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

Project No. 611391

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

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D8.2 Short Term Exploitation: First Results

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

Responsible Person: Alexandre Mazel Revision : 2.2

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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.

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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 D8.2 aims to report the steps and progresses made towards the short-term exploitation of the DREAM project, and more specifically on the Ask NAO Tablet applications for autism therapy developed by SBR.

This deliverable, first describes the development of 13 applications of the Ask NAO tablet developed by SBR and its B2B (Business to Business) partners, taking into account the input from the DREAM project but also building upon discussion with other stakeholders such as autism associations. This is followed by a discussion on pointers for a tentative commercialization plan.

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Version 2.1 (27/03/2017): Incorporated partner interaction

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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 D8.2

2.1 Description of Deliverable D8.2

Deliverable D8.2 reports the outcome of new Task T8.3 (defined in reply to recommendation 3 of the second period review report) in terms of steps and progresses made towards the short term exploitation of the DREAM project, and more specifically on the applications co-developed by SBR and its B2B partner ERM Robotique. It documents the basic infrastructure set up to facilitate the exploitation of the DREAM system in a coherent manner, by developing and identifying technical systems, using DREAM expertise, involving B2B partners of SBR and other stakeholders such as Autism associations. It also outlines the potential exploitation steps for commercialization.

2.2 Description of Task 8.3

Task T8.3 includes the creation of a new version of solutions for autism based on current feedback from users. The education of children with autism is an important market for SoftBank Robotics (SBR) in terms of both size and societal impact. The Innovation department (responsible for the long term R&D roadmapping of SBR) is committed to spend time and efforts to ensure technology transfer and to support the development of the products for this market. As such, a set of 13 applications has been rewritten for the NAO robot, taking into account users feedback.

As mentioned in task T8.2, at the beginning of the project it was difficult *"to predict the most effective plans towards exploitation of DREAM outcomes*". Today, by taking into account the nature of the developments steming from the DREAM consortium, and by analyzing the market as well as the best way to ensure "DREAM to the market", SoftBank Robotics has identified some additional business models: SBR will collaborate with industrial partners from its B2B ecosystem, who will commit to specialized education and ensure the development of Apps and the distribution of the whole package (robot and application) in the domain of special education.

SBR identified ERM Robotique as a relevant business partner for the exploitation of the DREAM project. SBR investigated together with ERM Robotique, and the French nonprofit autism association *Autistes Sans Frontières* to develop a solution based on DREAM results and will rely on the resellers for its distribution, to properly reply to market needs. SBR also plans to work with Avatarion, an

application developer, which is already familiar with SBR's robots, to release more autism-related solutions and test them within the DREAM project scope and ambition.

3 Short term exploitation

3.1 Software development as a user-driven process

SBR seeks out feedback as much as possible in order to optimise the Ask NAO Tablet[2] applications. These applications are at the core of the dissemination and exploitation process as they are the main product to showcase at events and to test in collaboration with partners. As such, the company participated in events regarding autism and presented its apps to professionals in order to get solid advice on the best path to follow.

Figure 1: Ask NAO Tablet Logo

The DREAM applications aim to create a link between robot, child and teacher. In this regard, the biggest hurdle is to ensure the best possible interaction between all the parties, while keeping ergonomics at the center of the development process. SBR took into account the previous feedback related to the Ask NAO web platform that was deemed somewhat overly complicated to use by teachers and schools. SBR therefore focused on including the use of a tablet as a controller, directly linked to the robot through its own hotspot (rather than through a pc application or through domestic Wi-Fi) which is the easiest and most robust way of interacting with the NAO robot. Keeping the interaction as simple as possible for a child with autism, without removing any features, was a priority.

SBR proposed an all-inclusive package that does not require any external manipulation or equipment to make the solution work as intended. The teacher uses a tablet as an administrator (which allows him/her to monitor NAO's activities and to access the control panel), and the child (referred to as "player") uses another tablet, that can only interact with the information that NAO sends. This way, the teacher never

[2] Ask NAO is an interactive, educational and easily implemented tool to engage kids through customized packages of applications for the Special education. The Ask NAO tablet tool goes further in ergonomics and allows all the manipulations to be done from a tablet.

has to physically move away from the child and the robot to set up activities. Inspired, for instance, by Stanley Greenspan's Floortime approach of autism therapy[3], SBR made sure that beyond ergonomics, it was also essential for the caregiver to remain close to the child, to let him/her enter the child's activities and to engage the child at his/her level. SBR conceived a solution that would allow the caregiver to be in the same position as the child: holding his own tablet, akin to the child's one, rather than having to manipulate the robot's software from a computer. The Ask NAO Tablet solution is adaptable to multiple approaches of autism therapy thanks to its user friendly interface and the complementarity with the caregiver.

