Computers and Virtual Reality (2)

Humans and Machines

—What of Human Beings in the Era of Digitalization?—

Michitaka Hirose

Graduate School of Information Science and Technology

the University of Tokyo

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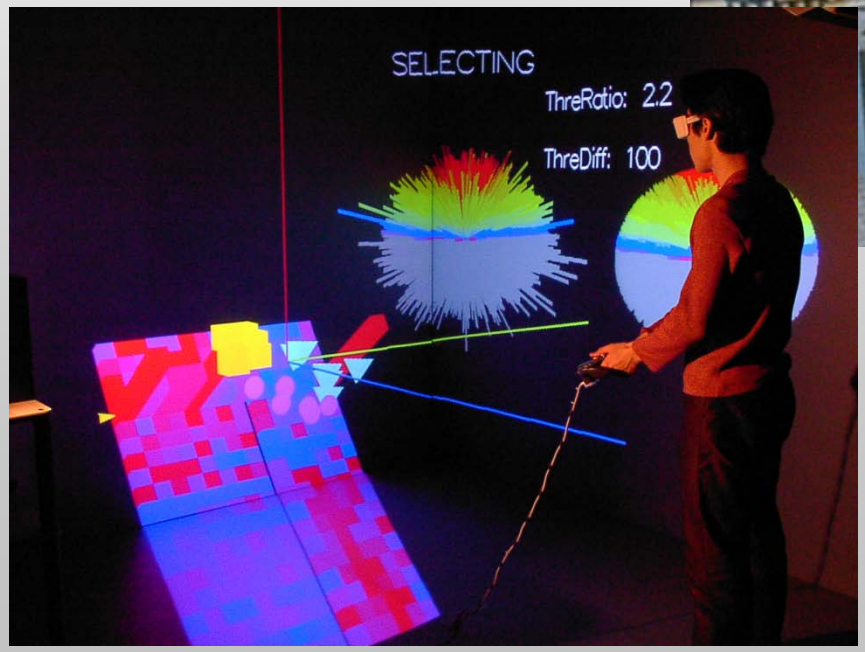


‡

‡ Shinichi Sakamoto
Research Office webpage

‡

1． What is Virtual Reality (VR)?

‡ NASA

2． VR as an Interface Technology

Creation of a Sense of Reality

(Presence)

New Interaction

Communications Technologies for

Information from Five Senses

‡

‡

‡

Photo provided
by Satoshi Yokoyama

3． Mixed Reality Technologies

Augmented Reality

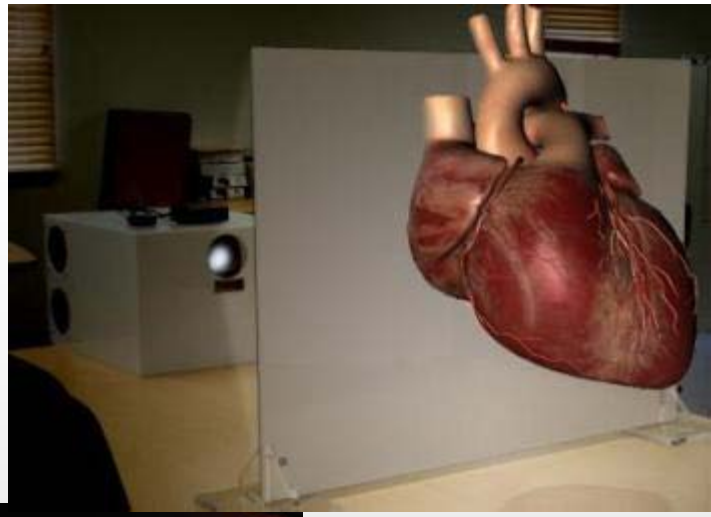
Augmented Virtuality

‡

VR as Visualization Technologies.

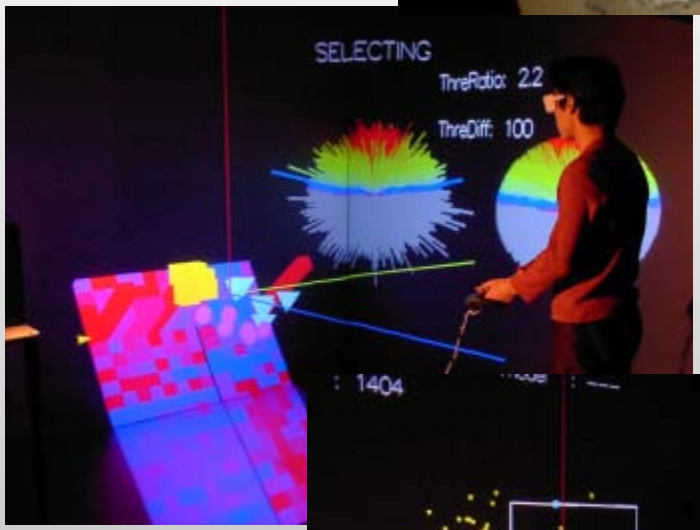
VR are Visualization Technologies.

The essence of “virtual reality technologies” is that they allow us to experience things that we originally could not see or could not experience. We therefore say that VR are technologies for making things visible.



‡ From Cyber-Anatomy Corp. web page

Renowned journalist Takashi Tachibana:
“Hearing something one hundred times does not match seeing it once;
Seeing something a hundred times does not match experiencing it once.”



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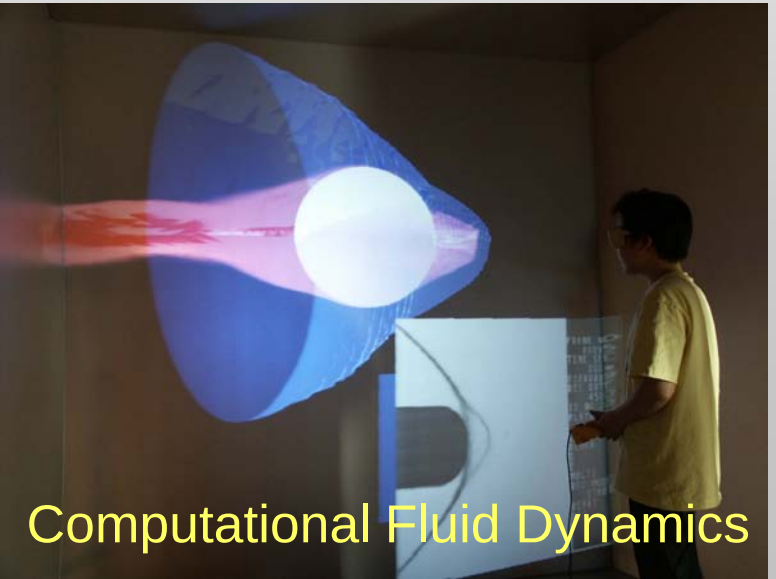

Computational Fluid Dynamics

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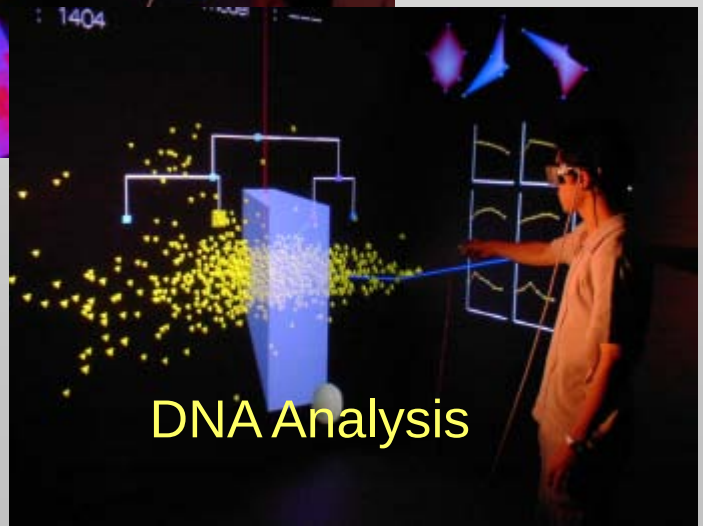


DNA Analysis

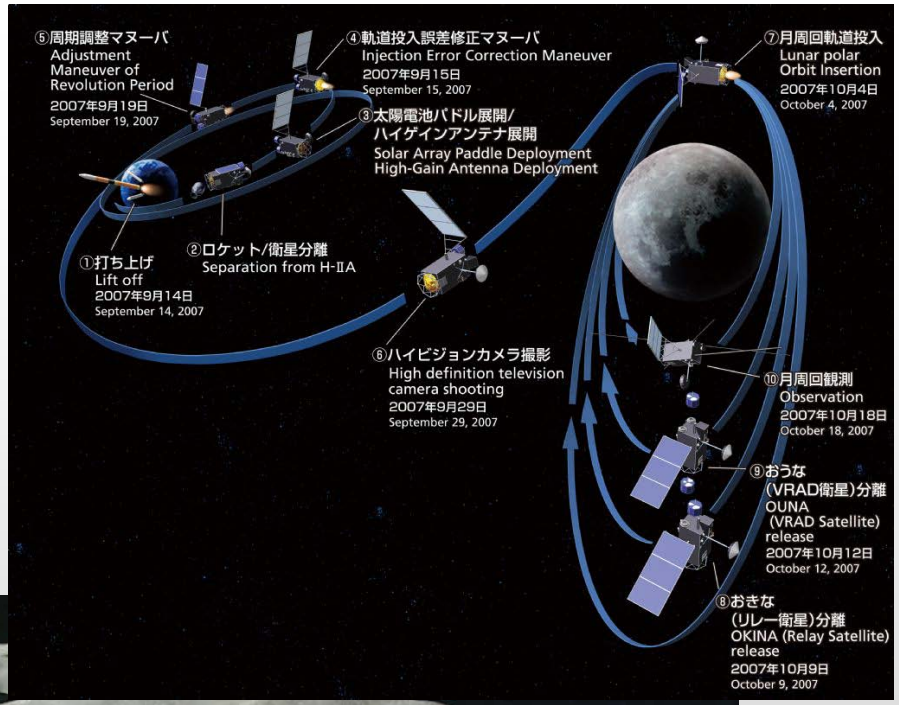
‡

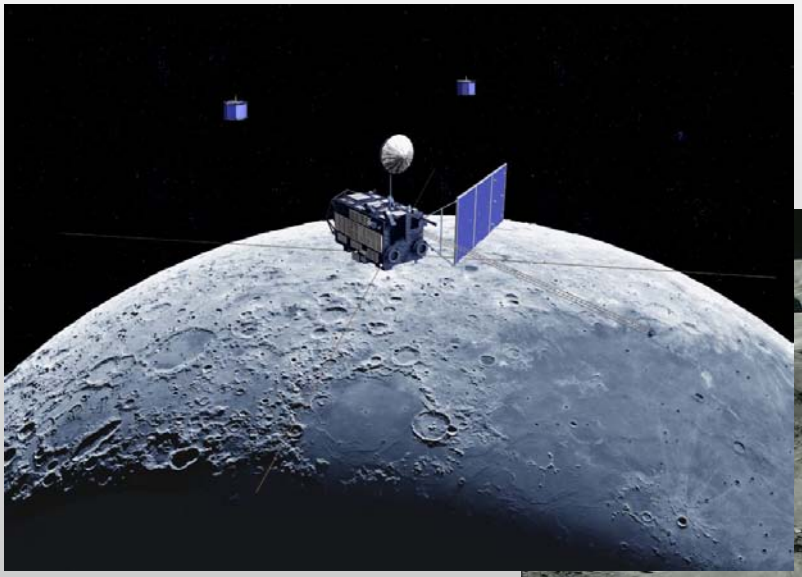
In the sense of taking a world that cannot actually be experienced and inserting it into a framework of a visible world, virtual reality technologies transcend the realm of being simple simulations.

A world straight out of Einstein’s Theory of Special Relativity

The “KAGUYA (SELENE)" Seleonological and Engineering Moon Explorer was launched in September 2007, equipped with a high-vision camera for use from its lunar orbit. Until completion of its mission in June 2009, it carried out various kinds of measurements.

‡





‡ From the JAXA web page

‡Last shot of the lunar surface

Figure removed due to
copyright restrictions

The role of visualization technologies in this age of information explosion is tremendous.

A “Tokyo Sinks” Map by Mixed Reality (MR) Technology

The Tokyo Metropolitan Government’s Civic Center after being submerged
Source: : TAMAKI’s Little Treasure
<http://www.ne.jp/asahi/nob/co/tamaki/> ‡

Environmental problems, of which global warming is a leading example, are social issues which we must solve. Even though such environmental issues are intimately tied to our lifestyles, in our everyday lives we hardly feel them as directly impacting us. That is because even if for example we are aware of the information that the ocean surface might rise several meters, it is difficult for us to comprehend this situation with a gut feeling. However, employment of virtual reality (VR) technologies and Mixed Reality (MR) technologies allow us to use information in the form of data to visualize the actual world. You might say that we have created “bodily sensation media.” For example, by utilizing mobile PCs, GPS devices, etc., we probably will be able to physically experience what a given location would appear like if the surface of the ocean rises.
In this seminar we will use a rise in the ocean’s surface and the metropolis of “Tokyo” as our starting points, so we can experience a map of Tokyo submerged under water through VR technologies and MR technologies.

