Vzense
ToF sensor & application

NebulaGUITool

User Guide

Windows

2023.04

Vzense Technology Co. , Ltd.

Contents

1. Overview

NebulaGUITool is a graphical interface tool based on Nebula SDK, providing depth image display, 3D point cloud display, filters tuning, device parameter setting, and RGB & depth alignment.

For Ethernet products, IP addresses setting and firmware upgrading could be handled through the settings page of NebulaGUITool.

NebulaGUITool Download Link:

Oversea: https://github.com/Vzense/NebulaGUITool

China: https://gitee.com/Vzense/NebulaGUITool

2. Products

NebulaGUITool currently supports products like:

- DS77 Lite/Pro
- DS77C Lite/Pro
- DS86 & DS87

2.1. DS77 Lite/Pro

Sensor	DS77 Lite	DS77 Pro
Sensor	SONY DepthSense ToF	
Laser	940nm VCSEL * 2	
TOF Resolution	640 * 480, Max. 25fps	
TOF FOV	70°(H) * 50°(V)	
Pixel Format	12bit Depth, 8bit IR	
Digital Interface	1000M Ethernet, RS485	
Power Supply	12V ~ 24V DC	12V ~ 24V DC or POE+
Accuracy	< 1% (4mm@1m)	
Detect Range	0.15m ~ 5m	
Operating Temperature	-20℃ ~ 50℃	
OS Support	Windows, Linux, Arm Linux	
Software Support	Nebula SDK, C++, C, Python, ROS, ROS2	
Ingress Protection	IP42	IP67

2.2. DS77C Lite/Pro

Sensor	DS77C Lite	DS77C Pro
Sensor	SONY DepthSense ToF + RGB	
Laser	940nm VCSEL * 2	
TOF Resolution	640 * 480, Max. 25fps	
ToF HDR Mode	Supported with Max. 15fps	
RGB Resolution	1600 * 1200, Max. 25fps	
TOF FOV	70°(H) * 50°(V)	
RGB FOV	77°(H) * 55°(V)	
Pixel Format	12bit Depth, 8bit IR, MJPEG RGB	
Digital Interface	1000M Ethernet, RS485	
Power Supply	12V ~ 24V DC	12V ~ 24V DC or POE+
Accuracy	< 1% (4mm@1m)	
Detect Range	0.15m ~ 5m	
Operating Temperature	-20℃ ~ 50℃	
OS Support	Windows, Linux, Arm Linux	
Software Support	Nebula SDK, C++, C, Python, ROS, ROS2	
Ingress Protection	IP42	IP67

2.3. DS86 & DS87

Model	DS87	DS86
Sensor	SONY DepthSense ToF CMOS	
Laser	940nm VCSEL * 2	
TOF Resolution/Frame rate	640 * 480, Max. 15fps	
ToF HDR Mode	Supported with Max. 10fps	
ToF FOV	70°(H) * 50°(V)	
RGB Camera	1600 * 1200, , Global Shutter, 77°(H)*55°(V)	
Output Format	RAW12(Depth, IR) + JPG(RGB)	
Interface	1000Mbps Ethernet and RS485	
Physical Connection	Aviation Plug x 2	RJ45 x1 8pin Connector x 1
Power Supply	PoE+ or 12V~24V (DC)	12V~24V (DC)
Accuracy	< 1%	
Working Range	0.15m ~ 5m	
Working Temperature	-20°C to +50°C	
Operation System&Platform	Windows/Linux/Arm Linux/ROS1/ROS2	
SDK	C/C++/Python	
Enclosure Rating	IP67	IP42
Conformity	CE, FCC, FDA	

3. Installation

3.1. Recommended System Configuration

Item	Recommended Configuration
OS	Win7 32/64 bits Win10 64 bits Win11 64 bits
RAM	At least 4GB

3.2. NebulaGUITool Contents

NebulaGUITool contains NebulaGUITool.exe, user manual, upgrade firmware, and related dynamic link libraries.

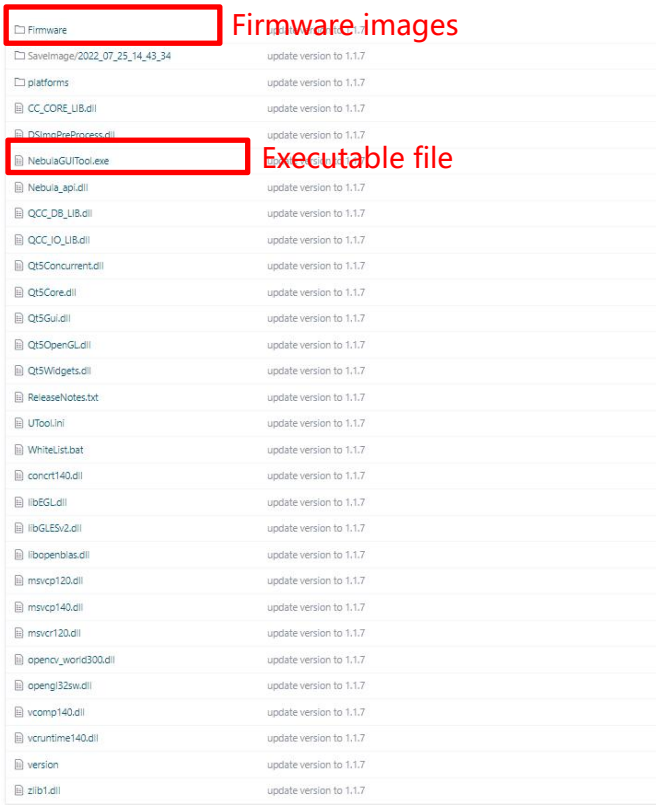


Figure 3. 1 NebulaGUITool Contents

3.3. Device Connection

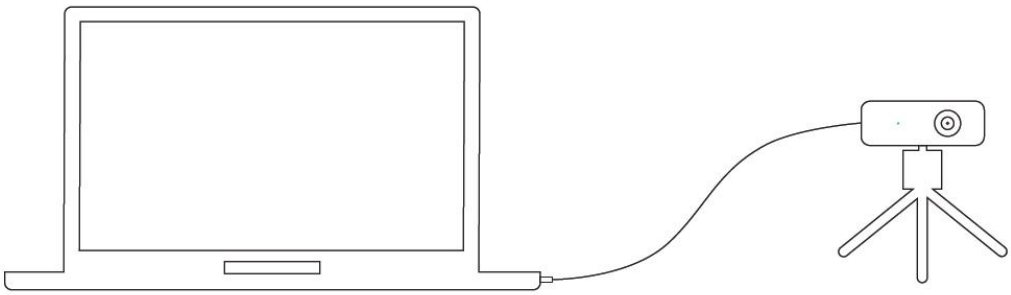


Figure 3. 2 Hardware Installation

Vzense devices have two connection methods: static IP address and DHCP. Static IP address is the default connection mode. The IP address, subnet mask and DHCP can be also changed by NebulaGUITool.

3.3.1. Static Address

Using static address connection method, device can be directly connected to computer, or with switch on the same network segment.

Direct connection: one end of the cable is connected to the camera, and the other end is plugged into RJ45 port of the PC. The default IP address of Vzense devices is 192.168.1.101, so the address of the PC can be set to 192.168.1.100. In Win10 system, the below picture can be referenced to set the PC network up.

