Image Sensor and Its Applications

Computer Graphics, Image processing and computer Vision
Division of Computer Information Engineering

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IAI
엠비언트 인텔리전스 연구소
Institute of Ambient Intelligence

Ubiquitous Frontier
Digital
DSU
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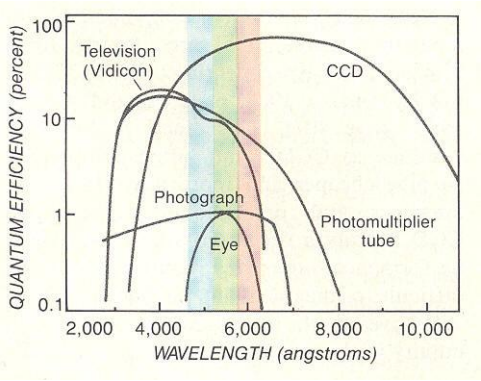
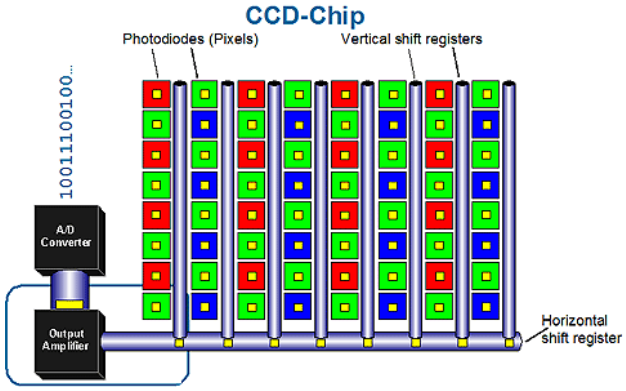
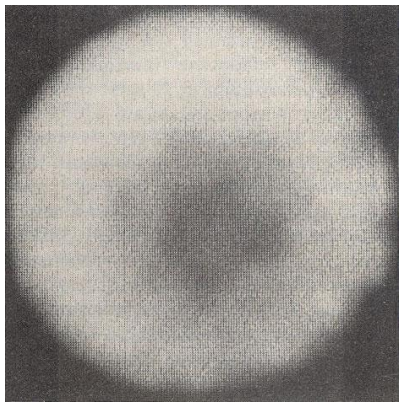
Image Sensor



- CCD(Charge Coupled Device) Sensor
- 1960년대 후반 Bell Lab. Williards S. Boyle과 George E. Smith가 새로운 형태의 컴퓨터 기억 회로를 설계
- 1970년에 처음 선보인 이 작은 반도체 실리콘은 가시광에 반응하기 때문에 천문 분야에서 최초의 영상 기기
- 1975년 제트 추진 연구소(JPL), 애리조나 대학, 천왕성

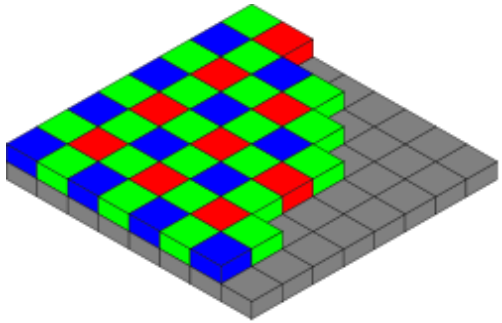




http://astro.kias.re.kr/~hshwang/ccd.htm

Image Sensor

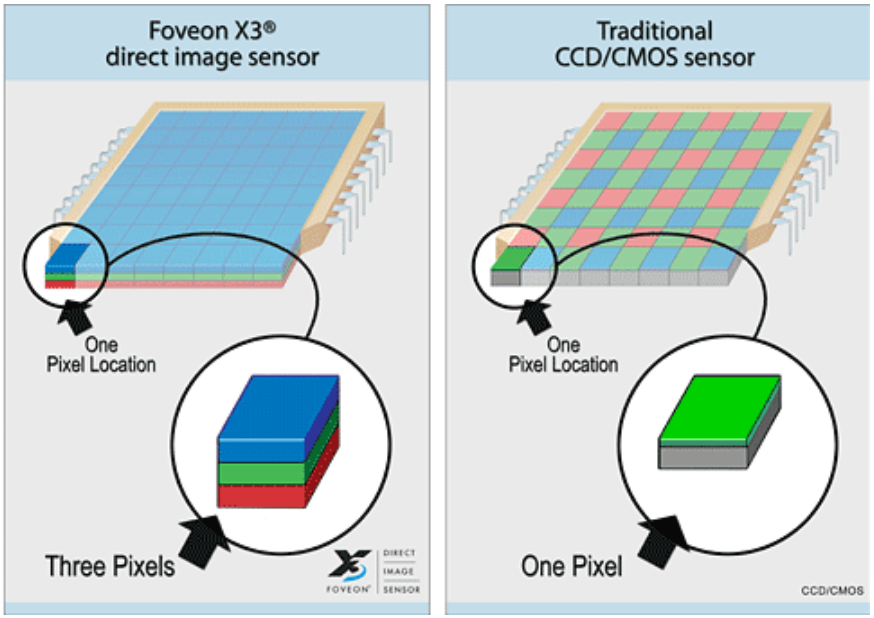
- CCD & CMOS(Complementary Metal-Oxide Semiconductor)
- CCD 감도,화질 좋다. 소비전력 많고 전송도중 잡신호의 영향
- CMOS 각 화소에 신호증폭회로설치, 전송속도가 빠르다
  소비전력과 발열이 적다. 라이브뷰 기능에 적합
- Demosaicking

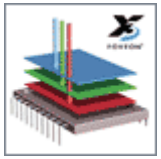


The Bayer arrangement of color filters on the pixel array of an image sensor. Each two-by-two cell contains two green, one blue, and one red filter

