# Adaptation in Humanoid Robots Serious Games for Mild Cognitive Impairment Older Adults

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# Social Robots

- Robots are increasingly used in many contexts
- Industrial robots vs social humanoid robots
- Social robots interact with us by voice, gestures and all the other modes typical of human communication
- Social humanoid robots can help us in housework, care of children, elderly and disabled people, hospitals, hotels …
- They can be useful also for supporting older adults in various ways

# Social Robots for MCI Older Adults

- Senior population is foreseen to more than double by 2050 worldwide
- An increasing demand for high-quality elderly support is expected in the coming years
- Mild Cognitive Impairment (MCI) is an intermediate stage between the cognitive decline associated with normal ageing and more serious forms of dementia
- It is especially important to offer them timely and engaging cognitive training to slow the progression of their decline

# State of Art

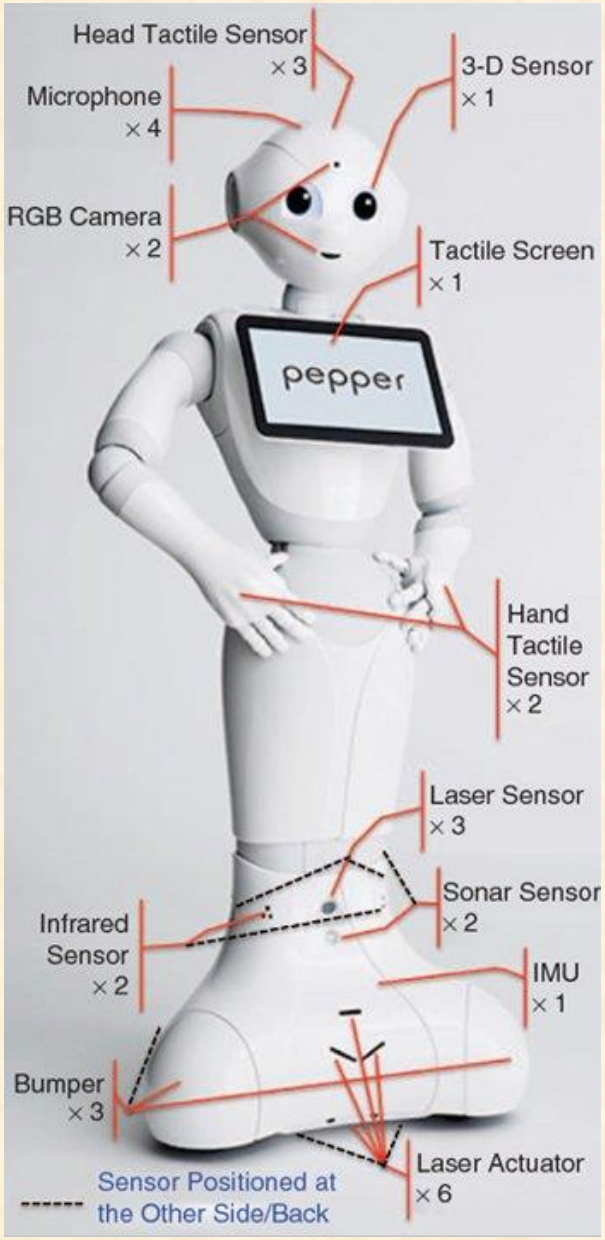
- The introduction of computerized serious games for cognitive support has received several proposals
- The possibilities that emerging interactive technologies may offer to such people seem largely untapped until now
- Need of understanding how they approach and perceive the cognitive interventions provided through various types of assistive interaction technologies
- Humanoid robots seem promising since they can support more engaging interactions with users, and there have already been some proposals exploring their use

# Goals

- Investigate how seniors with MCI relate with and perceive serious games accessed through humanoid robots
- Include exercises as part of a training program aimed to improve their cognitive status
- Collaborate with local Train The Brain project (Inst. of Neuroscience-CNR)
- Design and develop a quiz game to help the subjects to train their memory while receiving encouraging feedback from the application.
- Introduce also a version for tablets, as a useful reference point for our analysis, given that the tablet is currently the most used device in cognitive training

