

Future Trends

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Schedule

Introduction	Srinivasa, 10 mins
Assorted Pixels	Srinivasa, 20 mins
Coding and Modulation in Cameras	Amit, 45 mins
Break	10 min
Light Fields and Applications	Ankit, 60 mins
Break	10 min
Computational Illumination	Srinivasa, 45 mins
Future Trends	Amit, 15 mins
Discussion	

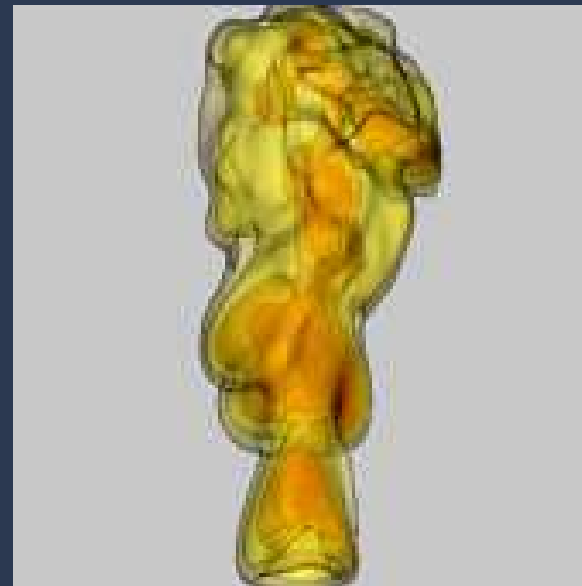
Future Directions

- Computational Imaging outside Photography
 - Tomography, Schlieren Imaging
- Smart Optics
 - Liquid Lens, Origami Lens, GRIN lenses
- Smart Sensors
 - HDR Cameras, Line-scan Cameras, 3D Cameras, Multi-perspective
- Smart Lighting
 - Pico projectors, Light stages
- Social Impact
 - Social Networking, Privacy, Developing Countries

Schlieren Photography

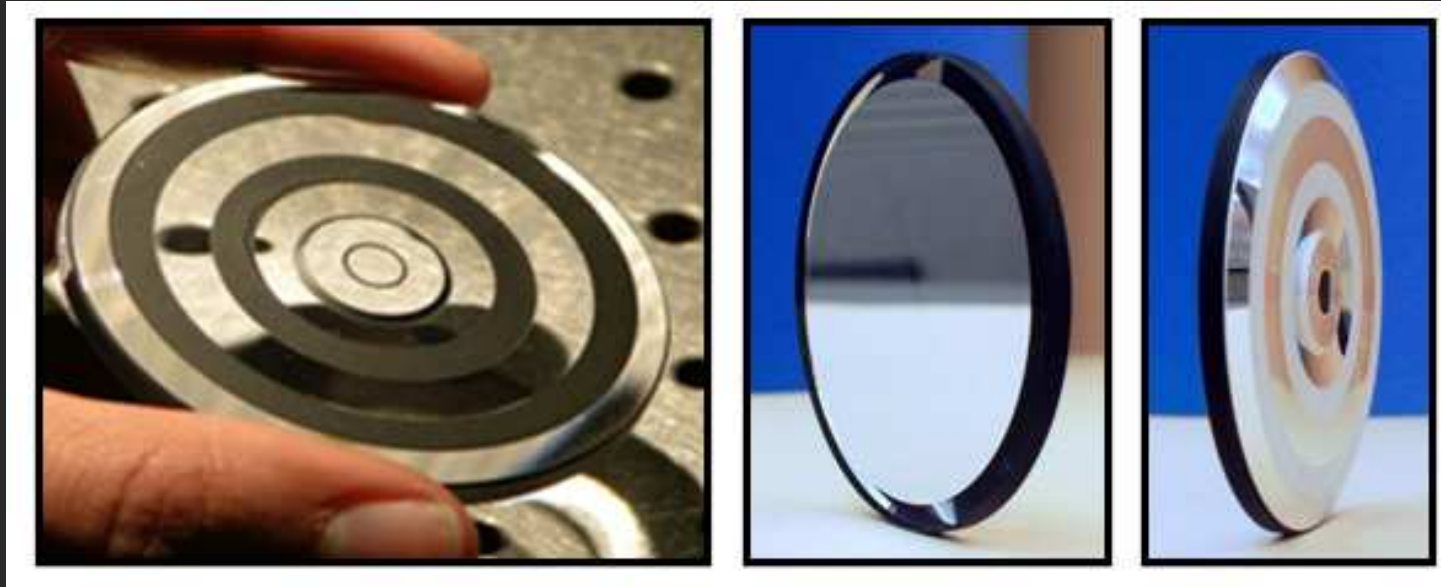


<http://www.mne.psu.edu/psgdl/FSSPhotoalbum/index1.htm>



Time-resolved 3D Capture of Non-stationary Gas Flows,
Atcheson et al. SIGGRAPH Asia 2008

