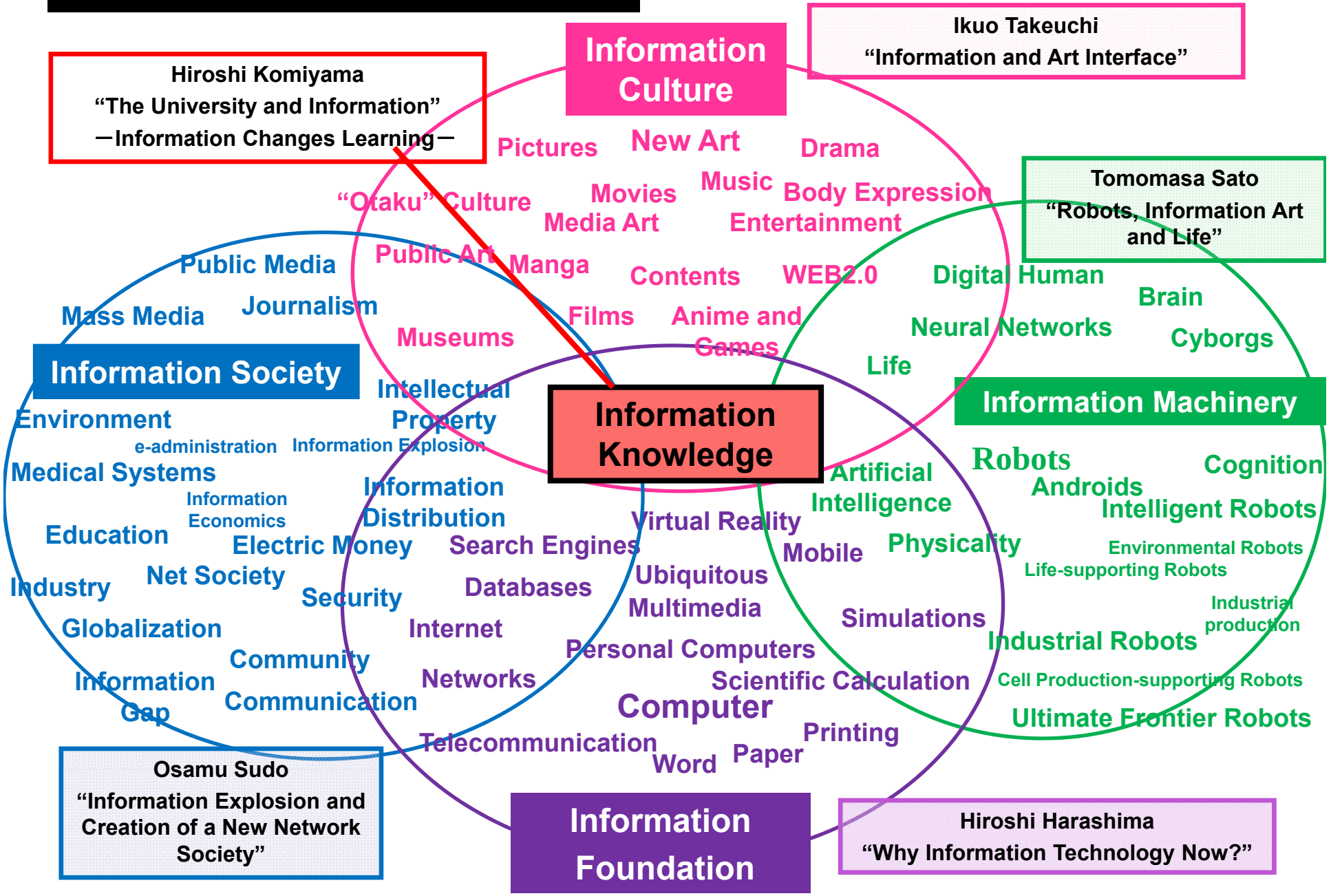
Information changes the world

Information, Robots and Life

Graduate School of Information
Science and Technology,
The University of Tokyo
Tomomasa Sato

Information Changes the World
—the Global View—

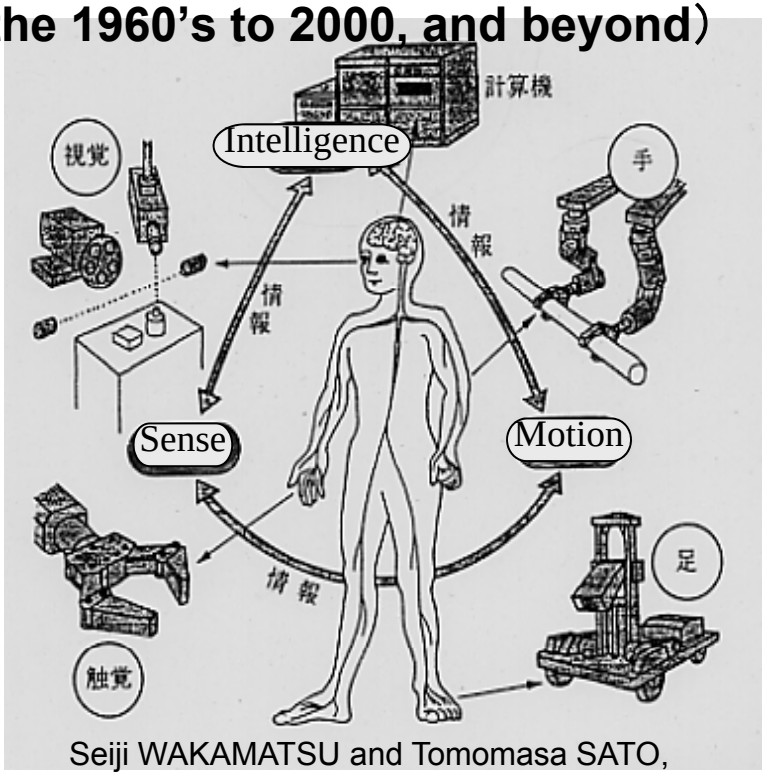


Information, Robots and Life Dec. 8

Informatics in robots designed to emulate and surpass human capability

～ Tomomasa Sato～

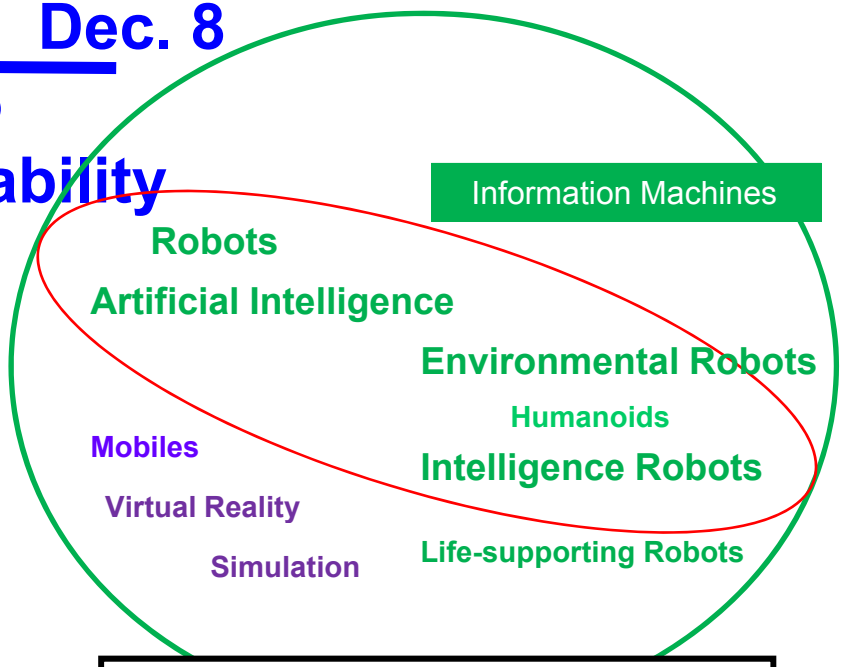
History of Intelligent Robots
（Video images of robots from the 1960's to 2000, and beyond）

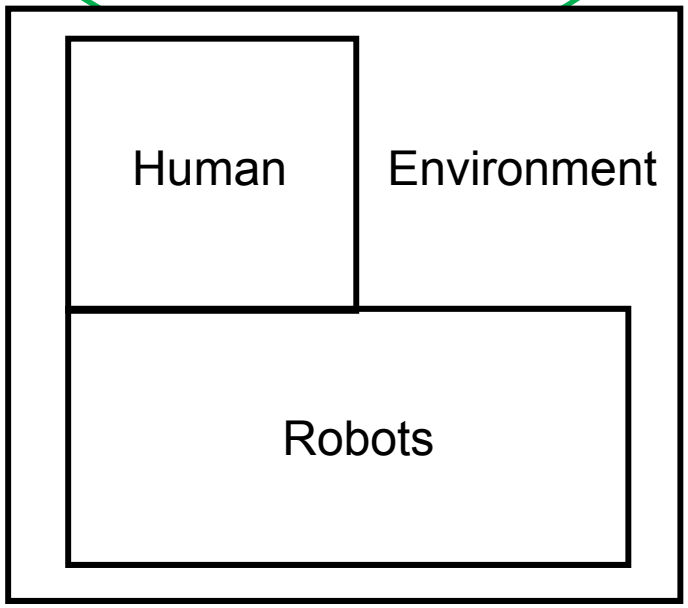


Seiji WAKAMATSU and Tomomasa SATO,
"*chinō robotto –jisedai no robotto gijutsu* -",
(1984), Ohmsha, p.4 Fig.1-2

‡

Sense – Plan - Execute model and its data processing capabilites, limitations and development

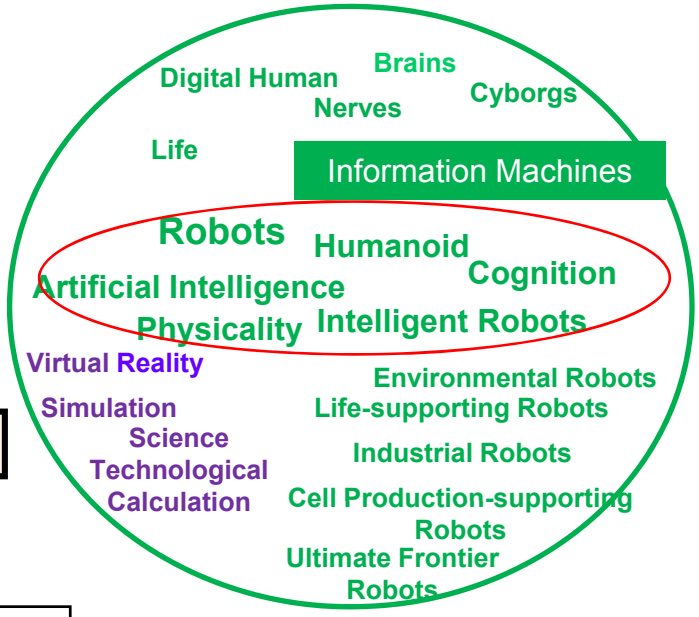




Man – Robot - Environment model and data processing

Information, Robots and Life Dec.13

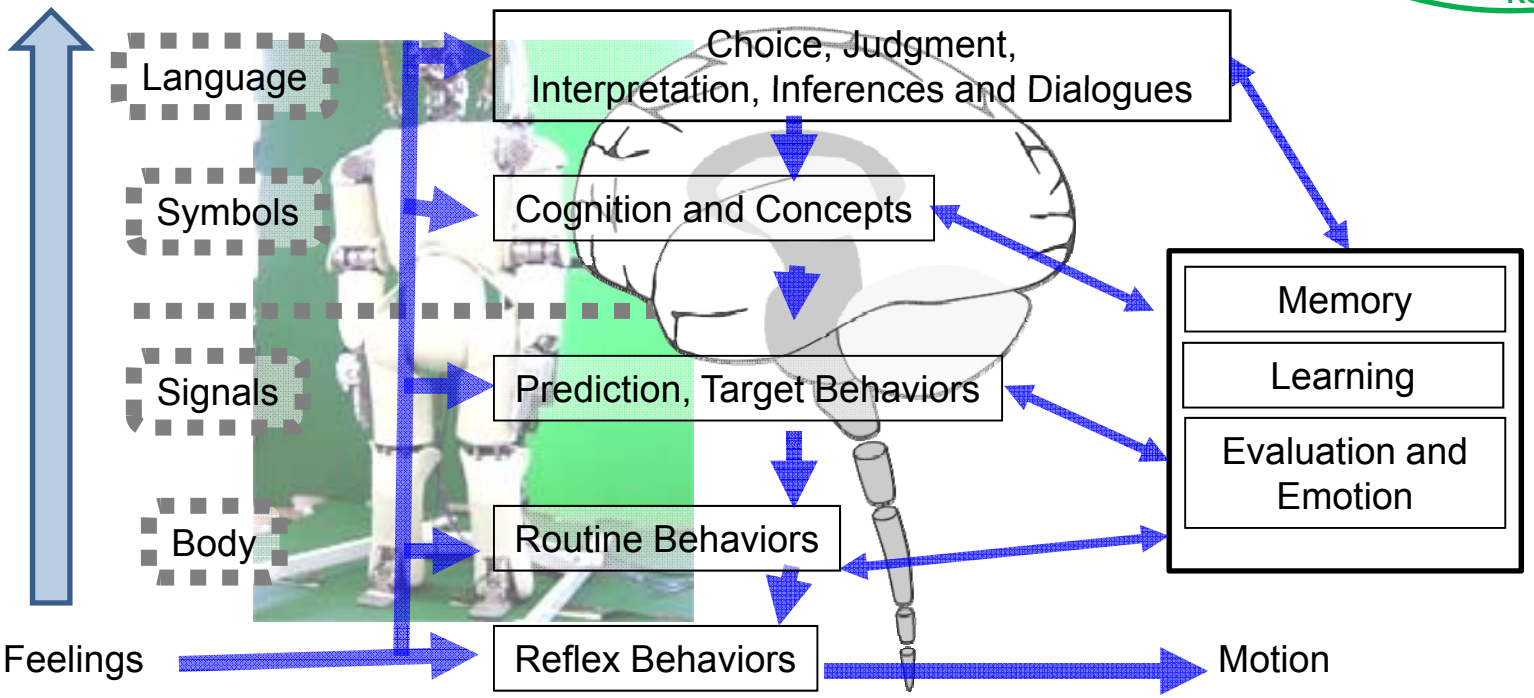
Informatics in Robots
Designed to Clarify Human Cognition
～ Yasuo Kuniyoshi～



Robots and Intelligence
（Learning and improving on robotics informatics）

Cognitive development robots ⇔ Understanding of human cognition

Theory of Evolution, development and Composition

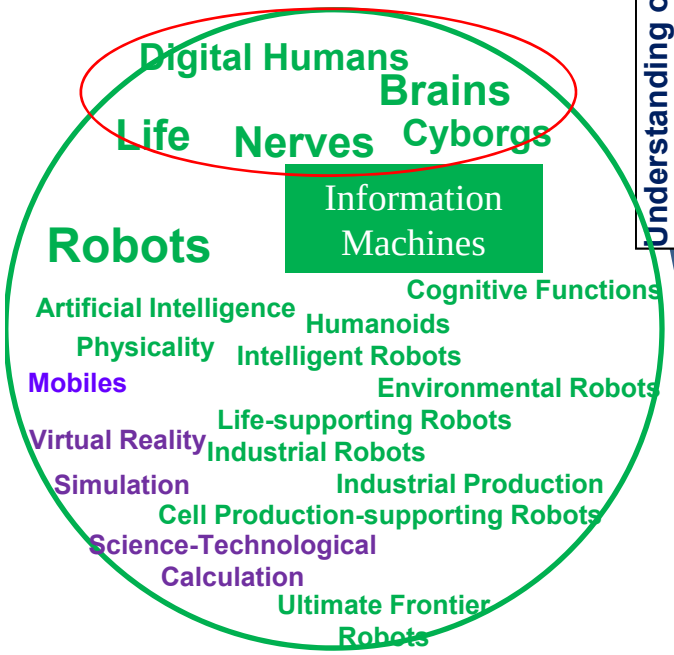


Information, Robots and Life　　Dec. 20

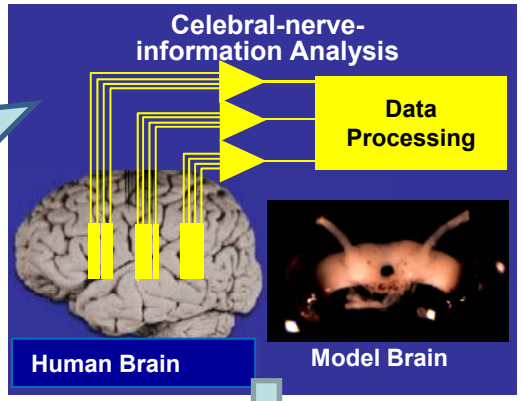
Informatics in Robots designed to study Life

～ Ryohei Kanzaki ～

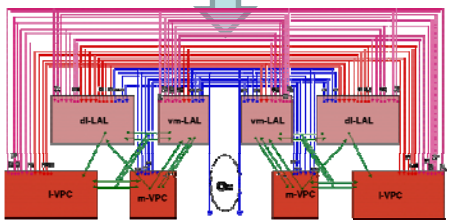
Life and Robots
（Informatics in brains and nerves through robots）



Understanding of humans and other creatures through robots



Biological Analysis of Brain and Nerves



Brain Model

Bio-informatics, Neuro-informatics

Robotic humanoid

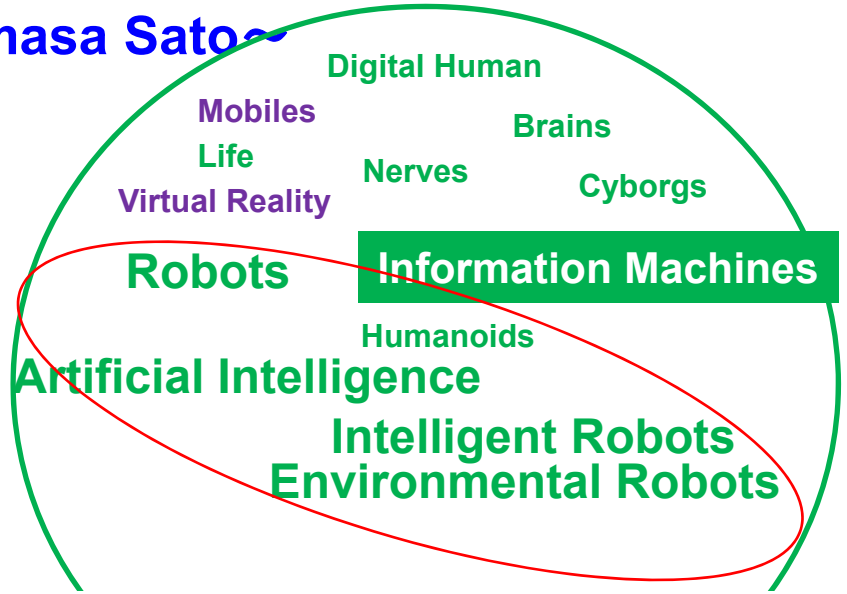
Biotic-model Robot

Evaluation by creating robots

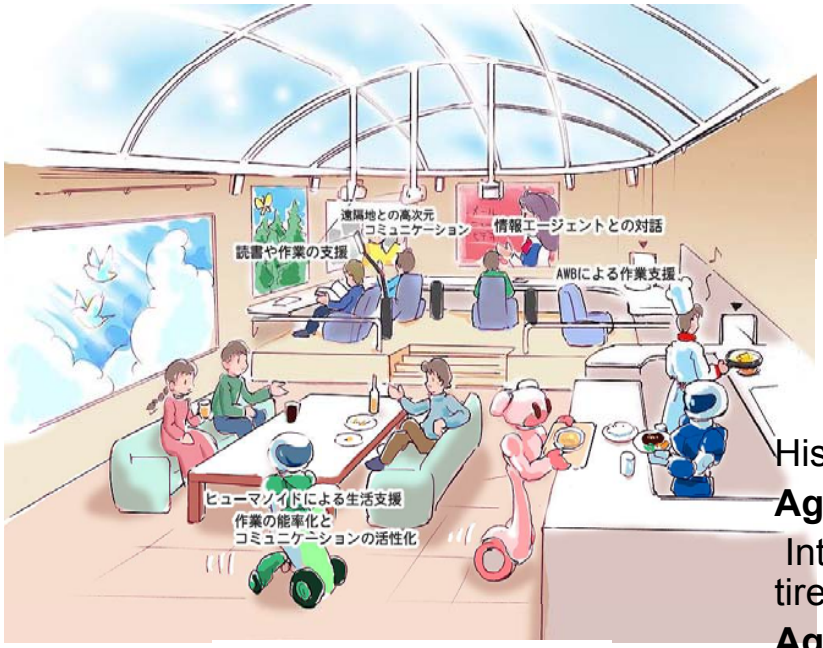
Information, Robots and Life Jan. 10

Informatics in Robots designed to be useful for humans

~ Tomomasa Sato~



Information Environment and Robots (Indoor-robot's informatics and ubiquitous systems)



Tomomasa SATO, editorial supervisor : The University of Tokyo 21 century COE *jitsusekaijōhō* project,
"hito to kyōzon suru conpyūta, robottogaku jitsusekai jōhō sisutemu" Ohmsha, p.2 Fig.1-1-1

Data processing of robot's infrastructures

A history of Automotive Technology-development and its Application to Robotic Development Strategy

History of automotive technological development

Age of Basic Technology Development - 1859 to WWI

Internal combustion engines, 4 wheel gas-fueled cars, pneumatic tires

Age of Social Technology Development - 1920's to WW2

‡ Asphalt roads, highways, highway networks

Consumer Technology Development Age - 1946 - present

Japanese cars prevailed as global consumer products

The 20th century is about automobiles; the 21st about robots

Before Describing Environmental Robots,

Let us grasp the history of robotic technology research and development, by getting an overview of the history of automotive technology research and development.

