

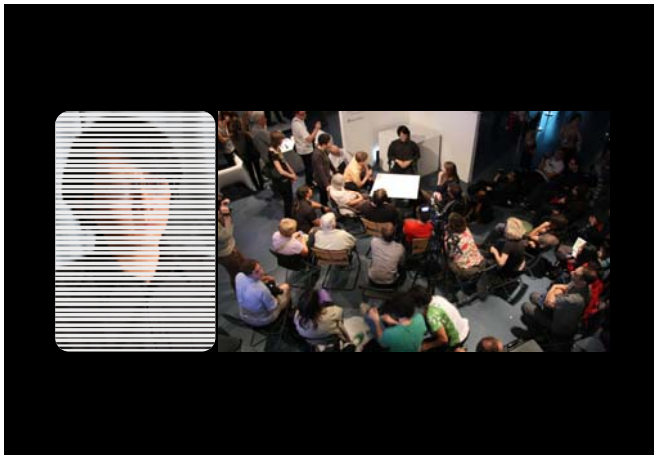
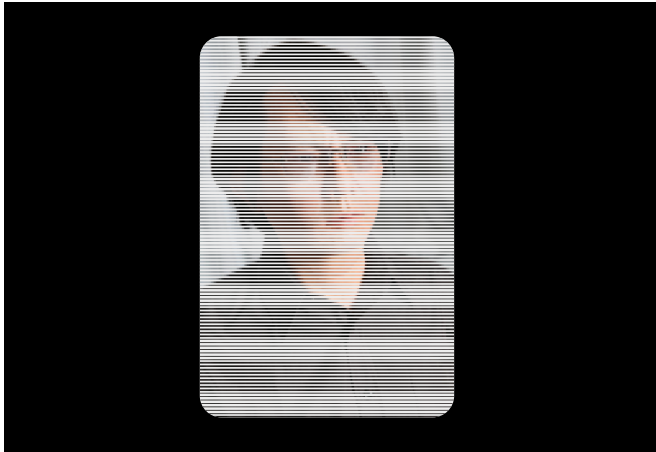
1

Studies on Interactive Robots

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ISHIGURO**




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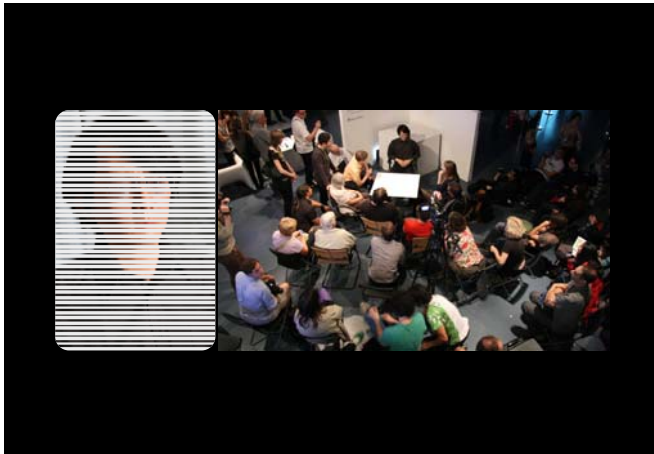


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What is identity?



- Who has the Ishiguro's identity?
- Is it Ishiguro or the Geminoid?



Robot Society

Human-Robot Symbiotic Society

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Information/sensor network



Humanoid robots and Android robots

Why Do We Need Humanoid Robots?



- Humans have a brain that recognizes humans.
- The ideal interface for humans is a human.
- Therefore, information media devices, e.g., talking rice cookers, should be at least partially humanlike.
- On the other hand, the very humanlike robots, android robots, are necessary for understanding humans.

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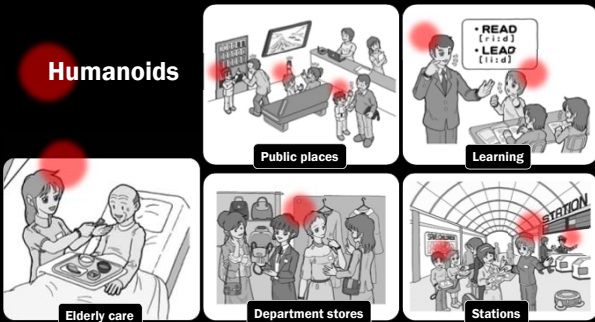
Personal Robots Interactive Communicative Robots



The Future Society Supported by Humanoids & Androids

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Humanoids



Robot and Science

Constructive Science with Intelligent Systems 13

- Past brain studies have found that human intelligence comprises elements of memory, computation, inference, learning, etc. The challenge is to identify how these elements can be put together for realizing human intelligence.
- The constructive approach will reconstruct robots and androids to model humans, and use such robots and androids to study human macro-level functions.

