Development of Robot-enhanced Therapy for Children with Autism Spectrum Disorders

Project No. 6113914

DREAM
Development of Robot-enhanced Therapy for Children with Autism Spectrum Disorders

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D8.4 DREAM Lite Architecture: long term exploitation

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Organisation name of lead contractor for this deliverable: **Softbank Robotics Europe (formerly Aldebaran Robotics[1])**

Responsible Person: Alexandre Mazel Revision :

Project co-funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	
PP	Restricted to the other programme participants (including the Commission Service)	
RE	Restricted to a group specified by the consortium (including the Commission Service)	
CO	Confidential, only for members of the consortium (including the Commission Service)	**CO**

[1] Aldebaran Robotics' legal name has changed to Softbank Robotics Europe in April 2015. This change is now reflected in the EC Participant Portal.

Contents

Executive Summary

WP8 is dedicated to the dissemination and exploitation of the results of the DREAM project to the international scientific community, including the one concerned with providing primary care for Autism Spectrum Disorder children (ASD). Within that frame, deliverable D8.4 aims to report the steps and progresses made towards the definition of the DREAM Lite Architecture, which goal is to reduce the DREAM system setup complexity to prepare exploitation with the NAO robot in schools and intervention centers.

Principal Contributors

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Revision History

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1 Overview of the Work Package

The dissemination and the exploitation of the scientific and technical results obtained in the DREAM project are one of the strategic objectives of the consortium, which is mainly achieved through WP8. This WP aims to disseminate the results of the project to the international scientific community, and more specifically the one concerned with providing care for Autism Spectrum Disorder children (ASD), including therapists and educators. It also aims to facilitate the exploitation of the results of the project, which is at the core of this report

2 Outline of Deliverable D8.4

2.1 Description of Deliverable D8.4

This deliverable is related to task T8.6, and will detail the architecture and functionality of DREAM Lite. This will also present the plans for the actual development and phases of DREAM Lite.

2.2 Description of Task 8.6

This task focuses on developing a 'light' version of the DREAM system that should be able to run on the Nao robot alone (i.e. without the additional sensors mounted on the intervention table), but still integrating as much as possible of the complete DREAM system's functionality. Naturally, this DREAM Lite version will most probably not be as powerful as the complete systems, but it will be significantly more mobile/portable, and thus hopefully will also facilitate real-world application and commercialization.

This task aims to elevate the DREAM exploitation achieved in the earlier tasks during the middle of the project. In addition to the sensing part, the theoretical and scientific results of the DREAM project and the partners' expertise, this task will also incorporate some DREAM modules, like behavior subsystems (attention, reaction, etc.) directly onto the robot, in a coherent technical framework, by using onboard sensors.

This task will also experiment with the solution through some pilot studies, which will be developed in partnership with UBB in order to test the effectiveness of the solution in increasing the children's engagement. The aim will be towards exploring a future version of the DREAM system with significant potential for commercialization.

More precisely, this task will be focused on the following:

- Finding complementary sensing and perception capabilities of the DREAM system, which are necessary but currently missing in SBR NAOqi system and integrating them in the NAOqi system, e.g. gaze detection of children with ASD.

- Integrating attention and/or learning components.
- Integrating these outputs into what will become the final DREAM Lite solution.
- Developing a pilot study with this solution to measure how the engagement and Robot-Enhanced Therapy (RET) is affected by the light version and what needs to be done to make the light version more useful from RET point of view.
- Creating, experimenting with, and validating a complete application package based on the DREAM experience and laying the foundations for the long-term exploitation of the DREAM project developments and results, towards ensuring the legacy of the project with potential for future commercialization.

3 DREAM Lite Architecture

3.1 Exploitation Solution

The deployment of a solution that has been developed as part of a research project can pose several challenges. First, the solution has to comprise as many of the features that have led to the experimental positive results, or otherwise it might not keep all of the advantages that were demonstrated via research. On the other hand, when deploying, several constraints coming from the ecosystem must be taken into account, such as ease of implementation, reduced time for setup and deployment, robustness and economic constraints. The exploitation phase of the DREAM project, called DREAM Lite, focused mainly on simplifying two aspects: removing sensors external to the robot and merging the role of the assistant (controlling the robot) and the therapist. The decision to remove the external sensors greatly reduced the decision-making capabilities of the robot, but it was considered as not feasible otherwise. Next, the use of a specifically developed tablet interface allows the therapist to control the robot while keeping enough attention for the interaction with the child, without necessarily needing an assistant.

Figure 1 shows the setup used for DREAM experimentation, besides technical setup it requires also a psychologist, and an assistant. Figure 2 shows the simplified setup, with lighter setup and only one therapist.

