DepthVista

DepthVista IMU Application User Manual

Version 1.3

e-con Systems

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Disclaimer

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Contents

Introduction to DepthVista

DepthVista is a 3D camera based on Time of Flight (TOF) technology, USB Video Class (UVC) compliant, USB 3.2 Gen 1 SuperSpeed USB camera from e-con Systems, a leading Embedded Product Design Services Company which specializes in advanced camera solutions.

DepthVista is an RGB-D camera containing both RGB and TOF depth cameras. RGB camera has 1/2.6" AR0234CS CMOS digital image sensor with global shutter from onsemi™. It has dedicated high performance color image signal processor. TOF depth camera has 1/4" CCD sensor and dedicated depth processor. DepthVista is a two-board solution containing camera board with the USB 3.2 Gen 1 interface and laser board along with enclosure.

This document describes how to build the DepthVista IMU application step by step on the host PC (Linux) and the application illustration.

Prerequisites

The prerequisites are as follows:

- DepthVista console application source code
- CMake (version 3.5 and above)
- DepthVistaSDK

Description

DepthVista has USB interface controller with USB Type-C connector to interface with the host PC. It is a ready-to-manufacture camera board with all the necessary firmware built-in and is compatible with the UVC version 1.0 standard. You can integrate this camera into the products, and this helps to cut short the time-to-market.

DepthVista is a UVC compatible and will work with the standard drivers available with Windows and Linux OS. There is no need for any additional driver installation. So, video streaming through UVC is possible without any special drivers on OSes that have built-in support for UVC standards.

Table 1: DepthVista supported Format, Resolutions, and Frame Rates

S.No	Format	Camera Mode	Resolution	Frame Rate (fps) USB 3.2 Gen 1
1	UYVY	RGB Mode	2.3MP (1920 x 1200)	30
			FHD (1920 x 1080)	30
			HD (1280 x 720)	60
			VGA (640 x 480)	60

2	Y16 (RAW 12-bit)	TOF Mode	Depth (640 x 480)	30
			IR (640 x 480)	30
			Depth + IR (640 x 960)	30
3		RGB-D Mode	1280 x 600 (RGB-D)	30
			1443 X 960 (RGB-D)	30

The TOF camera in DepthVista can be used in two depth modes as follows:

- **Far Mode**: Effective depth range is between 1000 mm to 6000 mm.
- **Near Mode**: Effective depth range is between 200 mm to 1200 mm.

The TOF camera controls of DepthVista are as follows:

- TOF Data Mode
- TOF Depth Range
- TOF Mask
- TOF Gain

The RGB camera controls of DepthVista are as follows:

- Brightness
- Contrast
- Saturation
- Gamma
- Gain
- Sharpness
- White Balance
- Exposure
- Power line frequency

Installing DepthVistaSDK for Linux

This section describes the installation of DepthVistaSDK which is essential for building DepthVista Application.

The steps to install the DepthVistaSDK are as follows:

1. Run the following command to extract the **package** file.

   ```
   unzip -X <packageName.zip>
   ```

   <Extracted Directory>\Linux\Bin\Ubuntu18.04\x64\SDK will have an install.sh file.

   Note: For Ubuntu 20.04 the install.sh file will be present in **<Extracted Directory>\Linux\Bin\Ubuntu20.04\x64\SDK.**

2. Open the folder containing install.sh in terminal.

3. Run the following command to give executable permission for install.sh file.

   ```
   chmod +x install.sh
   ```

4. Run the following command to install the **DepthVistaSDK**.

   ```
   sudo ./install.sh
   ```

   Once installation is success, **Installation DepthVistaSDK success** message appears.

