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

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Introduction - The Project

The Royal Children's Hospital Melbourne

In-situ design study:

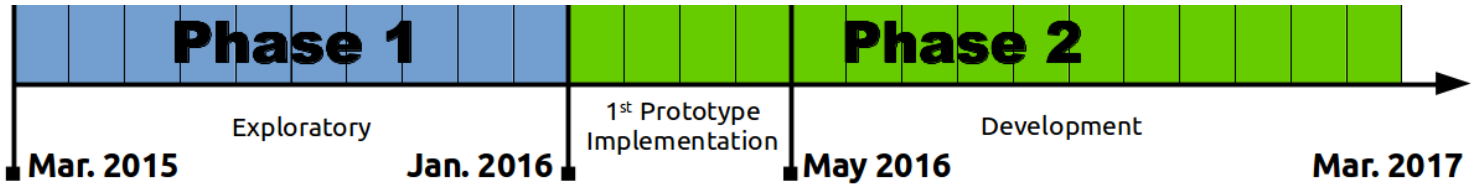
- Exploratory
- Iterative development and evaluation

Introduction - Outcomes

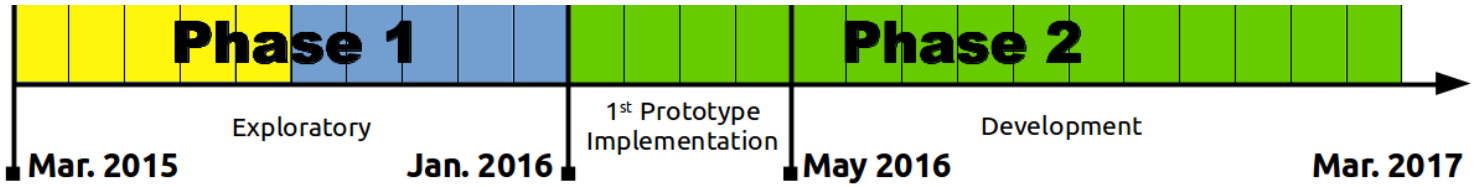
Outcomes In-Situ Design

- 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



Project Phases - Phase 1 - First half



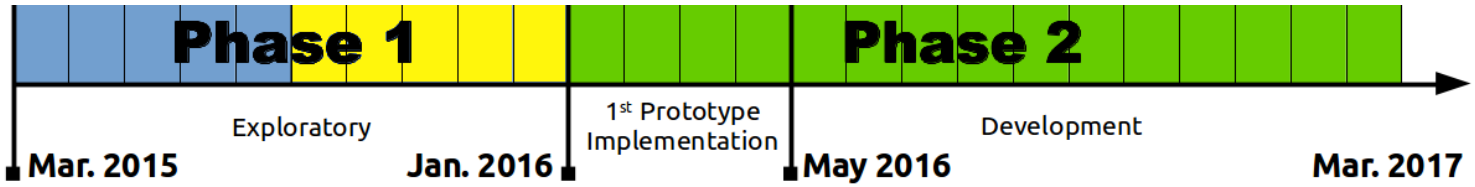
Goals

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

Outcomes

- Basic roles for the SAR
- Patient Population

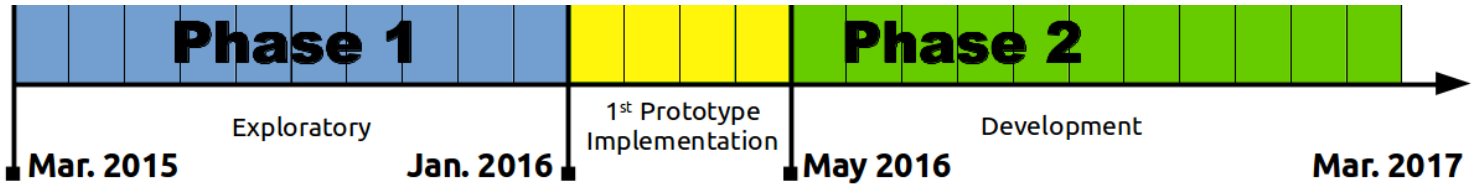
Project Phases - Phase 1 - Second half



Outcomes

- Core exercises and demonstrations
- Delivering full rehab sessions with limited autonomy
- Requirements for base level prototype

