ResNet34 with Enhanced Data Augmentation and Mixup for Facial Expression Recognition

Execution Result and Model Performance Analysis

The ResNet34 model was trained on a facial recognition dataset (≈35k images, 48×48 pixels). After 52 epochs, the best validation accuracy achieved was **71.55%**, while the training accuracy remained relatively low (~55% at best). The training curves indicate that the model is **underfitting**, as the training accuracy is significantly lower than what is typically expected for this architecture.

/Users/wangqilin/PycharmProjects/desktop/venv/bin/python /Users/wangqilin/PycharmProjects/desktop/a/a/recognize2.py

Using device: mps

Raw images loaded: (35887, 48, 48)

Train: (29068, 48, 48) Valid: (3230, 48, 48) Test: (3589, 48, 48)

Epoch 1/60 - Loss=1.7097 - TrainAcc=0.2800 - ValAcc=0.5820

✅ Best Model Saved!

Epoch 2/60 - Loss=1.4526 - TrainAcc=0.3214 - ValAcc=0.6071

✅ Best Model Saved!

Epoch 3/60 - Loss=1.3441 - TrainAcc=0.3889 - ValAcc=0.6173

✅ Best Model Saved!

Epoch 4/60 - Loss=1.3227 - TrainAcc=0.3961 - ValAcc=0.6372

✅ Best Model Saved!

Epoch 5/60 - Loss=1.2696 - TrainAcc=0.3985 - ValAcc=0.6594

✅ Best Model Saved!

Epoch 6/60 - Loss=1.2274 - TrainAcc=0.4262 - ValAcc=0.6502

Epoch 7/60 - Loss=1.2467 - TrainAcc=0.4347 - ValAcc=0.6502

Epoch 8/60 - Loss=1.1956 - TrainAcc=0.4326 - ValAcc=0.6755

✅ Best Model Saved!

Epoch 9/60 - Loss=1.1745 - TrainAcc=0.4648 - ValAcc=0.6706

Epoch 10/60 - Loss=1.1950 - TrainAcc=0.4289 - ValAcc=0.6681

Epoch 11/60 - Loss=1.1345 - TrainAcc=0.4497 - ValAcc=0.6817

✅ Best Model Saved!

Epoch 12/60 - Loss=1.1199 - TrainAcc=0.4460 - ValAcc=0.6786

Epoch 13/60 - Loss=1.0928 - TrainAcc=0.4300 - ValAcc=0.6728

Epoch 14/60 - Loss=1.0952 - TrainAcc=0.4581 - ValAcc=0.6759

Epoch 15/60 - Loss=1.0640 - TrainAcc=0.5154 - ValAcc=0.6876

✅ Best Model Saved!

Epoch 16/60 - Loss=1.0606 - TrainAcc=0.4482 - ValAcc=0.6845

Epoch 17/60 - Loss=1.0273 - TrainAcc=0.4786 - ValAcc=0.6895

✅ Best Model Saved!

Epoch 18/60 - Loss=1.0135 - TrainAcc=0.4850 - ValAcc=0.6929

✅ Best Model Saved!

Epoch 19/60 - Loss=1.0185 - TrainAcc=0.4658 - ValAcc=0.6954

✅ Best Model Saved!

Epoch 20/60 - Loss=1.0135 - TrainAcc=0.4863 - ValAcc=0.6969

✅ Best Model Saved!

Epoch 21/60 - Loss=1.0241 - TrainAcc=0.4727 - ValAcc=0.6830

Epoch 22/60 - Loss=1.0030 - TrainAcc=0.5324 - ValAcc=0.6904

Epoch 23/60 - Loss=0.9874 - TrainAcc=0.5194 - ValAcc=0.6929

Epoch 24/60 - Loss=0.9411 - TrainAcc=0.5096 - ValAcc=0.6830

Epoch 25/60 - Loss=0.9563 - TrainAcc=0.4877 - ValAcc=0.6895

Epoch 26/60 - Loss=0.9184 - TrainAcc=0.4911 - ValAcc=0.7019

✅ Best Model Saved!