Image Sensor

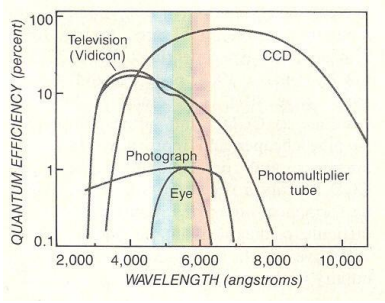
- CCD, CMOS & Foveon Sensor

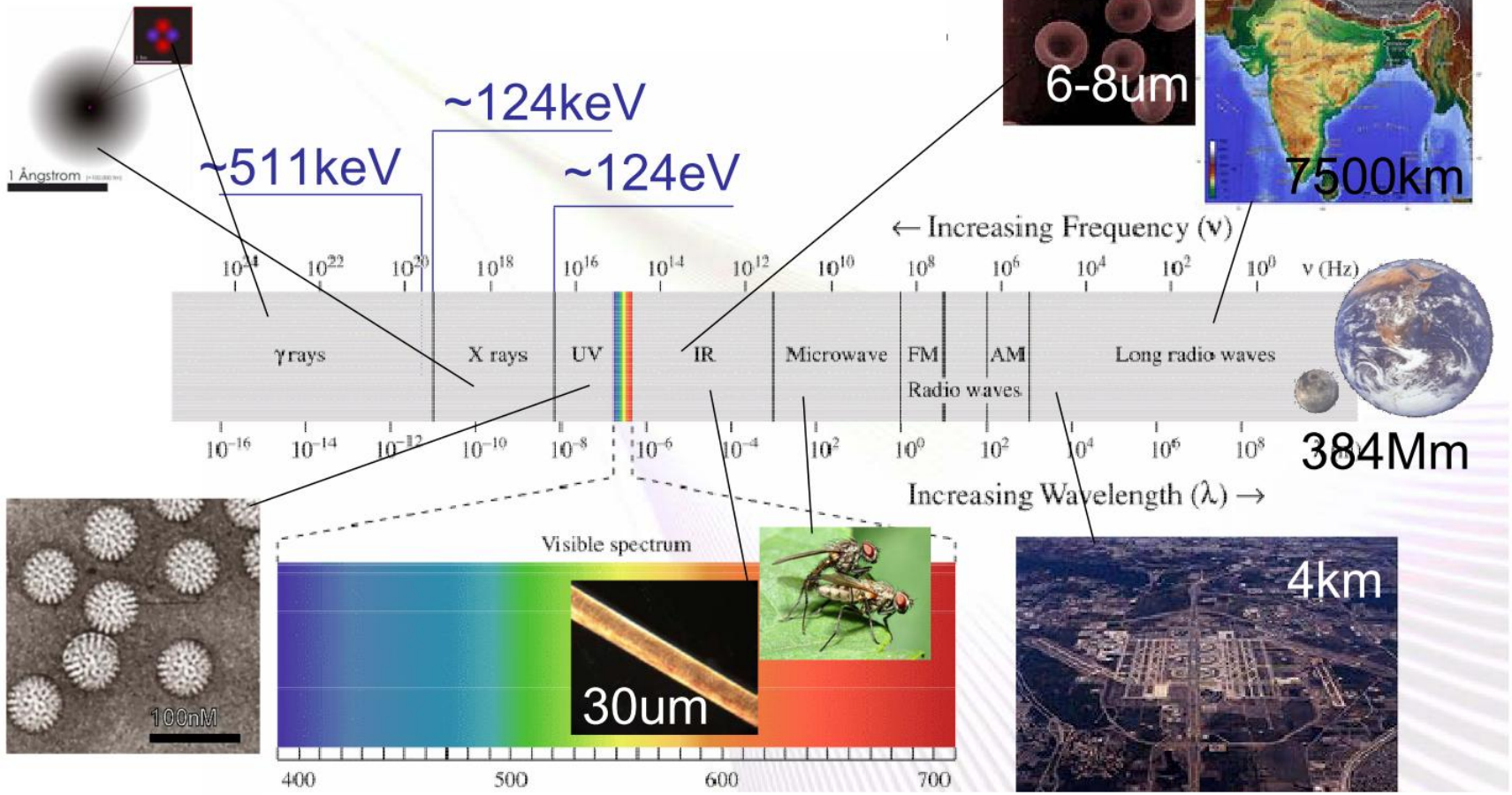




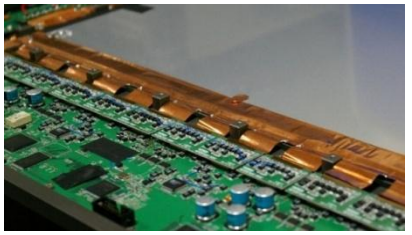
FOVEON

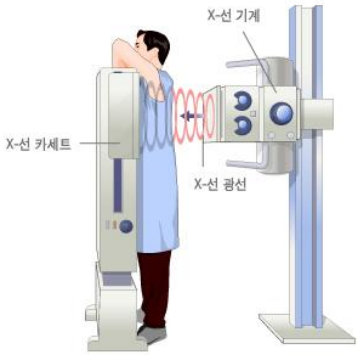
Spectrum

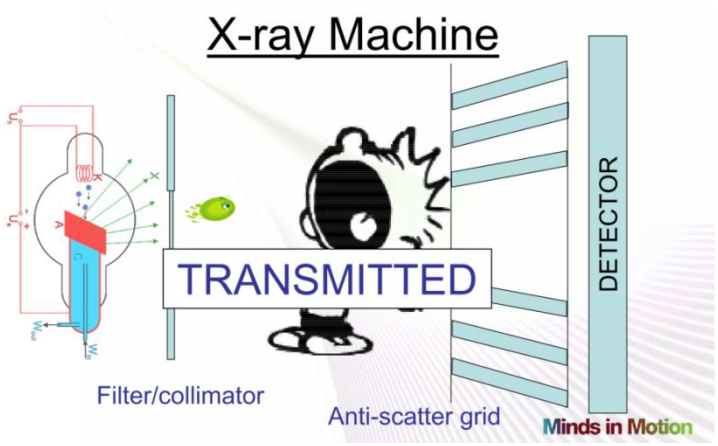

QUANTUM EFFICIENCY (percent)
100
10
1
0.1
Television (Vidicon)
CCD
Photograph
Eye
Photomultiplier tube
2,000
4,000
6,000
8,000
10,000
WAVELENGTH (angstroms)

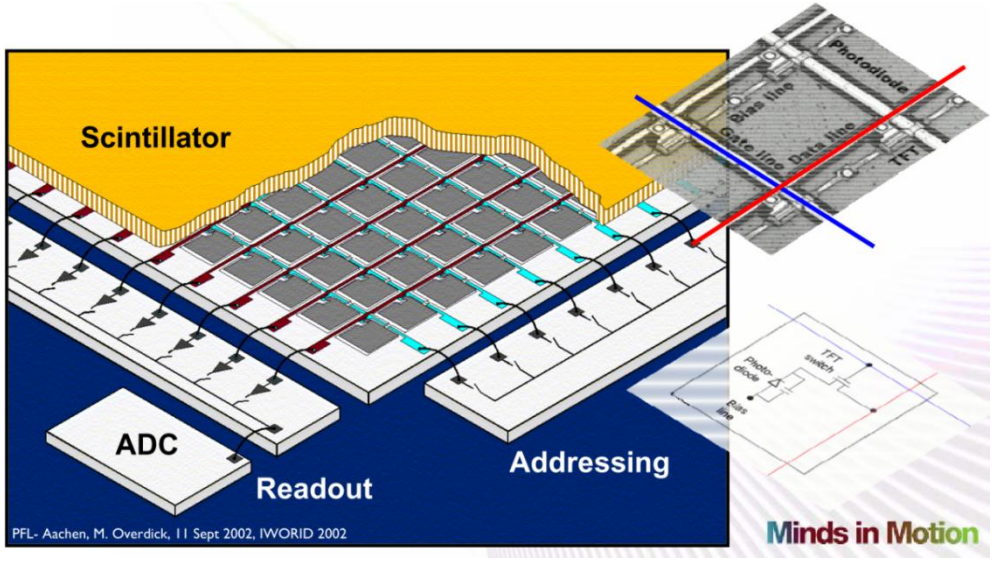

1 Ångstrom
~511keV
~124keV
~124eV
6-8um
7500km
← Increasing Frequency (ν)
ν (Hz)
γ rays
X rays
UV
IR
Microwave
FM
AM
Radio waves
Long radio waves
384Mm
Increasing Wavelength (λ) →
100nM
Visible spectrum
30um
4km
400
500
600
700

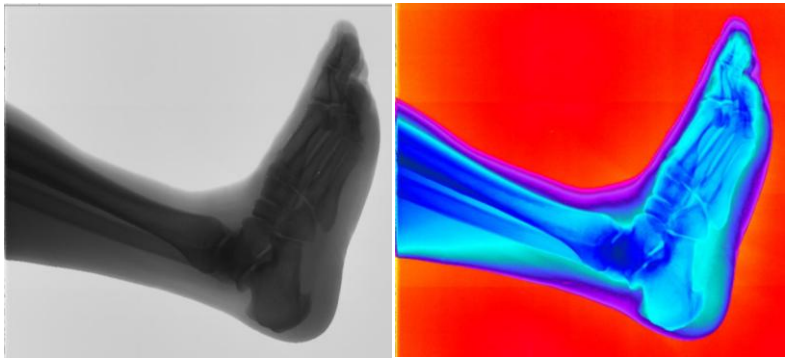
Samsung unveils flat-panel X-ray detector
Imaging sensor converts invisible X-ray images into digital signals 23 Nov 2007
The flat-panel X-ray measures 45cm x 46cm and boasts a 3,072 x 3,072 (9.4-megapixel) resolution providing ultra-high definition images.
To create its flat-panel X-ray, Samsung attached photodiodes to a TFT substrate produced using its proprietary amorphous silicon technology.
The device will be available worldwide from the first quarter of 2008.



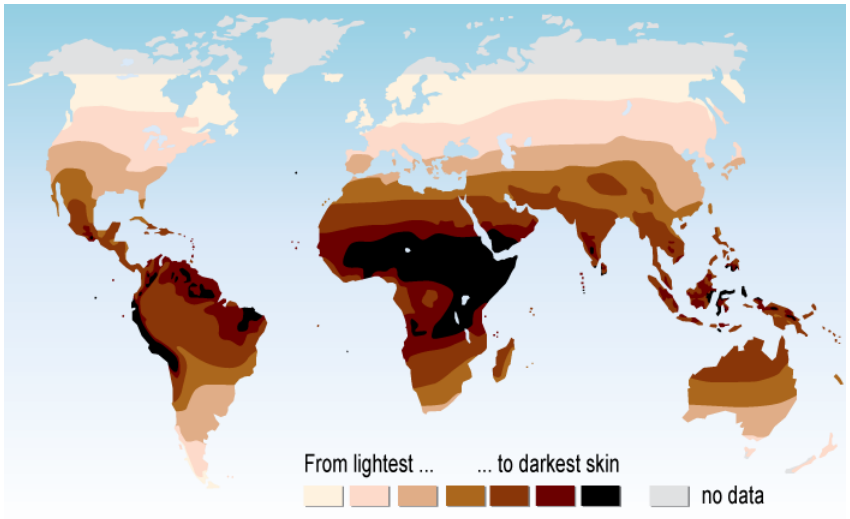




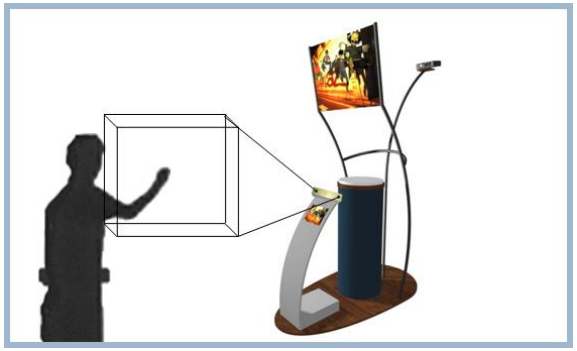




Hand Tracking



Source: Chaplin G.© , *Geographic Distribution of Environmental Factors Influencing Human Skin Coloration*, American Journal of Physical Anthropology 125:292–302, 2004; map updated in 2007.



