Computers and Virtual Reality (1)

The Real and the Virtual

— The Evolution of Computers and Creation of the World of Virtual Reality—

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the University of Tokyo

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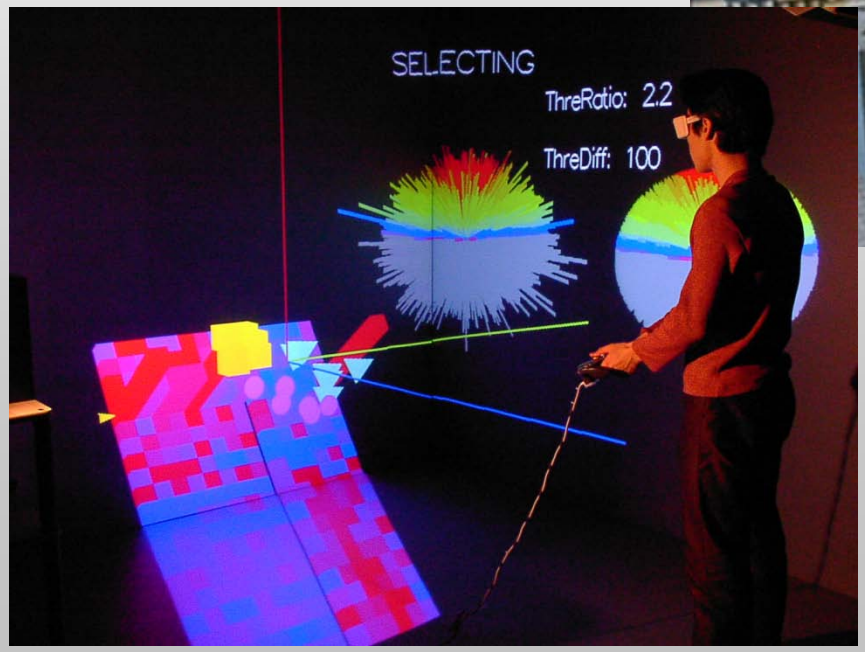


‡

‡ Shinichi Sakamoto
Research Office webpage

‡

What is Virtual Reality (VR)?

The term “virtual reality” first appeared in 1989.

It refers to technologies which create conditions which make it possible to enter into “worlds” created by computers and undergo experiences that are just like reality (pseudo-real experiences).

Figure removed due to copyright restrictions

US Air Force VCASS (Visually Coupled Airborne System Simulator) (1982)

(NASA) VIEW (1987)

Virtual Environment Workstation Project (VIEWlab) at NASA Ames Research Center, 1985 -1990. VIEWlab system including helmet mounted display with 3D sound, speech recognition, and datagloves. Project Director Scott S. Fisher.

Photo credit: " NASA - W. Sisler/S.S. Fisher 1987"

What is Virtual Reality?

Virtual

Something which although not actually existing duplicates the same functions and effects of something which actually exists.

Actual

The opposite of “Nominal”

Reality

Real Feeling Real (Authentic)

It is actually wrong to translate virtual as “*kasou* (=hypothetical, imaginary).”

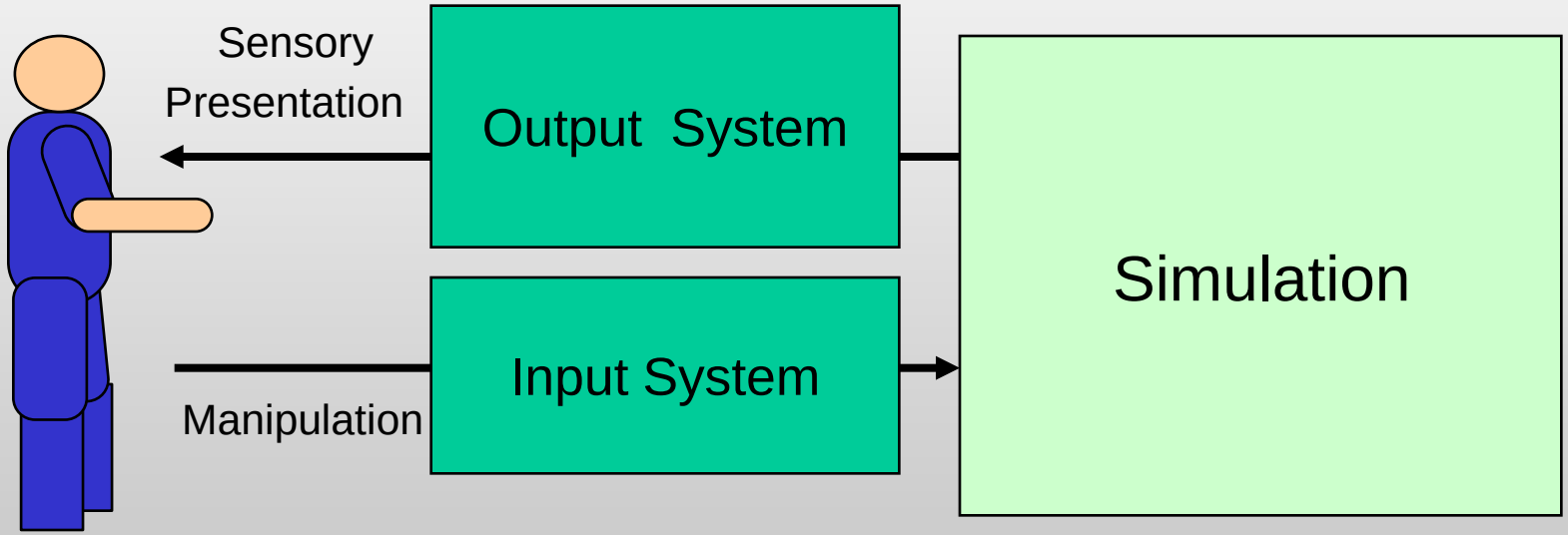
Using the translation *virtual enemy for “kasou-tekikoku* (=hypothetical enemy*)”* can have all kinds of repercussions.

A *virtual student* is not a “phantom student.”

In other words, *virtual* and *real* are not antagonistic concepts.
That is to say, there can be no doubt that *virtual* and *real* are oddly interlinked.

A VR world is. . .

- Essentially a simulation (mock phenomenon))
- Actually the essence of such manipulation is the fact that it makes possible direct, physical experience.



An examinee

Display Interface

Computers

Examples from the World of Virtual Reality

‡ Maya Civilization Exhibition organized by the National Museum of Nature and Science and TBS Broadcasting System Television, Inc.
The University of Tokyo/The National Institute of Information and Communications Technology/Toppan Printing Co., Ltd.

VR as an Interface Technology

VR technologies have several special characteristics.

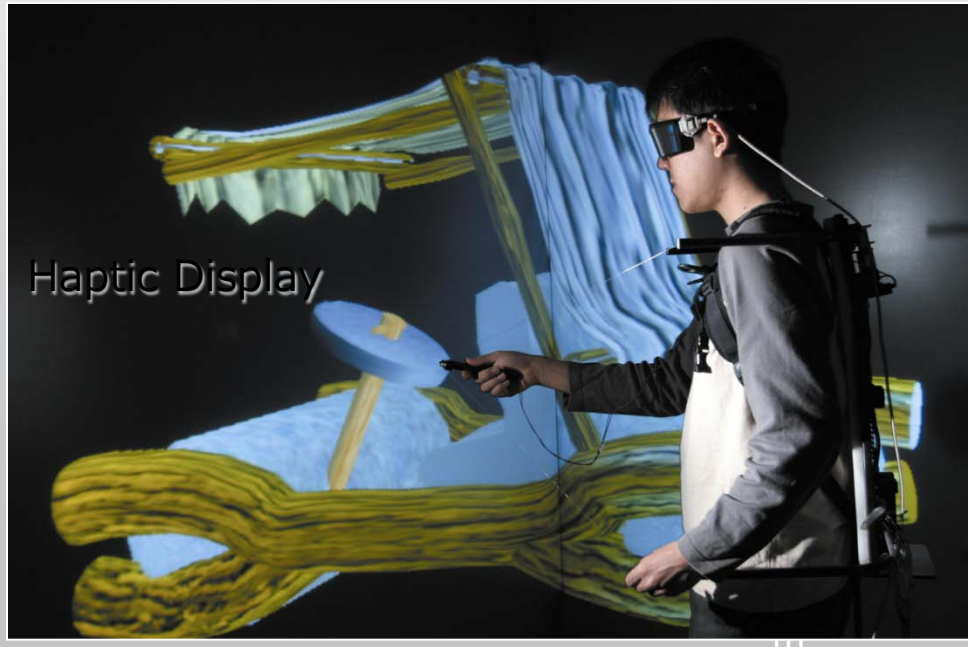
Image courtesy: www.5DT.com

Interaction：

(Interaction: Interaction not prearranged) ‡

Presence： ‡

（Immersion in VR worlds）



Multi-Sensory Interface：

(Interface: Interfacing involving senses other than sight) ‡

Immersive Presence: Entering into visual worlds

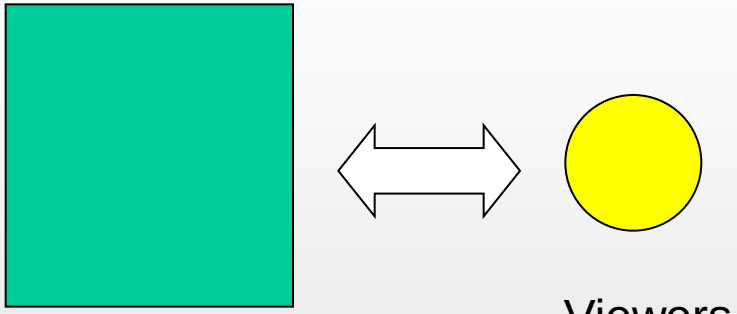
‡

Figure removed due to copyright restrictions

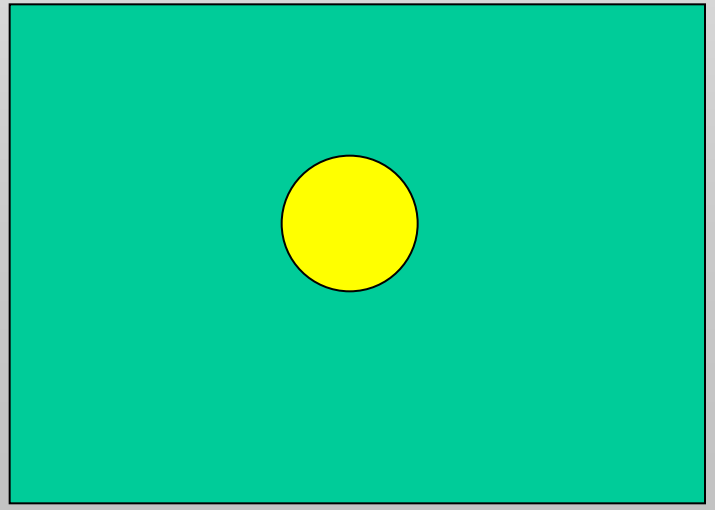
HMD :
Head Mounted Display

IPT: Immersive Projection Technology

Conventional connection between displays and viewers



Connection between VR displays and viewers



It is a more spatial experience. Experiencing a solar eclipse does not consist solely of viewing the spot where the sun is missing.

