Xvisio®SeerSense ™ DS80 Series

Datasheet

上海诠视传感技术有限公司

Xvisio Technology (Shanghai) Co., Ltd.

History Versions

Version	Descriptions	Author
1.0	Initial version	Xvisio
1.1	RGB H265 Revision	Xvisio
1.2	PIN Definition Revision	Xvisio
1.3	Power management Revision	Xvisio

Contents

1. Overview

1.1 Description

SeerSense ™ DS80 is an AI powered multi-sensor fusion VSLAM system on module. Subsystem components include a VSLAM engine, a multimodal depth engine, a RGB camera engine, and an AI inferencing engine. It can be connected to the host processor through USB 2.0/USB 3.1 Gen 1 or UART. Each function is supported with its corresponding SDK. The module has been adapted to OPEN CV development environment. It also contains a complete calibration data source of internal and external parameters between cameras. Developers can leverage OPEN CV to develop multi-camera applications rapidly. [1]

SeerSense ™ DS80 module comes with a TOF camera, a pair of fisheyes, a RGB and an IMU.

The SeerSense ™ DS80 is compact in size and configurable and customizable. It provides high performance spatial perception and interaction capabilities that XR HMD and robotics application require. It can be easily and quickly integrated with target systems.

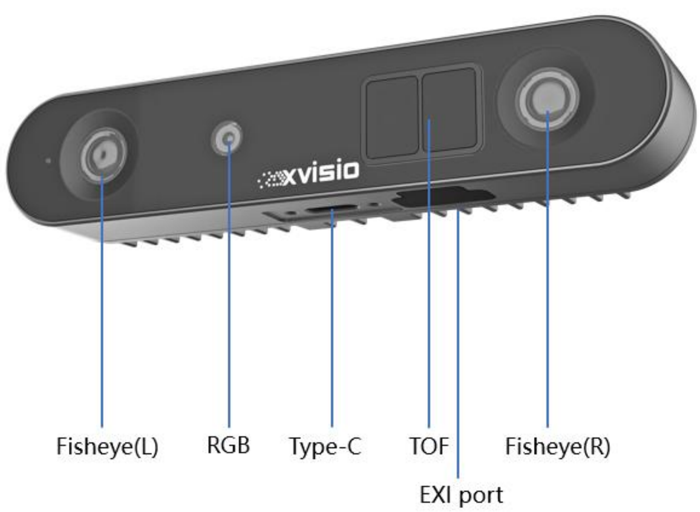


Figure 1-1 SeerSense ™ DS80 Module

1.2 Features

- High speed VSLAM engine powered by industry's leading VPU.
- Dual fisheye stereo camera based depth algorithm engine with 30/50/60 fps framerate and a resolution of 1280x800 is suitable for use in complex outdoor environment.
- Built-in CNN with AI inferencing support and compatibility with the OPEN VINO development environment.
- Industry leading high resolution (VGA) TOF depth sensing and computing engine. Great for applications that require localization, obstacle avoidance, navigation, object/scene recognition and 3D reconstruction.
- On-device sensor fusion enables 6DOF tracking, depth sensing, object detection.
- Integrated image processor and JPEG compression engine.
- Low power consumption and compact in size.

1.3 Applications

SeerSense ™ DS80 provides capabilities like localization, obstacle avoidance, navigation, object/scene recognition and 3D reconstruction. Its' prefect for the follow use cases.

Typical use cases:

- AR/VR;
- Drones;
- Robot;
- Family monitor;
- Smart manufacturing;
- Surveillance.

1.4 Minimum system requirements

- USB 2.0/USB 3.1 Gen 1.
- Ubuntu16/ Ubuntu18/ Ubuntu20/Windows10.

1.5 Preliminary Specification

1.5.1 Fisheye

- Baseline：80mm;
- Resolution：1280x800/640x400;
- Frame rate：30/50/60fps;
- FOV(D/H/V): 150°/130°/74°;
- Auto exposure adjustment;
- VSLAM (refer to Section 3.1.1 for more details);
- Stereo camera based depth algorithm engine (refer to Section 3.2.2.4 for more details).

1.5.2 TOF Depth Camera

- Resolution：640x480 / 320x240;
- FOV(D/H/V): 78°/64°/50°;
- Frame rate：5-30fps;
- Depth range: 0.5-5meter ,1% accuracy.

1.5.3 RGB Camera

- Preview&Picture mode：8MP@30fps 、1080p@30fps YV12、720p@30fps YV12、VGA@30fps YV12;

- FOV(D/H/V): 79.9°/68°/53°;
- Used for video collection, AI recognition and gesture recognition.

1.5.4 IMU

- 9 axis, sampling rate: 1000Hz
- data latency （Sampling to data transmission）<2ms
- Accelerometer range：±8G
- Gyroscope range：±2000deg/s
- Timestamp accuracy：nanosecond

1.6 Term

Term	Description
VSLAM	Visual Simultaneous Localization and Mapping, a vision based computer algorithm that uses synchronized camera frames and IMU for localization and map reconstruction.
FPS	Abbreviation of Frames Per Second. It generally refers to the transmitted or calculated frame rate by the sensor or camera.
FOV	Field of View. It describes the angular range of a given scene imaged by the camera. The FOV of the camera can be measured horizontally, vertically or diagonally.
Host system	Application devices like PC, computing pack or mobile phone that are connected with Xvisio module.
6DOF	6DOF describes the position and pose of a self-tracked device in 3D space. It includes translation (forward/backward, up/down, left/right) and rotation (pitch, yaw, roll).

Fisheye Baseline	The distance between the fisheye cameras.
Depth	Depth video stream is similar to color video stream. The difference is that each pixel has a value which representing the distance from the camera rather than the color information.
ISP	Image Sensor Processing.
CNN	Convolutional Neural Network.
Stereo Camera	Refers to Fisheye camera which also can be called FE.
RGB	Color camera.
TOF Depth Camera	Time Of Fight. The basic principle of TOF is to transmit the modulated optical pulse through the infrared transmitter. After encountering the object, the receiver will receive the reflected optical pulse, and calculates the distance from the object according to the round-trip time of the optical pulse. DS80 uses iTOF (indirect TOF). With iTOF, the time of flight of light is not measured directly, but through an algorithm of measuring phase offset. TOF cameras or depth cameras are used to represent such cameras in this document.
Passive binocular depth camera	The depth camera based on binocular stereo vision works similarly as human eyes. Instead of projecting light sources actively to outside, it uses the two pictures taken (left and right) to calculate the depth. Therefore, it is called passive binocular depth camera.

Table1-1 Term

[1] AI inference engine and related ancillary services, such as using OPENVINO tool chain, are optional functions. Please contact the dealer or XVISIO for corresponding operations.

2. Device Architecture and Interface

2.1 Device Architecture

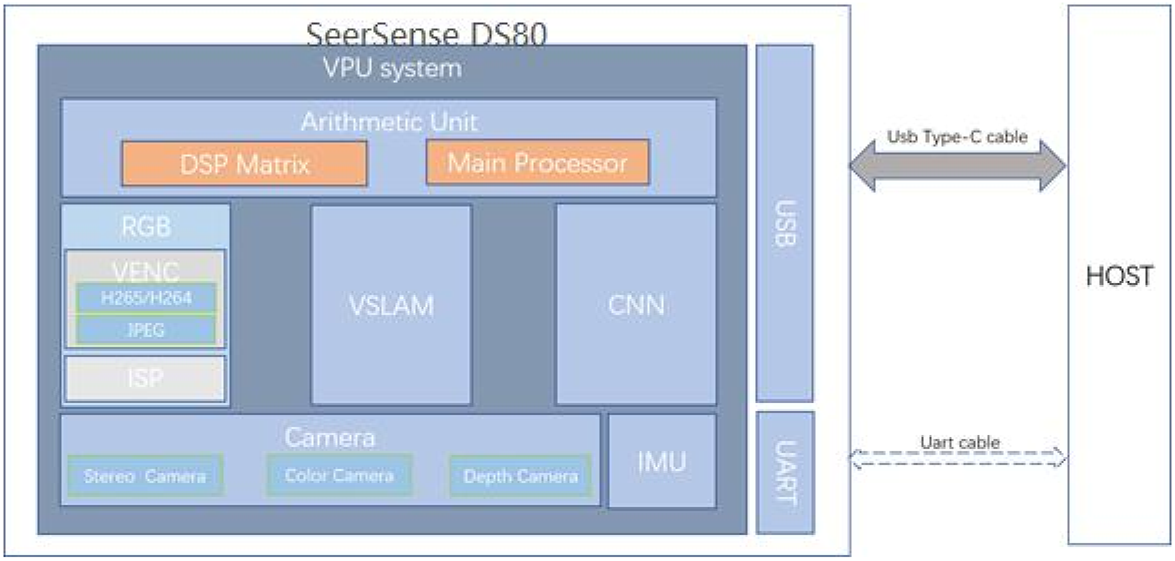


Figure 2-1 Frame

As Figure 2-1 shown, SeerSense ™ DS80 is a vision-based sensor fusion module powered by Intel's state of the art Movidius VPU. The built-in VPU system includes a computing unit which consists of a DSP array and a main processor. It integrates multiple functional camera sensors and provides, such as engines for RGB camera, SLAM, Depth and CNN. Please refer to Section 3 for more details. The supported interfaces are USB 2.0/USB 3.1 Gen 1. A UART port is provided as an auxiliary and debugging interface.

2.2 External Interface

2.2.1 USB Type-C Interface

➢ **USB Bandwidth**

SeerSense ™ DS80 supports USB 2.0/USB 3.1 Gen 1. The theoretical bandwidth is 10Gbps, but the measured maximum bandwidth is 3Gbps and the maximum upload speed is 375MB / s.

➢ USB Protocol

USB interface supports multiple application protocols. Depending on the function, a specific application protocol supported by the device will be used. Figure 2-2 shows a set of different functions and their corresponding application protocols. In fact, users can do USB related operations directly through the SDK from Xvisio without paying attention to the details of the application protocol.

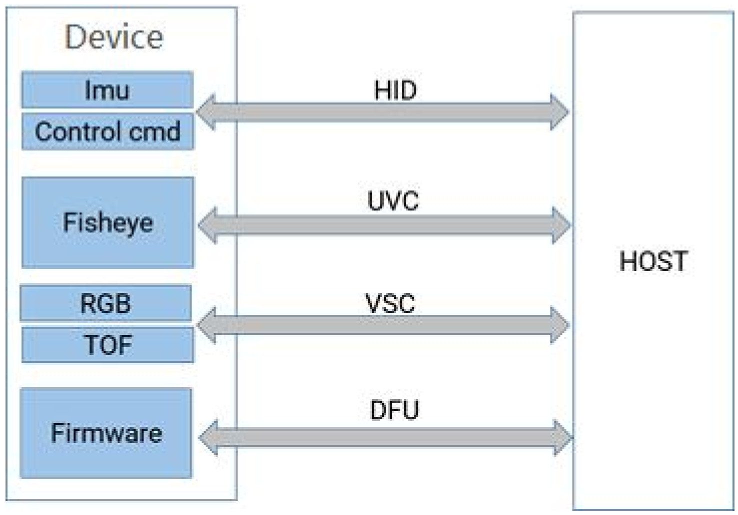


Figure 2-2 USB Protocol

➢ USB Device Descriptor

Normally, USB has two working mode: normal working mode and upgrading mode.

1） Normal working mode:

After power on：

Device VID&PID: “idVendor=040e, idProduct=f408”

Product name：“XVisio vSLAM”

Vendor: “XVisio Technology”

USB application protocol contains HID, UVC and VSC in normal working mode.

2） Upgrading mode：

After power on:

Device VID&PID: "idVendor=040e, idProduct=f003"

Product name："DFU Firmware Download"

Vendor: "XVisio Technology"

DFU protocol is used in upgrading mode.

