

Multi-Touch Control Wheel Software Development Kit User's Guide

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Introduction

What's in this Guide?

Welcome to the Grayhill Multi-Touch Control Wheel (MTCW) User's Guide. We'll first get your Control Wheel up and running with a demo so you can quickly begin to appreciate the MTCW's many features and capabilities. Next we'll dive in deeper into the MTCW operation. Lastly, we'll introduce **Grayhill's Instinct Gesture Recognition Library** that makes product development a snap. **Let's get started!**

What's in the Kit?

The Multi-Touch Control Wheel Software Development Kit contains a Quick Start Guide, and (1) Grayhill Multi-Touch Control Wheel (Part number: T201-7C1) mounted in a case, with a USB cable ready to plug into your type "A" USB host connector on your hub or PC.

Multi-Touch Control Wheel Features

The Grayhill Multi-Touch Control Wheel has the following features:

- **A 70mm round projected capacitive touchpad, that can track up to 5 touch positions.**
- **Proximity sensor**
- **Outer finger groove**
- **Joystick direction indicators**
- **Interface connector – (1) USB signaling**

Multi-Touch Control Wheel Medical Demo

Downloading the Medical Demo

The Medical Demo is a Windows XP or Windows 7 application that will introduce you to some of the basic features of the MTCW. The Demo is a simulation of some of the functions that may be required in a typical imaging application. To load and run the demo, follow these steps:

Plug in the USB cable into any convenient USB port on your PC. Your computer should automatically recognize the device without any special drivers.

Next find the MTCW Medical Demo Application at
<http://www.grayhill.com/instinct>

For users of Google's Chrome browser

Click on the link: MTCW Demo – Medical (zip)

When the download is complete, click on the zip file MTCWDemo_med.zip that should appear in the download area at the bottom of the screen.

Follow the instructions of your zip file extraction tool to extract and locate the file on your PC where it can be easily found (i.e. your desktop.)

For users of Mozilla's Firefox browser

Click on the link MTCW Demo – Medical (zip)

The browser should open a pop up box. Under “What should Firefox do with this file?” select your zip file extraction tool under “Open with.”

Follow the instructions of your zip file extraction tool to extract and locate the file on your PC where it can be easily found (i.e. your desktop.)

For users of Microsoft Internet Explorer

Click on the link MTCW Demo – Medical (zip)

The browser should open a pop up box. Under “Do you want to open or save this file?” select “Open.” Under certain settings this step may be skipped.

Follow the instructions of your zip file extraction tool to extract and locate the file on your PC where it can be easily found (i.e. your desktop.)

Running the Demo

To run the demo, navigate to the file on your system where it was downloaded and double click the filename. There is no special installation necessary since the program is self-contained. The connect screen should appear as shown below:

The screenshot shows the 'MTCW Demo' application window. At the top, there's a blue header with the text 'MTCW Demo'. Below the header, there are two buttons: 'Detect Devices' and 'Exit'. Underneath these buttons is a table with three columns: 'Serial Number', 'Firmware', and 'Connect?'. There are three rows labeled 'Device #1', 'Device #2', and 'Device #3'. Each row has input fields for the serial number and firmware, and a checkbox for the 'Connect?' column. To the right of the table is a 'Connect' button. Below the table is a 'Status:' label followed by a text box. At the bottom of the window is a large button labeled 'Start Demo App'.

	Serial Number	Firmware	Connect?
Device #1			<input type="checkbox"/>
Device #2			<input type="checkbox"/>
Device #3			<input type="checkbox"/>

Status:

Start Demo App

On the connect screen chose “Detect Devices” and a list of currently installed Grayhill Touch devices will appear. You’ll likely have only one unit connected, and this device should appear under device #1. If it does not, check your USB cable and click “Detect Devices” once again.

This screenshot shows the same 'MTCW Demo' application window after a device has been detected. The 'Detect Devices' button is now highlighted with a thick border. In the table, the 'Connect?' checkbox for 'Device #1' is checked. The 'Status' text box now contains the text 'GH MT device detected!'. The 'Start Demo App' button remains at the bottom.

