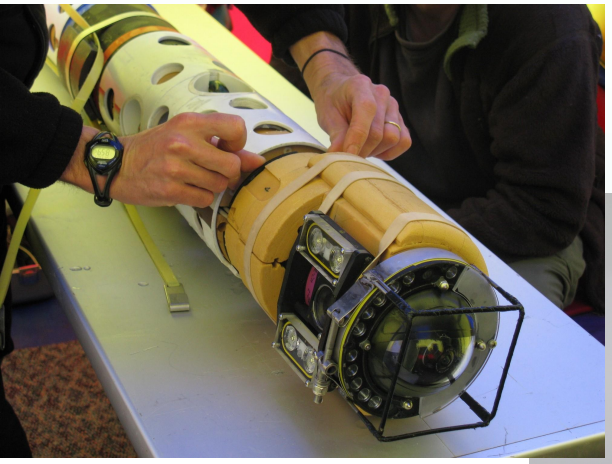
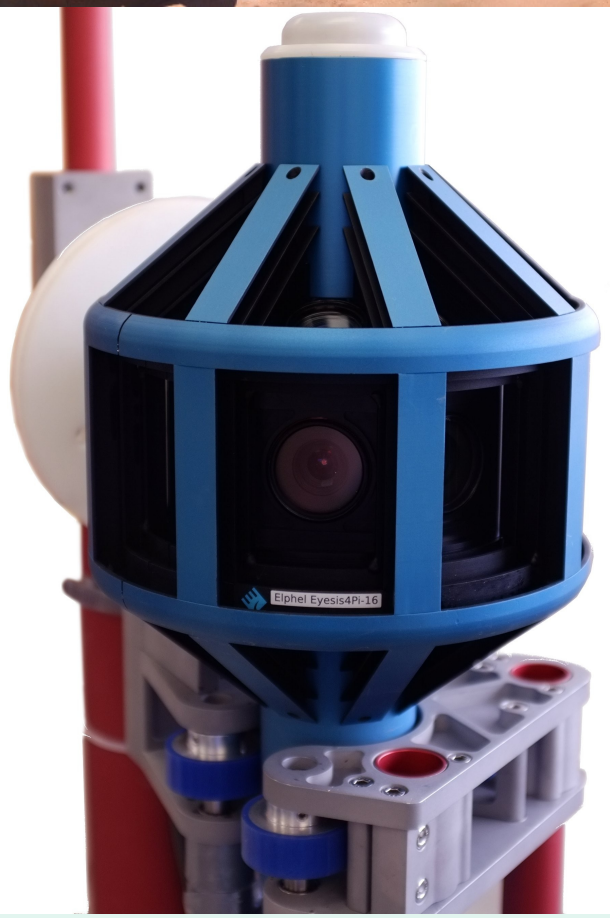
Open Hardware Cameras





Olga Filippova
Elphel, Inc. 1405 W. 2200 S. #205
West Valley City, UT 84119

NC353L camera

Tech specs

5MPix, color or mono CMOS sensor

Full resolution: 2592x1944@15fps

Full HD video (1080p@25fps)

FPGA with Image pipeline

75 Megapixels/second Throughput

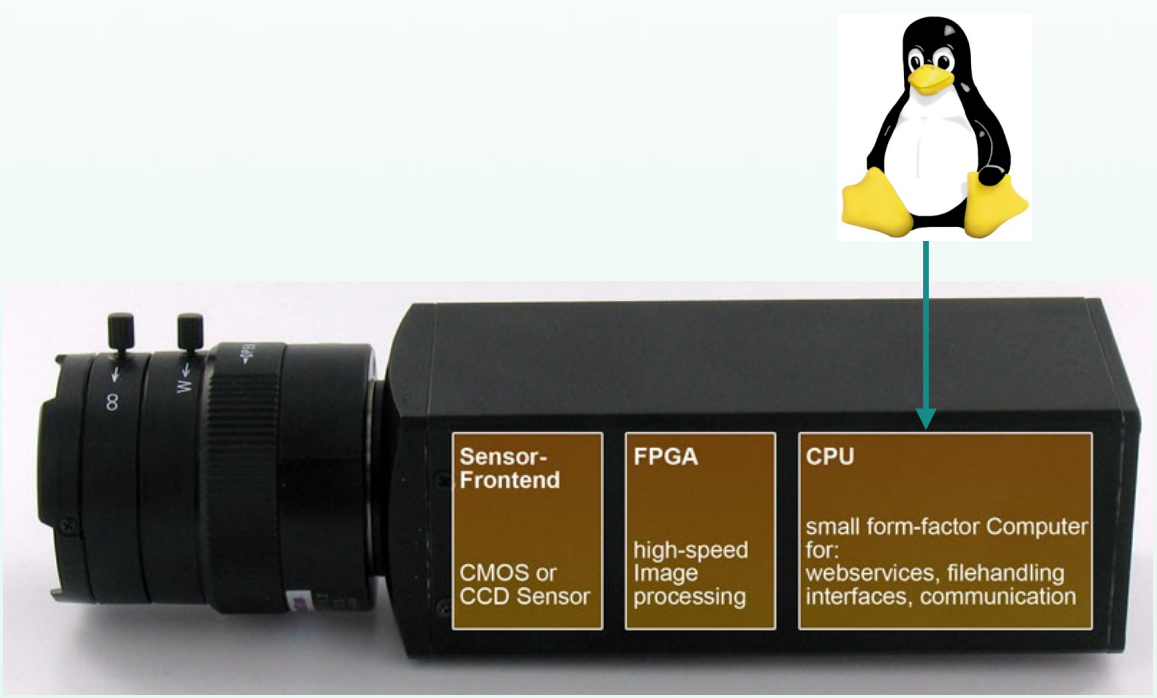
Ethernet: 100 Mbit/s

Recording formats: Quicktime, OGM, JPEG image sequence, JP4 RAW image

Embedded Linux computer

(webserver, Ethernet, USB, SATA connections)

User/developer friendly: HTML, JavaScript, PHP, CGI, C/C++, Verilog



Applications: Document Scanning

Elphel Model 323

35-mm format Kodak CCD image sensor

11 megapixels resoluion (4008 x 2672)

2 fps framerate

Nikon F-mount

Applications: Panoramic Imaging

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Current events
Random article
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Interaction
About Wikipedia
Community portal

Article | Discussion

Google Street View

From Wikipedia, the free encyclopedia
(Redirected from Streetview)

This article **may need to be updated**. Please update this article to reflec
the talk page for more information.

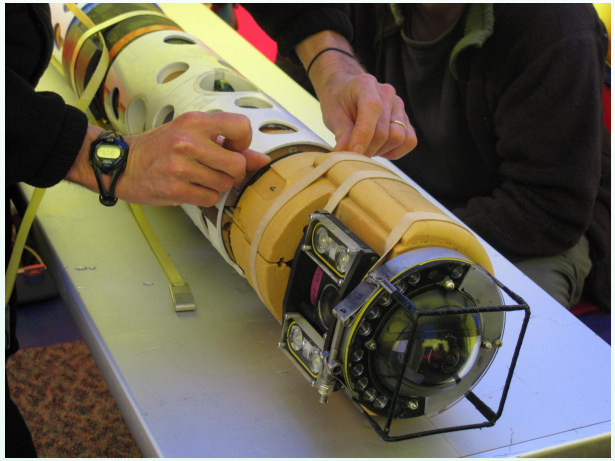
Google Street View is a technology featured in Google Maps and Google Earth that provides panoramic views
on May 25, 2007, originally only in several cities in the United States, and has since gradually expanded to includ

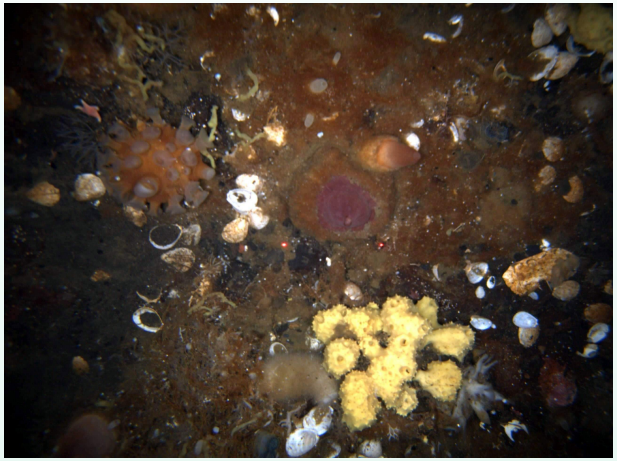
Google Street View displays images taken from a fleet of specially adapted cars. Areas not accessible by car, lik
sometimes covered by *Google Trikes* (tricycles) or a snowmobile.[2] On each of these vehicles there are nine dir
units for positioning and three laser range scanners for the measuring of up to 50 meters 180° in the front of th
and Wi-Fi hotspots.[3] Recently, 'high quality' images are based on open source hardware cameras from Elphel.

Variety of Applications:

SCINI - Antarctic Underwater Exploration Robot

Submersible Capable of under-Ice Navigation and Imaging

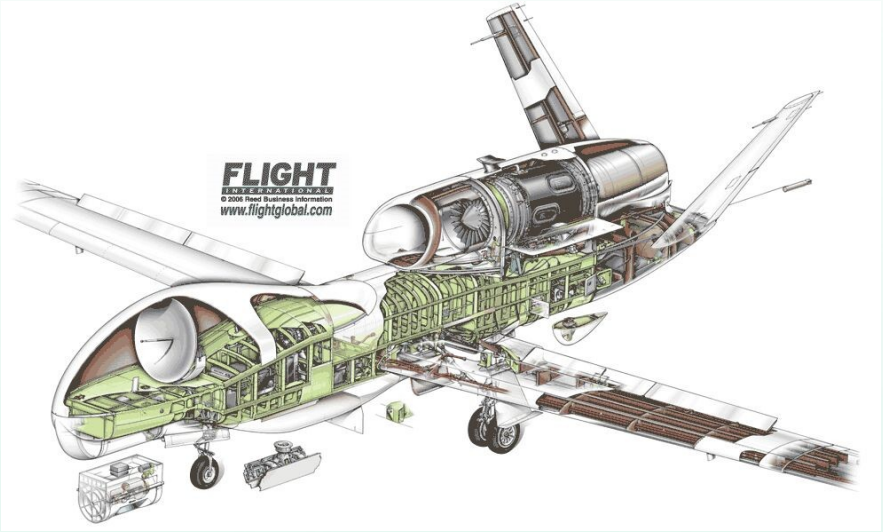




Moss Landing Marine Lab

Applications: NASA Global Hawk UAV

Aerial Near Space Exploration



Applications:

