Why socially assistive robots?

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- SAR
- Are SAR really useful?
- Designing SAR from the very beginning
- Use case: the CLARC robot
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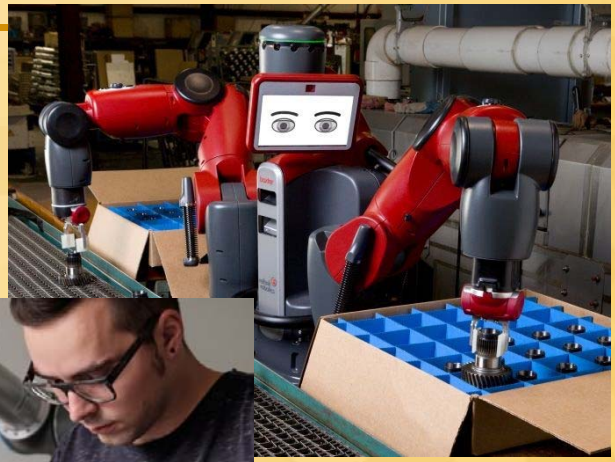
Current robot applications

- Traditional classification:
  - Industrial robots
  - Service robots

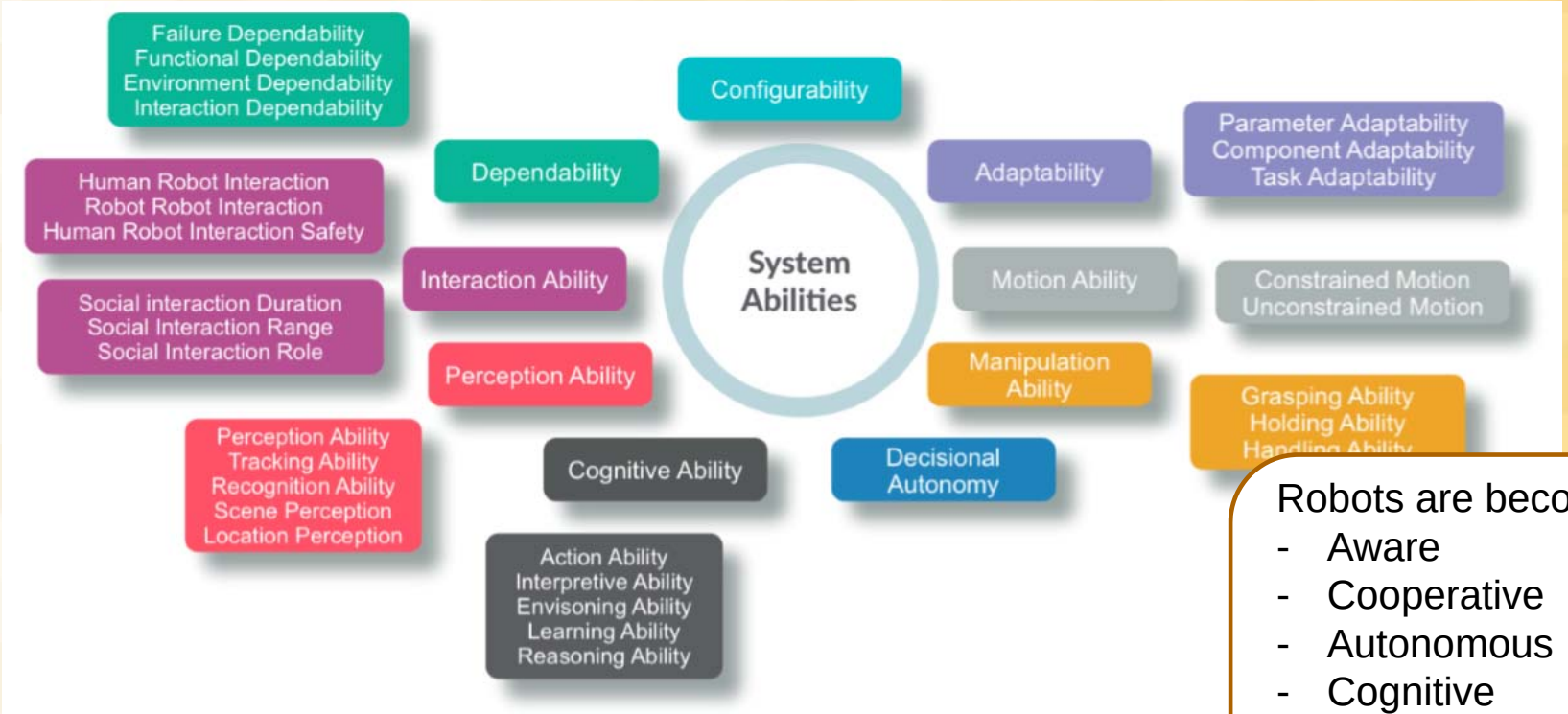
Too simple, not useful to describe current and future robots

