Vzense DCAM500 ToF Camera
User Manual

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1 General Information

The purpose of this document is to familiarize the customer with the correct operation of the Vzense ToF Camera. This document provides important information about the camera's features, hardware specification, safe use of the camera, and installation procedures.

1.1 Terms of Use

Vzense offers a 1-year-warranty for this camera.

Warranty Information

Please do follow the following guidelines when using the Vzense camera:

Do not remove the product's serial number label

Warranty must be void, if the label is damaged or removed and the serial number can't be read from the camera's registers.

Do not open the camera housing

Do not open the housing. Touching any internal components may damage the camera.

Prevent any objects or substances from entering the camera housing. Otherwise the camera may fail or damaged.

Avoid electromagnetic fields

Do not use the camera near strong electromagnetic fields. Prevent from electrostatic charging.

Transport in original packaging

Transport and store the camera in its original packaging only. Do not discard the packaging.

Clean with care

If you have to clean the housing of the camera, follow the guidelines in the notice as below:

- Use a soft, dry cloth that won't generate static during cleaning;
- To remove tough stains, use a soft cloth dampened with a small amount of neutral detergent(Pure water); after that wipe dry;
- Make sure no any residual detergent after cleaning, before reconnecting the camera to power

Read the manual

Do read the manual carefully before using the camera.

2 Precautions

2.1 Safe Usage Instructions

	DANGER
	**Electric Shock Risk** Non-standard and improper power supplies may result in fire and electric shock. You must confirm the camera power supply used that meets the Safety Extra Low Voltage(SELV) and Limited Power Supply (LPS) requirements.

	CAUTION
	**Invisible Radiation** This camera uses laser to work, improper use may damage the eye. Lasers are classified as risk group 1 (low risk) according to EN 60825 which means that the product presents no risk related to exposure limits under normal usage conditions. Eye safety is only guaranteed when the camera is used properly

2.2 Power

If you are supplying camera power via the camera's 6-pin connector cable and the voltage is higher than 11VDC (±10 %), the power supply will be cut off to protect the camera from damage. If the voltage is lower than 4.5V, the camera may not work as expected and you may not be able to start the camera. Use a power supply with a minimum output current of 3 A at 5V or 3A at 9V.

2.3 Usage

Don't try to open the camera housing. Each camera has been calibrated at the factory to achieve precise measurements. Touching internal components may damage the camera and cause calibration data lost.

Incorrect plugging in and unplugging of the camera's power cable can damage the camera. To avoid switch-on surges damaging the camera, please plug in the power cable into the camera's 6-pin connector firstly before getting power supply.

Don’t try to change the position of the lens, may cause damage to the camera.
Do store the camera carefully when not in use, in original package the best.

2.4 Temperature

To avoid damaging the camera and to achieve best performance, please observe the maximum and minimum housing temperatures in Section 3.1

3 Specifications and Requirement

3.1 General Specifications

Specification	**Vzense DCAM500**
Technology	ToF (Time-of-flight) Depth Camera
Depth Sensor Resolution and Frame rate	640 x 480(VGA)@30FPS
Output Formats	Depth & IR Map (RAW12)
Depth Sensor Field of View H-Horizontal, V-Vertical(degree)	H-69° V-51°（customizable)
Use Range	0.2m～6m(customizable)
Accuracy	<1%
Power Consumption	Average Max. 5W(Ref)
Illumination	In-door 850nm/Out-door 940nm,2 x Vcsel
Dimension(L*W*H)	78mm x 57mm x 23.5mm
Weight	122g
Power Supply	USB2.0 / DC5V-9V
Interface	USB2.0 / RS232
Digital I/O (Exposure Control, Synchronization etc.)	1in/1out
Enclosure Rating	IP42
Working/Storage Temperature	-20℃-50℃/-30℃-70℃
Software	C/C++ SDK

Operation System	Windows 7/8/10, Android, Linux
Cooling	Passive, no fan
Certification	FCC/CE/FDA
Eye safety	Class 1

3.2 Electrical Specifications

3.2.1 Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
6pin-connector power	VDD		5	9	10	V
USB2.0	USB		4.75	5	5.5	V
Digital I/O (Exposure_timing)	Vout	Work mode		5		V
Digital I/O (Ext_Trigger)	Vin		3.3		20	V
RS232			-12		12	V
Operating Temperature	Ta		-20		50	°C
Operating humidity			20		80	%
Storage humidity			20		80	%
Storage temperature			-30		70	°C

3.2.2 Power Consumption

Parameter	Conditions	Average	Max	Units
Current at near mode	250mm-1200mm @30 frame			mA
Current at far mode	800mm-4300mm @30frame			mA
Current at xfar mode	1200mm-6300mm@15frame			mA

Note: 12V input voltage

3.2.3 Absolute Maximum Ratings

This is a stress rating only and functional operation of the devices at those or any other conditions above those indicated in the operation listings of this specification is not promised. Exposure to maximum rating conditions for extended periods may affect device reliability

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
6pin-connector power	VDD		4		11	V
USB2.0	USB		-0.3		6	V
Digital I/O (Ext_Trigger)	Vin		-0.3		20	V
RS232			-13.2		13.2	V
Operating Temperature	Ta		-20		50	°C

3.3 Mechanical Specifications

This drawing contains information about the dimensions and user mounting location of the ToF Camera.

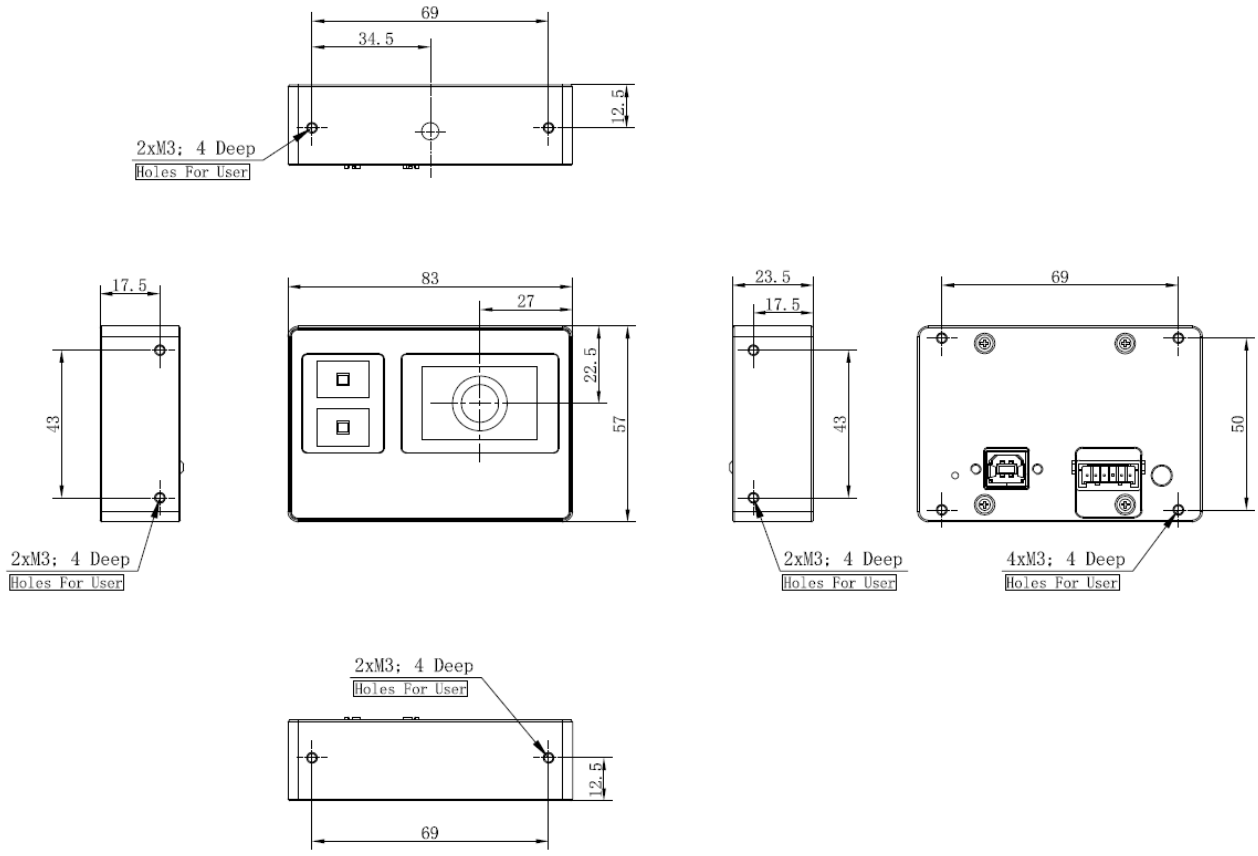


Fig. 1: ToF Camera Dimensions

Unit: mm

3.4 Working Condition Requirements

3.4.1 Hardware Requirements

Vzense ToF Camera

■ TYPE B USB cable (Included in package)

■ 6 pin cable which provide power and interface with host. (included in package)

3.4.2 Software Requirements

Operating system

■ 32-bit Windows 7/10

■ 64-bit Windows 7/10 (recommended)

■ Linux (x86, x64)

■ Android 5.0 or above

Vzense ToF Driver

The Vzense ToF Driver software is available for Windows, Linux and Android operating systems and includes the following:

■ SDK code

■ Sample code

■ Software user manual

3.4.3 Environmental Requirements

Temperature and Humidity

Housing temperature during operation:	-20–50 °C
Humidity during operation:	20–80 %, relative
Storage temperature:	-30–70 °C
Storage humidity:	20–80 %, relative

Heat Dissipation

Users can provide sufficient heat dissipation, like mounting the camera on a substantial, thermally conductive component that can act as a heat sink. Or a fan can be used to provide an air flow over the camera.