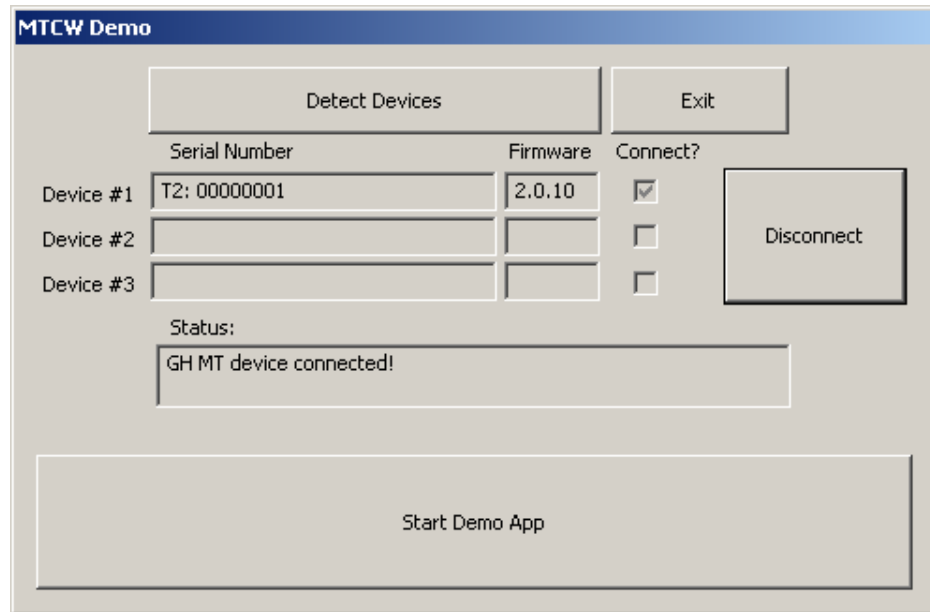
	Serial Number	Firmware	Connect?
Device #1	T2: 00000001	2.0.10	<input checked="" type="checkbox"/>
Device #2			<input type="checkbox"/>
Device #3			<input type="checkbox"/>

Status:

GH MT device detected!

Start Demo App

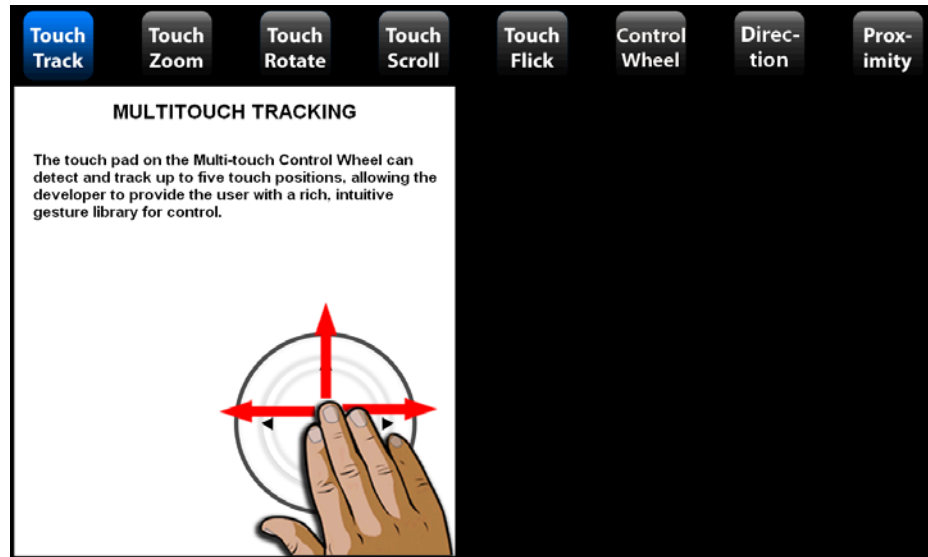
Next we’ll need to connect to the device. After ensuring the “Connect?” checkbox next to the device that you wish to connect is checked, hit the “Connect” button. Notice the “Status:” changes to indicate that you are connected to the selected device.



OK, if all that seems good so far, we're ready to start the demo. Hit the large "Start Demo App" button in the middle of the screen. You should see the splash screen shown below:



Next click on the splash screen with your mouse, or touch the touchpad on the MTCW to enter the demo screen. You can easily return to the connect screen afterward by hitting the "Esc" key on your keyboard.

