

INTELLIGENT SLEEP MONITORING SYSTEM: INTEGRATING RESPIRATORY AND MOVEMENT SIGNALS FOR PRECISE SLEEP STAGE SCORING

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The classification of sleep stages is an essential part of sleep studies. However, the classical approach using polysomnography causes discomfort to the patient due to the need of applying numerous sensors on the body. Consequently, alternative more convenient methods are highly appreciated and can offer numerous advantages [1]. The main objective of this research is to develop an algorithm for the automatic classification of sleep stages using signals that can be obtained in a non-obtrusive way. After reviewing the recent research, the authors chose multinomial logistic regression as the basis for their approach [2]. Several derived from movement and respiration signals parameters were designed, and various their combinations were explored to develop an accurate and stable sleep stage scoring algorithm. The test implementation was performed and allowed to obtain successful results: the achieved accuracy of the recognition of Wake/NREM/REM stages is equal to 73%, with a Cohen's kappa of 0.44 for the analyzed 19324 sleep epochs of 30 seconds each.

This approach has the advantage of using only movement and respiration signals, which can be recorded with less effort than heart or brain wave signals [3], and requires only four derived parameters for the calculations, providing high computational efficiency. In conclusion, the new system is a significant improvement over existing approaches for non-intrusive sleep stage identification.

References: 1. *Hirshkowitz M.* "Polysomnography Challenges" // *Sleep medicine clinics*, vol. 11, no. 4, 2016. 2. *Hosmer D. W., Lemeshow S. and Sturdivant R. X.* *Applied logistic regression*. Hoboken, NJ: Wiley, 2013. 3. *Gaiduk M., Wehrle D., Seepold R. and Ortega J. A.* "Non-obtrusive system for overnight respiration and heartbeat tracking" // *Procedia Computer Science*, vol. 176, pp. 2746–2755, 2020.