- New industrial robots:
  - Co-operative, interactive
  - Mobile, autonomous
  - Flexible, adaptable (learn)
  - *They are used for manufacturing…*



Service or industrial? →

New robots for new applications



Taken from:
SPARC: The partnership for robotics in Europe. *Robotics 2020 multi-annual roadmap for robotics in E*urope.
The EU framework programme for research and innovation. Report. 2015

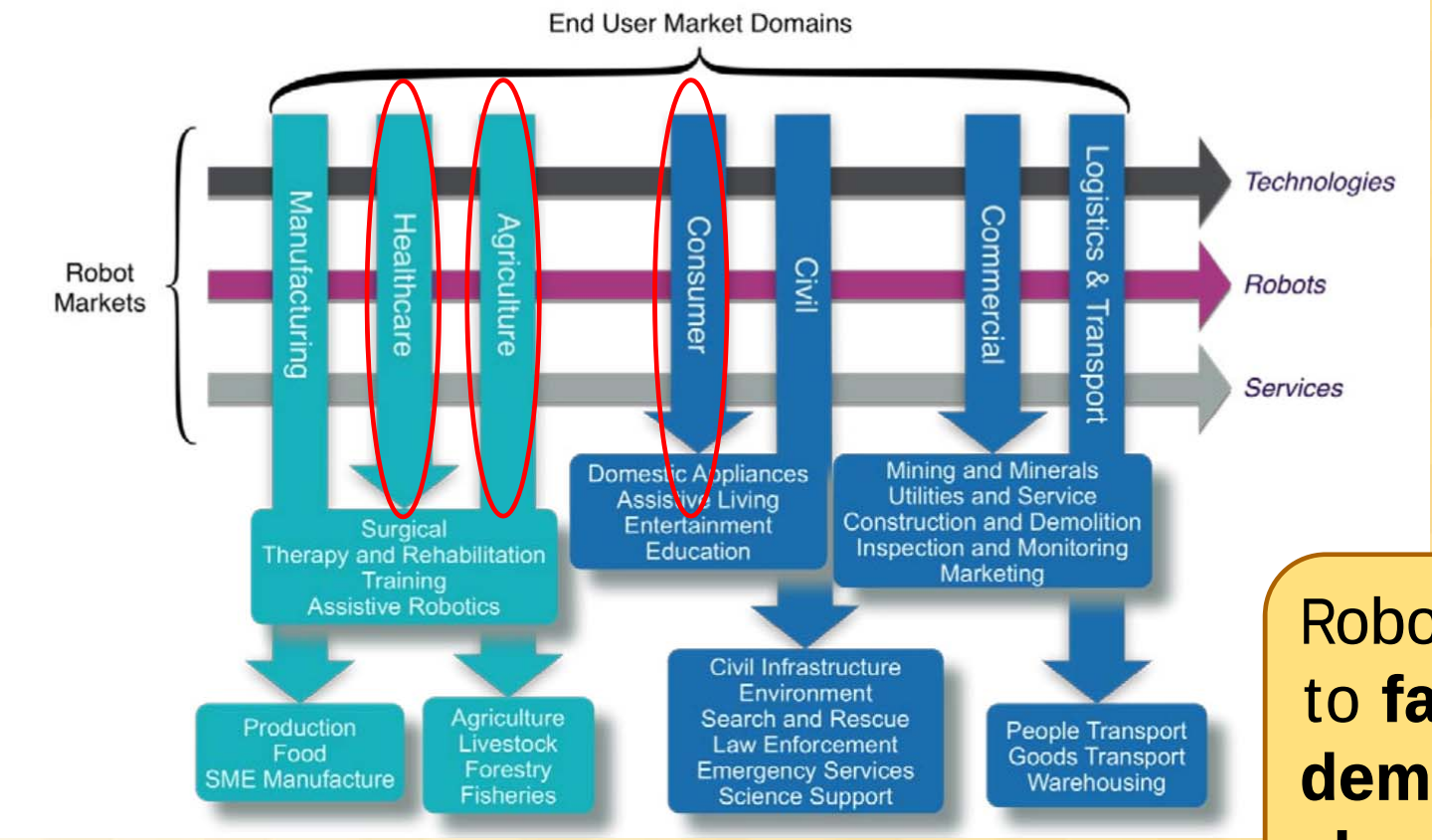
Robots are becoming:
- Aware
- Cooperative
- Autonomous
- Cognitive
- Adaptive
- Proactive
- ...