# The Pepper Humanoid Robot

- 1.2-m-tall wheeled humanoid robot
- by SoftBank Robotics




Interaction modalities:

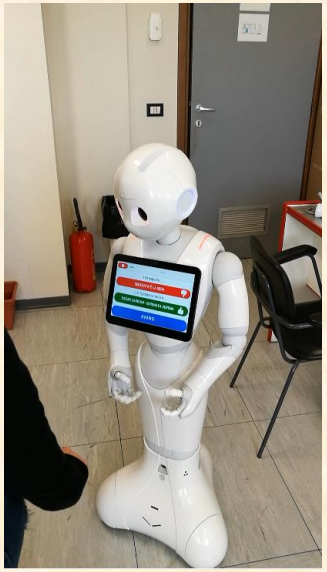
- speech;
- gestures;
- facial expressions;
- haptic;
- gaze orientation;
- proxemics and kinesics

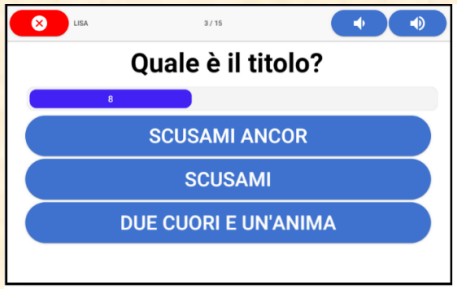
# The game

- Two versions (tablet vs. robot "Pepper" -based) of the serious game
  - In both versions:
    - touch-based interaction + vocal feedback
    - positive and encouraging feedback also in case of errors
  - Robot-based version use gestures, movements, and animations to provide more expressive and emotional feedback

- 15 questions with 20 seconds timeout
- Who is the singer ? or What is the title ?
- Three options available to choose from
- Feedback to the answer by providing a voice message and Pepper animation
- The application saves various pieces of information, such as reaction time, time taken to complete a session, number of correct and wrong answers

# Example of question and answers






DOMANDA


RISPOSTA ERRATA

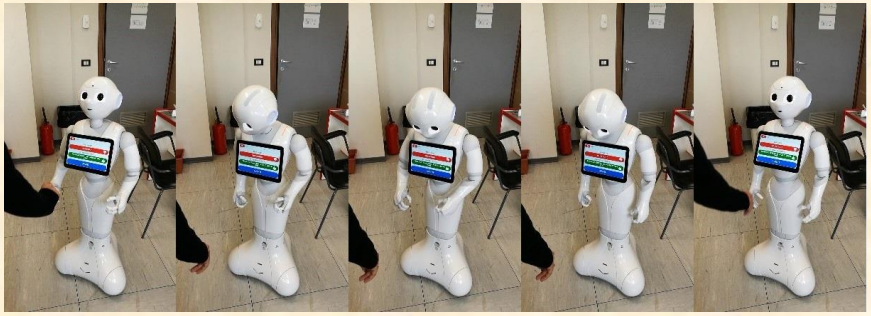

RISPOSTA CORRETTA


TIMEOUT

# Example of feedback and game analytics


- Positive

- Negative



# An older adult interacting with the robot game

# Users feedback

**Preliminary feedback from caregivers**

- Seniors really engaged by the game: feeling of "competition", they talked about it after the training, even with external persons
- Seniors tend to describe Pepper in a human-like manner ("tenero")
- Seniors feel "important" in being involved in a training with robots

**Preliminary feedback from users**

- They were happy to play with it - both versions well received
- They especially liked the enhanced expressivity of Pepper version

**User Engagement Scale + errors, task efficiency,...**

- Under analysis

# Conclusions

- In the context of interventions for reducing cognitive decline in the elderly population, technologies have been increasingly conceived as a support for patients, their caregivers and the clinicians.
- In this position paper we introduce how we are approaching the investigation on how seniors with Mild Cognitive Impairment relate with and perceive serious games accessed through humanoid robots
- In a next version of the game we plan to introduce adaptation of the level of difficulty according to the user performance.
- We also plan to consider a reinforcement learning approach to adapt the robot behavior during the game

**Thank you for your attention !**