PRELIMINARY EVALUATION OF AN EXPERIMENTAL SOMNOLENCE QUANTIFICATION SYSTEM BASED ON IMAGES OF THE EYE

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Somnolence is known to be a major cause of various types of accidents, particularly on roads, and ocular parameters are recognized to be good and reliable physiological indicators of somnolence. We have thus developed an experimental (software) system that uses ocular parameters extracted from images of the eye to produce a level of somnolence on a continuous numerical scale. The ultimate goal of this system is to prevent somnolence-related accidents.

The aim of the study described in part here is to verify that, for a number of subjects, the level of somnolence produced by our system correctly reflects, on average, the level of performance of these subjects in the accomplishment of a task. The two tasks considered here are (1) a visual reaction-time (RT) test and (2) in-simulator driving.

We conducted two independent experiments. In each, the healthy, volunteer subjects were subjected to three tests over two consecutive days, and they were not allowed to sleep between the first and last tests. In the first experiment (involving 21 subjects), each test was a visual RT test, with duration of 15 minutes. In the second (involving 12 subjects), each test was a driving run in a simulator, with duration of at least 45 minutes.

During each test, we continuously recorded images of the right eye of the subject at a high frame rate. We then used our somnolence quantification system to produce a numerical value for the level of somnolence for each minute of test. For each such minute, we also obtained a relevant task-related performance parameter, i.e. either the mean RT (for the first experiment), or the standard deviation of the lateral position (SDLP) of the car on the road (for the second).

The results show that our system indicates an increase in the numerical level of somnolence when the mean RT increases or when the mean SDLP increases, as appropriate. In the first experiment, the mean RT increased from 0.385 ms for a low level of somnolence to 0.681 ms for a high level of somnolence. In the second, the mean SDLP increased from 0.417 m for a low level of somnolence to 1.204 m for a high level of somnolence.

In conclusion, the above experiments indicate that our somnolence quantification system based on images of the eye has significant potential for indicating the level of performance of a subject accomplishing a task, and thus, ultimately, for preventing accidents due to somnolence, in particular during driving.

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