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<http://www.cs.unc.edu/~marc/>

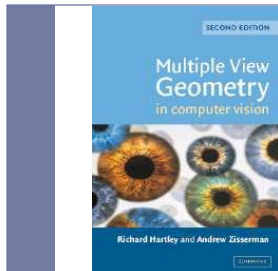
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Multiple View Geometry in Computer Vision

lb@dongseo.ac.kr





Figure 1.1: An image of a scene

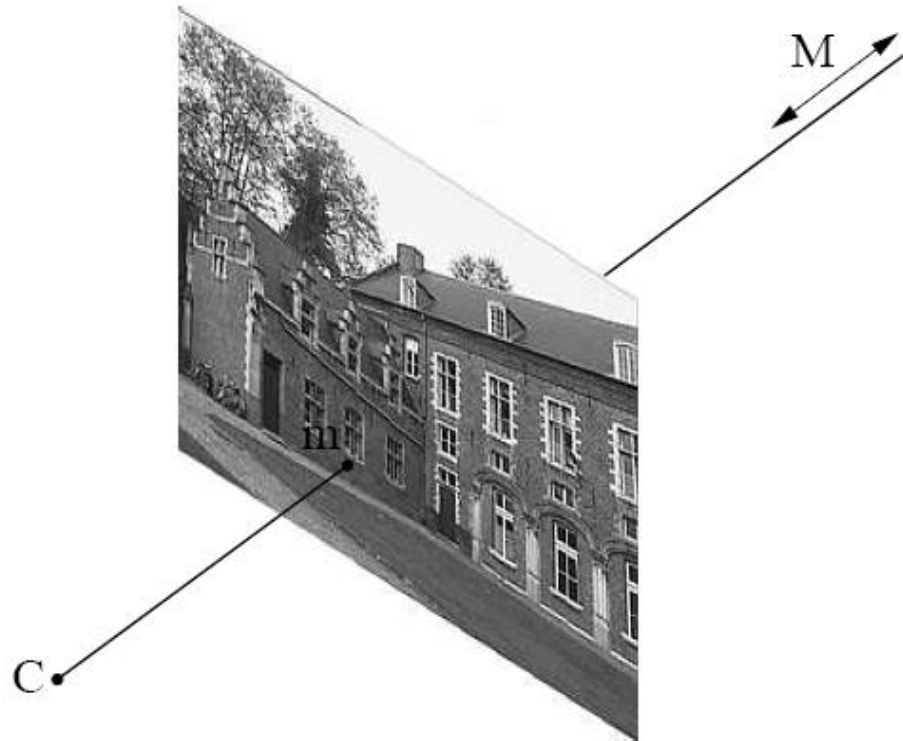


Figure 1.2: Back-projection of a point along the line of sight.

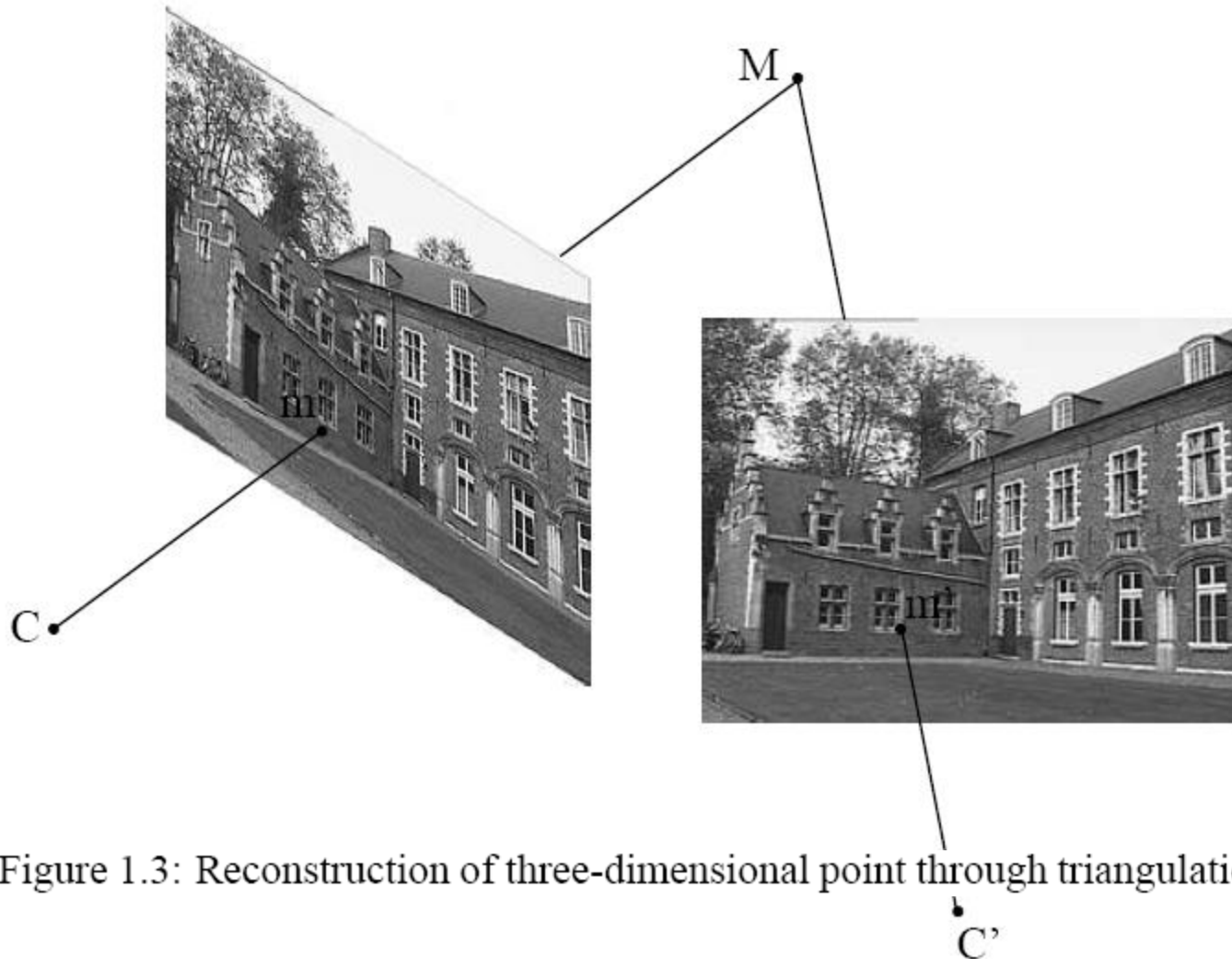
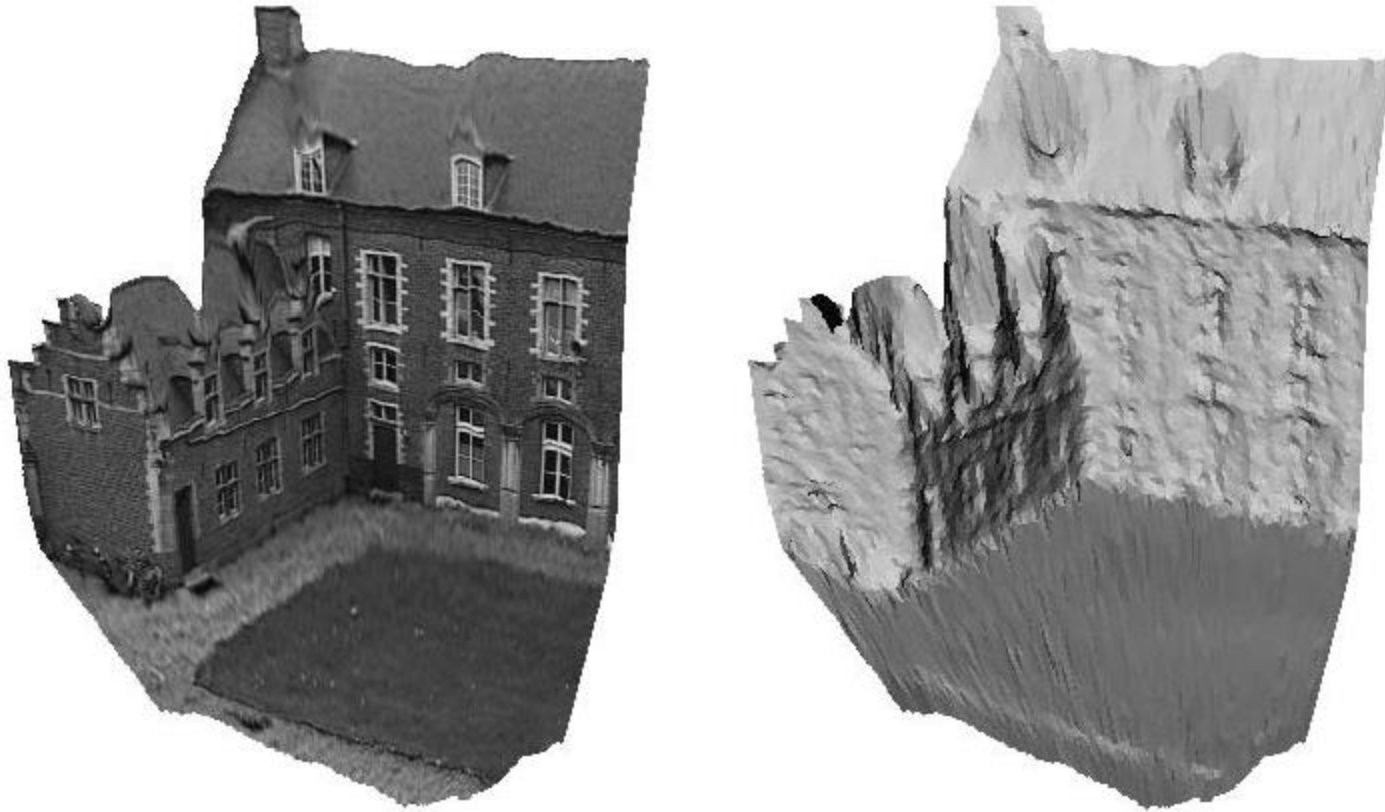


Figure 1.3: Reconstruction of three-dimensional point through triangulation.

Visual 3D Modeling from Images



- ▶ Projective Transformations
- ▶ Camera Calibration
- ▶ Epipolar Geometry
- ▶ Feature Points
- ▶ Correspondence Search
- ▶ RANSAC Algorithm
- ▶ 3D Reconstruction
- ▶ **SIFT&ASIFT**

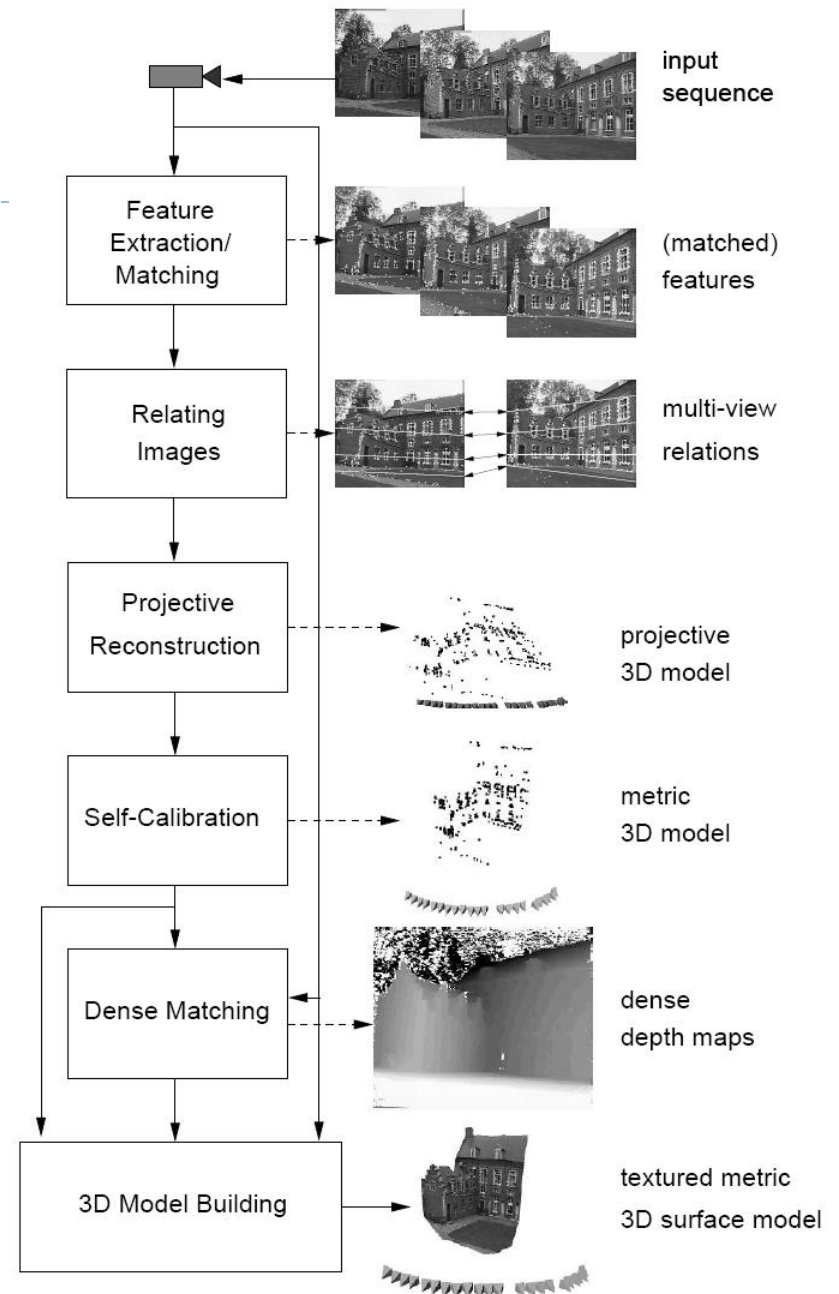




Photo Tourism

- ▶ <http://phototour.cs.washington.edu/>



(c)

