Diegetic Cues for Guiding the Viewer in Cinematic Virtual Reality

Extended Abstract

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ABSTRACT

Cinematic Virtual Reality has been increasing in popularity in the last years. Watching 360° movies with a Head Mounted Display, the viewer can freely choose the direction of view, and thus the visible section of the movie. We explored three cinematic methods of guiding the viewers' attention: lights, sounds, and movements. For that, we developed a measurement technique to obtain heat maps of viewing directions and applied statistical analysis methods for spatial data. The results of our work show that the attention of the viewer can be directed by sound and movements. New sound induces the viewer to search for the source of the sound, not all participants paid attention to the direction of the sound. In our experiments, lights without movements did not draw more attention than other objects. However, a moving light cone changed the viewing direction considerably.

CCS CONCEPTS

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

KEYWORDS

Cinematic Virtual Reality, guiding attention, spatial sound, directing gaze

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Figure 1: The place of the test scenes

1 INTRODUCTION

In Cinematic Virtual Reality (CVR), the viewer can freely choose the visible section of the movie - the Field of View (FoV). Therefore, it is not always possible to show the viewer what is important for the story. Several conventional filmmaking methods for guiding the viewer's attention - such as close ups or zooms - are not practicable in CVR. For other methods, a closer analysis is needed whether they are suitable to direct the attention of the viewer to important details in a CVR environment. In this work, we focus on some traditional alertness methods of filmmaking which we think are transferable to CVR: sound, light, and movement. From film theory, we absorb the terms diegetic and non-diegetic. Diegetic cues are part of the scene - for example, a musician playing music. Non-diegetic cues come from outside - for example, film music or a voice over. The cues considered in this work are diegetic cues.

Syrett et al. [Syrett et al. 2017] have discovered that some viewers feel distracted by the freedom to choose the viewing direction. In their experiments, they observed that important parts of the storyline were missed. In the literature [Coren et al. 1999; Goldstein 2010; Veas et al. 2011] several methods for guiding the viewer are explored for non-VR environments, such as salient objects, sounds, lights, or moving cues. Our work examines how this can be adapted to CVR, even if an object is not in the FoV of the viewer.

Nielsen et al. [Nielsen et al. 2016] compared a diegetic cue (firefly) with a non-diegetic cue (forced rotation) and no guidance. They figured out that the diegetic cue was more helpful than the non-diegetic cue. Furthermore, the results demonstrate that the non-diegetic cue may decrease the presence.

The goal of our study was to investigate whether the following diegetic categories can direct the attention of the viewer:

- lighted objects
- sound from a certain direction
- movements of stationary objects (e.g. swinging)
- locomotive objects (changing the position)

For determining which cues attract the attention of the viewer and can change the viewing direction, we decided not to use questionnaires. Instead, the head direction was recorded and evaluated to obtain more precise results.

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Figure 2: Scene 3 - two objects: phone with sound (right), phone without sound (left)

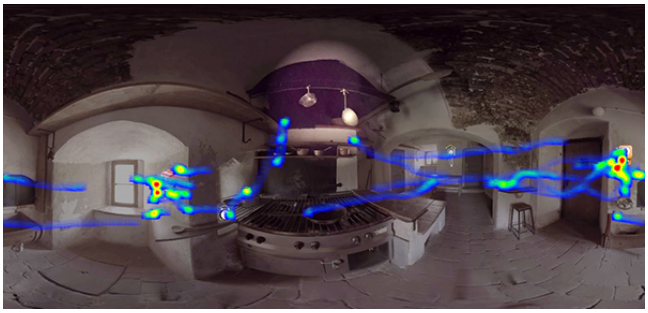

Figure 3: Scene 3 - clusters for two objects: phone with sound (right), phone without sound (left)

2 USER STUDY

We chose a within-subject test design - all participants watched the same movie. There was no special task - they should look around and follow the objects they are interested in.

The movie shown to the participants consists of 4 sections, which are separated by a neutral scene: a forest which looks similar in every direction. The viewers were requested to turn around in this scene to make sure that the viewing direction at the beginning of the next scene was random. All the other scenes are of the same place - a mystery kitchen in an old castle (Figure 1).

In the first part of the movie (scene 1 and 2) we investigated which cues can attract the attention of the viewer. The objects do not change their positions and are visible from the start to the end of the scene. Objects with movements are swinging or flickering. Other objects are lighted or connected with spatial sound. In the first scene, the investigated objects are connected to only one cue: movement, spatial sound, light. The objects in the second scene are provided with two cues: a lighted moving object, a moving object with spatial sound, and a lighted object with spatial sound.

The aim of the second part (scene 3 and 4) was to investigate if the viewing direction of the participants can be modified by objects, which are not in the scene at the beginning. Objects with different cues appear and disappear from time to time. In scene 3 objects are associated with sounds (Figure 3). In scene 4 we use locomotive objects.

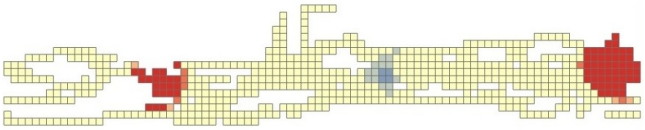

Figure 4: Scene 3 - result of significance tests: red - hot spots

3 STATISTICAL EVALUATION AND RESULTS

We developed a tool for generating heatmaps for every timecode of the movie and investigated the heatmaps for clusters (Figure 3). To find significant hotspots, the Getis-Ord Gi* statistic - a spatial statistic method - was applied. Our collected data are spatiotemporal data - data which have a space and a time component. This type of data is often used in geographical research. We used the GIS software ArcGIS Pro which includes a spatial statistic toolbox and outputs the confidence levels for the hot spots (Figure 4). In this way, we could explore if our cues influenced the viewing direction of the user. In summary, we found the following results:

- It is difficult to guide the viewer at the beginning of a new scene
- Non-moving lights had no effects in our tests
- Objects connected with sounds attract more attention than without sound
- Sound can change the viewing direction even if the sound is not spatial or is coming from another direction (Figure 2-4)
- Moving objects or lights can guide the viewing direction even without any sounds

4 CONCLUSIONS

Our approach using spatial statistic methods has proved of value and we will develop this approach further in our research. The results can be used for integrating diegetic cues in a movie for guiding the attention of the viewer to things which are important for the story. The investigated methods require the integration of cues in the movie. This is not always possible. In our future research, we want to examine non-diegetic methods for viewer guiding which should not decrease the presence. We found out that some people are afraid of missing something. Therefore, guiding can be helpful for making the enjoyment of Cinematic Virtual Reality more relaxed. Further investigations are necessary to explore the viewers' behavior in Cinematic Virtual Reality for finding methods to guide the viewers' attention.

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