Conversational Informatics

Toyoaki Nishida
Kyoto University

Conversational Informatics is a field of research aiming at investigating human conversational behaviors as well as designing conversational artifacts that can interact with people in a conversational fashion. Based on the foundation of Artificial Intelligence, Pattern Recognition, and Cognitive Science, we attempt to establish a new technology consisting of environmental media, embodied conversational agents, and management of conversational contents. In this talk, I will overview the field of Conversational Informatics and highlight major results.
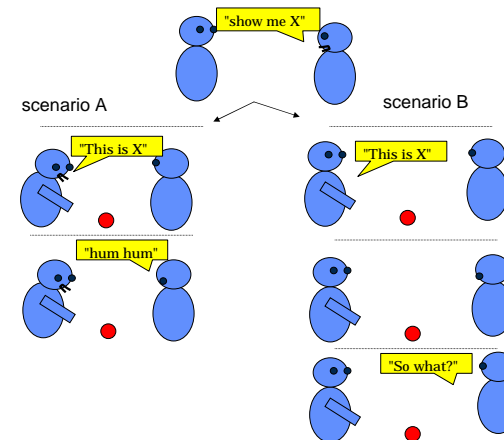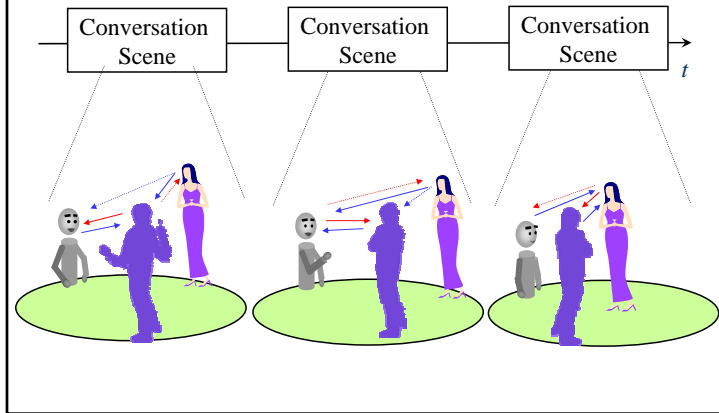
Conversation is everywhere

Goal:
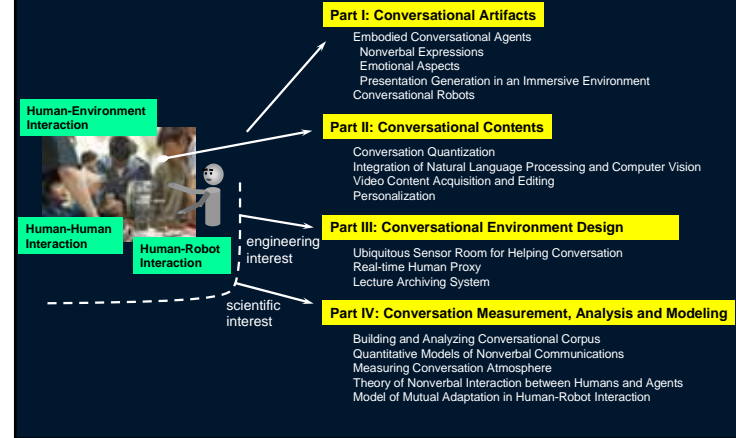Artifacts that can participate in conversations to help people create knowledge.

Conversation as interaction

"show me X"

scenario A

scenario B

"This is X"

"This is X"

"hum hum"

"So what?"

Content-oriented View

Conversation Scene → Conversation Scene → Conversation Scene t

---

Conversational Informatics

Human-Environment Interaction

Human-Human Interaction

Human-Robot Interaction

engineering interest

scientific interest

Part I: Conversational Artifacts
- Embodied Conversational Agents
  - Nonverbal Expressions
  - Emotional Aspects
  - Presentation Generation in an Immersive Environment
- Conversational Robots

Part II: Conversational Contents
- Conversation Quantization
- Integration of Natural Language Processing and Computer Vision
- Video Content Acquisition and Editing
- Personalization

Part III: Conversational Environment Design
- Ubiquitous Sensor Room for Helping Conversation
- Real-time Human Proxy
- Lecture Archiving System

Part IV: Conversation Measurement, Analysis and Modeling
- Building and Analyzing Conversational Corpus
- Quantitative Models of Nonverbal Communications
- Measuring Conversation Atmosphere
- Theory of Nonverbal Interaction between Humans and Agents
- Model of Mutual Adaptation in Human-Robot Interaction

