

The N-trig Approach to Multi-Touch: DuoSense™

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Overview

*“When you make it so that it's just visual — **touch and visual** — you're drawing on what humans are incredibly good at, You know, what people have been practicing their entire lives...”*

(Bill Gates, MSNBC, May 2007)

Multi-touch technology is the ability to manipulate objects and data on your computer screen, using your fingers. Multi-touch allows you to use two or more fingers simultaneously, to perform various actions, and use your screen much as you would utilize the top of your physical workspace; moving or rotating documents and other work paraphernalia on your desk, so you can now perform similar, and more useful, feats using multi-touch technology.

Touch: The Technological Context

Several types of touch technology exist in today's world, of which the two most prominent in mobile devices are resistive and capacitive.

What is Resistive Touch?

Resistive touch technology is when the pressure of touch on an electrically charged (switched on) screen presses its layers together, causing an electrical current to move through the screen, and a touch command to be registered. While resistive touch screens are very durable and can withstand the harshest of environments, the negative qualities far outweigh the positive for mobile computing applications. Resistive technology has no way of distinguishing between intentional and accidental touch; an example of which is the palm of one's hand.

What is Capacitive Touch?

Capacitive touch is the idea of using a surface or screen-overlay where the capacitive coupling or capacitive properties can be accurately measured in terms of size and position. In this way, the human touch or multiple touch points may be detected since the human hand has some inherent capacitive properties. Therefore, capacitive touch technology manifests itself when little to no-pressure touch is performed on a screen consisting of a glass panel with a capacitive (charge storing) material coating its surface. Circuits located at corners of the screen measure the

capacitance of the touch. Frequency and other changes are measured to determine the X and Y coordinates of the touch command.

Capacitive touch screens, (digitizers), are very durable, have high clarity, and are suitable for a wide range of functionality. The DuoSense™ digitizer can be easily integrated into a variety of computer applications, functionalities and programs. Performance is smooth, the digitizer is thin, and light, and easy to integrate. With high accuracy, seamless performance and above all, the capacity for multi-touch technology, DuoSense is not only a prime example of what capacitive touch should be, but is also the only single device combining pen, touch and multi-touch technology. A digital touch screen, with accurate positioning algorithms, can differentiate and track many touch points that simultaneously touch and manipulate data and objects on the screen and also recognize the size of the contact area for each touch point.

Touch: The Historical Context

Touch technology has existed for several years in the enterprise and consumer marketplace, and was the precursor to multi-touch; so much so, that an era without touch technology seems like a very long time ago. Touch technology is the power behind the bank cash point machines; something that has existed for so long that it is part of the collective consciousness. (Of today's generation of consumers, it is doubtful that more than a scant few can remember life prior to cash point machines, and the convenience they afford.)

Other examples of touch in the wider world of modern technology include hand-held personal organizer devices, an early example of resistive touch and handwriting recognition technology. Point of sale units (often found in restaurants) have also been part of the accepted modern-day landscape for many years, as have finger-operated touch panel mouse pads commonly found in notebook computers. These devices all employ single touch technology: a capability limited to the use of a single finger or pen (stylus device) on a screen that simply cannot recognize any more than this, which severely limits the options of touch for the user.

Note: While the purpose of this paper is not to describe pen and tablet computing in any detail, it is important to clarify that a stylus used as a simple pointing device on resistive screens would not be sufficient for any handwriting recognition, or digital inking programs. An electromagnetic stylus is capable of providing an accurate data stream at a high refresh rate, and is designed to work with the sort of sophisticated hand writing recognition software program that can now be found embedded in leading operating systems.

Multi-touch technology removes these limits. Using multi-touch technology, your screen can recognize and identify the position of two or more pointing devices (such as a finger or a stylus)

at the same time. Multi-touch also provides a wider and more varied set of gestures, than the traditional “point and scribble” movements, characteristic of traditional pointing devices. For example, you can rotate specific items, enlarge or reduce the size, select an application to open up as a result of a previously-configured gesture and so on.

DuoSense embodies the essence of multi-touch in that it recognizes the presence of simultaneous touch points. This is significant in that we do not perform any real-life, everyday activity with one finger; rather we always use a two, or even three fingers: to turn a knob, operate a device, use a remote-control, or read a document. Why should our on-screen manipulation be limited to one finger?