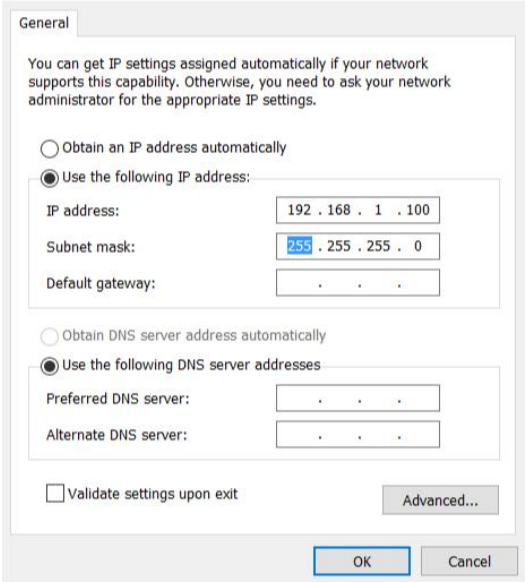


Figure 3. 3 Static Address

3.3.2. DHCP

Using DHCP connection mode, the Vzense camera need be connected to a router which DHCP is enabled, then connect a PC on the same LAN. Set the local Connection of the PC to obtain the IP address automatically. For details on how to set the camera to DHCP connection mode, refer to the 4.3.5.1.

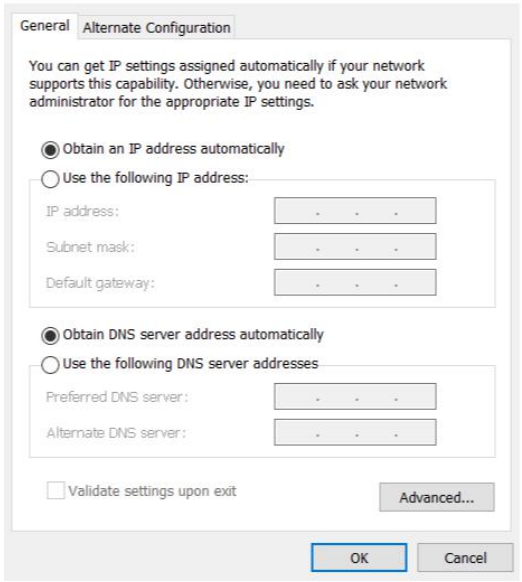


Figure 3. 4 DHCP

Note:

1. The network card, router and switch used on the PC have to meet the requirements of 1000Mbps.

2. When the NebulaGUITool first run, all options of the firewall should be chosen.

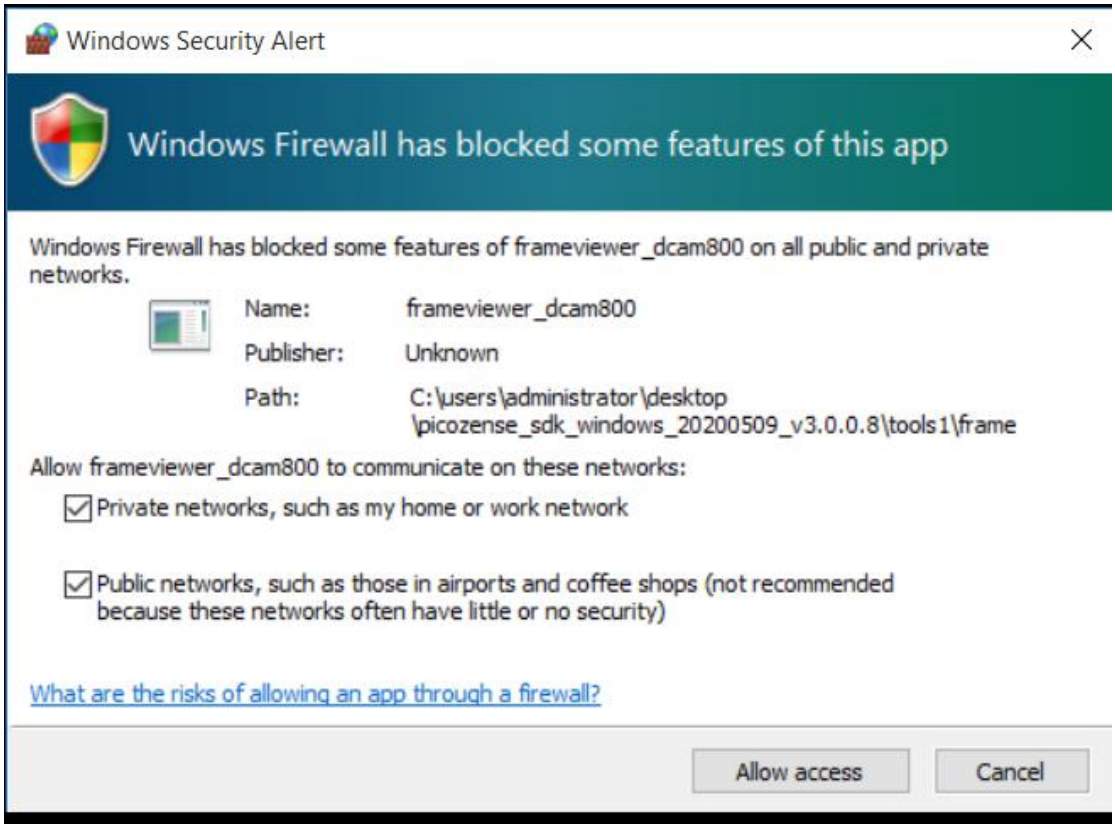


Figure 3. 5 firewall setting

4. Function Instruction

4.1. Device List

Device list is used to search and connect devices. For the purpose of demonstration, only one camera can be opened at the same time by NebulaGUITool, but SDK allows multiple cameras to work simultaneously.

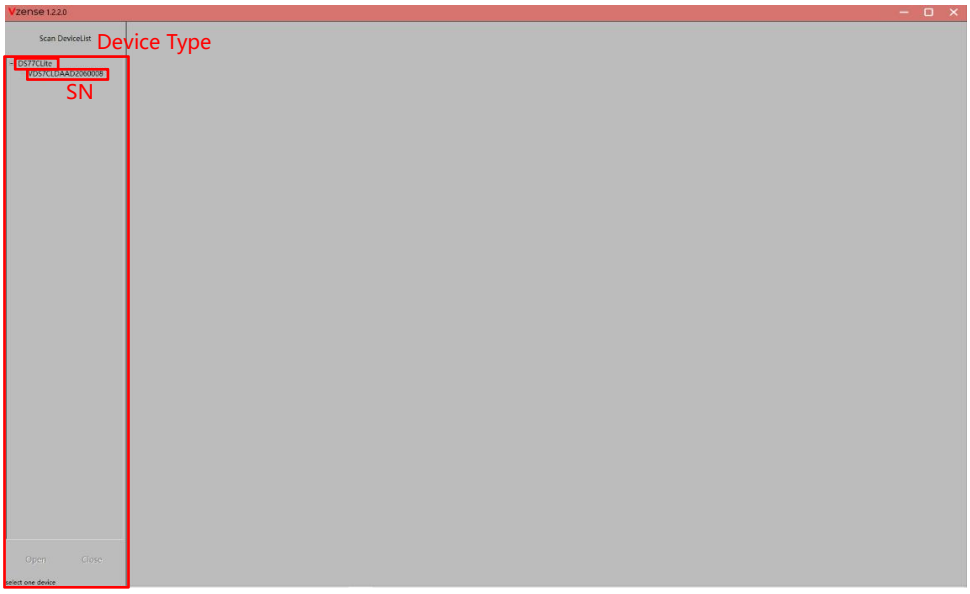


Figure 4. 1 Search Device

Connect device:

Figure 4. 2 Connect Device

1．Search the device.

2．Select the SN of the device.

3．Click “Open” to open the device, or double-click the device SN to open the device.