Visual experiences do not consist solely of viewing.

Figure removed due to copyright restrictions

Physical Interaction:
インタラクションにおける約束事の排除

‡

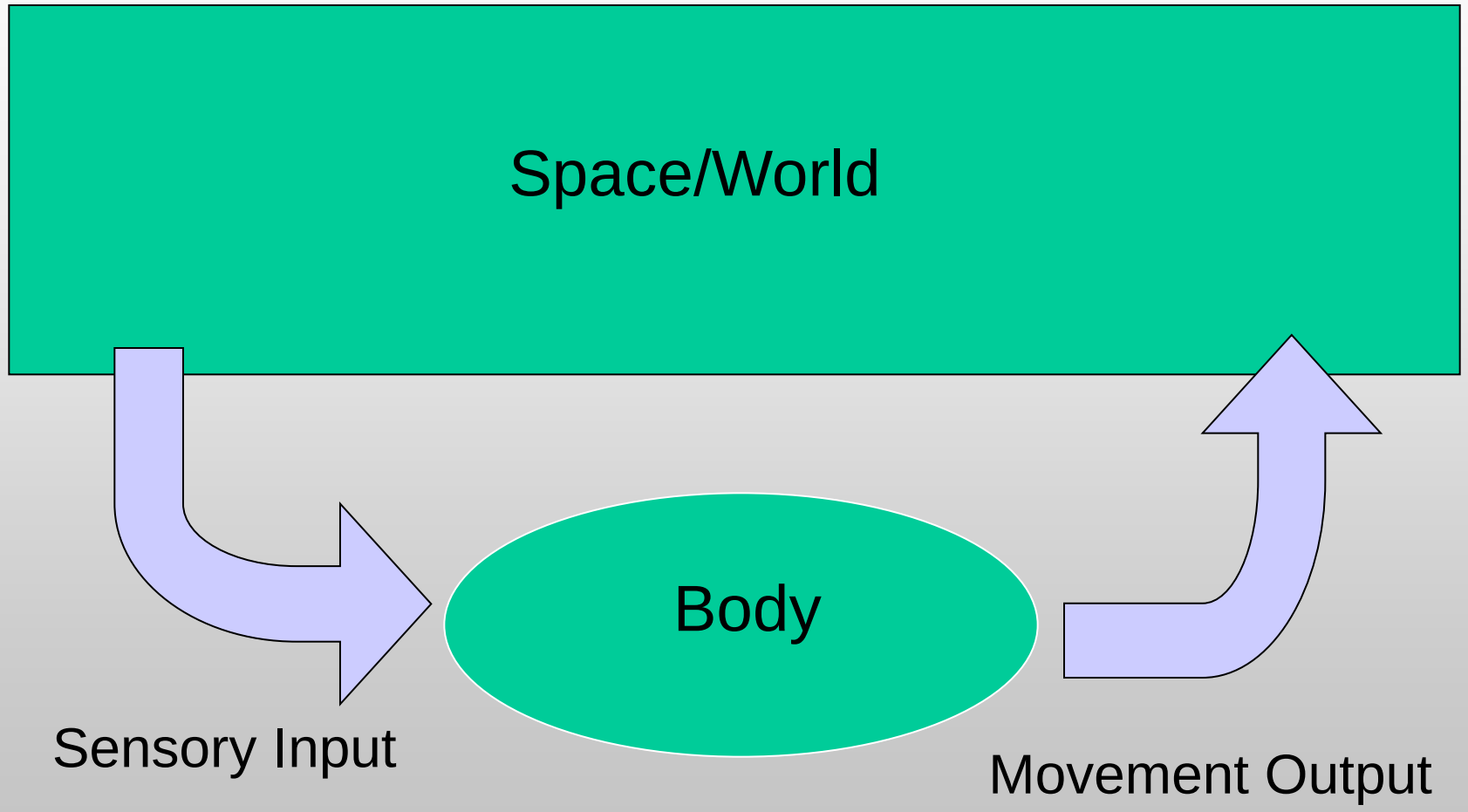
Image courtesy: www.5DT.com

Data gloves

Motion Capture

http://en.wikipedia.org/wiki/File:MotionCapture.jpg

Helping to restore the physicality lost through the shift to electronic

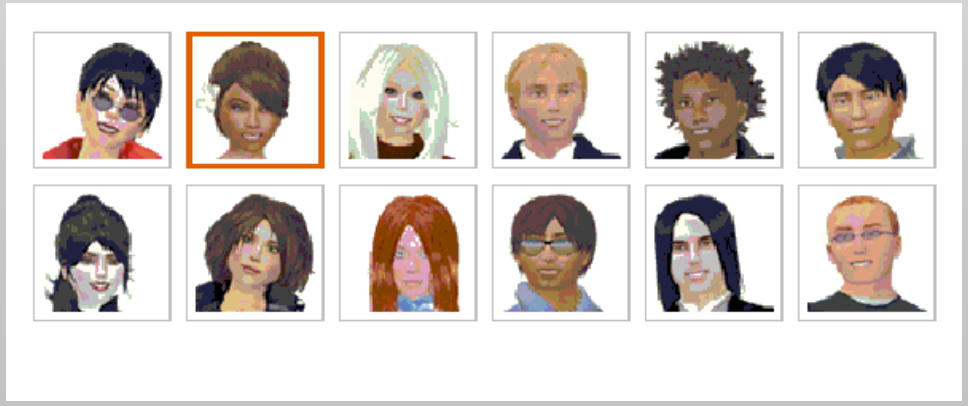


Avatars: Bodies within electronic space

Can be used within a comparatively large Internet community “Characters that embody individual selves (own personalities)”

Linden Lab

http://ja.wikipedia.org/wiki/ファイル:Wikipe-tan_avatar.png



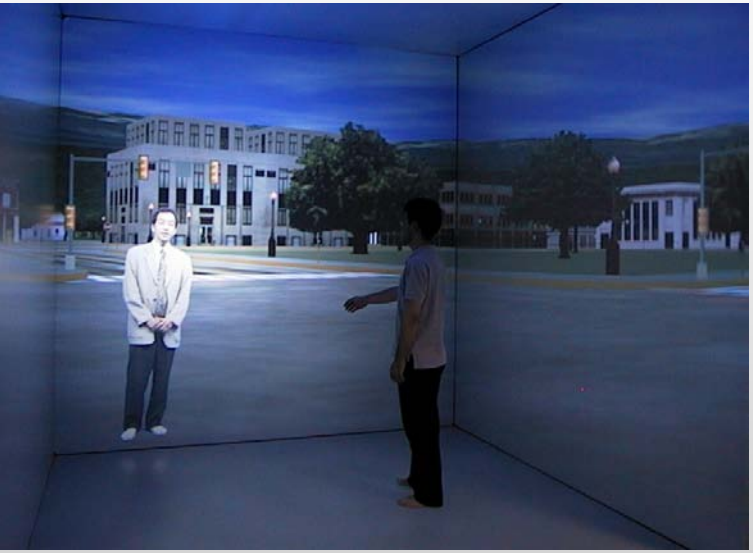
Linden Lab

Linden Lab

Figure removed due to copyright restrictions

Communications with Realistic Sensations
(Imparting a Sense of Presence)

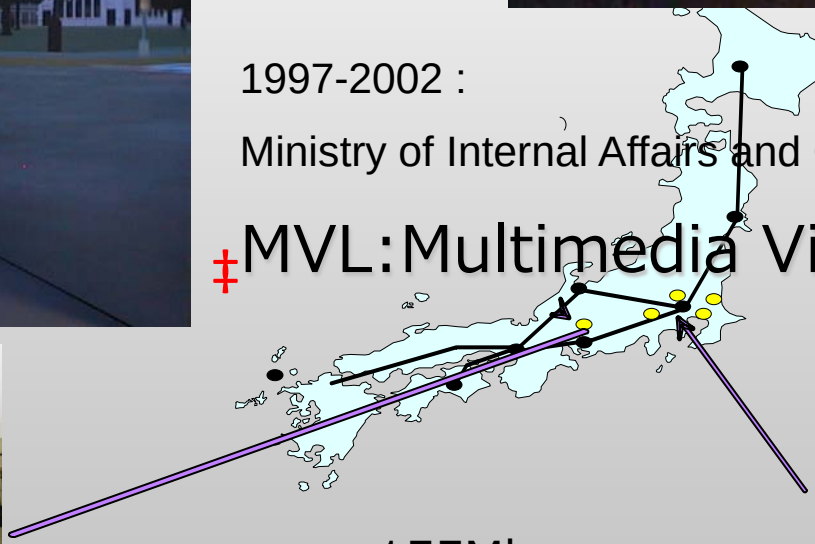
Technology development that seeks to introduce and share virtual spaces through the medium of broadband networks



1997-2002 :

Ministry of Internal Affairs and Communications (MIC)

MVL:Multimedia Virtual Laboratory



155Mbps

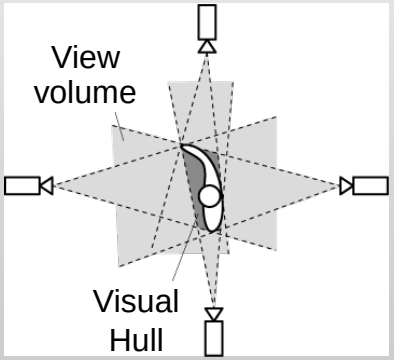
Gigabit Network

COSMOS/Gifu

CABIN/Tokyo

3D Video Avatar

Capture of
Multi-Perspective Images ‡



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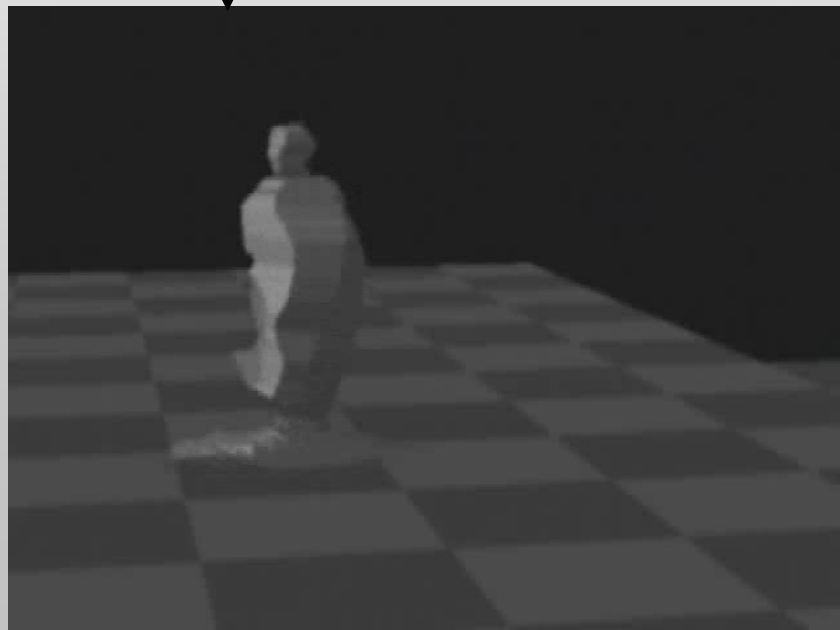
Composition of 3D
Geometrical Models



