

# Using Mobile Virtual Reality to Empower People with Hidden Disabilities to Overcome Their Barriers

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## ABSTRACT

This paper presents a proof of concept for an immersive and interactive mobile application which aims 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 the user to rehearse a series of sensory attenuated experiences within digitally reconstructed environments of the Aberdeen International Airport. Throughout rehearsals, environmental stressors are gradually increased making the environments more sensory challenging for the user. Usability and pilot testing provided encouraging outcomes ahead of future developments.

## CCS CONCEPTS

• **Computing methodologies** → **Virtual reality** • Software and its engineering → Virtual worlds training simulations

## KEYWORDS

Virtual Reality Exposure Therapy, Virtual Reality, Airport, Hidden Disabilities, Autism, Anxiety, Accessibility, Sensory Perception

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## 1 INTRODUCTION

People living with hidden disabilities such as autism, learning disabilities and mental health conditions are far more likely to experience high levels of discrimination, isolation, fear, anxiety and poverty. Environmental stressors like sounds, light and crowds can become huge barriers to independent living.

Although recent initiatives promoted the development of guidelines to support people with hidden disabilities in busy environments as airports<sup>†</sup>, they do not aim to prepare people with hidden disabilities to manage stress and anxiety. Currently, two strategies are used to familiarise people with hidden disabilities with critical places or events: (1) Social Stories<sup>TM‡</sup> which consist of a sequence of images along with descriptions of what to expect; and (2) pre-visits of facilities as a reasonable adjustment. However, these strategies 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 environment stressors.

Recent researches have suggested the potential of immersive visualisation to tackle hidden disabilities [1-3]. Today's affordable smartphones are powerful platforms that can be used for visualising digital environments in 3D over 360° through affordable Virtual Reality (VR) headsets. By gradually increasing the crowd density, adding audible alerts, potential threats and unexpected challenges, immersive visualisation can help people with hidden disabilities to prepare better for demanding experiences [1]. This is commonly referred as Virtual Reality Exposure Therapy (VRET) [3].

This paper presents a proof of concept for a VRET application for Android mobile phones, which aims to familiarise and

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<sup>†</sup> <http://clahrc-peninsula.nihr.ac.uk/news/2017/01/17/caa-guidelines>

<sup>‡</sup> <http://www.bath.ac.uk/psychology/research/projects/developing-delivering-digital-behavioural-interventions/>

desensitise people with hidden disabilities, and more particularly those who live with Autistic spectrum Disorder (ASD) and anxiety disorders, to environmental stressors in airport environments. Aberdeen International Airport has kindly accepted to participate as a case study.

## 2 VR EXPOSURE THERAPY IN AN AIRPORT

The VRET application was built upon the outcomes of participatory design approach which involved 26 volunteers, all living with hidden disabilities, across Scotland and served to tailor a sensory realistic immersive experience of an airport environment. Software engineering design using SysML and UML allowed defining 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 most, and experienced through an Android smartphone (e.g. Samsung 7), mounted on an affordable VR headset, and provides head tracked stereoscopic visualisation and Ambisonic audio reproduction using the Google VR SDK.

It provides the user with a series of experiences in 4 different controlled environments within the Aberdeen International Airport: (1) the entrance hall and check-in gates (Figure 1); (2) gender-specific toilets (Figure 2); (3) a coffee shop; and (4) a boarding gate facing a coffee shop (Figure 3); and enables the gradual increase of the environmental stressors that are typically found there, making each environment becoming more challenging throughout rehearsals.



**Figure 1: Queueing at a congested check-in gate at the Aberdeen International Airport.**

Environmental stressors encompass visual cues such as light brightness and crowd density, and sound cues which include loud shop music, people activities (speaking and shouting), recorded announcements on speakers, traffic sounds, maintenance assets and retails equipment noises. Throughout the rehearsals of an environment, the user is required to complete different tasks (e.g. queueing, reaching a destination, ordering a coffee...) in order to break monotony and reach the next level where environmental stressors will increase.



**Figure 2: Gender-specific toilets environments at Aberdeen International Airport**



**Figure 3: Congested boarding gate with coffee kiosk at Aberdeen International Airport**

Finally, the VRET application was tested among a postgraduate students population at the School of Simulation and Visualisation part of the Glasgow School of Art to explore its usability, and was then piloted among a reduced of sample of participants who live with ASD and anxiety disorders. Results highlighted a user-friendly interface despite further design improvements being needed; and encouraging outcomes about the capability of the suggested approach to help people with hidden disability to overcome their barriers towards a more independent life.

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