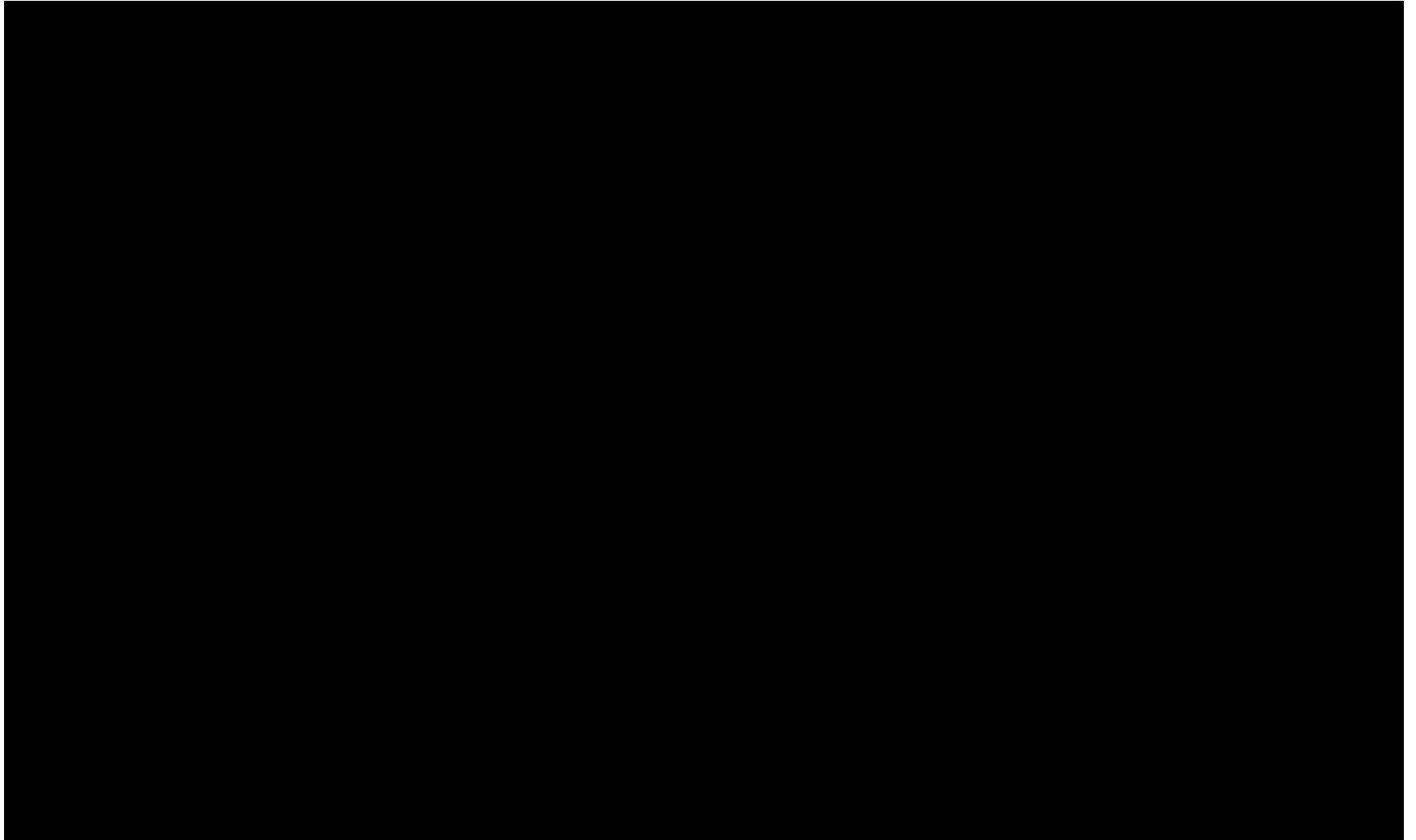
Photo Tourism

Exploring photo collections in 3D

Noah Snavely Steven M. Seitz Richard Szeliski
University of Washington *Microsoft Research*

SIGGRAPH 2006

Building Rome on a cloudless day



AutoStitch

► <http://cs.bath.ac.uk/brown/autostitch/autostitch.html>

AUTOSTITCH

[AutoStitch](#) | [Gallery](#) | [Download \(Windows demo\)](#) | [Buy Autopano](#) | [Licensing](#) | [Press](#) | [FAQ](#) | [Publications](#)

AutoStitch :: a new dimension in automatic image stitching



Serratus

Welcome to AutoStitch. If you have an iPhone, please check out our new iPhone version of AutoStitch below! If you're looking for the Windows demo version, you can download it using the link above, or read on to find out more about AutoStitch. Thanks for visiting!



New! AutoStitch iPhone

AutoStitch now brings the latest in image recognition technology to your iPhone. Stitch images in any order or arrangement, using photos taken from your iPhones camera. Just select a set of images from the camera roll or photo albums, and AutoStitch does the rest. For more details, see our [webpage](#), or go directly to the [app store](#):



The AutoStitch Process



25 of 57 images aligned



All 57 images aligned



Photosynth

- ▶ DeepZoom & HD View
- ▶ <http://photosynth.net/>

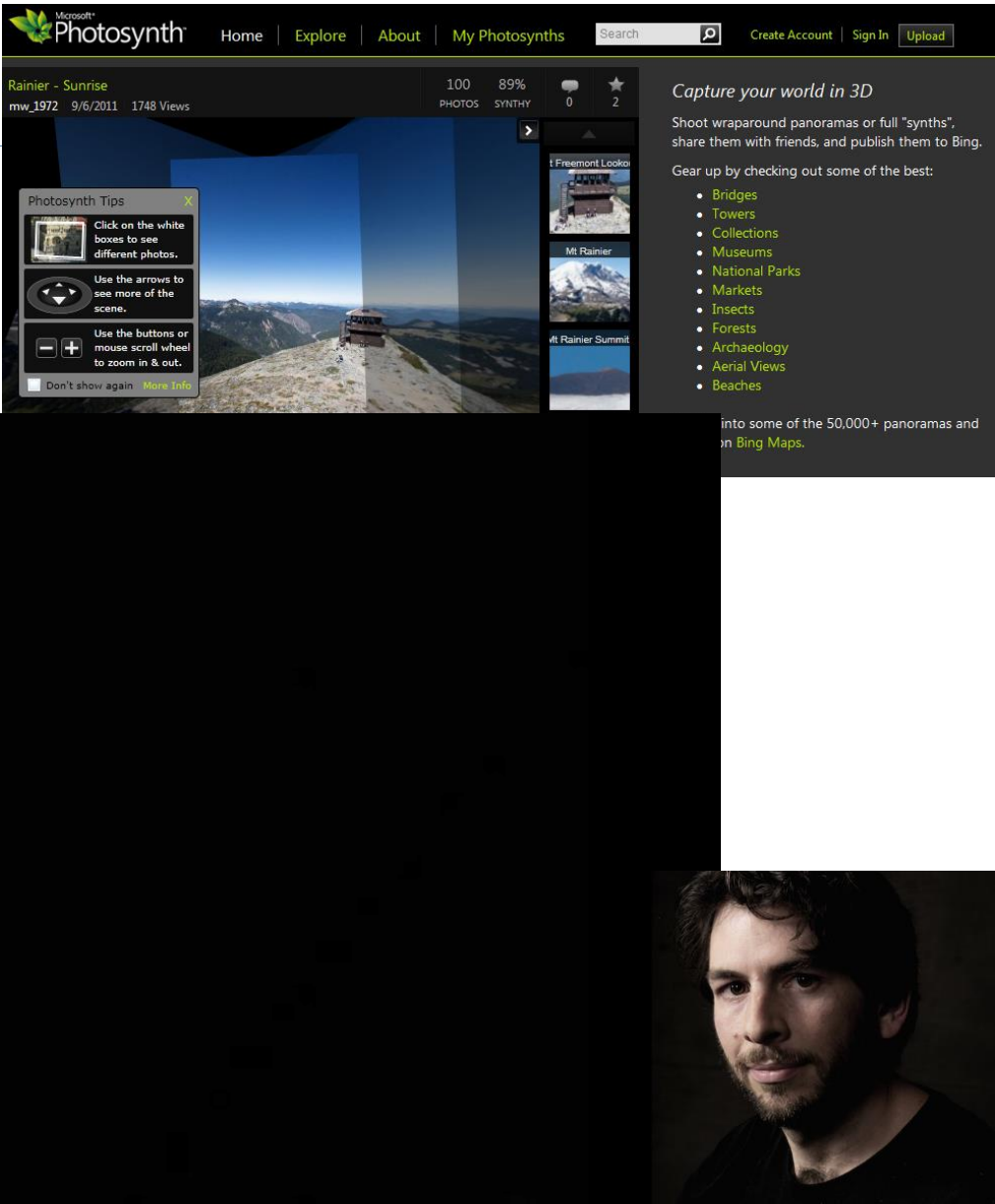


Image Composite Editor

- ▶ <http://research.microsoft.com/en-us/um/redmond/groups/ivm/ice/>

Microsoft
Research

Links

- ICE Forum
- Silverlight Deep Zoom
- HD View
- HD View SL

Compatibility

Microsoft Image Composite Editor works on 32-bit and 64-bit versions of Windows XP, Windows Vista, and Windows 7.

Download

Version 1.4.4
May 26, 2011

**Download for
32-bit Windows**

**Download for
64-bit Windows**

[Help: 32-bit or 64-bit?](#)

Image Composite Editor

What is Image Composite Editor?

Microsoft Image Composite Editor is an advanced panoramic image stitcher. Given a set of overlapping photographs of a scene shot from a single camera location, the application creates a high-resolution panorama that seamlessly combines the original images. The stitched panorama can be shared with friends and viewed in 3D by uploading it to the [Photosynth](#) web site. Or the panorama can be saved in a wide variety of image formats, from common formats like JPEG and TIFF to the multiresolution tiled format used by Silverlight's [Deep Zoom](#) and by the [HD View](#) and [HD View SL](#) panorama viewers.

▶

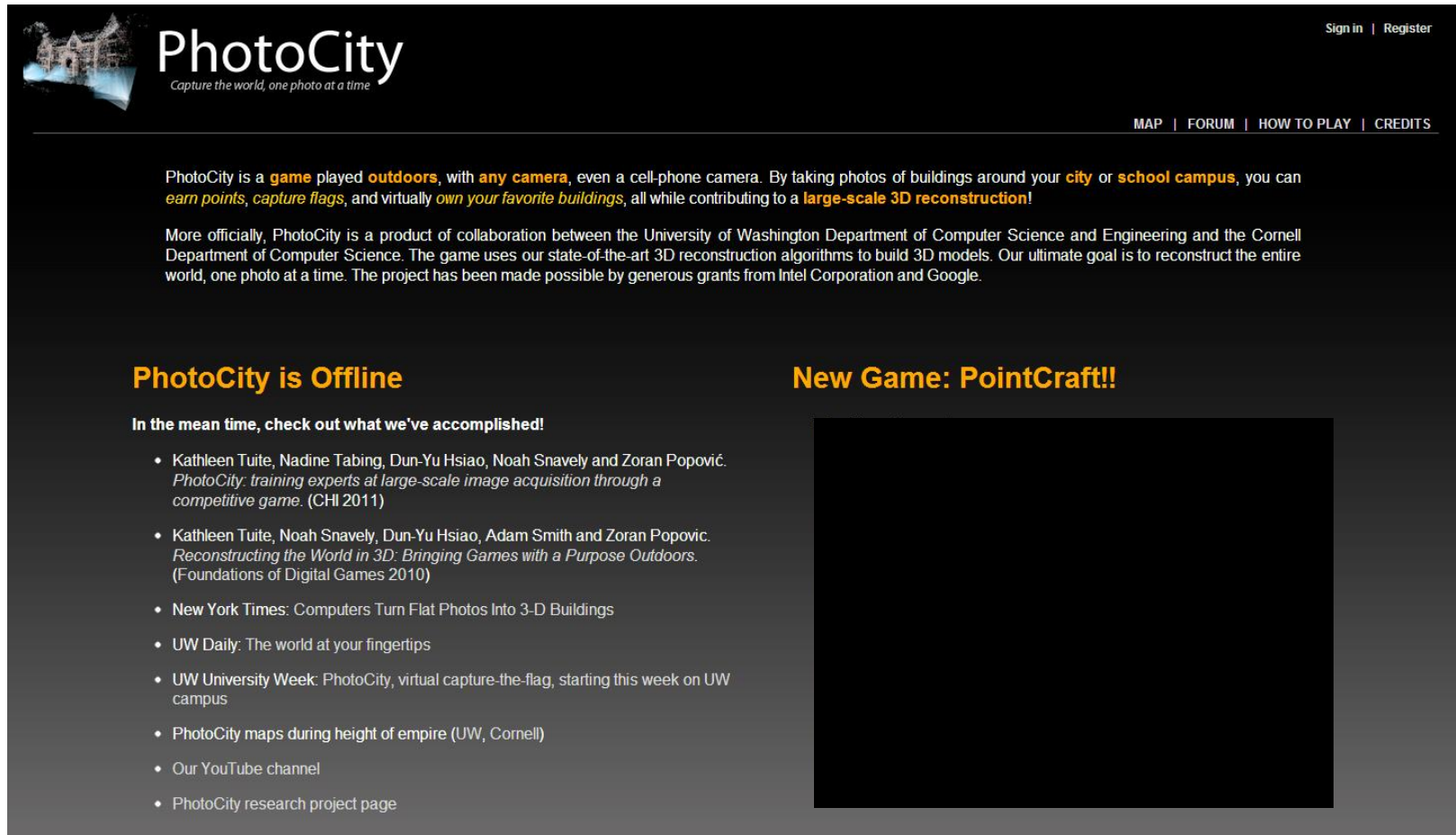
12

lbq@dongseo.ac.kr

1/12/2014

PhotoCity

► <http://photocitygame.com/>



PhotoCity is a **game** played **outdoors**, with **any camera**, even a cell-phone camera. By taking photos of buildings around your **city** or **school campus**, you can **earn points**, **capture flags**, and virtually **own your favorite buildings**, all while contributing to a **large-scale 3D reconstruction**!

More officially, PhotoCity is a product of collaboration between the University of Washington Department of Computer Science and Engineering and the Cornell Department of Computer Science. The game uses our state-of-the-art 3D reconstruction algorithms to build 3D models. Our ultimate goal is to reconstruct the entire world, one photo at a time. The project has been made possible by generous grants from Intel Corporation and Google.

PhotoCity is Offline

In the mean time, check out what we've accomplished!

- Kathleen Tuite, Nadine Tabing, Dun-Yu Hsiao, Noah Snaveley and Zoran Popović. *PhotoCity: training experts at large-scale image acquisition through a competitive game.* (CHI 2011)
- Kathleen Tuite, Noah Snaveley, Dun-Yu Hsiao, Adam Smith and Zoran Popovic. *Reconstructing the World in 3D: Bringing Games with a Purpose Outdoors.* (Foundations of Digital Games 2010)
- New York Times: Computers Turn Flat Photos Into 3-D Buildings
- UW Daily: The world at your fingertips
- UW University Week: PhotoCity, virtual capture-the-flag, starting this week on UW campus
- PhotoCity maps during height of empire (UW, Cornell)
- Our YouTube channel
- PhotoCity research project page

New Game: PointCraft!!