Origami Lens



Conventional
Lens

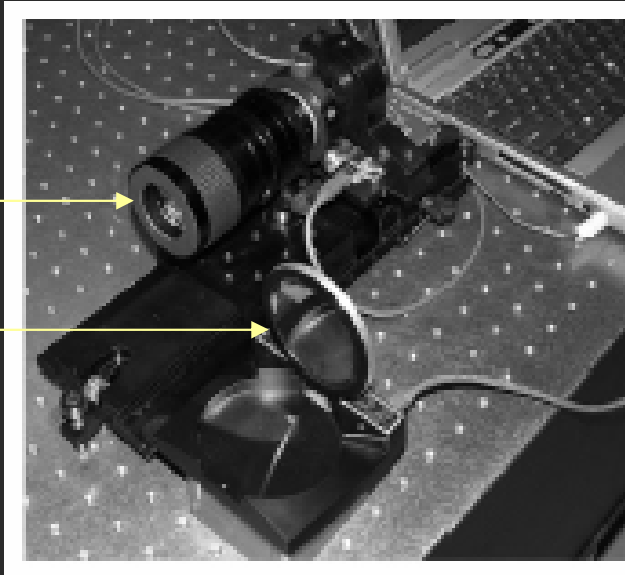


Origami
Lens

Optical Performance

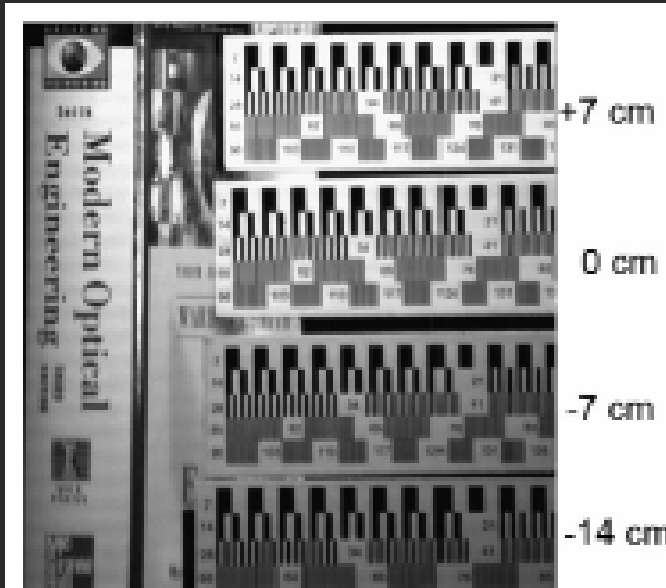
Conventional

Origami

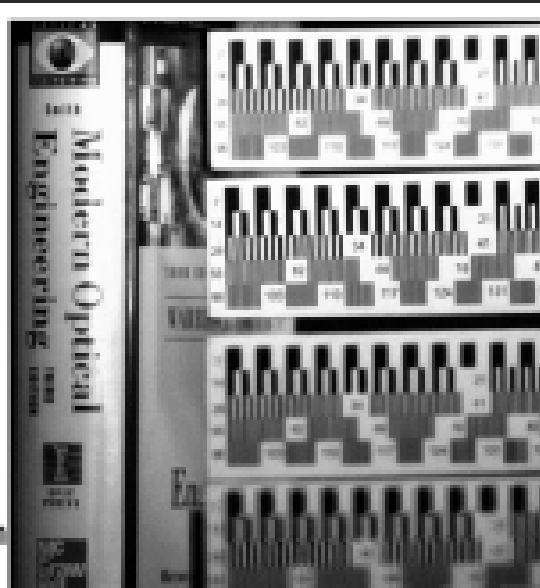


Scene

Conventional
Lens Image

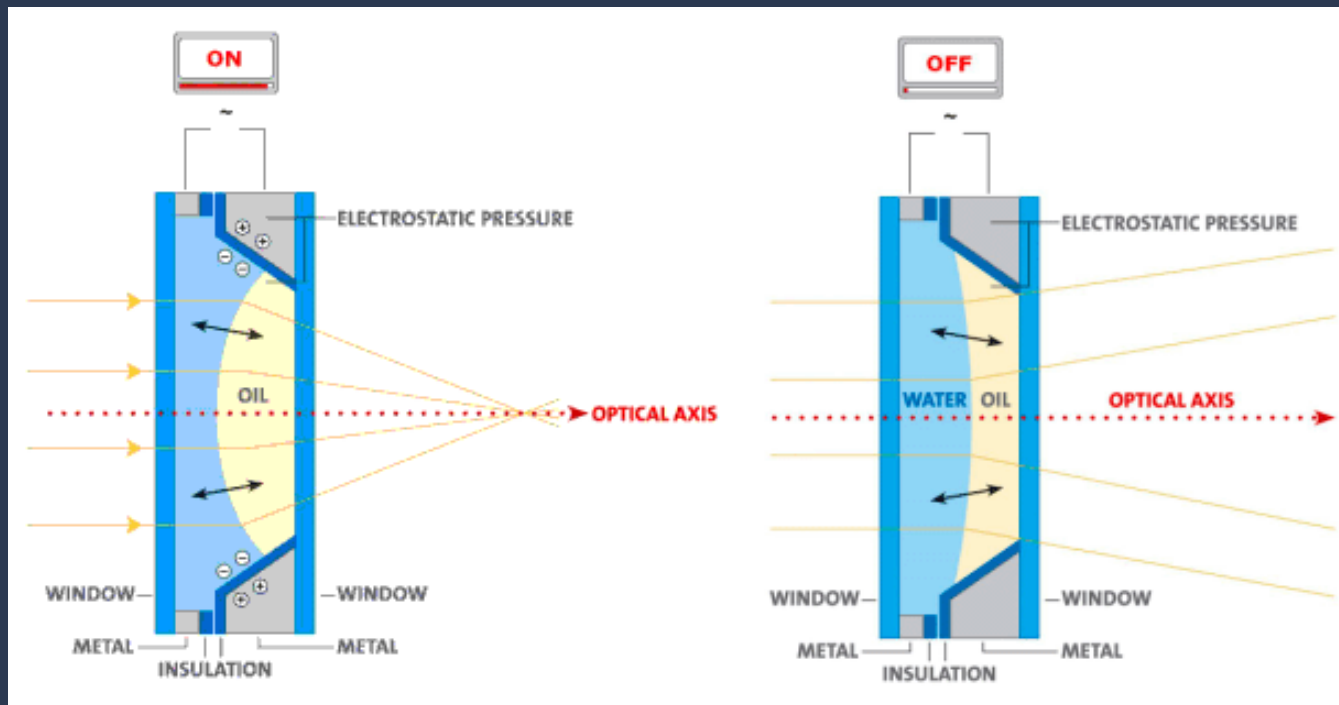


Origami
Lens Image



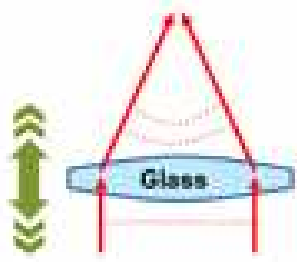
Non-Linear Optics

- Liquid lens
 - Varioptics




