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Designing a Virtual Reality Exposure Therapy to Familiarise and Desensitise to Environmental Stressors in Airports

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Abstract

This poster presents a participatory study which results in a prototype application for Android mobile devices mounted in affordable Virtual Reality headsets, to explore the potential of Virtual Reality Exposure Therapy through realistic immersive experiences in order to help people with hidden disabilities to develop tolerance to the environmental stressors that are typically found in crowded public spaces, and more particularly in airports. The application initially proposes users to rehearse a series of sensory attenuated experiences within digitally reconstructed environments of Aberdeen International Airport. Throughout rehearsals, environmental stressors are gradually increased making the environments more challenging for users. Usability testing was carried out and outcomes are encouraging whereas pilot testing on a small cohort of participants is currently being conducted.

Introduction

Many individuals living with Autistic Spectrum Disorder (ASD), acute sensory hypersensitivity, mental health conditions and severe anxiety issues have extreme difficulties with heightened noise and/or crowded situations within environments. These sensory cues can act as barriers in public and busy spaces, stopping individuals with hidden disabilities doing what most may think are everyday activities [1,2], and thus placing them at an unfair disadvantage compared to their peers in society.

Although there are already a set of strategies such as Social Stories™ which consist of a sequence of images along with situation descriptions [3,4]; and organised pre-visits of facilities as a reasonable adjustment, to familiarise those who live with hidden disabilities with critical places, they are often not enough to increase individual's confidence and ability to lead a more independent life as they do not contribute effectively to desensitise to environmental stressors. Thus, there is a need for a more "out-of-the-box" approach.

Gradual exposure therapy has been successfully applied in the past, to the treatment of fears and phobia, and when conducted in Virtual Reality (VR), allows to gradually desensitisation of stress-eliciting objects or situations from safe and reliable realistically digitally reconstructed environments [5,6]. On the one hand, Virtual Reality Exposure Therapy (VRET) has shown to be particularly effective to treat many anxiety disorders [7], empowering the customisation of the gradual sensory exposure to the patients needs. On the other hand, VR can induce cyber-sickness, and realism often strongly relies on technologies that may not be affordable by most.

This research adopted a co-design approach towards the development of a prototype of VRET application for mobile devices, which aims to familiarise and desensitise people with hidden disabilities, and more particularly those who live with ASD and anxiety disorders, to the environmental stressors that are typically found in airports. This poster presents the outcomes from a usability test which aimed to assess how a cohort of non-clinical users perceives the prototype of VRET application. A preliminary pilot testing is currently being performed involving a cohort of 7 participants who live with hidden disabilities.

Our Approach: Familiarisation and Desensitisation to Environmental Stressors in Airport using VR

The VRET application was designed with the help of 26 volunteers, who live with hidden disabilities across Scotland. This participatory design approach helped us identify the environmental stressors that sometimes or often lead people with hidden disabilities to experience high levels of anxiety and stress, in order to tailor a realistic sensory immersive experience of an airport environment. Software engineering design using SysML and UML allowed us to define a series of user and system requirements that provided a functional description of the application.

The VRET application, which was developed using Unity 5, is meant to be available to recent Android smartphones users (e.g. Samsung 6 & 7), mounted on an affordable VR headset (£5.99) and provides head tracked stereoscopic visualisation and spatial audio reproduction using the Google VR SDK [7]. The application drives the user through a series of 4 minutes long sensory controlled experiences in 4 different controlled environments within Aberdeen International Airport (Fig.1), which has kindly accepted to participate as a case study: (a) the entrance hall (Fig. 1.a); (b) a coffee shop (Fig. 1.b); (c) gender-specific toilets (Fig. 1.c); and (d) the boarding area (Fig 1.d). The system allows the gradual increase of environmental stressors such as ambient sounds (i.e. loud shop music, people conversation, recorded announcements on speakers and retails equipment noises) and crowd density, making each environment becoming more challenging throughout repeated use. For each experience, the user is randomly assigned a tasks to complete (e.g. queueing, reaching several destinations) in order to break monotony and reach the next level where environmental stressors will increase.

Figure 1. Digitally reconstructed airport environments – (a) the entrance hall, (b) coffee shop, (c) ladies toilets, (d) boarding gate

Usability Testing

A usability test has been conducted on 11 postgraduate students (M = 6; F = 5) from the Glasgow School of Art with no previous experience in VR. Participants were required to use the application as if they were one of our typical high-end users during 20 minutes, by authenticating with their email, specifying their gender, and experiencing each of the aforementioned digital environments with no sensory attenuation, while sitting down. Participants were required to fill a symptom checklist before and after using the application, rate a series of statements using a Likert scale: Strongly Disagree (1) –Disagree (2) – Neutral (3) – Agree (4) – Strongly Agree (5), and support their statements with comments in order to determine how user-friendly, intuitive, playful, engaging, realistic and comfortable, the application and setup were. Participants' comments were analysed based upon a methodology inspired in Theme-Based Content Analysis (TBCA) [8] , a methodology that enables reporting opinions/comments presented in the form of raw textual data in a consistent way. TBCA is a consistent analysis method for qualitative information that prevents the misinterpretation of terminologies when taken out of their original context.

