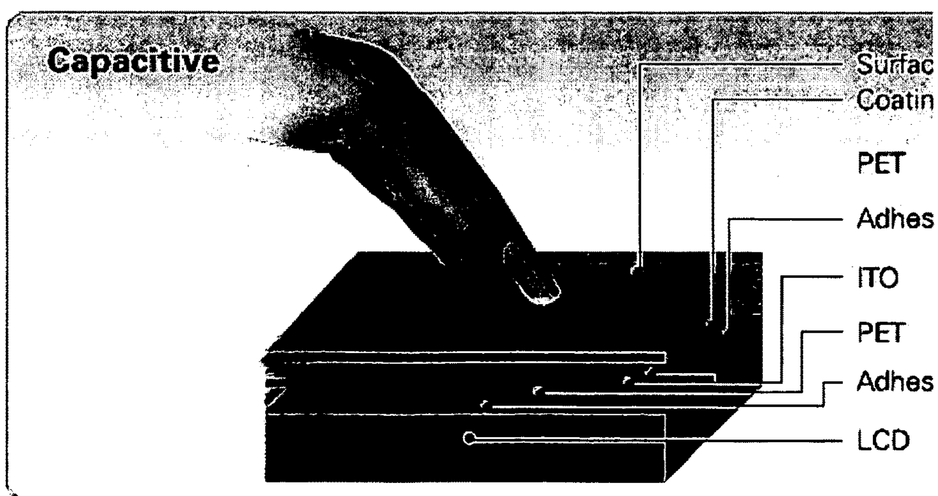

Figure 1

The most common alternative to transparent capacitive sensing is resistive technology. In a resistive touch screen, two layers of ITO-coated PET are separated by an air gap. When the pressed, the top layer bends to make contact with the bottom layer (Figure 2). The point of c calculated by placing a voltage gradient across the top ITO layer, and then measuring the v bottom layer.

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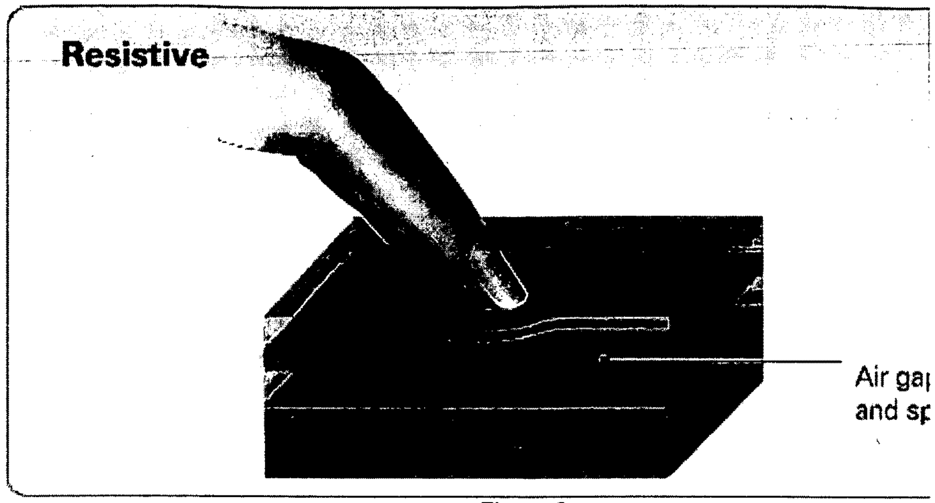

Figure 2

Advantages of Synaptics' Transparent Capacitive Position Sensing Technology

Synaptics' capacitive solution offers several fundamental technical advantages. Capacitive s completely solid state, with no moving parts---this contributes to its high reliability and durab contrast, resistive screens are physical switches that must flex and rub in use, decreasing th lifetime.

