

Case studies of interactive social robots

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Purpose of the lecture

In the near future, we may have robots as our partners...

The lecturer talks on development and evaluation of the interactive robots.

- **How do develop the robots**
- **How to evaluate the interactive robots**

We discuss fundamental problems of new robotics research through case studies.

- **How do we have social relationships with the robots?**
- **What is “interaction”? Behavior and appearance.**

Outline of the lecture

1. Introduction

- Research areas of the lecturer
- New wave of robotics research in Japan
- Robots as a new infrastructure

2. Development of interactive autonomous robots

- What is "intelligence"?
- Constructive approach
- Robots developed by the lecturer

3. Evaluation of the interactive robots

- Standard methods
- From subjective measures to objective measures

4. New research directions in robotics

5. Discussion 1: Social science and robotics

- Field experiments in elementary schools
- How do children accept the robot?
- What is the role of the robot in our society?

6. Discussion 2: Android science

- How do we react to the android robots?
- Which is more important, behavior or appearance?

7. Conclusion

Background of the lecture

- Active vision [1990~, Osaka Univ]
- Omnidirectional vision [1990~, Osaka Univ]
- Distributed vision [1996~, Kyoto Univ]
- Mobile robot navigation [1990~, Osaka Univ]
- **Interactive autonomous robots [1996~, Kyoto Univ. & ATR]**
- **Android robots [2001~, Osaka Univ.]**