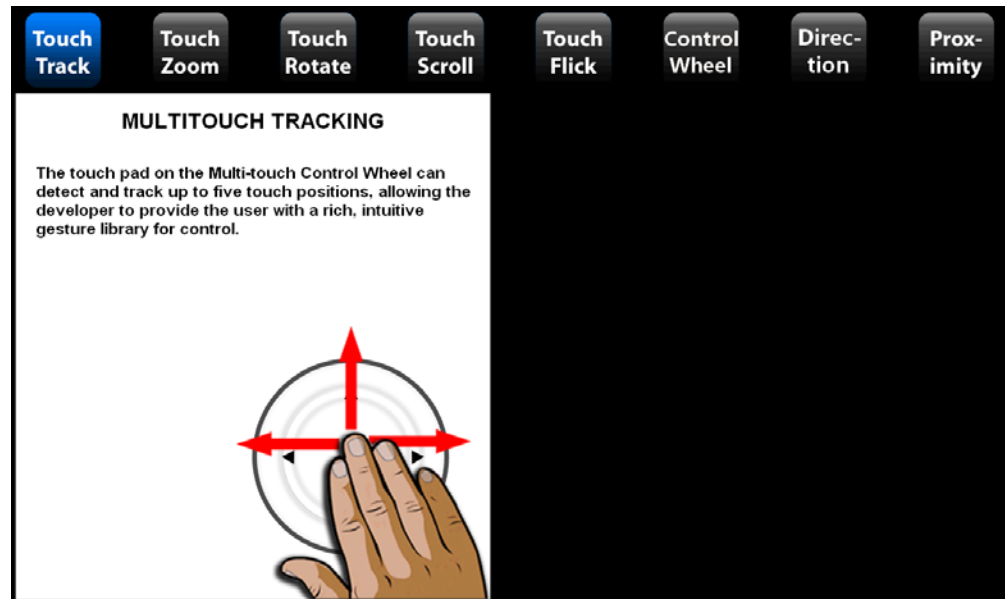


Once in the demo screen, you'll notice a row of MTCW demonstration functions across the top. To enter any of these, click the function with your mouse, or alternately, double-tap on the MTCW's left/right arrows to scroll through until the desired function is highlighted. You'll notice that the rest of the screen is separated into two halves. On the left are a description of the current function, and a picture of how the function is performed (if applicable.) On the right, you'll find the area where a simulation of an ultrasound screen is displayed.

Note: The demo functions have been realized using Grayhill's Instinct Gesture Recognition Library. For further information on Instinct, please refer to the Instinct Introduction section at the end of this document.

Demo Functions

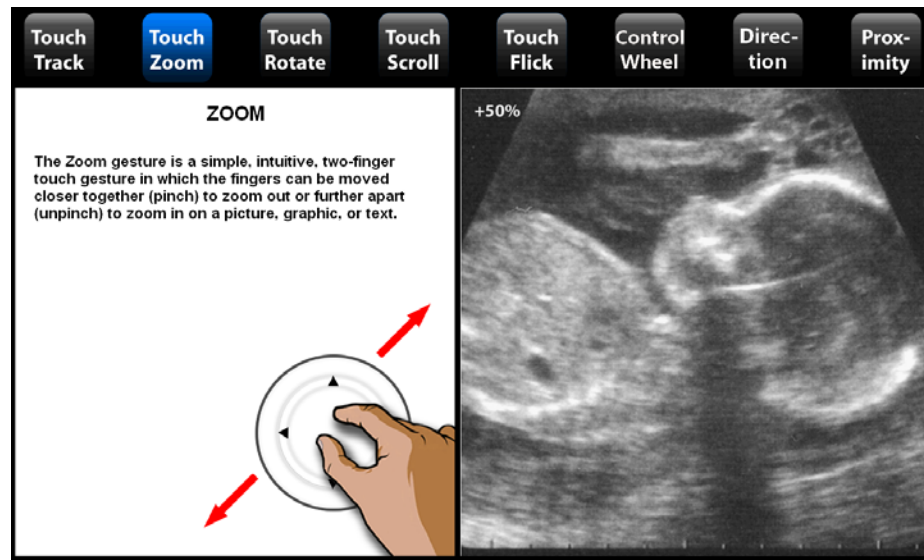
Touch Track



In the “Touch Track” demo function, touch the touch pad with up to five fingers and watch as your finger positions are tracked on the screen. Double-tapping on the MTCW’s up/down arrows at this point alternately toggles between regular and persistent tracking mode.

Note: high levels of common mode power supply noise can affect projected capacitive touch sensing. If you see some rapid movement in the touch points, try a different power arrangement. Using a self-powered hub usually solves this problem.

