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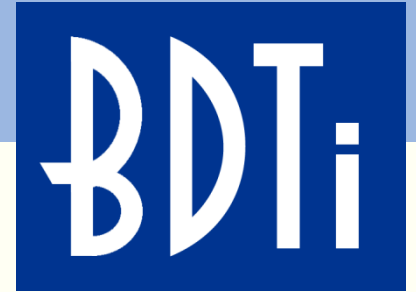


Image Sensor Options and Trends for Embedded Vision

Embedded Vision Alliance Summit
September 19, 2012

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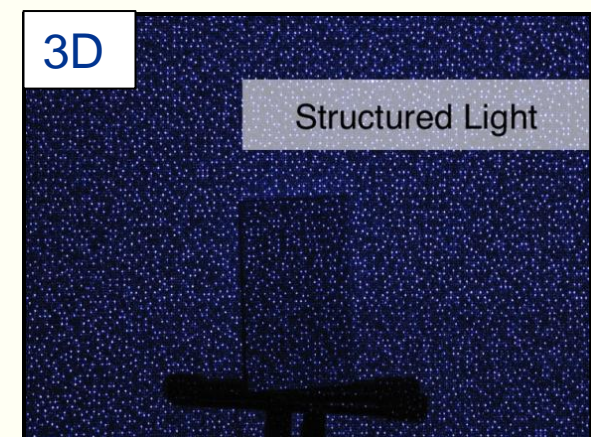
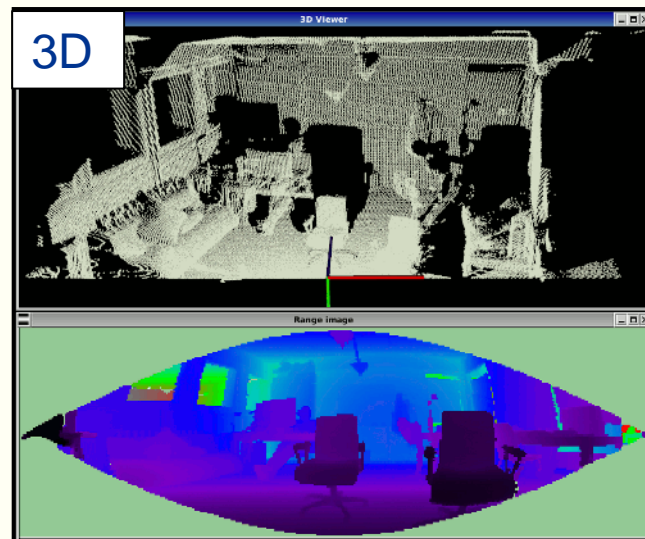
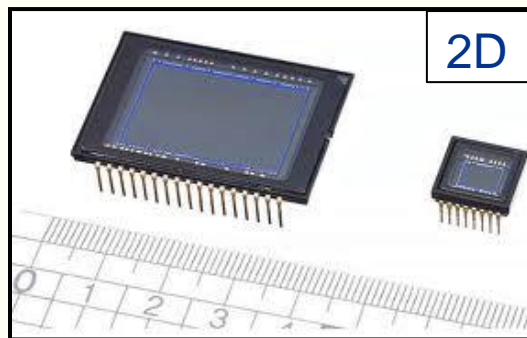
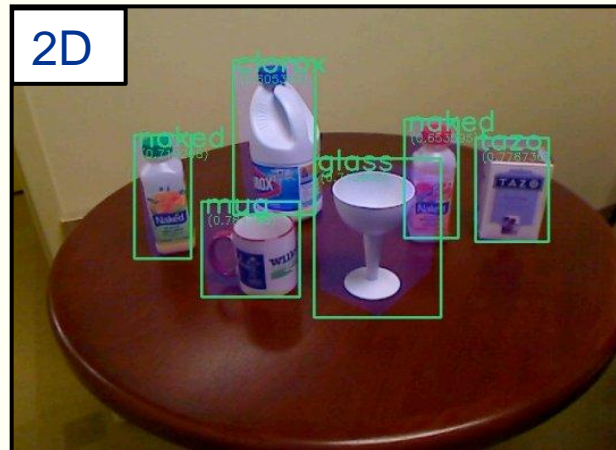
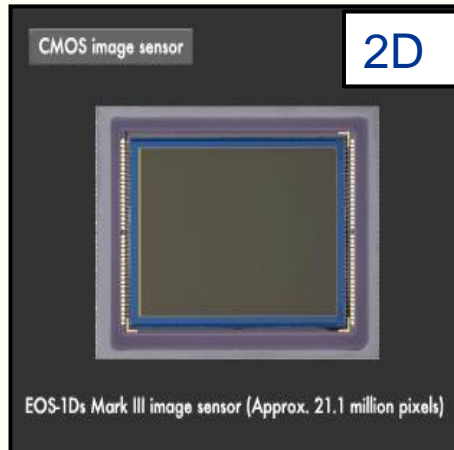
info@BDTI.com