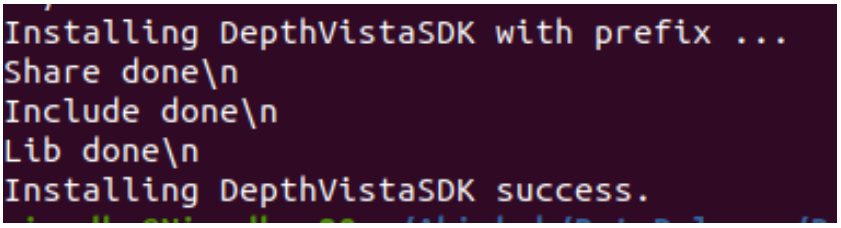

Fig 1: Installation success screenshot.

IMU Application

This section describes the IMU Application in detail.

Launching Linux DepthVista IMU application

The steps to launch the Linux DepthVista IMU application are as follows:

1. Run the following command to extract the **package** file.

```
unzip -X <packageName.zip>
```

<Extracted Directory>\linux\Bin\Ubuntu18.04\x64\Bin will contain DepthVistaIMU executable file.

(Note: For Ubuntu 20.04, the DepthVistaIMU executable file will be present in **<Extracted Directory>\linux\Bin\Ubuntu20.04\x64\Bin**)

2. Run the following command to run the application.

```
sudo ./DepthVistaIMU
```

Launching Windows DepthVista Console Application

The steps to launch the windows DepthVista console application are as follows:

1. Extract the given Package.

   <Extracted Directory>/Windows/Bin/CMD/x64 will contain the DepthVistaIMU.exe file.

2. Double click the DepthVistaIMU.exe.

IMU Configuration

The ICM-20789 is a six DOF IMU unit featured with triaxial accelerometer and triaxial gyroscope and supports different modes of configuration. These configurations are handled using Human Interface Device (HID) commands. To know more about the HID commands, please refer to the *DepthVista_SDK_API_Manual.pdf* document provided in the release package. To get the IMU values, based on the application requirement, you need to configure the following:

- Configure the IMU modes
- Output data rate
- Sensitivity
- IMU value update mode

Application Illustration

The IMU sample application included in DepthVista SDK is a basic example demonstrating the rotations of camera around x, y and z axis. The output rotation angles calculated from the IMU values are limited to the range from -90 to +90 degrees for illustration.

Getting the IMU Values

The steps to get the IMU values are as follows:

1. Configure IMU mode, Axis control, Output data rate and Sensitivity.

   IMU_MODE = IMU_ACC_GYRO_ENABLE
   ACC_AXIS_CONFIG = IMU_ACC_X_Y_Z_ENABLE
   IMU_ODR_CONFIG = IMU_ODR_104HZ
   ACC_SENSITIVITY_CONFIG = IMU_ACC_SENS_2G
   GYRO_AXIS_CONFIG = IMU_GYRO_X_Y_Z_ENABLE
   GYRO_SENSITIVITY_CONFIG = IMU_GYRO_SENS_250DPS

2. You must configure IMU value update mode.

   IMU_UPDATE_MODE = IMU_CONT_UPDT_EN

Once these values are configured, you must call the GetIMUValue HID command, and you will get the IMU values in a separate thread.

These raw values from accelerometer and gyroscope must be interpreted to use in the application. You can interpret these values, calculate the rotation angles and render an inclination window based on the rotation from the camera. By rotating the camera around a particular axis, the other two planes will be rotating. You can view how these results change based on the inclination of camera, and the application waits for a user interrupt (keyboard event). If you press Enter key in the keyboard, the application will exit.

Sample Application

The following figure shows the DepthVista camera depicting the axis.

Figure 1: DepthVista Camera with axis

The following figure shows the application-inclination screen which is captured when the camera is rotated in the first half of picture.

Figure 2: DepthVista Camera angel and its axis

For this position of camera, the angles are calculated as X rotation = 89 degrees, Y rotation = 0 degrees, and Z rotation = 0 degrees, based on the IMU values.

The following figure shows the application-inclination screen which is captured when the camera is rotated in the first half of picture.