Developing humanlike robots based on knowledge in science

←

Understanding humans by using the robots

→

Progress of Robot Technology and Human Science "Cognitive Science with Robots" 14

Voice recognition

Image understanding

Sensor

Manipulator

Mechanics

Social relationship

Consciousness

Intention/Desire

Multi-modal Integration

Embodiment

Intelligence

Meta-level Cognitive functions

Robot Development 15

Companion robots

Counseling robots

Conversation training robots

Interpreter/ Guide robots

Receptionist/ Concierge robots

Shop keeper robots

Conversational robots for elderly and children

Language teacher robots

Order-taking robots at restaurants

Intelligent sensor network

Self-organizing sensor network

Language teacher robots

Let me teach you some useful phrase.

Order-taking robots at restaurants

Conversational robots for the elderly

Receptionist/ Concierge robots

Science and Robot Development 17

Science

Intelligence

Embodiment

Multi-modal Integration

Intention/Desire

Consciousness

Social Relationship

Total Turing Test

Companion robots

Counseling robots

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Language teacher robots

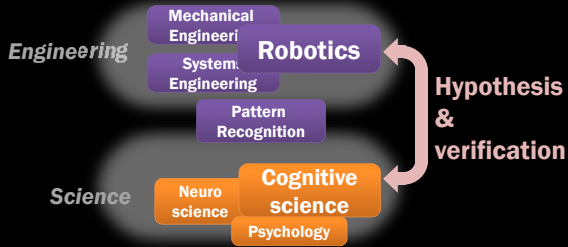
Order-taking robots at restaurants

Robot development

Total Turing Test (TTT) as a scientific and engineering goal 18

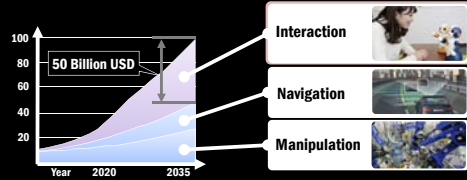
- TTT is to compare between a robot manipulated by human operators and an autonomous robot controlled by developed technology.
- One of the important challenges in intelligent robotics is to pass TTT.
- It evaluates the total humanlikeness through all of the modalities.
- It evaluates the social acceptance as a member of our society.

Studies on Interactive Robots



Interaction in Robotics

- Ishiguro has built a new field in robotics: Interaction.
- Before that, navigation and manipulation were major topics in robotics. Recently, 10-20% papers at major conferences focus on interaction.
- Japanese government expects that the market of interactive robots/service robots, will be bigger than manipulators and it will reach 50 Billion USD in 2035.



Applications of the Androids

Androids for Extending Human Presence



Ishiguro's Android Geminoid



Android of a Living National Treasure



Android of a Great Literary Figure



Androids and Human Presence



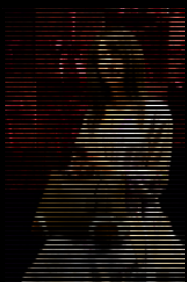
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**What is human presence?
What is human?**



**Androids for Representing
Humanlikeness
in Artistic Areas**



House Mannequin Android



Android as an Idol Singer



Android Theater

with Oriza Hirata



Movie "Sayonara (Goodbye)"



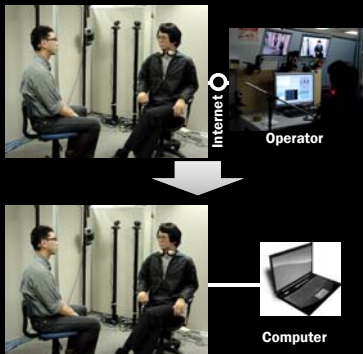
What is heart/mind?



- We feel the humanlike hearts /minds of the android, but it is a simple computer program.