Part   Conversational Artifacts
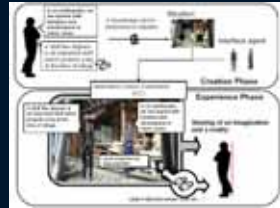## —— Applying Conversation Quanta
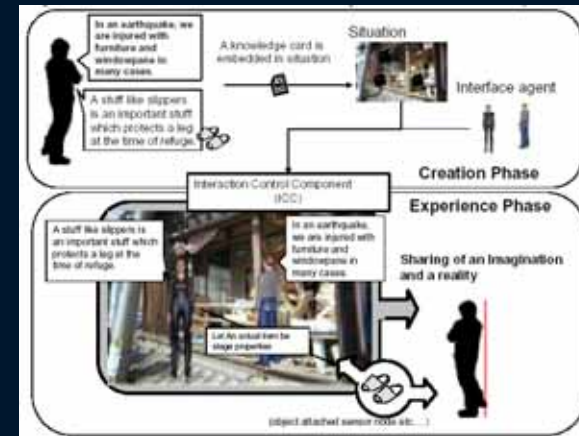
EgoChat

SPOC

IPOC

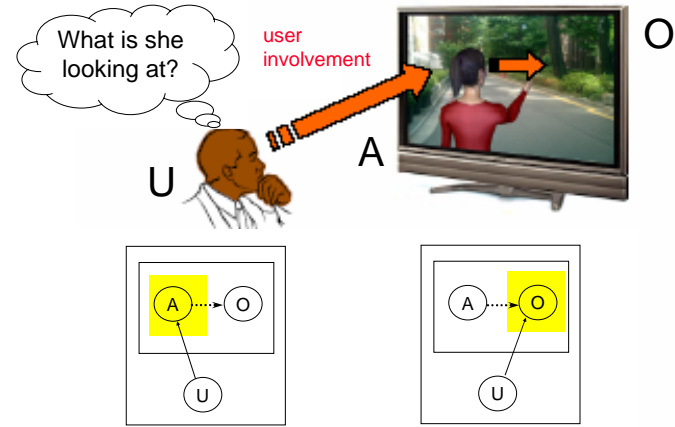
IPOC -- Immersive Conversation Environment

[Nakano, Murayama, Nishida]

IPOC -- demo

[Okamoto, Okamoto, Nakano, Nishida]

Cognitive Overlapping

What is she looking at?

user involvement

O

U

A

A ····> O

U

A ····> O
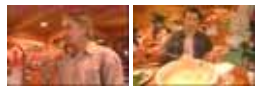
U

[Nakano, Okamoto, Okamoto, Nishida]
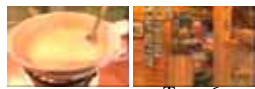

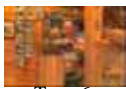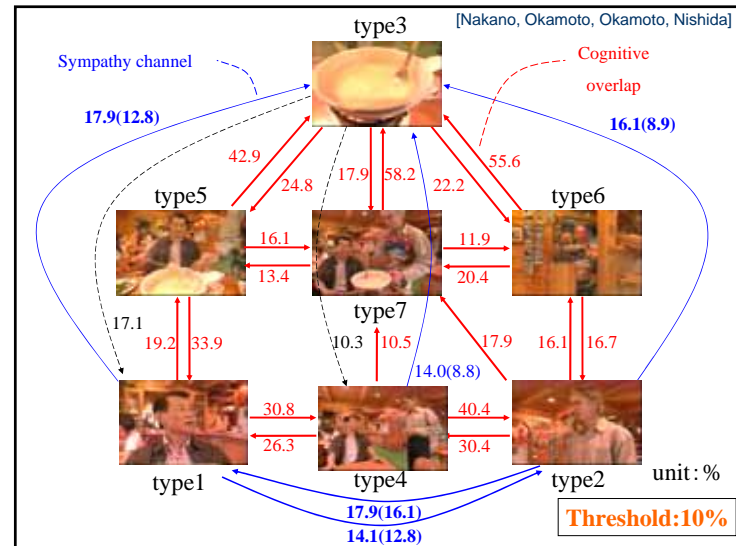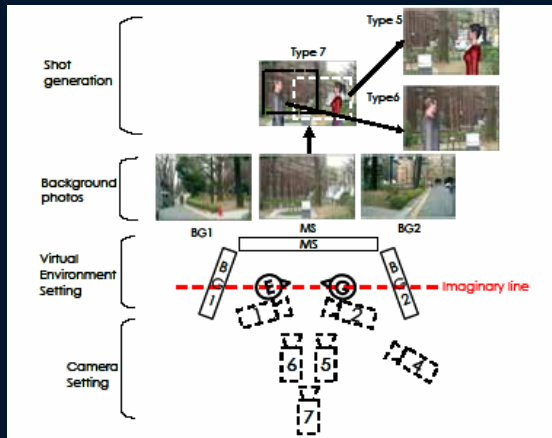**Analysis of presentation techniques on TV programs**
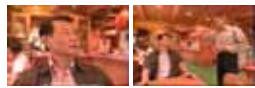
Type 1
Type 4
Type 2
Type 5
Type 3
Type 6
Type 7

type 1   {the host}
type 2   {the guest}
type 3   {the subject}
type 4   {the host, the guest}
type 5   {the host, the subject}
type 6   {the guest, the subject}
Type 7   {the host, the guest, the subject}