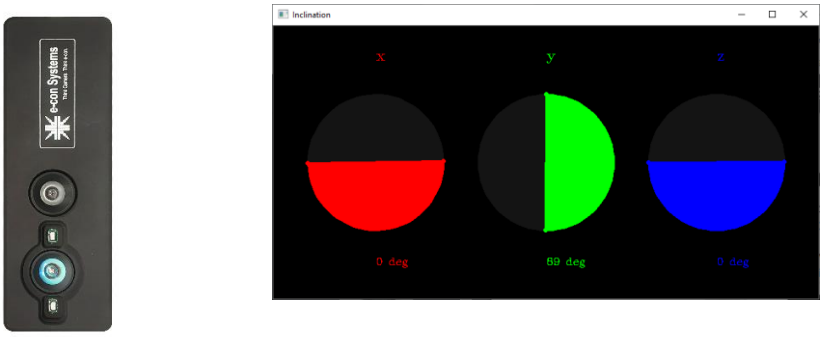

Figure 3: DepthVista Camera angel and its axis

For this position of camera, the angles are calculated as X rotation = 0 degrees, Y rotation = 89 degrees, and Z rotation = 0 degrees based on the IMU values.

Error while loading shared libraries: libdc1394.so.25: cannot open shared object file: No such file or directory

Warning: libdc1394.so.25, needed by /usr/lib/libopencv_world.so.4.2.0, not found

Run the following command in terminal to solve the issue.

```
sudo apt-get install libdc1394-25
```

In the DepthVista sample application, the device is selected but the preview window is black.

- Please make sure that the external power supply is connected to the device and then restart the application.
- Please check whether the device is connected to USB 2.0. If so, as this device supports only USB 3.2 Gen 1 interface, please connect the device to USB 3.2 Gen 1 port and then restart the application.
- You need to install the latest version of DepthVista sample application from the Developer Resources website.

Make sure external power supply is connected and the device is connected to USB 3.2 Gen 1 Interface. Then in the DepthVista sample application, the preview window is black.

It seems like no image is received from the camera. Contact e-con Systems online support support@e-consystems.com.

FAQ

1. **Does external power supply require for this camera?**

   Yes, we need external power supply to get depth frames and it will be provided with the kit**.**

2. **What is the supported external power supply current ratings?**

   The supported external power supply current ratings are listed below.

   Input: AC 100-240v, 50/60HZ

   Output: DC 12V, 4A

3. **What is the current operating temperature range supported by DepthVista?**

   The current operating temperature range supported is 0**°**C to 50**°**C.

4. **What is the light source used in this camera?**

   This camera uses two VCSEL laser diodes that work in the Near InfraRed (NIR) spectrum (850nm) and is safe for human eyes.

5. **Can the depth range be improved further?**

   Yes. Depth range can be improved by changing the no of VCSEL LEDs and their intensity. This is going to involve a customization effort.

6. **Is DepthVista suitable for outdoor environment?**

   As the laser diodes used in this camera operate in the 850nm NIR range, the likelihood of interference from sunlight is very high if you use it in outdoor applications. Hence, this camera is more suitable for indoor environments.

7. **What is the maximum accuracy that can be achieved?**

   DepthVista offers an accuracy of <1%.

8. **Is the DepthVista camera is pre-calibrated?**

   Yes, this camera is factory calibrated. Do not disturb the casing or the lens, which would alter the calibration done.

9. **What is the minimum distance that the lens could focus?**

   The minimum working distance (distance between the camera and the object) for this camera is 20 cm.

10. **Are these ToF and RGB sensors synchronized?**

Yes. Both these sensors work synchronously to make the best use of the depth and RGB data streams.

11. **What is IMU?**

    Inertial Measurement Units (IMUs) is a self-contained system that measures linear and angular motion usually with a triad of gyroscopes and triad of accelerometers and sometimes the magnetic field surrounding the body, also magnetometers.

