Intel® RealSense™ Touchless Control Software

User Guide

June 2021

Version 1.3.0.0

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Revision History

Revision Number	Description	Revision Date
1.0.0.0	Initial release	March 2021
1.1.0.0	Added options to turn on TCS service automatically and minimize control panel at app launch	April 2021
1.2.0.0	Added auto-drag (for signature)	May 2021
1.3.0.0	Support Windows 7 platforms	June 2021

1 Introduction

1.1 Purpose and Scope of this Document

This document is a comprehensive user guide for Intel® RealSense™ Touchless Control Software (TCS) release.

1.2 Components

The Intel® RealSense™ Touchless Control Software release package includes:

- Intel® RealSense™ Touchless Control Software
- Intel® RealSense™ Activation Tool (for license activation)

1.3 Hardware Requirements

Table 1-1. Supported Intel® RealSense™ Depth Cameras

Depth Cameras
Intel® RealSense™ Depth Camera D435

Note: The host system connection to the camera is through USB 3.1 Gen 1.

Figure 1-1. Intel® RealSense™ Depth Camera D435

Table 1-2. Supported Displays

No.	Display size and aspect ratios
1	32" 16:9 landscape and portrait mode
2	27" 16:9 landscape and portrait mode
3	19" 5:4 landscape and portrait mode

Note: While Intel® RealSense™ Touchless Control Software is capable of supporting almost any computer screen or monitor, only the displays in the table above were validated in this release.

1.4 Software Requirements

Table 1-3. Software Requirements

Software	Version
Intel® RealSense™ Depth Camera Firmware	5.12.6.0+
Operating System	Windows* 10 64-bit

1.5 Organization

This document contains seven main parts:

- **Overview** – Definitions of terminology, overview of Touchless Control, and high-level user flow
- **Getting Started** – summary of steps to setup and run TCS
- **Hardware Setup** – Hardware requirement for TCS, including details on camera installation position.
- **Software Installation** – Steps to install TCS software.
- **Running TCS** – App UI, setup, calibration, running service, troubleshooting
- **Customization** – customizing sound and visual effects
- **Troubleshooting** – settings and logging directories, potential issues and resolution

2 Overview

This chapter provides an overview of the Intel® RealSense™ Touchless Control Software.

2.1 Definitions

Table 2-1. Terminology List

Term	Definition	Comment / Access
Product Key	A text code sent to user after signing up TCS software and will be used to activate the license	
License	Product license granted to user of TCS software, including Trial, Full, or Bulk license	
VTP	Virtual Touch Plane	
Virtual Touch Coverage	The portion of the screen TCS is enabled	

2.2 Touchless Control

The Intel® RealSense™ Touchless Control Software (TCS) enables computer screen or monitor to become “air-touch” enabled, allowing users to interact with screens without physically touching them. It’s designed to work with screens ranging in size from small 11” self-checkout kiosks at supermarkets, to larger 22” or even 32” screens used in fast-food restaurants, malls or for digital signage.

Figure 2-1. TCS User Interaction

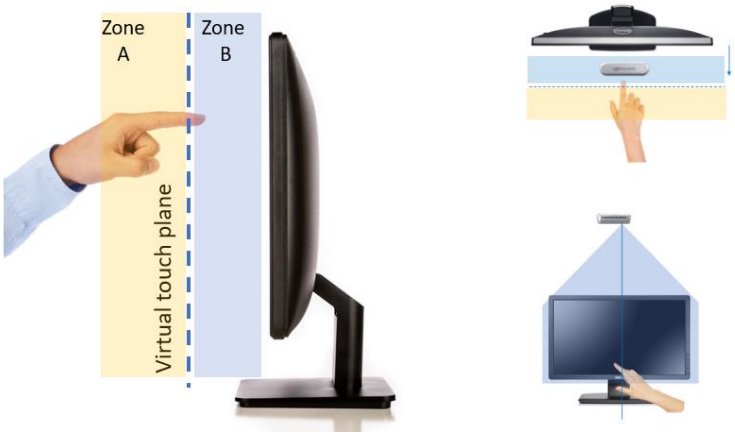


Figure 2-1 shows the very simple operating principle, based on the concept of a "virtual plane", hovering above the actual screen, in a one-to-one mapping.

A virtual touch screen hovers slightly above the real screen. When the user's finger touches the virtual touch plane, touch-events are sent to the system. In the recommended configuration, the Intel RealSense camera is mounting above the screen to provide full visual coverage of the volume in front of the screen

As a user brings a finger close to the screen, the system will immediately detect its presence and track the finger in 3D. When the finger enters the pre-defined engagement Zone A, a cursor will appear on screen in nominally the correct X-Y location of the screen (ergo the one-to-one scale mapping). As the finger moves closer to the screen, the cursor icon will change in size to provide visual feedback to the user on the distance of their finger away from the "virtual touch plane". This visual feedback is key to mitigating confusion stemming from optical parallax – as the finger will be hovering in the air above the screen, it could appear to the user to be above different parts of the screen depending on their viewing angle. The 3D visual feedback removes any ambiguity.

Upon "touching" the virtual-touch plane, a touch event (or "mouse click") is sent to the system, and auditory feedback is provided in the form of a "click sound", for example. The cursor color is then changed (while in the blue Zone B), and the user needs to withdraw their finger again back past the virtual touch plane before they will be able to reactivate new selections.

2.3 High Level TCS User Flow

The chart below illustrates high level user flow for Intel® RealSense™ Touchless Control Software (TCS).

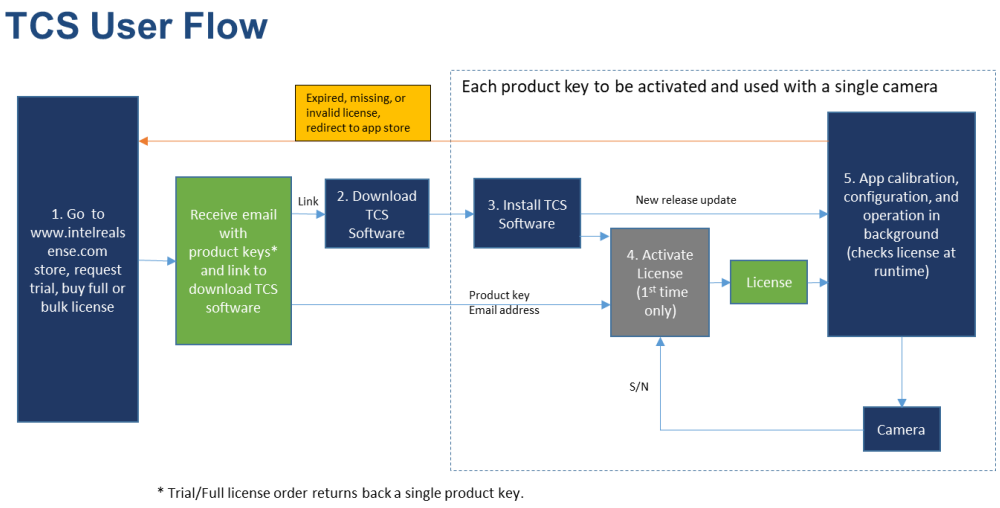
1. User goes to www.intelrealsense.com store to purchase the TCS software, either as trial user or paid customer. The software is available in trial, full or bulk licenses. User receives email with a product key and link to download TCS software.
2. User download TCS software which is packed in a Window installer package.
3. User setup hardware and software including installing TCS software on a Windows PC.
4. In initial run, user activates the license with product key and an Intel® RealSense™ Depth Camera D435. After license successfully activated, a physical license file is downloaded to user's local system. The license will be valid for a specified period, depends on the license that user purchased. A trial

license expires 30 days after activation. Paid licenses are perpetual. A license can only be used with a single Intel® RealSense™ Depth Camera D435.

5. Each time TCS software launches, it verifies the license and only proceeds if a valid license is present. If a valid license is not found or the license found is expired, the user will be redirected to www.intelrealsense.com store for purchasing a license.

This user's guide describes the processes required after downloading the TCS software, i.e., setup hardware and software to operate TCS with an Intel® RealSense™ Depth Camera D435.

Figure 2-2 High Level User Flow



3 Getting Started

3.1 What's Required?

- Intel® RealSense™ Depth Camera D435
- Monitor
- A fixture to mount the camera above the monitor
- PC/Tablet with Windows 10, USB3 port, mouse and keyboard
- A USB Type-C cable long enough to connect the camera to the computer
- Order Intel® RealSense™ Touchless Control Software at https://store.intelrealsense.com. You should receive a product key and link to download software via email
- A local user account on your windows system with administrator privileges

3.2 Setup Hardware

Follow instructions in Chapter 4 *Hardware Installation* to connect monitor, camera, and mount camera to the required position.

3.3 Download and Install Software

After signing up TCS, you should receive an email with the software product key and link to download the software. Follow instructions in Chapter 5 *Installing Intel® RealSense™ Touchless Control Software* to install the software.

3.4 Launching application and Activating License for Target Camera

TCS license must be activated for the target camera with the Activation Tool. Activation Tool can be invoked with the Activate button in TCS application or the Intel RealSense Activation Tool link under Windows Start menu.

Refer to Chapter 6 *Running TCS Application*, section 6.4 *Activating License* for detailed steps.

3.5 Configuring TCS

Once camera is activated, TCS creates a default configuration with automatically detected monitor size, virtual touch coverage, and default camera to screen distance. Modify the configuration to fit your application.

Refer to Chapter 6 *Running TCS Application*, section 6.5 *Initial Configuration* and 6.6 *Configuration* for detailed steps to adjust camera position and complete configuration.

3.6 Calibrating and Running TCS

Once TCS is configured, calibrate it with either Manual or Auto Calibration.

Refer to Chapter 6 *Running TCS Application*, section 6.7 *Calibration* and section 6.9 *Running TCS* for detailed steps to calibrate and run in background.

3.7 Advanced Settings, Tunning, and Customization

Half/Partial Screen Support - if you need to setup TCS only on partial screen, Chapter 8 *Half/Partial Screen Support with TCS* provides step by step example to configure half screen virtual touch on a 32" monitor.

Tunning – advanced settings are described in detail in Appendix B – *TCS Click Settings*

Customization – Chapter *Customizing TCS* provides details in customizing sound and visual effects with virtual touch.

4 Hardware Setup

4.1 Connecting the Monitor

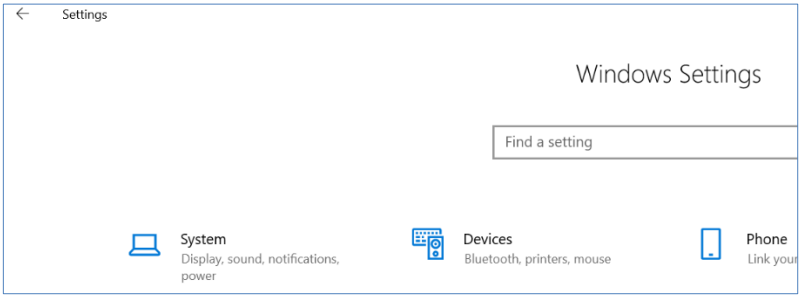
Connect the monitor to the PC. If you only have one monitor connected, skipped the multiple monitor steps below.

[IMPORTANT]

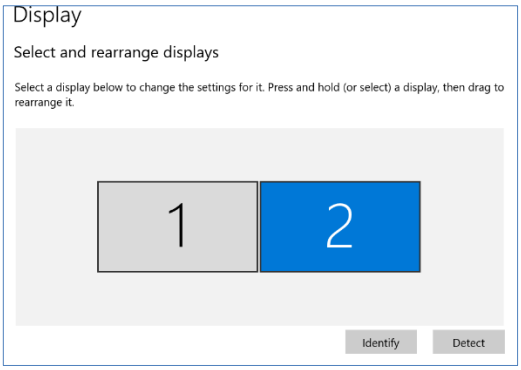
If multiple monitors are connected, make sure the target monitor is configured as main display in Windows OS Settings -> System -> Display.

Select Settings from Windows Start.

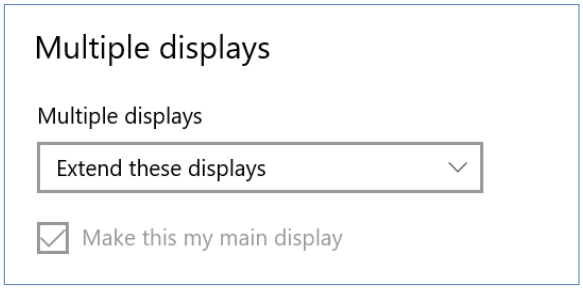
Choose System under Settings.



Under Display, identify the monitors by press the Identify button and choose your target display.



Under *Multiple Displays*, choose *Extend these Displays* and check the *Make this my main Display* checkbox.



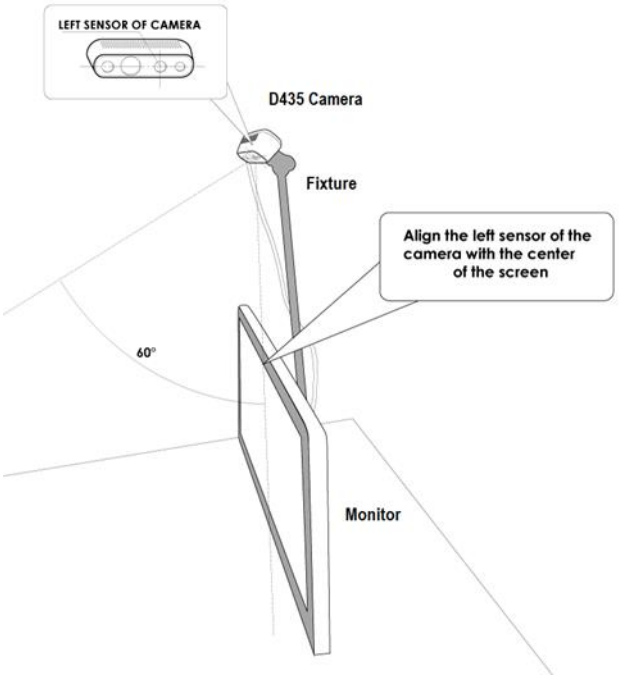
4.2 Connecting the Depth Camera

Connect the Intel® RealSense™ Depth Camera D435 to the USB3 port on the PC. For Camera connection and compatible cable requirements, please refer to *Intel® RealSense™ Product Family D400 Series Datasheet* for details.

4.3 Mount Camera above the Monitor

TCS requires the Intel® RealSense™ Depth Camera D435 mounted above the monitor at specified position. For use in production or commercial applications, specially designed fixture is recommended for better stability and accuracy. For experimental usages, a regular tripod with ¼" mounting screw can also be used to mount the camera.

Figure 4-1Camera Mounting Position Overview



4.3.1 Camera Horizontal Position

Position camera horizontally with baseline parallel to screen top edge as much as possible.

Align camera left sensor horizontally above the monitor with middle of the screen top edge (the depth origin is at the left sensor and FOV is centered around the left sensor).

4.3.2 Camera Tilt Angle

Camera should be tilted forward so that the monitor screen is not in camera vertical FOV (see Figure above). For D435, the tilt angle is about 30 degrees.

4.3.3 Camera Vertical Position

The camera should be positioned vertically a distance of L from the top edge of the display viewing screen to the camera. The distance varies with display size and orientation, and can be roughly estimated by the formula below, limited by horizontal FOV of the camera and the width of the display screen, as illustrated in the figure below.

L = 0.6 * W

The minimum camera to screen distance is 20 cm.

Figure 4-2. Camera Mounting Position Overview

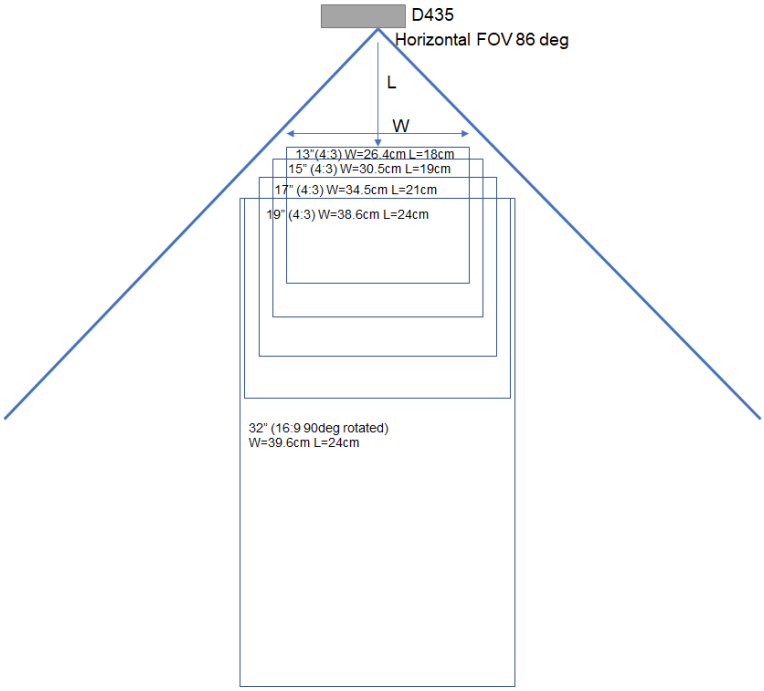


Figure 4-3 Illustration of the allowable interaction region, when D435 camera is mounted directly above a screen, showing different screen sizes and aspect ratios

The required distance may be impacted by other factors, Virtual Touch ROI (Region of Interest) when only partial screen coverage is required.

Later when run the TCS application, it will automatically compute the required distance and reports on the dashboard. It will be also reported in the setup process.

Install the camera at the distance based on the formula above, then fine tune if needed during the setup process while running the application.

4.3.4 Camera Installation Drawings

Figure 4-4. Camera position front view with monitor in landscape orientation

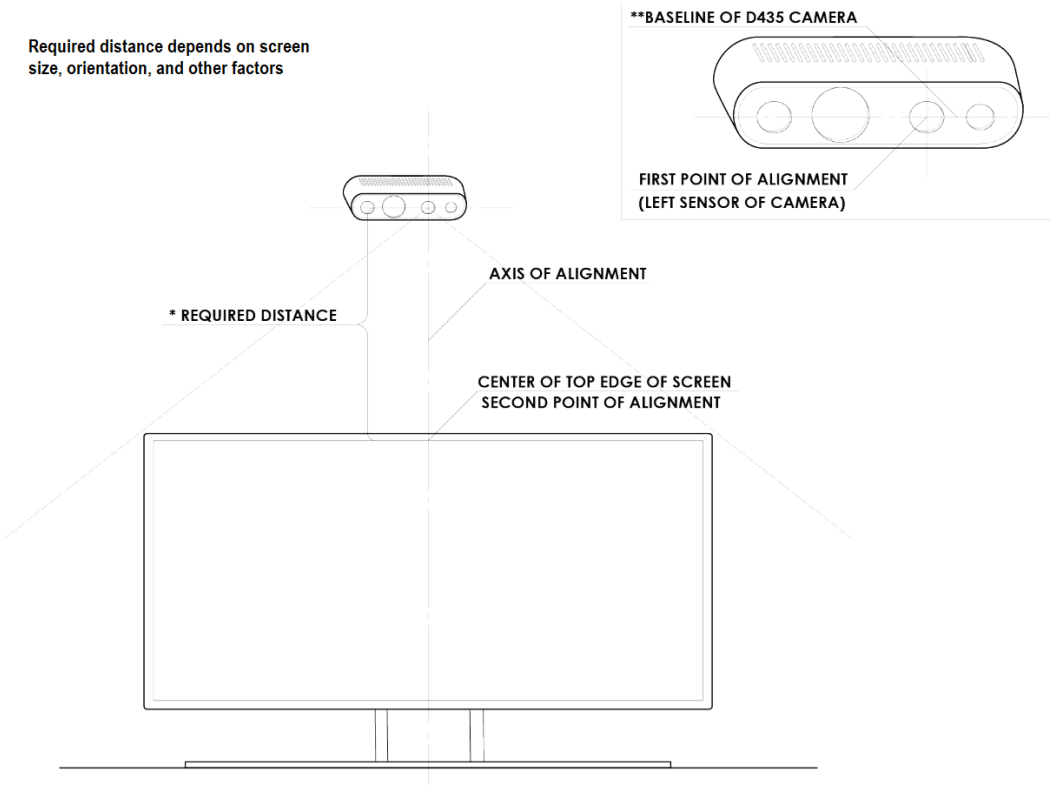


Figure 4-5 Camera position front view with monitor in portrait orientation

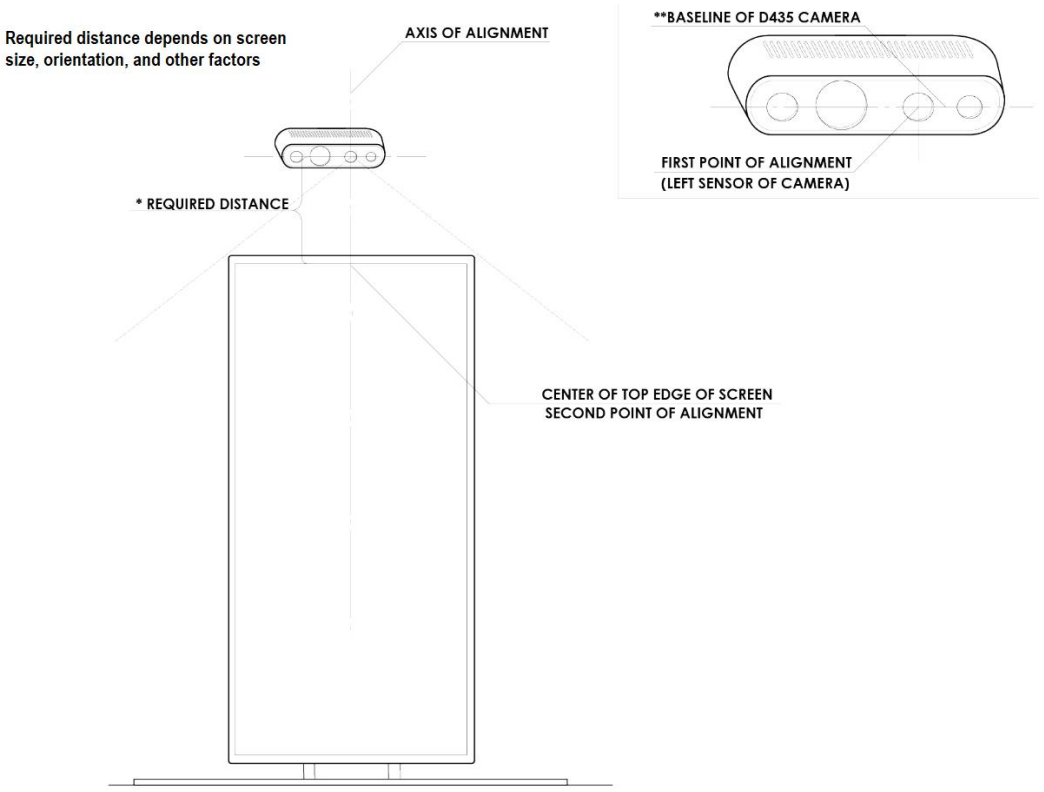
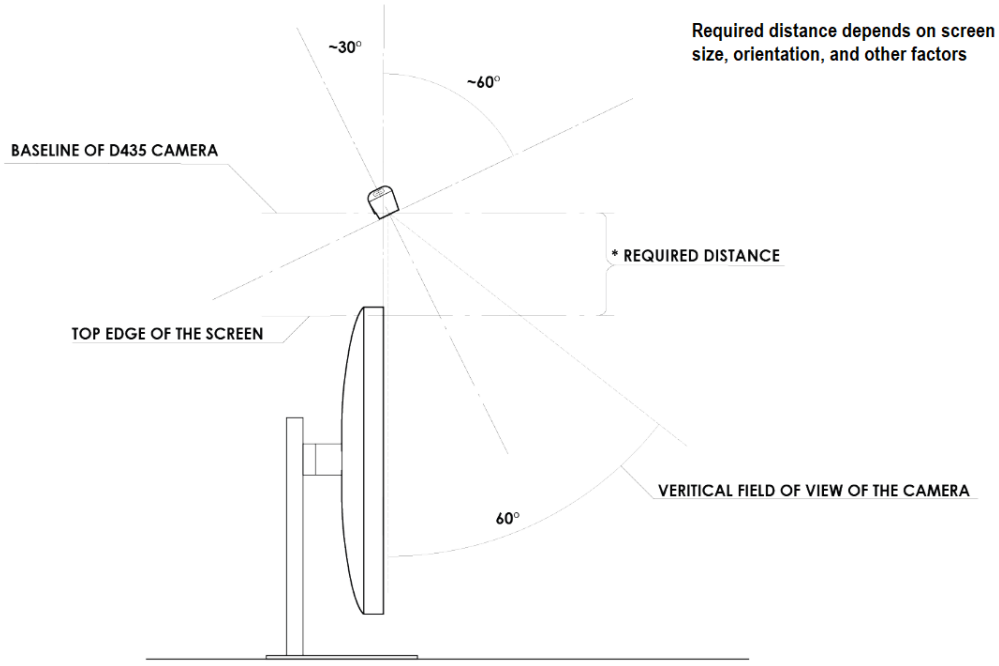


Figure 4-6 Camera position Side View with monitor in landscape or portrait orientation



4.4 Example Setups

Example setups with 32" display in landscape and portrait modes are shown below. The camera is mounted on top of the tripod above the monitor.