Skin Color Detection

- Peer and Solina's 2003

* Uniform daylight illumination

$R > 95,\ \ G > 40,\ \ B > 20\ \ and$

$max\{R,G,B\} - min\{R,G,B\} > 15\ \ and$

$|R - G| > 15\ \ and\ \ R > G\ \ and\ \ R > B$

OR

* Flashlight or light daylight

$R > 220,\ \ G > 210,\ \ B > 170\ \ and$

$|R - G| \leq 15\ \ and\ \ R > B\ \ and\ \ G > B$

- Hsu and Mottaleb Jain's Central 2002

$$W_{Ci}(Y) = \begin{cases} W_{LCi} + \frac{(Y - Y_{min})(W_{Ci} - W_{LCi})}{K_l - Y_{min}}; & Y < K_l \\ W_{HCi} + \frac{(Y_{max} - Y)(W_{Ci} - W_{HCi})}{Y_{max} - K_h}; & K_h < Y \\ W_{Ci}; & else \end{cases}$$

$$\bar{C}_b(Y) = \begin{cases} 108 + \frac{10(K_l - Y)}{K_l - Y_{min}}; & Y < K_l \\ 108 + \frac{10(Y - K_h)}{Y_{max} - K_h}; & K_h < Y \\ 108; & else \end{cases}$$

$$\bar{C}_r(Y) = \begin{cases} 154 - \frac{10(K_l - Y)}{K_l - Y_{min}}; & Y < K_l \\ 154 + \frac{22(Y - K_h)}{Y_{max} - K_h}; & K_h < Y \\ 108; & else \end{cases}$$

$RGB\ to\ YC_bC_r$

$Y = 0.299R + 0.587G + 0.144B$

$C_b = -0.168R - 0.331G + 0.5B$

$C_r = 0.5R - 0.418G - 0.081B$

$where\ i\ in\ W_{Ci}(Y)\ is\ b\ or\ r, W_{Cb} = 46.97, W_{LCb} = 23, W_{HCb} = 14, W_{Cr} = 38.76, W_{LCr} = 20, W_{HCr} = 10, K_l = 125, K_h = 188, Y_{min} = 16, Y_{max} = 235$

- Hsu and Mottaleb Jain's Ellipse 2002

$$\frac{(x - e_{cx})^2}{a^2} + \frac{(y - e_{cy})^2}{b^2} \leq 1$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} cos\theta & sin\theta \\ -sin\theta & cos\theta \end{bmatrix} \begin{bmatrix} C_b - c_x \\ C_r - c_y \end{bmatrix}$$

$c_x = 109.38, c_y = 152.02, \theta = 2.53 radian$

$e_{cx} = 1.6, e_{cy} = 2.41, a = 25.39, b = 14.03$

- M. Jones and J. Rehg's color histogram

$$P(rgb|skin) = \frac{s[rgb]}{T_s}$$

$$P(rgb|-skin) = \frac{n[rgb]}{T_n}$$

$$P(skin|rgb) = \frac{P(rgb|skin)P(skin)}{P(rgb|skin)P(skin) + P(rgb|-skin)P(-skin)}$$

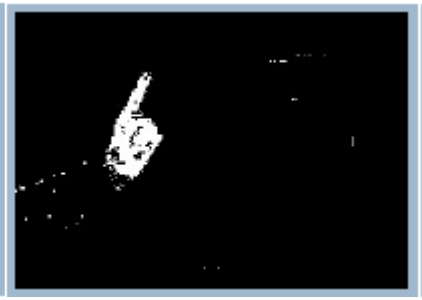
$$P(skin) + P(-skin) = 1$$

$$P(skin) = \frac{T_s}{T_s + T_n}$$

$$P(skin|rgb) \geq \sigma_s$$

H_s : The skin histogram
H_n : The non-skin histogram
$s[rgb]$: The pixel count in bin rgb of H_s
$n[rgb]$: The pixel count in bin rgb of H_n
T_s : The total counts contained in H_s
T_n : The total counts contained in H_n

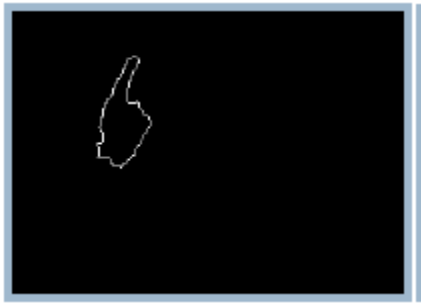
Background subtraction



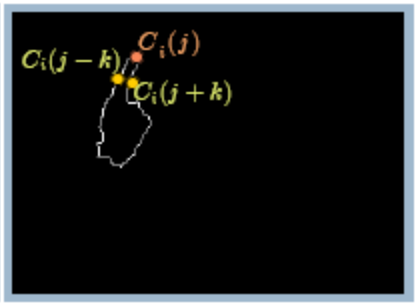
Skin Color Detection

Blob Analysis

Opening & Closing



Contour Tracing

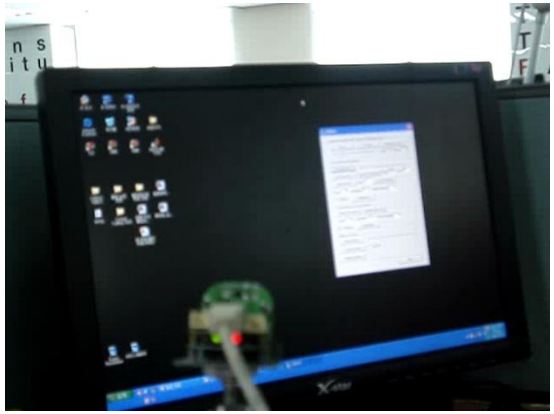


k Curvature

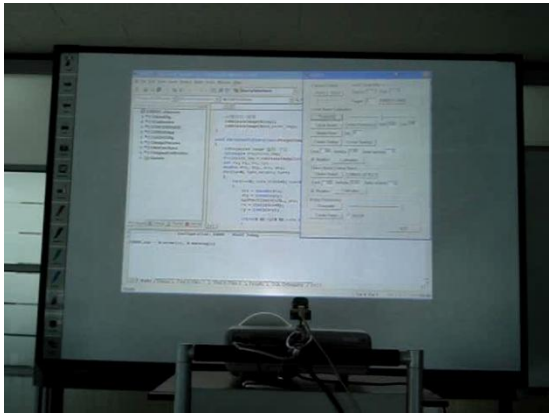
Peak Points

Peak & Valley Points


2009 세상을 담는 아름다운 그릇 한글
한글 영상 작가전 : [자모향유] 이병국 & 박상현
경북궁 홍례문 앞 한글 말풍선 전시관



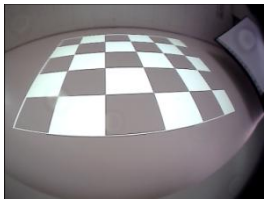
u-Pointer



U-Pointer 전자 판서 시스템

Byung-Gook Lee lbg@dongseo.ac.kr

2008.12.29~2009.02.11



U-Pointer

Ubiquitous Frontier Digital DSU Dongseo University

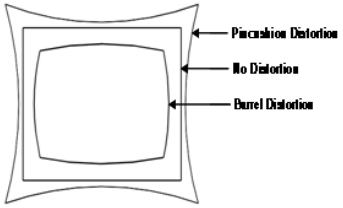
communications IScommunications CO., Ltd.

120 154 175

- U-Pointer Calibration
- Calibration을 위한 효율적인 feature point 위치 선정
- 광각렌즈 적용 Calibration 오차 보정
- 단 초점 projector U-Pointer의 좌표 매핑 알고리즘
- 유연한 판서를 위한 세부 알고리즘

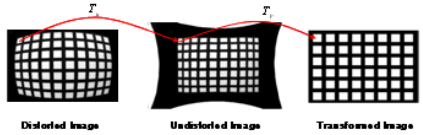
Lens Distortion

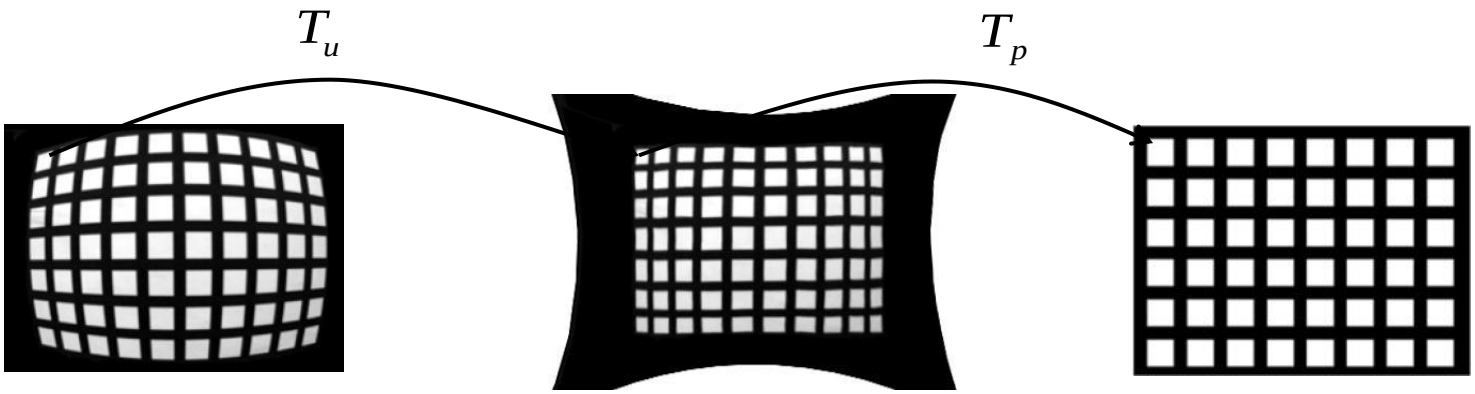
어안렌즈에 따라 생기는 왜곡의 종류



Zoom Lens Distortion

줌 렌즈(Zoom Lens)를 사용하면 Pincushion Distortion이 생기고, 어안 렌즈(Wide Angle Lens)를 사용하면 Barrel Distortion이 생긴다. 따라서 기존의 방법과 다르게 렌즈의 왜곡을 먼저 보정한 후 이미지의 왜곡을 보정하면 좀 더 정확한 결과가 나올 것이다. 아래의 그림은 렌즈의 왜곡 보정과 이미지의 보정을 도식화한 그림이다.