Why?

To do what?

Is it worthy?

Roadmap for robot applications



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Robotics as a tool to **face demographic changes**

The silver society

	2015	2030
Andalucia	19.6%	25.8%
Spain	18.2%	24.9%
Europe	18.3%	24%
Japan	25.9%	30,4%

% population > 64 years

- **2035:** There will be more people aging 64 or more, than people in working ages
- Less caregivers, more medical and social expenses

The silver society

Requires measures

- Active ageing
  - Help seniors maintain their functional ability
  - Healthy living, healthy ageing
  - Include medical equipment at home
- Improve hospitals, nursery houses and day care centers
  - with new tools to ease the daily work of healthcare professionals

Let the elderly people live as autonomous as possible, as long as possible

New technologies, including robotics

Medical robots

- **Clinical robots:**
  - Diagnostic or surgical assistance. Teleoperation
  - Minimally-invasive surgery
- **Rehabilitation robots:**
  - Prosthesis, exoskeletons, motion help and monitoring systems…
- **Specialist supporting assistant robots:**
  - Help in daily care routines, such as standing up, sitting down, going to the toilet, etc.

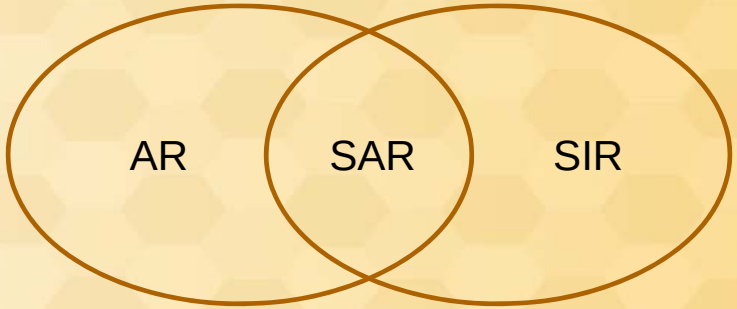
Assistive Robots

Assistive robot: one that helps a human user

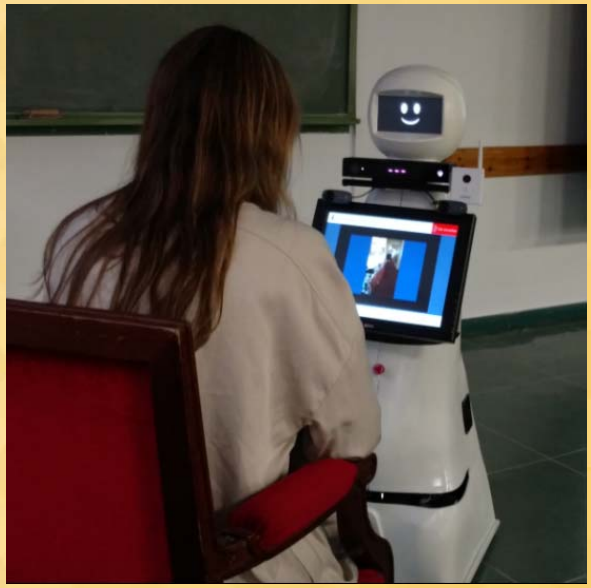
- Autonomous wheelchairs, robotic manipulators, companion robots…
- Key difference respect to medical robots: working scenarios
  - Daily life environments, not necessarily medical facilities
  - Constant supervision not required
  - Non invasive assistance
  - Devices more interactive and more versatile
  - **Consumer devices**
- Conceived as a part of a smart environment, in which they cooperate with other technologies, such as other assistive robots or smart houses

Socially Assistive Robots

We define socially assistive robots (SAR) as the intersection of assistive robots (AR) and socially interactive robots (SIR). SAR shares with assistive robotics the goal to provide assistance to human users, but it specifies that the assistance is through social interaction. *(Feil-Seifer y Mataric, 2005)*



Feil-Seifer,D.; Mataric, M.J. *Defining Socially Assistive Robotics*. Proc. of the 2005 IEEE C9th Int. Conf. on Rehabilitation Robotics. 2005, 465-48.