Because capacitance can be sensed through most materials, designers are not limited to pli materials as required by resistive sensing technology. Capacitive sensing operates even wh is placed underneath a durable surface, such as polycarbonate or acrylic. In this situation, th sensor has the environmental durability of its rigid overlay, allowing it to function in environm other technologies fail.

Synaptics' transparent capacitive sensors are optically simpler than resistive touch screens. index-matched adhesives, and the lack of an air gap and spacer dots, provide for fewer inte reflections. Absorption of light is also minimized, since very thin conductive layers are used. the physical stack-up of a resistive panel requires the use of an air gap, and steps must be t minimize the loss of light as it passes through layers with differing refractive indices.

Lastly, unlike resistive sensors, Synaptics' capacitive sensors don't need to maintain a critic between the sensor layers. Flexing or deforming a resistive sensor can affect the spacing be in contrast, Synaptics sensors can be attached to curved surfaces without loss of functionali these differences, the Synaptics technology allows designers to add inexpensive and simple sensing in applications that other technologies cannot approach.

 Legal Careers Sitemap

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How do touchscreen monitors know where you're touching?

Touchscreen monitors have become more and more commonplace as their
steadily dropped over the past decade. There are three basic systems that a
recognize a person's touch:

- Resistive
- Capacitive
- Surface acoustic wave

The **resistive system** consists of a normal glass panel that is covered with a
and a resistive **metallic** layer. These two layers are held apart by spacers, a
resistant layer is placed on top of the whole setup. An electrical current runs
two layers while the monitor is operational. When a user touches the screen,
layers make contact in that exact spot. The change in the electrical field is no
coordinates of the point of contact are calculated by the computer. Once the
are known, a special driver translates the touch into something that the oper
can understand, much as a computer mouse driver translates a mouse's mo
click or a drag.

In the **capacitive system**, a layer that **stores electrical charge** is placed or
panel of the monitor. When a user touches the monitor with his or her finger,
charge is transferred to the user, so the charge on the capacitive layer decre
decrease is measured in **circuits** located at each corner of the monitor. The
calculates, from the relative differences in charge at each corner, exactly wh
event took place and then relays that information to the touchscreen driver s
advantage that the capacitive system has over the resistive system is that it
almost 90 percent of the light from the monitor, whereas the resistive system
transmits about 75 percent. This gives the capacitive system a much clearer

the resistive system.

On the monitor of a **surface acoustic wave system**, two **transducers** (one
one sending) are placed along the x and y axes of the monitor's glass plate.
on the glass are **reflectors** -- they reflect an electrical signal sent from one t
the other. The receiving transducer is able to tell if the wave has been disturl
event at any instant, and can locate it accordingly. The wave setup has no m
on the screen, allowing for 100-percent light throughput and perfect image cl
makes the surface acoustic wave system best for displaying detailed graphic
systems have significant degradation in clarity).

Another area in which the systems differ is in which **stimuli** will register as a
A resistive system registers a touch as long as the two layers make contact,
that it doesn't matter if you touch it with your finger or a rubber ball. A capaci
on the other hand, must have a conductive input, usually your finger, in orde
touch. The surface acoustic wave system works much like the resistive syste
touch with almost any object -- except hard and small objects like a pen tip.

As far as price, the resistive system is the cheapest; its clarity is the lowest o
and its layers can be damaged by sharp objects. The surface acoustic wave
usually the most expensive.

Here are some interesting links:

- Elo Touchsystems
- Touchscreens.com
- Troll Touch Touchscreens
- How PDAs Work
- How Computer Monitors Work

Question Archive

Related Ad Categories

> Resistive Touch Screen
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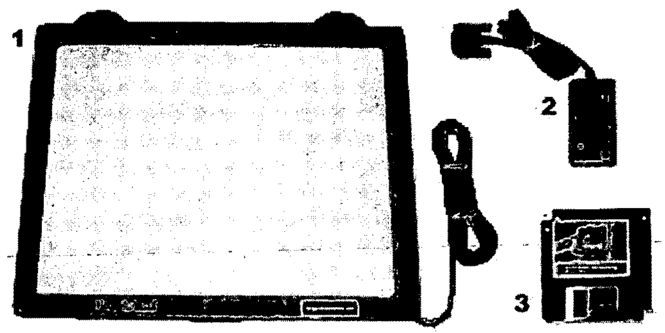
APLNDC00025591

How Does a Touchscreen Work?