[Nakano, Okamoto, Okamoto, Nishida]

[Nakano, Okamoto, Okamoto, Nishida]

type3

Sympathy channel

Cognitive overlap

17.9(12.8)

16.1(8.9)

42.9   24.8   17.9 58.2   22.2   55.6

type5   type7   type6

16.1   11.9
13.4   20.4

17.1   19.2 33.9   10.3 10.5   14.0(8.8)   17.9   16.1 16.7

type1   type4   type2

30.8   40.4
26.3   30.4

unit：%

17.9(16.1)
14.1(12.8)

Threshold:10%

3

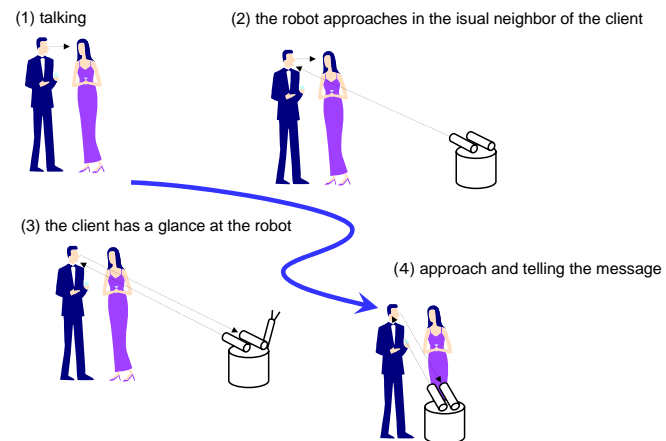## Settings and shot generation from background photos

[Okamoto, Okamoto,Nakano, Nishida]

IPOC -- eye gaze to control the discourse

[Nakano]

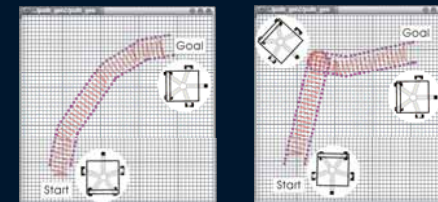## Conversational robots

(1) talking

(2) the robot approaches in the isual neighbor of the client

(3) the client has a glance at the robot

(4) approach and telling the message
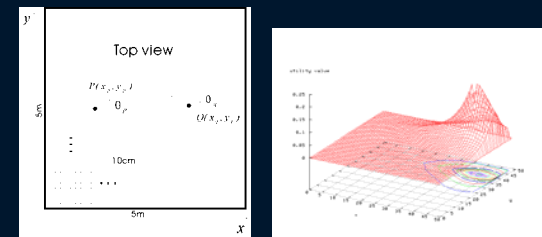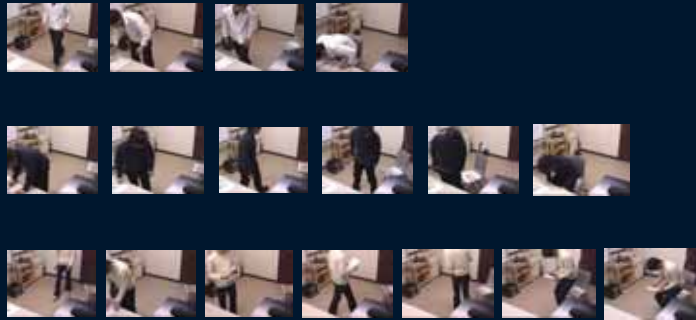

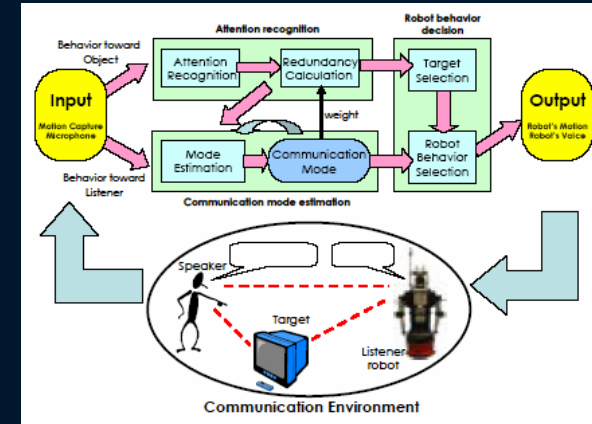## The autonomous mobile chair project

[Terada]

Mobile Chair Agent -- demo

[Terada]

