

HOW TO RECOGNIZE EMOTION WITHOUT SIGNAL PROCESSING: AN APPLICATION OF CONVOLUTIONAL NEURAL NETWORK TO PHYSIOLOGICAL SIGNALS

Authors

Nicolas Martin, Jean-Marc Diverrez, Sonia Em, Nico Pallamin, Martin Ragot

Uses & Acceptability Lab, b<>com, Cesson-Sévigné, France

{nicolas.martin,jean-marc.diverrez,sonia.em,nico.pallamin,martin.ragot}@b-com.com

Aims

Recognition of emotional state is a major challenge for affective computing¹. With the development of wearable with physiological sensors, recognition outside the laboratory becomes possible. To build a recognition system of emotion from physiological signals, the most common approach^{e.g. 2} is the use of a pipeline as follow: inducing emotion on individuals and collecting data, extracting statistical features with signal processing and detecting specific pattern related to emotion with machine learning algorithms. In this paper, we propose to avoid the signal processing step with deep learning models, especially with convolutional neural network (CNN). Thus, CNN offers the possibility to deal directly with raw data³. Moreover, in contrary to previous research^{e.g. 4}, we chose to predict continuous value of emotional state. This type of output (value on a dimension of emotion - e.g. arousal) seems to be more adapted to human functioning⁵ and offers more precision.

Method

To test the performance of CNN to classify emotional states from physiological data, we used the DEAP database⁶. This database contains physiological data from 32 participants who had been exposed to 40 minutes of music video as emotion inducer. We used only four sensors (sampling rate of 128Hz) from DEAP database: Galvanic Skin Response, Respiration Belt, Plethysmograph and Temperature. Indeed, these information can be extracted from actual consumer wearable (e.g. Microsoft Band). Technically, to recognize emotional state, we trained deep models composed of three layers of convolution (with respectively a depth of 32, 64 and 128) and two fully-connected layers. Convolution layers are composed of a convolution, a max pooling and a Relu layer. Fully-connected layers are composed of neural layers, activation functions and dropout.

Results

To test the accuracy of our models, we split the DEAP database into two datasets: a training dataset with 75% of data and a testing dataset with 25% of data. We tested three models: one by components of emotion: Arousal, Valence and Dominance. Tensorflow was used to construct, train and test our model. Results on testing dataset show accuracy around 76 % for the 3 models.

Conclusion

Deep learning with CNN seems to be an interesting approach to recognize emotional state without signal processing on data. Moreover, our models offer possibility to predict continuous values on emotion dimensions. The futures works should test this solution on physiological signals extracted from consumer wearable sensors.

Acknowledgements

This work was supported by the French government through the ANR Investment (ANR-10-AIRT-07).

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