Bumblebee®2

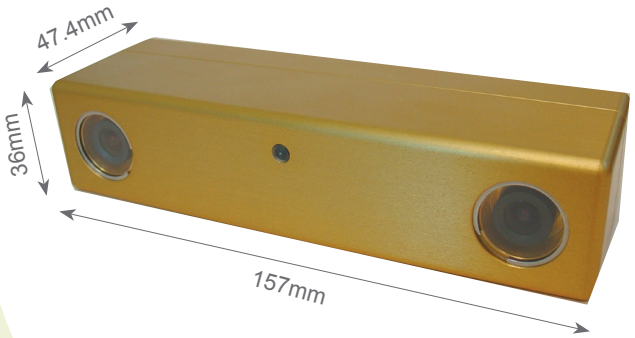
Stereo Vision System

POINT GREY RESEARCH

Preliminary Specifications - June 1, 2006. Subject to change without notice.

- **Two 1/3" Sony CCDs, BW or Color**
- **VGA* at 48 FPS, XVGA** at 18 FPS**
- **Pre-calibrated, stays calibrated**
- **GPIO pins for external trigger & strobe**

The Bumblebee®2 is the next generation Bumblebee stereo vision camera. It provides a balance between 3D data quality, processing speed, size and price. Developed as a drop-in replacement for the original Bumblebee camera, the Bumblebee2 also features double the frame rate and a GPIO connector for external trigger and strobe functionality.



Bumblebee®2 with 3.8mm microlens

Model Options	
BB2-03S2M/03S2C-XX	Sony 1/3" CCD, BW or Color 640x480 at 48 FPS
BB2-08S2M/08S2C-XX	Sony 1/3" CCD, BW or Color 1024x768 at 18 FPS

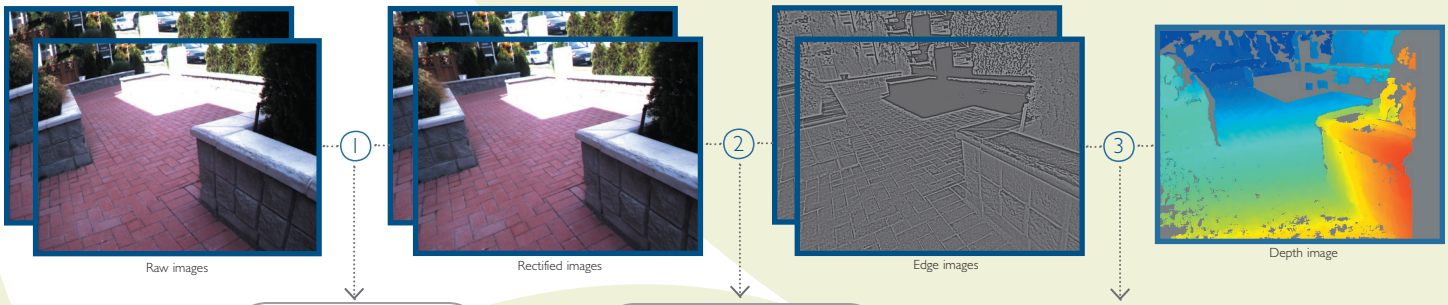
Camera Calibration

The Bumblebee2 is pre-calibrated for lens distortions and camera misalignments and the left and right images are aligned within 0.05*** pixel RMS error. Calibration files are embedded in the camera allowing the software to retrieve the image correction information. This allows seamless swapping of the cameras or retrieving the correct information when multiple cameras are on one bus. In addition, the calibration retention system prevents the camera from losing calibration when subject to mechanical shock and vibration.

Software

The Digiclops® software development kit (SDK) and Triclops™ SDK are included with all Point Grey Research® Stereo Vision Products. The Digiclops SDK is designed to allow image acquisition, camera control and comes with a variety of C/C++ source code examples. The Triclops SDK, which integrates seamlessly with the Digiclops SDK provides real-time depth range images using stereo vision technology. Additional Stereo Vision software components such as the Censys3D®, Compass3D™ and Multiclops™ SDKs are available at no extra cost.

Image Processing Pipeline



*VGA = 640x480 **XVGA = 1024x768 ***This figure is based on epipolar accuracy at a stereo resolution of 320x240 and is valid for both 1024x768 and 640x480 model. Calibration accuracy will vary from camera to camera.