The listener robot

[Ogasawara]

The Listener Robot

[Ogasawara]

The listener robot -- another example

[Ohya, Hiramatsu]

Part   Conversational Contents
        -- Accumulating Conversation Quanta

Sustainable Knowledge Globe
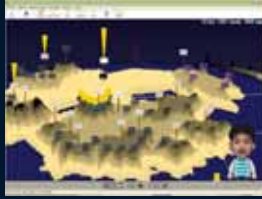
Contents Garden

Transforming from Other Media
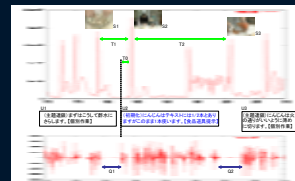
Sustainable Knowledge Globe
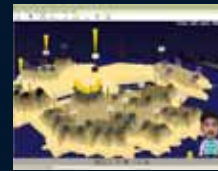
[Kubota, Nishida]

Contents Garden

Bird's eye view
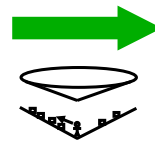
projection on
the cone surface

Immersive view

[Nomura, Nishida]

Reconfiguration assistance functions

distort

compact   expand

(original)

narrow

make space

region (A)

circle(a)   make
                space
circle(b)   (original)

push

rake   (original)

push
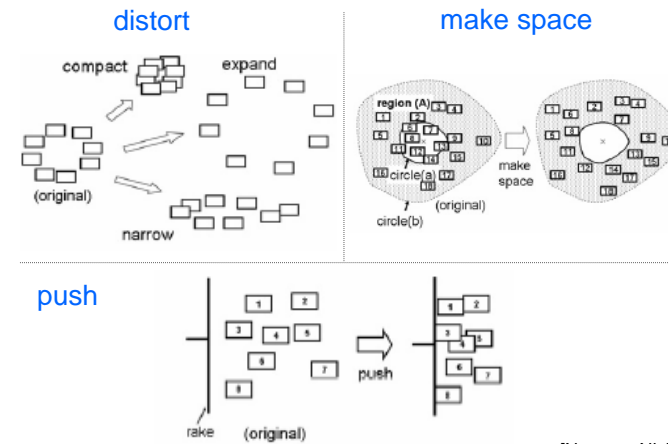
[Nomura, Nishida]

Contents Garden -- demo
[Nomura, Nishida]

Manipulation by gesture   -- demo
magnet metaphor
[Nakamura 2005]

Manipulation by gesture   -- demo
Throwing
[Nakamura 2005]
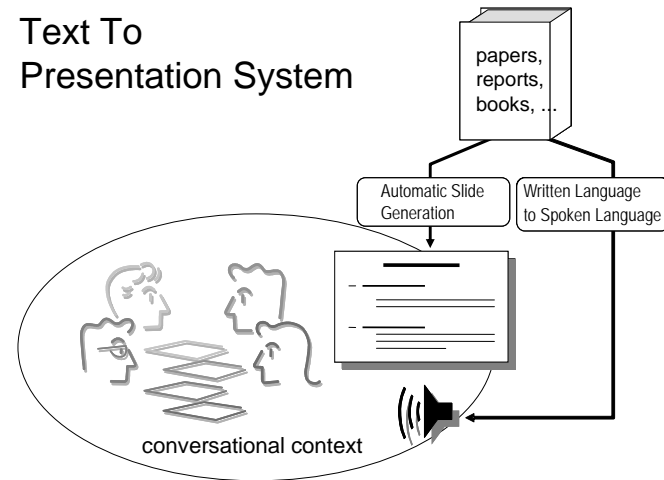
Text To
Presentation System
papers,
reports,
books, ...
Automatic Slide Generation
Written Language to Spoken Language
conversational context
[Kurohashi]

Text To Presentation System -- demo

the input text

まとめ
　社会問題の発生・沈滞の大きな要因として知識流通の閉塞が考えられる. その解決には, ソフトウェア・エージェント等の導入・支援が考えられるが, 人間は言葉の適切さ・不適切さに対して極めて敏感であり, 不十分な形式では受け入れられない. 本研究はこの問題を自然言語処理技術によって解決する方策を示した. 今後の課題としては, 本システムをソフトウェア・エージェント等の技術と融合して会話の場に導入する実証的な実験を行い, 提案した枠組みの有効性を検証する予定である.

[Kurohashi]

This slide is automatically generated.