Multi-touch as a “new” technology

New technologies have traditionally always astounded computer users as a hitherto unheard-of, yet phenomenally useful aid to working with a computer. The computer mouse is a prime example of this. First invented in 1965, it took approximately 30 years before it became an essential part of the computing world, with the advent of Windows 95. Several years prior to this, the mouse was considered a “nice to have” technological aspect, but the release of the operating system which defined modern-day computer usage, made mouse technology an essential part of this. The progression that can be seen is one from the aforementioned “nice to have” to “must have.”

Multi-touch changes the whole approach to modern-day mobile living, affording swathes of new possibilities for the interaction between the user and their computer. Multi-touch technology provides a crucial opportunity in which we can allow computer-usage to enrich and extend our technological capabilities much further than ever before, to the benefit of all users.

Technology today

Computers today – both standard desktop PCs or mobile laptops (notebooks), are becoming a more essential and natural part of everyday life for everyone. Wireless (wifi) and 3G technologies now enable online access in nearly every location – from the office, to the home, to any chosen leisure activity – users today are mobile and the demand for capability is rising to meet the demand for accessibility. Multi-touch fits into this paradigm as an aid to bridge the gap between the user and their computer.

With the release of Windows Vista™, computing has achieved new heights of technological advancement. Multi-touch is one of the offerings presented as a “nice to have” option, and the outlook for the future shows that multi-touch is destined to soon become the newest “must have” computing capability.

Multi-Touch Technology

Technologically speaking, multi-touch is the recognition of more than one input device touching a screen simultaneously – the natural progression of not just (single) touch technology, but also of the evolution of the computing necessity.

DuoSense's™ multi-touch technology (the input device, or digitizer) sets a new standard , removing the barrier between people and their computers, putting the “human” back in the interface and revolutionizing the way people interact with computers.

DuoSense is the ultimate and optimal touch experience in the market, and supports all standard dual and multi-touch gestures, including Windows 7 capabilities, plus all standard Microsoft single-touch specifications for Vista and Windows 7

Multi-Touch in the Market Today

Certain essential, if not automatically obvious, basic technological elements must be provided, in order to meet market requirements for a multi-touch solution. DuoSense's multi-touch solution for pen, touch and multi-touch encompasses all of the following:

- **Natural touch:** DuoSense enables a natural and smooth transition between pen, touch and multi-touch. The progression between these methods of input is seamless, displaying indicators when switching between any or all of them. Gestures can be performed smoothly, and the indicators merely confirm that the transition has occurred. In this way, DuoSense is breaking down the barriers between people and their computers, allowing us to use our two most basic extensions – the pen and our fingertips – to do things faster, easier, more efficiently, and more creatively.
- **Thin and light hardware:** in order to provide a market solution that meets the fundamental need answered by a multi-touch solution, the technology must not only boast ease of use, but must also conform to the accepted standards for mobile computer usage, and not hamper the user with unnecessary weight.
- **Recognizing and tracking multiple touch points simultaneously:** Two or more touch points defines multi-touch as a concept. Full multi-touch should be capable of recognizing preferably five or more simultaneous touch points, including both multi-hand, (or multi-user).
- **Palm rejection:** A “hidden” requirement of multi-touch technology is the capability not only to recognize intentional touch on the screen, but the ability to discern between this and unintentional or “false” touch. When writing freely on your screen, the likelihood that the heel or palm of the hand will rest on the screen is very high – just think of how you hold a pen and write on paper. An essential requirement of an effective and efficient multi-touch solution, is the ability to ignore unwanted touch such as this. This goes hand-in-hand with the ability to distinguish between finger touch and stylus touch, as well as multi-finger touch. Knowing what should be displayed is as important as knowing what should not.
- **Pressure sensitive stylus support:** For a full pen, touch and multi-touch solution, such as DuoSense™, the ability to support a pressure sensitive stylus is imperative.

- **No adverse effect on display:** The expectation that nothing should affect the brightness of the display, or other optical properties, is paramount to a successful solution such as DuoSense. Such an obvious anticipation is surprisingly often overlooked, and therefore also falls into the category of the “hidden” requirement.
- **Simple integration:** The ease with which an application is installed, configured and integrated into a system is a mark of its quality.
- **Development flexibility:** Ian LeGrow, Multi-Touch Group Program Manager, Microsoft Corporation said the following: *“Multi-touch enhances on-the-go use and opens up new scenarios for business”*. A good multi-touch application should be easy for independent software vendors to use for development purposes, and the DuoSense solution has the required level of flexibility for this.
- **On-screen touch buttons and modifiers:** On screen function buttons can enhance the user experience even further, by supplementing multi-touch finger and pen input with extra functionality, previously limited to the keyboard.
- **Customization ability:** The ability to customize gestures and the tasks that a gesture will perform expands the usability and usefulness of the product. The DuoSense SDK is available for ISVs wishing to implement and develop innovative multi-touch applications for all operating systems. Each program comprises a set of commonly used commands, shortcuts and special features. By linking these to intuitive multi-touch gestures, the expert as well as novice users, will use these programs in many ways with a multi-touch enabled system.