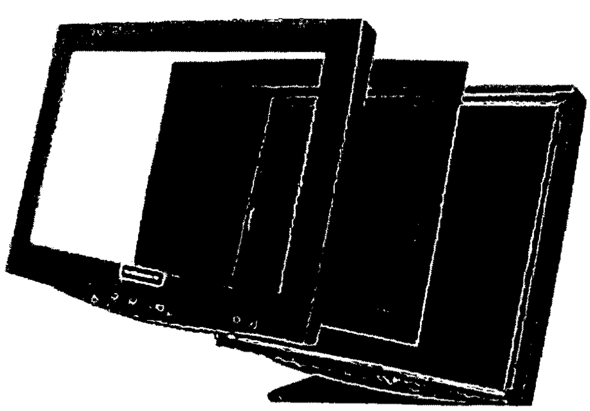
A basic touchscreen has three main components: a touch sensor, a controller, and a software driver. The touchscreen is an input device, so it needs to be combined with a display and a PC or other device to make a complete touch input system.



1. Touch Sensor
A touch screen sensor is a clear glass panel with a touch responsive surface. The touch sensor/panel is placed over a display screen so that the responsive area of the panel covers the viewable area of the video screen. There are several different touch sensor technologies on the market today, each using a different method to detect touch input. The sensor generally has an electrical current or signal going through it and touching the screen causes a voltage or signal change. This voltage change is used to determine the location of the touch to the screen.

2. Controller
The controller is a small PC card that connects between the touch sensor and the PC. It takes information from the touch sensor and translates it into information that PC can understand. The controller is usually installed inside the monitor for integrated monitors or it is housed in a plastic case for external touch add-ons/overlays. The controller determines what type of interface/connection you will need on the PC. Integrated touch monitors will have an extra cable connection on the back for the touchscreen. Controllers are available that can connect to a Serial/COM port (PC) or to a USB port (PC or Macintosh). Specialized controllers are also available that work with DVD players and other devices.

3. Software Driver
The driver is a software update for the PC system that allows the touchscreen and computer to work together. It tells the computer's operating system how to interpret the touch event information that is sent from the controller. Most touch screen drivers today are a mouse-emulation type driver. This makes touching the screen the same as clicking your mouse at the same location on the screen. This allows the touchscreen to work with existing software and allows new applications to be developed without the need for touchscreen specific programming. Some equipment such as thin client terminals, DVD players, and specialized computer systems either do not use software drivers or they have their own built-in touch screen driver.



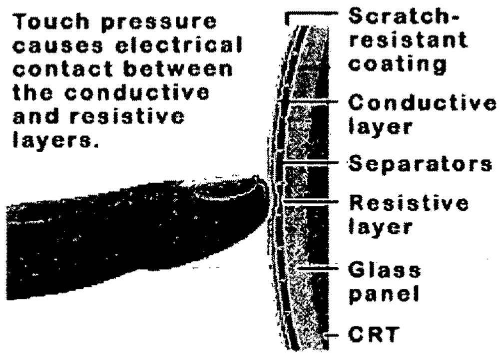
Touchscreens Add-ons and Integrated Touchscreen Monitors

We offer two main types of touchscreen products, touchscreen add-ons and integrated touchscreen monitors. Touchscreen add-ons are touchscreen panels that hang over an existing computer monitor. Integrated touchscreen monitors are computer displays that have the touchscreen built-in. Both product types work in the same way, basically as an input device like a mouse or trackpad.