Distorted Image $I_d(x_d, y_d)$ Undistorted Image $I_u(x_u, y_u)$ Projected Image $I_p(x_p, y_p)$

$$x_u = c_x + (x_d - c_x) f_2(r_d^2)\cos\theta - (y_d - c_y) f_2(r_d^2)\sin\theta$$

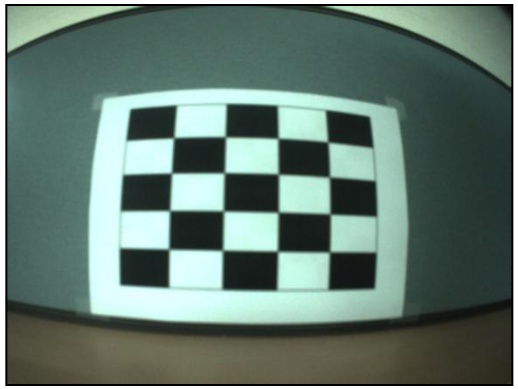
$$y_u = c_y + (x_d - c_x) f_2(r_d^2)\sin\theta + (y_d - c_y) f_2(r_d^2)\cos\theta$$

$$f_2(r) = 1 + k_1 r + k_2 r^2 + k_3 r^3 \quad r_d^2 = (x_d - c_x)^2 + (y_d - c_y)^2$$

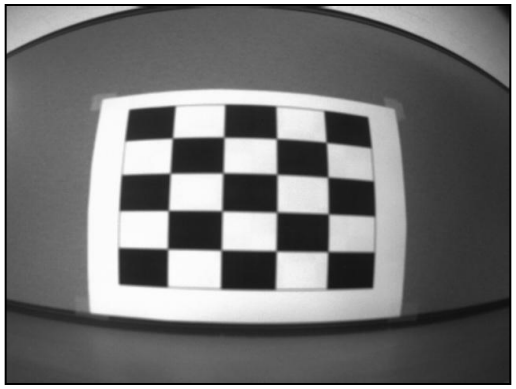
$C(c_x, c_y)$ center of radial distortion

$$x_p = \frac{m_0 x_u + m_1 y_u + m_2}{m_6 x_u + m_7 y_u + 1}$$

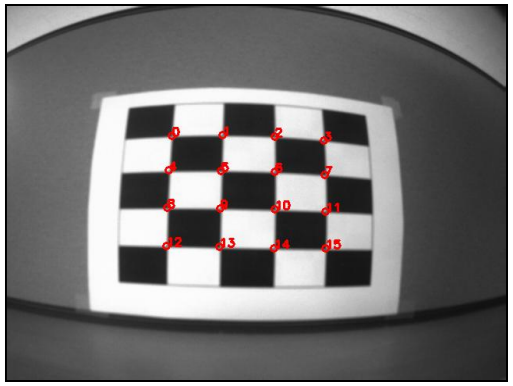
$$y_p = \frac{m_3 x_u + m_4 y_u + m_5}{m_6 x_u + m_7 y_u + 1}$$



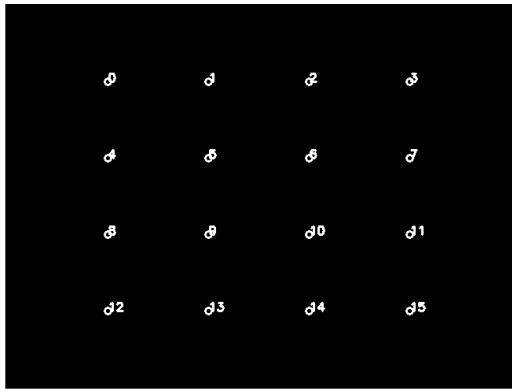
Original Image



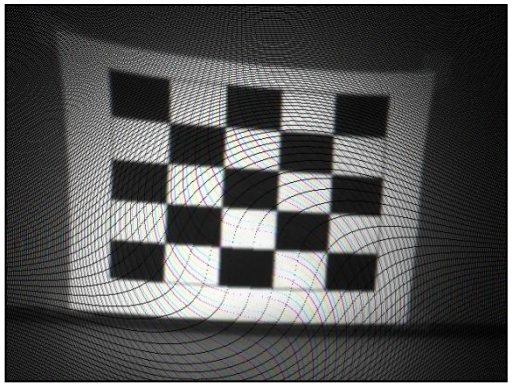
Gray Image



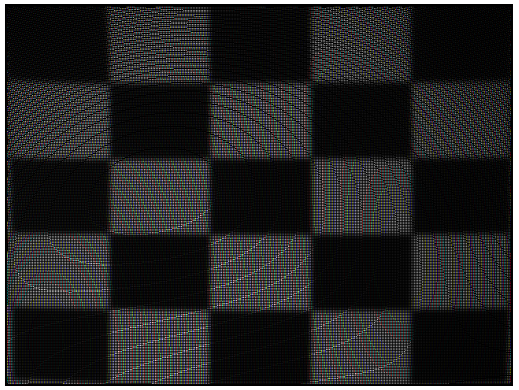
Corner Detection Image



Pattern Image

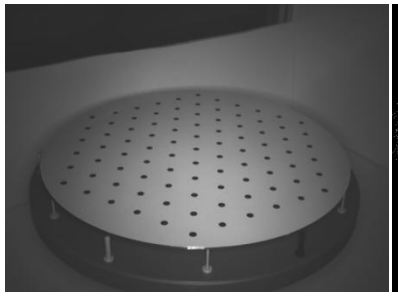
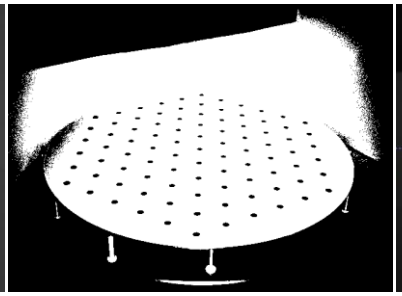
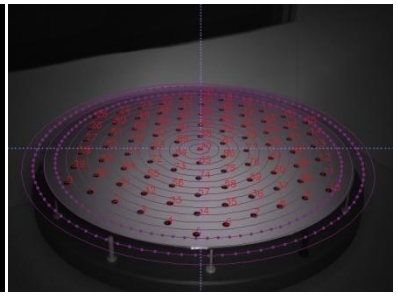
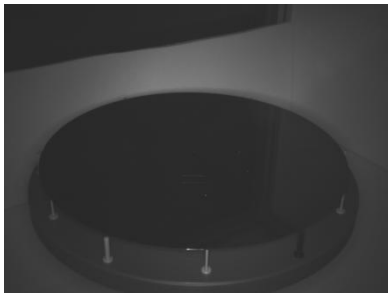


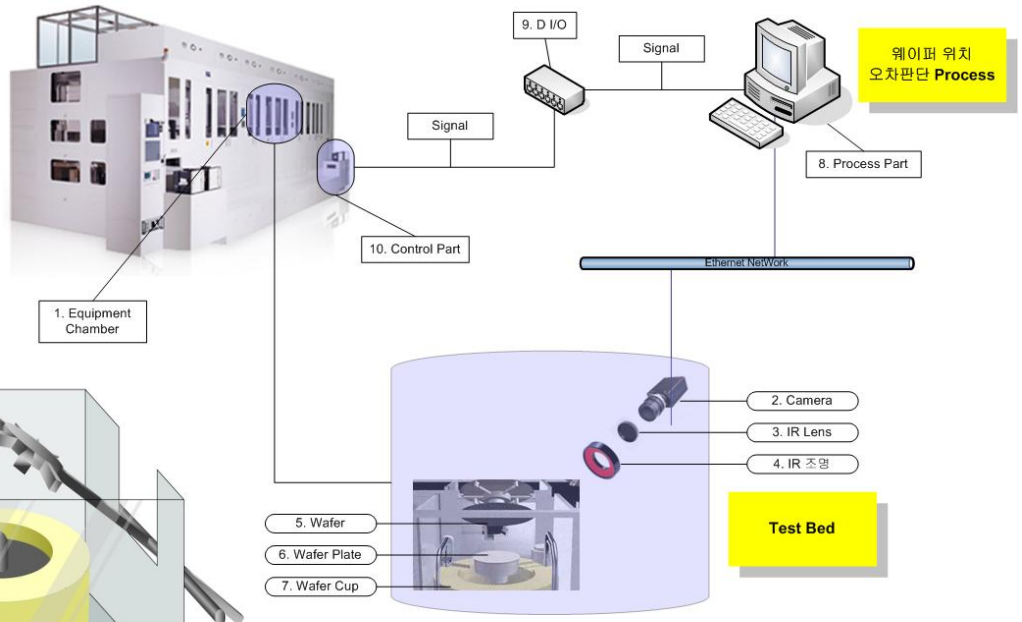
Undistorted Image

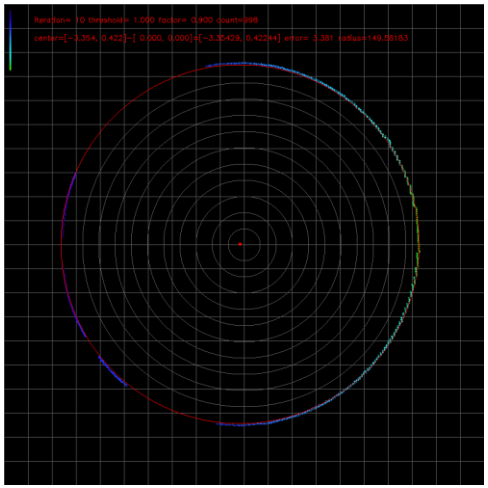


Projected Image

(주) 엠에스비전
Machine Solution Vision

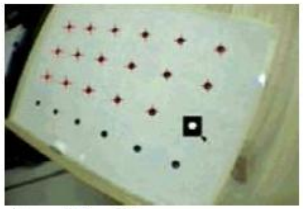









ARToolkit

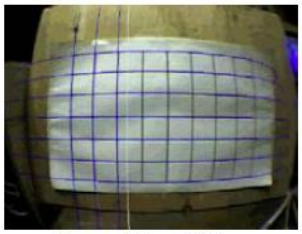
Step 1: Getting distortion parameters: 'calib_dist'