- Lens Vector

TRADITIONAL AUTOFOCUS

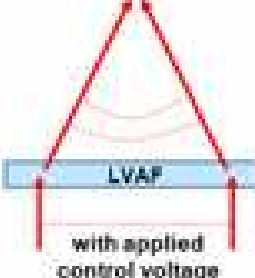


Motors mechanically move lens to adjust focus

LENSVECTOR AUTOFOCUS

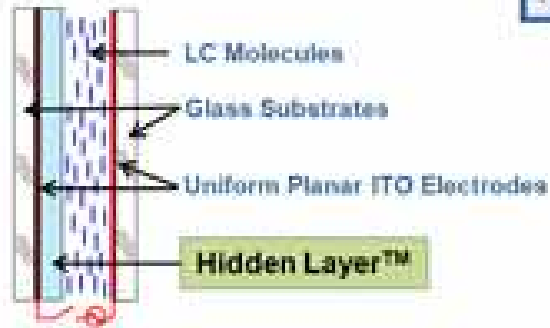


with zero control voltage



with applied control voltage

LVAF dynamically changes the gradient of refractive index to adjust focus

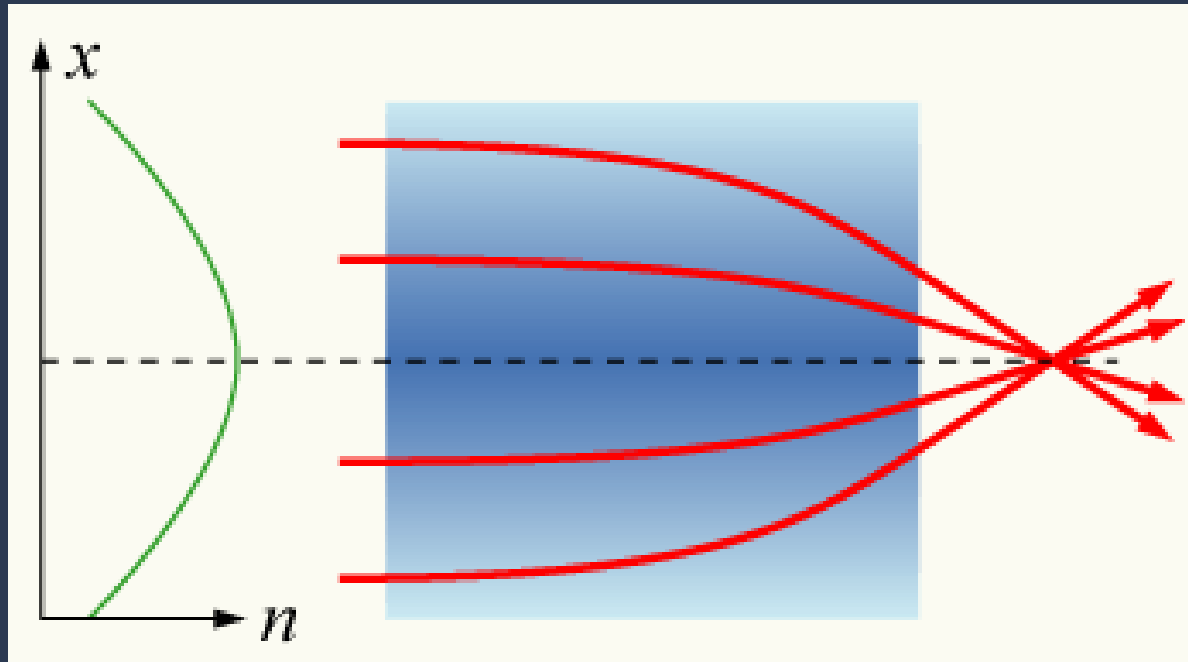


ADVANTAGES