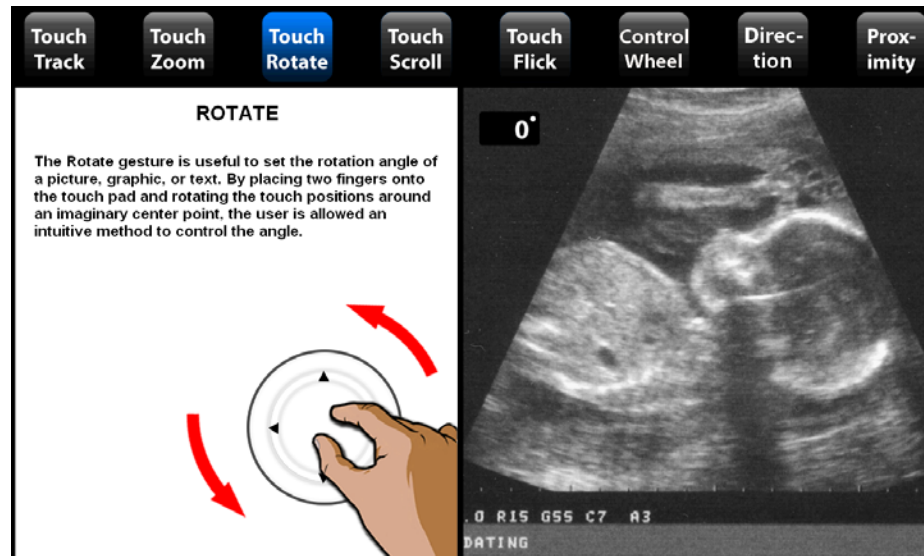
Touch Zoom



“Touch Zoom” is performed by making a pinch or un-pinch gesture with two fingers. It is commonly used to scale objects such as pictures, graphics or text.

Note: this demo was realized using Grayhill’s Instinct Gesture Recognition Library. Instinct will calculate the magnitude of the relative movement of two touches with respect to each other.

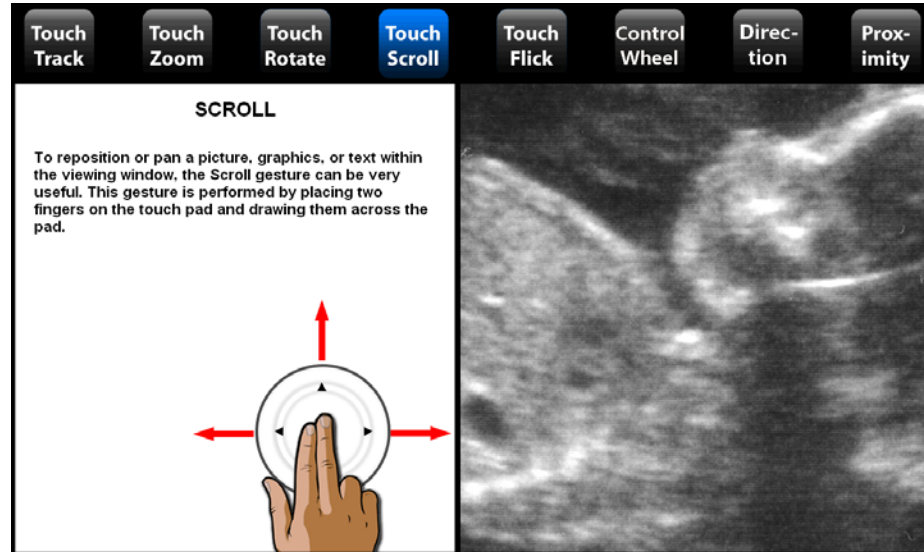
Touch Rotate



“Touch Rotate” is performed by rotating two touches about each other. It can be useful for rotating pictures, graphics or text on the screen.

Note: this demo was realized using Grayhill's Instinct Gesture Recognition Library. Instinct can calculate the angle as two touch positions are rotated about each other.