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Bumblebee®2 Specifications

Raw image

This image shows the lens distortion in images as they come from the camera. Based on camera calibration, this image is rectified to create an image that fits a distortion-free lens.

Rectified image

This is the corrected image. Rectified images are essential for high speed stereo algorithms.

Stereo Accuracy Chart

This chart shows the accuracy of the 3D point calculations versus the range to the point. This chart is heavily dependent on a variety of camera and stereo parameters such as image resolution, lens focal length and calibration accuracy. This chart was generated for a 3.8mm Bumblebee2 camera with a stereo resolution of 512 and typical calibration accuracy.

Specification	Low-Res (640x480)	High-Res (1024x768)
Imaging Sensor	Sony 1/3" progressive scan CCD	
	ICX424 (648x488 max pixels)	ICX204 (1032x776 max pixels)
	7.4µm square pixels	4.65µm square pixels
Baseline	12 cm	
Focal Length Lens	3.8mm with 70° HFOV or 6mm with 50° HFOV	
A/D Converter	12-bit analog-to-digital converter	
Video Data Output	TBD	
Image Data Formats	TBD	
White Balance	Automatic / Manual (Color model)	
Frame Rates	48, 30, 15, 7.5, 3.75, 1.875 FPS	18, 7.5, 3.75, 1.875 FPS
Interfaces	6-pin IEEE-1394a for camera control and video data transmission 4 general-purpose digital input/output (GPIO) pins	
Voltage Requirements	8-32V	
Power Consumption	Less than 2.5W	
Gain	Automatic/Manual	
Shutter	Automatic/Manual	
	0.01ms to 66.63ms at 15 FPS	
Trigger Modes	DCAM v1.31 Trigger Modes 0, 1, 3, and 14	
Signal To Noise Ratio	TBD	
Dimensions	157 x 36 x 47.4mm	
Mass	342 grams	
Camera Specification	IIDC 1394-based Digital Camera Specification v1.31	
Lens mount	2 x M12 microlens mount	
Emissions Compliance	Complies with CE rules and Part 15 Class A of FCC Rules	
Operating Temp.	Commercial grade electronics rated from 0° to 45°C	
Storage Temperature	-30° to 60°C	

Triggering and GPIO

The Bumblebee2 camera has a 12-pin connector on the back of the case. Inputs can be configured to accept external trigger signals. Outputs can be configured to send an output signal, strobe or PWM signal. Pins IO4-IO7 can be used for the built-in RS-232 serial port.

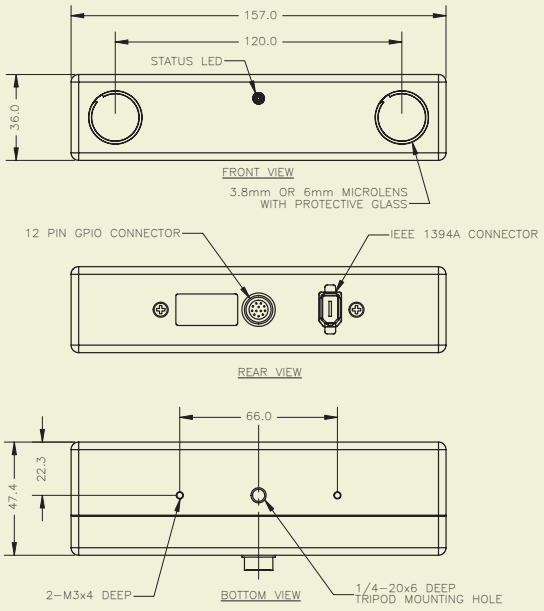
Development Kit Includes:

- 4.5 meter, 6-pin to 6-pin, IEEE-1394a cable with ferrites
- Hirose HR25 male GPIO connector prewired
- IEEE-1394a OHCI PCI Host Adapter 3-port 400Mb/s card
- Digiclops® SDK, Triclops™ SDK and device drivers

Recommended System Configuration:

- Windows XP Service Pack 1
- 512MB of RAM
- Intel Pentium 4 2.0GHZ or compatible processor
- AGP video card with 64 MB video memory
- 32-bit standard PCI slot required for IEEE-1394 card
- MS Visual C++ 6.0 (to complie and run example code)

Dimensional Drawings:



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Measurements in mm. CAD drawings available online at www.ptgrey.com/support

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