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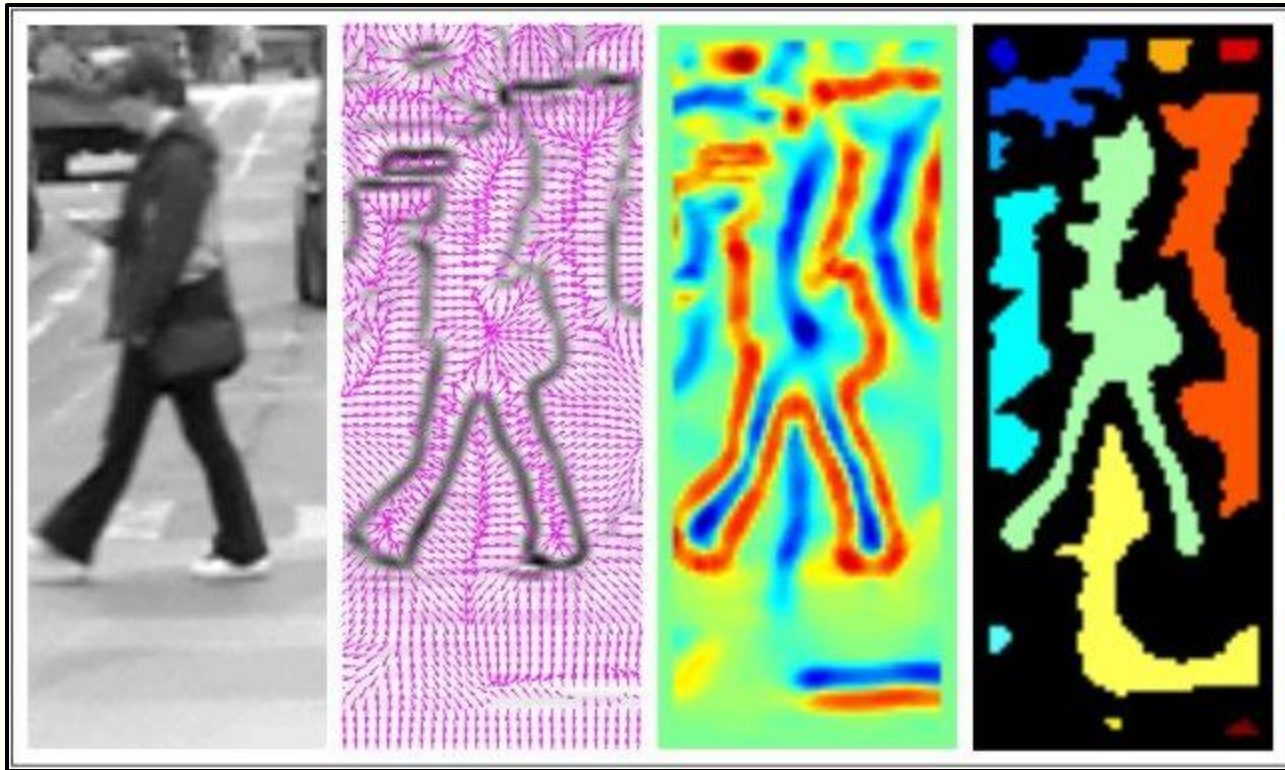


