INTRAORAL 3D SCANNER - TOF CAMERA

What is a TOF camera?

A TOF camera is a range imaging camera system that measures the distance between the camera and each point in the field of view by determining the round-trip time of an artificially pulsed light signal (usually a laser or LED). In simpler terms, it measures how long it takes for light to bounce off an object and return to the camera, allowing it to create a depth map of the scene .

Components of a TOF camera:

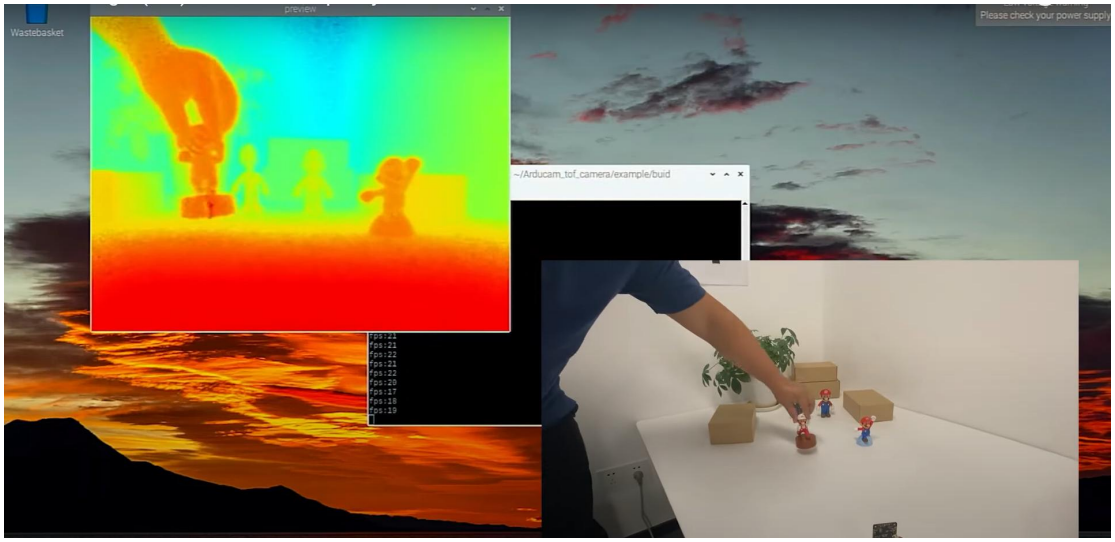
Light source: Typically a laser or LED that emits pulsed light in the near-infrared spectrum (invisible to human eyes).
Modulator: (Optional) In some cases, a modulator is used to vary the intensity or frequency of the light pulses for improved channel separation and accuracy.
Lens system: Focuses the pulsed light onto the scene and gathers the reflected light back to the camera.
Sensor array: An array of photodetectors that capture the reflected light pulses.
Timing circuitry: Measures the precise time difference between the sent and received light pulses for each pixel in the array.
Processing unit: Analyzes the timing data and generates a depth map of the scene based on the distances calculated.

Working principle:

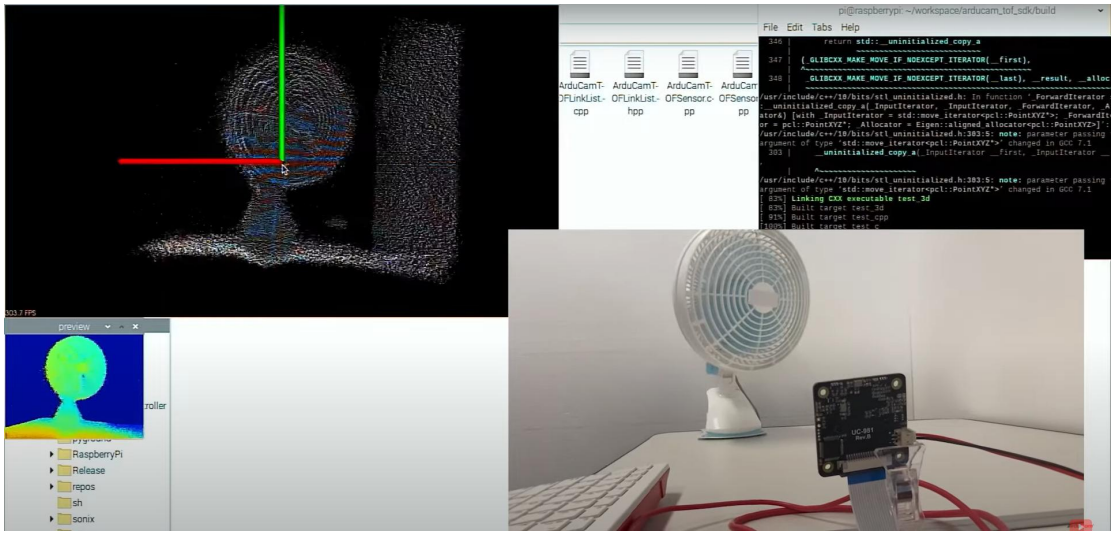
- The TOF camera emits a pulse of light towards the scene.
- The light hits objects in the scene and reflects back to the camera.
- The sensor array captures the reflected light pulses, and the timing circuitry measures the time it took for each pulse to return.
- The processing unit uses the time-of-flight measurements to calculate the distance to each point in the scene, generating a depth map.
- This depth map can be used for various purposes, including 3D imaging, mapping, and reconstruction.

3D imaging, mapping, and reconstruction:

3D imaging: The depth map from the TOF camera can be combined with a color image from a standard camera to create a 3D image of the scene.
3D mapping: By capturing multiple depth maps from different angles, a complete 3D map of the environment can be created. This is useful for applications like robotics, autonomous vehicles, and augmented reality.