    IMU chip used is a 6dof (degree of freedom) IMU (Inertial Measurement Unit) featured with triaxial accelerometer and triaxial gyroscope, supports different modes of configuration.

12. **Why is this camera not supported in USB 2.0?**

    Due to Bandwidth limitations of RGB-D streaming in USB 2.0, this camera supports only USB 3.2 Gen1 speed.

13. **What is the depth resolution and frame rate supported by DepthVista?**

    DepthVista supports a resolution of 640x480 at a frame rate of 30 fps for depth measurement.

14. **What are the output formats supported by DepthVista camera?**

    The output formats supported by DepthVista camera are listed in the below table.

Mode	Format
TOF	Y16(RAW 12-bit)
RGB	UYVY
RGB-D	Y16

15. **What is DepthVista SDK?**

    DepthVista Software Development Kit (SDK) package is built on OpenCV (**opencv-4.2.0**) Images Processing Library is bundled with DepthVista USB 3.2 Camera. SDK currently uses C++ API's of OpenCV.

16. **How to install the DepthVista?**

    DepthVista Installer package will be available with DepthVista deliverables. Follow the procedure in the document named **"DepthVista_Windows_Installation_Manual.pdf"** for Windows OS and **"DepthVista_Linux_Installation_Manual.pdf"** for Linux.

17. **Do we share the DepthVista sample application source code?**

    Yes, DepthVista sample application source code will be shared along with the SDK.

18. **What are the operating systems supported by DepthVista?**

    The operating systems are Windows 10, Ubuntu 18.04, Ubuntu 20.04.

19. **What is the shutter type on the sensor?**

    Both the TOF and RGB camera sensors are global shutter sensor.

20. **Does DepthVista comes with an enclosure?**

    Yes. This camera comes with a metal enclosure.

21. **What is the lens used in the DepthVista camera? – TOF and RGB**

    The lens used in the camera is S-mount (M12).

Description	RGB Camera Lens	Depth Camera Lens
Focal Length	3.252mm	2.16mm
Diagonal FOV	90.09	99.75

22. **What is the lens mount used?**

    The lens mount used in the DepthVista Camera reference design is S-mount M12 lens holder (M12 P0.5 lenses are supported by default).

23. **What is calibration? Why should I do that?**

    In DepthVista camera, the depth calibration is performed. Depth calibration process is carried out to get the accurate depth from the depth camera. Once the depth calibration is completed, calibration result parameters are programmed to the memory allotted for calibration in the SPI-flash.

24. **Can I get the depth of each and every pixel in the depth measurement resolution?**

    Yes, use the DepthVista sample application in the SDK, where the depth of the point selected by the user is displayed.

25. **What are the warranty terms of DepthVista camera?**

    For warranty, please refer the warranty page.

What's Next?

After understanding the usage of DepthVista console application, you can refer to the following documents to understand more about DepthVista IMU.

- DepthVista Windows Installation Manual
- DepthVista Linux Installation Manual
- DepthVista SDK API Manual

Glossary

ROI: Region of Interest.

USB: Universal Serial Bus

UVC Compliant: USB Video Class Compliant.

Support

Contact Us

If you need any support on DepthVista product, please contact us using the Live Chat option available on our website - https://www.e-consystems.com/

Creating a Ticket

If you need to create a ticket for any type of issue, please visit the ticketing page on our website - https://www.e-consystems.com/create-ticket.asp

RMA

To know about our Return Material Authorization (RMA) policy, please visit the RMA Policy page on our website - https://www.e-consystems.com/RMA-Policy.asp

General Product Warranty Terms

To know about our General Product Warranty Terms, please visit the General Warranty Terms page on our website - https://www.e-consystems.com/warranty.asp

Revision History

Rev	Date	Description	Author
1.0	31-October-2022	Initial Draft	Camera Products
1.1	04-November-2022	Changed Installation steps for Linux	Camera Products
1.2	02-June-2023	Document Update	Camera Products
1.3	15-June-2023	Document Update	Camera Products