Sensors—The “Eyes” of Any Embedded Vision System



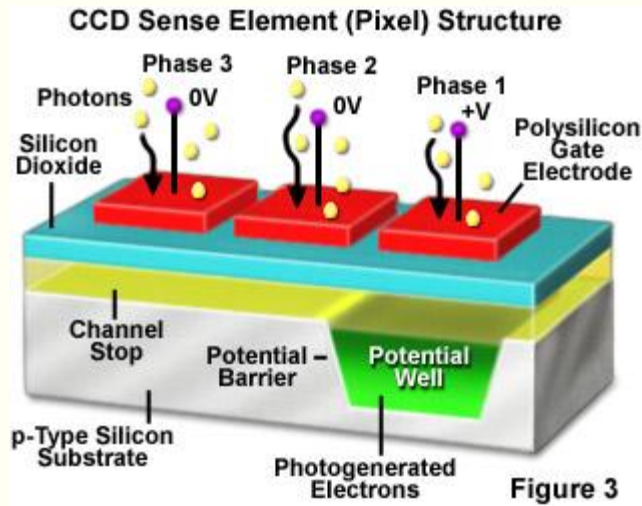
2D SENSORS

2D Sensors



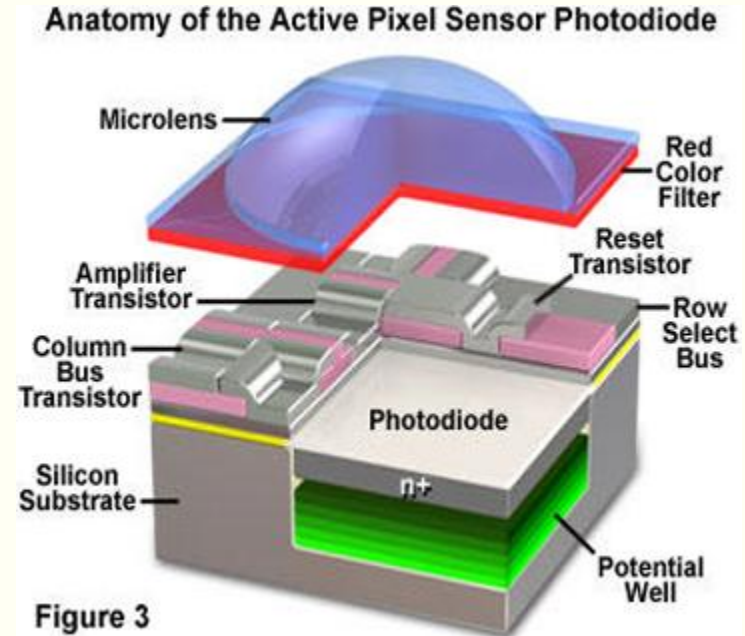
<http://withfriendship.com/user/sathvi/computer-vision.php>

The Most Popular 2D Sensors are CCD and CMOS



CCD

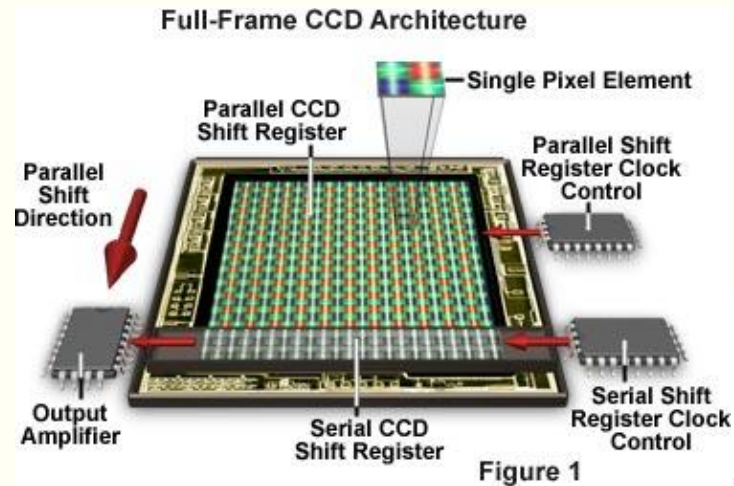
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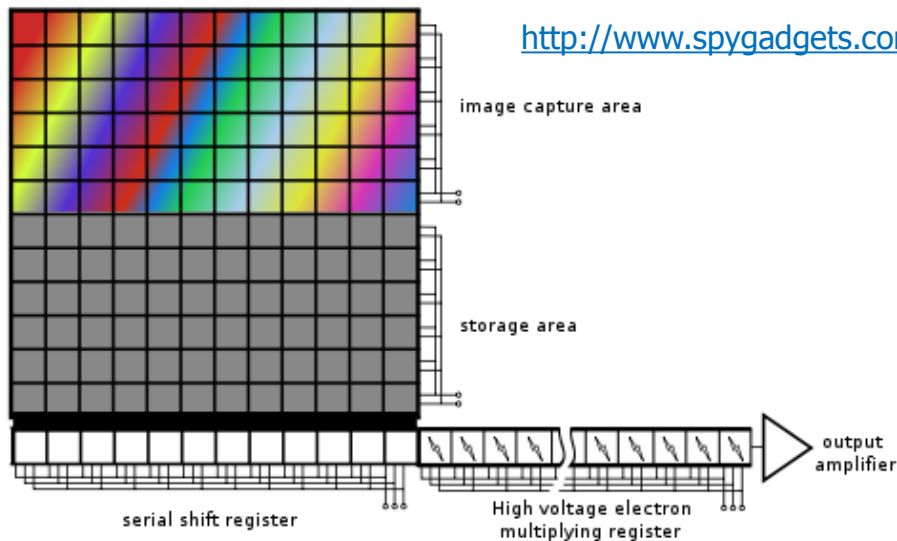
CMOS

<http://molecular.magnet.fsu.edu/primer/digitalimaging/cmosimagesensors.html>

2D Charge Coupled Device (CCD)



