

Automatic Depression Detection Through Compound Facial Expressions

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Author Note

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Introduction

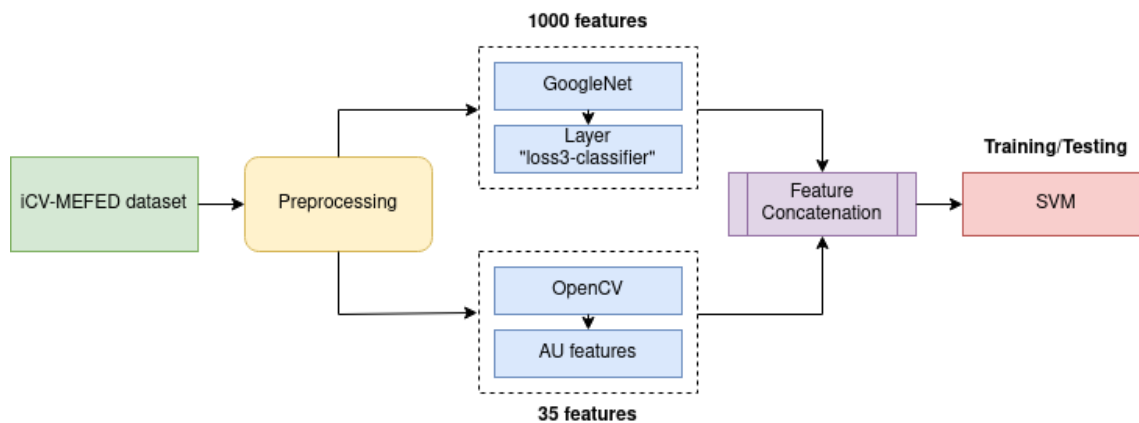
Human facial expression analysis starts from early 1900s where psychologists identify the basic facial expressions (Abrantes, 1999). In 1970s, the basic facial expressions are classified as Anger, Disgust, Fear, Happiness, Sadness, Surprise and Neutral (Ekman, 1976, Ekman and Friesen, 1978). In the last decades, with the advancements in artificial intelligence, it is possible to implement an automated human facial expression classifier (Wang et al., 2006, Mpiperis et al., 2008, Soyel and Demirel, 2012, Yurtkan and Demirel, 2014). Furthermore, micro expressions, muscle movements and compound facial expressions can be also analysed (Guo et al., 2018, Jiddah and Yurtkan, 2023). The main motivation is to support human-computer interaction as face is the most informative part. Also, facial expression analysis can be a driver for automatic emotion analysis. In this study, a novel method of depression detection based on compound facial expression analysis is proposed. The method employs 49 couples of basic facial expressions. iCV-MEFED facial expression dataset (Guo et al., 2018) is used in the experiments. The training and classification of compound facial expressions are done using the GoogleNet and Support Vector Machine (SVM). The texture features and the action units of the face are fused to represent a face. Then, the proper grouping of the compound expressions is done to detect the depression signs on the face.

Method

The method consists of the two main parts. The first part is about the feature extraction. Fusion of deep texture features extracted using a deep neural network in combination with facial action unit (AU) data are used. Then, a Support Vector Machine (SVM) classifier is trained and tested for the recognition of the compound facial expressions. Figure 1 illustrates the first part. The second part is about the depression detection based on the recognized compound facial expressions. Here, a combination of compound expressions is referenced for depression. This is the result of previous psychologists' findings and our expert opinions.

Figure 1

The block diagram of the feature extraction.



There are 49 classes of compound expressions and the neutral expression. Table 1 shows the compound facial expression classes.

The second part uses the grouping of the compound facial expressions and map them to depression in a binary form where depression is detected or not. SVM classifier is used for the second part.

Results

The proposed approach achieves improved accuracies on compound facial expressions until 27% of overall multiclass classification accuracy. For depression detection, the system achieves up to 90% of accuracy.

Contribution

The study contributes to the field by using compound facial expression analysis with the base of deep learning and action units to relate and detect the depression on frontal faces.

Table 1*Human facial expressions in the iCV-MEFED dataset (Guo et al., 2018).*

	<i>Angry</i>	<i>contempt</i>	<i>Disgust</i>	<i>Fear</i>	<i>Happy</i>	<i>Sadness</i>	<i>Surprise</i>
<i>Angry</i>	Angry	Contempt angry	Disgust angry	Fear angry	Happy angry	Sadness angry	surprise angry
<i>Contempt</i>	Angry contempt	Contempt	Disgust contempt	Fear contempt	Happy contempt	Sadness contempt	Surprise contempt
<i>Disgust</i>	Angry disgust	Contempt disgust	Disgust	Fear disgust	Happy disgust	Sadness disgust	Surprise disgust
<i>Fear</i>	Angry fear	Contempt fear	Disgust fear	Fear	Happy fear	Sadness fear	Surprise fear
<i>Happy</i>	Angry fear	Contempt happy	Disgust happy	Fear happy	Happy	Sadness happy	Surprise happy
<i>Sadness</i>	Angry sadness	Contempt sadness	Disgust sadness	Fear sadness	Happy sadness	Sadness	Surprise sadness
<i>Surprise</i>	Angry surprise	Contempt surprise	Disgust surprise	Fear surprise	Happy surprise	Sadness surprise	Surprise

Conclusion

The study proposes a novel approach about detecting the depression on frontal face images automatically through machine learning. The one of the most diverse expression dataset is used including 50 classes of expressions to detect the depression. The method extracts the facial features by using both texture and action units. Then the depression is detected accordingly. Overall, the system achieves encouraging results and ready for further improvements.

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