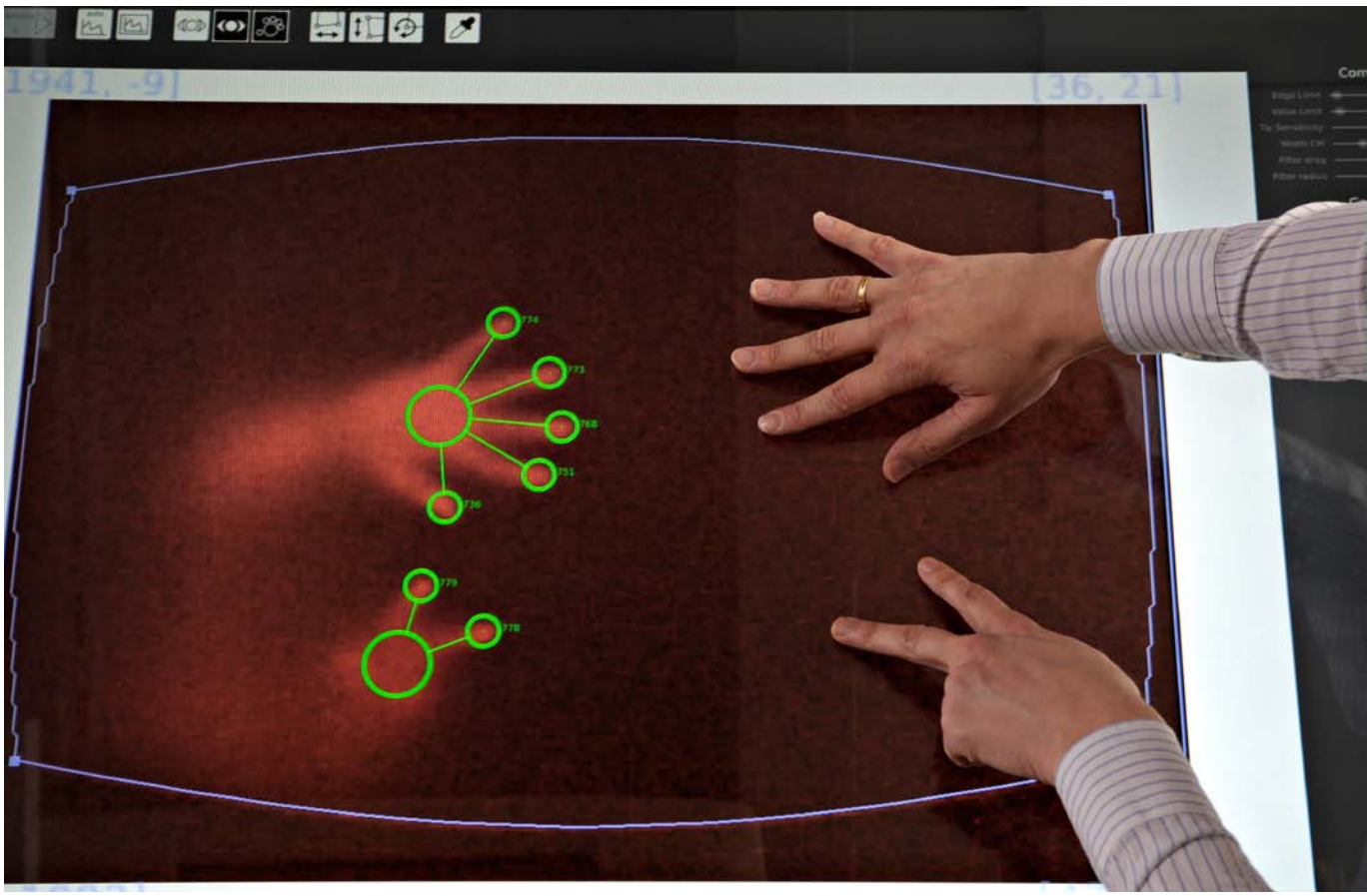
MultiTouch Cornerstone

Software for multitouch interaction and object tracking

High-performance tracking engine and SDK

Read more at http://multitouch.fi/developers



MultiTouch Cornerstone Engine tracks unlimited numbers of fingers, hands, fiducial markers and objects simultaneously. It is included with MultiTouch display products. The MultiTouch Software Development Kit (SDK) is your tool to create new applications that rely on multitouch interaction. You can also use the SDK for integrating a multitouch functionality to existing applications.