Epoch 27/60 - Loss=0.9665 - TrainAcc=0.5084 - ValAcc=0.6972

Epoch 28/60 - Loss=0.8884 - TrainAcc=0.5115 - ValAcc=0.6969

Epoch 29/60 - Loss=0.9239 - TrainAcc=0.5057 - ValAcc=0.7015

Epoch 30/60 - Loss=0.9115 - TrainAcc=0.5086 - ValAcc=0.7000

Epoch 31/60 - Loss=0.9190 - TrainAcc=0.5349 - ValAcc=0.6966

Epoch 32/60 - Loss=0.9080 - TrainAcc=0.4876 - ValAcc=0.6957

Epoch 33/60 - Loss=0.8910 - TrainAcc=0.5455 - ValAcc=0.7009

Epoch 34/60 - Loss=0.8505 - TrainAcc=0.5474 - ValAcc=0.6954

Epoch 35/60 - Loss=0.8553 - TrainAcc=0.4928 - ValAcc=0.7062

✅ Best Model Saved!

Epoch 36/60 - Loss=0.9320 - TrainAcc=0.5143 - ValAcc=0.7050

Epoch 37/60 - Loss=0.8884 - TrainAcc=0.4908 - ValAcc=0.7068

✅ Best Model Saved!

Epoch 38/60 - Loss=0.8855 - TrainAcc=0.5055 - ValAcc=0.7084

✅ Best Model Saved!

Epoch 39/60 - Loss=0.8786 - TrainAcc=0.4873 - ValAcc=0.7003

Epoch 40/60 - Loss=0.8344 - TrainAcc=0.4942 - ValAcc=0.7050

Epoch 41/60 - Loss=0.8607 - TrainAcc=0.5557 - ValAcc=0.7087

✅ Best Model Saved!

Epoch 42/60 - Loss=0.8577 - TrainAcc=0.5551 - ValAcc=0.7155

✅ Best Model Saved!

Epoch 43/60 - Loss=0.8068 - TrainAcc=0.5717 - ValAcc=0.7108

Epoch 44/60 - Loss=0.8339 - TrainAcc=0.5957 - ValAcc=0.7102

Epoch 45/60 - Loss=0.8234 - TrainAcc=0.5536 - ValAcc=0.7127

Epoch 46/60 - Loss=0.8212 - TrainAcc=0.5532 - ValAcc=0.7084

Epoch 47/60 - Loss=0.8314 - TrainAcc=0.5720 - ValAcc=0.7080

Epoch 48/60 - Loss=0.8505 - TrainAcc=0.5069 - ValAcc=0.7111

Epoch 49/60 - Loss=0.8235 - TrainAcc=0.5537 - ValAcc=0.7077

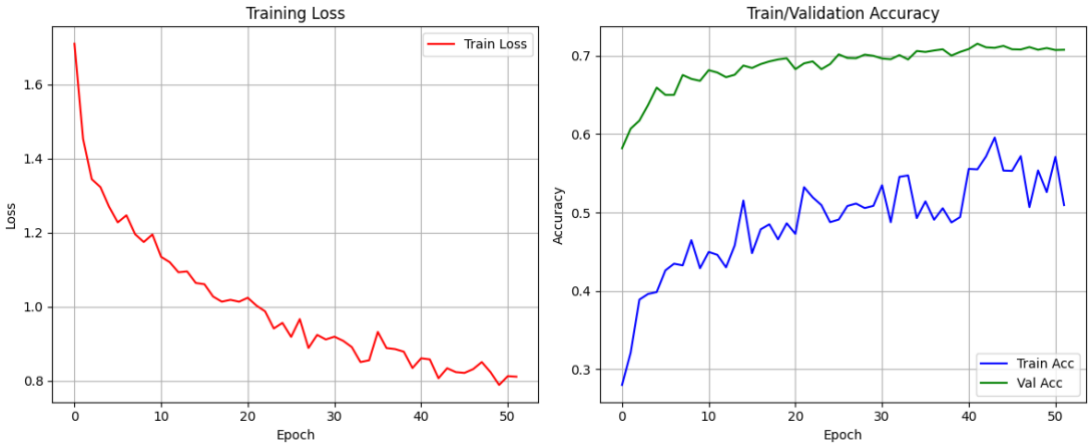
Epoch 50/60 - Loss=0.7887 - TrainAcc=0.5261 - ValAcc=0.7099