An Overview of Robotic Technology
--The History of Automobiles (1)

<The Era of Basic Technology>

1859 Internal combustion engine: Etienne Lenoir
Later, compression ignition engine: Otto

1885 Motor bike: Daimler and Maybach

1886 4-wheel gasoline-driven car : Daimler

1888 Pneumatic tire: Dunlop
By this time, Benz had 50 workers.

1890 First car with differential gear (Benz Victoria)

1893 Carburetor

1899 Detroit Automobile Company founded: Henry Ford

1907 Focus on the Model T 1908 Production started (65 cars in 1908)
1909 Approximately 11,000 cars produced

1914 World War I Severe conditions affected cars of wartime
→Quick loop to correct defects
←Automobile companies, too, expanded their production capacities for the war.

- **Red Flag Law**
- **"Why use something as shabby as a car, when you can come home by horse even when you are drunk?"**

An Overview of Robotic Technology
--The History of Automobiles (2)

<The Era of Social Technology>

1920's Dawn of mass transportation
Various vehicles co-existed on the street: cars, buses, motor bikes, vans, taxis, street cars, trolley buses, etc.

Early 1920's Streets paved with asphalt

1923 The first expressway in the US was built
Autostrade in Italy
Autobahn in Germany

1930 More than 250,000 miles of paved roads for automobiles were built in the US.

- **Road traffic network = Social infrastructure was developed.**
- **Roads were constructed using tax money.**

1939 World War II Most of the automobile companies shifted to military automobile production.

1940 Jeep: standard delivery vehicle of the American army

1948 Tank, Centurion

An Overview of Robotic Technology
--The History of Automobile (3)

<The Era of Manufacturing by private sectors>

1946 Soichiro Honda made motor bikes

1948 Volkswagen Plants Rebuilt

1959 Japan imposed restriction on imports of foreign cars.

1960's Japanese cars still unable to get rid of old-fashioned images in design and technology.

1970's The latest fashions were introduced in Japanese cars.

Latter 70's Japan began to produce reliable cars of high quality, that excelled in cost performance.

1980 Japan outnumbered the US in car production.

present More local productions abroad.
Toyota outnumbers GM in production.

For Getting an Overview of the Robotic Technology: List of Main Events in the History of Automotive Technology

< The Dawn of Automotive Technology> coincides with the advent of robots; 100 years ago

1859 Internal combustion engine: Etienne Lenoir Followed by compression ignition engine: Otto
1885 Motor bike: Daimler and Maybach
1886 4-wheel gasoline-engine car : Daimler
1888 Pneumatic tire: Dunlop At this time, Benz had 50 workers.
1890 First car with differential gear (Benz Victoria)
1893 Carburetor, float-feed model: Wilhelm Maybach
1899 Detroit Automobile Company founded: Henry Ford
1907 Focus on Model T 1908 Production started. (65 cars in 1908) 1909 Approximately 11,000 cars produced
1914 World War I Severe conditions affected cars in wartime →Quick loop to correct defects
Automobile companies, too, expanded their production capacities for war.

<Next Generation: Era of Infrastructure Development>

1920's Dawn of mass transportation
Various vehicles co-existed on the street: cars, buses, motor bikes, vans, taxis, street cars, trolley buses, etc.
Early 1920's Streets paved with asphalt
1923 The first expressway was built in the U.S., Autostrade in Italy, Autobahn in Germany
1930 More than 250,000 miles of paved roads for automobiles were built in the US.
1939 World War II Most of the automobile companies shifted to military automobile production.
1940 Jeep: standard delivery vehicle of the American army
1948 Tank, Centurion

The social infrastructure for automobiles.
This lecture series deal with an infrastructure for robots.

The 20th Century was the center of automobiles.
The 21st Century is the century of robots.

<Era of Popularization>

1946 Soichiro Honda made motor bikes
1948 Volkswagen Plants Rebuilt
1959 Japan imposed restrictions on import of foreign cars.
1960's Japanese cars still could not get rid of old-fashioned images in design and technology.
1970's The latest fashions were introduced in the Japanese cars.
Latter 70's Japan began to produce stable cars of high quality, that excelled in cost performance.
1980 Japan outnumbered the US in car production.
present More local productions abroad. Toyota outnumbers GM in production.

Development of Basic Technology

Development of Social Technology

Development of Technology by private sector

from http://waterplanet.homeunix.net/~ohno/car-history/

What We Can Learn from the History of Automobiles

・Although robots and automobiles are different, as are their prime eras, we can learn the following from them:

●Automobiles have a 150-year history (in base, social infrastructure, and manufacture by private sector)

In addition to the basically mature technical engineering,

★Japan has succeeded in private sector technology.

★The automobile industry in Japan has been securing profits by way of group affiliation.

On the other hand,

●Robots have only a 50-year history.

Maturity is yet to come (and so, it shouldn't be judged in short term).

●The future **※Simultaneous development of the following:**

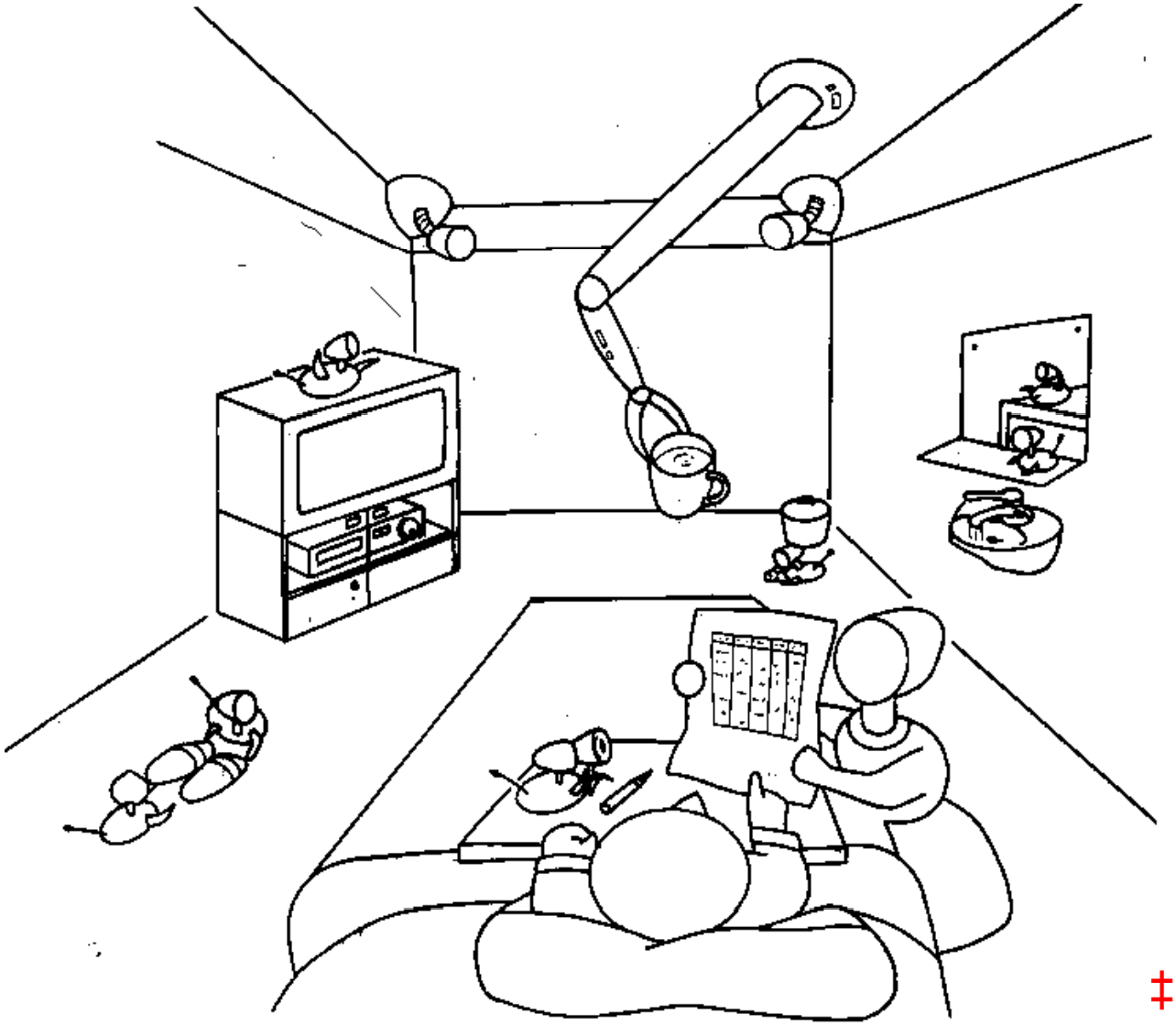
- implementation of T-type robots
- improvement of **robotic social infrastructures**→today's subject: environmental robots
- development as a fine-tuned technology in the private sector, which is Japan's forte

＜A key factor is the integration of service technologies and implementation of T-type robots＞

Description of the Environmental Robot (Part 1)

I. A Robotic Environment That Helps Humans

Environmental Robots
= Robotic Rooms

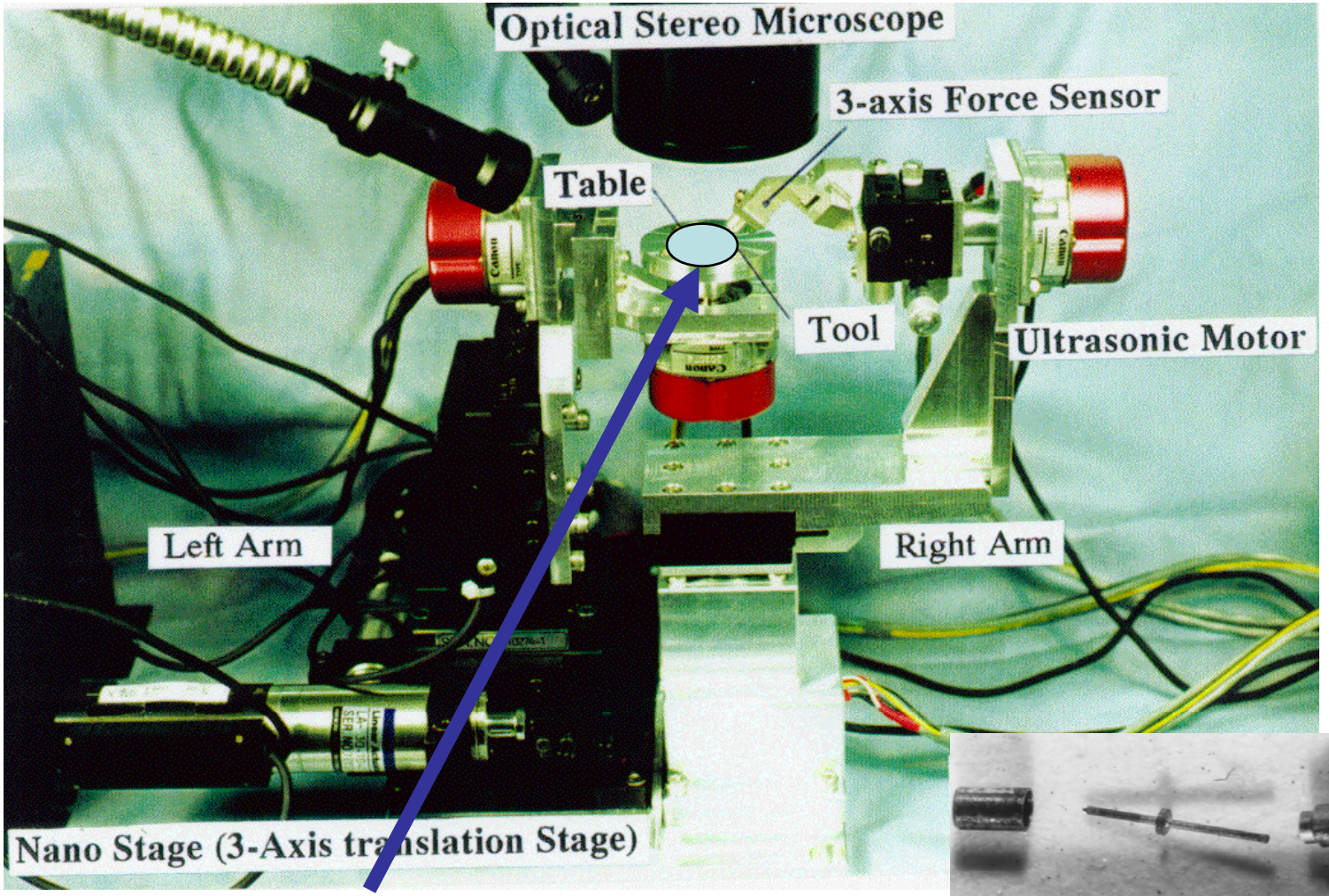


Provided by Shigeoki HIRAI,
National Institute of Advanced
Industrial Science and Technology

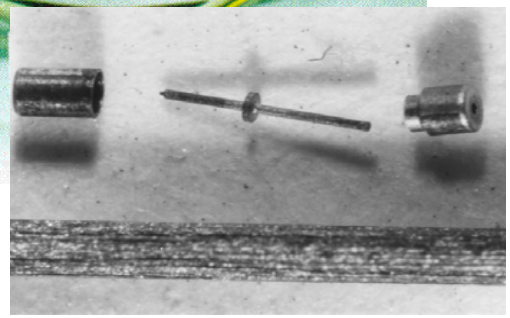
A Room that watches over people without making a fuss, gives assistance when necessary without complaint.

‡ in operation since around 1992 or 93

The Earliest Stage of the Robotic Room Study:
Study of Micro-object Handling Robots →
A System Whose Exterior Was Robots!



Space for Micro-object Handling
Concentrated Motion Manipulator

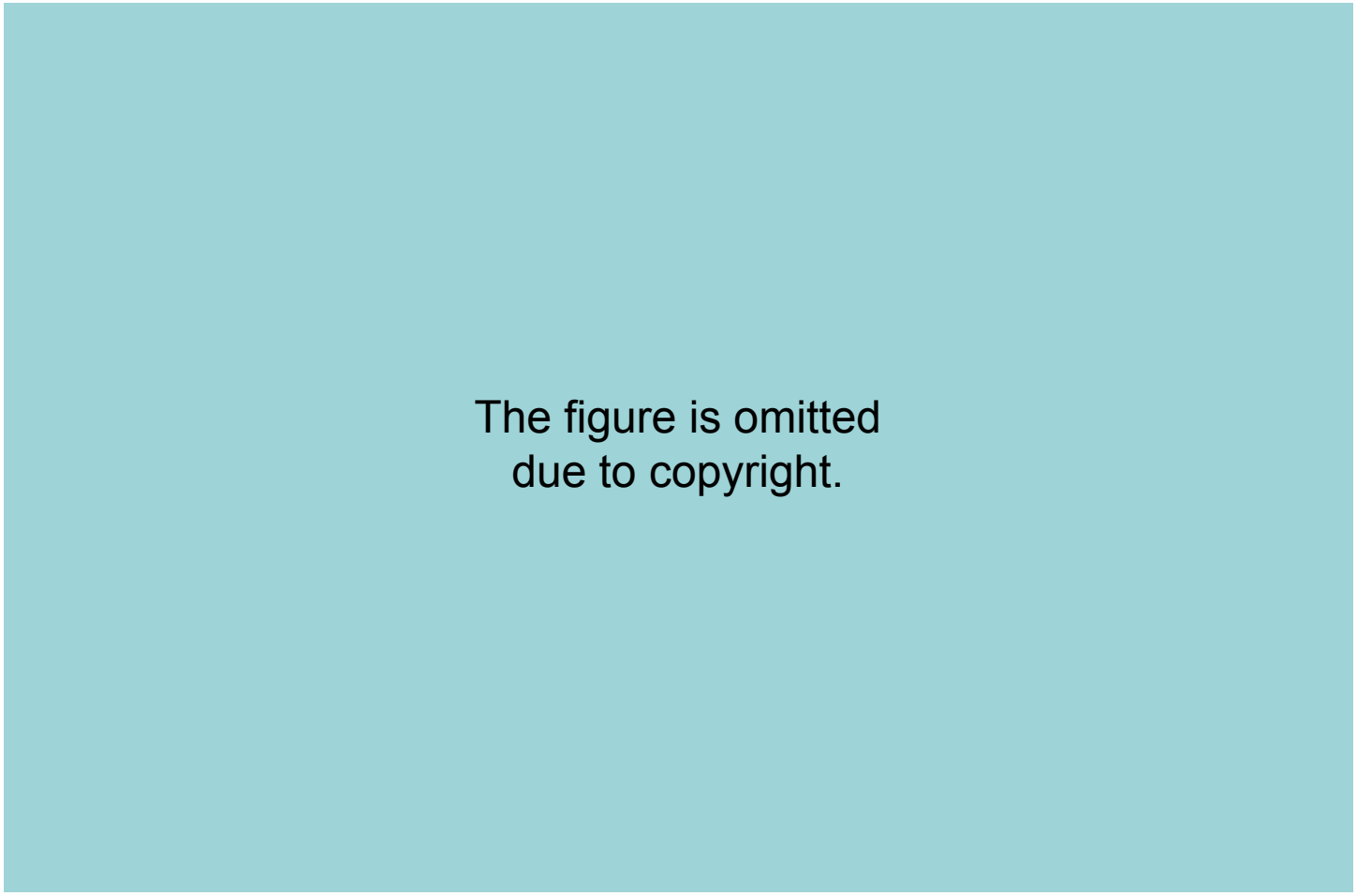


Implemented Robotic Room : A Robotic Hospital Room

November,1997

1997 : Robotic Room 1: RR1 Video

A Robotic Hospital Room



Significance of a System Designed as a Room

Merits of a Space System Format

1）**As a place where assistance is needed:**

A room is a space where people receive various services.

2）**As a place suitable to observing people:**

A room surrounds people.

→ non-restrictive → long term observation

→ a co-habitation system with people

Being natural and always non-restrictive, it makes co-habitation possible.

3）**As a place that can be materialized easily:**

People use rooms, which are 3-dimensional spaces, as if they are 2-dimensional.

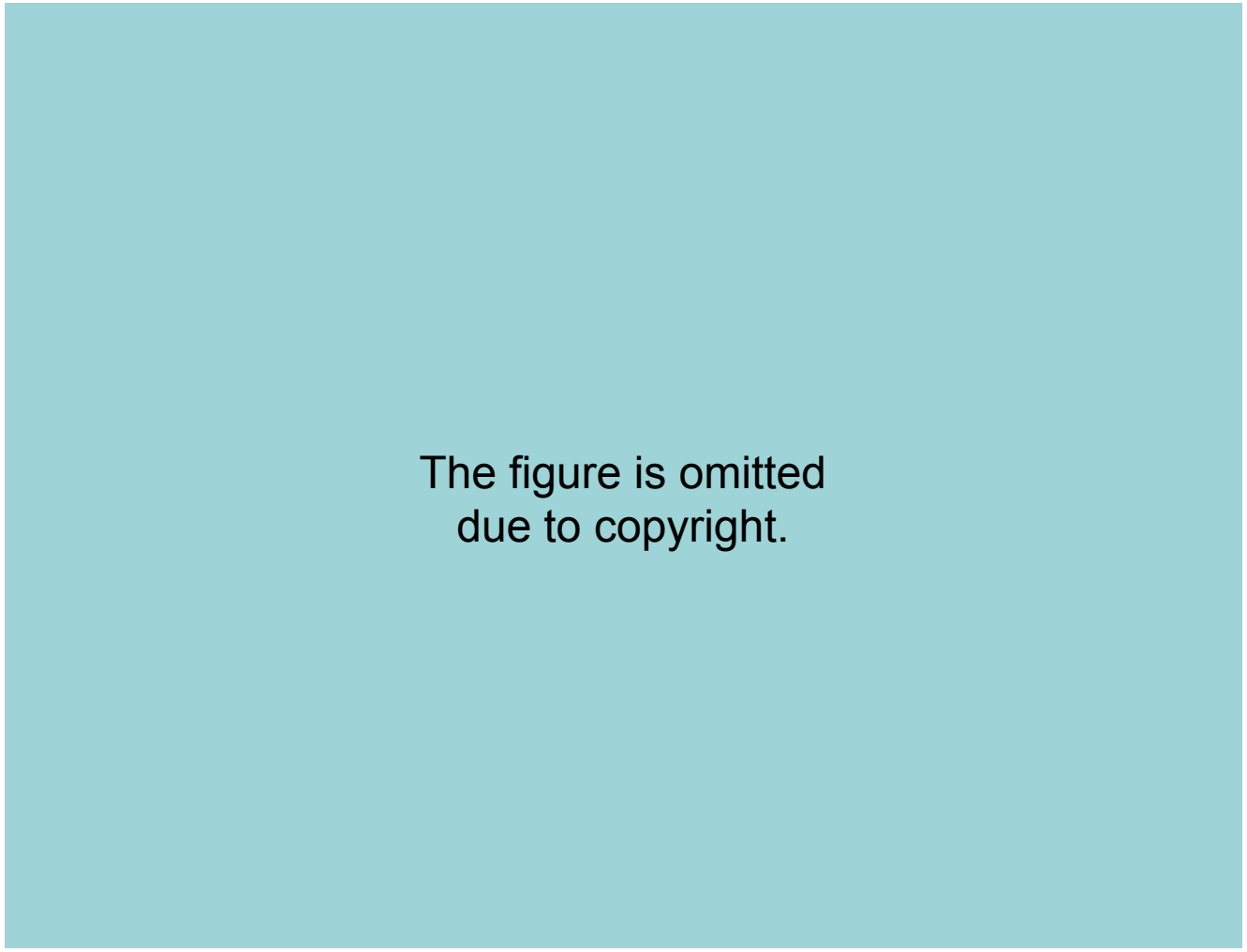
→Many elements can be placed separately.

