Addressing Dizziness in 3D Rally Simulation

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1 Introduction

In the realm of virtual reality and 3D simulations, rally games stand out for their exhilarating depiction of high-speed racing and challenging terrains. These simulations, leveraging cutting-edge graphics and dynamic physics, offer users an immersive experience that closely mirrors real-life rally racing. However, this immersion comes with its unique set of challenges, one of which is the user experience of dizziness, particularly in scenarios where the car flips or drives in steep mountainous paths. This phenomenon raises significant concerns in the context of 3D rally simulations due to the intense and unpredictable nature of the gameplay.

The issue at hand is not merely a minor inconvenience but a substantial barrier that can affect the user's comfort, gameplay duration, and overall perception of the game. Dizziness in 3D environments, often linked to motion sickness, is a well-documented problem, yet its specific manifestation in rally simulations has not been explored thoroughly. This gap in research and understanding highlights the need for a focused investigation into the causes and potential solutions to mitigate dizziness in these simulations.

The motivation for this research comes from the growing popularity of virtual reality gaming and the increasing demand for more realistic and engaging experiences. Addressing the challenge of dizziness in 3D rally simulations is crucial in enhancing user satisfaction and safety, which are paramount in the gaming industry's ongoing quest for innovation and improvement. By identifying the underlying factors contributing to this issue and exploring viable solutions, this research aims to enrich the 3D rally simulation experience, making it more accessible and enjoyable for everyone.

2 Background

The intersection of virtual reality (VR) and 3D simulations in driving presents unique challenges, most notably the phenomenon of motion sickness and dizziness. This discomfort, often exacerbated in high-motion environments such as rally simulations, raises significant concerns regarding user experience and safety. A survey of current literature reveals a growing body of research aimed at understanding and mitigating these issues.

A crucial study in this domain is "CarVR: Enabling In-Car Virtual Reality Entertainment" [HBGR17], which explores VR's potential in the confined space of a car. While primarily focused on in-car VR, this research provides valuable insights into how spatial constraints and visual cues can contribute to discomfort, relevant to the dizziness experienced in rally simulations. Similarly, "Vertigo and Dizziness from Environmental Motion: Visual Vertigo, Motion Sickness, and Drivers' Disorientation" by [BGG13] delves into the physiological and psychological aspects of motion-induced dizziness, offering a comprehensive understanding that is directly applicable to VR-based rally simulations. The study "Simulator based rehabilitation in refractory dizziness" [PLD+04] presents an intriguing perspective on using simulators for dizziness rehabilitation, indirectly shedding light on how similar simulations can induce such discomfort. Further, "I Am The Passenger: How Visual Motion Cues Can Influence Sickness For In-Car VR" [MNB17] examines the impact of visual motion cues on motion sickness, highlighting the critical role of visual stimuli in the perception of motion and subsequent discomfort in VR environments.

Additionally, "A Survey on Simulation Sickness in Driving Applications with Virtual Reality Head-Mounted Displays" [RA18] expands on the context of driving simulations. This research surveys various

factors contributing to simulation sickness, offering a more targeted perspective that aligns closely with the experiences within rally simulations.

Despite the insights these studies provide, there remains a gap in the specific application to rally simulations, especially in scenarios involving high-intensity maneuvers like car flips or mountainous climbs. This gap underscores the need for focused research on identifying and mitigating dizziness in these specific, yet critical, aspects of rally simulations.

3 Research Plan

The primary objective of this research is to investigate and mitigate the dizziness experienced by players during intense scenarios in 3D rally simulations, such as car flips or steep climbs. My research will be conducted in four distinct approaches: firstly, constructing a physical simulation rig that accurately mimics the movements of a rally car. This approach hypothesizes that synchronizing physical motions with visual stimuli will reduce the sensory conflict often responsible for dizziness in VR environments. Data will be collected through user experience questionnaires and physiological monitoring, such as tracking heart rate variability and nausea levels, both during and after the simulation. This data will be compared with experiences from standard non-physical simulations to evaluate the rig's effectiveness in mitigating dizziness. secondly, we plan to alter the game's programming to reduce or moderate the visual impact of rotations and flips. This strategy is based on the premise that less intense visual stimuli will decrease the likelihood of dizziness. We plan to implement a game version with these modifications and collect player feedback through detailed surveys focusing on their experiences with dizziness and overall game enjoyment. The feedback will be statistically analyzed to ascertain the effectiveness of these modifications compared to the original game dynamics. thirdly, introduction of a character ejection mechanism during extreme in-game events like car flips. This mechanism would temporarily change the player's viewpoint or eject the character from the vehicle during high-dizziness scenarios, thereby reducing prolonged exposure to disorienting visuals. We will assess this feature's impact on player comfort and dizziness through a combination of in-game real-time feedback mechanisms and post-game surveys. The aim is to understand whether altering the player's perspective during critical moments can significantly reduce the incidence of dizziness. and Finally, propose an in-depth investigation into the biological reasons behind motion sickness in virtual environments. This study will involve collaboration with medical professionals to monitor and record players' biological responses, such as vestibular system reactions and neurological signals, during gameplay. The goal is to correlate these biological responses with the subjective experience of motion sickness, providing a comprehensive understanding of the causes of dizziness in 3D rally simulations. The research, spanning a 12-month period, will culminate in a set of practical recommendations for game design and technology improvements, potentially including a prototype physical simulation rig and guidelines for game dynamics adjustment. The expected outcome is a set of actionable recommendations for game design and a deeper understanding of dizziness in virtual environments, potentially leading to significant advancements in VR technology and user experience.

References

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