



MULTI TACTION

Technology Platform for MultiTouch LCDs of Any Size by MultiTouch Ltd.

/// Executive Summary

Human-machine interfaces are increasingly implemented with gesture based multi-touch technology. Multi-touch has become the norm in handheld devices but in large display sizes from 30 to 100 inches there hasn't been an integrated and optimized solution available. Large size brings several challenges compared to handhelds and therefore their foil-based technology cannot be used. Large size also requires the capability to support multiple simultaneous users, so that effective collaborative applications can be developed. To address these needs, MultiTouch Ltd has developed MULTITACTION® technology platform for building large multi-user multi-touch LCD displays of any size.

MULTITACTION literally takes a new angle on multi-touch by working perpendicular to and through the LCD panel and screen surface. MultiTouch's patented Computer Vision Through Screen (CVTS) optical imaging technology allows, not only the tracking of unlimited number of touch points, but also detecting whole hands as well as objects and markers placed on the screen for sophisticated augmented reality applications. MULTITACTION utilizes multiple infrared cameras placed behind the LCD screen, and with the new Matrix Tracking System (MTS) it increases the number of cameras to anywhere between 4 and 100. This allows the development of Integrated Backlight Emitter Camera (IBEC) modules which allow the same thin form factor for the display products by just increasing the amount of modules as the display size increases.

MULTITACTION incorporates several other innovations, including Extensible Hybrid Tracking Engine (EHTE) software which is embedded in the display. Hybrid Tracking aims to mitigate the biggest drawback of optical multi-touch technologies: their susceptibility to external light sources. By alternating very fast between tracking reflections and tracking shadows MULTITACTION can greatly expand the deployment possibilities for large multi-touch displays.

To round things off, MULTITACTION supports all common standards for delivering multi-touch tracking data to the applications that request it through the Multi Format Tracking Output (MFTO) over Ethernet.

In this White Paper the following MULTITACTION benefits are presented and explained:

Benefit 1: MULTITACTION Computer Vision Through Screen works perpendicular to the screen to capture much more information than possible with other touch technologies.

Benefit 2: Smooth edge-to-edge front glass provides robustness and allows flexible integration to interiors. It also allows smooth stacking of multiple units.

Benefit 3: Modularity allows any size LCD to be used from 32" to 100"+ with the same thin depth.

Benefit 4: Matrix Tracking System merges all camera images together at very fast rates transparently to the developer.

Benefit 5: Using Hybrid Tracking, MULTITACTION provides the first optical multi-touch technology immune to external lighting conditions.

Benefit 6: By tracking whole hands instead of points only, MULTITACTION provides the first true multi-user support.

Benefit 7: MULTITACTION provides the most advanced set of capabilities of any interactive display.

Benefit 8: Most existing multi-touch applications and development tools work straight away with MULTITACTION.

MULTITACTION allows the development of any size multi-user multi-touch displays for professional, digital signage and consumer use. MULTITACTION is available for mass production now.

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Taction

Pronounced: \ 'tak-shən\
from Latin: *taction-*, *tactio*
meaning: *touch*

Source: Merriam Webster

/// Why MULTITACTION?

About large multi-touch displays

There are a number of multi-touch capable touch technologies in the market such as capacitive, resistive, infrared frames, surface acoustic wave and FTIR. GP Bullhound listed in their October 2010 report “The Era of Touch Interface is Upon Us” several key attributes for assessing different touch technologies. These include:

- Sensitivity to stylus, fingers and gloves
- Multi-touch support
- High durability
- No need for calibration
- Substrate independence
- Low cost
- Low power consumption
- High levels of clarity and transparency
- Flush (100% flat) surface
- Narrow borders

There has not been a technology available that would meet all these criteria. Especially in the large size LCD (or plasma) multi-touch display market only IR frame based technologies are widely available. These solutions are suboptimal for multiuser multitouch capabilities, as defined by MULTITACTION.

MultiTouch Ltd. has developed optical imaging based multi-touch technologies for many years and commercialized first LCD products already in 2008. So far MultiTouch Cells have been deployed in specialist applications in over 35 countries. These current products use single or dual camera setups and thus offer many of the same benefits to application developers. Their main drawback has been related to rather deep form factor which MULTITACTION is going to solve.

/// MULTITACTION Technology Platform

Overview

MULTITACTION is an innovative way to build an integrated multi-touch LCD display. It is not an add-on device: the display should be designed from the ground up to incorporate MULTITACTION. The front glass and LCD package is tuned to allow the integrated optical imaging system to work effectively through it. Imaging logic and processing power are embedded in the display unit. The illustration below shows the main technologies used in MULTITACTION.