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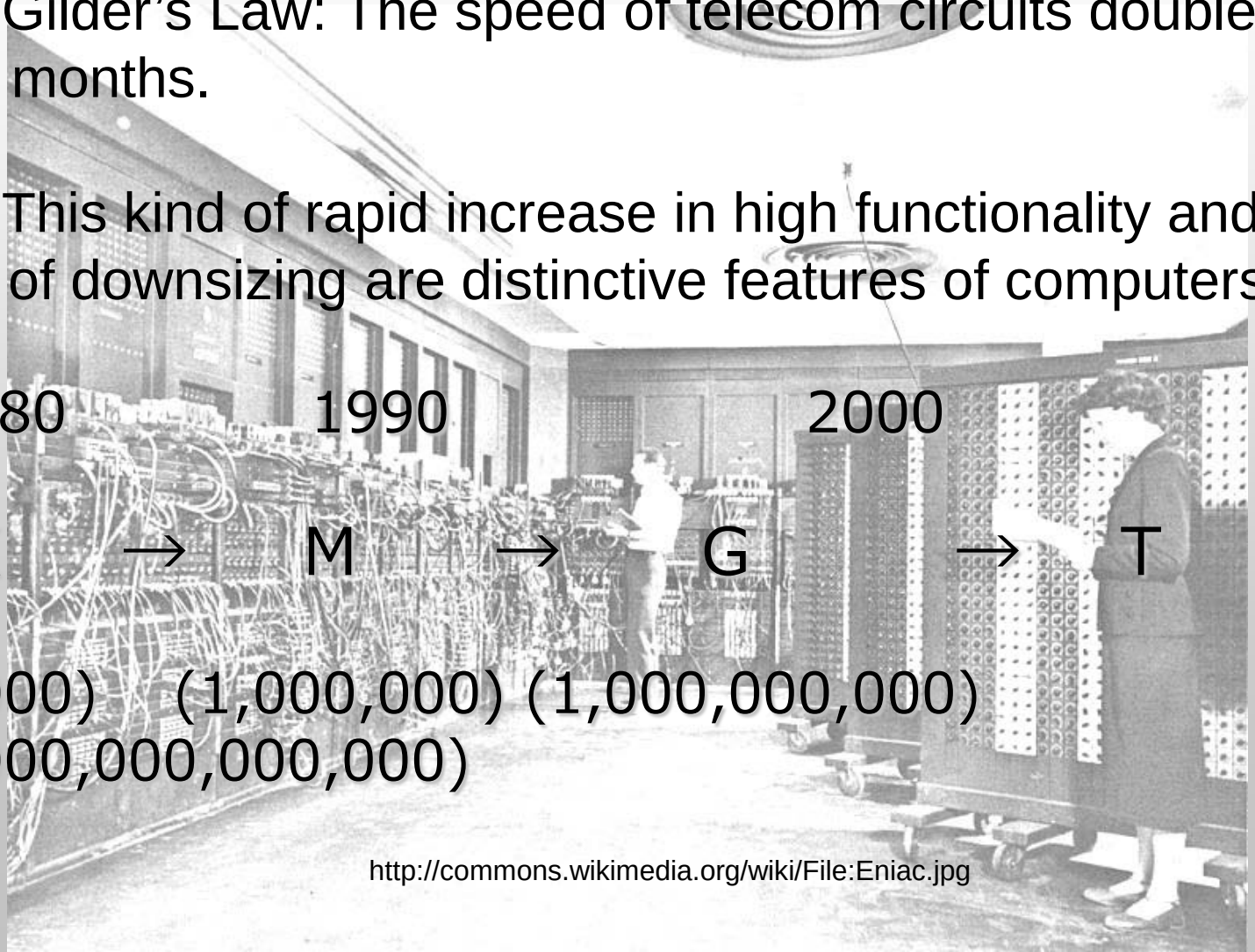
Addition of Texture

Rapid Evolution of Information Technologies

1. Moore's Law: The capacity of computer components (elements) doubles every 18 months.

   Gilder's Law: The speed of telecom circuits doubles every nine months.



This kind of rapid increase in high functionality and its flip side of downsizing are distinctive features of computers.

1980		1990		2000		2010
K	→	M	→	G	→	T
(1,000)		(1,000,000)		(1,000,000,000)		(1,000,000,000,000)

http://commons.wikimedia.org/wiki/File:Eniac.jpg

This kind of rapid increase in high functionality and its flip side of downsizing are distinctive features of computers.

K Information	characters and numbers
M Information	photos
G Information	video

The Advent of Virtual Reality in 1989

Virtual Reality arrives!

On June7, 1989, VPL will show the world's first shared Virtual Reality. The event will take place in the Pacific Bell booth at Texpo '89 in Brooks Hall in San Francisco.

Virtual Reality is a new plane of reality accessible through computerized clothing. A shared Virtual Reality is one in which two or more participants are in a Virtual World at the same time, can see each other, and undertake joint projects. June 7 is significant for a number of reasons. While we don't want to be overly dramatic, this will be the first new level of objectively shared reality available to humanity since the physical world. ….

VR day

Since VPL and Autodesk will be showing our systems on the same day, we decided to make it a holiday. VR Day will take place on June every year from now on. Like Columbus day, VR day celebrates the opening of a new world VR Day will be celebrated every year with a parade and virtual beauty contest held inside Virtual reality. ….

‡ NASA VIEW (1987)NASA

Figure removed due to copyright restrictions

Multi-Sensory Interfaces:
Activates entire spectrum of human senses.

Haptic (Tactile) Display Haptic ‡

Sound (acoustics) simulator in constructed space

‡ From Shinichi Sakamoto Research Office webpage

Sensorama

- Morton Heilig, 1963
- an “Experience Theatre”
- Moving pictures which include not just visual and auditory senses, but also are capable of expressing wind and olfactory (smell) effects

‡ ©Morton Heilig

VR is a technology involving all five senses: Since we experience the real world through our physical senses, synthesizing reality is nothing other than sensory synthesis.

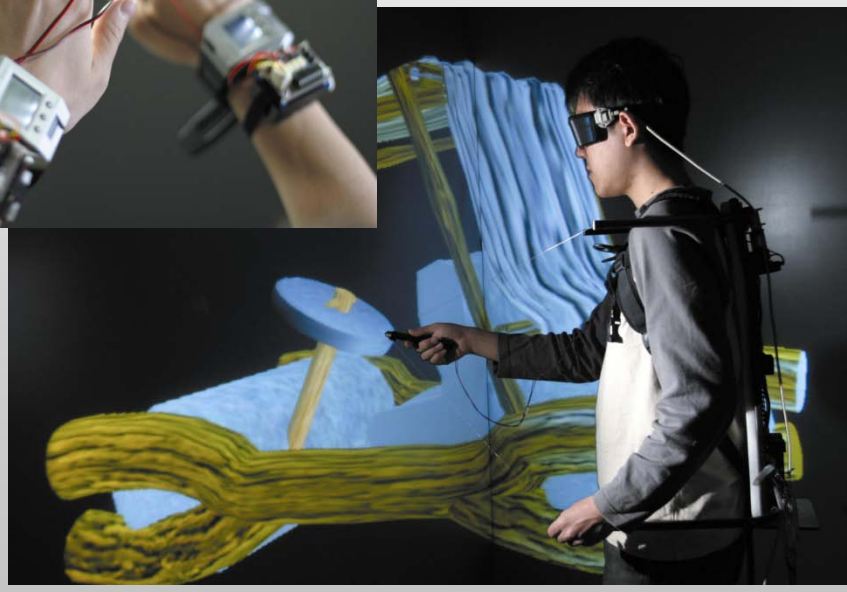
Sensory information and communications technologies that aim for the innovative development of computers capable of the acquisition, processing, display, etc. of information detected by the five senses have begun to attract considerable attention.

‡

Photos provided by Satoshi Yokoyama

Wearable olfactory display

‡



Wearable-type Haptic (Tactile) display “Haptic Gear” ‡

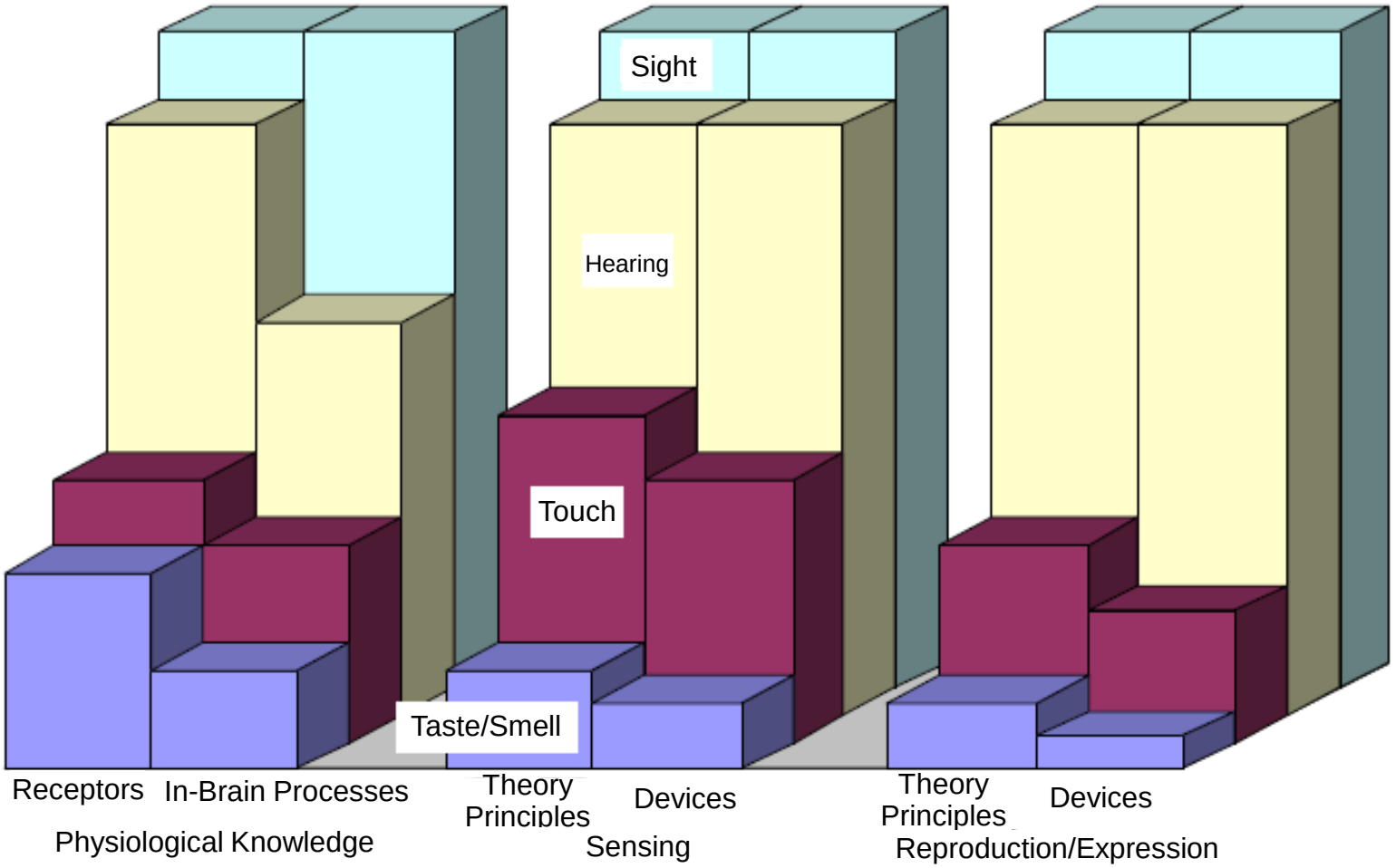
The five senses are:

