PUFFY PROJECT

Design and Technology Document

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Academic Course: Advanced User Interfaces

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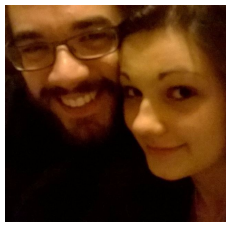

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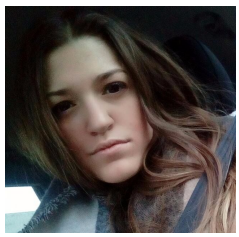

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1 Introduction

The project aimed to develop a robotic companion to educate and to play with children with Neurodevelopmental Disorder (NDD). We started from an IRobot robotic base (easily controllable from an Arduino board) and then created an anthropomorphic inflatable robot that communicates through words, the use of lights and projectors from inside the body. The body used is made by an inflatable transparent material provided by I3 lab.

1.1 Milestones Achieved

Date	**Milestone Achieved**
10/11/2016	Project Presentation
25/01/2016	Hardware Complete Construction
27/01/2016	Main Features Implementation
15/01/2017	Secondary Features Implementation
17/01/2017	UX User Evaluation (School)
15/02/2017	Activity Testing and Evaluation

1.2 Hardware Definition and Availability

Hardware Part	
Robotic Base	iRoomba
Body Material	Inflatable Adult Costume inspired to Baymax in the cartoon “Big Hero 6”
Kinect	Kinect One
Sensors	Not installed yet
Philips Hue Go Portable Lights	Yes
Head	Yes
Skeleton	Aluminium
Central Arduino Control Device	Arduino UNO
Audio System	Bluetooth speaker

Image Projector Device	Short-focal length
Microphone System	Embedded on Kinect
Mini PC	Yes

1.3 Project Website

More promotional information and advertisement are available at:
www.puffyprojectgroup.wixsite.com/puffy.

2. Target User Group and User Needs

2.1 Stakeholders

- Therapists & Caregivers
- Children with NDD

2.2 Needs

2.2.1 Caregivers

- Improve cognitive/social/emotional skills of the children
- Control the activities
- Collect data about the reactions of the children during the activity

2.2.2 Children

- Have fun
- Learn how to playfully interact with other children
- Keep himself/herself engaged
- Feel at ease and rewarded

2.3 Goals

- Provide remote control for the therapist to choose the behaviour of Puffy
- Bring children to a relaxation/affection states
- Create situations in which cognitive/social capability of the children is challenged
- Involve as much sense as possible in the activities

2.4 Requirements

- The robot should be attractive to the children and stimulate positive reactions.
- The robot behaviours should lead the children to a relaxation and affection state.
- The children have to trust the robot, think it is harmless, reliable and nice.
- The robot has to encourage the children to use his screen, to touch it and to provide instructions for the children.
- The screen on the robot should allow the development of the children's imagination through illustrations (I.e. drawings capabilities).
- The robot encourages the communication with others (caregivers, children) as a social mediator.
- The robot should provide feedback and rewards with lights, noises, movements, and images on its screen.
- The robot has to have spatial recognition to avoid any obstacles.

- The robot has to recognise each children and their emotions.
- The robot has to react with the behaviours/actions/emotions of the children.
- The caregivers have access to the robot behaviours in real time and then to the collected data.
- The robot has to communicate with children using sounds, lights, movements, and images on its screen.

3. State of the Art

Finding better ways to prevent and treat brain diseases is becoming urgent. Furthermore, understanding how our brains work is important to keep our economies at the forefront of new information technologies and services. The European Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn has stated that treating those affected is already costing EUR 1.5 million every minute and that brain research could help alleviate the suffering of millions of patients and their caregivers. Unlocking the secrets of how the brain works could open a whole new universe of services and products for our economies.

Part of the effort, made to fight the ever growing need of new and more effective therapies, is devoted to the design and testing of robotic solutions. With respect to teachers' acceptance of the use of robots in education, one study found that pre-school and elementary teachers accepted a human-like robot to serve as an interactive tool in the teaching process (Fridin and Belokopytov 2014). Other findings regarding attitudes towards the use of robots in (psycho)therapy or education for children show that people, overall, tend to have positive attitudes, considering them as useful and potentially effective tools in psychological treatments or interventions.