‡ Flood map
created by Mr. Alez Tingle

The Hiroshima Atomic Bomb Epicenter Restoration Project

‡ Photos provided by: Public Affairs Section, Office of the Mayor, Planning and General Affairs Bureau, City of Hiroshima

Figure removed due to copyright restrictions

Photos of Nakajima Ward in Hiroshima City

Significance of Visualization Technologies

(Enhanced Human Interfaces)

How do we manage the explosive growth of information? We have adopted strategies to use the great amounts of information available to enrich our daily lives.

Concerning information reception points for various media, the total volume of information offered in forms making possible selection by information consumers in a year has been increasing at an annual rate of 11.7%. (According to the 2002 Information Distribution Census survey)

2000	2005	2010	2015	
38,741	65,184	113,347	197,095	(petabytes)

Nevertheless, no matter how much we increase the speed and volume of information processing, that is all meaningless unless this information is actually transmitted to human beings.

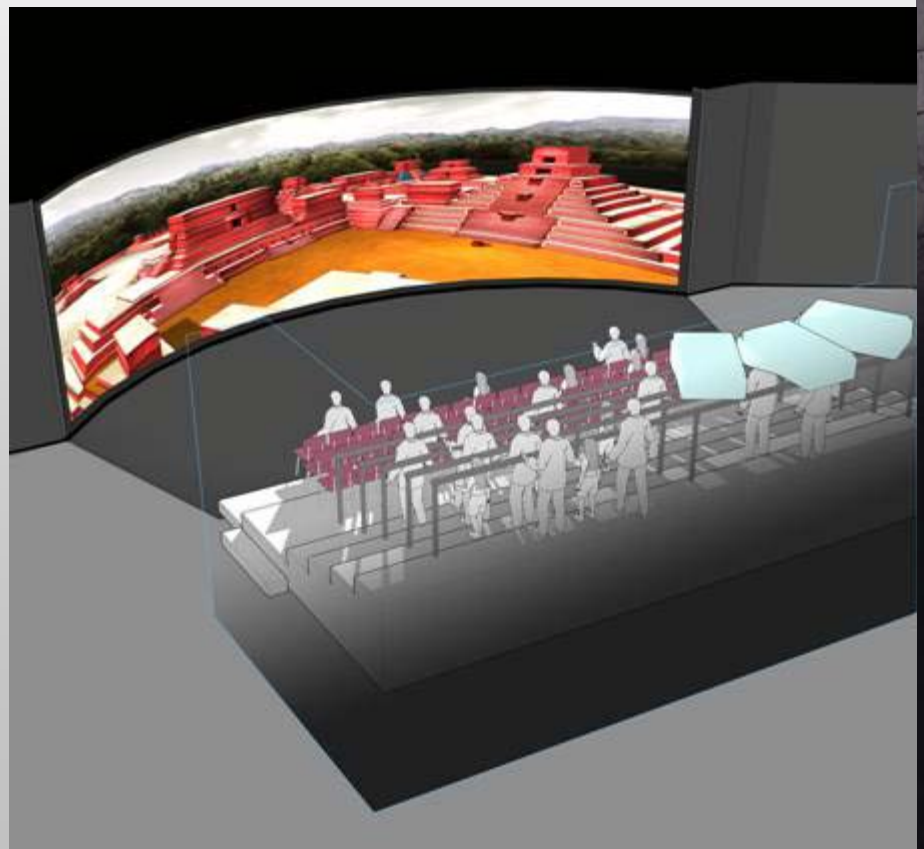
Digital Museum

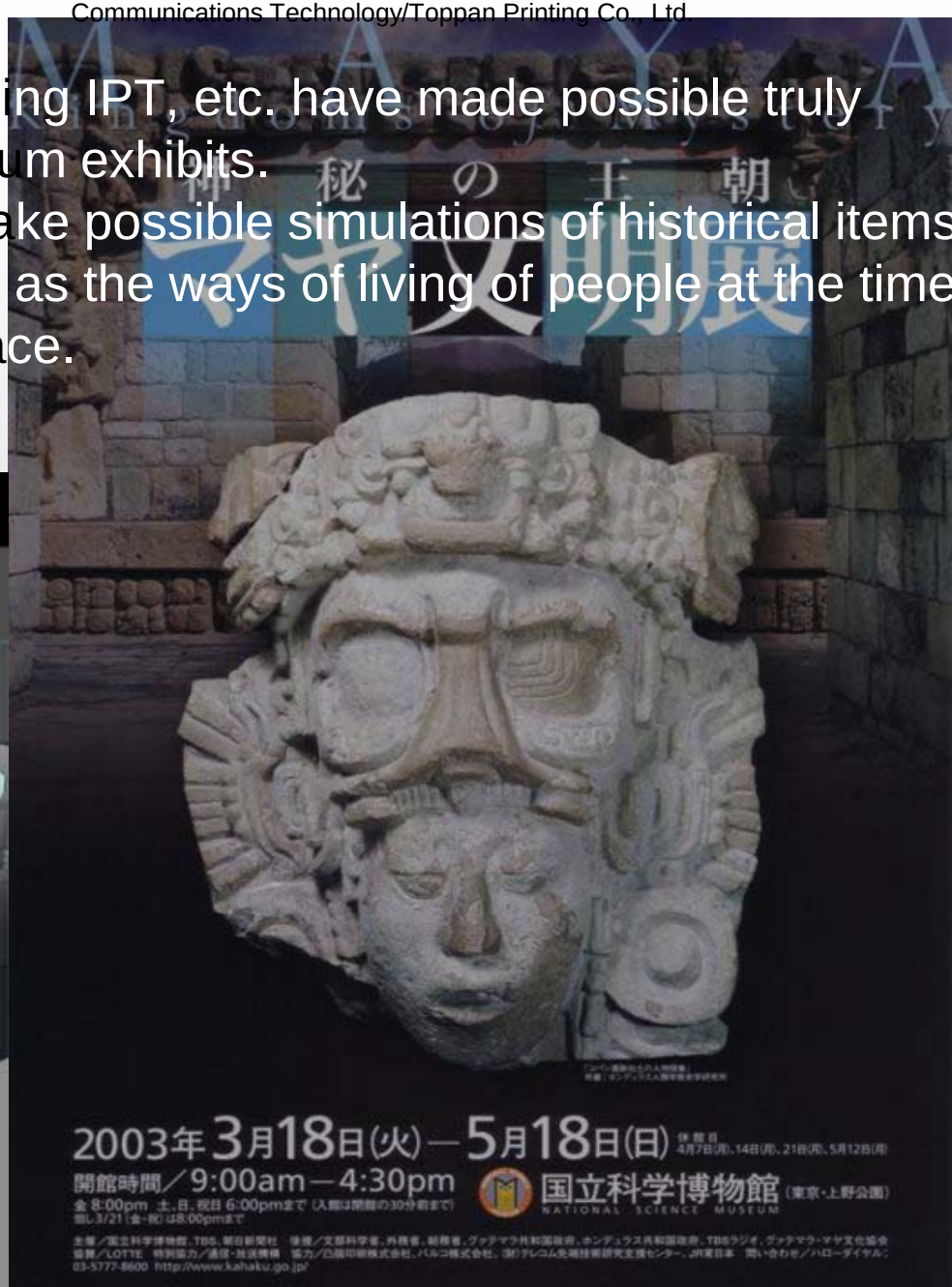
Mayan Civilization Exhibition – VR Theater

‡ Mayan 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.

High-definition VR technologies utilizing IPT, etc. have made possible truly applications for such things as museum exhibits.
These breakthrough technologies make possible simulations of historical items recovered from historic ruins, as well as the ways of living of people at the time being depicted, etc. within virtual space.

‡





The Mayan ruins at Copan, Guatemala, as recreated by VR. (#26 Temple)

‡ The University of Tokyo/The National Institute of Information and Communications Technology/Toppan Printing Co., Ltd.

The Mayan ruins at Copan, Honduras, as recreated by VR (Rosalila Temple)

‡ The University of Tokyo/The National Institute of Information and Communications Technology/Toppan Printing Co., Ltd.

‡

Ruins at Copan recreated to show how they looked at the time of use

‡

Mayan 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.

The primary mission of a museum is to preserve and accumulate valuable materials. The use of artifacts and other tangible things (*mono)* as a medium for transmitting culture to later generations of human beings is the basic philosophy of a museum. The background to the organization of a museum then is research, arrangement and display activities centering on *mono.*

A museum which does not have actual worthwhile materials (accumulated items) has abandoned its raison d'être and become nothing more than a curiosity show.

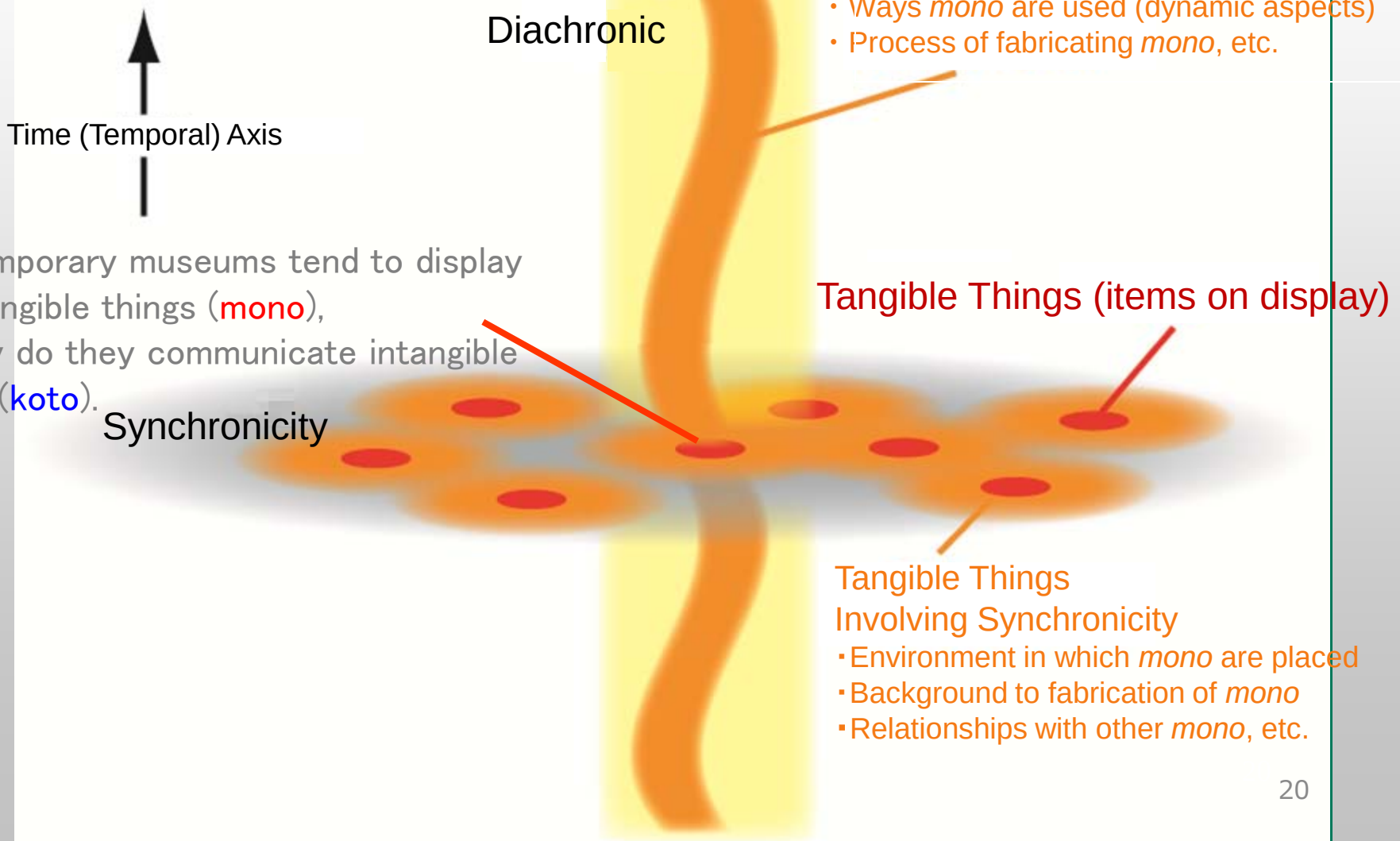
Nevertheless, are tangible things (*mono*) alone capable of communicating the desired information? Is viewing stuffed specimens enough to allow us to envision what the living creature was really like?