The “five senses” is a term used to refer to all the senses which allow us to be conscious of the physical world. We rely on these “five senses” to conduct our daily lives. Despite that fact, up till now information and communication technology channels have been limited to those for sight and hearing.

Types of senses:

- Special Senses
  - sight, hearing, taste, smell, vestibular senses
- Surface Sense
  - sense of tactile (touch) pressure, sense of warmth, sense of cold, sense of pain
- Deep Senses
  - sense of movement, sense of position, sense of deep pressure, sense of deep pain
- Internal Organ Senses
  - organic senses (sense of hunger, vomiting sensation), internal organ pain

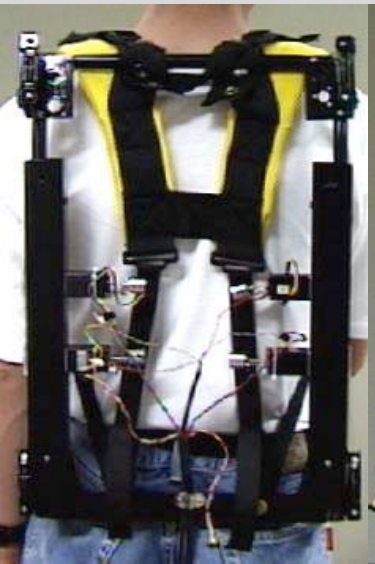
From a historical perspective, up till now information and communication technology channels have been limited to those for sight and hearing.



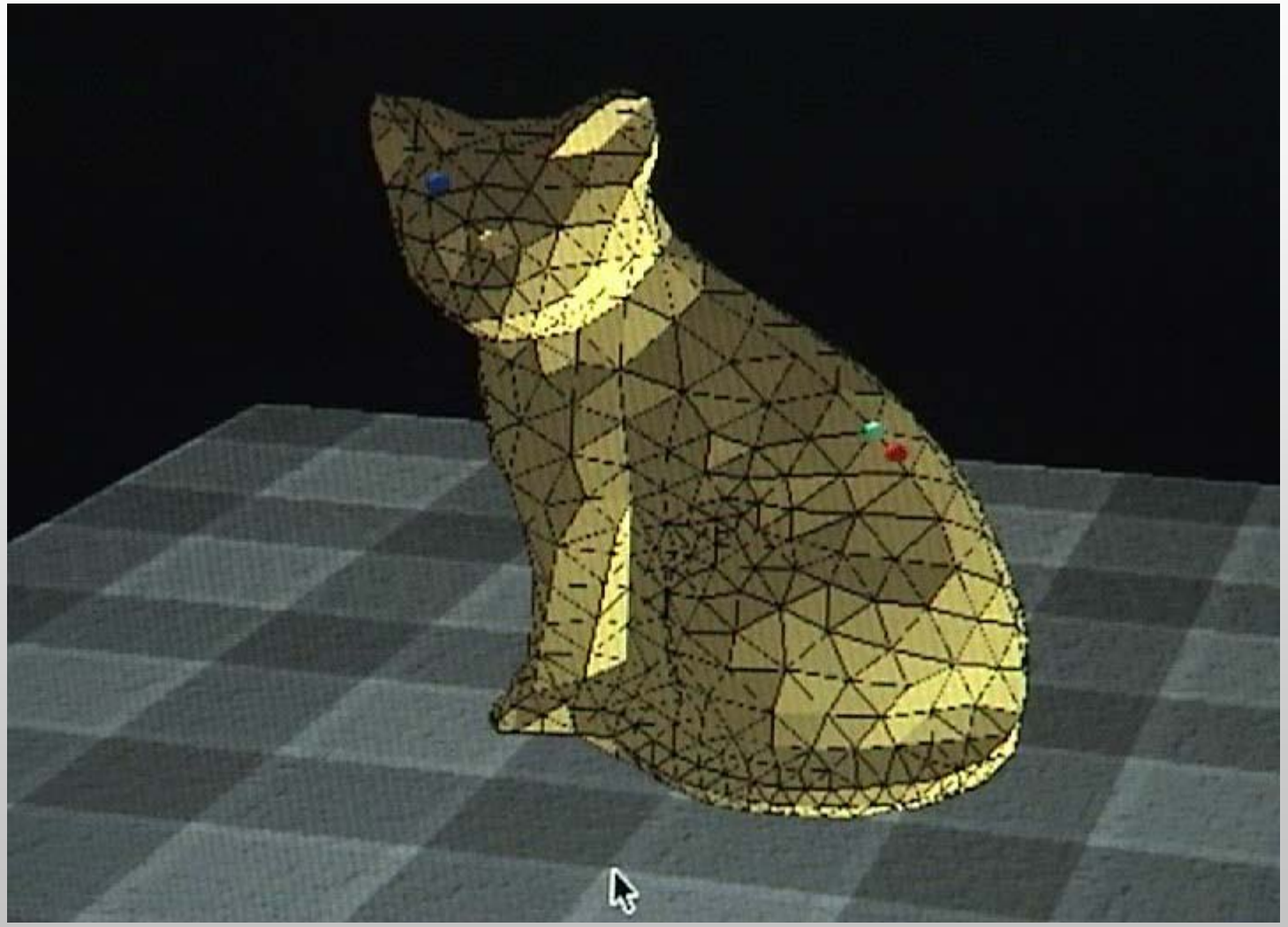
‡ Exhibit 1-1: Images of Development Rates for R&D related to Various Senses Using Sight Criteria

Haptic (Tactile) Display

Wearable-type Haptic (Tactile) Display
“Haptic Gear”

