**Reproducibility Guide: Dual-Ensemble Deep Learning for Emotion Recognition**

**Introduction**

Facial expressions play a crucial role in conveying emotions and personality traits. This research presents a dual-ensemble deep learning approach for recognizing both common and complex blended emotions from facial images. Unlike existing unimodal frameworks that focus solely on six basic emotions, our model integrates two ensemble layers to improve recognition accuracy. The first ensemble classifies primary emotions, while the second specializes in detecting complex emotional blends.

**Key Features:**

* Utilizes **DenseNet169, VGG16, and ResNet50** in the first ensemble for primary emotion classification.
* Employs **Xception and Vision Transformer (ViT)** in the second ensemble for recognizing blended emotions.
* Integrates a **Squeeze-and-Excitation (SE) block** to enhance feature selection.
* Trained and evaluated using **FER2013** and **IMED** datasets.
* Achieves **95% accuracy** for common emotions and **88% accuracy** for blended emotions.

**Implementation Steps**

**1. Prerequisites**

Ensure you have the following dependencies installed:

pip install tensorflow keras numpy pandas matplotlib scikit-learn opencv-python

**2. Dataset Preparation**

Download and extract the **FER2013** and **IMED** datasets:

* FER2013: <https://www.kaggle.com/datasets/msambare/fer2013>
* IMED: [Dataset availability to be linked if public]

Organize the dataset in the following format:

/dataset/

├── train/

│ ├── angry/

│ ├── happy/

│ ├── sad/

│ ├── ...

├── test/

│ ├── angry/

│ ├── happy/

│ ├── sad/

│ ├── ...

**3. Model Training**

Run the training script:

python train\_dual\_ensemble.py --dataset /path\_to\_dataset/ --epochs 50 --batch\_size 32

This script will:

* Train **DenseNet169, VGG16, and ResNet50** for primary emotion classification.
* Train **Xception and Vision Transformer (ViT)** for blended emotion classification.
* Apply a **Squeeze-and-Excitation (SE) block** to refine features.

**4. Model Evaluation**

To evaluate the trained model:

python evaluate\_model.py --model\_path saved\_models/ensemble\_model.h5 --dataset /path\_to\_test\_dataset/

This script calculates accuracy, precision, recall, and confusion matrices for both primary and blended emotion classifications.

**5. Inference (Real-Time Emotion Recognition)**

For real-time emotion detection using a webcam:

python real\_time\_emotion.py --model saved\_models/ensemble\_model.h5

This script captures facial expressions in real-time and predicts emotions using the trained model.

**Results and Performance**

* **Primary Emotion Recognition Accuracy:** 95%
* **Blended Emotion Recognition Accuracy:** 88%
* **Enhanced Feature Extraction** using SE blocks improves classification performance.
* **Robust Ensemble Learning** provides better generalization on unseen data.