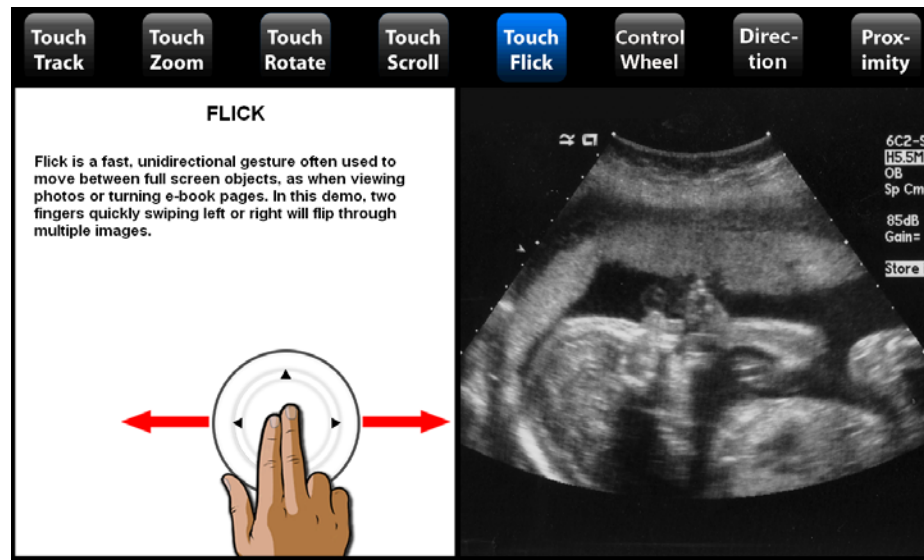
Touch Scroll



“Touch Scroll” is a two-finger gesture that allows the user to pan a picture, text or graphic. Note that the picture can be panned with momentum. To do this, try lifting your fingers as you move them across the touchpad. This is very useful when panning a large picture or searching a long list.

Note: this demo was realized using Grayhill's Instinct Gesture Recognition Library. Instinct can calculate the relative XY movement of a touch or group of touches. Momentum can be controlled for all Tracking Gestures with a simple setting.

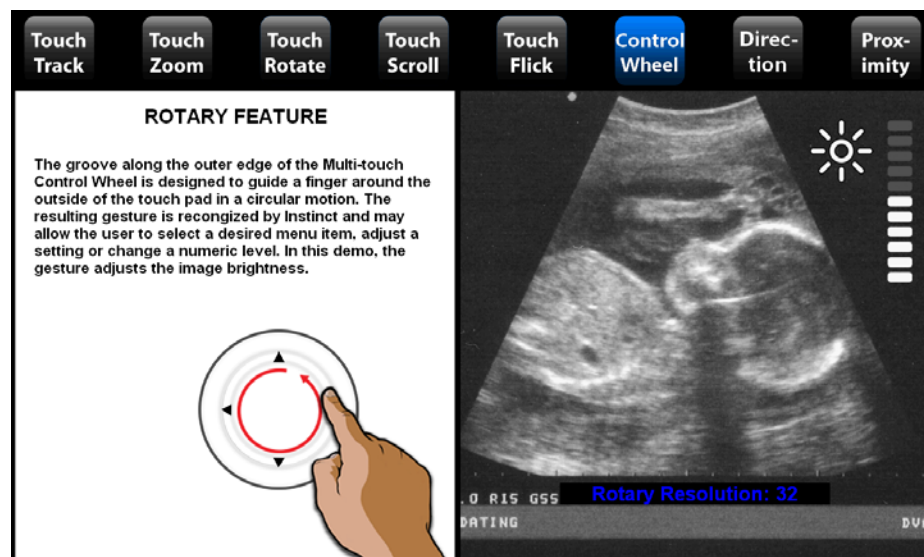
Touch Flick



“Touch Flick” as demonstrated here, is a two-finger gesture that can be used to move between screen objects. Be sure to hold your fingers slightly apart and flip your fingers horizontally across the screen – just like flipping pages in a book.

Note: this demo was realized using Grayhill’s Instinct Gesture Recognition Library. Instinct allows an application to determine when multiple touches are moved in unison, in a certain direction, and at a certain minimum speed.