3.4.4 Coordinate of the Camera System

There are two coordinate system need to be understood, one is camera coordinate system (CCS), one is world coordinate system (WCS).

CCS: CCS describe the two-dimensional data, the origin of coordinates is the optic center.
WCS: WCS describe the three-dimensional information.
The CCS data can switch to the WCS data using the camera internal parameters.

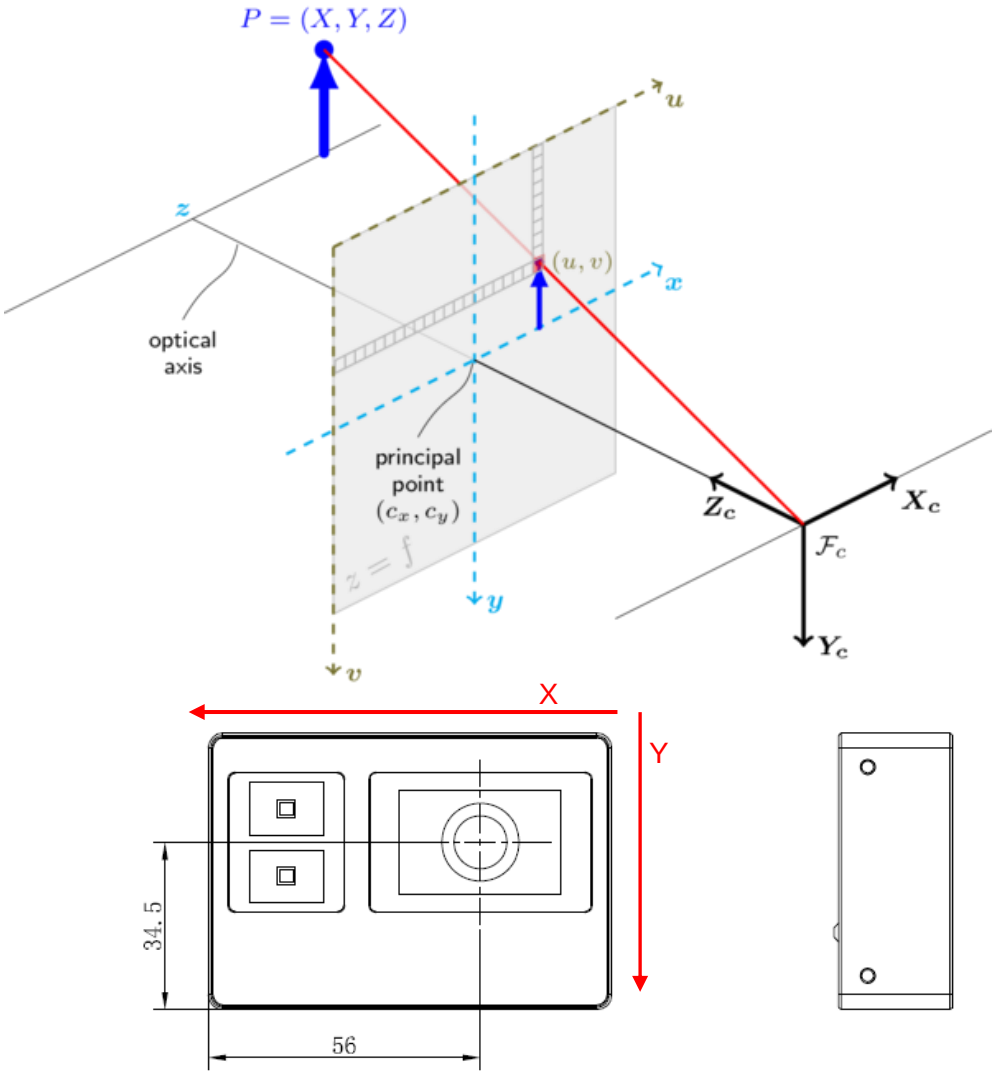


Fig. 3: Origin of the Coordinate System

Meshlab and CloudCompare tools are recommended to analyze the point cloud data saved by Vzense software or SDK method.

4 Interface with Host

DCAM500 ToF Camera is equipped with Type-B, LED,6pin connector at the back of its housing as shown in below figure.
For more information about pin assignments and connector types, see the following sections.

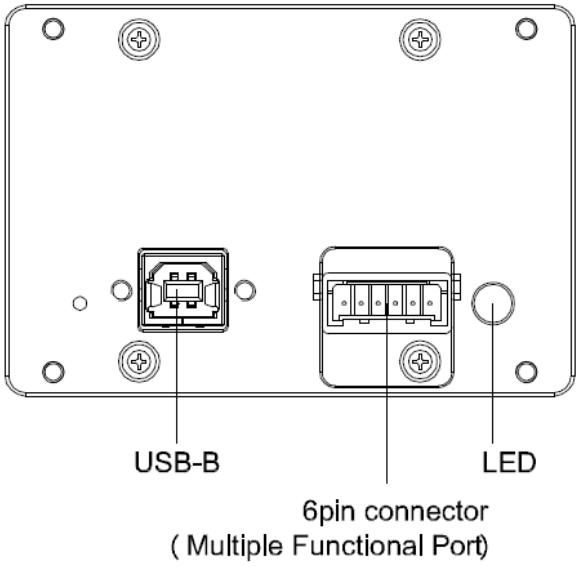


Fig. 4: Camera Connectors

4.1 6pin power and signal Connector

The 6pin connector includes the one physical input signals and one physical output signal, RS232 signal and power supply lines.
The pin assignments and pin numbering for the receptacle are as shown in below table.
The connector of the camera is a Molex receptacle, part number 535170630. The recommended mating connector is a Molex plug, part number 511030600.
The recommend detailed external signal connection ways please refer to section 3.4.and 3.4.

Pin	Designation
1	RX232-RXD
2	RX232-TXD
3	Ext_Trigger
4	Exposure_timing
5	GND
6	VDD

Pin Description

Pin	Designation	Direction	Description
1	RX232-RXD	INPUT	RX232 Receive(rx)Data
2	RX232-TXD	OUTPUT	RX232 Transmit(tx)Data
3	Ext_Trigger	INPUT	External trigger input（3.3V-20V）
4	Exposure_timing	OUTPUT	Control signal output 1

5	GND	GND	System ground
6	VDD	INPUT	5-9V power supply input

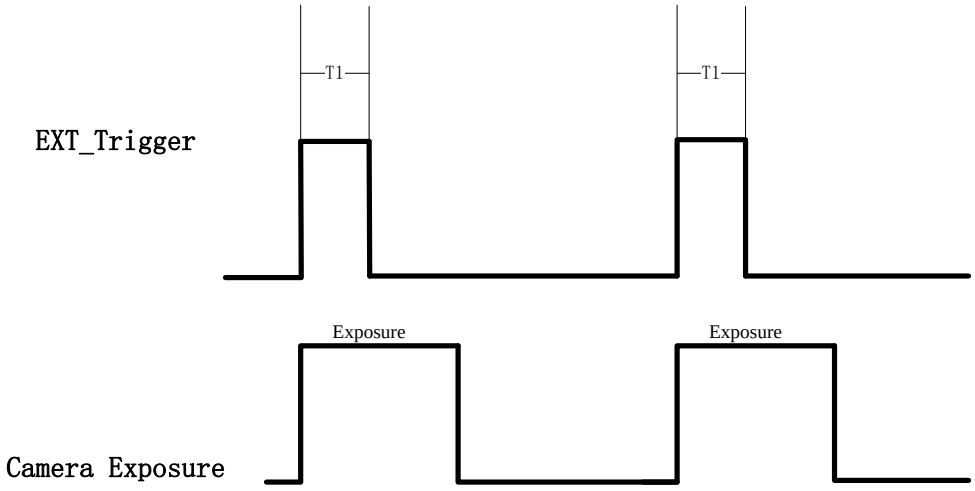
Hardware Trigger Function

Hardware trigger mode is available only when the camera works at slave mode, in slave mode the camera will wait for the hardware trigger signal on Ext_Trigger.

The EXT_Trigger signal is to driver the MOSFET, External input trigger signal voltage should range 3.3V-20V.

You can use input pin Ext_Trigger to send a hardware trigger signal to the camera. The hardware trigger can be used to trigger the acquisition start. **A hardware debouncer circuit shall be considered on the EXT_Trigger line.**

By default, the hardware trigger is rising edge activated, refer to below exposure timing:



The requirement to T1 should be from 1us to 1ms.

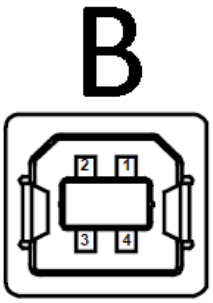
Exposure_timing Pin Description

This pin is an output indicates the whole exposure period of the camera. The internal circuit of this pin with a pull-up resistor 430Ω.The pull up voltage is 5V.

By default, the polarity is low level activated, which means a low-level signal indicates the exposure period. Please refer to below figure:

4.2 Type B USB2.0 Connector

The camera supports Type B-USB 2.0 transmission.