Touchscreens As Input Device

All of the touchscreens that we offer basically work like a mouse. Once the software driver for the touchscreen is installed, the touchscreen emulates mouse functions. Touching the screen is basically the same as clicking your mouse at the same point at the screen. When you touch the touchscreen, the mouse cursor will move to that point and make a mouse click. You can tap the screen twice to perform a double-click, and you can also drag your finger across the touchscreen to perform drag-and-drops. The touchscreens will normally emulate left mouse clicks. Through software, you can also switch the touchscreen to perform right mouse clicks instead.

4-Wire Resistive Touchscreens



4-Wire Resistive touch technology consists of a glass or acrylic panel that is coated with electrically condictive and resistive layers. The thin layers are separated by invisible separator dots. When operating, an electrical current moves through the screen. When pressure is applied to the screen the layers are pressed together, causing a change in the electrical current and a touch event to be registered.

4-Wire Resistive type touch screens are generally the most affordable. Although clarity is less than with other touch screen types, resistive screens are very durable and can be used in a variety of environments. This type of screen is recommended for individual, home, school, or office use, or less demanding point-of-sale systems, restaurant systems, etc.

Advantages

- High touch resolution
- Pressure sensitive, works with any stylus
- Not affected by dirt, dust, water, or light
- Affordable touchscreen technology

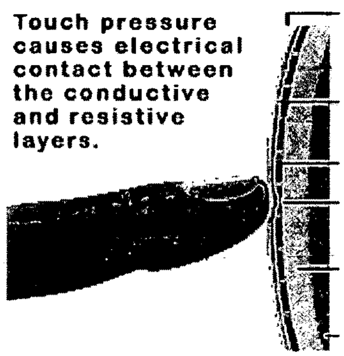
Disadvantages

- 75 % clarity
- Resistive layers can be damaged by a sharp object
- Less durable then 5-Wire Resistive technology

Touchscreen Specifications

Touch Type:	4-Wire Resistive
Screen Sizes:	12"-20" Diagonal
Cable Interface:	PC Serial/COM Port or USB Port
Touch Resolution:	1024 x 1024
Response Time:	10 ms. maximum
Activation Force:	50-120 grams per square centimer
Positional Accuracy:	3mm maximum error
Light Transmission:	80% nominal
Light Transmission:	80% nominal
Scratch Resistance:	3H pencil hardness
Life Expectancy:	3 million touches at one point
Temperature:	Operating: -10°C to 70°C Storage: -30°C to 85°C
Humidity:	Pass 40 degrees C, 95% RH for 96 hours.
Chemical Resistance:	Alcohol, acetone, grease, and general household detergent
Software Drivers:	Windows XP / 2000 / NT / ME / 98 / 95, Linux, Macintosh OS

5-Wire Resistive Touchscreens



5-Wire Resistive touch technology consists of a glass or acrylic panel that is coated with electrically condictive and resistive layers. The thin layers are separated by invisible separator dots. When operating, an electrical current moves through the screen. When pressure is applied to the screen the layers are pressed together, causing a change in the electrical current and a touch event to be registered.

5-Wire Resistive type touch screens are generally more durable than the similiar 4-Wire Resistive type. Although clarity is less than with other touch screen types, resistive screens are very durable and can be used in a variety of environments. This type of screen is recommended for demanding point-of-sale systems, restaurant systems, industrial controls, and other workplace applications.