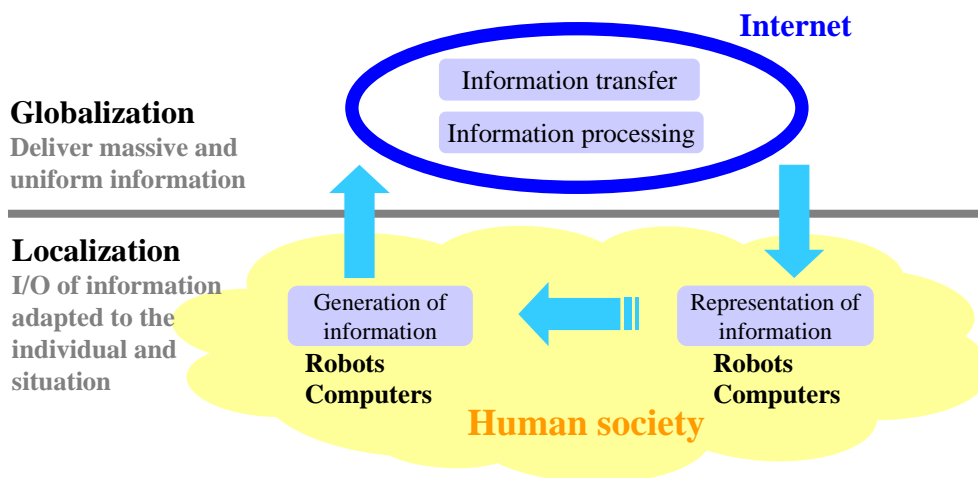


Robots in the near future

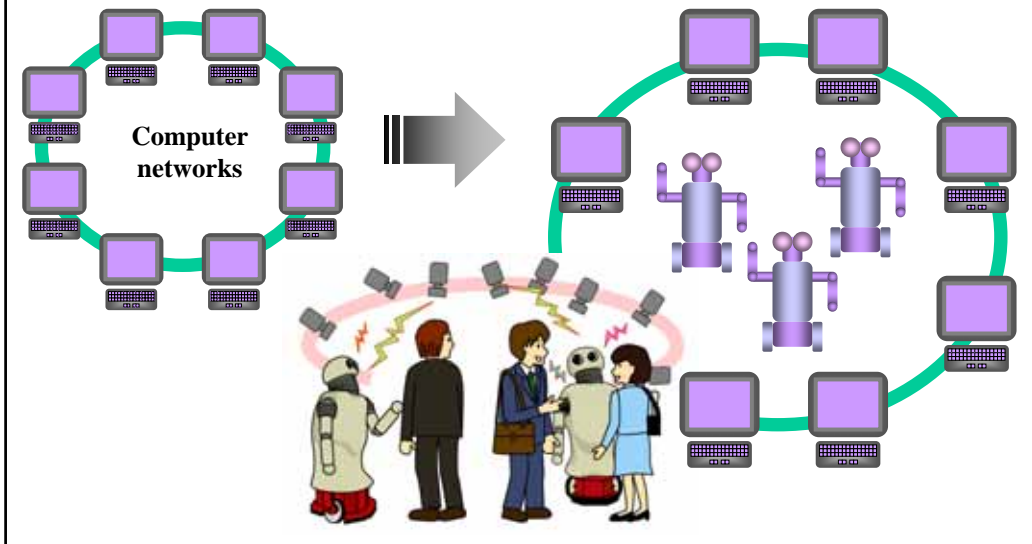
Robots as information media



Globalization & Localization

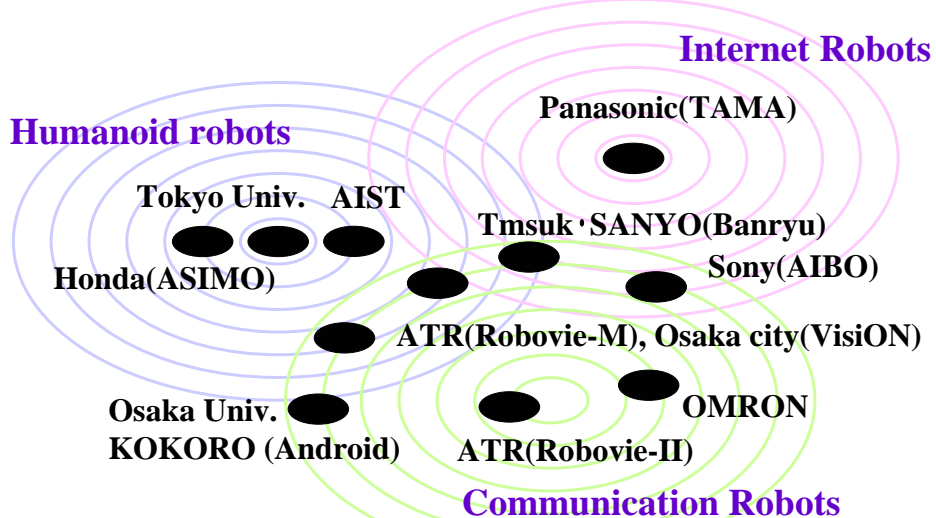


Robots as a robotic infrastructure supporting human activities



Robotics research in Japan

- Robots connecting people -



Robots as media

Robots as information media

- **A human personifies the object of conversation**
- **A humanoid robot is an ideal personification media**
- **Robots generates information by interacting with humans**
- **From particular tasks to communication tasks**

Advantages of Japanese robotics research

- **Research & development of humanoid robots**
- **Robot manufacturing technologies in industrial robotics**
- **Modulation technologies in household electrical appliances**