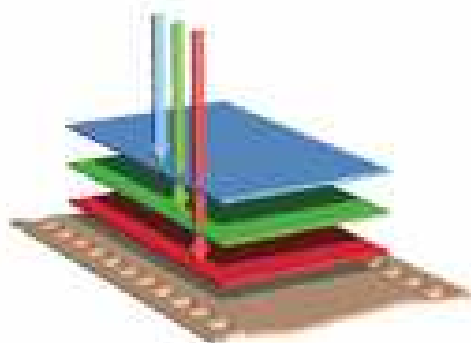
- Miniature
- No moving parts
- Silent / Lightweight
- Low power
- Wafer scale
- Proven manufacturing

GRIN Lenses

- Gradient Refractive Index Lenses

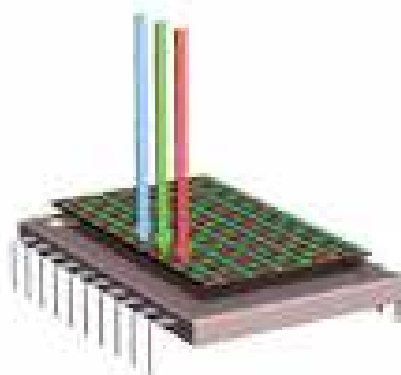


Foveon Sensor



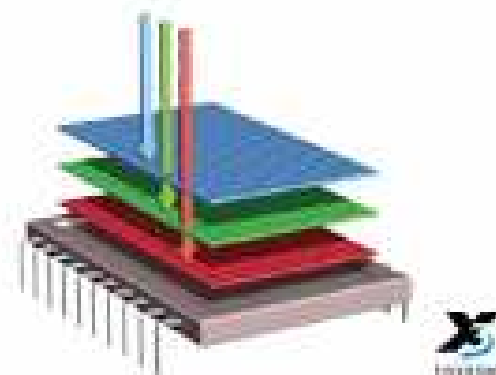
First came film.

COLOR FILM contains three layers of emulsion which directly record red, green, and blue light.