Despite this work with promising results, the actual current state of application of robots for children with autism in care/therapy and education practices is still relatively in an early stage. More research is needed to understand the actual clinical effects and added value in therapy and education. Moreover, it would be interesting to better understand the areas in which robots can actually add value to the functioning of children with autism, and how this relates to the "International Classification of Functioning, Disability and Health, which provides a classification for health and health-related domains and addresses all aspects of functioning specifically for children and youth.

Furthermore, although research has proved the potential added value of different kinds of technologies for children with autism, these tools currently lack the ability to personalise to a specific person's needs, as highlighted by the American Psychiatric Association in 2013. Especially for such a diverse and heterogeneous target group as children with autism, it is extremely important that interventions address challenges in different dimensions and a personalised offering is possible. Technologies, including robots might be able to fulfil this requirement as they allow for personalisation and customisation to the individual's specific needs.

Actual clinical application of robot technology in practice requires the expertise of both technology developers as well as experts in the area of children with ASD. Although public opinion and press devote more and more attention to the use of robots in the therapy or education for children with ASD, scientific peer reviewed publications of systematic clinical

effectiveness of the actual implementation of robot based interventions for children with ASD are still scarce.

As for now, Puffy has sparse competition with other similar products. For example, SAM in the robotic solution that aims to help children with intellectual disability (ID) to “learn through play” by interacting with digitally enriched physical toys. Though the aim is the same, the means greatly differ: while SAM is proposing activity based on Dolphin Therapy, a special type of Pet Therapy, Puffy abstractly represents a human being aiming ambitiously to improve the children’s social skills on a whole different level.
The robotic solution known as TEO is another competitor, since the social interaction during the activities shares the same principles, A defining difference could be found in the scale of the product and in Puffy’s capability to move around autonomously, being able to perform spatial-oriented activities and engage multiple children at once. Because of that, even if the starting point remains as well as the aim remains the same the two product’s functionalities do not overlap.
Puffy can therefore be viewed as a ground breaking project with a blue ocean as a expected market, as the versatility and the quality of its interaction are its strongest features.

4. UX Design

The Puffy project UX Design will focus mainly on usability and rewarding feedback. Lights and pleasant sounds will have the main role to keep the user engaged and amused, while the activity system we designed for puffy will ensure fun and healthy behaviours, which will aid in fight against the pathology. But, even more then that, we designed our product to be intuitive to use for both children and therapists, in order to maximize the engagement derived from its activities, since we strongly believe that having fun is key to create successful and positive sessions.
Because of all of this, we will gain feedback directly from the stakeholders. We plan to visit a school in Bareggio(MI) which treat some of the children affected by NDD. From the results of this important and learning experience, we will adapt our schedule to satisfy all those needs that we missed in the first design stage.

4.1. Activities and Behaviours Proposals

4.1.1 Interactive Story

Puffy will tell a simple story to its audience, which will be accompanied by sounds and projected images. At specific times, the storytelling will stop and Puffy will require its users to make decisions (by selecting one of the given options projected on his body) that influence the course of the story.
This activity focuses on keeping the child's attentive activity and teaching him/her some basic morals as well as showing the consequence of his/her decisions.

4.1.2 Introduction Mode

This is not an activity, but it serves the purpose of helping the child to familiarize with Puffy, achieved by talking to the children and gathering data by analyzing their emotions, gestures and facial expressions as well as eventual touching inputs as detailed in activity number 6. Puffy should also be able to follow simple vocal commands and/or recognize children, in order to store results from said subject's previous activities.
If there are no children next to him, Puffy will try to attract them via pleasant noises and lights but without movement.
This activity is important to create a pleasant atmosphere and an engaging bond with the user before starting the activities.