Disconnect device:

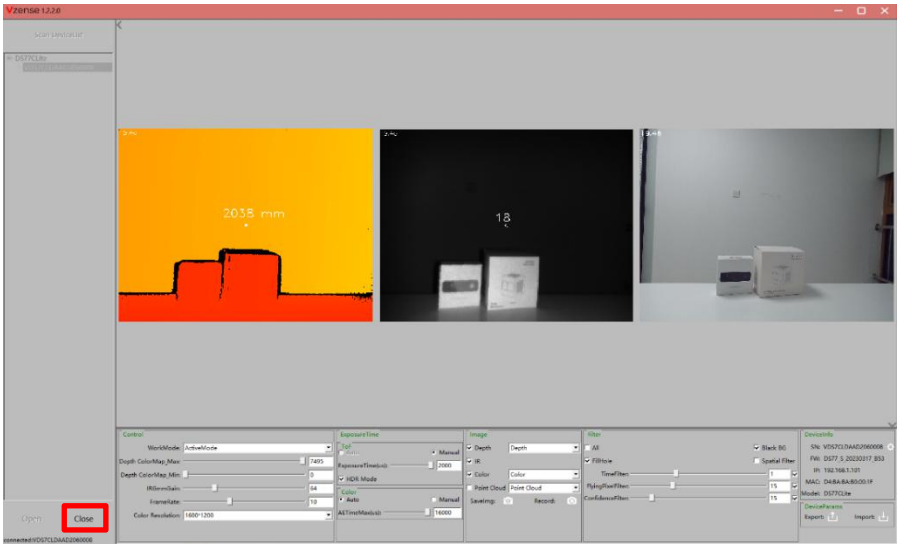


Figure 4. 3 Disconnect Device

1. Click “Close” to close the device.

4.2. Display Area

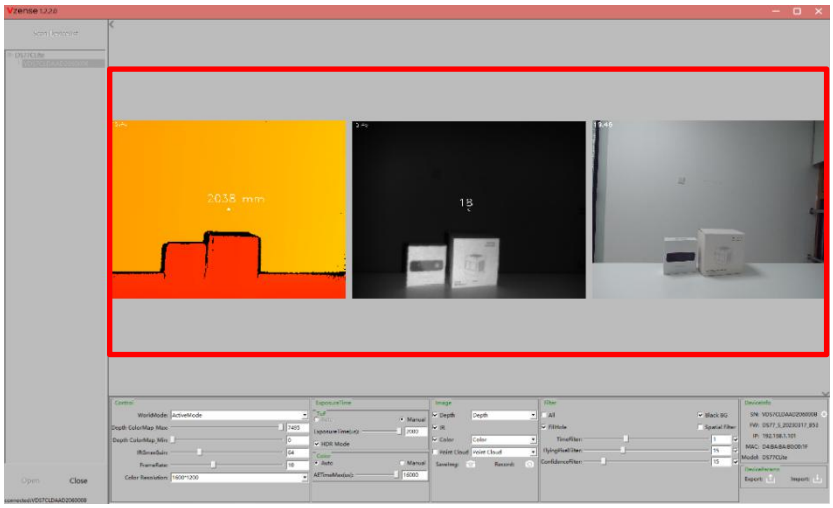


Figure 4. 4 Display Area

The display area is used to display images. From left to right, there are depth image window, IR image window, color image window and point cloud image window (closed by default).

The value displayed in the depth image window is the depth value of **the real-time pixel** at the white point, the unit is mm. As shown in the figure above, the depth value of the point is 2038mm.

Note: Click the right button of mouse to select the position of the white point and display the depth value of the corresponding point.

4.3. Operation Area

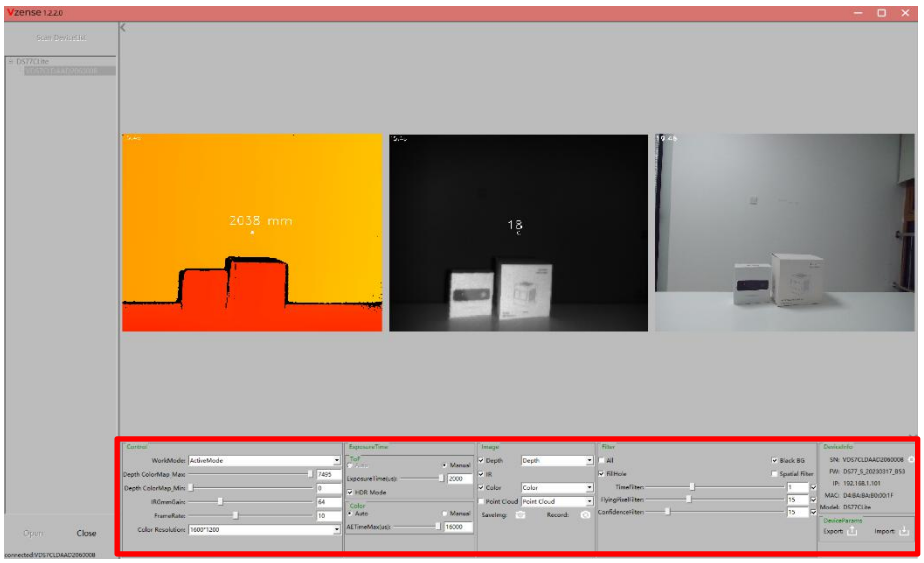


Figure 4. 5 Operation Area

The operation area is used to control the device parameter, set the image processing algorithm and view the device information.

4.3.1. Control

4.3.1.1. Work Mode

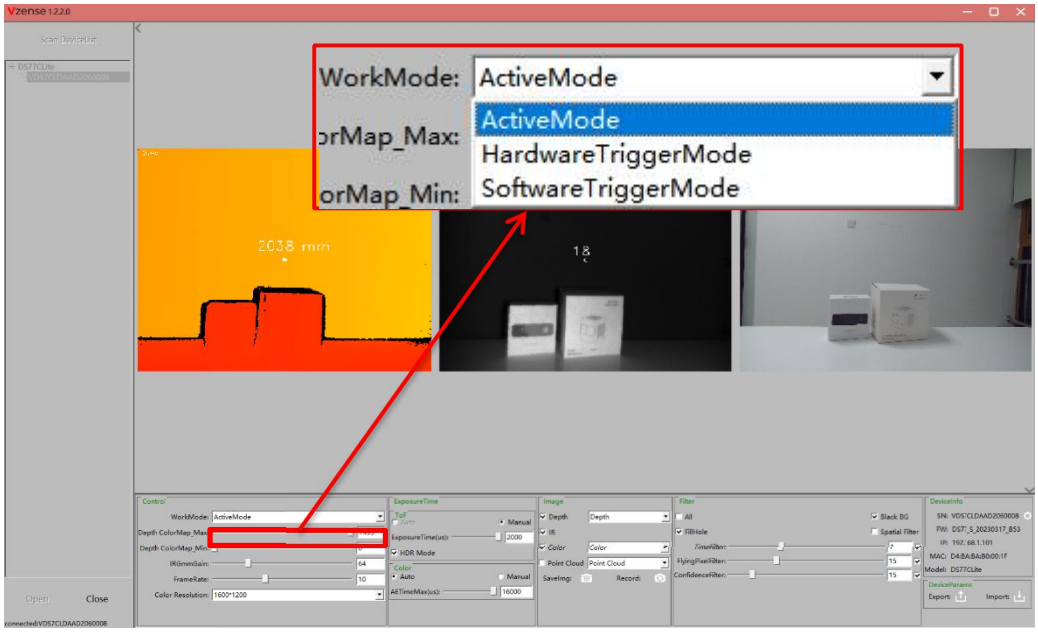


Figure 4. 6 Device Work Mode

ActiveMode: Active image with fixed frame rate.

HardwareTriggerMode: The image is triggered by the hardware signal. For details, please refer to the corresponding product specifications.