For example, “Static Preservation” vs. “Dynamic Preservation”

‡ http://ja.wikipedia.org/wiki/ファイル:Oonari-teppaku.jpg

‡ http://ja.wikipedia.org/wiki/ファイル:JRW-C622-SteamLoco.jpg

“Tangible Things” and “Intangible Things”

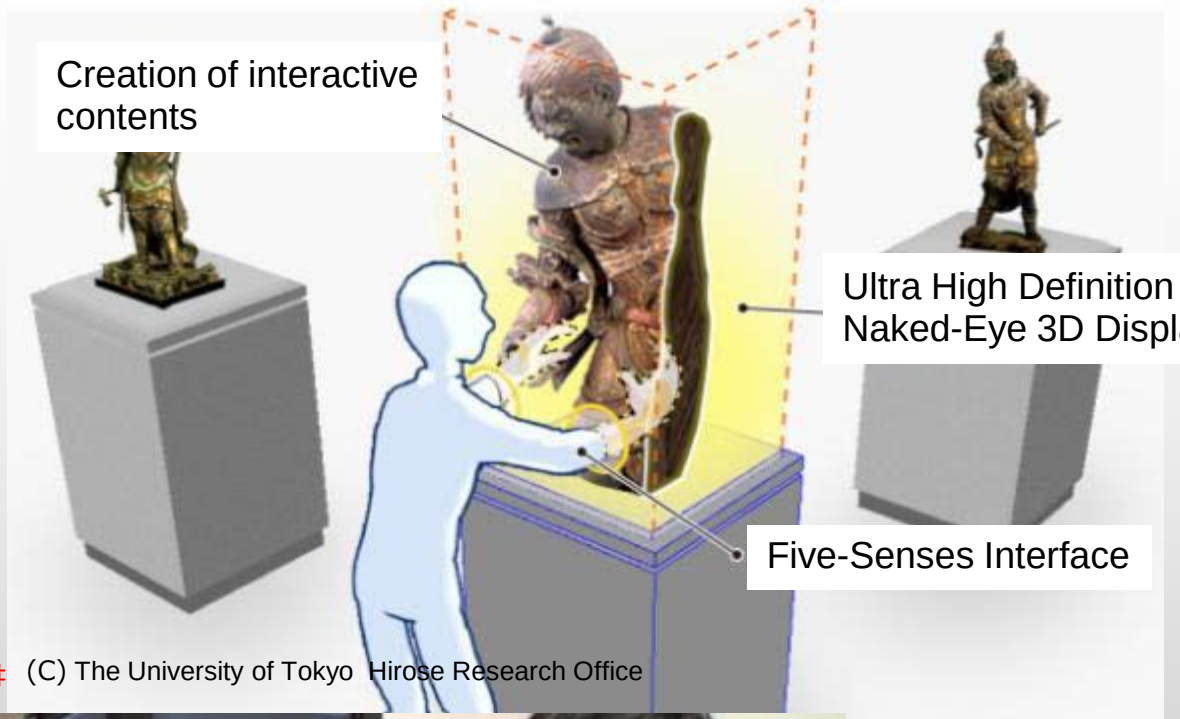


The Dilemma of “Preservation” and “Display”

Tangible Things (*mono*) are limited by their destructibility. The more we want to see certain materials, the greater the likelihood that these materials will be destroyed. But if we then declare that they should not be shown, then there would no longer be any justification for having museums. This then is the basic dilemma that museums face.

The Railway Museum opened its doors in 1921. Shinta Matsunawa was the second director of this Railway Museum. He wrote about the mission of this innovative museum as follows: “We will make untiring efforts to display a lineup of dynamic reference materials, so as to assist in educational research into the true face of transportation conveyances.” [*Kagaku Chishiki* (*Scientific Knowledge*) (1931.11.11). It therefore has concentrated on switching the signs within the museum reading “Never Touch” to whenever possible signs reading “Try Moving Things.”

Digital Display Cases



‡ (C) The University of Tokyo Hirose Research Office

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(C) The University of Tokyo Hirose Research Office

Special Characteristics

- Does not alter the “grammar” of conventional displays
- Makes possible diverse displays which can show time changes and internal structures.
- Makes possible appreciation through moving, touching and other interactive modes.

‡http://ja.wikipedia.org/wiki/ファイル:Tokyo_station01_1920.jpg

http://ja.wikipedia.org/wiki/ファイル:Tokyo_station_marunouchi_old.jp

Tokyo Station

Battleship Nagato

http://ja.wikipedia.org/wiki/ファイル:長門（戦艦）.jpg

http://ja.wikipedia.org/wiki/ファイル:Nagato_Japanese_Battleship_LOC_32962.jpg

http://ja.wikipedia.org/wiki/ファイル:Mutsu20.jpg

Mono on the Time (Temporal) Axis

Tangible things (*mono*) are by their very nature unique, with only one of the real thing existing. That is certainly true in terms of a given slice of time. Nevertheless, *mono* also have an existence which transcends time, and progressively changes over time. In order to gain an understanding of the whole picture, it is therefore necessary to look at the totality.

‡Railway Museum

No. 1 Steam Engine

(after restoration/Shimabara Railway)

‡Shimabara Railway

No. 1 Steam Engine
(original form/model)

‡http://ja.wikipedia.org/wiki/ファイル:Tokyo_station01_1920.jpg

http://ja.wikipedia.org/wiki/ファイル:Tokyo_station_marunouchi_old.jp

Tokyo Station

Battleship Nagato

http://ja.wikipedia.org/wiki/ファイル:長門（戦艦）.jpg

http://ja.wikipedia.org/wiki/ファイル:Nagato_Japanese_Battleship_LOC_32962.jpg

http://ja.wikipedia.org/wiki/ファイル:Mutsu20.jpg

Nezu Museum

6-5-1 Minami Aoyama, Minato-ku, Tokyo 107-0062

Tel:	03-3400-2536
Fax:	03-3400-2436
HP	http://www.nezu-muse.or.jp
Days Closed	:Every Monday, when exhibitions are being changed, year-end holidays. When a holiday falls on a Monday, the following Tuesday.
Hours Open:	10:00 a.m. ~ 5:00 p.m. (last entry 4:30 p.m.) Exhibit Rooms/Museum Shop/Garden/NEZU CAFE

‡

Approach as Seen from Front Gate ©Mitsumasa Fujitsuka

Tangible Things (*mono*) Have a Context

‡

Exterior View ©Mitsumasa Fujitsuka

‡

Hall ©Mitsumasa Fujitsuka

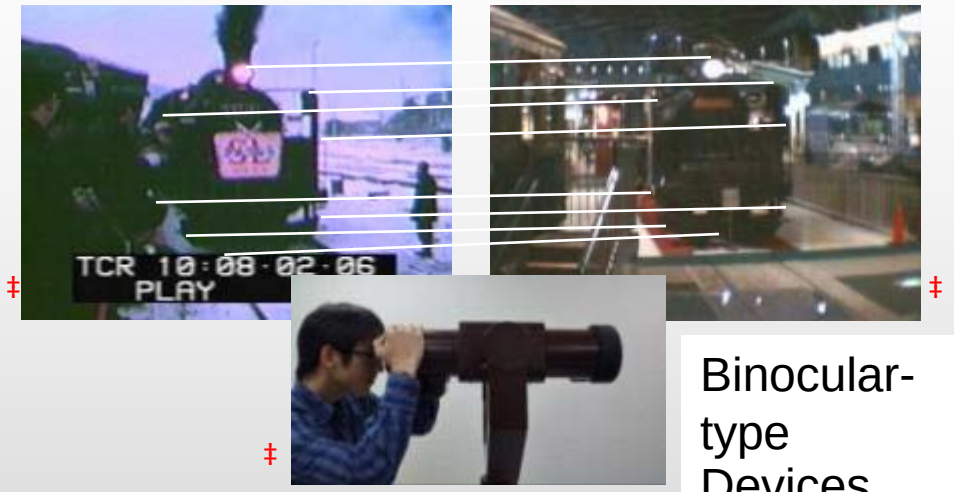
Digital Georama Prototype

Superimposing Historical Film Images on Displays of Actual Items

- Establishment of camera position estimation technologies which make possible superimpositions of historical film images stored in experience database on actual exhibit item.
- Video processing technologies for alteration/fabrication of superimposed images.
- Enjoyment with binocular-type devices

Historical Film Images

Display Items



Binocular-type Devices

‡ ‡

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

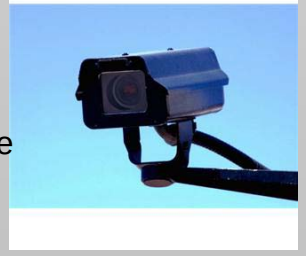
Actual Space Editing Technologies

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

Photos/Videos Taken by Fans and Other Records

Life of an Exhibit Item

November 1958 Special express train *Kodama* begins operations

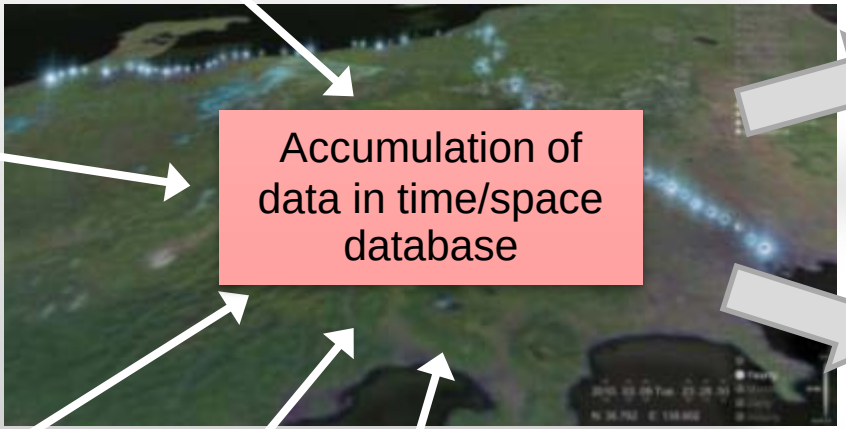
Birth of the “Bullet Train”

October 1964 Special express train *Raicho* begins operations

Birth of electric multiple-unit limited-express trains

October 1972 Special express train *Hakusan* begins operations

Birth of 489-type trains



March 1993
Express train *Noto* switches to 489-type trains

March 12, 2010 Regularly scheduled operations of *Noto* terminated

Accumulation of data in time/space database

Experiencing intangible things (*koto*) together with displays in digital georamas

Verifying one’s own photos/sharing experiences

Vicarious experiencing through outdoor galleries

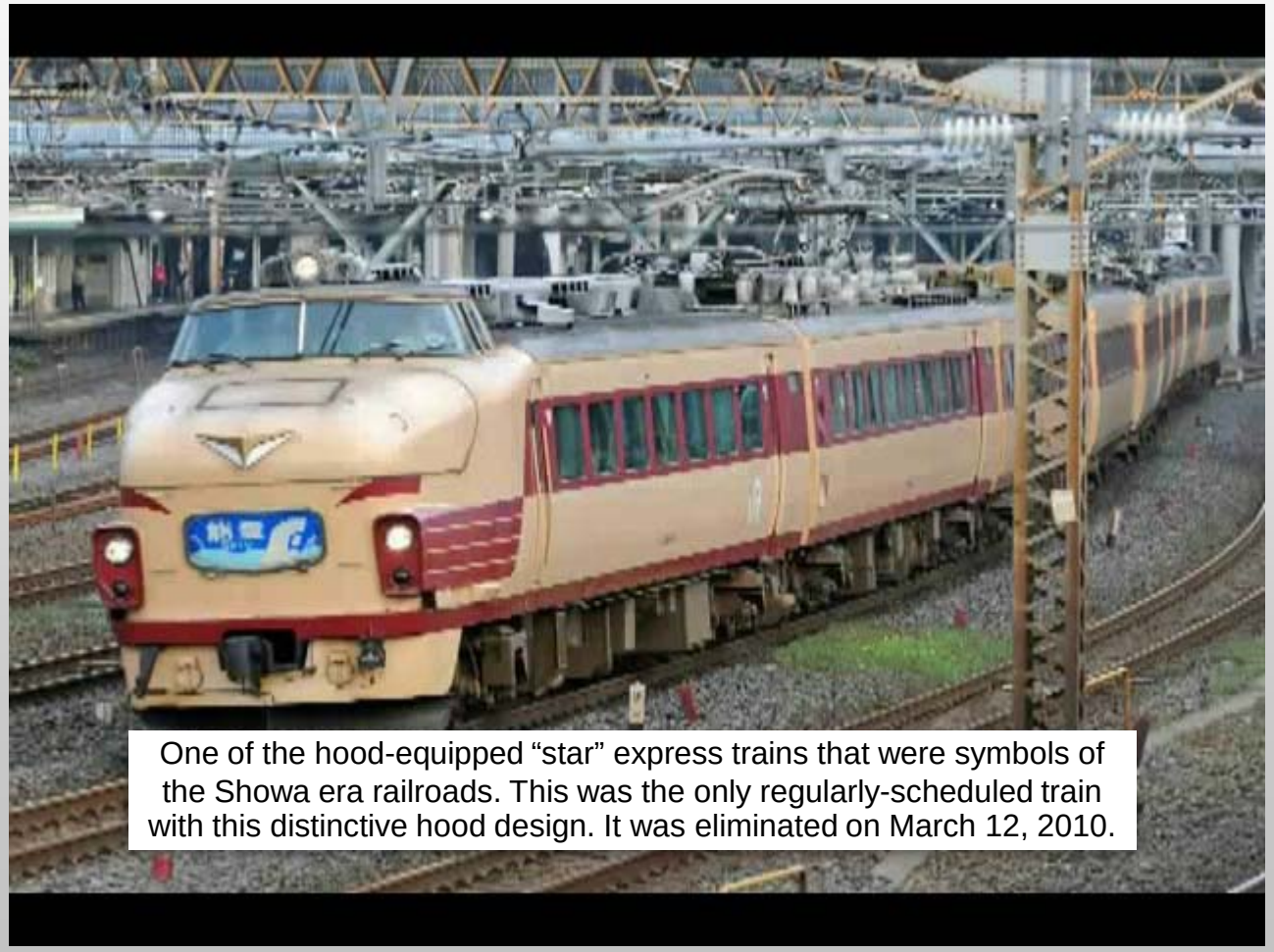
Posting/sharing of photos/impressions, etc. on blogs, twitter, etc.

