Facial Emotion Recognition Using Deep Learning

Project Title:

Facial Emotion Recognition Using CNN with Adam, RMSprop, and SGD Optimizers

Problem Statement:

Facial expressions are one of the most powerful and natural ways for humans to express emotions. The objective of this project is to develop a deep learning-based system that can classify facial expressions into distinct emotion categories such as Happy, Sad, Angry, Neutral, Surprised, Disgust, and Fear. This helps enable better human-computer interaction and has applications in mental health, customer feedback analysis, gaming, and surveillance.

Objective:

To design and implement a deep learning-based facial emotion classification system using three different CNN models, each trained with a different optimizer (Adam, RMSprop, and SGD). Evaluate and compare their performance on the FER2013 dataset.

Dataset Used:

- Name: FER2013 - Facial Expression Recognition 2013
- Source: Kaggle
- Description: The dataset contains 48x48 pixel grayscale images of human faces labeled with one of the 7 emotion categories.

Emotions Classes:

1. Angry
2. Disgust
3. Fear
4. Happy
5. Sad
6. Surprise
7. Neutral

Techniques Used:

- Image Classification using CNN
- Three models with different optimizers:
  - Model 1: CNN with Adam
  - Model 2: CNN with RMSprop
  - Model 3: CNN with SGD
- Evaluation Metrics: Accuracy, Loss
- Visualization:
  - 9 image predictions per model
  - Accuracy comparison histogram

Libraries Used:

- TensorFlow / Keras
- NumPy
- Matplotlib
- KaggleHub (for downloading dataset)

Model Comparison:

```
Model         | Optimizer | Accuracy
------------------|-----------|----------
Model 1       | Adam      | 48.41%
Model 2       | RMSprop   | 48.68%
Model 3       | SGD       | 43.34%
```

🖼️ Output Samples:

- Display 9 random predictions from each model (Actual vs Predicted)
- Accuracy histogram for all three models

Dataset Access:

You can access the dataset directly using kagglehub in the notebook:

```
import kagglehub
path = kagglehub.dataset_download("deadskull7/fer2013")
```

Submission Includes:

1. ✅ Jupyter Notebook File with model building, training, testing, and visualizations.
2. ✅ README.docx (this file)
3. ✅ Video Explanation (4-5 minutes demo of the project and code walkthrough)

Video Overview:

- Introduction to facial emotion recognition
- Explanation of dataset and preprocessing
- Description of 3 CNN models with different optimizers
- Training and performance comparison
- Visual outputs (predictions and accuracy histogram)

Future Improvements:

- Use Transfer Learning (e.g., MobileNet, ResNet)
- Real-time emotion detection via webcam
- Deploy as a web or mobile app