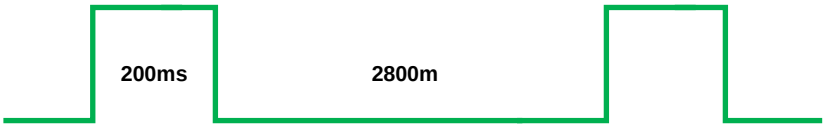
4.3 LED indication

An LED locates in the back side of the camera, LED animation indicates the camera status.
The LED animation table is shown as below:

Power off:

limbo：

USB Mode:



Upgrading:

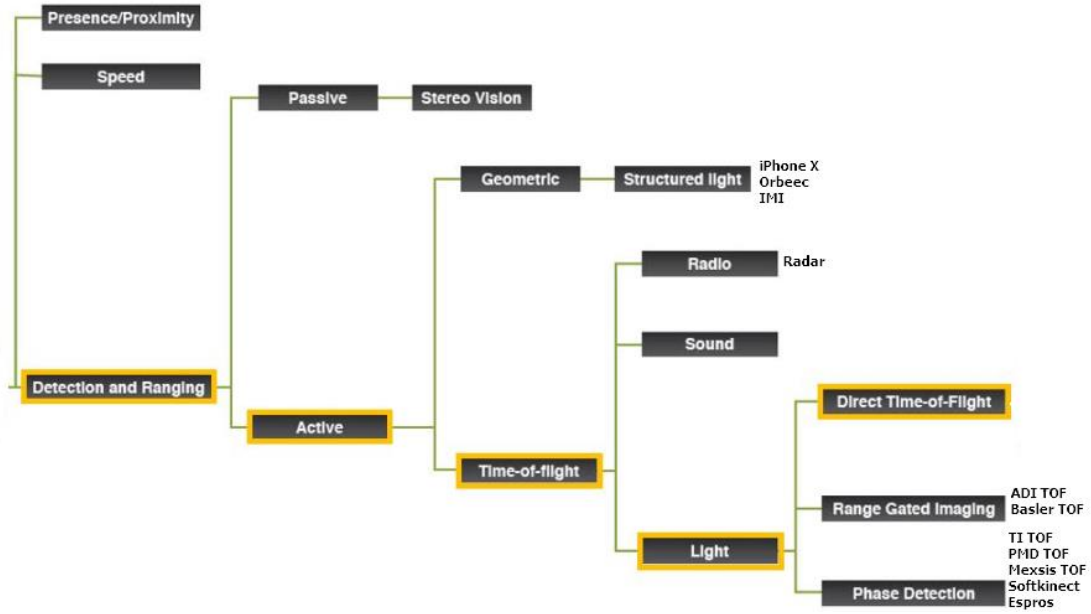
5 Principle of Time of Flight

5.1 Scope of remote sensing technology

· **Presence or proximity detection**, where the absence or presence of an object in a general area is the only information that is required (e.g., for security applications). This is the simplest form of remote sensing;

· **Speed measurement**, where the exact position of an object does not need to be known but where its accurate speed is required (e.g., for law enforcement applications);

· **Detection and ranging**, where the position of an object relative to the sensor needs to be precisely and accurately determined.
This document will concentrate on technologies capable of providing a detection and ranging functionality, as it is the most complex of the three applications. From the position information, presence and speed can be retrieved so technologies capable of detection and ranging can be universally applied to all remote sensing applications.

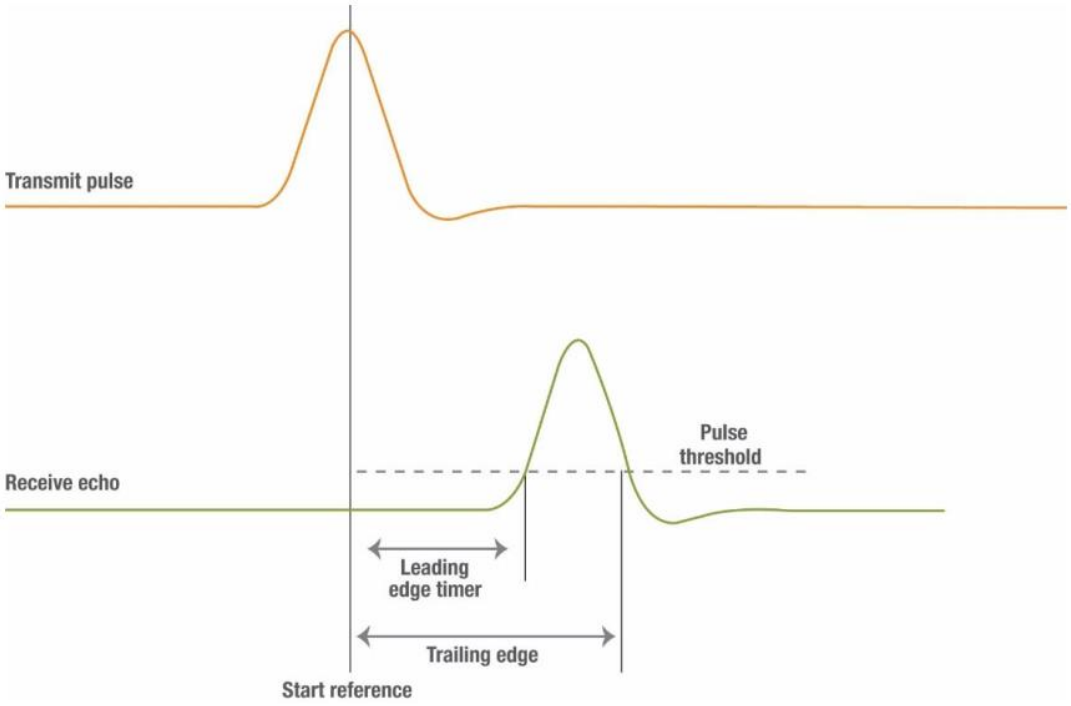


5.1.1 Direct Time of Flight

In the direct time-of-flight measurement method, a discrete pulse is emitted and one or several timers are used to measure the time difference between the emitted pulse and the return echo, based on threshold detection. This time difference can be directly

converted to a distance, based on the following equation:

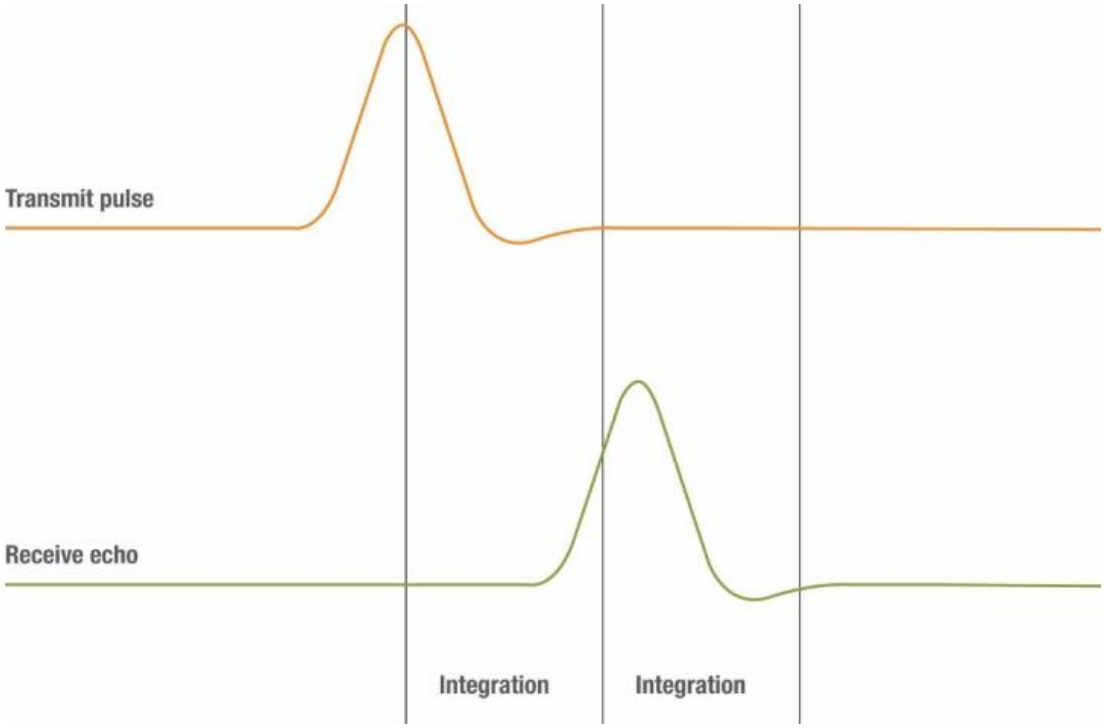
$$d = \frac{C * t}{2}$$



The difficulty in implementing the direct time-of-flight measurement method resides in the time intervals to be measured. In order to resolve a distance to centimeter-level accuracy, the required accuracy for the timers is 67 ps. Implemented in digital logic, this would require a 15 GHz clock speed, which is obviously not practical. Therefore, various time-to-digital conversion methods are typically used.

5.1.2 Range-gated Imaging ToF

Whereas direct time-of-flight relies on measurements made on the immediate value of the received signal, range-gated imaging uses signal integration methods, typically with CCD or CMOS imagers.

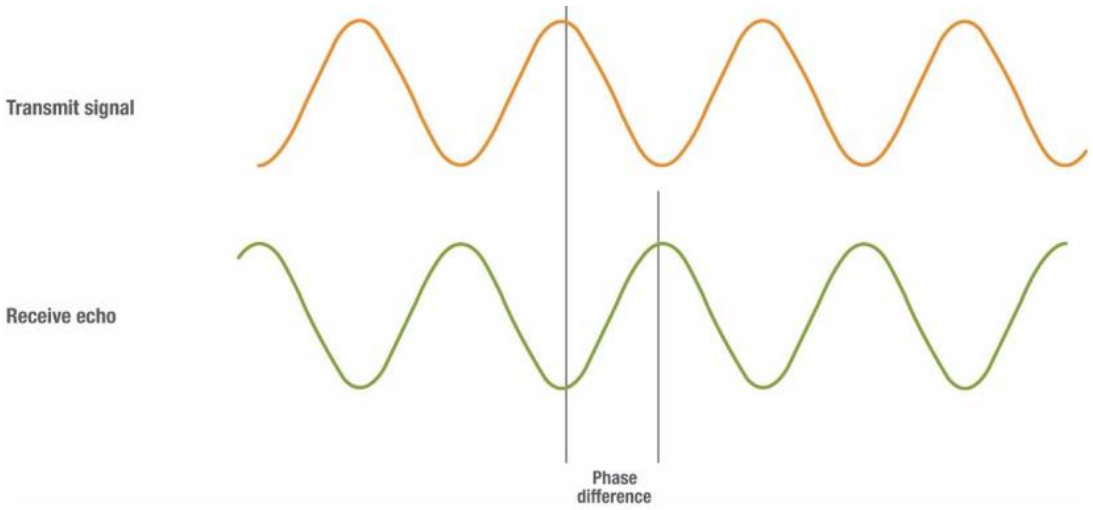


By measuring the energy received in successive integration intervals, it is possible to extrapolate the distance between the sensor and the measured object, based on the ratio of energy received in the different intervals.
The difficulty with range-gated imaging is that CCD and CMOS imagers have a limited dynamic range; therefore, strong ambient light can easily cause saturation and impair measurement. Furthermore, since neither the emitted and received pulses are perfect rectangle pulses, nor is the sensor perfectly linear, compensation is required and accuracy is ultimately limited.