4.2 Scenarios

4.2.1 Introduction mode Scenario

Analytical Description	
Leonardo enters the room where Puffy is. Leonardo calls Puffy by name and it reacts turning himself towards him and approaching the child. Puffy says "Hello!" to the child and, since its sensors reveal that is the first time they meet, it asks the child's name. Leonardo answers his name and then hugs it. Puffy reacts by lighting up itself in pink and by emitting pleasant sounds and exclaiming "I love hugs!". At this point, Leonardo shifts his attention towards the magic carpet with its toys. Puffy then follows him around for a minute, and then - since the child does not seem to pay attention to it anymore - it tries to bring his interest up by asking to him: "Do you wanna play with me?" and projecting onto its belly the activity proposed. Leonardo then says brutally "no!" and he pushes it away. Puffy perceives Leonardo's rough reaction and replies "Doesn't matter! You don't have to do that…", and since the child has still a grumpy expression on his face, the robot responds by projecting a sad emoticon on its belly and lighting up itself with a blue light.	
Interaction	**Requirement**
Puffy Turns toward when is called and says hello	➢ **React** to the children's actions
Puffy Asks child's name if he doesn't recognize him	➢ **Recognise** each child and his emotions ➢ **Collect** data
Puffy Lights in pink when child hug him and makes sounds	➢ Be **attractive** ➢ **React** to the children's behaviours/actions ➢ Provide **feedbacks**
Puffy Tries to bring interest by following, asking questions, projecting activities	➢ Encourage the children to **interact** ➢ Encourage the **communication**
Puffy Projects a sad emoticon, lights up in blue	➢ **React** to the children's behaviours/actions ➢ Provide **feedbacks**

4.2.2 Story Mode Scenario

Analytical Description	
Leonardo has agreed to join the Storytelling activity proposed by Puffy, so the robot starts telling the narrative accompanying it with (animated?) images and sounds. The story tells about an imprisoned princess in a lone tower, guarded by a fierce dragon. Puffy interrupts the flow of the narrative since it needs to ask the child, how the brave hero should proceed: will he face the monster with its sword or should he shoot it with his mighty bow? Leonardo is hooked on the story, so he swiftly selects the sword options so that puffy can continue: the lone tower was not only guarded by the fierce dragon, but also protected by some traps set under the bridge. The story continues for a while, and eventually the hero makes it to the lone tower. Puffy then asks the child to help the protagonist once again, by making remember the hero where the traps were placed. Leonardo answers right, so the hero slays the dragon and completes his quest.	
Interaction	**Requirement**
The child joins the game	➢ Be **attractive** ➢ Make children **trust** him, think it is harmless, reliable and nice
The Therapist uses the remote control to choose a story	➢ **Be accessible** by the caregivers in real time
Puffy asks questions to the children during the story to make him choose and remember	➢ Support the **development** of the children's **imagination**
The child focus his attention and answer correctly	➢ Lead the children to a **relaxation/affection state**

5. Implementation

5.1 Hardware Architecture

The hardware architecture is composed of a wheeled robotic base (insert precise name and details here) which sustains the skeleton of the robot and hosts a fair part of the electronic components. Attached to the skeleton and base, Puffy will feature HUGO/LED lights, a video projector, a minicomputer as well as the audio systems. Encased in the head, which is modeled after the famous cartoon character, a kinect system will be performing all the gestures and expressions recognition activities. The body, which surrounds the skeleton, will be made of white, semi-transparent, soft-plastic material, which will be both functional for image projecting and pleasant to touch. The body will also feature a number of Neopixels touch sensors which will be the main method of interaction with Puffy during its activities.

Technology	Use	How
Robotic Base	➢ Sustains the robot skeleton. ➢ Hosts a part of the electronic components.	Guarantees movement and stability through the wheeled structure.
Skeleton	Sustains: ➢ Body material. ➢ Hue Go/LEDS lights. ➢ Audio systems. ➢ Video projector.	Made similar to the TEO2 skeleton. It will work just the same.
Body Material	➢ Projection screen. ➢ Pleasant to touch.	Made of white, semi-transparent, soft-plastic material.
Philips Hue Go Portable Lights/Neopixels LED	➢ Communicates. ➢ Provides feedbacks.	It will be controlled by the arduino device to enhance each activity with visual feedback.
Input/Output Audio System	➢ Recognizes words and voices. ➢ Provides audio feedback to the users.	An audio cube will be installed on the skeleton, as well as a microphone on the head.
Image Projector Device	Projecting the activities on the	Will be attached at the longest

	robot's belly.	distance from the belly.
Head	➢ Sustains the Kinect. ➢ Attracts children.	Will remind the user of the fun cartoon hero.
Kinect	Performs gestures and expressions recognition activities.	The Kinect, acting also as camera, will be placed in Puffy's head.
Neopixels touch sensors	Interaction methods for activities.	Capsense Library Arduino Sensors.
Central Arduino Control Device	➢ Controls the devices ➢ Configures it.	It will be connected to the other devices through USB.

5.2 Software Architecture

The main programming languages used in this project will be Arduino for the hardware configuration and programming as well as some code written using Microsoft API for facial expression recognition. It will also be necessary to program the robot controller using C Sharp, in order to ensure the devices' compatibility and interoperability.

