DefakeHop++: An Enhanced Lightweight Deepfake Detector

What is DefakeHop++?

Enhanced Detector

- Improved version of DefakeHop.

Improvements

- **Facial Landmarks:** From 3 to 11 landmarks.
- **Feature Selection:** Uses Discriminant Feature Test (DFT) for supervised selection.

DefakeHop++ System Overview

1. Pre-processing Step
2. One-Stage PixelHop
3. Spatial PCA
4. Discriminant Feature Test (DFT)
5. Classifier

DefakeHop++ System Overview

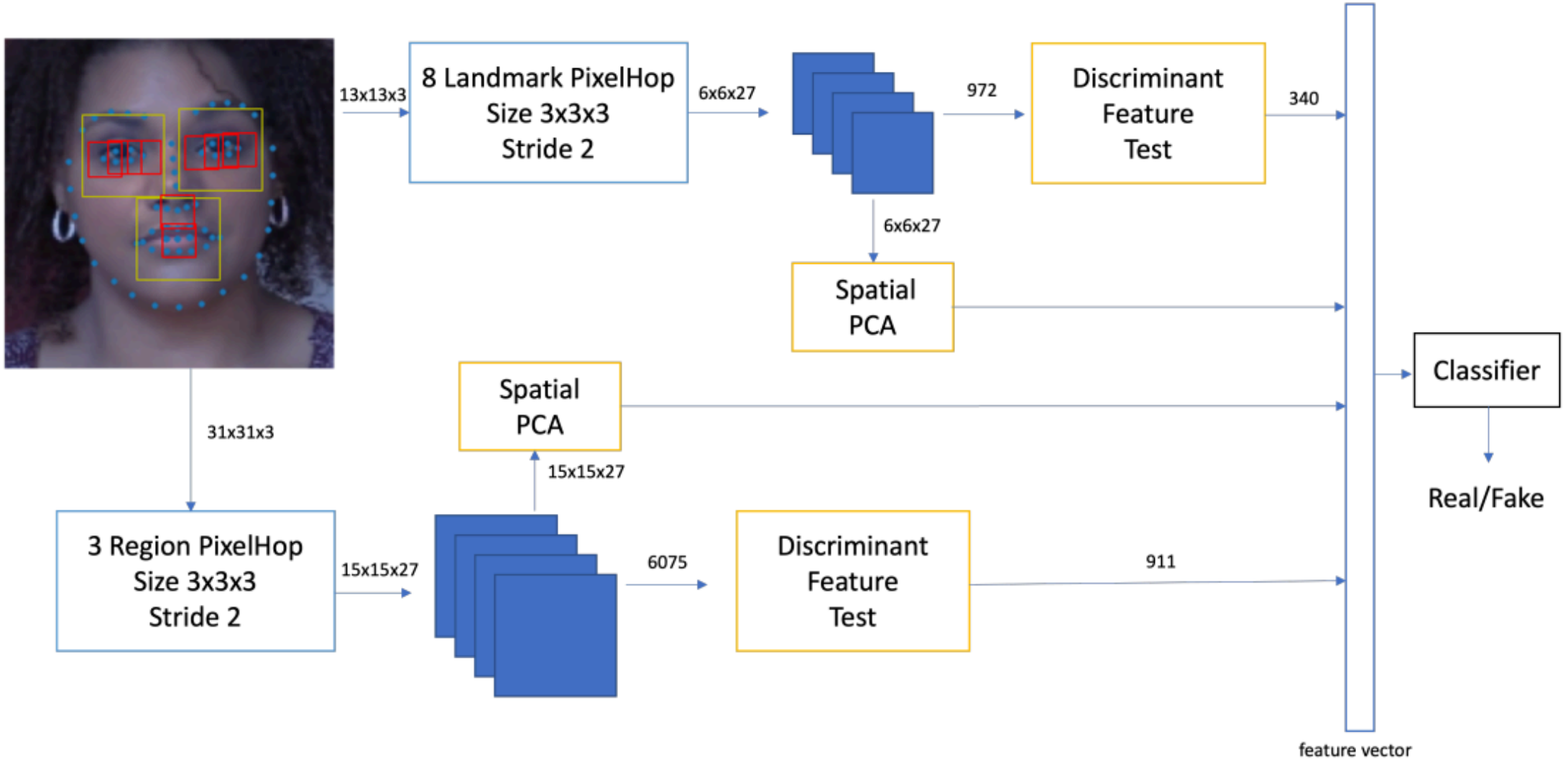


Figure 2: An overview of DefakeHop++.

Pre-processing Step

Frame Extraction

- Extract frames from video sequences (e.g., 3 frames per second).

Facial Landmark Detection

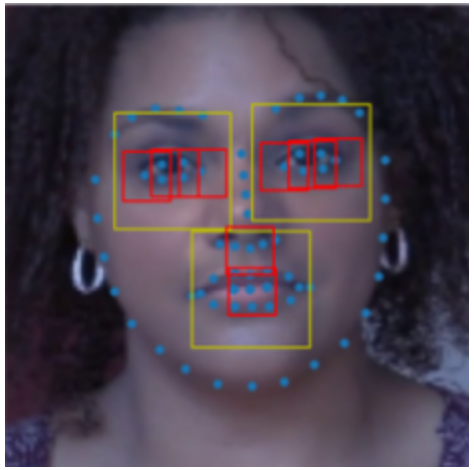
- Use OpenFace2 to detect 68 landmarks.

Block Extraction

- Crop and resize facial regions and landmarks (e.g., 128x128 pixels).

cropping

- crop sizes are hyper-parameters
- 3 big blocks (yellow) and 8 small blocks (reds)



One-Stage PixelHop

Description

- Data-dependent filter bank creation using the **Saab transform**.

Feature Extraction

- Decompose patches into DC and AC components, focusing on high-energy features.

Spatial PCA

Purpose

- Remove spatial correlations in feature components.

Method

- Apply PCA to each channel, retaining leading components up to 80% of total energy.

Discriminant Feature Test (DFT)

Supervised Selection

- Optimize feature selection using training labels by minimizing cross-entropy.

Process

- Split feature intervals at various positions, evaluate cross-entropy, select best split.

Classification

Classifier

- Use **LightGBM**, a gradient boosting framework, for final classification.

Features

- Integrate features from various facial regions and landmarks.

Experimental Results

Datasets

- Evaluation on UADFV, FaceForensics++, Celeb-DF, DFDC.

Performance Metrics

- Comparison of AUC scores, model size, training time.

Key Findings

Comparison with MobileNet v3

- Higher detection performance with significantly smaller model size (238K parameters vs. 1.5M).

Training Efficiency

- Lower training time and computational requirements, suitable for mobile deployment.

Conclusion and Future Work

Summary

- DefakeHop++: Lightweight, high-performance Deepfake detector for mobile devices.

Future Directions

- Extend to other fake image types (e.g., satellite images, spliced photos).
- Explore lightweight, weakly-supervised solutions for evolving Deepfake techniques.