5.1.3 Continuous Waveform ToF

In contrast to the previous two methods, phase difference measurement relies on a modulated light source and evaluates the phase difference between the transmit signal and the receive echo. This phase difference can be converted to a distance, using the following formula:

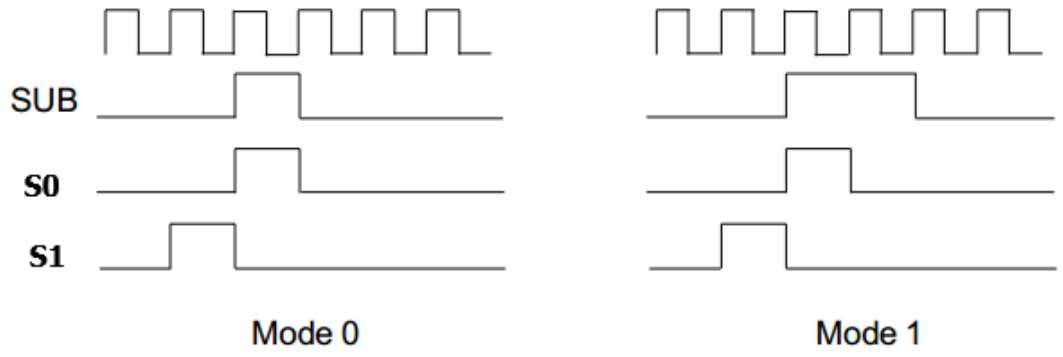
$$d = \frac{C * \emptyset}{4 * \pi * f}$$



Correlation methods are typically used to measure the phase difference of the receive echo
respective to the transmit signal as well as recover the propagation delay and therefore the
distance to the object to be measured.
Of course, a phase difference greater than 2 π is not resolvable; for instance, 3 π or 5 π will be measured as a π radian phase difference. Therefore, depending on the chosen modulation frequency, an artefacting phenomenon will occur where far-away objects will appear to be much closer than in reality.

5.1.4 Vzense ToF Principle

Vzense DCAM500 product principle is based on range-gated imaging ToF solution, and the sensor inside is based on Panasonic CCD sensor MN34906.



- **Mode #0:**
  - 1T,
  - Best LD pulse number,
  - good for distance from 10cm to 3.3m

$$Z = \frac{S_1}{S_0 + S_1}$$

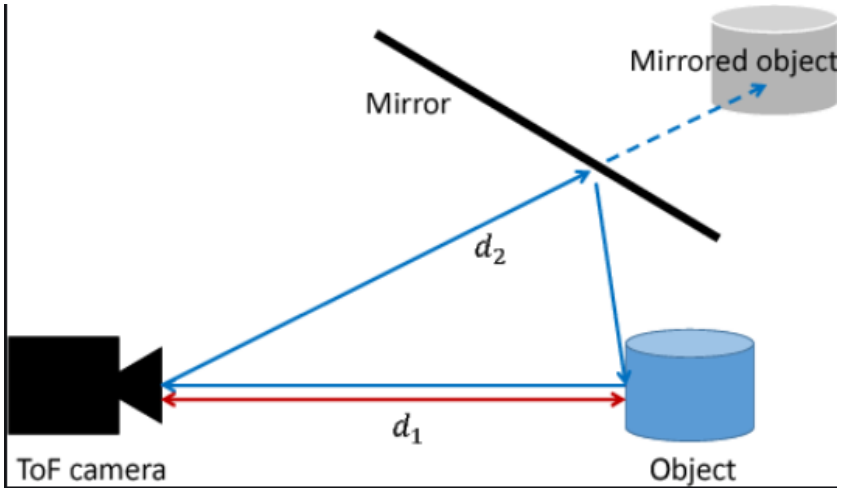
5.2 Noise Factors

5.2.1 Ambient Light

Because the ToF distance measurement relies on the reflection of light sent out by the camera, any additional light, e.g. artificial light sources or sunlight, may influence the measurement results.
A strong ambient light may affect the accuracy and precision of the depth data, the Vzense DCAM500 is suggested to in user below 50K LUX ambient light.

5.2.2 Multipath Propagation

Based on the principle of ToF, Multipath effect may happen when the light reflected more one once. Any light that has been reflected several times, by other objects in the camera's field of view or the environment can cause deviation to the measurement result.



To eliminate the multipath effect, you should:

1. Keep the camera working environment as clean as possible;
2. Avoid the camera be placed at concave forms environment, like corners of a room or inside of a narrow space;
3. Highly-reflective object shall be removed far away from the measurement target;

5.2.3 Reflectivity of the Target

Please note that different reflectivity of the target may cause measurement result deviation, objects which have 20% to 80% reflectivity to 850nm or 940nm infrared light have the best result.

5.2.4 Scattering Effect

Scattering light effect is a noise factor to ToF products, it is caused by multiple reflection inside the lens of camera or the cover of camera.

To eliminate the scattering light effect, you should:

1. Keep the cover glass of the camera clean;
2. Do NOT place any other cover glass in front of the camera;
3. Keep the camera working environment as clean as possible;

6 Installation

6.1 Hardware Installation

You have read and understood the warnings listed under "Precautions" on Chapter 2;
To achieve reliable distance measurements, please follow below tips:

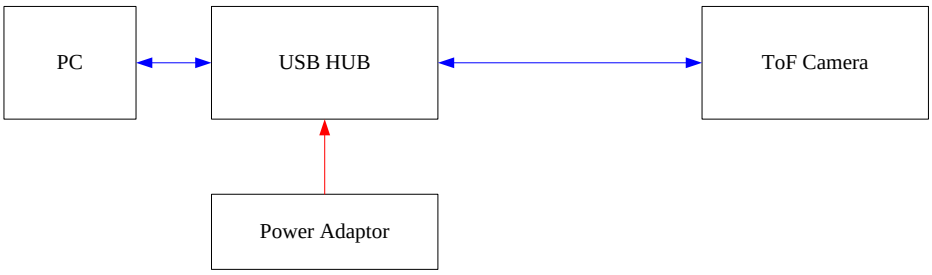
- Better not using the camera in strong sunlight. If have to, keep the ambient light below 50k Lux.
- Do NOT place any objects in the scene that are not part of your intended target, especially mirrors or other shiny surfaces/objects.
- Maintain a stable housing temperature during operation.
- Take measures to provide cooling to camera
- Mount the camera robustly.
- All accessories are ready

6.1.1 USB2.0 Mode Installation

In this mode, the camera transmits the required data to host by USB2.0 interface.
For the application of near distance, the USB2.0 host can supply power to camera, for the application of long distance which needs more power consumption, the multiple functional cable (VZENSE-MFP-6P-B) shall be in use.
The steps are as below:
1. Mount the camera in an appropriate fixture, e.g. a camera bracket;
2. Plug the type B end of the USB2.0 type B cable (VZENSE-USB-TYPEB-CABLE) into the type B jack at the back of the camera, and plug the other type A end into the USB port of your host processor;
3. Insert the cable (VZENSE-MFP-6P-B) of the power supply adaptor into the 5-9V at the back of the camera;
4. Connect the adaptor to power source;

6.1.2 USB2.0 External Power Mode Installation

If you need stronger power in your application, besides the additional power supplied to the MFP port via VZENSE-MFP-6P-B cable mentioned above, we also provide another option, which using an external powered USB HUB. You shall connect the system as below figure:



You can contact the Vzense team (info@vzense.com) for the external powered USB HUB.

6.1.3 Standalone Mode Installation

This mode is for advanced users who require customization to the software and application, the applications can run on the processor inside the camera, and output the result data by either RS232 or EXT_OUTPUT pin. NRE fee shall be charged if you need Vzense team to do software or application customization.
In this mode, the cable (VZENSE-MFP-6P-B) shall be used in this mode.

6.2 Software Installation

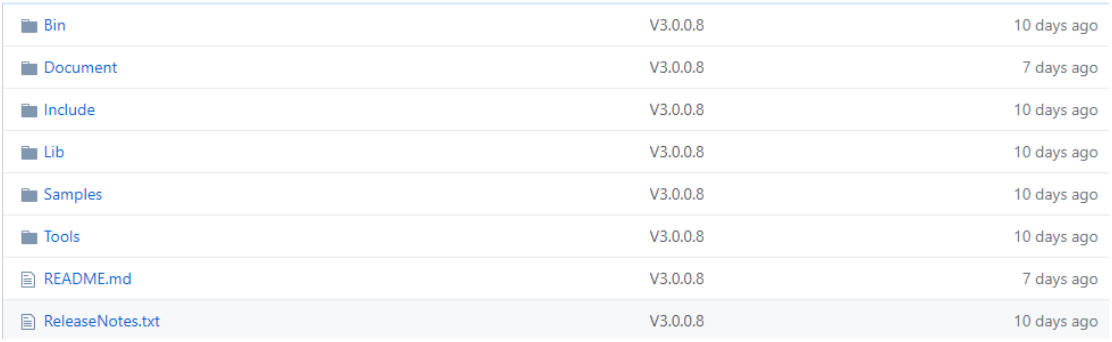
6.2.1 How to get

Download or clone SDK project from our GitHub /Gitee:
China：https://gitee.com/Vzense
Oversea：https://github.com/Vzense
Please chose the suitable version based on the product and system. Windows SDK, Linux SDK have different project repository.