Figure 4-7 Camera position Front and Side Views with 32” Monitor in Landscape Orientation and Full Screen Virtual Touch Coverage

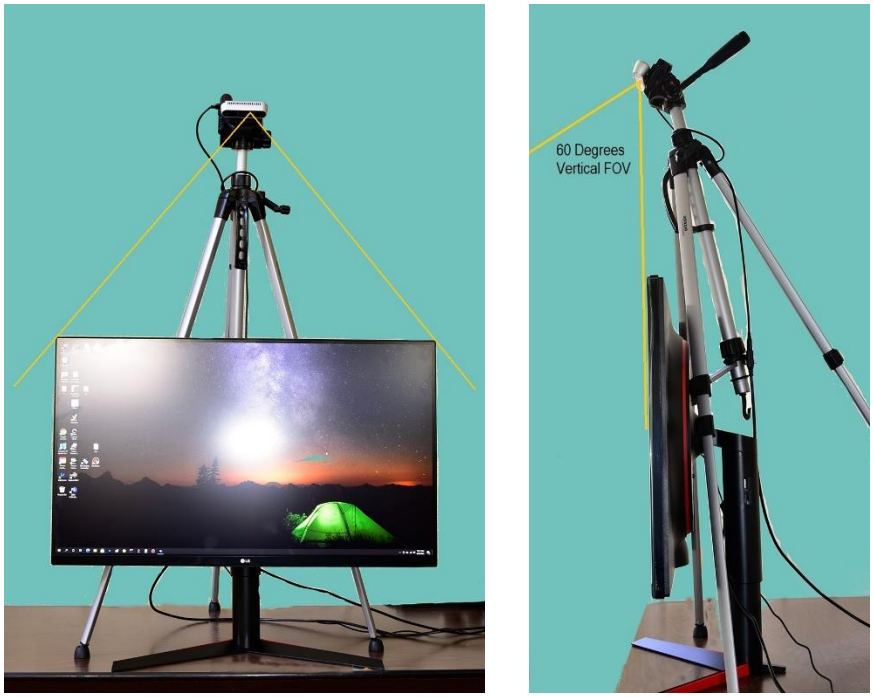
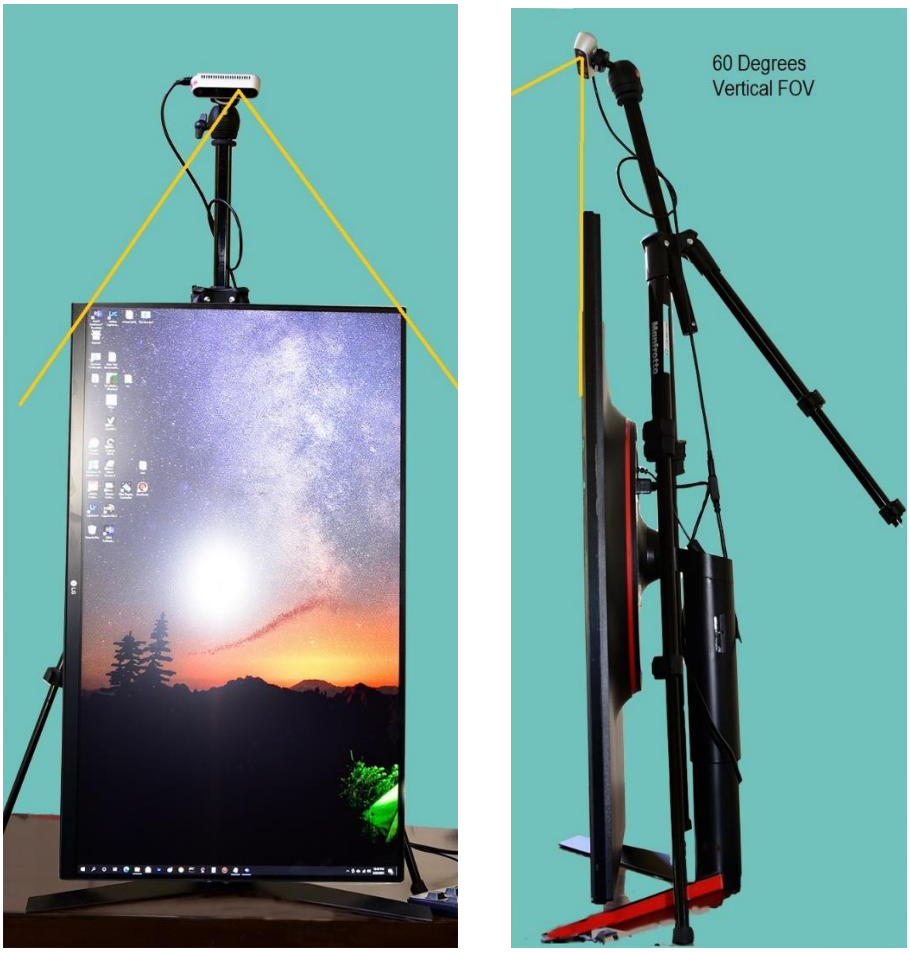


Figure 4-8 Camera Position Front and Side Views with 32” Monitor in Portrait Orientation and Full Screen Virtual Touch Coverage



5 Installing Intel® RealSense™ Touchless Control Software

Intel® RealSense™ Touchless Control Software (TCS) is supported on Windows 10 64-bit and Windows 7 64-bit platforms.

5.1 Download Installer Package

After ordering Intel® RealSense™ Touchless Control Software on Intel RealSense store site, you will receive a couple emails.

Download the TCS installer package Tcs-x.x.x.x.zip from the Download software link in one of the emails with title Software product key for order #xxxxxxxxxxx.

Unzip it into the single executable TCS installer and readme, for example,

- setup_realsense_tcs_1.0.0.0.exe
- TouchlessControlSoftware_README.txt

5.2 Connecting the Depth Camera

Connect the Intel® RealSense™ Depth Camera D435 to the USB3 port on the PC. For Camera connection and compatible cable requirements, please refer to *Intel® RealSense™ Product Family D400 Series Datasheet* for details.

On Windows 7 platforms, it is important to make sure the camera is connected to the system before running the installer because the installer also installs a device driver for Intel® RealSense™ Depth Camera D435.

5.3 Install Procedure

Double click the installer to install on your system. By default, it installs under C:\Program Files\Intel® RealSense™ Touchless Control Software.

If a previous version is already installed, TCS will detect it and provide user option to uninstall it automatically before installing the new version.

Figure 5-1 Detect existing installation

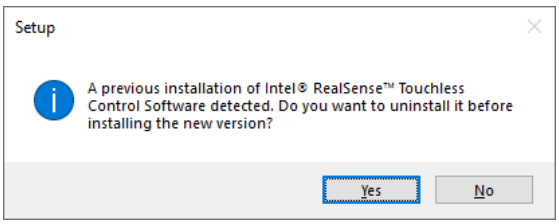


Figure 5-2 Installation start screen

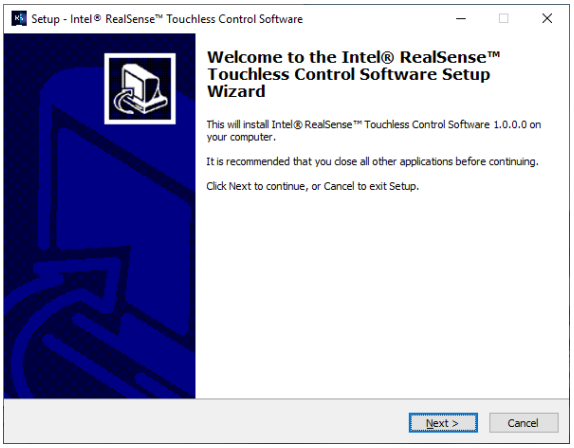
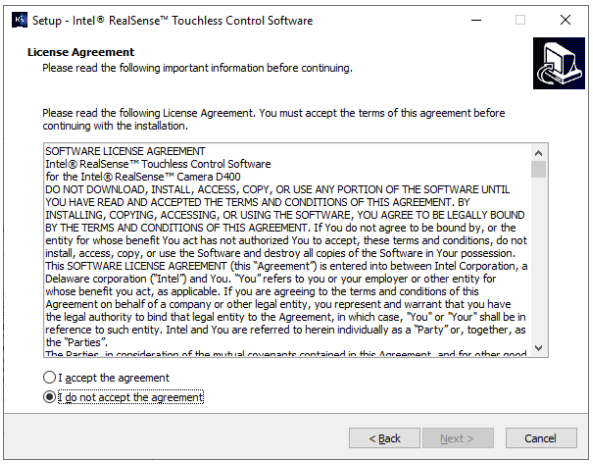


Figure 5-3 TCS Installation license review



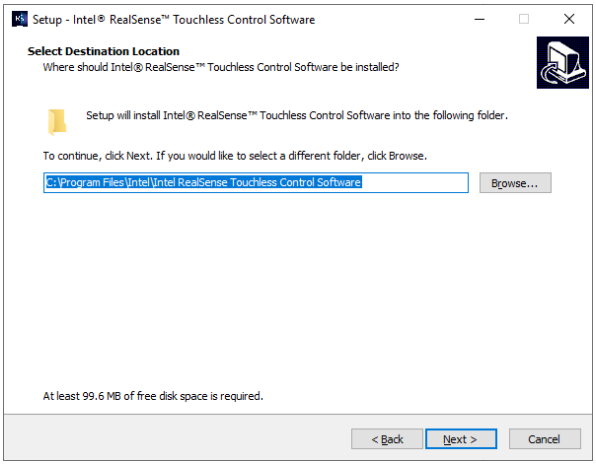


Figure 5-4 TCS Installation location

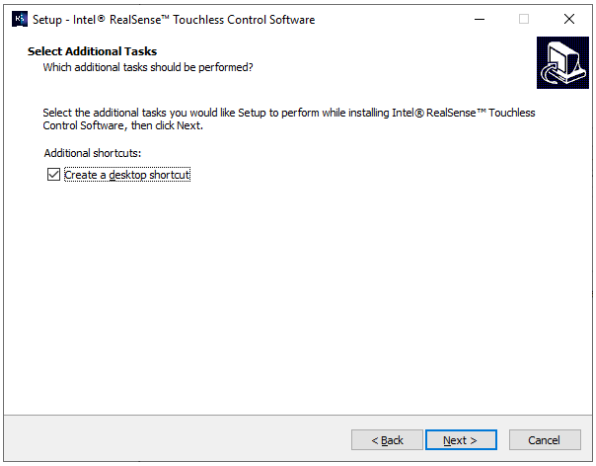


Figure 5-5 TCS Installation desktop shortcut

Intel® RealSense™ Touchless Control Software requires Microsoft Visual C++ 2019 Redistributable installed on the host system. The install package installs this library automatically, so normally user should not need to install this separately.

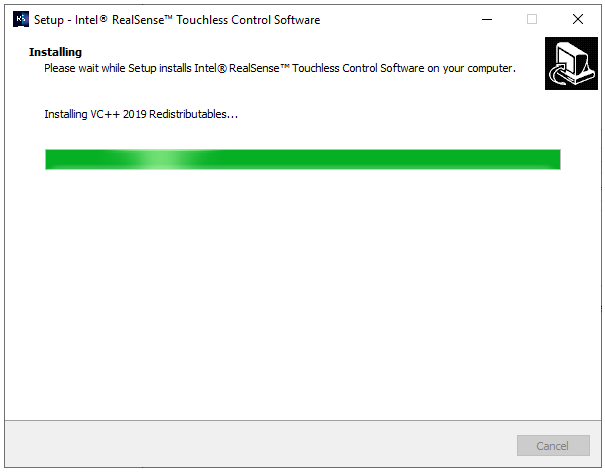


Figure 5-6 TCS Installation files copy and 3rd party libraries

Windows 7 Only

On Windows 7, a device driver for Intel RealSense Camera is required and it will be installed at end of the installation. A popup window displays options to user. Make sure check the *Always trust software from Intel Corporation* checkbox and click the *Install* button.

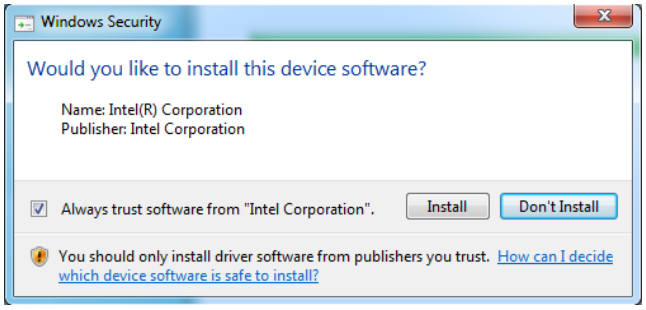


Figure 5-7 Installing Intel RealSense Camera Driver on Windows 7

After files are installed and configured, the installation is completed.

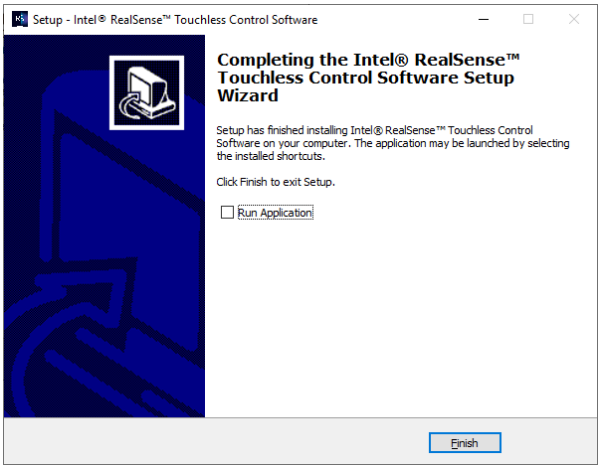


Figure 5-8 TCS Installation finish screen

Windows 7 Only

On Windows 7, the installer may initiate a system reboot. Choose *Yes* to complete the installation.

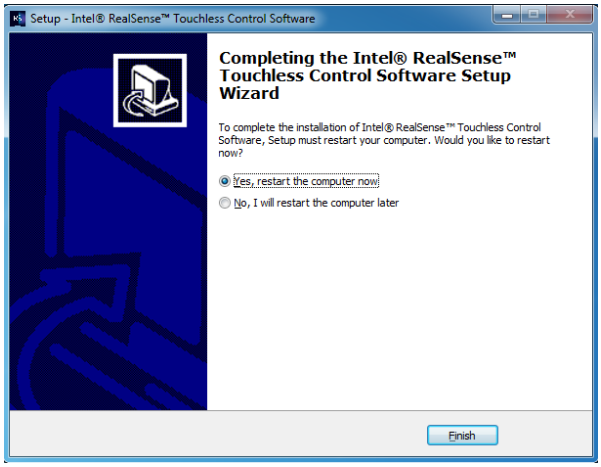


Figure 5-9 System Reboot on Windows 7

5.4 Installation Location, Desktop Shortcut, Start Menu

The installer installs files, creates shortcut on desktop, and links under the Windows Start menu.

5.4.1 Installation Location

The software is installed by default under

C:\Program Files\Intel\Intel RealSense Touchless Control Software
|-------- **realsense_tcs.exe**
|-------- **RealSenseActivationTool.exe**
|-------- unins000.exe
|-------- Legal Notices
| |-------- Attributions.pdf
| |-------- license.txt
| |-------- readme.txt
|
|-------- resources
| |-------- VC_redist.x64.exe
| |-------- .....
|-------- **drivers (Windows 7 only)**
| |-------- IntelRealSense_D400_series_win7.inf
| |-------- .....

The installed directory contains two applications and their dependent libraries and configurations:

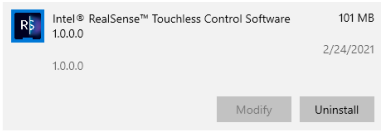
- **realsense_tcs.exe -** main TCS application
- **RealSenseActivationTool.exe** – Activation Tool for license activation
- Legal Notices – legal related files
- **Driver** – **Windows 7 platform only**. device driver for Intel® RealSense™ Depth Camera D435.

5.4.2 Desktop Shortcut

By default, the installer will create Intel® RealSense™ Touchless Control Software icon links to realsense_tcs.exe at the system desktop.

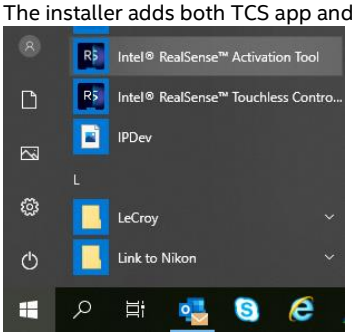
5.4.3 Windows Apps and Features List

After successful installation, Intel® RealSense™ Touchless Control Software with the correct version number should also appear in the Apps and Features list in Windows.



5.4.4 Windows Start Menu

The installer adds both TCS app and Activation Tool to the Windows Start menu.



5.5 Uninstall Procedure

Two ways to remove the Intel® RealSense™ Touchless Control Software:

- Through Uninstall in Apps and Features
- Invoke the uninstaller unins000.exe directly from the installed directory, by default, C:\Program Files\Intel\Intel RealSense Touchless Control Software.

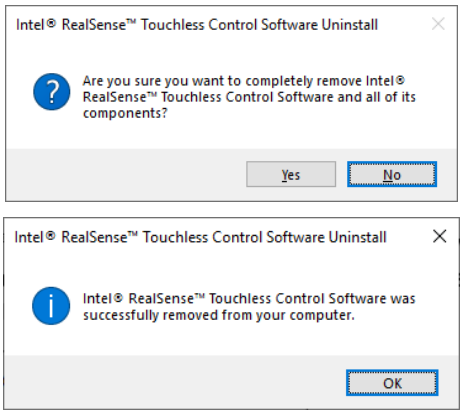


Figure 5-10 TCS uninstall

The uninstall process should remove all installed files except the license file or other user created files.

5.6 Install/Uninstall while Application is Running

The installer/uninstaller detects automatically if a TCS application process is running and provide user option to stop the process before install/uninstall or cancel.

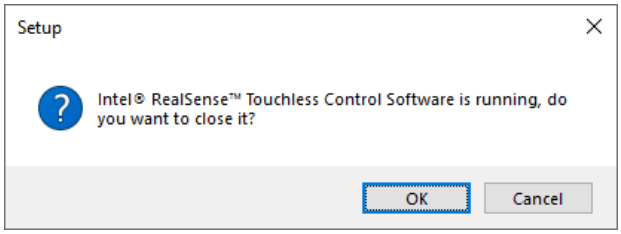


Figure 5-11Message to close running process before install/uninstall

5.7 Install Camera Device Driver on Windows 7

Intel® RealSense™ Depth Camera D435 requires a device driver on Windows 7 platforms. Normally if everything goes well, the installer should have already installed the driver as part of the installation process, and the connected camera should appear on device manager with device driver functional as shown below.

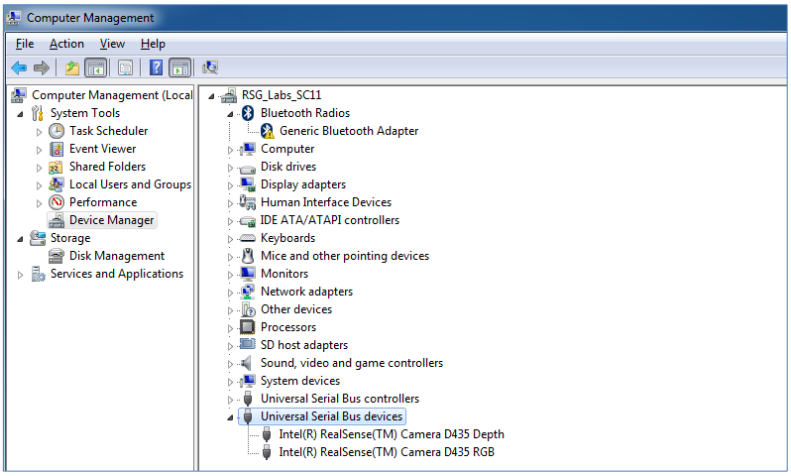


Figure 5-12 Intel RealSense Depth Camera D435 on Device Manager

However, if for any reason, the device driver is not configured properly during the installation process, the camera appears on device manager with a yellow bang (see Figure below) or the camera is not detected by TCS, the driver can be configured manually.

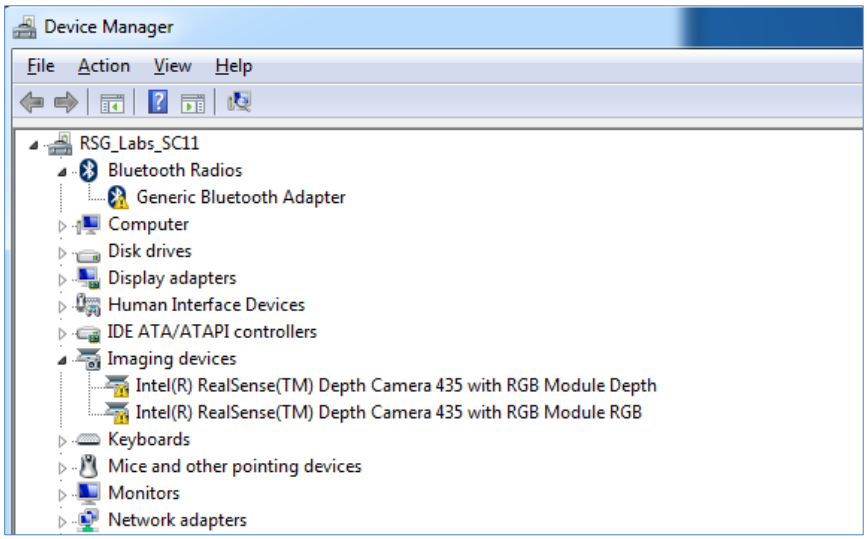


Figure 5-13 Intel RealSense Depth Camera D435 with Yellow Bang

The yellow bang on the camera in device manager indicates problem, most likely the device driver is not properly configured.

Follow the steps below to manually configured the device driver.