→Appropriate elements can be chosen from them.

Robot environment system is promising.

Smart Room (MIT MediaLab)

Intelligent Room (MIT AILab)



Intelligent Spaces

(Institute of Industrial Science, the University of Tokyo)

The figure is omitted
due to copyright.

Other Attempts to Construct an Intelligent Space

Easy Living (Microsoft)

Aware House（Georgia Tech.）

NeuroHouse: Ache (Univ. of Colorado)

Sweet House（KAIST)

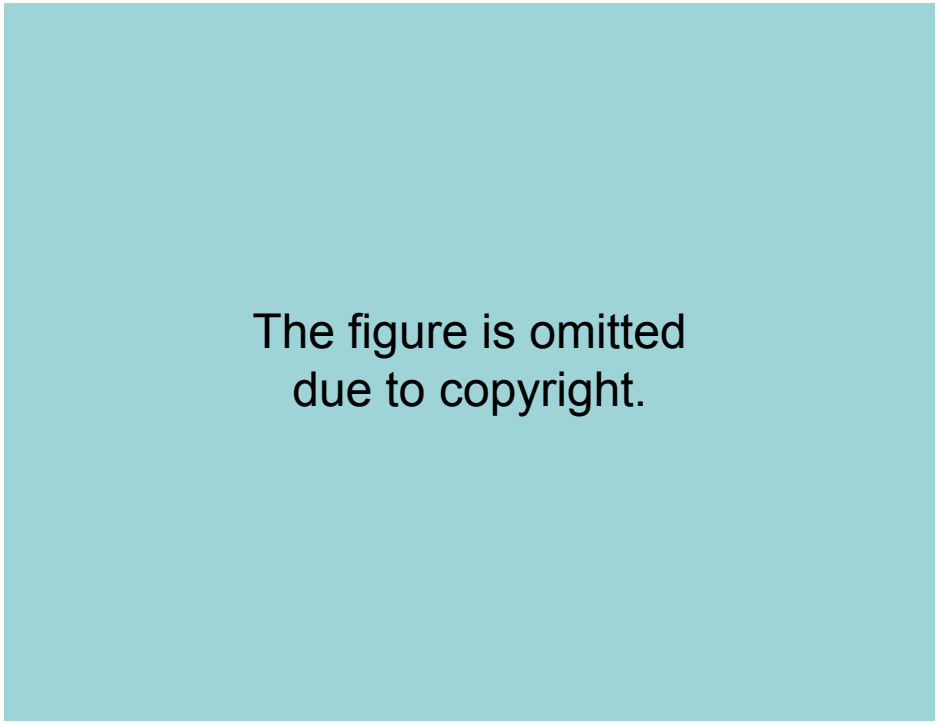
CMU

Self (AIST）

Gifu Prefecture

…

Networked Support System

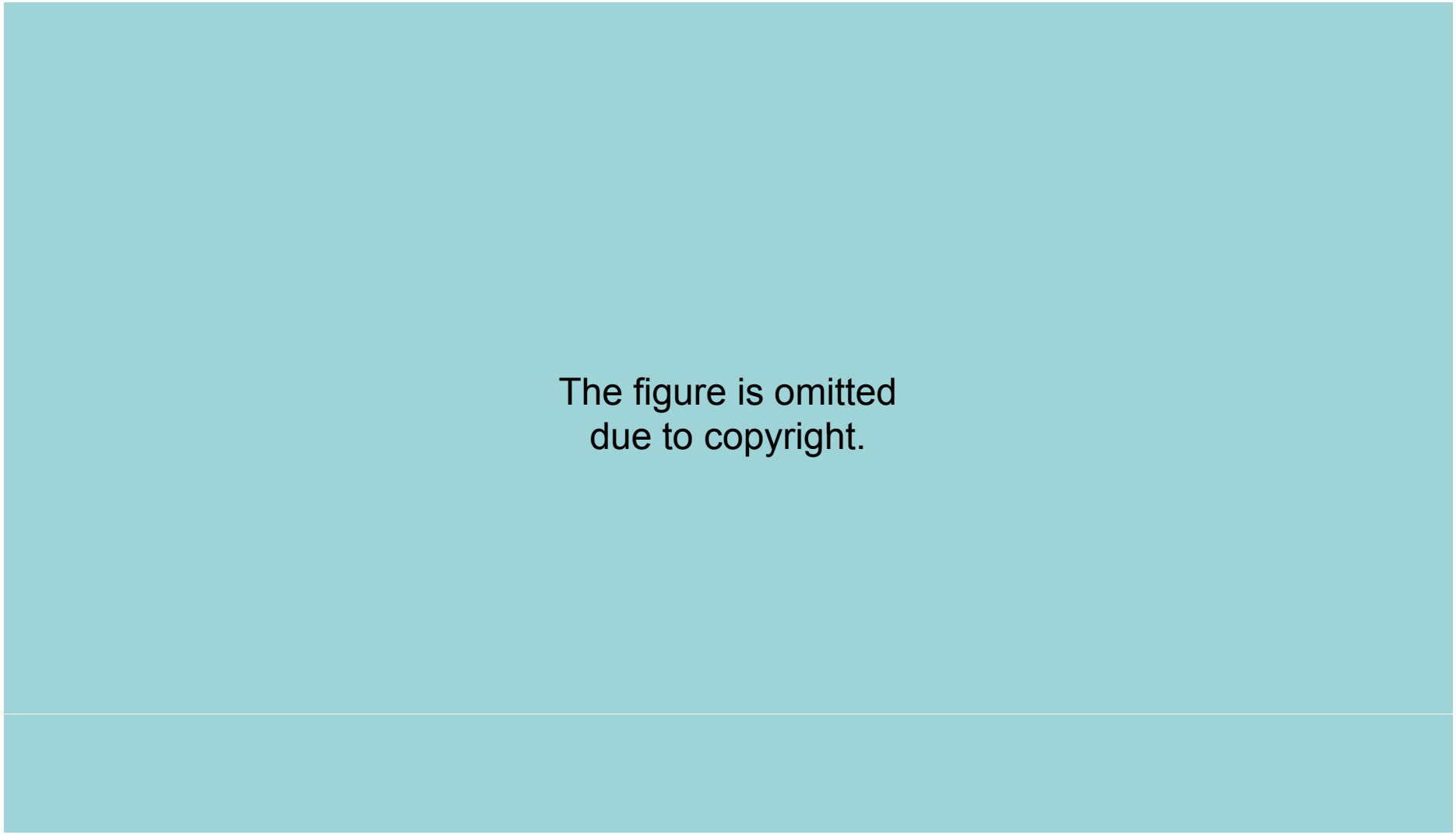


Networked air conditioner

Networked refrigerator

The Near Future of a Dispersed System

Networking machines and electric devices
that closely interact with human beings



“When Sensors are Connected to Networks”

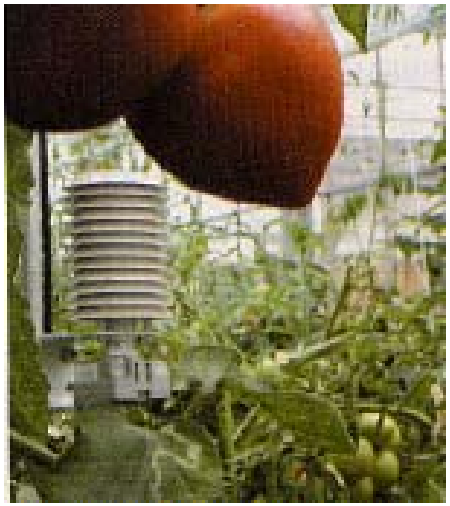
appeared in the July 15, 02 issue of ”Nikkei Electronics”

Busan Asiad Main Stadium (665 Illumination Sensors)
iGrassware (Mitsubishi Electric Research Laboratories）
Networked sensors for farm use（100 sensors）
Earthquake sensor（2000 sensors）

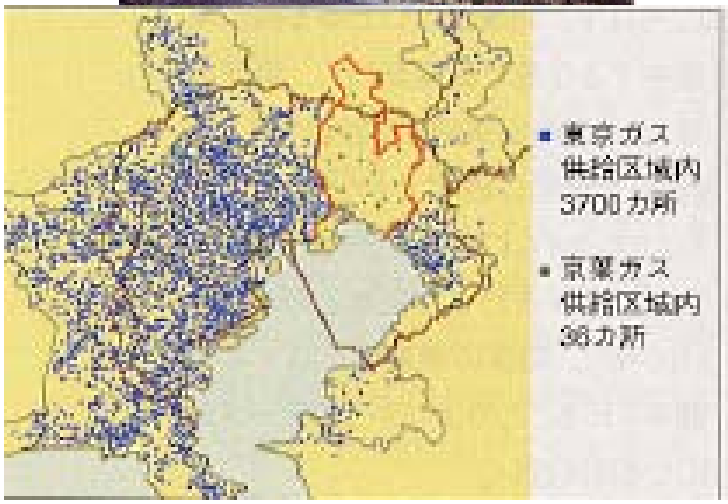
P.100 <Busan Asiad Main Stadium>

P.100 <Conceptual figure of iGrassware>

“Nikkei Electronics”, No.826, July 15, 2002



P.101 <Temperature sensor installed in *Ide* farm>



P.101 Fig.1(a) <Location of earthquake sensors deployed by TOKYO GAS Co., Ltd. >

‡

Moore’s Law in wireless communication

The Accumulation of Actions
Motives for the Next Stage of Development（1998）

Experience and reflection on the part of humans

Upon acting, humans accumulate experiences, and utilize them through reflection.

Human brain = an information processing and experience accumulation device

Current calculators

＝Unable to accumulate actions

●However, accumulation and utilization of actions
= a new concept
→**Showing accumulated actions alone is valuable**
（∵actions ＝ life, can be applied in extensive fields）
→ **Can be developed into personal contents industries**
（Industries that deal with information, the most valuable asset for individuals, can be developed.）

Usage of accumulated actions:

＜Example of Isetan Dept. Store＞Data of goods purchased by the shoppers enable the store to arrange layouts of sales floors to sell better.

・Money cards become human action sensors.
・Showing action records is useful.

Answer to the next step
In information appliances

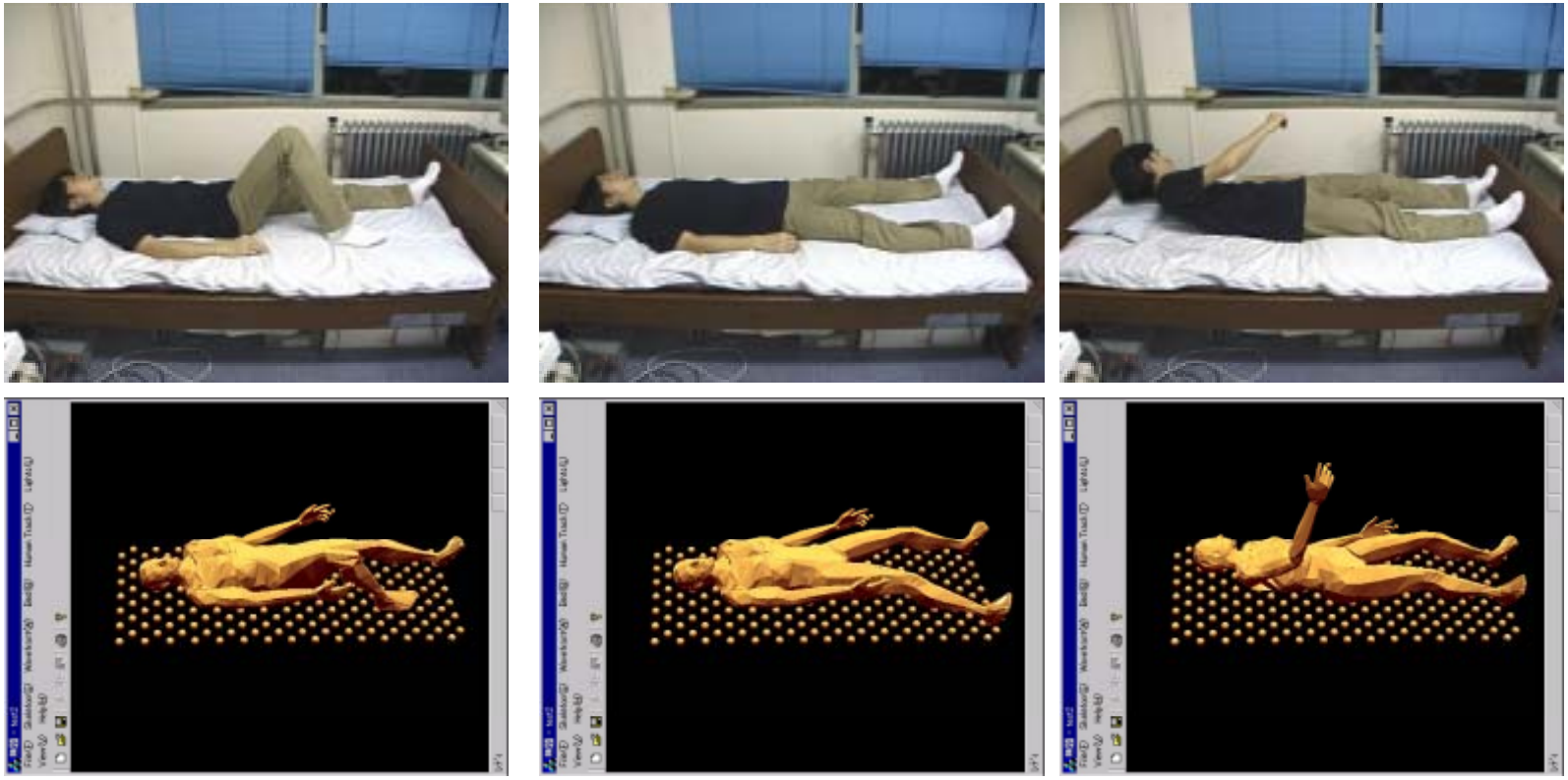
Actualized Robotic Room (2) in a Studio-type Room

Life support (checks well-being, medical factors, welfare. Results in peace of mind)

A. Physiological Measurement

Environmental sensing: sensory bed

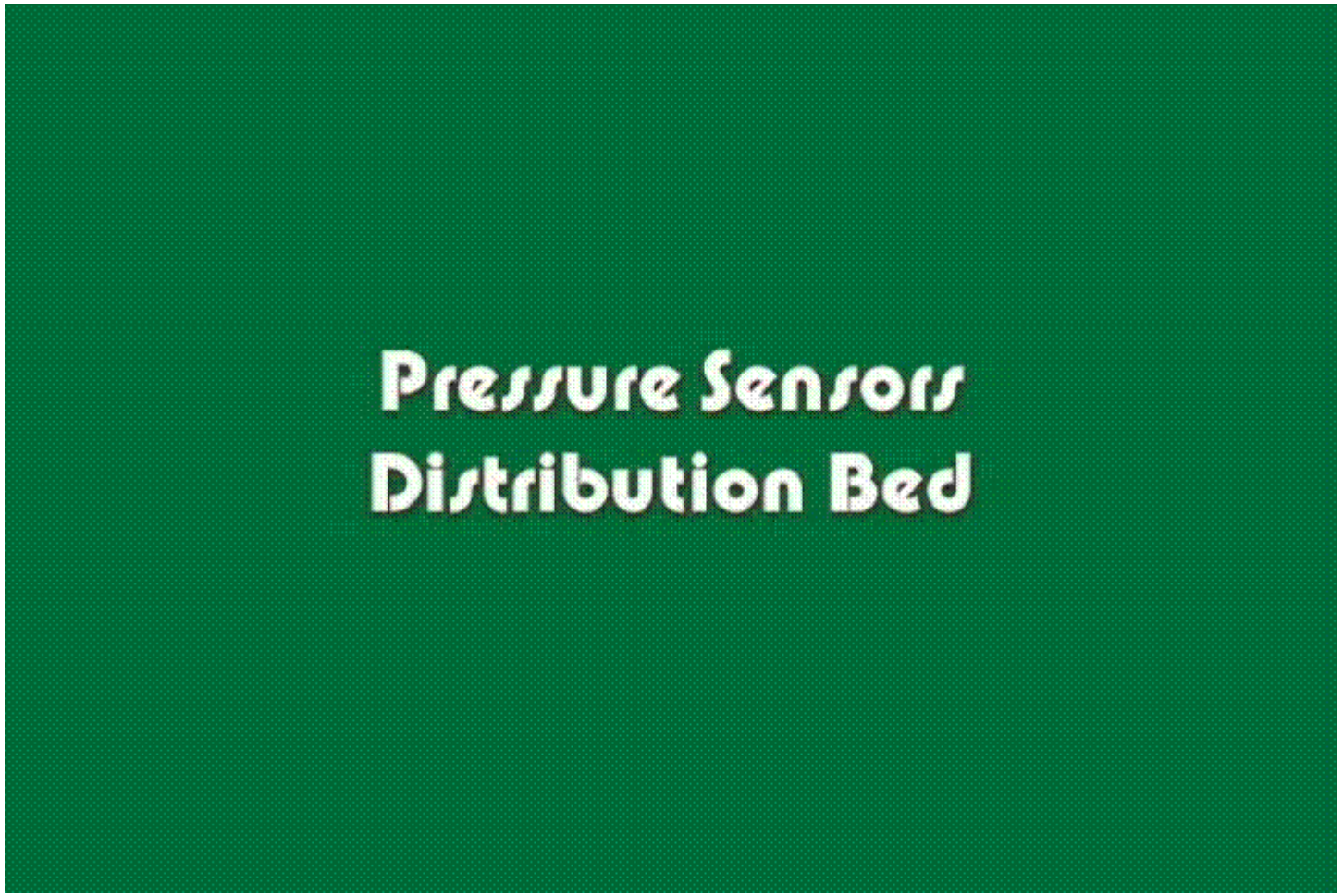
body movement tracking



Tracking of body movements detects : whether the person is in bed or not, postures, twisting, and up-and-down movements

