Human Robot Interaction in older adults with Mild Cognitive Impairments

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Outline

Motivation
Cognitive Degeneration
Mild Cognitive Impairments
Socially Assistive Robots
First study
Preliminary Results
Future Works
Motivation: Aging of Italian Population

Average Age
Motivation - Aging of Italian Population

Aging of Italian Population

Average Age

Average Age 2017

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Motivation

Degeneration in cognitive and physical domain

Increased number of caregivers

Gap health system

Assistive technologies
Cognitive Degeneration

- Preclinical
- Predementia
- Dementia

Cognitive decline normal age
  - Asymptomatic stage

Mild Cognitive Impairments (MCI)
  - Middle cognitive degeneration

Alzheimer’s disease
  - Severe cognitive degeneration
Cognitive Degeneration

Predementia

Mild Cognitive Impairments

- completion of complex tasks
- reduced coordination of brain activity
- performance of different cognitive domains (attention, memory, ..)
- maintain their independence during the activities of daily living
Mild Cognitive Impairments

- The MCI people are at high risk of dementia; every year about 10% of MCI people progress to dementia.
MCI Interventions

Cognitive and physical training

Improve cognitive performance

Reducing the incidence of dementia.

Intervene as soon as possible

Assistive technologies
Assistive Technologies

Assistive technologies paper-based material

Assistive technologies computer-based support
Socially Assistive Robot
Socially Assistive Robotics (SAR)

- Providing assistance and achieving measurable progress in convalescence, rehabilitation, learning
Benefit SAR

- Users did not experience any anxiety
- Features helps the user to facilitate the interaction with the robot
- More engagement
- Different type of interaction (voice, gesture, …)
- Secure environments
- Fill the gap between current healthcare and self-care
First study

HIIS Laboratory ISTI-CNR collaboration with Institute of Neuroscience-CNR

<table>
<thead>
<tr>
<th>Goal</th>
<th>Investigate how seniors with MCI relate and perceived a cognitive game accessed through a humanoid robots, as a part a training program aimed to improve their cognitive status</th>
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</thead>
<tbody>
<tr>
<td>Session</td>
<td>12 Session at CNR</td>
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<tr>
<td></td>
<td>14 participants (average age 75.3) with MCI</td>
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<td></td>
<td>Low level of computer experience</td>
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<td>Stages</td>
<td>Familiarization with devices</td>
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<td>Test (UES, demographic and computer experience questionnaires)</td>
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First study- Familiarization

Picture taken by our group during the familiarization with the robot at the Institute of Neuroscience of CNR
First study-Test

**Questionnaire**
- User Engagement Scale questionnaire
- Demographic questionnaire
- Computer experience questionnaires

**Groups**
- Tablet (control group)
- Pepper Robot

Picture taken during the Pepper Session
Pepper Robot

- Robot developed by Softbanks robotics
- Interaction is one of the key features of the Pepper robot’s capabilities
- Tablet
- Different laser sensors, cameras, tactile and movement sensors
First Study – Test set up
# First study

<table>
<thead>
<tr>
<th>Cognitive Training</th>
<th>Memory</th>
<th>Domains</th>
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<tbody>
<tr>
<td>Music Quiz</td>
<td>retrograde memory (known songs)</td>
<td>attention, memory, reasoning</td>
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<tr>
<td>15 songs of 20 seconds each</td>
<td>anterograde memory (unknown songs)</td>
<td></td>
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<tr>
<td>Recognize singer and song</td>
<td>autobiographical memory (known songs evoke personal memories)</td>
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Game - App

Ionic → Game

Python → Connection
- Receives events
- Pepper controller
Question: Chi è il cantante?

Wrong answer: Hai risposto...

Expired time: Mi dispiace. Tempo scaduto.

Singer: GINO PAOLI

Erreore: La risposta corretta è...

Avanti: FERRUCCIO TRAVAGLINI - VOGLIO VIVERE COSÌ
Game - Ionic App
### Game Feedback

<table>
<thead>
<tr>
<th>Adaptive Feedback</th>
<th>Changes depending on the answer chosen</th>
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<tbody>
<tr>
<td><strong>Tablet</strong></td>
<td>Voice</td>
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<td>Visuals</td>
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<td>Visuals</td>
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<td></td>
<td>Animation</td>
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<td>Coloured led</td>
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<td>Sounds</td>
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</table>
Game Feedback
Preliminary Results

- Data still under analysis
- Talked about the game after the training session and with persons external to the programme
- Game did not perceive as a tasks but as a stimolous
- Robot perceive as a friends and describe it in a human-like manner

"Pepper you are so cute"

"Ciao Pepper, you know... I woke up with back pain and I was deciding whether to come this morning... I decided to come because I knew I would play with you"
Future works

Gesture interaction

Different training games for different domain (math, logical, ..)

Adaptive behaviour (Reinforcement Learning)

Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications
Summary

- Motivation of the study linked with the aging of population and the increased of cognitive impairments create a gap in the health system.

- The benefit of the Socially Assistive robot as an Assistive technologies to fill the gap in the health system.

- Develop a cognitive training for elderly with MCI using a Socially Assistive Robot.

- Preliminary results of the project and future works.