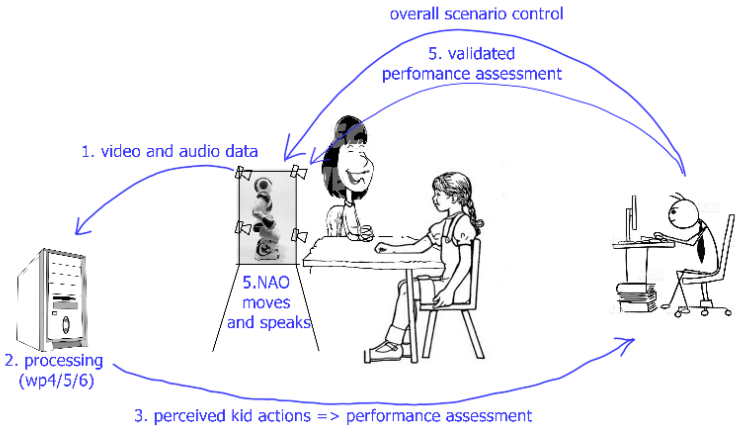

Fig.1 : DREAM Experimentation setup

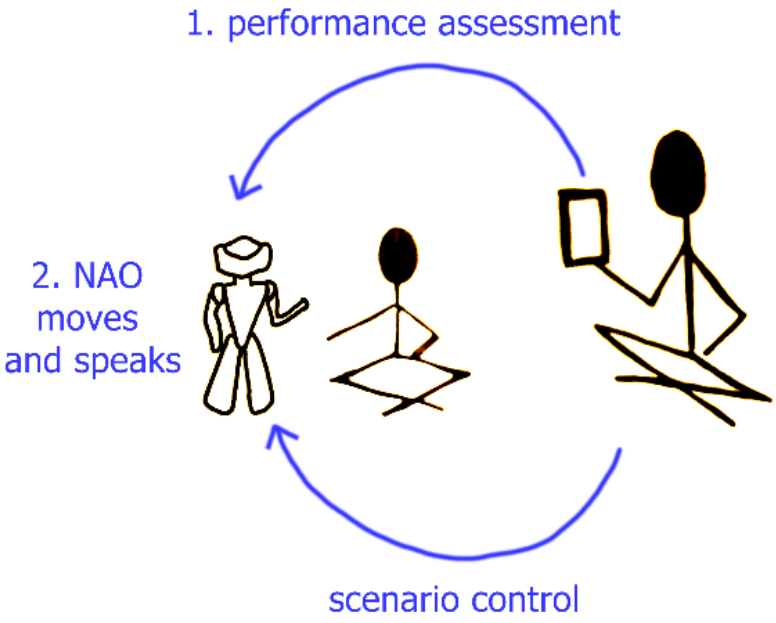

Fig.2 : DREAM Lite setup

In the following chapter we will describe the architecture we plan to develop in the next months

3.2 Choosen Architecture

The DREAM Lite system will be based on NAOqi, the NAO's Operating System and AskNAO Tablet which is an interface handling the link between NAO and an android tablet. The choice of AskNAO Tablet will help us to accelerate the reimplementation of the DREAM protocols and will also open us to easily experiments DREAM Lite in collaboration with existing AskNAO users.

In this architecture, the tablet will operate as a command control, allowing user to connect to the NAO, it will then launch application present on the robot, take control of the application and the scenario protocols and give a quick way to interact with children through the robot. The accent is put on the interactivity: NAO should be always ready to change his behavior according to the child's reaction, as for ASD's children, 3 seconds of bad interaction can disengage them.

Programs running on the robot will reflect directly the DREAM protocols as they have been tested during UBB experimentation, they will be programmed using Choregraph, the SBRE graphical development tool. We plan to have 3 dedicated application: one for the imitation protocol, one for joint attention and the last one for turn taking.

Figure 3 shows the complete technical implementation choice: (1) the tablet will provide a robot connection management: the therapist should be able to connect to some NAO in the local network, then (2) it can decide what is the exercise to work with and launch chosen programs, so (3) the program is started in NAO and (4) send an interface description to the tablet, (5) NAO will produces moves and speech to welcome the child, (6) the therapist can then select the settings of the session, as the exercise's type and the difficulty's level. (7) The tablet interface is then updated, and the session start with some interaction between the child and the NAO, the therapist deciding of the scenario control using tablet interface button (8).