Accessing databases which make possible real-time experiencing of events

Viewing from outside the museum

Information sent by customers to the museum

Gathering intangible things (*koto)* based on accumulation of individual experiences



One of the hood-equipped “star” express trains that were symbols of the Showa era railroads. This was the only regularly-scheduled train with this distinctive hood design. It was eliminated on March 12, 2010.

Digital technologies make possible contemporary “Cubism.”

Diverse viewpoints/relativization of viewpoints

Things which are recorded

Official records and oral histories

Signals and noise

What things are impossible unless virtual

Spatial axis and temporal axis

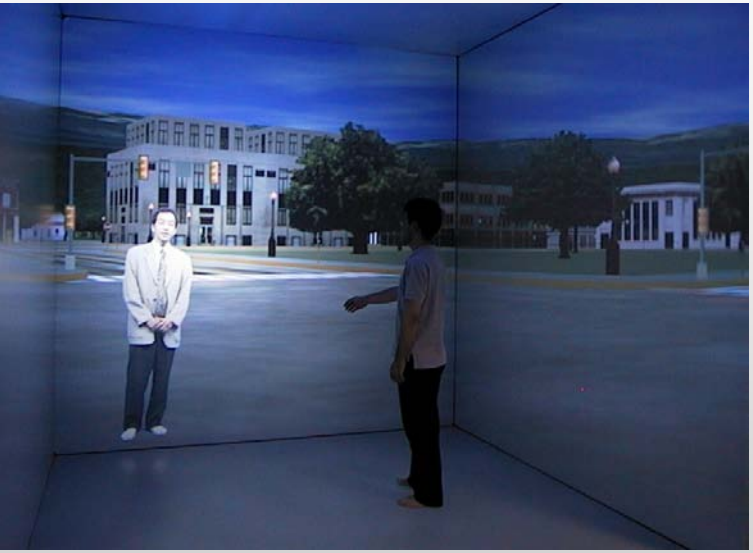
Orally transmitted things

The forms in which tangible things have been preserved

Change in the Temporal Axis

Communications with Realistic Sensations
(Imparting a Sense of Presence)

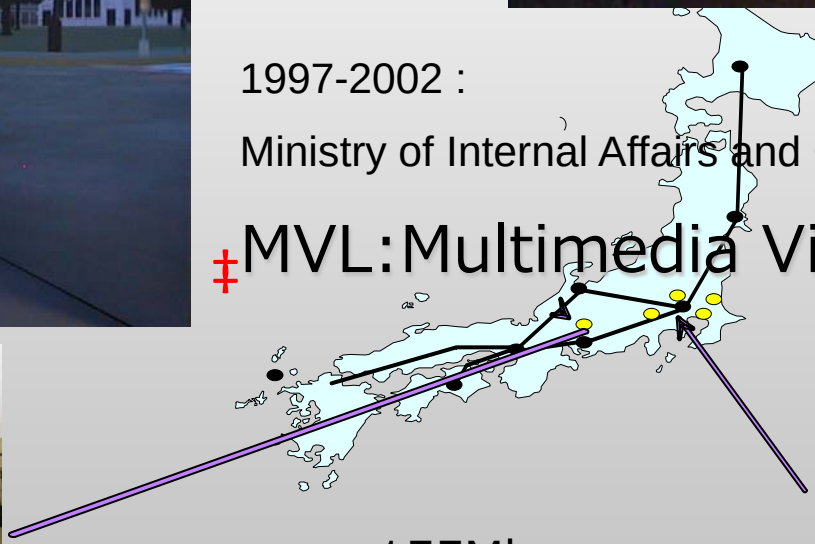
Technology development that seeks to introduce and share virtual spaces through the medium of broadband networks



1997-2002 :

Ministry of Internal Affairs and Communications (MIC)

MVL:Multimedia Virtual Laboratory



155Mbps

Gigabit Network

COSMOS/Gifu

CABIN/Tokyo

From the Present to the Past

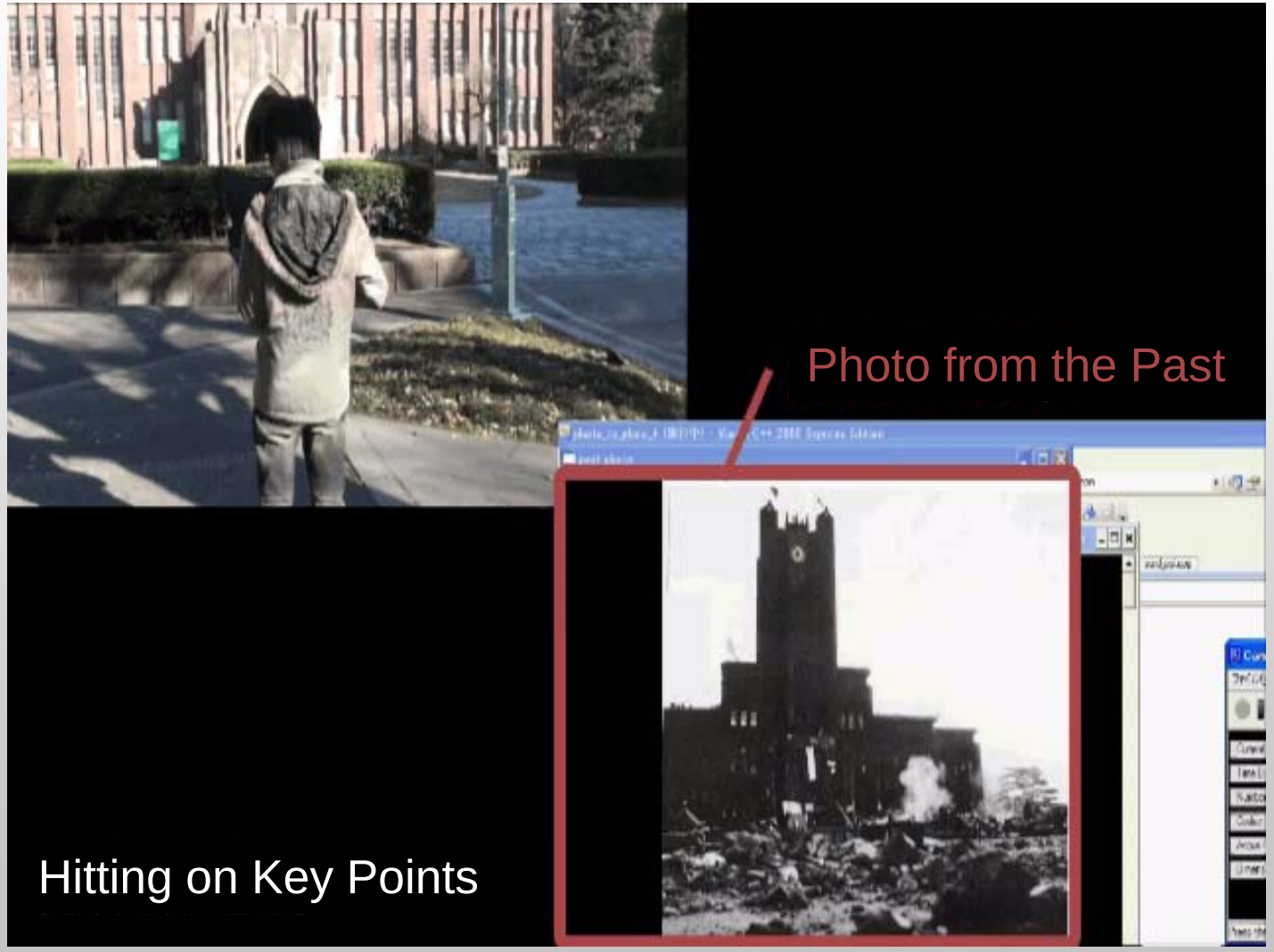
Area-specific [Territory-specific] Virtual Time Machines

- Appearance of on-the-spot virtual time machines
  - These systems use illustrations and photographic (film) images from the past to recreate spaces from the past with a palpable feeling of reality, so that people can experience them on the same spot.

- Camera position estimation based on real-time feedback
- Natural linking of photographic [film] images from the past with current scene

‡

Explanation of Key Principles



Linkage Results 1

- International Forum Exit, Yurakucho Station, Tokyo

‡ Source: (photos from 40 years ago) : *Tokyo 40 Years Ago* , by Masaaki Kasuga (Seikatsu Joho Senta/Lifestyle Information Center)
Source: (contemporary photos): (C) The University of Tokyo, Hirose Research Office

Linkage Results 2

- In front of Yurakucho Station…Old “Sushi Alley”

‡ Source: (photos from 40 years ago) : *Tokyo 40 Years Ago* , by Masaaki Kasuga (Seikatsu Joho Senta/Lifestyle Information Center)

Source: (contemporary photos): (C) The University of Tokyo, Hirose Research Office

Linkage Results 3

- Ginza 4-Chome Intersection

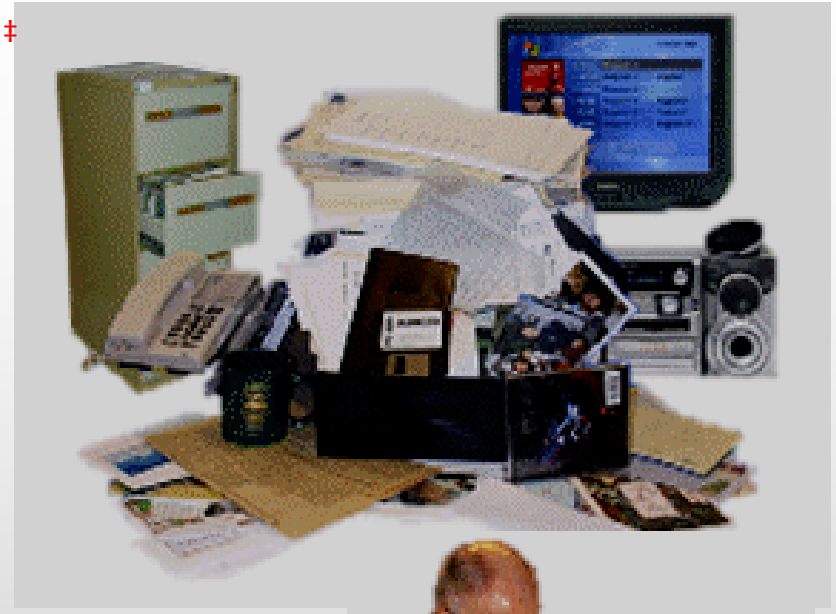
‡ Source: (photos from 40 years ago) : *Tokyo 40 Years Ago* , by Masaaki Kasuga (Seikatsu Joho Senta/Lifestyle Information Center)
Source: (contemporary photos): (C) The University of Tokyo, Hirose Research Office