Control Wheel

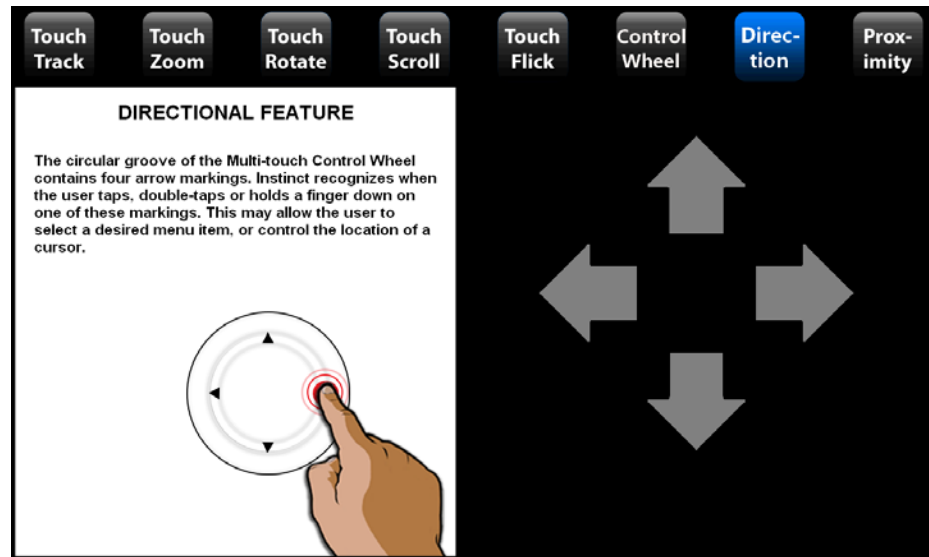


The MTCW touchpad has a unique indented outer ring. Sliding one finger inside this circular indentation can be recognized as a unique gesture. This

gesture is perfect for controlling machine levels. Double-tapping on the MTCW's up/down arrows adjusts the resolution of this rotary gesture.

Note: this demo was realized using Grayhill's Instinct Gesture Recognition Library. Instinct will indicate if a single-finger is being moved inside the circular indentation, either in a clockwise or counter-clockwise direction. Resolution can be controlled with a simple setting.

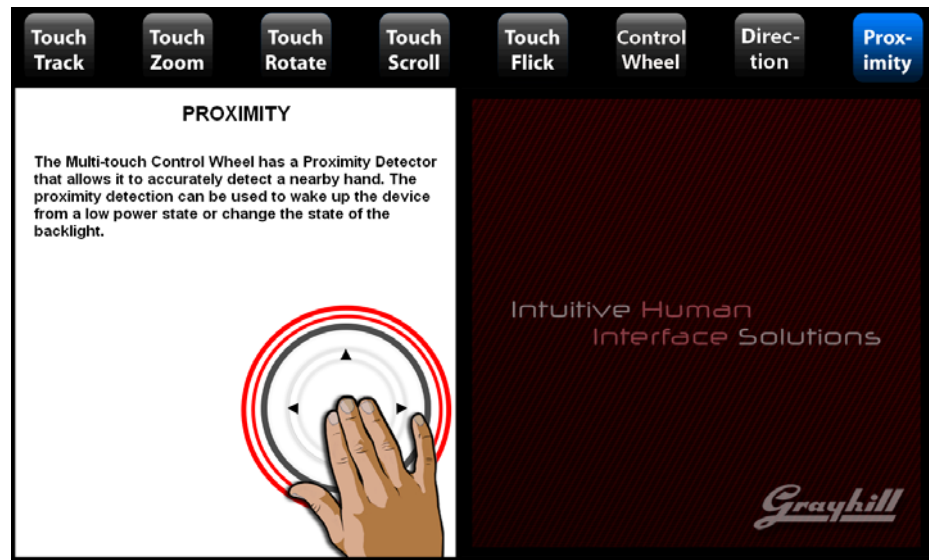
Joystick Control



The MTCW's indented outer ring contains four directional arrows (up/down/left/right). Tapping, double-tapping or touch-and-holding a single finger on these markings can be recognized as unique gestures separate from the rest of the touchpad. These gestures are perfect for typical joystick machine control operations.

Note: this demo was realized using Grayhill's Instinct Gesture Recognition Library. Instinct will resolve when a tap, double-tap or touch-and-hold gesture event is performed with a single finger within a certain area over these markings.

Proximity



If your product needs to meet green energy requirements, the built in proximity sensor can be a big help. The machine can be placed in a low power state, and when the proximity is sensed, the MTCW can notify the machine that a user is present. For battery powered applications, custom firmware can be written for the MTCW so that even the MTCW itself can be placed in a low power mode - while still monitoring for proximity.

Note: Because the touchpad is disabled in Proximity mode, the left/right arrows cannot be used to change the function. Instead, move your hand quickly in and out of the proximity sensor's range three times, and the demo will return to the first function.