まとめ

- 社会問題の発生・沈滞の大きな原因
  - 知識流通の閉塞が考えられる
    - その解決にはソフトウェア・エージェント等の導入・支援が考えられる
    - 人間は言葉の適切さ・不適切さに対して敏感であり、不十分な形式では受け入れられない
      - 本研究はこの問題を自然言語処理技術によって解決する方策を示した

- 今後の課題
  - 本システムとソフトウェア・エージェント等を融合して会話の場に導入する実証的な実験を行う
  - 提案した枠組みの有効性を検証する予定

The Narration

[Kurohashi]

Conversation content acquisition from closed caption video clips

[Kurohashi]

Part　　　Conversation Environment Design

Acquisition from presentation with a touch panel

The ubiquitous sensor room

The meeting capture
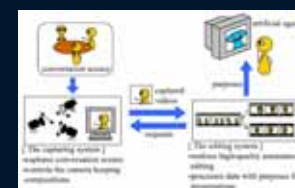
The virtual classroom on the net

Content Acquisition from Presentation with Touch Panel
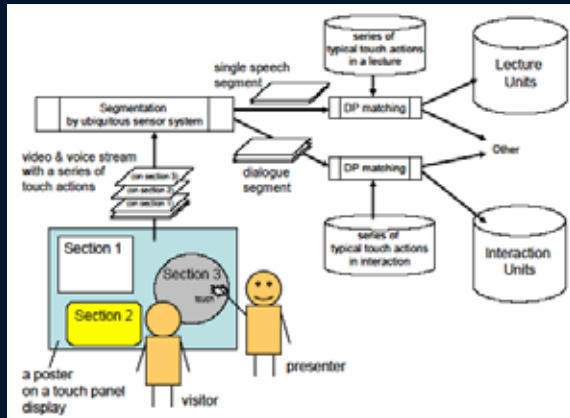
[Kawaguchi, Sumi]

Collaborative capturing of interactions by multiple sensors

[Sumi]

Video Contents Acquisition and Editing for Conversation Scene
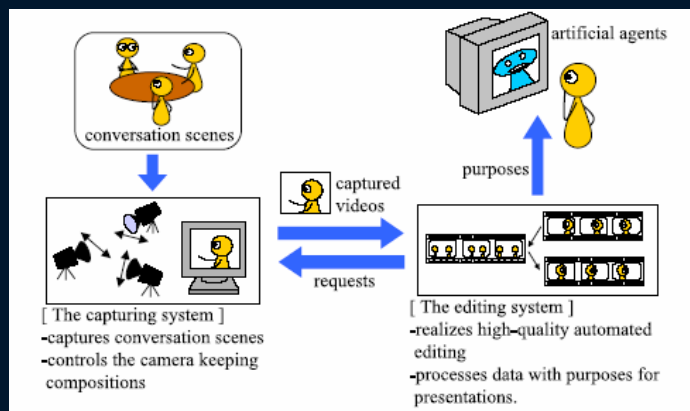
[Nishizaki, Ogata, Nakamura, Ohta 2002]

Smart capture/editing/indexing
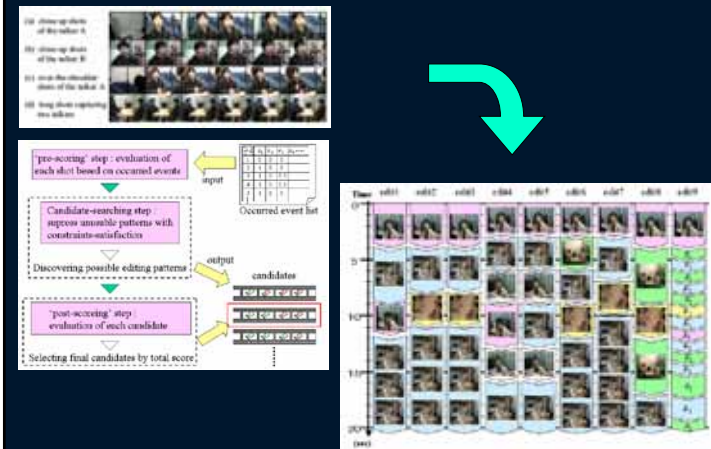
[Nishizaki, Ogata, Nakamura, Ohta 2002]

Computer-generated virtual environment
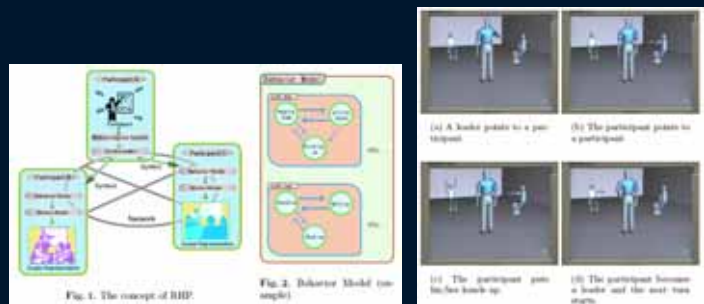
Real Time Human Proxy is an avatar-based interaction system, using real-time vision-based motion sensing, human action symbolization and human action visualization