This solution facilitates the ability of the educator, being an observer, to retrieve answers and send encouragement messages, while the robot is interacting with the child.

Figure 2: Example of a standard playtime session, from the point of view of the parent/caregiver

As of today, 13 Ask NAO Tablet applications have been developed in the DREAM project. All of them are the results of feedback from users and our academic partners, based on former applications developed by SoftBank Robotics. Using the former Ask NAO applications as a base, SBR implemented the use of the tablet for both child and caregiver as a way to remove the need for a computer. This way, the setup and interaction with the robot are more efficient and ergonomic.

The choice of applications considered for adaptation to the tablet interface was based on the application log of the Ask NAO website. The thirty most popular applications were identified according to the number of times each application was launched from the website and were included on the list of apps to be adapted on the new interface. This was used as a first attempt to define a part of the complete solution package and the offer to the end users.

[3] https://www.stanleygreenspan.com/resources/about-floortime

Game Name	Launch Times
Guess Emotions	285
Touch My Head	274
Head Shoulders Knees and Toes	269
Color Hunter	261
Wheels on the Bus	252
Spooky Dance	234
Animal Card Game	225
ABC Song	208
Goodbye Everyone	195
Yoga Adventure	194
Electro Swing	181
Guess Sports	171
Good Morning Class	159
Follow Me	154
How Do I Feel	123
Quiz Me!	122
Make Me Dance	115
Twinkle	114
Taichi dance	104
Math Power	103
Want To Know You	89
How is the Weather	82
ASK NAO Presentation	80
3 Musketeers Story - SE	80
Presentation	78
Rain	73
Pirate Story	73
Soft Robot	70
Small Talk	68
Classical Dance	67

Table 1: Application launch log from Ask NAO website (Top 30)

After studying the use of these applications, SBR discussed with ***Autistes sans Frontières*** and the ***French Red Cross*** to see which ones were the most interesting for these organisations to use. As such, thirteen applications were selected on the basis of their suitability to be adapted to the Ask NAO Tablet system efficiently and the demands of the aforementioned professionals. SBR and ERM then worked together in order to adapt them to the new interface. To this day, SBR and ERM have managed to develop 13 applications exploitable on the Ask NAO Tablet, for the DREAM project use. Some applications are interactive games while some other applications, like dances and acts, as rewards for the child, when the child answers questions rightly.

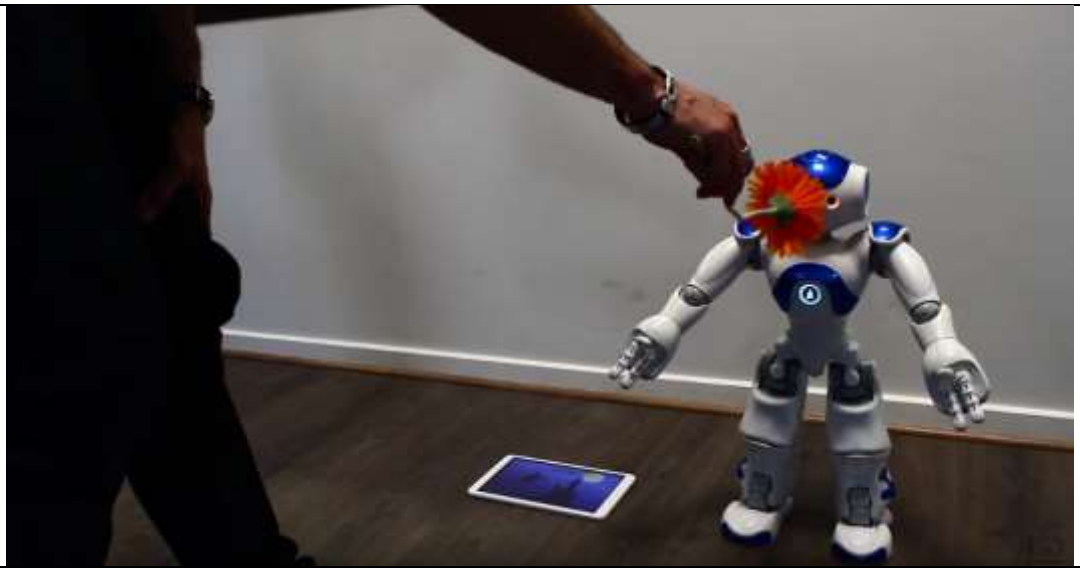
Figure 3: Control panel on teacher tablet