1. Right click on Intel RealSense Depth Camera 435 with RGB Module Depth
2. Select Update Driver Software
3. Select Browse my computer for driver software
4. Select Let me pick from list of device drivers on my computer
5. Select Have Disk
6. Browse to the folder where driver is located under C:\Program Files\Intel\Intel RealSense Touchless Control Software\driver.
7. Choose IntelRealSense_D400_series_win7
8. Click Open
9. Click Next
10. A window may popup with message Windows can't verify the publisher of this driver software
11. Click Install this driver software anyway
12. Once configuration completes, the yellow on Intel RealSense Depth Camera 435 with RGB Module Depth should disappear.
13. Repeat the same steps 1 to 12 on Intel RealSense Depth Camera 435 with RGB Module RGB

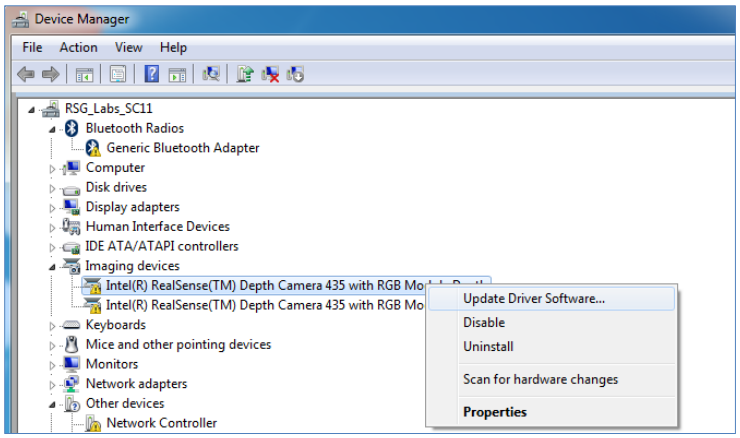


Figure 5-14 Update Driver Software

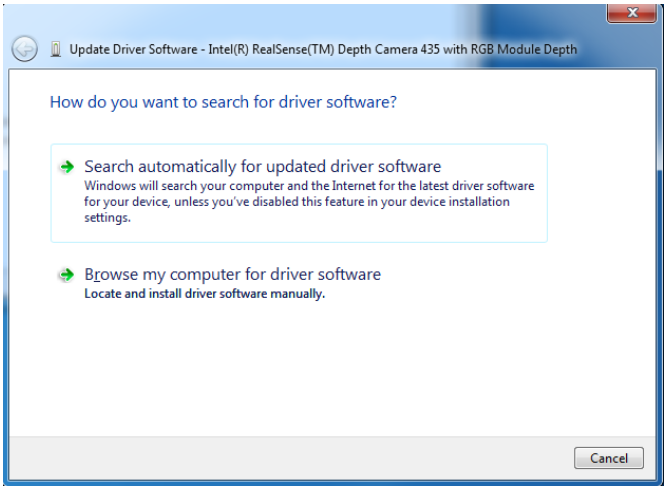


Figure 5-15 Browse driver software

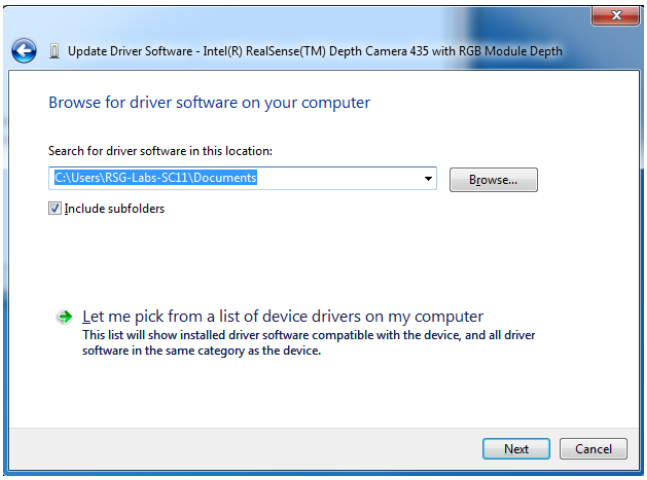


Figure 5-16 Pick from List of Drivers

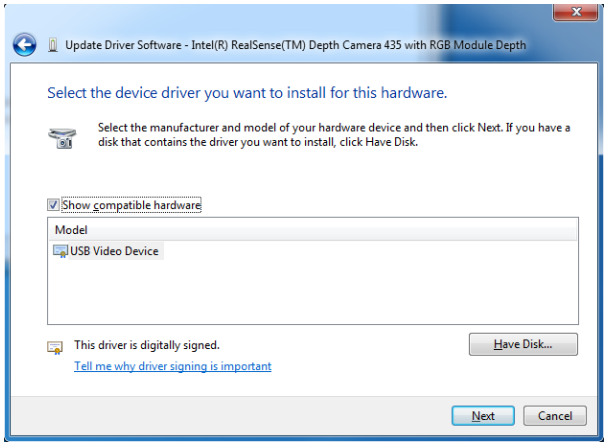


Figure 5-17 Select Device Driver from a specified location

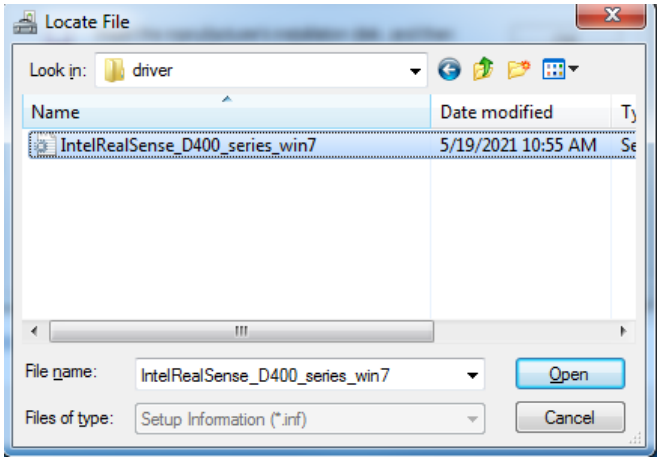


Figure 5-18 Select Intel RealSense D400 Series Windows 7

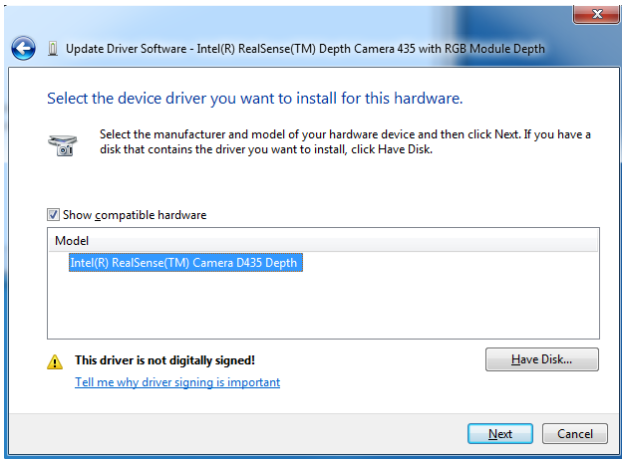


Figure 5-19 Device Driver Selected

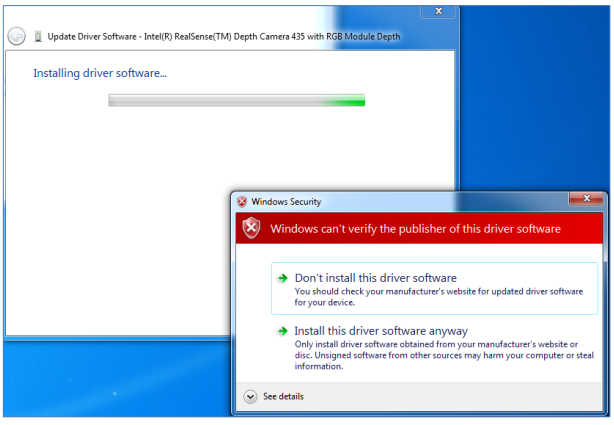


Figure 5-20 Install driver software

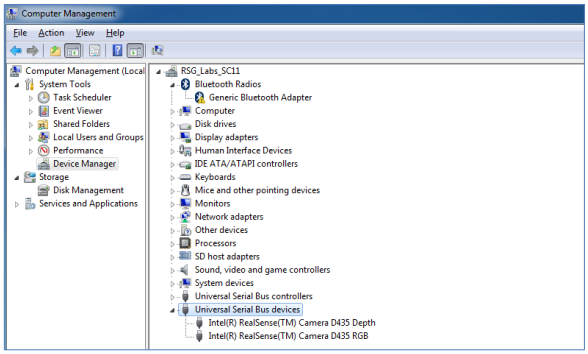


Figure 5-21 Intel RealSense Camera D435 with Driver Properly Configured

6 Running TCS Application

6.1 Launch App

Launch TCS app by double clicking the Intel® RealSense™ Touchless Control Software icon on desktop or click the Intel® RealSense™ Touchless Control Software link in Windows Start menu.

App starts a console window which disappears quickly and then a graphical Window appears. Keeps everything default for now.

6.2 User Interface

The application interface includes main Dashboard view and Settings view. Dashboard shows overall status, control and tools for setup and calibration. Settings for details, troubleshooting, and customization. A toggle button at the top right corner switches between the two views.
Once launched, the application also appears in system tray.

6.2.1 Dashboard View

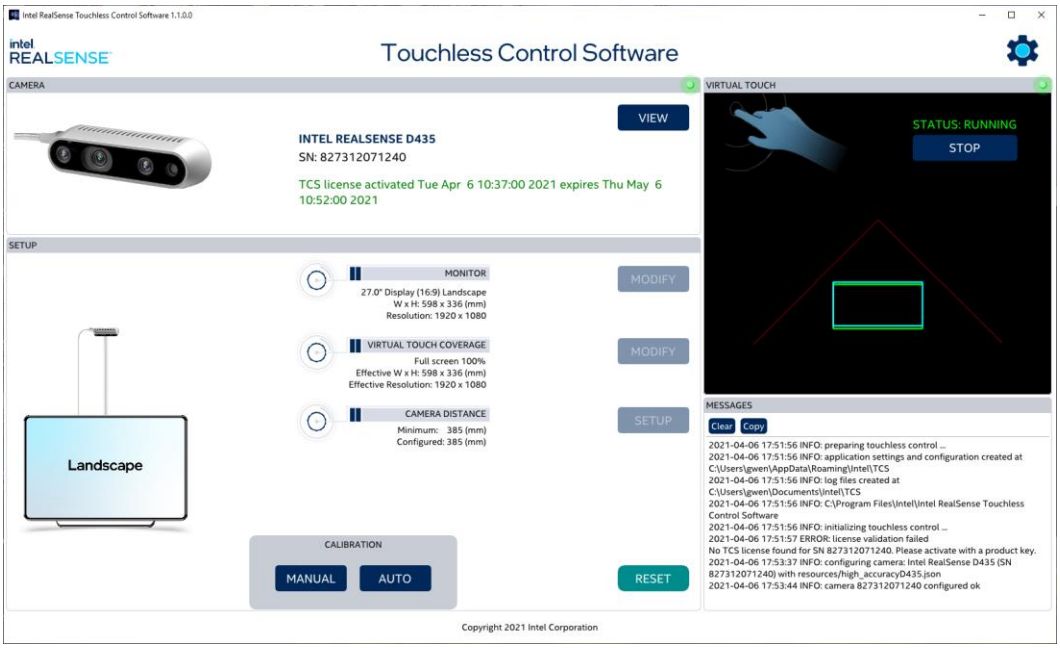


Figure 6-1Dashboard View

- **Camera** – show current camera status, licensing status, button to activate license, and button for camera views.
- **Setup** – monitor, and tools to setup and configure. At initial launch, detected camera and monitor listed as part of an automatic configuration. Minimum required camera to monitor distance is displayed in under camera distance. The setup button can be used to assist/verify camera installation and make sure it's installed at the correct position. It includes detailed drawings for the recommended camera position.
- **Virtual Touch** – once calibrated through the calibration tools, visualize the Virtual Touch Plane (VTP). The service start/stop button appears on the top.
- **Icon Button at top right corner** to switch between Dashboard and Settings.

6.2.2 Settings View

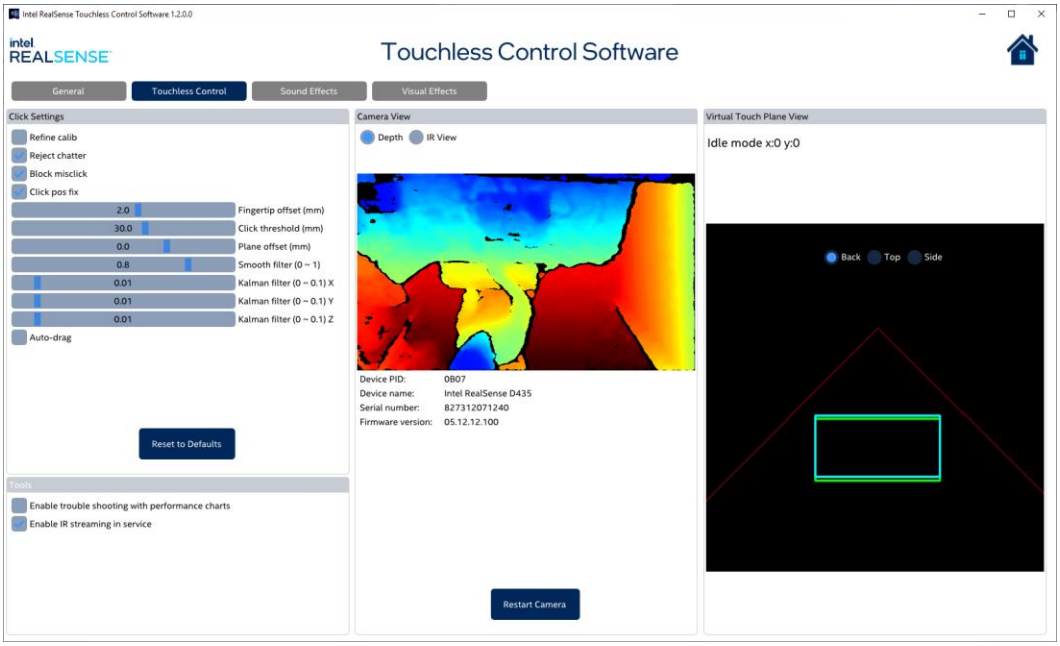


Figure 6-2 Settings/Debug View

- **Click settings** – parameters for tuning Touchless Control behavior and performance.
- **Camera View** – live camera view, by default, shows both depth and IR view. IR can be turned on/off through the *Enable IR streaming in service* under tools.
- **Virtual Touch Plane** with click activities.
- **Tools** – to capture and display performance charts for troubleshooting, also to switch on/off IR stream. By default, IR stream is turned on in TCS. When TCS is running production after setup, turn IR off can reduce CPU overhead and increase performance.

6.2.3 TCS Application in System Tray

Click the “Close” button at top right corner of the application window will hide the app into the system tray.

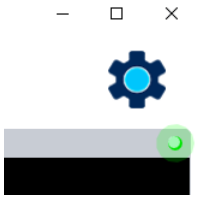


Figure 6-3 Close button to hide application window into system tray

TCS application appears in the system tray.

- The dashboard can be brought up again by clicking Control Panel in TCS tray app located in the lower right corner of the desktop.
- Enable Touchless Control option can enable/disable the service, and the application window can be brought up again through Control Panel in TCS tray menu

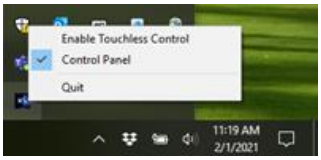


Figure 6-4 Control Panel option in Tray Menu

- The Quit option on tray menu shuts down the TCS service and exits from the application.

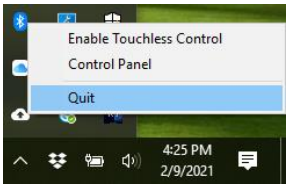


Figure 6-5 Quit option in Tray Menu

6.3 Initial Screen

The application dynamically detects camera device connection and disconnection.

If the camera already connected on the host, the application checks TCS license for the camera. Initially, no license should be found. The camera image with red “LIC” overlay appears at top left and a blue Activate button on the right side of the camera window. A warning message indicates no license detected and asks user to activate the license.

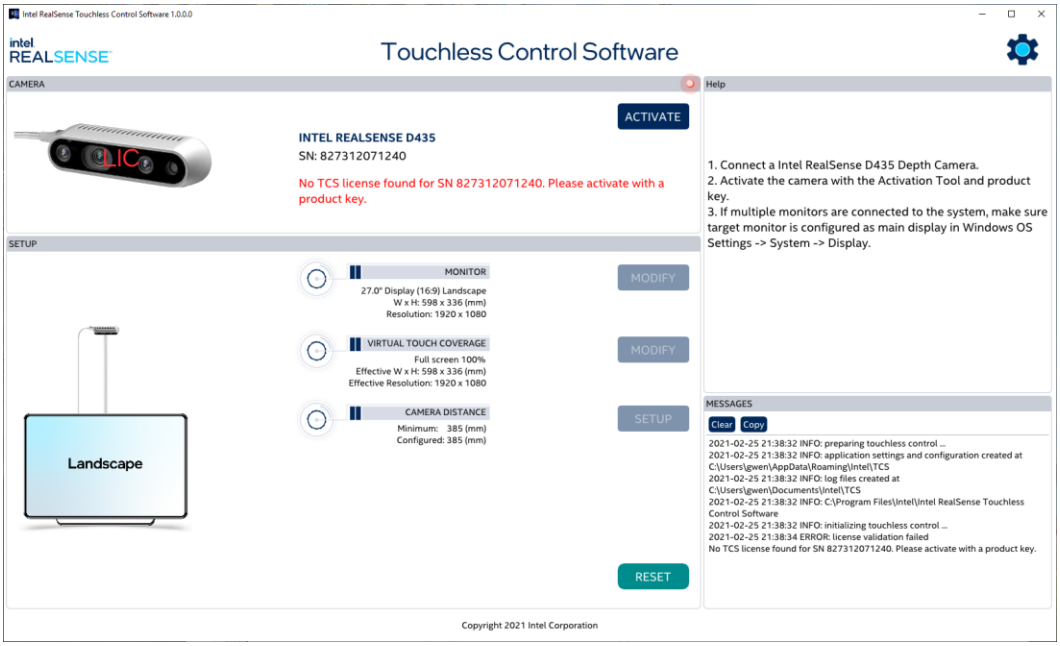


Figure 6-6 Initial Screen with Un-activated Camera Connected

6.3.1 No Camera Connected

If no camera is connected, a disconnected camera picture with a red question mark appears and warning message to alert user to connect an Intel RealSense camera D435.

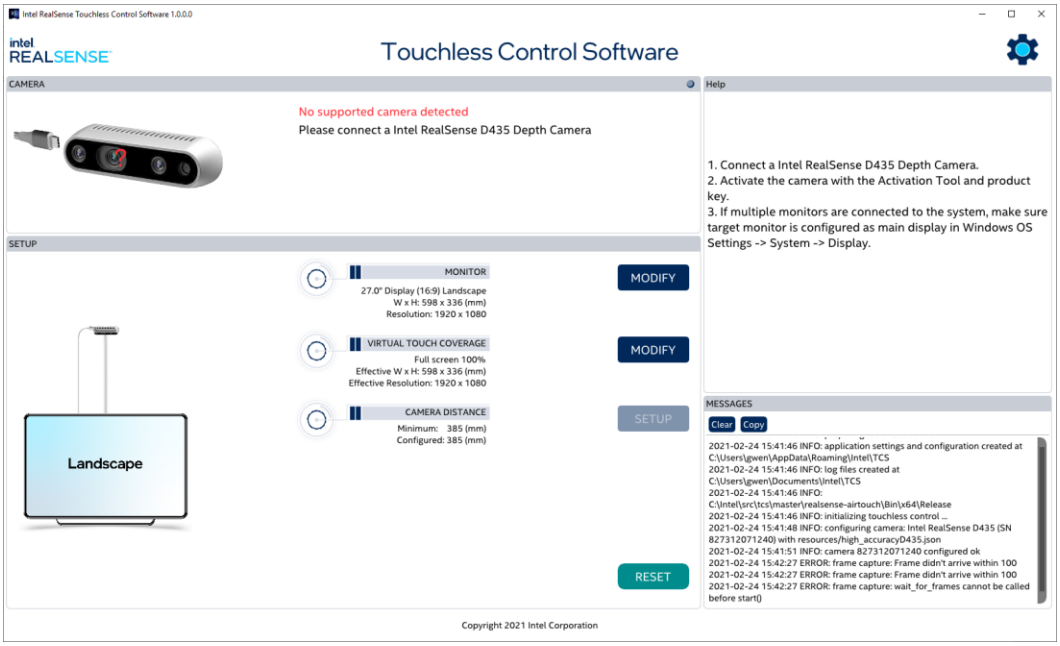


Figure 6-7 Initial Screen with No Camera Connected

6.3.2 Camera Enumerated as USB2 Device

If the connected camera enumerates as a USB2 device by error, a camera image with red USB2 overlay appears and alerts user the camera is enumerated as USB2. TCS requires USB3 cameras. In this case, please check the USB port, cable and hub to make sure all are USB3. Another possible cause is the camera was plugged in too slowly. Disconnect the camera and reconnect usually fixes the issue.

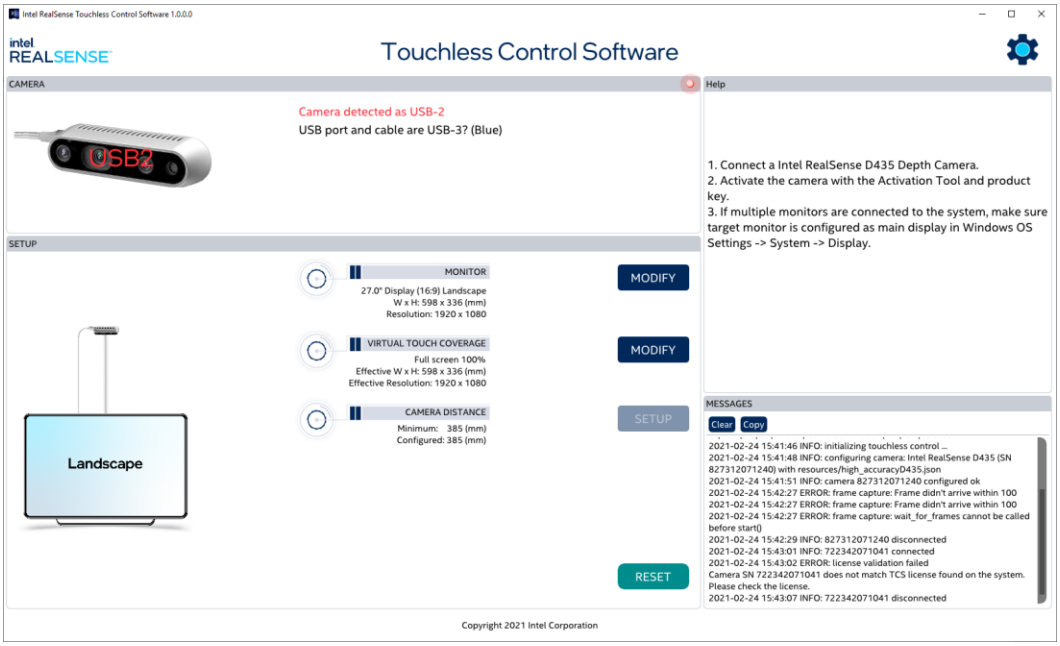


Figure 6-8 Initial Screen with Camera Enumerated as USB2

6.3.3 Unsupported Camera Connected

If the connected camera is not supported, the following screen appears and alert the user the camera is not supported. Currently, only Intel RealSense Camera D435 is supported.

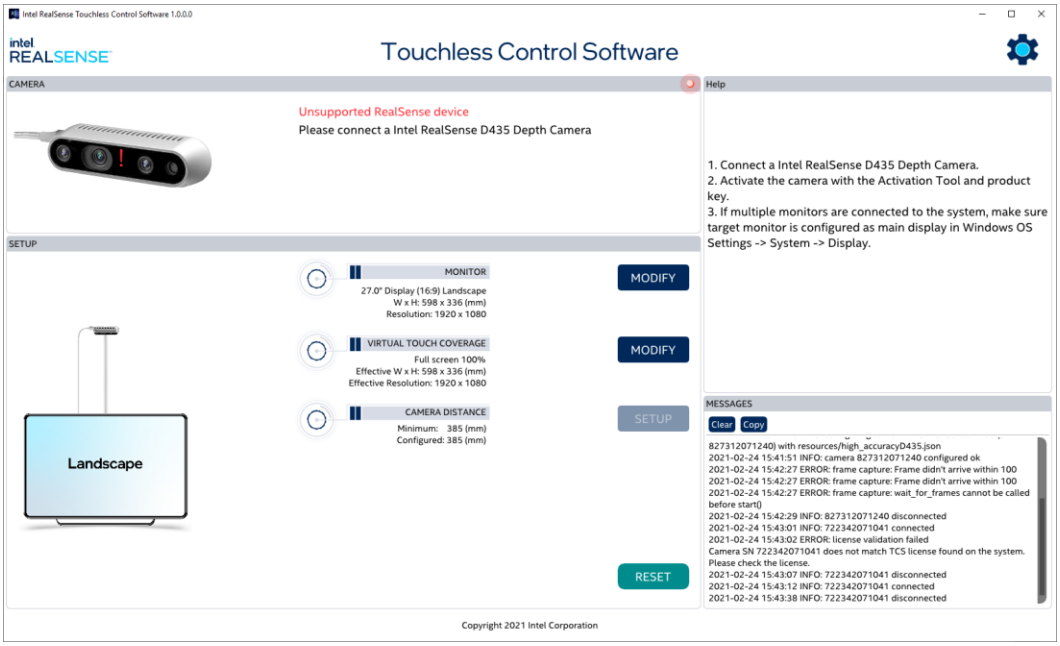


Figure 6-9 Initial Screen with Unsupported Camera Connected

6.4 Activating License

TCS is licensed for a specific Intel RealSense Camera D435. Each camera requires a separate license. A license can be activated with the Activation Tool by providing

- the camera's serial number
- product key
- email address (*the same email address used to order license and receive the Software product key for order #xxxxxxxxxx notification*)

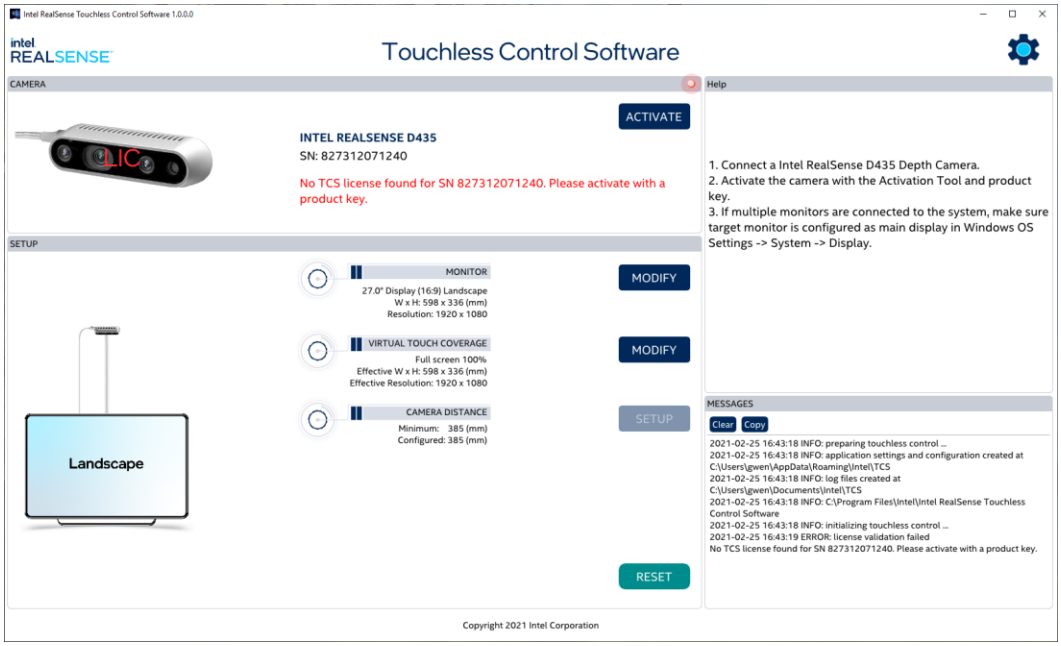


Figure 6-10 Camera Connected before Activation

6.4.1 Launch Intel RealSense Activation Tool

Launch the Intel RealSense Activation Tool by clicking the *Activate* button. An alternative is to launch it out side of the TCS application by invoking the Intel RealSense Activation Tool in the Windows Start menu.