SoftwareTriggerMode: The image is triggered by API call, click the ‘Trigger’ button to send the soft trigger instruction once.

Figure 4. 7 SoftwareTriggerMode

4.3.1.2. Color Map

Figure 4. 8 Color Map

For displaying the depth image intuitively, we map 16-bit depth image to color image. When mapping, we intercept the depth value in a given range: from **ColorMap_Min** to **ColorMap_Max**, and then map it to 0-255 range. Finally, the image is transformed into a color image by using color mapping.

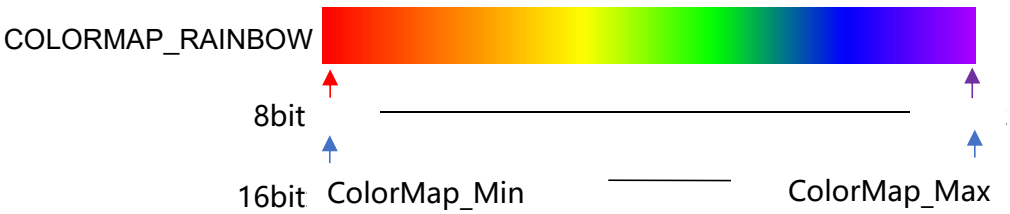
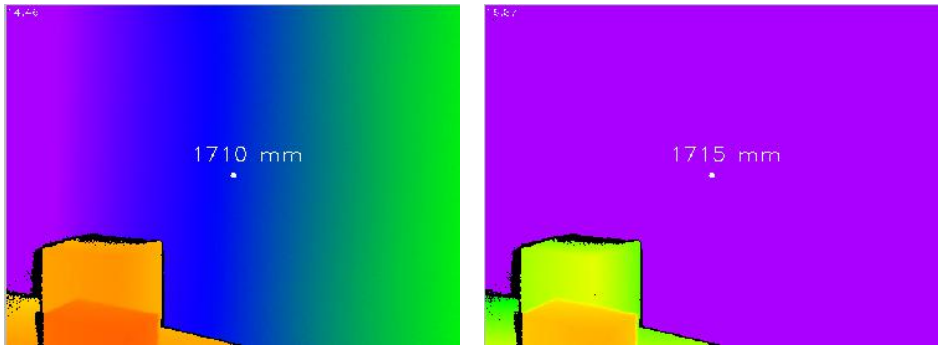


Figure 4. 9 Chromaticity Diagram

The effect of color map mapping is shown in Figure 4.10



ColorMap_Max value：2200　　ColorMap_Max value：1200

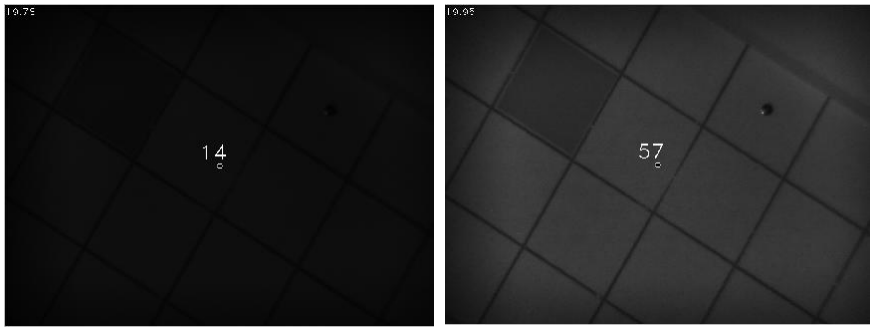
Figure 4. 10 Color Map Effect

4.3.1.3. IRGmmGain

Figure 4. 11 IRGmmGain

Set the gain of the IR image, the higher GmmGain value, the brighter IR image.

The default GmmGain is 64.



IRGmmGain value 64 IRGmmGain value 255

Figure 4. 12 IR image effect

4.3.1.4. RGB Resolution

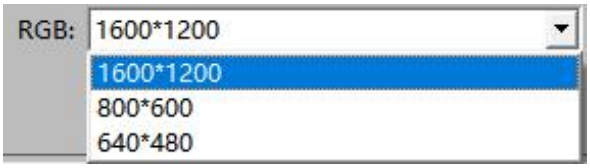


Figure 4. 13 RGB Resolution

The RGB resolution can be switched according to the actual list. For example, the resolution of the above figure is 1600* 1200,800 * 600,640 *480.

4.3.2. Exposure Time

4.3.2.1. ToF Sensor Exposure Time

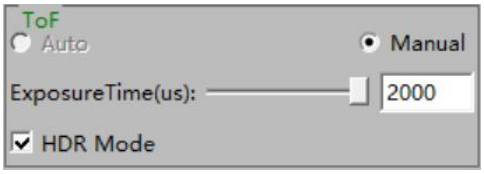


Figure 4. 14 ToF sensor exposure time setting

The exposure time of the ToF sensor can be set.

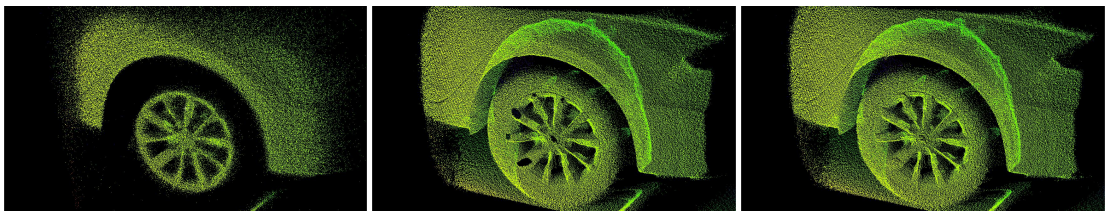
Auto: The ToF sensor is set to automatic exposure, and the device will adjust the exposure time according to the image.

Manual: The ToF sensor is set to manual exposure, and the exposure time is manually adjusted through the slider or input box.

The ToF sensor uses manual exposure mode by default, and the maximum exposure time that can be set is related to the frame rate.

Frame	ExposureTime(us)
5fps	4000
10fps	2000
15fps (max for HDR Mode)	1300
25fps	1000

HDR Mode: HDR (High Dynamic Range) mode completes the imaging of an entire complex scene by setting several different exposure times and composing the captured multiple images into a single frame.



Exposure time: 58 us　　Exposure time: 1000us　　HDR, Exposure time: 1000us

Figure 4. 15 ToF sensor exposure time effect

4.3.2.2. RGB Sensor Exposure Time

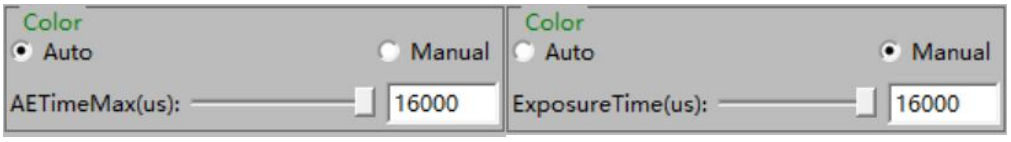


Figure 4. 16 RGB sensor exposure time setting

The RGB sensor exposure time can be set.

Auto: The exposure time of the RGB sensor is set to the automatic exposure.

AETimeMax(us): Set max ExposureTime for auto exposure, related to frame rate.

Frame	ExposureTime(us)
5fps	30000
10fps	16000
15fps (max for HDR Mode)	10000
20fps	5000
25fps	3000

Manual: The exposure time of the RGB sensor is set to the manual exposure.

ExposureTime(us): Set the exposure time for manual exposure.

The default exposure mode of the RGB sensor is the automatic exposure.