Machine Vision for multicopters UAV

Wadudu Octo-copter

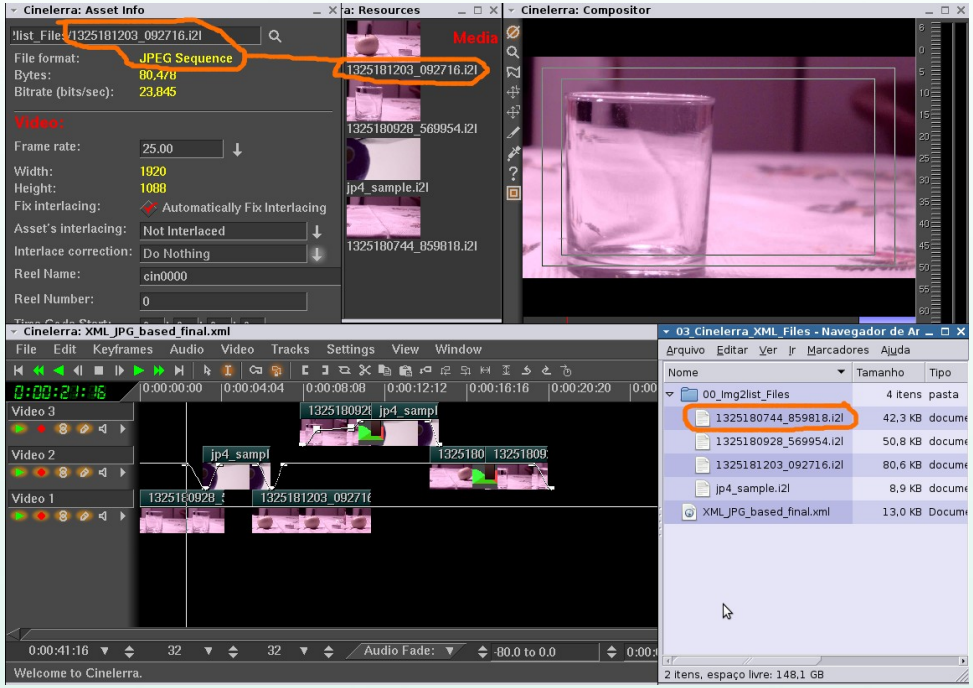
Quad-copter ”Tau”

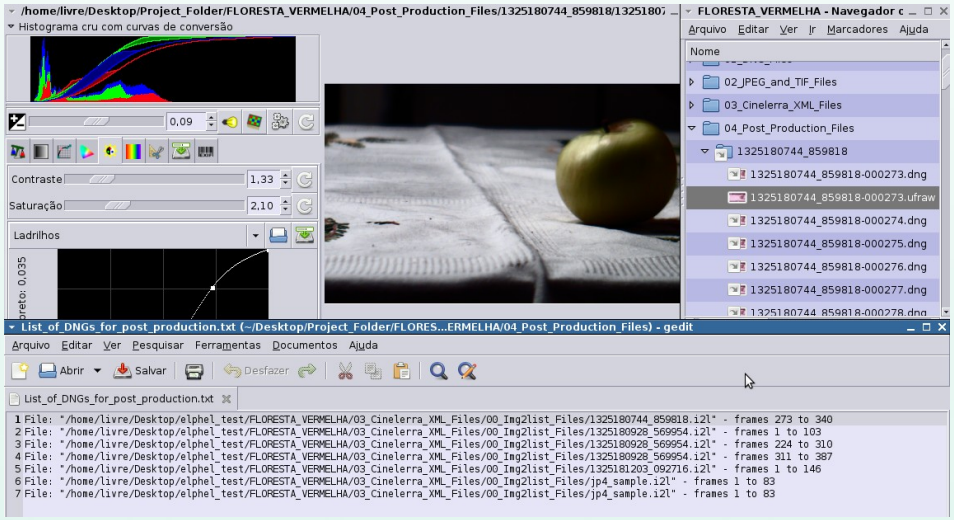
at the competition of flying robots in Moscow

Applications: Cinematography

Floresta Vermelha Open Cinema Project

florestavermelha.org

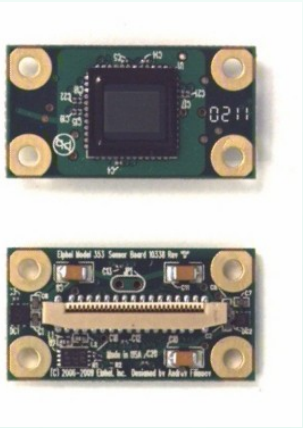




Boards Overview

10353 System Board

10369 IO Board



- *10338 Sensor Board*

- *10359 Multi Sensor Board*

Camera Configurations

Basic camera NC353

Stereo

Hammer

IMU & GPS

HDD

/* source is inside */

Camera is regonfigurable and user/developer friendly.

Controlled through a web-based user interface.

- HTML, JavaScript, PHP
- C, C++
- Verilog HDL

elphel open hardware imaging

sourceforge FIND AND DEVELOP OPEN SOURCE SOFTWARE

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SourceForge.net > Find Software > Elphel reconfigurable cameras

Elphel reconfigurable cameras

by apolto, elphel, geekjim, khlut, oneartplease, …

Summary | Files | Support | Develop | Hosted Apps | Tracker | Mailing Lists

Software and HDL code for Elphel reconfigurable network cameras

Download Now! elphel353-8.0.8.48.tar.gz (4.5 MB) OR View all files

/www3.elphel.com

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10353

10353 processor board is the computer part of the Elphel 353/363 series cameras.

- It uses ETRAX FS processor running GNU/Linux (currently kernel 2.6.19) that has support for multiple hardware interfaces with the following of them used/connected in the Model 353:
  - 10/100 Ethernet
  - USB 1.1 (host)
  - IDE (ATA-6)
  - RS-232
- Teridian 78Q2123 is used as Ethernet PHY in the camera - it has Auto-MDI/X, so no more crossover cables are needed when connecting camera directly to a PC.
- 64MB of 32-bit white system SDRAM provide memory to run multiple applications in the camera. It is also used as a buffer for video/images and as a RAM-disk.
- 128MB of system flash memory work as a

10353 board, top view

10353 board, bottom view

navigation
- Main Page
- Current events
- Recent changes
- Random page
- Community portal
- Help
- Elphel, Inc

search
Go Search

toolbox
- What links here
- Related changes
- Upload file
- Special pages
- Printable version

Code is available on

SourceForge.net

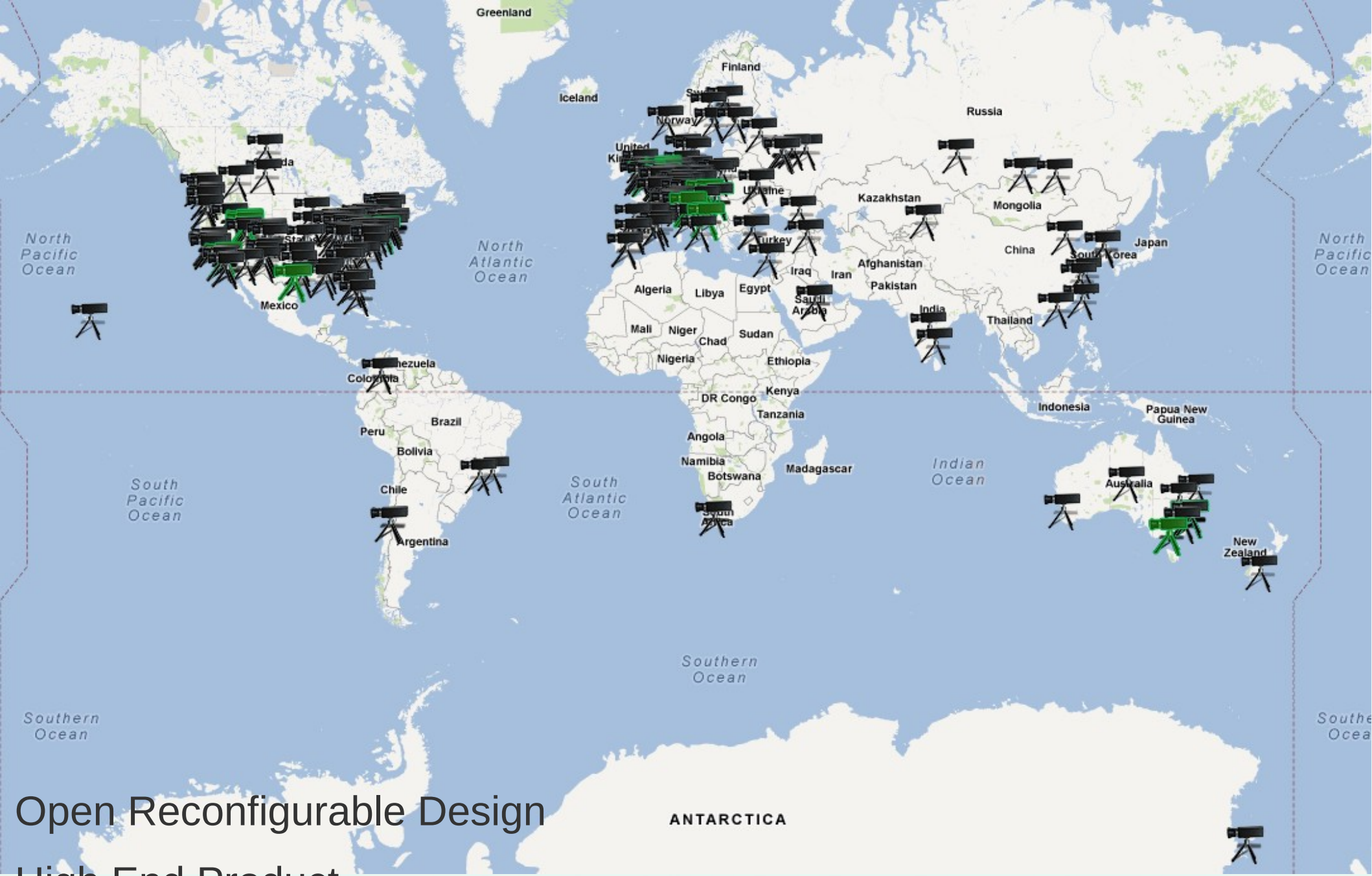
Schematics,

PCB layout & Documentation

wiki.elphel.com

Licenses:

- *GNU GPL V3*
- *GNU Free Documentation License V1.3*
- *CERN Open Hardware License V1.1*