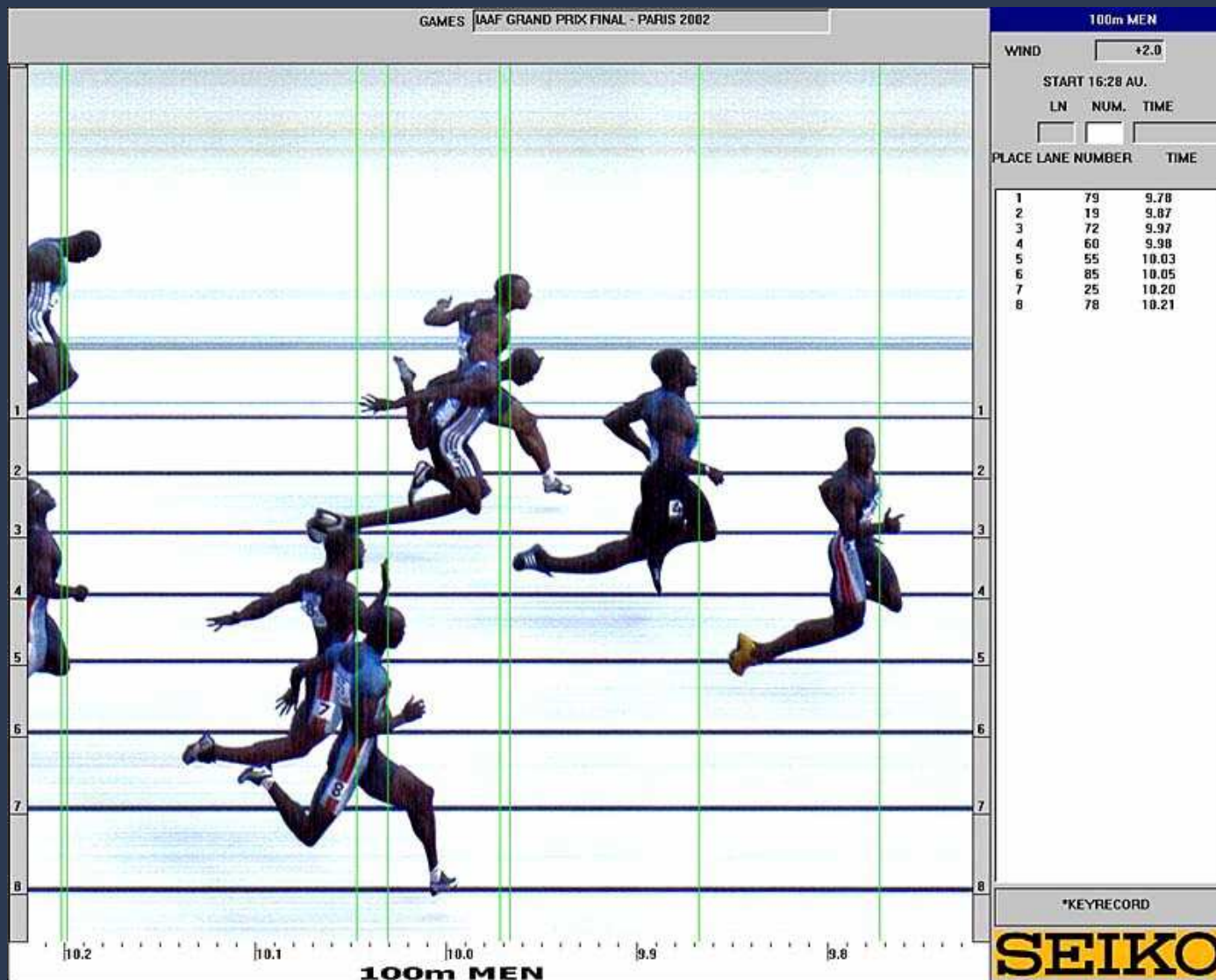
Then came digital.

TYPICAL DIGITAL SENSORS have just one layer of pixels and capture only part of the color.



Now there's Foveon X3.

FOVEON X3 direct image sensors have three layers of pixels which directly capture all of the color.



Line Scan Camera: PhotoFinish 2000 Hz



Multi-Perspective Camera?



