وزارة الاتصالات
وتكنولوجيا المعلومات

رواد مصر الرقمية

Facial Expression Recognition (FER)

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ATS

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Introduction

Facial Emotion Recognition (FER) is a critical area in computer vision that focuses on identifying human emotions from facial expressions. This report details the development and evaluation of a FER model using a Convolutional Neural Network (**CNN**) based on the **VGG16** architecture, by using **FER 2013** dataset.

2. Dataset

2.1 FER 2013 Dataset

The FER 2013 dataset consists of 35,887 grayscale images of faces, each measuring 48x48 pixels. The dataset is categorized into seven emotion classes:

- Angry
- Disgust
- Sad
- Surprise
- Fear
- Happy
- Neutral

2.2 Preprocessing

- **Using image_data_generator**
- **Reshaping**: Images were reshaped to fit the VGG16 input layer size of 224x224 pixels.
- **Dropout:** drop data with insufficient number of sets

3. Model Architecture

3.1 VGG16 Overview

VGG16 is a deep convolutional neural network known for its simplicity and effectiveness. It consists of:

- 13 convolutional layers
- 5 max-pooling layers
- 3 fully connected layers

3.1.1 Model Configuration

- **Input Layer**: 224x224x3 (RGB , grayscale images converted to RGB).
- **Convolutional Layers**: Used ReLU activation function.
- **Pooling Layers**5 layers
- **Fully Connected Layers**: Final output layer with softmax activation for multi-class classification with 6 output class

3.2 CNN overview

3.2.1 Model Configuration

- **Input Layer (**48x48 grayscale images).
- **Convolutional Layers**: Used ReLU activation function.
- **Pooling Layers**: 5 layers
- **Fully Connected Layers**: Final output layer with softmax activation for multi-class classification with 6 output class

4. Implementation

4.1 Environment Setup

- **Programming Language**: Python
- **Framework**: TensorFlow/Keras
- **Libraries**: NumPy, OpenCV, Matplotlib

4.2 Training

- **Train/Test Split**: The dataset was split into 80% training and 20% testing.
- **Batch Size**: 32
- **Epochs**: 100 with early stopping and monitor on accuracy value
- **Optimizer**: Adam optimizer.
- **Loss Function**: Categorical Crossentropy.

4.3 Evaluation Metrics

- **Accuracy**: Percentage of correctly predicted instances.
- **Confusion Matrix**: To visualize the performance across different emotion classes.
- **F1 Score**: To evaluate the balance between precision and recall.

5. Results

5.1 Training Performance

	VGG16	CNN
Training Accuracy	91%	57.46%
Validation Accuracy		58.69%

5.2 Testing Performance

	VGG16	CNN
Testing Accuracy	40%	57%

- **Test Accuracy**: The model achieved 78% accuracy on the test set.
- **Confusion Matrix**: Analyzed to identify misclassifications among emotions.

5.3 F1 Score

	Angery	Happy	Sad	Neutral	Surprise	Disgust	Fear
F1 score	0.55	0.79	0.45	0.55	0.76	-	0.27

6.Discussion

- **Strengths**:The model effectively captures features for emotion classification
- **Weaknesses**: The model struggled with certain classes due to class imbalance and the lack of data of some expressions
- **Improvements**:
  - Use of transfer learning from pre-trained weights.
  - Advanced augmentation techniques.
  - Dropout classes with lack of images

7. Conclusion

The implementation of a CNN model based on VGG16 for FER using the FER 2013 dataset demonstrated promising results. While the model shows strong performance, there remains room for improvement, particularly in handling class imbalances and refining feature extraction techniques.