The core technology of DuoSense allows it to be the forerunner of multi-touch in the market today. From a technological perspective, this is the only device that combines pen, touch and multi-touch in a single device, which has inestimable value for mobile device OEM's, ODM's and users in the marketplace.

Examples of this can be seen in the following table:

Parameter	DuoSense	Alternative Optical Solution
Pen (stylus)	Batteryless, tip pressure sensitivity (256 levels), two configurable buttons, hover, high refresh rate (133hz)	A stick-like object, no pressure function, acts like finger
Touch	High accuracy (sub-pixel), high refresh rate (133 positions per second)	Lower accuracy, false clicks when hovering
ID	Seamless integration with LCD, bezel-free design (glass to the edge)	Optical sensors enlarge the bezel on the Z-axis, causing dead areas on the screen (ID constraint)
Multi-touch	True multi-touch capability, already publicly available	Two-finger capability only
Multi-Touch Gestures and Buttons	Two-finger gestures (zoom, rotate, scroll, double tap) enabled in all operating systems and applications. Unique on-screen button functionality.	None
SDK support for Multi-Touch Gestures and Buttons	Available for ISVs wishing to implement or develop innovative multi-touch applications for all operating systems.	None

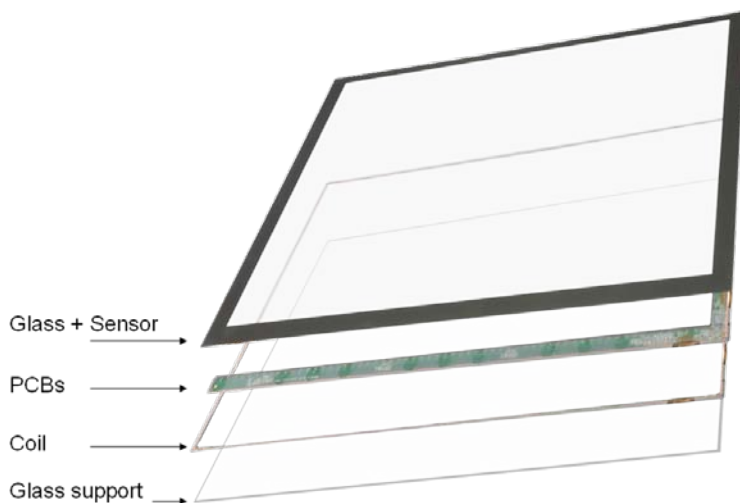
DuoSense Methodology

The basic and essential capabilities of the multi-touch methodology deployed by DuoSense are discussed [here](#).

N-trig's DuoSense digitizer combines the touch, and multi-touch capabilities of an ITO-based capacitive sensor with proprietary electronics and sophisticated signal processing algorithms that simultaneously enable pen input. The overall system design is thin, light, highly transparent, and has low reflectance.

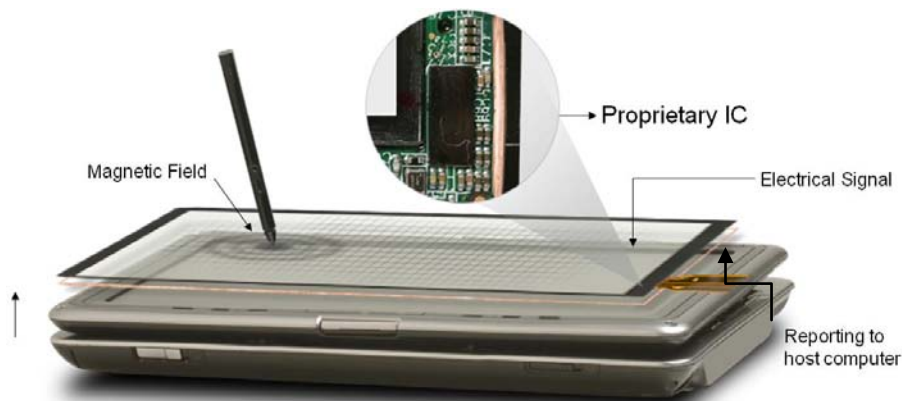
Combining Accuracy, No-Pressure, and Multi-Touch

DuoSense's robust multi-touch technology is highly scalable and can be applied to a wide range of form factors; from small mobile devices to very large display systems. DuoSense's high-touch accuracy of 2.5mm allows users to work with even the smallest icons. The N-Trig capacitive touch digitizer also boasts sub-pixel touch resolution, enabling users to take advantage of various innovative operating system features, for example, the Windows Vista on-screen mouse. With a touch response of 133pps, ultra-rapid cursor movement with fast zero pressure is enabled. Additionally, the ultra-low touch pressure (0 grams - contact only) eliminates accidental drops or skips, and allows convertible and laptop users to enjoy the full power of touch even when their screen is in a vertical position.