Breath and pulses become measurable ⇒ Next stage of development

Demonstration Video of Pressure Sensor Distribution Bed



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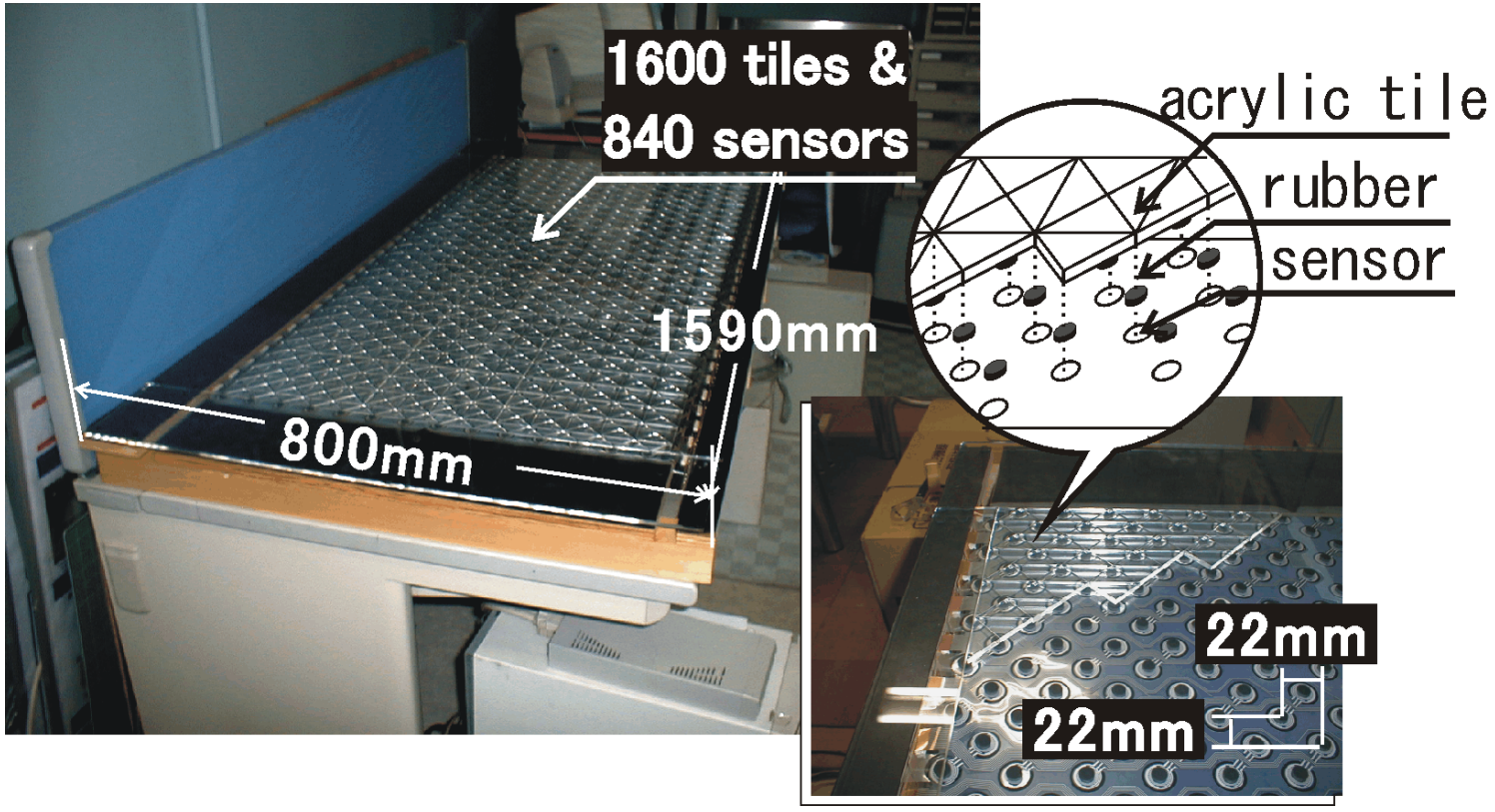
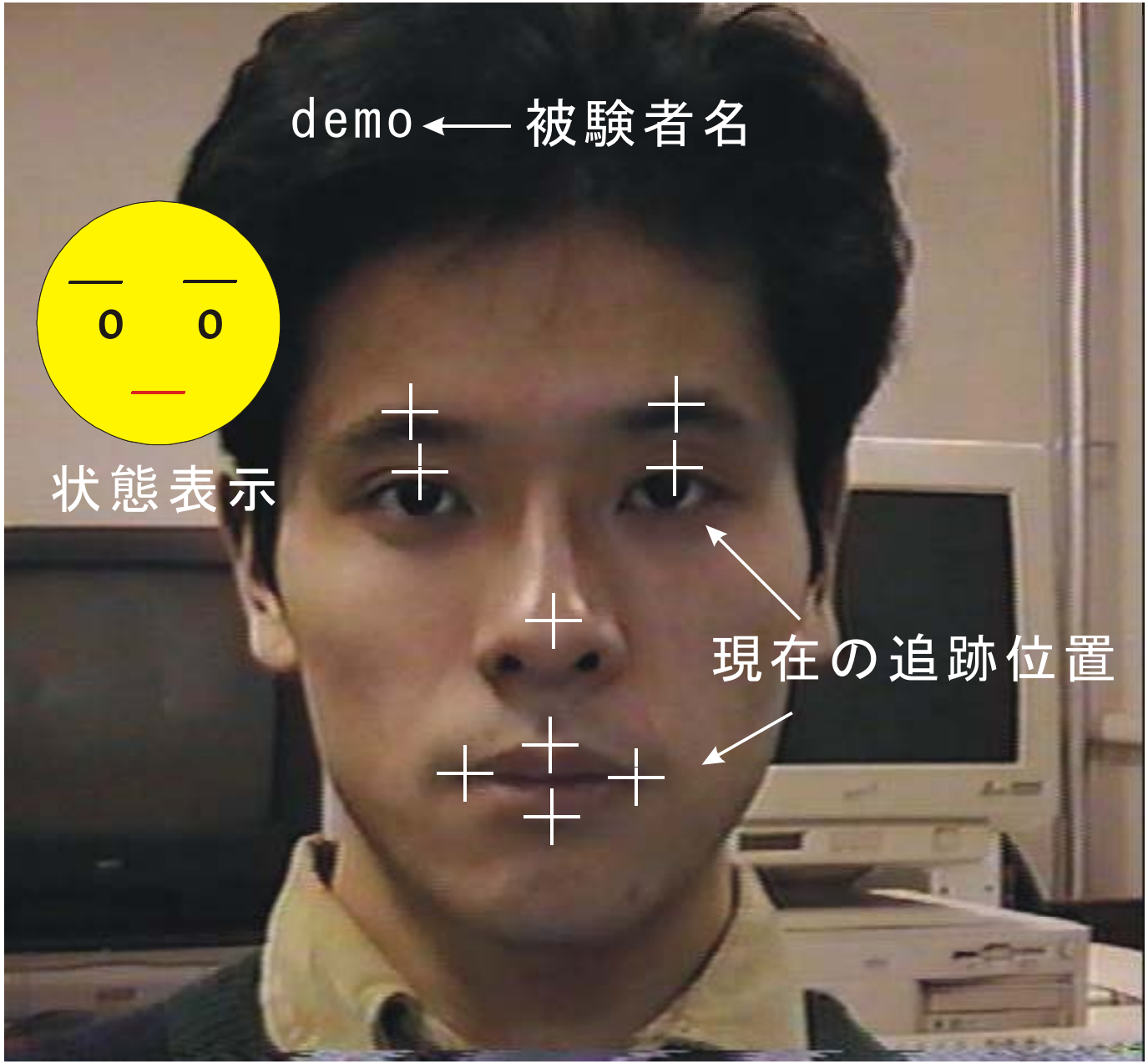
Provided by Tatsuya HARADA, Graduate School of Information Science and Technology, The University of Tokyo

B. Physical Measurement Sensory Desk

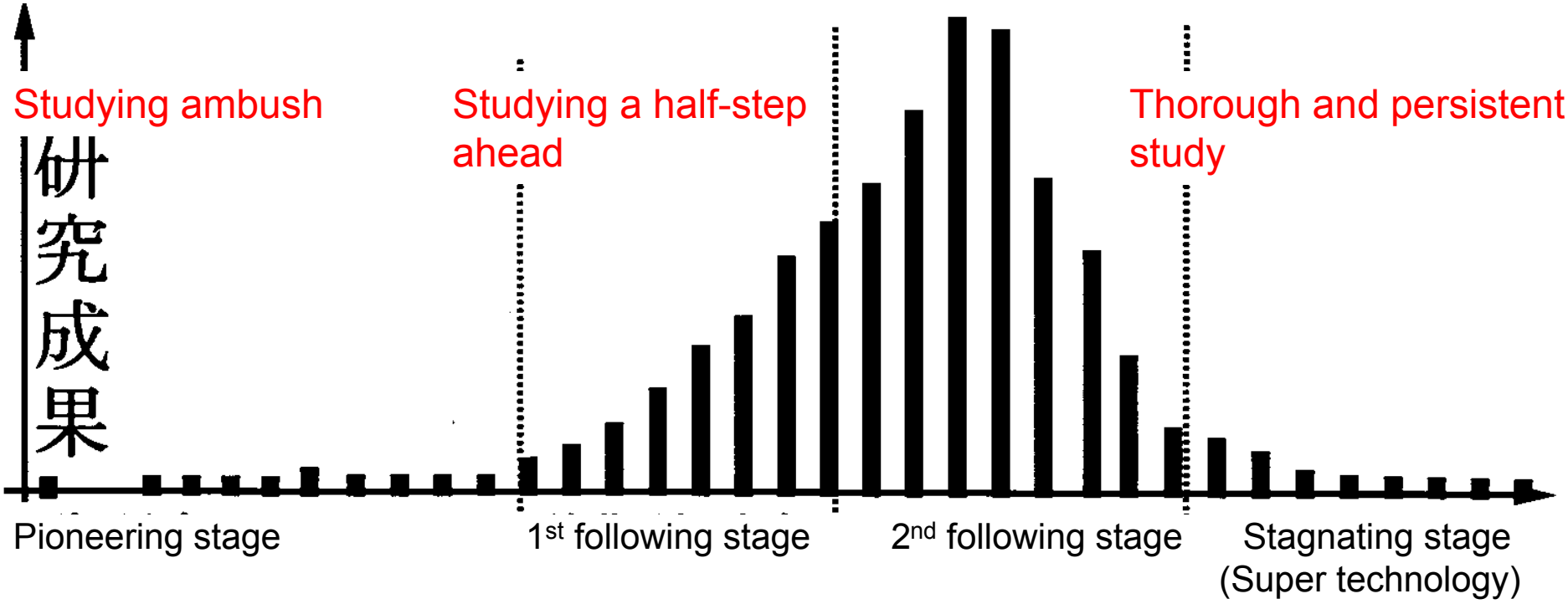


Records the work done → Assists in the work

C. Psychological Measurement　　Measuring Pain



Studying Life Cycles: Timings and Achievements



1992 1997 2002 ×Following stage

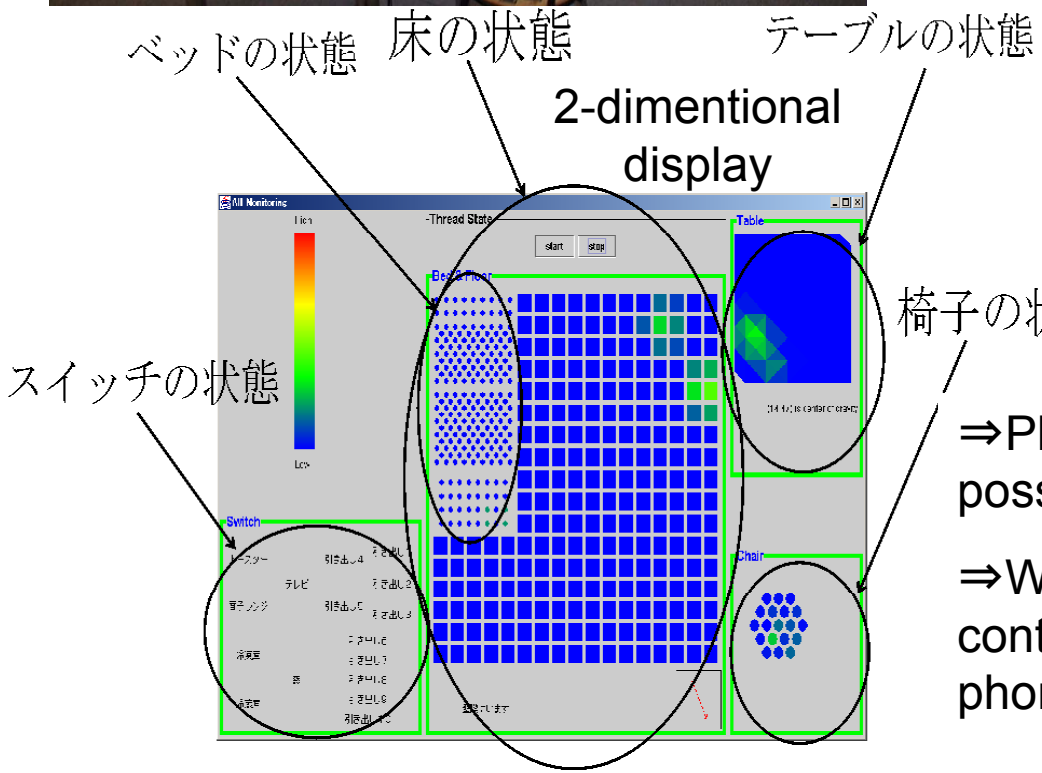
～1993 1998 (←Possibilities！ 2007

"Shall we persist, or give up?")