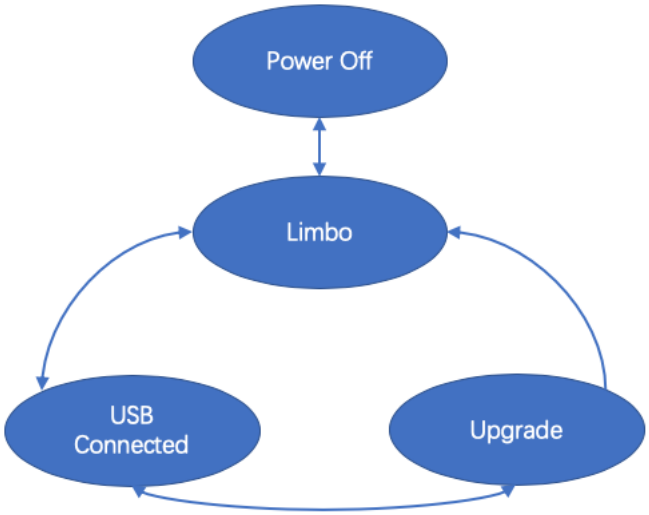
Download or clone uTool evaluation tool from our GitHub /Gitee:
China：https://gitee.com/Vzense/UTool
Oversea：https://github.com/Vzense/UTool

6.2.2 Frameviewer

Frameviewer is an opensource application in SDK project that can guide user how to call the SDK APIs. It has a pre-build version app in Tools folder, the source code is in Samples folder. See the document for the details.



6.3 Product State Machine



- Power Off: product have not any power
- Limbo: power up, but have any connection
- USB Connected: USB UVC connected, product can transfer image and answer host command
- Upgrade: product upgrade the firmware mode

6.4 Software Command Set

DCAM500 support different work mode like depth_30, IR_30, depth&IR_30.
Three default range: range0(0.35m~1.5m), range2(0.8m~4.4m), range5(1.2m~6.2m).
User can use Frameviewer to try the different command or can use the APIs to control the camera. The details please reference the SDK documents.

6.5 USB Connection

DCAM500 use UVC profile to transfer image and control command.

7 Features

7.1 Multiple Camera Synchronization

If you need to use more than one camera in a same narrow space, multiple camera synchronization method shall be in use, to avoid the light source interference among

each other.

7.2 Range Customization

By default, there are 3 different range modes calibrated for DCAM500, please see below table for more information:

Range number	Distance range
Range 0	0.35m~1.5m
Range 2	0.8m~4.4m
Range 5	1.2m~6.2m

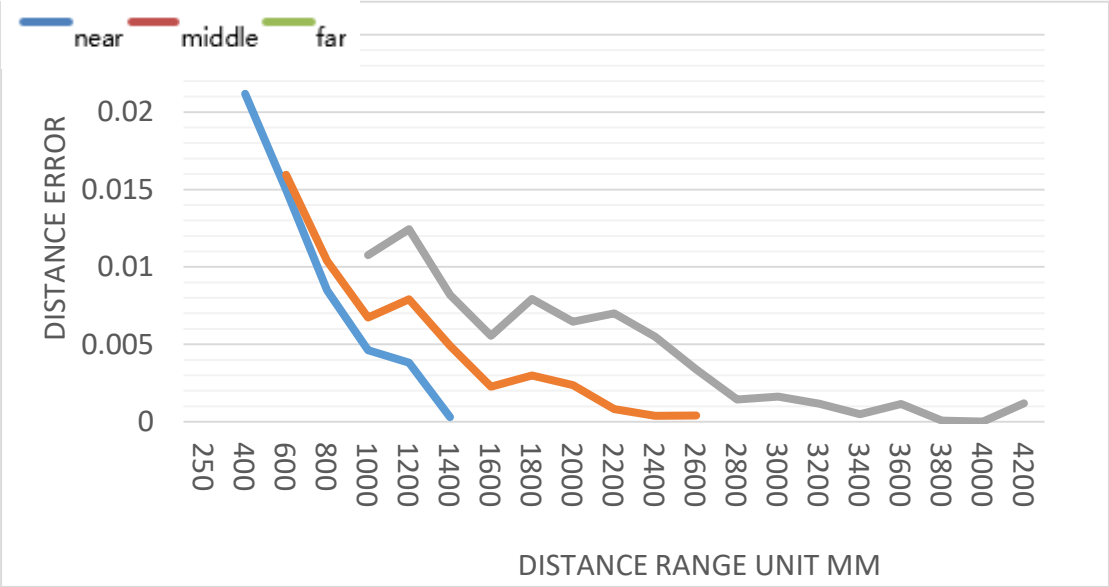
Please do NOT use uncalibrated modes, the measurement data will not be guaranteed.

If you need other range mode requirement, you can ask Vzense team to do range customization, reasonable NRE fee will be charged.

One range mode of the Vzense DCAM500 camera can fulfill furthest distance be at most 5 times to nearest distance. For example, if the near limitation is 0.4m, then the furthest distance in this mode can reach about 2m.

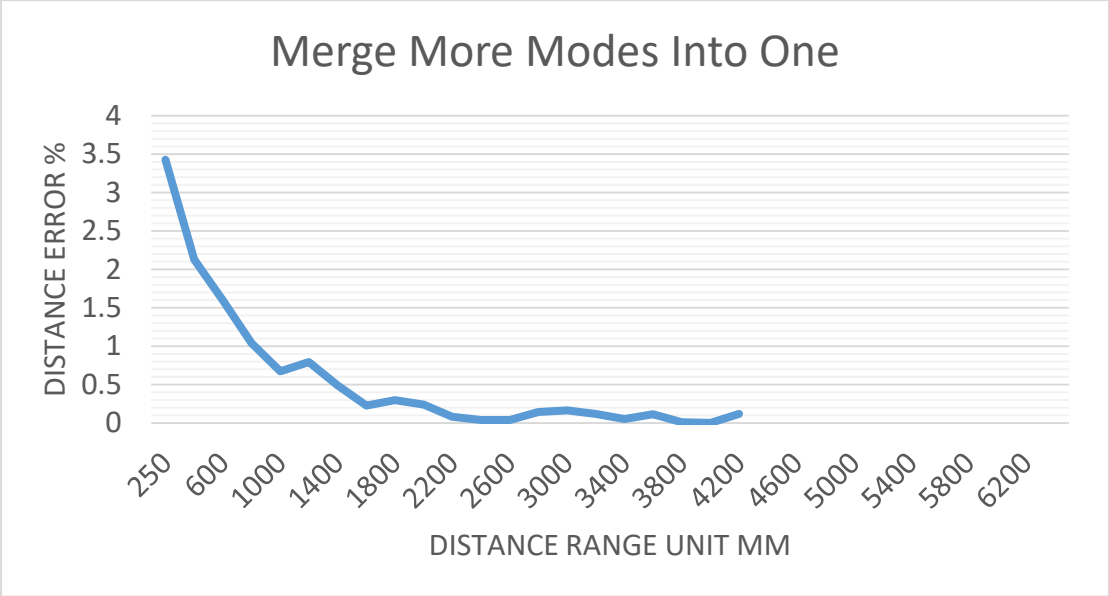
7.3 Wide Dynamic Range

As mentioned above, Most of the ToF based 3D sensing technology has range limitation to nearest and furthest distance, due to the sensor saturation of weak light strength to far objects. One range mode of the Vzense DCAM500 camera can fulfill furthest distance be at most 5 times to nearest distance. For example, if the near limitation is 0.4m, then the furthest distance in this mode can reach about 2m.



Wide dynamic range means that the camera can work at more than one range modes

alternately, then the camera itself will combine the result into one depth frame, therefore can expand the range limitation from furthest distance to nearest distance.



This feature requires customization service for Vzense team, you can refer to Chapter 8 in this document for WDR mode experience.

