Paving the way to culturally-competent robots: the CARESSES project

Prof. Antonio Sgorbissa - University of Genova, Italy, antonio.sgorbissa@unige.it
Prof. Nak Young Chong - JAIST, Ishikawa, Japan, nakyoung@jaist.ac.jp

The concepts expressed in this presentation have been contributed by all CARESSES partners, and in particular:

Prof. Irena Papadopoulos (Middlesex University), Prof. Hiroko Kamide (Nagoya University),
Prof. Alessandro Saffiotti (Orebro University), Prof. Jaeryoung Lee (Chubu University),
Dr. Amit Kumar Pandey (SoftBank Robotics), Dr. Sanjeev Kanoria (Advinia HealthCare),
Dr. Chris Papadopoulos (University of Bedfordshire)

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Antonio Sgorbissa,
EU Coordinator,
University of Genova, Italy
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• The idea
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• We consider personal robots that are physically identical, but we make them act and communicate in different ways to match the culture, customs, and etiquette of the person they are assisting.
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...take different forms in different individuals
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The idea

We consider personal robots that are physically identical, but we make them act and communicate in different ways to match the culture, customs, and etiquette of the person they are assisting.

Cultural Competence

General cultural characteristics (National Level)

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Stereotypes may lead to prejudice and discrimination: do we want to avoid them «only» for ethical reasons?

...avoiding stereotypes
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- The term stereotype derives from the Greek words στερεός (stereos), “firm, solid” and τύπος (typos), impression, hence “solid impression”.

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  “If you date an Italian man, he will pay the bill at the restaurant.” [1]


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The idea of the CARESSES project is to pave the way to culturally-competent robots.

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From a commercial perspective, stereotyped representations can lead to FAILURE.


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- More acceptable, higher quality of life
- Reduced caregiver burden and cost
- Easier to commercialize in different countries
- Cultural competence

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- Cultural competence
- More acceptable, higher quality of life
- Reduced caregiver burden and cost
- Easier to commercialize in different countries
- Integration of technologies and standardization

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- More acceptable, higher quality of life
- Reduced caregiver burden and cost
- Easier to commercialize in different countries
- Increased cultural competence
- Integration of technologies and standardization

Cultural competence

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Some practical examples...
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Some practical examples...

Choose the right action

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Some practical examples...

Choose the right action

Choose the right topic of conversation (which actor, food, holidays?)

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Some practical examples...

Choose the right action

Choose the right topic of conversation (which actor, food, holidays?)

Know the environment, furniture and objects.

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Some practical examples...

Choose the right action

Choose the right topic of conversation (which actor, food, holidays?)

Know the environment, furniture and objects.

Other...

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- **Orebro University**
- **Bedfordshire University**
- **University of Genova**
- **Middlesex University**
- **Softbank Robotics**
- **Nagoya University**
- **JAIST J. Adv. Inst. of Sci. & Tech.**
- **Chubu University**

**Health & user evaluation**
**Robot technology**
**Technical development**

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Transcultural
Robotic
Nursing
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Transcultural Robotic Nursing

Observing interactions between persons and caregivers...
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Transcultural Robotic Nursing

...and writing guidelines for Culturally competent robots.

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Transcultural Robotic Nursing

Cultural Knowledge Representation

Preparing a framework for cultural knowledge representation...

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Transcultural Robotic Nursing

Cultural Knowledge Representation

...that can be used to encode cultural knowledge about groups and individuals.
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- Transcultural Robotic Nursing
- Cultural Knowledge Representation
- Culturally sensitive planning and execution
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Transcultural Robotic Nursing

Cultural Knowledge Representation

Culturally sensitive planning and execution

Defining a framework and policies for planning actions by taking into account the cultural identity of the assisted person...

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Transcultural Robotic Nursing

Culturally sensitive planning and execution

Cultural Knowledge Representation

...by considering both sensorimotor behaviour and verbal interaction.

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Transcultural Robotic Nursing

Culturally sensitive planning and execution

Cultural Knowledge Representation

Culture-Aware Human-Robot Interaction

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Transcultural Robotic Nursing
Culturally sensitive planning and execution
Cultural Knowledge Representation
Culture-Aware Human-Robot Interaction

Design culturally competent sensorimotor behaviour and verbal interaction patterns.

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Transcultural Robotic Nursing
Cultural Knowledge Representation
Culturally sensitive planning and execution
Culture-Aware Human-Robot Interaction

Explore the opportunity of a smart ICT environment?