IMPORTANT:
The tool requires Administrator privilege. Depends on your system setup, a flashing UAC (User Access Control) message box may appear at the bottom. Sometimes it's hard to notice, especially on larger screens. Click the UAC message box, then click Yes to allow Intel RealSense Activation Tool to start the license activation process.

Figure 6-11 UAC Message Box after launch the Activation Tool

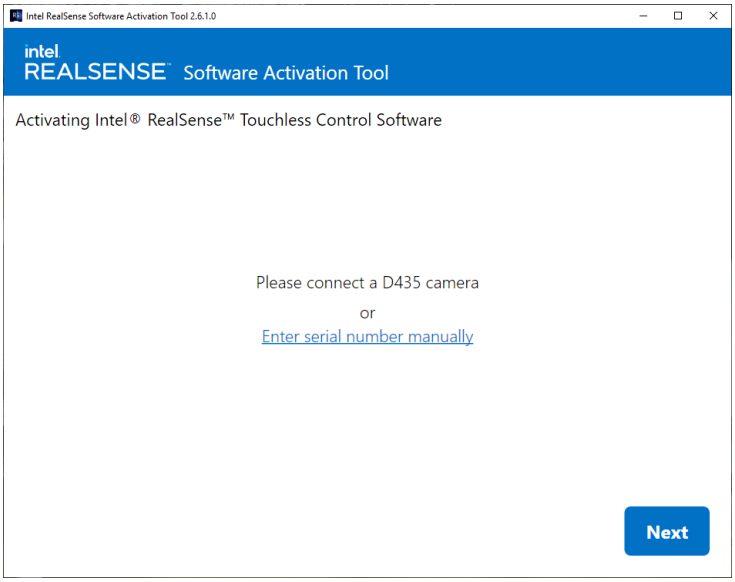


Figure 6-12 Activation Tool Launch

Make sure D435 camera is connected, or manually enter the camera's serial number. Click Next.

6.4.2 Providing Product Key

If no serial number is entered manually, the activation tool detects the connected camera automatically. Its serial number is displayed. Enter the product key you received in email. Click Next.

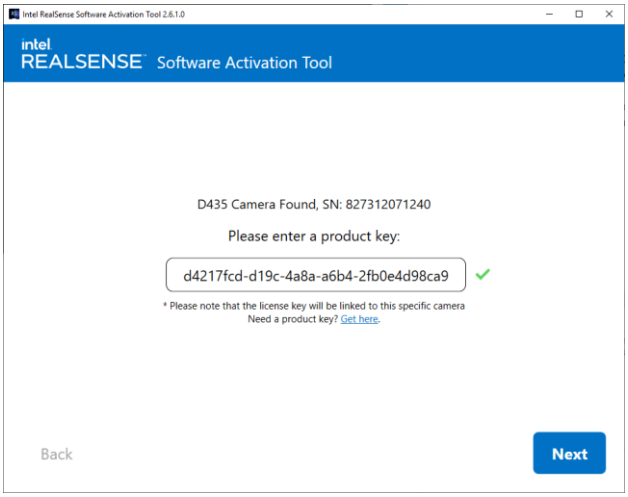


Figure 6-13 Providing Product Key

6.4.3 Providing Email Address

Enter the email address (should be the same email address used in ordering the license and receiving the product key). Click Next.

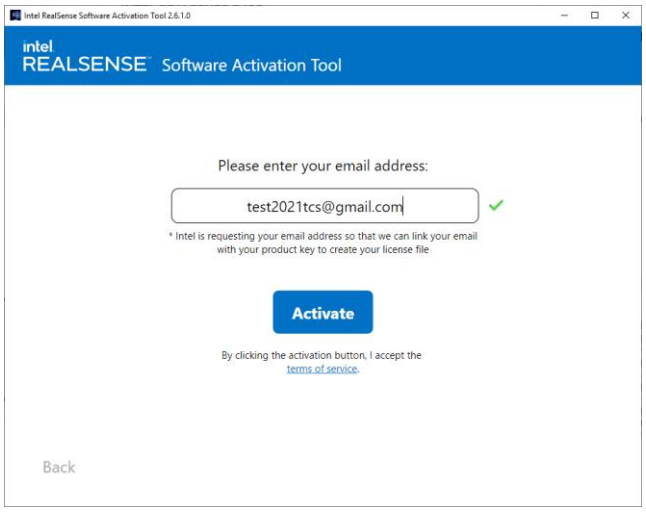


Figure 6-14 Providing Email Address

6.4.4 Activating

Activation starts. Depends on your network condition, may need to wait a few seconds up to 30 seconds.

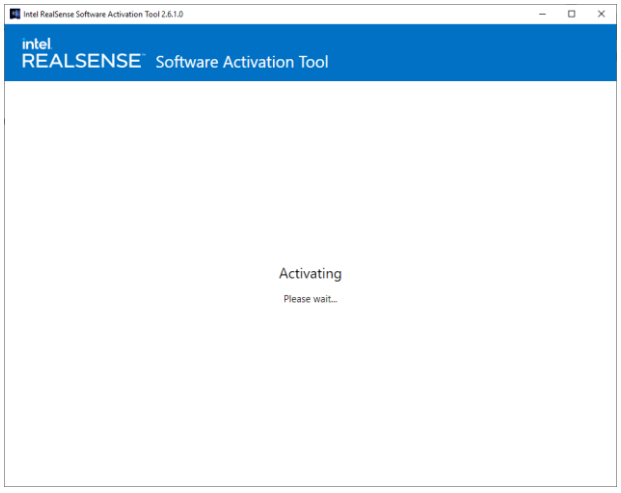


Figure 6-15 Activating License

6.4.5 Completing Activation

When activation completes, it displays the following message. The license is stored under the %APPDATA%\Intel\TCS folder. The expiration date for trial license should be days, and the full license will not expire (license file shows a 50 years expiration date but license itself is perpetual). Click the highlighted link to check the license. The license file name starts with realsense-tcs-lic and ends with the camera serial number. Please do not move the license file. TCS will automatically detects and use it later.
Click Done to exit the Activation Tool.

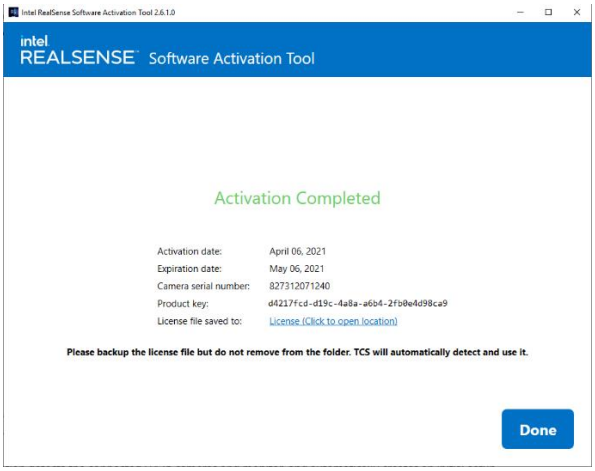


Figure 6-16 Activation Completed

6.5 Initial Configuration

Once camera is activated, the camera image becomes active with the license information below and a View button on the right side. The View button is used to view camera's live stream and troubleshooting.

TCS Application detects the connected D435 cameras and monitor, and automatically creates an initial setup configuration. The configuration is displayed on the dashboard.

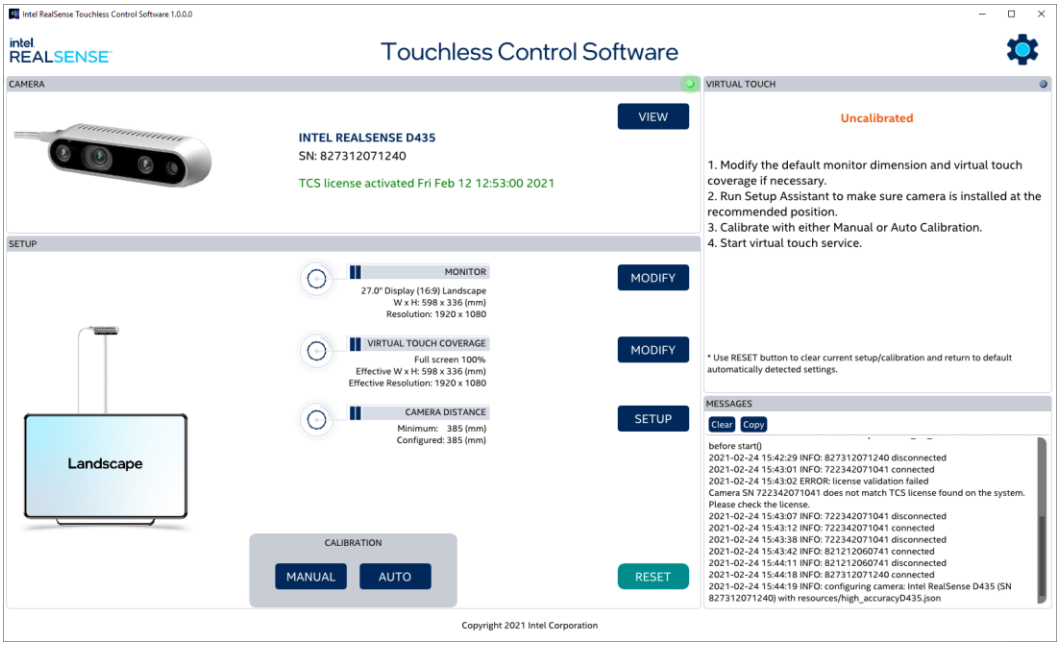


Figure 6-17 Initial Configuration with Automatic Detected Settings

The required camera distance is also computed and displayed under setup. Please use it as reference in adjusting camera position.

By default, TCS is not calibrated.

- **If camera is not already positioned as recommended** (see Hardware Setup), setup process can be used to configure, fine tune, and confirm. At end of setup, it will be calibrated once confirmed.
- **If camera is already installed properly**, can calibrate directly with **Manual Calibration** or **Auto preset**.

6.6 Configuration

When initial launch, TCS detects the camera and monitor and automatically creates a configuration with the detected settings, and a default full screen virtual plane coverage, Check and verify the automatic configuration, modify with the Modify buttons.

A minimum distance from camera to screen is recommended based on the monitor dimension and virtual touch coverage settings. The Setup button is an assistant tool to make sure camera is installed at the correct position.

6.6.1 Monitor configuration

Verify the automatic detected monitor and adjust if necessary. The automatic detected monitor information is displayed at the top left corner of the screen.

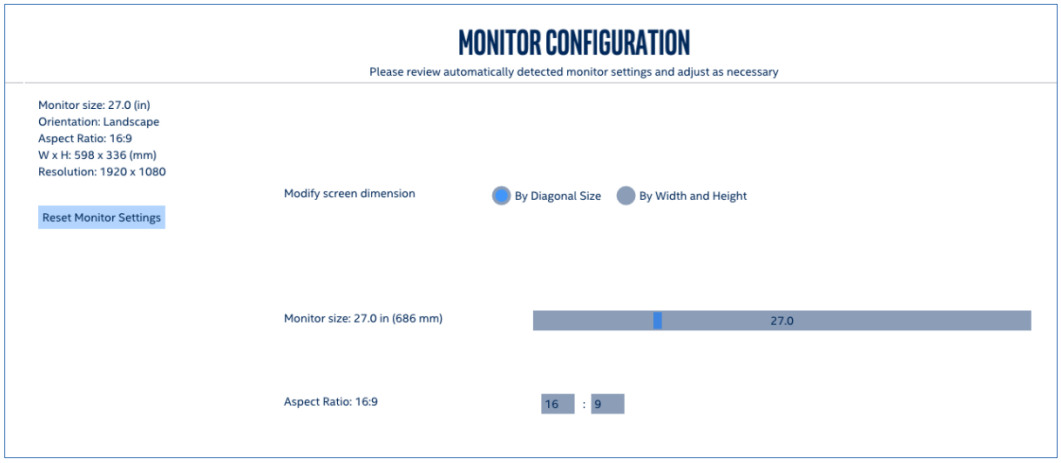


Figure 6-18 Monitor Configuration

If no change is needed, just continue by clicking the Next button.

6.6.2 Virtual Touch Screen Coverage

By default, TCS service covers the entire monitor screen. However, in some usages a partial screen coverage is desired. Virtual Touch Screen ROI limits TCS in a specified area.

Currently 5 options are provided for Virtual Touch ROI: Full, Left, Right, Top, and Bottom. User can also configure percentage of the screen to be covered.

Figure 6-19 Screen Coverage Configuration

If no change is needed, just continue by clicking the Next button.

6.6.3 Camera Position Setup

If valid camera is detected, the setup button on dashboard will be enabled. Otherwise, connect a D435 camera.

Click the Setup button to start the configuration process. At any time in the setup process, always can back out using the Back button or ESC key to abort and back to the dashboard.

6.6.3.1 Recommended Camera Installation Position

Provide camera position requirement and schematic drawing based on configuration. Minimum distance is also provided.

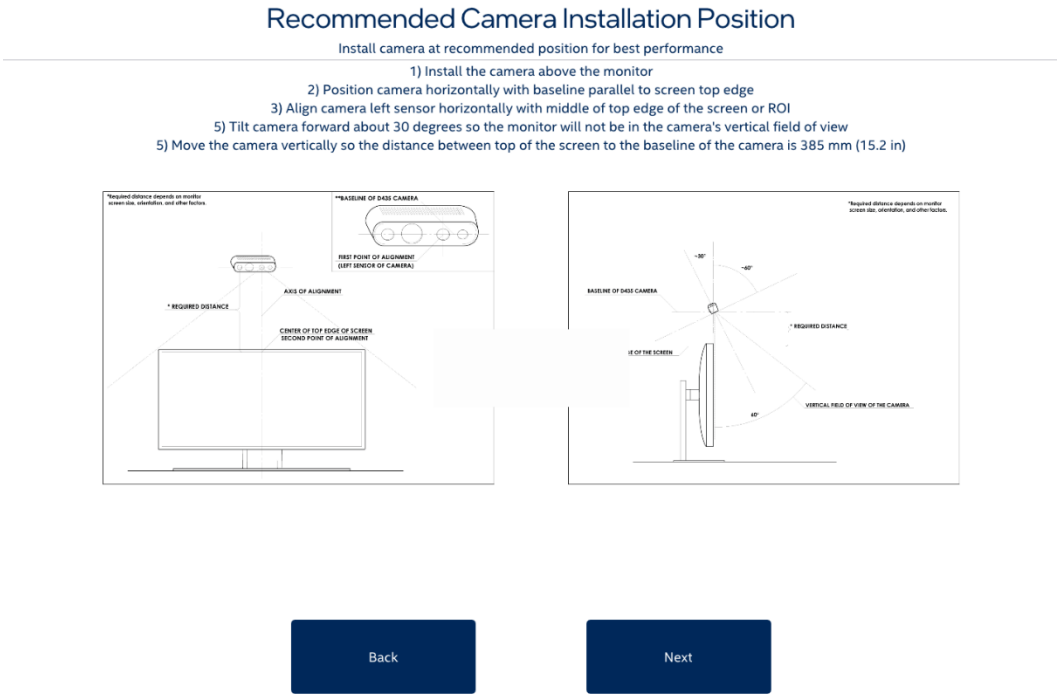


Figure 6-20 Recommended Camera Installation Position

6.6.3.2 Camera Position Configuration

IR camera view is provided aligned with previous configurations.

- The green circle indicates where the left should be aligned horizontally (in middle of the screen for example).
- Rotate the camera slowly from downward to about 30 degrees down forward, as illustrated in the drawings so that monitor is not in the camera's vertical field of view.
- The green circle is also a point to measure the distance from camera to top edge of the screen (or TCS Covered Region). Press your finger at the green circle, adjust the camera position until your finger overlaps the blue hand drawn on screen which means camera and monitor aligns. At that point, continue press your finger at the green circle and the distance should show in mm.
- Adjust the camera vertically so the distance is about the required distance.
- If camera is installed at higher distance, adjust the actual configured distance slider bar to match it.

6.6.3.3 Check if Monitor in Camera Vertical Field of View

To reduce interference, the monitor should be avoided in the camera view. Rotate the camera slowly forward up, until the monitor is not in the view.

6.6.3.4 The Green Circle and Blue Hand

The green arrow indicates the middle of top edge of screen or ROI where the left sensor should be aligned with. The tool is reading depth at the green arrow position, so it can be used to test if the left sensor is aligned, also detect the distance between the camera and the screen.

6.6.3.5 Align Left Sensor with Middle of Top Edge of Screen or TCS Covered Region

The green arrow can also be used to align the camera left sensor with the middle of the screen top edge at the green arrow. Put your finger at the green arrow, then move the camera horizontally left and right in small steps until the stream is blocked by your finger and the current camera to obstacle distance showed a much shorter distance than previously displayed.

6.6.3.6 Detect Distance between Camera and Screen

Press finger at the green arrow, check distance reading.

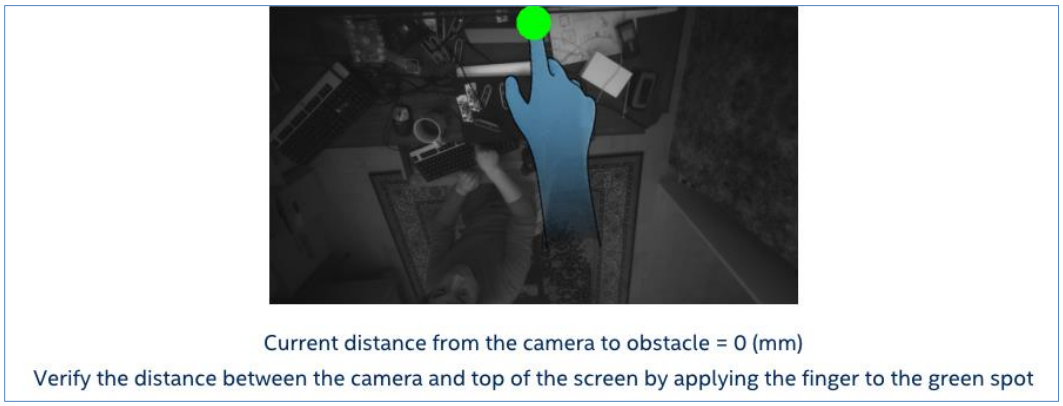


Figure 6-21 Verify Camera Position

Adjust camera height until it's approximately the required distance. If your usage requires to install camera higher or lower, enter the actual installed distance.

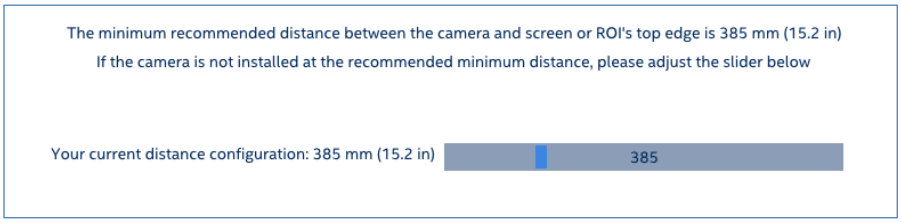


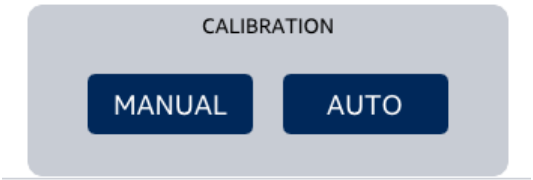
Figure 6-22 Confirm Camera Distance

Once camera is installed correctly, click Next to confirm.

6.7 Calibration

After camera is installed correctly and other parameters like virtual touch coverage configured, TCS should be calibrated with either Manual calibration or Automatic calibration. The tools are displayed at the bottom of the Setup section.

Figure 6-23 Calibration Tools



a) **Manual Calibration** – a simple 4-step calibration process to dynamically determine calibration parameters with your camera. The result depends on lighting condition and hand gesture but flexible.

b) **Auto calibration** – It's a single step process. It uses the monitor dimension, orientation, and virtual touch coverage in the current setting and automatically computes calibration settings. If your camera is installed at recommended position, this process will generate consistent result. Since it allows user to configure the camera to screen distance in case camera is not installed at recommended position, it should work with user setups, and will be more efficient when setup large number of cameras in same relative positions. It may also work better in large monitors.

At end of both calibrations, the same confirmation process as in setup is used to verify the calibration correctness.

Both calibration methods support full screen, half screen, or partial screen configuration.

Press the ESC key in both calibration processes will abort the calibration and back to dashboard.

6.7.1 Manual Calibration

Click the Calibration button, launches manual calibration:

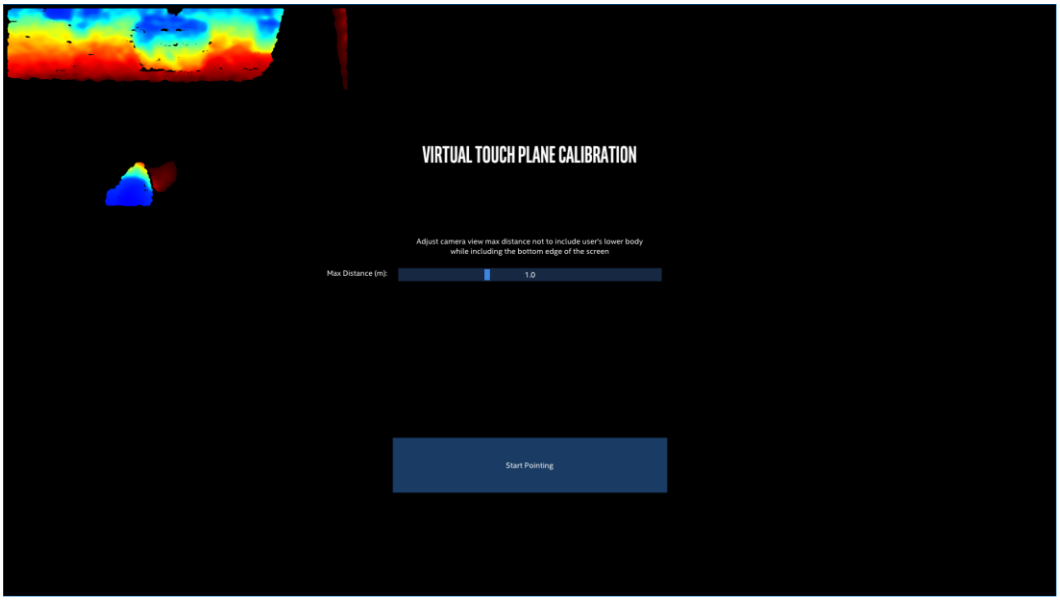


Figure 6-24 Manual Calibration Starting Screen

The manual calibration process is described in detail in *Appendix A - Manual Calibration.*

6.7.2 Automatic Calibration

If camera is installed approximately at recommended position, it's possible to compue an automatic calibration preset for the setup without going through the manual calibration process. This has advantage in avoiding interference from lighting conditions and background, especially on large screens. The result tends to be consistent. After the automatic calibration settings applied, user still can fine tune the camera positions so TCS performance is perfect.

Click the Auto Calibration button to launch the calibration process:

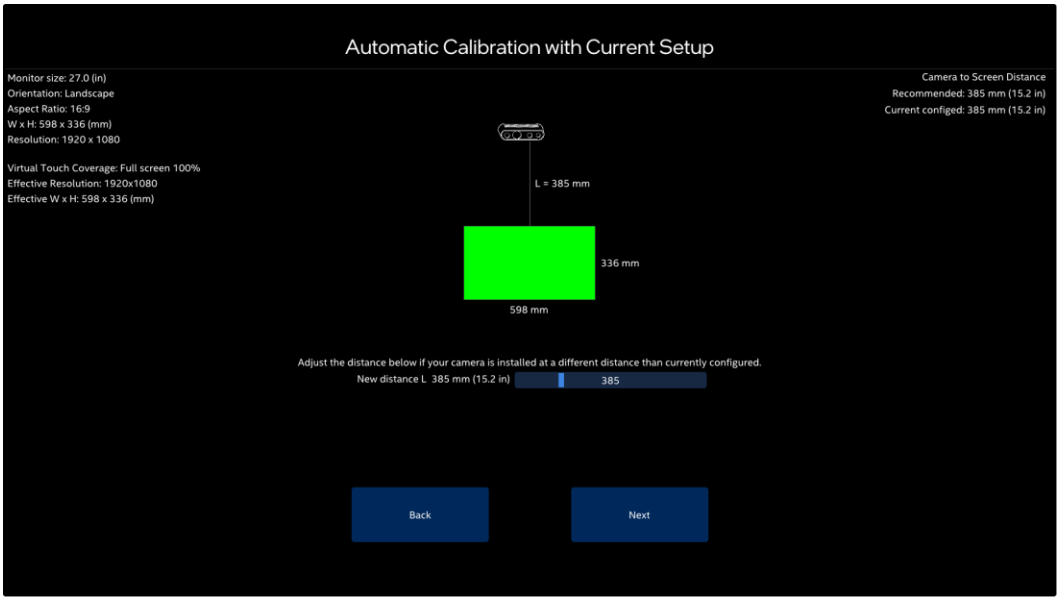


Figure 6-25 Automatic Calibration

It also displays recommended camera setup positions, the minimum required camera to screen distance is dynamically calculated based on screen size and camera field of view. If user camera is installed higher, just customize the distance value on the slider bar.