5 years 10 years 15 years 20 years

RR1 Same demonstrations Ubiquitous era

Sensing Network Made of Dispersed Objects for Measuring Human Actions

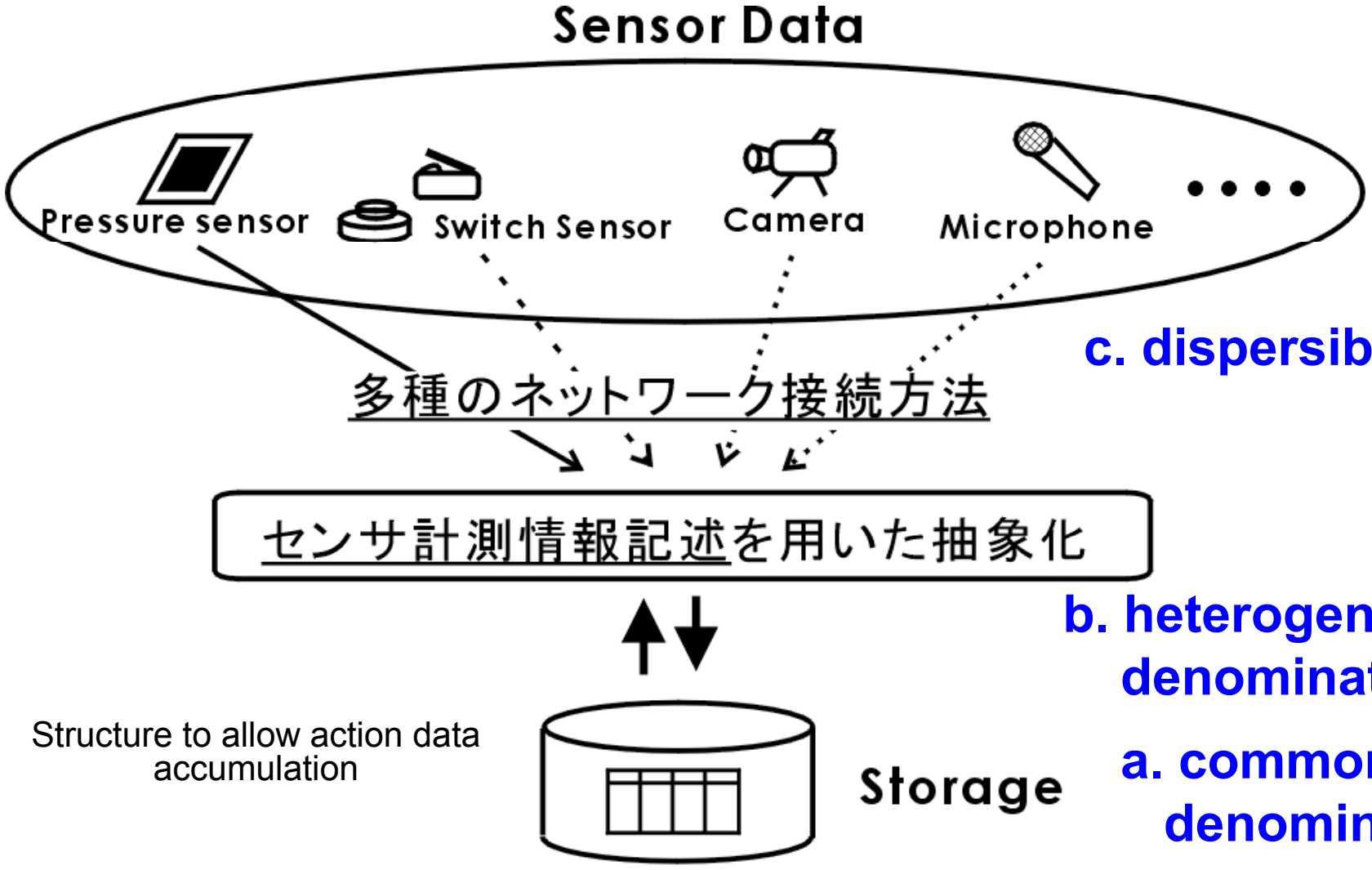


⇒Plug-in function made possible

⇒Welfare remotely controlled by mobile phone

Construction Software

for Digital Contents Used in Daily Actions



c. dispersibility

b. heterogeneous denominator

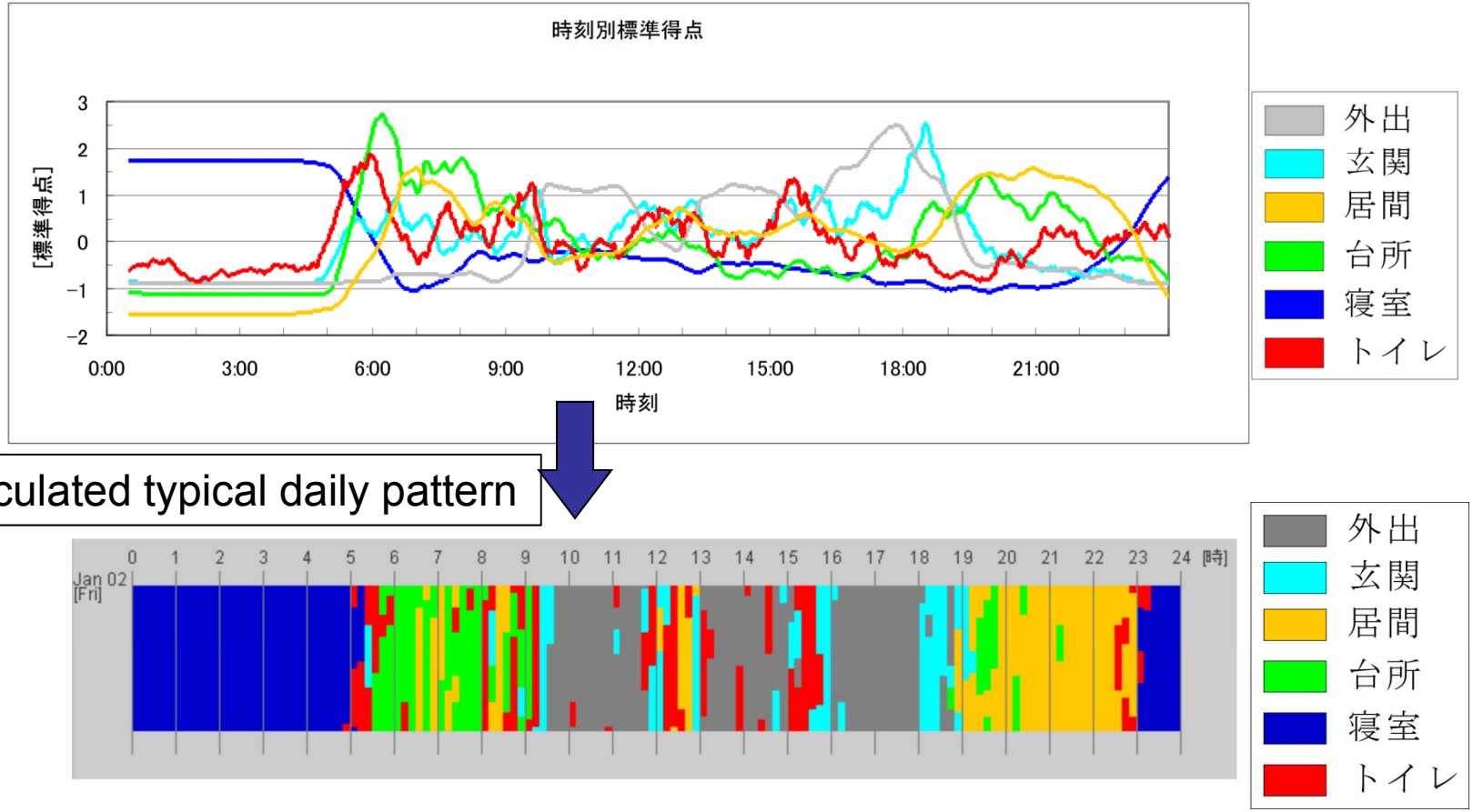
a. common denominator

Structure to allow action data accumulation

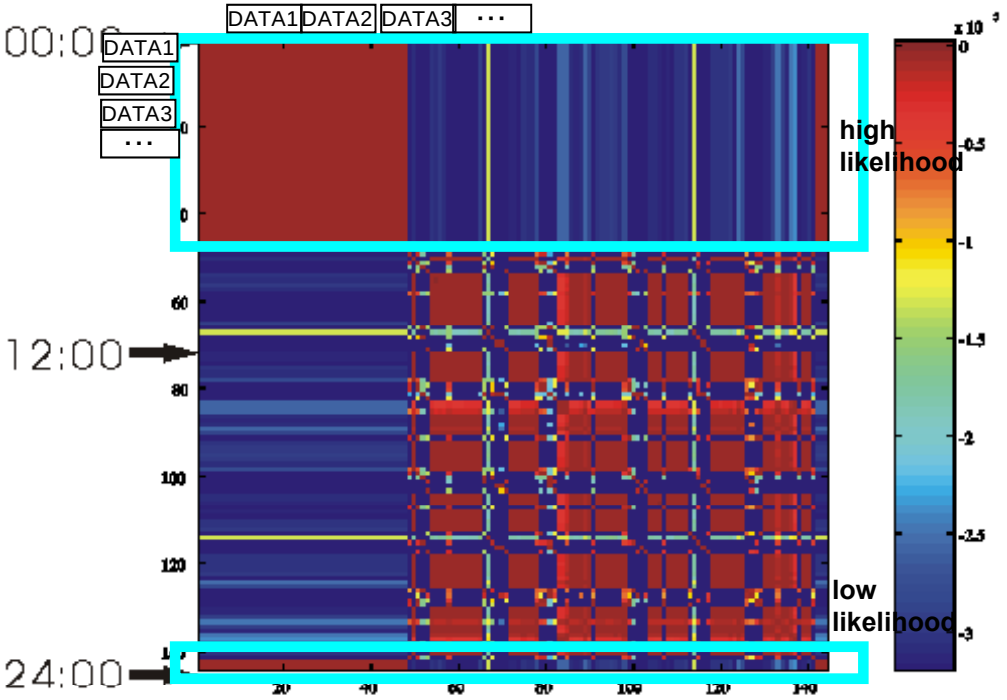
⇒Basic tool for studying

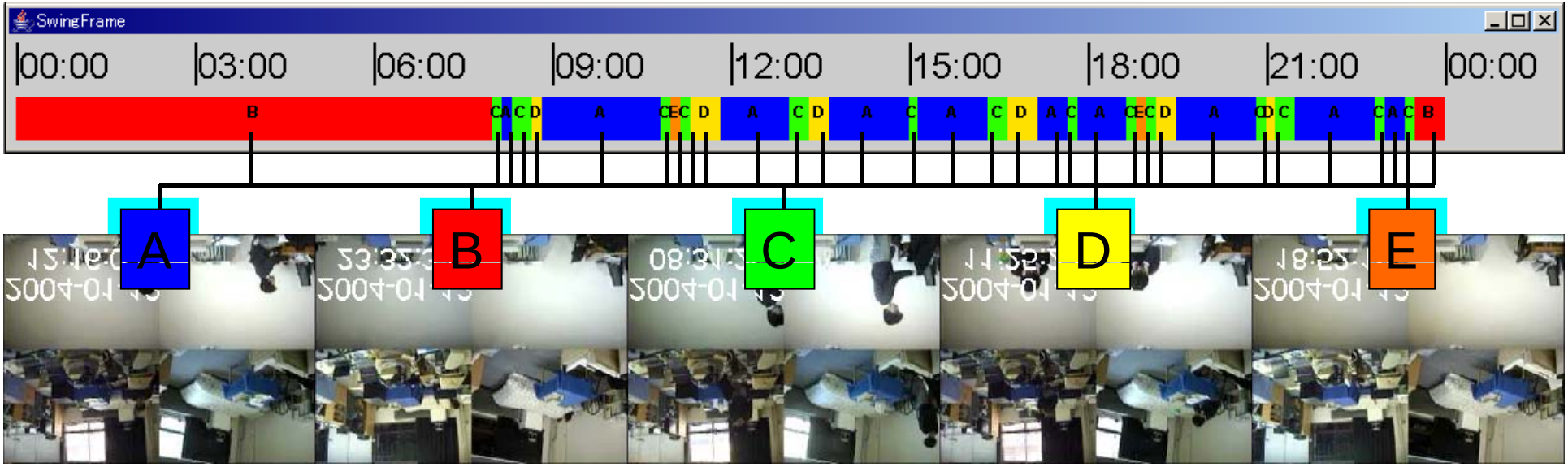
Calculation of A Typical Daily Pattern

- Calculate from the point distribution, in which time of the day a person spends a long time in each room.
- For each time slot, compare the point distribution in each room and designate the room with the highest points as a typical room to stay.



Study of Action Contents: Summary 3 of Daily Life





using PC

sleeping

walking in and out of the room

sitting at the desk

absent

Reason 2 for Robots Becoming a Room
(Merits of Co-habitation by Humans and Robots)

Merits of robots taking the form of a room

1) **They can observe people constantly.**
Merit of sensors in the environment
Not time-restrictive

2) **People can be observed naturally.**
People live surrounded by an environment.
Not space-restrictive

Ref）Human Action Project：1999～2003

System to Create a Living Environment Suitable for Human Actions

Environment to create products or things that people (getting older, more individualized) want.

Differentiation of products ·Creation of industries from dweller's viewpoint

→ Personalizing an environment to create products or things

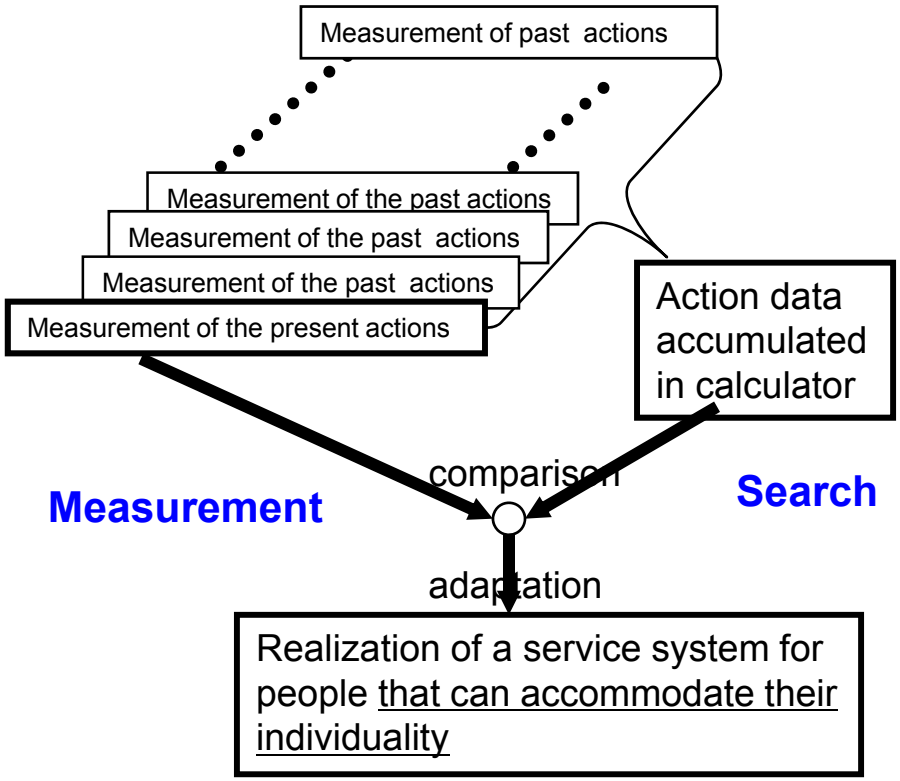
←Establishing technology that observes individual actions

Increasing international competitiveness by creating life related products that Japan is good at

<u>Calculator accumulation of individual action data/ Development project of application technology</u>

Personalization by accumulation of action data

Human Action Project

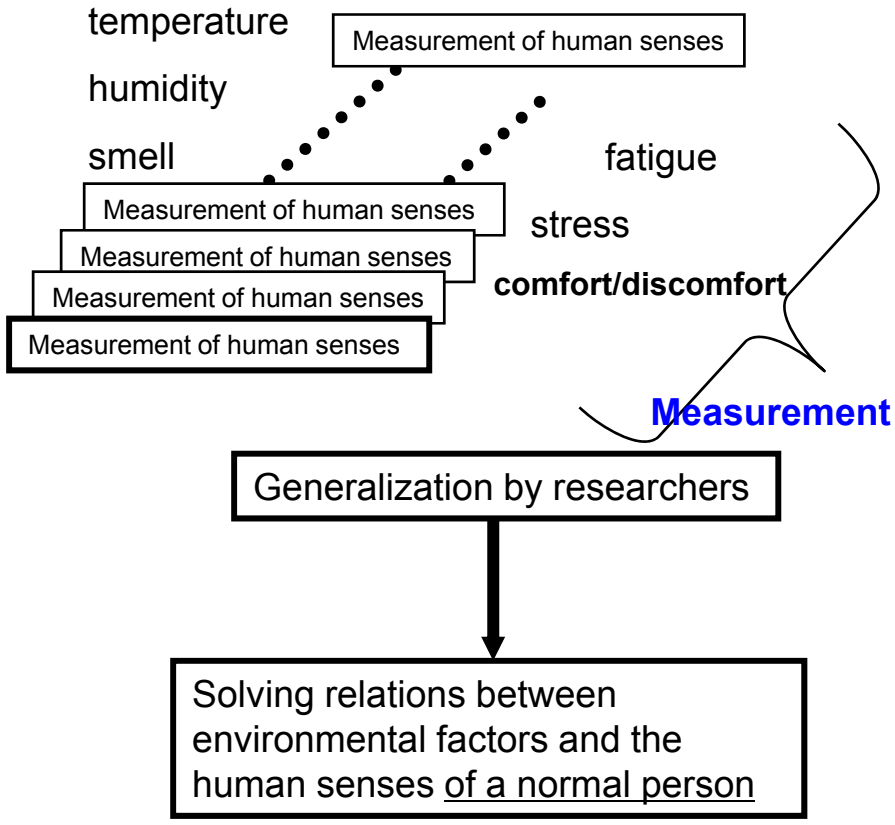


Human action project

Development of a new life industry technology

Adaptation to individual's actions

Differences from the Conventional Project Path

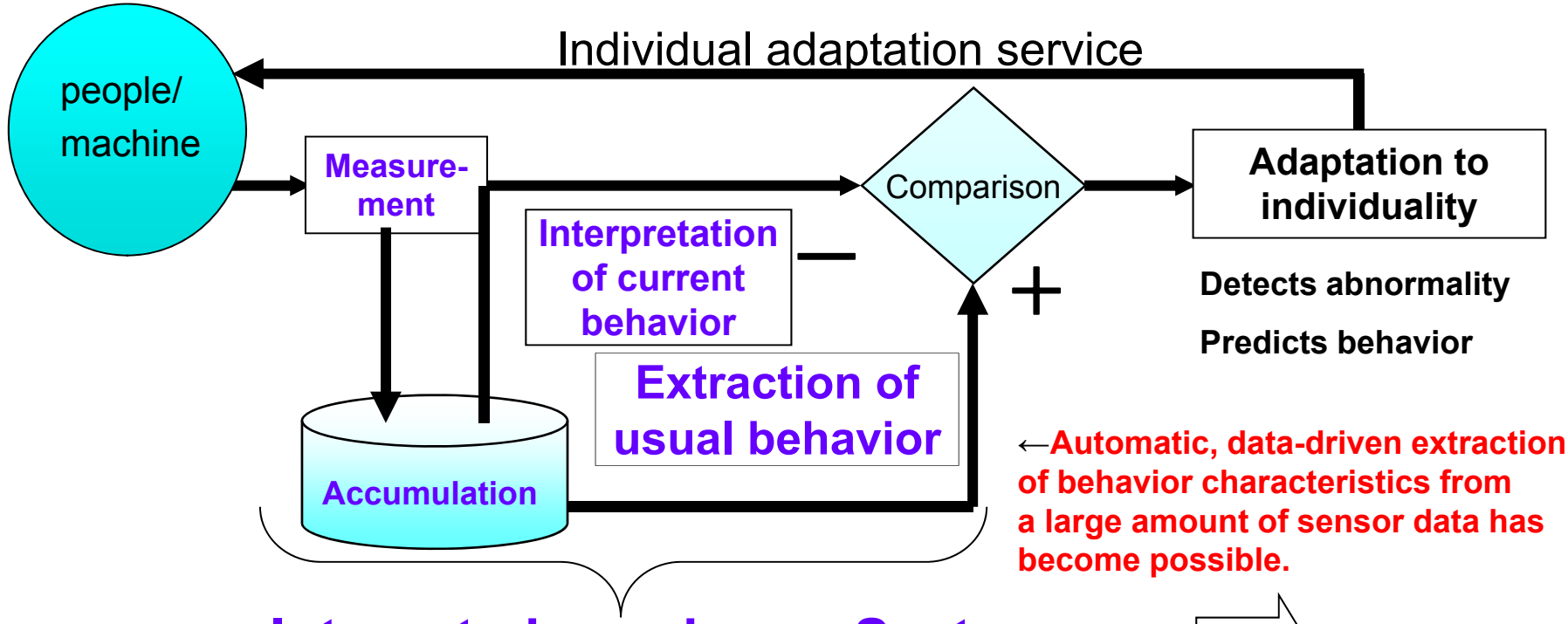


Human sense project

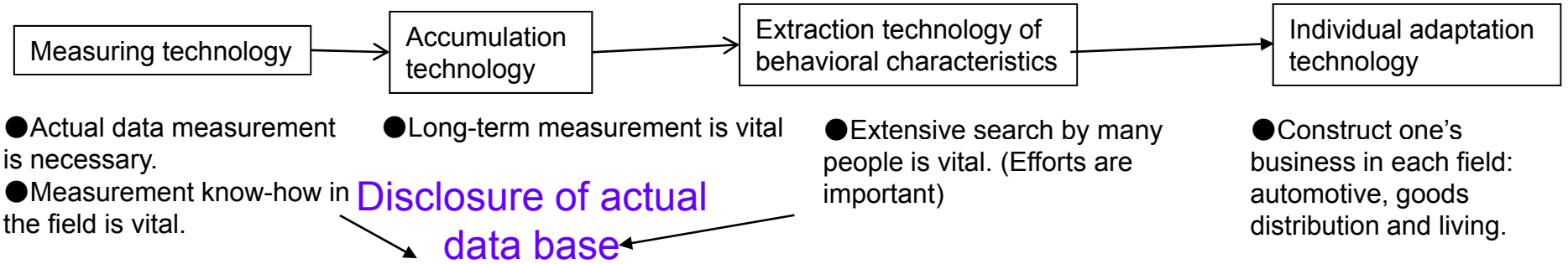
Basis of a new life industry technology

Solution

Japan Science and Technology Agency　Strategic Creative Study-Promotional Project
＜Team Study＞CREST　Advanced Integrating Sensing Technology
Supervised by：Prof. Kiyoshi Itao (Tokyo Univ. of Science)
Project of Moving Object-Sensing Technology for Security



Base technology



Action Data Accumulation and Applications

＜in residence　　natural, long-term, constant＞

A long-time record of a solitary senior citizen's actions at home would make possible:

- **detection of any abnormality**
- **provision of care and medical information.**

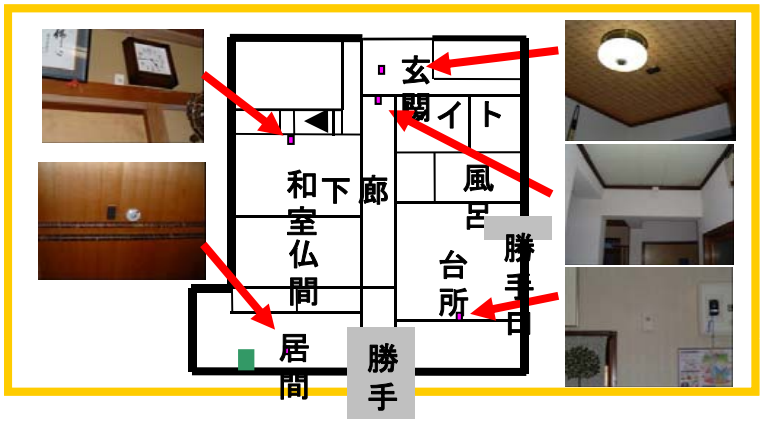
Thus, a house where seniors can live safely is made.

Detection of Abnormality, Based on the Patterns of Daily Life

Deviation from the pattern

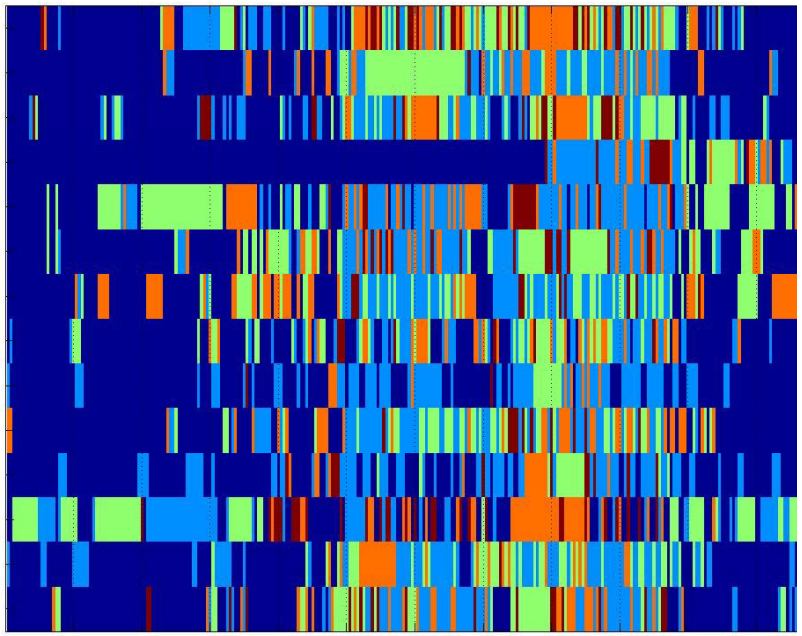
＝ Any abnormality can be found.

Method that expresses an action model proportionately, judges deviation from typical patterns (in terms of frequency and duration of action) by informational standards, and detects any abnormality.

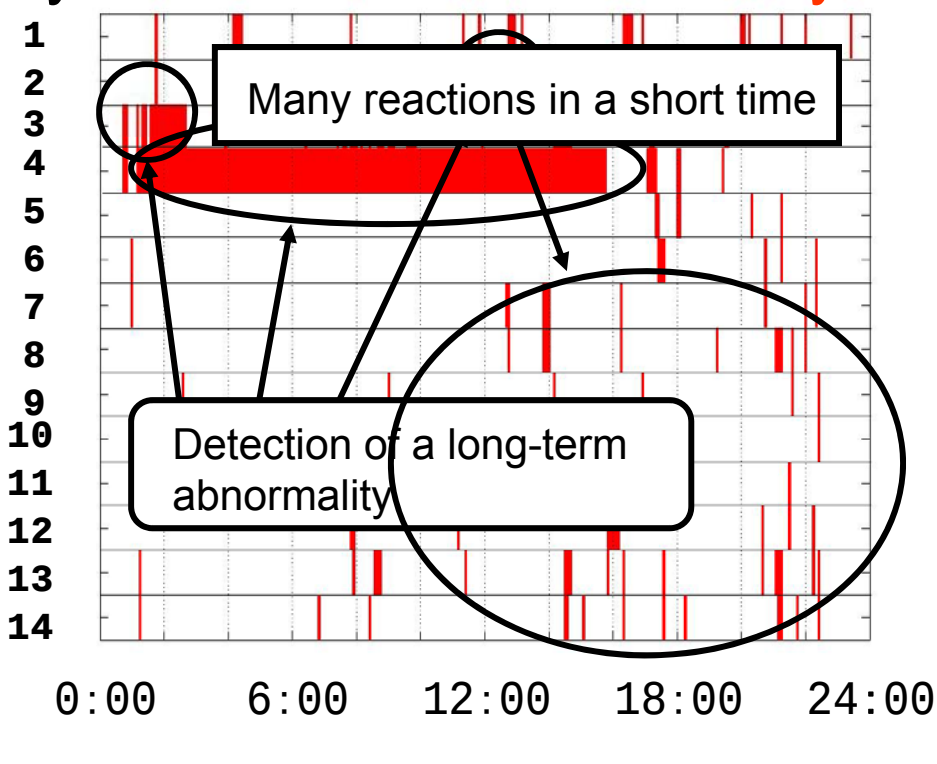


Learns patterns from data accumulated for 400 days, and detects any abnormality.

Summary of actions



Detection of abnormality



(Can be applied to pyroelectric data in senior citizen housing)

Action Data Accumulation and its Applications

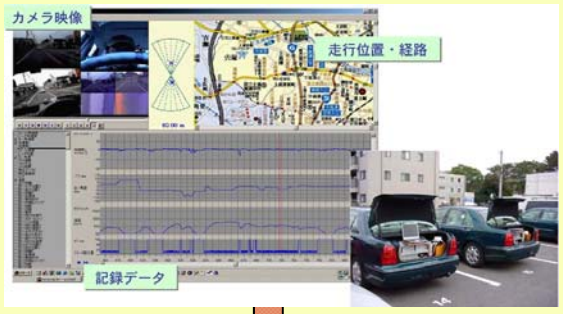
＜in driving　　a memory based-approach＞

By recording the driving conditions to the neighboring town where one goes often, a chat like “Three days ago, this place was very crowded, and you suddenly had to brake hard.” can offer warning.

・Assistance with a driving navigation system that perfectly fits an individual’s habits and his/her driving environment.