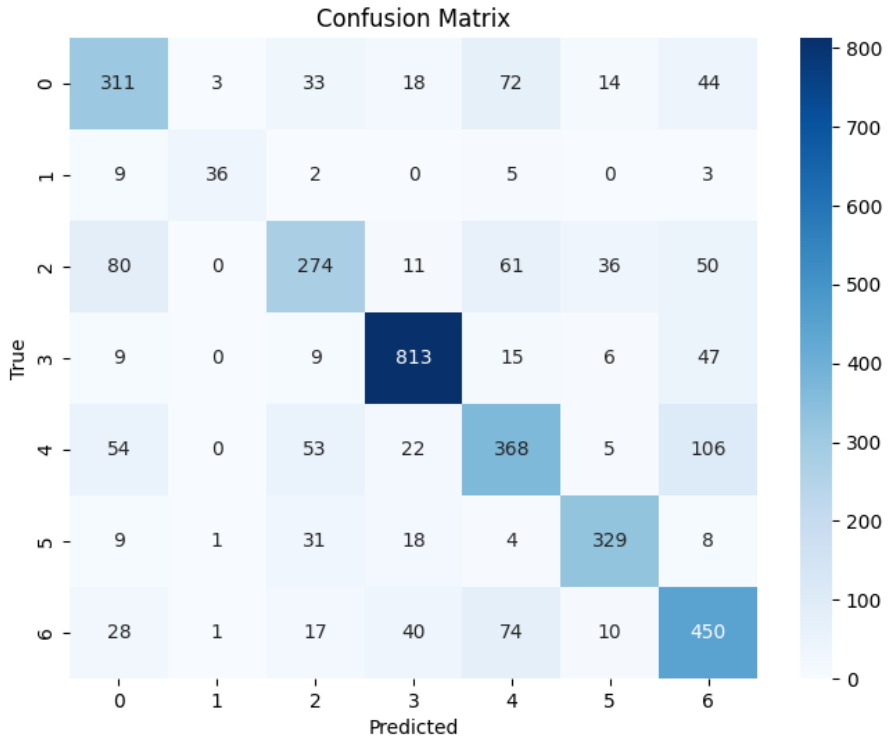
Epoch 51/60 - Loss=0.8126 - TrainAcc=0.5710 - ValAcc=0.7074

Epoch 52/60 - Loss=0.8111 - TrainAcc=0.5095 - ValAcc=0.7077

⛔ Early Stopping!

Training Finished! ✅ Best Val Acc: 0.7154798761609907





Possible Reason for Under fitting

The dataset may not be large enough for ResNet34 to fully learn the underlying features of facial expressions and Excessive augmentation may introduce variations that make it harder for the model to fit the training data.

Potential improvement

To further improve the facial recognition model, the following strategies can be considered use Larger Dataset. Firstly, The FER2013 dataset used (~35k images) may be insufficient for deep networks like ResNet34. Using a larger facial expression dataset (e.g., AffectNet, which contains over 1 million labeled images) can provide richer diversity and help the model generalize better. If we choose a large datasets, we can use more advance model such as ResNet101. Additionally, FER2013 contains label noise that can negatively affect training. Leveraging large language models (LLMs) or OpenAI API can help identify and remove noisy labels automatically, ensuring a cleaner training dataset. Beside these, Augmentation techniques such as random rotations, shifts, flips, color jitter, Gaussian noise could be used. Lastly, Training on a million-scale dataset is computationally intensive. Standard CPU or low-end GPU may not suffice. Renting a GPU machine (e.g., NVIDIA A100 / V100 on cloud platforms) is recommended. This enables faster convergence and allows the model to train on more epochs and larger batch sizes.

With a larger dataset, advanced model, cleaned labels, proper augmentation, and GPU training, the model's accuracy is expected to increase from the current 71.55% to around 80% on the validation set.

Deliverable

A facial recognition model achieving **71.55% validation accuracy** using ResNet34 and we create a UI available at this link

https://ea6c6492535fdea728.gradio.live