IAPR

A Robust Patch-Based Hierarchical Framework for Image Forgery Detection and Classification

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Overview

Problem Statement

This project aims to develop a patch-based hierarchical approach for image forgery detection and classification. The method analyzes local image regions to determine whether an image is authentic or forged and further identifies the type of manipulation present. A deep learning model (yet to be decided) is used to perform the analysis, with results aggregated to produce a final image-level decision. The effectiveness of the approach is evaluated using standard image forgery datasets.

Motivation

- Rapid growth of misinformation, deepfake generation, and manipulated digital media.
- Increasing demand for image authenticity verification in:
  - ▶ Digital forensics
  - ▶ Journalism and fact-checking
  - ▶ Social media content moderation
- Advances in generative models have made manipulations increasingly realistic and harder to detect.
- High benchmark accuracy does not guarantee robust real-world performance.
- Need for interpretable, reliable, and generalizable forgery detection systems.

- A multi-scale patch-based hierarchical framework with explicit separation of forgery detection and forgery-type classification.
- Patch-based learning to capture local texture and noise artifacts.
- Cross-dataset evaluation to assess robustness.
- Patch-level explainability using Grad-CAM aggregated for image-level forensic interpretation.

Research Background

Research Done

- Studied traditional image forgery detection techniques, including block-based and keypoint-based methods for splicing and copy–move detection.
- Reviewed CNN-based image-level forgery detection approaches that learn global visual features.
- Analyzed patch-based deep learning methods that focus on local texture, noise, and boundary inconsistencies.
- Examined single-stage and multi-class classification models and their limitations in distinguishing forgery types.
- Studied robustness issues in existing methods, particularly poor generalization across datasets and sensitivity to post-processing.
- Reviewed explainability techniques such as Grad-CAM to understand model decision regions in forensic analysis.
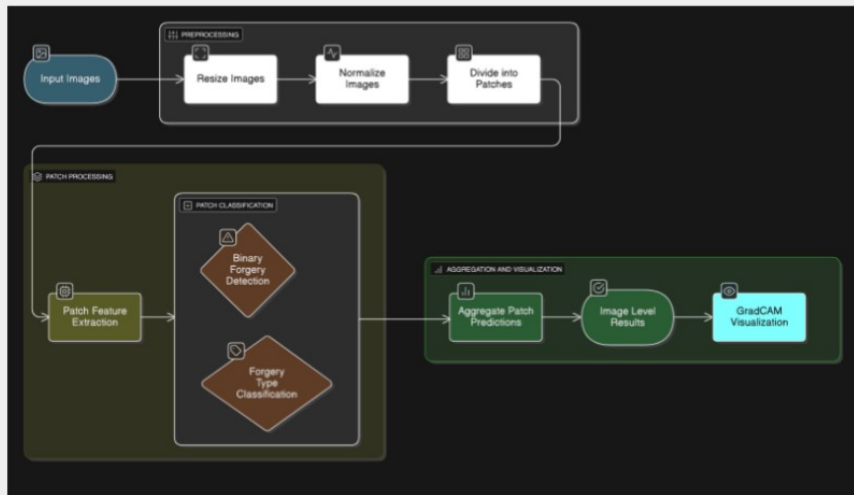
LITERATURE REVIEW

Method	Approach	Limitation
Block-based methods	Fixed block matching	Sensitive to noise and rotation
Keypoint-based methods	Feature point matching	Fail on smooth or low-texture regions
Statistical methods	Handcrafted forensic features	Limited generalization
Global CNN models	Image-level feature learning	Miss local forgery artifacts
Patch-based CNN models	Local region analysis	Requires effective aggregation

Why Patch-Based Analysis?

- Forgery artifacts are often localized and subtle.
- Patch-level learning captures texture and boundary inconsistencies.
- Enables robust detection and explainability.

SYSTEM WORKFLOW

Proposed Methodology

- Input images are resized and normalized.
- Images are divided into fixed-size non-overlapping patches.
- Patch-level feature learning using a lightweight CNN.
- Hierarchical classification strategy:
  - ▶ Binary forgery detection
  - ▶ Forgery type classification
- Patch predictions are aggregated to obtain image-level results.
- Grad-CAM is used for visual explanation.

THANK **You**!