Literature Review

Project Title:	Deep Learning Based Emotion Recognition Implementation and Study
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In the context of the success of deep learning, a branch of machine learning, facial expression analysis has also made great progress. Melinte, D. and Vladareanu, L present in one issue two different FR models, one known to be very accurate but with low inference speed (faster area-based convolutional neural networks) and the other less accurate but with higher inference speed (single lens detector convolutional neural networks). For emotion recognition, migration learning and fine-tuning of three CNN models (VGG, Inception V3, and ResNet) were used [1]. For extraction of face representation two different popular models of Deep learning based called Lightened CNN and VGG-Face and have reflected in < ICCCE 2019> [2], Kumar, A. and Mozar, S used of convolutional long- and short-term memory networks to predict surface air temperature is a good example of the role of deep learning in artificial intelligence techniques.This was a great source of inspiration for my project.

AMiner's thirteenth facial recognition study identifies three classical algorithms for face recognition: Eigenface, Local Binary Patterns and Fisherface [3]. We will understand and use these three algorithms in our project.

In Li Xuan's PhD thesis he details the fundamentals of deep learning[4], the advantages of deep networks, and the training process and results of deep networks. In his research, he shows the use of models trained with deep learning for face recognition with a 99.7% recognition rate, where the methods used may be applicable to my project.

Peng Xiaojiang and Qiao Yu declare that the tag of facial expressions recognition may be affected by fuzzy expression, Low quality images and The subjective influence of the annotator[5], so in our work we have to suppress these factors will allow deep learning to study real facial expression features.

Lee Shan and Deng Weihong separate emotion recognition type based on deep learning to static emotion recognition and dynamic emotion recognition, they explained what is different between the two types of emotion recognition. In static emotion recognition, the output is a single image, it only includes spatial information, In dynamic emotion recognition, the output is video sequence, it includes spatial information and time information [6]. We have to consider what type of emotion recognition we are using, and how to process static emotion recognition or dynamic emotion recognition.

Deep learning has made some achievements in the field of expression recognition after several years of development, and we have reviewed the literature to understand some of the main algorithms used today for optimization, for example, Yu [7] constructs a 9-layer CNNs structure and uses a softmax classifier in the last connecting layer to classify expressions into 7 classes, and the model achieves a recognition rate of 61.29% on the SFEW2.0 dataset. Lopes [8] added a preprocessing process before the CNN network to explore the impact of preprocessing on accuracy, and the final recognition rate reached 97.81% on the CK+ dataset with a shorter training time. wang [9] used softmax to train the CNN model, used triple loss function to tune the parameters, and applied data augmentation to increase the recognition rate by 2%, and the model improved the recognition rate for Zhao [10] fused MLP and DBN, linking the advantages of unsupervised feature learning of DBN with the classification advantages of MLP to improve the performance. he [11] combined deep learning with traditional machine learning, firstly using LBP/VAR to extract initial features, and using the initial features as the input of DBN to achieve classification. Li [12]

fused CS-LBP with DBN in order to solve the problem of DBN ignoring local features of images.

Face recognition methods can be divided into two categories: Appearance Based Method and Feature Based Method. In a paper of 2020, Gupta, Thakur, and Kumar **[13]** proposed a feature-based two-dimensional face image method, which used Accelerated Robust Feature (SURF) and Scale-Invariant Feature Transform (SIFT) algorithm to extract features.In the experiment, they used a total of 5 common data sets and tested various combinations of SIFT and SURF features with two classification techniques, decision tree and random forest. The highest recognition rate reached an astonishing 99.7%.

Syavira**[14]** uses modified local ternary with convolutional neural networks for facial expression recognition images which have illumination variation and noises problems, images are augmented using a geometric augmentation technique to prevent overfitting due to lack of training data. The paper supports image processing of our work.

Wang, Tan, Xin**[15]** using the Viola-Jones algorithm to detect the original data set, after screening, the face expression database is finally established. The convolution neural network model is applied to face expression recognition of the database. They think the method is able to effectively recognize facial expression. This paper provides an idea to detect and screen our dataset.

To conclude, Deep learning has been developed so far, various models and their variants have been proposed, and the basic model can no longer meet the performance requirements. Combined with a large amount of literature data, the future development direction of facial expression recognition is mainly reflected in improving the network depth, hybrid models, combining with traditional machine learning, migration learning, unsupervised learning, etc., while the development of mobile terminals has also started to receive attention. We can learn from those excellent methods to optimize our algorithms to make our face recognition more accurate and more efficient. There are at least 21 types of human facial expressions, and besides the common 6 types of happy, surprised, sad, angry, disgusted and fearful, there are also 15 distinguishable compound expressions such as surprise (happy + surprised) and sadness (sad + angry).We aim to make our program recognize the most basic 6 common expressions and also some compound expressions, such as surprise (happy + surprised) and sadness (sad + angry), which will be a difficult and complicated process, but we will try to achieve it!

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