<http://www.spygadgets.com>



www.astro.virginia.edu

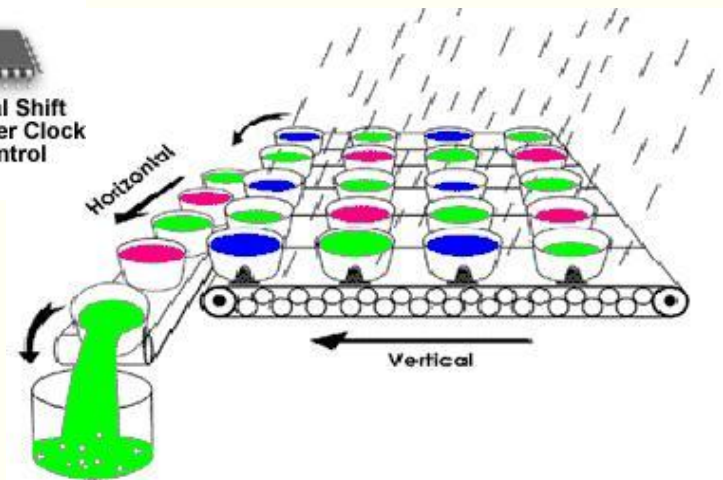
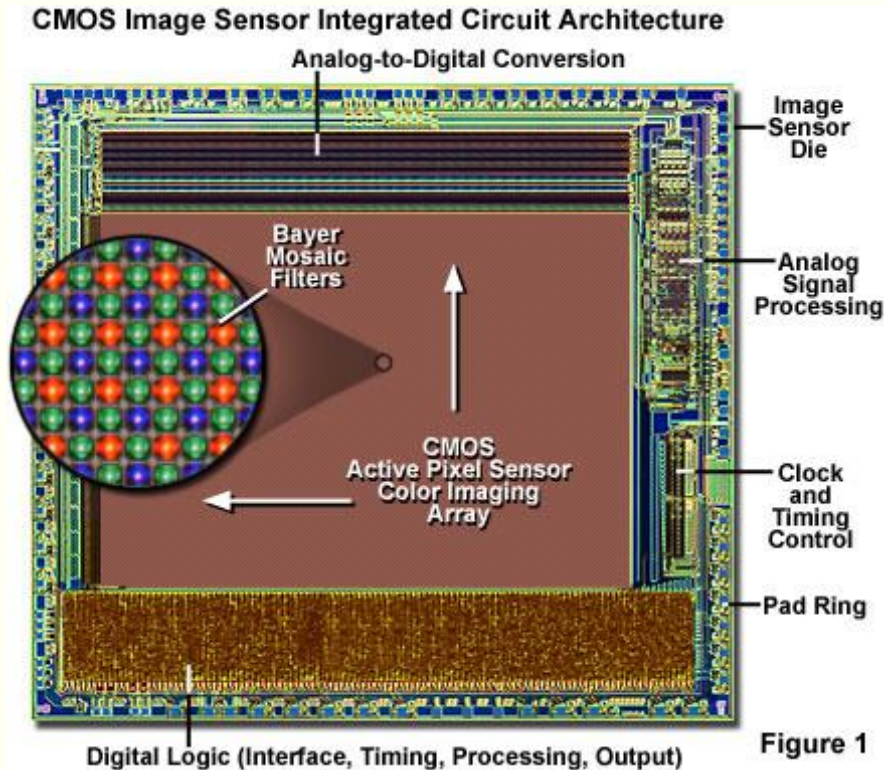
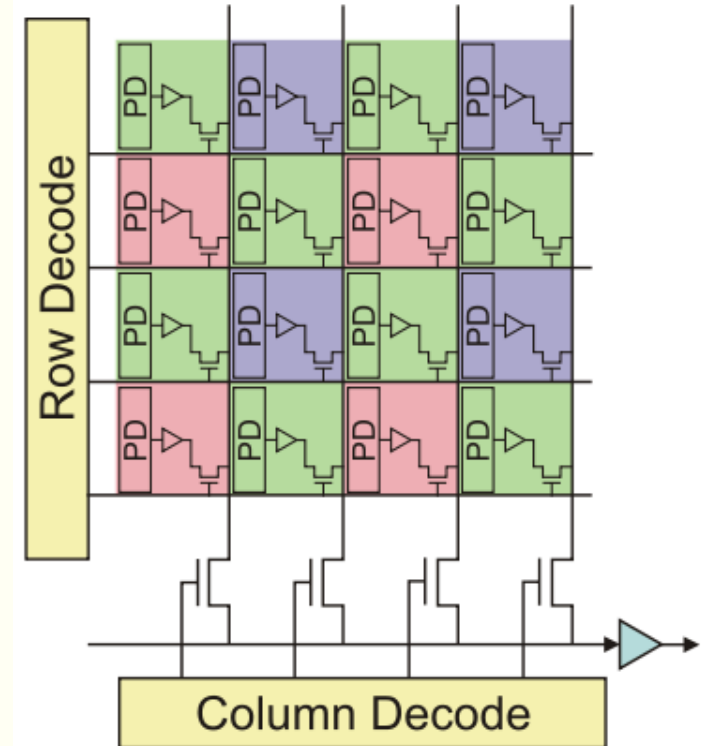


