Abstract

Brain Machine Interface (BMI) tools such as functional magnetic resonance imaging (fMRI), Magnetoencephalography(MEG), and electroencephalography (EEG) are conventional methods used to measure signals of brain functioning. However, the cost of measurement and the time and effort required for just one scan are drawbacks for fMRI and MEG. On the other hand, EEG is widely used in BMI research due to its low measurement cost and simplicity. Nonetheless, a shortcoming of EEG is that it captures extremely faint brain waves. Due to this, in order to make a judgment from the brain wave measurements, multiple trials must be conducted. This is a drawback in that, even making a simple binary judgment requires processing time. An additional flaw of EEG is that, as noise from slight body movements, like vibration or blinking, can easily cause the signal to disappear, there is a low percentage of correct answers when making a judgment from the brain wave measurements. Various approaches are being used in order to resolve these challenges, however solutions for the above-mentioned problems have yet to be reached. Meanwhile, there is also research being conducted using the behavioral and physiological signals of pupil size, eye movement, and heart rate to make judgments. There has also been research demonstrating that when subjects are given a working memory challenge, the larger the amount of information being stored becomes, the larger the opening of the pupil becomes. Both behavioral physiological signals and brain waves are characterized by a relation with cognition indicators such as judgment and memory capacity, and compared to EEG, it is possible to obtain highly accurate readings against noise. In addition, for the same working memory challenge, there is research showing that the more memory capacity used, the larger the amplitude of the brain waves becomes, and it is predicted that there is a correlation between pupil size and brain wave amplitude. In the present research, in order to resolve the problems with BMI using EEG, we will propose a “brain wave and pupil simultaneous measurement system” in which brain waves and pupil size are measured simultaneously, and the brain wave data is supplemented with the pupil data. Specifically, we will measure the pupil size change and brain waves simultaneously when conducting a working memory challenge to make a binary judgment. The measured data will be optimized with principal component analysis, and a Support Vector Machine will be used to study the two-choice pattern. With respect to the results of that study, new test data will be released and the result of the two-choice option will be hypothesized. Regarding the correct answer rate of the results hypothesis, we will verify that the correct answer rate from analysis of the EEG alone can be improved by adding the pupil information.