➢ Definition of Pin

A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2-	VBUS	SBU1	D-	D+	CC1	VBUS	TX1-	TX1+	GND
GND	TX2+	TX2-	VBUS	CC2	D+	D-	SBU2	VBUS	RX1-	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

Pin	Signal Name	Description	Mating Sequence	Pin	Signal Name	Description	Mating Sequence
A1	GND	Ground return	First	B12	GND	Ground return	First
A2	SSTXp1	Positive half of first SuperSpeed TX differential pair	Second	B11	SSRXp1	Positive half of first SuperSpeed RX differential pair	Second
A3	SSTXn1	Negative half of first SuperSpeed TX differential pair	Second	B10	SSRXn1	Negative half of first SuperSpeed RX differential pair	Second
A4	VBUS	Bus Power	First	B9	VBUS	Bus Power	First
A5	CC1	Configuration Channel	Second	B8	SBU2	Sideband Use (SBU)	Second
A6	Dp1	Positive half of the USB 2.0 differential pair – Position 1	Second	B7	Dn2	Negative half of the USB 2.0 differential pair – Position 2	Second
A7	Dn1	Negative half of the USB 2.0 differential pair – Position 1	Second	B6	Dp2	Positive half of the USB 2.0 differential pair – Position 2	Second
A8	SBU1	Sideband Use (SBU)	Second	B5	CC2	Configuration Channel	Second
A9	VBUS	Bus Power	First	B4	VBUS	Bus Power	First
A10	SSRXn2	Negative half of second SuperSpeed RX differential pair	Second	B3	SSTXn2	Negative half of second SuperSpeed TX differential pair	Second
A11	SSRXp2	Positive half of second SuperSpeed RX differential pair	Second	B2	SSTXp2	Positive half of second SuperSpeed TX differential pair	Second
A12	GND	Ground return	First	B1	GND	Ground return	First

Figure 2-3 PIN Interface Definition

➢ USB Specification

Parameter	Description	Diagram
Vendor	Molex	

Table 2-1 USB Specification

2.2.2 UART

- **UART Configuration**

Band rate：230400

Data bit：8

Check bits：None

Stop bit：1

Fluid control：None

- **UART Application Protocol**

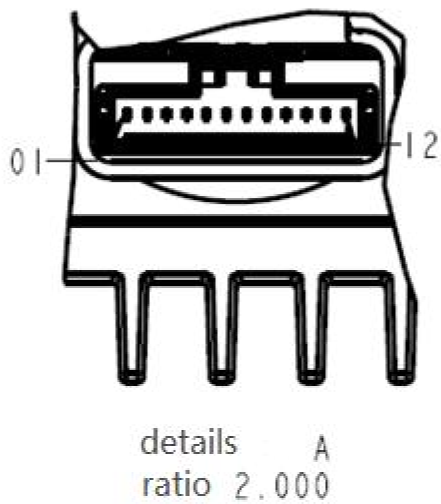
UART port is used as auxiliary port in SeerSense ™ DS80. The device only needs to report 6DOF data in some application scenarios, and the maximum frame rate is 500Hz.

The protocol format for reporting data：

Byte Index	Content	Description
byte[0:2]	reprot ID+CMD	head(fixed:0x02 0xA2 0x33)
byte[3:6]	frame_No	frame number
byte[7:14]	timestamp	current frame timestamp
byte[15:26]	pose_translation	X-axis(4byte),Y-axis(4byte),Z-axis(4byte)
byte[27:46]	pose_rotation	3x3 angel matrix, each element occupies 3 bytes

Table 2-2 protocol for UART reporting data

➢ Definition of PIN



No.	pin definition
01	VBUS_5V
02	VBUS_5V
03	RX3V3
04	TX3V3
05	I2C1_SCL_3V3
06	I2C1_SDA_3V3
07	SPI2_MOSI_DEBUG
08	SPI2_MISO_DEBUG
09	SPI2_SCLK_DEBUG
10	SPI2_SS_DEBUG
11	GND
12	GND

Table 2-3-1 PIN Definition

PIN NUMBER	Network name	Description	Note
1	VBUS_5V	5V input	
2	VBUS_5V	5V input	
3	RX_3V3	Serial port receive data	Debug
4	TX_3V3	Serial port send data	Debug
5	I2C1_SDA_3V3	I2C SDA	Power domains 3.3V
6	I2C1_SCL_3V3	I2C SCL	Power domains 3.3V
7	SPI_MOSI_DEBUG	SPI_MOSI debug port	SPI debug

8	SPI_MISO_DEBUG	SPI_MISO debug port	SPI debug
9	SPI_SCLK_DEBUG	SPI_SCLK debug port	SPI debug
10	SPI_SS_DEBUG	SPI_SS debug port	SPI debug
11	GND	GND	
12	GND	GND	

Table 2-3-2 Definition of PIN

- **Specification of Connector**

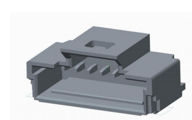
Parameter	Description	Diagram
Vendor	Molex	

Table 2-4 Specification of Connector

3. Function Description

3.1 VSLAM Engine

3.1.1 Introduction

Xvisio VSLAM Engine is a real time mapping and localization system based on binocular vision. It delivers first person view 6DOF pose data of the tracker device itself in real time by using innovative spatial descriptors and algorithm efficiently. The engine operates in a variety of working modes to achieve autonomous 6DOF positioning and tracking. The maximum frame is

100fps. The recommended default frame rate for typical use cases is 50FPS or 60FPS.

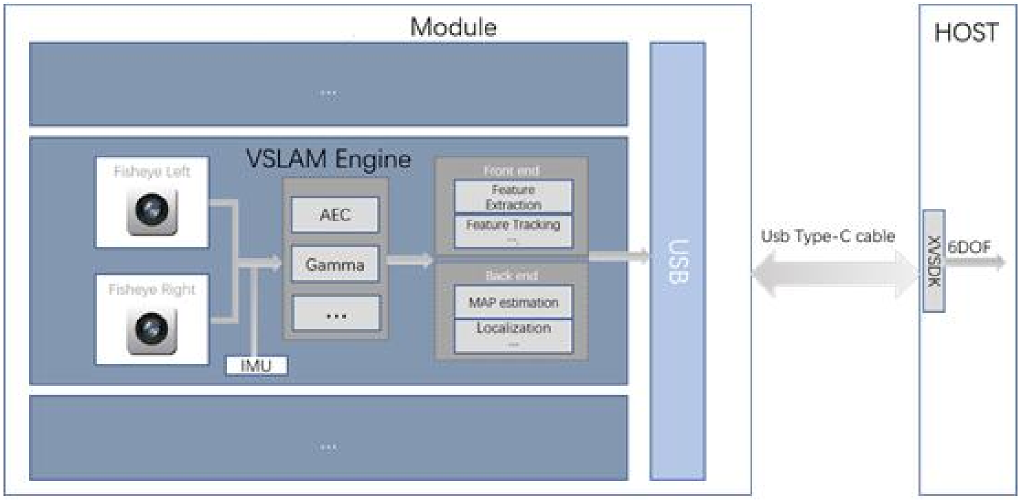


Figure 3-1 VSLAM Engine Diagram

Benefits of Xvisio VSLAM engine:

1） High performance, Real-time SLAM processing with up to 100 FPS and millimeter accuracy; Excellent balance between speed and accuracy.

2） Distributed edge computing; offloading valuable host platform computing resources; Cross platform deployment; Ease of computing unit upgrade.

3） Fast relocalization and loop-closure detection; Suitable for use cases that involves fast motion.

4） Highly efficient map data structure; Supporting map sharing between devices.

5） Proven product and technology; Deployed in mass-production products in AR glasses, robotics and other fields.

3.1.2 The origin Position and Initial Pose of VSLAM

Upon starting VSLAM, its world coordinate system will be established based on the gravity direction of the module. The origin position of the 6DOF is the center position of the IMU device. The initial 6DOF translation values (x, y, z) are all zeros when the module is at stillness state. Rotation values (pitch, yaw, roll) are dependent on the starting pose position. The following figures show two possible starting pose positions at the VSLAM startup.

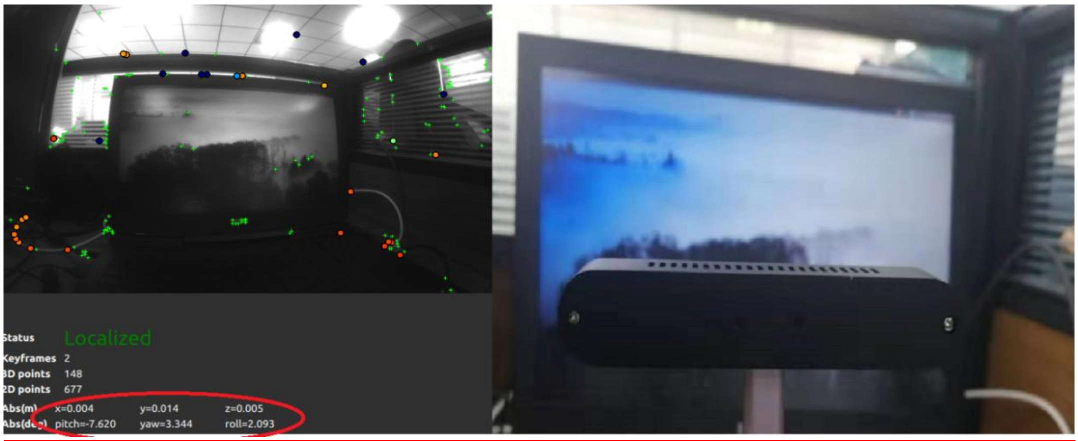


Figure 3-2 Module Paced Horizontally

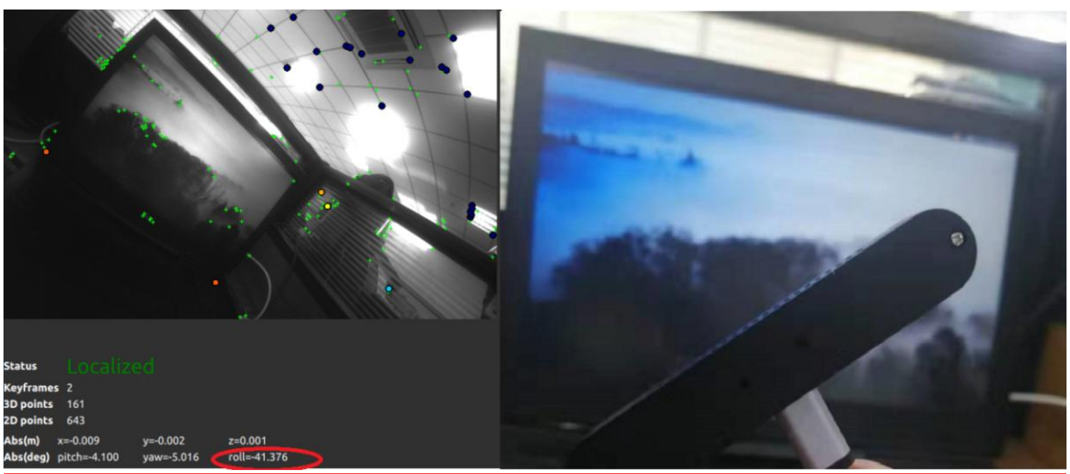


Figure 3-3 Module Placed at An Angle

3.1.3 VSLAM Coordinate System

Xvisio VSLAM uses right-hand coordinate by default. The positive direction of X-axis points towards the right, and Y-axis points down, Z-axis points away from you as below:

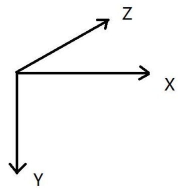


Figure 3-4 VSLAM Coordinate System

3.1.4 VIO Mode

In VIO mode, VSLAM uses stereo camera images and IMU data to calculate the position and orientation of the DS80 module. It does not use prebuilt map or loop-closure to correct errors. Over time, this leads to drift issue as the cumulative error increases.

Xvisio SDK provides APIs to start and obtain VIO 6DOF:

1） Register lost callback;

2） Call start() to start VSLAM;

3） Call getPoSe（） or register 6dof callback to get 6DOF data;

4） Call stop() to stop VSLAM;

Corresponded SDK interface:

bool start();

bool stop();

int registerCallback(std::function<void (xv::Pose const&)>);

bool unregisterCallback(int callbackId);

bool getPose(Pose &pose, double prediction) ;

Refer to Xvisio SDK Guide for more details on the API descriptions. For better tracking accuracy, CSLAM mode is recommended.

3.1.5 CSLAM Mode

In CSLAM mode, it uses loop-closure to correct the tracking errors and perform map optimization. Compared with VIO mode, the greatest benefit of CSLAM is a much improved tracking accuracy(absolute accuracy and repeatability accuracy). Xvisio CSLAM supports two methods: offline and online. This section will focus only on offline CSLAM and introduce the APIs of CSLAM. Please refer to Xvisio SDK Guide for more details.