Language	Use	How
Arduino	➢ Hardware configuration. ➢ Programming.	Using specialized function for hardware features.
Affectiva Affdex API	Facial expression recognition.	Will be used by the Kinect.
C Sharp	➢ Programs robot controller. ➢ Ensure devices' ○ Compatibility. ○ Interoperability.	We chose this since it is the best and most general language.

6. Empirical Evaluation

6.1 Evaluation Goal and research Question

6.1.1. Evaluation Goal

The evaluation plan is performed to validate the requirements, the design choices and the Hardware and Software implementation that have been selected to create Puffy. The main goal is to verify and validate the solution that we decided to implement.
The evaluation findings will be used by the project participants to improve the robot Puffy so that it fits the needs of the therapists and NDD children. For instance to correct the problems that may occurs during sessions, to change the behaviours of Puffy to make the children trust him and play with him...
They also will be used by the therapists to determine if Puffy can be used during their sessions with NDD children, if the results are good enough to do so.

Achieve this evaluation test during the prototype step is relevant because it is the first time when the coherence of the behaviours of Puffy can be tested efficiently. Before the software and hardware were not linked together and so the therapists and children cannot give their feedbacks. And after this step it must be to late to do big changes in the program of Puffy.

6.1.2. Research Questions

Here are the major questions that will be answered through the evaluation :

- Is Puffy easy to use by the caregivers ?
- Do the children consider Puffy as a friend (attracted by him) ?
- Do Puffy's behaviours help the children improve their skills ?

6.2 Evaluation Design

6.2.1 Context of Execution and Target

The data will be collected from a group of NDD children and their therapists directly during a trial session across Usability Testing. The therapists should follow a **task scenario testing** by achieve stages and the project participants will monitor the test, help them if necessary.
The children would only have to give their feedbacks about how they feel in the presence of Puffy, if they want to play with him or if they are afraid.

The reactions of the children would be analysed in the same time by the caregivers, that would evaluate the behaviours of Puffy, if it leads the children in a relaxing mode or not.

A sample is used for each test, it is an expected result, that will be achieve in the best case. If the obtained result is too different, the test is a failure. It have been created according to what the project participants expect Puffy to do.

The reliability of the data collected and their validity will depends on the stakeholders. We can assume that the test of the therapists can be trust because they are responsible, the children test should be done many times and the average of the result will be consider for more reliability.

Evaluation Question	Data Collection Method	Source of Data
Is Puffy easy to use by the caregivers ?	Task Scenario test	Therapists and caregivers
	Interview Post-Test	Therapists and caregivers
Do the children consider Puffy as a friend ?	Task Scenario test	Therapists and caregivers
	Meeting with Puffy	NDD Children
	Post-Meeting Questions	NDD Children
	Interview Post-Test	NDD Children Therapists and caregivers
Do the behaviours of Puffy help the children to improve their skills ?	Task Scenario test	Therapists and caregivers
	Interview Post-Test	Therapists and caregivers

6.2.2 Task

In this section we selected for each scenarios some key points to perform a given task for our Users.

In Summary, the main actions that the interface allow the therapist to do are the following:

Verification Controls		
User Profile	Therapists and Caregivers	
Test to do before	_	
Action number	Actions to do	Expected Result
1	Launch the Puffy Program	Opening of the User Interface
2	Start puffy by clicking on the Button “Start PuIn this	Message box “Puffy start” “Stop Puffy” and mode buttons available.

	section we selected for each scenarios some key points to perform a given task for our Users. ffy”	
3	Start the Introduction mode by clicking on the Button “Introduction”	Message box “Introduction Mode” Puffy says “Hello my name is Puffy”
4	Start the Story Telling Mode by clicking on the Button “Storytelling”	Message box “Story Mode” Puffy says “Do you want me to tell you a story ?”
5	Stop Puffy by clicking on the Button “Stop Puffy”	Message box “Stop” Puffy says “I am a bit tired”
6	Quit the program by clicking on the Button “Quit”	Message box “Server logout” Puffy say “Goodbye” The user Interface is closed

Based on the assumption above, we divided for each scenarios meaningful task to perform.