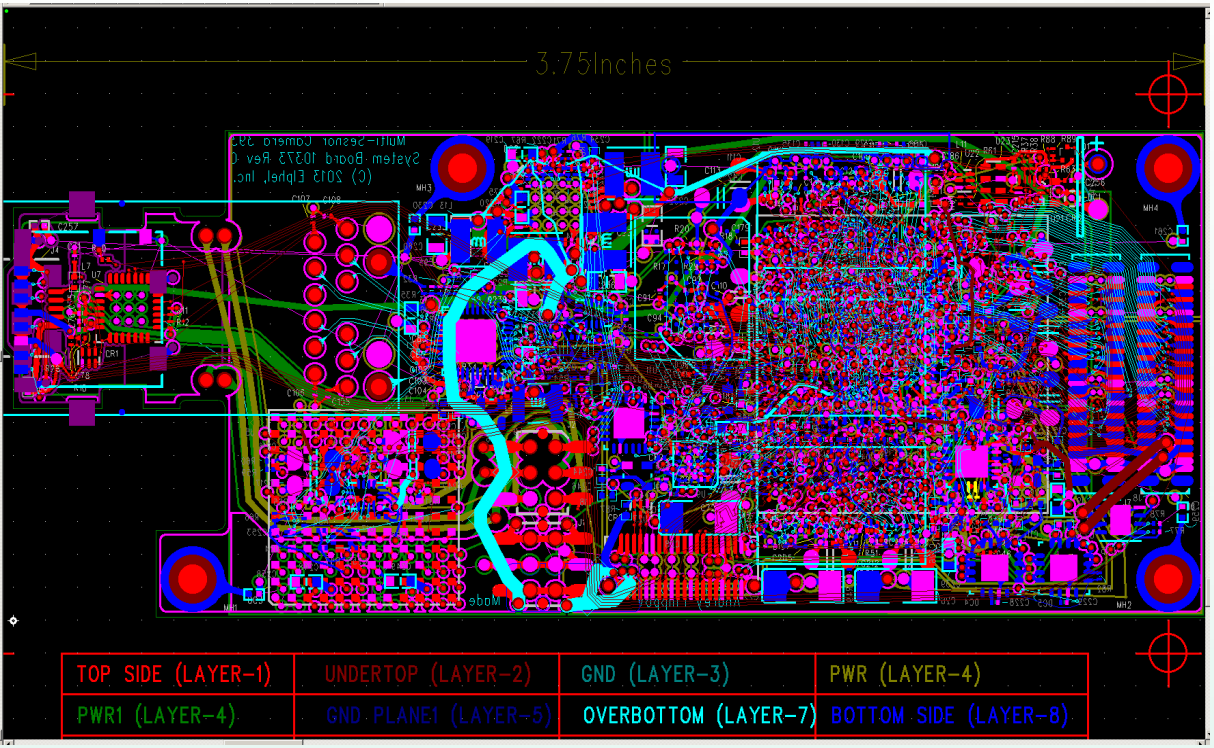


Open Reconfigurable Design

High End Product

Camera users around the world

NC393L camera - under development



System board can suport 4 sensors

With multiplexor – up to 12 sensors

Xilinx Zinc SoC – combines high performance with dual ARM CPU

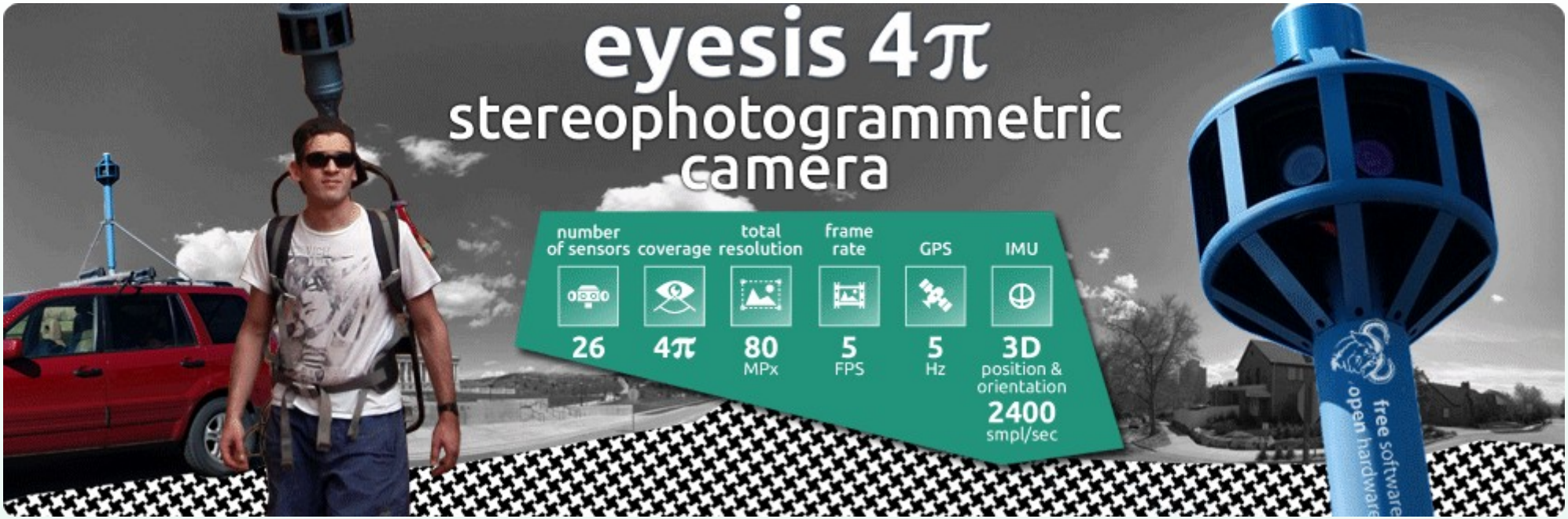
1GB of on-board system memory

512 MB of additional dedicated video/FPGA memory

Ethernet: Gigabit

Aplications: multi-sensor camera

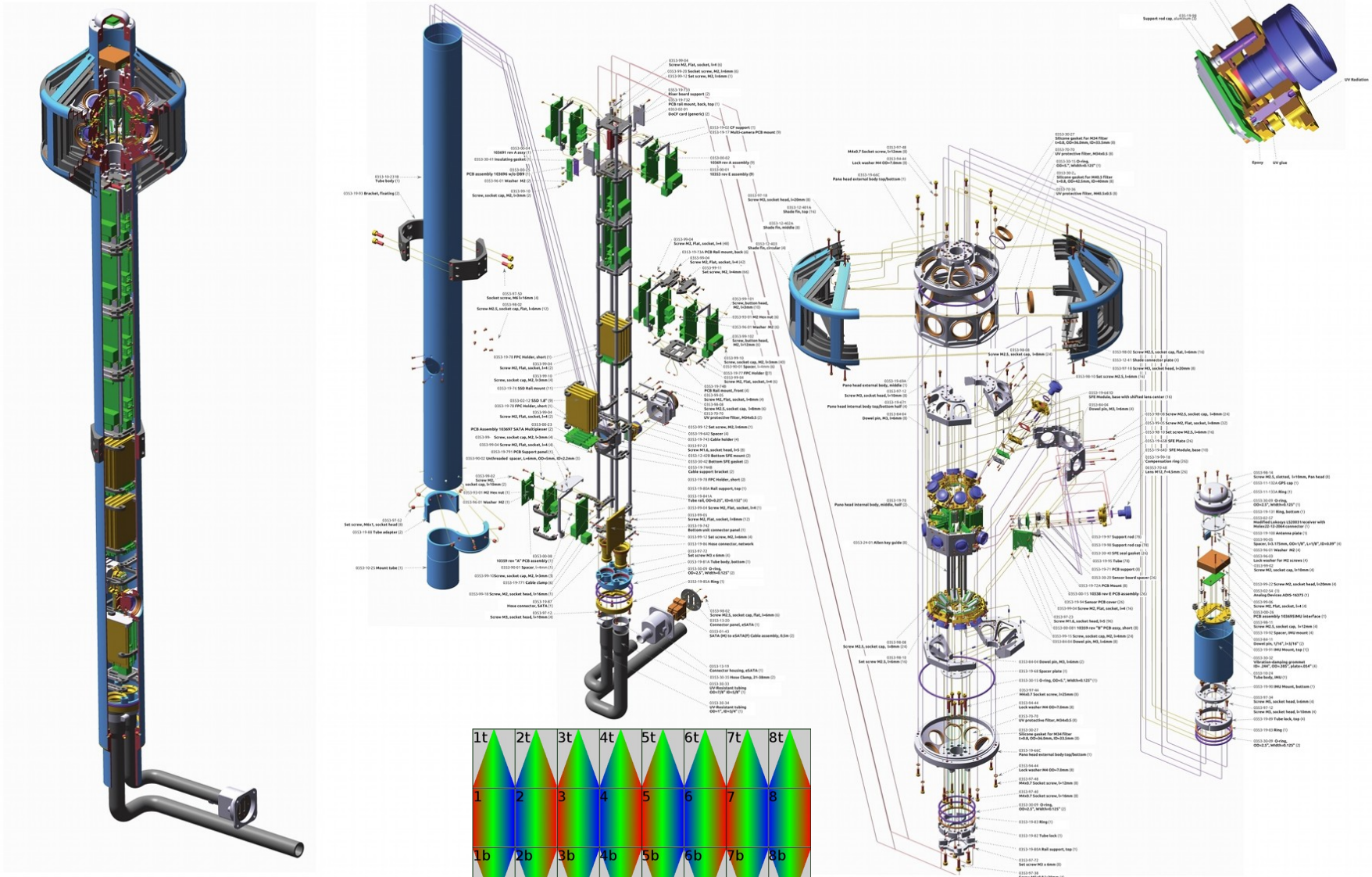
Eyesis 4π – Stereophotogrammetric Camera

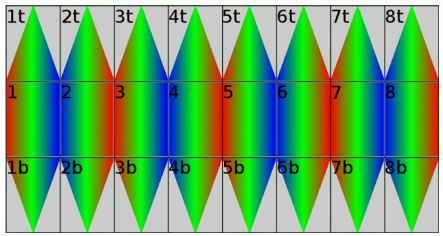


- Full Sphere Panoramic Camera
- High Resolution: 120 Mpix, total (64 Mpix - panorama)
- Images are synchronized with GPS and IMU
- Photogrammetry ready

eyesis 4π ASSEMBLY DRAWING

elphel imaging solutions

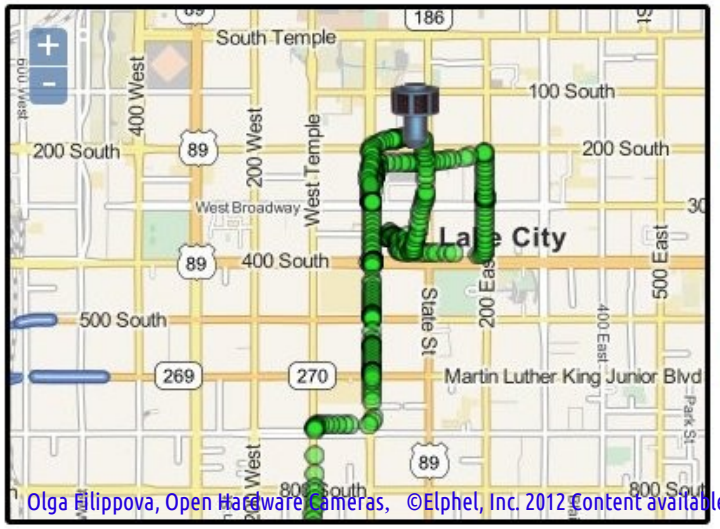




FOV of sub-cameras in Eyesis4Pi, color shows time of acquisition (from red to blue):1-8 horizontal sensors; 1t-8t top sensors;1b-8b bottom sensors

Elphel at SIGGRAPH 2012

Calibrated camera for 3D reconstruction



Eyesis 4π – Footage Preview

Full size preview

Process files as JPEGs:

