Research Article

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Eye Blink-Based Strain Detection Using Facial Landmark Tracking towards a Non-Intrusive Human Stress Monitoring System

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ABSTRACT
Monitoring human stress and fatigue is essential in environments requiring sustained attention, such as workplaces, healthcare, and transportation. Traditional strain detection methods often rely on physiological signals like heart rate or EEG, which require wearable sensors and complex processing, making them intrusive and less practical for continuous use. This research proposes a non-invasive, real-time strain detection system based on eye blinking analysis using computer vision and machine learning techniques. The system captures video input to track eye blink rate and duration through facial landmark detection and temporal pattern analysis. Changes in blinking behavior are interpreted as indicators of physical or mental strain, enabling early detection of fatigue or stress. Unlike conventional methods, this approach is contactless and operates without the need for specialized equipment, making it highly suitable for continuous monitoring in real-world settings. Experimental results demonstrate the system's effectiveness in identifying strain with high accuracy under various conditions. Its application potential spans multiple domains, including monitoring driver alertness, enhancing workplace safety, and supporting patient care in clinical environments. By offering a practical and accessible solution for fatigue and stress detection, this methodology promotes improved well-being, timely intervention, and increased safety in critical environments. The findings highlight the viability of eye-blink-based analysis as a reliable, real-time indicator of human strain.

Keywords: EAR, Eye Blink Detection, Stress Monitoring, Fatigue Detection, Real-time Analysis, Computer Vision, Non-invasive Monitoring, Workplace Safety.