Robots are an infrastructure

What is the infrastructure, ex. Internet

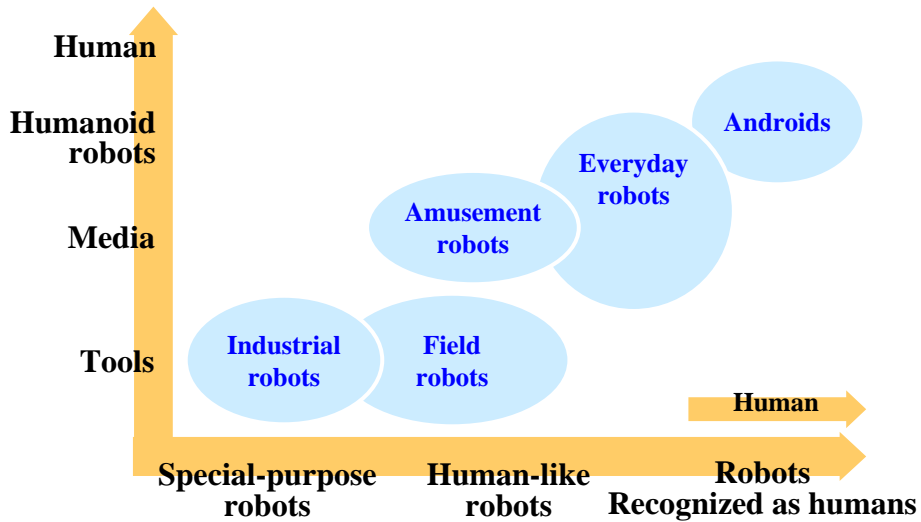
- **Studies on systems embedded in the human society, ex. social informatics.**
- **Technology developments and application finding happens simultaneously.**
- **The applications/requirements change as the social system changes.**
- **It is realized as a network of high-potential elements, ex. computers and robots**

How to develop the infrastructure

- **Iteration of technology developments and verifications in the real society.**
- **Finding of real problems through field experiments.**
- **Improvement of the elements.**

Robots evolves from tools to media

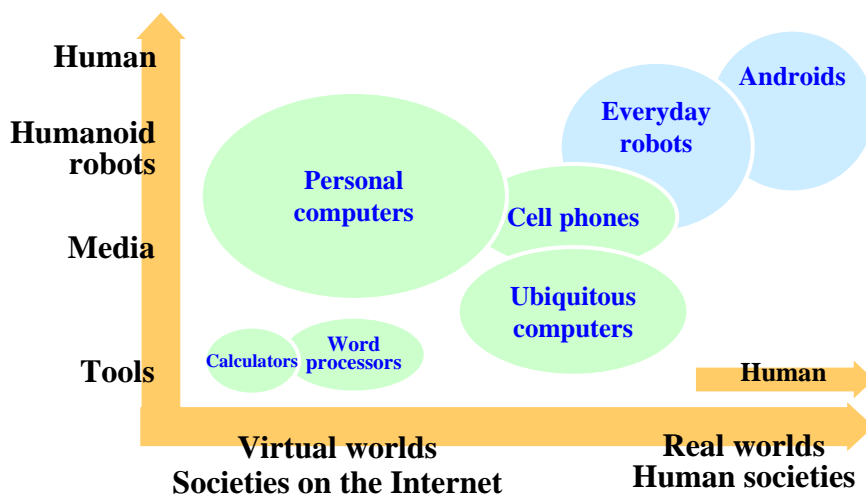
-A Human personifies the object-



From computers to robotic media

In visible ubiquitous systems and visible robots

-Revolution from virtual worlds to real worlds-



Robots integrated with the environment

In visible ubiquitous systems and visible robots

Ubiquitous Robots
Communication=Integration of perception and representation
Robot systems integrated with the environment

- Perception by ubiquitous systems and distributed sensing systems
- Situated information processing embedded in the environment.
- Human activities are closely related with the environment.

Four issues to develop robots

Establishment of new research areas by integration

Perceptual functions embedded in the environment

- Sensor network
- Robotic systems embedded in the environment

Information engineering
Social ethology

Humanoid robots for representation

- Robots as adaptive media/conversation media
- Robots as an ideal interface
- Robot as a human

Information engineering
Robotics, Psychology
Cognitive Science

Elements of the robotic systems

- Sensors (tactile, vision, audition)
- Actuators (high-performance motor)
- Energy (high-performance battery)