Depth Camera

lbg@dongseo.ac.kr

Bumblebee

► <http://www.ptgrey.com/products/stereo.asp>

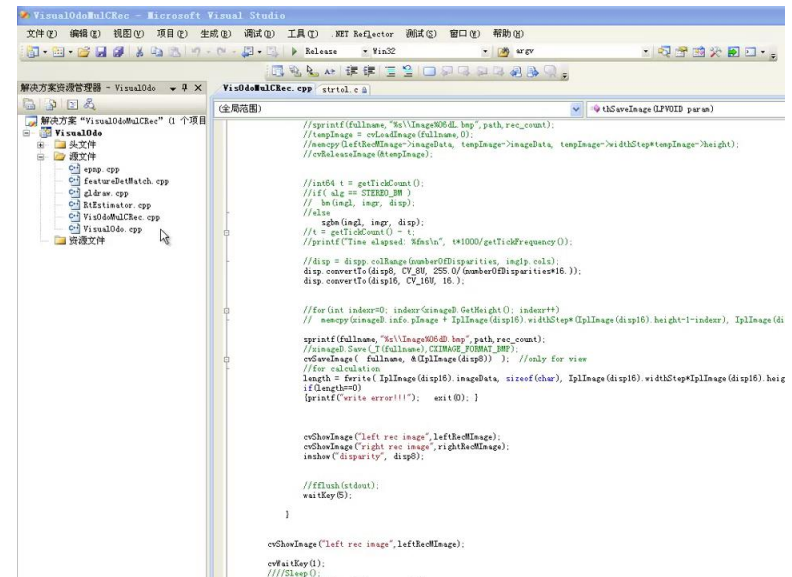


bumblebee™

Specifications:

- 640x480 Option: two Sony ICX084 Color or BW CCDs
- 1024x768 Option: two Sony ICX204 Color or BW CCDs
- 1/3 inch, progressive scan CCDs
- 640x480 square pixels at 30 Hz frame rate
- 1024x768 square pixels at 15 Hz frame rate
- 10 bit A/D
- Shutter speed: 1/16000 to 1/30 second
- Baseline: 12cm
- Choice of 2mm, 4mm or 6mm focal length lenses (100°, 70°, and 50° HFOV respectively)

Sony Bumblebee Stereo Camera



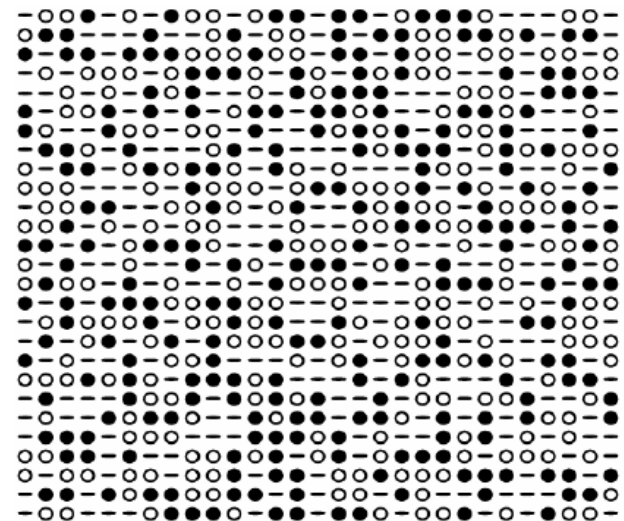
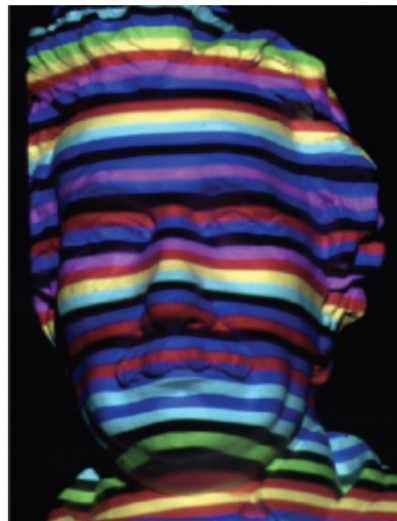
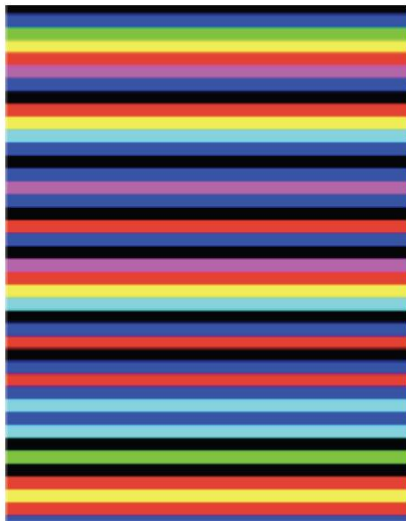
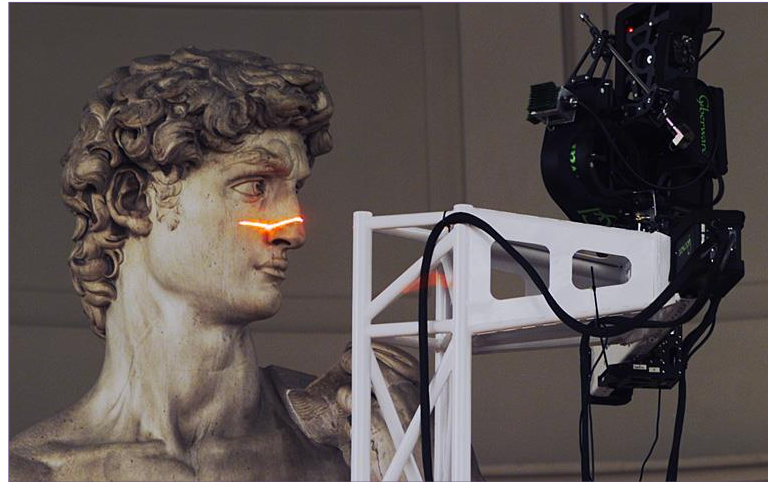
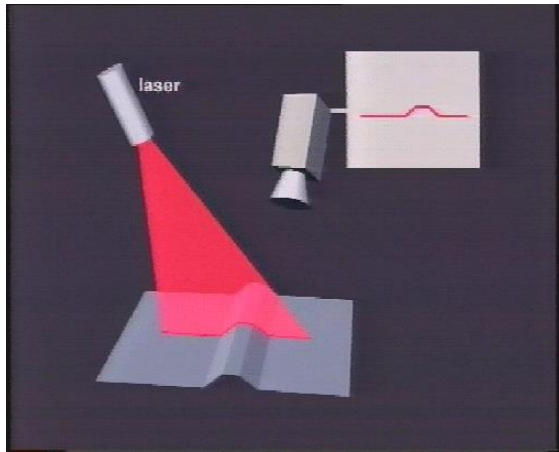
www.ptgrey.com

305-1847 West Broadway, Vancouver, B.C., Canada V6J 1Y6 T: +604-730-9937 F: +604-732-8231

Point Grey Research (PGR) is a worldwide leader in the development of advanced digital camera technology products. Based in Vancouver, British Columbia, PGR designs, manufactures and distributes IEEE-1394 cameras, stereo vision cameras and spherical digital video cameras to a broad spectrum of industries. Through a close working relationship with its customers, PGR continues to be at the forefront of innovation.

Revised February 14, 2005

Structured Light 3D Surface Imaging



Structured Light Projection (SLP) Classification Framework

Structured Light 3D Surface Imaging Techniques

Sequential Projections (Multi-Shots)

Binary Code

Gray Code

Phase Shift

Hybrid: Gray code + Phase Shift



Continuous Varying Pattern (Single Shot)

Rainbow 3D Camera

Continuously Varying Color Code



Stripe Indexing (Single Shot)

Color Coded Stripes

Segmented Stripes

Gray Scale Coded Stripes

De Bruijn Sequence



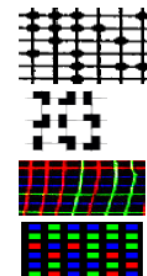
Grid Indexing (Single Shot)

Pseudo Random Binary-Dots

Mini-Patterns as Codewords

Color Coded Grid

2D Color Coded Dot Array

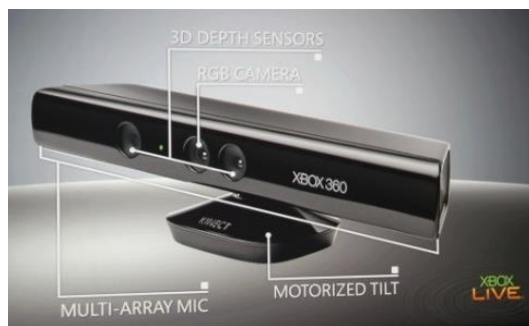


Kinect for XBox



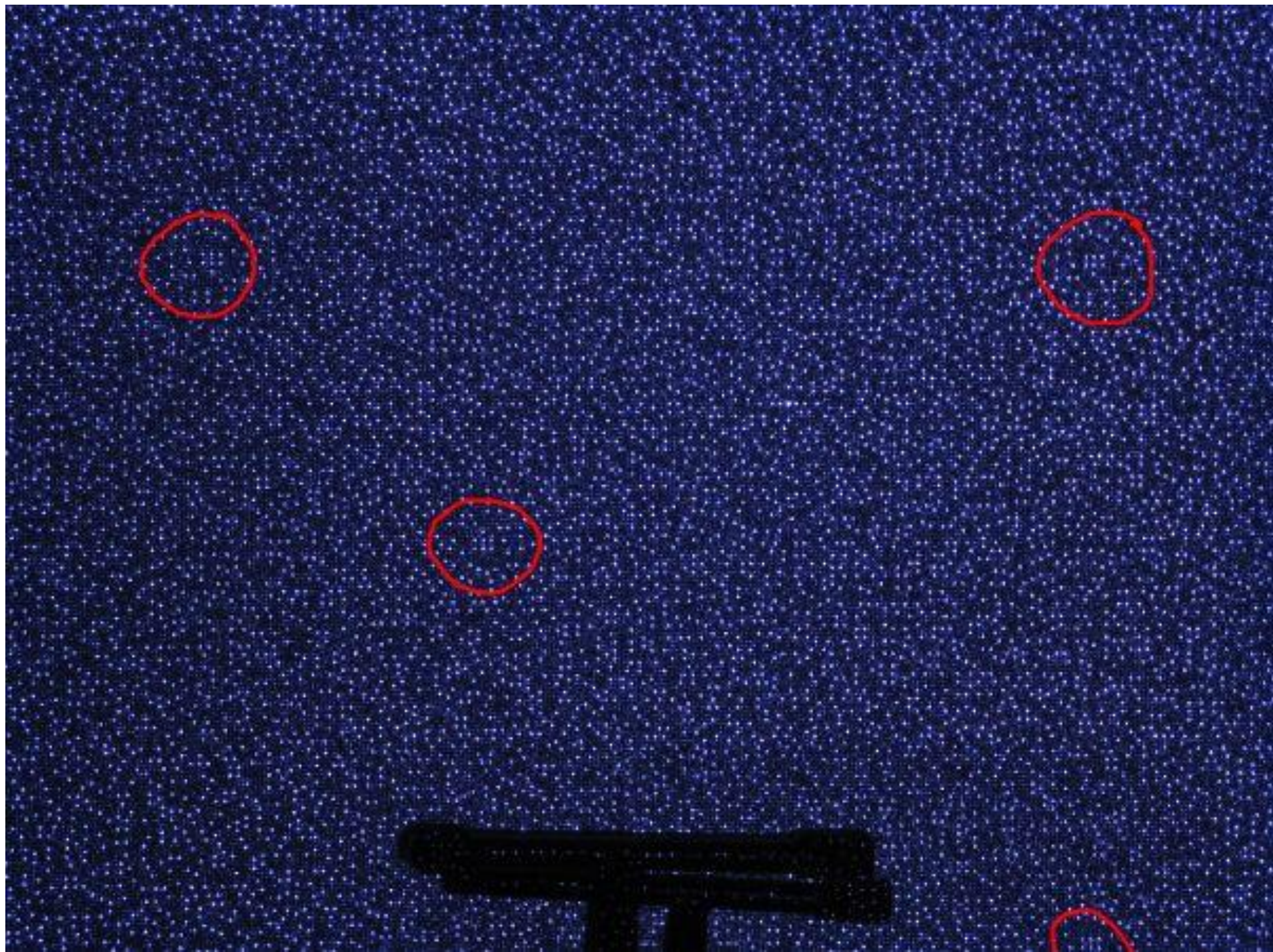
What is Kinect?

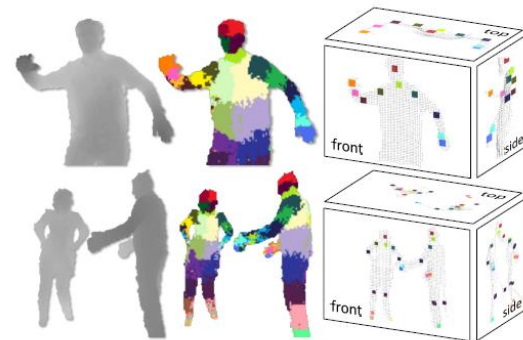
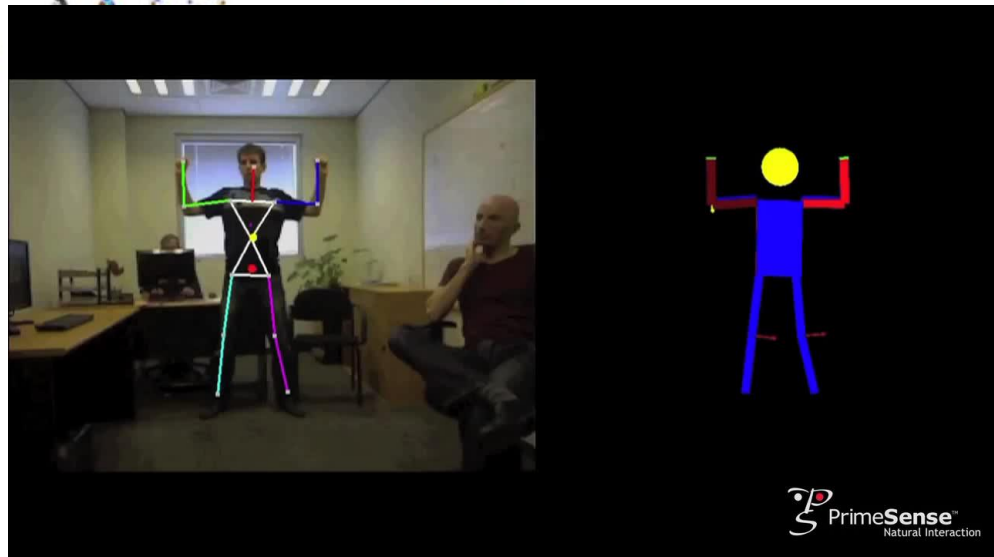
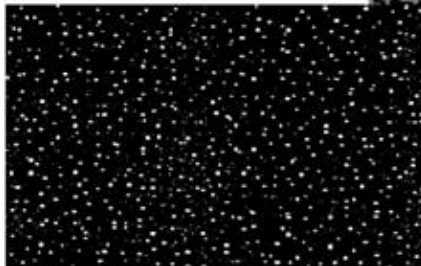
- ▶ Motion sensing input device by Microsoft
- ▶ Depth camera tech. developed by PrimeSense Invented in 2005
- ▶ Software tech. developed by Rare
- ▶ First announced at E3 2009 as “Project Natal”
- ▶ Windows SDK Releases



Kinect for XBox

- ▶ The subpattern is 211×165 , totalling to 633×495 spots, sensor chip with SXGA resolution (1280×1024)
- ▶ Both dimensions are odd numbers, so that there can be a central bright spot.
- ▶ The number of (bright or dark) spots inside the subpattern region is 34,815.
- ▶ 3,861 of them are bright $0.1109 = 1 / 9.017094$. Therefore, on average every 3×3 region there is one bright spot.
- ▶ No bright spots are 9-connected.
- ▶ No repetitive structures.
- ▶ Always 4 bright spots per 6×6 spots
- ▶ Each bright spot is surrounded by dark spots. the number of spots per pixel is constant, a local thresholding operation could be implemented, that quickly filters out the spots in the sensor image, and converts it in a binary image for easy neighbor extraction and ID computation.
- ▶ The average brightness looks quite constant.
- ▶ A small region of spots, that is unique within the whole pattern
- ▶ Depth or disparity is finding the ID in a reference image.





depth image → body parts → 3D joint proposals

KinectFusion

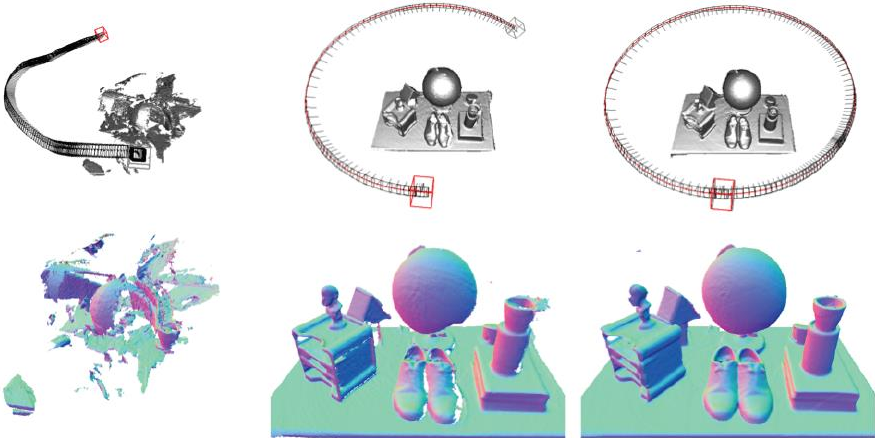
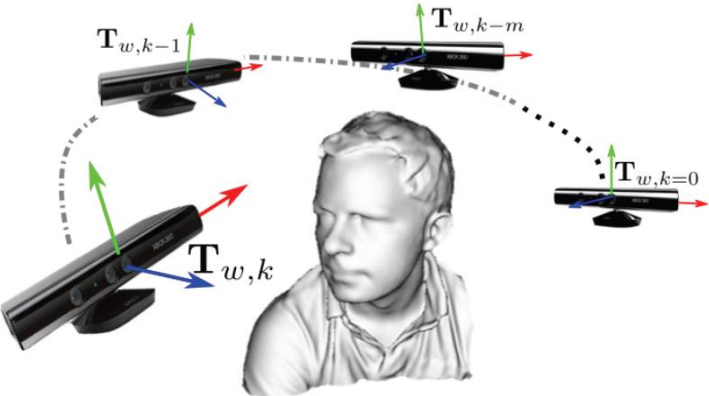
SIGGRAPH Talks 2011

