Research Project Proposal: Interactive Storytelling for children with neurodevelopmental disorders

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1. Introduction to the problem

My research aims at improving the lives of children with neurodevelopmental disorders by creating interactive storytelling experiences that enrich therapy and help them practicing necessary skills for their everyday life such as words pronunciation or emotional responses.

Given the goals, there are many areas of study involved in this kind of research. Psychology and more specifically developmental psychology and neuropsychology. Advanced user interfaces paired with Interactive Storytelling for children. These areas are broad and interdisciplinary, as such they intertwine and share many strengths and weaknesses.

This topic, more in general, focuses on studying how interactive systems and advanced user interfaces may allow us to tackle important issues that children with these kinds of disorders face each and every day.

These difficulties span from different kinds of linguistic issues to socialization problems and cognitive impairments. As research progresses there is a continuous need to explore the possible collaboration between these various fields. One new breakthrough technology could revolutionize forever the approach to certain kinds of disorders during therapy, and a brand new technique in therapy or pyschology in general, could be easily and more effectively implemented through the tools that the AUI and ISC fields give us[1]. Because of this and the clear impact this field may have on the lives of so many children, it seems obvious that this topic needs to be supported and explored.

More specifically there is the strong need to acquire more resources in terms of data-collection and effectiveness of on-going therapies. In order to generate any kind of meaningful conversational agent there is a strong need for large data-sets for the training of these massive models.

Vocalizations of kids with autism, for example, are hard to collect but would be hugely beneficial in any AI tool that wants to recognize certain sounds or emotions and act accordingly. By creating tools that enrich and help the therapy, we may collect data during the session and label it in effective and meaningful ways that would facilitate further efforts in creating conversational agents or any tool that would need to train on large batches of data.

The correct implementation of these tools could create a virtuous cycle in which we create interactions with kids that help them with particular actions and skills, while we collect data in order to improve those same interactions and build better ones with the help of artificial intelligence. This would not only improve the therapy sessions, but also allow research in the psychological field to progress faster with a greater access to labeled data.

The possibilities given by modern interfaces are many and could potentially change the way we intend therapy. As seen in the last few years of pandemic, we developed great tools to bridge physical barriers such as distance or health conditions, the use of these interactive tools could also expand behind the walls of the therapy sessions and be implemented at home, school or the hospital. This solution could even allow therapists to assign "homework" to children and study their behavior in a difference setting while gathering precious data.

To conclude: the possibilities of the different implementations of advanced user interfaces for children and in particular children with neurodevelopmental disorders are many and could potentially change the way we view therapy adding new solutions to the challenges posed by these disorders. In the next paragraphs I will describe more the details of the related works and my research plan.

2. Main related works

The main dimensions in which we may evaluate and classify the related works are closely tied to the effectiveness of the therapy. The difference between results obtained by classic means of therapy and the ones obtained with interactive approaches, especially with storytelling, reveal the importance of these works. Although there were various applications that while different seemed to share some of our ideas and gave some insights on research methodologies[2][3], we couldn't find something that resembled our idea closely enough for the results to be comparable. Because of these, we reviewed papers on the individual aspects of our projects and tried to derive observations from the mixing of these results while also listening carefully to the therapists' feedback.

What emerged is that the bases behind the technology implementation seem solid[4][5][6], the possibilities for the engagement of the child also seem like a strong point, while the ability to customize many of our features was the selling point for all the therapists we talked to and the storytelling seemed like a powerful tool for this kind of applications[7][8]. From these knowledge we believe that our idea has the potential to be an effective implementation of modern interfaces to tackle important issues for kids with neurodevelopmental issues, in particular language impairments, although we believe that further research is needed to fully comprehend the various aspects of this topic in order to create a meaningful application[9][10].

3. Research plan

The goal of the research is to create an interactive storytelling platform to help children with neurodevelopmental disorders. The project starts as an incremental work of the Comutti project curated at Politecnico di Milano by professor Franca Garzotto, in the context of her master course of Advanced User Interfaces. During the first meetings of the tutoring for the course me and my teammates proposed the idea of using storytelling in order to create an interactive experience to help children vocalizations. Since, for now, this project involves other students and is the assignment of the course, the development is being carried on by three people and we will build a prototype to present in the next winter session. From then on, I will proceed by myself, expanding the previous work and implementing new features and resources that we couldn't possibly develop in time for the deadlines of the course. Below I include a general GANT diagram of the prospected timelines.

The project will use storytelling in order to keep the children engaged while they perform exercises of words vocalization. The main target of this project are kids with neurodevelopmental disorders that struggle with vocalization and speech.
The use of interactive and digital interfaces helps in keeping their attention on the given task, on top of that the storytelling aspect makes the excercise even more compelling for the children. Our desire is to create vast and meaningful stories that aside from their application could be valuable tales per se.
On top of the stories there will be a complex Speech-to-Text software that will convert the children's vocalizations into text, from there we take the words and match them with the words the child should pronounce in that given moment of the story. By both evaluating the correctness of the vocalization and registering the sounds, we hope to create a tool that can help alongside the therapy sessions or that is used outside of therapy at home or school. We also will implement ways to gather meaningful data and to label it accordingly and then provide it to the

experts in order to enrich the therapy sessions with a robust data-collection system. This will hopefully help in the assessment of the effectiveness of our solutions while also providing valuable information for the children's state. Now that we have explained better the scope of the project, we want to outline the most relevant feature of our work: the ability to be personalized according to each child necessities.

We have been a bit general on the vocalizations and on the stories of our projects because our idea is to let these elements to be developed ad-hoc. Given the preferences of each kid we will be able to generate different kinds of stories with different kinds of images and visualizations and according to the specifics set by the therapist, we generate different words for the child to vocalize.

When meeting with the therapists at Medea Institute, it was clear from the get-go that the ability to develop a custom solution for each children was the key feature for them. The possibility to generate engaging stories starting from the interests of a child, while asking specific vocalizations set by therapist is the true point of strength of this project. Our intention is to keep the dialogue open with all that therapists that have and will show interest in our research and try to implement the features that, although seemingly not as relevant to us, could make all the difference for the experts.

The impact our research makes will be assessed during the therapy sessions and listening to the experts feed-backs. Since our goal is to provide the therapists with the tools to enrich their sessions, we will need months to properly evaluate our effort, comparing a traditional approach therapy to one that actively uses the tools we propose.

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