- First Scenario

Leonardo enters the room where Puffy is. Leonardo calls Puffy by name and it reacts turning himself towards him and approaching the child. Puffy says “Hello!” to the child and it asks the child’s name.		
User Profile	Therapists and Caregivers	
Goal	Choose the introductory mode after launching the Puffy’s interface	
Task to do before	Launch the controller program in order to choose Puffy Functionalities	
ID	Task	Expected Result
1	Suppose that a child is in the room and make Puffy introduce himself	Opening of the User Interface Message box “Introduction Mode” Puffy says “Hello my name is Puffy” Puffy turns to face the child Puffy says “Hello”

Leonardo answers his name and then hugs it. Puffy reacts by lighting up itself in pink and by emitting pleasant sounds and exclaiming “I love hugs!”.		
User Profile	Therapists and Caregivers	
Goal	Monitor the child’s reactions	
ID	Actions to do	Expected Result
2	Control the reactions of Puffy according to the child movement	Puffy adapts his position, color and answer in function of the child’s emotions : If he is afraid : goes backward, lights in blue and

		says “don’t be afraid” else (joy, caml…) : goes forward, lights in pink

At this point, Leonardo shifts his attention towards the magic carpet with its toys. Puffy then follows him around for a minute, and then - since the child does not seem to pay attention to it anymore - it tries to bring his interest up by asking to him: “Do you wanna play with me?” and projecting onto its belly the activity proposed.		
User Profile	Therapists and Caregivers	
Goal	Choose an activity mode for Puffy and stop it	
ID	Task	Expected Result
3	The child is bored , try to make puffy play	The therapist should choose the Introduction mode so that Puffy asks the child to play after a moment. If the answer is positive then she/he has to do the next task.
4	The child wants to play,choose an activity	The therapist chooses an activity and starts it
5	After starting an activity for the child, control the game and when the child is tired stop it	The Therapist should start an activity for Puffy and monitor the game, After a given period she/he should stop it through the program.

- Second Scenario

Leonardo has agreed to join the Storytelling activity proposed by Puffy, so the robot starts telling the narrative accompanying it with images and sounds. The story tells about an imprisoned princess in a lone tower, guarded by a fierce dragon. Puffy interrupts the flow of the narrative since it needs to ask the child, how the brave hero should proceed: will he face the monster with its sword or should he shoot it with his mighty bow? Leonardo is hooked on the story, so he swiftly selects the sword options so that puffy can continue: the lone tower was not only guarded by the fierce dragon, but also protected by some traps set under the bridge.			
User Profile	Therapists and Caregivers		
ID	Task	Expected Result	Goal
1	The child wants to hear a story from Puffy, choose the story that you prefer to play.	The Caregiver should select a story in the Story activity across the program.	Choose a story in the Story activity
2	After having chosen a story, start it	The Therapist should start the previously chosen story. Puffy	Start the story telling.

		should start telling a story to the child.	
3	Monitor the storytelling and control the child reaction during the stopping points	Puffy should stop in some important point of the story and ask the child to participate in it. The therapist should observe the reactions of the child and if he runs into difficulties	Monitor the child during the Storytelling
4	The child is tired and the story that puffy is telling is finished	The therapist should stop the storytelling mode from the program.	Stop the activity

6.2.3 Post Test Evaluation

The Post Test Evaluation allows to elaborate the collecting data from tests and also to acquire information about the sensation and impressions of Users during the trial activities.
To capture the User thoughts and expectation that had during the testing part, we can use questionnaires with specific questions for each User (Therapist, NDD children) concerning the tasks or the activities that they did.

We present here a simple template both for Caregivers and Children:

- Therapist Evaluation Questionnaire on each task

Name and User ID :
Task ID:
Evaluator ID:
How was the task ?
Very Easy ☐ ☐ ☐ ☐ ☐ Very difficult
Was the task stressful?
Absolutely Yes ☐ ☐ ☐ ☐ ☐ Absolutely No
Personal Reflection on the expectation

- Therapist Evaluation Questionnaire on the Complete Program

Name :					
Was the Interface well looking ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree
Was the Interface easy to understand ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree
Was the Interface easy to use ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree
Do you think that Puffy is useful to improve Children's disease ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree

- NDD Children Evaluation Questionnaire

Name :					
Did Puffy look nice ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree
Do you like Puffy ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree
Is Puffy your friend ?					
Completely disagree	☐	☐	☐	☐	☐ Completely agree

6.3 Data Analysis

6.3.1 Indicators and Standard

For the first question on the usability of Puffy, if a task takes too long to the therapist it is an indicator of failure. For the behaviours and the attractiveness of Puffy it is the feeling of the children which is important. A success is when the task is completed quickly by a therapist and when the children reach a relaxation state in presence of Puffy.