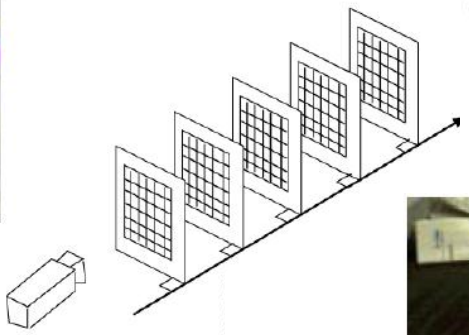
selecting dots with mouse

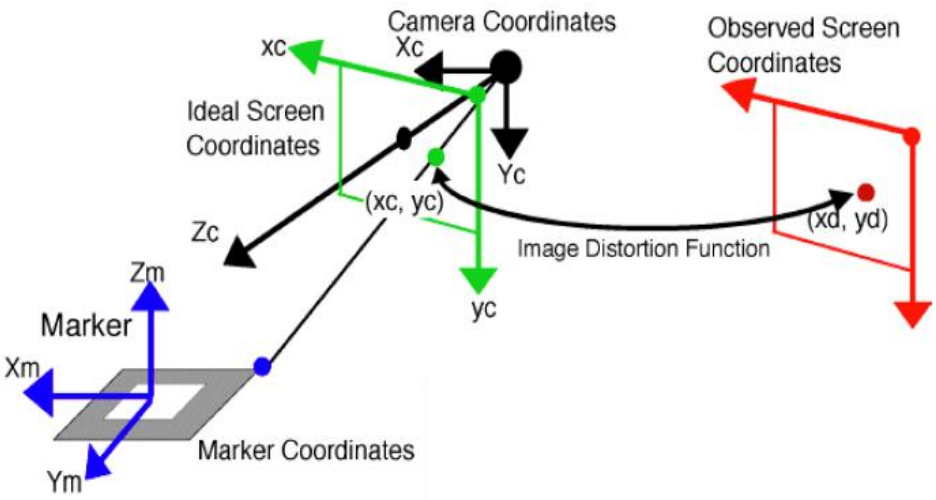
getting distortion parameters by automatic line-fitting

Step 2: Getting perspective projection matrix: 'calib_cparam'



Manual line-fitting





input video

thresholded video

virtual overlay

P I C T O M A T I O N

A Study on Effective Visual Communication Method with the 'Pictomation' Contents in Augmented Reality Environment

2009.07.15 | DEPT. OF VISUAL CONTENTS, DONGSEO UNIVERSITY
Hosung Myung, Byunggook Lee, Hyungwoo Kim, Shanghyun Kang
http://kowon.dongseo.ac.kr/~ibg/

Definition of pictogram

- The pictogram is a compound word where means the picture and a telegram.
- The pictogram delivers information easily & quickly.

pictogram = picture + telegram

Functions of pictogram

Guidance Function
Public people understand some information easily.

Command Function
The human being must observe.

Conditions of pictogram

- Must read quickly, easily and exactly.
- Must deliver the meaning easily.
- Must be considered the brief expression and an esthetic characteristic.
- Must be induced the act of consumer to original intent.
- Must be popular, public and convenient to use.

A Study on the 'PICTOMATION' Contents Effective Visual Communication Method in Augmented Reality Environment

Dept. of Visual Contents, Dongseo University
Hosung Myung, Namseok Choi, Hohwan Shin,
Eunkyung Jung, Byunggook Lee, Hyungwoo Kim
http://kowon.dongseo.ac.kr/~ibg/

This research was financially supported by the Ministry of Education, Science Technology (MEST) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Regional Innovation

Pictomation using ARToolkit

Ⓐ Marker pattern input
Ⓑ Video output (computer graphics area)
Ⓒ Video output (real world area)

Proposal of the pictomation

Visual elements of pictogram should be expressed and reconstituted in common experience, not creation a new one.

'A **MAN** IS DRINKING **WATER**'
Visual elements : 'Man', 'Water' : [noun]

'A MAN IS **DRINKING** WATER'
Animation elements : 'Drinking' : [verb]

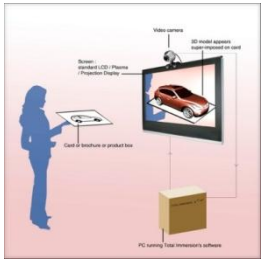
First, I abstracted 'man' and 'water' from linguistic element in 'a man is drinking water' and expressed it as visual elements. Second, I made an animation with behavior elements which is 'drink'.

Proposal of the pictomation

Pictomation = Pictogram + Animation

['DRINKING FOUNTAIN' PICTOMATION]

Augmented Reality



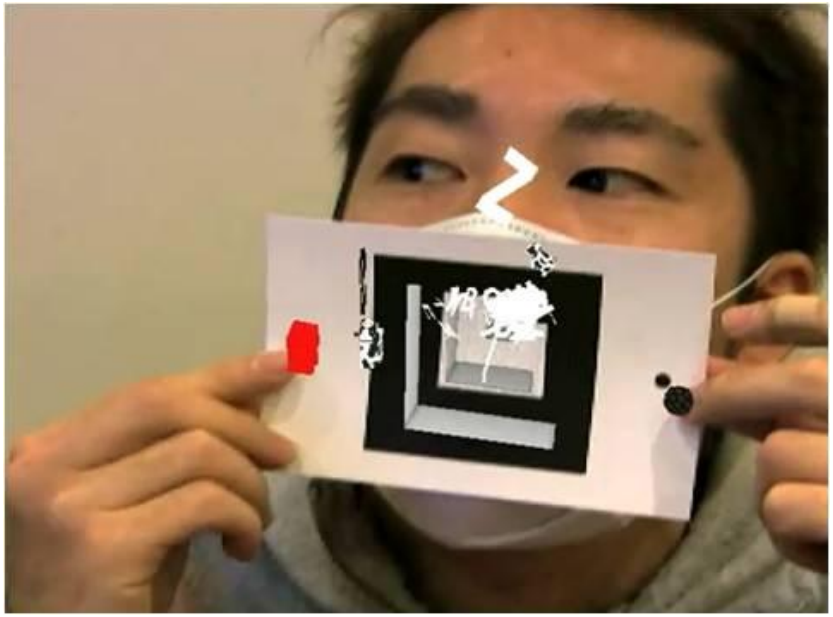
AR(augmented reality) provide vivid 3d information
[http://www.mini.de/webcam]

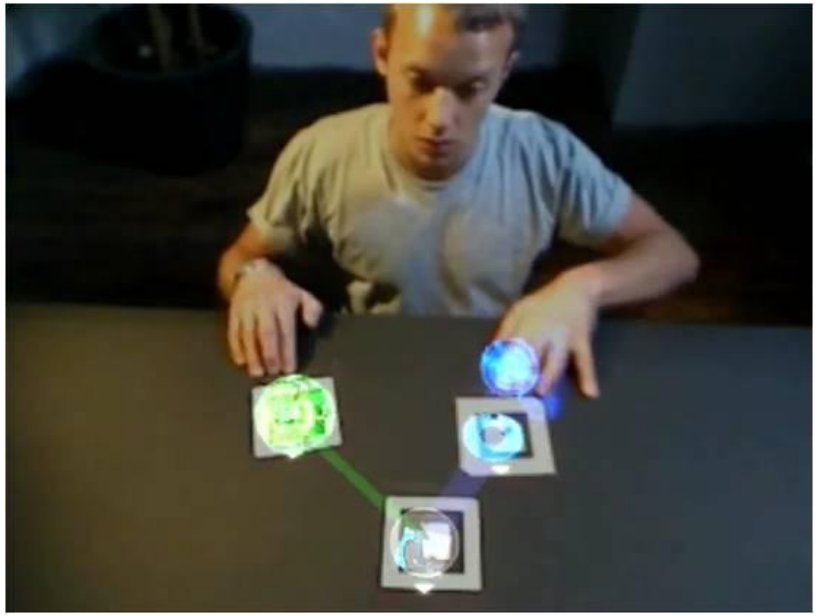
Shall we dance

'3DVIA 버툴 콘테스트' 대상

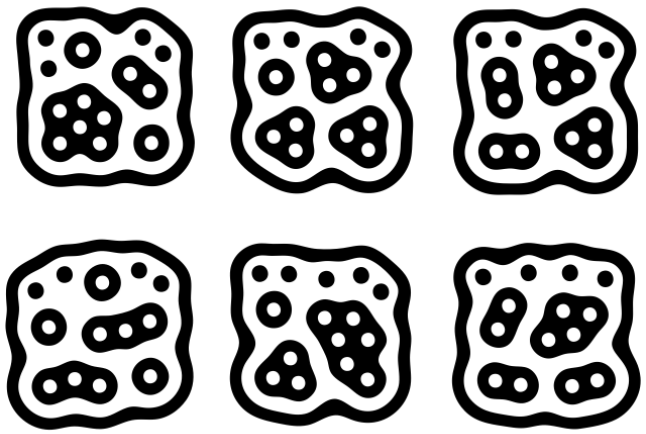
다쏘시스템이 주최한 제2회 3D 콘테스트에서 대상을 차지한 동서대 디자인학부 학생들(왼쪽부터 명호성, 구태우, 우정우, 연재혁씨).