4.3.3. Image

4.3.3.1. Image Display

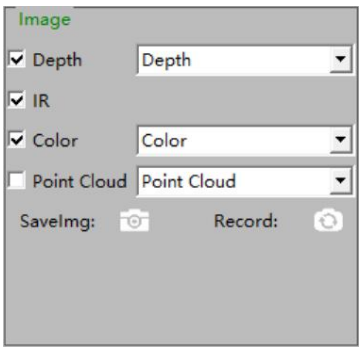


Figure 4. 17 Image display options

The display image content in the display area can be set. After deselecting, the display area will no longer display the corresponding image window.

Depth image, IR image and RGB image (if device contain) are enabled by default.

4.3.3.2. Point Cloud

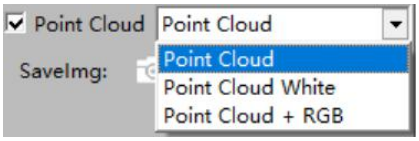


Figure 4. 18 Point Cloud display button

Check Point Cloud to set whether to display point clouds or not. Point clouds are displayed using depth pseudo-color by default.

Point Cloud White：Set point cloud using monochrome display (white).

Point Cloud + RGB：Set point cloud to be filled with the RGB map.

Point cloud control operations:

Double-click the point cloud： display the point cloud in full screen

Hold down the left mouse button and drag: Rotate the point cloud

Hold down the right mouse button and drag: Translate the point cloud

Mouse wheel: Zoom in/out of the point cloud

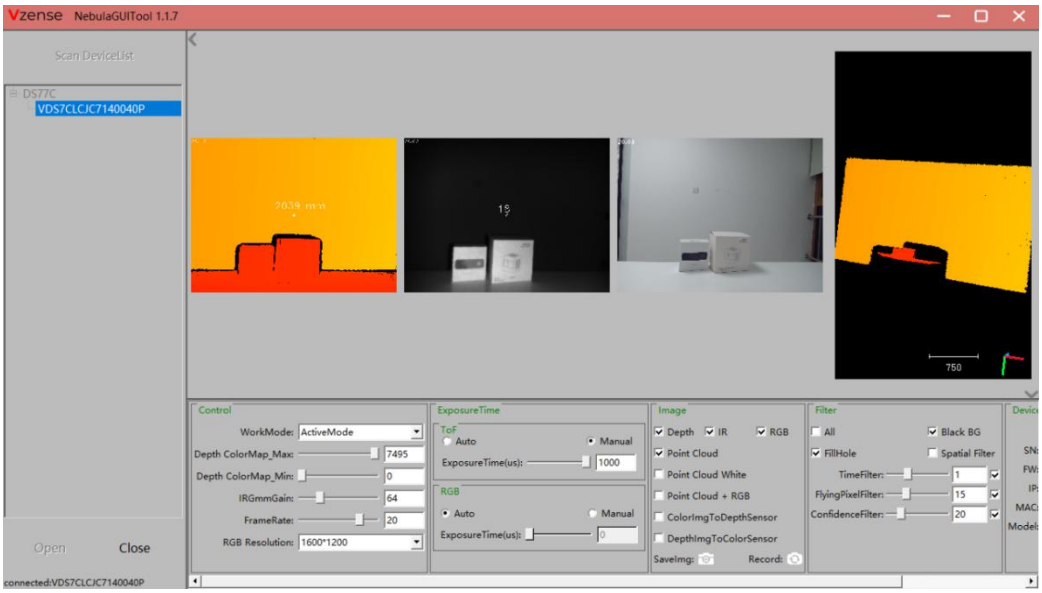


Figure 4. 19 Point Cloud

4.3.3.3. RGBD Map

1.DepthImgToColorSensor

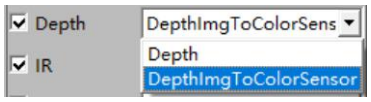


Figure 4. 20 DepthImgToColorSensor

Depth image map to RGB domain. When enabled, the images with Depth pixels aligned to the RGB pixel space are output and displayed, that is, the depth image corresponding to RGB pixel one by one.

DepthImgToColorSensor Image RGB Image

Figure 4. 21 DepthImgToColorSensor effect

2.ColorImgToDepthSensor

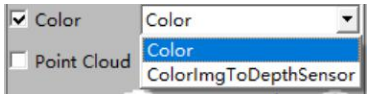


Figure 4. 22 ColorImgToDepthSensor

RGB image map to Depth domain. When enabled, images with RGB pixels map to Depth pixel space are output and displayed, that is, RGB images corresponding to depth pixels one by one.

Depth Image ColorImgToDepthSensor Image

Figure 4. 23 ColorImgToDepthSensor effect

4.3.3.4. Save Image

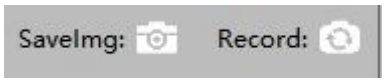


Figure 4. 24 Save button

SaveImg: Save a frame of all images in the current display area. Click to save one image at a time. If the display area is not enabled, it will not be saved.

Note: All the saved images/point clouds are stored in the same folder, named after the current time, in the SaveImage folder of NebulaGUITool directory. The saved file is named in the following format:

Figure 4. 25 Path to save the original data

Record: Continuously save the images of all display areas (do not support point cloud continuous save).

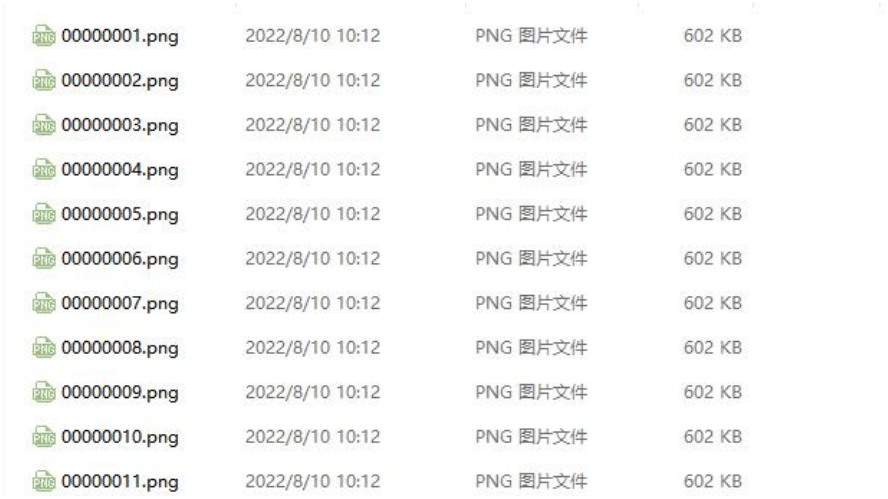


Figure 4. 26 Save depth effect continuously

File format:

The Depth image is stored in 16-bit PNG format, the unit is mm.

IR images are stored in 8-bit single-channel PNG format.

The RGB diagram is an 8-bit three-channel color map, saved in JPG format.

The PointCloud data is saved in txt format, and each row of data represents the coordinates of a point (X, Y, Z). The saved file can be viewed using CloudCompare.

Note:

NebulaGUITool's saved depth map is a 16bit single-channel PNG image, with each pixel represented by two bytes. Windows' default image display tool can only display 8bit single-channel images, so they look black. User can use Image J to display and view pixel distance values.

4.3.4. Filter

4.3.4.1. Image filter

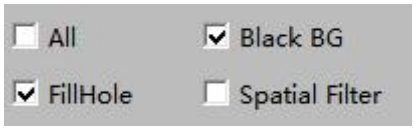


Figure 4. 27 Filter button

1．All

Enable/disable all filters.

2．Black BG

Black BG: enable or disable the Black background. The effect is as follows.

