Augmented Reality for Cognitive and Social Skills Improvement in Children with ASD

Pedro Cunha, Jorge Brandão, José Vasconcelos, Filomena Soares
University of Minho/Algoritmi R&D Centre
Guimarães, Portugal
fsoares@dei.uminho.pt

Vítor Carvalho
University of Minho/Algoritmi R&D Centre,
Guimarães, Portugal
IPCA-EST, Barcelos, Portugal
vcarvalho@ipca.pt)

***Abstract* - Nowadays ubiquitous technology can be a suitable way to motivate and engage children in interactive learning activities in order to promote their cognitive and social skills. Technologies, like augmented reality (AR), have the ability to catch the children's imagination and to promote their attention, as they can experiment artificial, safe and fascinating environments. Children with autism spectrum disorders (ASD) usually have difficulty to recognize facial expressions and to understand the associated emotions. Regarding that, an innovative GameBook to assist children with ASD to recognize and acquire emotions by engaging their attention and motivation was developed. The aim is to promote the interaction between the child/storyteller and his/her imagination as well as it will help the child to identify the correct emotional face to the situation. It can be played on any mobile device, such as a tablet, a smartphone or a laptop, with either an external or an inbuilt camera. We also intend to observe the impact of the game on children interaction, as well as to quantify and evaluate their performance, assess the usability of the technology, and evaluate how it affects the child emotion reactions and the benefits it offers.**

***Index Terms* - Augmented Reality, Autism Spectrum Disorders, Game Book, Serious Games**

I. INTRODUCTION

Autism Spectrum Disorder (ASD) is a lifelong group of neurodevelopmental disabilities characterized by abnormalities in social interaction, communication and restrictive and repetitive behaviors [1]. This affects development capabilities especially in areas like communication and interaction with others [2]. ASD children struggle with significant relationships and behavioural challenges and in most cases have serious implications for inclusion social adulthood [3]. One of the most promising applications in the intervention process of ASD children came from developing tools for promoting children's social and communication skills [4]. Several studies show that the majority of people with ASD exhibit a natural affinity with technology and a positive attitude towards computer-based training [5].

There are numerous practical advantages on using technology on ASD [6]. Technology has the potential to provide individually tailored interventions that are suitable for a wide variety of abilities [7]. Technological interventions allow its use at different speeds and locations, and never lose patience with the frequent repetition that people with ASD desire [8]. Nowadays, technology is ubiquitous and can be a safe and good way to motivate and engage children in interactive learning activities in order to promote their cognitive and social skills [9].

Technology is being increasingly used on a variety of pedagogical contexts, both as assistive technologies and as tools for helping us to understand user's motivation [10]. ASD children usually have difficulty to recognize facial expressions and to understand associated emotions, to imitate or use emotional expressions, to understand and control their own emotions, or to interpret emotions or empathy with others [11]. Technologies, like augmented reality (AR), have the ability to catch the children's imagination and to promote their attention. AR is a variation of Virtual Environments (VE), or virtual reality as it is more commonly referred. VE technologies completely immerse the user inside a synthetic environment. While immersed the user cannot see the real world around him. In contrast, AR allows the user to see the real world with virtual objects superimposed upon or composited with the real world [12].

AR is an optimal interface technology and a helpful tool to support autistic children capabilities. With AR it is possible to create more attractive and interactive interfaces that can be manipulated by hand, without using conventional peripherals such as the keyboard or the mouse [13]. This characteristic of AR promotes the interaction between the child and the object, raising their interest and curiosity in the task/activity [14].

II. GAMEBOOK

The GameBook (figure 1) aims to promote children with ASD recognizing and acquiring emotions by engaging their attention and motivation, increasing their competence on this handicap.

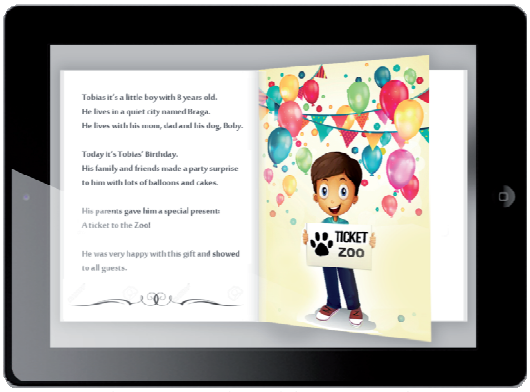

Figure 1- Interface of the GameBook.

The GameBook presents the story of Tobias's adventure during a visit to a zoo park [15], [16]. The story will describe five scenarios and interactions in real world situations which will conduct the children to become involved on fictional contents associated with emotions. The child will have to interact on these chapters, by playing with Tobias and learning his five different facial expressions, choosing the appropriate one to each situation and environment described at any page of the GameBook (figure 1).

The game tries to help him/her to make the proper choice by selecting the correct facial emotion for a certain scenario and situation, promoting his/her imagination and engaging. It can be played on any mobile technology, such as a tablet, smartphone or laptop, with either an external or an inbuilt camera and is available on online, which can be accessed by the url: www.tobiasadventures.in/thezoo.

The character Tobias was designed to captivate the children attention and to empathize with them. The character expresses five different basic human emotions during the game, as cited on [17] repertoire that served as the basis and foundation to countless works of scientific research, namely, joy, sadness, fear, anger and disgust.

The different scenarios was designed to involve the child on real life situations. These scenarios will promote the child's contact with different environments and will create some emotional reaction on Tobias. The child will have to recognize properly the emotion that Tobias is feeling on that context with the purpose of advance to the next scenario.

At the end of each chapter the player has a simple quiz before proceeding to the next chapter, where is questioned about which emotion Tobias felt on the situation described before. In order to help him/her, the game allows the child to observe Tobias avatar in 3D representation by AR. We believe that this feature will increase the attention of the child player and reinforce the memory skills of recognize facial expressions. At the end of the book the player has a simple and funny Memory Challenge game, where the child has to select the proper pair of all five emotions characters to finish the game. We believe that this technique is useful to children that have difficulties to remember faces, to encourage the child to observe and analyze different faces and to examine his/her facial expressions. Certainly, it will improve his/her capability to recognize some facial human emotions making associations of previous situations.

III. Conclusion and Future Work

The aim of this project was to make available a cost effective tool implemented in a platform pleasant for children with ASD.

Regarding the importance of the quality of the tool (Gamebook) and its application in the educational and everyday context of the ASD children, we intend to perform a case study. The main objective is to observe the impact of the game on children interaction, as well as to quantify and evaluate their performance, assess the usability of the technology, and evaluate how it affects the child's emotion reactions and the benefits it offers.

In the near future, a system that will allow monitoring the child's results and these outcomes will be available on the website of the game. This system will be synchronized with the game and it will have a login and member area to teachers and caregivers. Furthermore, new stories can be easily included.

It is the authors' belief that the GameBook will increase children with ASD engagement in the learning activities promoting their memory, cognitive and social skills and allowing them to reinforce facial expression recognition.

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