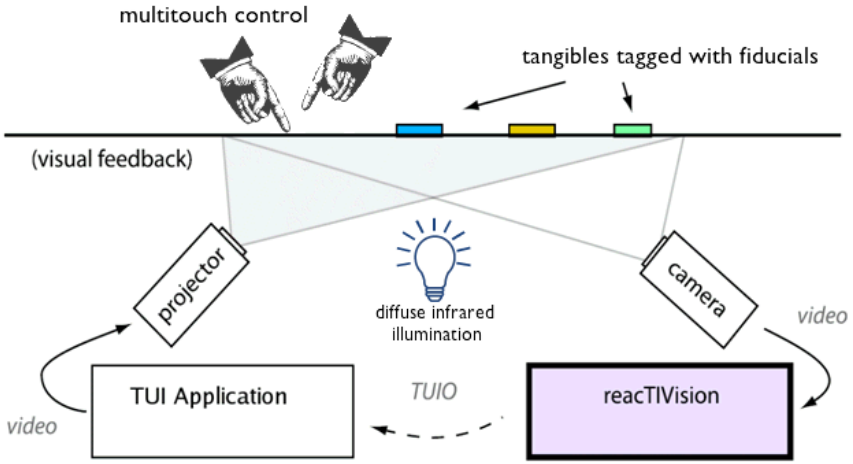
lbg@dongseo.ac.kr

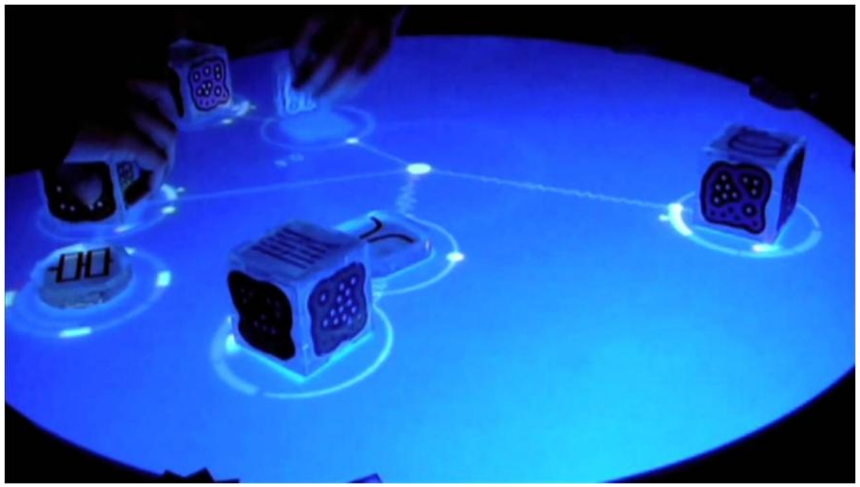


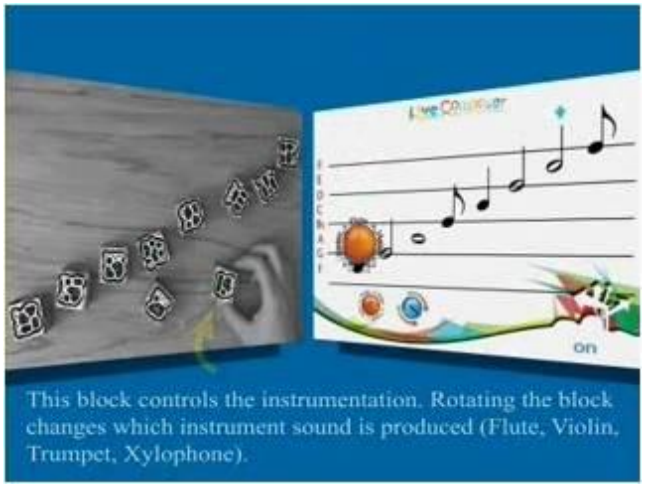


reacTIVision 1.4







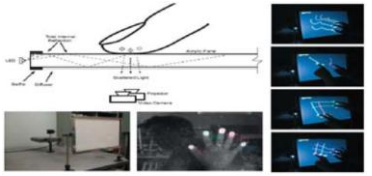

This block controls the instrumentation. Rotating the block changes which instrument sound is produced (Flute, Violin, Trumpet, Xylophone).

MultiTouch System

Multi-User Interaction Technology for Ubiquitous Smart Space – Multi Touch System

Dept. of Visual Contents, Dongseo University
Hosung Myung, Namseok Choi, Taehwan Lim, Byunggook Lee
http://kowon.dongseo.ac.kr/~lbg/

This research was financially supporting by the Ministry of Education, Science Technology (MEST) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Regional Innovation



Taxonomy is a hierarchical browser that visualizes the classification tree found in the ITIS taxonomic database (www.itis.gov).

Developed by Philip L. Davidson
© 2007, Perceptive Pixel

PERCEPTIVE PIXEL

MRI

&

StaDt Wien

MRI

a tangible experience.

CASE STUDY 3dvia

동서대학교의 Virtools 적용 사례 DSU Dongseo University

Virtools과 결합한 체감형 Expertainment 컨텐츠로 인간 중심의 '따뜻한 디지털 컨텐츠' 구현

동서대학교의 I&I연구소는 지난 해 2주 동안 Virtools 교육을 받으며 기존에 연구소에서 가지고 있던 기술을 Virtools과 연동할 수 있다는 아이디어에 착안, 학부생 · 석사과정의 학생들이 지도교수와 함께 Expertainment라고 하는 체감형 컨텐츠를 중심으로 5가지의 과제를 성공적으로 수행하였다.

exhibition

information

data

consulting

current

past

upcoming

ART PARK

press release | image | profile | article

하이브리드 지오메트리 (hybrid geometry)

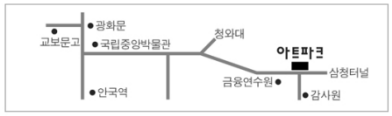
2009. 12. 9 - 12. 19

참여자
참여작가(미술) : 김병걸, 김인태, 리장뽈,(이상 조각) 박상현(미디어아트), 박종규, 임정은, 홍승혜(이상 평면)
참여건축가 : 유기찬, 김재준(이상 한양대 건축과), 김재관, 박치원(이상 건축가)
참여공학자 : 김덕수, 김정민, 원정인(이상 한양대 산업공학과), 스기하라 코키치(메이지대)
참여수학자 : 이병국(동서대)
디렉터 : 황인(아트 액티비스트)

주최 : AVA(Association of Voronoi Art)/Voronoi Diagram Research Center, Hanyang University

공동참여 : BK21 Sustainable Architecture Professional Education Center, Hanyang University

후원 : 서울문화재단



□ 전시소개글

<하이브리드 지오메트리> 전 미술가가 꿈꾸는 새로운 공간감각의 기하학, 건축의 표면과 건축적 세포의 번식을 꿈꾸는 건축가의 기하학, 공간의 비밀을 찾기 위해 기존 기하학을 부정하며 새로운 질서를 찾아내려는 수학자의 기하학을 한데 모아보는 좌충우돌의 전시이다.

체감형
Expertainment
컨텐츠로
인간중심의
따뜻한 디지털
컨텐츠 구현

2009 서울빛축제

행사명 _ 2009 서울빛축제

행사주제 _ 디: 라이트 서울
(The Light, Delight Seoul)
"빛으로 행복한 도시, 서울"

기간 _ 2009년 12월 11일 ~ 2010년 1월 17일

장소 _ 광화문광장 이순신 동상 뒷 공간

주최 _ 서울특별시 / 서울문화재단

전시추진 _

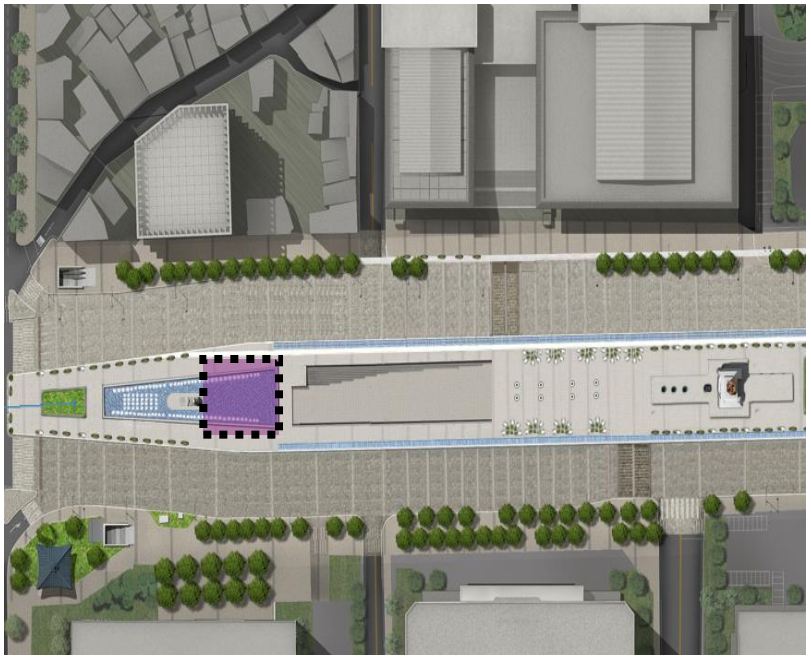
전시주제 _Dialogue_

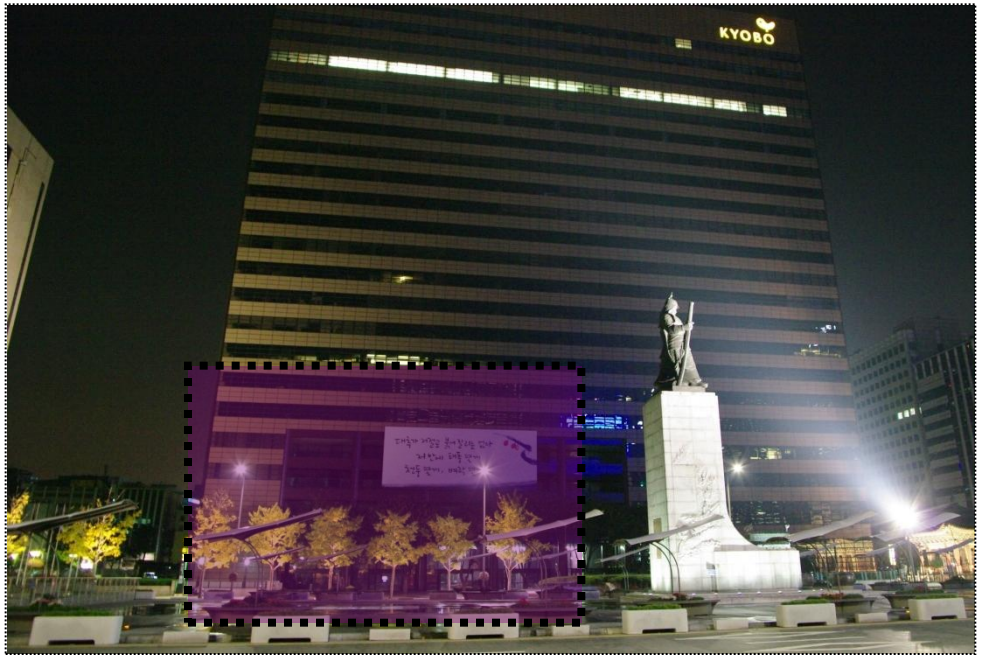
전시 출품작품 _ 총 3 점

2009 서울빛축제

전시공간 위치 (광화문광장 조감도)