To use CSLAM, a map needs to be created by running SLAM in the environment. The following shows the API calls for the process:

1） Call start() to register 6dof callback;

device->slam()->start(xv::Slam::Mode::Mixed);

device->slam()->registerCallback(poseCallback);

2） Create a map using SLAM;

3） After the map is created, call saveMapAndSwitchToCslam() to save the map and switch to CSLAM (if use callback to receive 6DOF, register done_callback, localized_on_reference_map);

device->slam()->saveMapAndSwitchToCslam(mapStream, cslamSavedCallback, cslamLocalizedCallback);

4） Call stop(),stop CSLAM

device->slam()->stop();

3.1.6 Performance Specification

1） Accuracy:

Specification	value
Average distance error	0.02m

Min distance error	0.0007m
Mix distance error	0.06m
Total movement	9.4m
Average accuracy	0.25%
Relative error	0.65%

Table 3-1 Accuracy Spec

2） Latency：

Axis	spec(ms)
X	≦5
Y	≦5
Z	≦5
Pitch	≦5
Yaw	≦5
Roll	≦5

Table 3-2 Latency Spec

3.2 Depth Engine

SeerSense™ DS80 includes two different types of depth engines:

- TOF depth engine
- Passive binocular depth engine

3.2.1 TOF Depth Engine

3.2.1.1 Introduction

Xvisio's depth engine employs industry's leading TOF camera. Coupled with the built-in depth sensing algorithm, it can achieve 1% of accuracy within the range of 5cm-5m. The framerate is adjustable with minimum being 5 FPS and maximum being 30 FPS. Compared with other depth sensing solutions, the

TOF based depth engine is more robust. It depends less on the working environment and is unaffected by light conditions or object surface textures.

3.2.1.2 TOF Depth Algorithm

The time-of flight (TOF) is based on measuring the time it takes for a wave to travel from a source (a time-of-flight sensor) to an object and back. Based on that data – as well as some knowledge of maths and physics (such as wave propagation) – you can establish the distance of that object from the source.

SeerSense ™ DS80 uses indirect time-of-flight (iTOF)(indirect TOF). The time of flight wave is not measured directly, but through the algorithm of measuring phase offset. The DS80 infrared emission wavelength is 940nm.

There are two modes of operation for DS80 TOF: edge mode which is still under development and host mode. For host mode, the depth algorithm runs on the host. Depth data stream is accessible using APIs available in XVSDK. Please refer to Xvisio SDK guide document for more details. For calibration data format, refer to Section 3.2.1.4.

The depth engine algorithm work flow is shown as below.

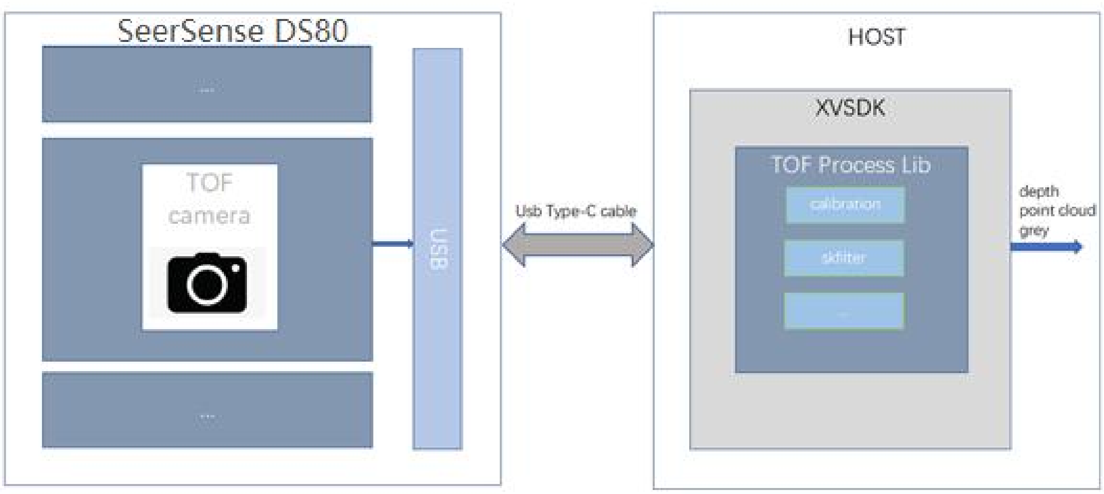


Figure 3-5 Depth engine algorithm flow chart

3.2.1.3 TOF Depth Image Format

format	resolution	Size per pixel (byte)	Description

Depth	640x480 320x240	2	The depth information of each pixel is represented by a 16 bit unsigned integer.
Point Cloud	640x480 320x240	4x3	The point cloud information of each pixel is represented by three 32-bit float data, which are x, y coordinate information and depth information in turn.
IR	640x480 320x240	2	The gray scale information of each pixel is represented by a 16 bit unsigned integer.

Table 3-3 Depth image format

3.2.1.4 TOF Depth Calibration Data Format

Items	TOF(PDM Intrinsic)
Extrinsic parameters	R[9]
	T[3]
Internal parameters	Fx
	Fy
	U0
	V0
	K1
	K2
	P1
	P2
	K3
	W
	H

Table 3-4 Depth Calibration data format

3.2.1.5 TOF Depth Quality Technical Parameters

TOF has a set of criteria for quantifying depth quality based on depth accuracy, data validity, and noise.

- **Depth accuracy and data validity**

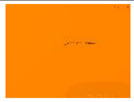
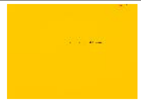
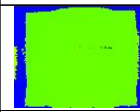
Technical Parameter	Object distance 0.5m	Object distance 1	Object distance 1.5m	Object distance 2m	Object distance 3m	Object distance 4m
Depth image						
Relative accuracy	$\leq$ 1%	$\leq$ 1%	$\leq$ 1%	$\leq$ 1%	$\leq$ 1%	$\leq$ 1%
Effective coverage	$\geq$ 99%	$\geq$ 99%	$\geq$ 99%	$\geq$ 99%	$\geq$ 90%	$\geq$ 70%

Table 3-5 Comparison table of TOF depth accuracy and data validity

3.2.2 Passive Binocular Depth Engine

Xvisio passive binocular depth engine collects and uses the data from binocular camera. It also leverages the internal/external calibration parameters of the cameras and runs SGBM (Semi-Global Block Matching) depth algorithm to produce the depth map data. Software based SGBM is computation intensive, but Xvisio SGBM is a hardware solution that is built into Movidius X chip, thus solve the problem of high CPU load by those imposed by the software based solution. Compared with other depth sensing solutions, passive binocular is cost effective and can be used in both indoors and outdoors environments.

3.2.2.1 Passive Binocular Depth Algorithm

Passive binocular depth algorithm includes the following two steps:

1) Establishing point to point correspondence between binocular stereo images.
2) Calculating the depth according to the disparity of points.

The built-in SGBM depth algorithm, as a global matching algorithm, has a good stereo matching effect. The algorithm selects the disparity of each pixel to form a disparity map and sets a global energy function related to the disparity map to minimize this energy function to achieve the purpose of solving the optimal disparity of each pixel.

The form of energy function is shown as below:

$$E(D) = \sum_p \left(C\left(p, D_p\right) + \sum_{q \in N_p} P_1 I\left[\left|D_p - D_q\right| = 1\right] + \sum_{q \in N_p} P_2 I\left[\left|D_p - D_q\right| > 1\right] \right)$$

The depth algorithm is completed in the hardware accelerator in Movidius X chip, and the depth data results can be readily accessed through APIs in Xivsio SDK.

Please refer to Xvisio SDK guide document for more details. For calibration data format, refer to Section 3.2.2.4.

The depth engine algorithm process is shown as below:

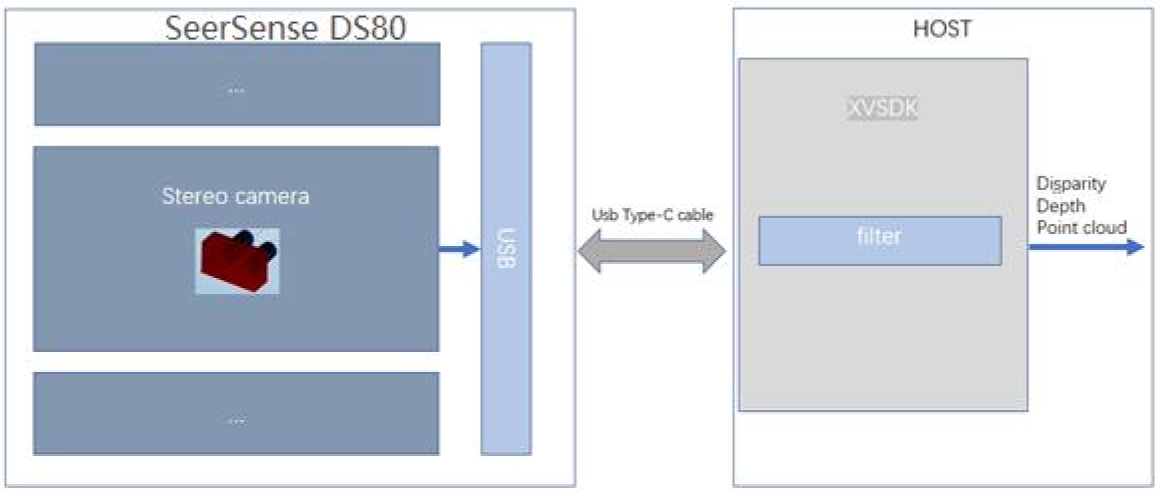


Figure 3-6 Depth Engine Algorithm Process

3.2.2.2 Passive Binocular Depth Image Format

Format	Resolution	Size of Each Pix（bytes）	Description
Depth	640x480 1280x720	2	The depth information of each pixel is represented by a 16 bit unsigned integer.
Point Cloud	640x480 1280x720	4x3	The point cloud information of each pixel is represented by three 32-bit float data, which represents x, y coordinate information and

			depth information in turn.
Disparity	640x480 1280x720	1	The disparity information of each pixel is represented by a 8-bit unsigned integer.

Table 3-6 Depth Image Format

3.2.2.3 Passive Binocular Depth Calibration Data Format

Items	**Stereo camera**
External parameters	R[9]
	T[3]
Internal parameters	Fx
	Fy
	Cx
	Cy
	K1
	W
	H

Table 3-7 Depth Calibration Date Format

3.2.2.4 Binocular Depth Quality Technical Parameter

Four types of depth mode are included, and each is supported by the stereo hardware acceleration module to achieve fast mode switching.

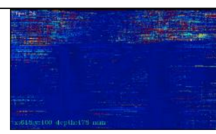
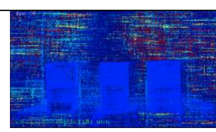
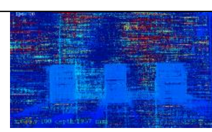
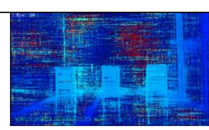
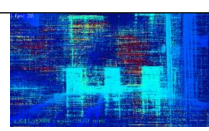
Technical parameters of four depth modes:

Mode	**Description**	**Technical Parameter**

Standard	Standard mode	VGA@60FPS 720P@30FPS
LRcheck	High precision in middle distance.	VGA@60FPS 720P@30FPS
Subpixel	High precision in far distance.	VGA@60FPS 720P@30FPS
Extended D	High precision in near distance.	VGA@60FPS 720P@30FPS

Table 3-8 Technology Parameters of Different Depth Mode

LRcheck mode depth quality and performance comparisons:

Distance to object	**Depth image**	**error**
0.5m		⩽ 3%
0.5m		⩽ 3%
2.0m		⩽ 3%
2.5m		⩽ 3%
3.0m		⩽ 3%

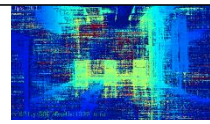
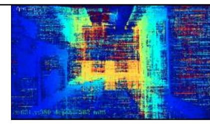
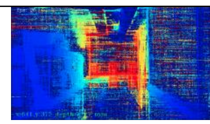
3.5m		⩽ 5%
4.0m		⩽ 5%
5.0m		⩽ 7%
6.0m		⩽ 10%

Table 3-9 Comparison Table of Depth Quality and Performance

3.3 RGB Engine

RGB engine uses a 13MP color camera which supports 8M static pictures and 30fps HD (up to 1080p) video streaming. 8MP static picture capture supports JPEG compressed output. Video streaming supports output in YUV format. In video mode, it also supports dynamic switching between 1080P, 720P and VGA formats. RGB engine workflow is shown as below:

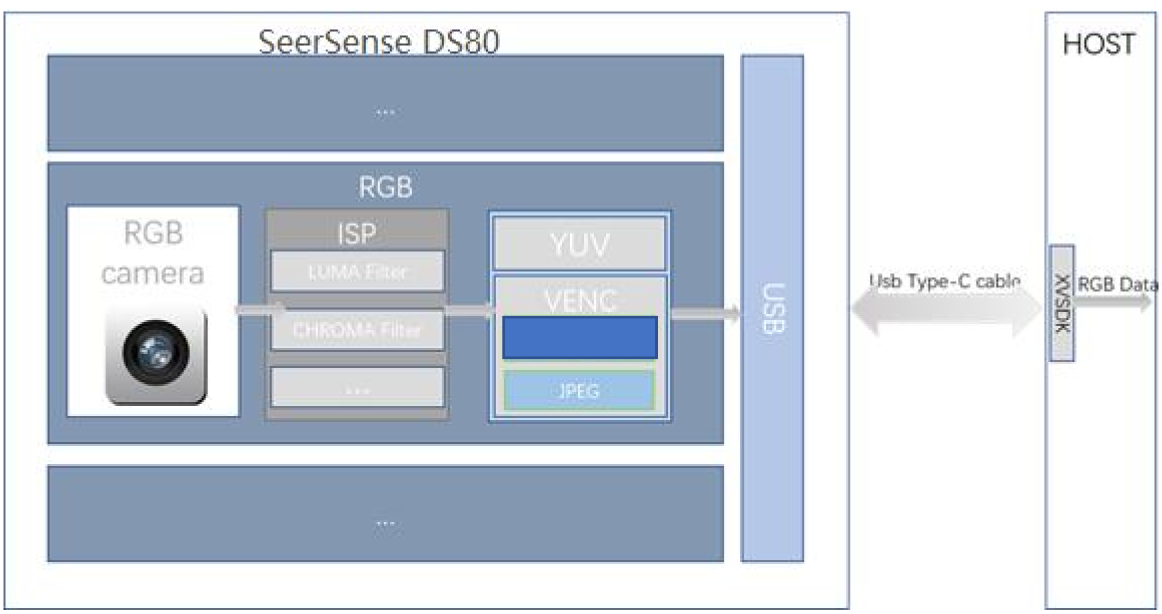


Figure 3-7 RGB Engine Workflow

RGB data access and control can be done through APIs in the Xvisio SDK. Refer Xvisio SDK Guide document for more details.