Robotics
Material engineering

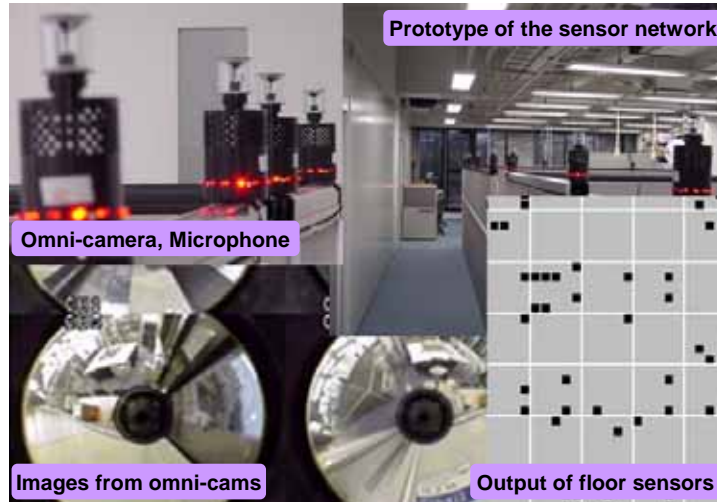
Sociology for robots

- Development of the infrastructure
- Field experiments
- Design methodology including robots and human societies

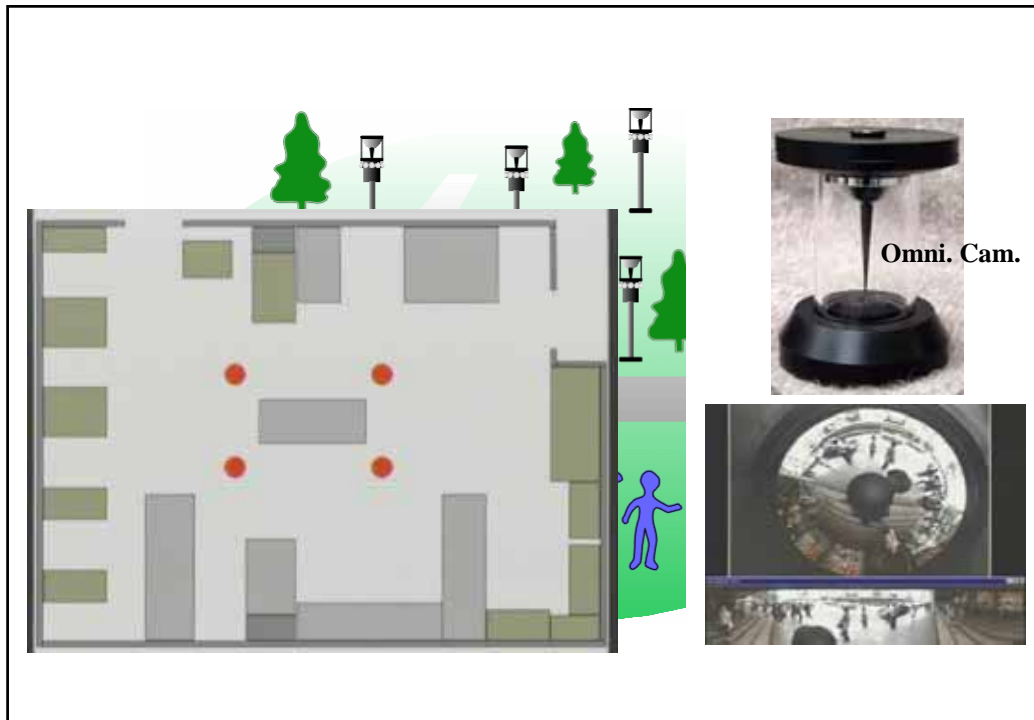
Robotics, Ethology
Environmental engineering