Advantages

- High touch resolution
- Pressure sensitive, works with any stylus
- Not affected by dirt, dust, water, or light
- More durable then 4-Wire Resistive technology

Disadvantages

- 75 % clarity
- Resistive layers can be damaged by a sharp object

Touchscreen Specifications

Touch Type:	Elo AccuTouch 5-Wire Resistive
Cable Interface:	PC Serial/COM Port or USB Port
Touch Resolution:	4096 x 4096
Response Time:	21 ms. at 9600 baud
Light Transmission:	80% +/-5% at 550 nm wavelength (visible light spectrum)
Expected Life:	35 million touches at one point
Temperature:	Operating: -10°C to 50°C Storage: -40°C to 71°C
Humidity:	Operating: 90% RH at max 35°C Storage: 90% RH at max 35°C for 240
Chemical Resistance:	Acetone, Methylene chloride, Methyl ethyl ketone, Isopropyl alcohol, Hexane, Turpentine, Mineral spirits, Unleaded Gasoline, Diesel Fuel, Motor Oil, Transmission Fluid, Antifreeze, Ammonia based glass cleaner, Laundry Detergents, Cleaners (Formula 409, etc.), Vinegar, Coffee, Tea, Grease, Cooking Oil, Salt
Regulations:	UL, CE, TUV, FCC-B
Software Drivers:	Windows XP, 2000, NT, ME, 98, 95, 3.1, DOS, Macintosh OS, Linux, Unix (3rd Party)

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BEYER WEAVER & THOMAS, LLP

INTELLECTUAL PROPERTY LAW

590 W. El Camino Real, Mountain View, CA 94040
Telephone: (650) 961-8300 Facsimile: (650) 961-8301
www.beyerlaw.com

FACSIMILE COVER SHEET

November 17, 2005

Receiver: **USPTO**
Art Unit 2673

TEL #:

FAX #: **571-273-8300**

Sender: Quin C. Hoellwarth, Reg. No. 34,239

Re: Petition to Revive an Application Abandoned for Failure to Notify the Office of a Foreign or International Filing
Application No. 10/840,862
Attorney Docket No. APL1P305/P3266

Pages Including Cover Sheet(s): 3

MESSAGE:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Hotelling et al.

Attorney Docket No.: APL1P305/P3266

Application No.: 10/840,862

Examiner: Unassigned

Filed: May 6, 2004

Group: 2673

Title: MULTIPOINT TOUCHSCREEN

Confirmation No. 8470

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being transmitted by facsimile to fax number 571-273-8300 to the U.S. Patent and Trademark Office on November 17, 2005.

Signed: ______________
Agnes Spence

**PETITION TO REVIVE AN APPLICATION ABANDONED FOR FAILURE TO NOTIFY THE OFFICE OF A FOREIGN OR INTERNATIONAL FILING
37 C.F.R. 1.137(f)**

Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

A non-publication request was included with the above-identified application on filing pursuant to 35 U.S.C. 122(b)(2)(B)(iii). However, subsequent to the filing of the above-identified application, an application was filed in another country, or under a multinational international treaty that requires publication of applications eighteen months after filing. The filing date of the subsequently-filed foreign or international application was April 26, 2005.

To the extent required and not already provided, notice of the filing of the foreign or international application pursuant to 35 U.S.C. 122(b)(2)(B)(iii) and 37 C.F.R. 1.213(c) is hereby provided.

Nevertheless, because a non-publication request was included with the above-identified application on filing pursuant to 35 U.S.C. 122(b)(2)(B)(i), the above-identified application may have become abandoned pursuant to 35 U.S.C. 122(b)(2)(B)(iii) for failure to timely notify the

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office of the filing of an application in a foreign country or under a multinational international treaty that requires publication of applications eighteen months after filing. The date of such abandonment would be the day after the expiration date of the forty-five (45) day period set in 35 U.S.C. 122(b)(2)(B)(iii). The entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 CFR 1.137(b) was unintentional.

In view of the foregoing, and pursuant to 37 C.F.R. 137(f), Applicant hereby petitions for revival of this application under 37 C.F.R. 137(b). The Commissioner is hereby authorized to charge the required fees ($1,500.00) to cover the petition fee set forth in 37 C.F.R. 1.17(m) or any additional fees to our Deposit Account No. 500388 (Order No. APL1P305).

