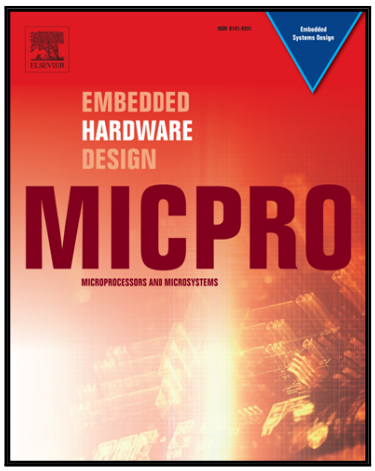

Single-channel-based automatic drowsiness detection architecture with a reduced number of EEG features

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Single-channel-based automatic drowsiness detection architecture with a reduced number of EEG features

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Abstract

This paper presents efficient EEG system for drowsiness detection. The proposed system is able to provide stable performances regardless their intrinsic features of drivers and is suitable for embedded implementation. This approach is based on spectral analysis where a new set of features is extracted from an electroencephalography (EEG) recording based on the analysis of sub-bands of 1Hz. In this work, the alpha sub-band is represented by only one frequency, i.e., the individual alpha frequency, instead of using the entire sub-band from 8 to 12 Hz. The use of this frequency as a representative feature helps to overcome the problem of interpersonal variability between different persons. Furthermore, we have reduced the EEG feature size while maintaining the accuracy at its highest level. By combining the reduction in the number of features with the use of only one differential EEG channel, we have succeeded in developing a more suitable system with good accuracy. In order to verify the performance of our approach, the proposed EEG-based signal processing technique was simulated and tested under Matlab using an existing offline database (MIT-BIH Polysomnographic Database Physiobank); consequently, it provides better drowsiness detection performance than similar published works with an average accuracy of approximately 88.80%. Furthermore, we have implemented our proposed architecture in an ARM-based processor platform to complete our virtual prototyping and to get a real evaluation of our drowsiness system architecture. Such system is able to process an epoch of 30seconds within 0.2 seconds. The proposed approach should be easily and efficiently handled by a driver to be warned against any risk from potential drowsiness in real-time.Obtained results show that the proposed system provides a short processing time while maintaining a high performance in term of classification accuracy.

Keywords: Electroencephalography(EEG), drowsiness, artificial neural network (ANN), FFT, ARM

1. Introduction

Reliable somnolence detection is one of the preeminent objectives in developing novel advanced driver assistance systems. Several automatic detection methods studied driving performance behavior, such as the lateral position of the vehicle and the steering-wheel angle [1, 2]. Nevertheless, their waking and drowsiness states vary easily according to the vehicle type and driving conditions. Many preventive techniques for drowsiness detection

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