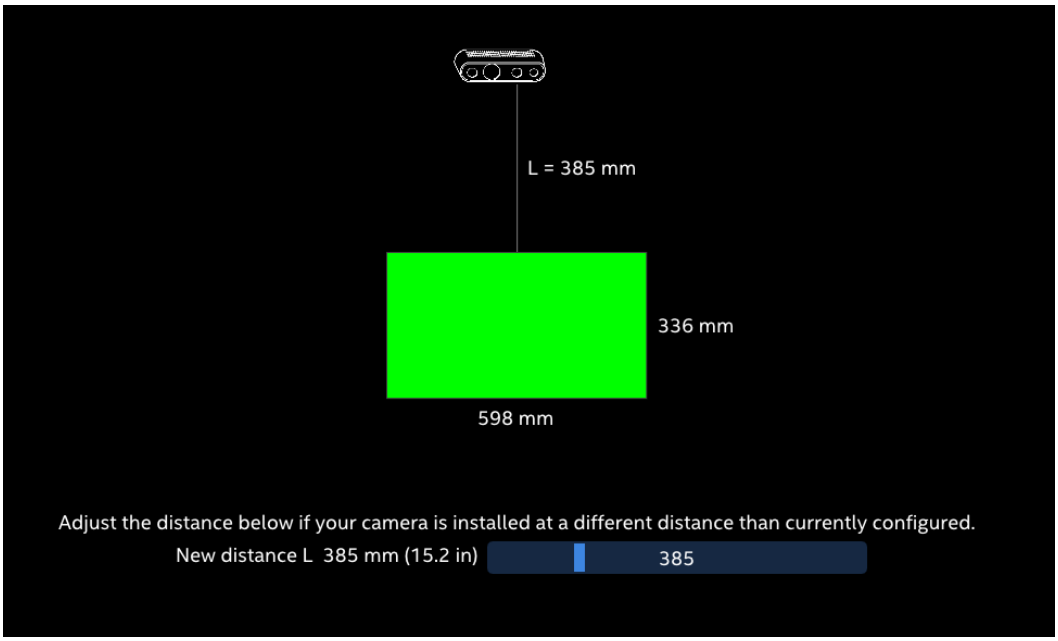


Figure 6-26 Adjust Camera Position

At bottom of the window, click Next to apply the calibration settings.

The calibration settings will be automatically applied, and wait for user to move cursor and click the button to confirm. The process will be timeou in 10 seconds if not confirmed or if problem with calibration setting, and in that case, the calibration settings will be rolled back and process returns.

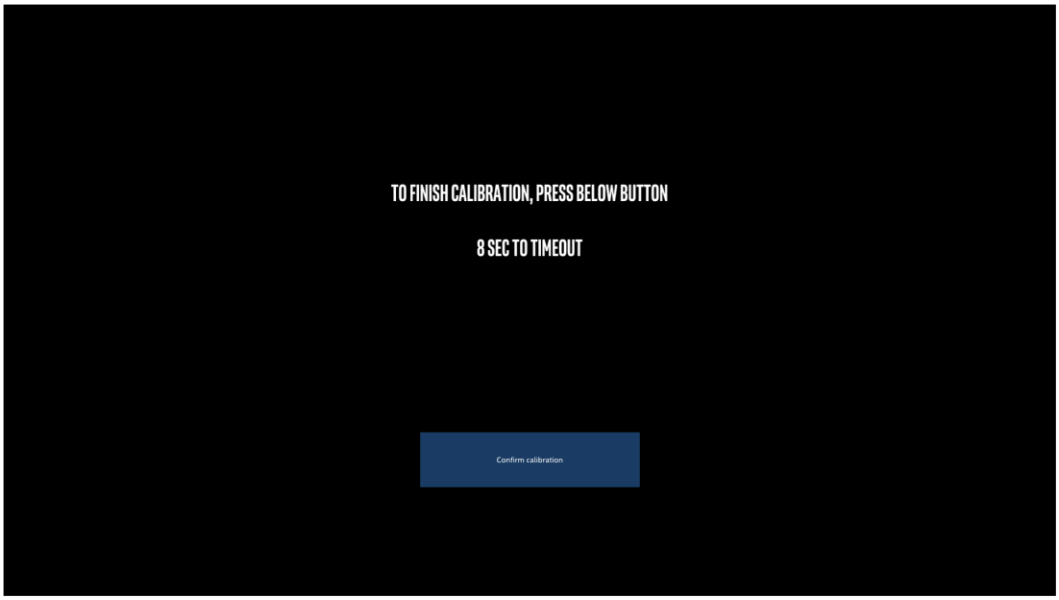


Figure 6-27 Confirm Calibration

After successful confirmation, the calibration settings should reflect immediately in the virtual plane displayed below.

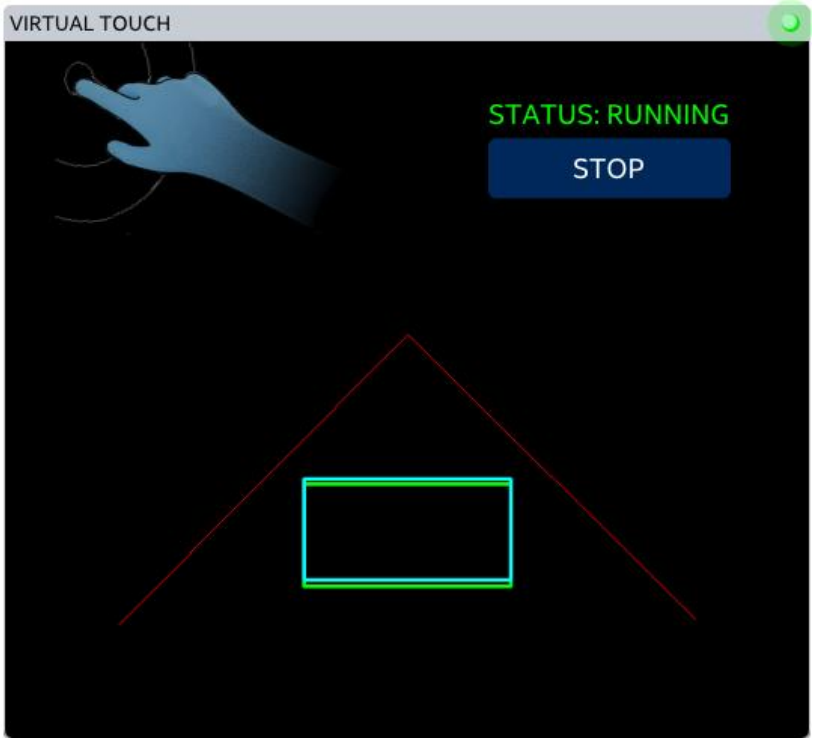


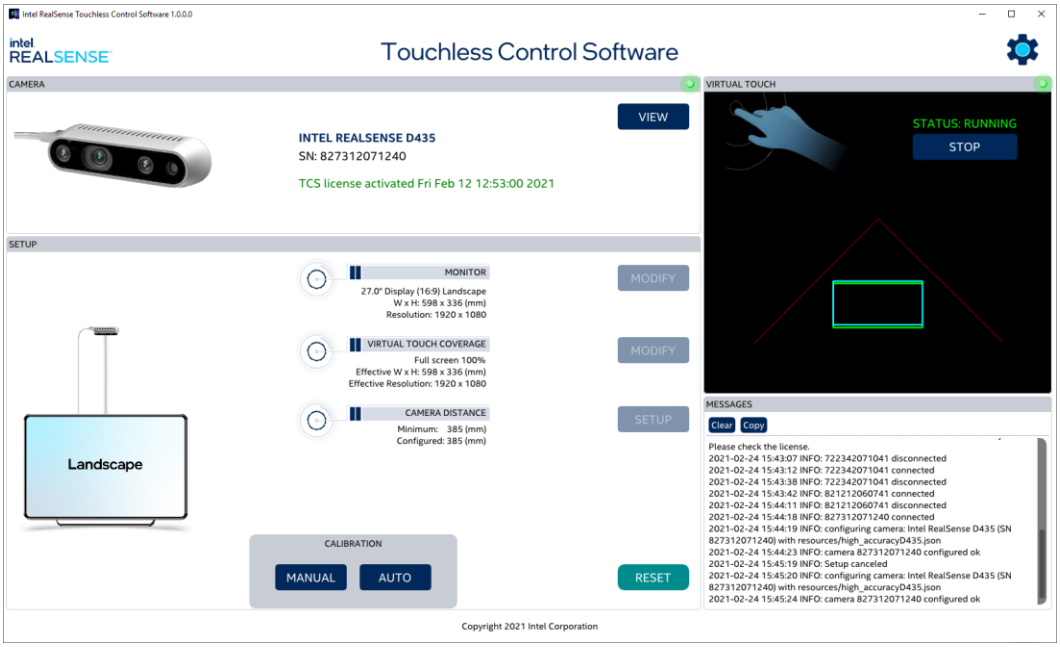
Figure 6-28 Calibrated Virtual Touch Plane

The **Automatic Calibration** is handy if user knows the camera setup and can quickly setup TCS. It also provides a way to fine tune the calibration since user can adjust the camera distance and recalibrate it quickly.

6.7.3 UI After Calibration

Once calibrated, the current configuration is locked, including the camera, monitor, virtual plane coverage, and camera distance. The Modify and Setup buttons will appear in grey and disabled. The camera will be tracked. If the configured camera is disconnected, a message will appear to warn the camera is disconnected and ask user to reconnect it back.

Figure 6-29 TCS Calibrated after Configuration



The **Reset** button can be used to unlock the configuration and reset both setup and calibration to the initial automatic configuration.

6.7.4 Running Service After Setup

As shown in the figured above, once confirmed, TCS is calibrated and enabled automatically.

Move the mouse cursor over the Virtual Touch Plane image on dashboard, a popup window will show details about calibration.

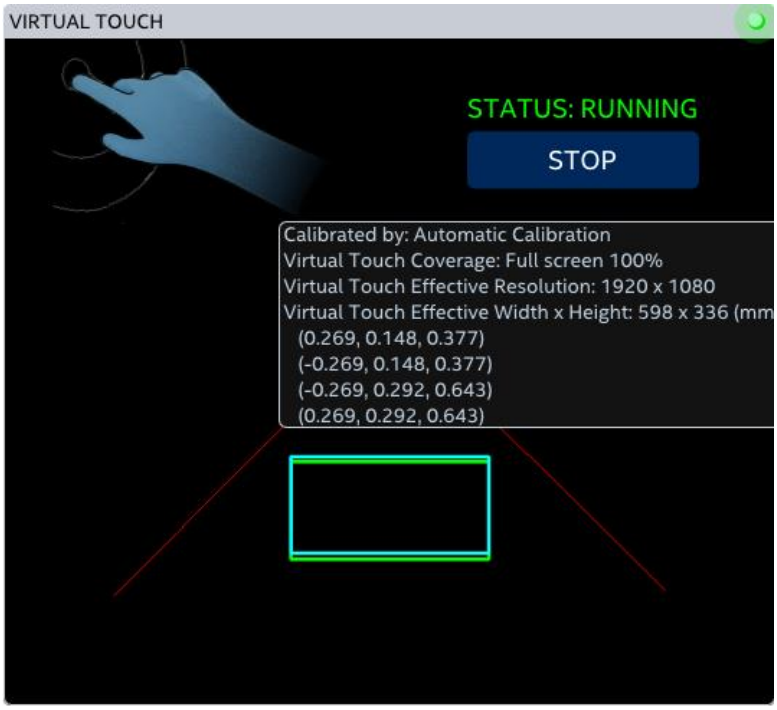


Figure 6-30 Calibrated Virtual Touch Plane

6.8 Checking TCS Effectiveness

Open Windows Calculator app and maximize it in full window mode.

Try to point finger to the buttons and move slowly toward the screen, at certain point, a green circle will appear on screen, then after finger pass through the virtual touch plane, virtual click occurs and the button pressed. Afterwards, a red circle appears, pull back your finger. Repeat this process for other buttons.

Test calculate a formula like 2 * (9 + 1)*42 that requires click multiple buttons.

Check if clicks are at the correct position

Move along the screen edges and corners and click to check any issue.

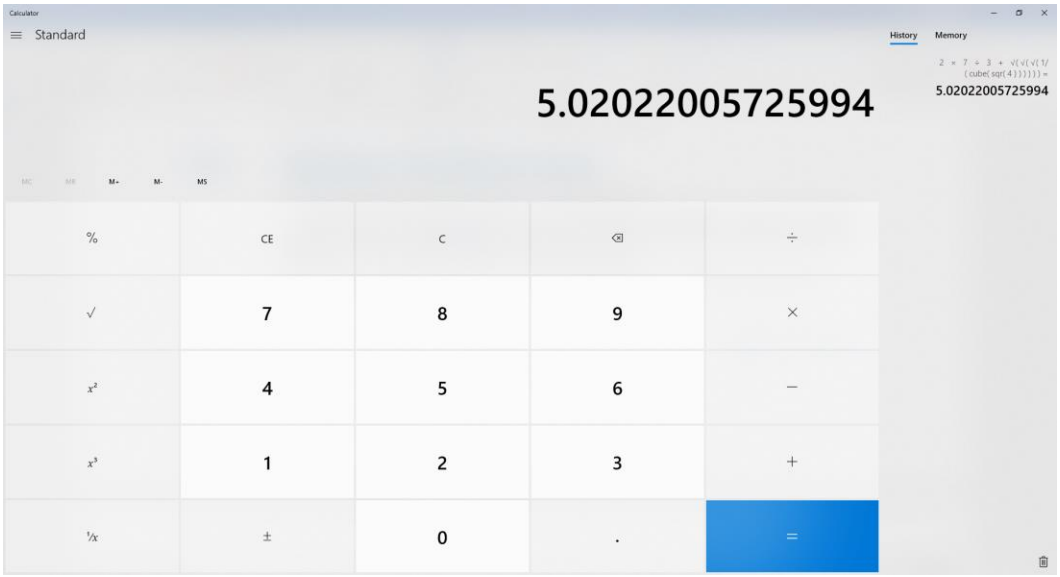


Figure 6-31 Checking TCS by Clicking the Buttons in the Calculator app

If a virtual click of a button happens at the correct location and no false click, then TCS is working properly. If you are satisfied with the results, then no manual calibration is required.

6.9 Running TCS App in Background

Once you are satisfied with the TCS effectiveness, close the TCS window. Intel® RealSense™ Touchless Control Software will be running in the background as a Windows tray app in the bottom right corner of Windows.

Figure 6-32 TCS Tray Menu

The TCS process will run in background until user stops it by click on the Quit menu.

To return to the graphical control interface, click the **Control Panel** menu.

6.10 Configuring TCS to Start Automatically at Windows Startup

Intel® RealSense™ Touchless Control Software and service can be configured to launch at Windows startup when the host system reboots.

6.10.1 Add Intel® RealSense™ Touchless Control Software to run automatically at Windows Startup

1) Select the **Start** button and scroll to find the Intel® RealSense™ Touchless Control Software app.

On **Windows 10**:

Select the **Start** button and scroll to find the Intel® RealSense™ Touchless Control Software app.

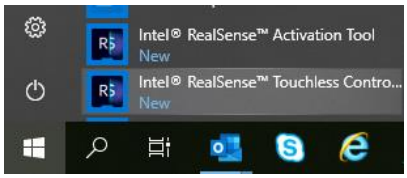


Figure 6-33 TCS app in Windows Programs on Windows 10

On **Windows 7**:

Select the **Start** button, click All Programs, then scroll to find the Intel® RealSense™ Touchless Control Software app.

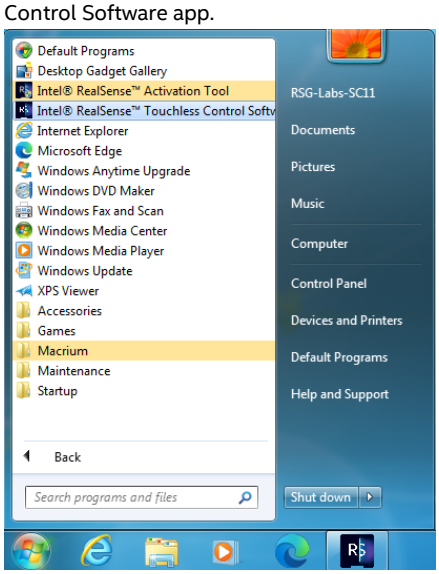


Figure 6-34 TCS app in Windows 7 All Programs

2) Create a shortcut to the Intel® RealSense™ Touchless Control Software app

On **Windows 10**:
Right-click the app, select More, and then select Open file location. This opens the location where the shortcut to the Intel® RealSense™ Touchless Control Software app is saved.

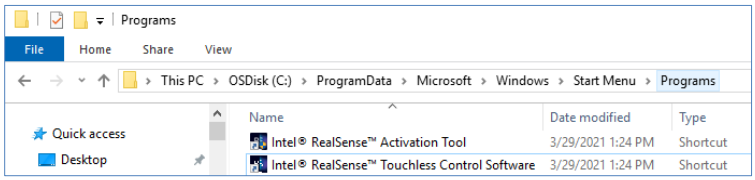


Figure 6-35 TCS app shortcut

On **Windows 7**:
Right-click the app, select Copy.

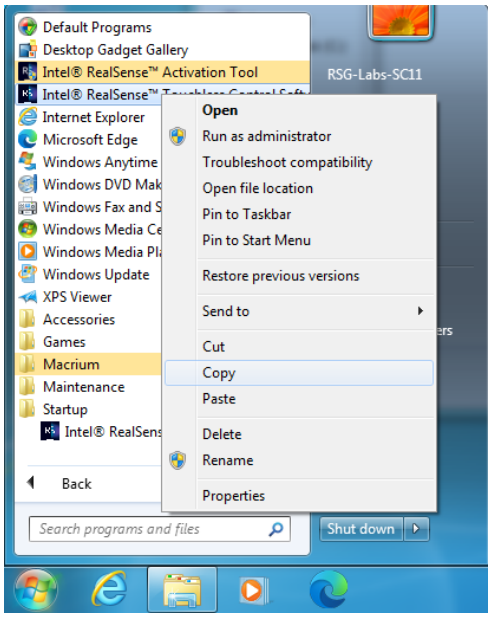


Figure 6-36 TCS app shortcut on Windows 7

3) With the file location open, press the Windows logo key + R, type shell:startup, then select OK. This opens the Startup folder.

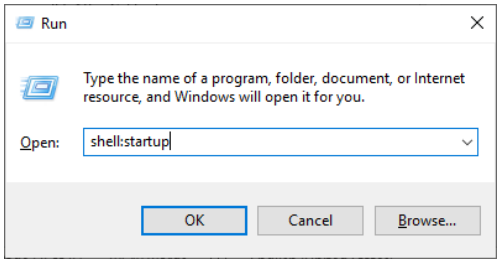


Figure 6-37 Open Windows Startup Folder

4) Copy and paste the shortcut to the Intel® RealSense™ Touchless Control Software app from the file location to the Startup folder.

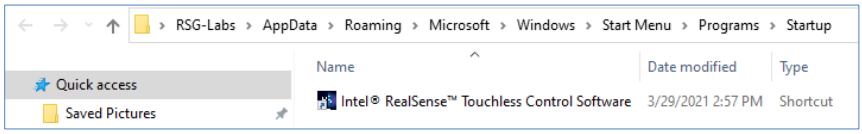


Figure 6-38 Add TCS app shortcut to Windows Startup

6.10.2 Starting TCS Service automatically at App Launch

1) Find “Start TCS service automatically at launch” and “Minimize TCS Control Panel at launch” options in TCS settings → General tab. By default, both options are turned off.

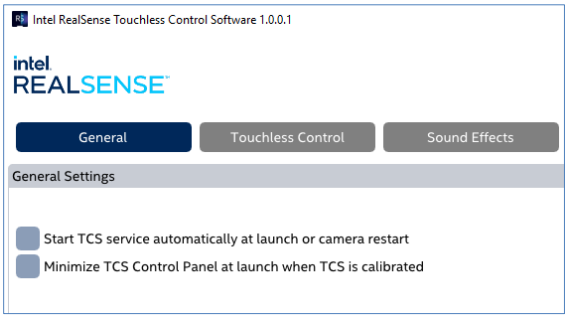


Figure 6-39 Default options in TCS General Settings

2) Turn on “Start TCS service automatically at launch” so it will start automatically when the app launches. If you would like the TCS Control Panel GUI minimized at launch, turn on the “Minimize TCS Control Panel at launch” option as well.

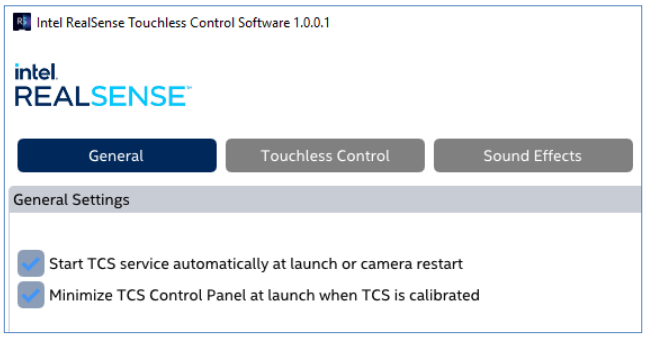


Figure 6-40 TCS Service and Control Panel Minimize Options Enabled

3) Exit TCS and reboot system to make sure TCS launches as expected. Both options will take effect only when TCS is calibrated.

6.11 Disconnection and Recovery

TCS keeps track of the configured camera. If it's disconnected, the camera image on dashboard will becomes inactive with an image of disconnected camera.

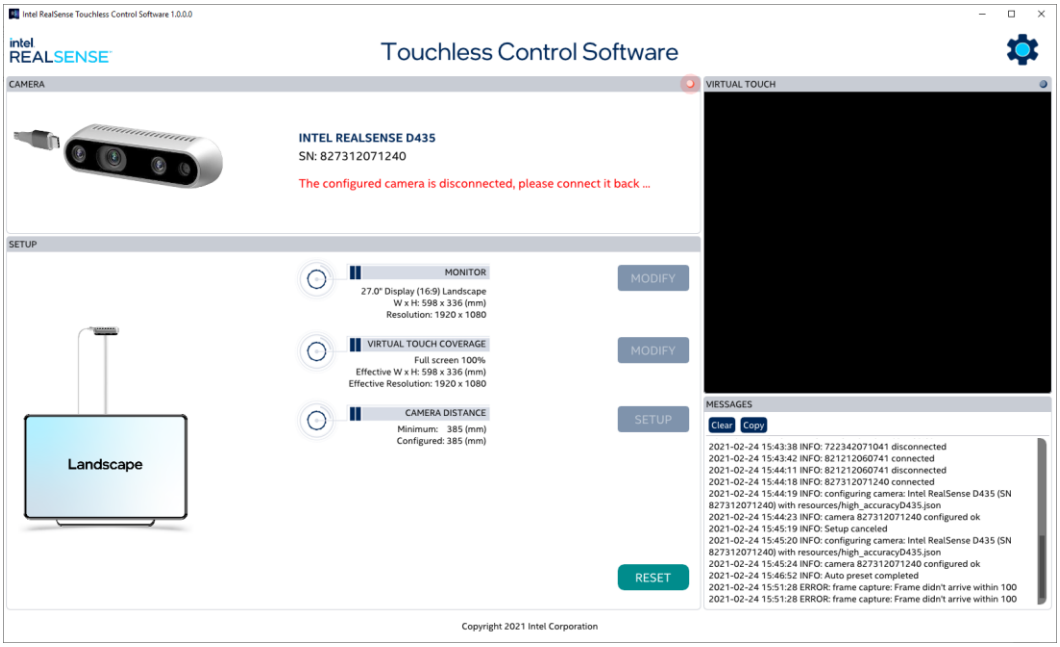


Figure 6-41 Configured Camera Disconnected

Once reconnected back, the service is recovered, no recalibration is required.