Below are shown the applications, as well as their operation. The tables below details, for each application (divided in categories), if it has a specific tablet interface, if all the planned features of the application have been implemented, and if it can work with no major issue. Some applications, still in early stages of development, are also included in the table. Even though some of them do not have a specific tablet interface, the teacher tablet can boot them from the tablet:

- **Didactic games :**

Name	Specific tablet interface	All features implemented	No Major issue
Color Hunter	Yes	X	X
Animal Cards	Yes	X	X
Guess Emotion	No but could do	X	X

Guess Sport	No but could do	X	X
Point At?	No but could after reworking	X	Has to be reworked

Color Hunter

https://youtu.be/WjnKcPzSauY
NAO asks the child to get objects of specific colors and put them in front of its camera.

Animal Card Game

https://youtu.be/-jLpzPtnSN8

NAO asks the children to point at a specific animal on the tablet, and delivers different messages and animations depending on whether the answer is right or wrong.

Guess Emotions game

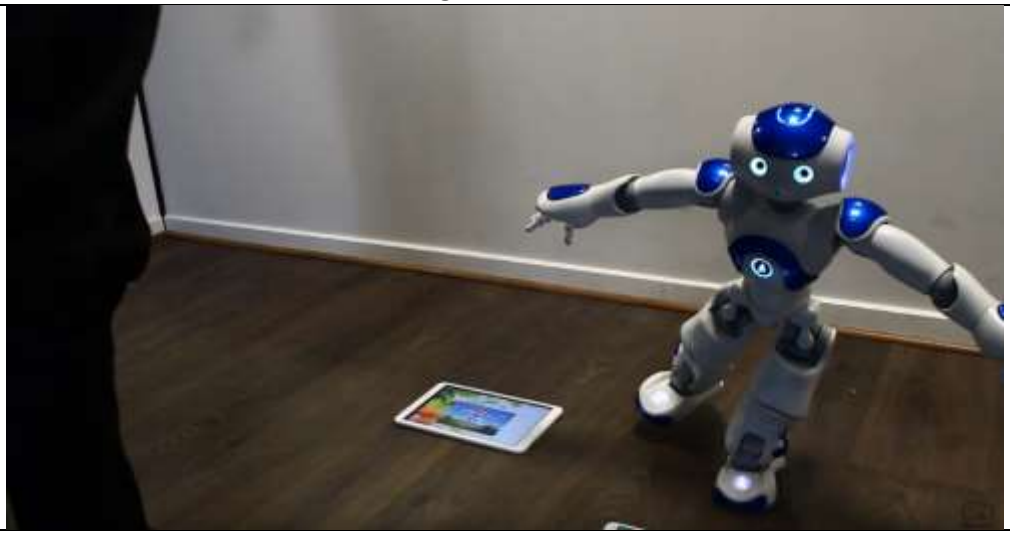
https://youtu.be/pTZPiqHA_tc
NAO mimics an emotion, which the child has to determine. The child then has to orally voice his guess.

Guess Sport

https://youtu.be/8-AwxzA3Dgw
NAO mimics different sports, and asks the child to orally pronounce the name of the sport he guessed.

- **Physical Activities:**

Name	Specific tablet interface	All features implemented	No Major issue
Yoga Adventure	Yes	X	X
Follow Me	No		

Yoga Adventure

https://youtu.be/kW24AOHc-Yc
NAO animates a Yoga class by giving instructions, which it demonstrates as well. At the same time, he plays calm music through its speakers. The teacher tablet is used to change poses and the student one gives a different point of view of the pose to better apprehend it.