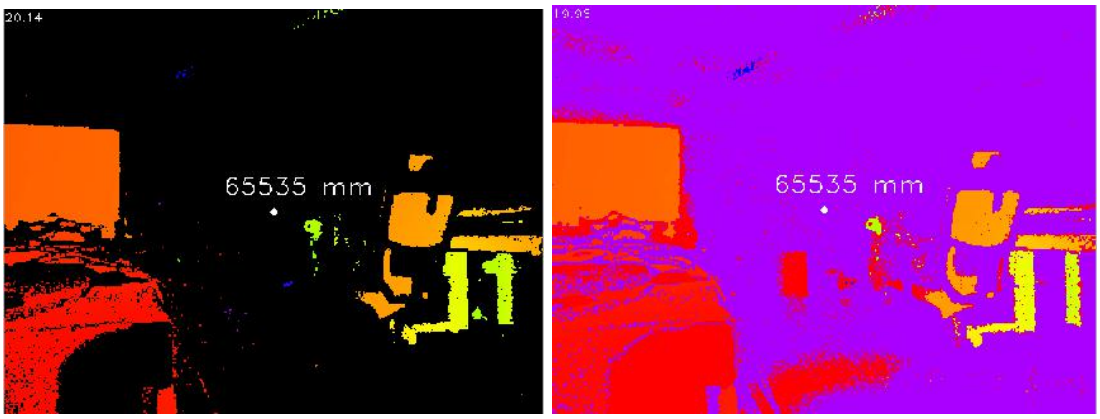


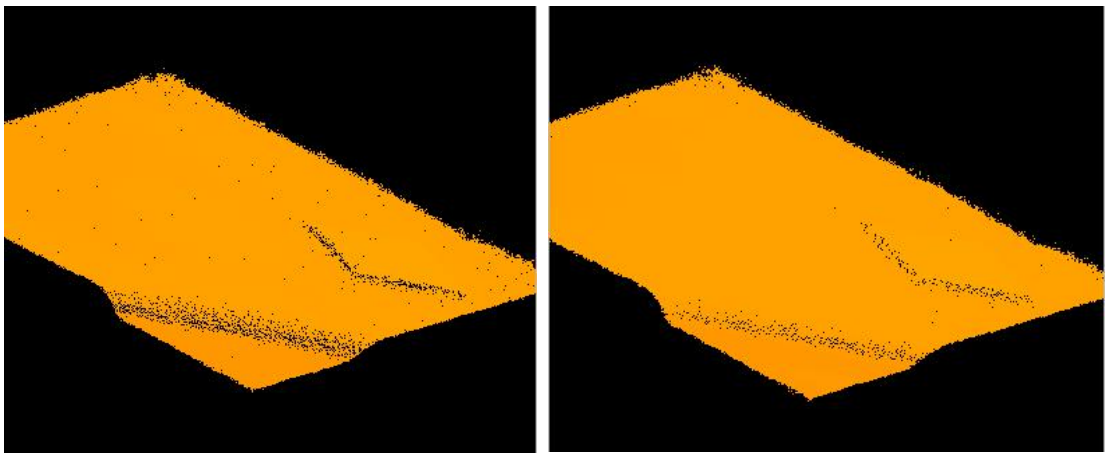
Figure 4. 28 Turn on/off the black background effect

3．FillHole

FillHole: fill up some empty data. This function is enabled by default.

4．Spatial Filter

Spatial Filter: similar to Gaussian filter, reduce noise. This function is disabled by default.



Spatial Filter close　　Spatial Filter open

Figure 4. 29 Spatial Filter Close/Open effect

4.3.4.2. Time Filter

Figure 4. 30 Time Filter Switch and threshold

Time Filter: Time Filter reduce image noise. By default, this function is enabled and the default value is 1. (The larger value, the stronger filtering effect).

4.3.4.3. Flying Pixel Filter

Figure 4. 31 Flying Pixel Filter Switch and threshold

Flying Pixel Filter: Flying Pixel Filter eliminate the depth value of the boundary. flying points. The default value is 15 (the larger value, the stronger filtering effect).

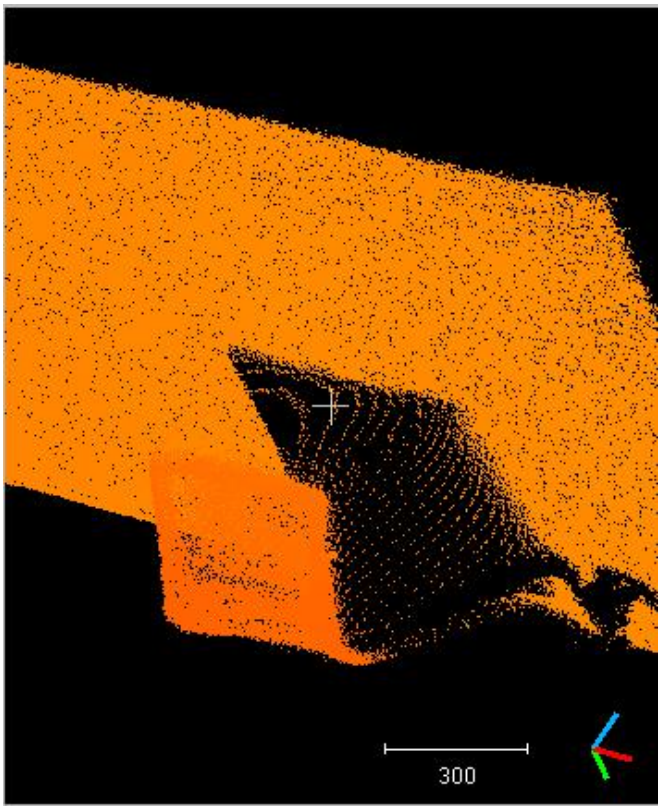


Figure 4. 32 Flying Pixel Filter close

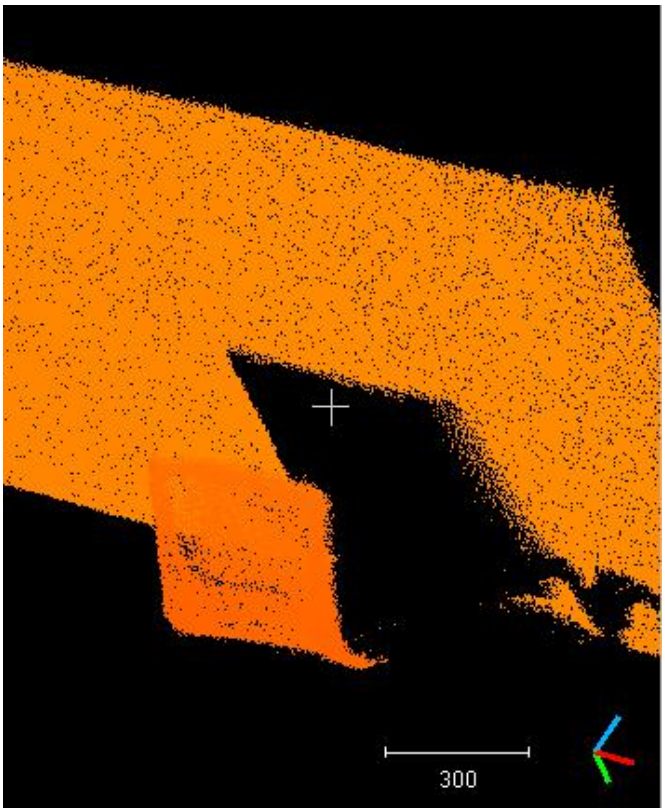
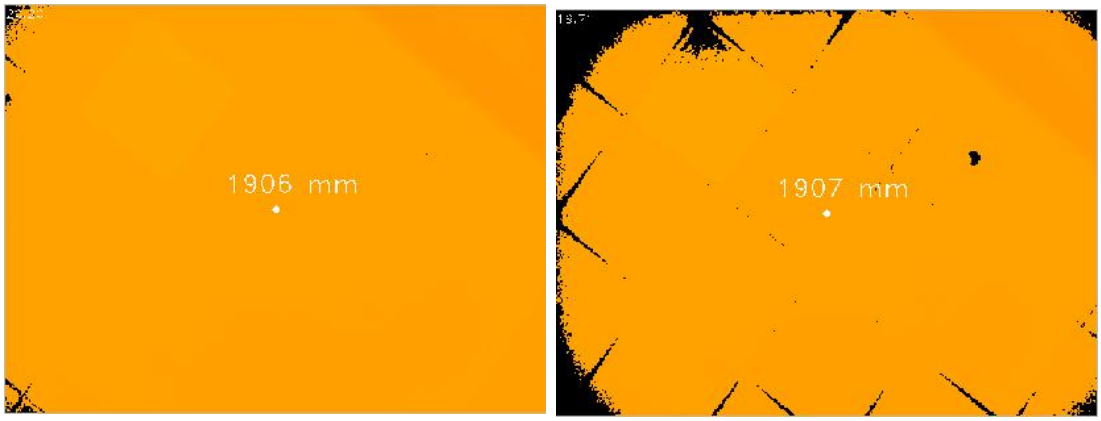


