NAOTHERAPIST: AUTONOMOUS ASSISTANCE OF PHYSICAL REHABILITATION THERAPIES WITH A SOCIAL HUMANOID ROBOT

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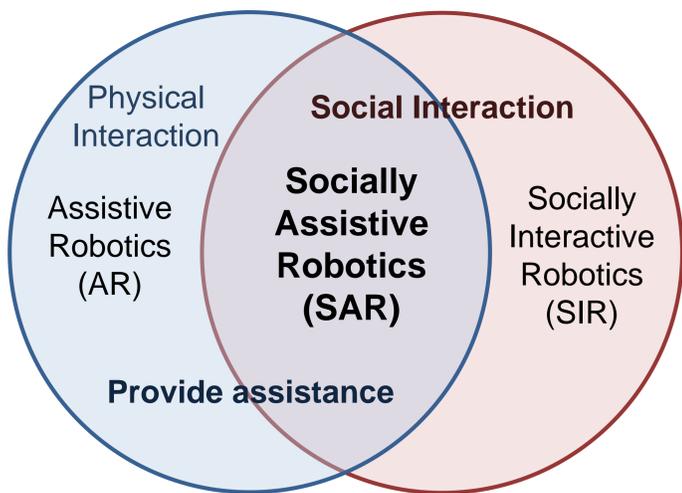*Av. de la Universidad 30, 28911, Madrid, Spain*

1. BACKGROUND

"Socially Assistive Robotics provide assistance through social interaction and without physical contact"

Physical Interaction — Assistive Robotics (AR)

Social Interaction — **Socially Assistive Robotics (SAR)** — Socially Interactive Robotics (SIR)

Provide assistance

- The social robot is able to:
  - **Carry out sessions autonomously**
  - **Coach and encourage to do activities**
  - **Remind to use the affected limb**
- Non-contact interaction → **less risk to patients**
- **Easily tested and deployed**

2. TARGET PATIENTS

- Children from **4 to 14 years old**:
  - Obstetric Brachial Plexus Palsy (OBPP)
  - Infantile Cerebral Palsy (ICP)
- Causing **upper limb disorders**
- Patients are **unmotivated** with the treatment

