Virtual Reality Application for OCD Assessment

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Figure 1: Overview of the virtual kitchen setup (a) adaptable for checking or washing assessments, where the participant (b) can interact with multiple objects whilst their physiological responses (recorded using EmteqPRO [4] and Emotibit [7]).

Abstract

This paper provides an overview of a fully implemented Virtual Reality (VR) application which aims to support the assessment of the most common subtypes of Obsessive Compulsive Disorder (OCD): cleaning and checking behaviours. The VR application consists of a tool for the therapist to select differing levels of tasks for the participants to fulfil within an interactive 3D virtual kitchen. Participants' assessment will be taking place at tasks completion level whilst their behaviour will be analysed through continuous recording of physiological measures and self-reporting questionnaires.

Index Terms: Obsessive Compulsive Disorder, Physiological Input, Virtual Reality.

1 Introduction

Obsessive Compulsive Disorder (OCD) is a chronic mental health condition characterised by obsessions and compulsions [1], affecting 1–2% of the global population. The most common subtypes are washing (25%) and checking (22%) behaviours [1]. The World Health Organisation identifies anxiety disorders, including OCD, as the sixth leading cause of non-fatal health loss worldwide [3]. In the UK, OCD imposes a significant economic burden, with annual costs estimated at £378 million for healthcare providers, rising to £5.1 billion when societal costs—such as lost productivity and specialised therapy—are included, accounting for 92.3% of the total burden[4].

Current OCD assessments in the UK predominantly rely on self-reported questionnaires like the Y-BOCS and OCI-R, alongside clinical interviews [2, 3]. These subjective tools can lack objectivity and fail to account for physiological stress biomarkers. Factors such as embarrassment or fear of judgment may bias self-reports, potentially not fully capturing a patient's symptom profile.

The NHS's OCD diagnostic process also faces resource constraints and high demand [5]. Limited capacity and staff shortages lead to delays assessments and treatment, worsening symptoms and hindering recovery.

A potential improvement in OCD assessment is the use of Virtual Reality (VR) technology, especially for subtypes like checking and contamination. Observing real-life triggers—such as using public restrooms or visiting someone else's home—is challenging in clinical settings. VR allows for objective measurement of emotional responses to near-real-life triggers, crucial for understanding symptom severity. Furthermore, unlike current methods, it captures all key aspects of emotion processing by combining subjective measures (self-ratings), physiological responses (e.g., heart rate variability (HRV), galvanic skin response (GSR)), and behavioural responses (e.g.,facial expressions, compulsions), providing comprehensive patient profile.

Despite its potential, only a few VR studies with OCD patients used physiological measures and none of these applications is commercially available [6, 8]. While we acknowledge that VR holds significant promise as a digital health tool for OCD treatment, its success depends on first achieving high-quality symptom assessment. Accurate baseline evaluations are essential for effectively measuring the impact of subsequent interventions.

2 Rationale

The aim of our project is to develop a feasible OCD assessment tool to improve diagnosis, ultimately leading to better-informed treatment strategies. This tool advances current methods by incorporating interactive tasks with behavioural and physiological measurements.

This paper focuses on the assessment aspect of OCD using VR, with future treatment applications in mind. We have designed a prototype VR application that simulates environments intended to trigger OCD symptoms in individuals with checking or contamination concerns. It features a virtual kitchen adaptable for checking or washing assessments. Participants can engage passively or interactively at varying trigger levels, freely performing compulsions

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	Checking levels	Cleaning levels
Mild	1. Bring the chair back to the table 2. Turn the stove off 3. Turn the microwave off	1. Put the rubbish in the (clean) bin 2. Empty the fridge of mouldy items 3. Sweep the (clean) carpet
Moderate	1. Switch off the toaster 2. Switch the wall sockets off 3. Turn the stove off	1. Empty the fridge of mouldy items 2. Sweep the (mildly dirty) carpet 3. Clean the stove
Severe	1. Switch off the running water 2. Turn off the stove 3. Turn off the microwave	1. Empty the fridge of mouldy items 2. Sweep the (very dirty) carpet 3. Clean the wine stain

Figure 2: Organisation of the tasks to be undertaken by the participants according to three different levels for checking and cleaning.