Life Log

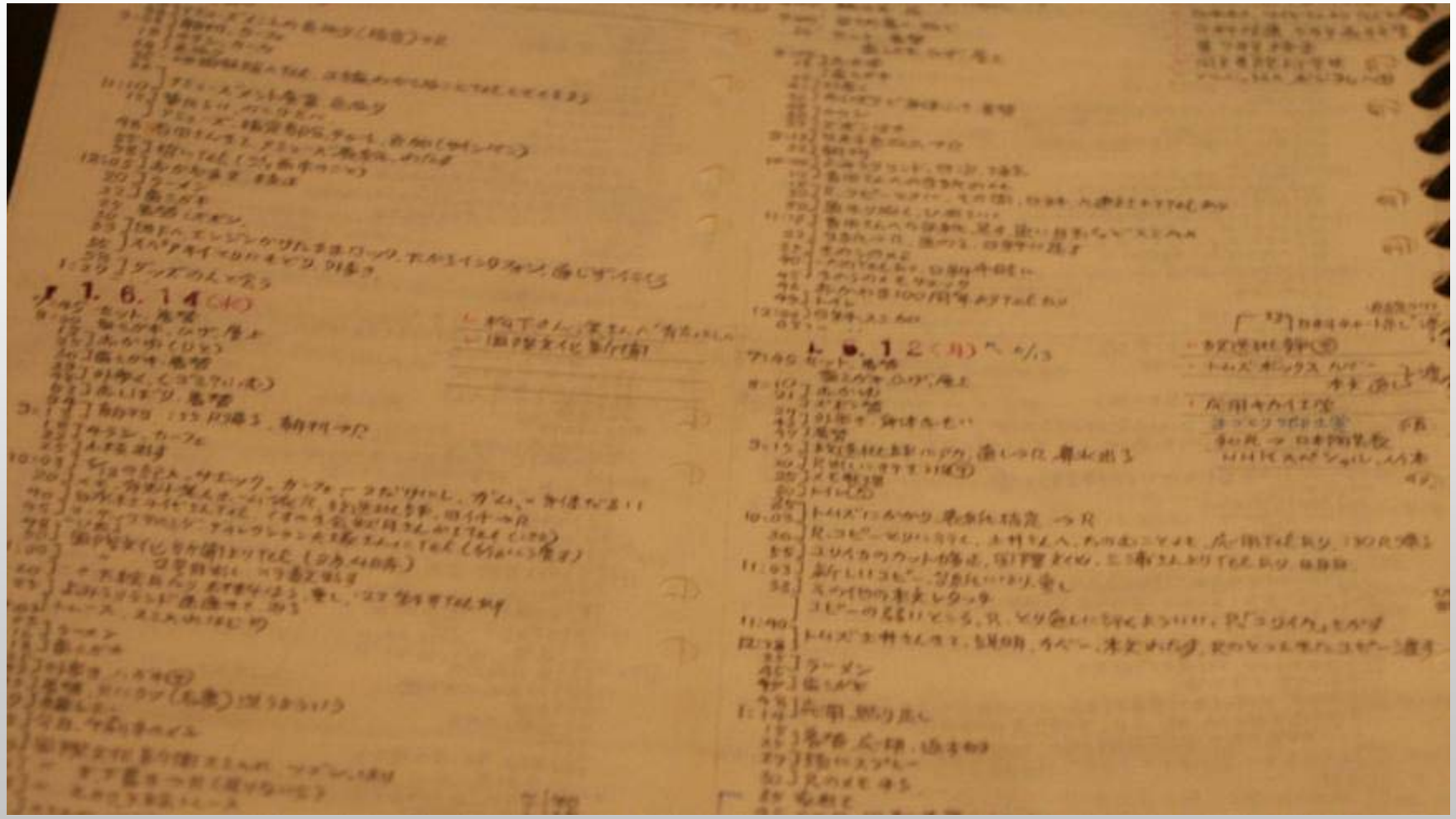
Life Log (DARPA)

Figure removed due to copyright restrictions

My Life Bits(Microsoft)



Diary of Hiroshi Manabe

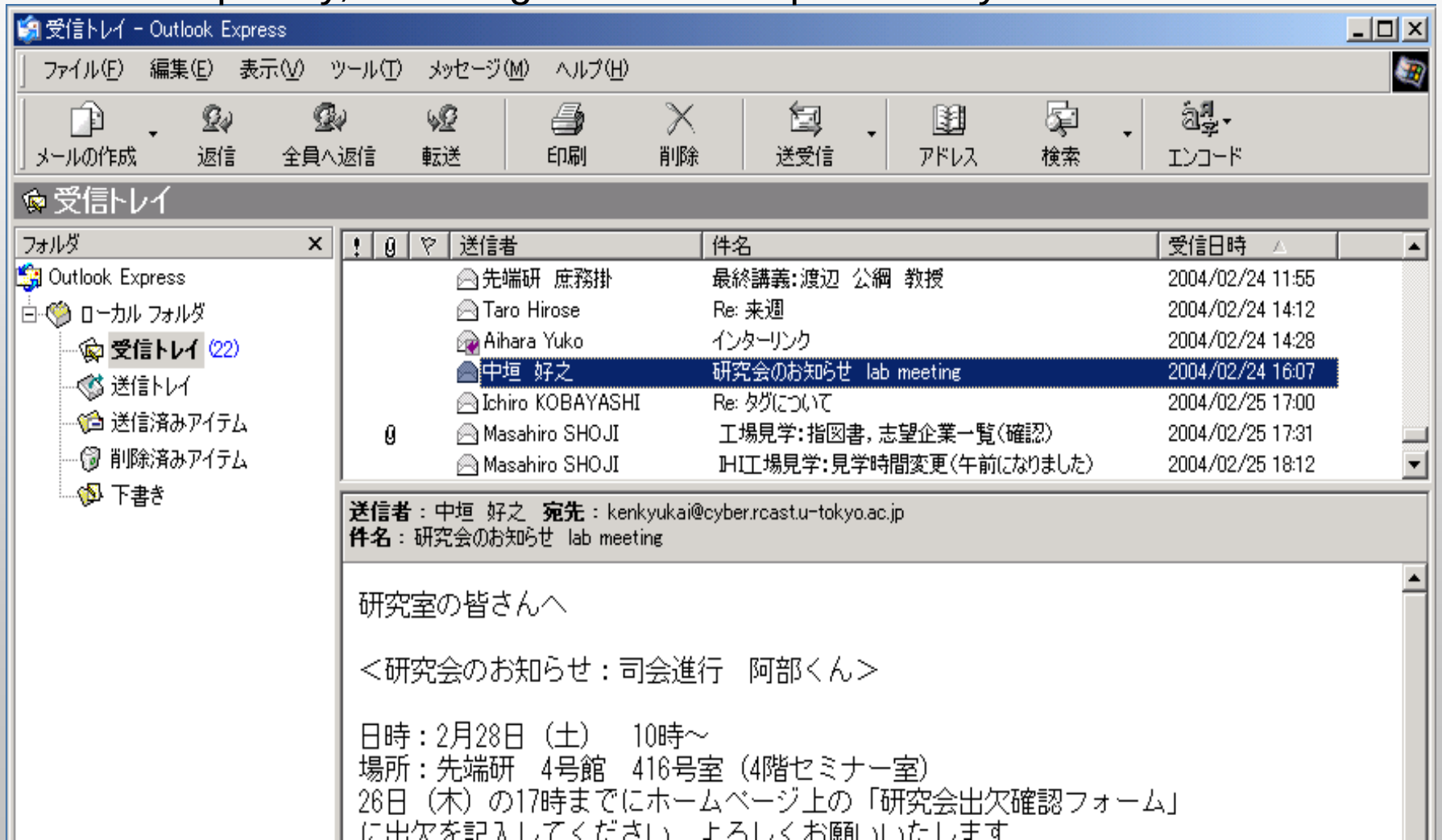


‡ From the Ehime Prefecture Library Collection

Computers are a tool for recording.

As long as the back-and-forth exchanges recorded in e-mails are not intentionally erased, they will remain forever.

→ Consequently, we can go back to the past at any time.



By making use of wearable computers we can record whatever we see or hear as it actually occurred. Thus, the boundaries between memory and record become blurred. Incidentally, if every day records are made for 16 hours in TV conference quality format, then over a 70-year span the volume of recorded information will reach just 10T Bytes.

Emotion

Internal information about the person having the experience in terms of mental state, interests, etc.

Location

Information showing the position and posture of the person having the experience.

Vision

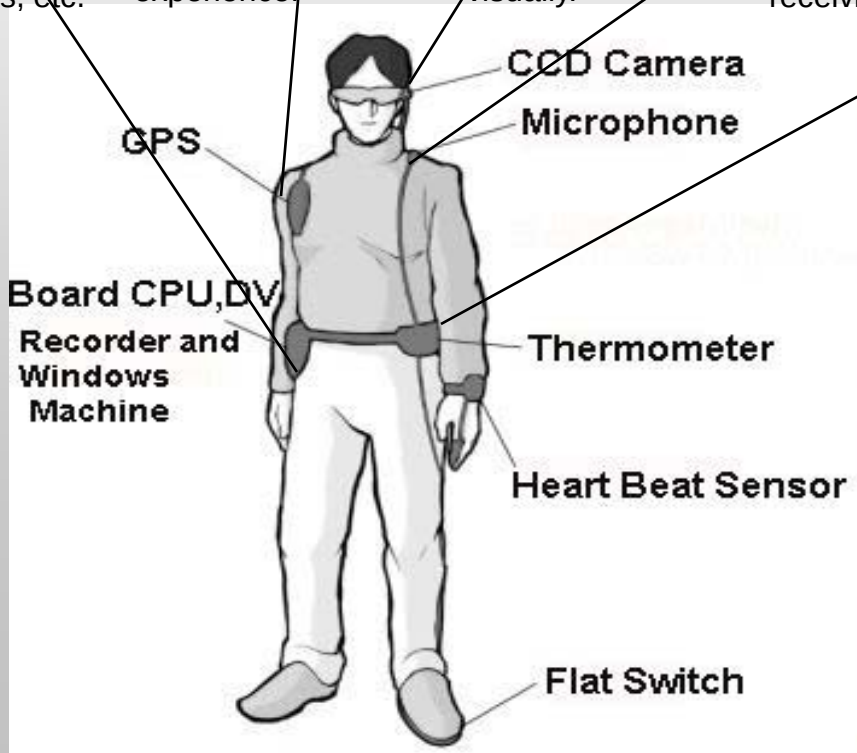
Information about what the person undergoing the experience is receiving visually.

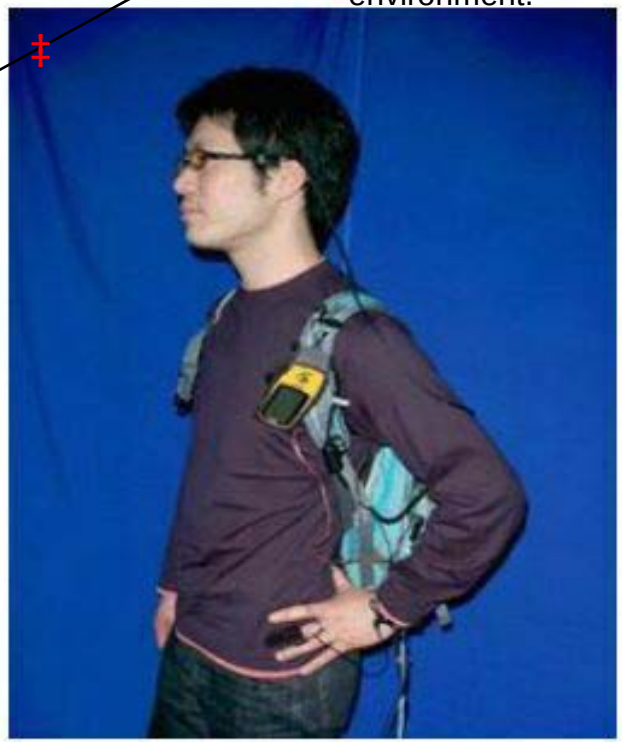
Audio

Information about what the person undergoing the experience is receiving aurally.

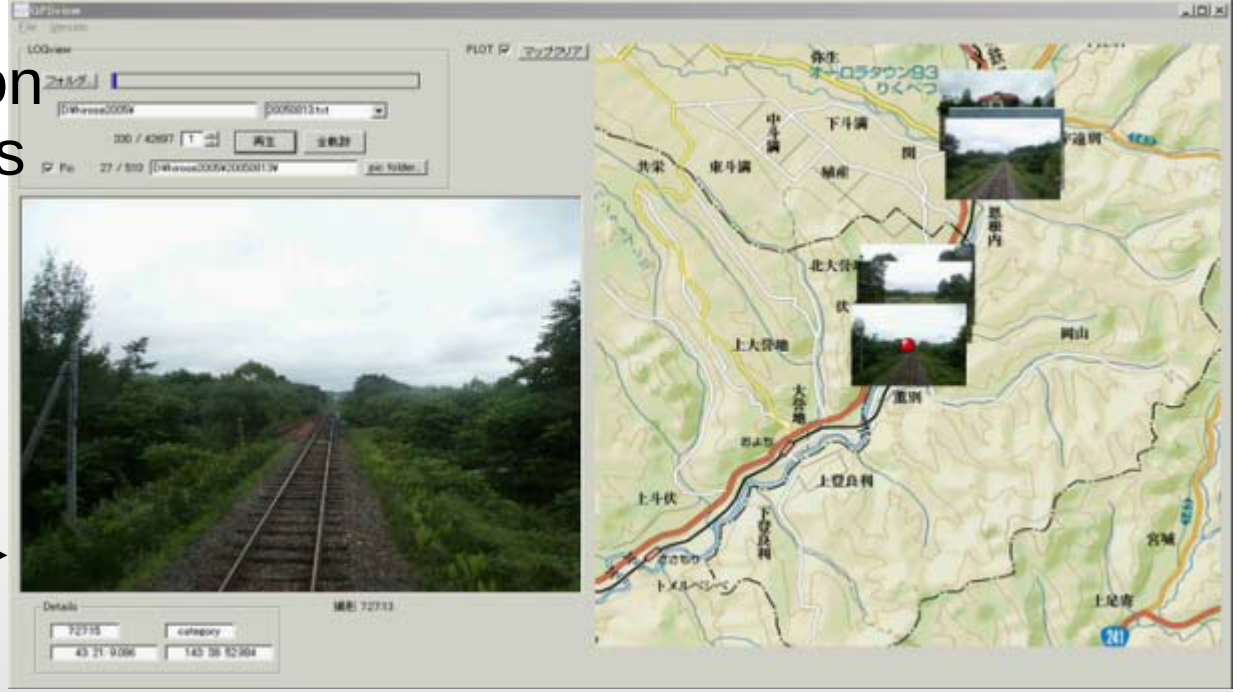
Ambience

Information about what the person undergoing the experience is receiving from the environment.