M. C. Escher



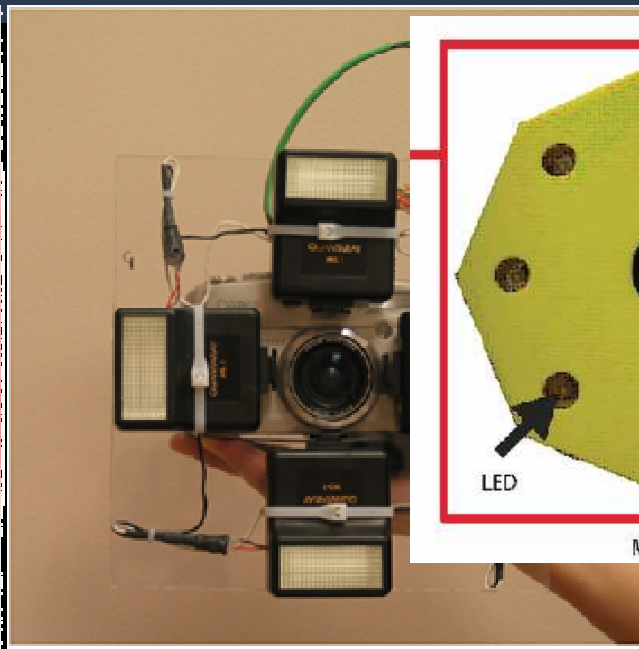
Rademacher et al, Siggraph 1998



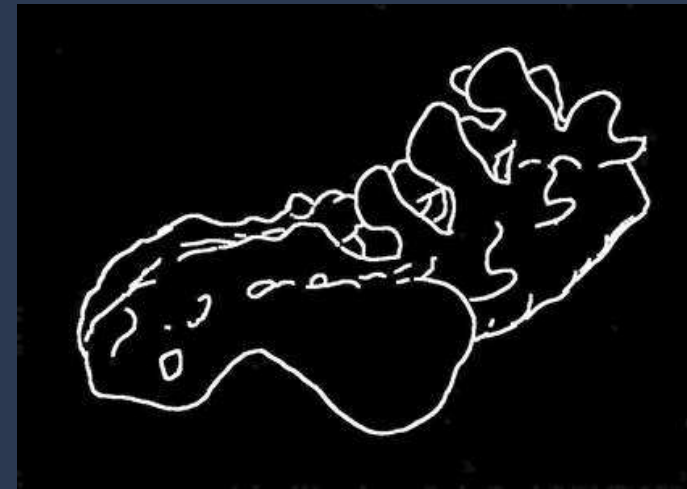
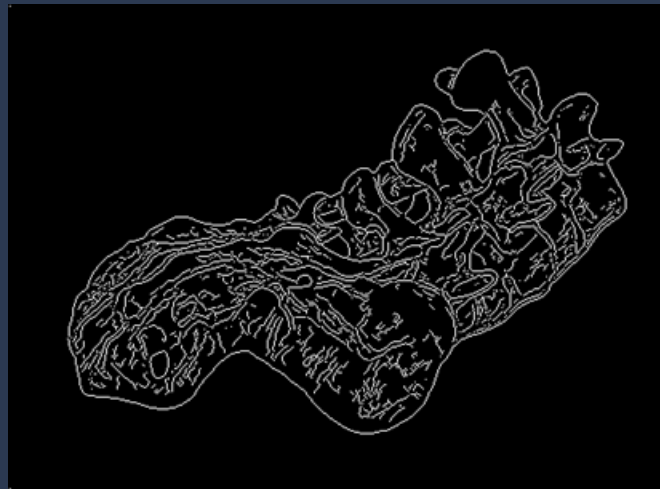
Steve Seitz



Jingyi Yu

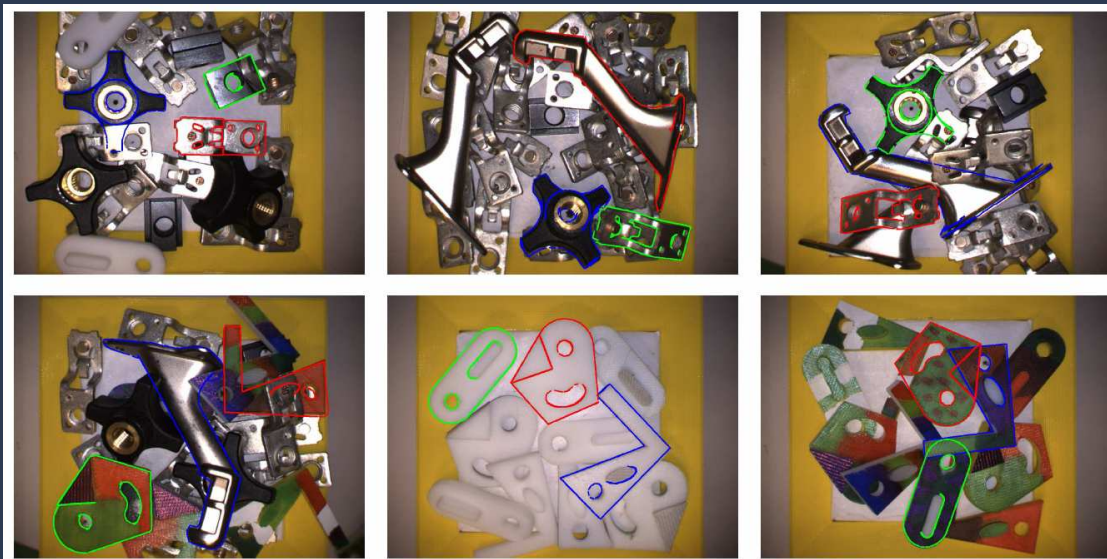
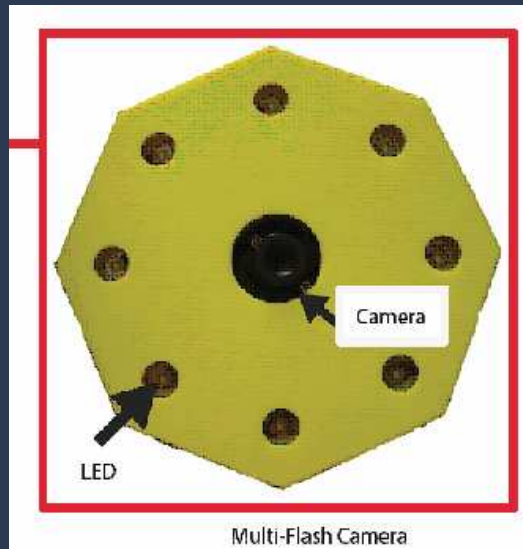