[Taniguchi, Arita]

smart capture/editing/indexing

automated capture

automated indexing

object tracking / behavior recognition

automated editing

Video Live on Demand

display

annotated data

annotation

PC pentiumIII
600MHz dual

position

utterance

[Nakamura]

smart capture/editing/indexing -- demo

appearance of the held-object is changing
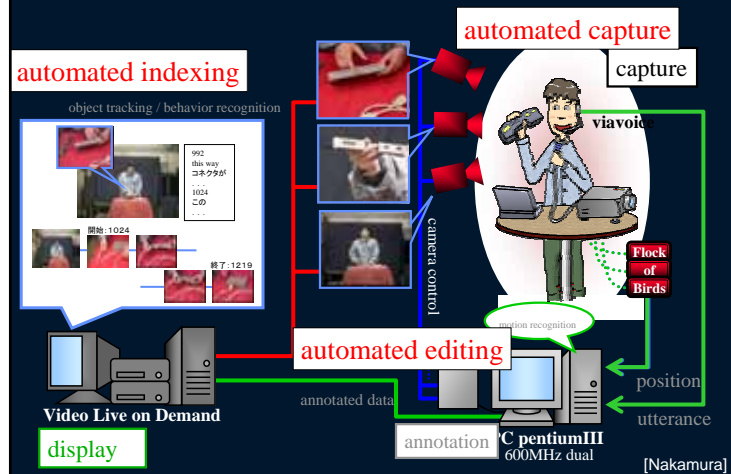
[Nakamura]

Computer-generated virtual environment -- demo

[Taniguchi and Arita]

Part   Conversation Measurement and Analysis

Conversation corpus

categorization y o r u g o h a N q t e

categorization   head declines   head declines

structurization   nodding
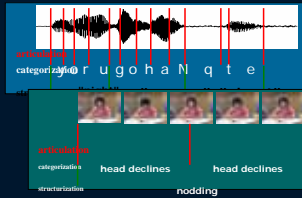
Mutual adaptation
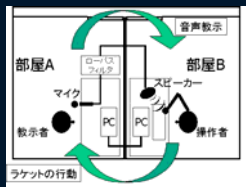
Causal model of conversations
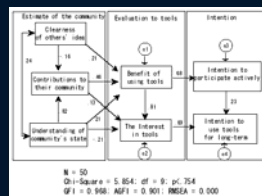
Tagging the conversation
- parallel annotation to verbal and nonverbal information
- articulation, categorization, and structurization

cameras

categorization y o r u g o h a N q t e

structurization   "night"   "supper"   "about"

categorization   head declines   head declines

structurization   nodding

[Den]
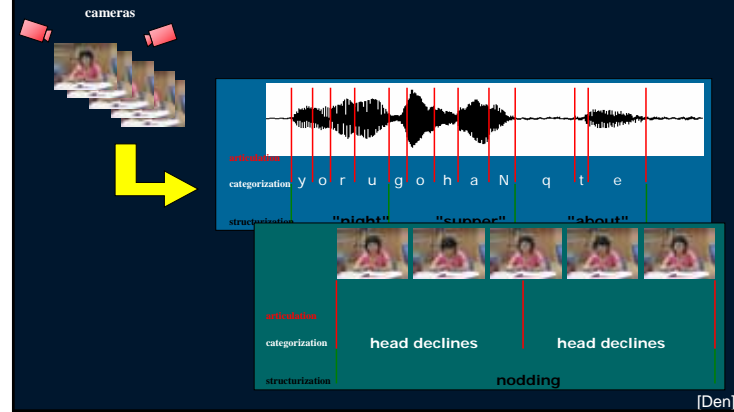
Communication Atmosphere   [Rutkowski 2004]
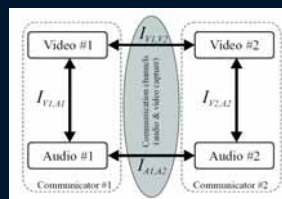
the scheme
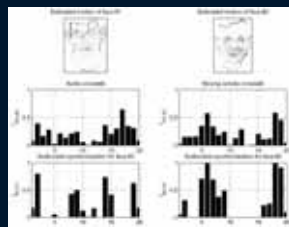
mutual information estimate   communication efficiency
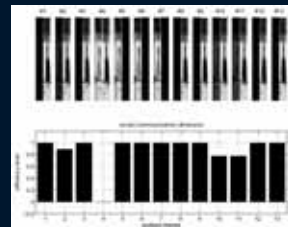
A causal model concerning the intention of participation in a community and using a tool