MULTITACTION® technologies

CVTS – Computer Vision Through Screen

IBEC – Integrated Backlight Emitter Camera

MTS – Matrix Tracking System

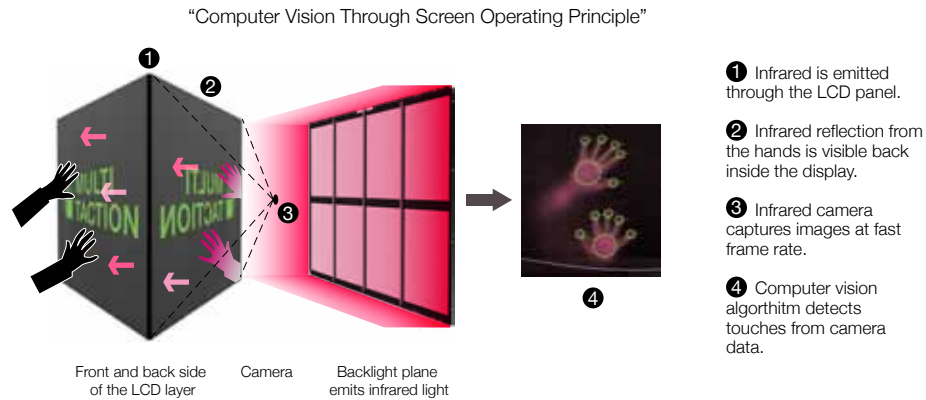
EHTE – Extensible Hybrid Tracking Engine

MFTO – Multi Format Tracking Output

CVTS – Computer Vision Through Screen

Computer Vision Through Screen is the technological principle with which MULTITACTION detects touches. In 2008 MultiTouch commercialized the first ever implementation of rear diffuse infrared (RDI) illumination that worked through the LCD panel. Since then MultiTouch Cell LCDs have been delivered to more than 35 countries and are used by some of the leading brands. Widely used in rear projector based installations RDI is exponentially more difficult to do through an LCD panel because the LCD panel blocks 95-97% of the light passing through. This was overcome with very sophisticated, patented computer vision algorithms of MultiTouch Cornerstone Engine software.

CVTS's uniqueness is based on the amount of information seen through the LCD panel at a perpendicular angle which is a lot more than we'd get looking only from the sides as in the traditional IR frame solutions. It becomes possible to detect not only finger tips but whole fingers and the hands they belong to as well. Furthermore this principle is used to track optical markers (tags) placed on objects, or the shape of the object.



Computer Vision Through Screen Operating Principle

Benefit 1: MULTITACTION Computer Vision Through Screen works perpendicular to the screen

to capture much more information than possible with other touch technologies

With CVTS the front surface is typically durable tempered safety glass. Uniquely,

the front is smooth from edge to edge as CVTS does not require anything to be placed around the display edges.

It is even possible to replace the front glass with an oversized one for seamless integration to custom interiors.

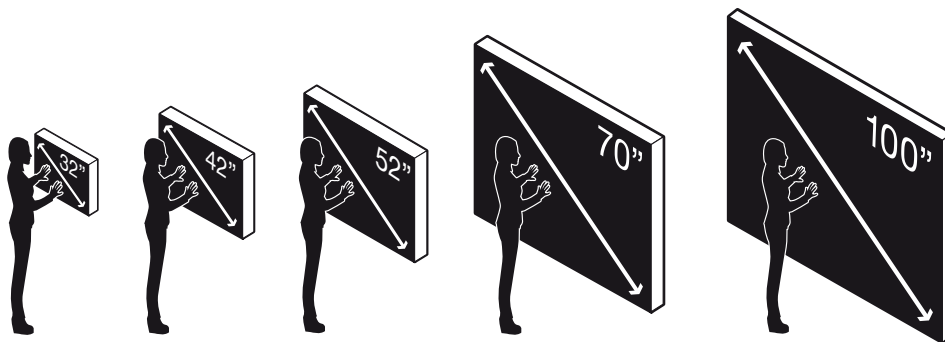
Benefit 2: Smooth edge-to-edge front glass provides robustness and allows flexible integration to interiors.

It also allows smooth stacking of multiple units.

IBEC – Integrated Backlight Emitter Camera modules

Integrated Backlight Emitter Camera modules are integrated circuit boards suited for mass production. They uniquely include white LEDs for standard LCD backlighting, infrared LEDs for emitting IR through the LCD panel so that some will reflect from hands and objects back inside the display where infrared cameras capture the IR images at up to 200 frames per second.