Image source: Digital Photography Review

2D Active Pixel Sensors (CMOS)



<http://olympusmicro.com>



<http://commons.wikimedia.org>

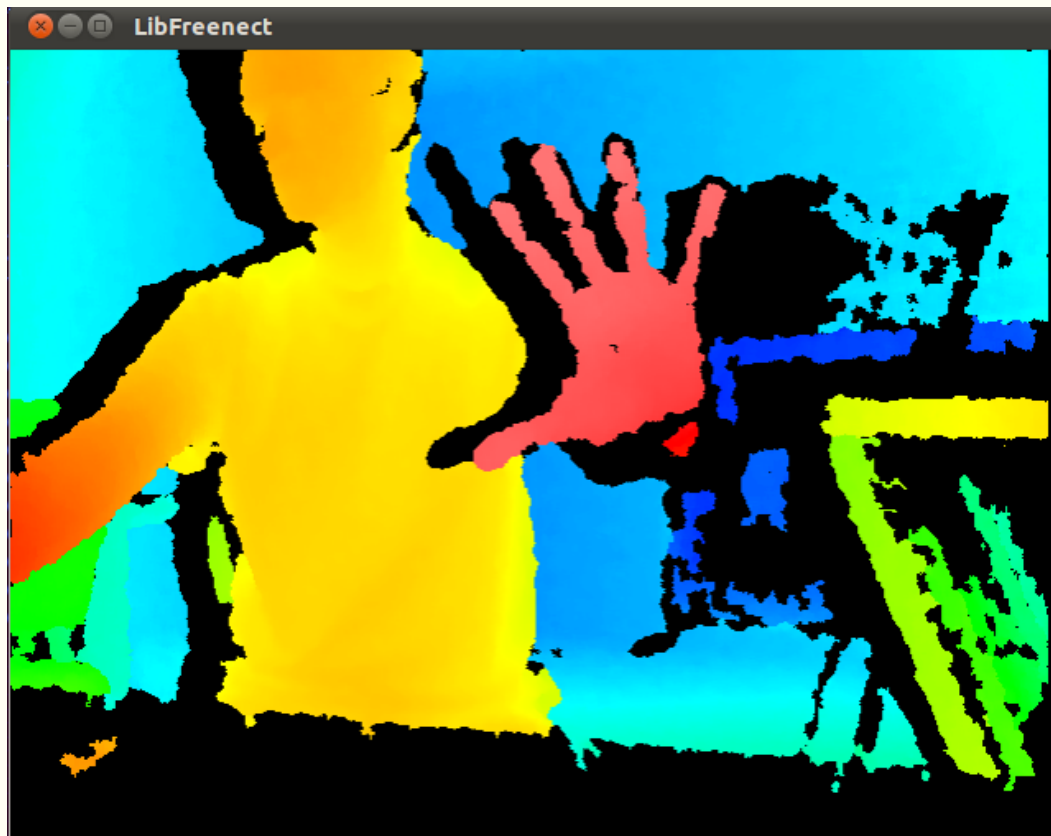
3D SENSORS

3D Sensors



Primary Output of 3D Sensors is a Depth Map

A depth map is an image matrix in which each entry represents the distance between the sensor and a point in front of the sensor