Project Phases - Phase 2 - Prototype

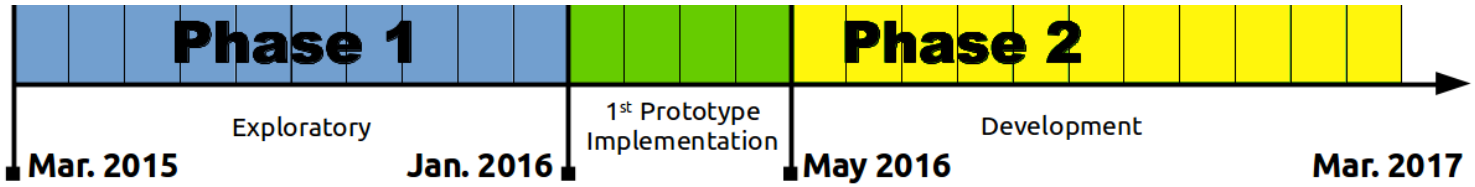


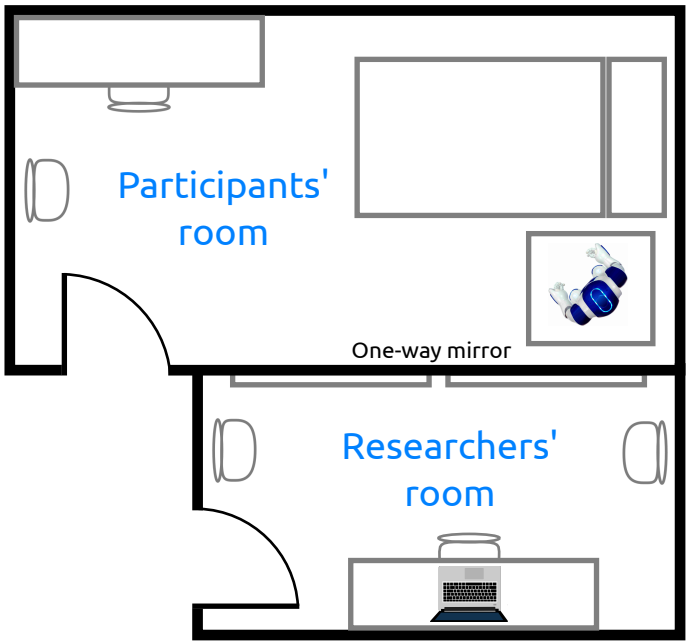
SAR rehabilitation exercises

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





Study setting floor plan

Goal

- Iterative development and evaluation

Data (Ongoing)

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

Roles and Requirements

Roles

- Demonstrator
- Companion
- Motivator
- Coach

Roles and Requirements

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- Demonstrator
- Companion
- Motivator
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Requirements

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

Design Decisions

Requirements

- **Configurability**
- Stability
- Adaptability
- Interaction
- Integration
- Responsiveness
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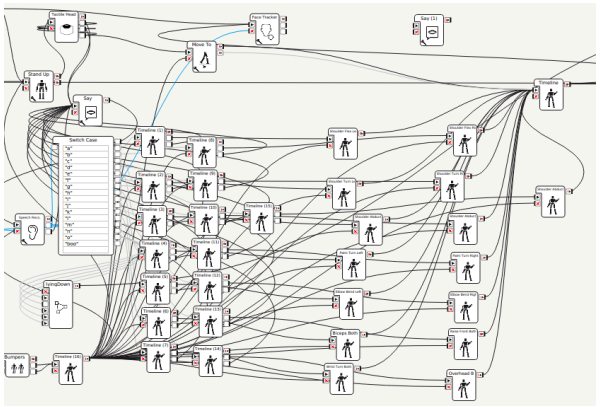
- Robustness and Endurance

Design Decisions



Mock-up code in Phase 1

ROS

Parameters

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

Requirements

- **Configurability**
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- Configurability
- **Stability**
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Design Decisions

Sit-to-Stands using a seat

Sit-to-Stands crouching

Requirements

- Configurability
- **Stability**
- Adaptability
- Interaction
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Design Decisions