Figure 4. 33 Flying Pixel Filter value: 15

4.3.4.4. ConfidenceFilter

Figure 4. 34 Confidence Filter Switch and threshold

Confidence filter: Confidence filter eliminate points with poor signal quality. The default threshold of Confidence Filter is 15.



Confidence filter value 15 Confidence filter value 50

Figure 4. 35 Confidence filter different threshold effect

4.3.5. Device Information

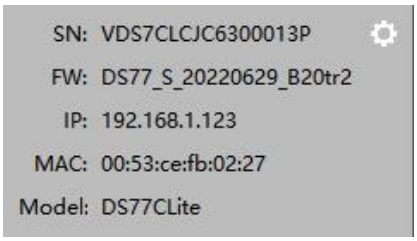


Figure 4. 36 Device information

SN: serial number.

FW: the firmware version.

IP: the current IP address of the device.

MAC: the MAC address of the device.

Model: device type.

 : Device IP address setting and firmware upgrade page.

4.3.5.1. Change the IP

Click  ,NebulaGUITool shows below.

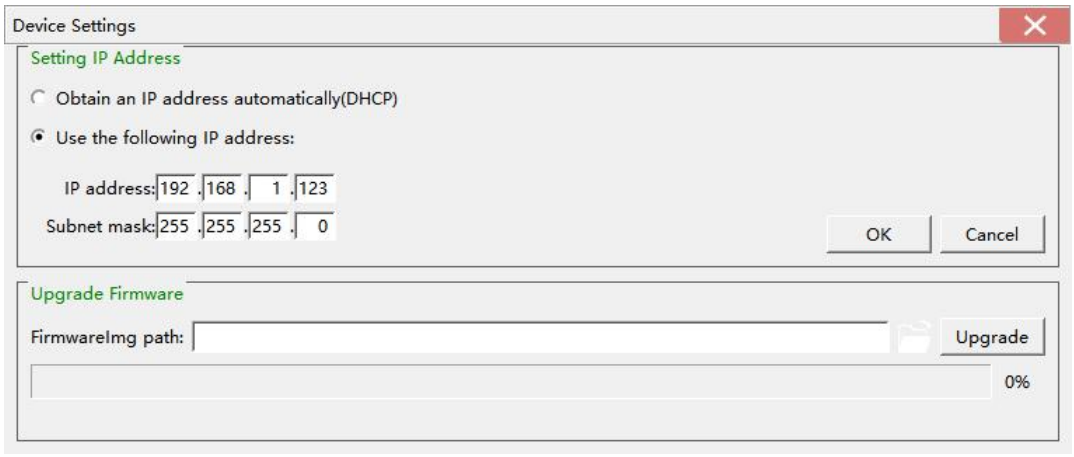


Figure 4. 37 Device Setting Interface

Obtain an IP address Automatically (DHCP): Set the network mode of the device to the DHCP mode, which allows the router to assign IP addresses. When this mode is used, DHCP mode need to be set on the PC.

Use the following IP address: Set the connection method of the device to static IP address. In this mode, ensure that the host IP address and subnet mask are on the same network segment as the device IP address.

1. To set dynamic IP address:

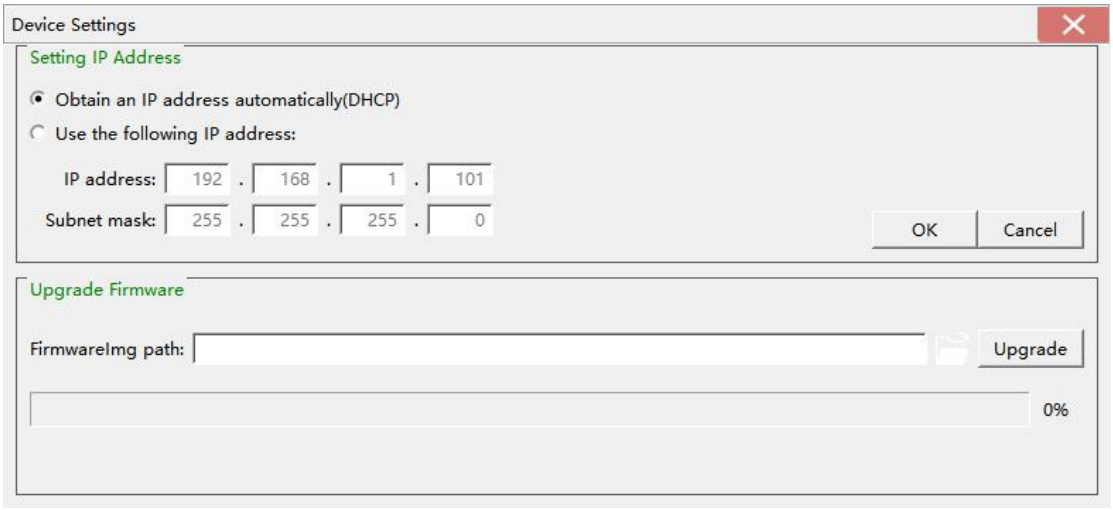


Figure 4. 38 Set DHCP

Step1: Choose “Obtain an IP address automatically (DHCP)”.

Step2: Click OK to save.

Step3: The device takes effect after automatic restart.

2. To set static IP address:

Step1: Select "Use the following IP address".

Step2: Change the IP address and subnet mask.

Step3: Click OK to save.

Step4: The device takes effect after automatic restart.