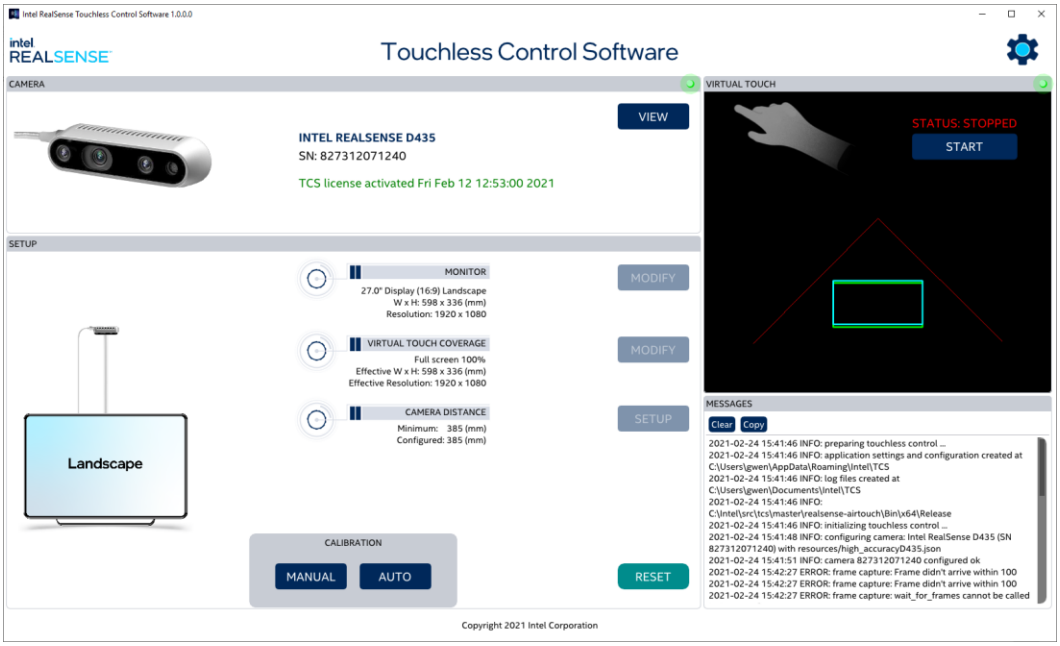


Figure 6-42 Recover after Camera Reconnected

6.12 Tuning and Troubleshooting

TCS performance can be customized through tuning the advanced settings (see Appendix B for details). It also provides tools to assist troubleshooting.

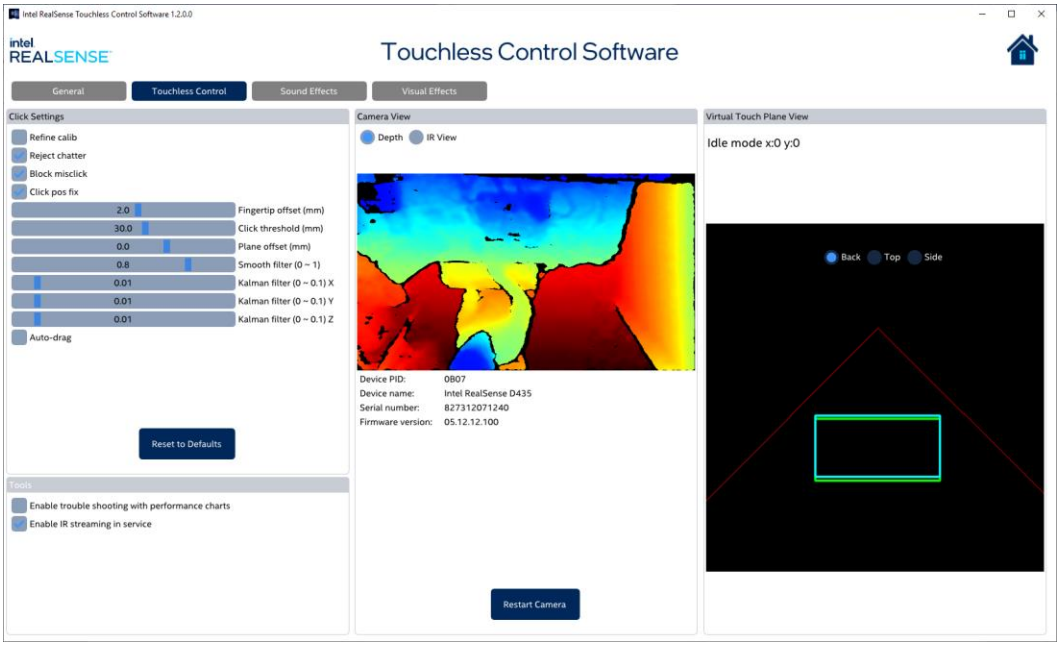


Figure 6-43 Tunning and Troubleshooting View

7 Touchless Clicking with TCS

While TCS runs in the background, the user can use the touchless control by pointing a finger at the screen, but it can also detect other objects like a pen. When a fingertip enters the touch interaction volume, a green pointer appears.

As the fingertip approaches the virtual touch plane, the circle inside the red pointer grows larger, and when it crosses the touch plane, a click is registered. When clicked, an animation effect occurs. The visual overlay pointer then changes to red.

If the user wants to click again, the user must move their finger back until the pointer turns green again and touch is re-armed. Currently, only the input of a single left-click equivalent is possible.

Figure 7-1. Time sequential images of visual 3D overlay animation of virtual touch click.

From *left*: Green spot indicates that a fingertip is being tracked. The relative size of central red spot indicated distance from the virtual touch plane. Center: The moment when the finger passes the virtual touch plane, the spot turns green. Right: While the finger is behind the virtual touch plane, the spot remains red, indicating that the finger needs to be pulled back again before it can reactivate a touch event. When user's finger stays behind the virtual touch plane close the physical screen for too long, a pullback waning message (*Right*) will popup.

This visual and sound effects in this process can be customized to better fit customer application. Please see next chapter for details.

8 Half/Partial Screen Support with TCS

By default, TCS operates on the entire screen. In some cases, user may need to use only portion of the screen for TCS, for example, left half, right half, or any percentage of the screen. This is supported in TCS through the Virtual Touch Coverage.

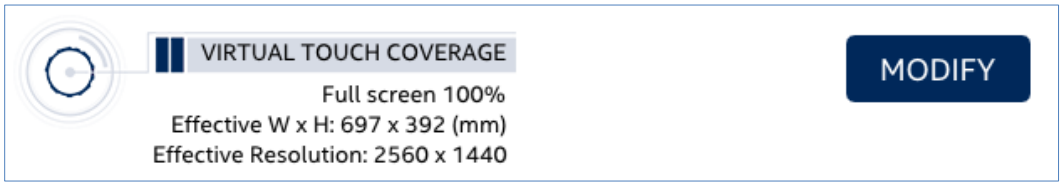
One of the advantages of partial screen virtual touch is that the camera can be installed much lower than normally required in a full screen coverage.

Example below demonstrate how to setup virtual touch on the right half screen on 32" monitor in landscape orientation. The monitor resolution is 2560x1440.

8.1 Virtual Touch Coverage

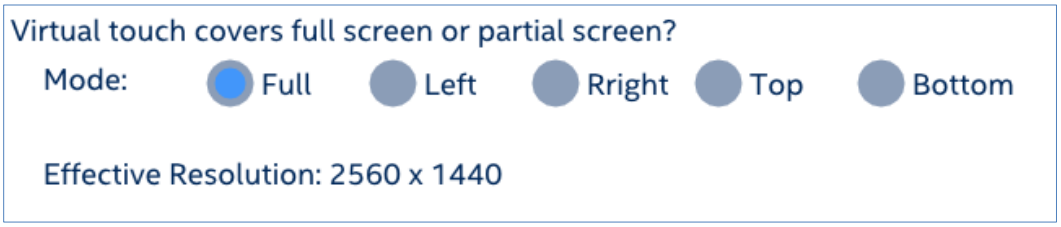
Partial screen virtual touch can be configured by modifying Virtual Touch Coverage.

Figure 8-1 Virtual Touch Coverage



A few Virtual Touch Coverage options available modes for user to select for their configuration.

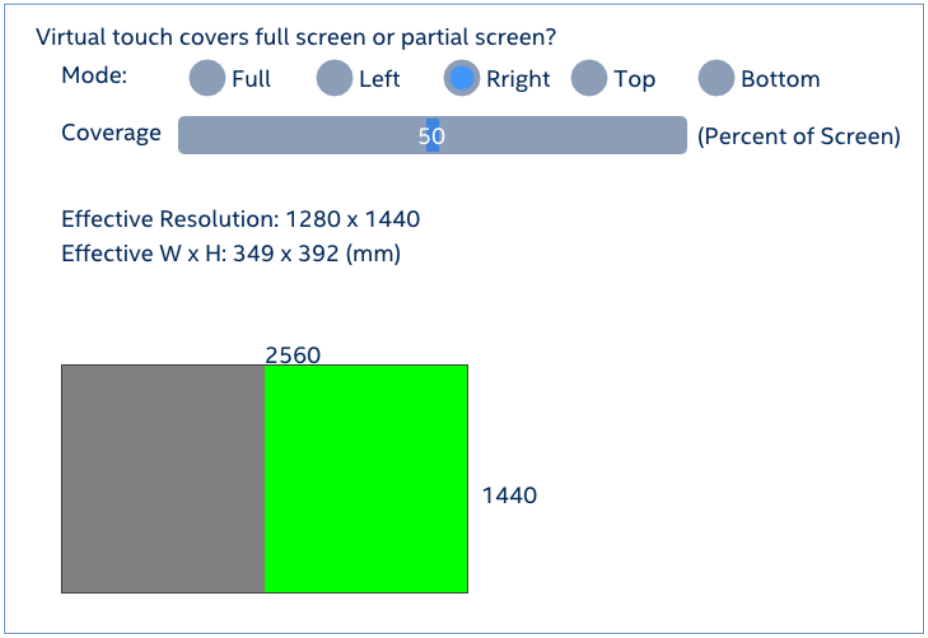
Figure 8-2 Options for Virtual Touch Coverage



- Full - by default, it's full screen, mean TCS will be calibrated and operated on the entire screen.
- Left – left half or partial screen
- Right – right half or partial screen
- Top – top half or partial screen
- Bottom – bottom half or partial screen.

For the half/partial screen modes, TCS also allow user to customize its size, by default, it's 50% of the screen, i.e., half screen.

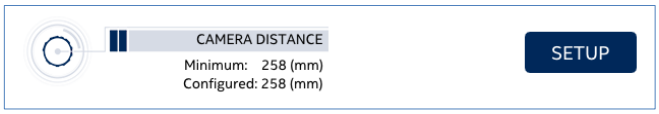
Figure 8-3 Configuring Virtual Touch Coverage at Right Half Screen



8.2 Camera Position

With half/partial screen setup, the required camera to screen vertical distance is lower. In this case with the 32” monitor, the distance is reduced to 258 mm for half screen coverage from 436mm for the full screen coverage, as displayed on dashboard.

Figure 8-4 Camera to Screen Distance Reduced for Half Screen Virtual Touch Coverage



NOTES:

The distance required in half coverage is more than 50% of the distance in full screen coverage. This is partly due to impact from other factors, including *Invalid Depth Band* which reduces effective field of view at shorter distances. Depends on your application requirement, the camera maybe installed lower, if possible impact on top right corner of the screen is not critical. Please refer to *Intel® RealSenseTM Product Family D400 Series Datasheet* for more details on Invalid Depth Band.

Horizontally, the camera left sensor should approximately align with the middle of top edge of the screen region of interest where TCS is to be enabled.

Figure 8-5 Camera Left Sensor Aligns with Middle of the Virtual Touch Covered Region

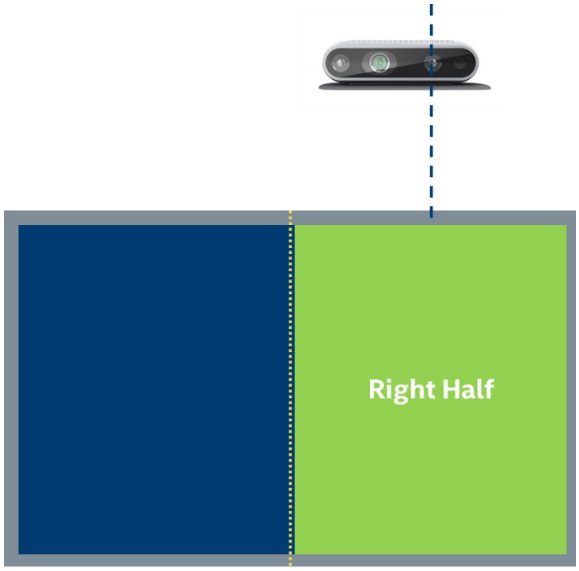
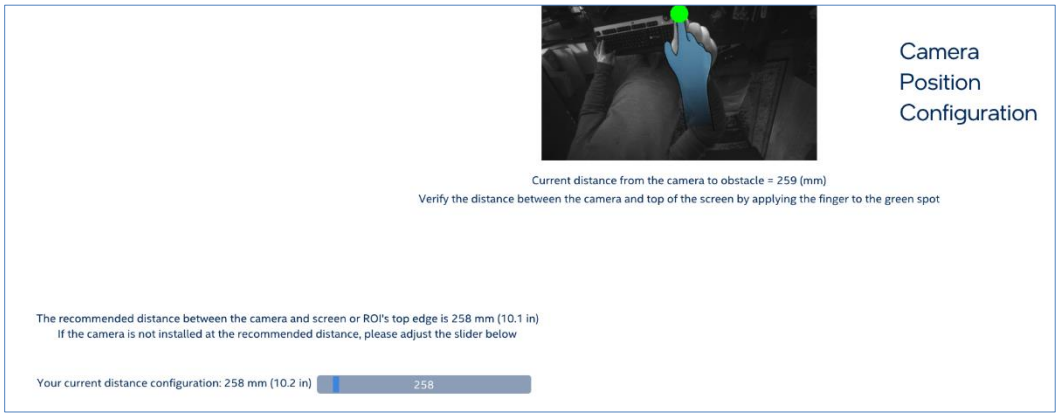


Figure 8-6 Camera Position Front and Side Views with 32" Monitor in Landscape Orientation and Half Screen Virtual Touch Coverage

8.3 Camera Setup Assistant

The Setup button on dashboard provides instruction and tools to setup the camera and monitor. It helps align the left sensor and screen, and also calculates required camera to screen distance dynamically based on user selection.

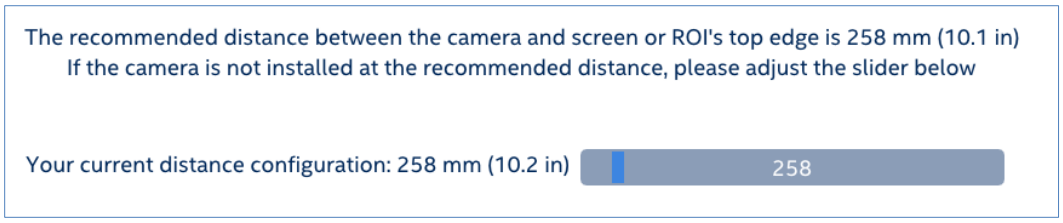


The tool display IR image so user can look through it to know if monitor is in the view. Rotate the camera forward until the monitor is not in the view.

This can also be used to align the camera left sensor with the middle of the screen top edge at the green arrow. Put your finger at the green circle, then move the camera horizontally left and right in small steps until your finger in the image overlaps with the blue hand, depth stream is blocked by your finger and the current camera to obstacle distance showed a much shorter distance than previously displayed.

Adjust the camera vertical position until the camera to your finger distance is approximately what's required. If you decide to install the camera at a different distance, update the distance configuration at the slider below the IR image.

Figure 8-7 Update Camera Distance Configuration

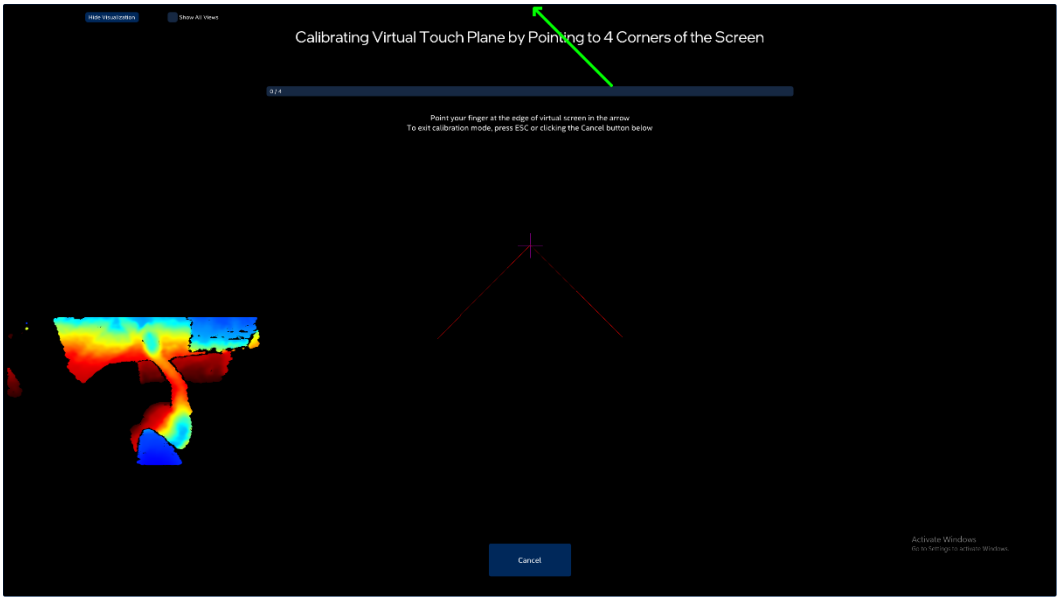


Now the camera is aligned with the monitor forward/backward orientation, horizontally and vertically, and is ready to calibrate with either Manual Calibration or Auto Calibration.

8.4 Manual Calibration

Manual calibration process is same. The only difference is the arrows highlight the 4 corners now reflect the boundary of the half screen ROI instead of the entire screen, as shown below in calibrating the right half screen.

Figure 8-8 Manual Calibration with Half Screen Virtual Touch Coverage



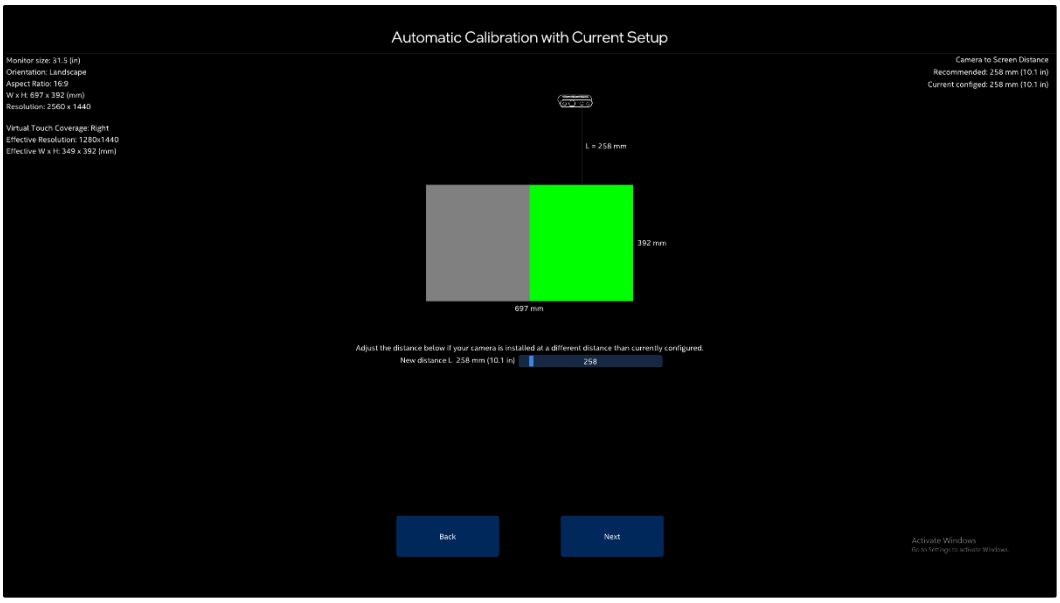
8.5 Automatic Calibration

Same process as full screen usage. Once Virtual Touch Coverage and camera position is setup, press the **Automatic Calibration** quick button.

In the example below, camera was installed at the required distance, so the distance automatically displayed on the slider is same as required.

If you need to adjust camera's vertical position at this point, simply adjust the actual distance at the distance slider. This is useful if fine tunning is needed to achieve perfect calibration.

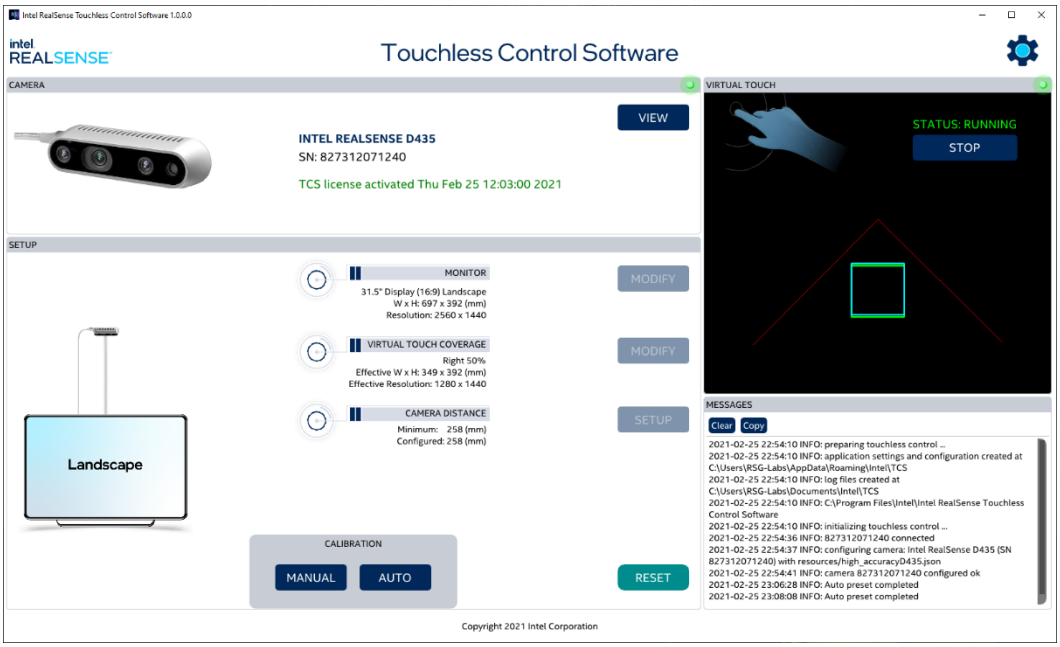
Figure 8-9 Automatic Calibration with Half Screen Virtual Touch Coverage



8.6 After Calibration

Once calibrated, service is automatically started.

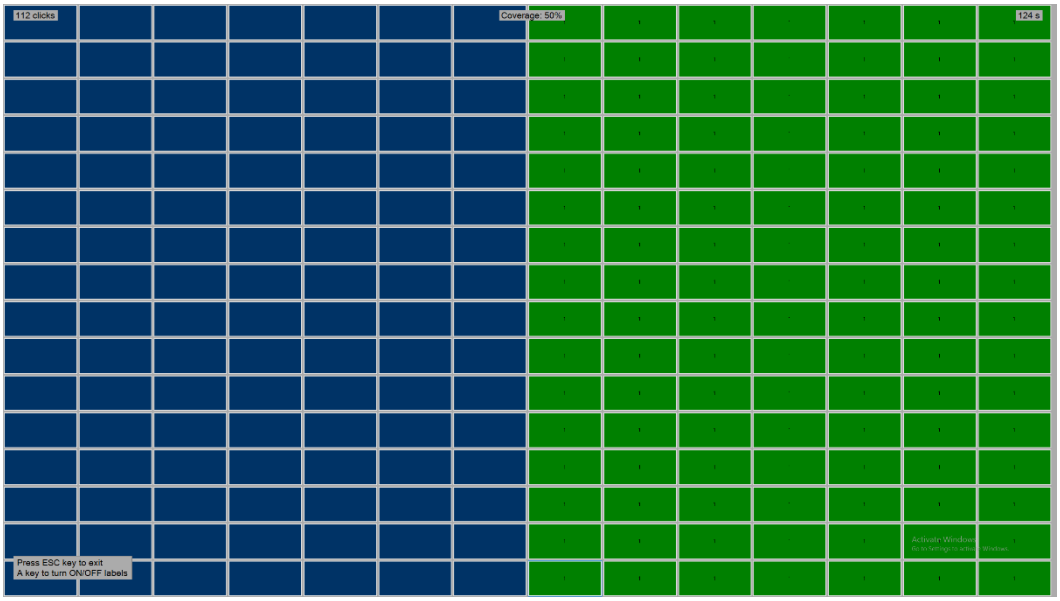
Figure 8-10 Calibrated with Half Screen Virtual Touch Coverage



8.7 TCS Performance with Half/Partial Screen

After calibration, TCS only operates on the half of screen user configured, and not operate on the rest of the screens, i.e., coverage reduced to 50%, as shown in Figure below with a screen coverage test program.

Figure 8-11 TCS Performance with Half Screen Virtual Touch



9 Customizing TCS

TCS plays a sound and display graphical overlay during the clicking process as user's finger approaches toward the virtual touch plane, triggers touch clicking events, and move toward the physical screen. An optional pullback warning message is also displayed if user's finger is too close to the screen.