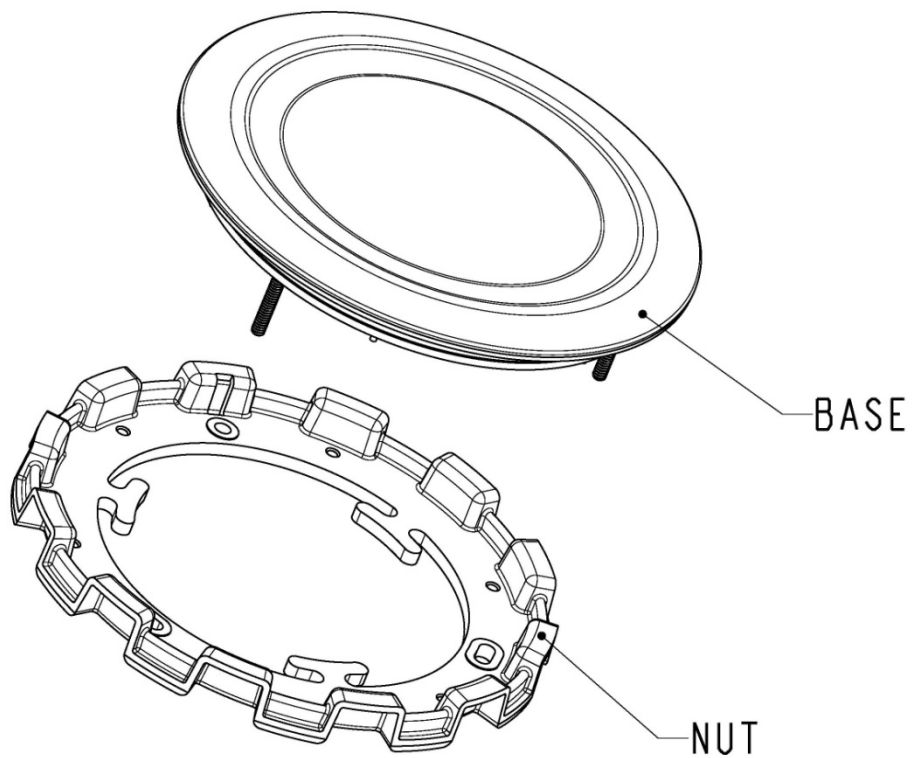
Exiting the Demo

To Exit the demo, hit the "ESC" key on your keyboard and then on the connect screen, hit the "Exit" button using the mouse.

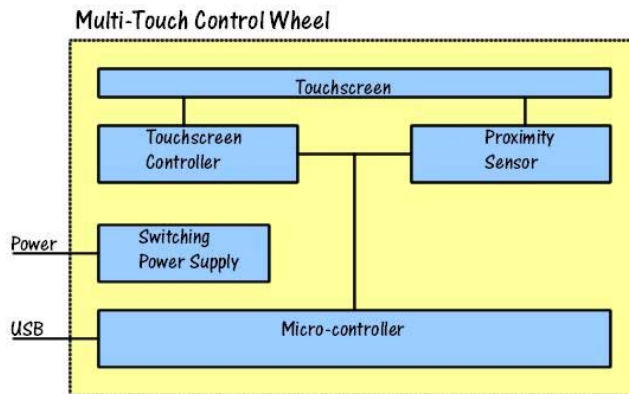
Multi-Touch Control Wheel Overview

We've demonstrated some of the functions of the MTCW with a simple demo application - but we've only scratched the surface of its possibilities. While the demo can show some examples of the ways the MTCW can be used, it cannot match your imagination of how it might be used. In this section we'll cover the basic operation of the MTCW so that you can appreciate its flexibility.

Mechanical Drawing



For the discussion of the components of the MTCW see the block diagram of the MTCW shown below:



USB - I/O Interface

The MTCW has a built in full speed USB device interface. Data that is transmitted from the MTCW to the host includes the overall status, raw touch positions, and proximity status, data can be sent to the MTCW to set the current touchpad/proximity mode.

In addition to the USB connector, a redundant output is provided that contains the quadrature output I/O from the encoder and the pushbutton status.