20120721a

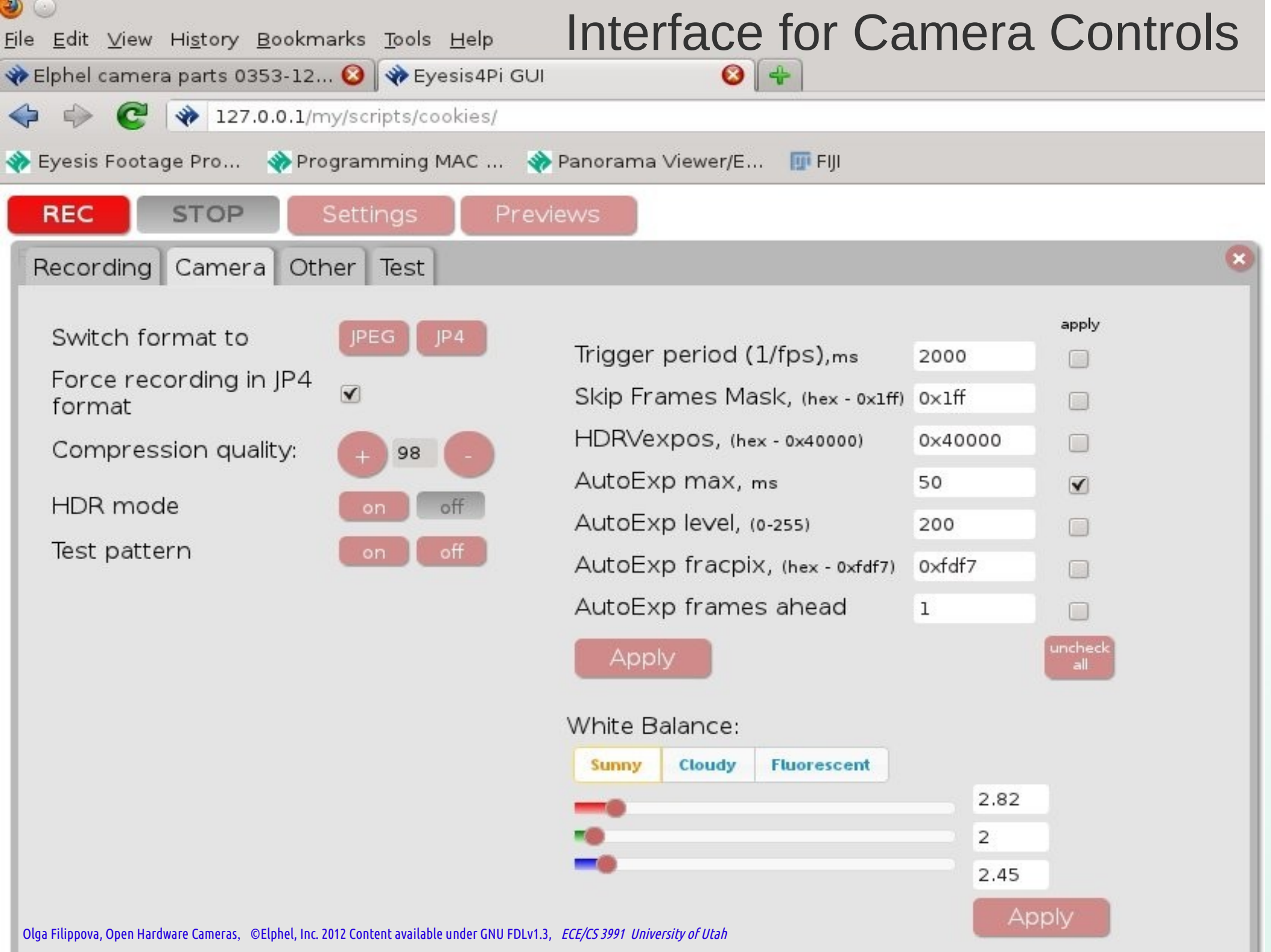
Image number - 295 +

Image name: **1/1342928263_838636_1.jp4**

Copy All OR 1 image set(s) Copy to /data/post-processing/src/

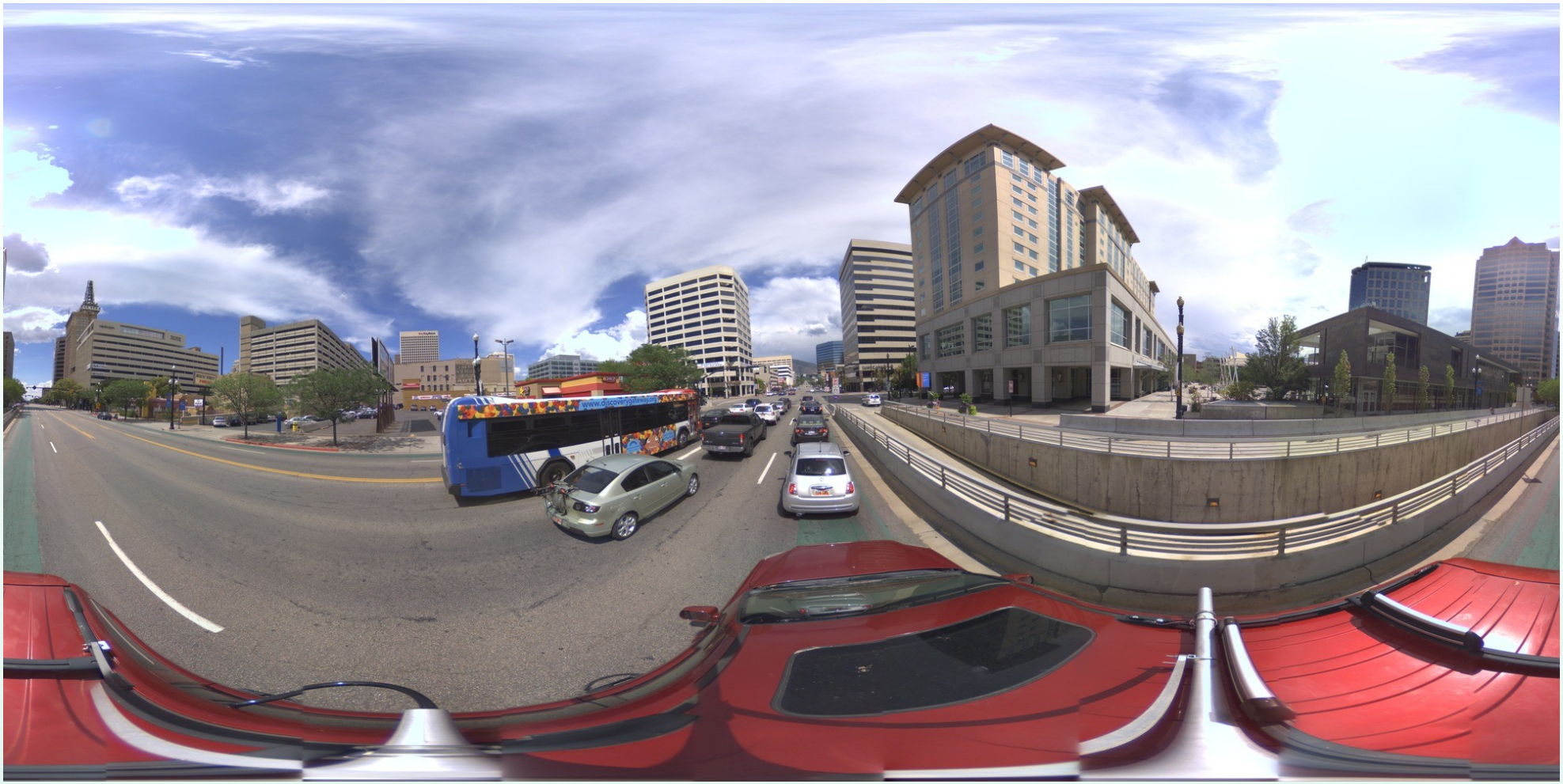
Status: *Working.*

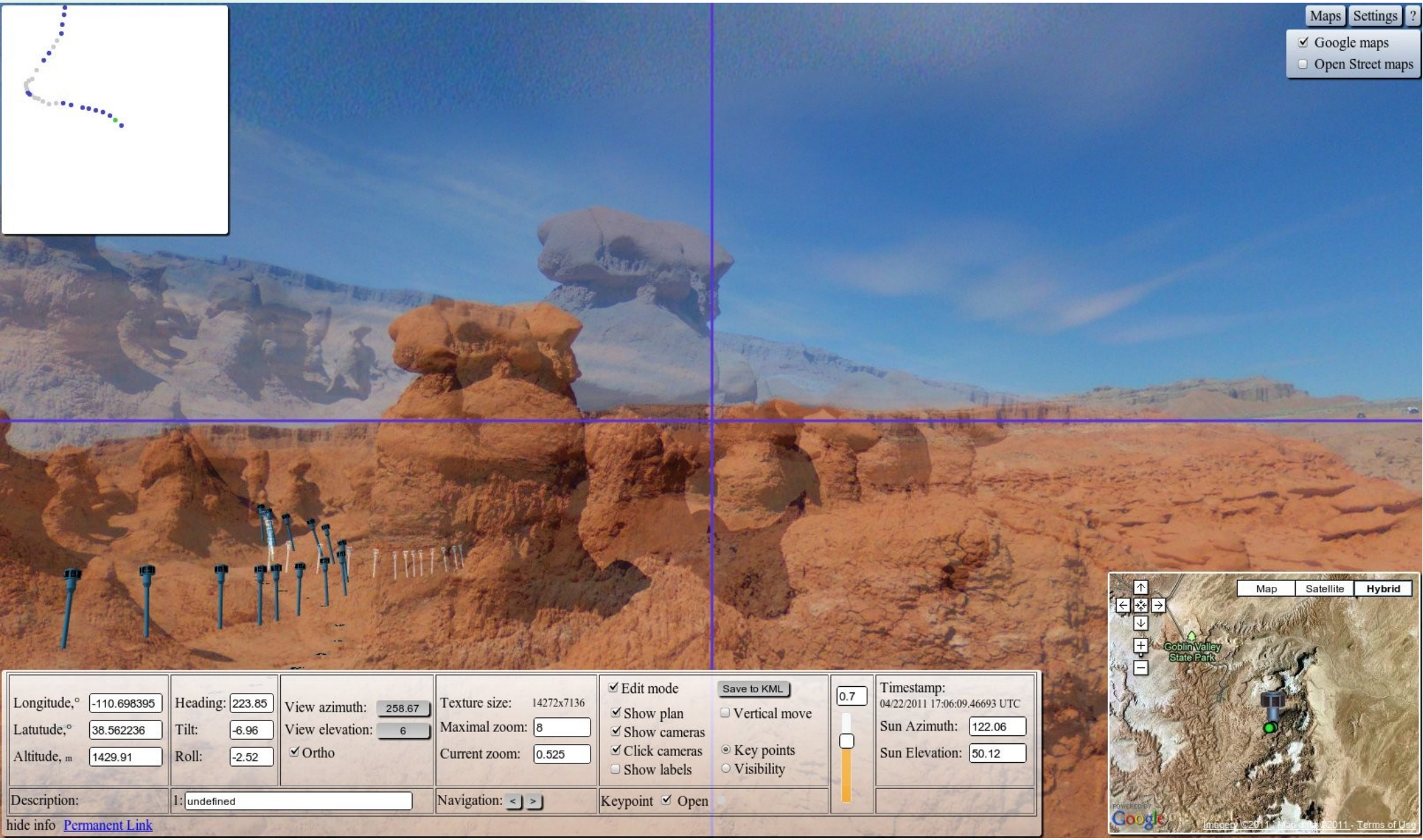
Interface for Camera Controls



Eyesis 4π – Panoramic Image

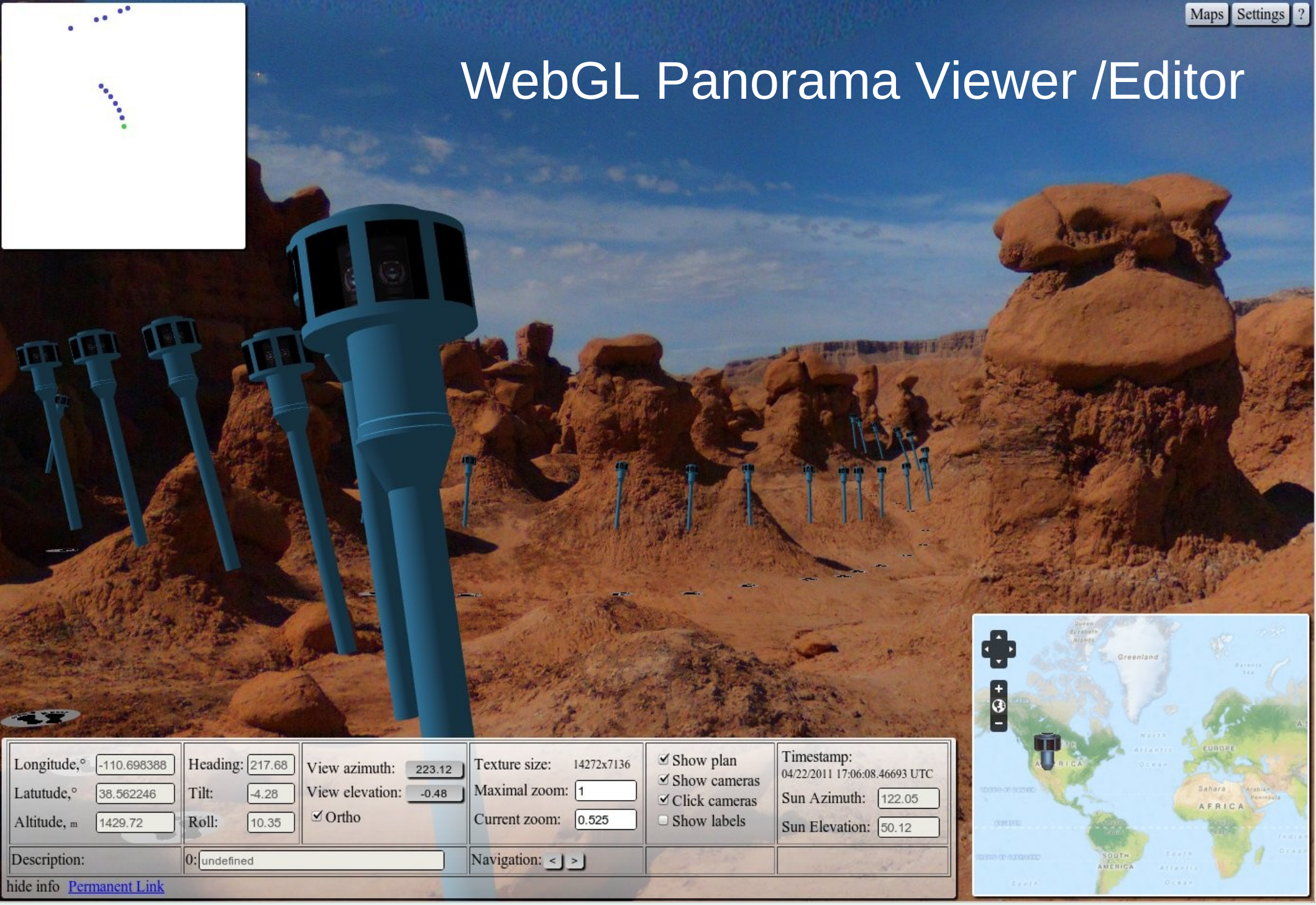
- Full Size(14268x7135), Equirectangular Projection
- WebGL Viewer