3.3.1 RGB Attribute

Parameter	RGB attribute
Pixel in video mode	1920x1080/1280x720/640x480
Size in video mode	16:9/4:3
Pixel in photo mode	3840x2160
Format	10-bit RAW
Aperture	f/2.0
Focus	3.56mm
Focusing mode	fixed-focus
Shutter type	Rolling shutter
Horizontal viewing angle	67.2°±3°
Vertical viewing angle	52.5°±3°
Diagonal viewing angle	79°±3°
Distortion	<1.0%

Table 3-10 RGB Attribute

3.3.2 RGB Function

Function	Description	Min	Max
Auto-exposure mode	Exposure time and gain are automatically set by ISP.	0	1
Exposure time	Set exposure time in manual exposure mode.	100ms	100000ms
Exposure gain	Set exposure gain in manual exposure.	1	16
Exposure compensation	Increment exposure compensation in manual mode	-9	9
Brightness	Set brightness in auto-exposure mode.	-10	10
Contrast ratio	Set contrast ratio depends on brightness configuration.	-10	10

Saturation	Set saturation	-10	10
Sharpness	Set sharpness	0	4
Manual white balance	Set white balance when disable AWB.	0	8
Automatic white balance	Enable auto white balance in ISP.	0	1
Prevent flicker	Specify according to the local power line frequency to avoid flickering	0	3
JPEG shooting	Compressed output for 8M picture.	0	1

Table 3-8 RGB Function

3.3.3 RGB Image Format

Format	Resolution	Frame	Note
YUV	1920x1080	30	Video mode supports YUV/ YV12 format.
	1280x720	30	
	640x480	30	
	3840x2160	15	
JPEG	3840x2160	NA	The photo mode supports 13M JPEG mode output.

Table 3-12 RGB Image Format

3.3.4 RGB Calibration Data Format

Items	RGB(PDM Intrinsic)
External reference	R[9]
	T[3]
Internal reference	Fx
	Fy
	U0
	V0
	K1
	K2
	P1
	P2
	K3

	W
	H

Table 3-13 RGB Calibration Data Format

3.4 Stereo camera data stream

SeerSense ™ DS80 include two fisheye cameras in the module, one on the left and the other on the right. It feeds image data stream to the on device VPU that runs image processing algorithm optimized for machine vision and runs the SLAM engine to complete real-time mapping of the binocular vision. The default frame rate of typical use cases is 50FPS.

3.4.1 Stereo Camera Attribute

Parameter	Camera attribute
Video mode pixel	1280x800/640x400
Video mode scale	16：10
Format	8-bit RAW
Aperture	f/2.0
Focus	1.69mm
Horizontal field angle	129°±3°
Vertical field angle	79°±3°
Diagonal field angle	150°±3°
Depth of field	13.1cm~∞

Table 3-14 Stereo Camera Attribute

3.4.2 Stereo Camera Function

Function	Description	Min	Max
Auto-exposure mode	Set exposure time and gain automatically.	0	1
Exposure time	Set exposure time in manual exposure time.	0	330
Gain	Set exposure gain in manual exposure mode	0	16
Brightness	Set the brightness in auto-exposure mode.	0	255

Semi-automatic exposure mode	Fix the exposure time and adjust the exposure gain.	0	1

Table 3-15 Stereo Camera Function

3.4.3 Stereo Camera Image Format

Format	Resolution	Frame	Note
NV12	1280x1600/ 640x800	50	Mono image: the UV component is 0 in pure-image mode. The two cameras are merged of top left and bottom right. See section 3.4.5 for further information.

Table 3-16 Stereo Camera Image Format

3.4.4 Stereo Camera Calibration Data Format

Items	**Fisheye(Unified Intrinsic)**
External parameter	R[9]
	T[3]
Internal parameter	Fx
	Fy
	U0
	V0
	Xi
	W
	H

Table 3-17 Stereo Camera Calibration Data Format

3.4.5 Example Pictures Taken by Stereo Camera

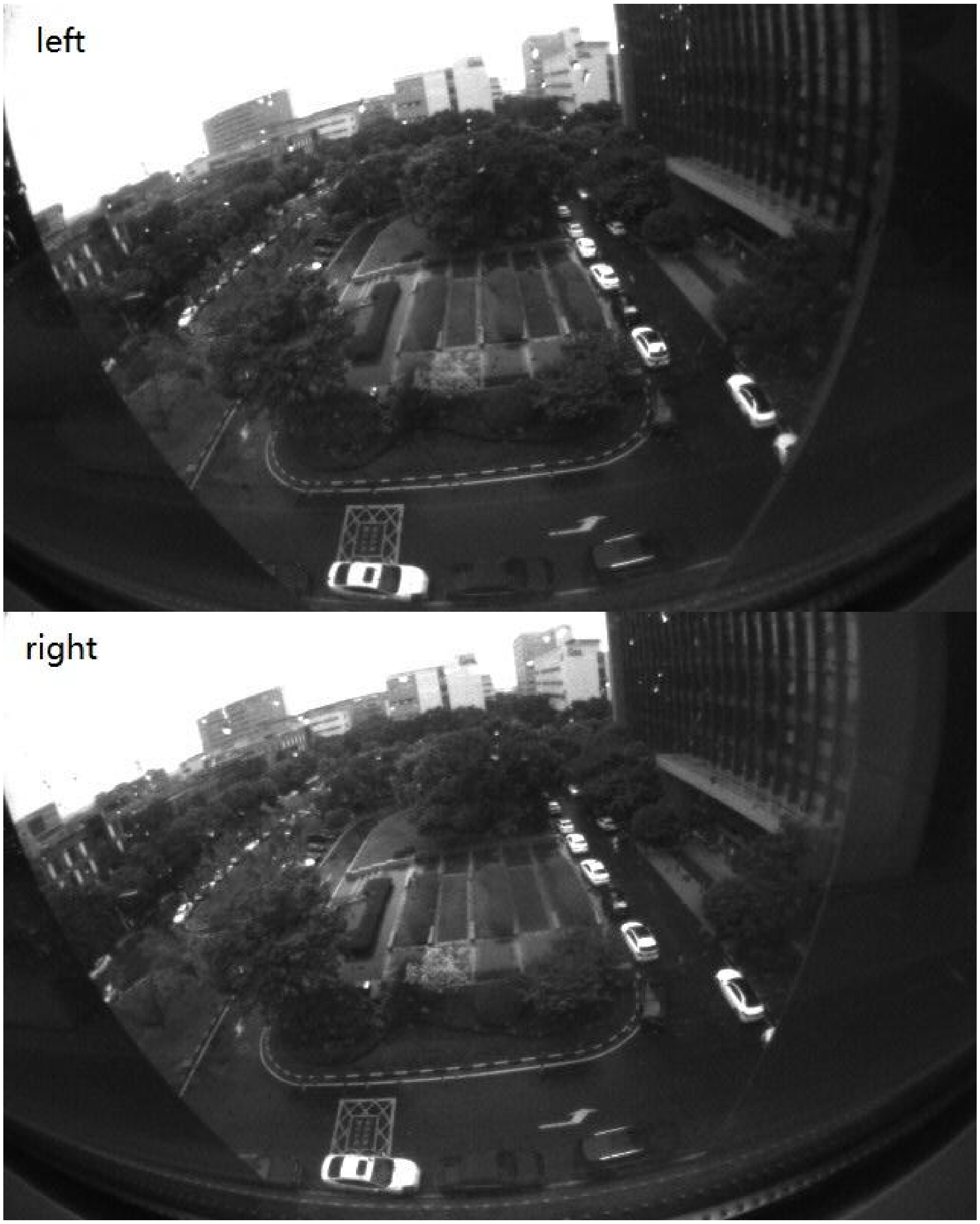


Figure 3-8 Example Picture Taken by Stereo Camera

3.5 IMU

The IMU in DS80 includes a three-axis gyroscope, a three-axis accelerometer and a three-axis magnetometer. It is not only the measurement equipment of object three-axis pose angle and acceleration, but also a key data component of VSLAM engine.

1） 9 axis running at 1000HZ;

2） Acceleration range ±8g;

3） Gyroscope range +/2000deg/s;

4） Magnetic field range 1300UT（X， Y axis）,+/-2500UT（Z axis）;

3.6 AI (CNN) Engine

3.6.1 Xvisio AI Engine Framework

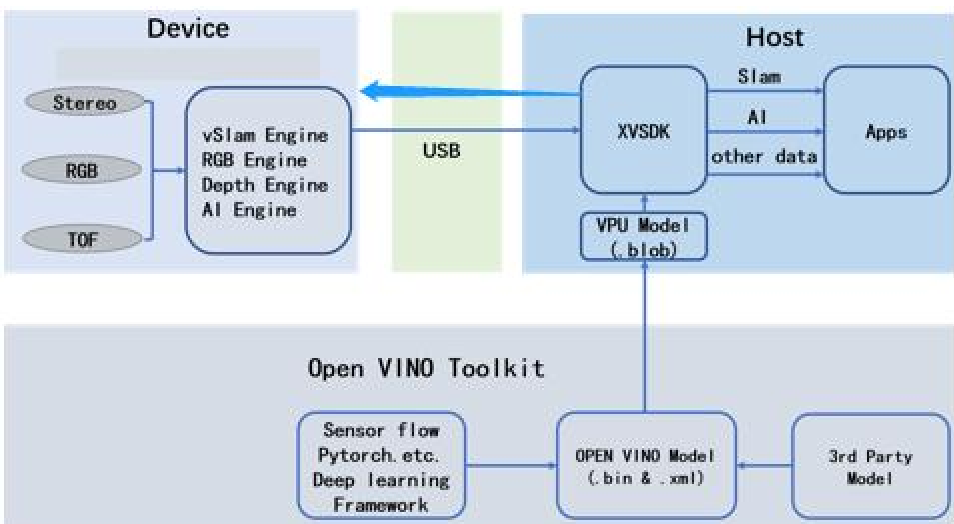


Figure 3-9 AI(CNN) Engine Architecture

Xvisio AI (CNN) engine framework is shown above. It includes three parts: the Device, the Host and the OpenVINO Toolkit. Each part plays a different role in AI inferencing framework.

3.6.2 Device (SeerSense ™ DS80)

SeerSense ™ DS80 device is the execution component of Xvisio AI inferencing framework. The execution component is where most of the computation load is at.

1） Input： Typically, DS80 has three different input data sources which corresponding to three types of camera respectively: Fisheye Camera, RGB and TOF. The input data source of AI engine can use one of these three types, which can be specified according to the user's requirement.

2） Inferencing: The converted model (.blob file) needs to be transferred to Device using utilities in Xvisio SDK. The AI engine of device will parse the blob file and generate a corresponding AI Tensor Graph. Based on different inputs, the AI engine on the device will perform corresponding preprocessing (such as resize, normalize, etc.) and then make inferencing.

