The Impact of Virtual Reality on Motion Sickness Incidents: Causes, Roles, and Prevention Strategies

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Abstract

Background: Technology is increasingly developing, over time the virtual reality (VR) industry is increasingly in demand. VR is a three-dimensional object that displays the real world. With this sophistication, VR actually provides discomfort for its users, namely Motion Sickness. Motion Sickness is a change in dynamic movement in the virtual world that causes discomfort to its users.

Method: The method used in this paper is the literature review method.

Discussion: The results of the literature review show that there are causes of VR Sickness, namely hardware, content, and human factors. VR Sickness can be prevented through pharmacological and non-pharmacological means.

Conclusion: Virtual Reality is one of the causes of Motion Sickness incidents.

Keywords: Virtual Reality, Motion Sickness, VR Sickness, motion sickness, Treatment of Motion Sickness

Introduction

Technology is advancing rapidly, and the virtual reality (VR) industry is increasingly in demand, with applications spanning movies, games, and education.[1] VR technology encompasses various visualization tools, including advanced devices like CAVE systems, augmented reality systems, HMD helmets, and spherical displays, as well as simpler devices such as 3D widescreen projection screens, 3D theaters, and virtual reality glasses.[2] Initially, this technology was utilized to develop specific skills, such as enhancing the spatial abilities of pilots and astronauts.[3] However, its sophistication has introduced negative symptoms resembling motion sickness, characterized by eyestrain, disorientation, and nausea.[1]

These uncomfortable symptoms have been a barrier to VR adoption and are considered an urgent issue to address.[4] Early attributions of these symptoms pointed to technical flaws in VR technology, but improvements in video resolution and optical tracking systems have mitigated some of these issues, delaying symptom onset.[5] The negative symptoms associated with VR, often likened to motion sickness experienced in natural environments, are believed to stem from a conflict between sensory signals from the vestibular and visual systems (Reason, 1978). For instance, a person on a ship might see a stationary cabin while vestibular signals sense body movement, leading to discomfort.[6] Similarly, users interacting with VR environments often experience the illusion of body movement despite remaining physically stationary.[7]

To address VR-induced discomfort, researchers have investigated the technology's impact and the role of individual differences. Eye movement characteristics, such as oculomotor activity, have been studied to explain simulator sickness. Proprioceptive signals from eye muscles are linked to vection illusions, where stationary observers feel as though they are moving.[3] The vestibulo-ocular reflex also plays a role in these illusory movements, prompting numerous studies to investigate adverse symptoms and propose guidelines to alleviate VR sickness.[8] This article explores the impact of VR on motion sickness and the associated factors.

Methods

This article employs a literature review methodology, analyzing sources such as journals to investigate VR-induced motion sickness. Keywords used in the literature search include "Virtual Reality," "Motion Sickness," "Treatment of Motion Sickness," and "Impact of Virtual

Reality"

Discussion

Motion sickness, often referred to as cybersickness in VR contexts, is a physical discomfort characterized by symptoms such as nausea, dizziness, and cold sweats.[9] Users perceive dynamic movement in VR despite remaining stationary in the real world, leading to disorientation and discomfort.[1] VR creates three-dimensional environments that replicate real-world experiences, allowing users to feel immersed through headsets resembling large glasses.[2] While VR's initial use was professional, it has expanded into entertainment and education, offering both benefits and risks.[1]

Motion sickness is a physiological response to unusual movement, either real or perceived.[6] Forms include seasickness, air sickness, and train sickness, with space sickness specific to microgravity conditions. In VR, symptoms follow a sequence, starting with abdominal discomfort, followed by nausea, pallor, and cold sweats, and potentially worsening to dizziness and vomiting.[6] Symptoms can persist for hours after exposure ends, emphasizing the need for mitigation strategies.

As VR technology becomes more widespread and affordable, motion sickness has become a pressing issue.[4] Research identifies multiple factors contributing to VR sickness, including gender differences, virtual environment type, graphic properties, and lighting.[2] These factors also affect physiological responses, such as heart rate and blood pressure.[5] Understanding these associations is critical to mitigating VR-induced discomfort.[1]

Causes of VR Sickness

Chang et al.[1] identify three primary causes of VR sickness: hardware, content, and human factors. Hardware is a critical determinant of VR quality, with early VR sickness often attributed to poor hardware performance.[4] Display devices, which deliver VR content, are the most frequently studied hardware-related factors.[2] Improved systems have allowed for more realistic virtual scenes but have not eliminated user discomfort.[6]

Content is another significant factor influencing VR sickness. Faster scene motion correlates with increased nausea, although discomfort plateaus at speeds exceeding 10 m/s. Oscillation frequency and amplitude also impact user experiences, with certain patterns exacerbating adverse effects.[1]

Human factors, including age, gender, and motion sickness susceptibility, further contribute to VR sickness variability. Diagnostic tools, such as heart rate variability and

electrogastrography, assess the physiological effects of motion sickness. Questionnaires and tests, such as the Coriolis Motion Sickness Susceptibility Index, help identify individual susceptibilities.[10]

Prevention Strategies

Preventive measures for motion sickness include pharmacological and non-pharmacological approaches. Pharmacological interventions involve prescription drugs, while non-pharmacological methods aim to reduce sensory input, accelerate sensory adaptation, and manage psychological stressors. Strategies such as controlled breathing, hydration, and aromatherapy can alleviate symptoms. Avoiding smoking, limiting caffeine, and using distraction techniques like music can also be effective.[6]

Conclusion

Motion sickness is a significant challenge in the VR industry, with mixed results in mitigation efforts. The primary causes—hardware, content, and human factors—highlight the complexity of the issue. Prevention strategies, both pharmacological and non-pharmacological, offer pathways to alleviate user discomfort. Continued research is essential to fully address VR-induced motion sickness and improve user experiences.

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