Stylus (Pen)

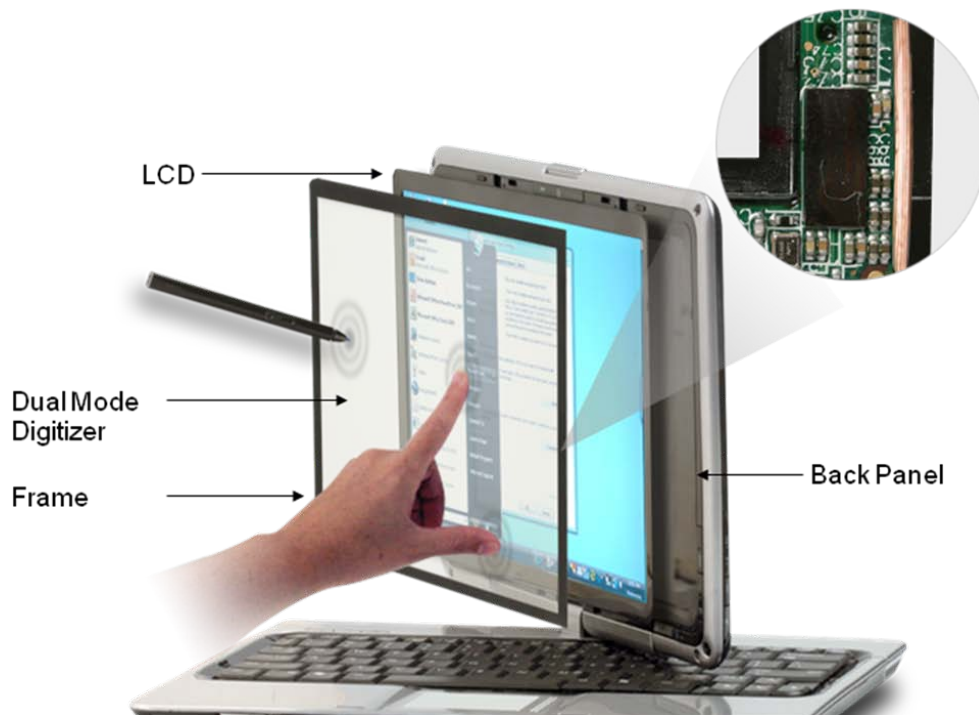
The stylus is an essential part of the DuoSense methodology. The unique electrostatic N-trig stylus is light and ergonomic, and requires no internal power source, making it maintenance-free for end users. The energy source for the N-trig stylus is magnetic energy produced by the excitation coil built into the digitizer itself. The signal from the coil is picked up by the stylus and triggers the stylus to transmit an electric field. The transmitted electric field is sensed by a matrix of conductive lines, accurate stylus position determined using the low amplitude signals received on the vertical and horizontal conductors, and an appropriate signal is transferred to the digitizer's on-board processor.



Sophisticated palm rejection capabilities

In order to facilitate true ease of use for tablet and other touch computing, the DuoSense digitizer can effectively differentiate between intentional contact and inadvertent contact. It boasts the industry's most advanced palm rejection algorithms, including a unique automatic area detection and sensitivity level feature that takes into account differing writing and handling styles.

N-trig's technology has multi-touch capabilities that offer manufacturers a technological edge to their products, with an additional level of full on-screen manipulation. DuoSense™ is the only interface device in the market to support user input from both pen and capacitive touch in a single apparatus. It takes the human interface to the next level – creating an environment for multi-finger input interaction in a manner that is far more ergonomically intuitive, spontaneous, feature-rich and efficient than the traditional model of personal computing.



Multi-Touch Gestures and Manipulation

N-trig's multi-touch input capabilities include a set of four built-in, naturally intuitive movements or “gestures” that furthers the agenda of removing the barrier between user and machine. They will set the industry benchmark for introducing multi-touch functionality into the mobile computing world.

Note: For all gestures, you can also set the required level of sensitivity response for the gesture.