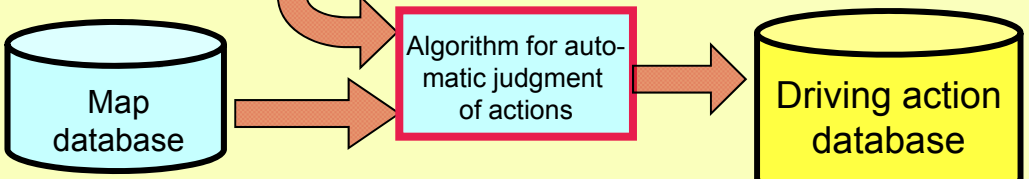
Vehicle-mounted Support System for Advancement

Provided by Motoyuki AKAMATSU, AIST



Measurement and accumulation:

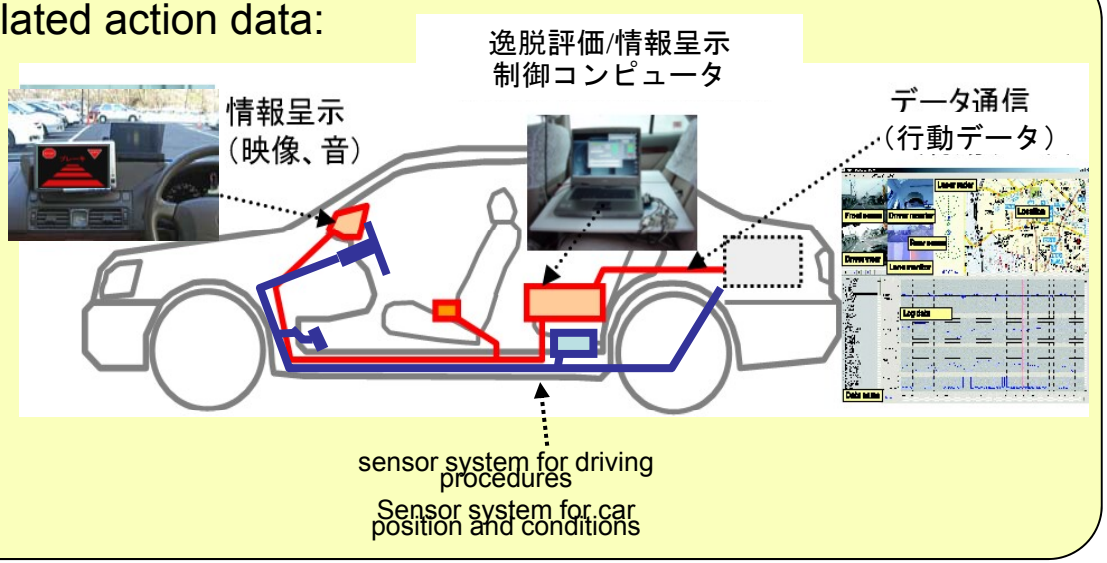
Construction of the world's largest driving action database on actual roads
（Search using driving actions as key words）



Support system based on accumulated action data:

Driving support system that detects and notifies of any abnormality:

（object: reduction of speed before a stop sign, halting, using a proportionate model)



‡

Personal Contents and Information Support System

Individual information:

physiological contents
physical contents
psychological contents
social contents

Personal services:

support of dignity
medical support
welfare support
support of comfort and security
work support
shopping support
brain activation

Framework and technology that enables a person to collect individual information currently dispersed in the society when he/she needs them as his/her fundamental human right in an information society. It also causes the information to fit personally when used.

Case Study of Action Contents

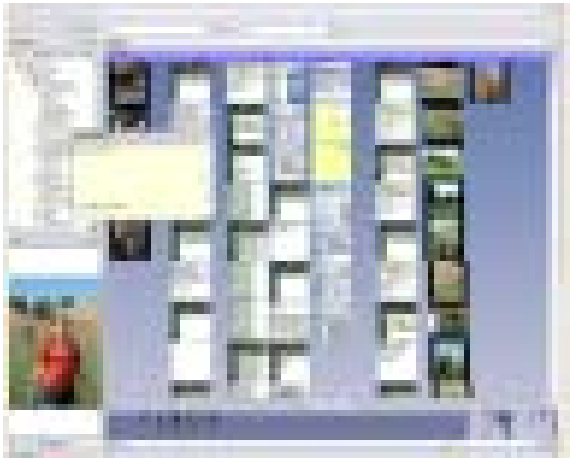
MyLifeBits Project (Microsoft)

MyLifeBits is a lifetime store of ***everything***. It includes full-text search, text & audio annotations, and hyperlinks. There are two parts to MyLifeBits: an experiment in lifetime storage, and a software research effort.

The experiment: Captured a lifetime's worth of articles, books, cards, CDs, letters, memos, papers, photos, pictures, presentations, home movies, videotaped lectures, and voice recordings and stored them digitally. He is now paperless, and is beginning to capture phone calls, IM transcripts, television, and radio.

The software research: MyLifeBits software leverages SQL server to support: hyperlinks, annotations, reports, saved queries, pivoting, clustering, and fast search. MyLifeBits is designed to make annotation easy, including gang annotation on right click, voice annotation, and web browser integration. It includes tools to record web pages, IM transcripts, radio and television. The MyLifeBits screensaver supports annotation and rating. We are beginning to explore features such as document similarity ranking and faceted classification.

‡ Source: http://research.microsoft.com/barc/mediapresence/MyLifeBits.aspx



Support Program for Action Contents Studies

DARPA Lifelog Program(2003）

The LifeLog Program addresses a targeted and very difficult problem: how individuals might capture and analyze their own experiences, preferences and goals. The LifeLog capability would provide an electronic diary to help the individual more accurately recall and use his or her past experiences to be more effective in current or future tasks.

Program Description:

To build a cognitive computing system, a user must store, retrieve, and understand data about his or her past experiences. This entails collecting diverse data, understanding how to describe the data, learning which data and what relationships among them are important, and extracting useful information. The research will determine the types of data to collect and when to collect it. The goal of the data collection is to “see what I see,” rather than to “see me”. Users are in complete control of their own data collection efforts, decide when to turn the sensors on or off, and decide who will share the data.

Ex: “Memories for life” Managing information over a human lifetime

⇒Point #2. This ubiquitous information system is equipped with action contents.

Application Examples of Action Contents (Human Activities)

Activity	Accumulated Information	Support Contents
shopping	**when, where, what, how much**	**Support Bookkeeping.**
supermarket	**※Gathers information through network.**	
		→To be developed into local POS.
meeting	**when, where, with whom, on what**	**Support making meeting reports.**
office	**※Record a meeting summary by pressing the wearable switch button.**	
work	**contents of usual activities**	**Supports in report/record.**
factory	**※Records what activities were done.**	
	Information that comes with activities is collected and used.	
	Facilities maintained in order, no mistakes repeated.	
see doctor	**medical info. on charts**	**Seek second opinion for treatment**
hospital	**⇒ a person's life log**	

Application Examples of Action Contents (Actions That Use Tools)

Activities	Accumulated Life Information	Support Contents
Driving	**Driving information**	**Comfortable seat height, and wheel angle**
		Support to maintain comfortable driving conditions
		Gear alignment of your preference
	Driving on a routine route	
		“You are slow in applying the brake today. ”
		（Security support）
		Support preparing a driving log
Operation of devices	**Remember the operational process, and conditions when devices were used.**	
		No mistakes repeated twice.
		Notifies when the device is about to break down.
		Provides design guidelines for the next generation devices.

→ Life log of machines

Application Examples of Action Contents
（Activities in Public Places）

Activities	Accumulated Life Information	Support Contents
Getting on the train	**Comfortable seat temperature** **※Communicates with the station and your seat on the train.**	**Adjusts seat temperature**
	Logs of past travels	**Environment data for wheel chairs at an each destination**
	Stations to get off	**Prevents from missing the station to get off.**
At hotels	**Remembers usual air conditioning**	**Air conditioner personalized**
At plant	**Remembers usual operating conditions**	**Monitoring by ultra fast forwarding**

→ Life log of social system

A Step towards the Study on the Contents of Nuclear Power Plants（Information Field Technology for the Safe Maintenance of Nuclear Power Plants）

Initiatives for Promoting Science and Technology to be used for studies of software in science and technology
Development of intelligent technology that enables plants to exist in harmony with humans.

Kashiwazaki Nuclear Power Plant (TEPCO)

←Image of the actual plant to be monitored

Ex. Detection of an abnormal signal

Problems to be solved

※ Humans cannot monitor around the clock.

※ Humans can forget.

※ Humans have difficulties grasping what has happened and its implications.

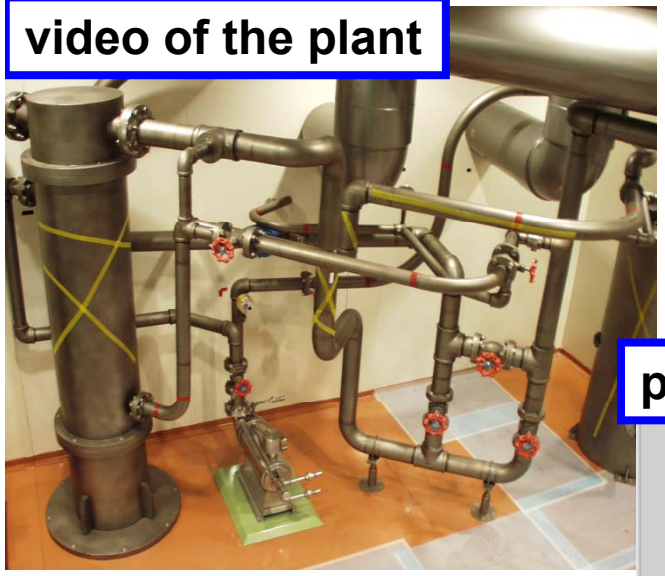
‡ Provided by Nobuyuki KITA,
The Tokyo Electric Power Company,
AIST

Solution → Assistance by calculator
Information of the nuclear power plant to be collected by RIKEN、accumulated by AIST, and visually presented by NMRI.

Points to be Covered in Information Field Technology for the Safe Maintenance of Nuclear Power Plants

Provided by Nobuyuki KITA, AIST

video of the plant



← Video of quasi-plants to be monitored

※Collection and accumulation of visual information by calculators…Information field maintenance technology

← Humans cannot monitor around the clock, and they are forgetful.

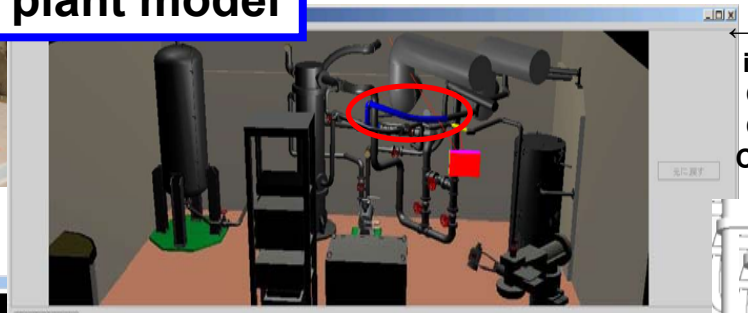
※ Appropriate display to humans by calculator …Information field-display technology

← What has happened? What are the implications? They are hard to grasp.

※Information gathered by robots …Information field construction technology

‡ ← There are places that cannot be monitored by fixed cameras.

plant model

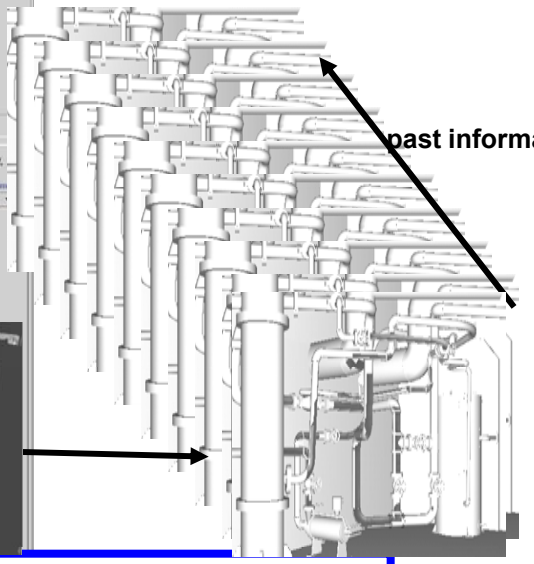


←Quasi plant that was turned into information field

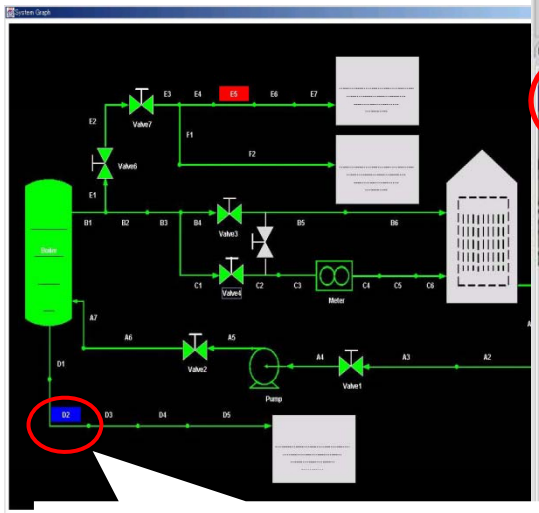
Constant monitoring＝Won't be forgotten

Comparison of big pictures in details

Comparison by ultra fast forwarding

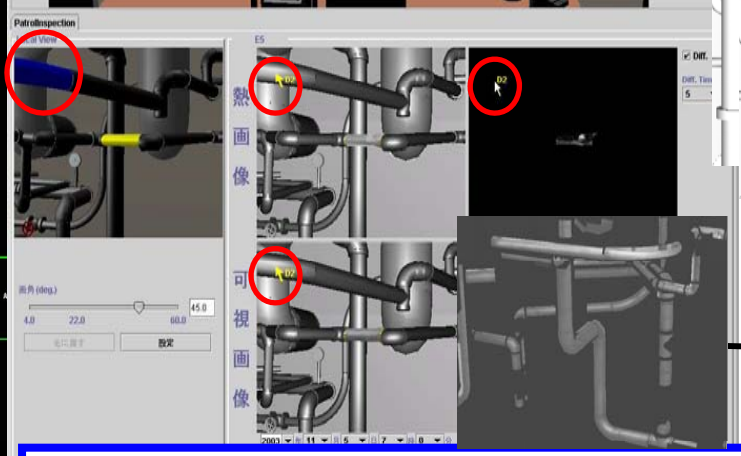


past information



interlocking cursor

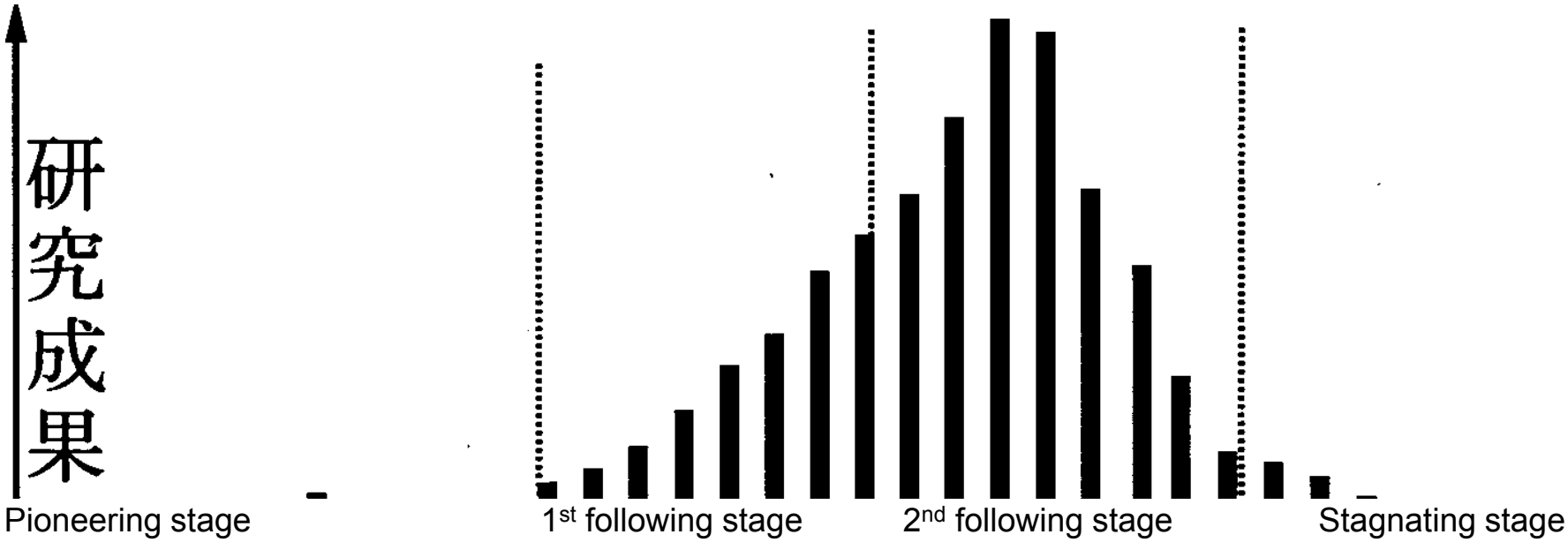
‡



Images of device surface being cut out and pasted onto the relevant parts of the plant model ＝ long-term accumulation

‡

Studying Life Cycles:
Timings and Achievements



1998 2006 2008

5 years 10 years 15 years 20 years

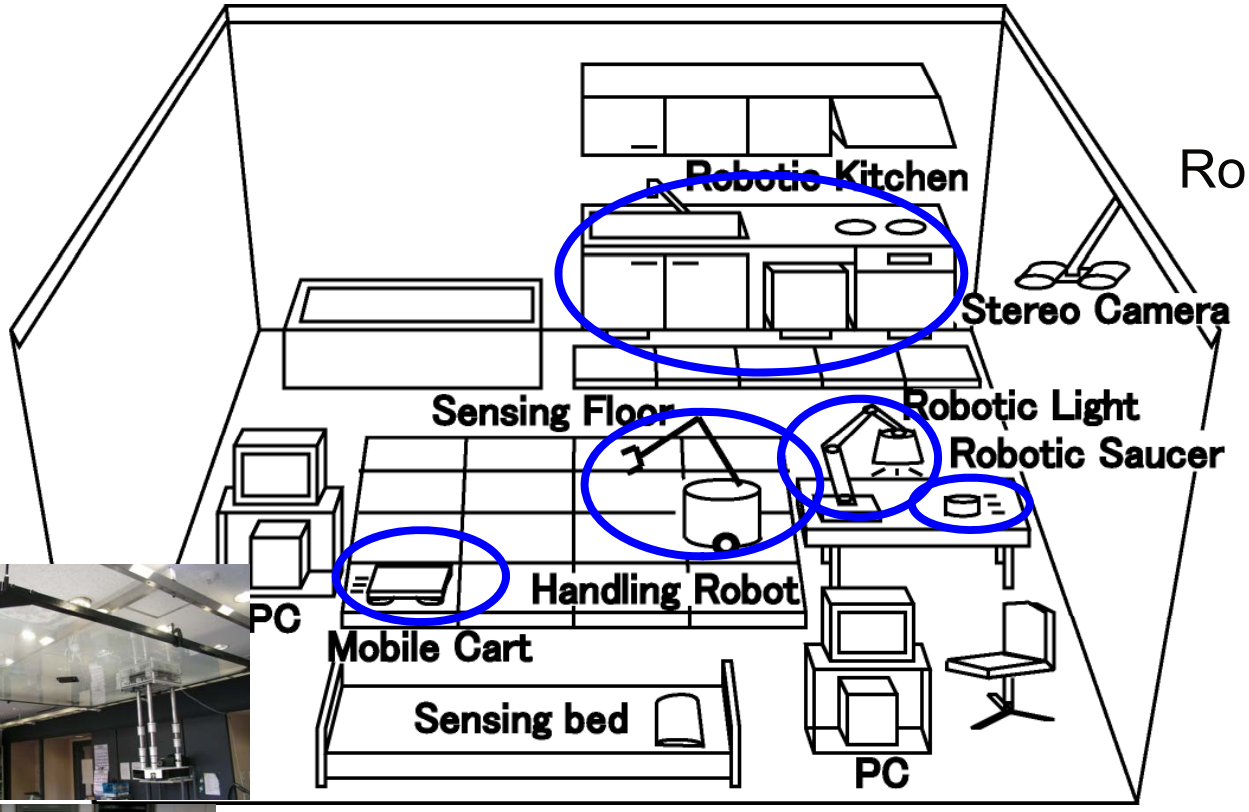
RR2 Contents Creation Department

Action ・Study should take off

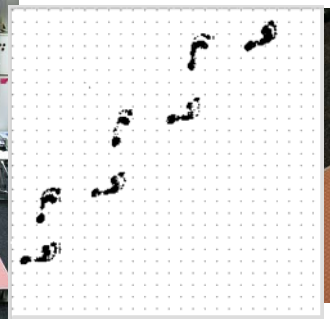
accumulated around this time

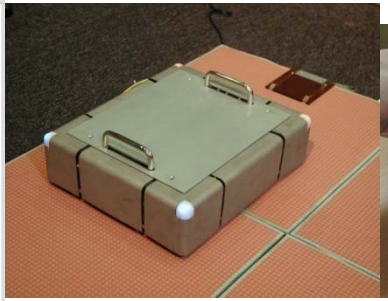
Robotic Room 3 (2000 to present)

Physical Support Environment Made Possible

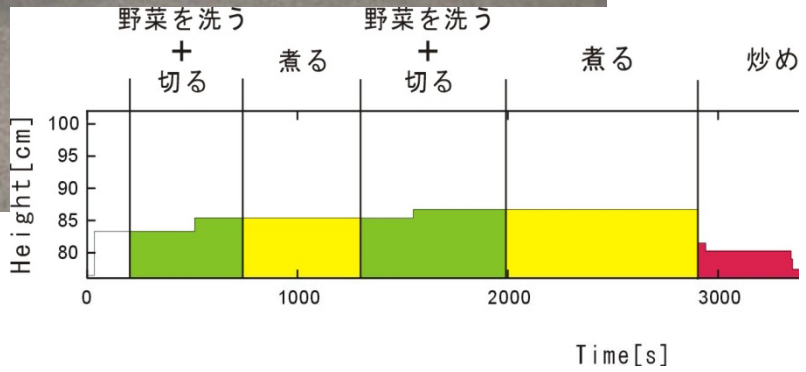


Robotic Room 3 is a personalized, physical support environment that can be assembled from relevant parts of the room.