MultiTouch Cornerstone Engine

- Computer Vision Through Screen tracks unlimited numbers of fingers, hands and objects
- Uses rear diffuse infrared technology
- Scalability up to 24 Full HD displays
- Fast tracking, up to 200fps
- Supports Windows, Mac and Linux operating systems
- Supports multiple programming languages and protocols
- Runtime libraries included with MultiTouch display products
- Clustered tracking for massive installations

MultiTouch Cornerstone SDK

- Tool for creating interaction-rich multitouch applications
- High performance C++/OpenGL development environment
- Flash/ActionScript 3 development environment
- Multitouch emulator for developer use
- Supports wide range of development environments
- Gesture engine
- Integration with multiple tracking engines
- Hardware independent

/// Unlimited

You can simultaneously track as many fingers, hands and objects on display as you need.

/// Scalable

You can drive up to 24 displays concurrently.

/// Flexible

MultiTouch Cornerstone supports a range of operating systems and development environments.

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MultiTouch Cornerstone

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<tr><td rowspan="2">C++
apps</td><td>Cornerstone apps</td><td>Flash apps</td><td rowspan="2">Apps that
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<tr><td>Cornerstone C++/OpenGL SDK
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<tr><td colspan="2">MultiTouch Cornerstone C++/OpenGL SDK</td><td colspan="2">XML
Stream</td><td>TUIO
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<tr><td colspan="6">MultiTouch Cornerstone Engine
(finger/hand/object tracking)</td></tr>
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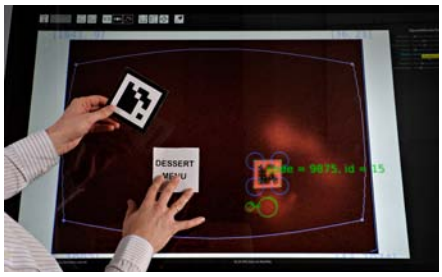
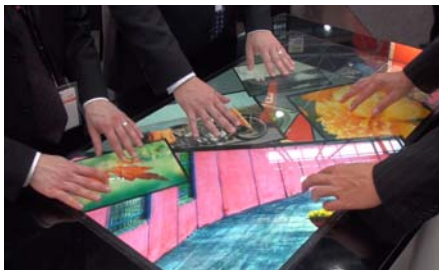
MultiTouch Cornerstone software stack supports multiple development environments and methods.



Computer vision tracks fiducial markers.

The SDK includes an emulator for code testing.



MultiTouch Cornerstone includes ready-to-use applications.

/// Environments, protocols

MultiTouch Cornerstone supports an array of programming languages, developing environments and protocols:
C++/OpenGL, Adobe Flash/Flex/Air, C#, .NET, Microsoft Visual Studio, Windows Presentation Foundation, Silverlight, MT4Java, Max/MSP, QtCreator, XCode, GNU Make, TUIO, XML stream.

/// Rich set of information

MultiTouch Cornerstone produces a rich set of information:
The location of the fingertip (2D vector), Direction from the fingertip towards the palm (2D vector), Age of the tip (integer), Unique identifier of the fingertip (integer), Unique identifier of the hand where this finger belongs (integer), Fingers that are part of the hand (list of finger identifiers), Palm location (2D vector), Age of the hand (2D vector), Unique identifier of the hand (integer), Marker center (2D vector), Rotation of the marker (floating-point value), Age of the marker (2D vector), Unique identifier of the marker (integer), Marker code value (integer).

/// Customer cases

Example projects done with Cornerstone SDK
- Lincoln Tech Table
- Opel Ampera table
- Wall of Chile at Shanghai Expo
- Interactive Graffiti Bar in Tokyo
- Official CES 2011 Twitter Wall
- FIMM Virtual Microscopy
- T-Mobile

MultiTouch Cornerstone SDK Overview

Core Features

Extendable widget-based C++ interaction engine guarantees swift performance, with easy expandability.

Integrated animation environment allows the extension of widgets in a flexible way.