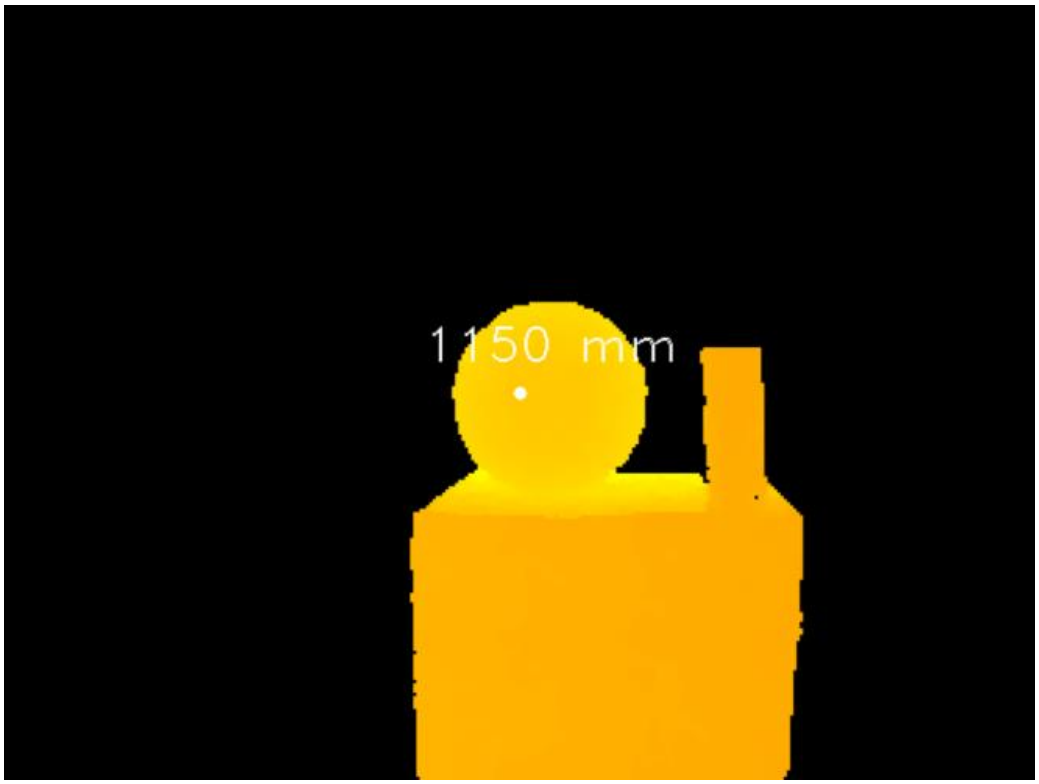
7.4 Data Filtering

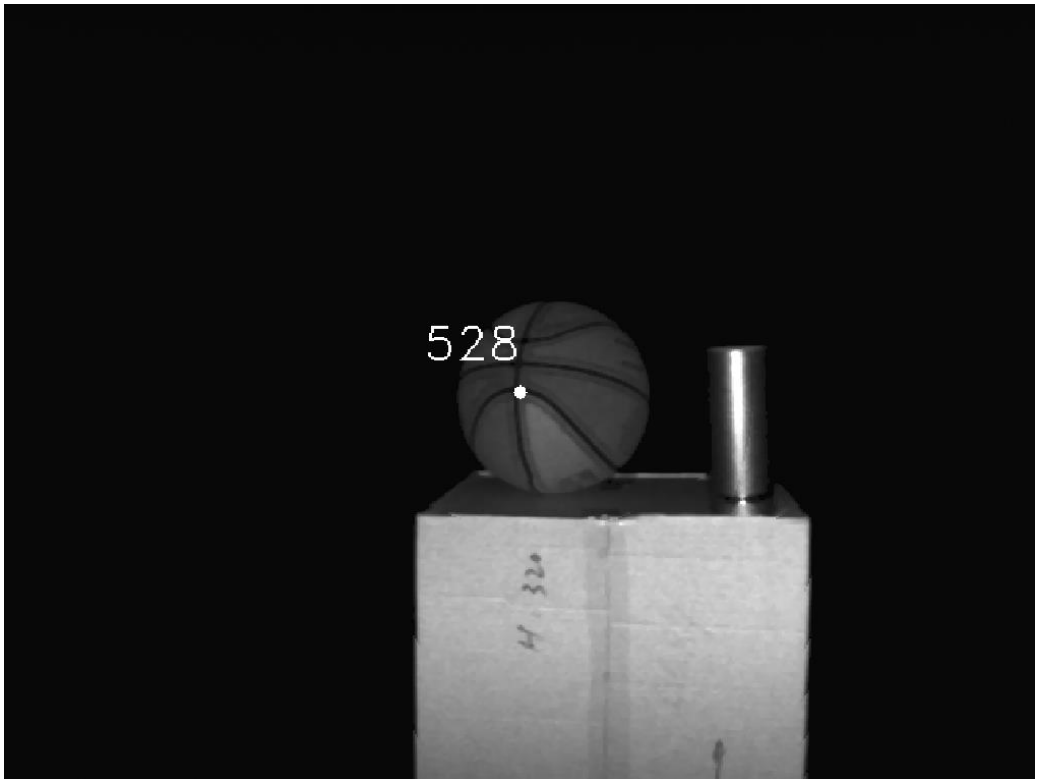
In the software SDK and Frameviewer, we implemented data filtering to improve the depth data performance.
The filtering algorithm includes:

- Median filtering;
- Gaussian filtering;
- Bilateral filtering;
- Timing filtering;
- Flying pixel removing;

7.5 IR Image

Besides the depth image, Vzense DCAM500 camera can also output a VGA resolution IR image. And the IR image is strictly timing synchronized with the depth image. Pixel to pixel mapping is also strictly aligned.


1150 mm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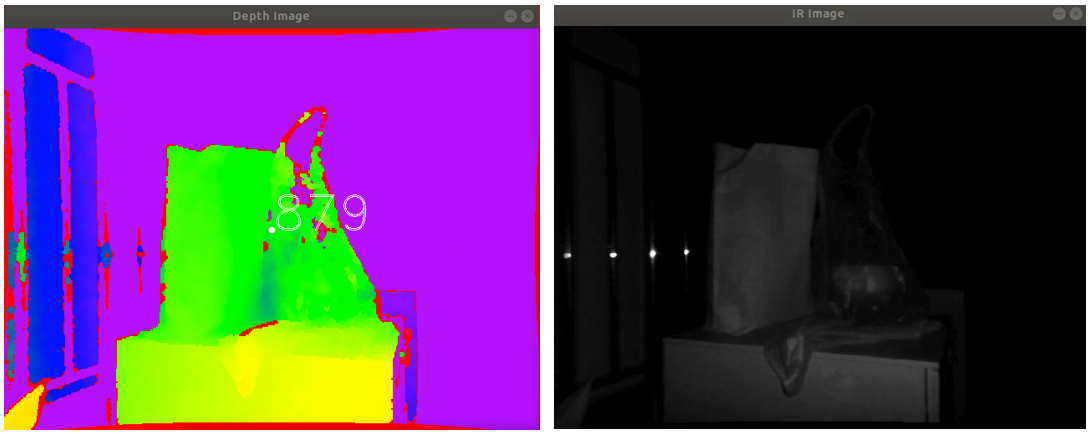
8 Camera Operation on Frameviewer

Function		Description
2D image show		depth image colorize
Camera hardware information show		like SN, version
Image store		
Mode Switch	Depth 30	depth image in 30fps
	IR 30	IR image in 30fps
	Depth&IR 30	both depth and ir in 30fps
	WDR	see the detail in below
Range Change	Range 0-7	different depth detect range
Exposure parameter modify	Pulse count	laser pulse parameter
	Gamma gain	IR image gamma gain
Filters switch		different image filters
IR_BG		the background light swtich

8.1 Main screen

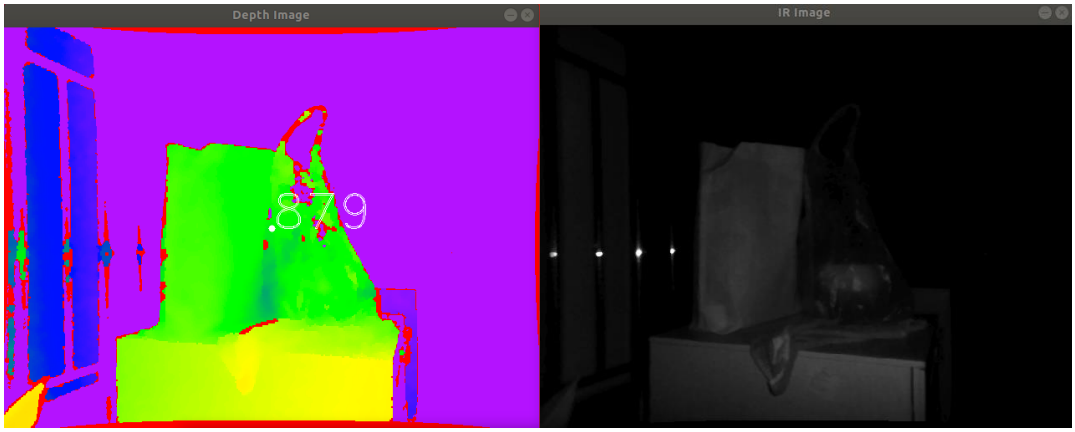
Frameviewer have some areas for different function, for example, image windows, command and information area.



```
File  Edit  View  Search  Terminal  Help
------------------------------------------------------------------
Press following key to set corresponding feature:
0/1/2...: Change depth range Near/Middle/Far...
S/s: Enable or disable the Depth and RGB synchronize feature
P/p: Save point cloud data into PointCloud.txt in current directory
T/t: Change background filter threshold value
M/m: Change data mode: input corresponding index in terminal:
                    0: Output Depth and RGB in 30 fps
                    1: Output IR and RGB in 30 fps
                    2: Output Depth and IR in 30 fps
                    3: Output Depth/IR frames alternatively in 15fps, and RGB in
 30fps
                    4: Output WDR_Depth and RGB in 30 fps
R/r: Change the RGB resolution: input corresponding index in terminal:
                            0: 1920*1080
                            1: 1280*720
                            2: 640*480
                            3: 640*360
Q/q: Enable or disable the mapped RGB in Depth space
L/l: Enable or disable the mapped Depth in RGB space
V/v: Enable or disable the WDR depth fusion feature
Esc: Program quit
------------------------------------------------------------------
------------------------------------------------------------------
```

8.1.1 Image area

Image area is the area of showing depth image, IR image.