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Socially assistive robots (SAR)

Goal:

- Assist people

Improving tech.

Motivation to use them:

- Versatile
- Proactive
- Social interaction is a key part of many therapies
- Embodiment eases acceptability
- No physical contact required

Utility

Acceptability
- Attitude
- Usability
- Confidence

Socially assistive robots (SAR)

Shared characteristics:

- Physical
- Safe and social navigation
- Multimodal interaction: robust and accesible
- Expressions: to let the user know about the robot's state (no emotional interaction)
- Passive and active monitorization

SARs today: A review

Relevance:

- Important inversion
- Many projects: Accompany, HOBBIT, SILVER, SERROGA, Florence, Mobiserv, Robot-ERA, ROREAS, SIRMAVED, CLARC, Assesstronic, …
- Great potential for applications
- Relevant business opportunity

Results:

- Useful: They can motivate, monitorize, inform…
- efficiently, and in a non-invasive way
- User's overall opinion: Good qualitative results
  - Helps maintaining an independent living
  - Stress reduction
  - Improves mood
  - Decreases loneliness

Short -term

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Two real examples of SAR

- **Project #1**
- Funding (total): 4,8M EUR
- SAR purpose:
  - Entertainment
  - Cognitive and social assistance
  - Physical support for retrieving or transporting items
- SAR employed: Expensive
- Working scenario: Homes

- Relies on increasing acceptability via affection and emotions.
- Experiments: Two elderly people used the robot at home for three weeks.
- Results:
  - Technically correct
  - Potentially interesting tool
  - Show that after novelty effect the seniors didn't adhere very much to the robot

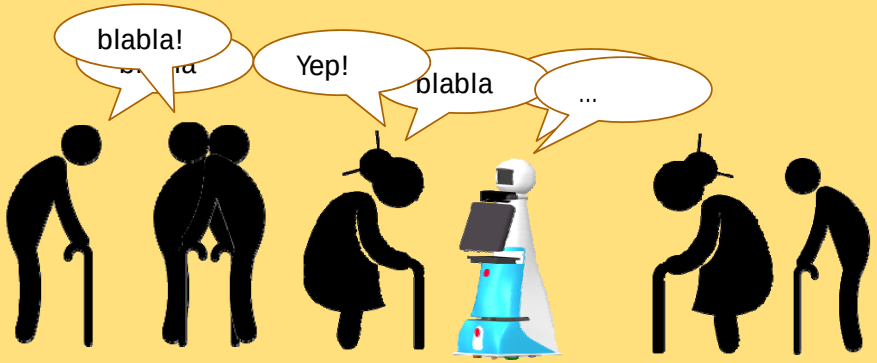
Two real examples of SAR

- **Project #2**
- Funding (total): 4,1M EUR
- Started as an effort to identify new technologies able to assist people.
- SAR purpose: Ease independent living
- SAR employed: Robotic walker.
- Working scenario: Home, day care centers, hospitals,…
- User-centered designed.
- Designed to be useful and accepted via accesibility, usability and confidence
- Results:
  - The robot is currently on the market

What are SAR doing well?