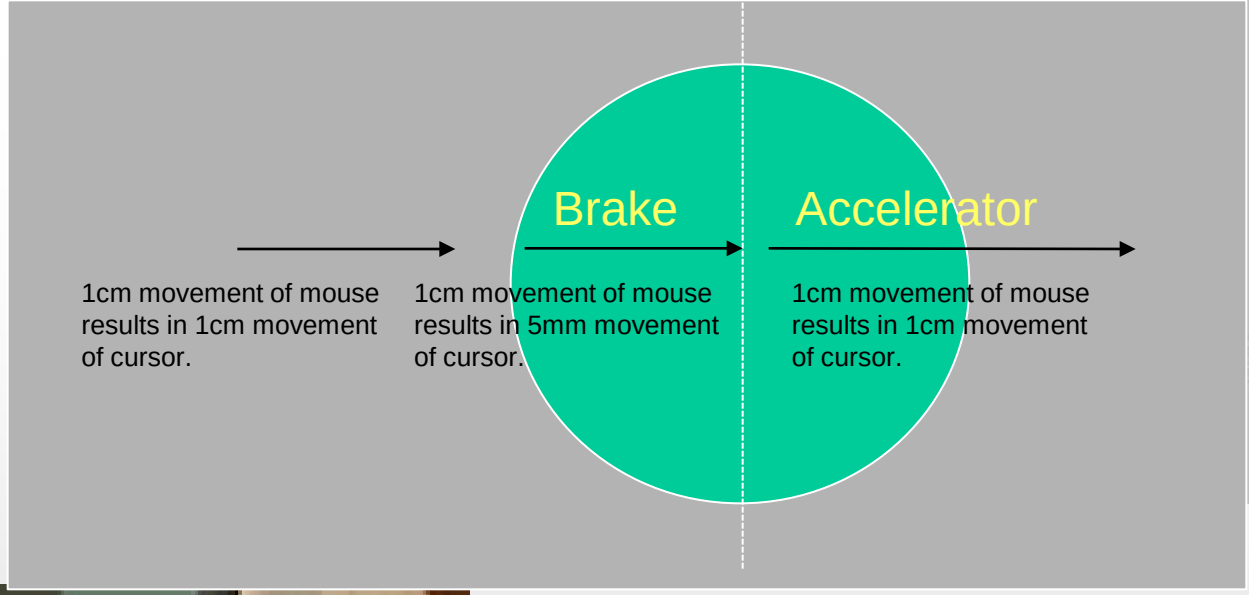


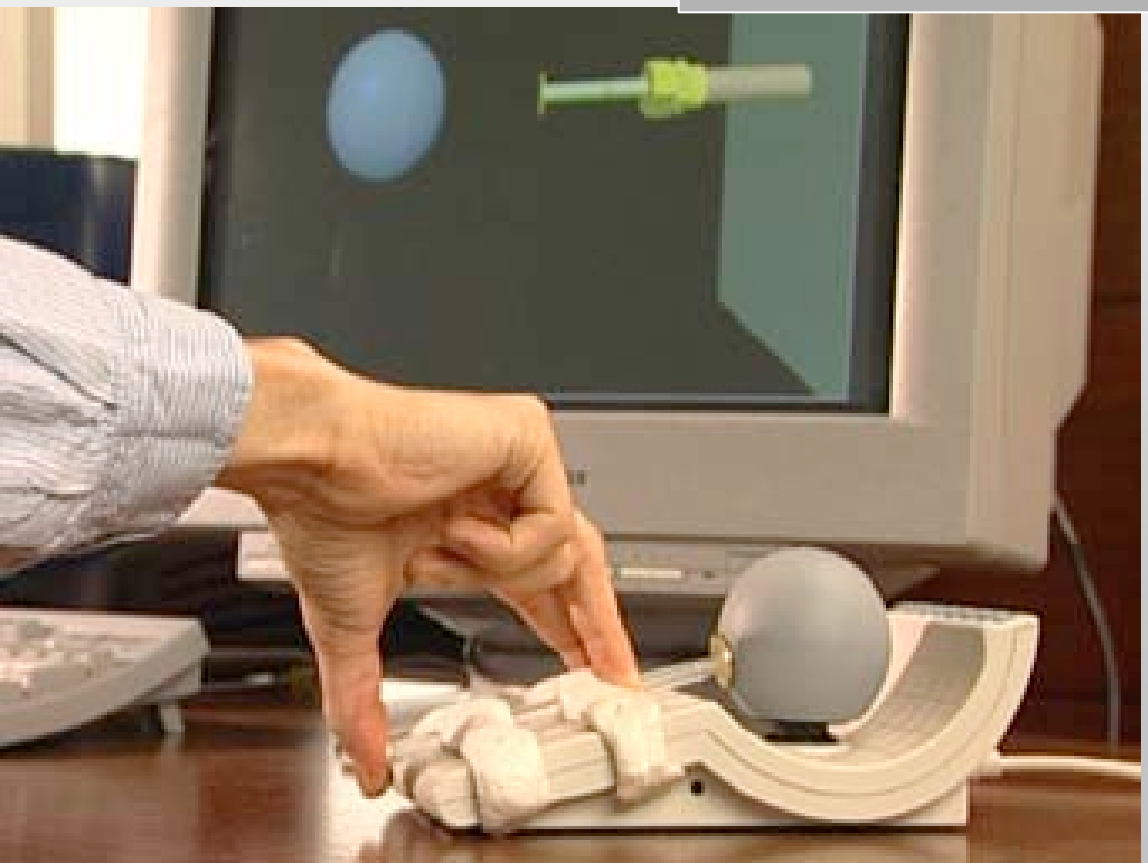
Manipulation of 3D Object



Imitation Tactile Sensing

(Pseudo Haptics)





‡ A. Lecuyer et.al

Haptic (Tactile) Navigation Device

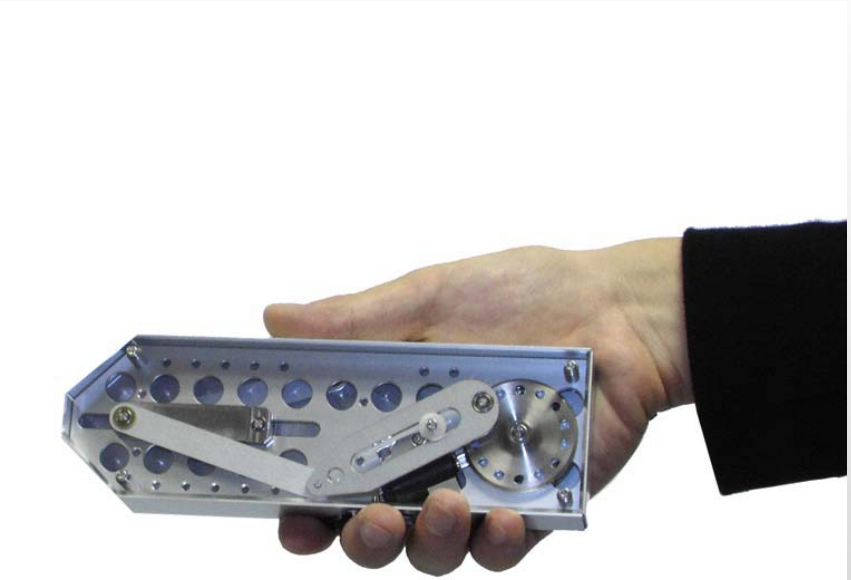


Photo Provided by: NTT Communications Science Laboratories

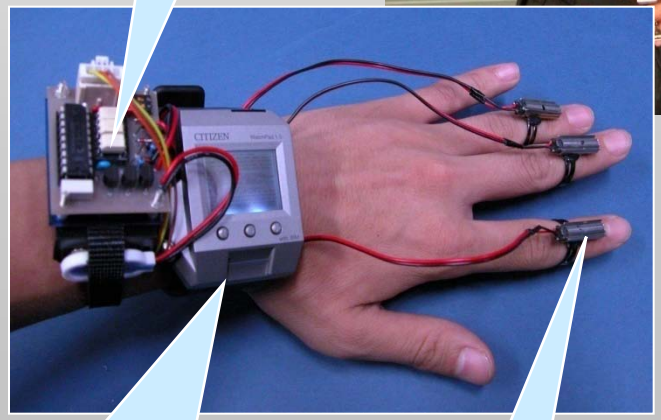
‡

Braille Device

Photo Provided by: Tomohiro Amamiya

‡

Control Unit



‡

Photo Provided by: Tomohiro Amamiya

Wristwatch-type Computer

Oscillator

Olfactory Display

Fragrance-Producing Component

Control Component

Olfactory Display

‡

Online Shopping

Transmission of Fragrance Information

‡

Photos provided by Satoshi Yokoyama

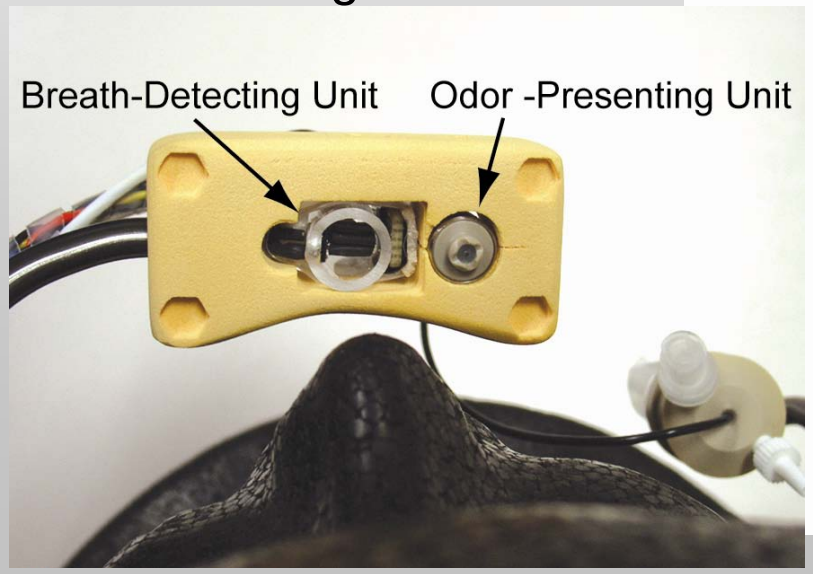
TV/WEB for Fragrances

Direct Inhalation-type Olfactory Display Device

- Odor-Presenting Unit
  - Piezo-type Injector Nozzle ‡

‡ microdrop GmbH

- Breath-Detecting
  + Odor-Presenting Unit



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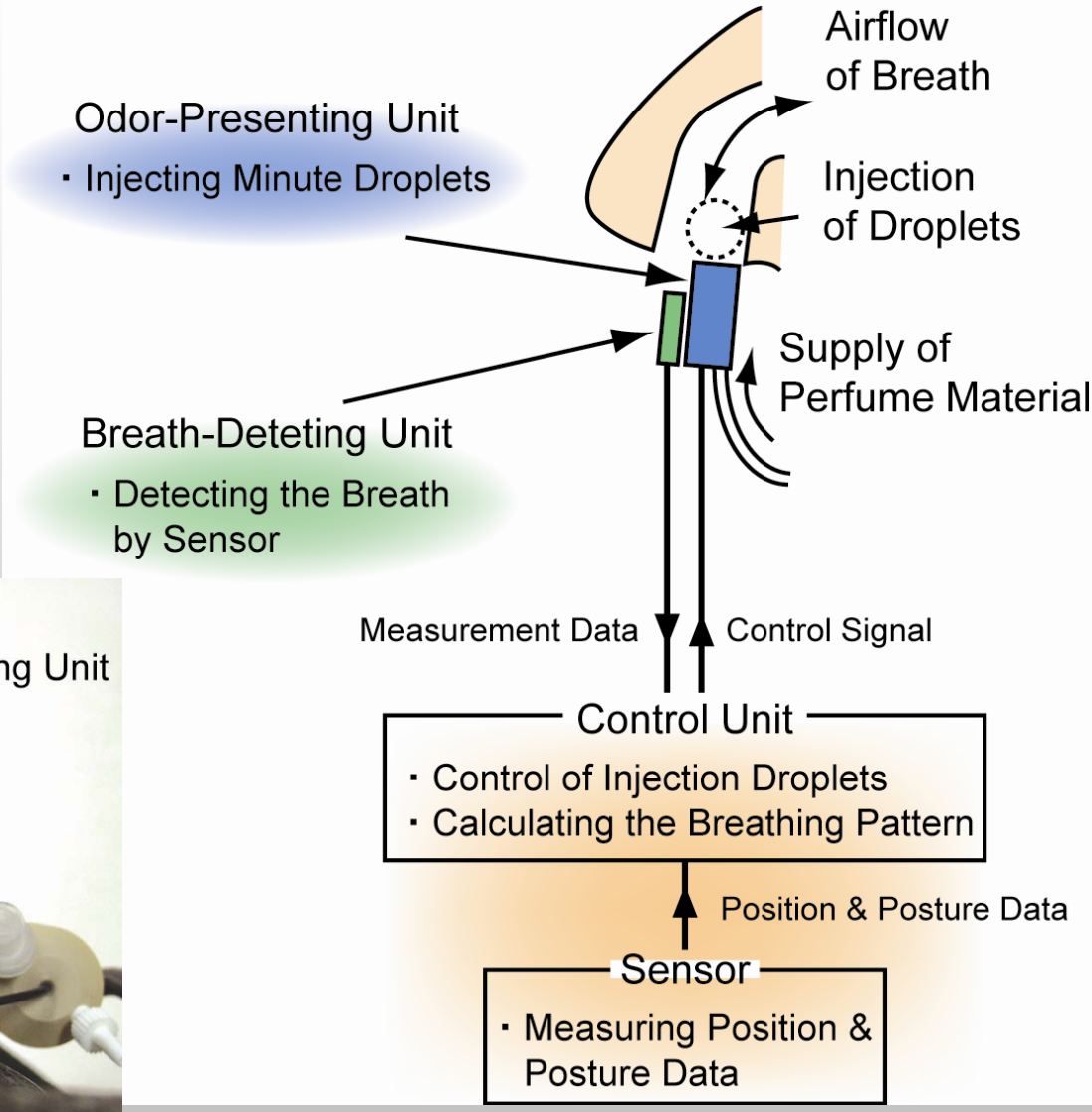
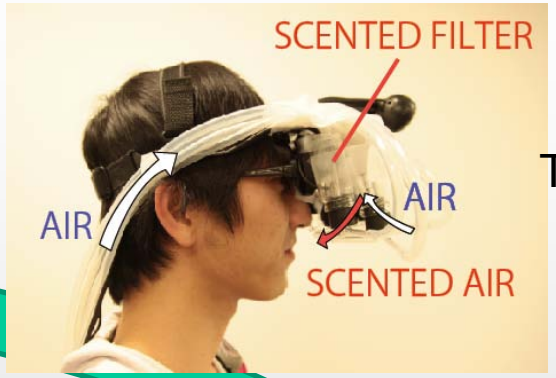