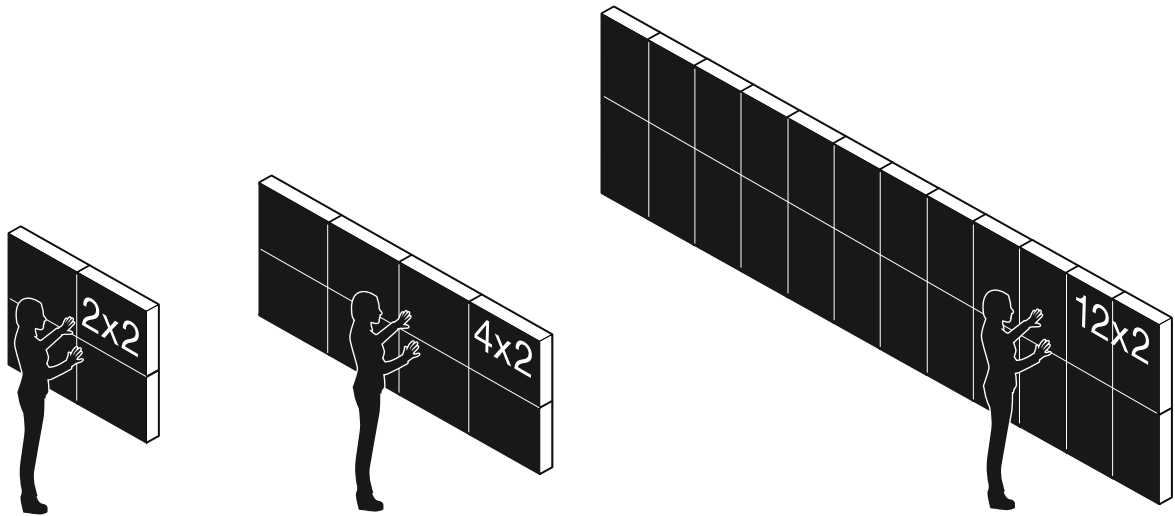
Each IBEC module has a fixed size so the number of modules needed depends on the required display size. Each module has multiple cameras so the number of cameras in a MULTITACTION system can vary between 4 and 100.



MULTITACTION® displays of different sizes with same thin depth

Benefit 3: Modularity allows any size LCD to be used from 32" to 100"+ with the same thin depth.

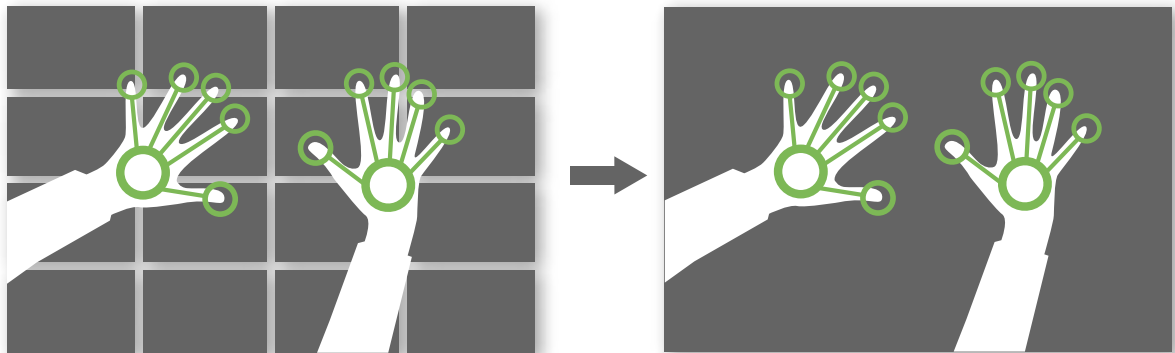
Beyond 100" sizes, MULTITACTION displays can be stacked like existing MultiTouch Cell displays to form large video walls or tables.



Example Configurations for stacking MULTITACTION displays

MTS – Matrix Tracking System

Matrix Tracking System combines software and hardware logic to interface with all the cameras in the IBEC modules, process their images and merge them in real time into one full image covering the whole display area. This is done at a very fast rate of up to 200 frames per second. MTS scales from four to more than one hundred cameras depending on the display size.



