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Human Operator Mental Fatigue Assessment Based on Video Analysis Using AI and ML

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Abstract: The detection of the human mental fatigue state holds immense significance due to its direct impact on work efficiency, specifically in system operation control [1,2]. Numerous approaches have been proposed to address the challenge of fatigue detection, aiming to identify signs of fatigue and alert the individual. This research introduces an approach to human mental fatigue assessment based on the application of machine learning techniques to the video of a working operator.

Main Part: For validation purposes, the approach was applied to a dataset, “Human Fatigue Assessment Based on Video Data” (HFAVD), integrating video data with features computed using our computer vision deep learning models. The incorporated features encompass head movements represented by Euler angles (roll, pitch, and yaw), vital signs (blood pressure, heart rate, oxygen saturation, and respiratory rate), and eye and mouth states (blinking and yawning). The integration of these features eliminates the need for manual calculation or detection of these parameters, and it obviates the requirement for sensors and external devices, which are commonly employed in existing datasets. The main objective of our work is to advance research in fatigue detection, particularly in work and academic settings. To achieve this, we conducted a series of experiments utilizing machine learning techniques to analyze the dataset and assess the fatigue state based on the features predicted by our models. The results reveal that the random forest technique consistently achieved the highest accuracy and F1-score across all experiments, predominantly exceeding 90%.

Conclusion: These findings suggest that random forest is a highly promising technique for this task and prove the strong connection and association among the predicted features used to annotate the videos and the state of fatigue. This research contributes to the ongoing efforts to improve fatigue detection methods, enhancing work efficiency and safety in various operational environments.

List of sources used:

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2- Shilov, N.; Othman, W.; Hamoud, B. Operator Fatigue Detection via Analysis of Physiological Indicators Estimated Using Computer Vision. In Proceedings of the 26th International Conference on Enterprise Information Systems—Volume 2: ICEIS, Angers, France, 28–30 April 2024; SciTePress: Setúbal, Portugal, 2024; pp. 422–432.

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