Multi-Flash Camera, Raskar et al. SIGGRAPH 2004



Canny Edges

Depth Edges



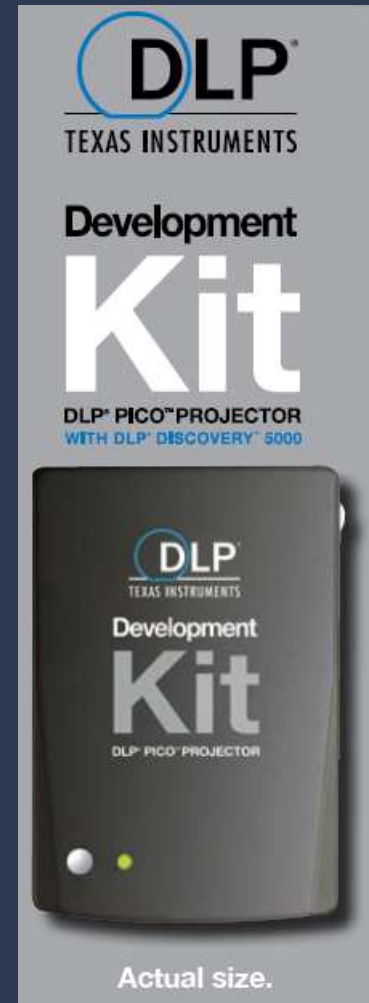
Live Demo on
Thursday at
CVPR 2010

Pico Projectors

- TI's DLP Technology with LED
- Laser Scan (MEMS mirror)



Microvision Laser Pico



TI's DLP, \$349



Light Stage, Paul Debevec, ICT

Trust in Images

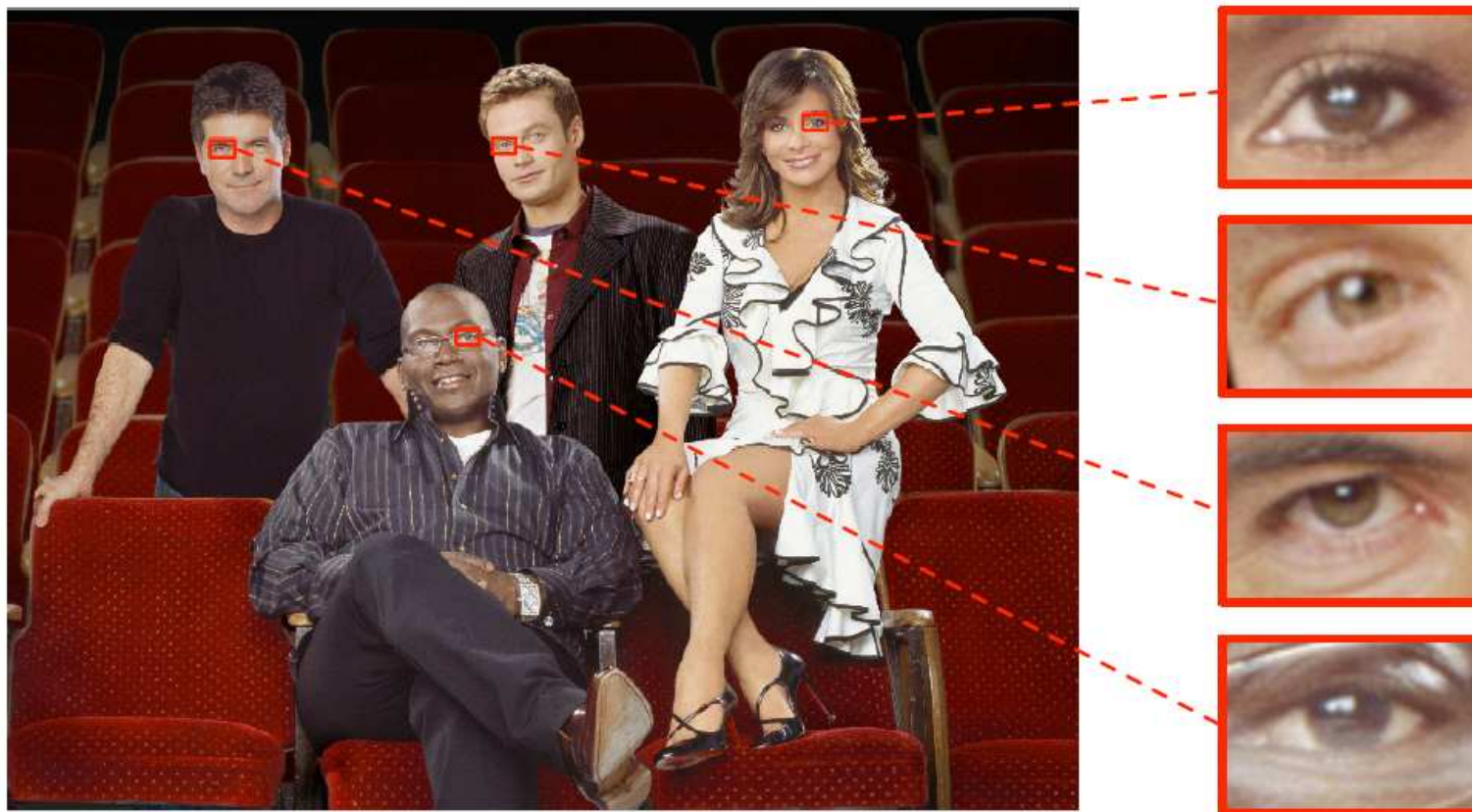


Fig. 1. This photograph of the *American Idol* host and judges is a digital composite of multiple photographs. The inconsistencies in the shape and position of the specular highlight on the eyes suggest that these people were originally photographed under different lighting conditions. Photo courtesy of Fox News and the Associated Press.