Meta Cookie:
Cookies which effect changes of taste through expanded sense of reality

Olfactory Display



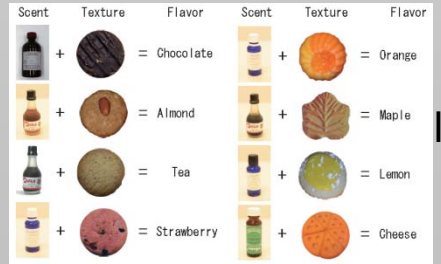
Marker Recognition
+
Texture Overlay Display
+
Olfactory Display

Meta Cookie

Brand for Creating Marks

Chocolate Cookie

Almond Cookie



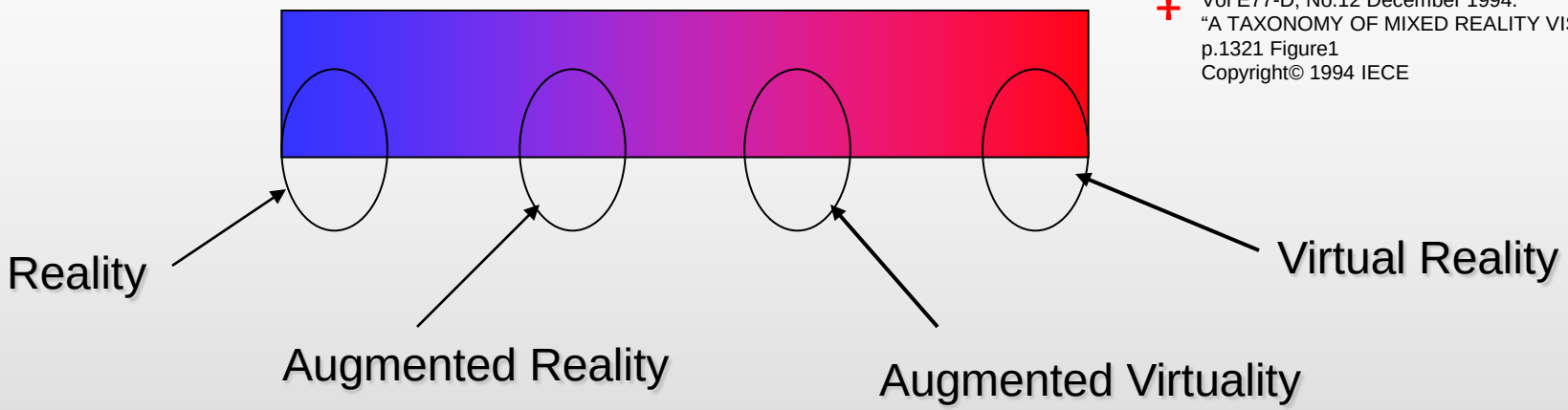
The combination of sight and smell information lets people feelthat they are eating various kinds of cookies!

(Percentage of individuals who detected a change in taste: roughly 80 percent)

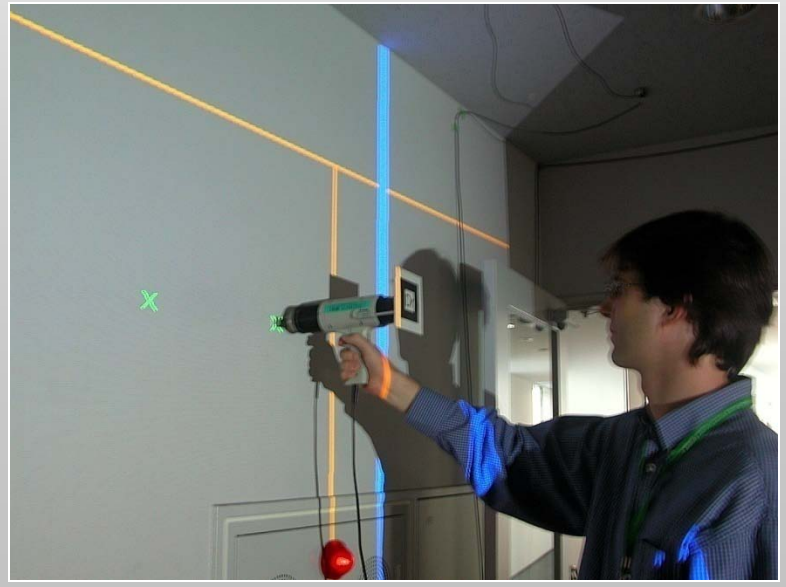
‡

Mixed Reality Sensory (MR) Technologies

One form that the evolution of VR technologies has taken is mixed reality (MR) technology. Reality and virtual reality are already not disconnected concepts.



‡ IECE Transactions on Information Systems,
Vol E77-D, No.12 December 1994.
"A TAXONOMY OF MIXED REALITY VISUAL DISPLAYS"
p.1321 Figure1



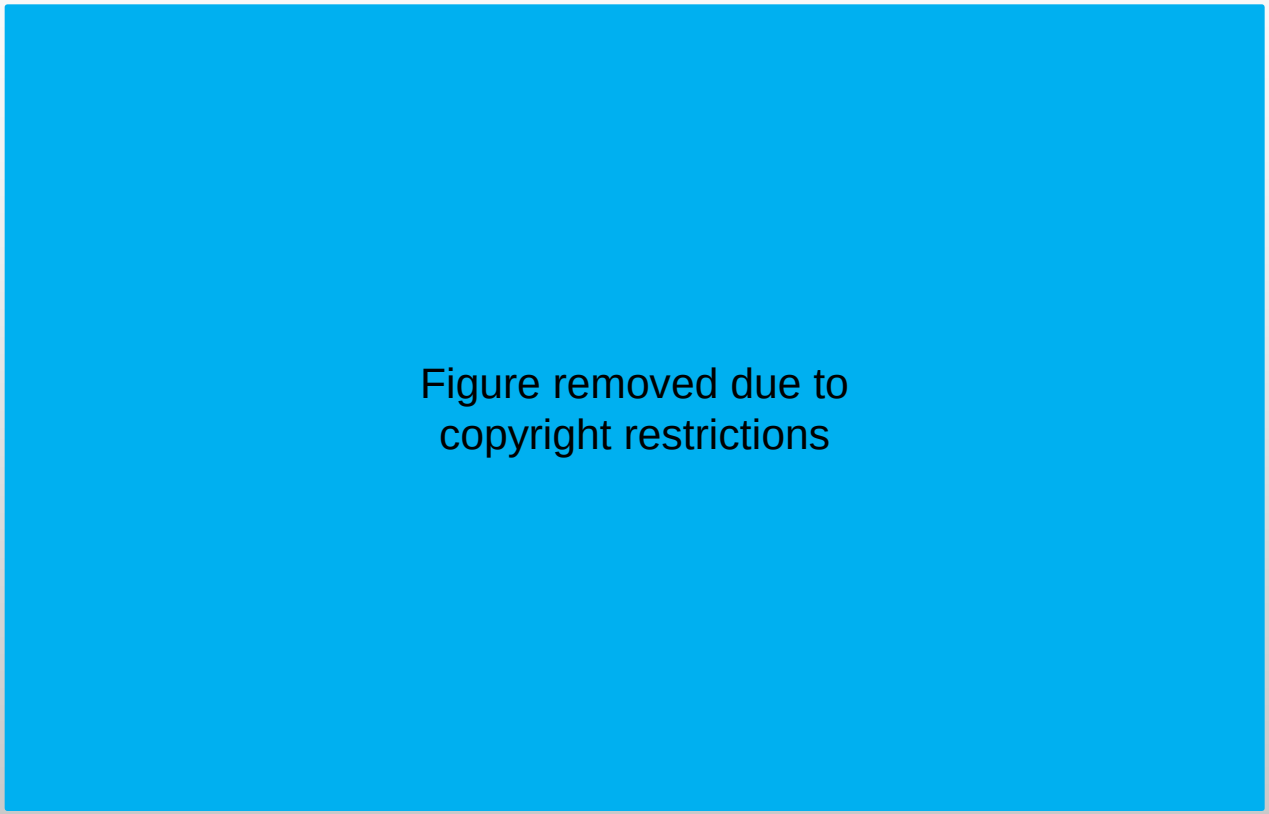
The essence of MR is that VR is capable of responding to an expanded real world.

Mixed Reality = Augmented Reality + Augmented Virtuality

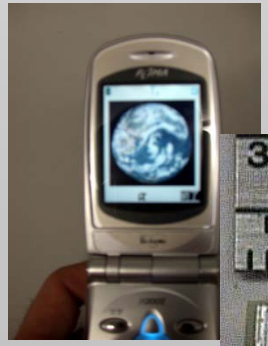
Augmented Reality is a technology for embellishing real spatiality with virtual spatiality.

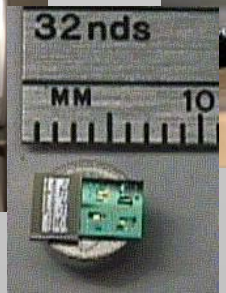
Augmented Virtuality is a technique for embellishing virtual spatiality with information from real spatiality.

Augmented Reality : Superimpose “virtual” onto “real”.



See-through HMD is used for this purpose.