8.1.2 Command and information area

Frameviewer use CMD shell for camera control and information output. Like the image below: switch mode, change detect range, save 3D image and so on.


```
File  Edit  View  Search  Terminal  Help
------------------------------------------------------------------
Press following key to set corresponding feature:
0/1/2...: Change depth range Near/Middle/Far...
S/s: Enable or disable the Depth and RGB synchronize feature
P/p: Save point cloud data into PointCloud.txt in current directory
T/t: Change background filter threshold value
M/m: Change data mode: input corresponding index in terminal:
                    0: Output Depth and RGB in 30 fps
                    1: Output IR and RGB in 30 fps
                    2: Output Depth and IR in 30 fps
                    3: Output Depth/IR frames alternatively in 15fps, and RGB in
 30fps
                    4: Output WDR_Depth and RGB in 30 fps
R/r: Change the RGB resolution: input corresponding index in terminal:
                            0: 1920*1080
                            1: 1280*720
                            2: 640*480
                            3: 640*360
Q/q: Enable or disable the mapped RGB in Depth space
L/l: Enable or disable the mapped Depth in RGB space
V/v: Enable or disable the WDR depth fusion feature
Esc: Program quit
------------------------------------------------------------------
------------------------------------------------------------------
```

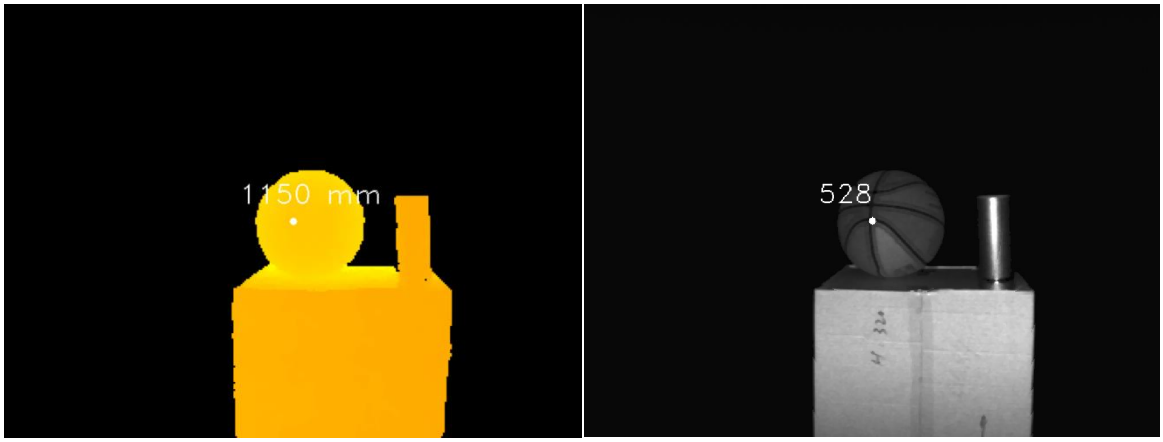
8.2 Connect devices

Frameviewer will auto-connect the device, and output the base information on the window.

```
Get device count: 1
Set Data Mode to PsDepthAndIR_30
Set Depth Range to Near
Get PsGetCameraParameters status: 0
Depth Camera Intinsic:
Fx: 462.147
Cx: 330.051
Fy: 461.97
Cy: 248.288
Depth Distortion Coefficient:
K1: 0.865453
K2: 0.912947
P1: 0.00318054
P2: -0.00251837
K3: -1.5716
K4: 0.464547
K5: 1.85229
K6: -1.96393
Get PsGetCameraExtrinsicParameters status: 0
Camera rotation:
0.999929 -0.00893352 -0.00789697 0.00891819 0.999958 -0.00197372 0.00791428 0.00
190315 0.999967
```

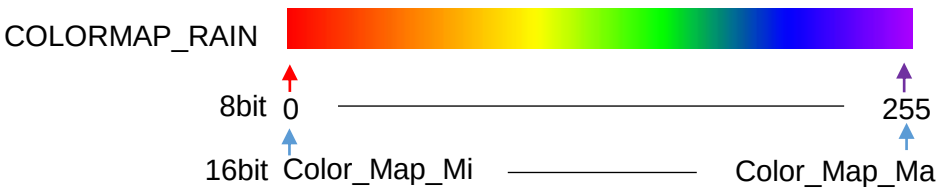
8.3 2D view

The display area can show different type image.

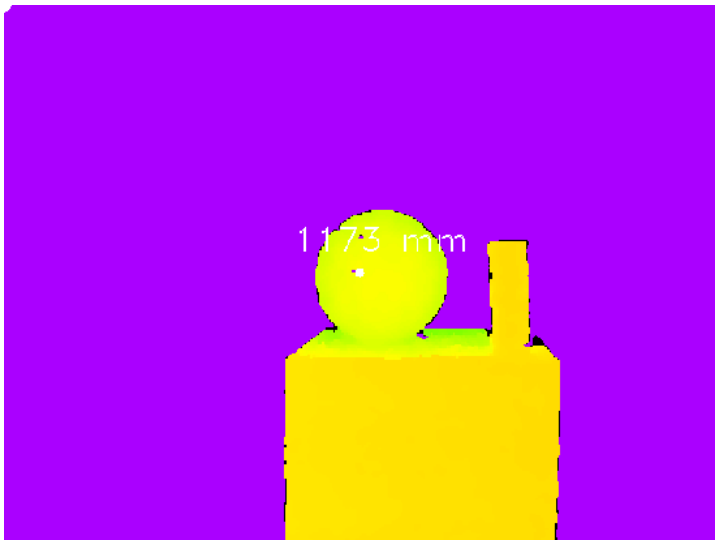


8.3.1 Depth Image

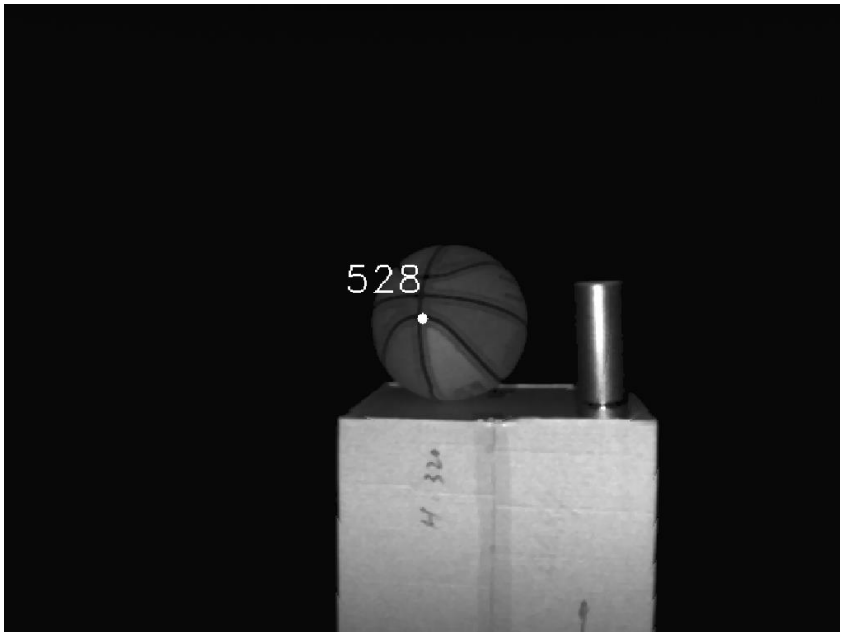
Depth image is covert to a rainbow image for real distance showing.



Depth Image with color map:

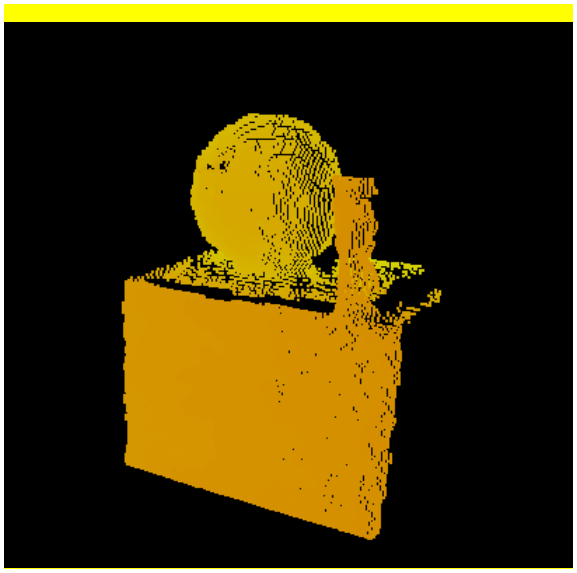


8.3.2 IR Image



8.4 3D image store

When the depth image is showing, input ‘s/S’ to store the point cloud file. User can use CloudCompare to viewer the 3D image.



8.5 Camera Control

8.5.1 Mode switch

```
M/m: Change data mode: input corresponding index in terminal:
                    0: Output Depth and RGB in 30 fps
                    1: Output IR and RGB in 30 fps
                    2: Output Depth and IR in 30 fps
                    3: Output Depth/IR frames alternatively in 15fps, and RGB in
```

DCAM500 can support Depth_30, IR_30, Depth&IR_30.
Depth_30: depth image only in 30 fps.
IR_30: IR image only in 30 fps.
Depth&IR_30: depth and IR image all in 30 fps.

8.5.2 Range change

```
Press following key to set corresponding feature:
0/1/2...: Change depth range Near/Middle/Far...
```

DCAM500 have 8 detect ranges in it, but by default, there are 3 different range modes calibrated, please see below table for more information:

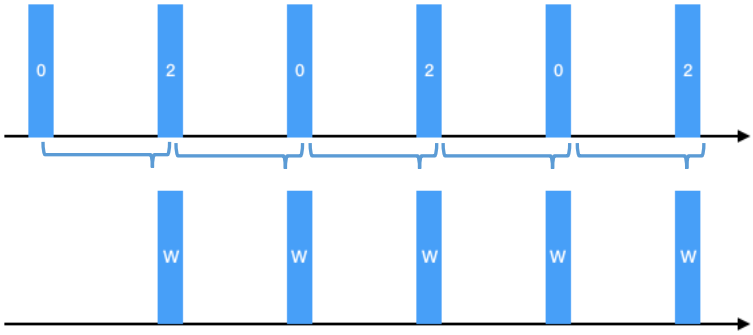
Range number	Distance range
Range 0	0.35m~1.5m
Range 2	0.8m~4.4m
Range 5	1.2m~6.2m

Please do NOT use uncalibrated modes, the measurement data will not be guaranteed.
If you need other range mode requirement, you can ask Vzense team to do range

customization, reasonable NRE fee will be charged.