Respectfully submitted,
BEYER WEAVER & THOMAS, LLP

Quin C. Hoellwarth
Reg. No. 45,738

P.O. Box 70250
Oakland, CA 94612-0250
(650) 961-8300

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IFW

PTO/SB/96 (11-05)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Steve Hotelling

Application No./Patent No.: 10/840,862 Filed/Issue Date: May 6, 2004

Entitled: MULTIPOINT TOUCHSCREEN

Apple Computer, Inc., a California corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☑ the assignee of the entire right, title, and interest; or
2. ☐ an assignee of less than the entire right, title and interest
(The extent (by percentage) of its ownership interest is ______ %)

in the patent application/patent identified above by virtue of either:

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 015311, Frame 0760, or for which a copy thereof is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at
Reel ______, Frame ______, or for which a copy thereof is attached.

2. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at
Reel ______, Frame ______, or for which a copy thereof is attached.

3. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at
Reel ______, Frame ______, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

☐ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

[signature] 1/3/06
Signature Date

Billy C. Allen III 832 446 2400
Printed or Typed Name Telephone Number

Attorney of Record
Title

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby appoint:

[X] Practitioners associated with the Customer Number: 29855

AND

[X] Practitioners associated with the Customer Number: **34599**

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

The correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) is:

[X] The address associated with Customer Number: 29855

OR

[ ] Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Apple Computer, Inc.
1 Infinite Loop
Cupertino, CA 95014

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature	[signature]	Date	10-12-05
Name	Richard J. Lutton, Jr.	Telephone	(408) 974-9453
Title	Assistant Secretary and Chief Patent Counsel		

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/840,862	05/06/2004	Steve Hotelling	APL1P305/P3266

CONFIRMATION NO. 8470

OC000000017874736

29855
WONG, CABELLO, LUTSCH, RUTHERFORD & BRUCCULERI, P.C.
20333 SH 249
SUITE 600
HOUSTON, TX 77070

Date Mailed: 01/19/2006

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/10/2006.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

L. Lam

LYNN LAM
PTOSS (703) 308-9150

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/840,862	05/06/2004	Steve Hotelling	APL1P305/P3266

CONFIRMATION NO. 8470

OC000000017874718

022434
BEYER WEAVER & THOMAS LLP
P.O. BOX 70250
OAKLAND, CA 94612-0250

Date Mailed: 01/19/2006

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/10/2006.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

L. Lam
LYNN LAM
PTOSS (703) 308-9150

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APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
10/840,862	05/06/2004	Steve Hotelling	APL1P305/P3266

CONFIRMATION NO. 8470

29855
WONG, CABELLO, LUTSCH, RUTHERFORD & BRUCCULERI,
P.C.
20333 SH 249
SUITE 600
HOUSTON, TX 77070

Date Mailed: 01/27/2006

Communication Regarding Rescission Of Nonpublication Request and/or Notice of Foreign Filing

Applicant's rescission of the previously-filed nonpublication request and/or notice of foreign filing is acknowledged. The paper has been reflected in the Patent and Trademark Office's (USPTO's) computer records so that the earliest possible projected publication date can be assigned.

The projected publication date is 05/11/2006.

If applicant rescinded the nonpublication request before or on the date of "foreign filing,"[1] then no notice of foreign filing is required.

If applicant foreign filed the application after filing the above application and before filing the rescission, and the rescission did not also include a notice of foreign filing, then a notice of foreign filing (not merely a rescission) is required to be filed within 45 days of the date of foreign filing. See 35 U.S.C. § 122(b)(2)(B)(iii), and Clarification of the United States Patent and Trademark Office's Interpretation of the Provisions of 35 U.S.C. § 122(b)(2)(B)(ii)-(iv), 1272 Off. Gaz. Pat. Office 22 (July 1, 2003).

If a notice of foreign filing is required and is not filed within 45 days of the date of foreign filing, then the application becomes abandoned pursuant to 35 U.S.C. § 122(b)(2)(B)(iii). In this situation, applicant should either file a petition to revive or notify the Office that the application is abandoned. See 37 CFR 1.137(f). Any such petition to revive will be forwarded to the Office of Petitions for a decision. Note that the filing of the petition will not operate to stay any period of reply that may be running against the application.