Evaluation Question	Criteria or Indicator	Standards (What Constitutes "Success"?)
Is Puffy easy to use by the caregivers ?	Task Goal	Achieve
	Time on Task	Small
	Waiting Time	Small
	Therapist Feelings	Positive
Do the children consider Puffy as a friend ?	Child Feelings	Interested
		Calm and relax
Do the behaviours of Puffy help the children to improve their skills ?	Child Feelings	Concentrate/Positive
	Relevance of the Activities	Therapists approval

6.3.2 Analysis

The data will be analyzed by descriptive statistics like in the graph below for the tests and from a qualitative point of vue for the interview of the children and the therapists.

The data elaboration can be made across the observation of the testing task focusing on errors, output of the tasks, time needed, time lost, and uncertainties.
In the graph below it is showed the relation between the final score and the time consuming for different task, in order to measure efficiency, effectiveness, attention and failure.

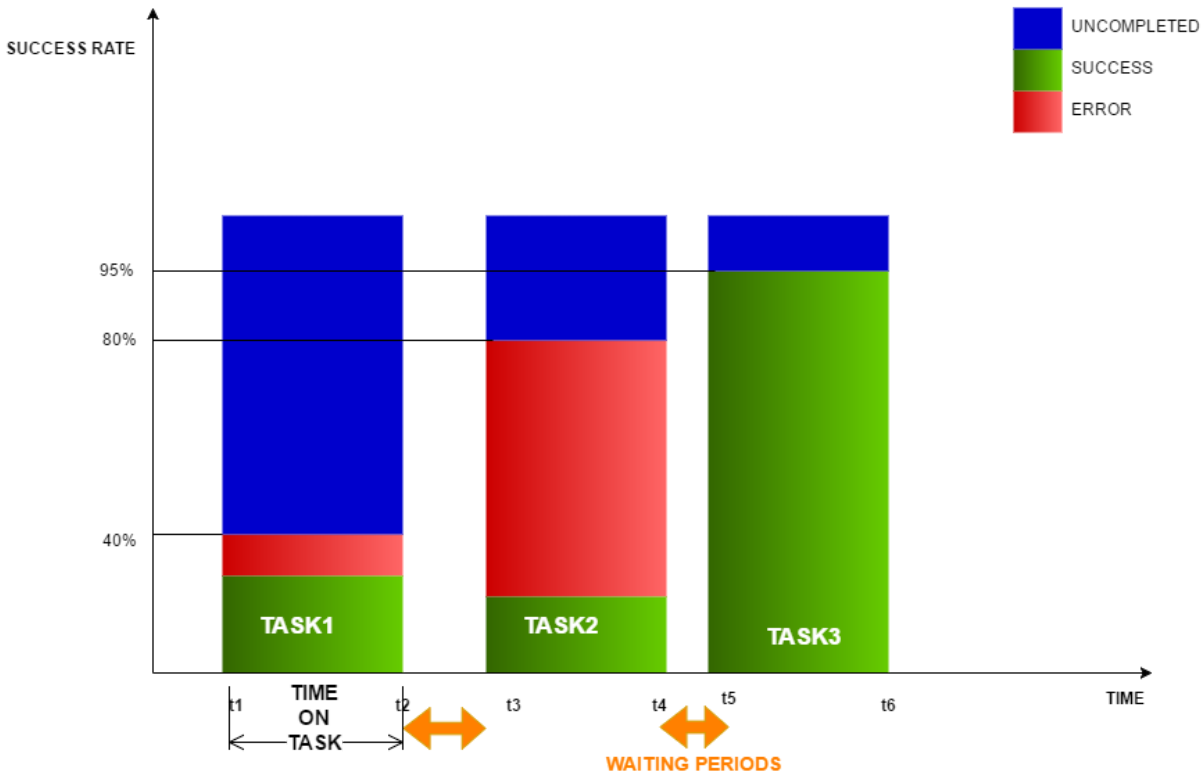

Figure 0: Data elaboration across Observation

6.3.3 Interpretation

The interpretation of the test about the first question (*Is Puffy easy to use by the caregivers ?*) will be done by the project participants to improve the usability of the User interface and Puffy. The other one will be completed by the therapists to explain the reactions and feelings of the children and conclude if the behaviours and the shape of Puffy are good.