CSS support allows applications, or their individual components be controlled via CSS files. This allows ordinary designers to adjust various parameters as desired, using a familiar file format. Cornerstone uses a simplified version of CSS, which can be used to adjust not only the looks, but also the behavior of widgets as needed.

XML file format for widgets makes it possible to load/store widgets from the hard-disk. This can be used to aid application development so that application blocks is defined in the XML files, rather than specifying them in code.

Core Technologies

The following technologies are used throughout the Cornerstone SDK.

Threaded rendering framework provides support for running several displays from one application computer. This framework is optional, so for simple setups single-threaded rendering can be used.

Multi-display rendering pipe supports both LCD displays, and rear-projection systems. For rear-projection systems, the rendering engine includes keystone correction, and projector edge blending features. With these options one can achieve smooth transitions between adjacent video projectors, without the need for costly high-end projectors. The image warping is performed in the graphics hardware, with minimal overhead or latency.

Multi-channel audio processing framework enables the use of spatial audio, as an integrated part of the applications. Different sound streams can be targeted to either specific loudspeaker/headphones, or used with dynamic 2D panning engine for delivering the sound where the content is.

Background threading of complex tasks frees the application to run fluently even when time-consuming operations need to be performed. Use cases for this technology are data-base access and media loading.

Core Components

The following components are available in the MultiWidgets library, and the auxiliary support libraries.

Widget class with integrated gesture support. The core widget class implements all the basic multitouch gestures (scale, rotate, translate), and allows for additional gesture processing by the user.

Image widget with background image loading and scaling. This class can be used to display images that fit into a single OpenGL texture (typically limited to 4096x4096 pixels). The image loading and scaling is performed in the background, to eliminate latencies caused by the loading process.

Video widget uses the FFMPEG video decoder to play videos. The video rendering is performed with pixel shaders, giving the option to perform image enhancements without additional overhead. Sound panning is integrated to the video widget, so that the sounds of the video can be positioned using multichannel audio setup.

TextBox and TextEdit widgets provide basic text support (interactive/non-interactive). The text rendering supports Truetype font files (TTF). The rendering is done with multi-resolution textures, to guarantee smooth rendering at small and large sizes, without specific programming work.

Virtual keyboard allows the users to type text into various components, such as text boxes, web-browser URLs etc.

Web browser is available on Linux and OS X. The browser on Linux supports all normal web technologies, including Adobe Flash, while the OS X browser is limited to standard HTML and Javascript. Keyboard naturally pops up when you tap on text field.

Gallery widget can be used for making galleries with any kind of widgets as the content.

View widget is a tool for compositing different viewports on the screen, at the same time. Views are useful for live-previews, or various containers, such as lists and galleries.

Widget3D is a base class for implementing widgets that display 3D content.

ItemFlow implements a cover-flow -like collection of widgets. As list contents one can use any Cornerstone widgets.

Wheel widget implements a collection of widgets in a circle. As list contents one can use any Cornerstone widgets.

List widget implements a scrollable list of widgets. As list contents one can use any Cornerstone widgets.

Flipping widget can be used to implement widgets that can be turned around, in a 3D fashion. The turning is in implemented as a projective transformation on a 2D plane, which looks and feels like 3D transformation.

ImageMovie is another image animation player. This is widget, the images are loaded dynamically, so that they are more easily adapted to different sizes.

Embed widget (on Linux only) allows the embedding of arbitrary applications into the multitouch environment. Using this widget one can for example run Firefox, Chrome, Open-Office or other normal Linux applications inside the Cornerstone environment.

Game widget provides a basic environment for games, with high-score lists, etc.

Layer widget simplifies the task of creating layers. This is basically a short-cut for creating a transparent container widget with locked depth, and no input processing.

Plugin Components

While the most important widgets are included in the core libraries, additional plugin widgets increase the range of available widgets significantly. Many plugin components provide visual effects that can be added to the applications with a single function call. The plugins can also be used as stand-alone applications.

Book widget implements a book with flippable pages. As page contents one can use images. In the future this will be expanded to include any widgets.

Drawing widget implements a simple drawing application. This application can be used to create drawing overlay for other plugins or applications.

