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Tunnel Vision - Dynamic Peripheral Vision Blocking Glasses for Reducing Motion Sickness Symptoms

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Abstract: Motion sickness affects roughly a third of all people. Narrowing the field of view (FOV) can help to reduce motion sickness symptoms. In this paper, we present Tunnel Vision, a type of smart glasses that can dynamically block a wearer' s peripheral vision area using switchable polymer dispersed liquid crystal (PDLC) film. We evaluate the prototype in a virtual reality environment. Our experiments suggest that our method statistically and significantly reduces typical motion sickness symptoms such as "difficulty concentrating", "head feeling heavy" and "nausea".

Keywords: smart glasses, motion sickness, virtual reality, peripheral vision

1. Introduction

Approximately one in three people are highly receptive to motion sickness, and most people become motion sick in extreme circumstances [1]. Mismatches between a user's perception of motion and their visual system are regarded as triggering factors of motion sickness.

This study aims to propose a dynamic peripheral vision adjusting system to enable us to be less sensitive to or less affected by fast-moving scenery [2] (e.g., train ride, roller coaster ride). We hypothesize that dynamically blocking parts of the peripheral vision during fast-moving scenes can reduce motion sickness symptoms. According to related studies, narrowed FOV could ease users' cybersickness while watching fast-moving and rotating scenes in VR [3]. Our dynamic peripheral vision blocking glasses can also reduce cybersickness while experiencing fast-moving scenery in VR without completely removing access to visual information from peripheral vision.

1.1 Approach and Hardware Design

In order to build a device that can narrow its user's FOV, we use a switchable film instead of an optical lens, known as polymer dispersed liquid crystal (PDLC) switchable smart film. Even when the film is in its transparent mode, it is not as clear as a regular optical lens. Due to this limitation, we cut out the area between both pupils. As the control system for changing between transparent and opaque mode, we use an Arduino compatible Pro Mini development board. We use two photoreflective sensors to detect users' eye movements.

2. Experiments

Our experimental protocol has three conditions. We use an ordinary lensless frame as the baseline condition. Condition two is wearing a frame with our dynamic peripheral vision blocking film while the dynamic clear-opaque mode is locked in its opaque state, which means the glasses work as FOV narrowed glasses. The third condition is wearing a frame with our peripheral vision blocking film while its clear-opaque mode is set to dynamic.

3. Results

In most cases wearing our prototype with its dynamic clear-opaque mode on or off resulted in less severe motion sickness symptoms compared to wearing lensless glasses, except for "headache" and "increased salivation", in which the "dynamic clear-opaque mode on" condition had the lowest score. In other words, using peripheral vision blocking glasses significantly reduced almost all motion sickness symptoms listed in the SSQ compared to using a lensless frame. In particular, there was a statistically significant difference between groups in the case of "difficulty concentrating" along with "fullness of head" and "nausea" as determined by one-way ANOVA.

4. Conclusion and Future Work

Our study presents a potential method to reduce motion sickness symptoms while having less impact on immersion. It may fit real-life scenarios as well since its portable design was not exclusively created for use in a VR environment. Our experimental results show that there was a statistically significant difference in the following SSQ items without impacting immersion scores.

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