- Work autonomously
- Interact with Smart Environments
- Positive initial response
- Adapt to different roles, tasks and scenarios
  - Not better than a computer game for cognitive training…
  - Not much better than a pet or toy to reduce stress in one-to-one interactions…
  - Not better than other devices to monitor people…
  - **But one SAR can do all these tasks and more**

- They are very good **social facilitators**
  - Best when they are included in a group of people
  - Best scenarios: Retirement houses, daily care centers, hospitals,…



What's wrong?

- **Limited experimentation.** Common issues (Broekens et al. 2009, Mataric 2017):
  - Control group
  - Reproducible experiments
  - Long term experiments (months, or years!)
  - Studies should cover a significant sample of the target population

- Broekens, J.; Heerink, M.; Rosendal, H. *Assistive social robots in elderly care: a review*. Gerontechnology. 2009; 8(2):94-103.
- Mataric, M.J. *Socially assistive robotics: Human augmentation versus automation*. Science Robotics. 2017; 2.

What's wrong?

More commonly detected issues:

- Uncanny valley:
  - False expectations
- Boredom:
  - No real effects in daily routines,
  - Feeling that the robot is not of real use
- Not useful for healthcare professionals:
  - If it doesn't **save time**, if it doesn't provide new **really useful** features…
  - WHY USING THEM?
- Many current SAR are **not correctly designed**, are **not adequately tested** in real scenarios, are **not really useful**, and/or are not being used in adequate applications.
- They cannot be a 'promising' device forever. It's time to begin creating really useful SAR.
- How can we do so?

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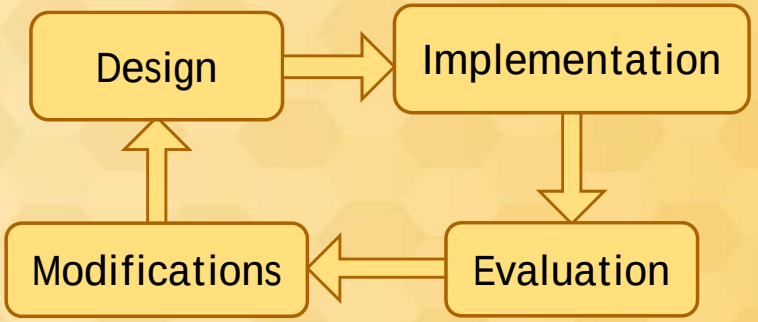
User centered design

- Count with the users in **all** stages of the design process
- Which users / stakeholders? ALL.
  - For instance, for a SAR working in a retirement house:

Primary	Elderly people, caregivers
Secondary	Family, friends, visitors, external healthcare professionals
Tertiary	Rest of workers, management staff, external hw & sw providers

- Matches with prototyping models



Listening to the elderly people

Elderly people is a wide target!

- Cultural issues
- Use of technology
- Expectatives
- Cognitive issues
- …

In general:

- They are positive towards the robot
- False expectations are very harmful for adherence
- **Functionality** is the key component for long-term acceptance
  - Attitude, Usability, Confidence

Listening to the caregivers

Also a wide target

- Cultural issues
- Use of technology
- Expectatives
- Concerns
- …

In general:

- Worried about robots that seem to be designed to replace or monitor them
- Happy if the robot makes their job easier
  - Saving time, easing tasks…
- **Utility** is the key component for long-term acceptance

Listening to the manager

Why using a SAR?

