International Conference on Artificial Reality and Telexistence
Eurographics Symposium on Virtual Environments (2023)
A. Campbell, C. Krogmeier, and G. Young (Editors)

*Poster*

# Mitigation of Fear Triggers for Image Viewing in Virtual Reality

Amelie Hetterich[1,2], Sebastian von Mammen[1] and Daniel Pohl[2]

[1]Julius Maximilian University of Würzburg, Germany
[2]immerVR GmbH, Germany

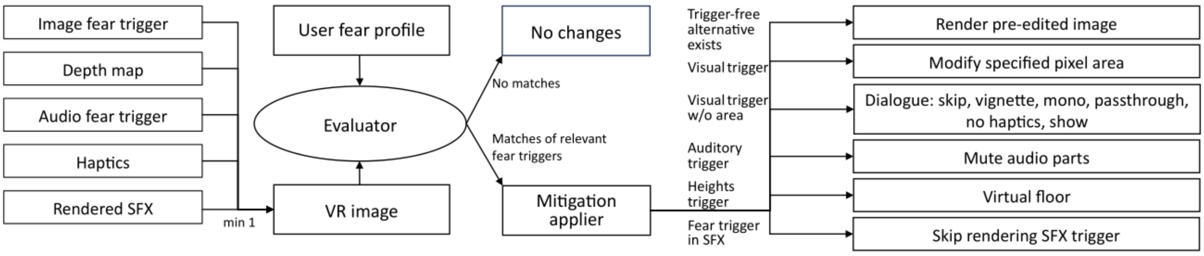


**Figure 1:** *Pipeline with inputs, evaluator, and applied fear mitigation strategies for VR image viewing.*

**Abstract**

*Modern VR image viewers combine immersive photos with audio, special effects and haptics to provide a highly immersive experience. However, users with specific phobias may encounter discomfort while browsing through random images, specifically, considering the high presence in VR. We explore strategies to reduce fear triggers and implement tailored mitigation measures in our image viewing app, specifically for 3D and spherical images. We address automating fear reduction in different VR formats, audio, and special effects to improve the accessibility and experience for VR image viewer users with specific phobias.*

**CCS Concepts**

• ***Human-centered computing*** → ***Virtual reality;***

## 1. Introduction

Photography for virtual reality (VR) allows to re-immerse into captured moments. However, sudden switches between unknown images are challenging for users with phobias. Our research focuses on minimizing the impact of fear triggers in VR images through various mitigation strategies (Figure 1). We investigate manual and automatic VR image modifications and suggest further usages of our work. **Our contributions are:** introducing user fear profiles, extending mitigation strategies in VR image viewing, offering new insights, conceptualizing automatic fear trigger removal, and creating an automated spherical image editing pipeline.

## 2. Related Work

Alsina-Jurnet et al. [AJGMRG11] found that subjects in a virtual environment responded with higher fear levels in fear-inducing situations with high realism. Subsequently, lowering presence could decrease anxiety when viewing images. Cummings et al. [CB16] highlighted the positive impact of wide field-of-view (FOV) and 3D content on presence. Hodges et al. [HRK*95] used virtual floors in VR therapy for the treatment of acrophobia. Applications and games render interactive 3D content, enabling content replacement based on user phobias. In captured images, we cannot alter the underlying 3D content. Pohl [Poh22] summarizes 13 mitigation strategies for reducing the impact of trigger elements in 2D, 3D and spherical VR media with special effects (SFX), audio and haptics to be used individually or combined. The proposed mitigation strategies are: remove media, reduce FOV, view image through moveable lens or fixed rotatable screen, blur/replace triggers, change content from 3D to 2D, lower volume of audio triggers, remove haptics, add virtual floor, change interpupillary distance, move user away from triggers (6-DoF media), mix in real-world surrounding.

## 3. Methodology

To improve VR viewing regarding fears, we employ selected mitigations from Pohl [Poh22] and introduce own concepts. Our Unity 2021.3 LTS app allows users to navigate through their images, enhancing them with two audio tracks and a special effect. We manually tag fear triggers in a file. A user profile allows selecting fears.



DOI: 10.2312/egve.20231344

As Figure 2 shows, spherical images are either displayed in a half or full sphere. Regular images with a lower FOV are displayed on a flat or a curved canvas. The image formats can be 2D or 3D.