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Transcultural Robotic Nursing

Culturally sensitive planning and execution

Cultural Knowledge Representation

Culture-Aware Human-Robot Interaction

System Integration
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Transcultural Robotic Nursing

Culturally sensitive planning and execution

Cultural Knowledge Representation

Culture-Aware Human-Robot Interaction

System Integration

Integration of EU and Japan technologies for smart ICT environments

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- Transcultural Robotic Nursing
- Cultural Knowledge Representation
- System Integration
- Testing in Health-Care Facilities
- Culturally sensitive planning and execution
- Culture-Aware Human-Robot Interaction

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- Transcultural Robotic Nursing
- Cultural Knowledge Representation
- Culturally sensitive planning and execution
- Culture-Aware Human-Robot Interaction
- System Integration
- Testing in Health-Care Facilities

Make tests with persons in their own living space in a natural way.

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- Transcultural Robotic Nursing
- Cultural Knowledge Representation
- System Integration
- Testing in Health-Care Facilities
- Culturally sensitive planning and execution
- Culture-Aware Human-Robot Interaction

Both in the EU and JAPAN

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Assess the impact of cultural competence and pave the way for future studies.

Transcultural Robotic Nursing
Cultural Knowledge Representation
System Integration
Testing in Health-Care Facilities

Culturally sensitive planning and execution
Culture-Aware Human-Robot Interaction
End-User Evaluation

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Transcultural Robotic Nursing

Cultural Knowledge Representation

Human-Robot Interaction

Testing

End-User Evaluation

ETHICS BY DESIGN
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More details in:

Barbara Bruno, Nak Young Chong, Hiroko Kamide, Sanjeev Kanoria, Jaeryoung Lee, Yuto Lim, Amit Kumar Pandey, Chris Papadopoulos, Irena Papadopoulos, Federico Pecora, Alessandro Saffiotti, Antonio Sgorbissa,


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*The CARESSES EU-Japan project: making assistive robots culturally competent*, forital 2017, Ambient Assisted Living 8th Forum, Genova, Italy, June 12-15
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- Transcultural Robot Nursing
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- Transcultural Robot Nursing
  - To write realistic scenarios defining the robot’s attitude towards clients of different cultural groups during daily routines;
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- **Transcultural Robot Nursing**
  - To write realistic scenarios defining the robot’s attitude towards clients of different cultural groups during daily routines;
  - To collect examples of encounters between older clients and their carers, to identify and verify the relevant verbal and nonverbal behavioural cues;
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- **Transcultural Robot Nursing**
  - To write realistic scenarios defining the robot’s attitude towards clients of different cultural groups during daily routines;
  - To collect examples of encounters between older clients and their carers, to identify and verify the relevant verbal and nonverbal behavioural cues;
  - To produce guidelines and a huge number of «facts» and «rules» to describe the behaviour of a culturally competent robot;

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  • To write realistic scenarios defining the robot’s attitude towards clients of different cultural groups during daily routines;
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  • To «merge» general cultural characteristics (e.g., at national level) with individual characteristics.

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- Cultural knowledge representation
Paving the way to culturally-competent robots: the CARESSES project.

- **Cultural knowledge representation**
  - To encode guidelines in a format that is useful to generate the robot’s plans and adapt behaviours (ontologies, Bayesian networks, fuzzy representation);
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  - To encode guidelines in a format that is useful to generate the robot’s plans and adapt behaviours (ontologies, Bayesian networks, fuzzy representation);
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  - To make use of existing knowledge encoded in formal languages (e.g., upper ontologies, other domain ontologies).
  - To be able to use general characteristics as «hints» to investigate about the individual cultural identity;

```
Maybe he likes football
Do you like football?
Nope.
```
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- **Cultural knowledge representation**
  - To encode guidelines in a format that is useful to generate the robot’s plans and adapt behaviours (ontologies, Bayesian networks, fuzzy representation);
  - To make use of existing knowledge encoded in formal languages (e.g., upper ontologies, other domain ontologies).
  - To be able to use general characteristics as «hints» to investigate about the individual cultural identity;
  - To be able to update the cultural knowledge base using new information acquired through observations and dialogue.

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• Culturally-sensitive planning and execution
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• Culturally-sensitive planning and execution
  • To understand how and when cultural information should be used to choose goals, actions, or quantitative parameters (speed, distance, volume).

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- Culturally-sensitive planning and execution
  - To understand how and when cultural information should be used to choose goals, actions, or quantitative parameters (speed, distance, volume).

Should I suggest the user to invite a friend for 4th July?

Use cultural information to set the right goal at the right time.
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- Culturally-sensitive planning and execution
  - To understand how and when cultural information should be used to choose goals, actions, or quantitative parameters (speed, distance, volume).
  - Should I greet the visitor with a bow or shaking hands?
  - Should I suggest the user to invite a friend for 4th July?