- Catch attention of potential clients
- Monitor people
  - Careful!
- Provide new functionalities
- Affordable **cost**
  - Careful!

Listening to the engineers

What's "easy" for a SAR?

- Connect to smart environments
- Carry tactile interfaces
- Speak
- Monitorize
- Detect people
- Avoid collisions when navigating and trace reasonable routes
  - Autonomous navigation can be considered a solved problem
- …

What's complex?

- Recognize emotions
- Free talking
- Listen
- Social navigation
- Manipulate in unconstrained scenarios
- Imagine, prevent,
- …

Listening to the engineers

Main requirement: Make a set of specifications for the SAR

- Adaptability VS (Cost & Robustness)
- The more you ask, the more it costs
- So… what do you really need the SAR to do? Do you really need < arms / complex expressions / hand gesture recognition >?

Safety concerns

- ISO 13482:2014 standard for service robots: Not enough… not widely used
- Current common trick: Compliance of all components makes the total machine compliant
  - Careful!

Ethics

SAR Goal:

- Assist people: Two different meanings are posible
  - Become an autonomous assistant that can replace a human caregiver
  - Become a tool for caregivers to help assist people more efficiently

Ethics

SAR Features:

- A SAR should not look like human
- The more anthropomorphic a SAR is, the more expectations it produces.

  False expectations have to be avoided at all cost!!!

- Ethical risk of identification and **confusion** is greater in the target population (elders with possible cognitive impairments)
- Same applies to emotional stuff: The **less emotional** the SAR is, the better.

Ethics

SAR behaviours and legal issues

- A SAR is a machine. It is not a person, not even from a strictly legal point of view.
- Who is responsible?
  - Designer or maker
  - Open source: Hw or Sw maker
  - Supervised learning: The user who taught
  - Autonomous learning.

The ‘electronic person’ concept is not a legal not an ethical option

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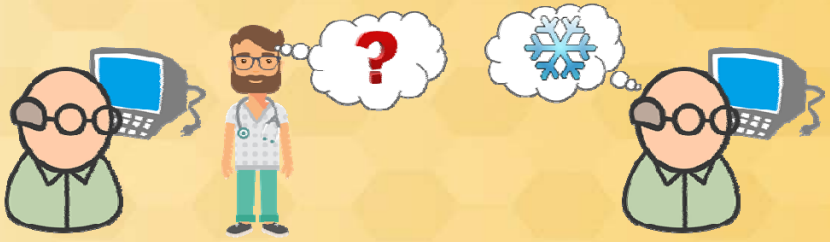
The approach

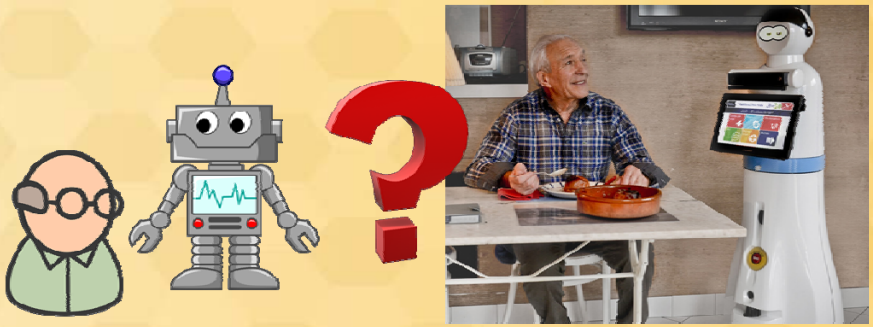
Active ageing

- requires continuous monitoring and assessment.