- **Stories (rewards and/or work basis)**

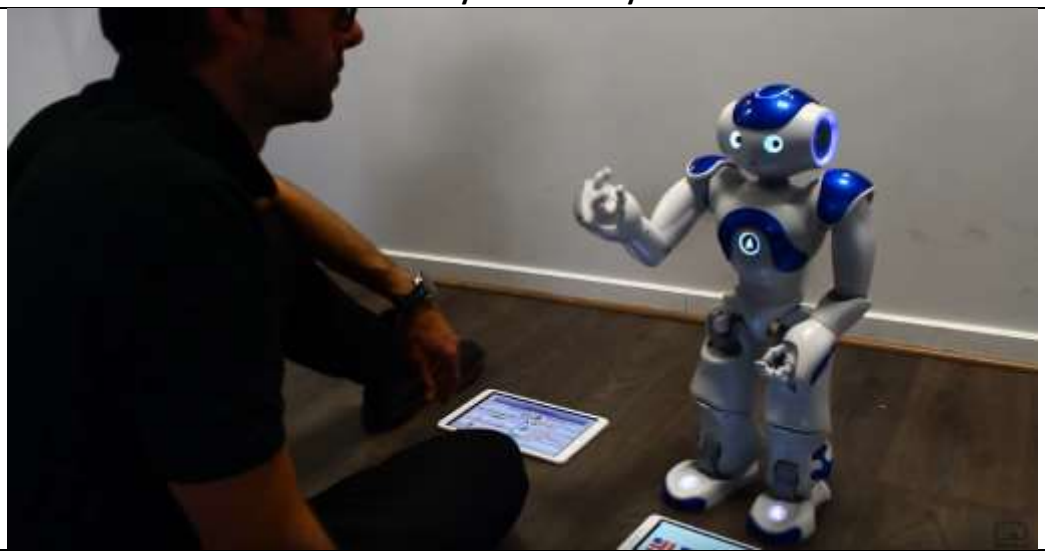
Name	Specific tablet interface	All features implemented	No Major issue
The 3 musketeers	No	X	X
The night before Christmas	No	X	X
Pirate story	No	X	X

Story - The 3 Musketeers

https://youtu.be/8-AwxzA3Dgw
NAO tells a story while moving his body and gesturing

Story - The night before Christmas

https://youtu.be/6S5jHRMWl3w
NAO tells a Christmas story

Story - Pirate Story

https://youtu.be/3de_ewmqwb8
NAO tells a story about pirates, including ambiance noises

- **Dances (rewards)**

Name	Specific tablet interface	All features implemented	No Major issue
Zombie Disco	No	X	X
Electro Swing	No	X	X
Mister Funk	No	X	X
Taichi	No	X	X
ABC	No	X	X

Dance - Zombie Disco

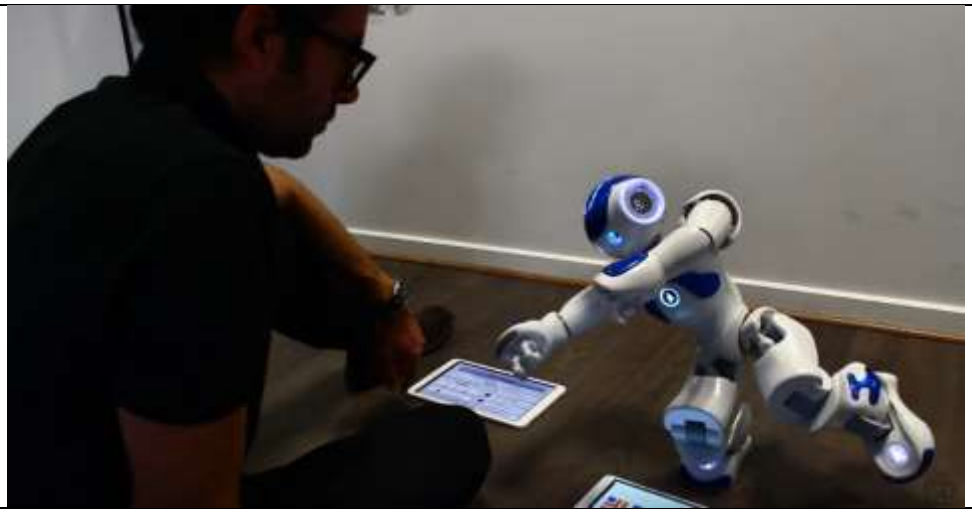
https://youtu.be/OTUOpbXuUqI
Nao imits a zombie while playing disco music.

Dance - Electro Swing

https://youtu.be/NkL2Po11lgA
Nao swings his body while playing electro music.

Dance - Mister Funk

https://youtu.be/4oK82pY9G10
Nao dances wildly while playing funky music.

Dance - Taichi

https://youtu.be/p52h_247Gis
Nao makes slow movements while playing zen music.

Dance - ABC

https://youtu.be/EdOFD70ite0
Nao moves gently while singing a lullaby.

3.2 Potential Market and commercialisation

As explained above, SBR works with professionals of the autism sector, such as associations and hospitals (in France mainly) in order to explore the potential solutions towards the best distribution package to offer to the end user. To this end, SBR also attended meetings with professionals and the first outcomes, also gave SBR a direction to which it should move towards.

