IMPLEMENTATION AND INTEGRATION OF ADVANCED ROBOTIC SYSTEMS AND INTELLIGENT ENVIRONMENTS IN REAL SCENARIOS FOR AGEING POPULATION

Experience of evaluating social service robotics in assisted living

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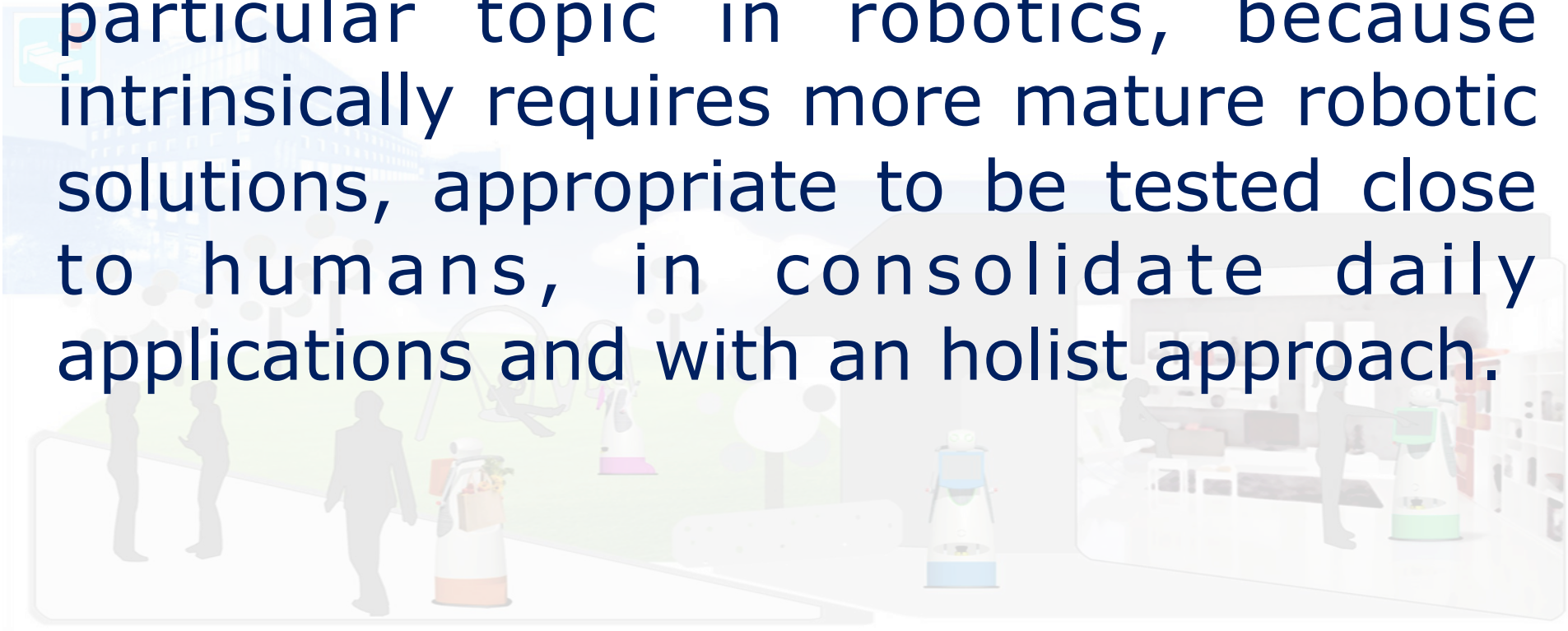
The Robot-Era Project has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement num. 288899 -

Evaluating Social robotics

The evaluation of Social Robotics is a particular topic in robotics, because intrinsically requires more mature robotic solutions, appropriate to be tested close to humans, in consolidate daily applications and with an holist approach.



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Robot-Era Objectives

The **OBJECTIVES** of the Robot-Era project are to develop, implement and demonstrate the general **feasibility, S/T effectiveness** and **social/legal plausibility** and **acceptability** by end-users of a **plurality of complete advanced robotic services, integrated in intelligent environments**, which will actively work in real conditions and cooperate with real people and between them to provide favorable **independent living, improving the quality of life and the efficiency of care for elderly people**.

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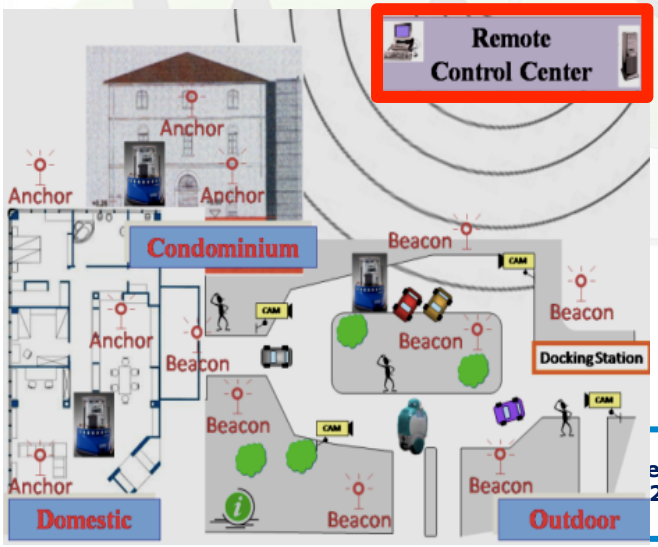
Robot-Era innovations