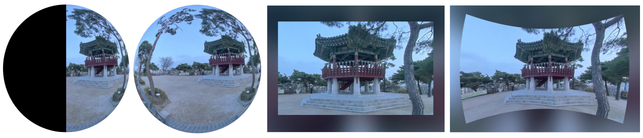

**Figure 2:** *Left-to-right: 180°×180° image on a half sphere, 360°×180° image on a full sphere, regular image on a flat canvas, cylindrical panorama on a curved canvas.*

## 4. Fear Mitigation of Different Phobia Types

When the area of a fear-trigger is specified in our file, we automatically censor it in the image and its thumbnail with a context-appropriate color. We explored AI inpainting to generate trigger-free content. If a user has fear of heights and the image is flagged with that fear, analogue to [HRK*95], we add a virtual floor. However, 3D spherical images can have a negative effect on the usability of the virtual floor. If the floor seems further away than other image elements, it looks unnatural (Figure 3 (right)), and can lead to eye strain or motion sickness. In 2D 360°×180° images, the floor of the content seems far away due to missing left-right disparity. To compensate this, Kojack [Koj19] used a rendering method where the lower part of the equirectangular image is projected onto a plane at ground level, eliminating the need for a virtual floor.

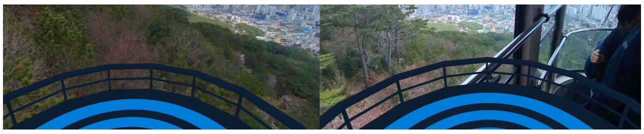

**Figure 3:** *Left: virtual floor over 3D image with far away ground. Right: virtual floor covers 3D objects appearing closer.*

Audio tracks, SFX and haptics enhance immersion, but can also raise anxiety. Disabling vibrotactile feedback of controllers and a fear-inducing audio track is an additional mitigation. If a part of the audio is affected, that segment can be skipped or muted. Also, substitute sounds without triggers can be used. In our app, real-time SFX such as a meadow environment with butterflies and pollen can be enabled. For users with fear of butterflies, this triggers. Hence, we disable the butterflies and keep the other parts active.

If image-based mitigations are unavailable for relevant fear triggers, a dialogue opens with options to lower the immersion. Users can choose to skip the image, view 3D as 2D, add a vignette to limit their FOV or to show the real surroundings with a passthrough mode. In casual subjective testing, we found that discomfort can arise from sudden switches to unknown images. To alleviate that, we added the thumbnail of the next image to the virtual controllers, showing a preview before switching an image. Also, there is a smooth transition between images.

## 5. Conceptual Automation

Automatic modification of image sections requires knowledge of the element's rectangular boundaries. For equirectangular images, the element detection can fail in distorted areas as shown in Figure 4 (left) when using the Amazon Rekognition labeling software.

**Figure 4:** *Left: text recognition fails in equirectangular image. Right: blue outline of detected text in perspective image.*

Pohl [Poh22] proposed to split spherical images into smaller perspective images for labeling. We use algorithms by Paul Bourke [Bou] to render six perspective parts of an equirectangular image. After the conversion (Figure 4 (right)), the text is recognized correctly and can be edited and reprojected. To automatically decide whether the distance to the ground in 3D images requires a virtual floor for certain users, we generate a depth map. If the distortion and distance of both camera lenses are known, we can map depth values to their physical distance and make the decision. Audio tracks with triggering fear elements should be removed. For audio containing speech, a detection of fear-related words is possible through speech recognition systems. Generally, automatic sound labeling services for non-verbal audio appear rare today.

## 6. Conclusion and Future Work

We explored promising mitigation strategies for VR image viewing for users with phobias. We extended these concepts to handle triggers in audio, SFX and haptics. We found new improvements such as a thumbnail on the virtual controller for the next image to mitigate the fear of image switching. We conceptualized the automation of fear trigger removal. Further development may utilize user studies to identify optimal strategies. We propose a severity variable for each fear to diversify VR therapy settings.

## References


[AJGMRG11] ALSINA-JURNET I., GUTIÉRREZ-MALDONADO J., RANGEL-GÓMEZ M.-V.: The role of presence in the level of anxiety experienced in clinical virtual environments. *Computers in Human Behavior 27*, 1 (2011), 504–512. 1

[Bou] BOURKE P.: Papers and projects on 360° content and more. http://paulbourke.net/. Accessed: 2023-05-16. 2

[CB16] CUMMINGS J. J., BAILENSON J. N.: How immersive is enough? a meta-analysis of the effect of immersive technology on user presence. *Media psychology 19*, 2 (2016), 272–309. 1

[HRK*95] HODGES L. F., ROTHBAUM B. O., KOOPER R., OPDYKE D., MEYER T., NORTH M., DE GRAFF J., WILLIFORD J.: Virtual environments for exposure therapy. *IEEE Computer Journal, July* (1995), 27–34. 1, 2

[Koj19] Increasing immersion of 360 panoramas. https://communityforums.atmeta.com/t5/Talk-VR/Increasing-Immersion-of-360-Panoramas/td-p/743195, 2019. Accessed: 2023-06-03. 2

[Poh22] POHL D.: System and method for object detection in immersive images, 2022. Patent application no. PCT/EP2022/063164. 1, 2