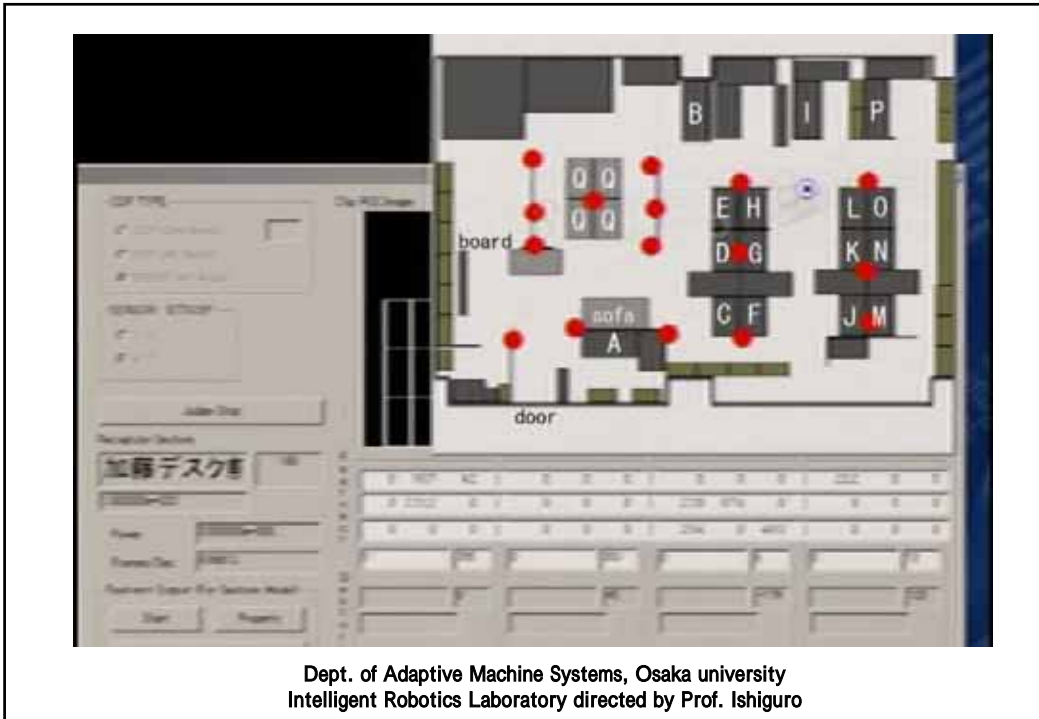
Perception by the environmental systems

Perceptual information infrastructure recognizing human activities



Dept. of Adaptive Machine Systems, Osaka university
Intelligent Robotics Laboratory directed by Prof. Ishiguro





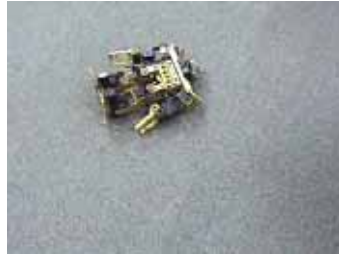


Robovie II: ATR Intelligent Robotics and Communications Laboratories



Robovie II, IIS, III: ATR Intelligent Robotics and Communications Laboratories

Humanoid robots for education

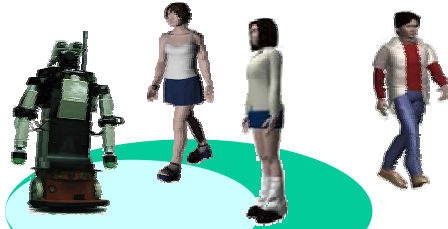


Humanoid robots for education



Robots detect social relationships

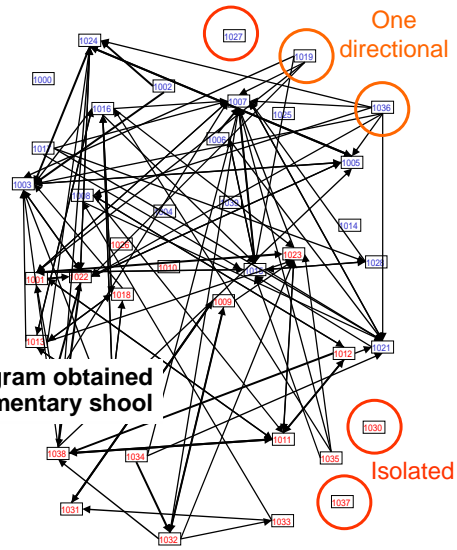
-Acquisition of sociograms-



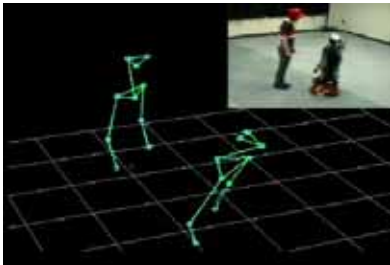
A and B play with the robot together.
A and B are friendly each other.