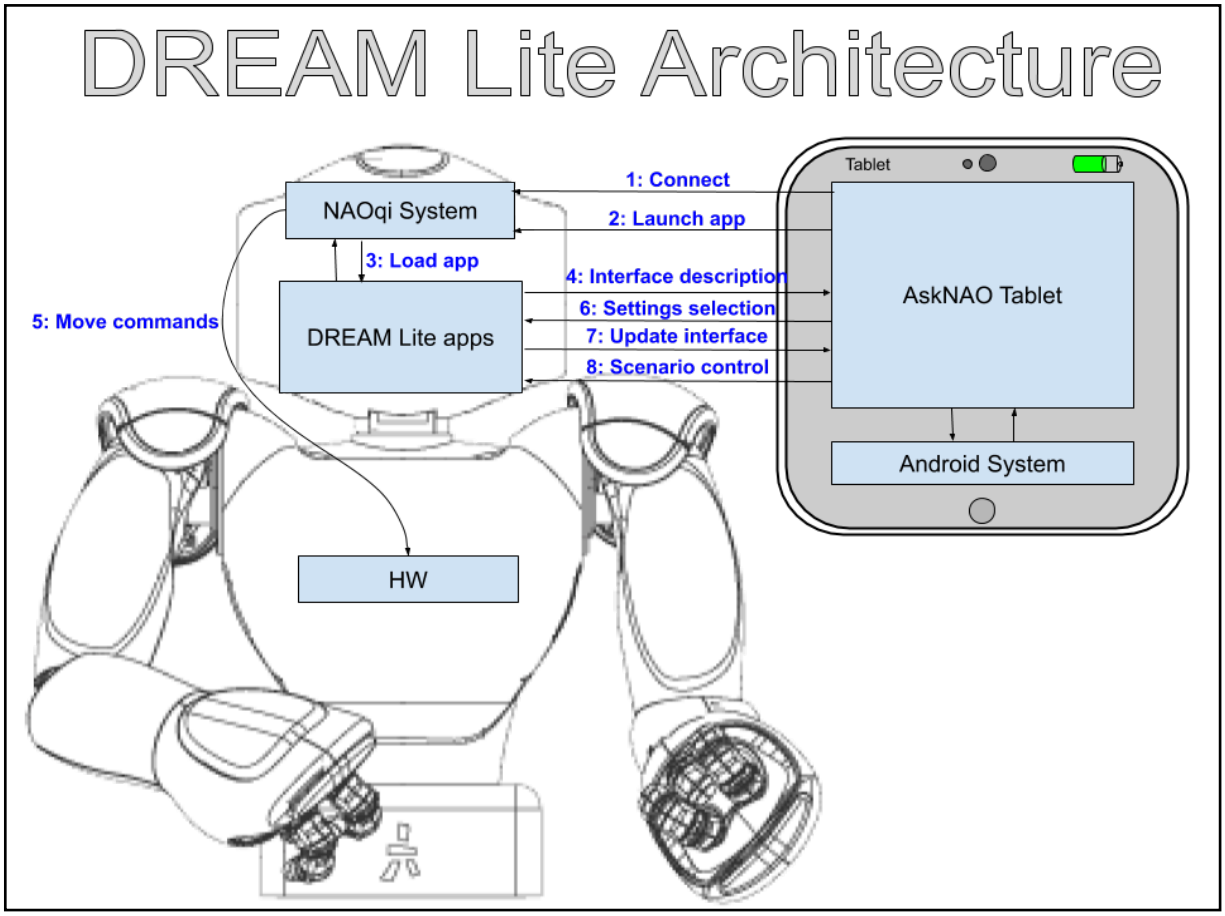

Fig.3 : DREAM Lite architecture

4 Development plan

4.1 Development of a POC version

The development will be made in separate phase: first a proof of concept of a simplified protocol.

This version should include:

- The link between protocols and AskNAO Tablet
- the connection management,
- a realistic interface of a protocol,
- all stages should be present, even if in a simplified form:
    - child welcoming
    - gaze attention
    - positive and negative feedback
    - rewards
    - pause and resume

The goal of this phase is to check the robot reactivity, validate the system is simple enough to use, and also to tackle all the technical limitations. It will be developed in English language.

4.2 Feedback on the POC version

We plan to present this simplified version to some professionals and child we have in our ecosystem. We wish to ask them feedbacks and validate the interest of this type of protocols and setup. At this time we want to be sure the system is simple enough to be used by them, alone.

4.3 Development of one complete protocol

Based on the feedback from professional, we plan to develop with advice from UBB the imitation protocol in its complete form. We would like to have it in two languages: English and Romanian.

4.4 Experimentation with the complete protocol version

We will then start to have single case experimentation with this complete protocol. The thing we want to explore is the various type of reaction from the children to be sure every case is covered by the application.

4.5 Development of the full solution

Based on feedbacks and after some validation, we will implement the two others scenarios: Joint Attention and Turn Taking. This complete version will support three languages: English, Romanian and French.

4.6 Wide experimentation

Having the solutions developed in English, Romanian and French will open us to experimenting in manifold institutions: in some hospital we're used to work with in Paris, with remote association in France, an institution in London seems to be already interested and for sure with UBB in Romania. If things goes well we think about experimenting with large testing with UBB in Romania.

5 Conclusion and Future experimentations

This development and exploitation plan seems to have great potential to produce a new momentum for the DREAM project and open perspective for the legacy of this project.