KinectFusion:

Real-Time Dynamic 3D Surface Reconstruction and Interaction

Ahram Izadi 1, Richard Newcombe 2, David Kim 1,3, Otmar Hilliges 1, David Molyneaux 1,4, Pushmeet Kohli 1, Jamie Shotton 1, Steve Hodges 1, Dustin Freeman 5, Andrew Davison 2, Andrew Fitzgibbon 1

1 Microsoft Research Cambridge 2 Imperial College London
3 Newcastle University 4 Lancaster University
5 University of Toronto



(a) Frame to frame tracking

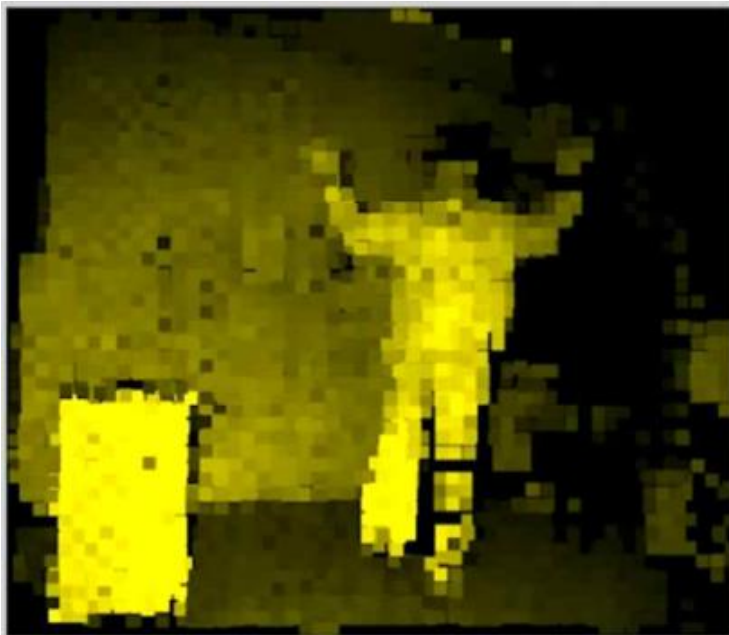
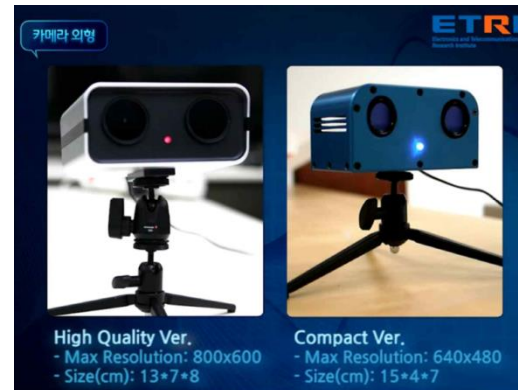
(b) Partial loop

(c) Full loop

Z-CUBE@ETRI

ETRI Electronics and Telecommunications
Research Institute

ETRI 한국전자통신연구원
www.etri.re.kr



ToF 3D Camera

Time of flight cameras

3DV ZSense



3DV, Canesta (no-longer public)

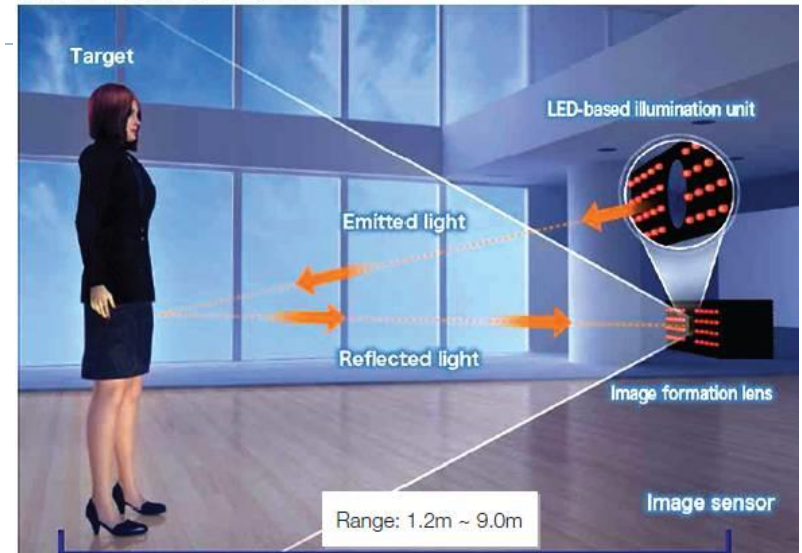
PMD Technologies <http://www.PMDTec.com>

Mesa Technologies <http://www.mesa-imaging.ch>



The PMD Technologies CamCube 2.0 is a lesser-known, but equally impressive ToF depth camera. It has a range of 7 meters, 204 x 204 pixel resolution with 40.0° x 40.0° field of view. It operates at 25 fps, and last time I checked, it costs around \$12,000.

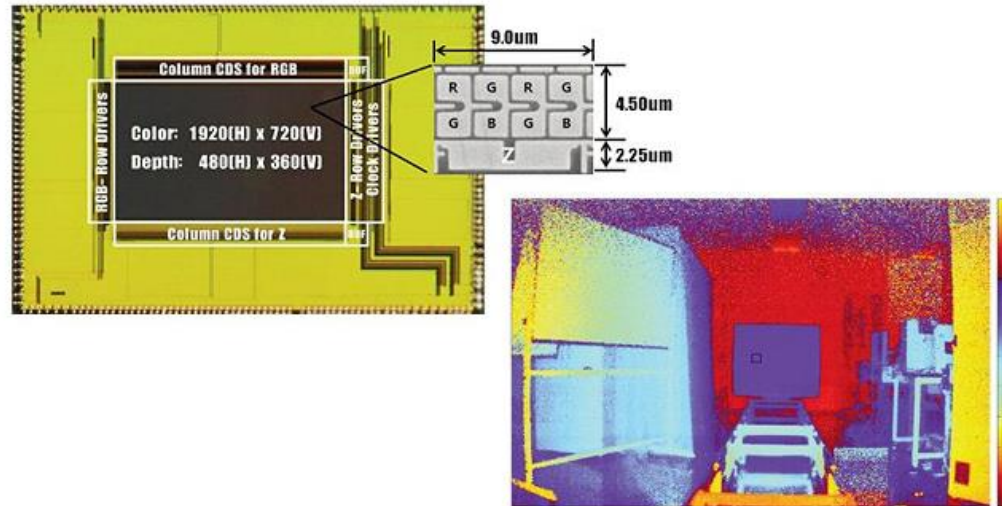
TIME-OF-FLIGHT TECHNOLOGY



The Mesa Imaging SwissRanger 4000 (SR4000) is probably the most well-known ToF depth camera. It has a range of 5-8 meters, 176 x 144 pixel resolution over 43.6° x 34.6° field of view. It operates at up to 54 fps, and costs about \$9,000. I've seen these used in a number of academic laboratories.



DepthCamera@Samsung



GUTS

New Camera Sensor Captures Images and Depth Data At the Same Time

Samsung has developed what they're touting as the [world's first sensor](#) that can capture both an RGB and range (or depth) image at the same time, granting Kinect-like gesture recognition capabilities to a host of devices.

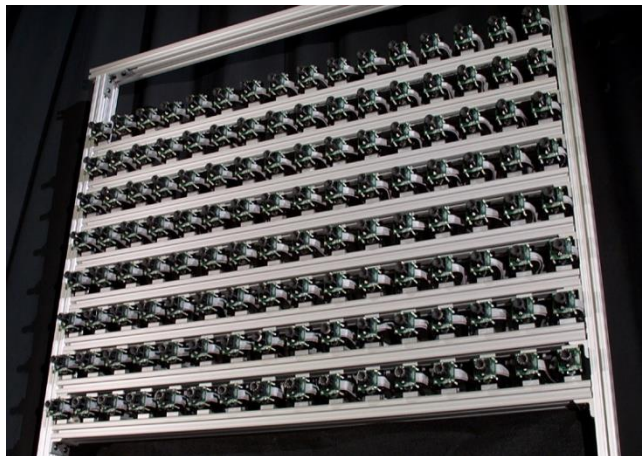
The new CMOS sensor uses an array of red, blue, and green pixels that sit alongside the depth-recording z-pixels, which are four times as large. As a result, the sensor can only capture images with a resolution of 1,920 x 720, while the depth map is limited to just 480 x 360.



Light Field Camera

lbg@dongseo.ac.kr

Stanford Multi-Camera Array



- ▶ 640×480 pixels $\times$ 30 fps $\times$ 128 cameras
- ▶ synchronized timing
- ▶ continuous streaming
- ▶ flexible arrangement



Stanford Light Field Archive



The (New) Stanford Light Field Archive

Computer Graphics Laboratory, Stanford University

[Home](#) [Light Fields](#) [Calibration](#) [Acquisition](#) [Software](#) [Publications](#)

Listed below are the light fields in our archive. For each light field, there is a link to the imagery - sometimes in several forms, and sometimes accompanied by calibration information. Following this is a link that allows you to view the light field in your browser using our Flash-based light field viewer.

Notes about the light field viewer

In most cases you shouldn't need to download any software to use our viewer; just click on the indicated links below. Be warned though, this involves loading the entire light field (usually at slightly reduced spatial resolution) into memory. For the largest light fields, this involves downloading about 30MB of data, and will cause your browser to use up to a gigabyte of RAM. Firefox 3 uses notably less RAM than Firefox 2 when viewing these light fields, as does Internet Explorer 7. Safari and Opera should also work, with the appropriate flash player plugin.

You're free to take the viewer and use it for your own light fields. The [source code and instructions](#) for the using or modifying viewer are available.

Light Fields from the Lego Gantry

The light fields in this section were acquired by [Andrew Adams](#).



Chess

289 views on a 17x17 grid, image resolution 1400x800
[Original camera images](#), [Rectified and cropped images](#)

A chess board with pieces. Chess boards are great for demonstrating refocusing.

[View light field online](#)



Lego Bulldozer

289 views on a 17x17 grid, image resolution 1536x1152
[Original camera images](#), [Rectified and cropped images](#)

A Lego Technic bulldozer. Very complex geometry.

[View light field online](#)



Lego Truck

289 views on a 17x17 grid, image resolution 1280x960
[Original camera images](#), [Rectified and cropped images](#)

A Lego Technic truck. Very complex geometry.

[View light field online](#)



Eucalyptus Flowers

289 views on a 17x17 grid, image resolution 1280x1536
[Original camera images](#), [Rectified and cropped images](#)

Some traditional Australian flowers. Lots of fine geometry.

[View light field online](#)

Stanford Light Field Archive



Lytro Camera

[STORE](#)
[CAMERA](#)
[GALLERY](#)
[LEARN](#)
[SIGN IN](#)

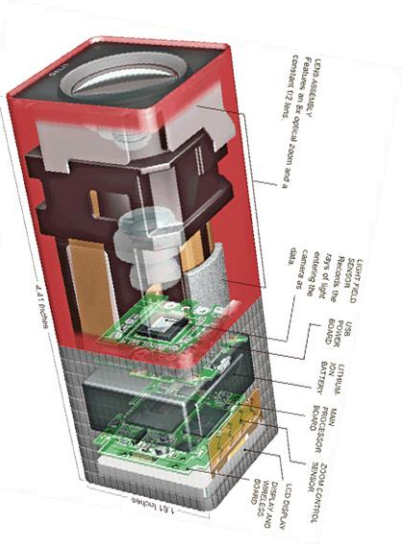
Free two-day shipping

The Lytro camera.
Create pictures that are worth exploring.

Buy now



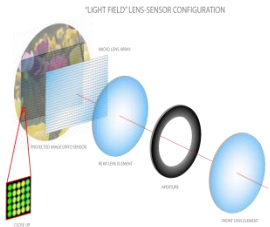
Fred R. Conrad/The New York Times
Ren Ng, chief executive of Lytro, a start-up company in Silicon Valley.



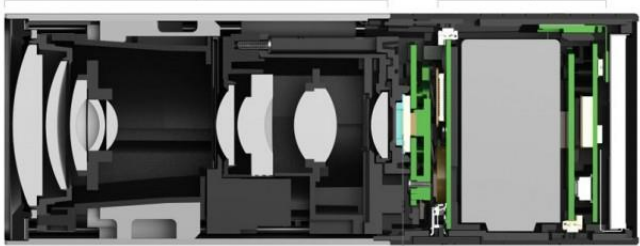
Red Hot
16GB
750 Pictures
\$499.00



Electric Blue
8GB
350 Pictures
\$399.00



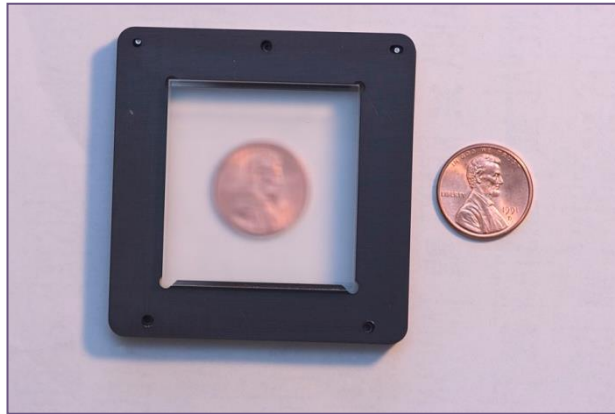
Light Field Engine 1.0
The Light Field Engine replaces the supercomputer from the lab and processes the light ray data captured by the sensor.
The Light Field Engine travels with every living picture as it is shared, letting you refocus pictures right on the camera, on your desktop and online.