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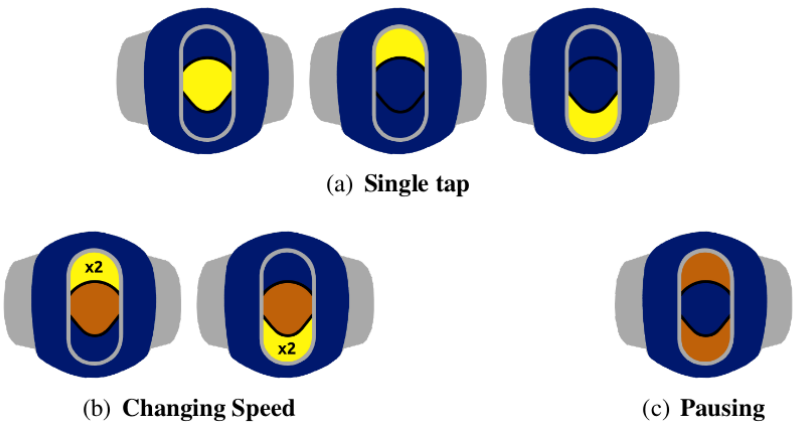
Design Decisions



(a) **Single tap**

(b) **Changing Speed**

(c) **Pausing**

Tactile Interface

Requirements

- Configurability
- Stability
- **Adaptability**
- **Interaction**
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Design Decisions

Requirements

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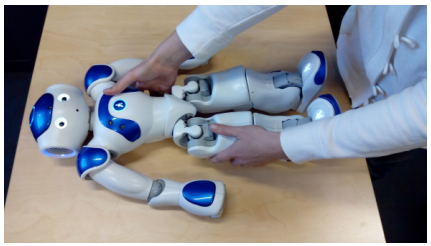
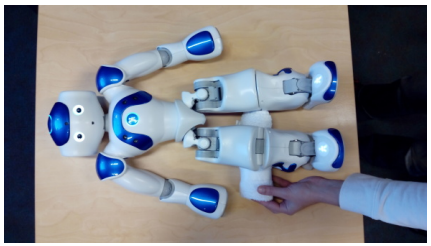
Design Decisions



Positioning the robot



Placing auxiliary aids

Posture

Helping to keep pace

Requirements

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

Preliminary Session Results - Physios' Feedback

Physios' Feedback (N=4)

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

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

Question	PT-1	PT-2	PT-3	PT-4
I think I will know quickly how to use the robot	5	4	3	5
I find the robot easy to use	5	4	3	4
I think the robot is useful to help in paediatric therapy	5	4	4	4
It would be convenient to have the robot for therapy sessions with children	5	4	4	4

Likert scale
1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

Preliminary Session Results - Parents' Feedback

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

Question	G-1	G-2	G-3	G-4
I think I will know quickly how to use the robot	5	5	5	3
I find the robot easy to use	5	5	5	3
I think the robot is useful for paediatric rehabilitation	5	5	5	5
It would be convenient to use the robot in sessions together with the physio	3	5	5	4
It would be convenient to use the robot when the physio is not in the session	4	5	5	3

Likert scale
1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

Design Process Evaluation

Outcomes In-Situ Design

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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

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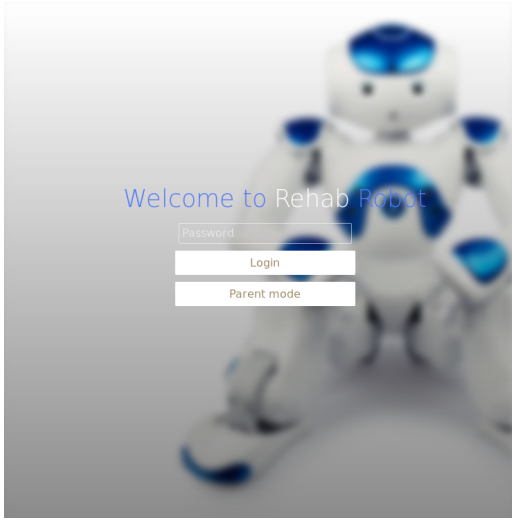
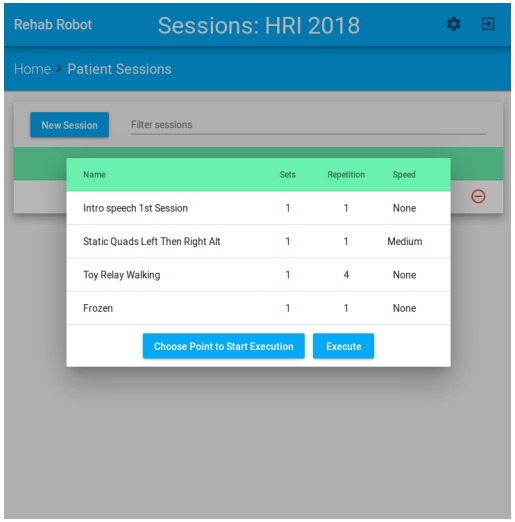
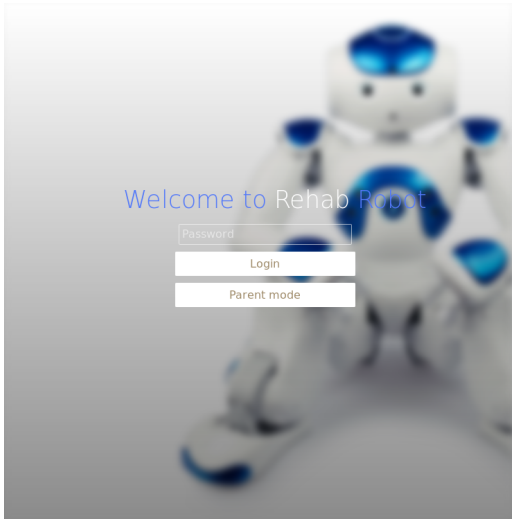
- Tablet interface to configure the robot