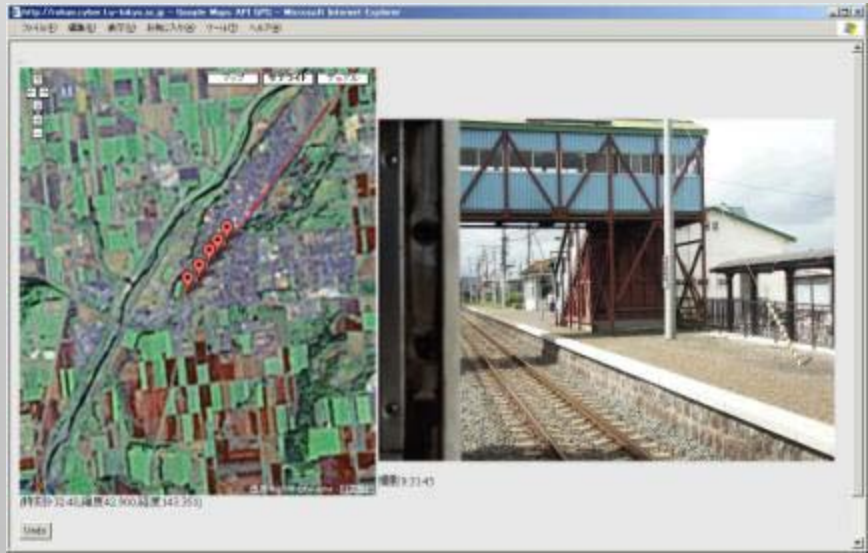


Coordination of Position Information and Photos



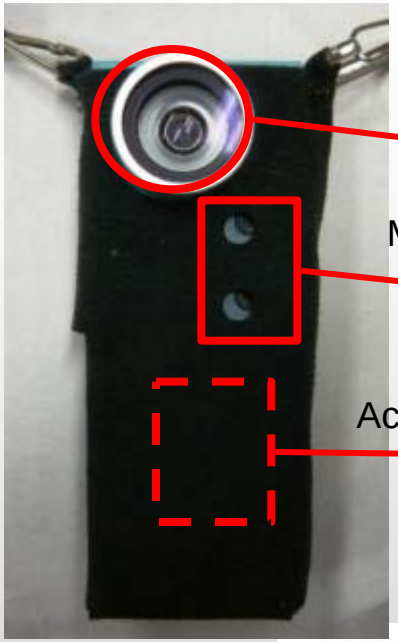
Use time information included on both sides to locate positions on the map and display the corresponding images next to them.

Position identified by GPS
Recorded and saved on a PDA
Images (pictures) taken with a video camera



Prototype of a Life Log Camera

‡



‡

Camera

Microphone

Acceleration Sensor

‡

- Images (1 / sec)
- Sound
- Acceleration
- Height
- Heart Beat (pulse)

- ・Posture
- ・Movement
- ・Sound
- ・Facing

[interview]

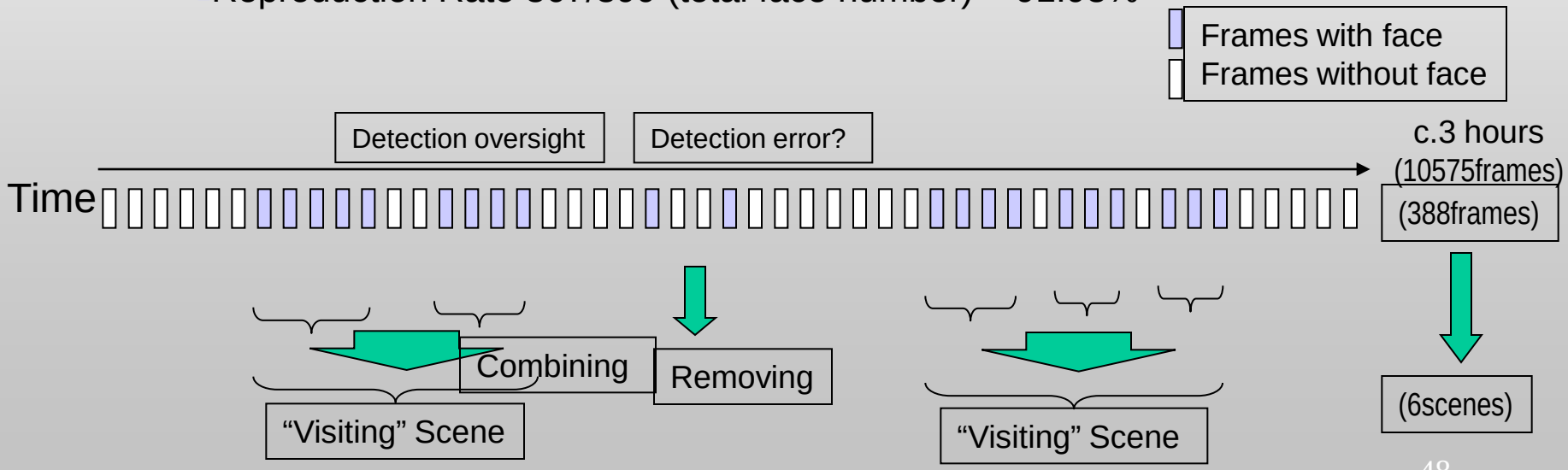
Basic Conditions

Structuring based on “Visiting Events”

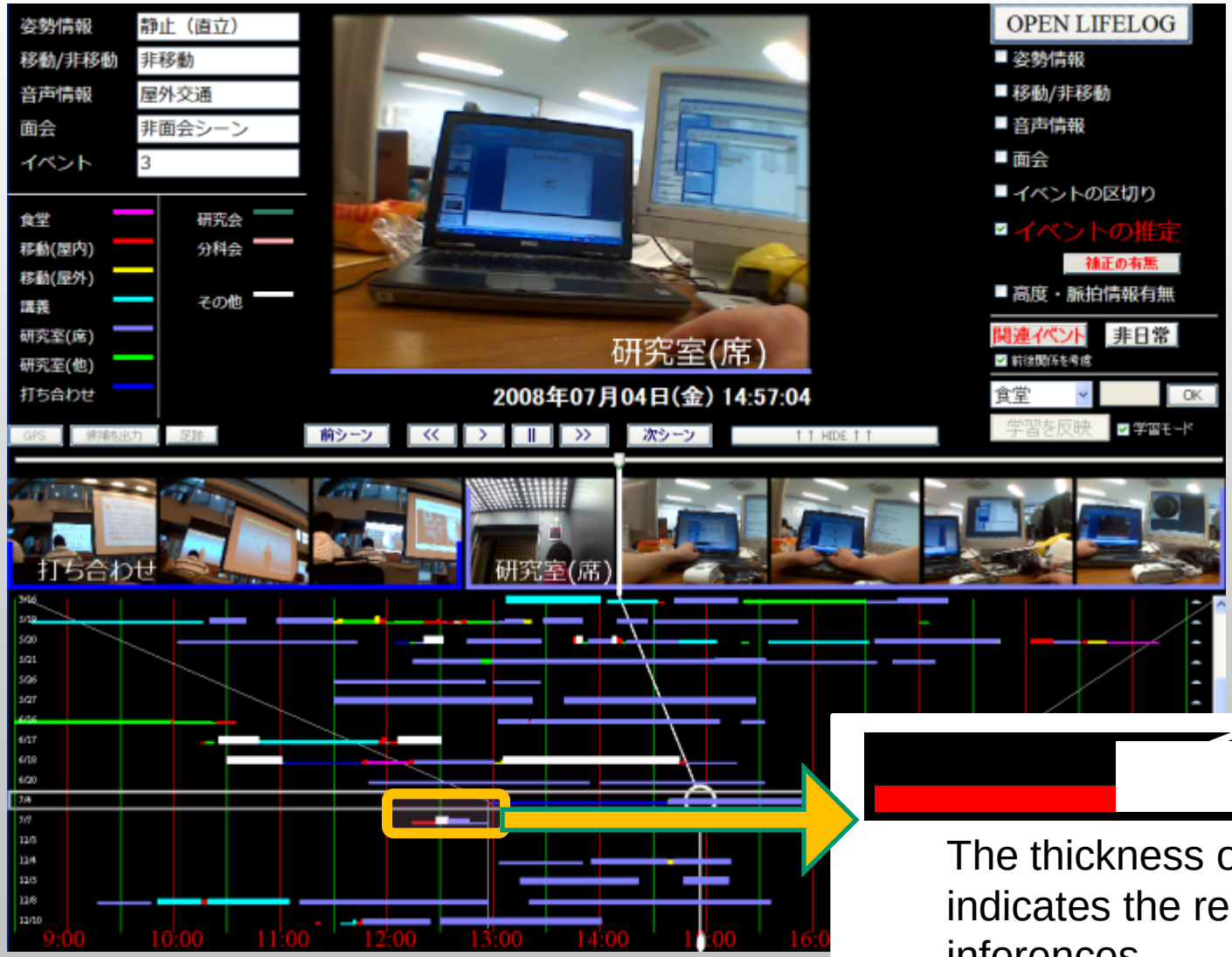
- Face Detection (trial engine from Panasonic)
  →Creation of visiting events
  - Exclusion of isolated data, combination of adjoining data
  - Real-time analysis possible

Conformity Rate 367/388 (total recognition number) = 94.59%

Reproduction Rate 367/399 (total face number) = 91.98%



Inferred Results for Events Displayed by Color Bar
Vertical Axis: Date　　Horizontal Axis: Time



Classification Impossible

The thickness of the color bar indicates the reliability rate for inferences.

Application Fields for Life Log

Health Management (lifestyle diseases)

By analyzing the behavior patterns of the person being monitored for experiential information, health management can be effected.

Marketing Surveys

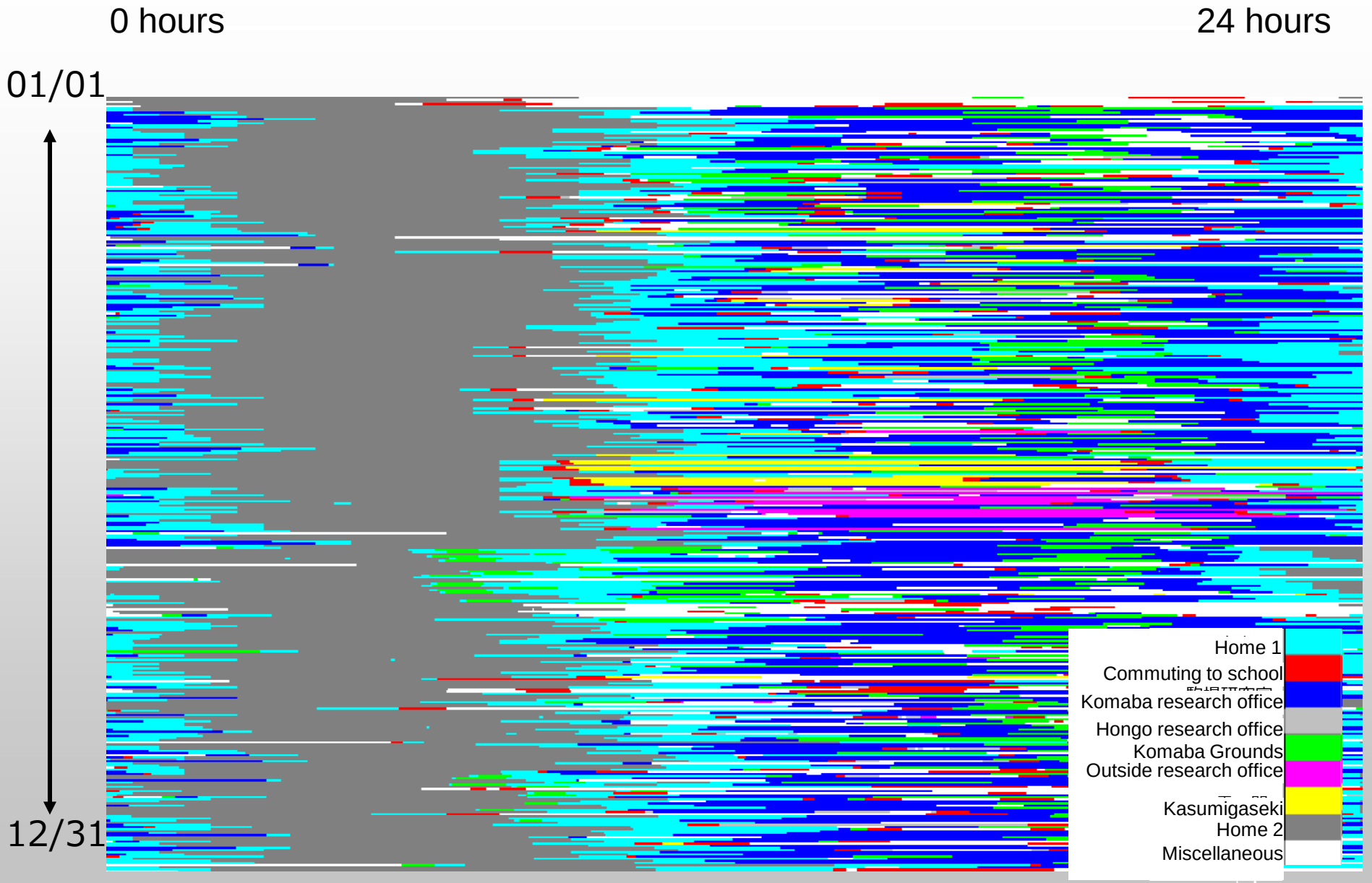
Makes possible objective recording of the behavior of consumers at a given store.

