Emotion Detection using EPOC EEG Device

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Due to the growing need for computer applications capable of detecting the emotional state of the users [1], studying emotions in informatics has increased. The direct options of detecting the emotions are inquiries and questionnaires with specific questions which participants answer on the Likert scale. Because of the fact that every participant has to answer all the questions and those need to be manually evaluated, it is not a very efficient method. That is the reason for inventing new methods for classifying emotions for example through physiological responses.

Motivated by every day interaction among humans, a great part of the research in this area has explored detecting emotions from facial and voice information. One of the available software solutions is *Noldus FaceReader*[1], which can recognize six emotional states: joy, sadness, anger, surprise, fear, disgust, and a neutral state. However, it depends on good light conditions and the accuracy could be also decreased by an object covering part of a participant's face, e.g., glasses. In order to address these shortcomings, other approaches to detect emotions have been proposed which focus on different physiological information, such as heart rate, skin conductance, and pupil dilation [2].
A still relatively new field of research in affective brain-computer interaction attempts to detect emotions using electroencephalograms (EEGs) [3].

In our approach, we aim to evaluate EEG devices Emotiv EPOC and Emotiv Insight and classify emotions from the data captured by this devices. Our method is based on the method was used by the psychologists. In order to represent emotions we use dimensional approach [4] which is based on the fact that all subjective feelings could be projected into the 3D space where dimensions are: (*i*) *arousal* – positive/negative emotion, (*ii*) *valence* – strong/weak emotion, and (*iii*) *tension* – tensed/relieved emotion.

We omit the third dimension due to the difficulty of determining the amount of tension. When classifying emotions by this method, respondents identify how positive (valence) and how strong (arousal) was their emotion. These values are projected to 2D space, called Valence–Arousal model, which could be divided to four quadrants: strong-

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[1] http://www.noldus.com/human-behavior-research/products/facereader

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negative emotions, strong-positive emotions, weak-negative emotions and weak-positive emotions. We try to compute valence and arousal from EEG signal and use them as one of the features for machine learning algorithm to recognize specific emotions.

Our method could be divided into two steps. First we apply linear regression in order to predict valence and arousal from EEG data. Then we use support vector machines to classify six emotions: joy, surprise, sadness, fear, disgust, anger and neutral emotion. The preliminary results on an existing dataset show 37.72% accuracy of our approach. In addition, we replicated the experiment within the dataset was created, in which participants watched music videos and answered the questionnaires about emotions they were feeling. We used EEG devices to capture the electrical signal from their brains.

Firstly, we held a pilot study with two people. Then nine participants took part in our study with Emotiv EPOC and three people with Emotiv Insight. As we do not have enough date to split them into three sets, we used cross validation technique to evaluate our method. Results of analysis show performance 53% of classifying correct emotion with Emotiv EPOC and around 40% with Emotiv Insight. As the next step, in order to verify the potential of the Emotiv EEG devices for classification of the emotions, we plan to compare these results with one of the existing tools, namely Noldus FaceReader.

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