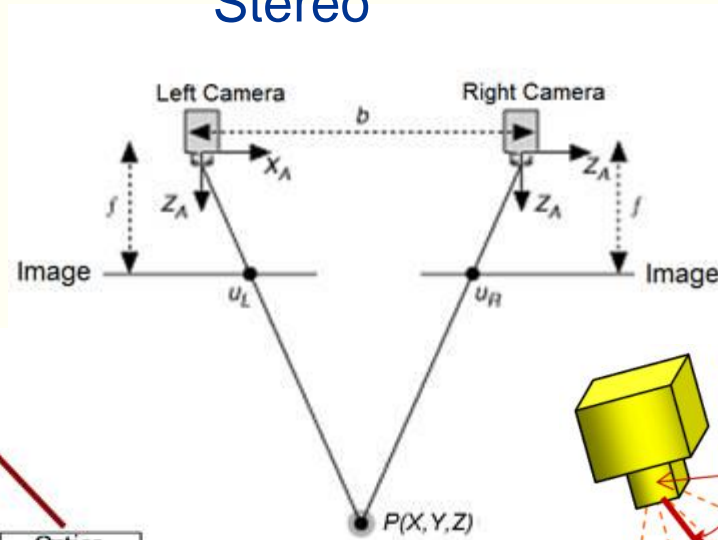


Three Different Types of 3D Sensors

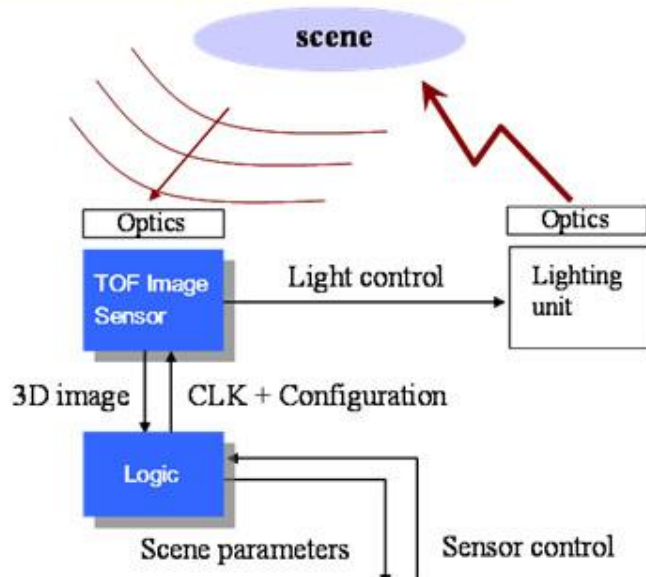
Time
of
Flight

Stereo

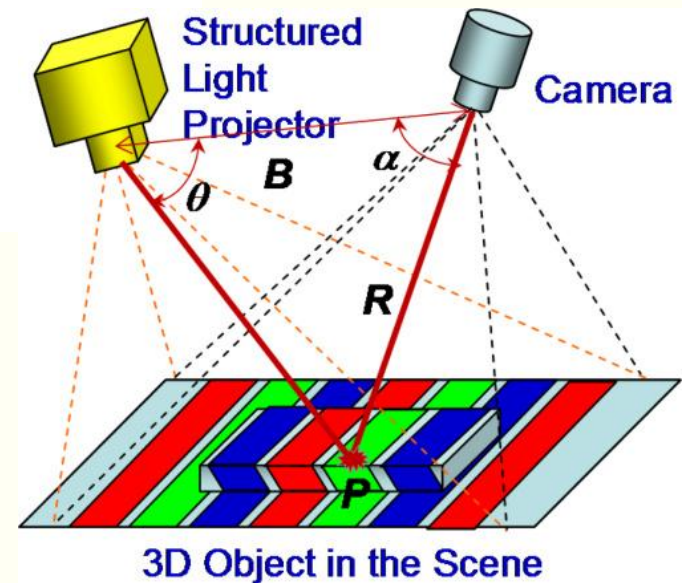
Structured
Light



<http://Ni.com>

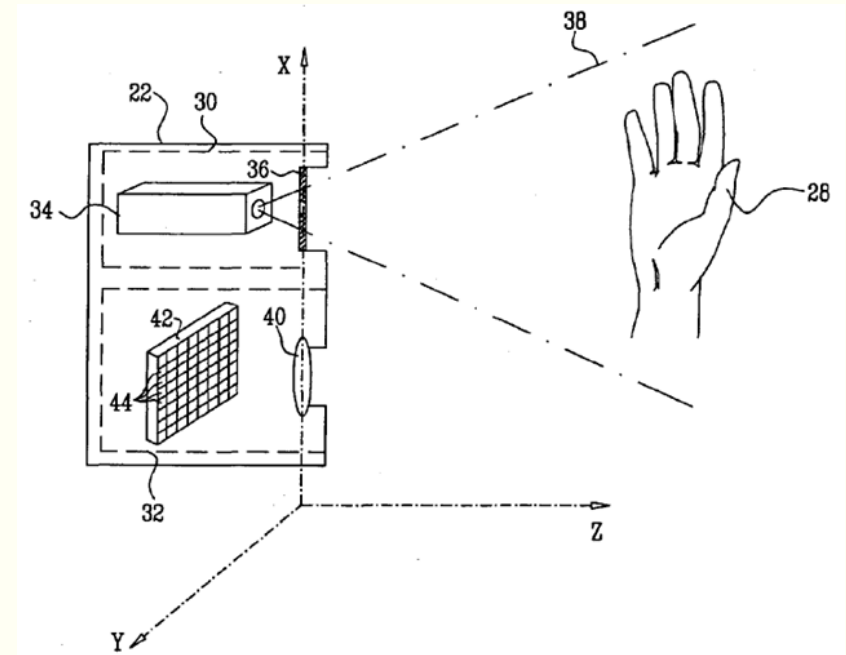
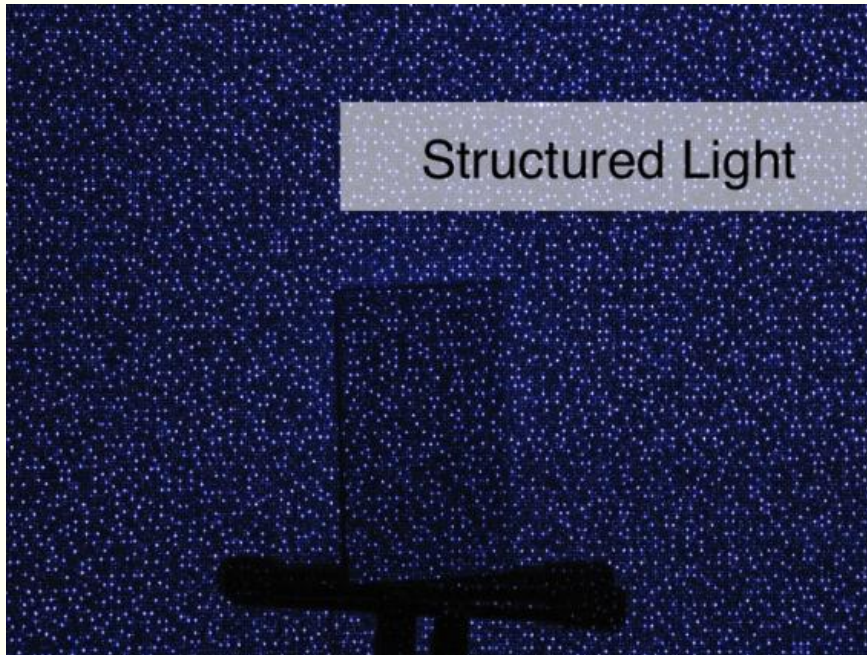