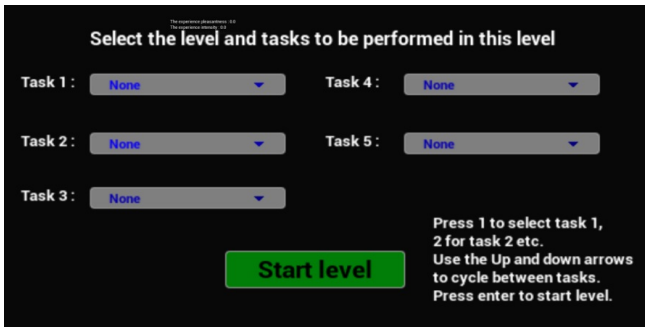

Figure 3: Interface for the therapist to select tasks and levels.

like virtual checking, cleaning.

3 Method

The virtual kitchen was created using Unreal Engine 5.3 and participants navigate through VR using the HTC Vive Pro headset, which is augmented with EmteqPRO [4] to record fEMG primarily. We further record participants' physiological responses using Emotibit [7] through heart rate variability, electrodermal activity (EDA) (see Figure 1-b).

The VR application is split into two main parts: **a)** GUI-based interface (3) used by the therapist to set the sequence of tasks for the participants to engage with, and the varying trigger levels for each selected task. For instance, Figure 1-a provides a view of the selection of tasks related to checking and cleaning; **b)** the actual VR environment which participants explore by undertaking the sequence of tasks defined by the therapist.

The selection of tasks available within the VR kitchen are:

- **Checking** tasks: turn the light on, turn the stove off, turn the toaster off, turn the microwave off, switch the wall sockets off, switch off the tap, check that the fridge door is closed, check that the ovens are closed, bring the chair back to the table.
- **Cleaning** tasks: Clean the rug, clean the wine stain, clean the milk stain, dust the cobweb, empty the fridge of mouldy items, put the rubbish in the bin, clean the stove, clean the counter, clean the counter drawer, clean the walls.

Participants are required to undertake three tasks in each level for the experiment, as shown in Figure 2. The tasks are the same in each experiment. The experiment is composed of a *practice session* for the participant to familiarise themselves with the VR environment as well as the controls for navigation and interaction with objects, followed by a *session where participants are expected to fulfill the tasks* identified by the therapist. In order to reduce the potential for participants to be overwhelmed within their early exploration of the virtual environment controls and setting, they are located within a simplified virtual room and only provided the opportunity to interact with a single virtual object. This allows participants to take as much time as they need to familiarise themselves with both the controls and the appearance of the virtual kitchen. Since this takes place within a simplified environment, participants' focus is more easily centred on the objects they are cycling through. In the actual sessions where participants are expected to complete the tasks set for them, the virtual environment is allowing them to freely navigate and interact with all objects giving them both an opportunity to fulfil the tasks as well as for the therapist to appropriately assess their ability to fulfil the tasks identified. The interface available to the therapist allows them to progressively increment the difficulty for the participants, or adapt the compulsions to suit the participants' symptoms.

Real-time data collection consists of data recorded through physiological measures from both EmteqPRO and Emotibit by continuously recording and synchronising sensors' data through LabStreamingLayer (LSL) network, in line with timestamped markers being generated from the virtual environment (e.g. start and end of trials, interaction with objects). Pre- and post-experiment questionnaires are included in the overall protocol to provide self-rated and free text information from the participants (experiment questionnaires include OCD, presence and VR sickness).

4 Conclusion

This research aims to develop a feasible OCD assessment tool to improve diagnosis, ultimately leading to better-informed treatment strategies. This tool will advance current methods by incorporating passive and interactive tasks with behavioural and physiological measurements. Our future work includes the evaluation and refinement of this initial VR application, the assessment of its effectiveness in healthy participants, and OCD patients, with varying levels of OCTs.

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