

Title : ARVA: An Augmented Reality-Based Visual Aid for Mobility Enhancement Through Real-Time Video Stream Transformation

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Abstract: Visual field loss (VFL) is a persistent visual impairment characterized by limited vision spots (scotoma) within the normal visual field, significantly impacting daily activities for affected individuals. Current Virtual Reality (VR) and Augmented Reality (AR)-based visual aids suffer from low video quality, content loss, high levels of contradiction, and limited mobility assessment. To address these issues, we propose an innovative vision aid utilizing AR headset and integrating advanced video processing techniques to elevate the visual perception of individuals with moderate to severe VFL to levels comparable to those with unimpaired vision. Our approach introduces a pioneering optimal video remapping function tailored to the characteristics of AR glasses. This function strategically maps the content of live video captures to the largest intact region of the visual field map, preserving quality while minimizing blurriness and content distortion. To evaluate the performance of our proposed method, a comprehensive empirical user study is conducted including object counting and multi-tasking walking track tests and involving 15 subjects with artificially induced scotomas in their normal visual fields. The proposed vision aid achieves 41.56% enhancement (from 57.31% to 98.87%) in the mean value of the average object recognition rates for all subjects in object counting test. In walking track test, the average mean scores for obstacle avoidance, detected signs, recognized signs, and grasped objects are significantly enhanced after applying the remapping function, with improvements of 7.56% (91.10% to 98.66%), 51.81% (44.85% to 96.66%), 49.31% (43.18% to 92.49%), and 77.77% (13.33% to 91.10%), respectively. Statistical analysis of data before and after applying the remapping function demonstrates the promising performance of our method in enhancing visual awareness and mobility for individuals with VFL.

Keywords: Augmented reality, empirical evaluation, mobility enhancement, video remapping ,visual assistant.

<https://doi.org/10.1109/ACCESS.2024.3462628>

<https://research.bau.edu.tr/en/publications/arva-an-augmented-reality-based-visual-aid-for-mobility-enhanceme>