VideoAnnotations provides a live video feed from a camera, combined with drawing plugin for annotation purposes.

Canvas is a simple application for organizing pictures and videos in a rectangular grid.

TimeLine is a more complex plugin which can be used for showing pictures and videos with time-stamps (or without time-stamps). It can support a fairly large number of objects, and has been tested with up to 50 000 images. It also features a presentation mode, where the time-stamps are ignored, and items are organized sequentially.

Games collection includes simple, and fun games for multitouch displays:

- **FingerPhysics** is a simple game where one tries to force various target object out of the screen by drawing new objects
- **Missile Commander** implements the missile commander game for a multitouch display
- **Falling Spheres** is a game where one tries to keep an increasing number of spheres from falling to the ground
- **ClassicPong, and WildPong** are multitouch variations of the classical Pong game

Visual effects collection can be used to add playful, lively components to any application. Available effects include:

- **LightBeings** - slow-moving things that like to circle around users' fingers
- **Champagne** - simulation of champagne bubbles Sparkles - fluid effect with plenty of action
- **Graffiti** - simulated graffiti painting, with flowing paint effect
- **Lightning** - draws lines of electricity between fingers on the screen
- **Curls** - generates snow-flakes and other organic shapes when interacted with
- **Collisions** - throw balls around the screen, with the balls bouncing from the display borders, and from each other
- **Divisions, LivingStripes, Rectangles and ShaderEffect** - non-interactive background animations, with different geometrical shapes

Examples

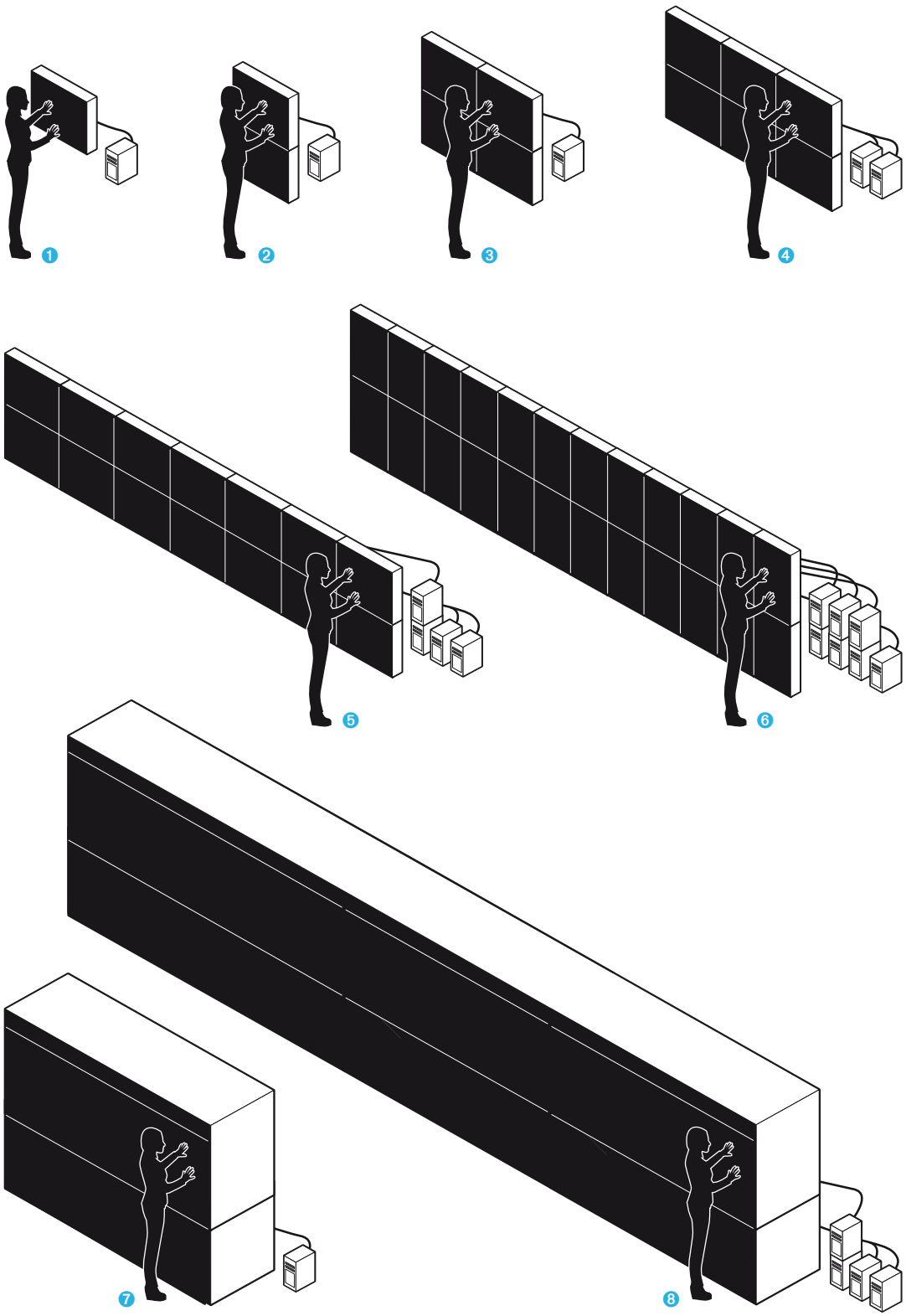
Cornerstone includes example code for getting started, and learning the different components.