1. Services provided by a set of autonomous and well orchestrated mobile robots **integrated in smart environments** : **outdoor, condominium and domestic** (3D service robotics)



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Robot-Era innovations

1. Services provided by a set of autonomous and well orchestrated mobile robots **integrated in smart environments** : **outdoor, condominium and domestic** (3D service robotics)
2. Design and provision of **11 different services** to users with a **User- and society- centred approach**
3. **Extensive tests with 70 (first loop) + 40 (second loop) real users** in two different sites (IT, SE)and in a long experimental campaign (**real environments**)

Peccioli, Pisa (IT)

- Small ancient town
- A *Living Lab* spread over an entire small town
- DomoCasa Living Lab

Orebro (SE)

- Residential apartments
- Senior with special needs and care
- Health center with medical service

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Analysis of end-users needs and service definition

Robot-Era Services Definition
Communication
Indoor escort at night
Reminding
Outdoor walking support
Laundry support
Drug and shopping delivery
Garbage collection
Food delivery
Objects transportation

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Experimental Loop

Communication

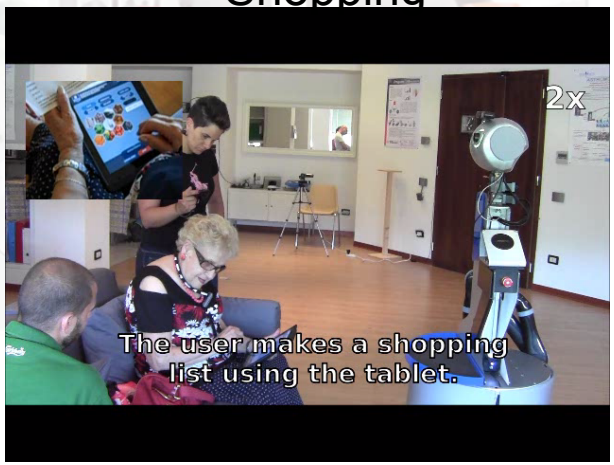
Escort

Garbage

Walking

Reminding

Shopping



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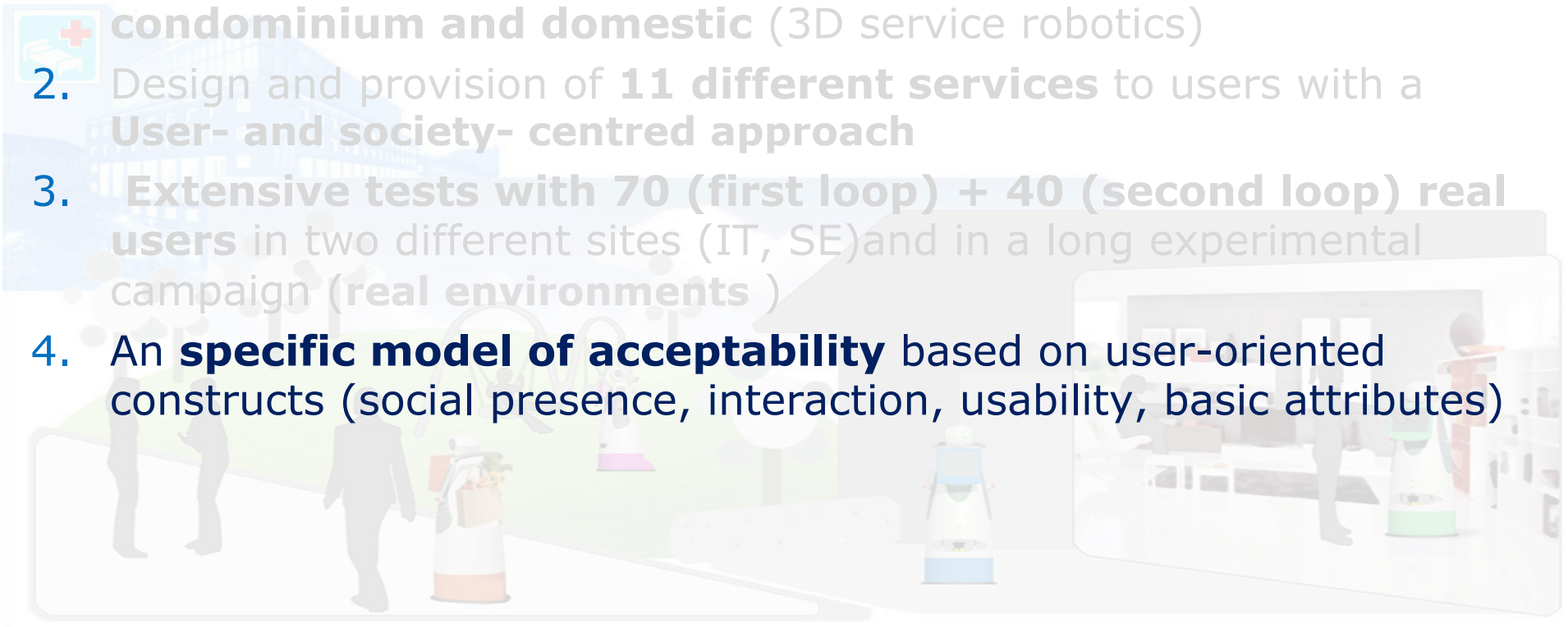
4. An **specific model of acceptability** based on user-oriented constructs (social presence, interaction, usability, basic attributes)