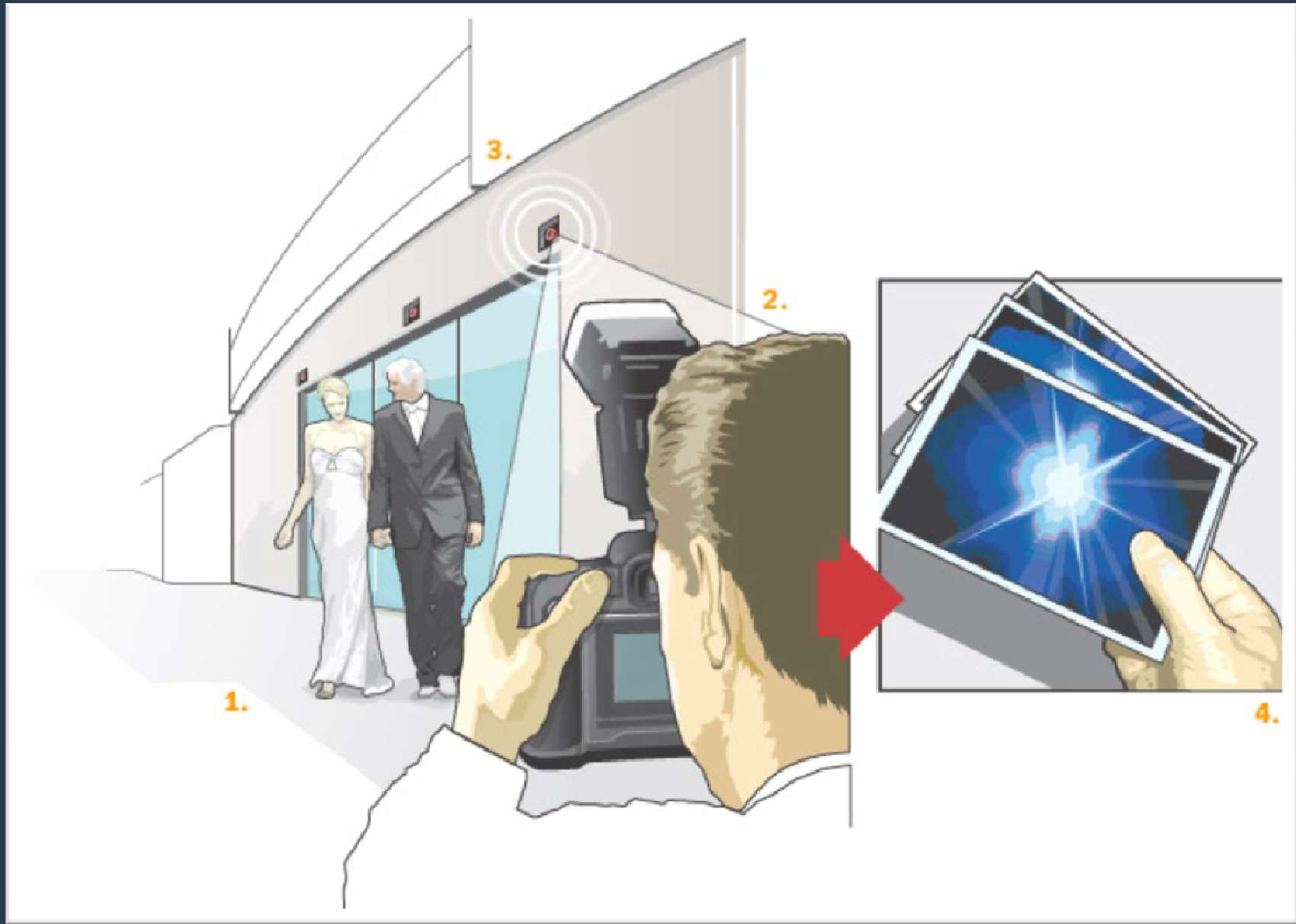
Truth in Images



LA Times March'03



From Hany Farid





Retroreflective CCD of cellphone camera



Preventing Camera Recording by Designing a Capture-Resistant Environment, Khai N. Truong, Shwetak N. Patel, Jay W. Summet, and Gregory D. Abowd. Ubicomp 2005

Aydogan Ozcan, UCLA



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Blind Camera



Sascha Pohflepp,
U of the Art, Berlin, 2006