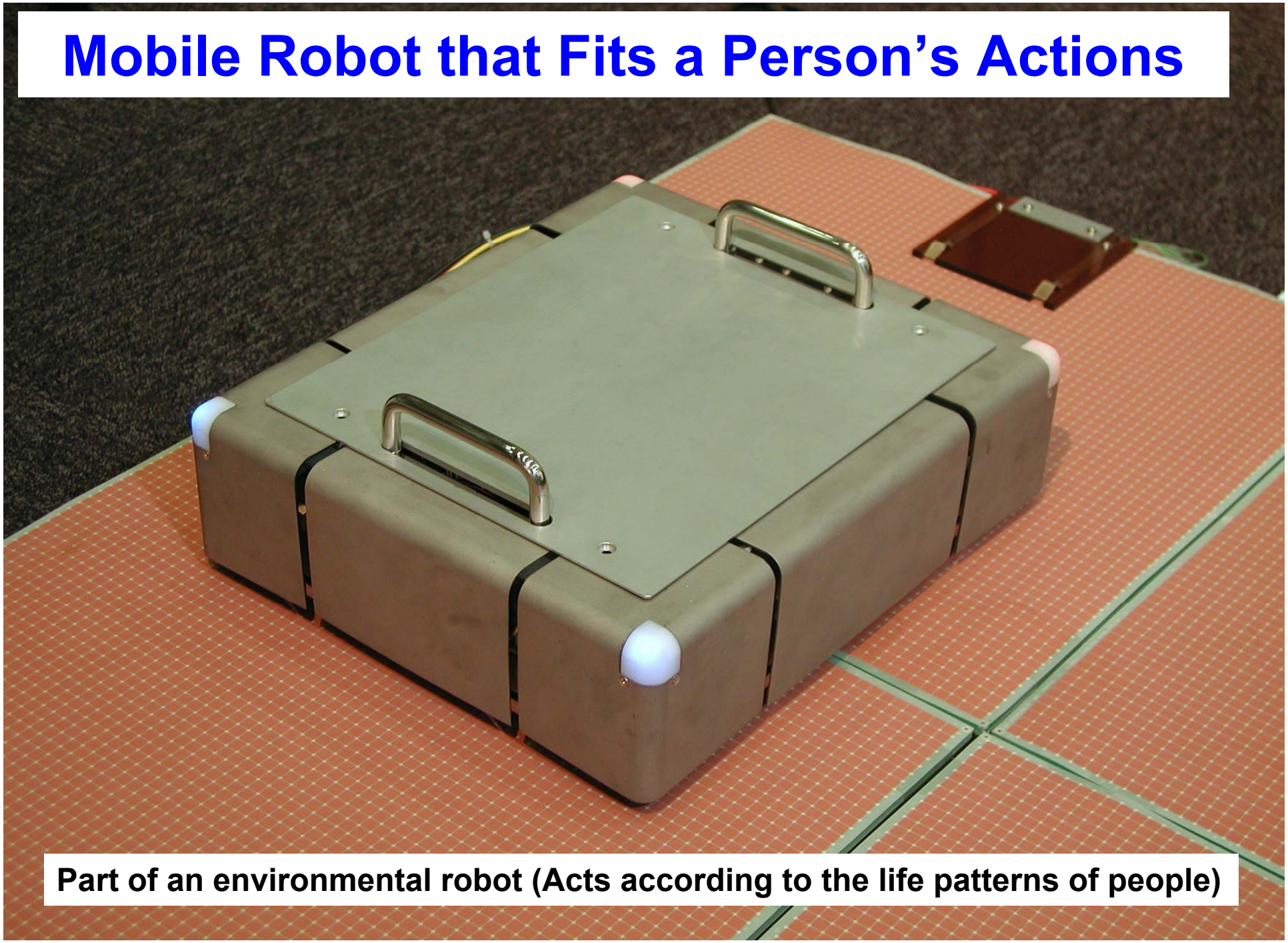


A Robotic Kitchen That Gives Support by Adjusting the Cooking Surface Height



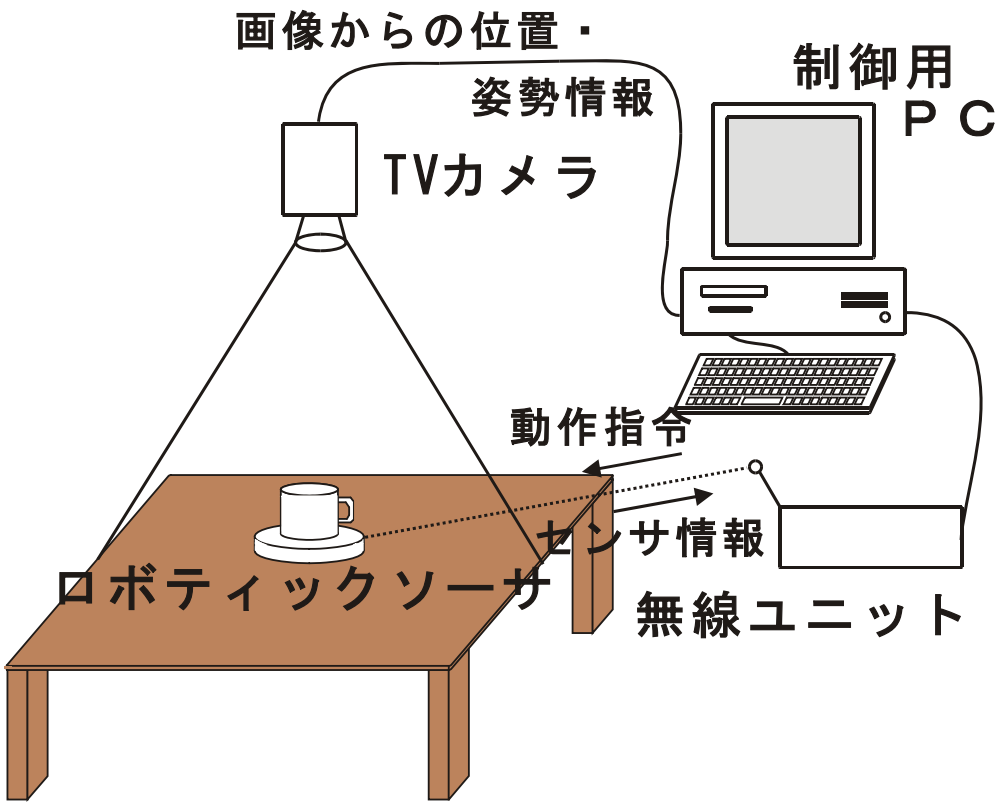
⇒Personalized machines based on observations of an individual's daily actions

Mobile Robot that Fits a Person's Actions



Part of an environmental robot (Acts according to the life patterns of people)

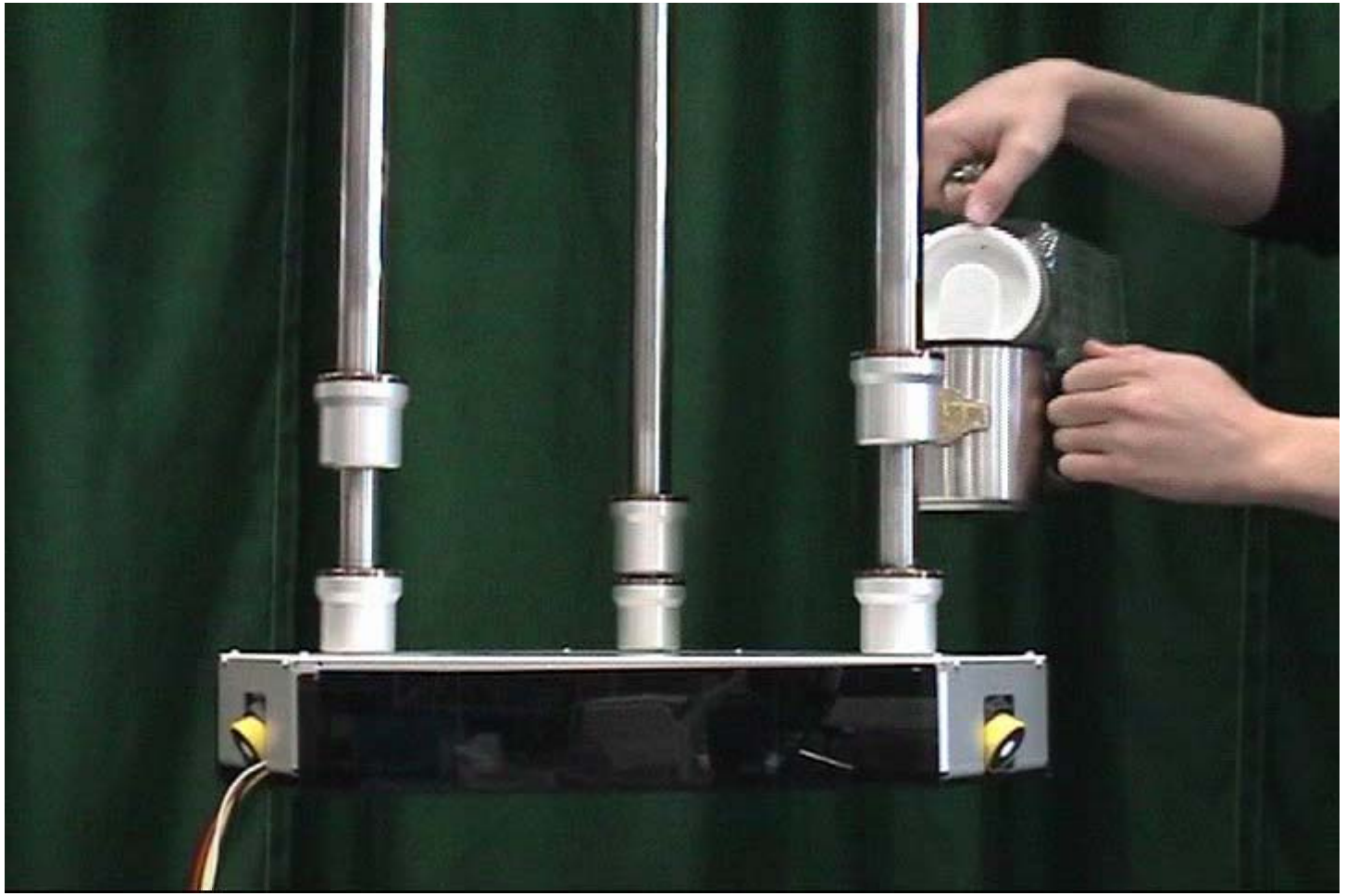
A Robotic Saucer that Supports People at the Table



“Anticipates actions of the people, and brings the cup.”

Study in Action Environment Support by Roof Robot

Robotic Room 3 Roof Robot



Senior Thesis: Study in Robotic Systems（Robotic Room 3)

・Study in constructing dispersed robot hardware（Designing, producing, and controlling of machines)
・Study in a ubiquitous robotic system based on human actions (Measuring people, interaction intelligence with people)

Reason 3 for a Robot Becoming a Room (The Merits of a Dispersed System)

Merits of a robot taking the form of a room:

1) People and robots can be measured simultaneously.
People can be measured without getting their attention.

2) People and robots can be worked on simultaneously.
People can be worked on without getting their attention.

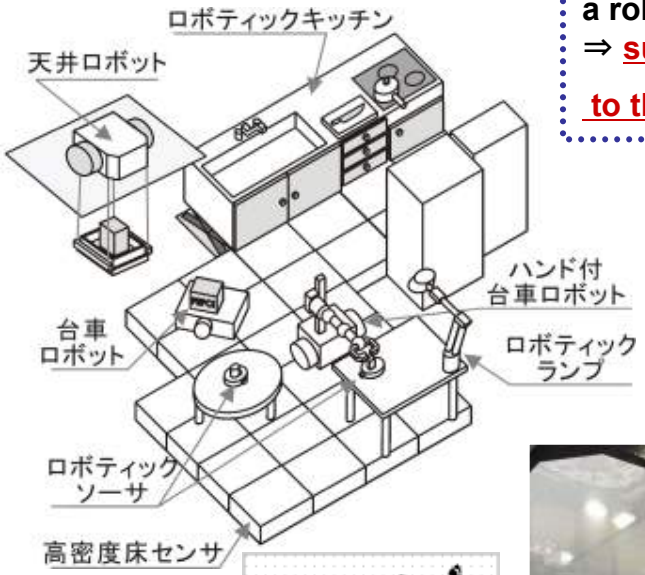
3）Robot can work on people from the most suitable place.
Interaction from the suitable place.

Study in an IRT Environment

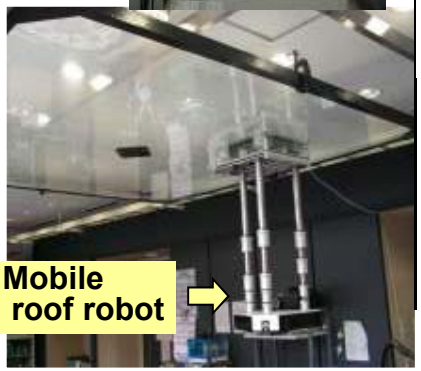
Robotic Room 3

～Environmental Robots to support life～

●a system (room) where various robotic elements exist and relate with each other to watch over humans in a quiet manner



a robotic lamp
⇒ supports to adapt to the person's action



a high-density floor sensor
⇒ watches over a person while respecting his/her privacy

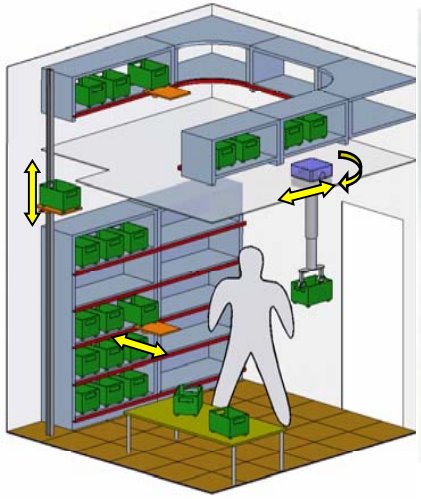
mobile roof robot
⇒ gives physical assistance without being invasive to the living space

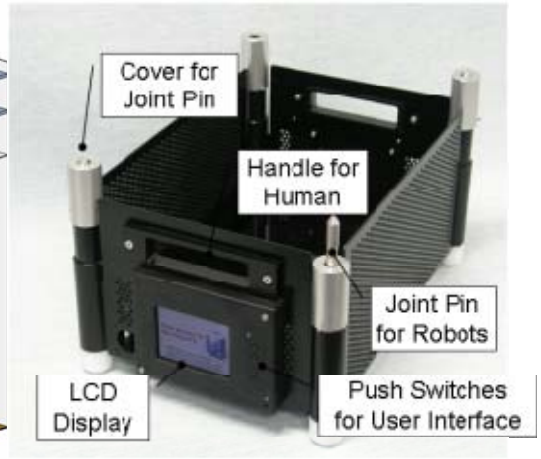
IRT Project

～Environmental Robot Systems that supports humans～

【a system to help accessing and managing objects 】

●an environmental system (house) that helps comprehensively accessing, storing, managing household objects





(i-container)

(1) intelligent container
- Reads tags on everyday items, and acquires object usage logs.
- Structure is made easy for robots to carry and store.

(2) mobile roof robot for transportation
- Moves containers with little contact with humans.

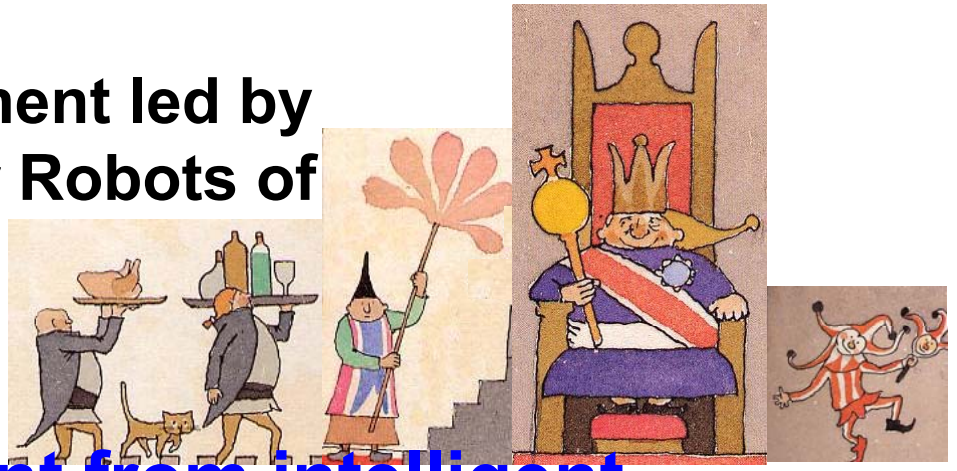
(3) under-roof storage and shelf-type storage
- 【under-roof】 long term storage with efficient use of space.
- 【shelf-type】 Can be set and used for storage just like usual shelves.

(4) container storage robot
- connects under-roof and shelf-type storage spaces seamlessly.

Description of Environmental Robots (Part 2)

I. A System of Co-operation Between Environmental Robots and Individual Robots

Human Information Environment led by Ubiquitous Computing Hyper Robots of the Physical World



‡ Image compounded from the book, “Grimm’s Fairy Tales Picked Up by a Fox”, by Mitsumasa Annno, Iwanami Shoten, P.19, 22, 23

※What do humans want from intelligent machinery?