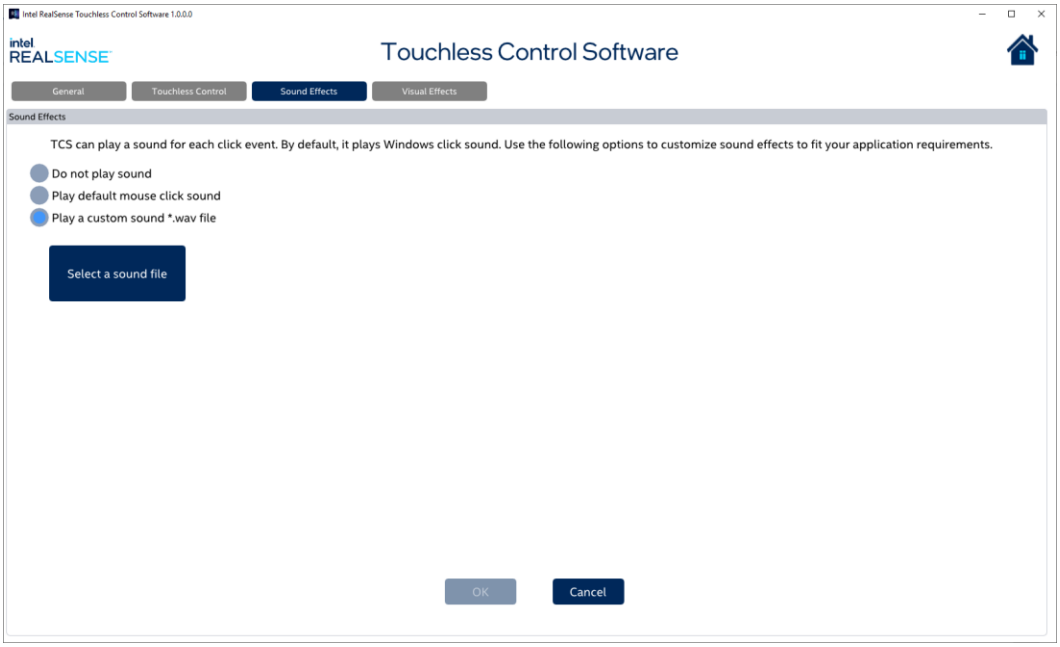
The process can be customized to better fit customer application, including the sound to play, color and pullback warning to display.

9.1 Sound Effects

By default, TCS plays a Windows click sound when user's finger triggers a click event. This is optional and can be disabled so no sound is played. Additional option is provided to play a custom sound *.wav file.

This gives customers full control in the sound effects that best fit their applications.

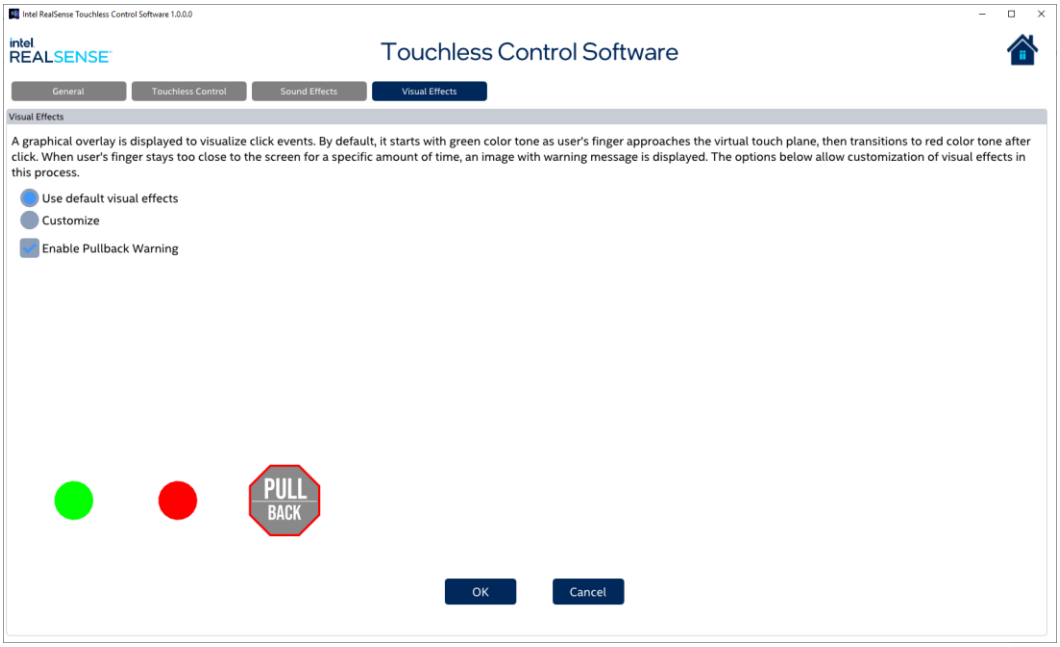
Figure 9-1 Customizing Sound Effects



9.2 Visual Effects

A graphical overlay is displayed to visualize click events. By default, it starts with green color tone as user's finger approaches the virtual touch plane, then transitions to red color tone after click. When user's finger stays too close to the screen for a specific amount of time, an image with warning message is displayed.

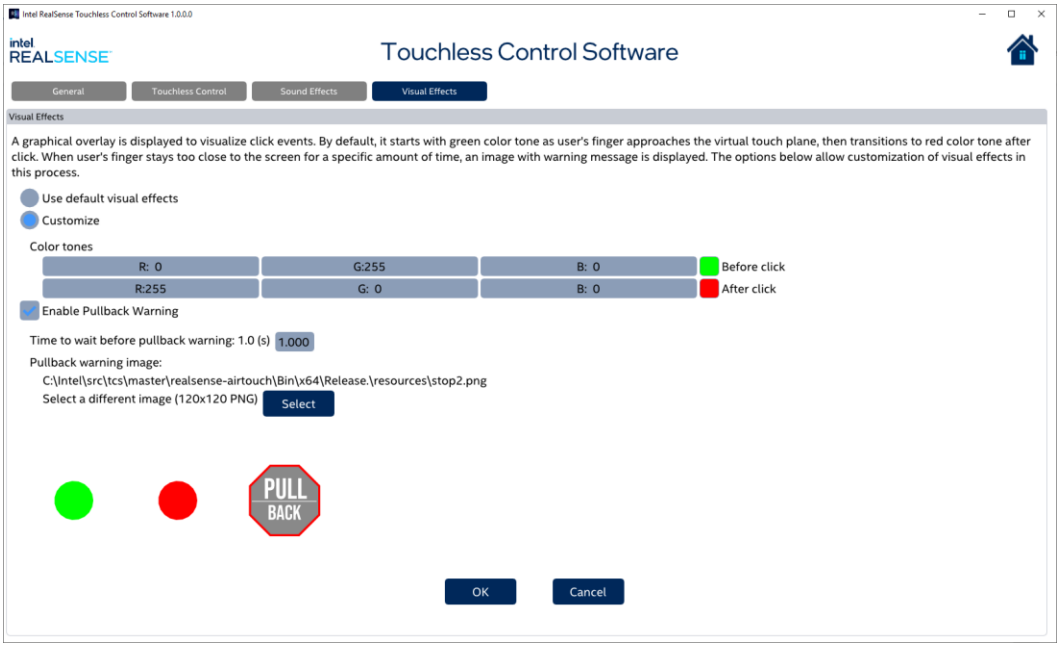
Figure 9-2 Default Visual Effects



A few options provided to customize the process and gives customers full control in the visual effects that best fit their applications.

- Ability to choose custom colors
- Option to turn on/off the pullback warning
- Time to wait before displaying the pullback warning.
- Ability to choose and display user supplied custom pull back warning images. The image should be in PNG format. Image size should not exceed 120 x 120 pixels.

Figure 9-3 Customizing Visual Effects



Click on the color squares and a color picker appears to choose color, or CTRL + click the individual RGB color components to enter value directly. Color must be RGB values 0 – 255 for each component.

Figure 9-4 Customizing Color by directly entering RGB values

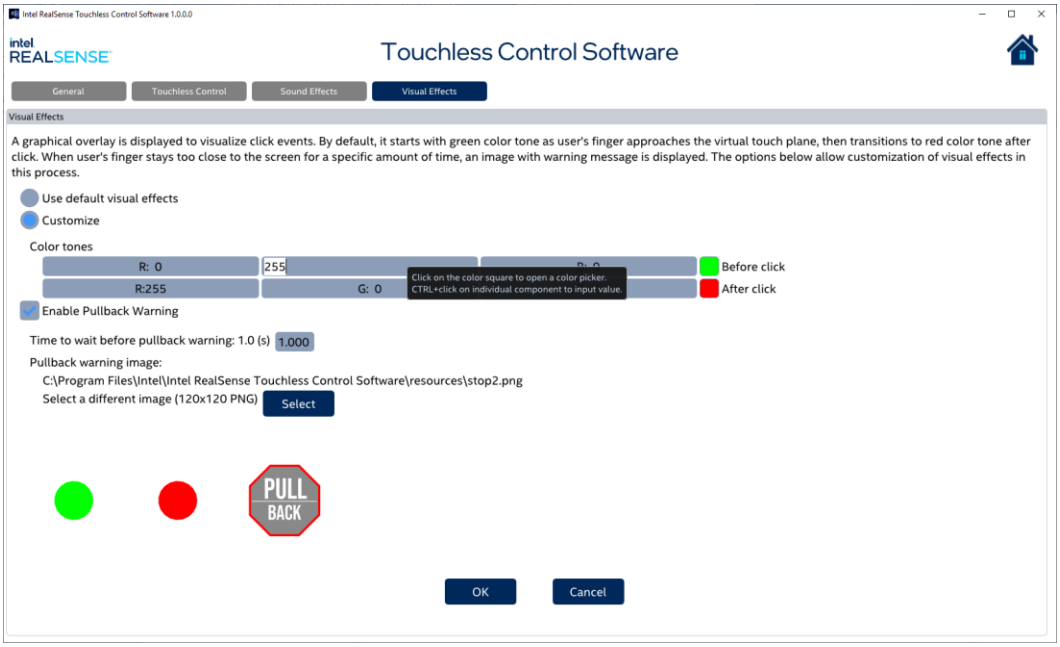
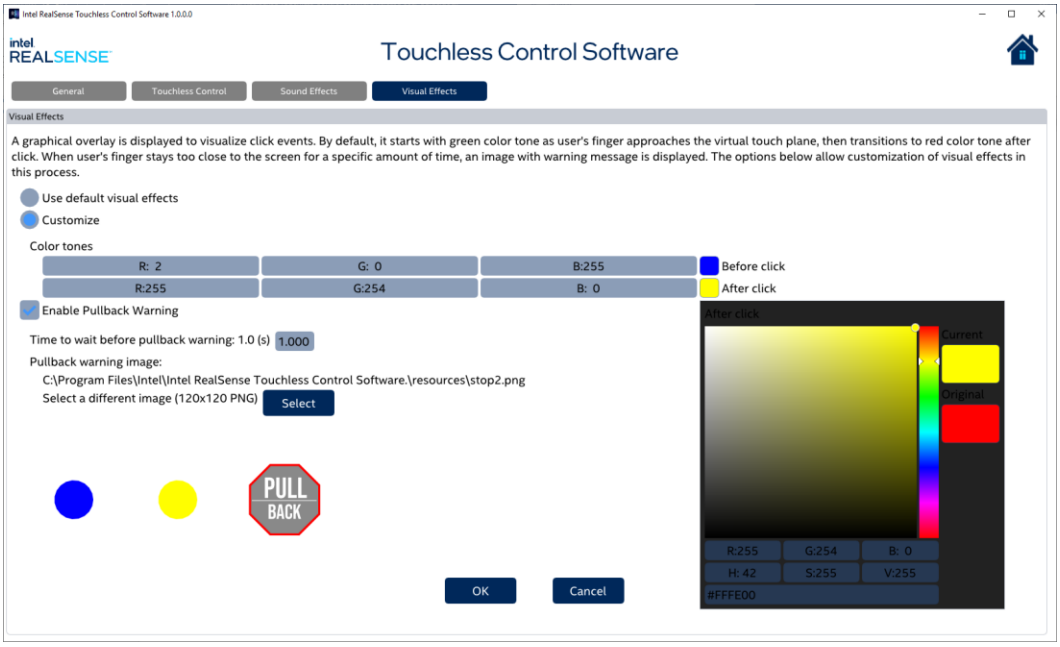


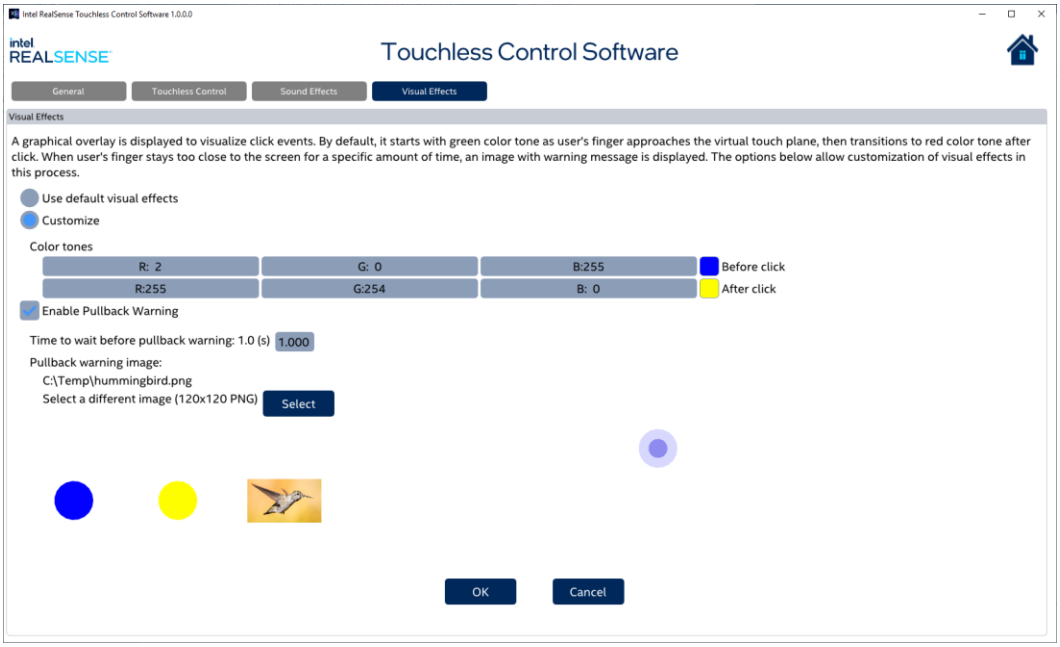
Figure 9-5 Customizing Color Before Click by Color Picker

Figure 9-6 Customizing Color After Click by Color Picker



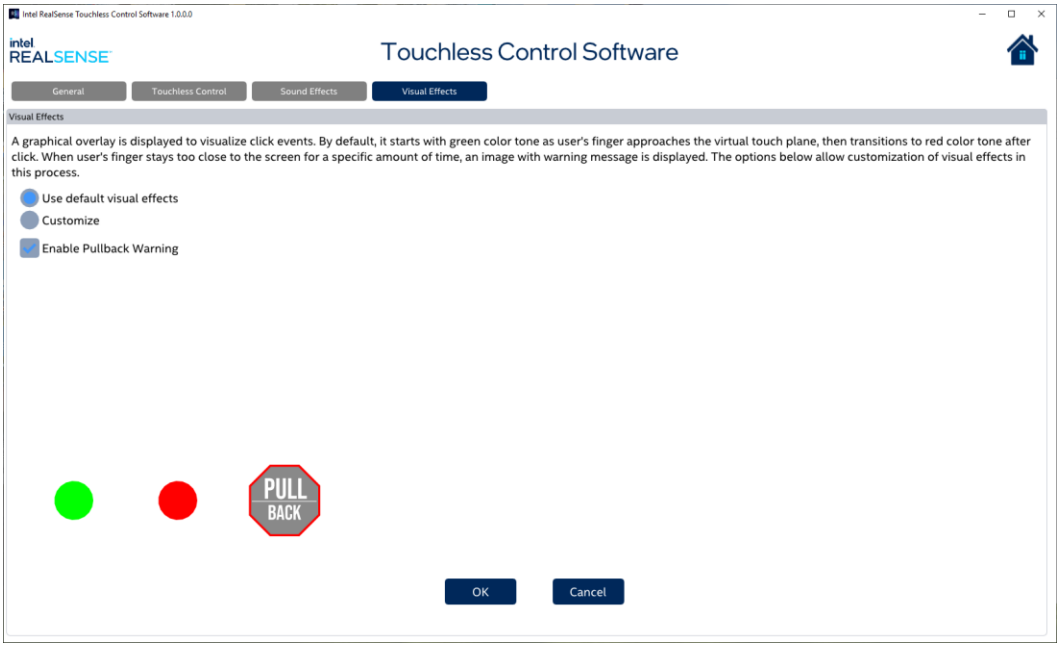
Select your preferred pullback warning image. It must be in PNG format and preferred to be 120x120 pixels in size. The max size is 160x160 pixels.

Figure 9-7 Customized Visual Effects



To return to default settings, select Use default visual effects option and press OK.

Figure 9-8 Visual Effects Returned to Defaults

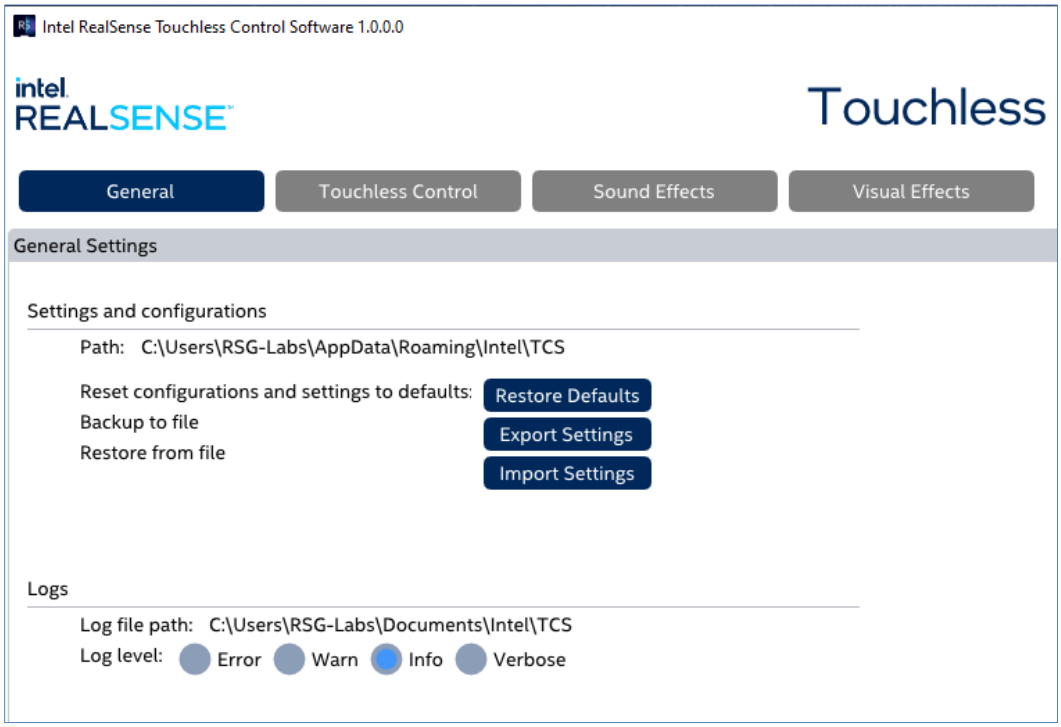


10 Troubleshooting

10.1 Settings and Configuration

TCS saves all settings and configuration into a JSON format file realsense-tcs-config.json under %APPDATA%\Intel\TCS folder. The general setting tab display the exact path on the system, as shown in the figure below.

Figure 10-1 Settings, Configuration and Logging Directory Paths Shown in the general settings tab



10.2 License File

Once activated, the license is stored under the %APPDATA%\Intel\TCS folder.

The license file name starts with realsense-tcs-lic and ends with the camera serial number, for example, realsense-tcs-lic-sn-827312071240.

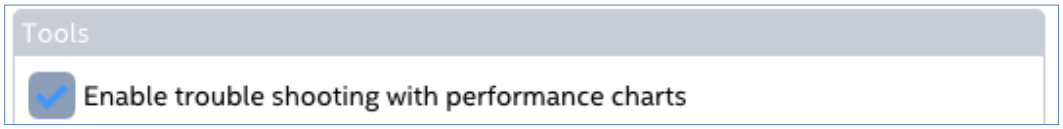
10.3 Logging Files

A shown in the figure above, logging files created in the Intel\TCS subfolder in Documents folder under user profile. The file name is in the format tcs-log-xxxx.txt where xxxx is the timestamp when the log file is created, for example 2021-02-26-12-35-47.txt.

10.4 Performance Charts

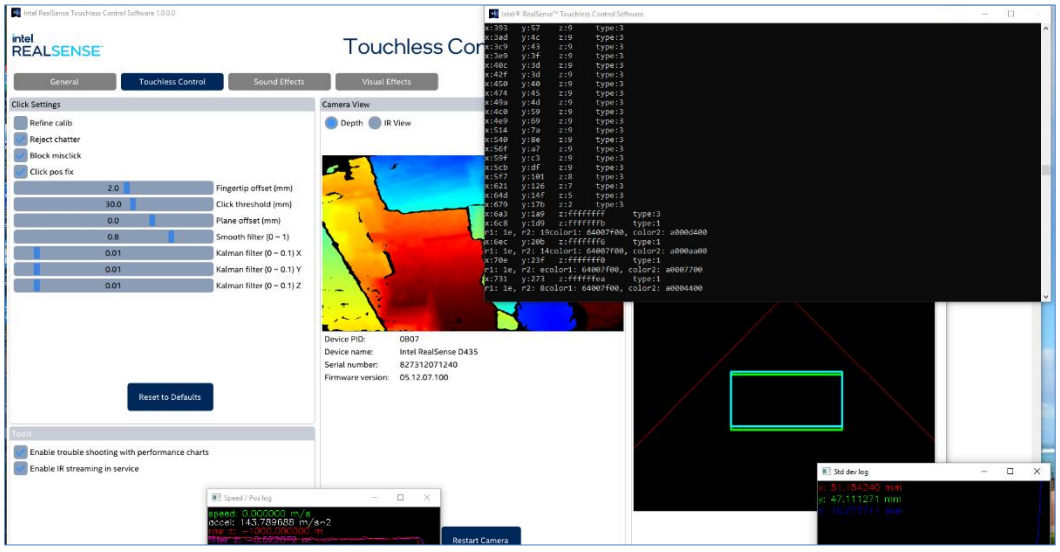
A detailed performance report can be generated by enabling the troubleshooting option under Tools on the Touchless Control settings tab.

Figure 10-2 Enabling Troubleshooting Performance Charts



Try a few virtual clicks and performance charts should appear.

Figure 10-3 TCS Performance Charts



Turn off the Troubleshooting option, the graphical charts should disappear. Detailed report should be generated in the same folder as the logging files, for example, 20210226221920events.csv.

10.5 Potential Issues

Table 10-1 Troubleshooting

Issue	Resolution
Very slim and dark objects, such as black pen, do not work well with TCS	Use finger or thicker and lighter objects
Lights below camera directly facing the camera negatively impact click performance in impacted area	Avoid lights directly facing the camera
If camera is in installed incorrectly or shifted to a wrong position too close to floor or desk surface, cursor may be stuck	Free the cursor by blocking the camera's left or right sensor and then stop the TCS service. Correct the camera position to avoid the issue.
cursor jumps around or inaccurate clicks.	A few possible causes: 1) This is usually caused by the camera positioned too close to the monitor. Adjust it higher according to the required distance from camera to monitor. 2) The monitor may be in the camera's vertical FOV. Check the camera view or rerun the camera setup, slowly tilt the camera forward so the monitor in not in FOV. 3) Also keep an eye on objects in front or on the side of the monitor that may negatively impact TCS operation. 4) If the monitor sits too close to the floor and strong sunlight shines on the floor, TCS may be negatively impacted. Raise the monitor away from the floor or block the sunlight a bit in case there is issue.
when devices disconnect and reconnect while in streaming, TCS would detect and recover the device. However, occasionally after repeated disconnect and reconnect, the device connect event is not transmitted through the USB port and the device would not appear.	Quit the application and relaunch.
No camera detected on Windows 7	Check if camera connected properly Check if camera device driver is configured correctly. See section *5.7 Install Camera Device Driver on Windows 7* for details.

11 Appendix A - Manual Calibration

The Intel® RealSense™ Touchless Control Software should be calibrated in initial setup or when performance degraded due to shifts in display or camera positions.

11.1 Start Calibration

[IMPORTANT]

Camera should be installed at recommended positions at approximate camera to screen top edge distance. The Camera should be tilted forward so that monitor screen is not in camera vertical FOV. The depth view in calibration can be used to determine if the monitor top edge is in the FOV. Refer to Hardware Installation section for details.

[IMPORTANT]

In this manual calibration process, background subtraction is applied to detect fingertip. Please make sure your hands or other obstacles don't exist in the virtual touch plane area when pressing "MANUAL" button.

If fingertip detection seems not working correctly, something obstacles might be included in the area. Please exit from manual calibration once by pressing esc key, and enter manual calibration again keeping virtual touch plane area clear.

Enter the calibration mode by clicking the "**Manual Calibration**" button. The app will enter full screen mode with a big **Start Pointing** button in the middle.

