Exploring Usability and Accessibility of Avatar-based Touchless Gestural Interfaces for Autistic People

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ABSTRACT

Many prior works investigated the potential of pervasive technologies and interactive applications to increase access capabilities to digital content for people with disability, particularly Neuro-Developmental Disorders (NDDs). In this paper, we present an exploratory study aimed at understanding if an avatar-based touchless gestural interface is able to foster interest towards digital representations of artworks, e.g. paintings or sculptures usually exhibited in museums, and to make them more accessible for such people. In particular, the study involved three autistic people and a therapist, and allowed us to report the potential of an avatar to communicate the interactivity and stimulate interaction with just a few directions to start, or not at all. We also shortly present and discuss some possible idea for future developments.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

Author Keywords

Autism; Touchless Gestural Interaction; Public Displays.

INTRODUCTION & BACKGROUND

The Autistic Spectrum Disorder (ASD) is a range of complex neurodevelopment disorders characterized by social impairments, communication difficulties, and repetitive and stereotyped patterns of behavior, sometimes accompanied by restricted motor capabilities [6, 2].

Recently, HCI research has investigated several solutions aimed at improving the overall life of autistic people. For instance, assistive technologies have been explored for improving autistic children learning abilities, ranging from VR-based solutions [5], mobile applications [4], mobile interactive robots [3] and touchless gestural applications [6]. Many of these works mostly focused on autistic children, and observed a crucial impact of playful activities in learning tasks [8].

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Figure 1. An ASD user interacts with our avatar-based touchless gestural interface.

In this paper, we present the lessons learnt from an exploratory study, aimed at understanding the impact of an interactive avatar shown in the middle of a projected visual interface. In particular, we developed an information provision system to let autistic people access digital content about artistic masterpieces, envisioning possible applications of such idea in museums and art exhibitions.

SYSTEM DESCRIPTION

The hardware consisted in a projector and a Microsoft Kinect sensor, both connected to a laptop. The projector was placed at a distance of 1 meter circa from the wall, and the Kinect was placed right behind the projector, pointing the camera toward the opposite direction of the projection (see Figure 1).

We developed a touchless user interface based on the one described in [7]. Such interface is based on an interactive avatar, that appears whenever a user enters in the field of view of the Kinect, and remains permanently present in the middle of the screen, continuously replaying user's movements. In our previous studies, the avatar proved to be effective in communicating users both the interactivity of the system and its touchless nature [7].

A total of five interactive tiles are placed all around the avatar, each showing a thumbnail of an artwork representing the entry point for the related content. The user can interact by using the hands to drive the avatar's hands and place them on top of the available tile-shaped components, with no need for using any particular activation gesture to start the related content. This is particularly useful for autistic users, due to their peculiar and highly variable cognitive and motor capabilities.

Once the user selects a tile, a multimedia is played, showing textual and audio-visual information on a specific artwork. At the end of each multimedia, we show up to two icons: one for returning to the main interface, and another one (shown in one case only, due to the specific multimedia content) for allowing to access additional support content and helping the user to better understand it. For both the icons, we used two well-known pictures used in the PECS (Picture Exchange Communication System), i.e. typical images used by autistic to communicate their needs to the therapists [1].

STUDY DESIGN

We conducted an exploratory study aimed at understanding if our avatar-based touchless gestural interface is sufficiently usable and intuitive to be used autonomously by autistic people. Our goal was also to understand other possible issues, in order to understand the applicability of such idea in other contexts.

Our study involved 3 autistic users (23, 24, 36 y/o, 2 males), and we were assisted by a therapist. Participants were asked to stand in front of the display, at a distance of about 1.7m from the Kinect. We asked users to interact once with each tile, helping them only if required. At the end of each multimedia, users had to return to the home view by selecting the corresponding icon (or select the "help" icon if present).

During the interaction sessions, each of which lasted about 4 minutes, we observed the behavior of the users. At the end of each session we shortly discussed with the therapist, who evaluated both verbal and non-verbal signs in order to infer the users' feelings and preferences.

