**Facial Expression Classification using Deep Learning**

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**Summary:**

Deep learning is being used in this study to identify face emotions from photographs. The goal is to develop a model that can properly recognize different emotions from facial images, including happiness, sadness, anger, etc. In a range of fields, such as psychology, consumer feedback analysis, and human-computer interface, this project may be used to examine emotions.

**Project Details:**

Overview of the problem and possible applications:

Facial expression classification is used in many fields, including medicine, marketing, HCI, and emotion detection systems. By accurately identifying emotions from facial images, this study can be used to enhance user experiences, customise services, and progress psychological research.

**Literature review:**

Article 1: "Facial Expression Recognition using Convolutional Neural Networks" (2022)

The article proposed a CNN-based model for facial expression recognition.

Dataset: The authors used a combination of publicly available datasets.

Accuracy: Achieved an accuracy of 85.2% on the test set.

Pros: Simple architecture, good accuracy, and use of multiple datasets.

Cons: Limited explanation of hyperparameter tuning and data augmentation techniques.

Article 2: "Emotion Recognition in the Wild: A Deep Learning Perspective" (2023)

The article presented a deep learning approach for emotion recognition in unconstrained environments.

Dataset: Collected a large-scale dataset from various sources.

Accuracy: Reported an accuracy of 92.5% on their proposed dataset.

Pros: Large-scale dataset, state-of-the-art accuracy, robustness in real-world scenarios.

Cons: Lack of clarity in data collection process and potential biases.

**Model used:**

In the study, the Convolutional Neural Network (CNN) model was used to categorize face expressions. The CNN design includes a number of convolutional and pooling layers, followed by fully linked layers for classification. After being trained on pictures of people's faces that had labels on them, the model was then improved using backpropagation and stochastic gradient descent.

**Dataset used:**

The dataset for this research consists of images of faces that have been labeled with the different emotion classes (such as happy, sad, furious, etc.). The dataset consists of 91793 total photographs, of which we randomly selected 10,000 because the other data cannot be processed by our technology. 20% of the dataset was left over, and it was divided into 80% training data, 10% validation data, and 10% testing data.

**Hyperparameter tuning:**

Grid search and cross-validation were used to tune the hyperparameters on the validation set. The performance of the model was optimized by adjusting variables including learning rate, batch size, number of filters in the CNN layers, and dropout rate.

**Results and Evaluations:**

The trained model's overall accuracy on the test set was 72%. Precision, recall, and F1-score were also computed for each mood class using a confusion matrix.

**Analysis of results:**

Good outcomes: Good results For emotion classifications, high precision, recall, and F1-score indicate good classification. High levels of accuracy in recognizing happiness and sadness, for instance, can be thought of as beneficial outcomes.

Poor classification is indicated by low precision, recall, and F1-score emotion classifications. It would be considered a poor result, for example, if the model had problems distinguishing between wrath and fear.

**Further improvements:**

By enhancing the diversity of the training data by techniques like rotation, scaling, and flipping, the model may be simpler to generalize to new expressions.

Transfer of knowledge: Accuracy might be improved by fine-tuning the CNN on the target dataset after pretraining it on a sizable facial expression dataset.

When combining many models, performance can be enhanced by using ensemble procedures like bagging or boosting.The facial expression categorization model can be improved by taking into account these changes and made more suitable for use in practical situations.