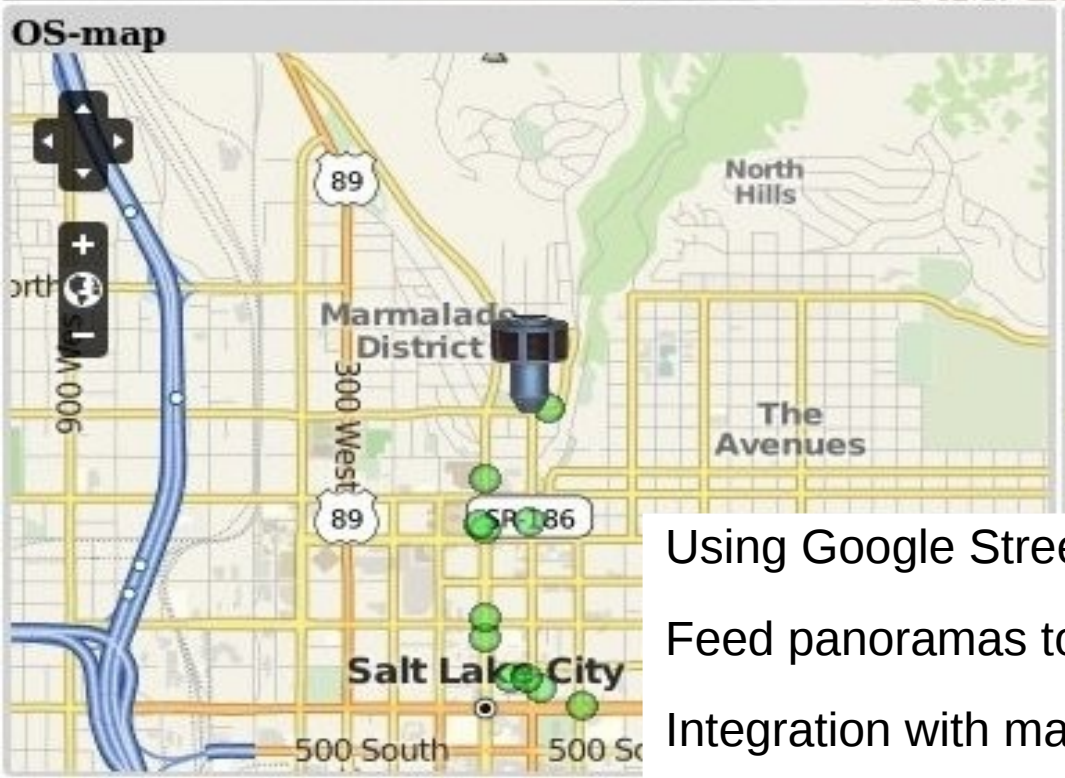


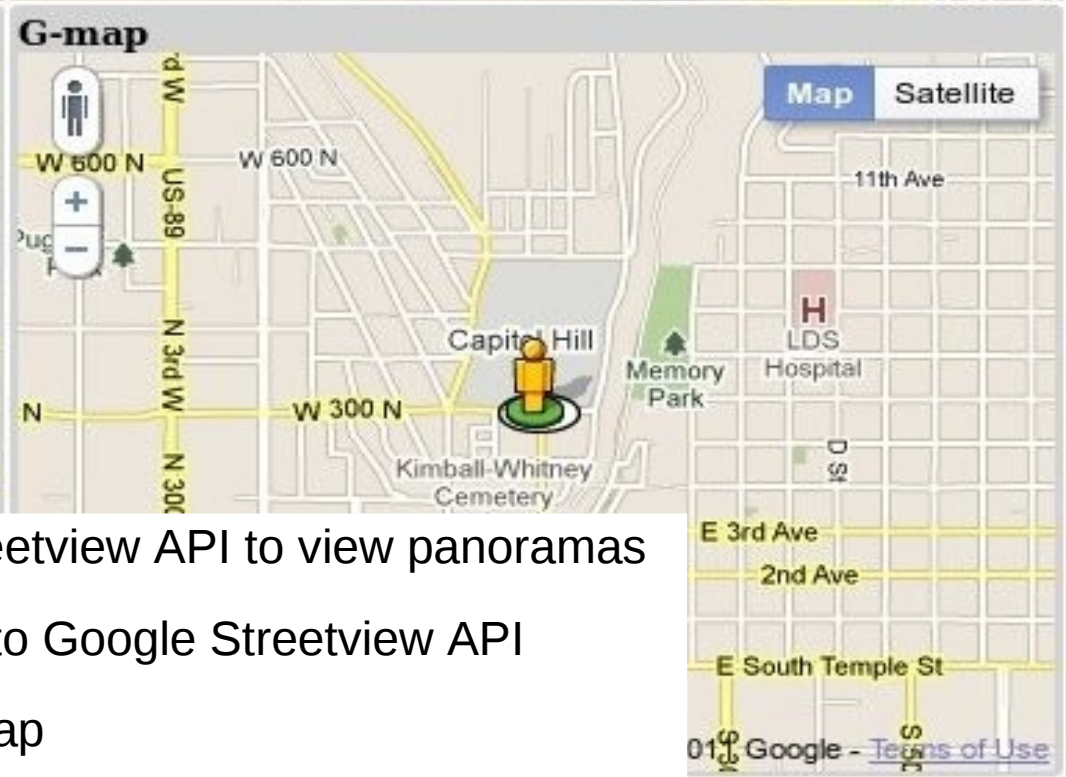
WebGL Panorama Viewer / Editor

WebGL Panorama Viewer /Editor



Integration with Maps





Using Google Streetview API to view panoramas

Feed panoramas to Google Streetview API

Integration with map

Post-processing

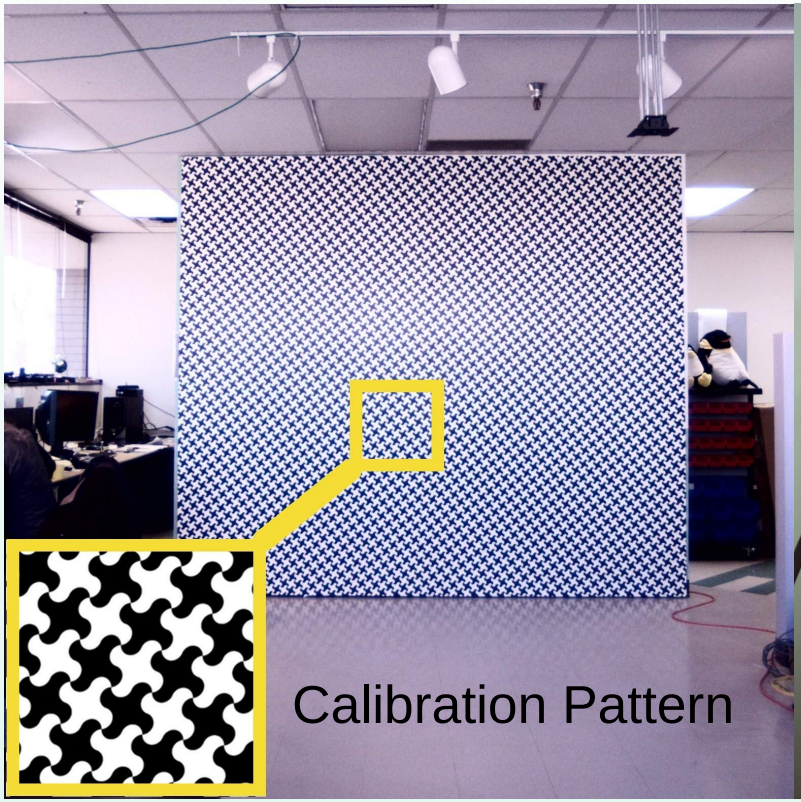
- Metadata extraction
- RAW conversion
- Aberration correction
- Distortion Correction
- Photogrammetry ready