4.3.5.2. Firmware upgrade

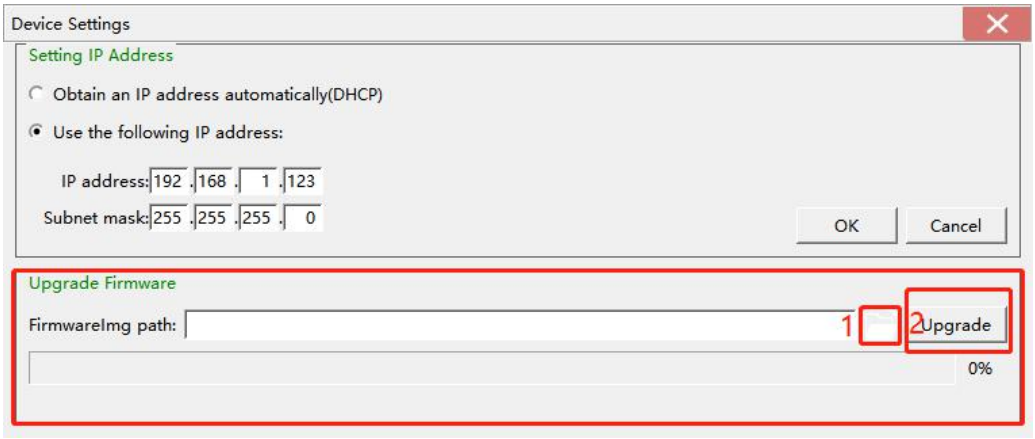


Figure 4. 39 Device Settings - Upgrade

Perform the following operations to upgrade firmware:

1. Click , and select NebulaGUITool's firmware image inside the NebulaGUITool folder, as shown here:

Figure 4. 40 Path for storing the firmware image

Note: The path cannot contain Chinese

2. Tap the Upgrade button and wait for the Upgrade to start (do not power off the device during the Upgrade).

3. After the upgrade starts, the progress bar increases to 100%.

4. The system prompts you to restart the device. Click OK then the software will shut down automatically.

4.3.5.3. Signal Parameters Settings

The signal parameters are configured on the Device Setting page, as shown in the following figure:

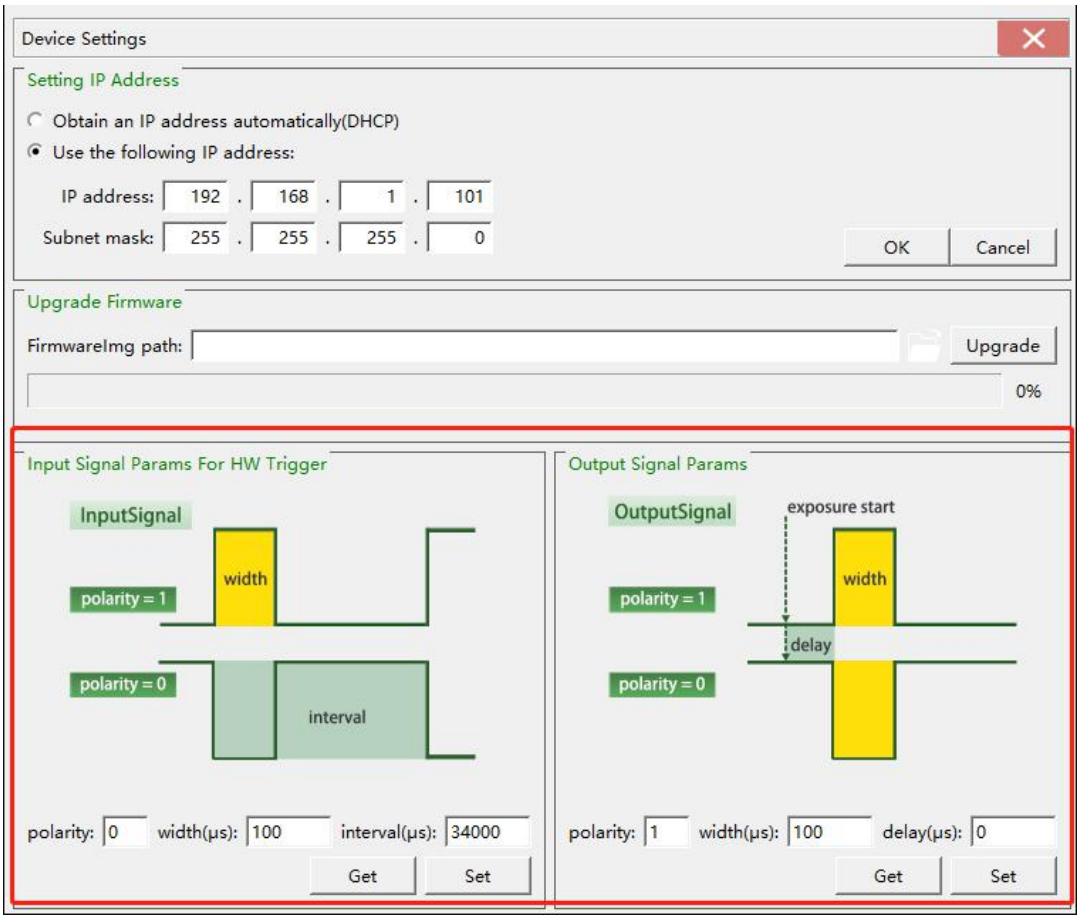


Figure 4. 40 Signal Parameters Settings

Input Signal Parameters for hardware trigger:

1) polarity: Signal validity detection polarity. 0 represents low level effective, and 1 represents high level effective.

Value range: [0,1]

2) width: Signal width validity detection. Signals smaller than the width setting will not respond. 16-bit, unit: μs.

Value range: [1,65535]

3) interval: Continuous signal interval validity detection. Signals smaller than the interval setting will not respond.

Value range: [34000,65535]

Output Signal Parameters:

1) polarity: Output signal polarity. 0 represents low level effective, and 1 represents high level effective.

Value range: [0,1]

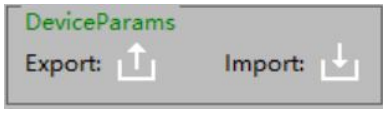
2) width: Output signal width. 16 bits, unit: μs.

Value range: [1,65535]

3) delay: Output signal delay, that is, after receiving the input signal, how long is the delay before starting to output the signal.

Value range: [0,65535]

4.3.6. DeviceParams



Export: Export the parameters set by NebulaGUITool

Import: import parameters into NebulaGUITool

Exported parameters can be used in self-written program by calling API functions.

5. FAQ

Q1: Why can I search for network devices but can't turn on the camera?

A1: There are several situations when the camera cannot be turned on when the webcam is found:

1 Whether the connection between the camera and the host is good, and whether the network card of the host is available.

2. The camera and the host are not in the same network segment. If the camera is set to a non DHCP mode, make sure that the fixed IP address of the camera is on the same network segment as the host, such as 192.168.1. X. If the camera is set to DHCP mode, please ensure that the camera and the host are in the same LAN, and the router/switch has the DHCP sever function.

3. Whether the network permission to run the software is restricted.

4. Whether the UDP function of the network is prohibited by the LAN security policy.

5. Whether the 900790089009 port number of the LAN is prohibited.

6. Whether the power supply of the camera is sufficient. If you use a non PoE mode, make sure that the adapter is turned on and plugged in.

If none of the above measures can solve the problem, please use the ipconfig command to check the network status on the PC side and disable the network except for the same network segment with the camera to search for devices again. If the problem still can’ t be solved after that, please contact our engineer for support.

Q2: Why can't I open the IR map and depth map saved through GUI? How to view the point cloud map?

A2: The IR and Depth images saved by both are 16bit image data, which cannot be opened by using the system's own image browser but can be opened and viewed by using software such as ImageJ; The point cloud map saved by the GUI is in. txt format. From top to bottom, it is the coordinate point information from pixel 0 to the last pixel. The values in each row are the X, Y, Z coordinates of the pixel. The saved point cloud map can be viewed using CloudCompare software. For related instructions, please refer to the link:

https://cdn.yun.sooce.cn/4/62267/pdf/16339227552770a0bd9e3dcaf8a6b.pdf

Q3: How to improve the camera's detection of black objects?

A3: The following methods can be tried:

1. Reduce the product frame rate (for example, 5 frames) and increase the exposure time (for example, 4000);

2. Change the Confidence filter threshold to 2 or 5

Contact Information:

Email address: info@vzense.com

Technical support platform: https://www.vzense.com/faq

https://support.qq.com/products/377143

GitHub: https://github.com/Vzense/NebulaGUITool/issues

Gitee: https://gitee.com/Vzense/NebulaGUITool/issues