Touchpad

The touchpad built into the MTCW uses the mutual projected capacitive method to track up to 5 touch positions simultaneously with a 20mS sample rate. Some features of the touchpad are listed below:

- As each individual touch is sensed, the touch is assigned the lowest number available from 1 to 5 for reporting.
- The touch is tracked under this number until it has been released.
- The screen has an overall resolution of 1280 x 1280, although because of the round shape, not all of these positions are utilized.
- No gesture recognition is provided in the MTCW, but “Instinct” - Grayhill’s Gesture Recognition Library, is available to our customers and will be introduced later in this guide.
- Two-touch differentiation can be sensed down to about 3mm.
- Touch sensing will work with latex gloves.
- The MTCW can be set to either Touch or Proximity mode, but they cannot be used simultaneously.

Proximity

The device has two modes of operation, touchpad, and proximity. The device is set to proximity mode by command over the USB. In Proximity mode the device sends make and break codes over the USB corresponding to the current status of the proximity sensor. Proximity is detected using the mutual projected capacitance method.

Additional Information

Please visit <http://www.grayhill.com/instinct> for updates to this document, updates and releases of demos, updates to unit firmware and settings files, Errata, and other application notes.

Documentation for the USB data input and output format is available to our customers with a signed Non-Disclosure Agreement. To request a form please email Grayhill at instinct@grayhill.com.

Grayhill's Instinct™ Gesture Recognition Library Introduction

The **Grayhill Instinct Gesture Recognition Library** is a C code source library – which is intended to be included and built into your application. Simple initialization calls allow the flexible setup of parameters to fine-tune the recognition process for your application. During normal operation, data from the Grayhill touch device is passed directly to the library. The data is quickly processed and the results are passed back to your application.

What makes the Grayhill Instinct Gesture Recognition Library unique?

When we looked at Human/Machine interface we found two basic, but powerful types of gestures useful for machine control – we call them **Event Gestures** and **Tracking Gestures**.

Event Gestures

An Event Gesture is defined as any gesture that is performed and recognized as a single exclusive event. For example Tap, Double-Tap, Tap-and-Hold etc – these are all gestures that usually cause immediate state changes. Note that these events don't require any position, timing, magnitude or directional information - they are simply recognized as the user performs them as single exclusive events. These types of events have a rich history in user interface. A mouse click, a key press, both can be thought of as an event. However, since a touch panel has many more dimensions than a simple pushbutton, these Event Gestures can be far more complex and powerful.

Event Gestures Recognized:

- TAP(1) One Finger Tap
- TAP (2) Two Finger Tap
- TAP (3) Three Finger Tap
- TAP (4) Four Finger Tap
- TAP (5) Five Finger Tap
- Double_Tap(1) One Finger Double Tap
- Double_Tap(2) Two Finger Double Tap
- Double_Tap(3) Three Finger Double Tap
- Double_Tap(4) Four Finger Double Tap
- Double_Tap(5) Five Finger Double Tap
- Press&Hold (1) One Finger Press and Hold
- Press&Hold (2) Two Finger Press and Hold
- Press&Hold (3) Three Finger Press and Hold

- Press&Hold (4) Four Finger Press and Hold
- Press&Hold (5) Five Finger Press and Hold

Tracking Gestures

A Tracking Gesture is not recognized as a single event, but rather, a continuous stream of control as long as the user performs the gesture. Tracking Gestures are very useful for viewing and positioning 2-D and 3-D objects or images, or positioning the view in a field of text. Pan, Zoom, Rotate and Scroll, are examples of Tracking Gestures. Note that these gestures need not be exclusive (they can all occur simultaneously) and magnitude and direction information are very important in providing the most intuitive experience. This is why we feel it is best to describe these gestures by providing a continuous stream of data regarding the level at which each of these parameters are occurring, rather than simply acknowledging the gesture. Four basic parameters, as well as the number of touches provide all the necessary information. The parameters, MotionX, and MotionY provide the relative average X and Y movement of all the current touch positions and is useful for panning. The Angle parameter provides the average relative rotation of all the current touch positions and is useful for rotating. The Scale parameter provides the average relative expansion or contraction scale for all the touch elements on the screen and is useful for zooming. In addition, all these parameters can have programmable momentum applied. If the touches are released with speed, the library will continue to provide intuitive movement based on the current momentum settings.

Additional Information

The Grayhill Instinct Gesture Recognition Library is available to our customers with a signed Non-Disclosure Agreement. To request a form please contact Grayhill at instinct@grayhill.com.

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