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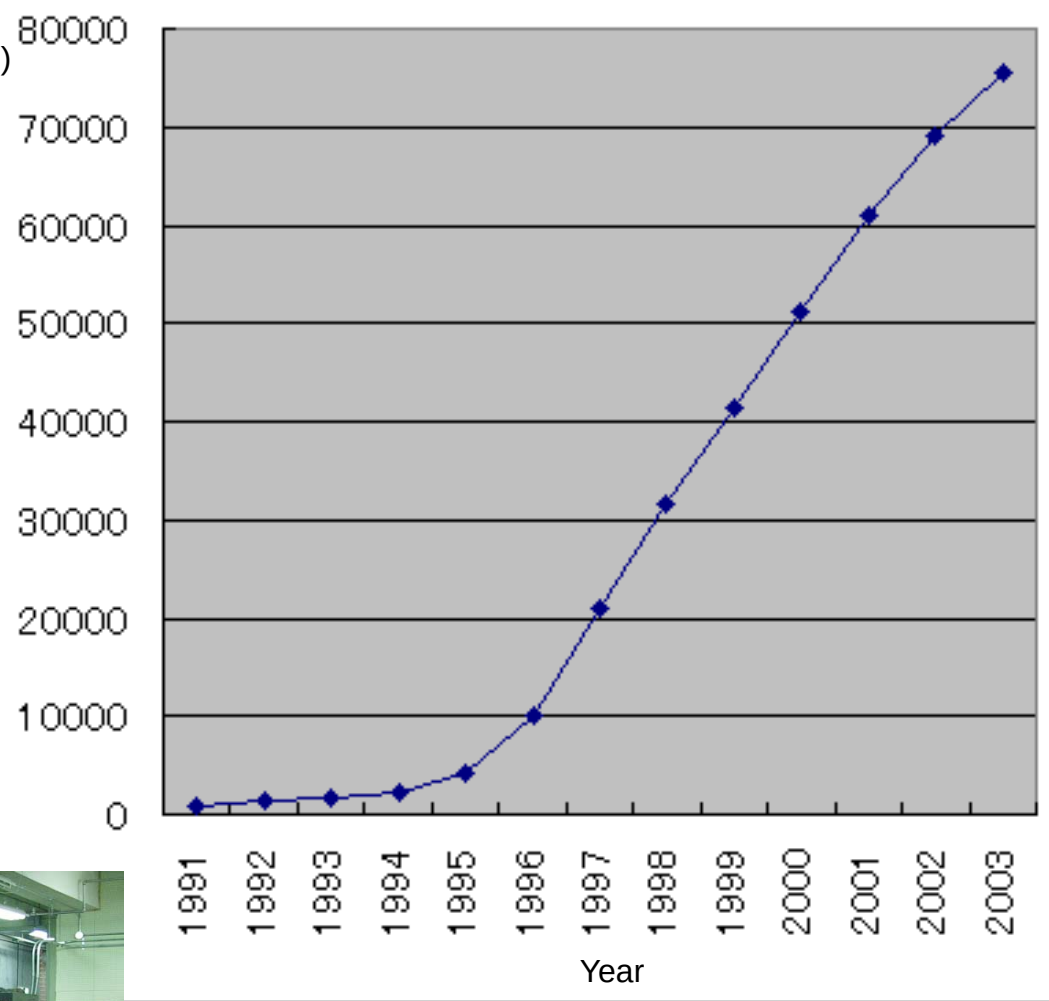
Units
(thousands)
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1991
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2001
2002
2003
Year

Increased mobility has resulted in a 180-degree diametrical change in the relationship between computers and human beings.

That is to say:

- Human beings went to where computers were located

  ⇒ Computers can now accompany people

- From where content is generated has become more important

  than where a computer is located.

Desktop – Laptop – Palm Top – ?

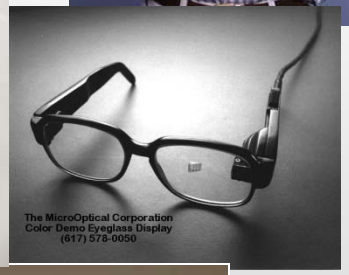
What precedes volume fluctuation dispersion/compactness?

Wearable Computers

With the rapid miniaturization of information devices, we have begun to see a new evolution towards “portability.” Computers have gone beyond being “personal” to becoming “intimate.”

‡ Shown with the permission of IBM Japan, Ltd

‡ Shown with the permission of Citizen Watch Co., Ltd. and IBM Japan, Ltd.



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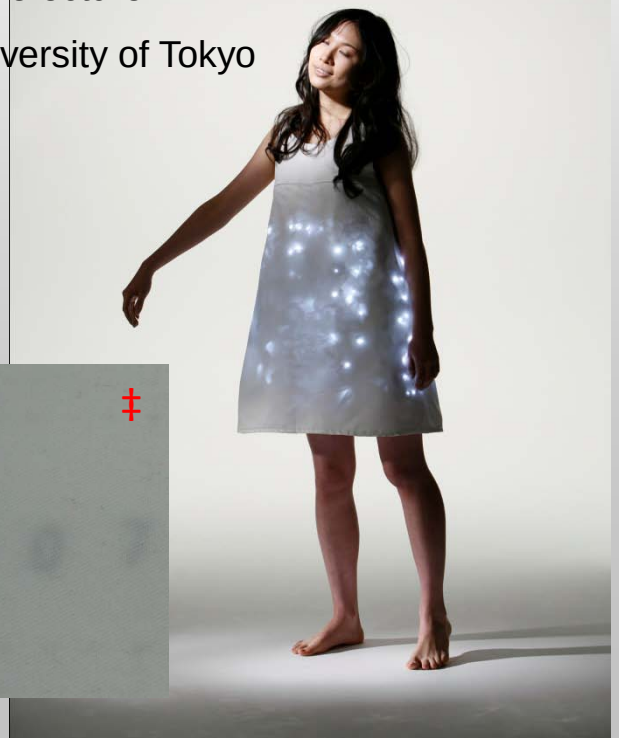
‡ Photo Provided by: Reiko Kamioka

Photographer: Masaharu Hatta

Fukui Prefecture

The University of Tokyo



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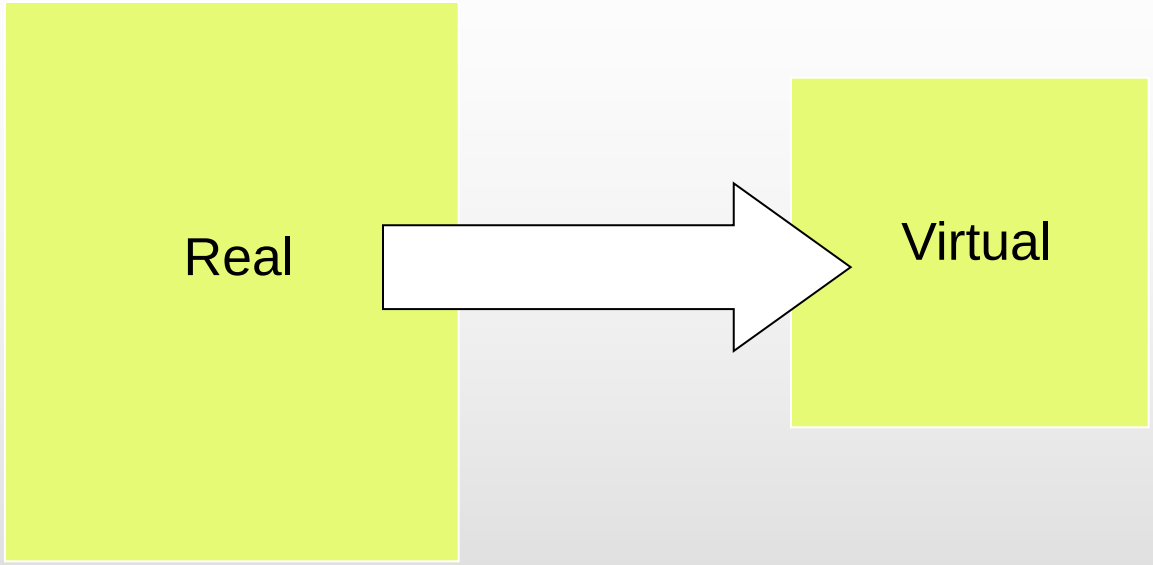
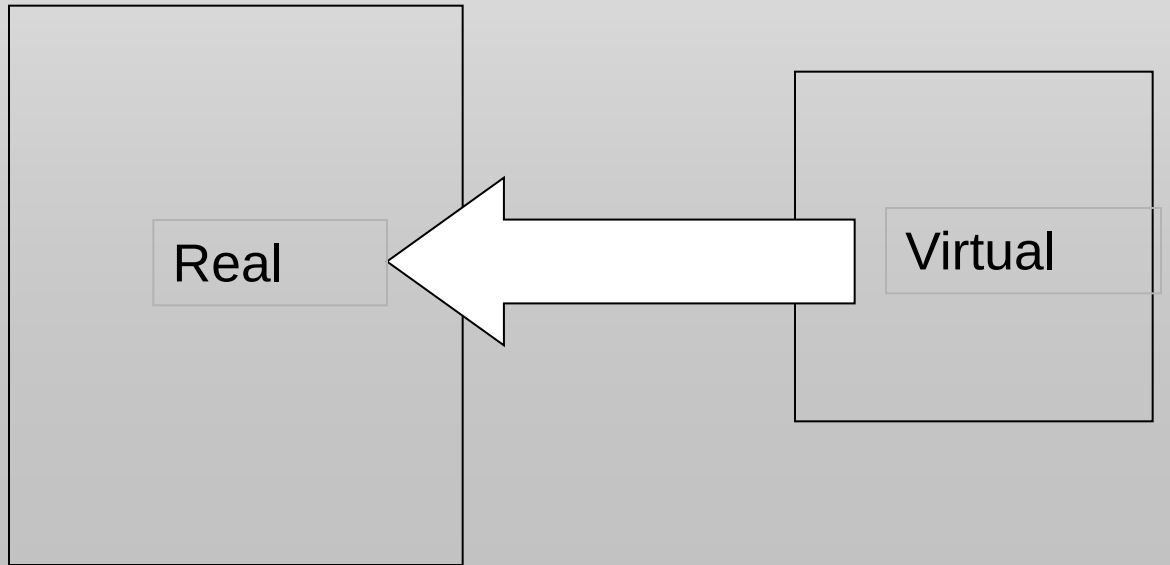
‡ Photo Provided by: Reiko Kamioka

Augmented Virtuality (AV) Technology involves the introduction of information from the real world to a virtual world.



Augmented Reality (AR) Technology



Augmented Virtuality

http://commons.wikimedia.org/wiki/File:Projection-screen-home2.jpg

Home Theater System

‡ Sony Computer Entertainment Inc.

‡

From Kunihiro Nishimura Webpage

Virtual Stadium

Ultra-Realistic Dissemination

PDA

Wearable Computer

Interactive Input

High Field of Vision Angle Image Creation Technologies

Interactive Input

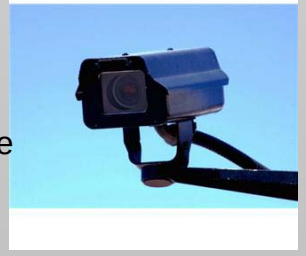
Actual Space Editing Technologies

Technologies for Converting 2D to 3D

Camera-equipped Cellphones

Video Cameras with Wireless Capabilities

Input of Real World Information



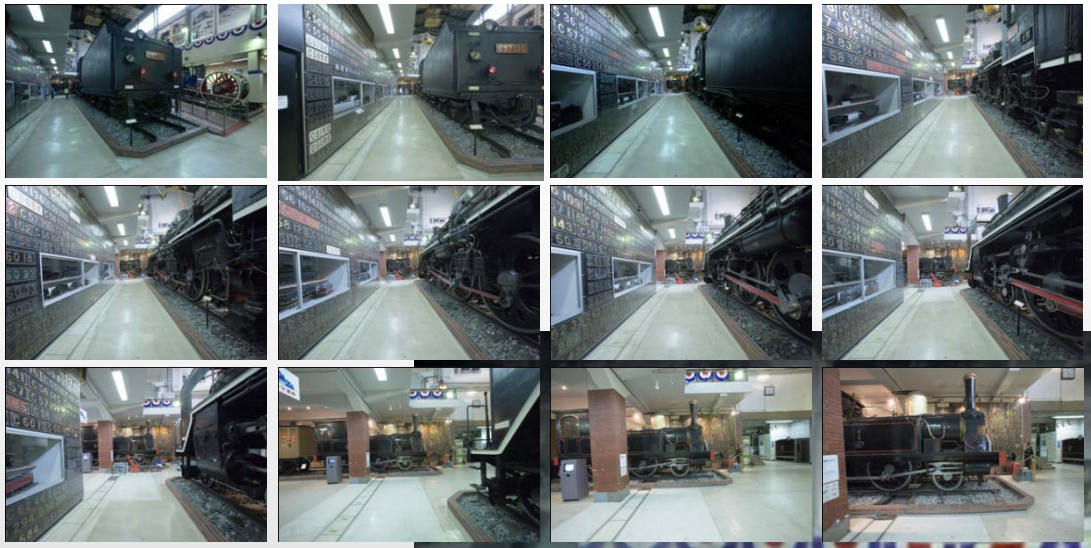
Surveillance Camera

Image Capturing System

Range Scanner

Photo-Pop-UP (1)