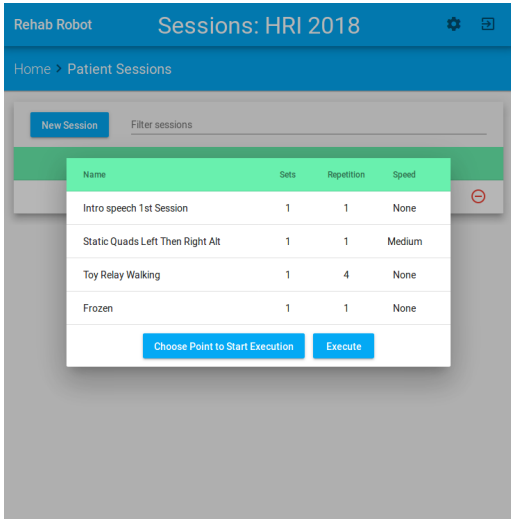




Future Work

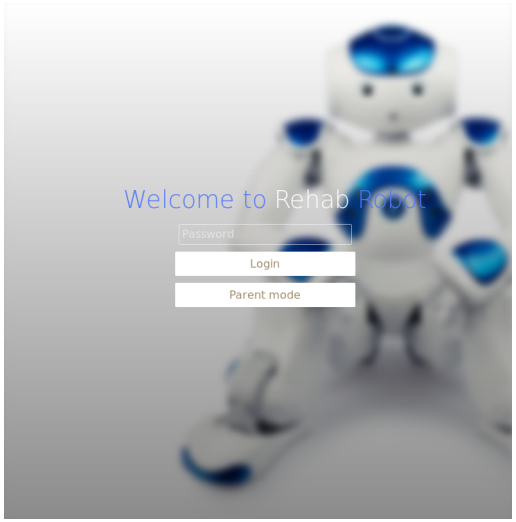
- Phase 2 analysis
- Tablet interface to configure the robot
- Phase 3 case studies aiming for clinical trials

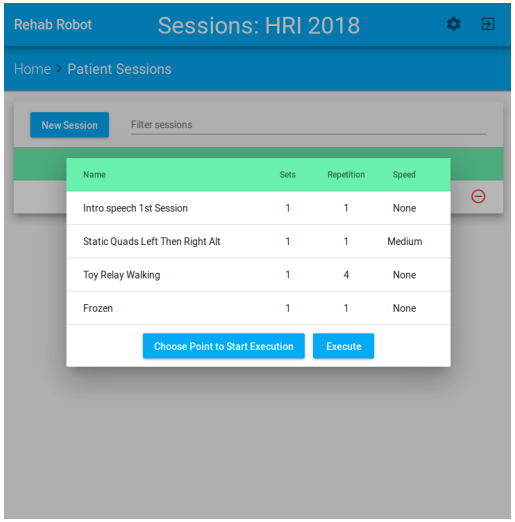




Future Work

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





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Participants

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DATA 61

CSIRO

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Brainary interactive

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