Making Things

Makes possible accumulation and transmission of manufacturing process management information and creation knowhow.

Figure removed due to copyright restrictions

Record of Experiences over a Long Term



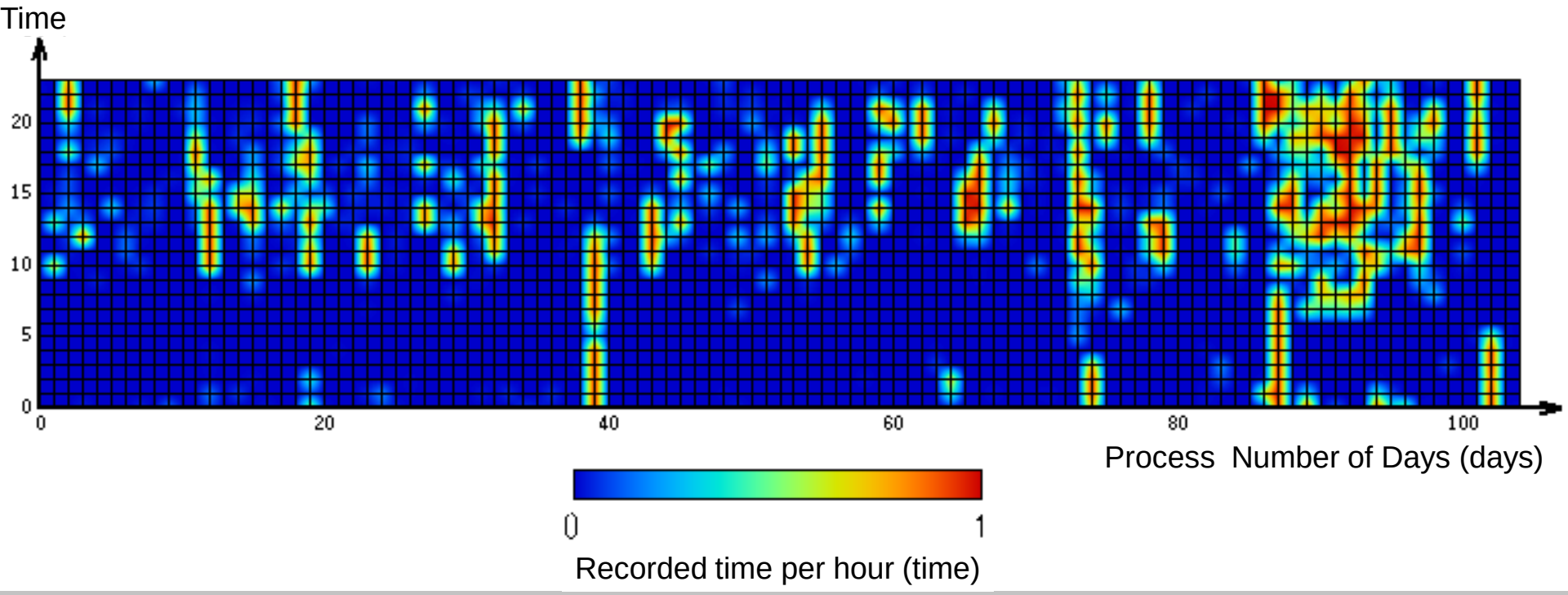
Recorded Utterances

September 30 ~ January 11 (roughly 3-month period)

Average: 2 hours 56 minutes 55 seconds

Maximum: 15 hours 53 minutes 42 seconds (December 11)

Minimum: 16 seconds (January 6)



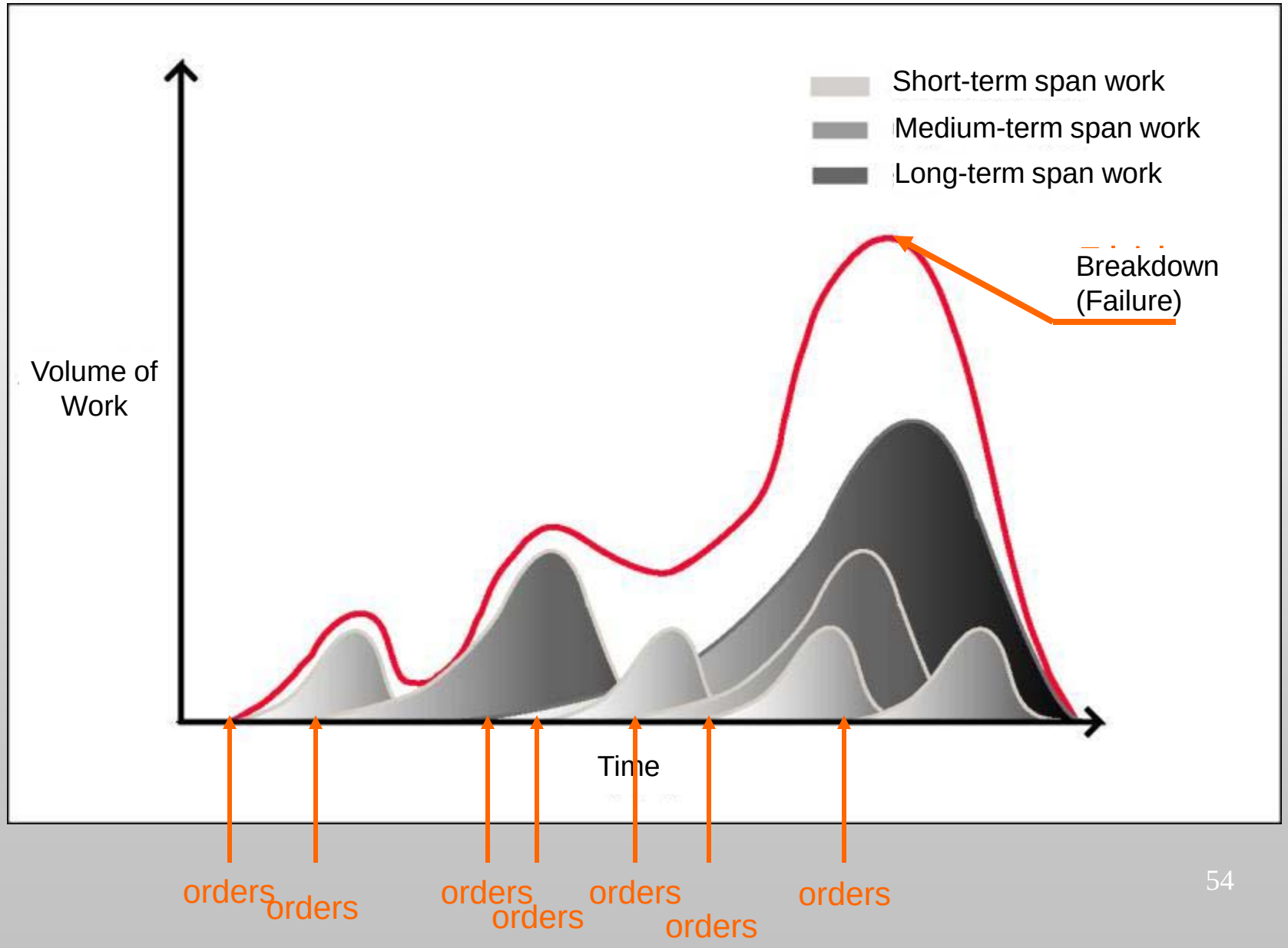
Opportunities for activities based on a scenario researched before the fact, such as with train station navigation systems, are on the rise.

→ “Future” that can be

experienced in the present

‡ Yahoo!Maps

Behavior in the Present/Past Impacts the Future

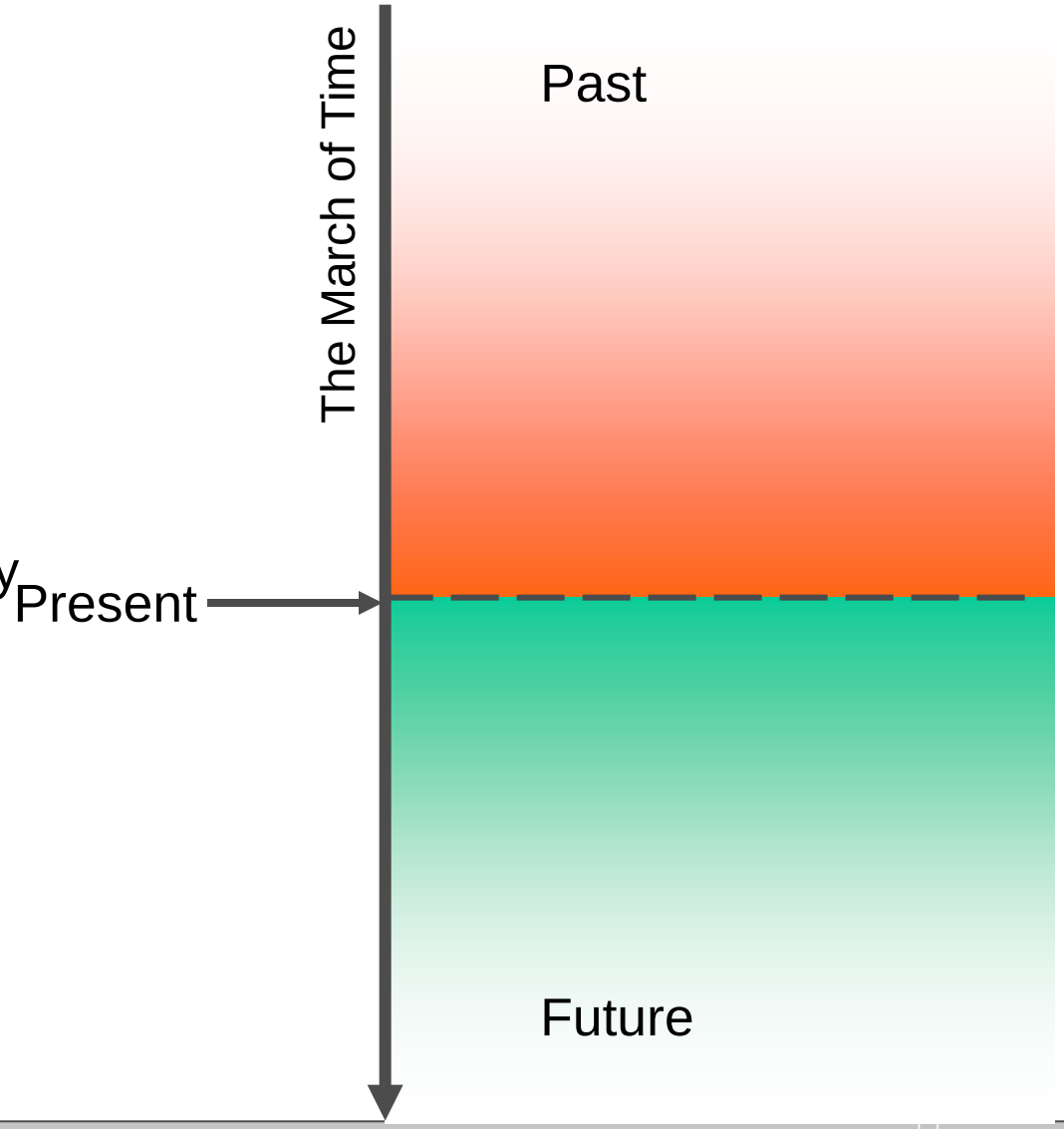


Making the “past” and the “future” present

Demise of History?