Figure removed due to copyright restrictions

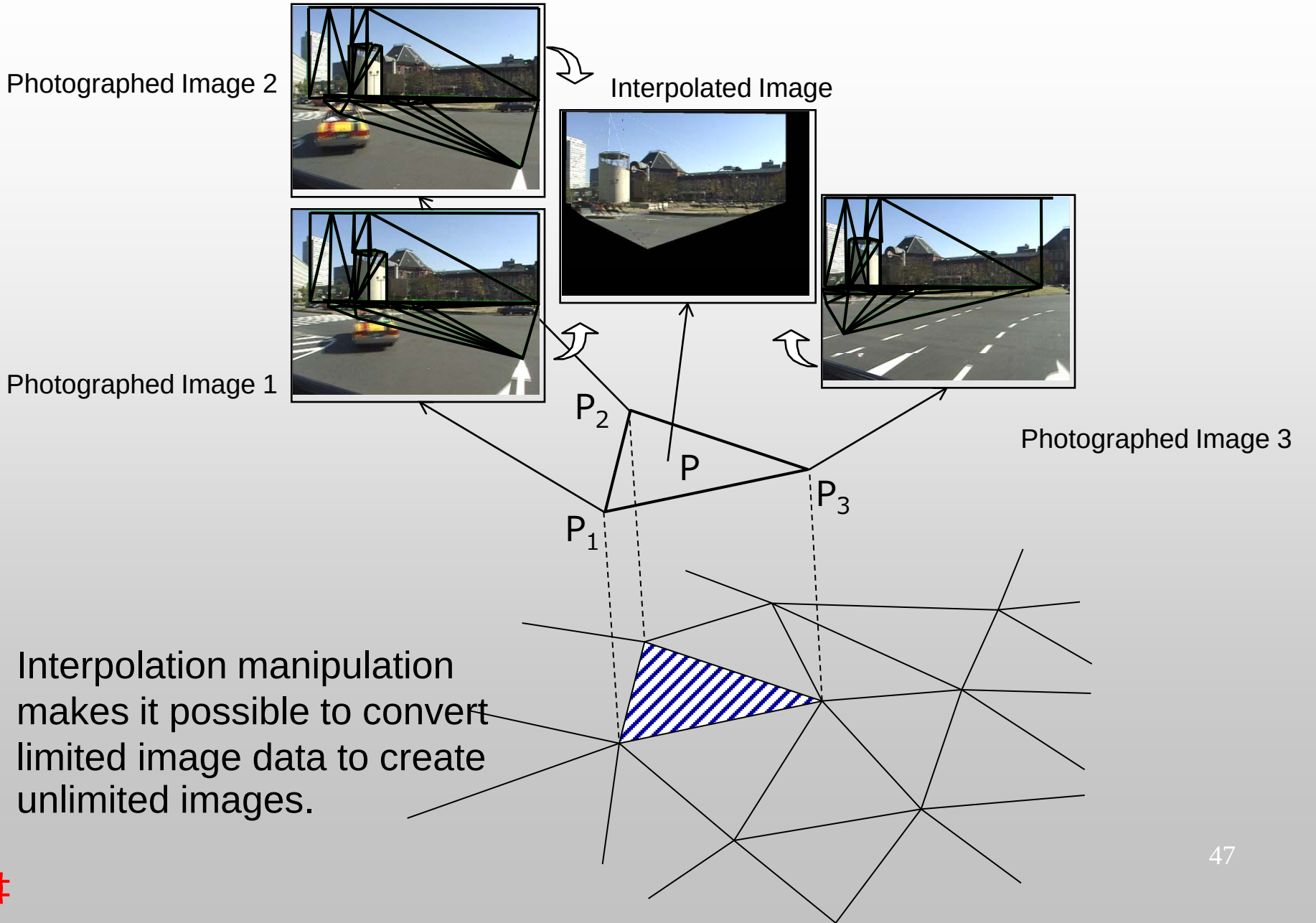


‡

Interior of Former Transportation Museum
(currently closed)

‡

Creation of 3D Worlds with “Image-Based Rendering”



Interpolation manipulation makes it possible to convert limited image data to create unlimited images.

Elimination of objects in the foreground obstructing the view

What mixed reality technologies can teach us is that the real and the virtual are not antagonistic concepts.

The rapid development of computer technologies up till now has created a situation in which they now have an integral position in society.

In other words, we are now in a position to choose how to resolve things in terms of how far to go with constructive methods or from where to proceed.

- Entering a Second Generation for VR Technologies
  - HMD/Stereoscopic Eyeglasses → Naked Eye Stereoscopic Vision
  - Haptic (Tactile) Displays → Multi-Modal, Application of Perceptual Characteristics
  - CG-based VR Spaces → Real World-based VR Spaces
  - Confined Spaces → Wide, outside, open spaces

First Generation VR Technologies

NASA

Haptic (Tactile) Displays

http://commons.wikimedia.org/wiki/File:Sensacio3D.png

hoto Provided by: NTT Communication Science Research Laboratories

http://commons.wikimedia.org/wiki/File:Radiosity_scene.jpg

http://en.wikipedia.org/wiki/File:CAVE_Crayoland.jpg

Interior of Former Transportation Museum (currently closed)

Second Generation VR Technologies

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‡

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Nintendo

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State-of-the-art devices which previously could only be found in the research laboratories of universities can now be bought in home-use versions at astonishingly cheap prices.

Large Screen Projectors

150-inch Plasma Screens ‡

‡ Source: Panasonic Corporation CyberShowcase Blog

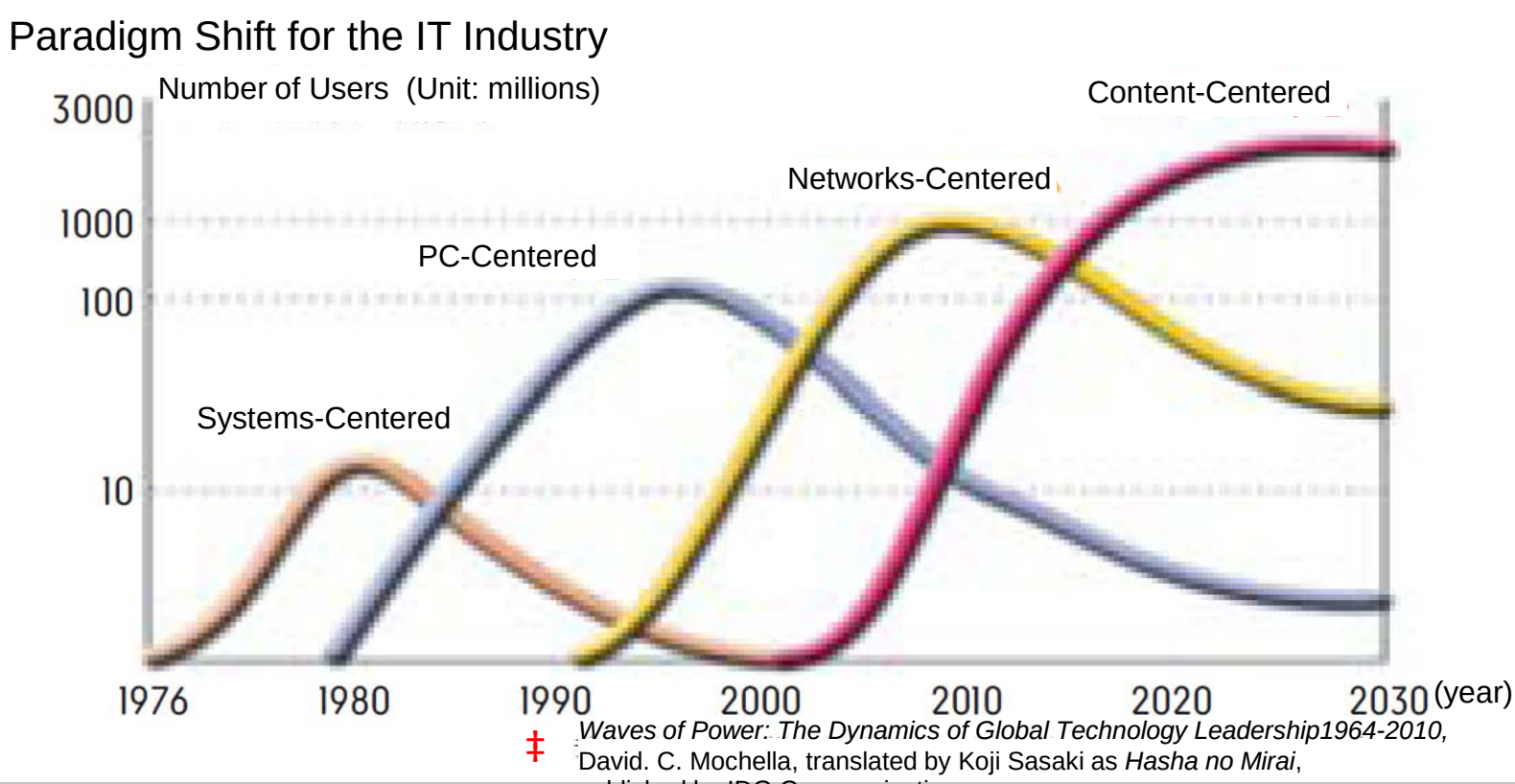
Hand-Carried Projectors

OS Company Ltd. ‡

3D ブーム到来

Figure removed due to copyright restrictions

Paradigm Shift for the IT Industry



‡ *Waves of Power: The Dynamics of Global Technology Leadership1964-2010,* David. C. Mochella, translated by Koji Sasaki as *Hasha no Mirai*, published by IDG Communications

IBM, Microsoft, Softbank, Yahoo, Rakuten, Index. . .

1. What is Virtual Reality (VR)?
2. VR as an Interface Technology
   - VR as an Interface Technology
   - New Interaction
   - Communications Technologies for Information from Five Senses
3. Mixed Reality Technologies
   - Augmented Reality
   - Augmented Virtuality