N = 50
Chi-Square = 5.854; df = 9; p<.754
GFI = 0.968; AGFI = 0.901; RMSEA = 0.000
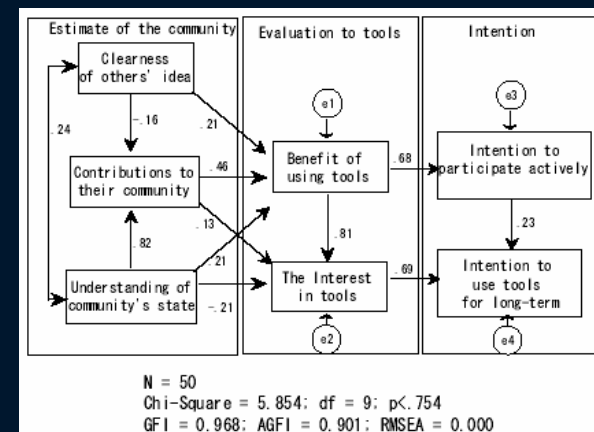
[Matsumura]

Model of mutual adaptation
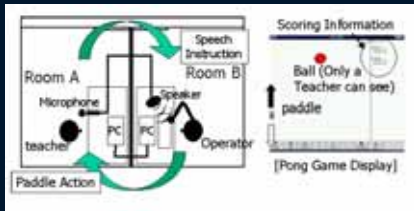
The environment of experimentation
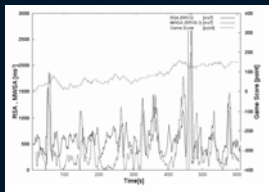
RSA>MWSA: game score increasing   RSA>MWSA: game score decreasing
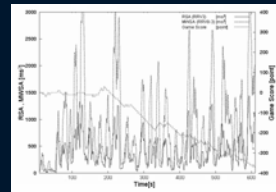
RSA: Respiratory sinus arrhythmia, MWSA: Mayer wave sinus arrhythmia

---

Conversation Quantization

conversation quantum   ersation antum   nversation quantum

conversion / spatialization

accumulation

conversation quantum   conversation quantum   conversation quantum

dematerialization

materialization

embodied conversational agent

a conversational situation

another conversational situation
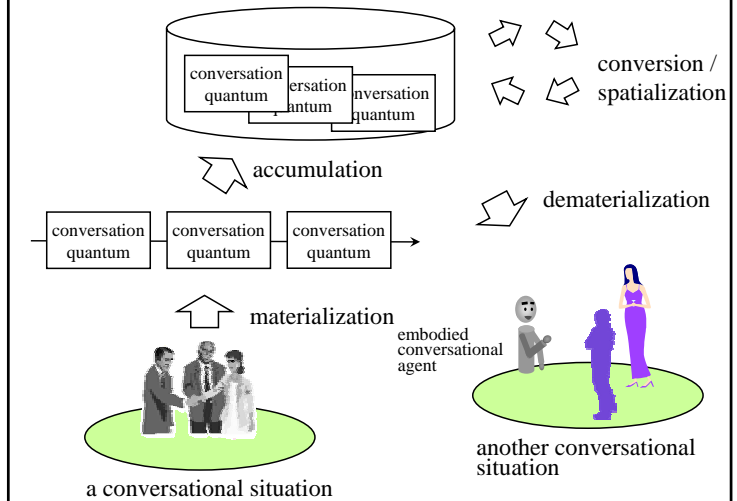
Conversation Quantization (elaborated view)

conversational situation

social intelligence quantity

embodied conversational agent

measure

information landscape

additional services such as navigation, summarization, ...

conversation quantum
conversation quantum
conversation quantum

capture

conversion   archives

temporal expansion   spatial expansion

editor

Representing Conversation Quantum

conversation as a phenomenon

Representation of a Conversation Quantum

Representation of Content

"This tree is called a "Kai no ki". It was planted for commemorating Professor Koshiba's Nobel Prize in Physics "

Representation of Interaction

...
《introduction》
《focus attention》
《add new information》
...

Representing Conversation Quantum

conversation as a phenomenon

Representation of a Conversation Quantum

Representation of Content

"This tree is called a "Kai no ki". It was planted for commemorating Professor Koshiba's Nobel Prize in Physics "

IPOC

Representation of Interaction

《introduction》

《focus attention》

《add new information》

…

Robot as an embodied knowledge medium

Listener Robot — conversation quantum / conversation quantum — Presenter Robot

Ohya, Hiramatsu
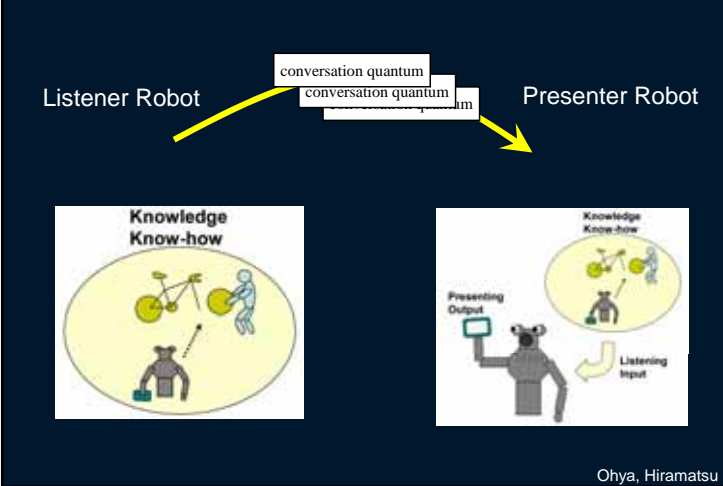
Dynamic binding of Content and Interaction