Use cultural information to set the right goal at the right time

Use cultural information to choose among alternative actions

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- Culturally-sensitive planning and execution
  - To understand how and when cultural information should be used to choose goals, actions, or quantitative parameters (speed, distance, volume).

Should I suggest the user to invite a friend for 4th July?

Should I greet the visitor with a bow or shaking hands?

How far should I stay from the user?

Use cultural information to set the right goal at the right time

Use cultural information to choose among alternative actions

Use cultural information to parametrize behaviours

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- Culture-aware interaction in a smart ICT environment
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- Culture-aware interaction in a smart ICT environment
  - To provide motion and perceptual capabilities allowing the implementation of scenarios defined by health-care experts;
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- Culture-aware interaction in a smart ICT environment
  - To provide motion and perceptual capabilities allowing the implementation of scenarios defined by health-care experts;
  - To find smart solutions to make verbal interaction «culturally competent» and «not boring» in spite of its technological limitations;

Do you prefer quantum physics or pizza?

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  • To assess the user’s preference and personality traits by observing emotions, activities, and habits

Do you prefer quantum physics or pizza?

It is dinner time.

He is watching TV now.

He looks satisfied.

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Contact

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  - To assess the user’s preference and personality traits by observing emotions, activities, and habits (possibly in a smart ICT environment), and update the cultural knowledge base.

Do you prefer quantum physics or pizza?

It is dinner time.

He is watching TV now.

He looks satisfied.

He likes having dinner in front of the TV.

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Do you prefer quantum physics or pizza? It is dinner time. He is watching TV now. He looks satisfied. He likes having dinner in front of the TV.

Explored in details in the following presentation by Prof. Nak Young Chong.

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• Testing in Health-Care facilities: Key issues and challenges
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- Testing in Health-Care facilities: Key issues and challenges
  - Clients in their own living space: traditional care homes and supported home-care settings;

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- Testing in Health-Care facilities: Key issues and challenges
  - Clients in their own living space: traditional care homes and supported home-care settings;
  - Clients from different cultural groups

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• Testing in Health-Care facilities: Key issues and challenges
  • Clients in their own living space: traditional care homes and supported home-care settings;
  • Clients from different cultural groups
  • Experimental and control arms (with and without cultural customization);

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- **Testing in Health-Care facilities: Key issues and challenges**
  - Clients in their own living space: traditional care homes and supported home-care settings;
  - Clients from different cultural groups
  - Experimental and control arms (with and without cultural customization);
  - Testing for a «long» period during daily routines.

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• What is a robot without cultural customization?
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- What is a robot without cultural customization?

Existing robots tend to have the cultural identity of the robotic scientists and engineers that developed them!
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• What is a robot without cultural customization?

Existing robots tend to have the cultural identity of the robotic scientists and engineers that developed them!
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- End-user evaluation: Key issues and challenges
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• End-user evaluation: Key issues and challenges
  • Client perception of robot’s cultural competence;
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• End-user evaluation: Key issues and challenges
  • Client perception of robot’s cultural competence;
  • Client and caregiver quality of life;
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• End-user evaluation: Key issues and challenges
  • Client perception of robot’s cultural competence;
  • Client and caregiver quality of life;
  • Informal caregiver burden;

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• End-user evaluation: Key issues and challenges
  • Client perception of robot’s cultural competence;
  • Client and caregiver quality of life;
  • Informal caregiver burden;
  • Client satisfaction with robot;
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- End-user evaluation: Key issues and challenges
  - Client perception of robot’s cultural competence;
  - Client and caregiver quality of life;
  - Informal caregiver burden;
  - Client satisfaction with robot;
  - ...
  - To acquire sufficient information to prepare a roadmap and guidelines for future similar trials
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Recommendations Summary

• Avoid stereotypes: culture-generic information (e.g., at national level) can only be a starting point for acquiring user-specific information.
Conclusions

• Cultural competence can make robot more acceptable, which increase the quality of life of the users but also makes robots easier to commercialize in different countries.