8.6 WDR

WDR mode can merge the multi-range image to extend the detect range. For example, if you want to get the distance from 0.35m to 4.4m, only one range mode can't cover the whole distance. Use range 0 and 2 WDR can match this requirement.



- Configure the WDR mode:

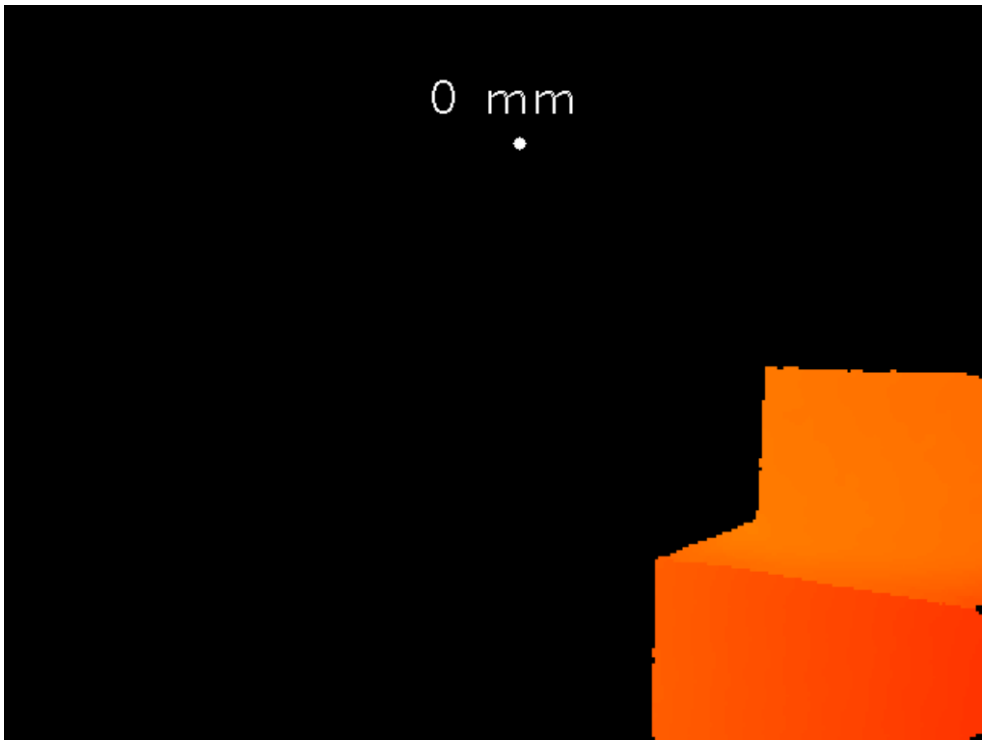
```
#WDR1
t1_totalRange=2
t1_range1=0
t1_range1Count=1
t1_range2=2
t1_range2Count=1
t1_range3=0
t1_range3Count=1

t1_threshold1=1250
t1_threshold2=2500
```

If you have some particular requirement and want to use WDR mode, you can contract with Vzense FAE first.

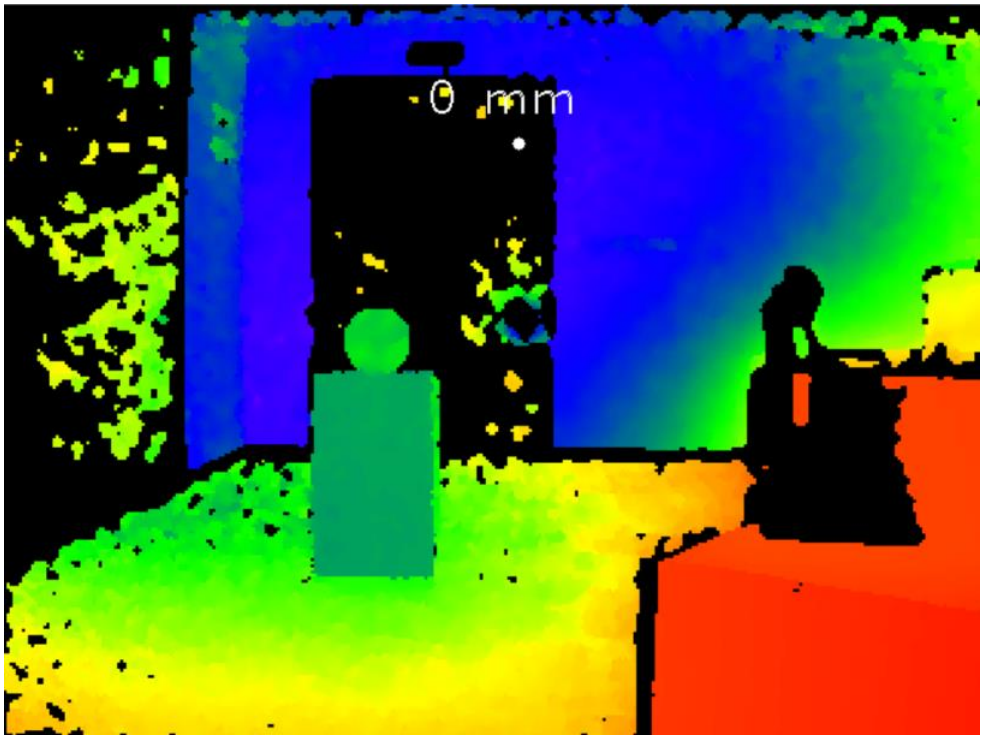
- Change mode to WDR mode:

```
M/m: Change data mode: input corresponding index in terminal:
                    0: Output Depth and RGB in 30 fps
                    1: Output IR and RGB in 30 fps
                    2: Output Depth and IR in 30 fps
                    3: Output Depth/IR frames alternatively in 15fps, and RGB in
 30fps
                    4: Output WDR_Depth and RGB in 30 fps
```

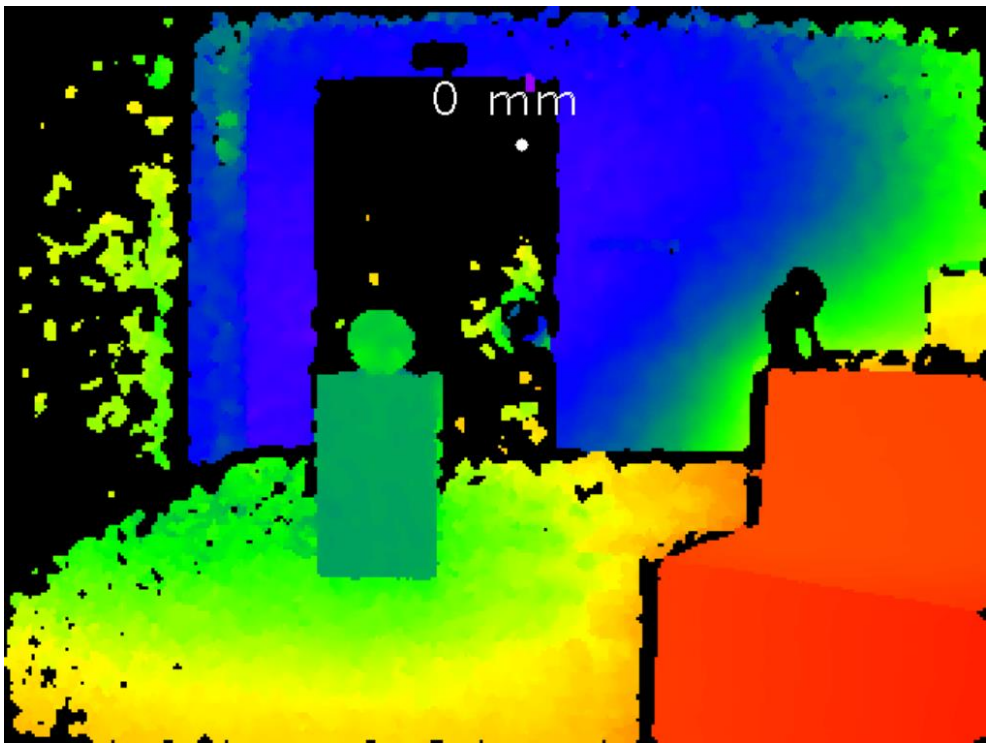
Depth image in range 0:



Depth image in range 2:



Merged depth image in WDR mode



9 DCAM500 Accessories and Package

In package item list:

Item	Part number	Description	Quantity
1	DCAM500	Vzense DCAM500 Depth Camera Module	1
1	VZENSE-USB-TYPEB-CABLE	Dual Head Type B Lockable Cable	1
5	User Guide	User guide	1

You can ask Vzense to do customization to the cable for any reason, for example extending the cable length.

Please do NOT use the accessories from other parts except Vzense Company, otherwise warranty will void.

Optional item list:

Item	Component	Description	Quantity
1	VZENSE-MFP-6P-B	Multiple Functional Cable(Power, RX232, EXT IO)	1
2	VZENSE-EU-HUB	External Powered USB HUB	1

Optional items need customer to pay for.

10 Customization Service

Vzense team has rich experience in ToF product design and delivery, we welcome customer to send customization requirement besides the standard module. Reasonable NRE fee shall be charged depends on the requirement.

Appendix

ROHS Declaration

Eye Safety Declaration

Reliability Declaration

Revision History