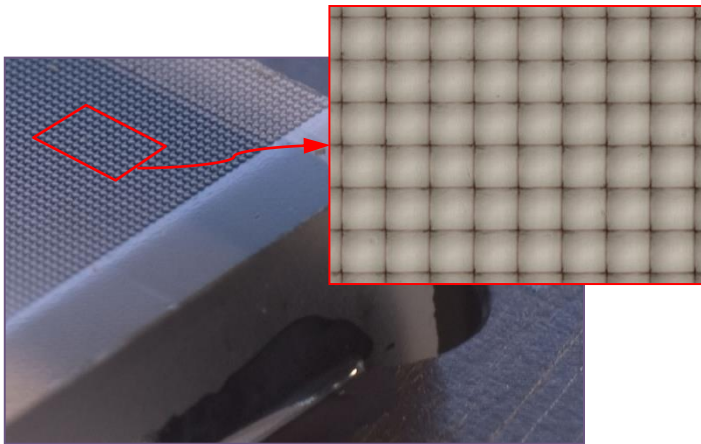
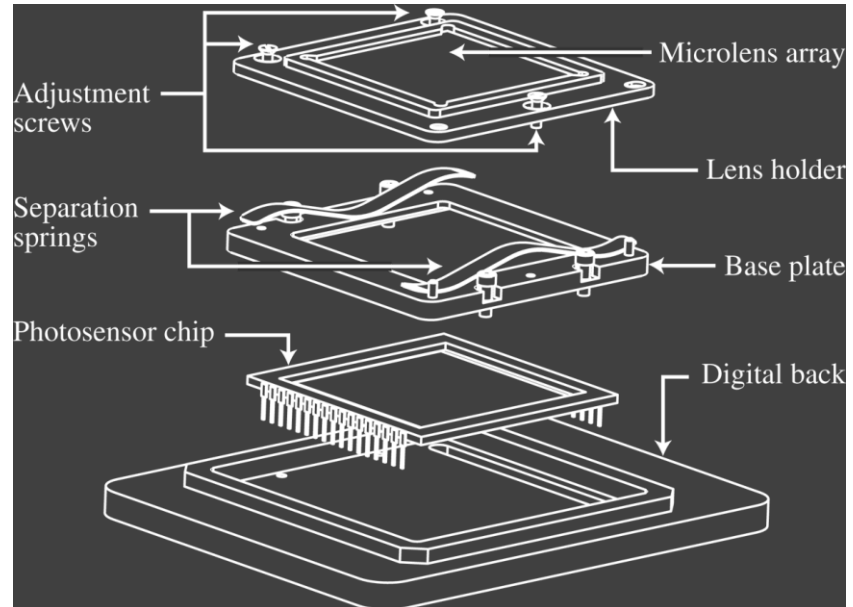
Light Field Sensor
From a roomful of cameras to a micro-lens array specially adhered to a standard sensor, the Lytro's Light Field Sensor captures 11 million light rays.



Adaptive Optics Microlens Array



Adaptive Optics microlens array



125 μ square-sided microlenses



$$4000 \times 4000 \text{ pixels} \div 292 \times 292 \text{ lenses} = 14 \times 14 \text{ pixels per lens}$$

Adobe LightField Camera

Adobe LightField Camera Prototypes

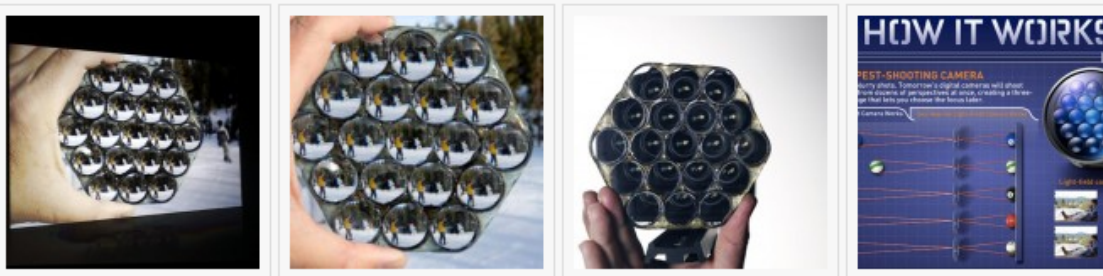
Adobe Systems, the leading specialist of image manipulation, multimedia and creativity software products, has long been investigating the possibilities of LightField photography and computational imaging. Known prototypes date back to 2004, and have evolved from compound lenses with only a few sub-images to microlens arrays.

Here's an overview of Adobe's (publicly shown) LightField camera prototypes.

1. Generation Prototype: Magic Lens

Adobe's first LightField camera prototype was tested and developed in 2004-2006, and publicly demoed in 2006/2007. It consisted of a 100 megapixel camera with a special compound lens (dubbed "Magic Lens") made of 19 sub-lenses in a hexagonal array. Each of these is facing an individually configured prism set at a unique angle, resulting in 19 different focal points.

This setup created 19 subpictures of the entire scene, with a resolution of 5.2 megapixels per subpicture.

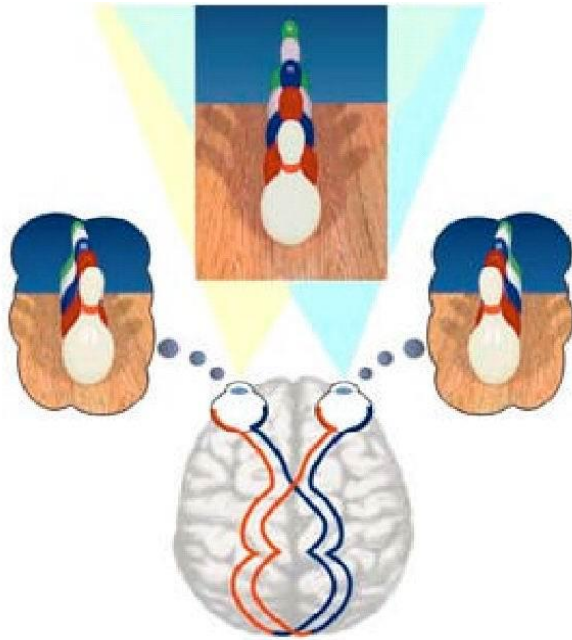


3D Display System

lbg@dongseo.ac.kr

3D Display

Human Visual System



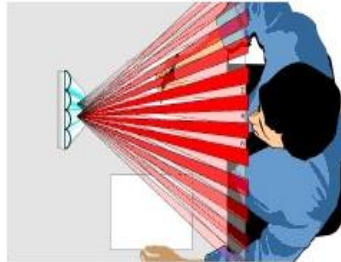
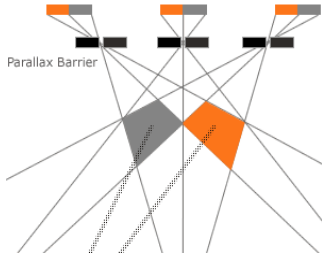
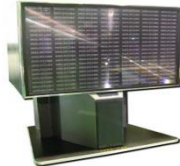
Stereo Disparity

3D Display Systems

- **Stereoscopic display**
- **Autostereoscopic display**
- **Holographic display**

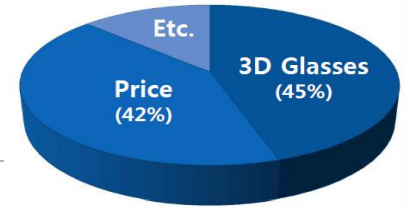


Classification of 3D Display

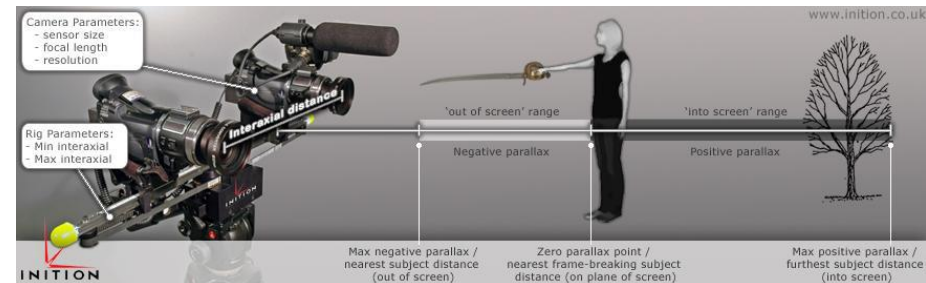
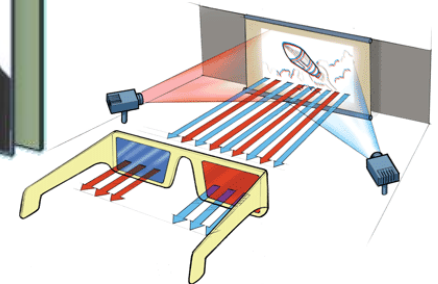
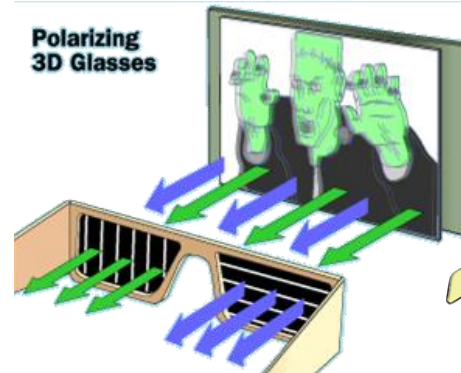
	Glasses	Non-glasses
	Stereoscopic display - Polarization method - Sutter glasses method	Autostereoscopic display - Lenticular-type - Barrier-type  
Real 3D		Floating Integral imaging Holography  

3D Display

- ▶ **Stereoscopic display**
- ▶ Multiview display
- ▶ Integral Image display
- ▶ Holographic display

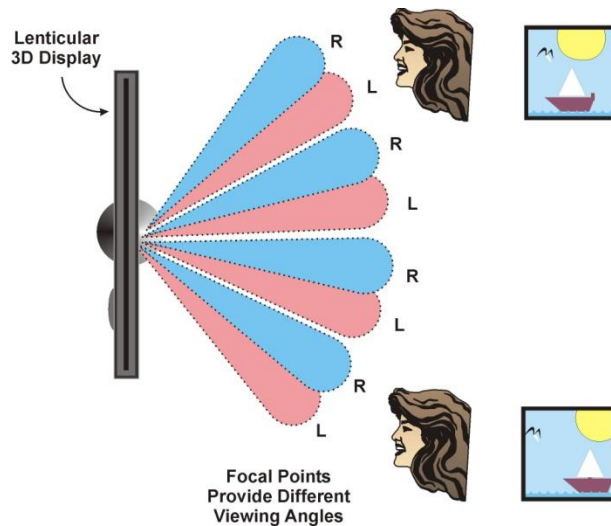


Reasons for not buying 3D TV
(NPD Group, 2011)



3D Display

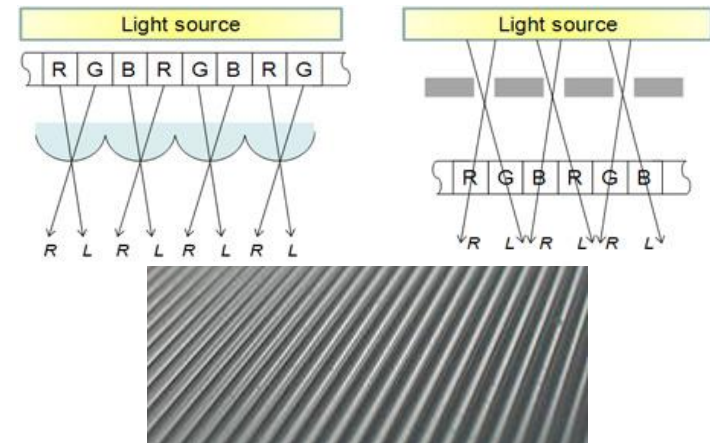
- ▶ Stereoscopic display
- ▶ **Multiview display**
- ▶ Integral Image display
- ▶ Holographic display



15 views 50" 1999

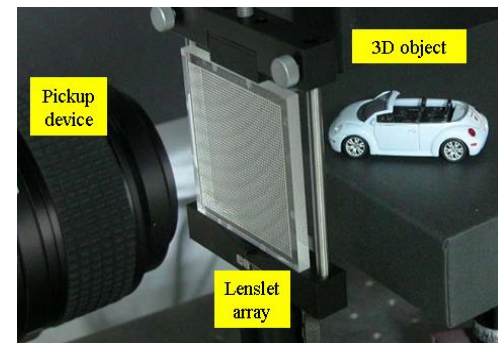
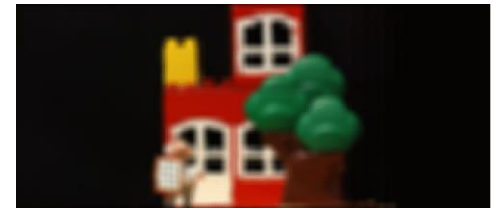
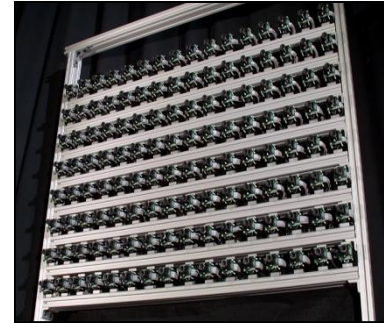


Cambridge Univ.



3D Display

- ▶ Stereoscopic display
- ▶ Multiview display
- ▶ **Integral Image display**
- ▶ Holographic display



Super multi-view camera system
M x N CCD Camera [1024X768]
Resolution : 1024 x 768 x M x N

3D Display

- ▶ Stereoscopic display
- ▶ Multiview display
- ▶ Integral Image display
- ▶ **Holographic display**

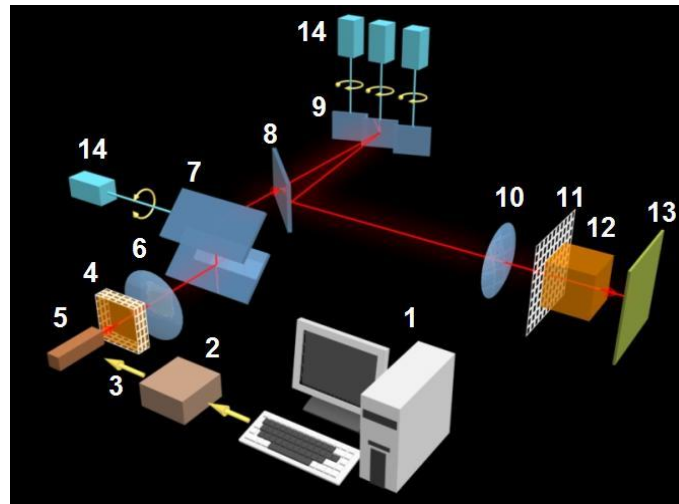
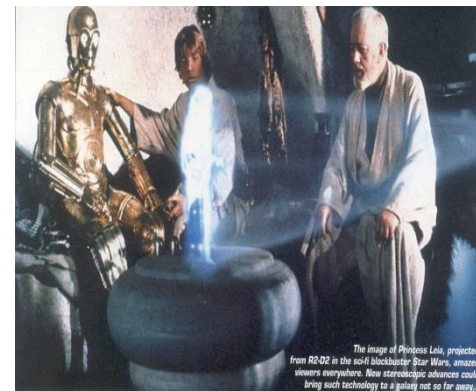


Fig. 4-1 Chart of the principle of holographic display operation

1 – computer, 2 – RF processor, 3 – RF signal, 4 – acoustic-optical modulator, 5 – laser, 6 – lens, 7 – vertical scanner, 8 – beam splitter, 9 – horizontally connected scanners, 10 – output lens, 11 – dispersion window (ground-glass), 12 – display area, 13 – display plane, 14 – drive

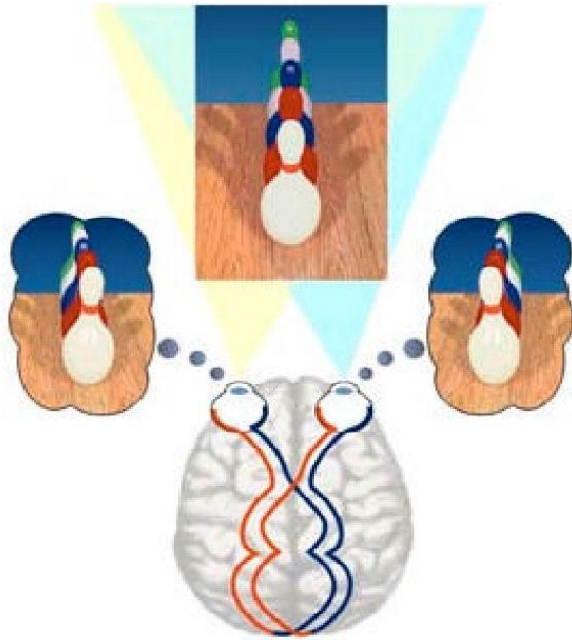


Ideal 3D Display Technique

- Based on Wave Optics
- Real images in space
- Full parallax
- Continuous viewing points
- Coherent illumination
- Color images