3） Output: the inferencing results will be sent out through USB port along with other data streams, and the final results can be accessed through the SDK APIs.

Note: User needs to know or specify the device's input source and understand the output format.

3.6.3 Host

Host plays the analysis role in Xvisio AI inferencing framework through the use of Xvisio SDK (XVSDK). XVSDK provides the utility and APIs for deploying, activating, and running the CNN model. The output results of AI inferencing are also accessible through XVSDK APIs.

1） Model Layout

XVSDK uses "json" file as configuration file to read in and parse CNN models. For example:

model_type	**tensorflow**
classes	["background","face"]
threshold	0.5
video	video0
model	CNN_2x8x_r14_5.blob
source	rgb
CNN_input_flip_stereo	false
CNN_input_flip_RGB	false
CNN_input_flip_TOF	false

Table 3-18 Model Layout Example

2） Introduction of XVSDK build-in models

XVSDK supports the following algorithms:

a： Single Shot MultiBox Detector algorithm

b： OpenPose algorithm

c： YoloV3/V4 serial algorithm

Face recognition, pose detection and gesture detection can be achieved leveraging the above algorithms.

The output result of XVSDK is a data structure. The definition of object is shown as below:

Shape	Output Result Type
typeID	Object ID
type	Description of Object
x	Width of object center point
y	Height of object center point
width	Width of Object
height	Height of Object
confidence	Confidence of object
keypoints;	Keypoints gather

Table 3-19 Object Definition

3.6.4 Open VINO Toolkit

The main function of Open VINO is listed below:

1） Converting models generated by deep learning training frameworks like TensorFlow, caffe and pytorch, etc to a model format supported by hardware device.

2） Solidify the transformed model and improve the inferencing speed.

3） Optimizing and quantifying model.

Processing:

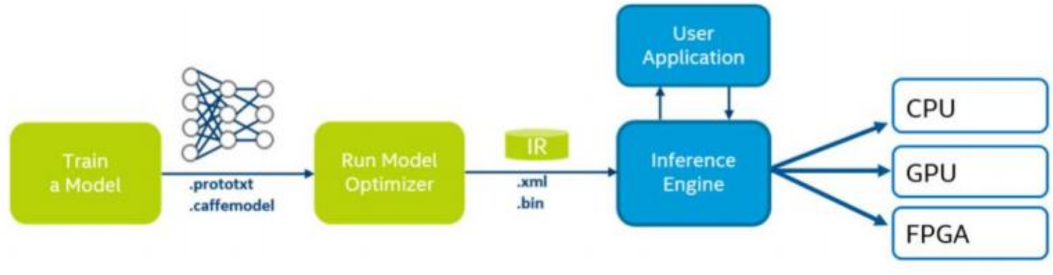


Table 3-10 Open VINO Processing

OpenVINO Toolkit module is used for the model conversion part of Xvisio AI inferencing framework. It's also a bridge between trained model to deployment model.

The following is the typical workflow:

1） Completing training corresponding machine-learning model through machine-learning framework like TensorFlow or Pytorch.

2） Solidifying and transforming trained model(pb or onnx,etc) into IR middleware(bin and xml file) through OpenVINO framework.

3） Converting IR middleware to VPU format (.blob) through OpenVINO.

In general, the main task of OpenVINO is to transform the model and generate the blob file.

3.6.5 CNN Tool Chain Input

Refer to Section 3.13 in the Xvisio SDK Guide document for more details on CNN tool chain input.

4. Specification

4.1 Electrical Characteristics

When Ta = 25°C, the absolute max value:

List	Name	Min	Max	Unit
Supply voltage	VBUS		5.8	V
Digital voltage range	CTS_3V3,RTS_3V3,RX_3V3,TX_3V3	-0.5	4.6	V
Digital input clamp current	CTS_3V3,RTS_3V3,RX_3V3,TX_3V3		-50	mA
Digital output clamp current	CTS_3V3,RTS_3V3,RX_3V3,TX_3V3		-50	mA

Table 4-1-1 Electrical Attribute

The recommended rated value when Ta = 25°C.

List	Name	Min	Typical	Max	Unit
Supply voltage	VBUS	4.75	5	5.3	V
Supply current	I - VBUS	2.5			A
IO Circuit voltage range	CTS_3V3,RTS_3V3, RX_3V3,TX_3V3	3.1	3.3	3.6	V
IO Circuit current range	CTS_3V3,RTS_3V3, RX_3V3,TX_3V3			12	mA

There is instantaneous peak current when TOF starts. The pulse width of peak current is less than 2ms. It is recommended that I-VBUS supply current is greater than 2.5A.

Table 4-1 Electrical Attribute

4.2 Power Consumption

Consumption (Typical)	Work mode	VBUS supply voltage V	Average current mA	Average consumption mW
	Default work mode:	5	459	2295
	Default idle mode:	5	237	1185
	Light sleep	5	<100	<500

Note： Use the above power consumption test results as reference. The actual rest results may vary with different configuration and usage scenarios.

Table 4-2 Power Consumption Test

4.3 Operating Condition

List	Min	Typical	Max	Unit
Storage temperature	-40	25	85	℃
Working temperature	0	25	60	℃

Table 4-3 Working Condition

4.4 USB Performance Characteristics

Attribute	USB2.0	USB3.1 GEN1
Data transmission speed	480 Mbits/s（high-speed） 12 Mbits/s（full-speed） 1.5 Mbits/s（low-speed）	5.0 Gbits/s（super-high speed） 480 Mbits/s（high-speed） 12 Mbits/s（normal speed） 1.5 Mbits/s（low speed）
Cable signal quantity	Four signals in total: - Two of them are for USB 2.0 （D、D–） - The other two are for VBUS and GND	Nine signals in total: - Four are for super-high speed data - Two are used for USB 2.0 （D、D–） - Three are used for VBUS and GND
Bus data transmission protocol	Connect host protocol directly. Polling data stream Data packets are transmitted to all the downlink devices. No data stream is reused.	Connect host protocol directly. Asynchronous notification. Packets can only be transmitted to the destination device. Multiple data streams can be transmitted in batch.
Power management	Multi-level link power management supporting idle, sleep, and suspend states. Link-, Device - and Function-Level power management.	Port-level Suspend with two levels of entry/exit latency Device-level power management.

Table 4-4 USB Performance Parameter

5. Firmware Upgrade

5.1 Prerequisite

1） Supported OS: Window10, Ubuntu 20.04/18.04 /16.04;

2） Xvisio SeerSense ™ DS80 module and USB 3.0 cable;

3） Specific firmware image for the device (provided by Xvisio);

4） Firmware upgrading tool provided by Xvisio.

5.2 Windows OS

5.2.1 Install DFU Driver

Note: User can skip these steps and go straight to Section 5.2.2 if DFU driver has already been installed.

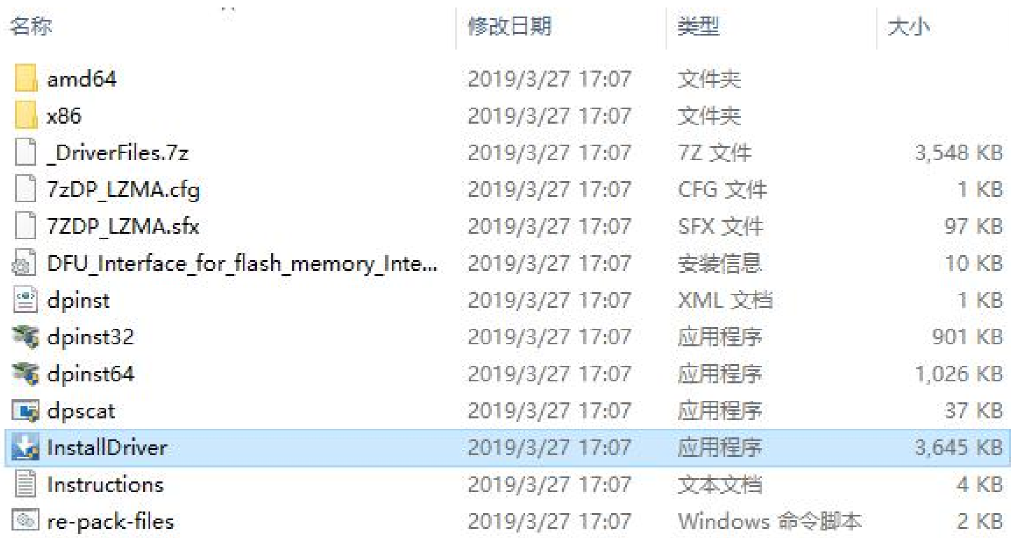
1） Plug the USB 3.0 cable to device and connect it with a PC host. Bring up the **“device manager**” and check to see whether DFU interface shows up as Figure 5-1.

Figure 5-1 Device Manager

2） Save the DFU install package on a local drive and open it from File Explorer:

Figure 5-2 DFU Install Package

3） Click “Install Driver”:



名称	修改日期	类型	大小
amd64	2019/3/27 17:07	文件夹	
x86	2019/3/27 17:07	文件夹	
_DriverFiles.7z	2019/3/27 17:07	7Z 文件	3,548 KB
7zDP_LZMA.cfg	2019/3/27 17:07	CFG 文件	1 KB
7ZDP_LZMA.sfx	2019/3/27 17:07	SFX 文件	97 KB
DFU_Interface_for_flash_memory_Inte...	2019/3/27 17:07	安装信息	10 KB
dpinst	2019/3/27 17:07	XML 文档	1 KB
dpinst32	2019/3/27 17:07	应用程序	901 KB
dpinst64	2019/3/27 17:07	应用程序	1,026 KB
dpscat	2019/3/27 17:07	应用程序	37 KB
InstallDriver	2019/3/27 17:07	应用程序	3,645 KB
Instructions	2019/3/27 17:07	文本文档	4 KB
re-pack-files	2019/3/27 17:07	Windows 命令脚本	2 KB

Figure 5-3 Install Driver

4） Click “下一步”:

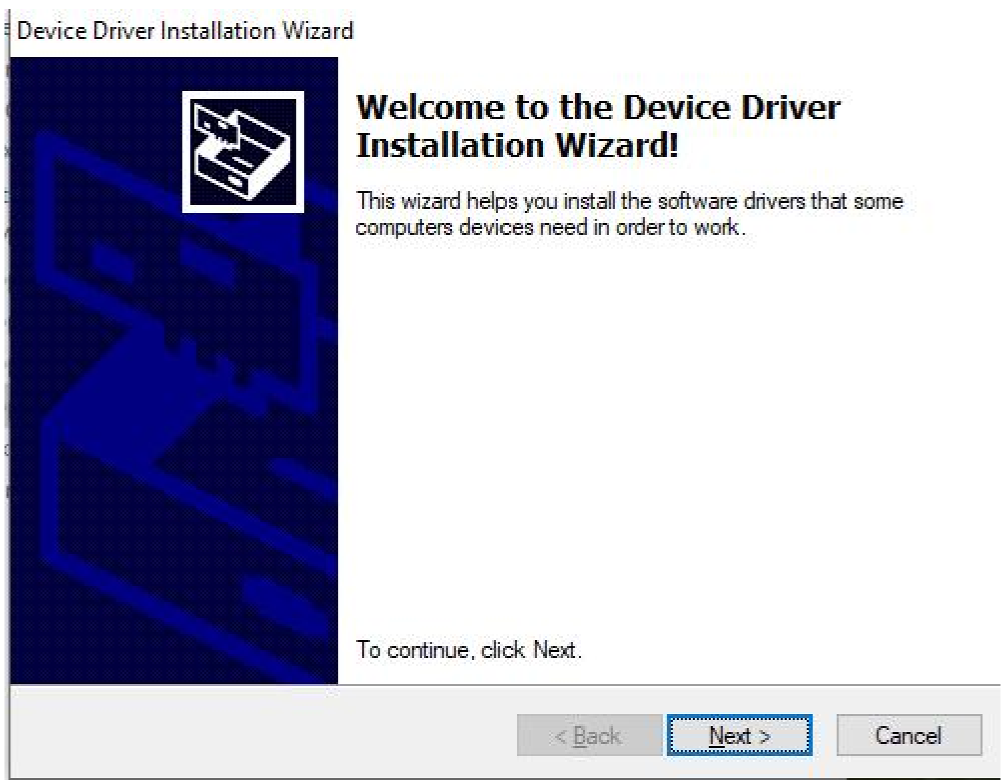


Figure 5-4 Install Driver

5） Install completed which means the DFU driver has been installed successfully.

