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| **InterBlink Interval**  Temesgen Gebrehiwot, Rafal Paprocki , Artem Lensky\*  School of Electronics and Communication Engineering, Korea University of Technology and Education | | | **Article history**  Received  *TBA*  Received in revised form  *TBA*  Accepted  *TBA*  \*Corresponding author  lensky@koreatech.ac.kr | |
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| **Graphical abstract** | | **Abstract**  The  *Keywords*: Dendritic gels; tunable materials | | |
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**1.0 INTRODUCTION**

Blinking is a semi-autonomic closing of the eye lids .Every time we blink, our eyelids spread a cocktail of oils and mucous secretions across the surface of the eye to keep your globes from drying out. Blinking also keeps eyes safe from potentially damaging stimuli, such as bright lights and foreign bodies like dust. So why don't we notice the world plunging into darkness every two to ten seconds? The sudden changes in an image due to saccades or blinks do not interfere with our subjective experience of continuity [29], the very act of blinking suppresses activity in several areas of the brain responsible for detecting environmental changes, so that you experience the world as continuous.

Blinks have been known to be linked to internal brain activities. Increasing the accuracy of blink detection is of high importance as humans look for an easier method of collecting internal brain activity information. The detection of eye blinks had a huge impact in various fields in some BCI (Brain Computer Interface) they detected eye blinks and analyzed the pattern with the duration after collecting this analysis they used it in as an input to a computer in similar manners that we use our mouse. This implementation of the use of blinks have opened a wide door of new possibilities for disabled people [28]. World Health Organization (WHO) has announced that the ninth cause of death globally are car accidents. National Motor Vehicle Crash Causation Survey (NMVCCS) has found that 30% of car accidents are caused by the drowsiness of drivers [30]. It is known that workload increases heart rate and heart rate are known to decrease in monotonous and drowsy conditions [25]. BR is inversely correlated with increase of workload so blinks can be used to detect drowsiness before it creates damage [25]. Researchers have shown that blinks can play an important role in detecting many difference brain disorder and brain activities, Spontaneous blink rate(BR) has been studied in many neurological disease like Parkinson's disease and Tourette syndrome[1][2][3]. The use of blink detection doesn't stop there researchers have found that Blink rates can be used as a source of data in detecting psychiatric disorders like schizophrenia and attention hyperactivity all this is because blinks are regarded as a non-invasive peripheral markers of the central dopamine activity which makes there accurate detection more important [4] [5] [6] [7] [8] [9].

**2.0 EXPERIMENTAL**

**2.1 Data acquisition**

For the purpose of collecting data we developed special questionnaire software, and software for detecting eye blinks within EEG signals.

The video stream was captured with a Logitech HD Pro Webcam C920 . Video stream was stored on a disk drive to be processed in the future. Simultaneously EEG signals were recorded. For the recording of EEG signals we employed Mitsar-EEG 201 amplifier and accompanying WinEEG software. The electrodes were placed according to the international “10-20 system”[15]. Electro-gel has been injected into electrodes hollow in order to decrease the electrode-skin resistance. Currently, the EEG signals were recorded with the purpose of eye blink detection. In the future work we are planning to analyze EEG to detect various types of brain activity.

The experimental setup is shown in the figure 1.

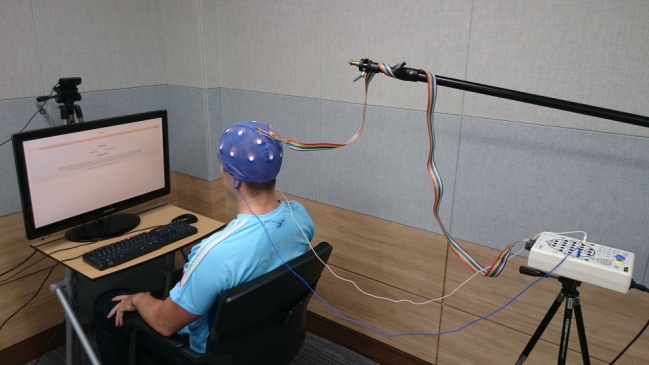


Figure 1 Experimental setup

**2.1 Methods**

Electrodes are applied to the head according to 10-20 System. Electrode placement has been standardized in order to fit anatomical skull landmarks. Name ’10-20’ comes from the fact, the distance between nasion, the inion and the head circumference, marking electrode locations based on 10% or 20 % intervals of those distances. We used bipolar montage, which means we determine the potential between Fp1 and Fp3, also Fp2 and Fp4. Figure 2 presents EEG signals for both pairs.