RESULTS & DISCUSSION

The therapist noticed the ability of all the three users to easily access the information by selecting one of the available tiles. Two of them needed few simple verbal instructions at the beginning of the interaction, while one user was able to interact on her own, with no need of instructions. This confirms the ability of the avatar to communicate the touchless interactivity [7], even to users with particular cognitive capabilities. Interestingly, some users showed less interest while watching the multimedia (hidden avatar), than during the selection task (visible avatar). This is in line with prior works on the effectiveness of playful interactions [8]. The therapist reported also that all the users expressed their enjoyment in driving the avatar via both verbal and non-verbal signs.

It is worth noting that the need to stay still, looking at the display, may result stressing and not adequate to all autistic users. In one case, a user asked for a chair, and she remained able to interact with no difficulties also while seated. Another user decided to walk around for a while, maybe because she felt bored or because her inability to keep her attention focused on the task (a typical disorder of autistic people).

CONCLUSION & FUTURE WORK

Our avatar-based touchless gestural interface seems a promising solution to let autistic people access interactive systems, supporting immediate usability and making the interactions more playful. In conclusion, interfaces like the proposed one may result helpful, but the need to keep the users' attention focused suggests that interactions should take place from restful positions (e.g. while seated).

Future work will exploit the above considerations in order to design more playful interactions and to better quantify the user experience and the general usability.

REFERENCES

1. Andrew S. Bondy and Lori A. Frost. 1994. The Picture Exchange Communication System. *Focus on Autistic Behavior* 9, 3 (aug 1994), 1–19. DOI: http://dx.doi.org/10.1177/108835769400900301
2. Beryl Charlton, Randy Lee Williams, and T. F. McLaughlin. 2005. Educational Games: A Technique to Accelerate the Acquisition of Reading Skills of Children with Learning Disabilities. *Intel. J. of Special Education* 20, 2 (2005), 66–72. https://eric.ed.gov/?id=EJ846936
3. Audrey Duquette, François Michaud, and Henri Mercier. 2008. Exploring the use of a mobile robot as an imitation agent with children with low-functioning autism. *Autonomous Robots* 24, 2 (feb 2008), 147–157. DOI: http://dx.doi.org/10.1007/s10514-007-9056-5
4. Lizbeth Escobedo, David H. Nguyen, LouAnne Boyd, Sen Hirano, Alejandro Rangel, Daniel Garcia-Rosas, Monica Tentori, and Gillian Hayes. 2012. MOSOCO: a mobile assistive tool to support children with autism practicing social skills in real-life situations. In *Proc. of ACM annual conf. on Human Factors in Computing Systems (CHI'12)*. ACM Press, New York, New York, USA, 2589. DOI: http://dx.doi.org/10.1145/2207676.2208649
5. Franca Garzotto, Mirko Gelsomini, Daniele Occhiuto, Vito Matarazzo, and Nicolò Messina. 2017. Wearable Immersive Virtual Reality for Children with Disability: a Case Study. In *Proc. of Conf. on Interaction Design and Children (IDC'17)*. ACM Press, New York, New York, USA, 478–483. DOI: http://dx.doi.org/10.1145/3078072.3084312
6. Franca Garzotto, Mirko Gelsomini, Luigi Oliveto, and Matteo Valoriani. 2014. Motion-based touchless interaction for ASD children: a case study. In *Proc. of Intl. Working Conf. on Advanced Visual Interfaces (AVI'14)*. ACM Press, New York, New York, USA, 117–120. DOI: http://dx.doi.org/10.1145/2598153.2598197
7. Vito Gentile, Salvatore Sorce, Alessio Malizia, Dario Pirrello, and Antonio Gentile. 2016. Touchless Interfaces For Public Displays: Can We Deliver Interface Designers From Introducing Artificial Push Button Gestures?. In *Proc. of Intl. Working Conference on Advanced Visual Interfaces (AVI'16)*, Paolo Buono, Rosa Lanzilotti, and Maristella Matera (Eds.). ACM, 40–43. DOI: http://dx.doi.org/10.1145/2909132.2909282
8. Rita Jordan. 2003. Social Play and Autistic Spectrum Disorders. *Autism* 7, 4 (dec 2003), 347–360. DOI: http://dx.doi.org/10.1177/1362361303007004002