I. Facial Emotion Detection Using Deep Learning

Prepared By (Group 8) - Ankit Kumar (2230146)
Arya Vats (2230155)
Divya Gautam (2230169)
Himanshu Singh (2230172)

A. Abstract

Facial emotion detection is a key application in human-computer interaction, psychology, and surveillance. This paper presents a robust system for detecting emotions using deep learning techniques. The proposed system leverages convolutional neural networks (CNNs) to classify facial expressions into predefined categories, achieving significant accuracy on standard datasets.

B. 1. Introduction

Understanding human emotions is crucial for interactive systems. Facial emotion detection plays a pivotal role in applications ranging from security to healthcare. Traditional approaches relied on handcrafted features, but advancements in deep learning have introduced more accurate and scalable solutions.
This paper focuses on the implementation of a CNN-based model trained on the FER-2013 dataset to classify emotions into seven categories: Angry, Disgust, Fear, Happy, Sad, Surprise, and Neutral.

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Presentation video link

1) 1.1 Problem Statement

Automating emotion recognition is challenging due to diverse facial expressions, variations in lighting, and occlusions. The aim is to develop a system that addresses these challenges using deep learning techniques.

C. 2. Related Work

- **Traditional Approaches:** Feature-based methods (e.g., Haar cascades, HOG) were earlier used but lackedrobustness.
- **Deep Learning:** CNNs and transfer learning have revolutionized facial emotion detection. Models such as VGGNet, ResNet, and MobileNet have been successfully employed in recent works.

D. 3. Methodology

1) 3.1 Data Preprocessing

- **Dataset:** FER-2013 was used, consisting of 35,887 grayscale images of size 48x48 pixels.
- **Preprocessing:** Normalization, resizing, and data augmentation techniques such as rotation and flipping were applied to enhance model generalization.

2) 3.2 Model Architecture

- **CNN Layers:** The architecture includes convolutional layers with ReLU activation, max-pooling layers, and fully connected layers.
- **Optimization:** Adam optimizer was used with a learning rate of 0.001.
- **Loss Function:** Categorical cross-entropy.

3) 3.3 Training and Validation

- **Split:** The dataset was split into 80% training and 20% validation sets.
- **Frameworks:** TensorFlow and Keras were employed for implementation.

E. 4. Results and Discussion

1) 4.1 Evaluation Metrics

- Accuracy
- Precision, Recall, and F1-score
- Confusion Matrix

2) 4.2 Experimental Results

The proposed model achieved an accuracy of 72% on the FER-2013 test set. The confusion matrix highlights confusion among similar emotions like Fear and Surprise.

3) 4.3 Comparative Analysis

Our approach outperforms traditional machine learning methods and performs on par with state-of-the-art CNN models.

F. 5. Conclusion

The proposed CNN-based facial emotion detection system effectively classifies emotions with high accuracy. Future work includes incorporating attention mechanisms and deploying the model in real-time applications.

G. References

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