Figure 5-5 Installation finished

5.2.2 Upgrade

1） Connect the device with PC. Bring up the Device Manager and check if the device shows up as a XVisio vSLAM and VSC interface listed under Other Devices as shown below:

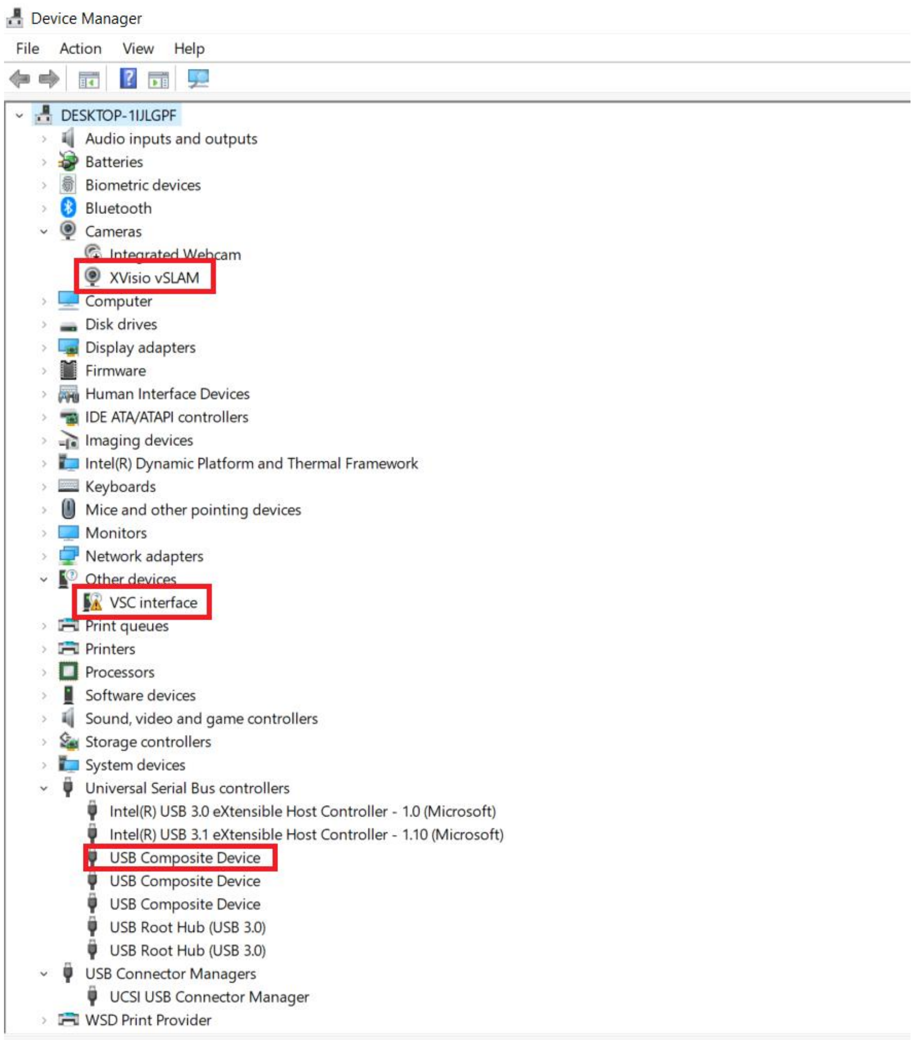


Figure 5-6 Device Manager

2） Double click “**XvisioUpgradeTool.exe**”:

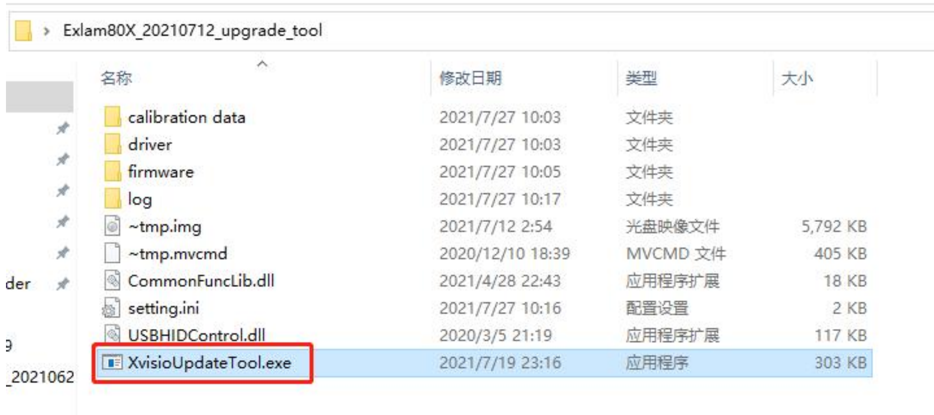


Figure 5-7 Upgrading Tool

3） Click “Batch” button to start the upgrade. The program will save the upgrade logs automatically into the folder “log”. If the firmware upgrade fails, try to unplug and plug the USB cable and follow step 2 again or sent Xvisio engineer logs.

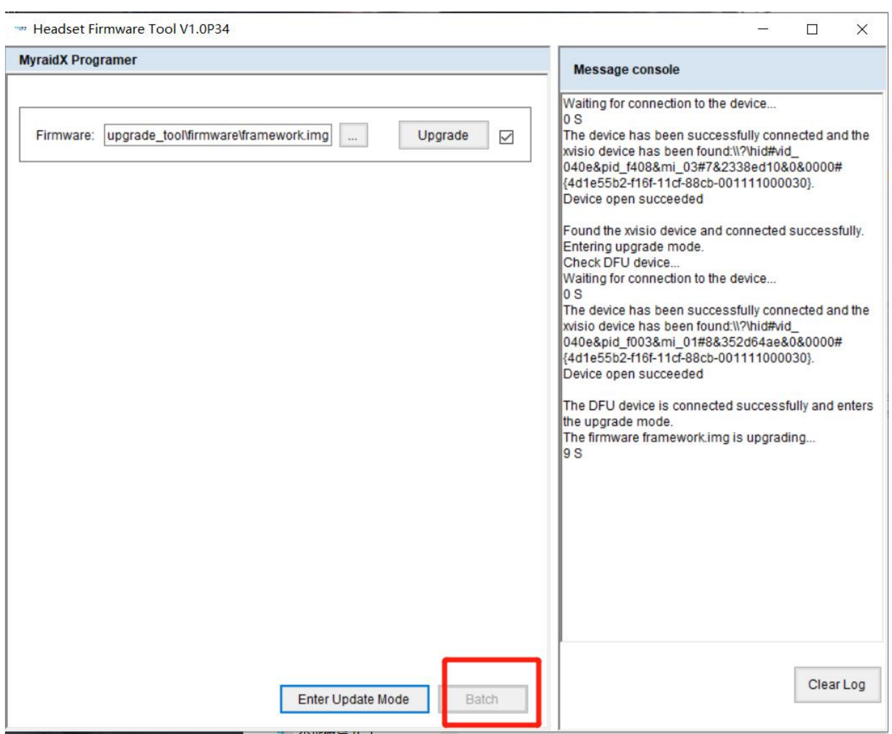


Figure 5-8 Upgrading

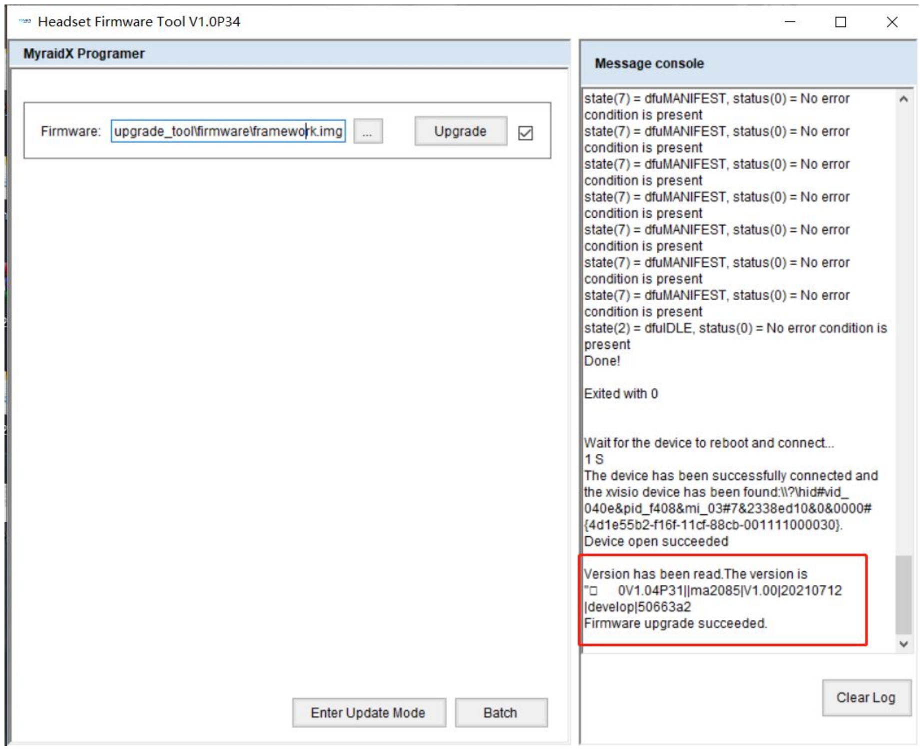


Figure 5-9 Upgrading Succeeded

5.3 Linux OS

5.3.1 Install DFU-UTIL

User can install dfu-util using either one of the following two methods:

1） Find the Linux install guide by the following link:

https://github.com/redbear/Duo/blob/master/docs/dfu-util_installation_guide.md

2） DFU driver： $ sudo apt-get install dfu-util

Note: No need to re-install if DFU driver has been installed.

Add UDEV rule: $ sudo vim /etc/udev/rules.d/77-mm-usb-device-blacklist.rules

Add: ATTRS{idProduct}=="d058", ATTRS{idVendor}=="2b04", MODE="664", GROUP="plugdev"

Restart and try again if it tips "DFU device can't be opened successfully".

Please note that dfu-util utility can be invoked ($dfu-util) from the whole system. Otherwise, reboot and try again after installation.

5.3.2 Performing Firmware Upgrade

1） Place "yunupdateimg" (the file properties should be executable) and "framework.img" into the same folder.

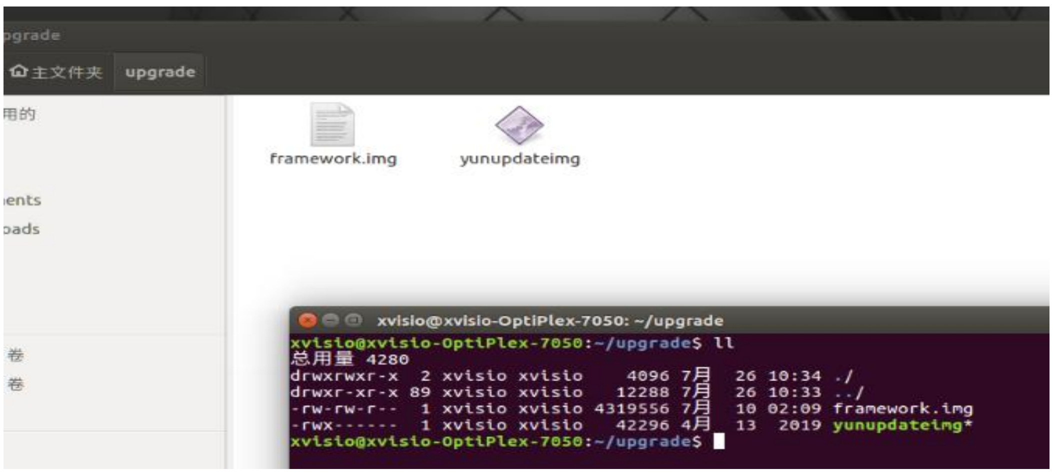


Figure 5-10 Yunupdateimg

2） Connect the device with PC, open the terminal to run *$lsusb*: usb port should appear as **040e:f408** or **040e:f003**.