Benefit 4: Matrix Tracking System merges all camera images together at very fast rates transparently to the developer

EHTE – Extensible Hybrid Tracking Engine

The embedded computer runs the Extensible Hybrid Tracking Engine. It is an embedded version of the proven MultiTouch Cornerstone Engine, which has been used with single and dual camera based MultiTouch Cell displays already since 2008.

The breakthrough feature of EHTE is Hybrid Tracking which is illustrated below.



EHTE can be configured to use the active IR on every other frame to capture reflections and passive ambient light for every other frame to capture shadows. This is highly useful when the environment has powerful infrared light sources such as sunlight or halogen spot lights. EHTE will then process the two images together to capture all possible detail and apply the computer vision algorithms to detect touches and objects as usual.

Benefit 5: Using Hybrid Tracking, MULTITACTION provides the first optical multi-touch technology immune to external lighting conditions.

Extensibility means that the tracking system can be used to see virtually anything placed on the display and visible with IR. EHTE can track and pass information to applications on:

- Finger points
- Fingers
- Hands
- Objects (shapes)
- Optical markers (fiducials, tags)
- Proximity (presence of users in front of display)

This makes MULTITACTION the most advanced multi-touch solution available.

Furthermore, developers have the possibility to further extend the tracking system using the available SDK.

BENEFIT 6: By tracking whole hands instead of points only, MULTITACTION provides the first true multi-user support.

BENEFIT 7: MULTITACTION provides the most advanced set of capabilities of any interactive display.

MFTO – Multi Format Tracking Output

MULTITACTION is fully compliant with the prevailing standards for passing touch tracking data to applications, including TUIO protocol, Windows 7 Native Touch as well as an XML stream. TUIO and XML have extensions available which include support for all the advanced tracking data available from EHTE.

Furthermore, a powerful API for C++/OpenGL SDK is offered.

All outputs are available simultaneously over RJ-45 Ethernet connection.

BENEFIT 8: Most existing multi-touch applications and development tools work straight away with MULTITACTION.

/// MULTITACTION Technology Demonstrator Presented at CES 2011

MultiTouch Ltd brought forward a working technology demonstrator for MULTITACTION at CES 2011. The prototype had these key features:

- 55" Full HD LCD
- Thickness of only 20 cm (7.9 inches)
- 8 IBEC modules in the Matrix Tracking System
- Running a fully functioning multi-touch application built on Cornerstone C++/OpenGL SDK

/// Conclusion

MULTITACTION offers several breakthrough capabilities for large size multi-touch displays. From the GP Bullhounds generic list of key attributes MULTITACTION fulfils all.

Key Attribute	MULTITACTION supports	Explanation
Sensitivity to stylus, fingers and gloves	✓	Any IR reflective item can be tracked in standard mode. Furthermore, also non-reflective items with Hybrid Tracking.
Multi-touch support	✓	Unlimited simultaneous touch points supported
High durability	✓	Tempered front glass is highly durable and easy to clean.
No need for calibration	✓	Products are typically factory calibrated.
Substrate independence	✓	Any substrate transparent in IR can be used.
Low cost	✓	Optimized for mass production.
Low power consumption	✓	In line with the standalone LCD screens.
High levels of clarity and transparency	✓	Tempered glass is completely clear and transparent.
Flush (100% flat) surface	✓	Tempered front glass from edge to edge
Narrow borders	✓	Limited only by LCD panel structure

Furthermore, large display sizes allow different kinds of usage and require new kinds of attributes from the technology.

Further valuable attributes for large size multi-touch displays	MULTITACTION supports	Explanation
Multi-user support with hand tracking	✓	Unlimited number of hands are tracked simultaneously. Finger points belonging to hands separate users effectively.
Freedom of orientation and integration to interiors	✓	Replaceable front glass allows integrating the displays flush with the interior
Stackability for very large display systems	✓	Uniquely; MultiTouch software architecture supports multi-screen and flush front glass allows fluid swipes across screens
Advanced tracking features and augmented reality applications	✓	Optical markers, shape and proximity tracking bring new possibilities for the application developer.

To summarize, MULTITACTION packages together a world leading feature set for large multi-touch displays with a hardware design that is designed for mass production. MULTITACTION provides for an astonishing user experience, covers all the bases for developers and integrates all into highly usable hardware form factors.

/// Contact and Further Information

For further enquiries about MULTITACTION or MultiTouch Ltd products, please email sales@multitaction.com, sales-us@multitaction.com, or sales-asia@multitaction.com

Please visit for further information:

<http://www.multitaction.com>

<http://cornerstone.multitouch.fi/>

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Multiple patents pending.