Questions regarding petitions to revive should be directed to the Office of Petitions at (571) 272-3282. Questions regarding publications of patent applications should be directed to the patent application publication hotline at (703) 605-4283 or by e-mail pgpub@uspto.gov.

[1] Note, for purpose of this notice, that "foreign filing" means "filing an application directed to the same invention in another country, or under a multilateral international agreement, that requires publication of applications 18 months after filing".

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OFFICE OF PETITIONS

In re Application of	:	
Steve Hotelling et al	:	
Application No. 10/840,862	:	DECISION GRANTING PETITION
Filed: May 6, 2004	:	UNDER 37 CFR 1.137(b)
Attorney Docket No. APL1P305/P3266	:	

This is a decision on the petition, filed November 17, 2005, which is being treated as a petition under 37 CFR 1.137(b) to revive the instant nonprovisional application for failure to timely notify the U.S. Patent and Trademark (USPTO) of the filing of an application in a foreign country, or under a multinational treaty that requires publication of applications eighteen months after filing. *See* 37 CFR 1.137(f).

The petition is **GRANTED**.

Petitioner states that the instant nonprovisional application is the subject of an application filed in an eighteen month publication country on April 26, 2005. However, the USPTO was unintentionally not notified of this filing within 45 days subsequent to the filing of the subject application in an eighteen month publication country.

In view of the above, this application became abandoned pursuant to 35 U.S.C. § 122(b)(2)(B)(iii) and 37 CFR 1.213(c) for failure to timely notify the Office of the filing of an application in a foreign country or under a multilateral international agreement that requires publication of applications 18 months after filing.

A petition to revive an application abandoned pursuant to 35 U.S.C. 122(b)(2)(B)(iii) for failure to notify the USPTO of a foreign filing must be accompanied by:

(1) the required reply which is met by the notification of such filing in a foreign country or under a multinational treaty;
(2) the petition fee as set forth in 37 CFR 1.17(m);

and
(3) a statement that the entire delay in filing the required reply from the due date of the reply until the filing of a grantable petition was unintentional.

The instant petition has been found to be in compliance with 37 CFR 1.137(b). Accordingly, the failure to timely notify the USPTO of a foreign or international filing within 45 days after the date of filing of such foreign or international application as provided by 35 U.S.C. § 122(b)(2)(B)(iii) and 37 CFR 1.213(c) is accepted as having been unintentionally delayed.

The previous Request and Certification under 35 U.S.C. § 122(b)(2)(B)(i) has been rescinded. A Notice Regarding Rescission of Nonpublication Request which sets forth the projected publication date of May 11, 2006 was mailed under separate cover on January 27, 2006.

The address on the petition differs from the address of record. Therefore, if appropriate, a change of address and/or appropriate power of attorney documentation should be submitted. A courtesy copy of this decision (as well as a copy of the Notice mailed January 27, 2006) is being mailed to the address on the petition. However, all future correspondence will continue to be mailed to the above address of record, unless otherwise appropriately notified.

Any inquiries concerning this decision may be directed to the undersigned at (571) 272-3218.

This application is being forwarded to Technology Center Art Unit 2674 for examination in due course.

Frances Hicks
Frances Hicks
Petitions Examiner
Office of Petitions

ATTACHMENT TO CC: Copy of Notice mailed 1/27/06

cc:

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Date: Monday, February 06, 2006

To USPTO - Examiner: Edouard Patrick Nestor Art Unit: 2673

Fax: 571/273-8300

From: Billy C. Allen III Customer No: 29855

Atty. Docket #: 119-0093US Serial No.: 10/840,862

Re: *Please see the attached*

Pages (including cover page): 2

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1. Change of Correspondence Address (1 page).

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