Example applications include:
- **HelloWorld** - a minimal multitouch application
- **HelloImages** - a simple image browser application
- **Autorotate** - automatic rotation of widgets, based on the location of the user
- **CustomWidget** - how to customize the basic widget classes
- **DonutWidget** - another widget customization example
- **ThreadedCanvas** - how to use threaded rendering
- **ViewExample** - demonstration of view widgets
- **VirtualKeyboard** - use of TextEdit and Keyboard widgets
- **TouchBrowser, TouchBrowser2, BrowserWidget2** - web browser component demonstration

Example plugins include:
- **PluginSample** - a very basic plugin widget
- **CSSSample** - shows how to use CSS to control the looks (fonts, colors etc.) of the widgets
- **Browsers** - shows a bookmark list, which can be used to start web browsers
- **MarkerView** - shows how to access marker data
- **InputFlags** - shows how to enable/disable various gestures
- **Flow** - demonstrates the use of the ItemFlow widget
- **Events** - shows how to use the internal event passing mechanism

More detailed information about the SDK at http://cornerstone.multitouch.fi

Example deployment scenarios with Cornerstone



1 1 PC, 1 Cell
1 PC running 1 Cell. PC can be running Window, Linux, or OS X. Application can be written with C++ or Flash or any other language using TUIO, XML or Windows 7 Touch.

2 1 PC, 2 Cells
1 PC running
2 Cells. PC can be running Window, Linux, or OS X. Application is written with C++ or other suitable language using TUIO or XML outputs.

3 1 PC, 4 Cells
1 PC running
4 Cells. PC can be running Windows or Linux.
Application is written with C++ or other high performance language using TUIO or XML outputs.

4 1 PC "Tracking", 1 PC "Application", 6 Cells
1 tracking PC and 1 application PC running 6 Cells. The tracking PC is running Linux, while the application PC can be running Windows or Linux. Application is written with C++.

5 3 PCs "Tracking Cluster", 1 PC "Application", 14 Cells
3 tracking PCs and 1 application PC running 14 Cells. The tracking PCs are running Linux, while the application PC is running Windows or Linux. Application is written with C++.

6 6 PCs "Tracking Cluster", 1 PC "Application", 24 Cells
5 tracking PCs and 1 application PC running 24 Cells. The tracking PCs are running Linux, while the application PC is running Windows. Application is written with C++.

7 1 PC, Projector box with 4 projectors in portrait mode (3 meters wide)
1 PC running a projection box with 4 projectors in portrait mode. PC can be running Windows or Linux. Application is written with
C++. Projector keystone correction and edge-blending are handled by Cornerstone.

8 3 PCs "Tracking Cluster", 1 PC "Application", Projector box with 8 projectors in portrait mode (10 meters wide)
3 tracking PCs and 1 application PC running 8 projectors in portrait mode. The tracking PCs are running Linux, while the application PC is running Windows or Linux. Application is written with C++. Projector keystone correction and edge-blending are handled by Cornerstone.

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