EmoEye Project

Deep learning-based approach to commercial eye-tracking data analysis

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Intoduction

Detection of emotion is one of the core elements of Affective Computing and is often used both in scientific and commercial settings.

As the demand in neuromarketing analysis expands, we, not unlike many other neuromarketing laboratories, were tasked with psychophysiological emotion detection for advertisement purposes.

We encountered various solutions in the market, but eventually decided to develop our own approach for the following reasons: most of affect recognition products and applications could only perform facial emotion recognition [1], [2], are not sensible to cultural differences and are not based on large samples [3]–[5]

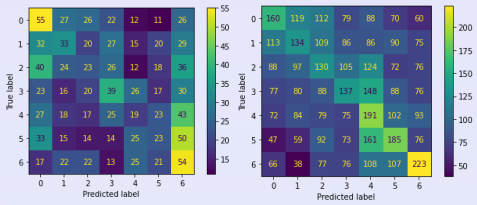
Thus, we decided to develop our own Deep Learning analysis method consisting of Convolutional (CNN) and Long Short-term memory (LSTM) networks and collected the largest (by our estimations) multimodal psychophysiological database.

Results

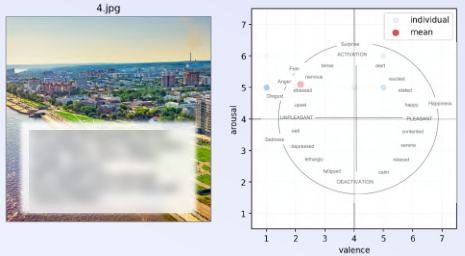
Final CNN-LSTM neural network relied on 3 types of input for emotion recognition - *scan paths, GSR and HR signal data*.

We were able to achieve a maximum accuracy of 30% and 28% for arousal for 7 classes.

We decided to optimize our approach by limiting the number of classes to 3 and were able to achieve *86% and 78% accuracy* for chosen dimensions.



Confusion matrices for Valency (left) and Arousal (right)

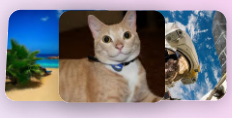


Commercial case study results
This picture caused stress for the viewers

Methods

Eye-tracking, galvanic skin response (GSR) and heart-rate (HR) variability data were collected from 200 (27.46±11.45 years) subjects while they were viewing 316 pictures from Open Affective Standardized Image Set, balanced by Arousal and Valency, and assessed them by 7-point 2 dimension Self-assessment manikin scale.

OASIS



SAM

Gazepoint GP3, biometrics

Conclusion

EmoEye neural network was able to achieve decent accuracy in emotion recognition tasks and was successfully probed in one of our commercial projects.

We are currently in a phase of development for EmoEye-based detection of emotions in combined stimuli (text+picture) and other types of emotional content (e.g., articles, videos).

References

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[3] J. Z. Lim, J. Mountstephens, and J. Teo, "Emotion recognition using eye-tracking: Taxonomy, review and current challenges," Sensors (Switzerland), vol. 20, no. 8. MDPI AG, Apr. 01, 2020, doi: 10.3390/s20082384.

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[5] R. Subramanian, J. Wache, M. K. Abadi, R. L. Vieriu, S. Winkler, and N. Sebe, "Ascertain: Emotion and personality recognition using commercial sensors," IEEE Trans. Affect. Comput., vol. 9, no. 2, pp. 147–160, Apr. 2018, doi: 10.1109/TAFFC.2016.2625250.