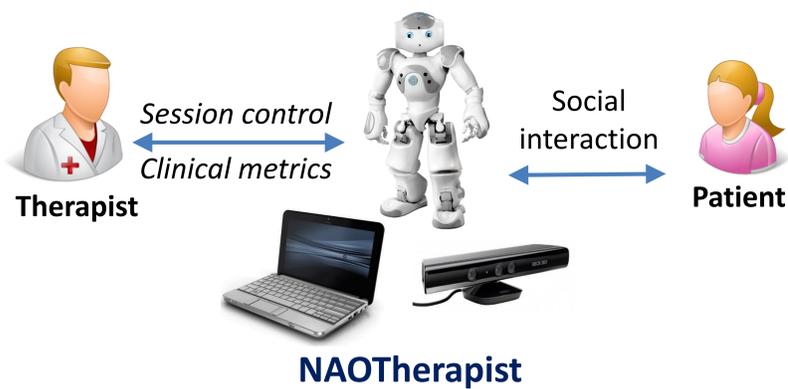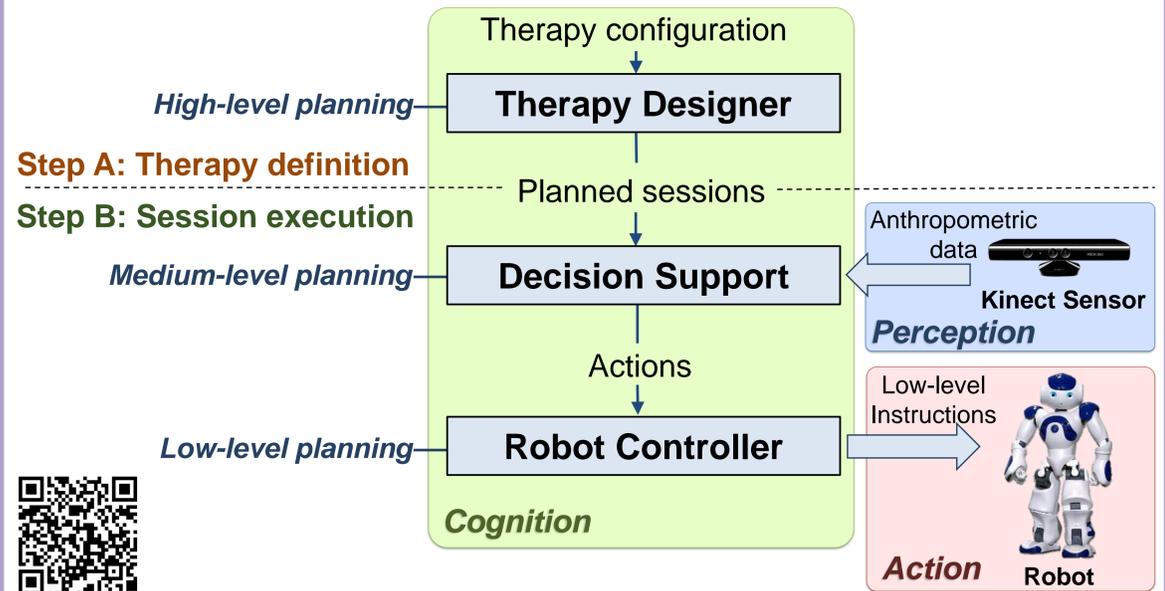Cervical vertebrae — Brachial plexus
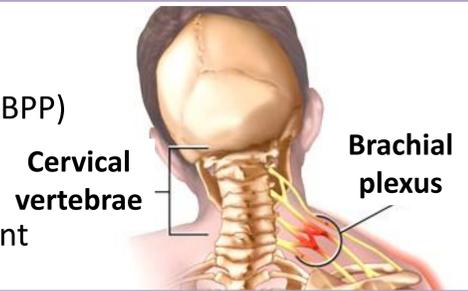
3. OBJECTIVES
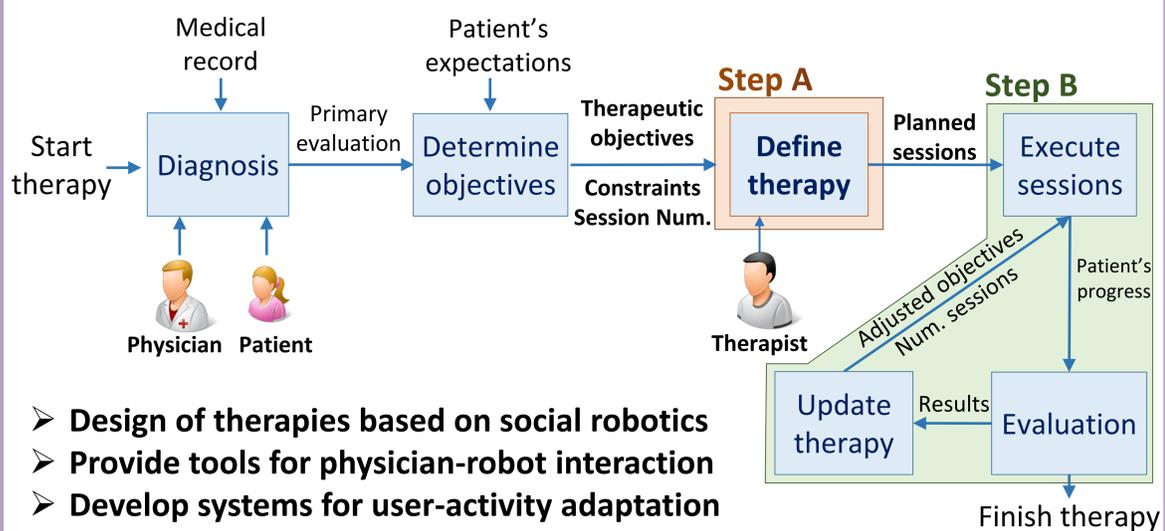
- Design of therapies based on social robotics
- Provide tools for physician-robot interaction
- Develop systems for user-activity adaptation
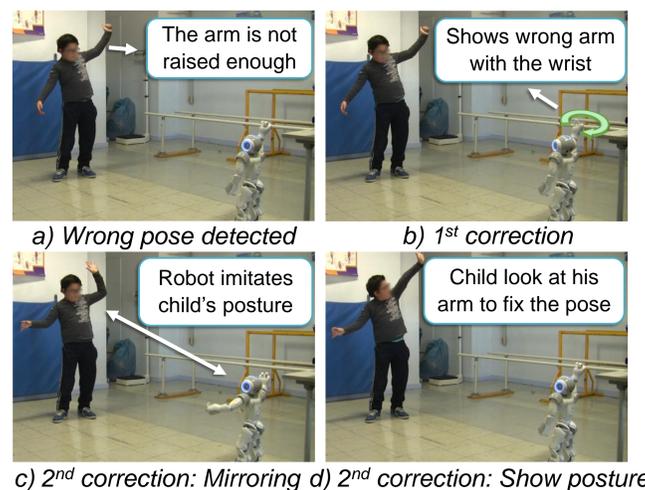
4. TOWARDS NOVEL THERAPIES

Therapist — *Session control / Clinical metrics* — NAOTherapist — *Social interaction* — Patient

5. ARCHITECTURE OVERVIEW

Therapy configuration

High-level planning — **Therapy Designer**

Step A: Therapy definition
Step B: Session execution

Planned sessions

Medium-level planning — **Decision Support** ← Anthropometric data — Kinect Sensor — *Perception*

Actions

Low-level planning — **Robot Controller** → Low-level Instructions — Robot — *Action*

Cognition

6. USE CASE AND CORRECTION MECHANISMS

The arm is not raised enough
Shows wrong arm with the wrist
Robot imitates child's posture
Child look at his arm to fix the pose

a) Wrong pose detected b) 1st correction
c) 2nd correction: Mirroring d) 2nd correction: Show posture

- The patient **imitates** the poses of the robot
- The poses are prescribed and **adapted to each patient**
- The level of difficulty is **adjusted online** while training
- Each **pose is verified**
- The system provides **feedback** to correct the poses

7. EVALUATION AND CONCLUSION

	1st Phase	2nd Phase	3rd Phase
	First contact		Long term
Participants	117	3	8
Condition	Healthy	2 OBPP, 1 ICP	6 OBPP, 2 ICP
Age	7.9 ± 1.4	7.66 ± 0.94	6.87 ± 2.42
Gender	53 F, 64 M	3 M	3 F, 5 M
Duration (m)	5 ± 0.83	13 ± 0.81	24 ± 2.71
N. of sessions	1	1	11.62 ± 3.93
Place	Schools	Hospital	

- NAOTherapist proposes a general framework of **hands-off robotics rehabilitation**
- The participants are able to **follow the sessions** with the instructions of the robot
- The **platform works autonomously** and achieves an **active engagement** from the children
- Experts believe the robot is **useful for physiotherapy**

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IWART — International Worshop on Assistive & Rehabilitation Technology — Elche, 14-16 Dec. 2016

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