Adapting a General Purpose Social Robot for Paediatric Rehabilitation through In-situ Design

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International Conference on Human-Robot Interaction
5th-8th March 2018
Chicago, IL
Introduction - The Project

In-situ design study:
- Exploratory
- Iterative development and evaluation
Introduction - Outcomes

Outcomes In-Situ Design

- Over 40 unique patients across both phases of development
- From exploration activities to stand-alone clinical deployment in 23 months
- Frequent in-situ engagement with clinical stakeholders established trust and rapport
- Therapist, and psychology expertise incorporated in the team
- Stakeholder engagement promotes a sense of ownership
- Patient population identified in Phase 1, extended in Phase 2
Project Phases

Phase 1
- Exploratory
- Mar. 2015

Phase 2
- 1st Prototype
  - Implementation
- Development
  - May 2016
- Mar. 2017
Project Phases - Phase 1 - First half

Phase 1: Exploratory
- Mar. 2015

Phase 2: Development
- 1st Prototype Implementation
- May 2016

Phase 2: Development
- Mar. 2017

Goals
- Stakeholder engagement
- Rapid prototyping (WoZ and Visual IDE)

Outcomes
- Basic roles for the SAR
- Patient Population
Outcomes

- Core exercises and demonstrations
- Delivering full rehab sessions with limited autonomy
- Requirements for base level prototype
Project Phases - Phase 2 - Prototype

Prototype implementation

- Following the Roles and Requirements (Phase 1)
- No Wizard-of-Oz
- Robot Operating System
- SAR leading Sessions
- Existing rehab exercises
Project Phases - Phase 2 - Testing

Phase 1
- Exploratory
- Mar. 2015

Phase 2
- 1st Prototype Implementation
- Development
- May 2016
- Iterative development and evaluation
- Mar. 2017

Goal
- Iterative development and evaluation

Data (Ongoing)
- Observations
- Adapted versions of Acceptance questionnaire (Heerink et al. 2009)
- Open questions
- Robot log

Study setting floor plan
- Participants' room
- Researchers' room
- One-way mirror
Roles and Requirements

Roles

- Demonstrator
- Companion
- Motivator
- Coach

Requirements

- Configurability
- Stability
- Adaptability
- Interaction
- Integration
- Responsiveness
- Stand-alone
- Robustness and Endurance

Watch how I do a bridge!!
Notice how I lift my bottom up high like a bridge
Roles and Requirements

Roles

• Demonstrator
• Companion
• Motivator
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• Configurability
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Design Decisions

Requirements

- Configurability
- Stability
- Adaptability
- Interaction
- Integration
- Responsiveness
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Design Decisions

Mock-up code in Phase 1

Parameters

- Participants’ name
- Exercises (Activities)
- Sets, Repetitions, Speed

Requirements

- Configurability
- Stability
- Adaptability
- Interaction
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Design Decisions

Requirements

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Design Decisions

Requirements

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Sit-to-Stands using a seat

Sit-to-Stands crouching
Design Decisions

Requirements

- Configurability
- Stability
- Adaptability
- Interaction
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- Responsiveness
- Stand-alone
- Robustness and Endurance
Design Decisions

Tactile Interface

- Configurability
- Stability
- **Adaptability**
- Interaction
- Integration
- Responsiveness
- Stand-alone
- Robustness and Endurance
Design Decisions

Requirements

- Configurability
- Stability
- Adaptability
- Interaction
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Design Decisions

Positioning the robot

Placing auxiliary aids

Posture

Helping to keep pace

Requirements

- Configurability
- Stability
- Adaptability
- Interaction
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- Stand-alone
- Robustness and Endurance
Preliminary Session Results - Physios’ Feedback

Table: Perceive easy-of-use and usefulness questions for physiotherapists

<table>
<thead>
<tr>
<th>Question</th>
<th>PT-1</th>
<th>PT-2</th>
<th>PT-3</th>
<th>PT-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think I will know quickly how to use the robot</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
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<td>5</td>
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<td>3</td>
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</tr>
<tr>
<td>I think the robot is useful to help in paediatric therapy</td>
<td>5</td>
<td>4</td>
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</tr>
<tr>
<td>It would be convenient to have the robot for therapy sessions with children</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Physios’ Feedback (N=4)

• Physios without training exhibited competence
• Most useful feature: Demonstrate exercises

Likert scale
1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree
Parents’ Feedback (N=4)

- The robot helped to keep child’s focused
- Two parents preferred a neutral gender colour

Table: Perceive easy-of-use and usefulness questions for parents

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<td>5</td>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>It would be convenient to use the robot in sessions together with the physio</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>It would be convenient to use the robot when the physio is not in the session</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>3</td>
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Limitations

- Time investment
- Managing stakeholders’ expectations
- Developers have to concede to the needs of the stakeholders
Future Work

• Phase 2 analysis
Future Work

- Phase 2 analysis
- Tablet interface to configure the robot
Future Work

- Phase 2 analysis
- Tablet interface to configure the robot
- Phase 3 case studies aiming for clinical trials
Future Work

- Phase 2 analysis
- Tablet interface to configure the robot
- Phase 3 case studies aiming for clinical trials
- System Improvements
Participants

Tablet Interface developed by:

Funding Support:
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