Sociogram obtained
in an elementary school



Android of which appearance is very similar to a real human



Representation by humanoid robots

Android of which appearance and behaviors are very similar to a real human



Repliee Q1:
Intelligent Robotics Laboratory, Dept. of Adaptive Machine Systems, Osaka university
KOKORO, Co. Ltd., ATR Intelligent Robotics and Communications Laboratories

Robots approaching to humans

ATR IRC
Robovie II



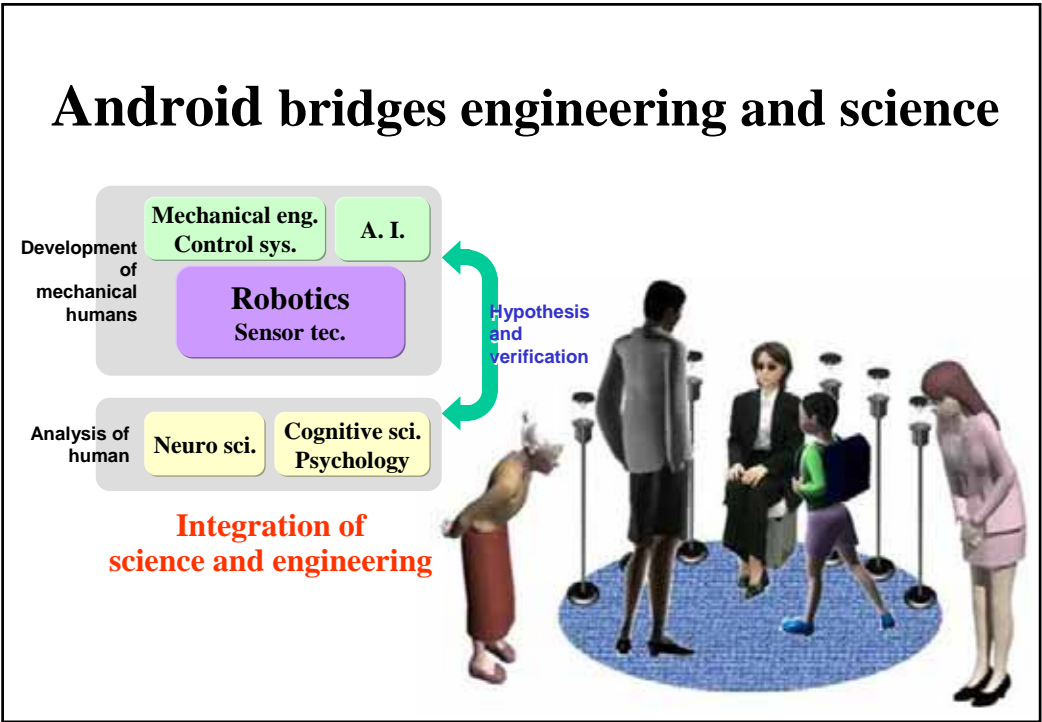
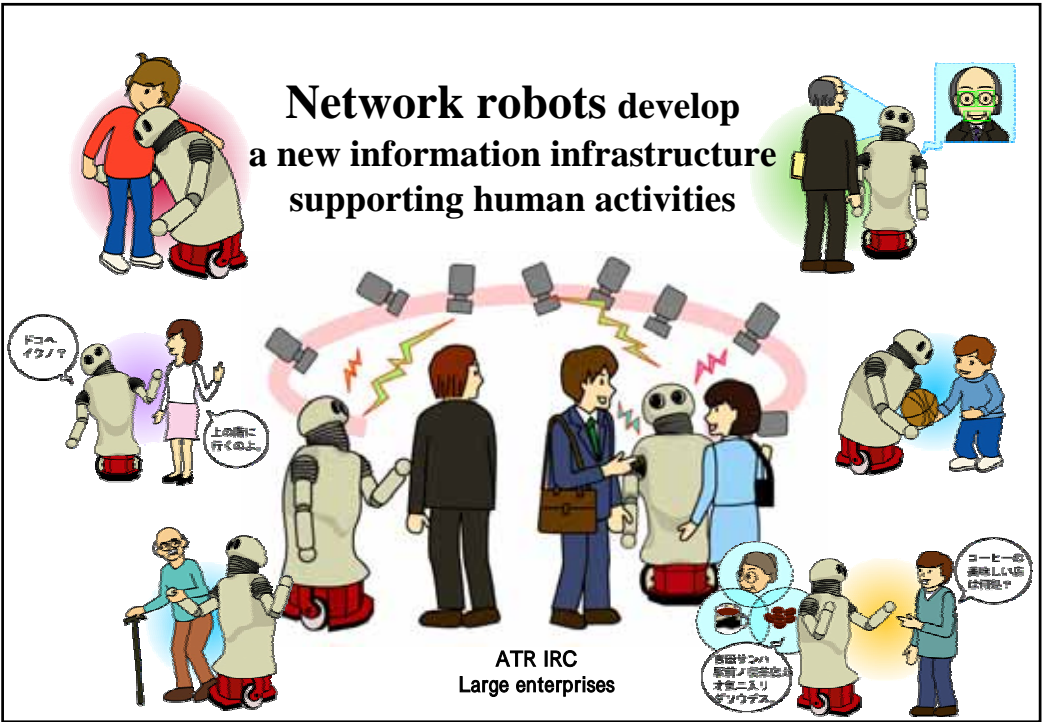
MHI
Wakamaru