Androids with Conversational Functions - Toward Total Turing Test -

Autonomous Conversational Android



Big-data approach

- Collection of simple conversational patterns through the Internet for unlimited topics
- Chatbots

Story-based approach

- Stories presented in graphical models
- Complex conversation for limited topics

Conversational Autonomous Androids



NTT Laboratories
Osaka University and ATR

- Microphone array by NTT
- Voice recognition by NTT
- Chatbot by NTT
- Android by Osak Univ.
- Lip and head movements by ATR



Chat-Oriented Dialogue System

with NTT



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Androidol U



Internet TV



with NTT



Casual Discussion Dialogue System

with NTT



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Deep Discussion Dialogue System

with NTT



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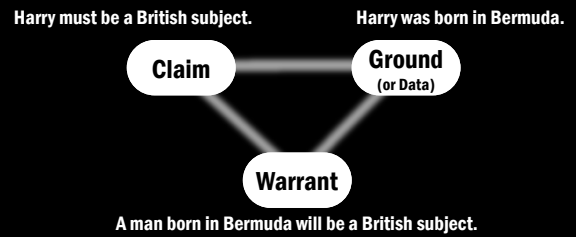
Mechanism of Deep Discussion

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Toulmin Model of Argument

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Big-data approach

- Collection of simple conversational patterns through the Internet for unlimited topics
- Chatbots

Story-based approach

- Stories presented in graphical models
- Complex conversation for limited topics

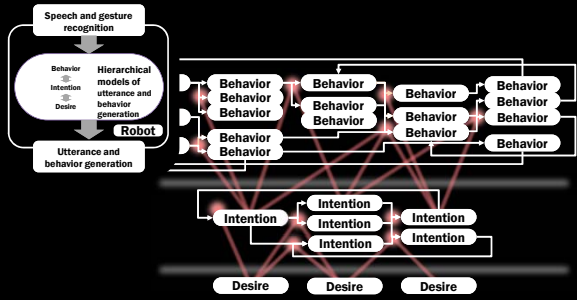
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JST ERATO ISHIGURO Symbiotic Human Robot Interaction Project 2014-2020

mainly with Prof. Kawahara (Kyoto University) Dr.
Minato, Dr. Ishii, and NTT

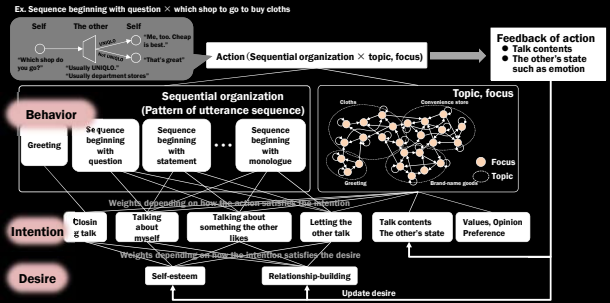
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Android with Intensions and Desires

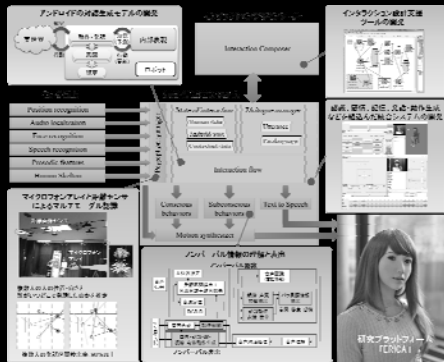


Implementation of Desire Behavior Model

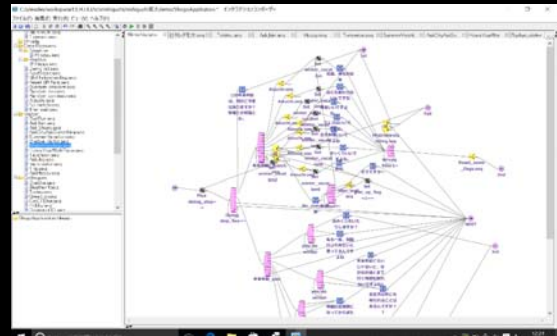
- The intention binds the desires and actions to satisfy them.
- The action that mostly satisfies the current desires is chosen.



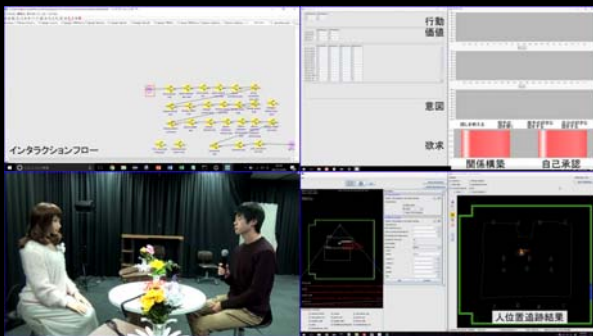
ISHIKI System with Prof. Kawahara (Kyoto Univ.)