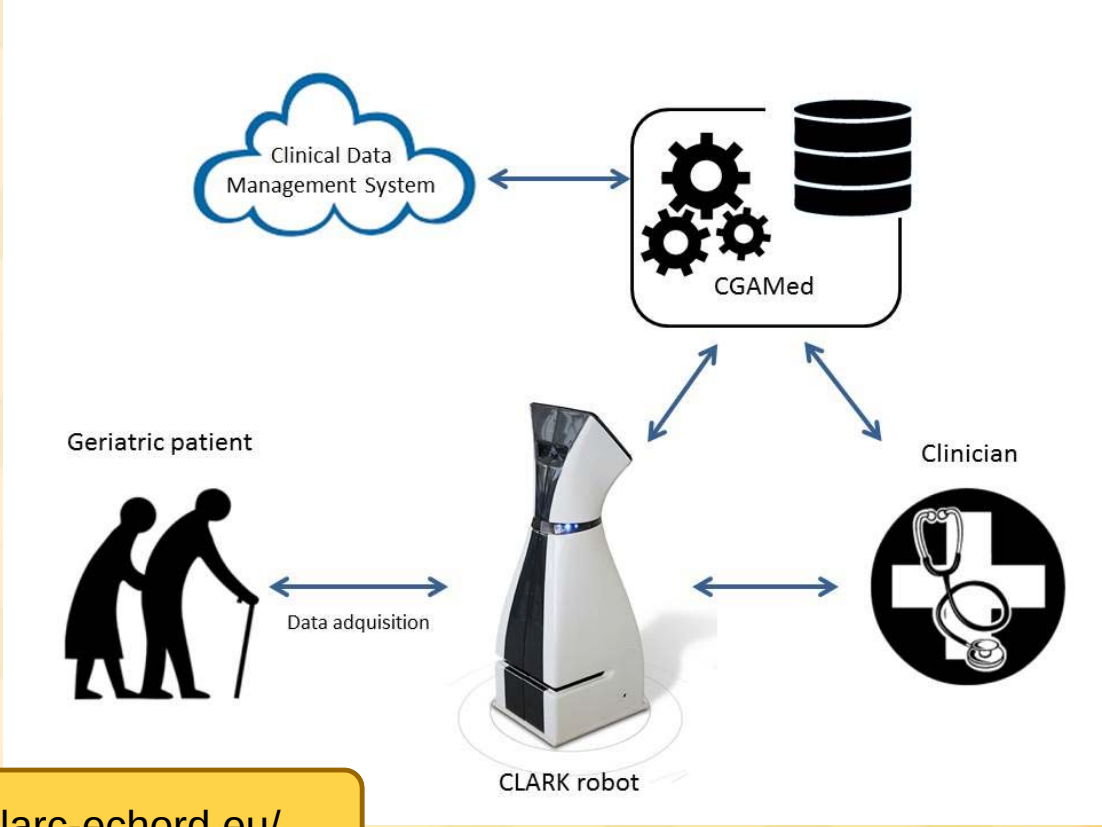
Comprehensive Geriatric Assessment (CGA)

- Captures medical, psychosocial and functional capabilities and limitations.
- Includes different tests (e.g. Barthel, Minimental, Get Up & Go)
- Some activities can be automated.
- ECHORD++ Project
  - CLARC (FP7-ICT-601116).
  - Assesstronic.



