24 Reading minds from unconscious eye movements
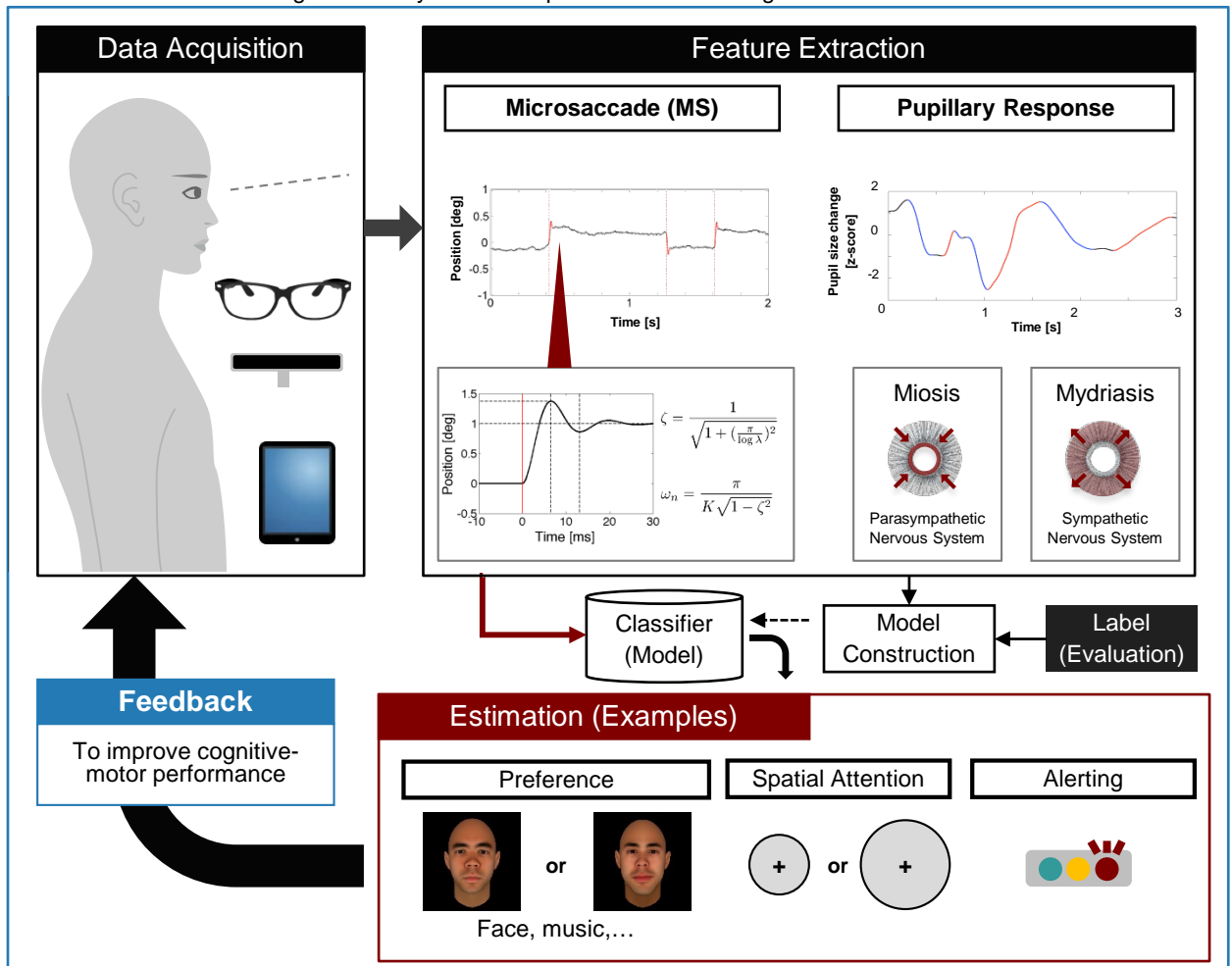## - Decoding implicit mind from fixational eye movements -

Abstract

Eye is known as "one part of brain" and reflects various types of our emotion or perceptual states. Instead of using brain-imaging methods such as Electroencephalography (EEG) , we used eye-movement and pupil size data, which can be measured with high signal-to-noise ratio using low-cost equipment, to decode mental states. However, eye movement data were thought to convey less amount of information than EEG data, due to their signal properties or the fewer number of recording channels. Here, we developed new feature extraction methods for microsaccade (small, rapid, involuntary eye movements) and pupillary response, based on a control theoretic model. Computing the novel features as additional information enables us to decode various types of our emotion or perceptual states (preference, attention, and drowsiness etc.) from eye measurement. Using this technology, we aim to create an AI which has an emotion recognition ability that are superior to human beings.

Data Acquisition

Feature Extraction

Microsaccade (MS)

Pupillary Response

$$\zeta = \frac{1}{\sqrt{1 + (\frac{\pi}{\log \lambda})^2}}$$

$$\omega_n = \frac{\pi}{K\sqrt{1-\zeta^2}}$$

Miosis — Parasympathetic Nervous System

Mydriasis — Sympathetic Nervous System

Classifier (Model)

Model Construction

Label (Evaluation)

Feedback — To improve cognitive-motor performance

Estimation (Examples)

Preference — Face, music,…

Spatial Attention — + or +

Alerting

Reference

[1] S. Furukawa, M. Yoneya, H-I. Liao, M. Kashino, "Eyes as an Indicator of Mind: A Key Technology of Heart-Touching AI," *NTT Technical Review*, Vol. 14 No. 5 May 2016

[2] M. Yoneya, S. Furukawa, M. Kashino, "Potential Use of Microsaccade in Personal Identification," in *Proc. 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2015.

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