For instance, SBR contacted the French Association *"Vaincre l'autisme"* (will be detailed in section 4) on February 17th 2017.This association proposed a closer partnership in order to develop additional applications adapted to autistic children, and shared a precious insight on the B2C (Business to Consumer) market: prices, way to finance the research on autism, etc. They also shared the message that applications should not be free since it is important that part of the price paid by the user comes back to contribute to application development for autism therapy and help the global dynamism of said development.

In the same way, SBR and ERM Robotique met the French Red Cross regarding the applications and the possibilities of B2A (Business to Academics) in September and December 2016. Lessons were taken from these meetings and used as input for the application development. Some ideas regarding the B2A commercialisation were discussed as well. At this stage, no precise commercialisation plan can be detailed, but future progress will give us better direction.

It should also be noted that developing and distributing these applications will pave the way to more opportunities for application development companies, in particular SMEs. For instance, within the frame of the first Ask NAO iteration, the SME ERM became a developer in addition to being one of the resellers of the NAO platform. SBR's wish for the rest of the DREAM project is to help multiple SMEs to grow based on this principle, and create a bigger and sustainable ecosystem of stakeholders for potential commercial solutions for Autism and Special Education.

4 The next steps

SBR will conduct and coordinate further integration and testing with other partners of the project, in particular UBB. In addition, SBR will keep informing industry and business promoters to foster the creation of new ICT robotics business opportunities, and more generally, will contribute to strengthen the competitive position of European industry in the emerging market of social robotic technologies for assistance and therapy. SBR will thus focus on the preparation for the task T8.4 relative to tests and feedback.

This series of tests will be conducted in May 2017 in collaboration with the DREAM partner UBB in their laboratory in Babeș-Bolyai University in Cluj-Napoca, Romania. The applications on the Ask NAO tablet will be tested with autistic children following the testing protocol created by UBB. As stated above, SBR is currently translating the applications and interface in Romanian with the help of UBB. Several videos showing the child-robot interaction will be released after the testing, and will be used in order to get feedback and update the Ask NAO Tablet applications based on these returns.

SBR also participated in other conferences and meetings to strengthen the dissemination process of DREAM, such as the Digital Festival Tahiti in Papeete, Tahiti (FR, March 16-18 2017 – most of the

costs being paid by the organizers) and the Autism Conference 2017 in Salford Manchester (UK, April 3rd 2017), which will be detailed in Deliverable D8.3. Another round of events will start with the ORNA (Observatory of Adapted Numeric Resources) in Suresnes, France, on May 17th, 2017, a conference focused on the numeric tools made to help Autistic people in their growth and daily life. In this frame, SBR will present its new applications created in collaboration with ERM in the framework of DREAM to professionals of the autism sector.

In the longer term, SBR is planning to make the Ask NAO tablet launcher compatible with YEOLab, which is a user-friendly tablet solution designed to interact, teach, work & develop with the NAO robot, developed by SBR's B2B partner Avatarion, in order to release more possibilities of robot interaction and test them within the DREAM project.

Regarding its professional network of partners, SBR is pursuing agreements with associations of the autism sector in order to test the Ask NAO Tablet system with users. The first agreement being currently finalized is with *Vaincre l'autisme,* a French association dedicated to autism created in 2001. Its importance is already recognized by the French government to the point where the association co-supervises the formation of *Auxiliaires de Vie Scolaire* (people whose role is to help mentally and and/or physically handicapped children in elementary schools) with the French Ministry of Education. Their expertise will be an inestimable plus to the future exploitation of results.

vaincre l'autisme
LE NOUVEAU DÉFI DE LA RECHERCHE

autistes sans frontières.

On the same topic, SBR is also in contact with *Autistes Sans Frontières*, a French association dedicated to helping autistic children, active since 2004. *Austistes Sans Frontières* already worked with NAO robots in the past, in the frame of an exploratory study called *« Intérêt et modalités d'utilisation du robot NAO pour le développement des capacités collaboratives des enfants ayant un TSA »* (2015). Just like *Vaincre l'autisme*, this association will bring an essential field expertise.

Finally, SBR is already working on a collaborative online platform around autism, a "Robot Enhanced Therapy for Autism – Forum", in order to create an independent community of developers and users on NAO and autism. As such, this community could share open-source applications, treat subjects linked with the use of NAO in autism and beyond, and work as a second hand technical support. This project is still in its first steps, but it could work as an alternative mean of dissemination within the frame of the DREAM project.

All of these new steps of dissemination and exploitation will be reported in more details in Deliverable 8.3.