3D Display

Human Visual System



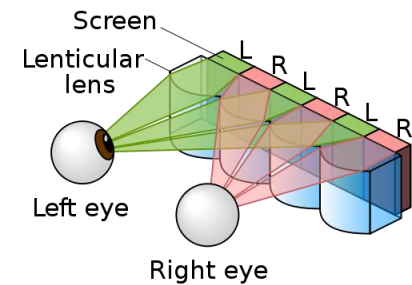
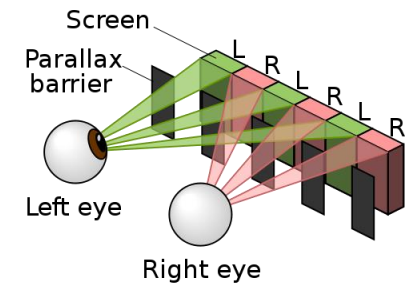
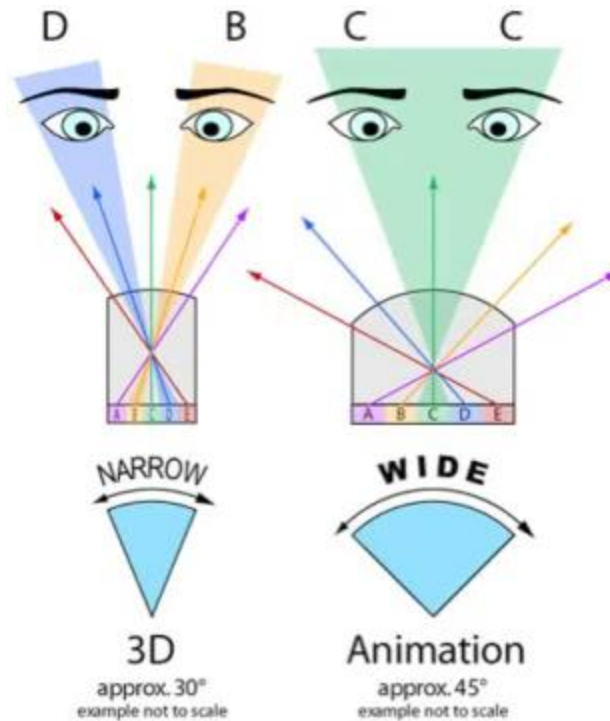
Stereo Disparity

3D Display Systems

- Stereoscopic display
- **Autostereoscopic display**
- Holographic display

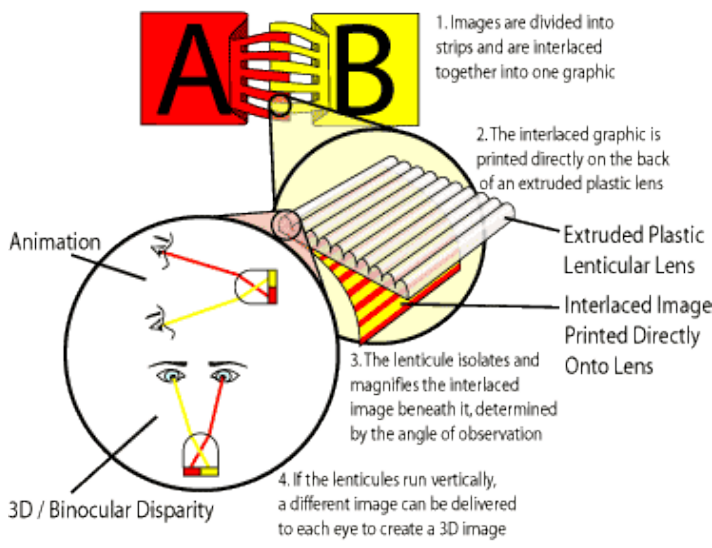
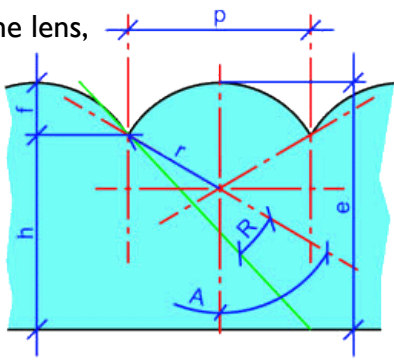


Lenticular lens

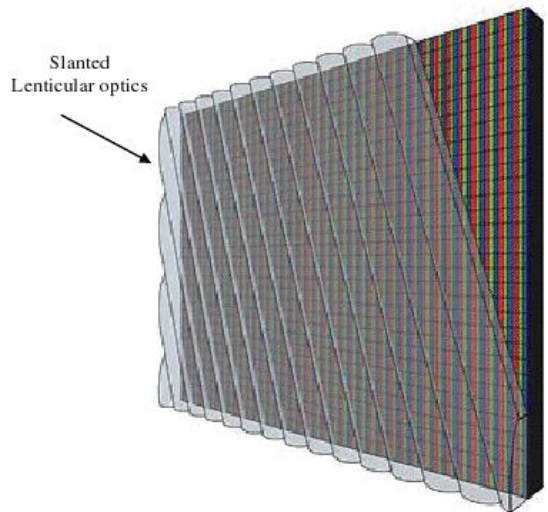


Lenticular Lens

- ▶ R is the angle between the extreme ray and the normal at the point where it exits the lens,
- ▶ p is the pitch, or width of each lenticular cell,
- ▶ r is the radius of curvature of the lenticule,
- ▶ e is the thickness of the lenticular lens
- ▶ h is the thickness of the substrate below the curved surface of the lens, and
- ▶ n is the lens's index of refraction.

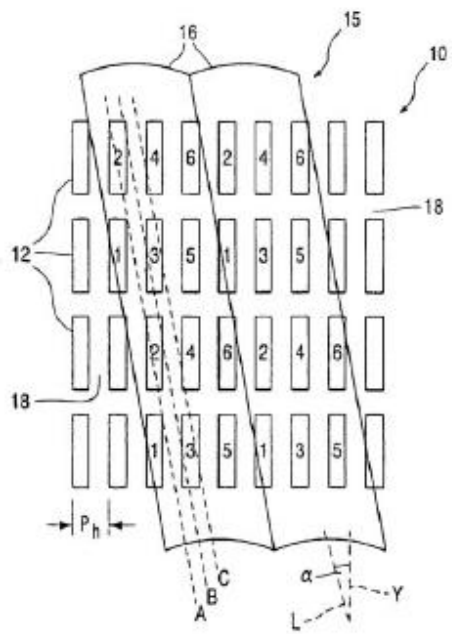


Slanted Lenses



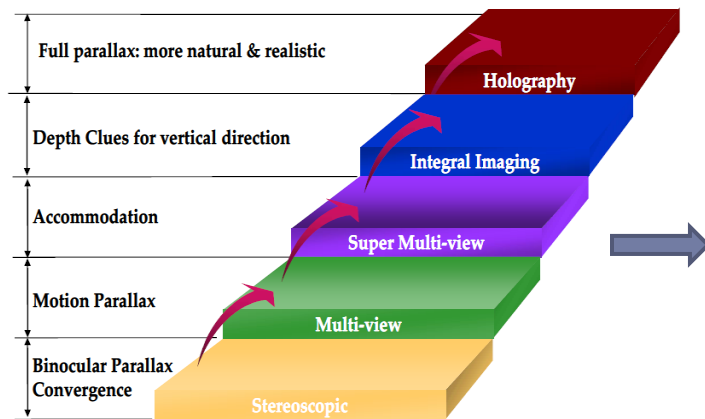
slanted lenses

- more views
- 7 views (Philips)
- 9 views (Stereographics)
- no visible dark bands

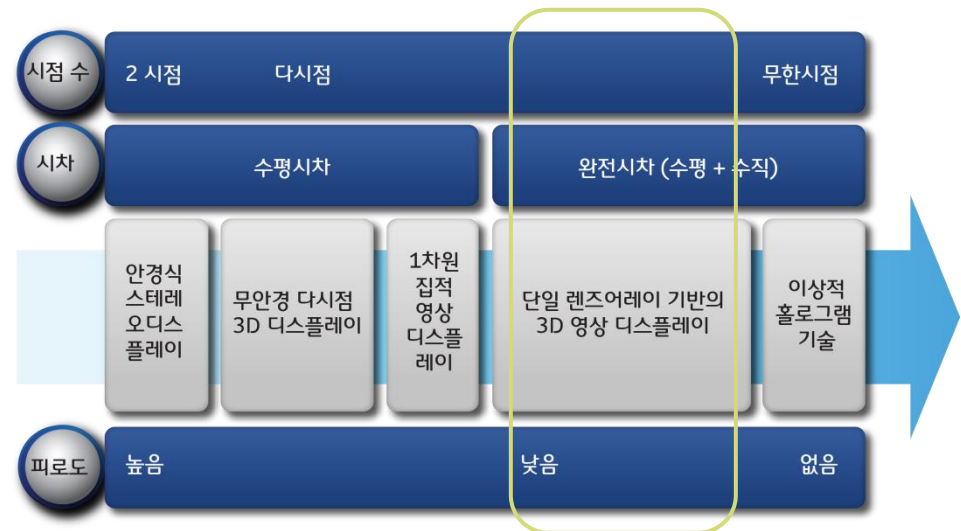


This all changed in the mid 1990s, when Cees van Berkel, at Philips research lab in the UK, discovered that slanting the lenticular array solved both problems. The slanted configuration meant that both horizontal and vertical resolution are divided amongst the multiple horizontally-spaced views. We thus get a reasonable resolution in both dimensions in all views. The slanted lenslets also smear out the dark bands so that they are no longer visible.

Real 3D Display



2010 방송통신 산업전망 컨퍼런스



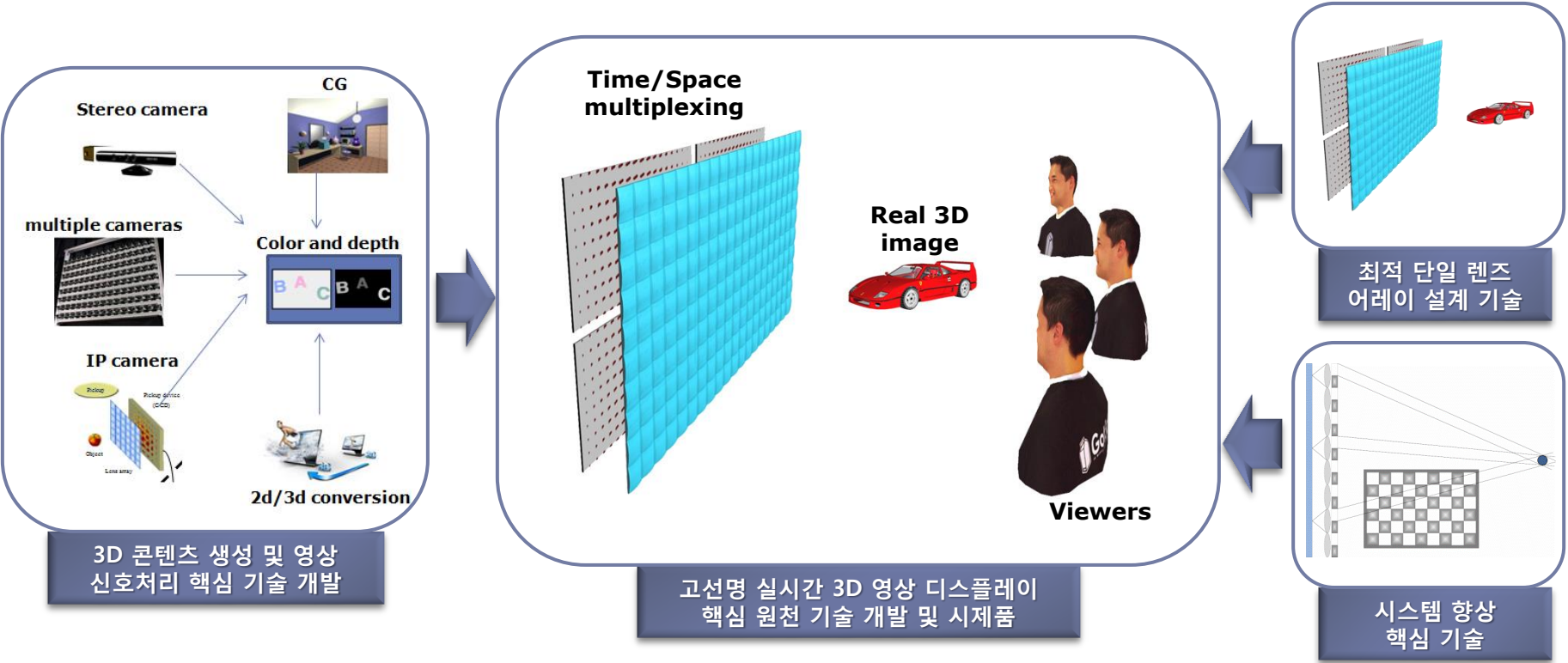
Real 3D display

- 완전시차 연속시점 제공
- 저 피로도 구현
- 간단한 시스템 구조
- 컬러 Real 3D 영상 구현 용이
- 공간 영상 재생 기술

Real 3D Display System

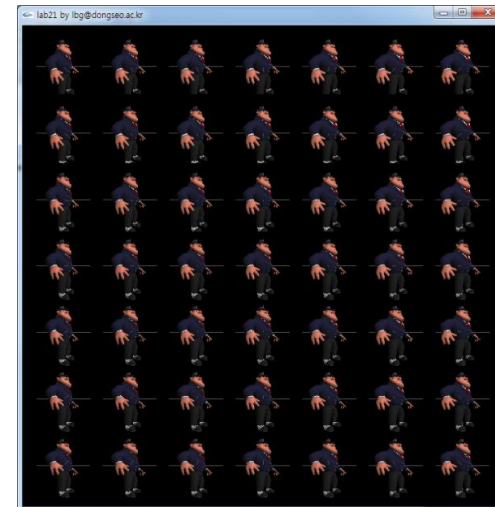
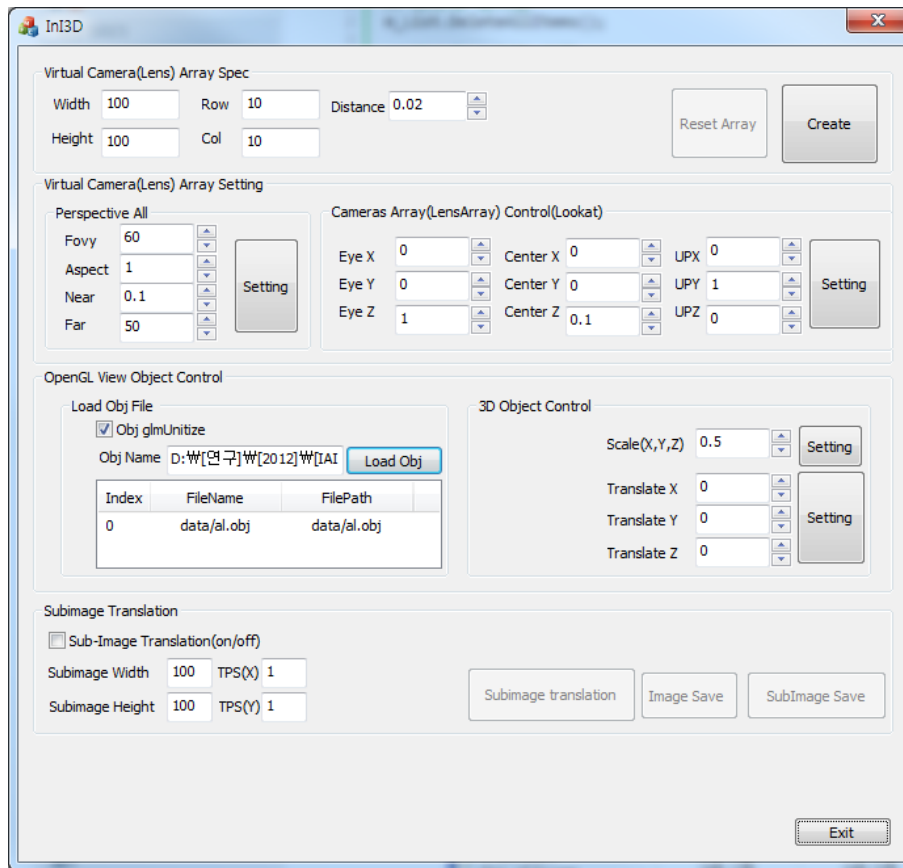
최종
목표

