A Study on Sleep Detection using Posture and Face Recognition

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Abstract

This research is intended as a preliminary study to establish a system to detect sleepiness and to confirm the possibility of sleep detection through posture slopes and facial recognition. Previous studies have used methods such as using EEG (ElectronicsPalograms) and HRV (HeartRateVariability) signals and imaging processing techniques. These methods are difficult to apply in real life due to the inconvenience of attaching sensors to the body and the increased amount of calculations for imaging process. Thus, in this research, we conducted a study on how we can use fabric pressure sensors to measure posture slopes and minimize calculations in using face recognition technology. As a result of the experiment, we were able to identify the possibility of sleep detection by using the tilt of posture and facial recognition.

Keywords: Sleep detection, Fabric pressure sensor, Histogram,

1. Introduction

Recent studies of sleepiness are mainly based on bio-signalling, car movement and imaging technology. Biometric signals are used to predict psychological conditions using EEG(Electroencephalogram) signals or HRV(HeartRateVariability) signals, which are used to measure sleepiness [1]. A method that utilizes video processing technology determines sleepiness by characteristics of facial features such as number of flicker and yawning of eyes [2][3].

However, the above mentioned methods have the inconvenience of having sensors attached directly to the human body and the increased amount of calculations for video processing. Therefore, in this research, as a preliminary study aimed at achieving the goal of implementing an actual system for preventing drowsy driving, we conducted a study to compare the stability and posture of normal sleep by attaching a sensor to a chair. In addition, a study was conducted on how to use the histogram as a preliminary study to build an image processing algorithm using facial recognition.

2. The study of sleepiness

2.1 Biometric method

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Research using HRV (HeartRateVariability) and EEG (Electroencephalogram) is typical in biometric studies. Referring to the 2014 study, [4] it is possible to analyze the time zone and frequency domain using the R-R interval (RRI) value after detecting the R-peak using the difference operation algorithm as shown in Figure 1.

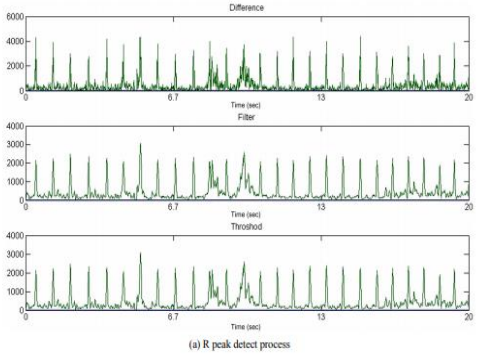

Fig. 1. R-peak detection

2.2 Video processing technology method

The majority of studies used the Haar-like feature [5] method, which selects the characteristics shown in Figure 2, and the characteristic values are calculated as the difference in brightness values of black partial pixels from the sum of brightness of white partial pixels in a square.

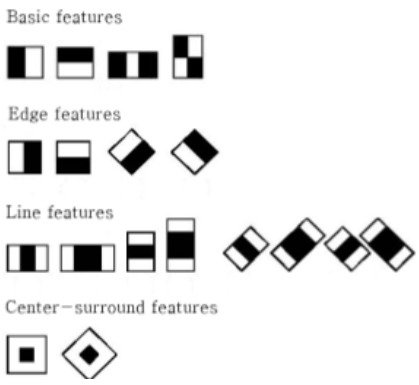

Fig. 2. Type of Haar-like feature

3. Experiment and Results

3.1 Experimental environment

In this research, a pressure sensor was created using fabric cloth as shown in Figure 3(a) to estimate sleepiness using a pressure sensor, and zones were designated as shown in Figure 3(b). Atmega 328 was used to calculate the pressure signal for the sensor.

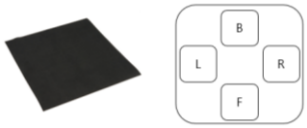

Fig. 3. System Diagram

For image processing related to face recognition, the MATLAB program was performed using computers with Intel(R) Core(TM) i5-6200 CPUs and NVIDA GeForce GTX950M.

3.12 Result of an experiment

A total of five measurements were taken for sleepiness, and the results were available in the following table.

Table 1. Good posture

Good posture					A forward posture				
-	F	B	L	R	-	F	B	L	R
1	129	293	454	445	1	491	66	235	185
2	127	293	452	446	2	490	67	236	186
3	129	294	453	446	3	489	66	236	213
4	129	294	452	445	4	492	68	236	282
5	128	294	452	447	5	495	67	237	191

As a result of an experiment to determine sleepiness through the eyes, images were extracted where the threshold was initially specified as 40. Figure 4 shows normal conditions, while Figure 5 shows sleepy cases.

Fig. 4. Normal case(Threshold)

Fig. 5. A sleepy case (Threshold)

Figure 6 and Figure 7 are the results of the histogram for normal and sleepy. Comparisons through the histogram show that the whole picture is tilted to the left overall. Comparing normal to sleepy cases, we were able to see that the distribution in the light of day is more visible when normal at 100.

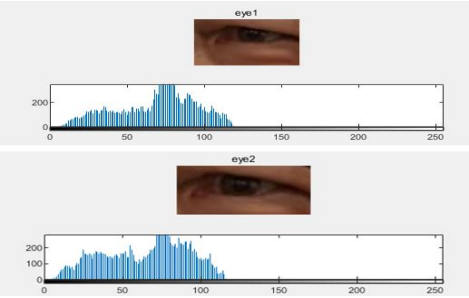

Fig. 6. Normal case (histogram)

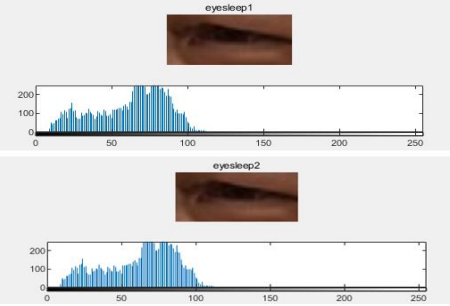

Fig. 7. A sleepy case (histogram)

4. Conclusions

This study was done in advance to recognize sleepiness through posture recognition and light imaging algorithms. In addition, a study was conducted to recognize sleepiness using pressure on posture and histogram. In fact, when sleepiness is intense, we can see that the body is leaning, and based on a test using a pressure sensor made from fabric, the pressure changes according to the body's inclination. In particular, it was possible to verify that the corresponding pressure sensor and the corresponding pressure level rise depending on the direction in which the overall pressure distribution is similar when normal. This allowed us to check whether we were sleepy or not through tilting. Histograms are used to recognize drowsiness using video. In this research, to apply light algorithms that can overcome this point, a method using a histogram was used to identify the difference between normal and sleepy histograms. These results confirm that sleepiness can be distinguished by the most basic imaging techniques.

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