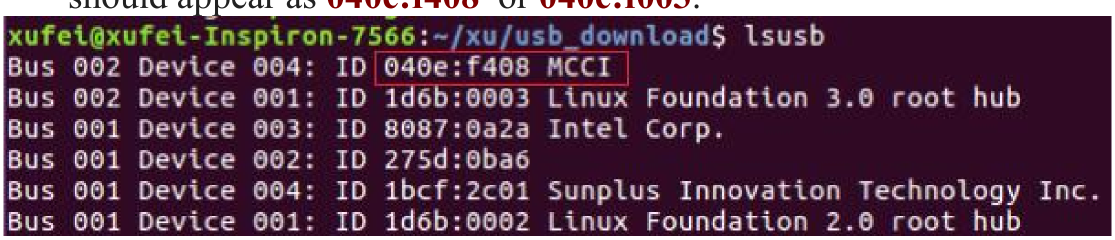


Figure 5-11 USB Port

3） Run the command to do the firmware upgrade: $sudo ./yunupdateimg framework.img. This step will call dfu-util to download the "framework.img" into device and perform the upgrade process.

```
xvisio@xvisio-OptiPlex-7050:~/upgrade$ sudo ./yunupdateimg framework.img
start check usb mode
Start hid_enumerate
.Device Found
  type: 040e:f408
  path: /dev/hidraw1
  serial_number: 0.0
sent the hid command: (2 0xde 0x12).
send pre_mode ok
Start hid_enumerate
.Device Found
  type: 040e:f408
  path: /dev/hidraw1
  serial_number: 0.0

Usb bootloader mode:
  type: 040e:f003
  path: /dev/hidraw2
  serial_number: 0.0
in usb bootloader mode
send switch_mode ok

Usb bootloader mode:
  type: 040e:f003
  path: /dev/hidraw2
  serial_number: 0.0
start download file: framework.img
About to run dfu-util for downloading...
dfu-util 0.8

Copyright 2005-2009 Weston Schmidt, Harald Welte and OpenMoko Inc.
Copyright 2010-2014 Tormod Volden and Stefan Schmidt
This program is Free Software and has ABSOLUTELY NO WARRANTY
Please report bugs to dfu-util@lists.gnumonks.org

dfu-util: Invalid DFU suffix signature
dfu-util: A valid DFU suffix will be required in a future dfu-util release!!!
Opening DFU capable USB device...
ID 040e:f003
Run-time device DFU version 0110
```

Figure 5-12 Downloading

4） Firmware upgrade is finished.

```
state(2) = dfuIDLE, status(0) = No error condition is present
Done!
```

Figure 5-13 Downloading Finished

5） Run $lsusb to check what the usb port is. If the usb port is 040e:f408 which means the firmware has been updated. Plug the usb and repeat step (3) if the usb port is f003. Connect Xvisio engineer for help if problem can't be solved.

6. SDK

Xvisio SDK is OS agnostics and work across three major platforms: Android, Ubuntu and Windows. The main difference is that the lib library is compiled separately for these three platforms, but the header file APIs are the same. In this section the SDK structure for each supported OS is introduced respectively. Users can refer to Xvisio SDK Guide document for more details.

6.1 Android SDK

SDK contains following files:

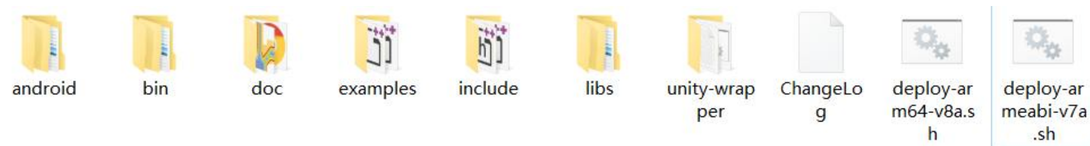


Figure 6-1 Android SDK Files

File **"bin"** refers to the tool of 64bit and 32bit.

File **"doc"** refers to the definition documents of interfaces.

File **"examples"** is Xvisio demo code which includes the example of how to use Xvisio SDK API.

File **"include"** is the header file of SDK API.

File **"libs"** includes SDK .so file. **"arm64-v8a"** is 64bit library, "**armeabi-v7a" is** 32bit library.

6.2 Ubuntu SDK

SDK API header file is in the path "/usr/include/xslam/".

Examples code is in the path "/usr/share/xvsdk".

Lib is in the path "/usr/lib".

6.3 Windows SDK

Windows SDK contains following files:

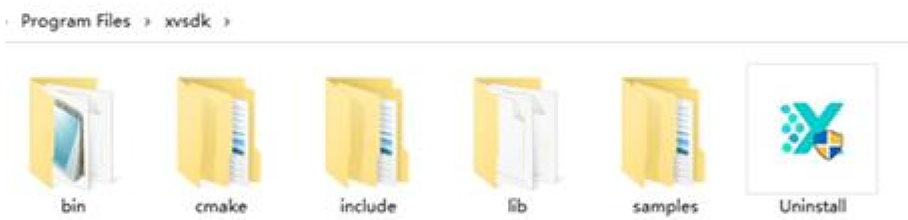


Figure 6-2 Windows SDK

File **"bin"** contains executable file and library.

File **"samples"** is the Xvisio demo code which includes the example of how to use Xvisio SDK API.

File **"include"** is the header file of SDK API.

File **"libs" contains** SDK dll.

7. Integration & Installation Guide

7.1 Description

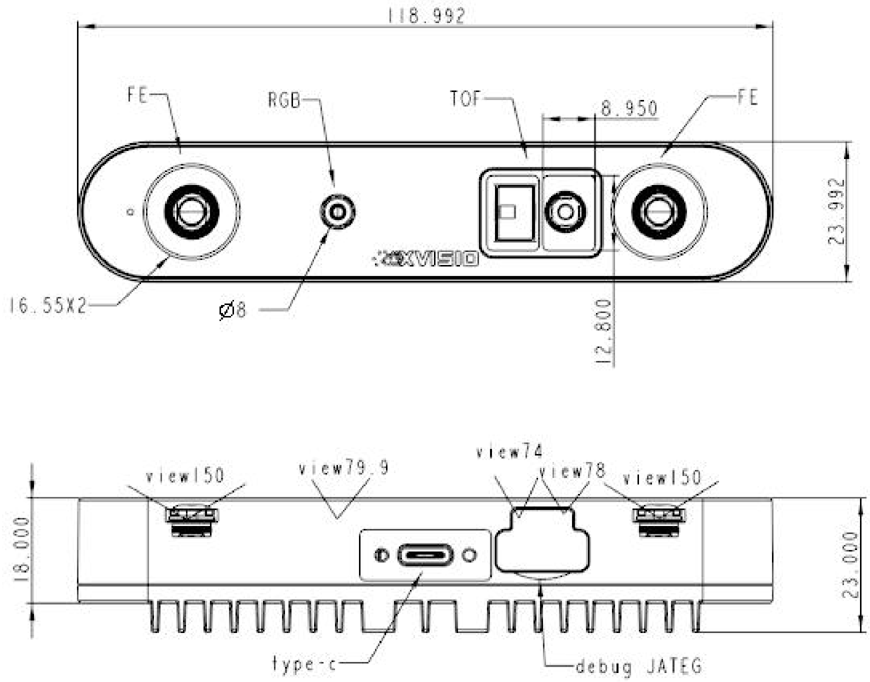


Figure 7-1 Description

7.2 Product Dimension

1) The dimension of the device is L119mmxW24mmxH18mm.
2) The fisheye baseline is 80mm.
3) The distance between two assembly fixing screw holes on the back of the module is 16mm.
4) The spacing between two TYPE C male fixing screw holes on both sides of type C interface at the bottom of the module is 15mm.

7.3 Heat Dissipation Solutions

1) There are several heat sources in the DS80 module such as fisheye lens, TOF, RGB, PCBA and other components. As such, it is important to do heat dissipation for the entire module. The metal bracket used in the module plays a key role in heat dissipation in addition to its normal functions as strengthening the module and hold components in place. Sufficient size and weight can To ensure a reasonable range of the working temperature of each component and the long term robustness of the module, sufficient size and weight of the metal bracket have to be used.
2) Heat dissipation measures also need to be added for the on board VPU. The current scheme is to bring heat into the metal aluminum parts of the rear casing through heat-conducting silica gel gasket on the main chip and other memory devices.

7.4 Heat Dissipation Measures

1) There is metal heat dissipation inside the camera module and at the back of the casing. Sufficient air convection space is needed to ensure heat dissipation on the module surface when integrating DS80 with the rest of the system. If the module is completely enclosed inside the system, sufficient heat conduction scheme shall be used to bring the heat of the module to the product surface.
2) The ambient temperature of the place where the camera is installed shall be controlled within 40°C (temperature after thermal balance). If the temperature of the installed space cannot meet this requirements, heat dissipation measures need to be taken inside the equipment. It is recommended to add a fan to reduce the internal ambient temperature. Otherwise the radiator can be used increased in the heat source to reduce the average temperature. The added fan speed needs to be damped to avoid transmitting the vibration to the camera.

7.5 Installation

Two installation methods for customer to choose:

1） There are two M2.5 screw holes on the back of the metal bracket and the maximum assembly depth is 3.0mm. The screw hole can be directly used to fix the module on the internal plane if there are die castings or plastic parts inside the customer's product. The peripheral ring of the module can be designed with corresponding limit, both the front and back parts are pressed to fix with structural parts.

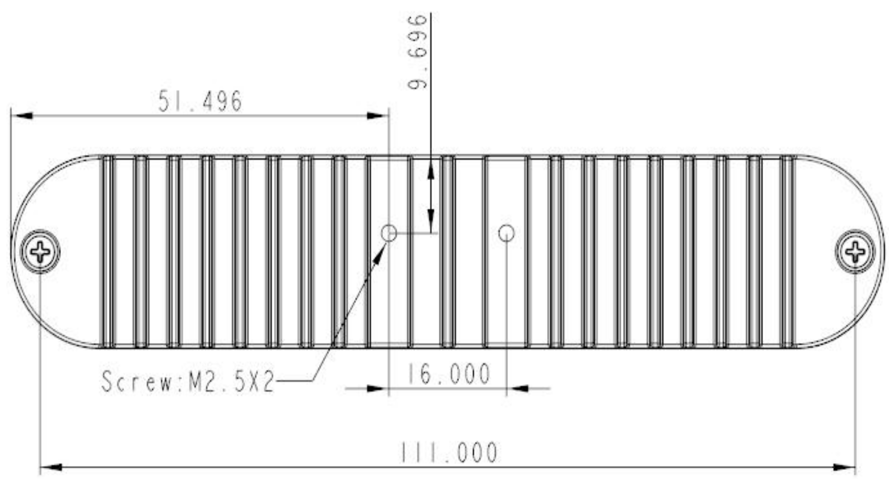


Figure 7-2 Screw Holes

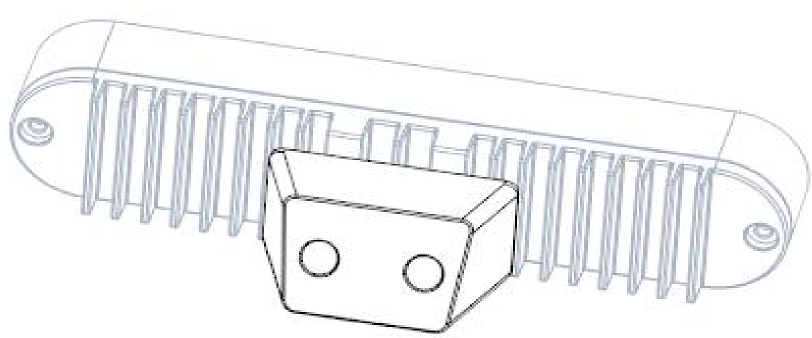
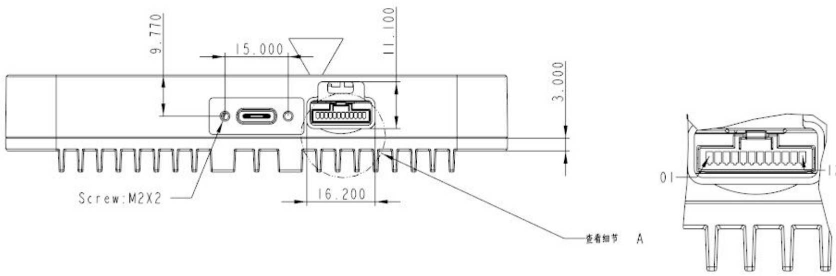


Figure7-3 Assembly

2） Two M2.0 screw holes are reserved on both sides of module type C interface, and the maximum assembly depth is 2.5mm. Customer can use these screw holes if the type C male head has a custom fixing the hole position, otherwise it is necessary to use other structural parts to fix the type C interface to prevent loosening.



number	pin definition
01	VBUS_5V
02	VBUS_5V
03	RX3V3
04	TX3V3
05	I2C1_SCL_3V3
06	I2C1_SDA_3V3
07	SPI2_MOSI_DEBUG
08	SPI2_MISO_DEBUG
09	SPI2_SCLK_DEBUG
10	SPI2_SS_DEBUG
11	GND
12	GND

Figure 7-4 Screw Holes

8. Compliance

8.1 Product Certification

- CE

EC Declaration of Conformity

We, the undersigned

Applicant:	Xvisio Technology(Shanghai) Co., Ltd
Address, City:	Room 6300, 6/F, No. 999, Changning Road, Changning District, Shanghai
Country/Region:	P.R.CHINA
Manufacturer:	Xvisio Technology(Shanghai) Co., Ltd
Address, City:	Room 6300, 6/F, No. 999, Changning Road, Changning District, Shanghai
Country/Region:	P.R.CHINA

certify and declare under our sole responsibility that the following product(s):

EUT Description:	SeerSense™ DS80
Brand/Trade Mark:	/
Model:	2085V5
Rating :	Type-C: 5V⎓0.95A Min

conforms with the essential requirements of the EMC Directive 2014/30/EU, based on the following standard(s) applied:

EN 55032:2015+A11:2020
EN 55035:2017+A11:2020
EN IEC 61000-3-2:2019
EN 61000-3-3:2013+A1:2019

and therefore compiles with essential requirements and provisions of the EMC Directive. Further information refers to Technical Documentation kept by manufacturer or authorized representative. The CE mark can be affixed on the product(s) by declarer when other applicable directives also are observed.