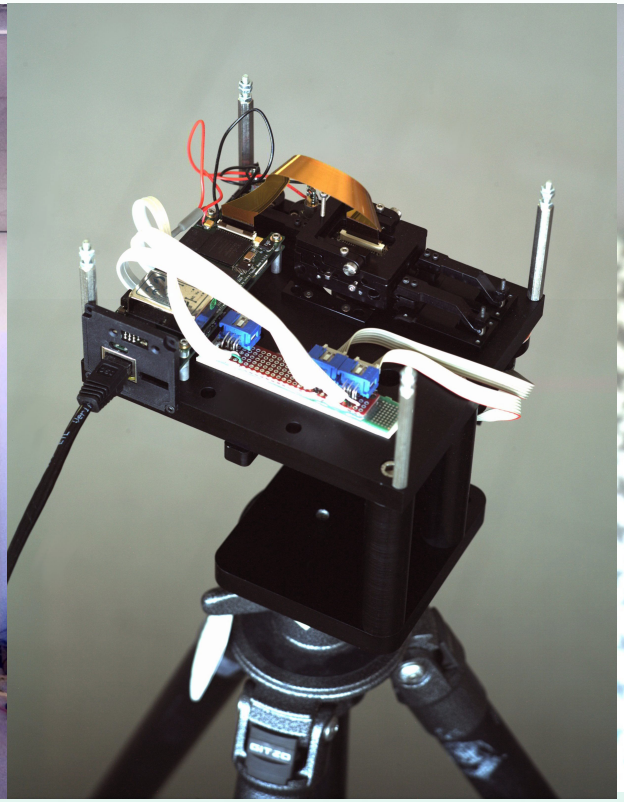
original

enhanced

Focus and Alignment

optical aberration measurement and correction developed for Eyesis cameras



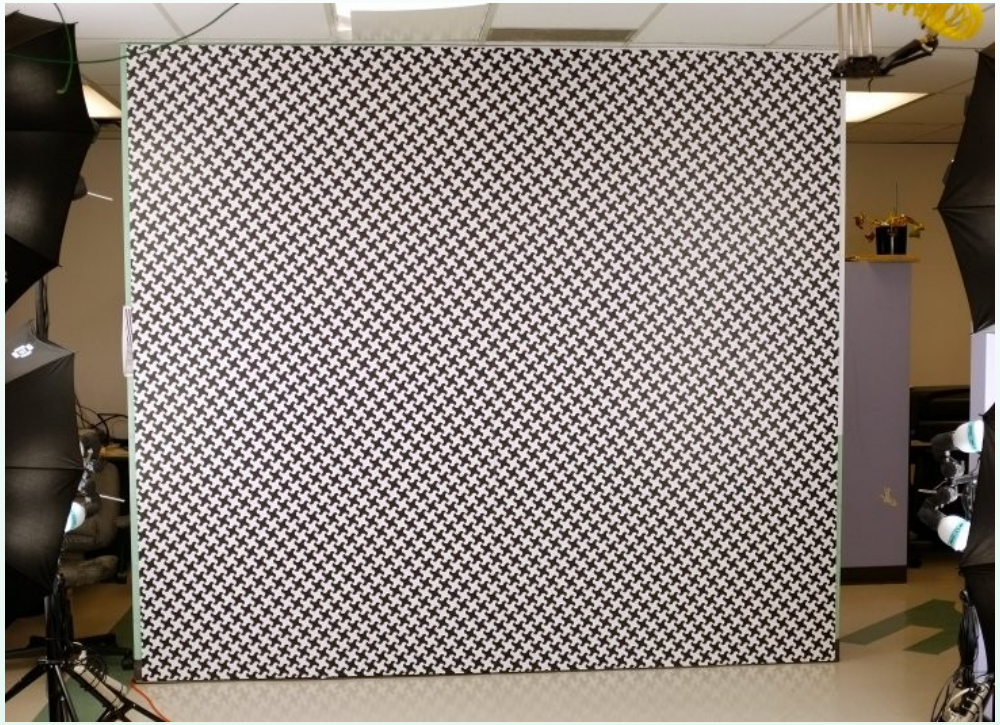


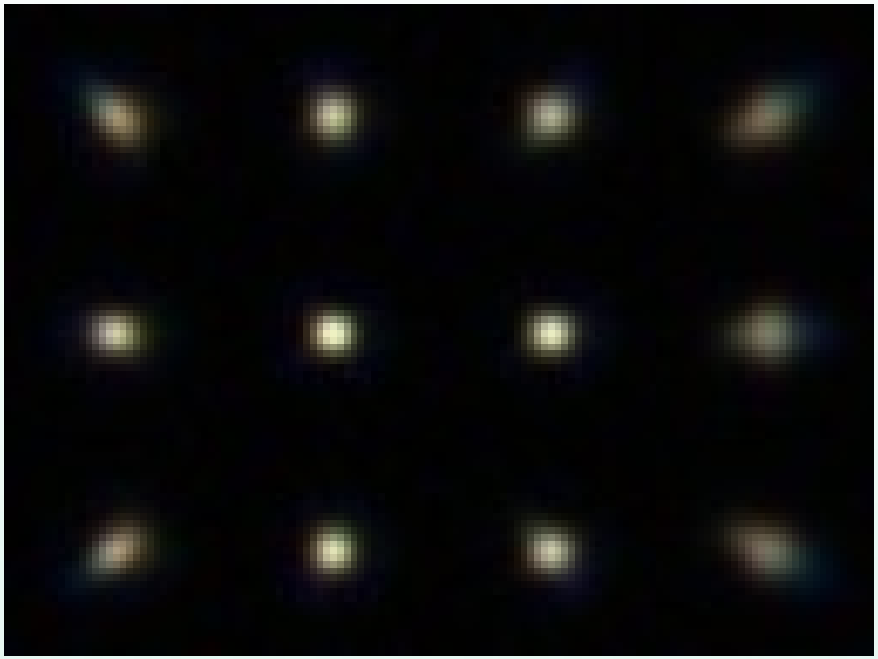
Lens is aligned and centered with sensor

Optical Aberrations of the Lens

Aberrations are more in the corners then in the center of the lens;

Point Spread Function of one of 12 areas of the pattern.

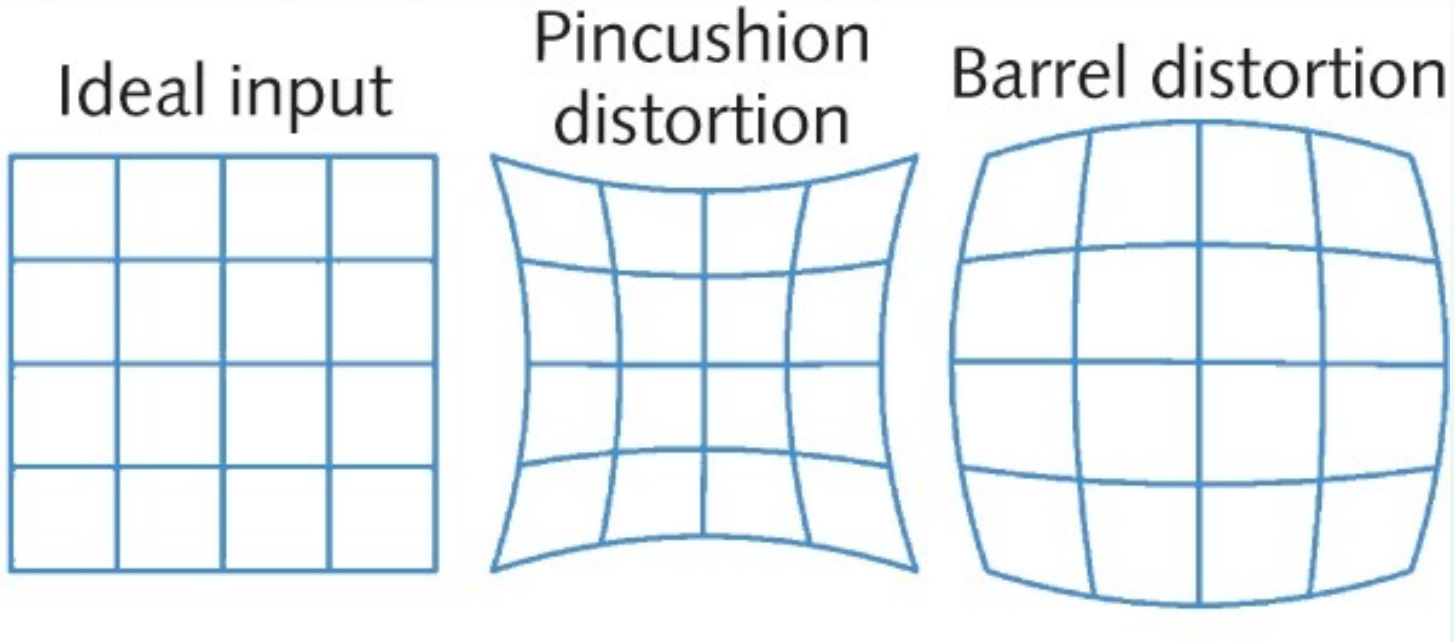




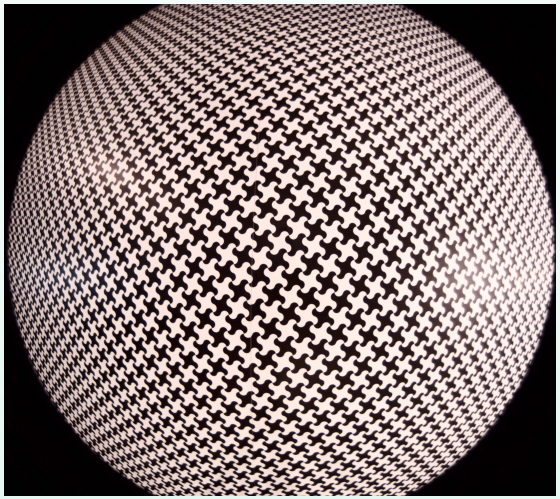
Aberration Correction - Results

With 1/2.5″ 5 megapixel sensor we achieved average sharpness improvement over the image area around 40% compared to the raw images, effectively doubling the resolved pixel count.