Scenes   **Conversation Quanta**

Content

"attach the rear wheel"

Interaction

《show it to the listener》
《speak to the listener》

Content

"open the lever and push the wheel"

Interaction

《focus attention》
《speak to the listener while attaching the wheel》

focus of the discourse — objects/events focused in interaction
part/whole — semantic gesture suggesting the hierarchy
key objects — those that are demonstrated with emphasis
key action/movement — those that encourage the listener synchronize
same meaning — those displayed by the same gestural features

Difference from previous work

previous work	this work
PICK UP A BIG RED BLOCK. OK.	
task-oriented dialogue	conversation as content
dialogue as a means	conversation as the goal
verbal communication	multimodal communication
rule-based methods	data-driven methods

Directions

Intelligence → Communication

Algorithms → Phenomena

Interface → Contents

Analysis, Support, and Materialization of Real World Interaction

Toyoaki Nishida, Yuichi Nakamura, Kazuhiro Ueda, Sadao Kurohashi, Yasuyuki Sumi, Igor Pandzic

Real World Interaction Corpus

Real World Interaction Content

⇔ real world knowledge sharing (beyond the scope of this research)

automated archiving

utilization as content

content production

content utilization

Real World Interaction Data

media data (image, speech, sound)
motion data (kinematics, dynamics)
physiological data (gaze, blood, perspiration, tactile sense)

display controlling robots

augmented conversation environment

human-environment interaction

virtual assistant

real world assistant

human-human interaction

human-agent interaction

Research Agenda

Interaction Content Acquisition and Utilization
- automated acquisition using commonsense knowledge
- media conversion, materialization, embodiment

Interaction Science
- automated acquisition using commonsense knowledge
- grounded corpus

Interaction Support Technology
- natural communication without disturbance
- mutual adaptation

collaboration with
• Interaction Measurement and Analysis Environment
• Super Precision Computer Vision
• Humanoid Robotics

Summary - Conversational Informatics

Human-Environment Interaction

Human-Human Interaction

Human-Robot Interaction

engineering interest

scientific interest

Part I: Conversational Artifacts

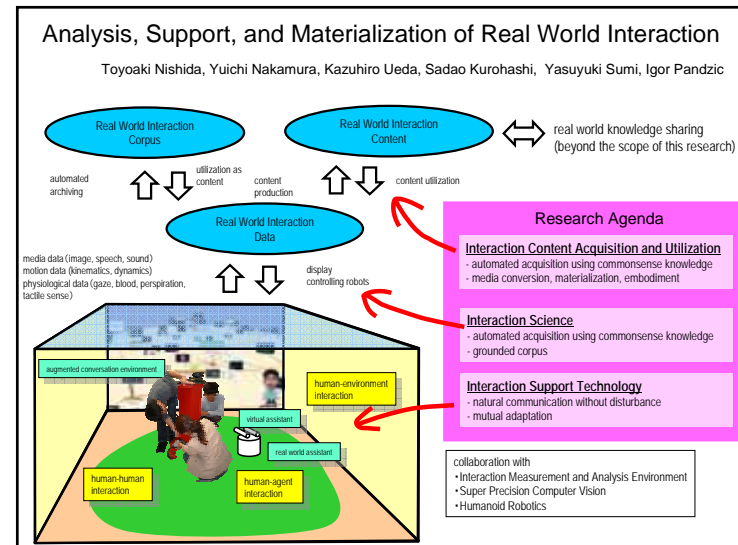Embodied Conversational Agents
 Nonverbal Expressions
 Emotional Aspects
 Presentation Generation in an Immersive Environment
Conversational Robots

Part II: Conversational Contents

Conversation Quantization
Integration of Natural Language Processing and Computer Vision
Video Content Acquisition and Editing
Personalization

Part III: Conversational Environment Design

Ubiquitous Sensor Room for Helping Conversation
Real-time Human Proxy
Lecture Archiving System

Part IV: Conversation Measurement, Analysis and Modeling

Building and Analyzing Conversational Corpus
Quantitative Models of Nonverbal Communications
Measuring Conversation Atmosphere
Theory of Nonverbal Interaction between Humans and Agents
Model of Mutual Adaptation in Human-Robot Interaction