☐ Manufacturer
☐ Authorized representative
Name:
Title:
Signature:

Date: ____________

T/R No.:S20220419911801
DoC No.:CE20220419911801

CE

Test Laboratory
FGTEST
Fangguang Inspection & Testing Co.,Ltd.

Signature: Connie Yang

Date: May 06, 2022

- FCC

Ver.NO.:S20220419911802-SDOC

FGTEST

ATTESTATION OF CONFORMITY

This Attestation of Conformity is hereby issued to the below named company. The test results of this report relate only to the tested sample identified in this report.

Technical Standard : FCC 47 CFR PART 15 SUBPART B AND ANSI C63.4 (2014)

General Information

Applicant	:	Xvisio Technology(Shanghai) Co., Ltd
Address, City	:	Room 6300, 6/F, No. 999, Changning Road, Changning District, Shanghai
Country/Region	:	P.R.CHINA
Manufacturer	:	Xvisio Technology(Shanghai) Co., Ltd
Address, City	:	Room 6300, 6/F, No. 999, Changning Road, Changning District, Shanghai
Country/Region	:	P.R.CHINA

Product Description

EUT Description	:	SeerSense™ DS80
Brand/trade Name	:	/
Model Number	:	2085V5
Laboratory	:	Fangguang Inspection&Testing Co.,Ltd. Wuxi Branch

This device has been tested and found to comply with the stated standard(s), which is(are) required by the Federal Communications Committee. The test results are indicated in the test report and are applicable only to the tested sample identified in the test report number: S20220419911802

Connie Yang/ Director
Fangguang Inspection & Testing Co., Ltd.
Date:May 06, 2022

- RoHS

GRGTEST

TEST REPORT

CheckCode:204970
Report No.:C202204191083E

Applicant: Xvisio Technology（Shanghai） Co.Ltd

Address: Room 509, building 1, Xuhui international, No. 288, Tongxie Road, Changning District, Shanghai

The following sample information was submitted and identified by/on the behalf of the client

Name: SeerSense™ DS80
Type/Model: 2085V5
Supplier: Xvisio
Sample State: Normal

Date of Receipt: Apr.20, 2022   Test Period: Apr.20, 2022 – Apr.28, 2022

Test Request: As specified by client, to determine the Lead(Pb),Cadmium(Cd),Mercury(Hg), Hexavalent Chromium [Cr(Ⅵ)], Polybrominated biphenyls (PBBs), Polybrominated diphenyl ethers (PBDEs) , Bis(2-ethylhexyl) phthalate (DEHP) , Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP) , Diisobutyl phthalate (DIBP)content in the submitted sample(s).

Judge Standard: RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU.

Test Result: Please refer to following page(s).

Conclusion: Based on the performed test on submitted sample, the result(s) comply with the limits as set by RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU.

Edited by ________ Reviewed by ________ Approved by ________

扫一扫 验真伪

Seal of:
GUANGZHOU GRG METROLOGY & TEST WUXI CO., LTD.
Issue date:Apr.28,2022

GUANGZHOU GRG METROLOGY & TEST WUXI CO., LTD.
Address: No.200, Linghu Road, Taihu International Science and Technology Park, Wuxi Xinwu District, Wuxi, Jiangsu, China
Tel: 4006020999 Fax: +86-0510-68002628 Website: http://www.grgtest.com

Page 1 of 38

8.2 TOF Component Compliance Certification

- CB

IEC IECEE

Ref. Certif. No.

SG PSB-MC-00048

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

CB TEST CERTIFICATE

Product	Laser products (SeerSense DS80)
Name and address of the applicant	**Xvisio Technology (Shanghai) Co., Ltd.** Room 6300, 6 / F, No. 999, Changning Road Changning District 200050 Shanghai PEOPLE'S REPUBLIC OF CHINA
Name and address of the manufacturer	Xvisio Technology (Shanghai) Co., Ltd. WUXI Branch Room E2-527, 200 Linghu Avenue, Xinwu District, 214142 Wuxi City, PEOPLE'S REPUBLIC OF CHINA
Name and address of the factory	Xvisio Technology (Shanghai) Co., Ltd. WUXI Branch Room E2-527, 200 Linghu Avenue, Xinwu District, 214142 Wuxi City, PEOPLE'S REPUBLIC OF CHINA
Ratings and principal characteristics	Ratings: 5VDC Laser Class: 1 Wavelength: 940nm Pulse duration: 5.47ns
Model/type Ref.	2085V5
Additional information (if necessary)	Only hazards resulting from laser radiation have been addressed.
A sample of the product was tested and found to be in conformity with	IEC 60825-1:2014
as shown in the Test Report Ref. No. which forms part of this certificate	211-14220252-000

Page 1 of 2

This CB Test Certificate is issued by the National Certification Body

CBS 116957 0001 Rev. 00

Date, 2022-06-14

(Taylor Yao)

TÜV SÜD PSB Pte Ltd 15 International Business Park TÜV SÜD @ IBP Singapore 609937

TÜV SÜD PSB Singapore

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

Trademark / Brand (Image)

Page 2 of 2

This CB Test Certificate is issued by the National Certification Body

CBS 116957 0001 Rev. 00

Date, 2022-06-14

(Taylor Yao)

TÜV SÜD PSB Pte Ltd 15 International Business Park TÜV SÜD @ IBP Singapore 609937

PSB Singapore

- FDA

---------- DOCUMENT RECEIVED, FILED, & ACKNOWLEDGED ----------

This automated notification from the CeSub Submission Process contains general information about the aforementioned submission:

Accession Number: **2211136-000**
Date Loaded: **Jul 5, 2022**
Document Date: **Jul 5, 2022**
Establishment Name: **XVISIO TECHNOLOGY (SHANGHAI) CO., LTD. WUXI BRANCH**
Purpose: **This submission is a(n) Initial Product Report. These Data Measurement, Transmit, Control Laser Products include designated model family SeerSense DS80 Module with model(s) 2085V5.**

Submitter: **Wallace Xu**
Email: **wallace.xu@zuoce.org**
Reporting Official: **Qiong Lin**
Email: **johnlin@xvisiotech.com**

Please note that your firm is required to submit an Annual Report to CDRH every year by September 1.

If you meet all other applicable FDA requirements, you may market the product(s) reported. Please be aware that additional electronic product radiation control or medical device regulations may apply to your product, such as:

> 21 CFR 1002.11, requiring report supplements under certain circumstances following the same reporting forms as used for product reports on your products
>
> 21 CFR 1002.13, requiring annual reports to be submitted each year by September 1 using the appropriate reporting form for annual reports
>
> 21 CFR 1010 - 1050, requiring certification to FDA radiation safety performance standards
>
> 21 CFR 807, requiring manufacturer registration and device listing, and
>
> 21 CFR 807, 812 and 814, requiring medical device clearance or approval

For further information see:

Radiological Health web site - http://www.fda.gov/Radiation-EmittingProducts/default.htm
FDA Electronic Submissions Gateway website -
http://www.fda.gov/ForIndustry/ElectronicSubmissionsGateway/default.htm

If you have any questions, please contact the Director of the Division of Radiological Health, or the branch chief of your respective product area, as listed on the CDRH Management Directory, under the Office of In Vitro Diagnostics and Radiological Health, Division of Radiological Health.
http://www.fda.gov/AboutFDA/CentersOffices/OfficeofMedicalProductsandTobacco/CDRH/CDRHOffices/ucm127854.htm

Please include a primary (and optional secondary) contact email address in all submissions (and/or cover letters) to facilitate electronic correspondence.

Sincerely yours,

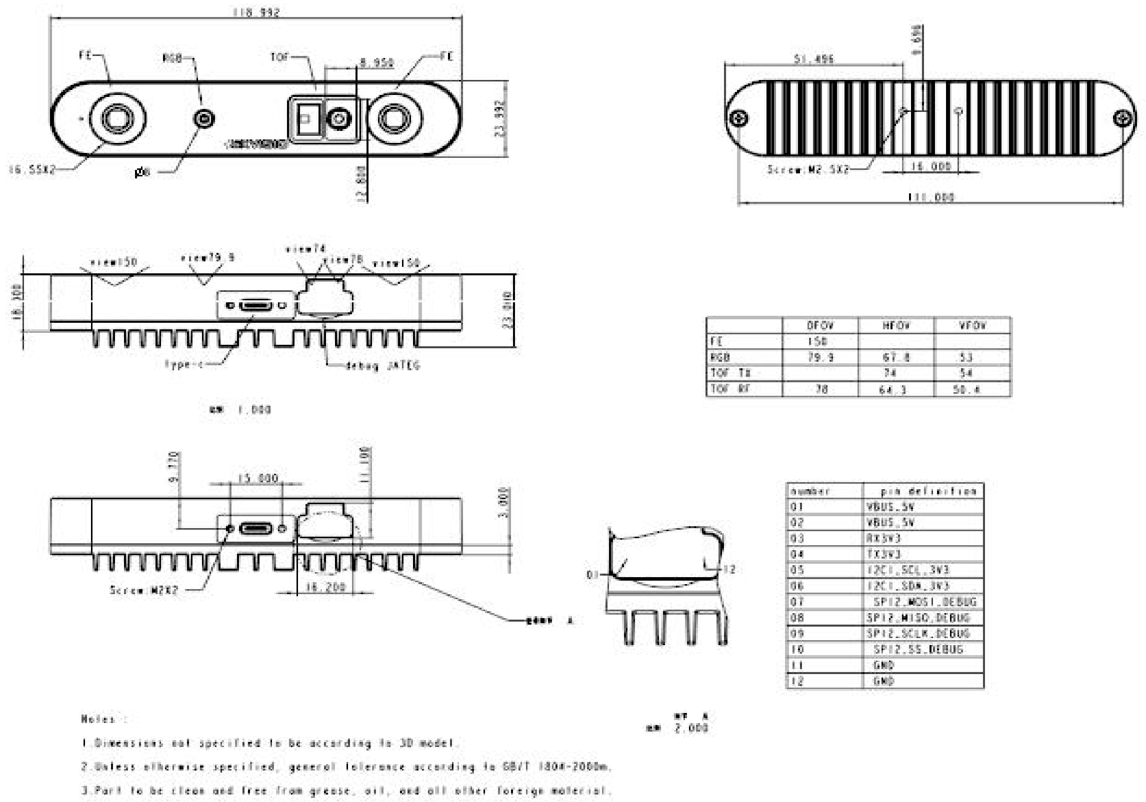
Division of Radiological Health

Office of In Vitro Diagnostics and Radiological Health

Center for Devices and Radiological Health

FDA U.S. FOOD & DRUG ADMINISTRATION

9 Product Drawing



	DFOV	HFOV	VFOV
FE	150		
RGB	79.9	67.8	53
TOF TX		74	54
TOF RF	78	64.3	50.4

number	pin definition
01	VBUS_5V
02	VBUS_5V
03	RX3V3
04	TX3V3
05	I2C1_SCL_3V3
06	I2C1_SDA_3V3
07	SPI2_MOSI_DEBUG
08	SPI2_MISO_DEBUG
09	SPI2_SCLK_DEBUG
10	SPI2_SS_DEBUG
11	GND
12	GND

10 About Us

Xvisio Technology Corporation is a cross border innovative company focusing on key enabling spatial perception and interaction technologies that power XR HMD and robotics applications. It was founded in Silicon Valley in 2016 and head quartered in Shanghai in 2017. In addition to its core 6DOF VSLAM multi-sensor fusion technology, it also offers a complete AR HMD solution and end product for various vertical markets such as industrial, medical, education and remote assistance. The core technologies include vSLAM algorithm, depth sensing, AI, hardware deployment of algorithm, AR scheme and SDK development or customization. It has R & D centers in China, the United States and Europe.