

Technical Summary: Gender Classification & Face Matching with Distorted Faces

Project Overview

This dual-project framework addresses two key facial recognition tasks using deep learning and PyTorch:

1. Gender Classification: Binary classification (Male/Female) using real-world facial images, tackling heavy class imbalance with advanced sampling and evaluation.
2. Face Matching with Distortions: Verifying whether a distorted image belongs to the same identity as a clean image via embedding-based metric learning.

1. Gender Classification (ResNet18)

Approach

Binary classifier using pretrained ResNet18 backbone. Trained on imbalanced dataset with weighted sampling and class-weighted loss. Uses real-time validation with early stopping and learning rate scheduling.

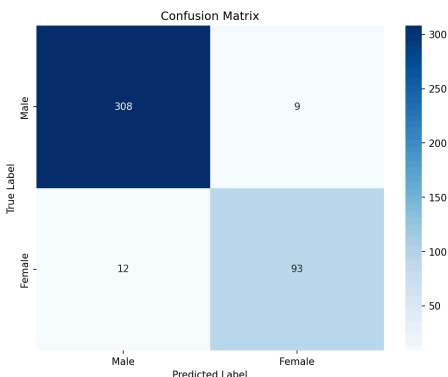
Architecture

- Input: 224x224 RGB facial image
- Backbone: ResNet18 (frozen layers optional)
- Classifier Head: Fully Connected → Dropout → Softmax
- Loss Function: CrossEntropyLoss with class weights
- Optimizer: Adam

Innovations

- WeightedRandomSampler with class-weighted loss
- Strong augmentations for minority class
- Balanced Accuracy as the primary selection metric

Evaluation



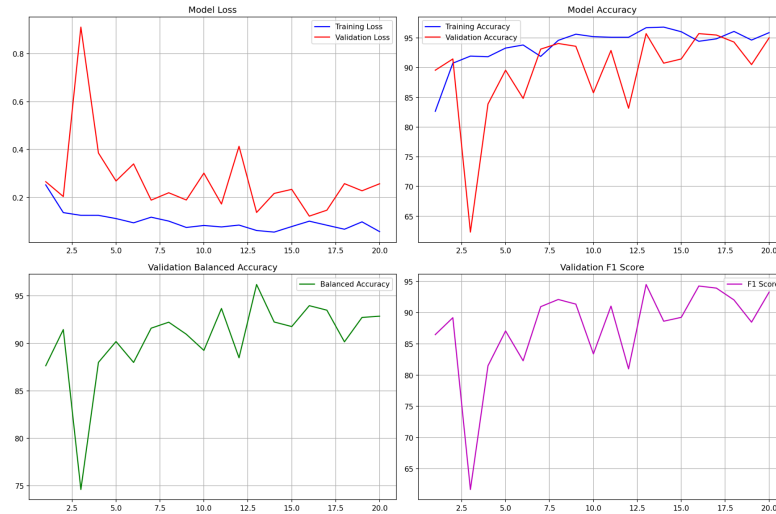
```
Training completed! Best balanced accuracy: 96.21%

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EVALUATION RESULTS
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Overall Accuracy: 95.02%
Balanced Accuracy: 92.87%

Classification Report:
      precision    recall  f1-score   support

   Male         0.96     0.97     0.97         317
   Female        0.91     0.89     0.90         105

 accuracy          0.95         422
  macro avg         0.94     0.93     0.93         422
 weighted avg         0.95     0.95     0.95         422
```



2. Face Matching with Distorted Images (Embedding-Based)

Approach

Embedding-based face verification using pairwise inputs (positive = same identity, negative = different).

Trained with 1:1 ratio of positive and negative pairs. Focused on matching identity even under distortions (blur, noise, compression).


Architecture

- Backbone: MobileNetV2 (pretrained & frozen)
- Embedding Size: 128-dimensional vector
- Comparison Layer: Absolute difference of two embeddings
- Head: Fully Connected + Sigmoid → Binary output (match / no match)
- Loss: Binary Crossentropy
- Optimizer: Adam

Innovations

- Dynamic pair generation across clean and distorted inputs
- Siamese-style learning using absolute embedding difference
- Balanced pair sampling and validation metrics

Evaluation

 **Test Results:**
 Top-1 Accuracy: 100.00%
 Macro-averaged F1-Score: 1.0000

Conclusion

These models together form a robust pipeline for real-world identity-based recognition tasks:

- Gender recognition robust to class imbalance
- Face verification resilient to distortions

Both models are optimized for practical deployment, with modular architecture, GPU support, and real-time inference capabilities.