이순신 장군 동상 뒤

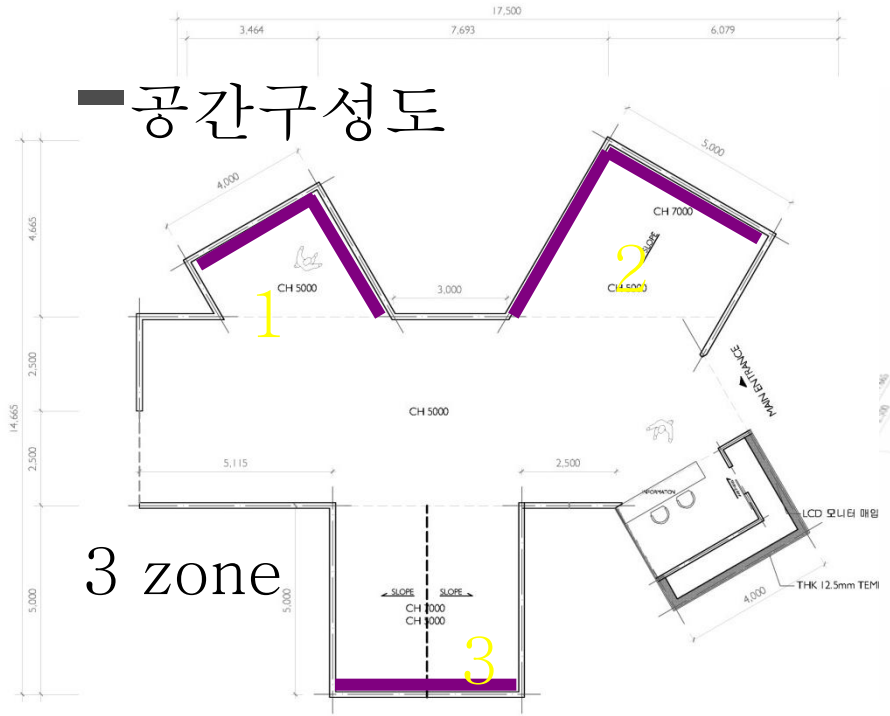




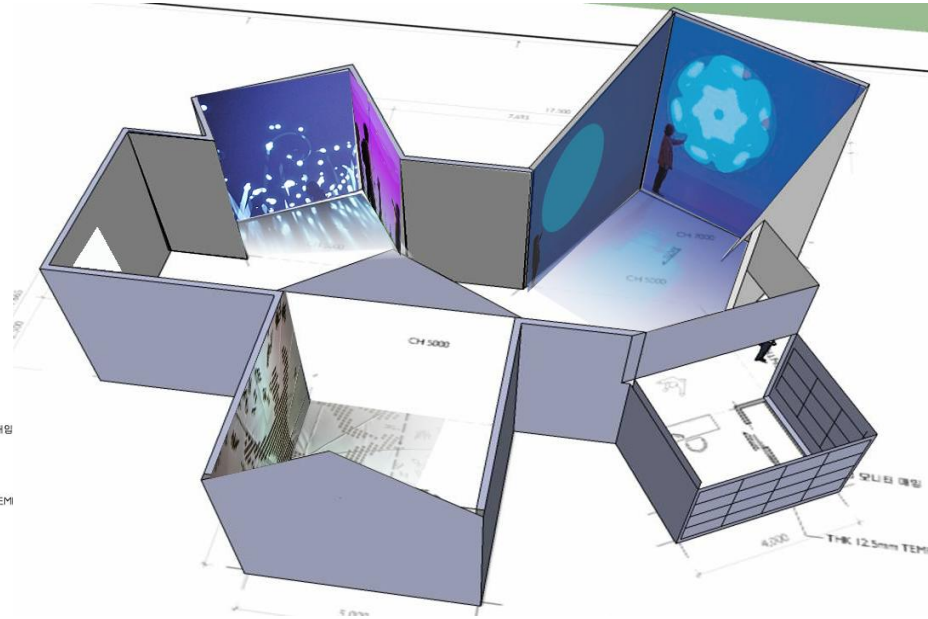
공간 구성

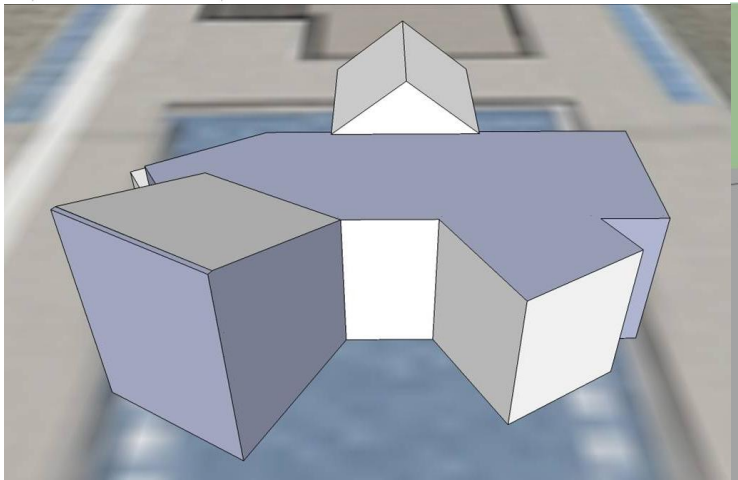
2009 서울빛축제

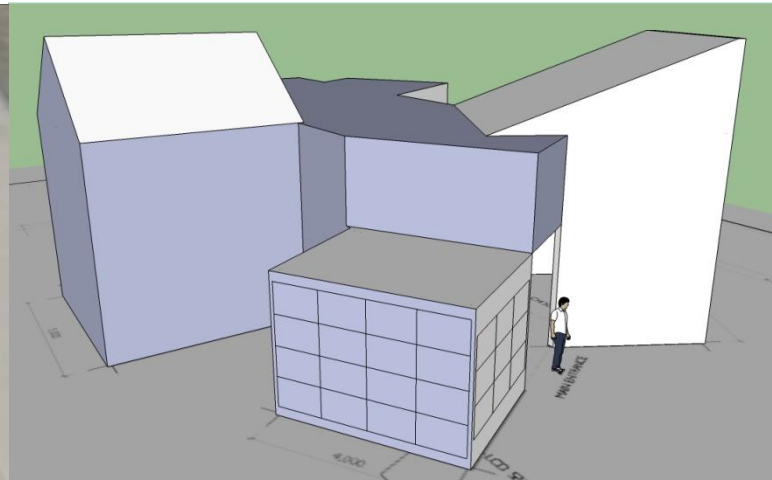
- 공간구성도



3 zone

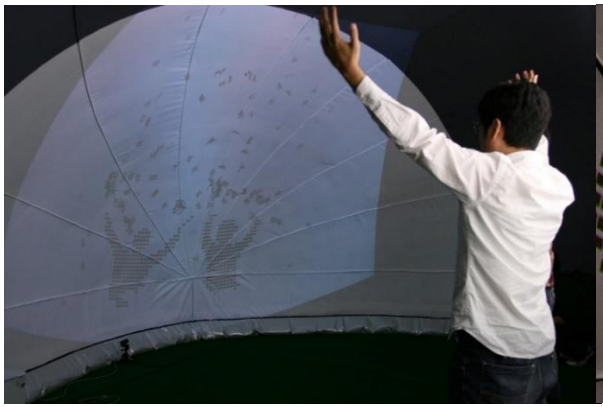


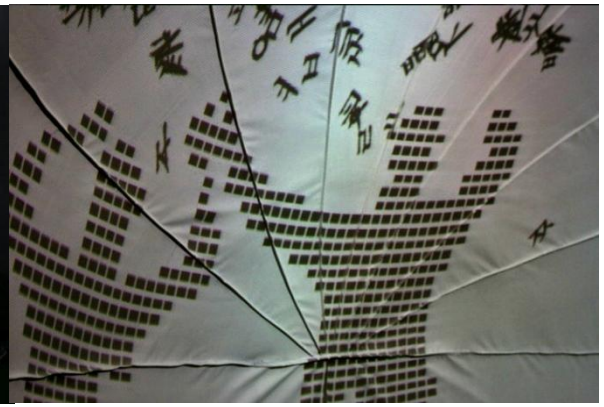


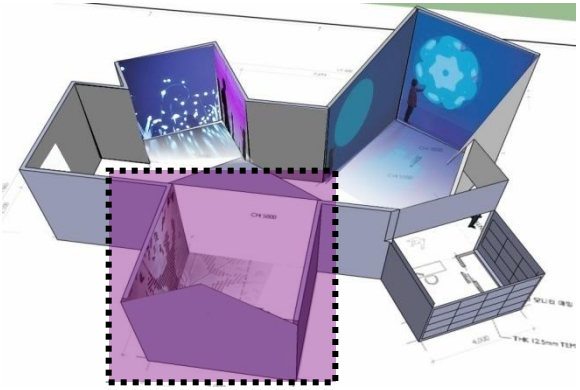


2009 서울빛축제

작가별 작품 소개 이병국, 박상현

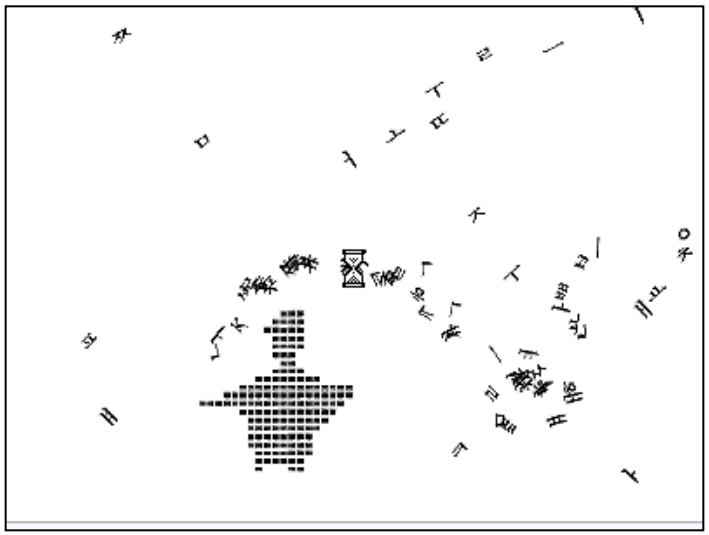






자모향유
interactive installation.

텍스트(한글자모)가 하늘에서 내려오면 사람의 실루엣에
반발하여 다시 튀기게 반응되는 작품



Thanks

Lee Byung Gook, Professor
Division of Computer Information Engineering
Dongseo University

http://kowon.dongseo.ac.kr/~lbg/
e-mail : lbg@dongseo.ac.kr

Background Modeling

Bayesian Modeling of Dynamic Scenes for Object Detection

IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 27, NO. 11, NOVEMBER 2005