Osaka Univ.
Osaka City
Vstone
VisiON

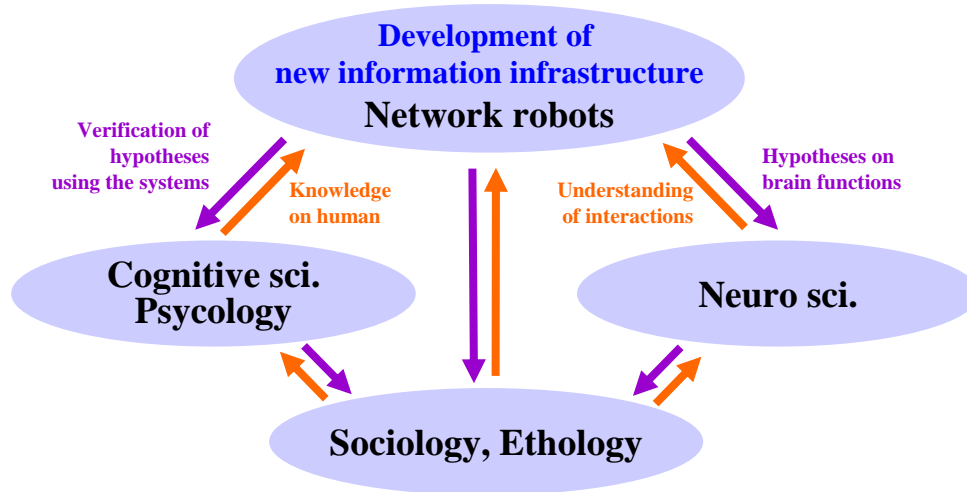


Osaka Univ.
KOKORO
Repliee Q1





Interdisciplinary research and establishment of new areas



Advantages of Kansai area in robotics research and development

Field, Research, Funds

Information infrastructure vs. robotic infrastructure.

-Robotics infra. needs closed area

Interactive/everyday robots needs field experiments.

-It needs supports from cities, prefectures

-Kankeiren, Osaka City, Osaka prefecture, ...

A robot consists of various technologies.

-It needs various research groups and companies.

-Osaka Univ., Kyoto Univ., Kobo Univ, ATR, CRL,

-MHI, SANYO, Panasonic, SHARP, ...

➡ Kansai is an ideal region

Advantages of Kansai area in robotics research and development