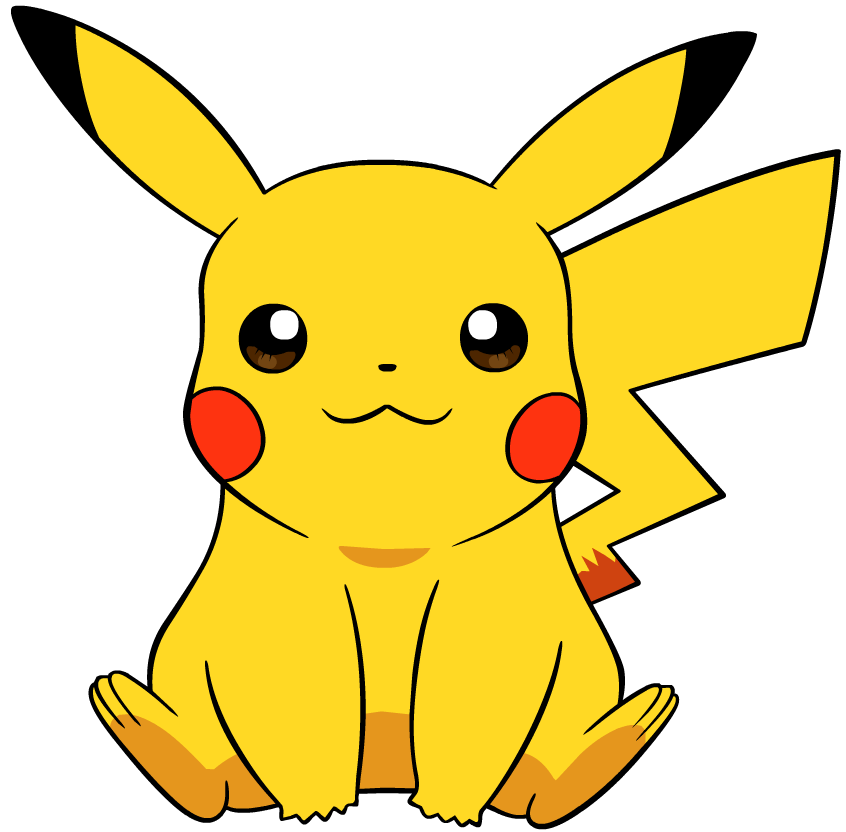
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Figure 2 Fp1-Fp3 and Fp2-Fp4 electrode pairs

Usually we want to get rid of ocular artifacts from EEG signal, as the eye blink is artifact and leads to interpretation problems[24]. This time we are going to extract blinks from EEG. In order to do that we employ fastICA[38] algorithm for solving Blind Source Separation (BSS)[39], which allows us to separate neural activity from muscle and blink artifacts[40]. ICA algorithm consist of two stages. First is decorrelation or whitening, we remove any correlations in the data.

Let be the data whitened using the mean vector and the covariance matrix .

Second stage is separation, which is orthogonal transformation of whitened signals (rotation of the joint density). The task is to find orthogonal matrix such that has independent components[38]. One by one we are looking for the rows of the matrix so a measure of non-Gaussianity is maximized by such that the length of is one and orthogonal to rows . The function can be any nonquadratic function, which is twice continuously differentiable with and with first and second derivative functions and .

Nonlinearity is defined as the derivative function . Variety of optimizing criterions (cost functions) can be used. By choosing kurtosis measure we obtain the nonlinearity (). Another choice could be functions () and () properly parameterized [31]. The () we can get from skewness measure. There exist some general directions of choosing nonlinearity for fastICA algorithm. For example, the () nonlinearity is efficient for sources with light-tailed distributions. For heavy-tailed sources ()and () are desirable. The () nonlinearity finds skew sources but in the case of symmetric sources is not efficient. Therefore in practice, and nonlinearities are common choices.

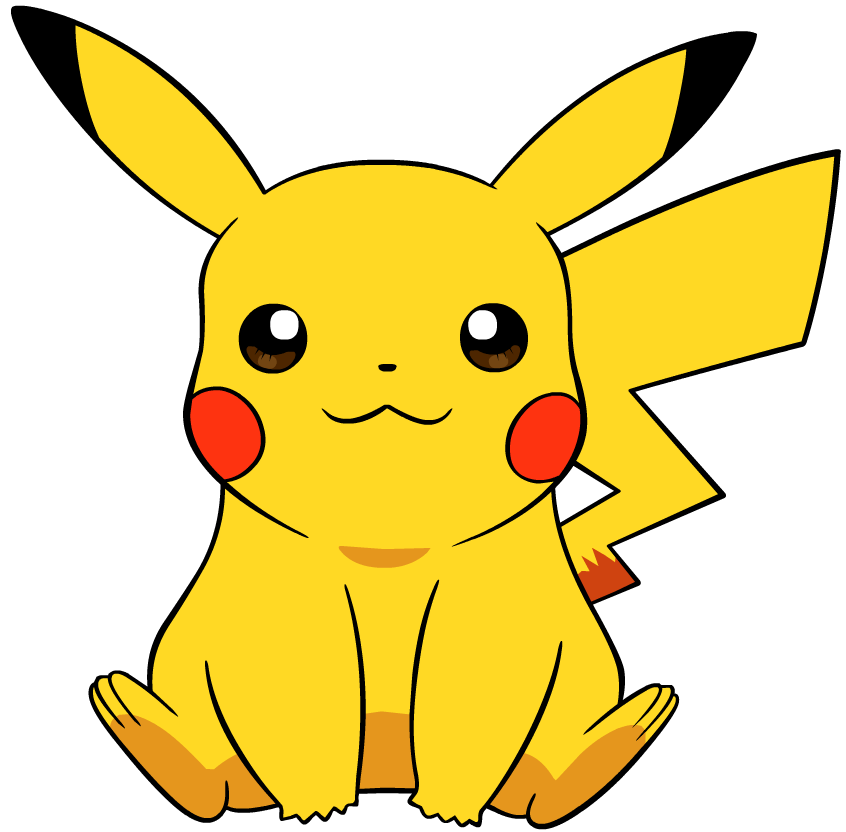
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Figure 3 Independent components

**3.0 RESULTS AND DISCUSSION**

**3.1 Full Hardware Setup**

**3.2 Object Highlighting**

**4.0 CONCLUSION**

**Acknowledgement**

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