Digital Image Processing
Final Project Proposal

1. Project Topic and Problem

Topic: The Impact of Image Pre-processing on Face Detection in Poor-Quality Images.
Problem: Face detection algorithms struggle with low-quality images that suffer from issues like noise, low contrast, or blur. This project aims to evaluate how various image pre-processing techniques (such as contrast enhancement, denoising, and deblurring) improve the accuracy and robustness of face detection algorithms.

2. Team Members

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3. What we Wish to Learn from the Project

The primary objective is to explore the impact of image pre-processing techniques on the performance of face detection algorithms. Specifically, we aim to:

- Investigate how denoising techniques like BM3D and K-SVD affect detection performance.
- Analyze the role of contrast enhancement methods (e.g., CLAHE) in improving visibility for detection.
- Evaluate how deblurring techniques (e.g., Wiener filtering, Blind deconvolution) contribute to face recovery and detection.

4. Steps We Will Implement to Achieve our Goals

The following steps will be taken to achieve the project objectives:

1. **Dataset Preparation:** Use a dataset of poor-quality images containing faces (e.g., noisy, low-contrast, or blurry images).

2. **Image Pre-processing:** Apply various pre-processing techniques:
    - Contrast Enhancement: e.g., CLAHE (Contrast Limited Adaptive Histogram Equalization).
    - Denoising: e.g., BM3D and K-SVD algorithms.
    - Deblurring: e.g., Wiener filtering and Blind deconvolution.
3. **Face Detection Algorithms:** Evaluate multiple face detection algorithms:
    - **Viola-Jones (Haar Cascade Classifier):** A traditional algorithm known for its real-time face detection capabilities using OpenCV.
    - **HOG + SVM:** Histogram of Oriented Gradients with Support Vector Machine, a feature-based approach.
    - **MTCNN:** Multi-task Cascaded Convolutional Network for face detection and facial landmark localization.
    - **YOLO/SSD:** Advanced object detection models capable of detecting multiple objects, including faces, with high speed and accuracy.
4. **Performance Evaluation:** Measure the performance using metrics like precision, recall, F1-score, and detection time for each algorithm with and without pre-processing.
5. **Analysis:** Compare the impact of various pre-processing techniques on the performance of the traditional Viola-Jones algorithm versus modern deep learning models like MTCNN and YOLO/SSD.

5. Expected Insights

This project will provide insights into:

- Which image pre-processing techniques significantly enhance face detection performance.
- Whether traditional algorithms (like Viola-Jones) benefit more from pre-processing compared to modern deep learning-based methods (like MTCNN and YOLO).
- The trade-offs between computational cost and detection performance across different algorithms.