

Towards Effective Human Performance in XR Space Framework based on Real-time Eye Tracking Biofeedback

Abstract

This paper proposes an eye tracking module for the XR Space Framework aimed at enhancing human performance in XR-based applications, specifically in training, screening, and teleoperation. This framework provides a methodology and components that streamline the development of adaptive, real-time virtual immersive systems. It contains multimodal measurements - declarative in the form of in-VR questionnaires, and objective including eye tracking, body movement, and psychophysiological data (e.g., ECG, GSR, PPG). A key focus of this paper is the integration of real-time eye tracking data into XR environments to facilitate a biofeedback loop, providing insights into user attention, cognitive load, and engagement. Given the relatively high measurement frequency of eye tracking - recognized as a non-invasive yet robust psychophysiological measure - this technology is particularly well-suited for real-time adjustments in task difficulty and feedback to enhance learning and operational effectiveness. Despite its established role in cognitive and attentional studies, implementing eye tracking metrics within dynamic, real-time XR environments poses unique challenges, particularly given the complex, moving visuals presented in head-mounted displays (HMDs) such as Varjo. This paper addresses these challenges by focusing on essential aspects of integrating eye tracking in immersive systems built on real-time engines, ultimately facilitating more efficient, adaptive XR applications.