CLARC hypothesis: A social robot is the best tool to automate CGA procedures

The approach



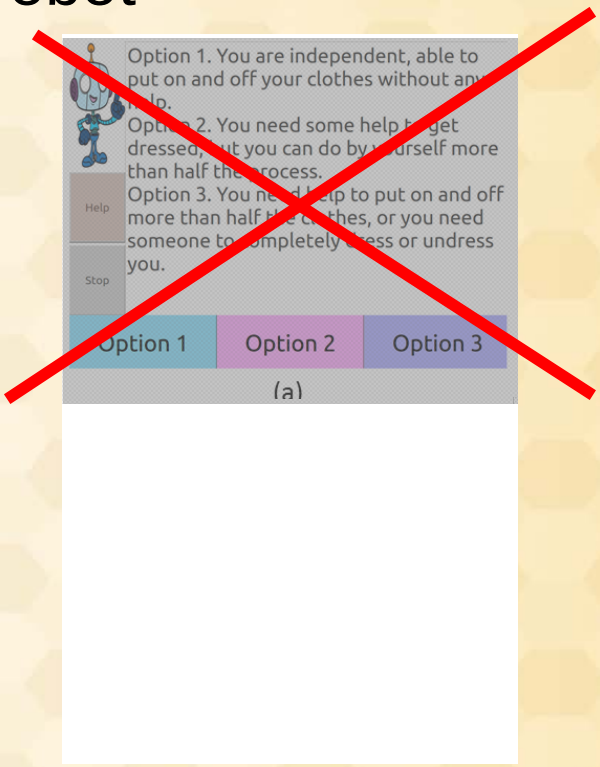
http://www.clarc-echord.eu/

CLARC robot

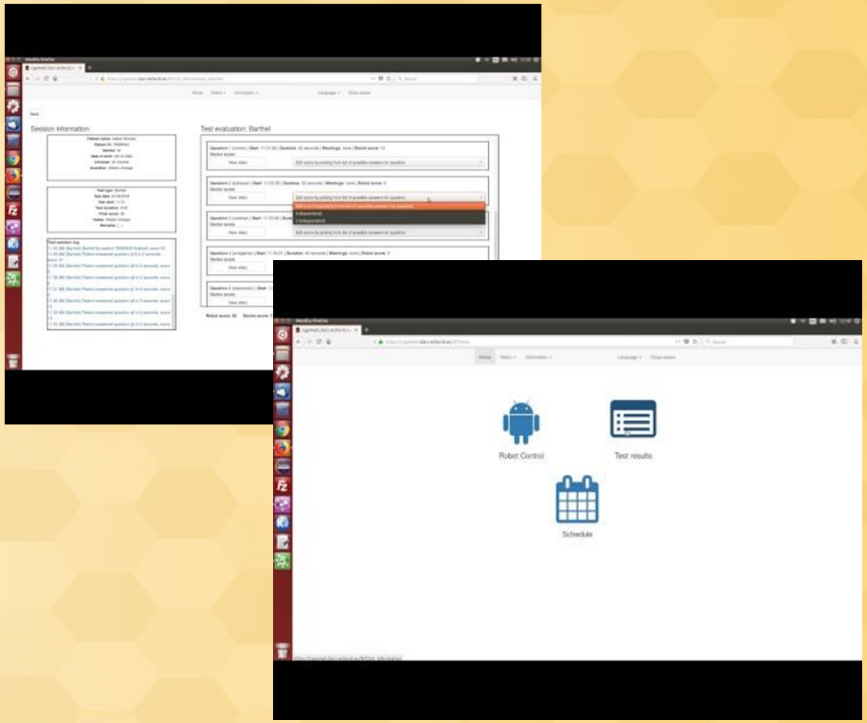
http://www.clarc-echord.eu/

CLARC interfaces

- For the person interacting with the robot



- CGAMed for the clinician



Tests performed so far

- Many technical and lab experiments
- Autonomous navigation
- Functional tests (Barthel): 13 users
- Cognitive tests (Minimental): 11 users
- Motor tests (Get Up & Go): 15 users

- Autonomous tests
- Not completely autonomous use cases

CLARC: Phase III

- 3 prototypes
  - Retirement houses
  - Hospital
  - In France and Spain
- 1 robot for backup, update & experimentation
- 3 months of testing
- **Starting now!**

http://www.clarc-echord.eu/

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Conclusion: What's a SAR good for?

A SAR is a valuable tool:

- when interacting with groups of people
- when it saves time for the clinician
- when it can perform different tasks and adapt
- when it's accepted by the user
  - Accesible, useful, trusted
  - Functionality!
- when it's cheap enough

A SAR is not an option:

- in long-term one-to-one interactions (not right now)
- if it tries to replace human caregivers
- if it tries to be too emotive
- if it has to be too complex
  - Safety
  - Legal issues
- if it's too expensive

Grupo ISIS AVISPA

Universidad de Málaga

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Thank you very much!

Questions?

September 10th, Singapore