論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Emotion recognition from EEG and individual characteristics in HCI scenarios
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出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第12138号, 授与年月日:2021年9月24日, 学位の種別:課程博士, 審査員:小池 康晴,金子 寛彦,八木 透,吉村 奈津江,小尾 高史
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第12138号, Conferred date:2021/9/24, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	ﾗｲﾌｴﾝｼﾞﾆｱﾘﾝｸﾞ 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 (Philosophy) Doctor of
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Brain computer interfaces (BCIs) are technological communication systems that allow users to interact with external devices using brain activity. BCIs have adopted the use of emotions recognition under the domain of affective brain computer interfaces (aBCIs), which attempt to create devices able to detect affective states from neurophysiological signals to enhance the human-computer interactions. Emotion recognition using electroencephalographic signals has been a recent and wider field of study where the researchers try to predict emotions using information derived from EEG. However, one of the many challenges faced by these kinds of researches is the selection of tools and data sources in the human body that allow to assess the emotions without being intrusive.

The general pipeline of emotion recognition needs 2 basic sources of information to be able to classify emotions from the input data: the data describing the behavioral reactions related to the emotional experience from the participant, and the participant's answers related to what they felt during the exposure to the emotional stimuli. In previous works, the experimental time window for emotion recognition goes from 35 seconds to 10 min approximately, in those cases, long time windows do not allow to identify specific moments where the emotion takes place, due to the lack of labeling, not allowing the study of dynamic changes of emotion inside the experimental time window. Also, to predict more accurate emotional states it is important to identify which kind of input information is more relevant for the whole emotion recognition pipeline.

This study aims to propose an emotional elicit tool (videogame) that allows to analyze the emotional reactions, both inside and after the experimental time window where the participant is expose to the emotional stimuli, using EEG and individual characteristics as input data. As a conclusion, it is possible to identify emotional reactions using EEG traits using videogames as an emotional stimulus. Videogames are powerful tools to elicit emotions due to the combination of digital media as music, picture, videos, game mechanics and story-telling, with the interaction with virtual environments, becoming an efficient tool to study emotional reactions under HCI scenarios. The emotional reactions came represented in self-assessment responses, and also, in game time events.

Due to the nature of the individual characteristics (age, sex, and personality), and the small number of participants, this kind of information is not suitable to use in arousal-valence classifications. For that reason, information related to behavioral reactions related to the emotional stimulus tool were used to improve the classification performance. Regarding EEG features, PSD and DE features were more suitable to increase the classification performance of both arousal-valence scores and emotional stimulus time events. There is a high number of common EEG features that correlated with game time events for all the participants, PSD and DE features of theta and alpha bands for all the EEG channels except of P2 correlated negative with positive events and positively with negative events.

For arousal regression, mean absolute error (MAE) had an average of 0.973 ± 0.316 on train set, and 1.199 ± 0.321 on test set, mean square error (MSE) had an average of 1.786 ± 1.122 on train set and on test set 3.186 ± 2.876. For valence regression, the MAE had an average of 1.199 ± 0.321 on train set, and 1.670 ± 0.784 on test set, the MSE had an average of 2.504 ± 1.2112 on train set and on test set 4.680 ± 4.032. From the prediction models' implementation, better result for arousal scores were obtained than valence scores in both the train set and the test set.

From the classification scores, it was clear the good performance of the classifiers to discriminate between

positive and negative time events, the features selected from the majority of the participants were DE from the theta band and form the full EEG frequency spectrum. The results proved that with each of the EEG signals is possible to identify emotional states in the participants using a smaller time window with game events and these events have a relation with the arousal-valence scores gave by the participants.

Some ERP components were found in the EEG signals related with the channels that highly correlated with emotional stimulus time events. The ERPs have some common characteristics related to positive and negative events across the 10 participants of this study. P200 characteristics on the EEG signals in presence of positive events were found for FCz, CPz, Pz, and POz channels, with stabilization before the event onset and after 0.5 seconds of the event onset. In contrast, a pronounce peak in amplitude in presence of negative events, and a decrease in amplitude (negative amplitude) before the occurrence of the event was found for FCz channel, this suggest that the participants' signal can predict when a negative event is about to occur (0.5s before the event).