<http://melexis.com>



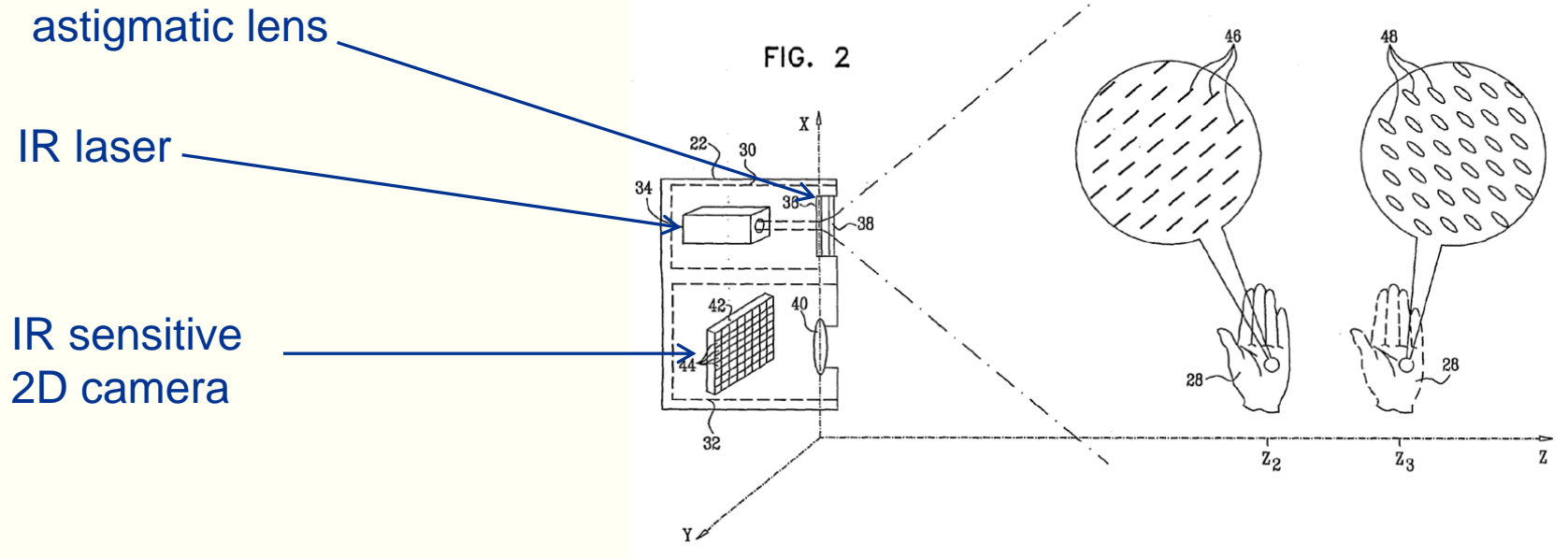
<http://opticsinfobase.org>

3D Via Structured Light

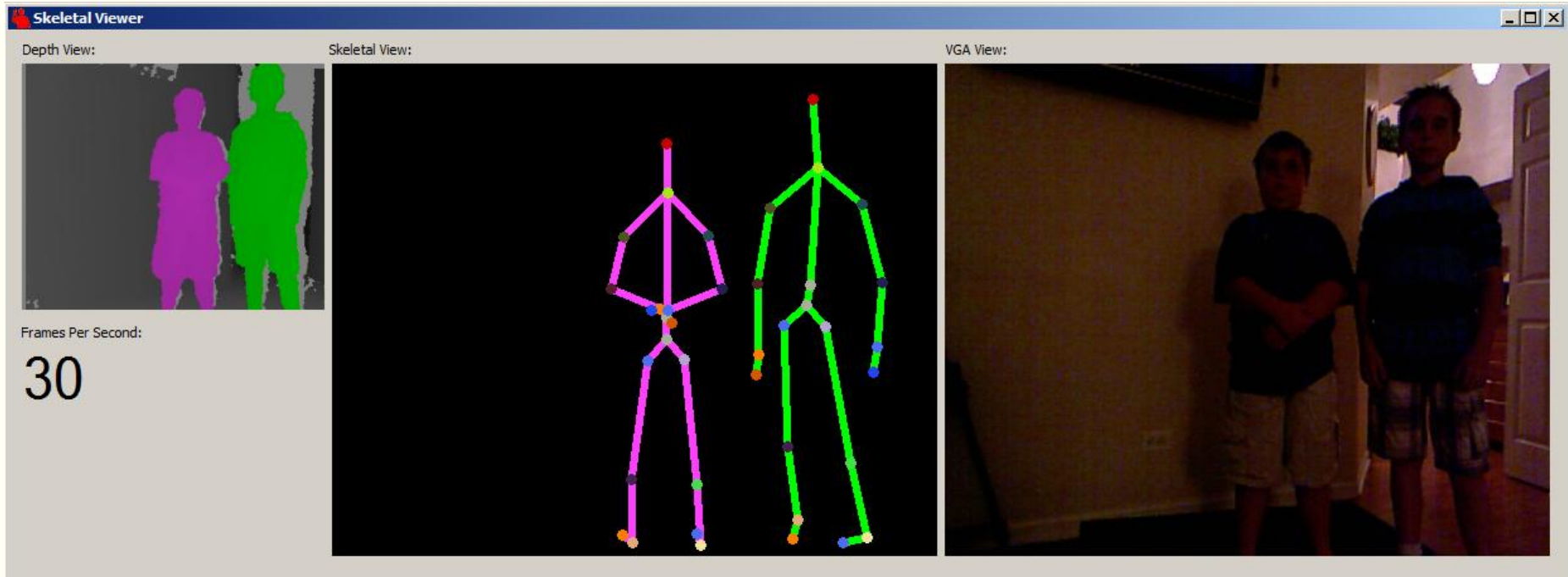


Freedman et al, PrimeSense patent application
US 2010/0290698

3D Via Structured Light (Kinect)



3D Sensor Demo



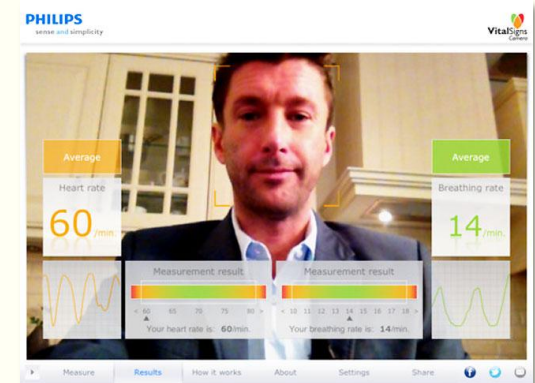
CONCLUSIONS

Conclusions

- Sensors are the “eyes” of embedded vision systems
- Improvements in sensor functionality, performance, integration, cost and energy efficiency are helping to enable the proliferation of embedded vision
- Innovation in sensors is accelerating, fueled by high-volume application such as mobile devices and video games
- The choice of a sensor has a huge impact on the capabilities of the system, and on the required algorithms, processing power, bandwidth, etc.

See Sensors in Action at the BDTI Demo Table!

- Turtlebot-Based Interactive Sign Prototype—turns to face the viewer
 - Based on Microsoft Kinect
- Philips Heart-Rate-From-Video iPad App
 - Uses only the built-in 2D CMOS sensor
- LiveScribe Smart Pen
 - Records Synchronized Audio and Notes
 - Uses miniature infrared sensor



Selected Resources

- CCD/CMOS Sensors:
 - DALSA white paper, “Applications Set Imager Choices”
 - “Noise Sources in Bulk CMOS”, Kent H. Lundberg

Additional Resources

BDTI's web site, www.BDTI.com, provides a variety of free information on processors used in vision applications

BDTI's free "InsideDSP" email newsletter covers tools, chips, and other technologies for embedded vision and other DSP applications. Sign up at www.BDTI.com

The "[Embedded Vision Insights](http://www.embedded-vision.com/user/register)" newsletter showcases tutorials, interviews, and other videos, along with technical articles, industry analysis reports, news write-ups, and forum discussions that have recently appeared on the Embedded Vision Alliance's website. Sign up at <http://www.embedded-vision.com/user/register>