The Scroll Gesture

Scroll up and down through a document or move from page to page by panning across the screen. This unique, multi-directional scrolling function is accomplished by moving two adjacent fingers up and down or left and right, for easy and accurate access of the data and objects you are looking for.



Note: You can invert the scroll direction in the Control Panel, in the Multi-Touch Gestures tab, by selecting the **Invert Selection** checkbox.

The Zoom Gesture

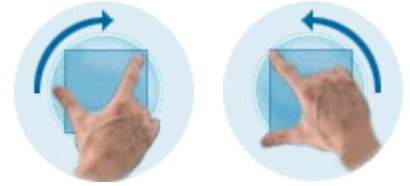
A simple thumb and forefinger “pinch” movement that enables a user to enlarge objects onscreen (moving fingers away from each other) or make them smaller (move them towards each other). This intuitive zooming function replaces the standard point-and-click functionality of a mouse and provides far greater



accuracy to the user. Moreover, it empowers software developers with the ability to implement object and text enlargement/reduction in virtually any standard software application.

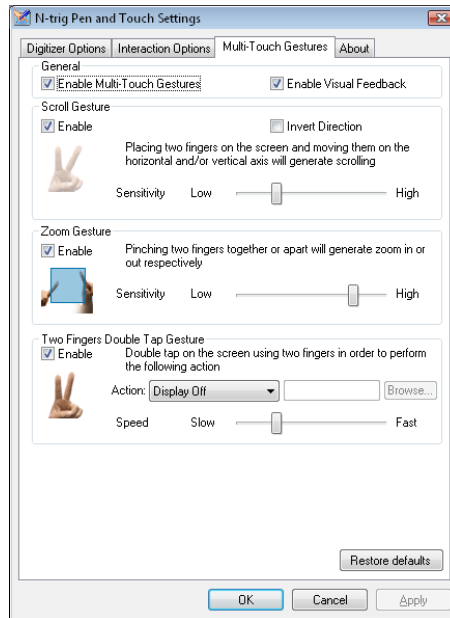
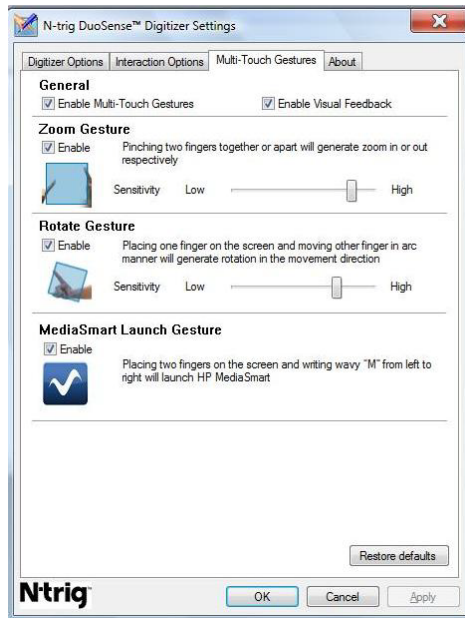
The Rotate Gesture

Rotate objects onscreen by making simple clockwise (right) or counterclockwise (left) movements with the anchored thumb and forefinger. This multi-touch function enables swift and accurate positioning of objects without needing to point and click repeatedly on a rotate left-right function button in order to achieve the desired effect.



Two-Fingered Double-Tap Gesture

This is a flexible function that can be easily set up to suit a user's needs. By simply tapping the computer screen twice in quick succession with two adjacent fingers, a user can perform any of several pre-determined functions, including turning the touch input, and the display, off.



Hands-on computing: the Natural Progression

Multi-touch is the natural progression of not only touch technology, but also of the computing market as a whole.

The PC has undergone many phases of evolution in recent years, in terms of display technology, and the various communication options that have become an accepted norm in day-to-day computing (wireless, network, Bluetooth and so on).

However, there have been no real, significant enhancements to the UI, or noticeable changes in trends for the PC since the advent of the laptop. Prior to this, the addition of the mouse to the must-have list of computer devices was the only equal computing paradigm shift. This is true – until the advent of multi-touch.

DuoSense's multi-touch technology takes computing a step ahead, enabling the user to expand their horizons, and reach far beyond the standard click and type approach to PC technology. With the options of pen, touch and multi-touch literally at their fingertips, the user is presented with a broad spectrum of innovation, usability and easy computer access.

Glossary

Terminology	Definition
LCD	Liquid Crystal Display
ID	Industrial Design
SDK	Software Developer Kit
ISV	Independent Software Vendor