If the “past” can be completely vicariously experienced, then it becomes the “present.”

If the “future” can be completely vicariously experienced, then it becomes the “present.”

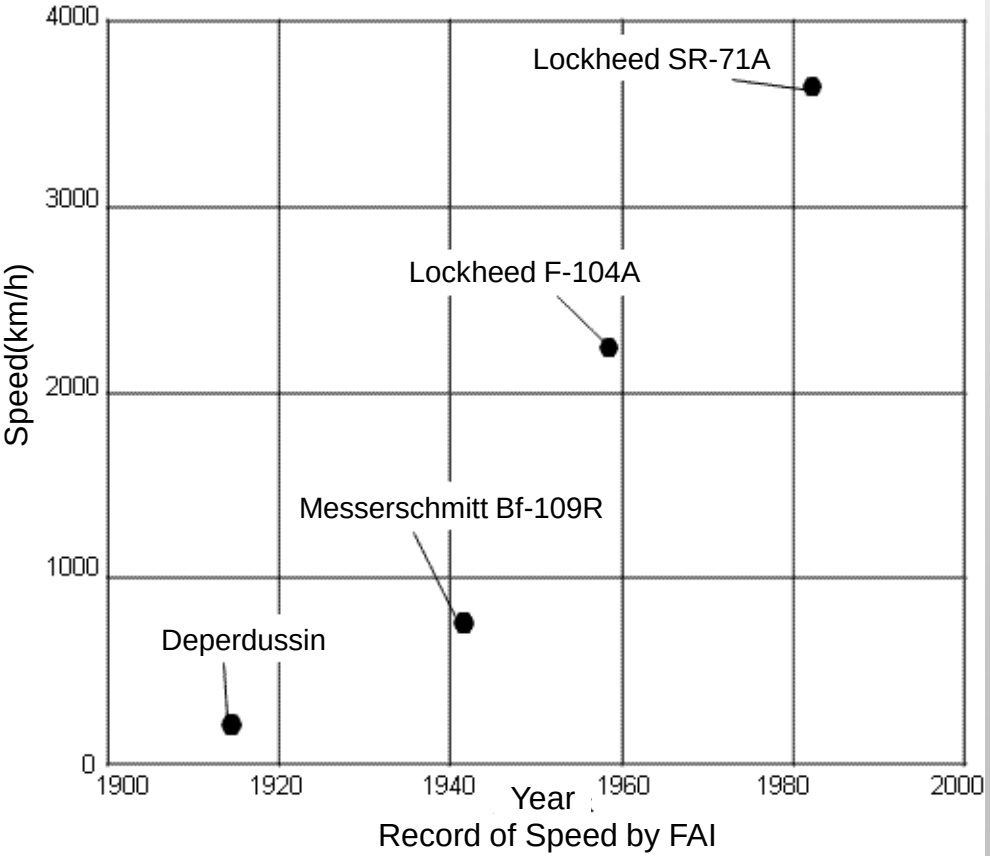


Human Beings and Machines

The 20th Century was the Age of Machines

1903	Wright Brothers' Airplane
1908	Ford Model-T
1941-45	World War II
1946	ENIAC
1964	Tokaido Shinkansen "Bullet Train"
1969	Apollo 11 Lunar Landing
1980	Advent of micro-computers
1990	GPS Car Navigation Systems

http://commons.wikimedia.org/wiki/File:Lockheed_SR-71_Blackbird.jpg



Record of Speed by FAI

http://ja.wikipedia.org/wiki/ファイル:Wrightflyer.jpg

The 20th Century Lifestyle

The lifestyle of the 20th Century was in tune with industrial society characterized by high economic growth.

Polarization between urban offices (workspace) and suburban housing (places for relaxation).

Premised on the development of modes of transportation (especially motor vehicles).

Figure removed due to copyright restrictions

Le Corbusier Weissenhof Siedlung, Stuttgart

Human Beings and Machines Are Different.

- There are individual differences among people.

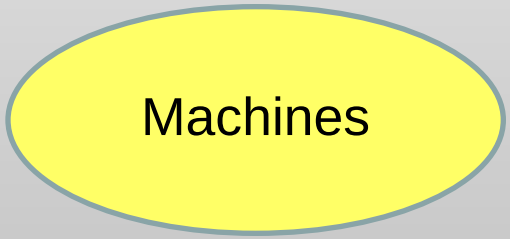
→ The concept of average value is not applicable

- People can change. → fatigue, experience

  Conditions and contexts have effects.

- People have a reason for living. → motivation, memory

(On the other hand, information technologies start from the standpoint of excluding meaning)

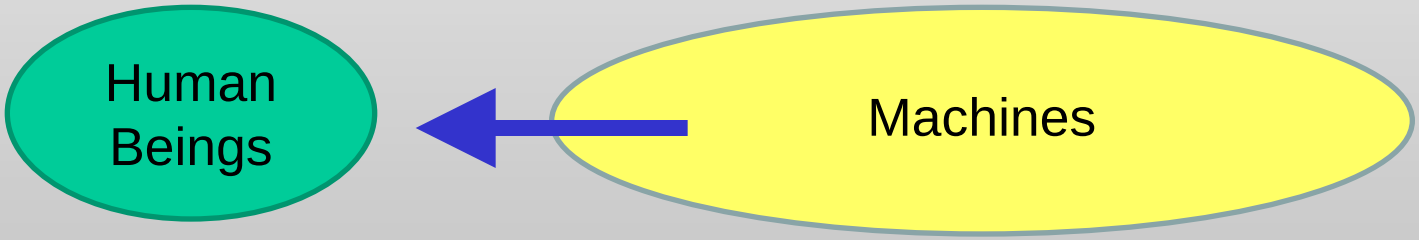


How can these different types of existences be harmonized?

Substitutable-type Machines

Machines becoming more like human beings

“Humanization” of machines



Automation Technologies

(Happy that machines can handle various jobs)

Cybernetics

Appearance of the Concepts of “Control” and “Regulation”

Artificial Intelligence, Humanoids

‡ Photo provided by Panasonic

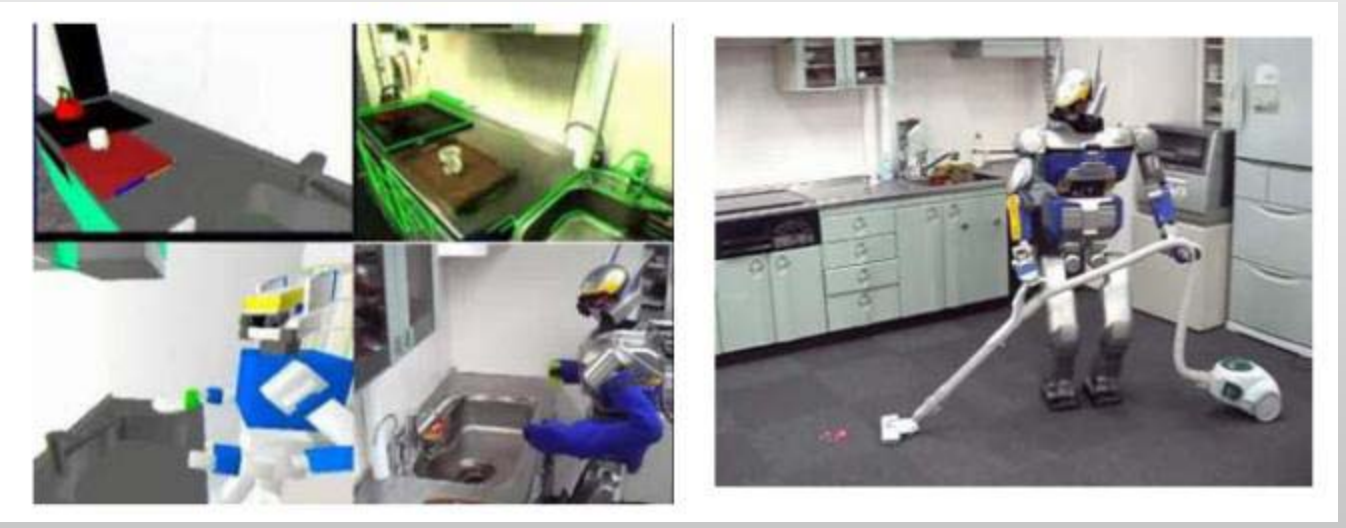
Figure removed due to copyright restrictions

Robot Penetration of Daily Life

The place of activities for robots has expanded from the factory floor to everyday life spaces. Their opportunities for sharing sensibilities with human beings are increasing all the time.

‡ http://ja.wikipedia.org/wiki/ファイル:Model_7000-First_of_Yurikamome.JPG

Development of automation



‡ http://www.irt.i.u-tokyo.ac.jp/seeds/robot_sys/index.shtml

Housekeeping robots

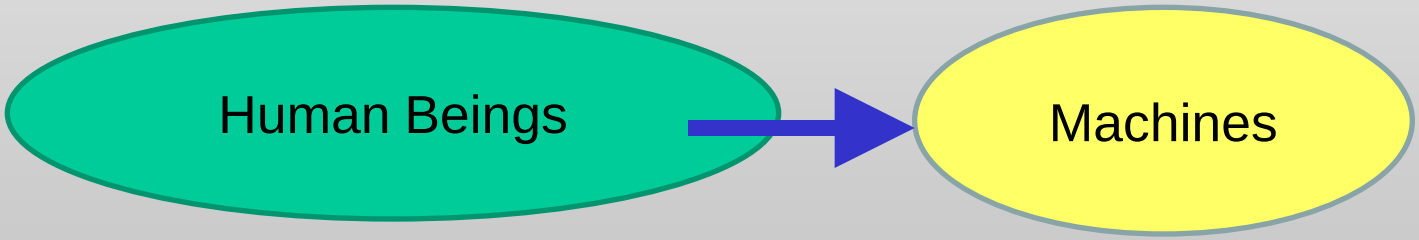
‡ http://commons.wikimedia.org/wiki/File:Conveyor_belt_at_Yo!_sushi_by_wyzik_in_Soho.jpg

Mechanical devices inside human beings are also evolving.

Expansion-type Machines

People becoming more like machines

"Mechanization" of human beings



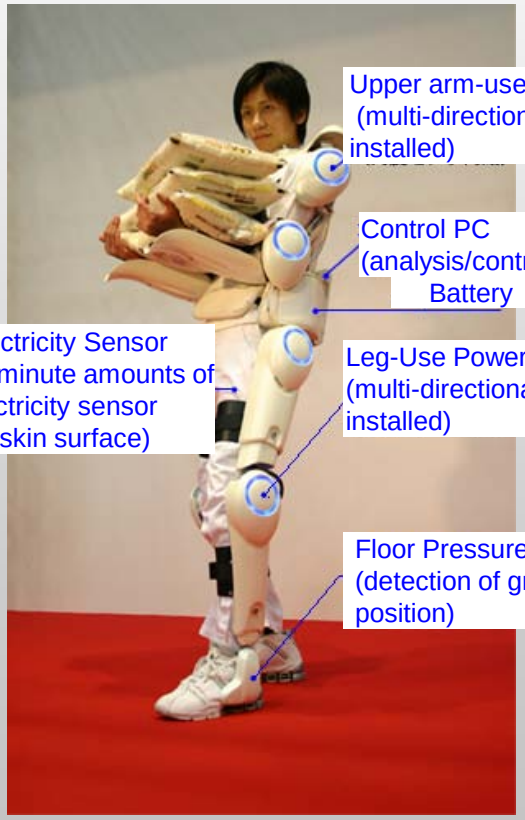
Interface Technologies

(Human beings are increasingly incorporating machines)

Machines as Tools

‡ http://ja.wikipedia.org/wiki/ファイル:Half_rim_glasses.JPG

‡ From the Sankai Research Office at Tsukuba University



Artificial Internal Organs

Cyborgs

‡ http://commons.wikimedia.org/wiki/File:JARVIK_7_artificial_heart.jpg

Extension-type Machines

Wearable Computers

Extension-type machines are internalized machines.

Progress with machines is said to occur in three stages.

Institutional Technology
→ Personal Technology
→ Intimate Technology

“Intimate” has the meaning of “close to one’s heart, personal (close to one’s person), and individual,” so such things as eyeglasses and false teeth are “intimate tools.”

Extension-type Intelligent Machines

Bodies extended thanks to machines

- Extended sensory devices → Virtual Reality, Visibility
- Extended body → Telexistence
- Extended memory → Life Log

Henceforth, how again will human beings and machines engage in a merger of very different existences?

How can we alleviate

the sense of unease?

‡ NASA

“Washlette” Automated Toilets
Walkmans
7-Segment LEDs

Or will the feeling always remain?

1. Virtual Reality (VR) as technologies for making visible
2. Digital Museums

    Tangible Things (*mono*) and Intangible Things (*koto*)

    Unlimited Nature of *koto*
3. Changes in the Temporal (Time) Axis

    Life Log and Virtual Time Machines

    Summaries of Large Amounts of Information
4. Human Beings and Machines