Optical Distortions



Fish-eye lens distortion

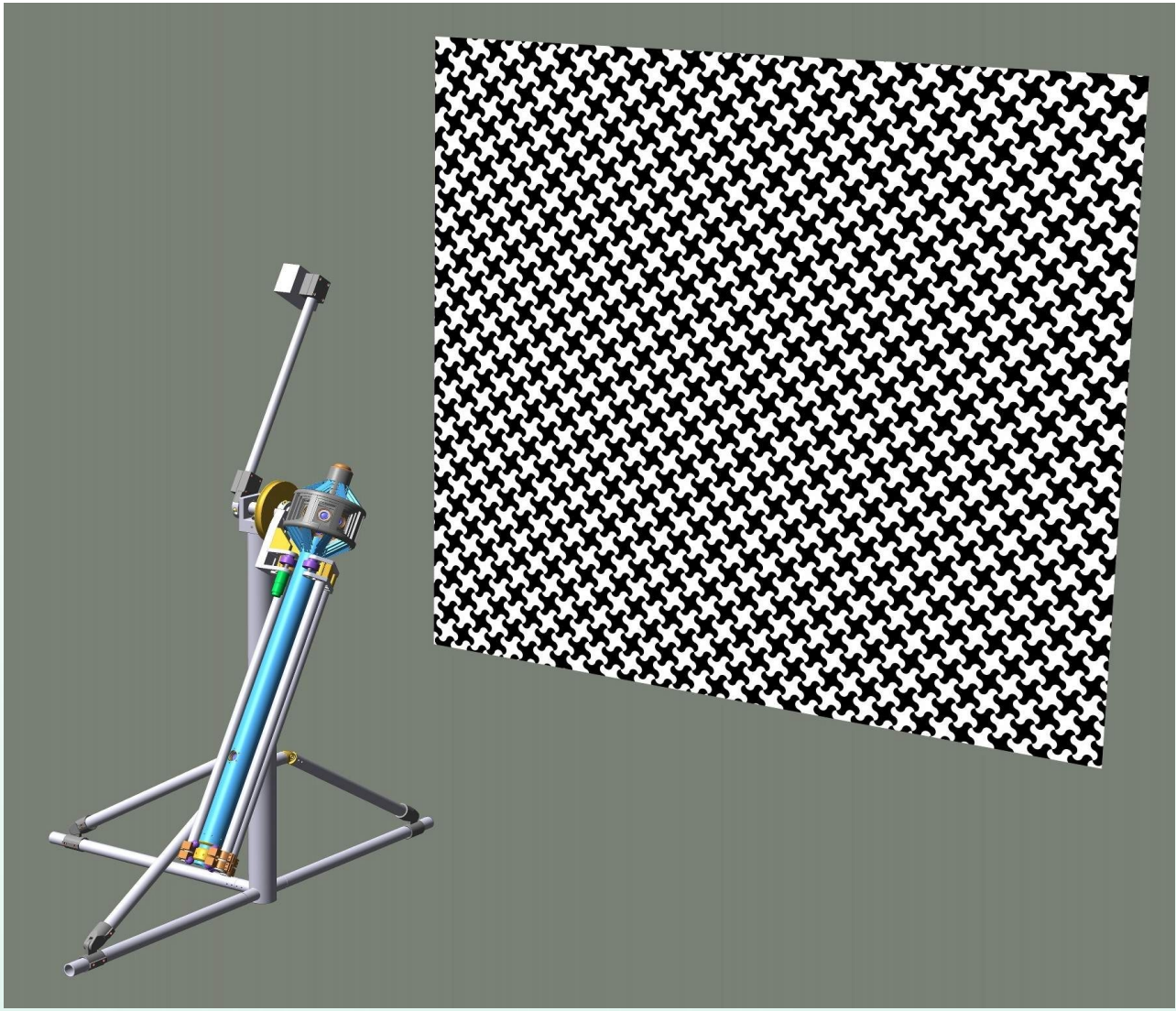


Pixel Mapping with sub-pixel resolution

Camera as a measuring tool

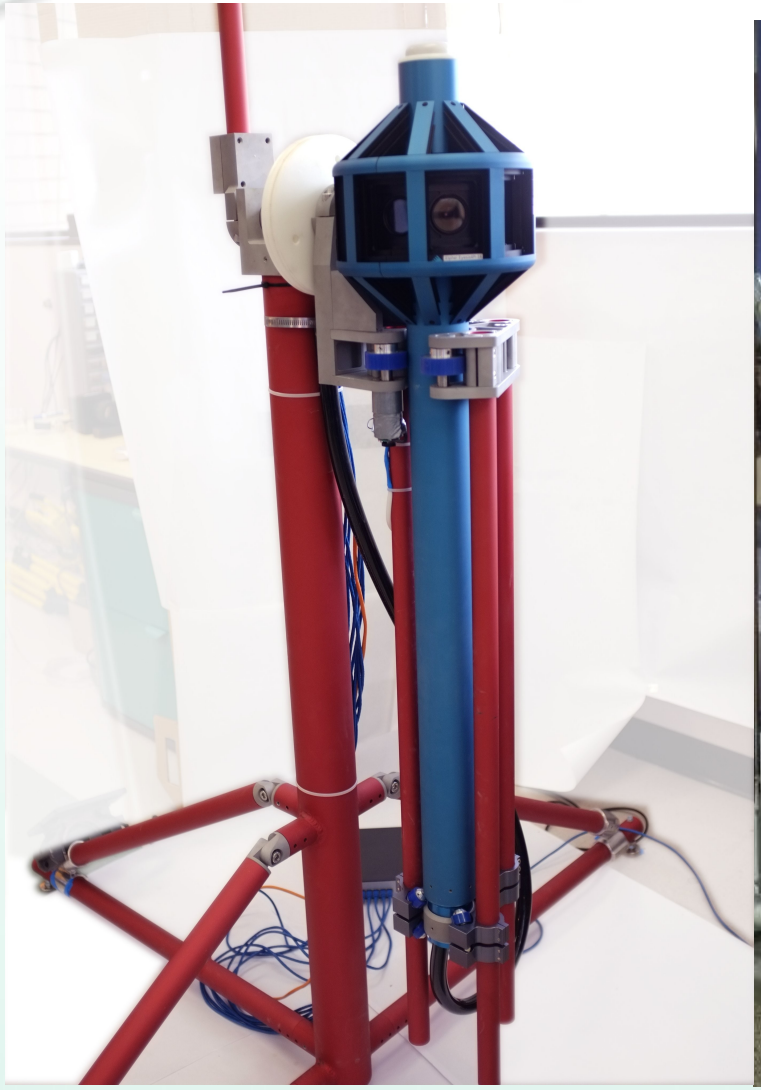
Photogrammetry

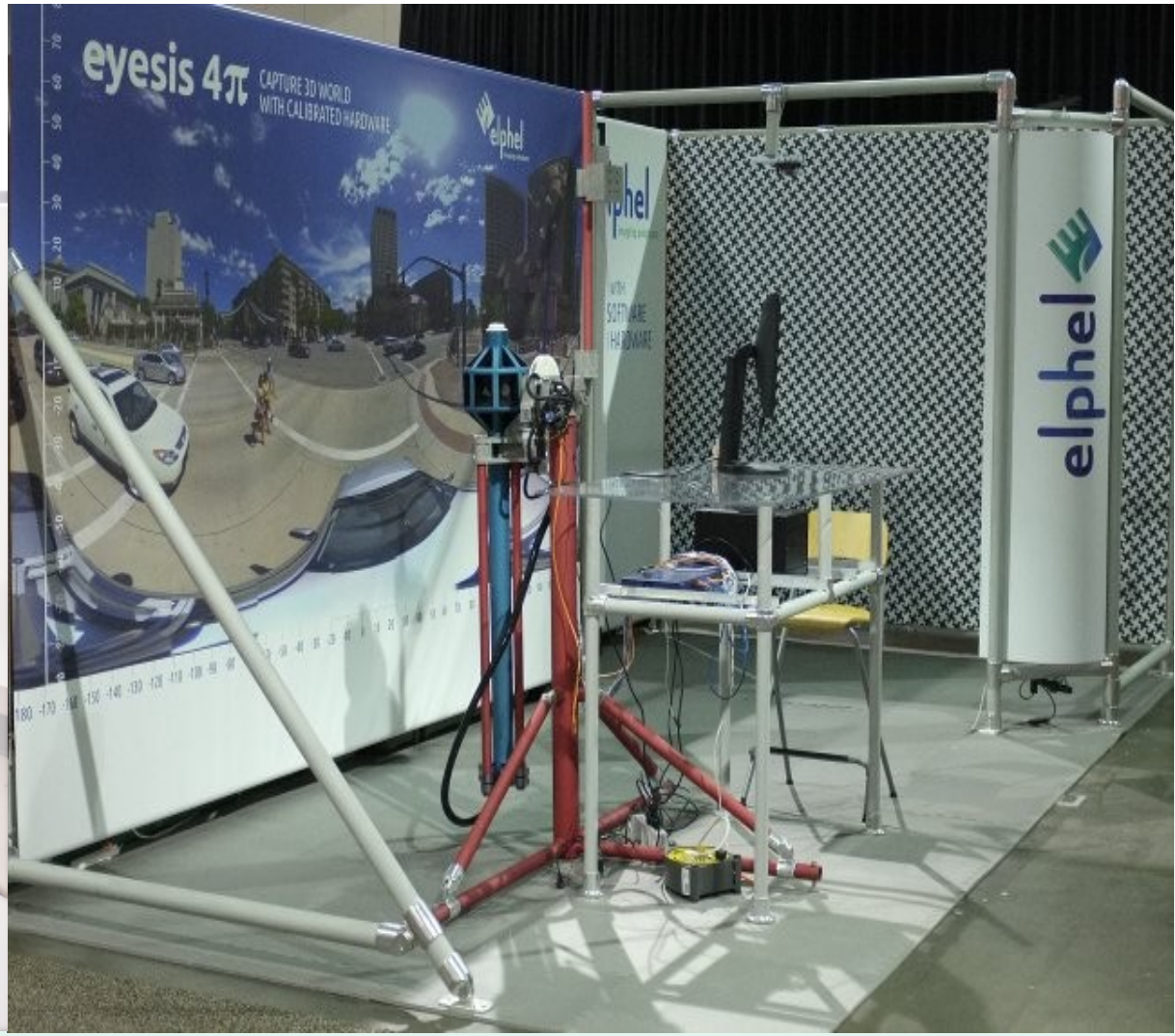
3D reconstruction



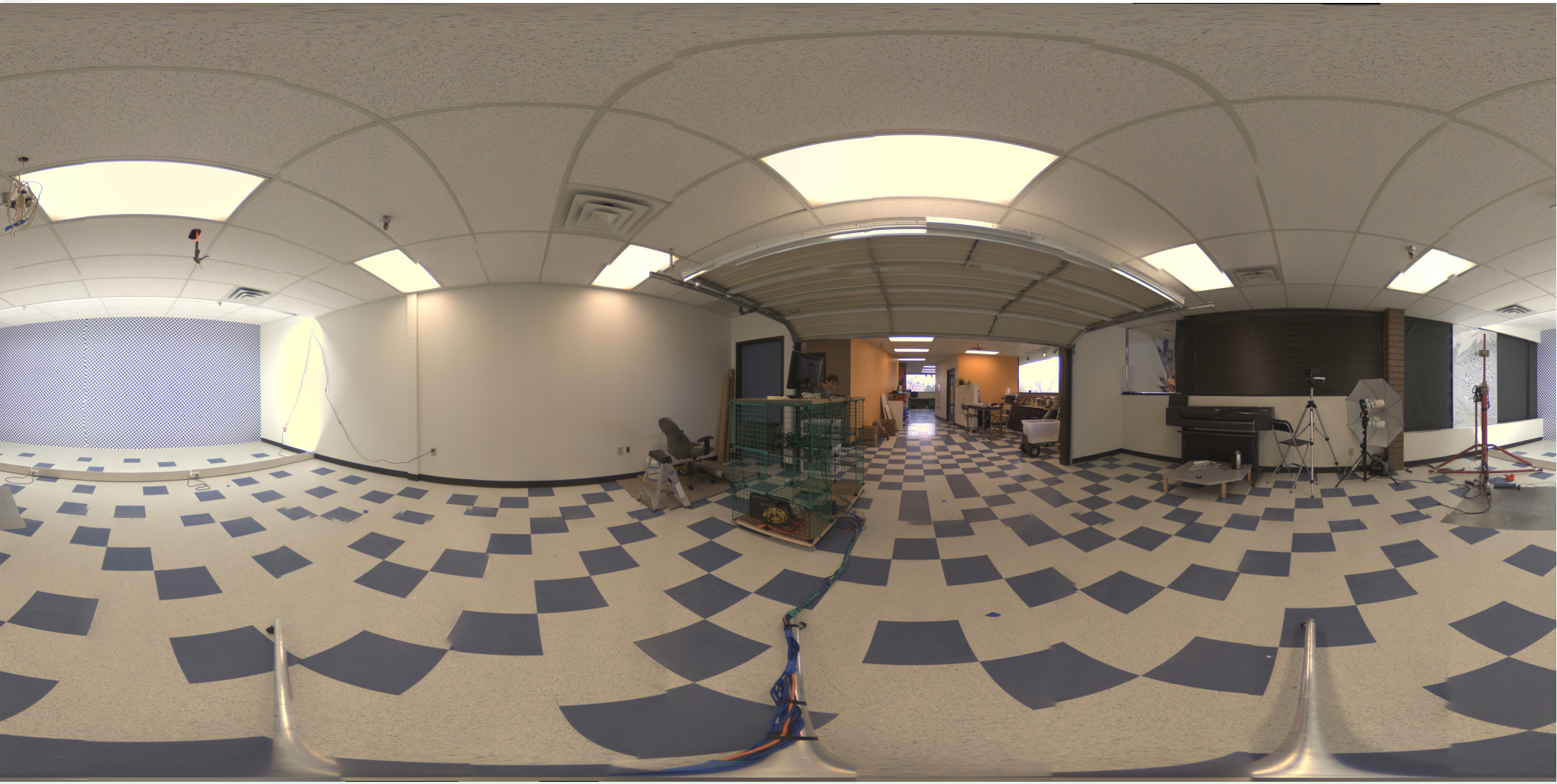
Calibration for Distortions

Calibration Machine and Pattern



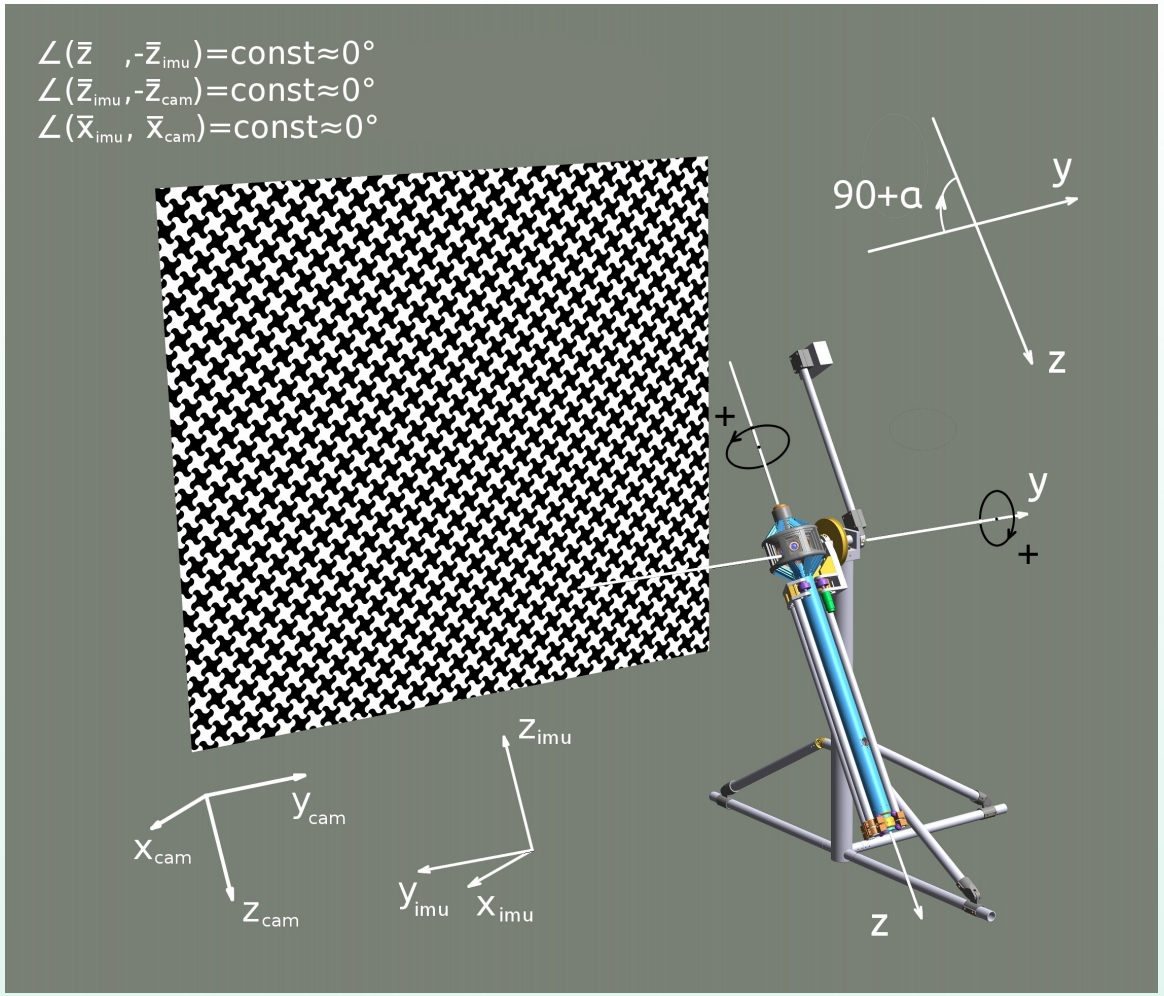


Elphel Calibration Facility



Inertial Measurement Unit (IMU):

IMU calibration

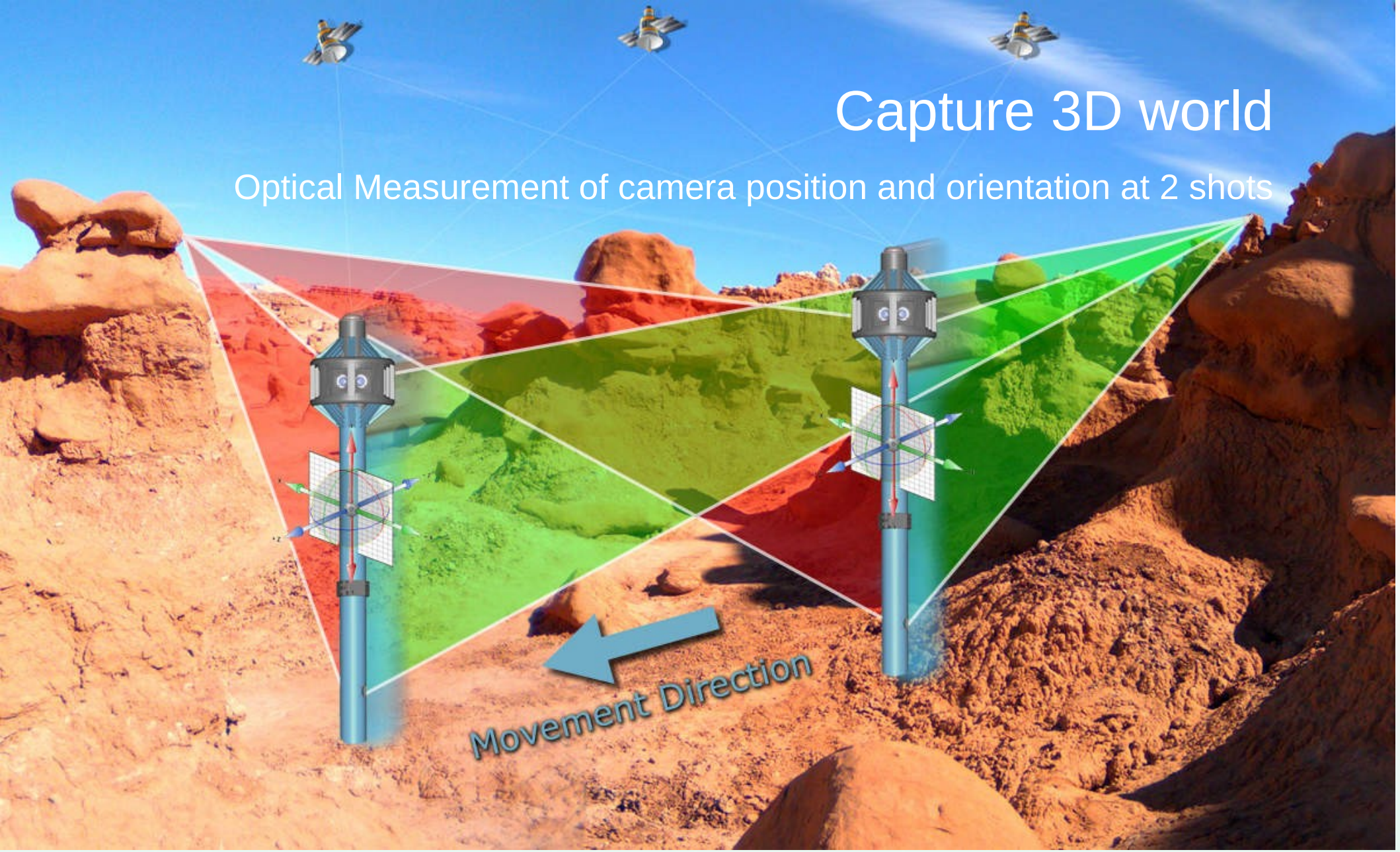


Inertial Measurement Unit (IMU):

Compensate ERS (Electronic Rolling Shutter) distortion by recording position /orientation of camera several times within each frame

Capture 3D world

Optical Measurement of camera position and orientation at 2 shots



HDR with moving camera,

will be possible with textures on 3D mesh