- 단일 렌즈어레이를 이용하는 집적 영상 기반의 고선명 실시간 3D 영상 디스플레이 시스템 핵심 원천 기술 개발 및 시제품 제작
- 집적 영상용 실시간급 3D 콘텐츠 생성 및 영상 신호 처리 핵심 원천 기술 개발

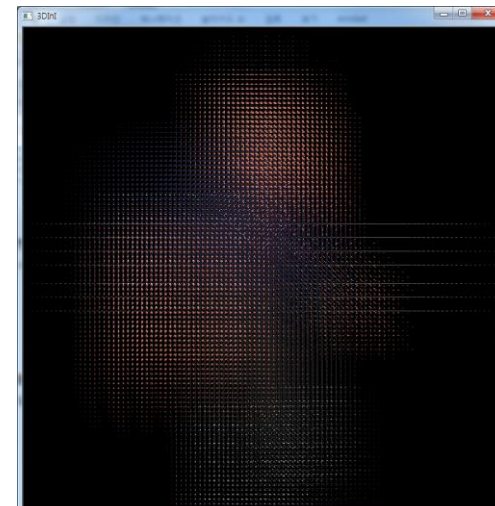


2012년 산업융합원천기술개발사업 홈/정보가전분야
집적영상(IP) 깊이 표현 범위를 개선한 고선명 3D 영상 처리 기술 개발

Camera Array Simulation using OpenGL



SubImage



ElementImage

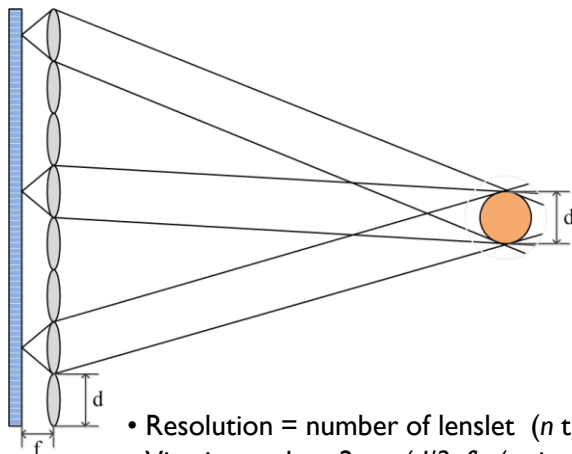
Resolution Improvements

단일 렌즈어레이와 전자마스크를 이용한 깊이우선 IP 기반의 3D 영상 디스플레이 기술

▶ 깊이우선 IP 기술에서 해상도를 복잡한 기계적 구조물 없이 증가시킬 수 있는 핵심 기술

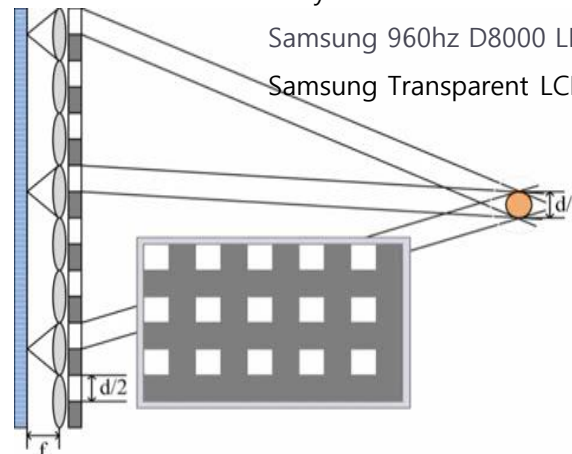
- 기존 방법 : 렌즈 어레이를 통하여 발생하는 레이들의 교차점이 렌즈 어레이의 기초렌즈 크기와 동일하기 때문에 고해상도 구현이 힘들
- 핵심 기술 : 세계 최초로 깊이우선 IP 방식에 **전자마스크**를 결합 사용하는 방법을 접목 **시분할 기법**을 통하여 해상도를 급격히 증가시킴

<기존 방법의 예>



- Resolution = number of lenslet (n times $\uparrow$)
- Viewing angle = $2\arctan(d/2nf)$ (n times $\uparrow$)
- Depth range = $d^2/\lambda n^2$ (n^2 times $\downarrow$)

<개발예정 핵심 기술>

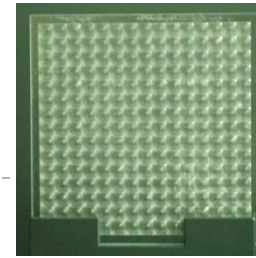


Sony 960HZ 3D LED TV KDL-55HX850 - 55" 1080P

Samsung 960hz D8000 LED TV - 46", Full HD

Samsung Transparent LCD - 22" 1680x1050 15%

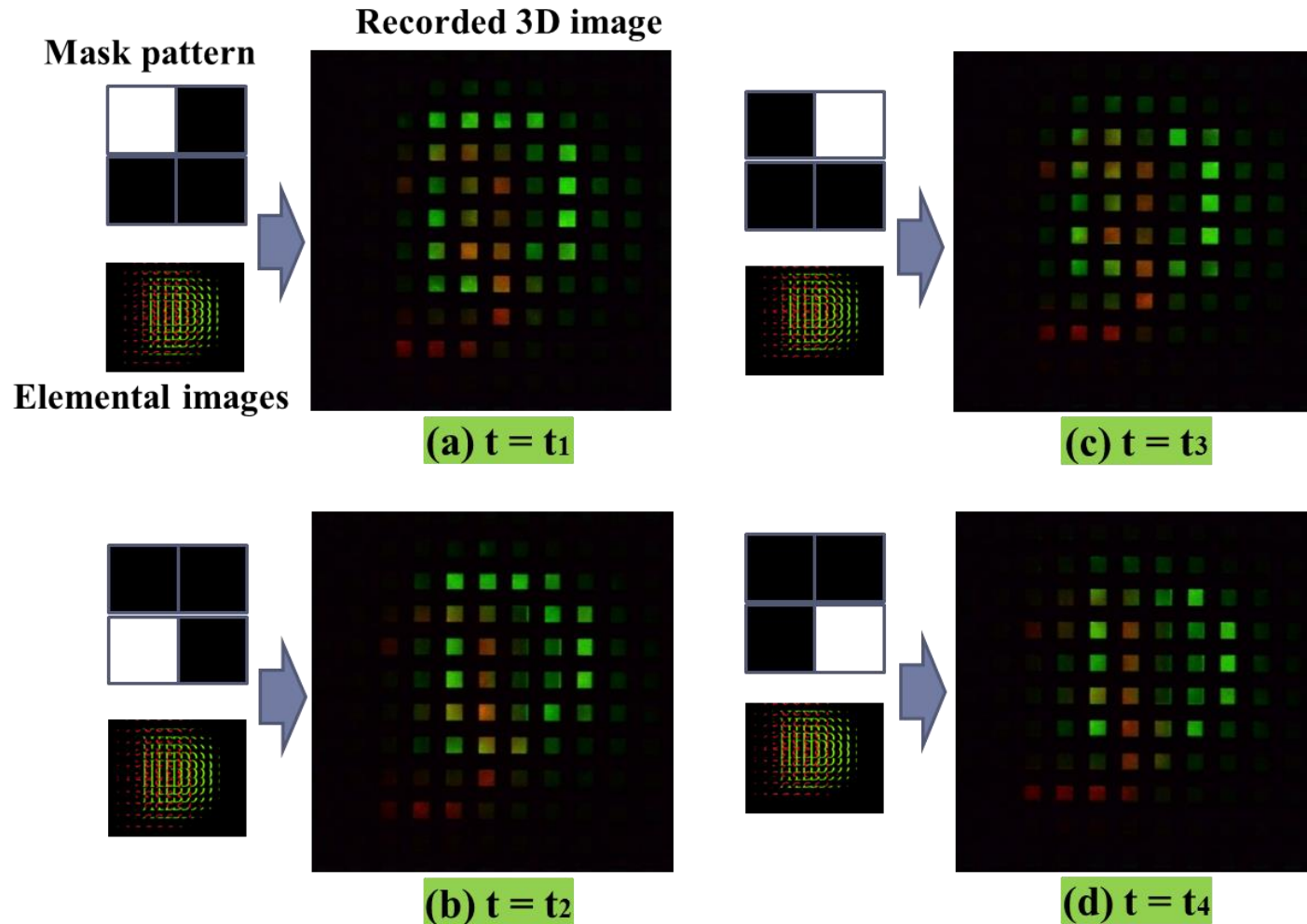
Optical System Setup



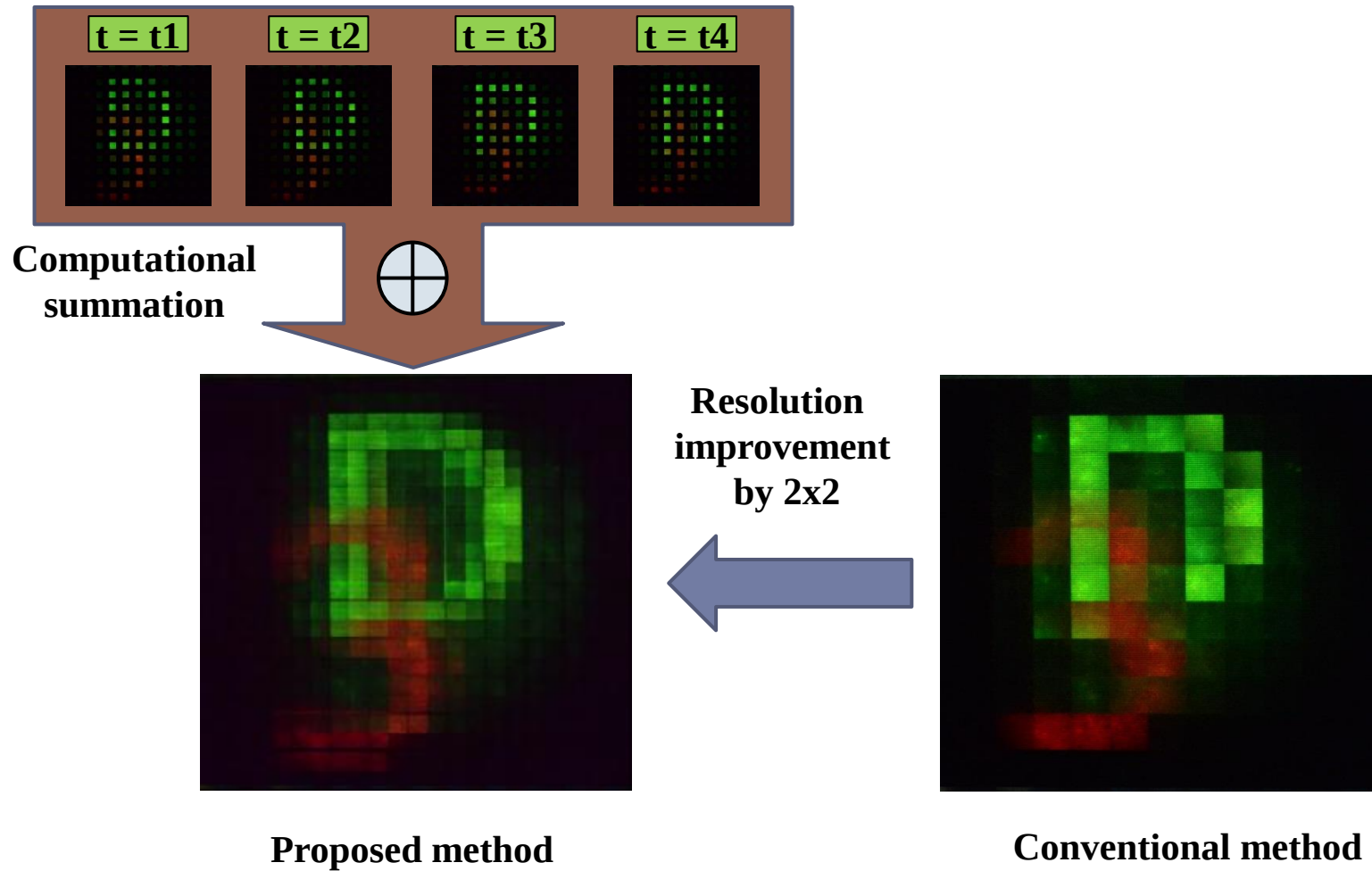
Specifications of Lenslet Array	
Type	Fresnel, Square
Lenslet pitch	5mm
No. of Lenslet	15 × 15
Focal length	10mm



