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Drowsiness Classification using Convolutional Neural Network based on Electroencephalography Signals

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Introduction

◆ Goals
- Binary classification of drowsiness states and alert states using electroencephalogram(EEG) signals

◆ Motivation
- Detection drowsiness in driving environments was mostly achieved through visual technology-based cameras [1]
- The mental state of the general public can be detected based on neurophysiological signals

◆ Related Works

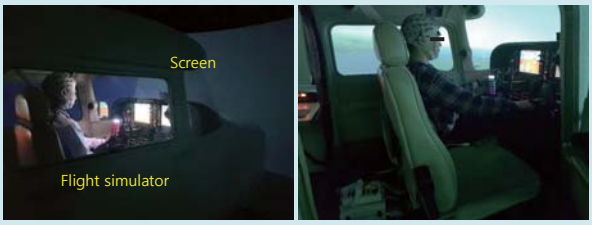

Fig. 1. A preliminary study on drowsiness based on EEG [1]

Experimental Protocol and Environment

◆ Experimental Setup
- Six healthy subjects (S1-S6, 5 males and 1female, aged 28.5(±3)), participated in our experiment
- The day before the experiment, we asked subjects if they had consumed alcohol and coffee, and if they had slept more than 7 hours

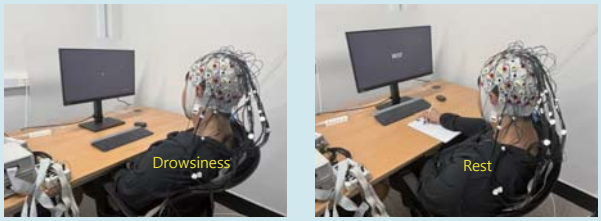

Fig 2. Experimental environment for EEG data

◆ Experimental Paradigm
- Drowsiness (1 hr.), Rest (< 10 s)
- Subjects entered within 10 seconds of hearing a beeping sound, as measured by the KSS value

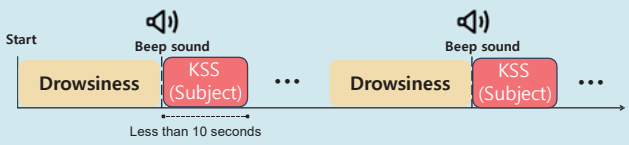

Fig 3. Experimental paradigm for data of drowsiness

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Proposed Method and Evaluation

◆ Specification of proposed CNN
- ➢Layers : 7
- ➢Epoch : 50
- ➢Activation function : ELU*

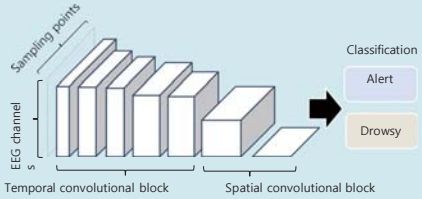

Fig 4. Structure of the proposed CNN

◆ Fig 6 shows the confusion matrices for binary classification using proposed CNN* and DNN*
- ➢ Proposed CNN, the true positive rate of Drowsy and Alert state were 84.6% and 50%, respectiv ely
- ➢ DNN, the true positive rates of Drowsy state and Alert state were 69.2% and 16.7%, resp ectively

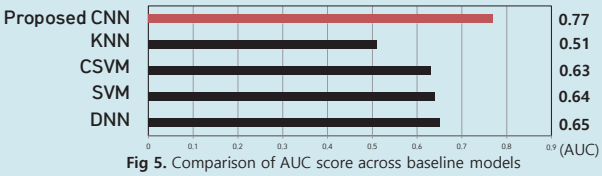

Fig 5. Comparison of AUC score across baseline models

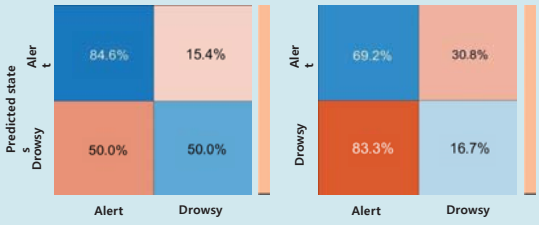

Fig 6. Confusion matrices of classification two mental states

*Long-Term Short memory *Convolution Neural Network
*Exponential Linear Unit *Deep Neural Network

Discussion and Conclusion

◆ Presenting a drowsiness experiment in the general population using physiological signals

◆ By conducting an experiment under a driving envi ronment, more accurate information about the dri ver's mental state can be obtained

References

1) J.-H. Jeong, B.-W. Yu, D.-H. Lee, S.-W. Lee, "Classification of Drowsiness Levels Based on a Deep Spatio-Temporal Conv olutional Bidirectional LSTM Network Using Electroenceph alography Signals," *Brain Sci.*, Vol. 9, No. 12, 2019, pp. 348.

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