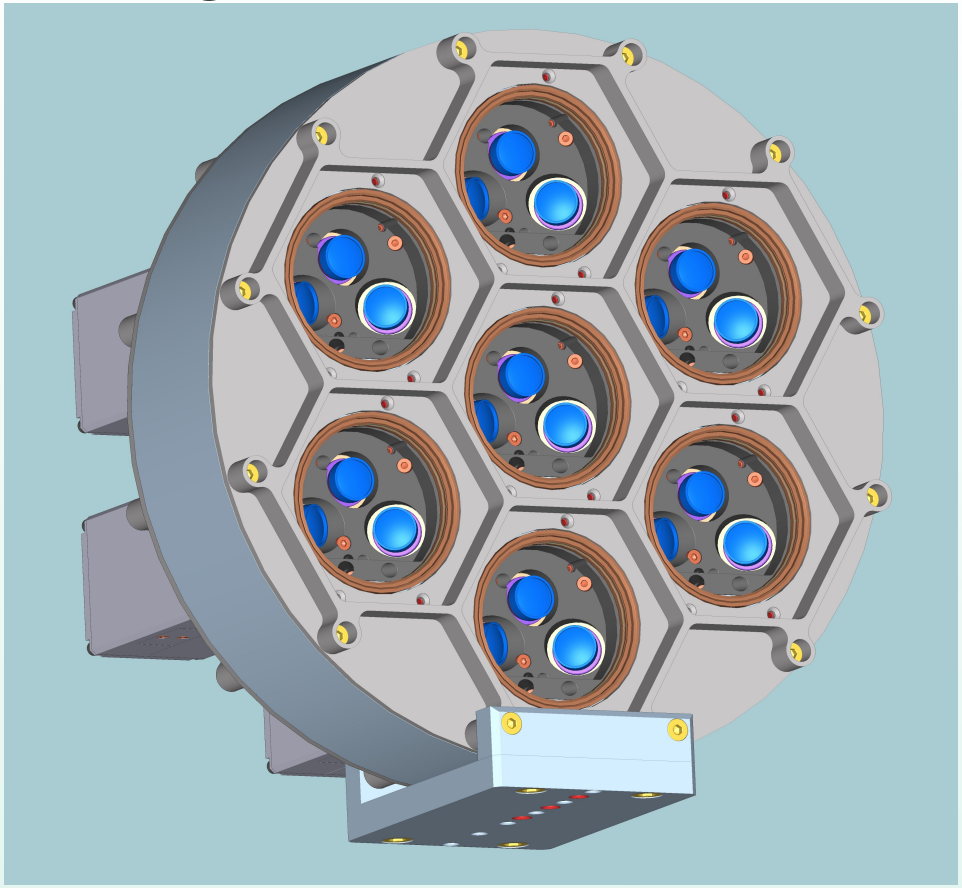
Other applications of photogrammetric cameras:

Depth of Field with Triclops Camera

Other applications of photogrammetric cameras:

High Resolution, High Dynamic Range 3D Cinema Camera

- 7 groups of 3 sensor+lens modules
- 3D Mesh
- High Dynamic Range
- Synthesize Depth of Filed
- 6K Resolution



Elphel projects and R&D

- NC393 camera development (Schematics, PCB design, FPGA programming (Verilog), image processing, camera GUI (HTML, PHP, Javascript, WebGL)
- Image Processing (Java, C/C++)
- Photogrammetry
- IMU data processing: filtering, orientation (Java, C/C++)
- 3D reconstruction (Java, C/C++)
- adapting camera for specific applications (PHP,Javascript, HTML, Java)

Elphel, Inc.

1455 W 2200 S #205 WVC, UT 84119

www.elphel.com

Development Blog: http://blog.elphel.com

Documentation: wiki.elphel.com

Code: SourceForge.net