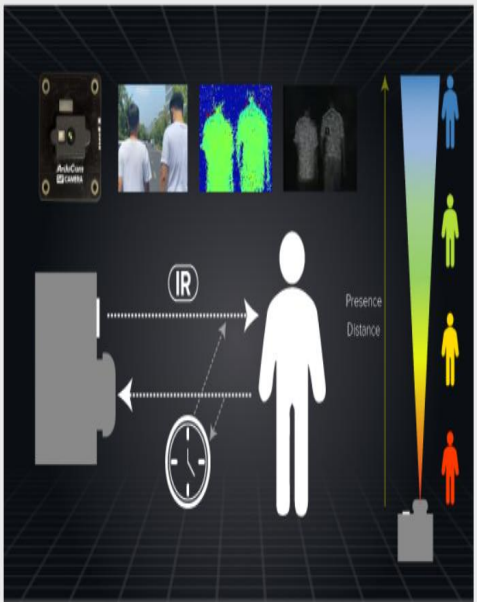


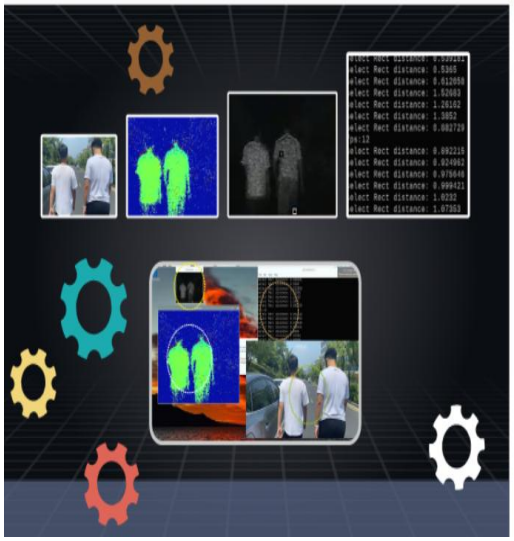
3D reconstruction: Using multiple depth maps and additional information, 3D models of objects or entire scenes can be reconstructed.



PRODUCT LINK
https://www.arducam.com/time-of-flight-camera-raspberry-pi/
PURCHASE LINK
https://robu.in/product/arducam-time-of-flight-camera-for-raspberry-pi/?gad_source=1&gclid=Cj0KCQiA4Y-sBhC6ARIsAGXF1g7s5VY4n3hVES_TBWE76Z8N3Rig0kc32HNQy8GOALrW65-CIhqKc9gaAplTEALw_wcB

ToF stands for "Time of Flight".
A ToF Camera emits modulated lights (CW method) and uses the time it takes for the said lights to be reflected back to measure the distance/depth info of any given object/scene, and you can obtain depth data (X,Y & Z coordinate position) in every pixel.
Light travel is calculated with d=C/2f, where C is the speed of light and f is the modulation frequency.



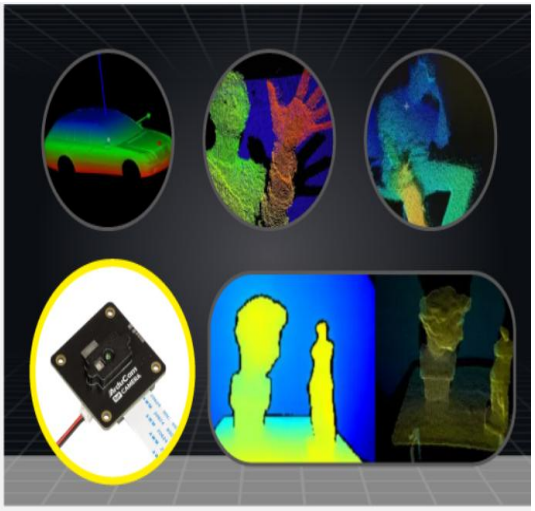


From 2D to 3D, It's Fully Customizable.

More applications will be inspired.
Your "hello world" of depth sensing starts with raw, depth, and amplitude frames. Being able to acquire depth data will produce better/more accurate results for CV algos designed for a wide range of 3D, tracking, recognition, estimation, reconstruction, navigation, localization, and classification tasks.
The camera can also be calibrated with RAW frame data for improved precisions. Please get in touch with us if you want the camera to be customized.

Point Clouds Primed?
ROS Ready?
Easy-Breezy.

In real-time, on your Raspberry Pi.
Mapping, 3D, and photogrammetric (etc.) applications that require point coulds generated from a ToF camera's captured 3D depth data can be easily achieved on a low-power, RPi-based system, with less than 100 bucks.



Number of Effective Pixels	240×180
Image Size	1/6″
Max. Frame Rate (Sensor)	120fps
Max. Depth Frame Rate (Raspberry Pi)	30fps, 4-phase
Raspberry Pi OS	Bullseye (32-bit/64-bit) 01/28/22 or later releases
TDP	3.5W Power supply for Pi should be at least 5V/4A
Supported Platforms	Pi 2/3/CM3/4B Zero W/Zero 2 W/CM4
Modulation Frequency	75MHz/37.5MHz
Viewing Angle	70° Diagonal
Measurement Distance	Far Mode: 4m Near Mode: 2m
Light Source	940nm VCSEL illuminator
Board Size	38mm x 38mm
Interface	MIPI (2-Lane)
Output Formats	4-phases RAW Frame, Depth Frame, Grayscale Amplitude Frame

References

https://www.youtube.com/watch?v=pu9bSo-b11A
https://www.youtube.com/watch?v=wNWYwHoZJuw