• Designing a culturally competent robot requires the contribution of different disciplines, and has an impact on all RTD activities.
Culture-Aware Interaction in a Smart ICT Environment

Nak Young Chong,
Japanese Coordinator,
JAIST, Ishikawa, Japan
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• Culture-Aware Interaction
• iHouse Smart Home
• HISUISUI Health Care Facility
• Standardization

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• Culture-Aware Interaction
• iHouse Smart Home
• HISUISUI Health Care Home
• Standardization
Background and Motivation

• Japan: Super-Aging Society
• Changing Demographics
• Cultural Diversity
• Need for culturally Competent Elderly Care Robots
Japan: Super-Aging Society

Sources: Census (1920-2010) and "Population Projections for Japan:2011-2060" (2015-2060)
Culture-Aware Interaction
Theoretical Foundations

• Hofstede’s Cultural Dimensions (National Level)
• Papadopoulos’ Transcultural Nursing and Cultural Competence (Individual Level)
• How a robot should behave depending on the cultural identity of the user.
Culture-Aware Interaction

Dimensions of National Culture

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<th>Power Distance</th>
<th>Individualism</th>
<th>Masculinity</th>
<th>Uncertainty Avoidance</th>
<th>Long Term Orientation</th>
<th>Indulgence</th>
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<td><strong>United States</strong></td>
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</tr>
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</table>

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Culture-Aware Interaction

HREI: Human-Robot-Environment Interaction

**EU Consortium**

**CARESSES**

**uAAL-ECHONET interface**

**iHouse (ECHONET)**

**Smart ICT Environment**

**CARESSES Robot**

**User**

**Mrs Yamada**

**ADL data logs**

**Culturally competent services**

**Individual information**

**Personality traits**

**Culture-Aware Verbal/ Nonverbal**

**Human-Robot Interaction**

**Human emotion/intention estimation**

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Culture-Aware Interaction

Robot Emotion Generation Model

Environment

Sensory Representation

Object-based Visual Features

Scene-based Visual Features

Memory Retrieval

Emotion Model

Long-term Memory

Semantic Memory

Episodic Memory

Storage Filter

Memory Storage

Personal Emotion

Human

Social Referencing/Sharing

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Culture-Aware Interaction

Emotional Body Expression

Arousal (Fast)

Valence (Positive)

Neglect

α

γ

β

α

γ

(Slow)

(Negative)

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Culture-Aware Interaction

Social Navigation

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“The interrelated observations and theories of man’s use of space as a specialized elaboration of culture.”  [Edward T. Hall]
Cultural Identity Assessment

• Multimodal emotion recognition (audio, facial expression, wearable wrist sensors)
• Signal processing and machine learning
• What are good and bad interactions?
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• Human Robot Interaction
• iHouse Smart Home
• HISUISUI Health Care Home
• Standardization

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iHouse Smart home: Energy Monitoring & Management System (Nomi, Ishikawa, Japan)

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iHouse Smart Home

Learning user daily routines, activities, and preferences

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iHouse Smart Home

- Power over Ethernet (PoE)
- ECHONET Circuit Part for Driving Motor
- Normal Outlet
- Experiment Outlet
- Curtain Automatic Motor
- Communication Module
- Driving Motor Module
- Motion Sensor
- Door Open/Close Detection Sensor
- Temperature & Brightness Sensor
- WiFi Communication Adapter

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iHouse Smart Home

![Diagram of iHouse Smart Home system](image)

- **iHouse**: Central system for smart home automation.
- **ECHONET-based Devices**: Actuator, Device, Sensor, Appliance.
- **Home Gateway**: echowand, ECHONET Interface, uAAL Middleware.
- **CARESESES Cloud**: uAAL Middleware, SB, CB.
- **Robot Controller**: uAAL Middleware, SB, CB.
- **Robot**: Mrs. Yamada.

Data Transferring:
- Arrows indicating data transfer between different components.

Links:
- [EU-Japan Centre for Industrial Cooperation](http://www.EUbusinessinJapan.eu)
iHouse Smart Home

iHouse Network Infrastructure

- Heterogeneous network integration (ECHONET JPN-universal EU)
- Robot integration into iHouse
- Natural language user interface for smart home control

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- Human Robot Interaction
- iHouse Smart Home
- HISUISUI Health Care Home
- Standardization
HISUISUI Health Care Facility

Nomi, Ishikawa, Japan

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Geriatric Health Care Service

- Nursing, Short-stay rehab, Day care
- Caregiving needs and expectations
- Role assignment in caregiving (human vs. robot)
- Robot caregiving guidelines and protocols
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IEEE P1872.1 Robot Task Representation

• IEEE RAS/ Standing Committee for Standards
• A robot task ontology for knowledge representation and reasoning
• Expected date of submission of draft 01/2020
• Need for a common vocabulary with clear and concise definition
Recommendations Summary

• Culture-aware verbal/non-verbal interaction
• Smart home system integration
• Testing and assessment in a healthcare facility
• Need for a standard and well-defined robot task representation
Conclusions

• Cultural identity components and assessment
• Heterogeneous ICT network-robot integration
• Human Robot Interaction evaluations: What are good/bad practices?