

# DepthCam

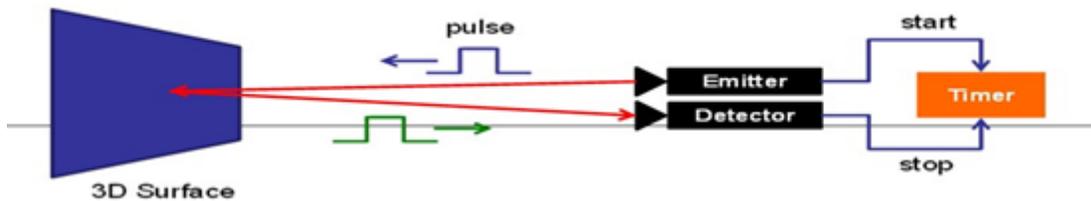
## FUNWITHOPTICS KIT



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## Optical Principle Time of Flight

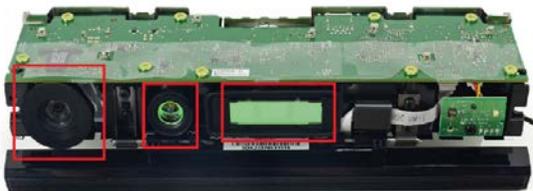
As the name suggests, Time of Flight (ToF) measures the distance between the sensor and the object based on the time difference between the emission of a signal and its return to the sensor, after being reflected by a measurement object.



Using this approach and with the knowledge that electronics cannot go faster than 1 nanosecond, the theoretical limit of depth measurement is 0.15 m. To increase this resolution, the light source is modulated and distance is calculated based on the phase difference between the emitted and detected light waves as where  $\phi$  is the measured phase difference,  $c$  is the velocity of light and  $f$  is the modulation frequency

$$d = \frac{\phi c}{2f}$$

## DepthCam



The DepthCam Sensor comprises of a RGB Camera, IR Camera and Modulated IR sources. The RGB camera has 1920x1080 pixels and operates at 30 fps. The IR camera has 512x424 pixels and can measure distances between 0.5 m and about 5 m with an accuracy of 2.5 cm



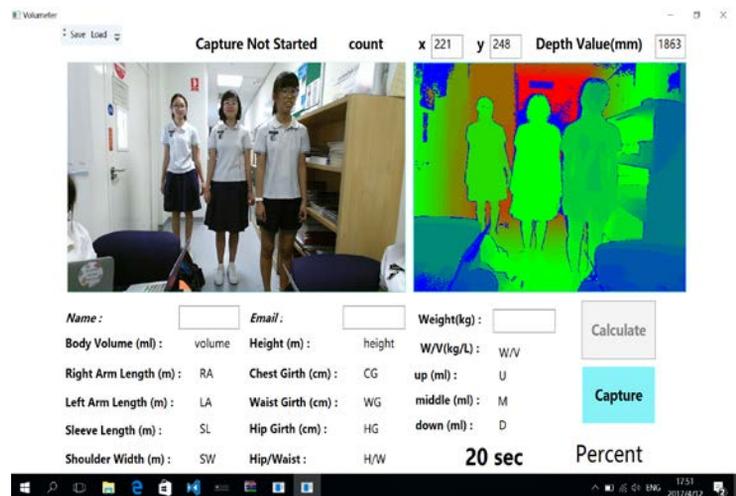
The DepthCam software shows both the RGB camera and the depth camera in realtime. The depth camera provides realtime information on the depth in a color coded format. In addition the depth at any point can be determined by placing the cursor at the specific location. The DeptCam can also be extended and used as a BodyCam to measure the Body Volume and related parameters.

# Experiment

## Setup and Procedures



Setup of Experiment



DepthCam Software Interface

## Laboratory Experiments

1. Setup the DepthCam as shown
2. Launch DepthCam software. You might need to “warm up” the sensor for about 10 minutes before making measurements.
3. Place object/s or person/s at different distances from the sensor as shown
4. Hover your mouse cursor over each object/person on the screen to show their location and depth from the sensor.
5. Move the objects towards and away from the sensor and notice the change in depth as well as the change in color.
6. Determine the closest depth and furthest depth that can be measured. How does this compare with the specification of the sensor.
7. Record the depth of the object/person as measured by the sensor and as measured using a measuring tape and plot the difference.
8. For each color band (ie.Red, Green and Blue) determine the range of depths that they represent.

## Discussion

### Discussion and Additional projects

1. Does the resolution change with increasing distance from the sensor?
2. Does the room lighting have any effect on the sensor? Does doing the experiment outside in sunlight affect the result? Give reasons.
3. Does the colour of clothing have any effect? Give reasons
4. If more than one person is within the field of depth sensing, how would it affect the measured depth?
5. Setup an experiment to measure the smallest depth. One suggestion is to have an inclined surface to check the resolution.

### Reading References

Miles Hansard, Seungkyu Lee, Ouk Choi, Radu Horaud. Time of Flight Cameras: Principles, Methods, and Applications. Springer, pp.95, 2012, SpringerBriefs in Computer Science, ISBN 978-1-4471-4658-2. .

A. Pentland, "A new sense for depth of field," IEEE Trans. Pattern Anal. Mach. Intell., 1987, 9:523-531.

### Related Products



3DCam



RainbowCam

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