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Rahman, F.A.[a] , Roslizan, I.U.A.[a] , Gunawan, T.S.[a] , Fitriawan, H.[b] , Kartiwi, M.[c] , Habaebi, M.H.[a]

EEG-Based Fatigue Detection Using Binary Pattern Analysis and KNN Algorithm

(2024) *Proceeding of the IEEE International Conference on Smart Instrumentation, Measurement and Applications, ICSIMA*, (2024), pp. 19-23.

DOI: 10.1109/ICSIMA62563.2024.10675542

[a] International Islamic University Malaysia, Electrical and Computer Engineering Dept., Kuala Lumpur, 53100, Malaysia
[b] Universitas Lampung, Department of Electrical Engineering, Bandar Lampung, 35145, Indonesia
[c] International Islamic University Malaysia, Information Systems Department, Kuala Lumpur, 53100, Malaysia

Abstract
Fatigue is a prevalent issue that disrupts the overall well-being of individuals, leading to impaired cognitive functions such as learning, thinking, reasoning, remembering, and problem-solving. Chronic fatigue significantly increases the risk of accidents due to reduced focus, vigilance, and delayed reaction times. Traditional self-assessment methods for detecting fatigue are subjective and often unreliable. Recent advancements in neuroimaging have demonstrated that EEG signal analysis can objectively classify an individual's mental state. This research aims to develop a reliable and accurate EEG signal fatigue detection system. The EEG signals are decomposed into four levels using a one-dimensional discrete wavelet transform (1D-DWT). Textural features are extracted using binary pattern (BP) analysis and combined with seven statistical features. Then, these features are fed into a k-nearest neighbors (KNN) classifier to distinguish between the rest and fatigue states. Utilizing a dataset from the Mendeley Data website, the proposed system achieved an accuracy of 93.75%, precision between 93% and 95%, recall ranging from 92% to 95%, and an F1-score of 93% to 94%. This study highlights the potential of EEG-based systems to provide objective and accurate assessments of fatigue levels, thereby reducing the risks associated with chronic fatigue in daily life. © 2024 IEEE.

Author Keywords
binary pattern analysis; electroencephalogram (EEG); fatigue detection; k-nearest neighbors; wavelet transform

Index Keywords
Functional neuroimaging, Image coding, Image segmentation, Local binary pattern, Nearest neighbor search, Risk assessment; Binary pattern analyze, Binary patterns, Chronic fatigue, Electroencephalogram, Electroencephalogram signals, Fatigue detection, K Nearest Neighbor (k NN) algorithm, Nearest-neighbour, Pattern analysis, Wavelets transform; Discrete wavelet transforms

References

- Patterson, P.D., Weaver, M.D., Frank, R.C., Warner, C.W., Martin-Gill, C., Guyette, F.X., Hostler, D.
Association between Poor Sleep, Fatigue, and Safety Outcomes in Emergency Medical Services Providers
(2012) *Prehospital Emergency Care*, 16 (1), pp. 86-97.

- Techera, U., Hallowell, M., Stambaugh, N., Littlejohn, R.
Causes and consequences of occupational fatigue: Meta-Analysis and systems model
(2016) *J Occup Environ Med*, 58 (10), pp. 961-973.

- (2023) *Driver Drowsiness Ground Truths Compared: JDS, KSS, and EEG-Optalert*, 13. Accessed: Dec. [Online].

- Zhu, T.
Research on a Real-Time Driver Fatigue Detection Algorithm Based on Facial Video Sequences
(2022) *Applied Sciences Switzerland*, 12 (4).
Feb

- Min, J., Wang, P., Hu, J.
Driver fatigue detection through multiple entropy fusion analysis in an EEG-based

system
(2017) *PLoS One*, 12 (12).
Dec

- Chai, R.
Improving EEG-based driver fatigue classification using sparse-deep belief networks
(2017) *Front Neurosci*, 11.
no. MAR Mar

- Tuncer, T., Dogan, S., Subasi, A.
EEG-based driving fatigue detection using multilevel feature extraction and iterative hybrid feature selection
(2021) *Biomed Signal Process Control*, 68.
Jul

- Subasi, A., Saikia, A., Bagedo, K., Singh, A., Hazarika, A.
EEGBased Driver Fatigue Detection Using FAWT and Multiboosting Approaches
IEEE Trans Industr Inform, 18 (10), pp. 6602-6609.
Oct. 2022

- Zhou, Y., Zeng, C.Q., Mu, Z.D.
Optimal feature-Algorithm combination research for EEG fatigue driving detection based on functional brain network
(2023) *IET Biom*, 12 (2), pp. 65-76.
Mar

- Liu, Y., Lan, Z., Cui, J., Sourina, O., Möller-Wittig, W.
Inter-subject transfer learning for EEG-based mental fatigue recognition
(2020) *Advanced Engineering Informatics*, 46.
Oct

- Zeng, H.
An eeg-based transfer learning method for crosssubject fatigue mental state prediction
(2021) *Sensors*, 21 (7).
Apr

- Abdubrani, R., Mustafa, M., Zahari, Z.L.
A robust framework for driver fatigue detection from eeg signals using enhancement of modified z-score and multiple machine learning architectures
(2023) *IIUM Engineering Journal*, 24 (2), pp. 354-372.

- Ojala, T., Pietikäinen, M., Mäenpää, T.
A generalized local binary pattern operator for multiresolution gray scale and rotation invariant texture classification
(2001) *International Conference on Advances in Pattern Recognition*, pp. 399-408.
Springer

- (2024) *Data For: Research on Fatigue Driving Detection Based on Adaptive Multi-scale Entropy-Mendeley Data*, 6.
Accessed: Jun. [Online].

Correspondence Address
Rahman F.A.; International Islamic University Malaysia, Malaysia; email: faridah_ar@iium.edu.my

Publisher: Institute of Electrical and Electronics Engineers Inc.

Conference name: 10th IEEE International Conference on Smart Instrumentation, Measurement and Applications, ICSIMA 2024
Conference date: 30 July 2024 through 31 July 2024
Conference code: 202737

ISSN: 26406543
Language of Original Document: English
Abbreviated Source Title: Proceeding IEEE Int. Conf. Smart Instrum., Meas. Appl., ICSIMA
2-s2.0-85208463256
Document Type: Conference Paper
Publication Stage: Final
Source: Scopus