Pre-symptom and post-symptom checklists were compared to assess the effect of using the VR application on each participant. Analysis revealed that prolonged 20 minutes exposure to the VRET application did not contribute to increasing significantly participant general physical discomfort, which included headache ($\Delta M = 0.273$; $\Delta \sigma = 0.508$), drowsiness ($\Delta M = 0.273$; $\Delta \sigma = 0.508$), eye focusing difficulty ($\Delta M = 0.182$; $\Delta \sigma = 0.166$), nausea ($\Delta M = 0.364$; $\Delta \sigma = 0.674$) although one participant reported to feel nauseous afterwards, and fatigue ($\Delta M = -0.091$; $\Delta \sigma = -0.037$). However, participants eye-strain seemed to increase almost significantly ($\Delta M = 0.455$; $\Delta \sigma = 0.386$; $t(10) = 2.23$, $p = 0.053$ with significance at $p = 0.05$).

In addition, analysis of participants' responses to the usability questionnaire showed that they enjoyed using the application ($M = 3.727$; $\sigma = 0.467$) (Figure 2), finding it relatively engaging ($M = 3.273$; $\sigma = 0.786$) really intuitive ($M = 4.273$; $\sigma = 0.467$), with a quick learning curve ($M = 4.545$; $\sigma = 0.522$). The physical setup was perceived to be relatively comfortable ($M = 3.545$; $\sigma = 0.688$) and not cumbersome ($M = 4.273$; $\sigma = 0.467$). Graphical ($M = 3.273$; $\sigma = 0.786$) and spatial audio ($M = 3.273$; $\sigma = 1.104$) realisms were both reported to be acceptable offering a "…*nice experience for a mobile phone driven device*", although several improvements regarding the random paths followed by walking avatars across the environments, and the location and volume level of the reproduced sounds were suggested.

Finally, as some lagging was experienced by some participants when the environments displayed simultaneously a large number of avatars, further pathways to visualise high quality rendered environments for familiarisation and desensitisation purposes in airports need to be explored. A possible solution could consist of using moderately affordable integrated VR headsets as the Oculus Rift enhanced with hand interaction using Leap Motion to provide more immersive experiences.

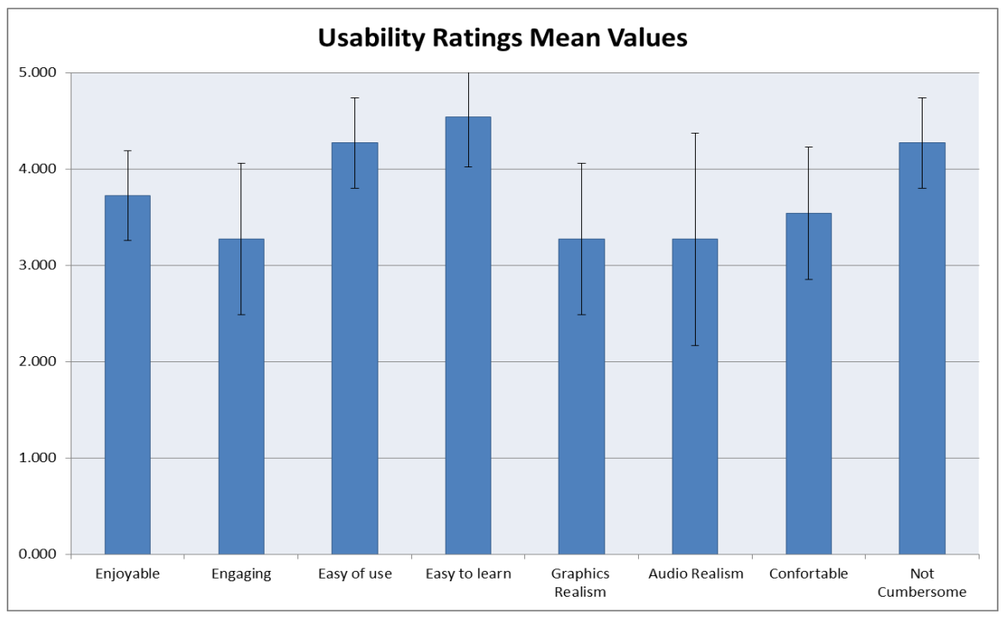

Figure 2. Usability Testing Outcomes

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