Yaser Sheikh, and Mubarak Shah by lbg@dongseo.ac.kr 2009.02.25

Background $\varphi_b = \{y_1, y_2, \cdots, y_n\}, y = (r, g, b, x, y) \in \mathbb{R}^5$

Foreground $\varphi_f = \{z_1, z_2, \cdots, z_m\}$

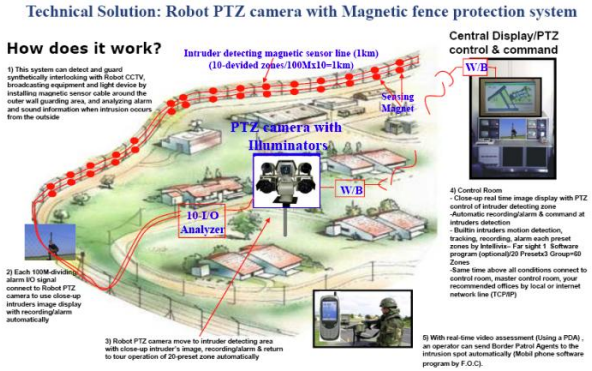
$$P(x \mid \psi_b) = \frac{1}{n}\sum_{i=1}^{n} \varphi_H(x - y_i)$$

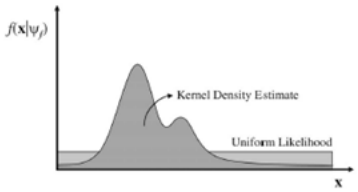
$$P(x \mid \psi_f) = \alpha\gamma + (1-\alpha)m^{-1}\sum_{i=1}^{m} \varphi_H(x - z_i)$$

d-variate Gaussian density

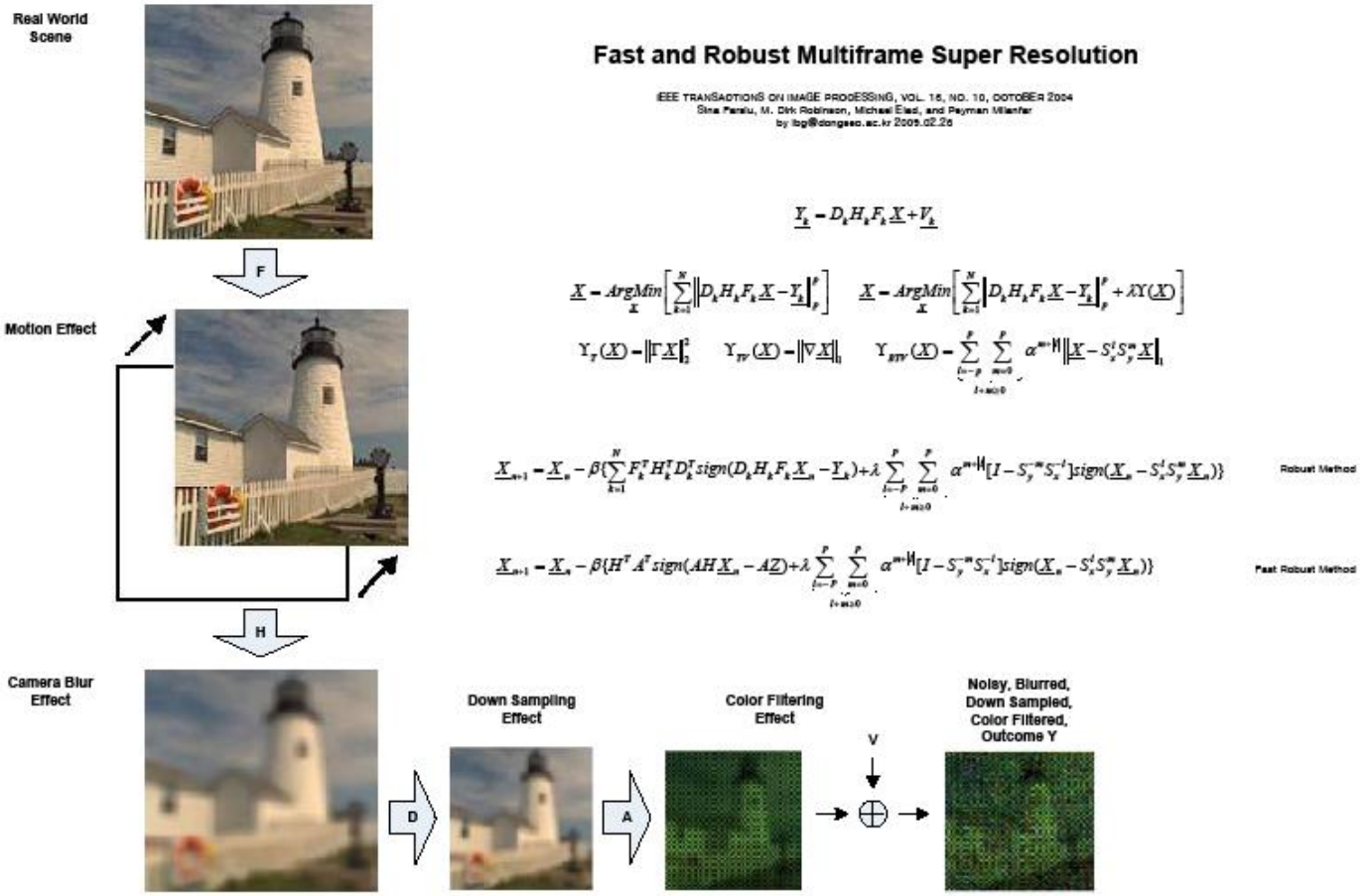
$$\varphi_H^{(N)}(x) = |H|^{-1/2}(2\pi)^{-d/2} \exp(-\frac{1}{2}x^T H^{-1} x)$$

Likelihood ratio classifier $\tau = -\ln \frac{P(x \mid \psi_b)}{P(x \mid \psi_f)}$



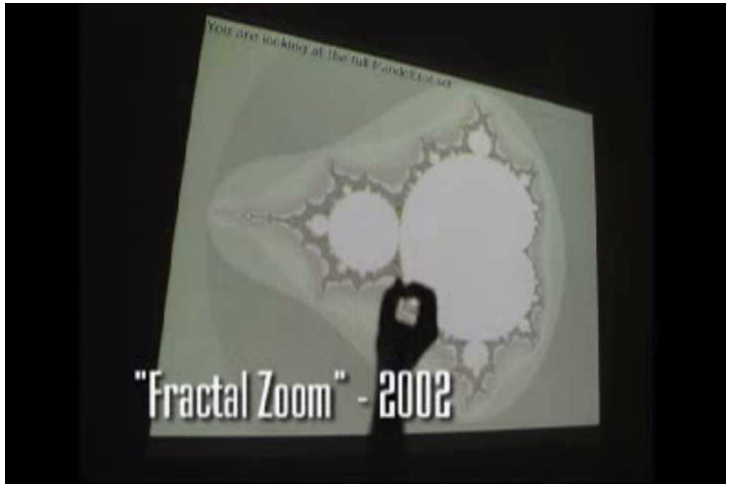


SuperResolution



Shadow Garden

Interactive Art



Interactive Digital Performance

KUBIK