6.4 Results

During the early test phases, conducted in the Institute of Infancy ICS G.Perlasca, Puffy was met with enthusiasm by both children and caregivers. Its activity were followed with interest and received by a display of positive attitude and by a lasting engagement which proved to be capable to keep the participants hooked for the complete duration of the test.

7. Value Proposition

Puffy is an ambitious project that aims to bring the fight versus the neural developmental disorder to a new different level. It proposes a transition from a non-verbal or sound-only communication with abstract entities or animals (SAM and TEO being two example), to the capacity of verbal dialogue and an anthropomorphic shape, capable of movement and endowed with a scale proper of what a child can think as another human being.

The critical point when defining the efficacy of the activity presented above, is situated in their quality and their capability to either adapt to the individual or to cover at once multiple aspect that the children require. This can only be achieved with months of testing with the aid of the experts, in order to constantly improve its content and methodologies. We believe Puffy to be a good solution: right now it is but a simple product, but could be easily used as the standard to house a variety of different application and a methodical data collection to help the research progress. Its versatility is at the core of our features: what we want to set is a staple in the NDD-related robotic industry that can be the starting point for developing new activities which exploits Puffy advanced hardware capabilities.

8. Future Work

Puffy's first prototype will leave us with nothing if not room for improvement. In order to achieve greater results both during the therapies' sessions and during the data collection, an extensively testing period with experts in the NND and child ASD field would be necessary to point out what needs to be addressed and what has the highest priority. Once the already implemented activity has been thoroughly tested, a new set of activity with specific, different aims could be designed in the short term, such as:

Cause and Effect Relation Game

The child will be challenged to complete different actions that Puffy will be able to recognize and evaluate via different sensors. This will involve touching specific parts of the body, interacting with projected images, associating sounds to figures/pictures, and display different emotions/gestures in front of puffy.
Every time the child will complete one of these tasks, he/she will be rewarded with soothing sounds/light animations; in case of error, a different animation will be displayed and the same task will be asked again.
This activity serves the purpose of teaching the child the cause/effect relation in addition to simple object and body parts recognition.

Customize Puffy

The child will be able to customize by touching it on different parts of its body. The parts touched will be lighted differently according from the number of "touches" that the child has performed on said body part via LED/HUGO lights,
It could also be implemented a system that will be able to make the child draw on puffy's belly, by projecting the lines traced with the child's finger.
This activity will be helpful to develop the child's imagination and creativity.

Find the Differences

Puffy will be able to project couples of similar images and challenge the child to find all the differences. The user will need to draw the lacking part of the drawing, to complete the minigame.
This activity is important to teach the attention to details and stimulate the visual memory of the child.

Emotional Response Mode

Puffy will be able to react to different actions made by the children (like caressing, touching, pushing, punching and so on) and display an emotional response via lights, movements, noises and by projecting a stylized version of the emotion it is try to communicate on his belly.

This activity is important to teach the child the cause-effect relation regarding behaviour and emotion, as well as try to teach and improve his/her social skills

Hide And Seek / Tag Game

Puffy will colour his body (via LED lights/HUGO lighting) and will ask the child(ren) to play with him. The child will then need to escape from Puffy while the robot will try to chase the child down. When Puffy reaches the child, he will change colour again and challenge the child to chase him and tap on his head/body.
This activity will teach the child a playful attitude which will serve the purpose of engaging the child in a prolonged group activity.

Competition/Memory Arcade games and Co-Op.

This is a collections of mini-games, which will comprehend activities like memory, puzzles and reactivity games (such as touching all the lights displayed as soon as possible to achieve the best score). The child is invited to retry the mini-game to improve its skills and his learning process. This could also have a multiplayer feature so that two child can help each other to achieve a better score.
This is an important activity because it will push the limits of memory and reaction skills of the child as well as (in the Co-Op version) teach the value of cooperation and social benefits.

In a medium term, the project would probably focus on the data collection and to improve usability for the therapists. A new database system could be developed to sample with greater accuracy and frequency the data mined during the various activity and stored them into and organized cloud common to all Puffy users, in order to facilitate and promote the information sharing between experts.

A long term project, could be the design and implementation of a genetic algorithm to make Puffy learn about the child it is working with. The data stored in his databased would be data mined and analyzed autonomously in order to adapt and react differently to different children, giving the customized experience closest to the best fit of the individual child needs.

Bibliography

- Microsoft API.
- Arduino Specification Language.
- Advanced User Interface Course Slides
- Kinect SDK