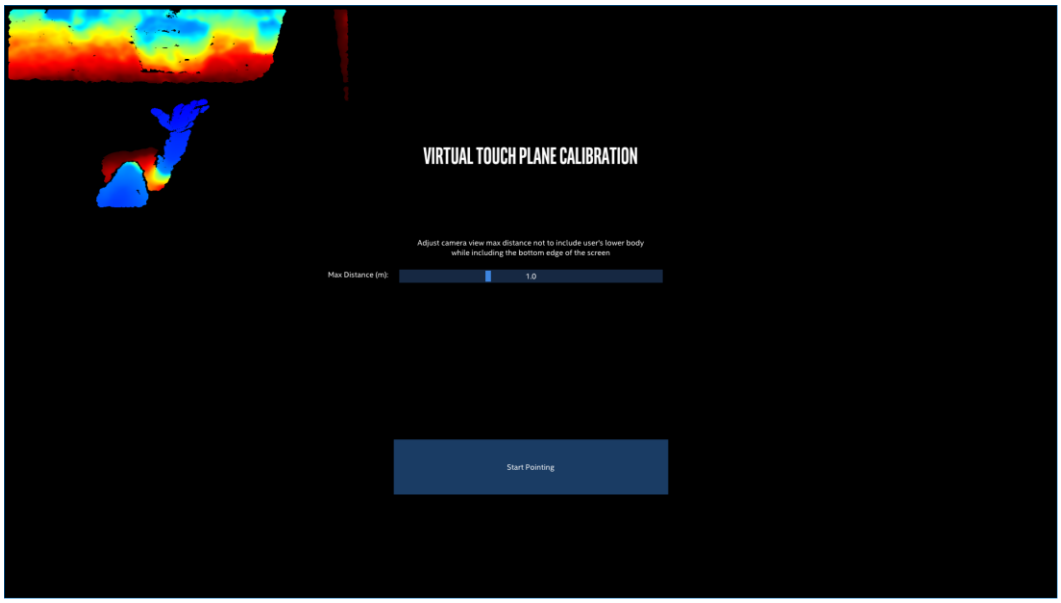


Figure 11-1 Starting Manual Calibration

Click the Start Pointing button to start calibration. Follow on screen instruction to point finger at the 4 corners of the screen, start at the top left corner.

[IMPORTANT] In the next steps to capture calibration input data, the tip of your finger should be detected and highlighted in a red cross. A count down timer appears with a message highlighted in green color. If not detected, pull finger away from the monitor a bit and retry, or check if app is caught anything in the background instead of your finger.

11.2 Capture Calibration Input at Top Left Screen Corner

Point finger at the top left corner of virtual screen (about 30 – 50mm from the screen surface) as the arrow indicator. Wait until the data capture is successful.

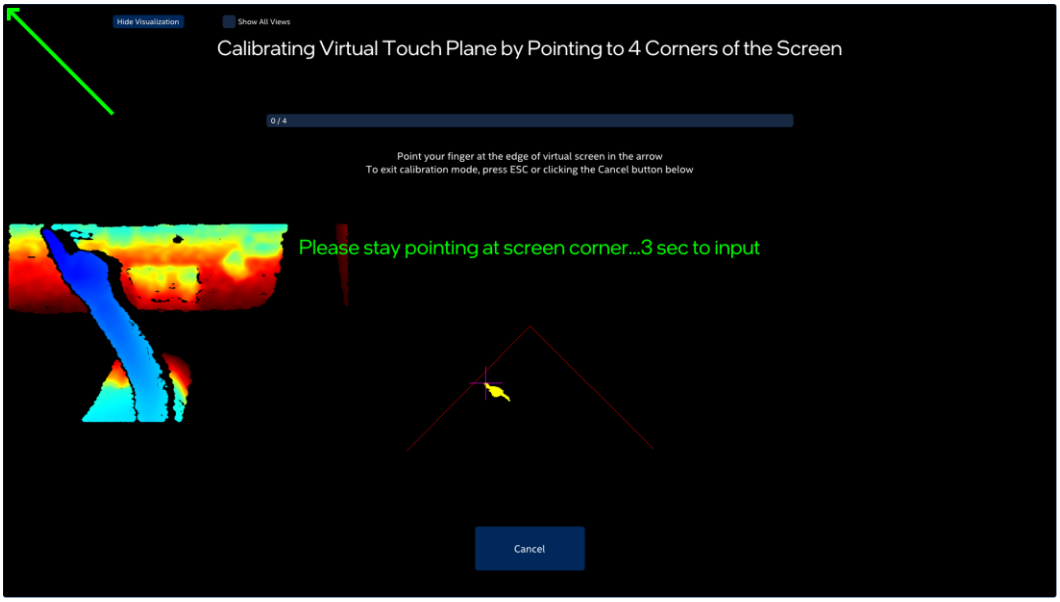


Figure 11-2 Calibration Input Capture at Top Left Corner

11.3 Capture Calibration Input at Top Right Screen Corner

Point finger at the top right corner of virtual screen as the arrow indicator. Wait until the data capture is successful.

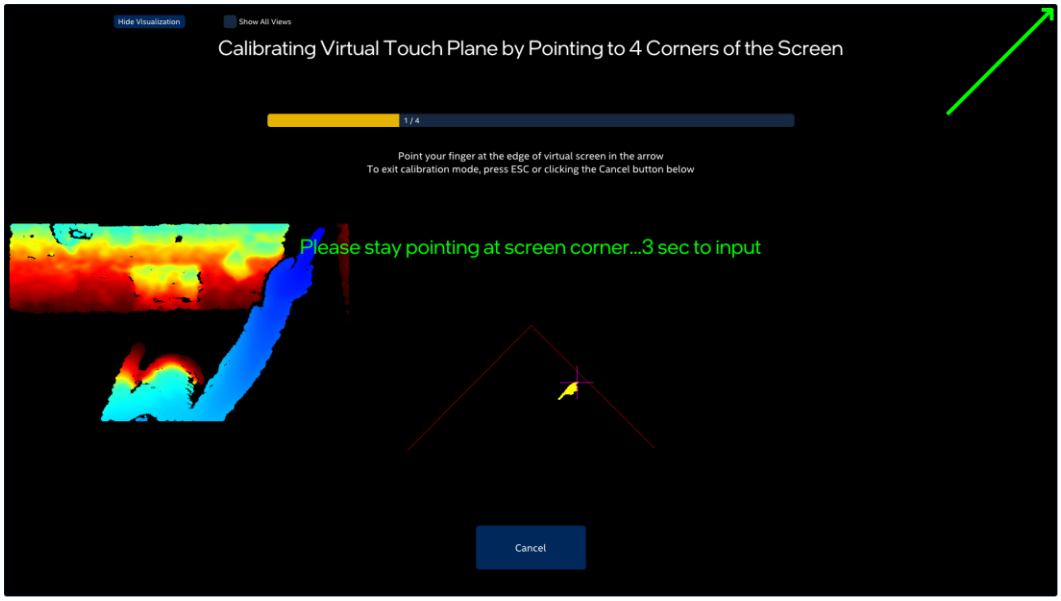


Figure 11-3 Calibration Input Capture at Top Right Corner

11.4 Capture Calibration Input at Bottom Right Screen Corner

Point finger at the bottom right corner of virtual screen as the arrow indicator. Wait until the data capture is successful.

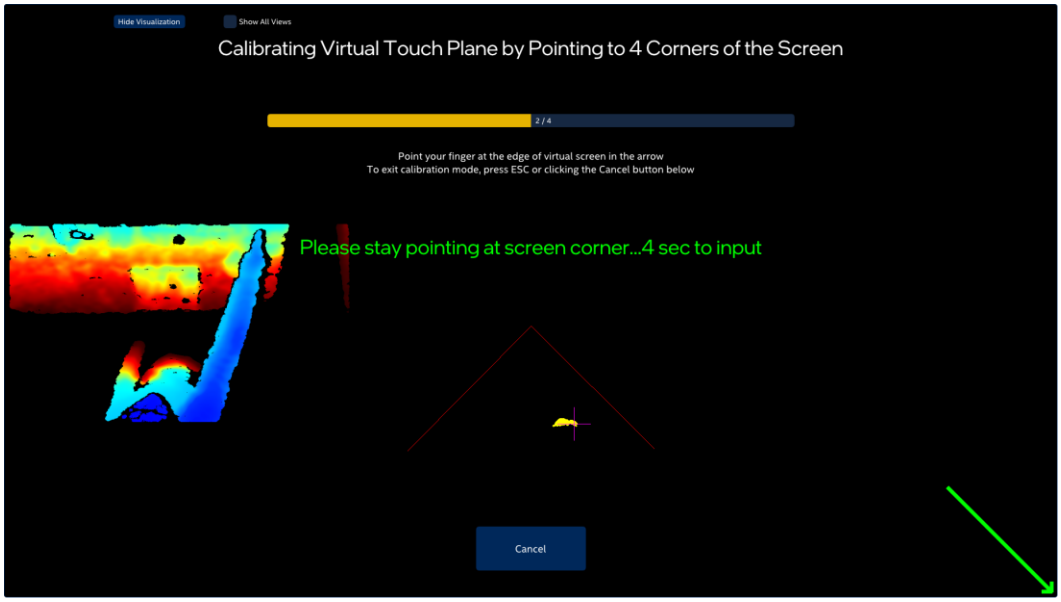


Figure 11-4 Calibration Input Capture at Bottom Right Corner

11.5 Capture Calibration Input at Bottom Left Screen Corner

Point finger at the bottom left corner of virtual screen as the arrow indicator. Wait until the data capture is successful.

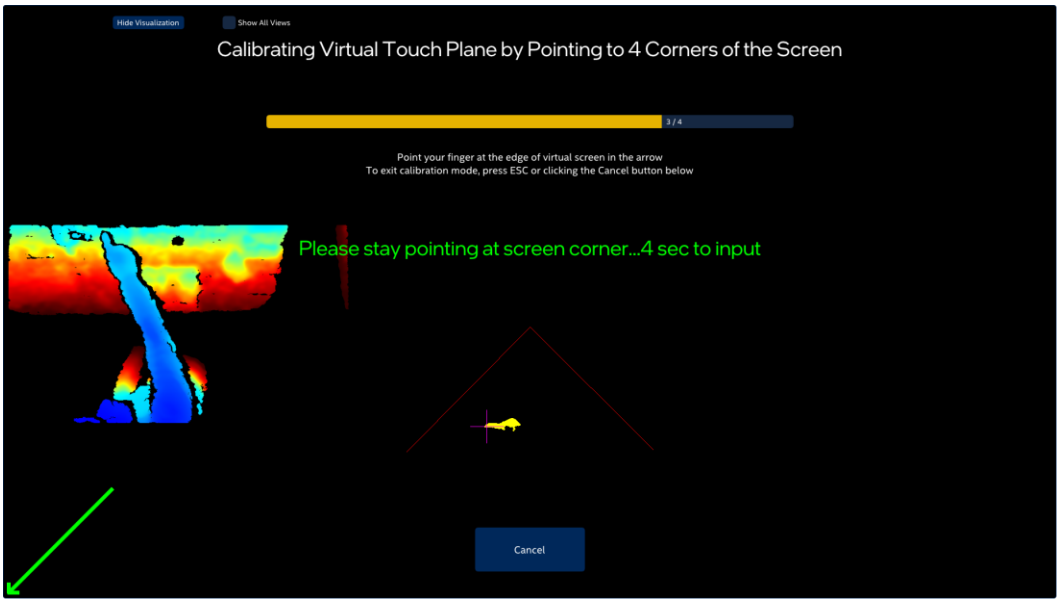


Figure 11-5 Calibration Input Capture at Bottom Left Corner

11.6 Calibration Complete

Once all 4 corners inputs are captured, TCS automatically computes the calibration and present a confirm screen to apply the result to the current session.

Move your finger around and check if the cursor position is correct. If you are satisfied with the result, click the Confirm button to apply the results. Otherwise, let the count down time out and the result is discarded without any impact.

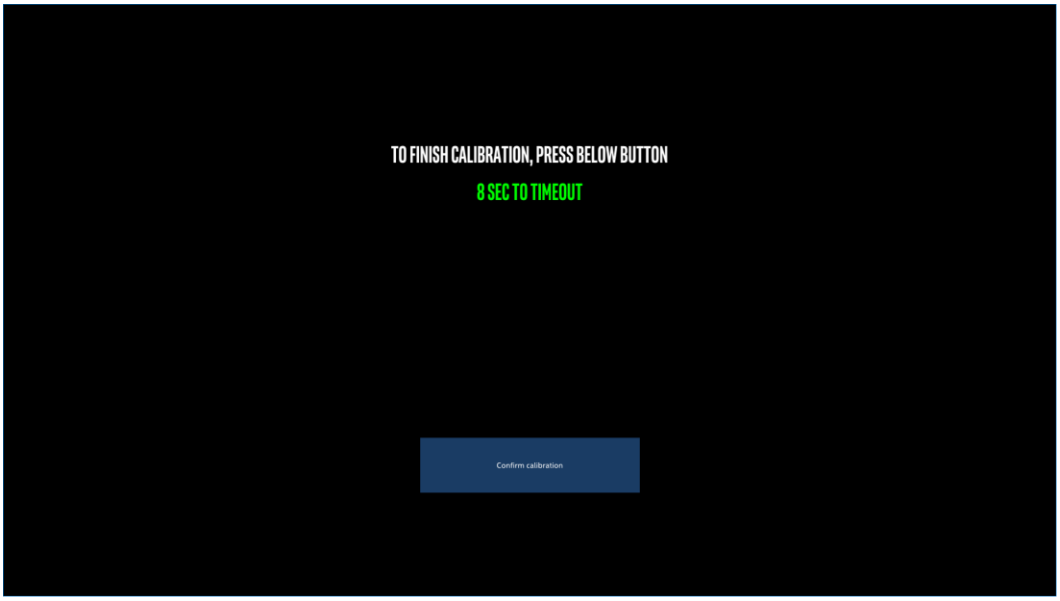


Figure 11-6 Manual Calibration Completed

11.7 Check Calibration Effectiveness

Open Windows Calculator app and maximize it in full window mode. Try to point finger to the buttons and move slowly toward the screen, at certain point, a red circle will appear on screen, then a green circle appears and virtual click occurs, the button pressed. Afterwards, a yellow circle appears, pull back your finger. Repeat this process for other buttons.

If a virtual click of a button happens at the correct location and no false click, then calibration is ok.

If you are not satisfied the calibration effectiveness, quit the app and restart the calibration process.

[IMPORTANT] If calibration runs multiple times in the same app session, bad calibration seems to stick in TCS app and subsequent calibration would be impacted. This is a known issue to be fixed in future releases. For now, a workaround is to restart app for every calibration run.

12 Appendix B – TCS Click Settings

This section describes the TCS click settings.

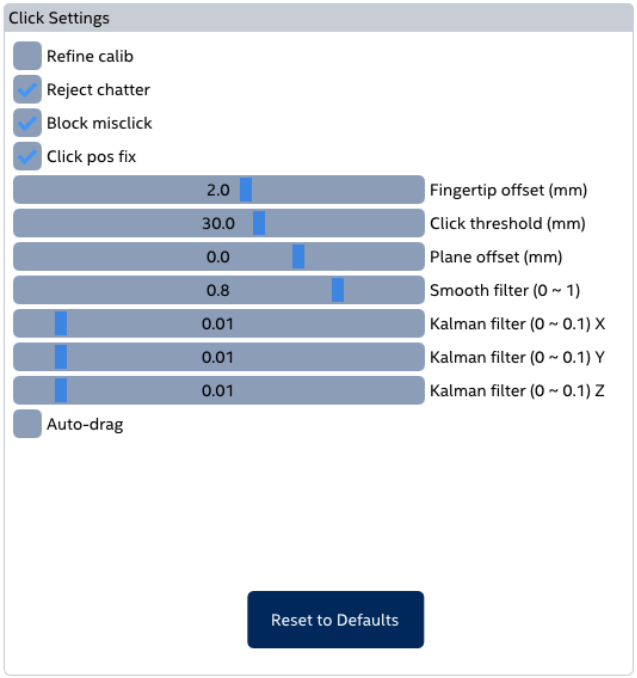


Figure 12-1 TCS Advanced Settings

12.1 Fingertip offset

It is possible to adjust the fingertip offset as shown in Figure 13. This offset is not only caused by the distance between the finger surface and center, but also by the parallax between the fingertip and the physical screen from user's viewpoint. In calibration mode, the offset is applied to the z-direction of the camera. In touch input mode, the offset is applied to the y-direction (up and down) of the virtual screen.

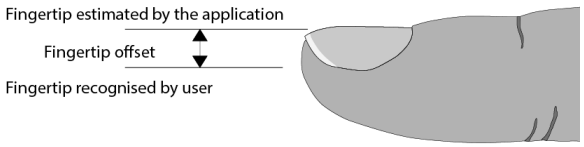


Figure 12-2 Fingertip offset can be adjusted in the Settings

12.2 Virtual plane offset

This allows for adjusting the z-direction offset to of the virtual touch plane, as shown in Fig. 14, without requiring the user to redo the full 4-point calibration. However, care must be taken to not increase the offset so much that it moves outside the camera's view. Also, if the plane is moved to overlap with the physical screen, false recognition will occur. To prevent this, the physical screen should not be placed within the FOV of the camera as mentioned earlier.

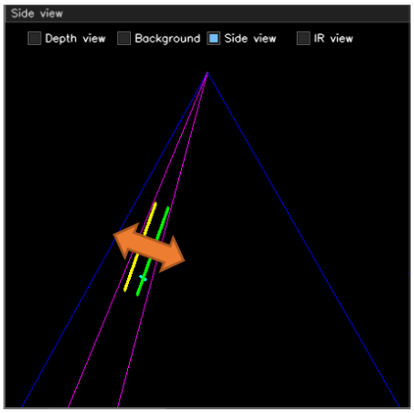


Figure 12-3 Virtual plane offset. Both start of the interaction volume and the virtual touch plane Z offset will be moved

12.3 Click threshold

This changes the distance between the interaction start plane and the virtual touch plane (Fig. 15). The sensitivity in the Z direction from detection start to touch detection is changed by this parameter.

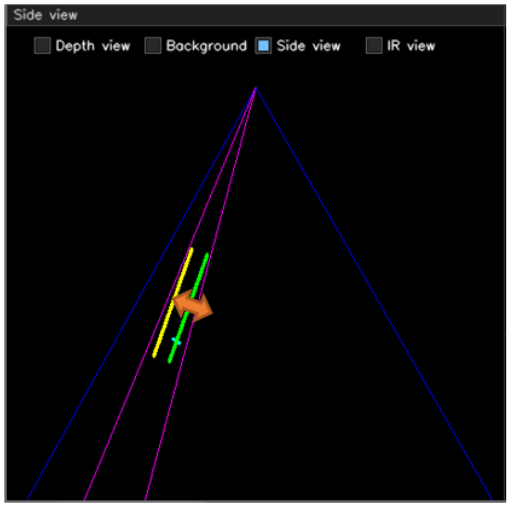


Figure 12-4 Click threshold changes only the relative offset between the start of plane of the interaction volume, and the virtual touch plane

As with the virtual plane offset, care must be taken to stay make sure adjustments don't move the planes outside of the cameras field-of-view. The purple line shows the region-of-interest (ROI) that is being detected. This ROI is automatically calculated by the position of detection start plane and virtual touch plane, to minimize processing load.

12.4 Smooth filter

Set the coefficient for temporal averaging. The closer to 0, the stronger the temporal averaging is, the smoother the pointer will look, but it introduces an increase in latency in pointing.

12.5 Kalman filter

In this application, a Kalman Filter is applied to the 3D pointer coordinates. Each noise component in X, Y and Z direction can be adjusted separately. The default value is 0.01 for X, Y, and Z. In most cases, this default value is a good compromise between perceived accuracy and reduction in jitter with ~22" screen size.

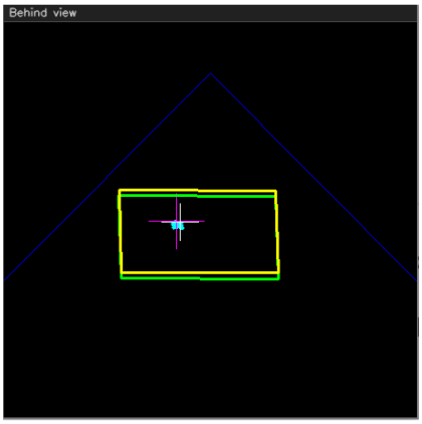


Figure 12-5 Raw (purple cross) and filtered (white cross) results

The result of applying "Smooth filter" and "Kalman filter" is shown in Top, Behind and Side view. If "Raw cross" option in the Top view is enabled, a purple cross appears in these views as raw detection results without any filters. Similarly, if "Filtered cross" is enabled, a white cross appears as filtered results (Fig. 16). By comparing these displays, filter values can be tuned while checking its effectiveness.

12.6 Block miss-click (Optional)

If a user's finger is moving parallel to the virtual plane, rather than in the Z-direction, it can be presumed that there is an intention to move laterally and not to click. However, when detected simply by plane thresholding, if the fingertip crosses the virtual touch plane while moving, a click will be detected regardless of intent. This option enables an algorithm intended to prevent such false clicks by looking at the relative speed vector and gating the click to require more Z-motion than XY-motion.

12.7 Click pos fix (Optional)

When a user performs the in-air Z-pecking motion to click, the XY-position will inevitably change as well. This may cause the click to appear offset from the intended click position. To prevent this offset, this option allows momentarily stopping of motion in XY direction, at the instant of the clicking. The clicking will feel much more stable, but there may be a small jump in cursor location once the motion tracking resumes.

12.8 Refine Calib (Optional)

Even after performing either MANUAL or AUTO calibration, there may be a slight offset from the intended pointing position due to factors such as the camera installation position/orientation and the deviation of the fingertip and screen position by parallax. To correct such offset, you can adjust the camera position or redo the MANUAL calibration. If you enable this "Refine Calib" option when you redo the MANUAL calibration, false detection of fingertips will be reduced and you can expect more accurate calibration.

Note: This option is only valid for refinement of Manual Calibration. It cannot be used when NOT calibrated or AUTO Calibration.

12.9 Reject chatter

This option is to prevent accidental click input if there is a problem with the quality of the depth image output from the camera.

It may not be possible to obtain a stable fingertip depth value due to the lighting environment of the installation location and the influence of the background texture.

In such a situation, if the depth value of the fingertip repeatedly appears and disappears in a blinking manner, the user's unintended click may be input at high frequency.

This is called "chatter" in TCS, and this option instantly and automatically disables this chatter clicks when detected.

This option does not interfere with normal click input and should normally be kept on.

If you feel that click input doesn't work correctly, please refer "cursor jumps around or inaccurate clicks." in "8 Troubleshooting".

12.10 Auto-drag (Optional)

This option allows user to drag the cursor instead of a click, for example, to draw a signature. To enable this feature, user application would need to use the cross-cursor pointer (as shown below) in the area where drag is desired, for example, in a signature area. TCS then detects the change of mouse cursor while user moves finger and automatically switch between click to drag (for signature).

arrow (default)

cross

As an example, on the web page below (web page is only for example, unrelated to Intel), user can first enable this option in TCS and then test the auto drag for signature.
https://generatesignature.com/DrawSignature

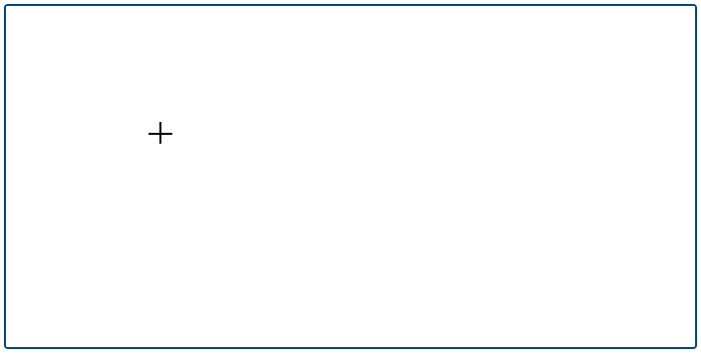


Figure 12-6 Example Signature Area with Cross Cursor

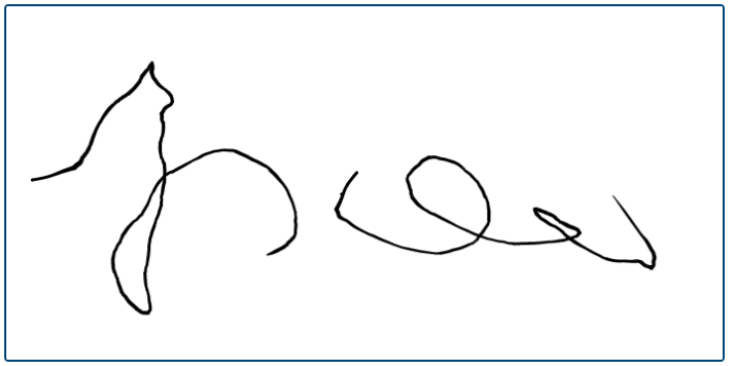


Figure 12-7 Example Signature Draw by TCS with Auto-drag option ON