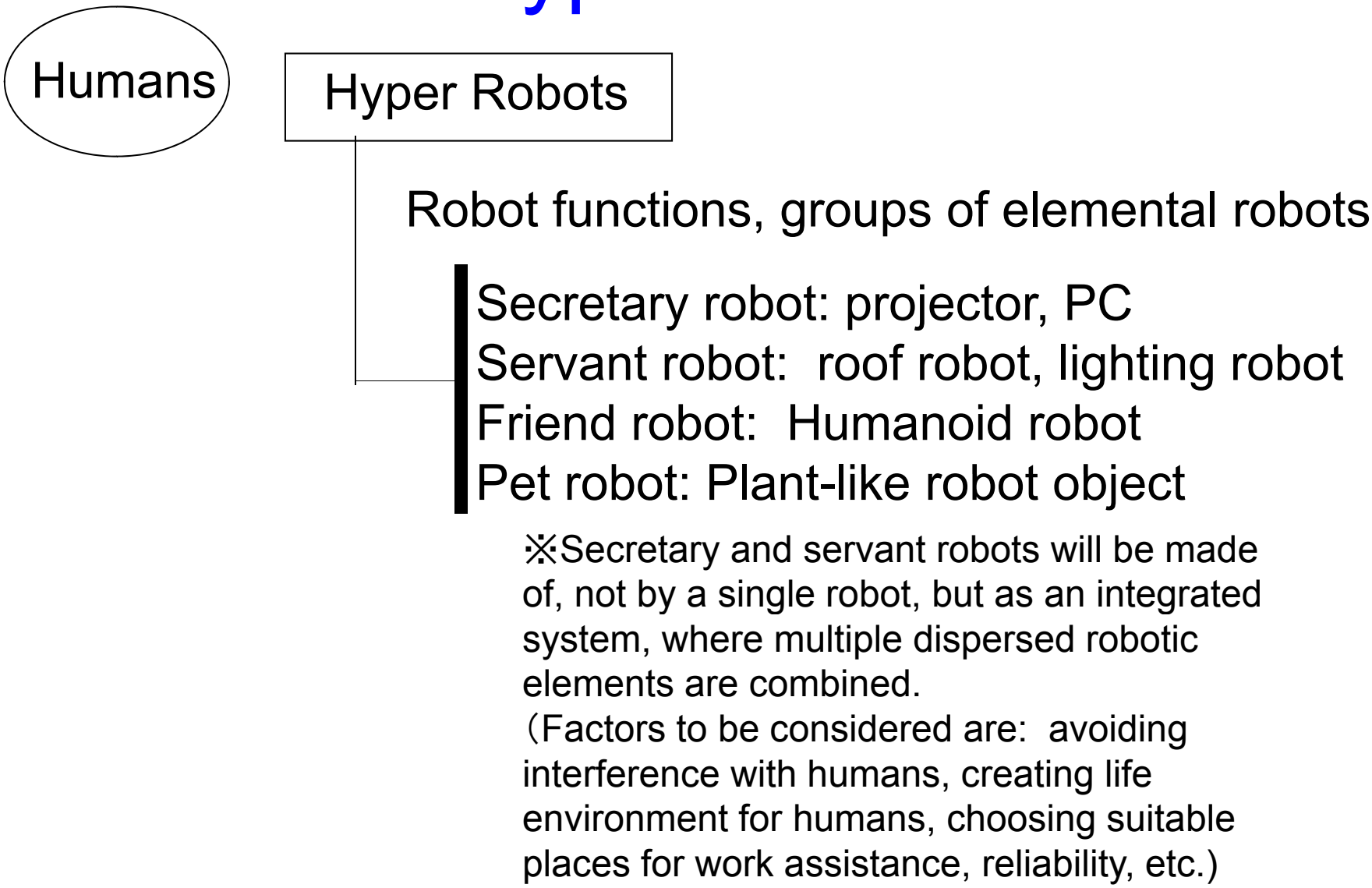
●servant, secretary, friend, pet

←●King’s life in ancient times ⇔ switching of functional modes

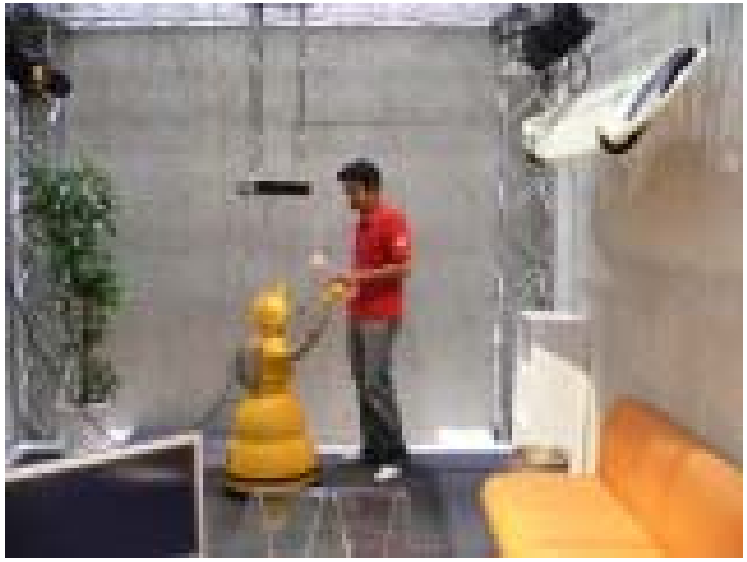
This will be realized through a co-operative system of environmental robots and individual robots

Co-operative System 1
-Environmental Robots and Individual Robots

Hyper Robots



Assistance 1 in the Robotic Room 3: At the Entrance



◆Hyper Robot detects that Mr. P is coming home, from his conversation on the mobile phone.
◆Hyper Robot issues “Get ready” orders to the group of dispersed robots in the house.
<Servant Robots>
●Lighting Robots：Create enough light.
●Roof Robot：Moves to where it should receive items from Mr. P. →（after Mr. P returns）Receives his mobile phone, keys, etc.→ Returns these items to where they should be.← Searches them from the usual action data base.
◆Hyper Robot switches the processing agent from Mr. P’s mobile phone to the server at home.

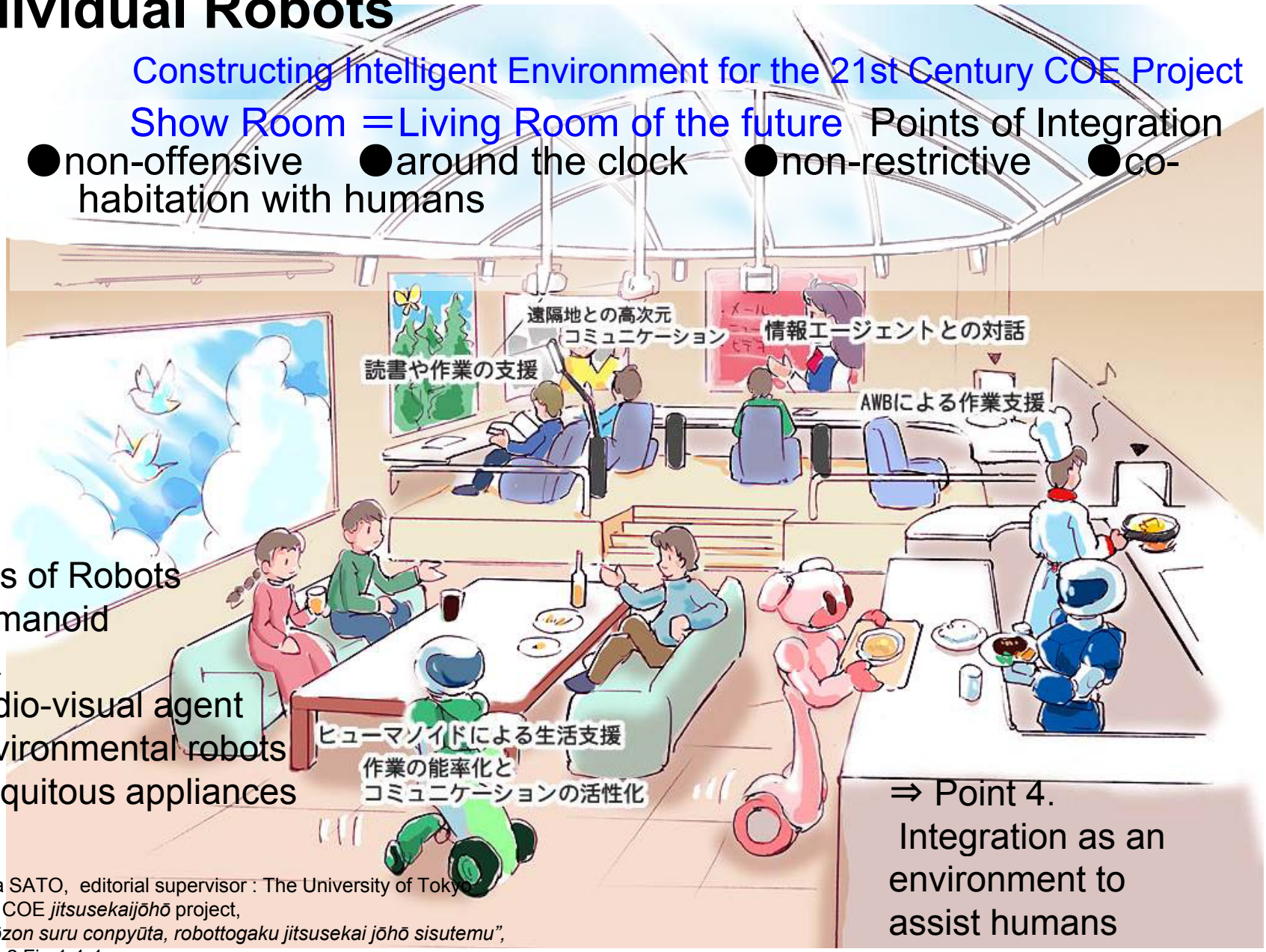
Action assistance environment is constructed according to a person’s actions.

Co-operation System 2-Environmental Robots and Individual Robots

Constructing Intelligent Environment for the 21st Century COE Project

Show Room ＝Living Room of the future　Points of Integration

●non-offensive　●around the clock　●non-restrictive　●co-habitation with humans



Forms of Robots

●humanoid
●VR
●audio-visual agent
●environmental robots
●ubiquitous appliances

⇒ Point 4.
Integration as an environment to assist humans

Tomomasa SATO, editorial supervisor : The University of Tokyo
21 century COE *jitsusekaijōhō* project,
"hito to kyōzon suru conpyūta, robottogaku jitsusekai jōhō sisutemu",
Ohmsha, p.2 Fig.1-1-1

‡

Real World Information System Project, Strategic Core, the 21st Century COE Information Science Technology

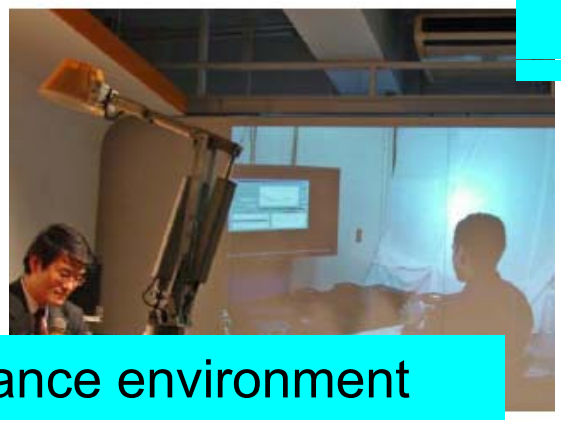
Demonstration of the Final Achievement (January 10, 2007)

Lighting environment

Advanced communication environment

Assistance Environment for Human Actions

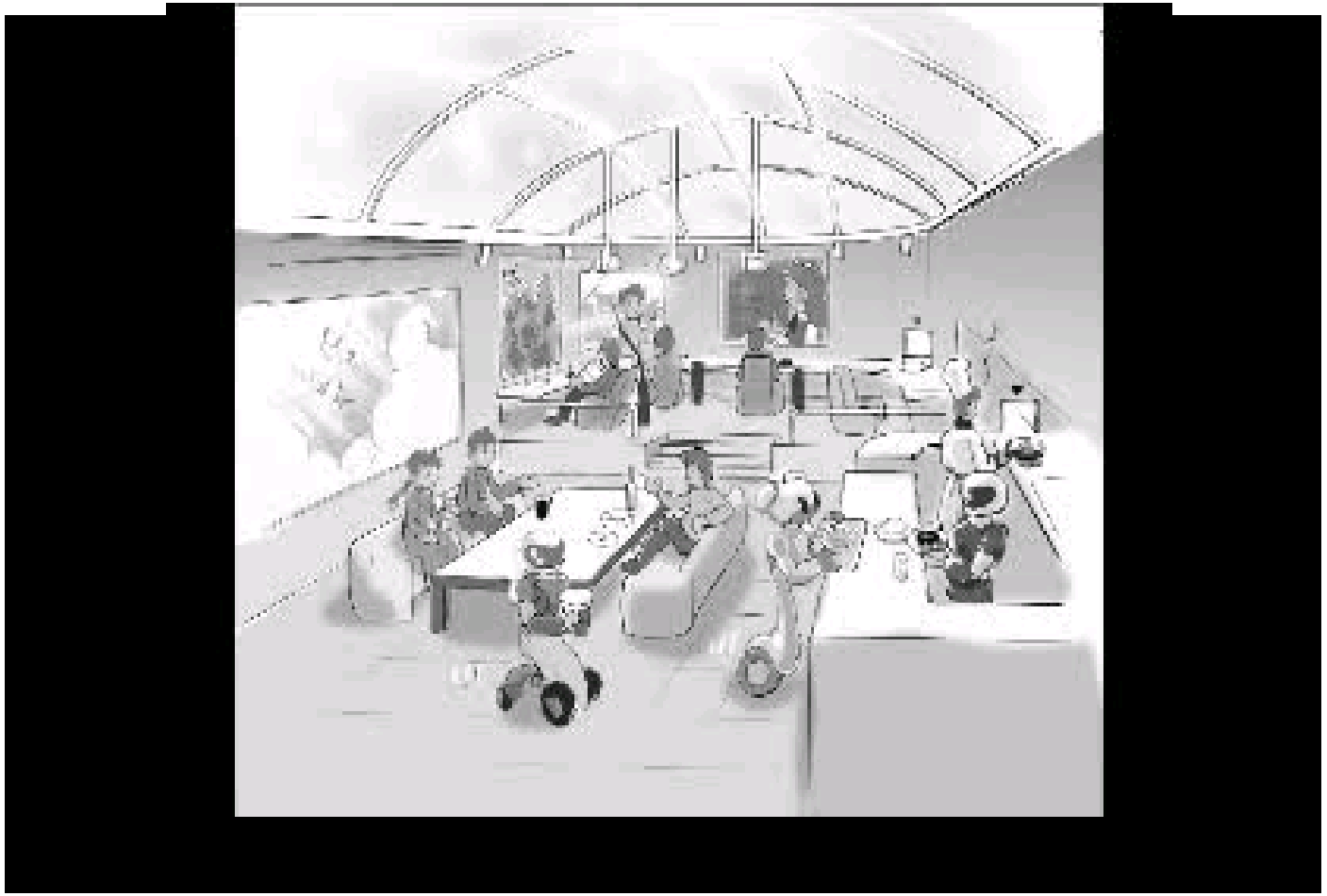
Object access environment



Work assistance environment

Healing environment

An Assistance Environment for Human Actions that "watches over people, talks to people, walks up to people, and offers a hand to people."



Summary: Direction of Technology 1

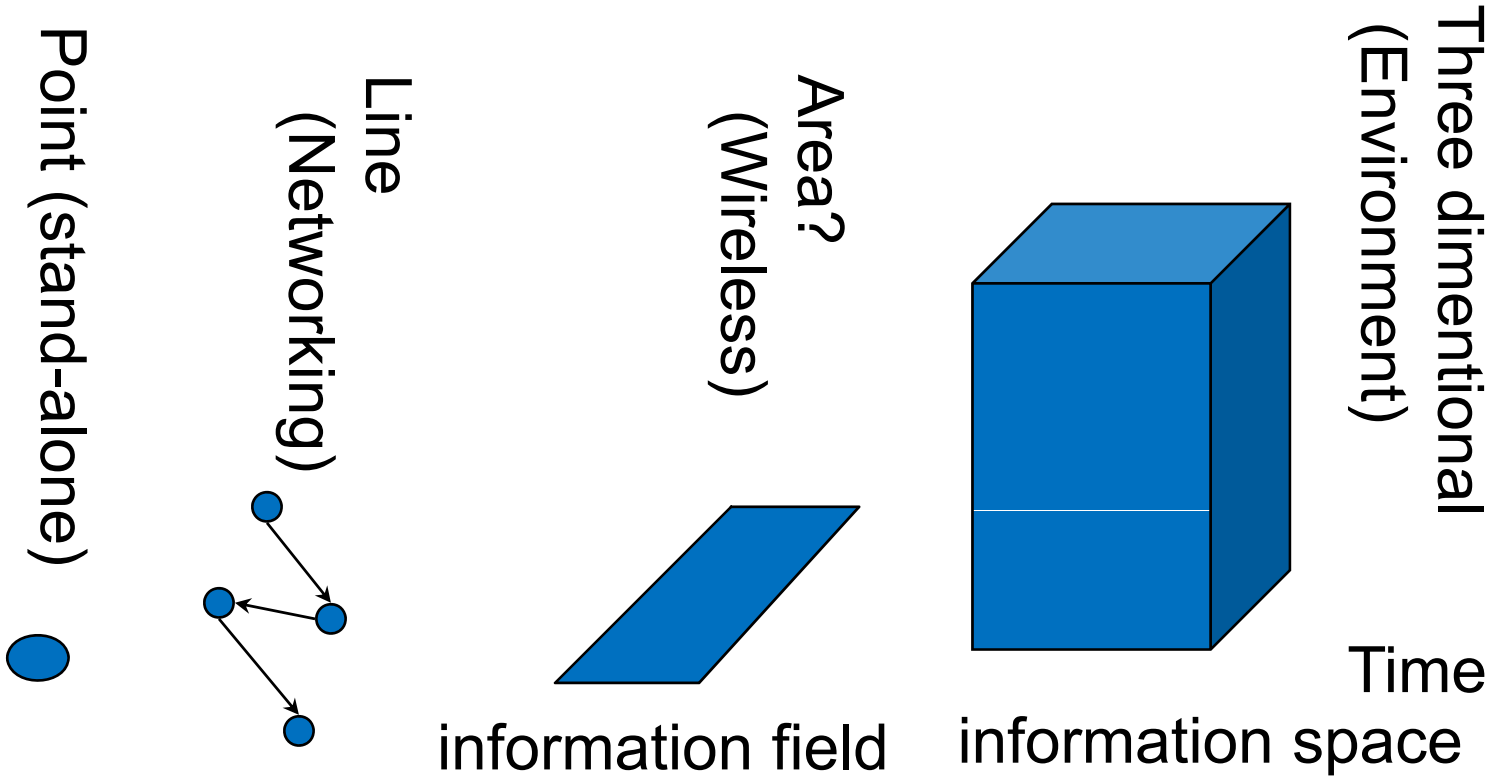
Machines for humans to **Machines for individuals**

a) To deal with individual information
（Action accumulation technology）
Technology to collect individual information
Technology to accumulate and search individual information
（Personalizing technology）
Technology to fit each individual personally

b) To bring about specific living assistance
roof, bed, pillow, desk, chair, coaster, etc.

c) To learn about humans → To learn about individuals
（P**roduct differentiation**）

Summary: Direction of Technology 2
Historic Change in the Information Processing Spatial Structure
～The Information System will become an environment～



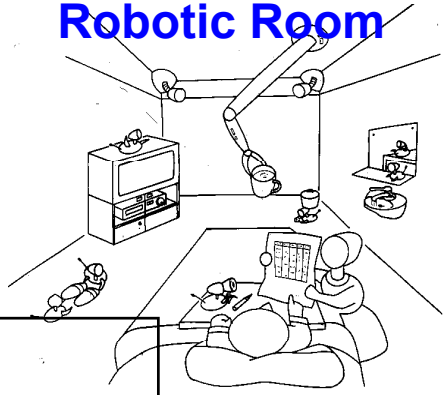
Era of K
numeric calculation processing

Era of M
moving images processing

Era of G
processing symbols

Era of T
processing actions

Summary: Direction of Technology 3
Robotic Contents



around the clock

non-offensive

Action anticipation technology

Action summary technology

displays

Action information expression technology

Action accumulation technology

Robotic content industry

Action information display technology

watches over

supports

Action cognition technology

Personalizing technology

non-restrictive

co-habitation with humans

Action measuring technology

Action assistance technology

company/factory

station

individual

hospital

home

supermarket

From light information to heavy information

In Preparation for the Conclusion:
The Roles of Robots and Future Development

●To learn about humans → Review the study domains by robots

※Robots are not just exit points. There is a science to them. By making robots, we understand them better.

●To be useful to humans → Creation of a new industry that follows the automobile industry

→ Resolving social problems, meeting social needs

※The last 1 meter is a world of robots that have shapes and movement.

●To inspire humans → Education and awareness-building of humans by robots

※Cultivation of human resources who could deal with both soft and hard elements and integrate them.

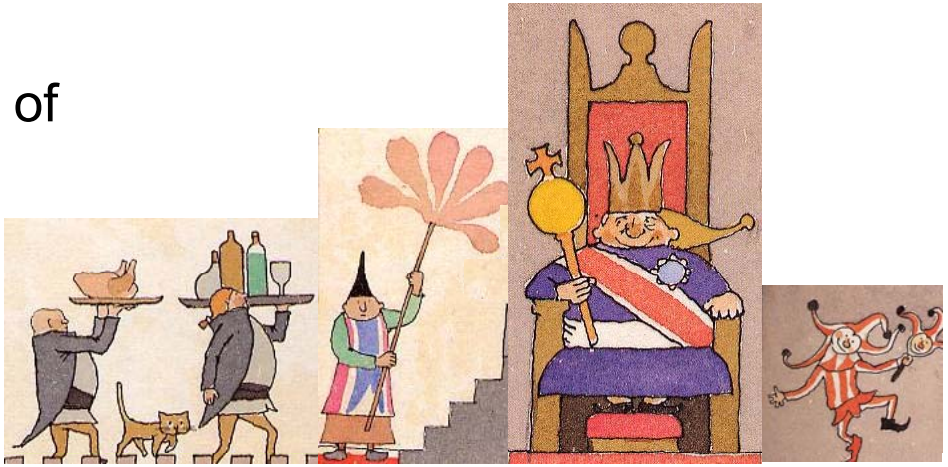
※Robot Apollo Project

Conclusion

The Robot's 3 Roles

- To be useful to humans
  by providing solutions for an aging society with fewer children, and for environmental and resource problems
- To learn about humans
  by grasping the society, humans, and other living creatures in terms of configuration logic
- To encourage humans
  Young people are losing interest in natural science
  national robot project

Image compounded from the book, "Grimm's Fairy Tales Picked Up by a Fox", by Mitsumasa Annno, Iwanami Shoten, P.19, 22, 23



‡

Make humans King, and leave the rest to robots and RT.

Humans + robots（RT laborers, RT servants, RT butlers, RT friends, RT pets ）
＝ will increase the gross population and decrease the gross resources
Tax will be invested to realize this goal.