Interaction Composer



ERICA with Prof. Kawahara (Kyoto Univ.)



ERICA





ERICA



Fundamental Issues of Conversational Robots

How to represent the feeling of presence?

mainly with Prof. Ogawa, Dr. Nishio and Dr. Sumioka



What is conversation?

mainly with Prof. Yoshikawa



Feeling of presence "Sonzaikan"

Geminoid: Teleoperated Android to Transfer Human Presence

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Meeting with the Geminoid

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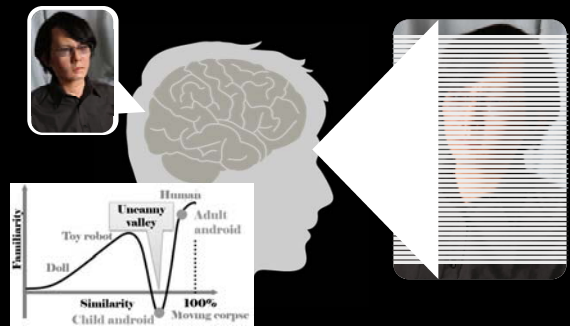


How do we recognize the robot/android?

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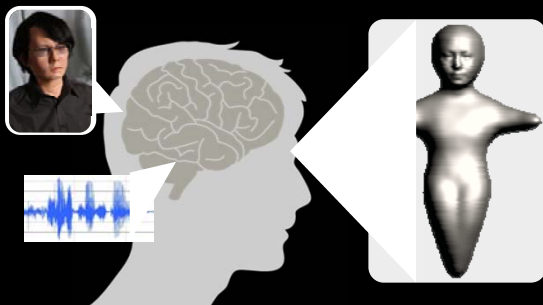
Recognition Based on Observation

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Recognition Based on Imagination

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Robot that Activates User's Imagination

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Telenoid: Teleoperated Robot Based on User's Imagination

With Nishio

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The Minimum Media to Transfer the Human Presence

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The minimum condition to feel human presence

With Sumioka

- It requires two modalities.
- Hugvie: the minimum media.

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Relaxing Effect of Hugvie

With Sumioka

Talking to an unknown person for 15 min.

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Cortisol, the Stress Hormone, Is Reduced with Hugvie.

Scientific Reports, 2013

with Sumioka

Condition	Cortisol decrease (pg/dl)
Hugvie	~ -1.5
Phone	~ -0.5

Condition	Cortisol decrease (pg/dl)
Hugvie	~ -0.05
Phone	~ 0.02

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Representation with two modalities for activating the imagination

- Voice + Tactile sensation
- Appearance + Tactile sensation
- Smell + Tactile sensation
- Voice + Smell

Strength of feeling

of modalities

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1st grade children in an elementary school

With Sumioka

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With Hugvie

With Sumioka

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Conversation

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CommU: Communication with Two Robots

with Yoshikawa

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Conversation without voice recognition

With Yoshikawa

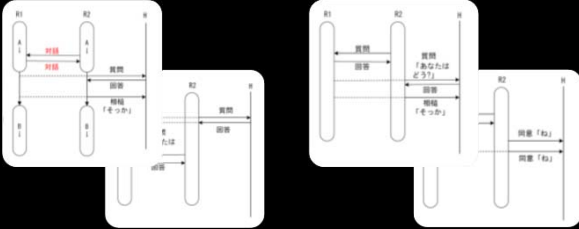
- If there are two robots, robots do not need to understand the person's utterance.
- The robots talk to each other and bring the person to their conversation.

How to Ignore the Person's Utterance

with Yoshikawa

Ask the person a question just before switching the subject.

Ask the same question to both another robot and the person.



What Is Conversation?

Robots do not need to recognize the voice.

Shopkeeper android

with Ogawa



Conversation by Using Touch-Panel

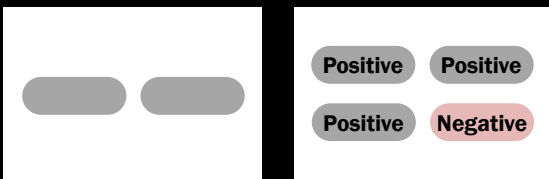
with Ogawa

- Selecting an option is much easier than speaking.
- The visitor coming to the shop does not have many stories.



Touch-Panel

with Ogawa



What Is Conversation?

Robots do not need to recognize the voice.
People do not need to pronounce.
(Choice from options is enough)