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Questionnaires and Constructions

Aesthetics questionnaire

- Anxiety
- Aesthetics
- Safety
- ITI: Intention to interact
- FC: Facilitating Conditions
- PF: Perceived Functions

SUS

System Usability Scale (SUS) provides a "quick and dirty", reliable tool for measuring the usability. It consists of a 10 item questionnaire with five response options for respondents

INTERVIEW on USABILITY, ATTITUDE & ACCEPTANCE of the single service

- ATT: Attitude
- ACC: Acceptability Parameters
- QoL: Quality of Life
- HRI
- GUI
- Speech: Speech Interaction

UTAUT Questionnaire

ANX	Anxiety	Evoking anxious or emotional reactions when using the system.	PEOU	Perceived ease of use	The degree to which the user believes that using the system would be free of effort
ATT	Attitude	Positive or negative feelings about the appliance of the technology.	PS	Perceived sociability	The perceived ability of the system to perform sociable behavior.
FC	Facilitating conditions	Objective factors in the environment that facilitate using the system.	PU	Perceived usefulness	The degree to which a person believes that using the system would enhance his or her daily activities
ITU	Intention to use	The outspoken intention to use the system over a longer period in time.	SI	Social influence	The user's perception of how people who are important to him think about him using the system
PAD	Perceived adaptability	The perceived ability of the system to be adaptive to the changing needs of the user.	SP	Social presence	The experience of sensing a social entity when interacting with the system.
PENJ	Perceived enjoyment	Feelings of joy or pleasure associated by the user with the use of the system.	Trust	Trust	The belief that the system performs with personal integrity and reliability.

Technology experience | Health Status | Education | Gender | Age

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Results

Robot-Era services	Usability*		Acceptance*	
	Peccioli	Ängen	Peccioli	Ängen
Shopping and drug delivery	80,86 ± 15,81		87,69 ± 8,23	
Communication	85,57 ± 14,09	71,04 ± 20,30	88,54 ± 7,94	72,74 ± 7,86
Garbage collection	90,14 ± 14,76		89,97 ± 8,33	
Reminding	75,28 ± 23,12	56,09 ± 28,85	87,26 ± 12,32	84,36 ± 14,31
Indoor walking support	89,70 ± 9,29		88,70 ± 7,12	
Escort at night		75,17 ± 24,92		88,56 ± 14,31
Outdoor walking support	83,44 ± 12,51		89,01 ± 8,06	
Food delivery		77,34 ± 20,24		86,84 ± 11,20
Laundry delivery		76,72 ± 21,70		89,68 ± 11,02
Object transportation	91,63 ± 11,11	81,48 ± 13,19	92,46 ± 5,43	86,67 ± 10,78

*0-64: not usable / acceptable - 65-84: usable / acceptable - 85-100: excellent

Experimental protocol definition for the second experimental loop

Real Assisted Tests

Scenario-based experimentation

Scenario 1
- Communication
- Reminding
- Indoor escort
- Surveillance
- Object Transportation

20 Users
20 Users

Scenario 2
- Cleaning
- Garbage Collection
- Outdoor walking Support
- Shopping and Drug Delivery

20 Users

Scenario 3
- Cleaning
- Food Delivery
- Laundry

20 Users

Real Tests

Use-case 1 Ancona
- Communication
- Reminding
- Indoor escort
- Surveillance
- Object Transportation

Use-case 2 Peccioli
- Walking support in Ghizzano park
- Walking support in the bike lane close to the Lab
- Walking support and shopping assistance

Use-case 3 Ängen
- Food Delivery
- Laundry
- Mail Delivery

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4. An **innovative model of acceptability** based on user-oriented constructs (social presence, interaction, usability, basic attributes) :
5. Concrete actions to ensure the establishment of **permanent infrastructures** after the end of the Robot-Era project
6. The project has taken into consideration the **transferability and feasibility of the robotics solution** (market analysis; legal, insurance, ethical and certification issues)

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Conclusions: Key points

- Make efforts in developing real experimental settings, which can be justified by
  - Marketability/Business profitability / Exploitation
  - Technological readiness
  - Social, ethical and legal barriers (approval)
  - Stakeholder requirements and acceptability (services useful to satisfy users' needs)
  - Deployability in place
- Identify innovative model of acceptability and usability for robotic solutions
- Set a permanent infrastructure designed with an holistic approach (ELS issues, stakeholders involvement, extensive tests with users in real cases)

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