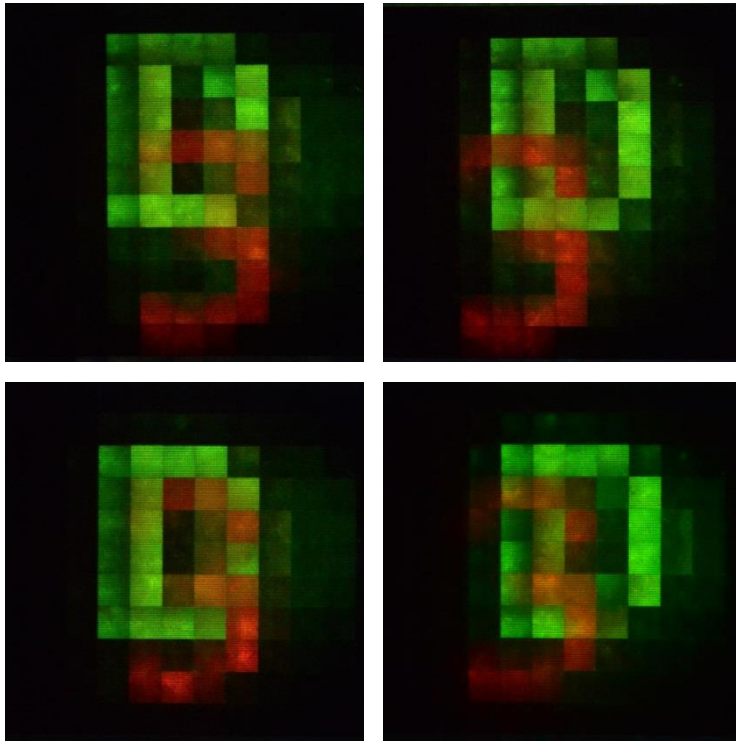
Experimental Results



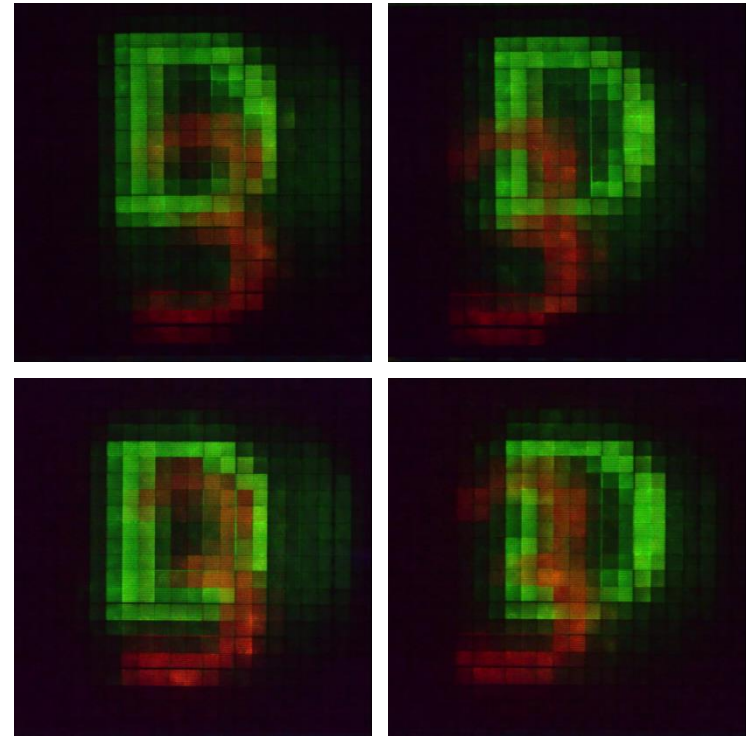
Experimental Results



Different Viewing Angle



Conventional method



Proposed method

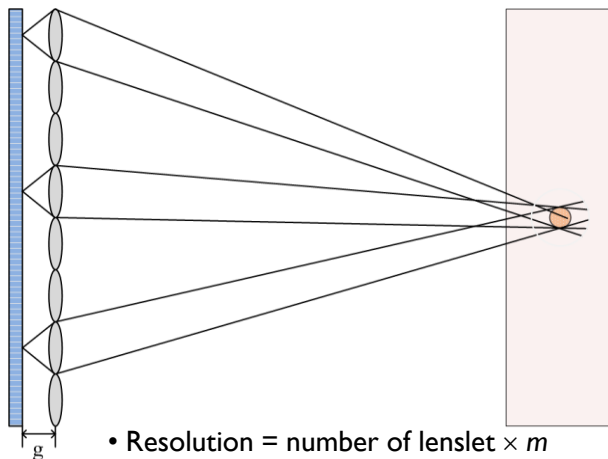
Depth Improvements

단일 렌즈어레이와 전자렌즈를 이용한 해상도우선 IP 기반의 3D 영상 디스플레이 기술

▶ 해상도우선 IP 기술에서 깊이 영역을 증가시킬 수 있는 핵심 기술

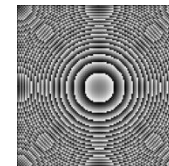
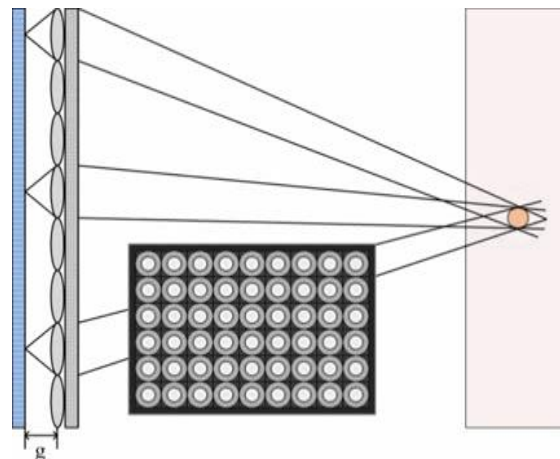
- 기존 방법 : 해상도 우선 IP 기술에서 깊이 영역을 향상시키기 위해서는 디스플레이 패널과 렌즈어레이 사이의 거리(g)를 변화시켜야 함. 이전의 방법들은 기계적으로 디스플레이 패널 또는 렌즈어레이를 움직이는 방법을 사용하였음.
- 핵심 기술 : 세계 최초로 해상도우선 IP 방식에 **렌즈 어레이와 전자렌즈를 결합** 사용하는 방법을 접목 **시분할 기법**을 통하여 깊이 영역을 급격히 증가시킴
전자렌즈 shifting 효과를 추가한 렌즈자국을 제거

<기존 방법의 예>



- Resolution = number of lenslet $\times m$
- Viewing angle = $2\text{atan}(d/2g)$
- Depth range (n times $\uparrow$)

<개발예정 핵심 기술>

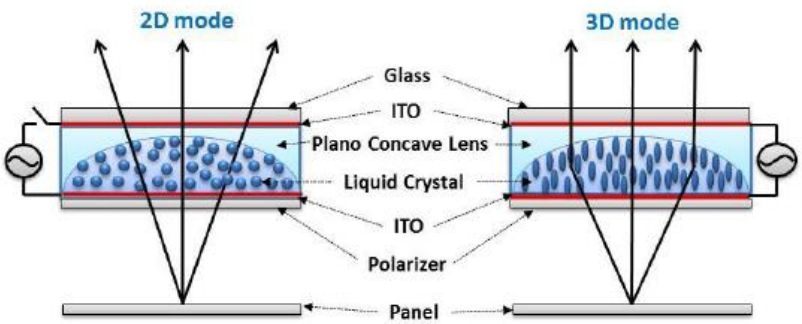




Current LC-lens for 3D Display

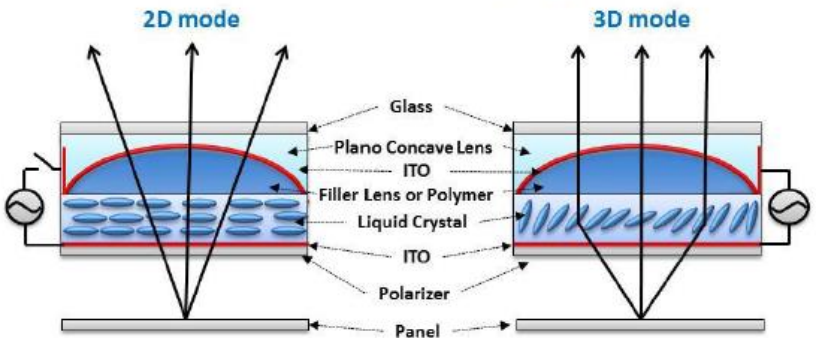
Active LC lenticular lens

S. T. De Zwart, et al., *J. Soc. Inf. Display*, 14/8, pp. 715-722, (2006)



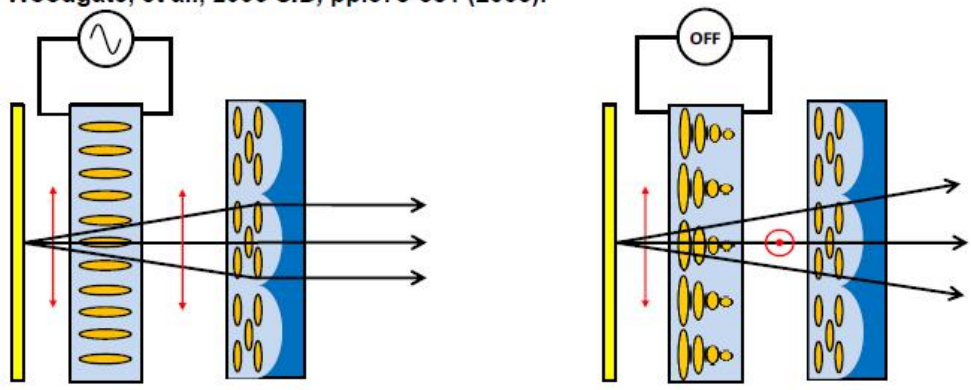
Electric-field-driven LC(ELC) lenticular lens

H. W. Ren and S. T. Wu, *Optics Express*, 15, pp. 5931-5936, (2007)



Polarization active micro-lens

G.J. Woodgate, et al., *2005 SID*, pp.378-381 (2005).



- **Complex Fabrication**
- **High Voltage**
- **Slow Response**
- **Only 2D/3D Switching**

Adaptive Liquid Crystal Lens(LC-Lens) Array for 3D Display, Interaction, and Capturing, Yi-Pai Huang

InI Camera & Display Systems

IP 카메라 및 9 인치 프로젝션형 3D 디스플레이 시스템

- ▶ 국내특허: 중간 요소 영상을 이용한 입체 영상 표시 장치, 등록번호 100730406, 2007.06.13
 국제특허: US Patent Pending, Appl No. 12/004309, 2007.12.19

기술 개요

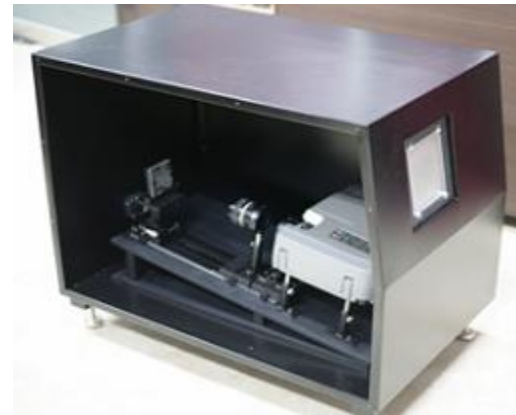
- ❖ 고해상도 IP 카메라 제작
- ❖ 집적영상 기술의 콘텐츠 제작전용 S/W 개발
- ❖ 집적영상 전용 소프트웨어로서 최적화
- ❖ 고해상도 영상 디스플레이 장치
- ❖ 3D 영상표시를 위한 렌즈 어레이부 포함
- ❖ Real/Virtual 영역 구동이 가능한 동영상 콘텐츠 제공

IP 카메라 사양



유효화소수	렌즈 배열스펙
610만 (3000*2000)	폭:1.08mm 초점:3.0mm

Display 시스템 사양



렌즈릿 배열개수	렌즈릿 초점거리	요소영상 해상도	프로젝터 모델
150x150 (9인치)	5.02mm	1600x1200	EPSON EMP-820

iPhone4 3D Display System

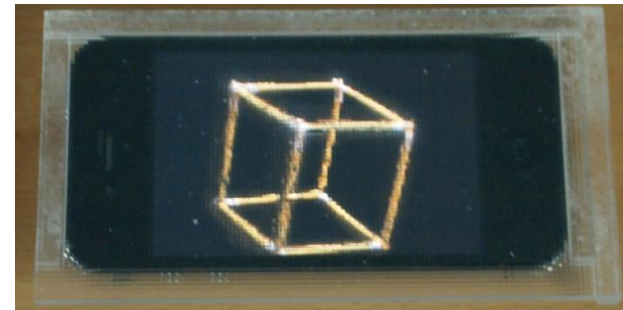
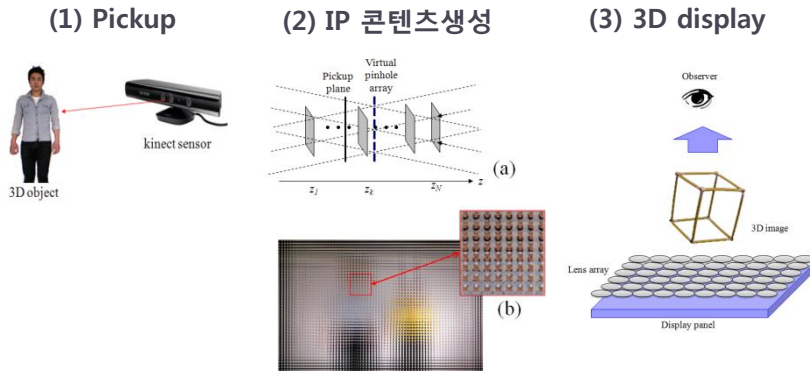
iPhone4를 이용한 깊이우선 IP 기반의 3D 영상 디스플레이 시제품

▶ 국내외 특허 출원 진행 중 : 탈착식 렌즈어레이 기반의 3D 영상 디스플레이 방법 및 시스템

기술 개요

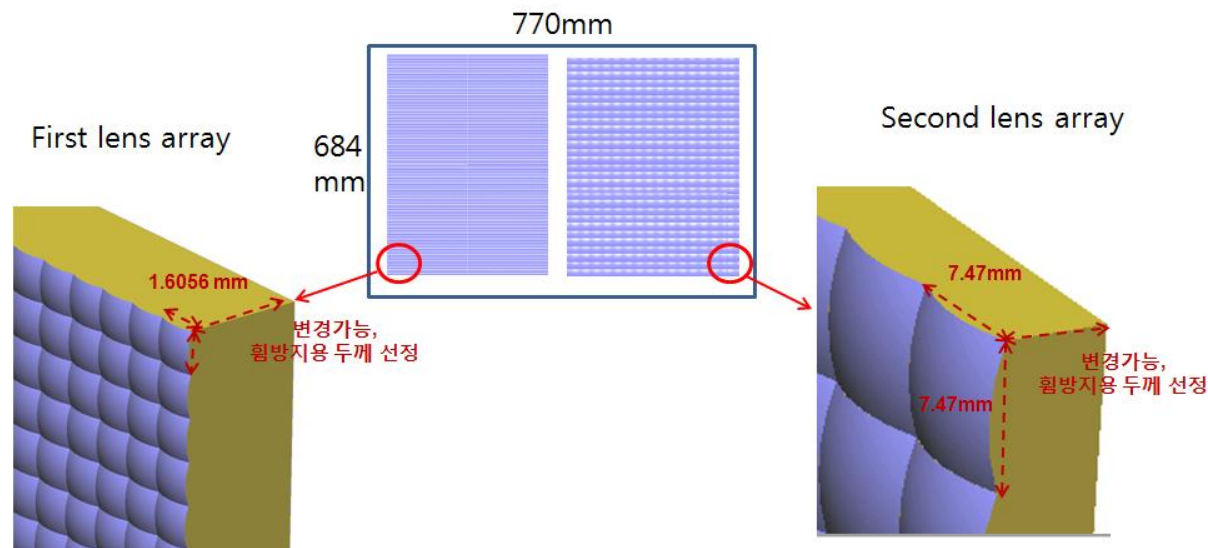
- ❖ 깊이우선 IP 기술을 이용한 무안경 3D 영상 표시
- ❖ Retina Display를 이용한 컬러모아레 제거
- ❖ 탈착식 구조의 렌즈어레이 사용

기술 특징



렌즈릿 배열개수	렌즈릿 초점거리	요소영상 해상도	Display 모델
75x50 (4인치)	5.02mm	960*640	iPhone 4

Lens Array



- 디스플레이 장치 : Barco3420
- 2048 x 1536 화소크기 : 0.207 mm
- 렌즈어레이 사양
- 전체크기 : 684mm x 385.3440 mm
- 전체렌즈개수 : 426x240 개
- 기초렌즈 사양
- 초점거리 : 8.028 mm
- 직경 : 1.6056 mm

- 디스플레이 장치 : IBM t221
- 3840 x 2400 화소크기 : 0.1245 mm
- 렌즈어레이 사양
- 전체크기 : 679.77 x 380.97 mm
- 렌즈개수 : 91x51 개
- 기초렌즈사양
- 초점거리 : 29.88mm
- 직경 : 7.47 mm

a Real 3D Display System using Integral Imaging Technology



Thanks you!!

lbg@dongseo.ac.kr

<http://kowon.dongseo.ac.kr/~lbg/>