Module 8: Portfolio Project

Option #2: Face Detection and Privacy

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**Detecting and Blurring Eyes in Human Faces for Privacy**

In an era where privacy is paramount, anonymizing personal information in images has become increasingly important. This project aimed to develop an algorithm that detects human faces in images and applies Gaussian blur to the eyes for privacy protection. Using OpenCV’s Cascade classifiers, the algorithm detects faces and eyes in images, then blurs the eyes to obscure personal details. This paper provides an overview of the techniques used, the challenges faced, and the accuracy of the results for three different test images.

The core of this project involved face and eye detection using Cascade classifiers models that can identify objects (faces and eyes) based on their features. The algorithm first converts the image into grayscale and enhances it with histogram equalization and Gaussian blurring. These preprocessing steps improve face detection by increasing contrast and reducing noise.

Once the image was preprocessed, the algorithm used the CascadeClassifier function to detect faces in the image. After detecting faces, the region of interest (ROI) around each face was extracted and the eye detection process began using a second classifier for detecting eyes within each face region. The eyes were then anonymized using Gaussian blur, which is effective for blurring specific areas in an image while maintaining the integrity of the rest.

Initially, the face detection algorithm struggled with faces that were partially obscured, angled, or at varying distances from the camera. To address this, the algorithm’s parameters (scaleFactor and minNeighbors) were fine-tuned. Preprocessing steps like histogram equalization and Gaussian blurring also enhanced the contrast and reduced noise, improving face detection accuracy.

Eye detection faced challenges in detecting eyes, especially when individuals were at different distances or in unusual poses. In some cases, eyes were missed or falsely detected. To improve accuracy, I experimented with additional classifiers, such as the haarcascade\_eye\_tree\_eyeglasses.xml, which helped detect eyes more reliably.

High-resolution images initially slowed down processing. To speed up the algorithm, I reduced the resolution of the input images while ensuring that the output still maintained an acceptable level of accuracy and privacy protection. The accuracy of face and eye detection varied across different images.

The image with a single person, has the individual facing directly at the camera. The face detection and eye detection worked very well, with all faces and eyes successfully detected and blurred. In the image containing several people, multiple people appeared at varying distances. The face detection algorithm struggled with individuals farther from the camera, but after adjusting parameters and using an additional eye classifier, the algorithm detected most of the eyes, though some in the background were missed. Nevertheless, the detected faces had their eyes blurred effectively. The face in the image with the dog was tilted. While the face detection worked decently, the tilted angle made it harder to detect the eyes accurately. Using multiple classifiers improved the results, but some of the eyes were still missed or imperfectly blurred.

This project demonstrated the application of Cascade classifiers for face and eye detection, followed by the use of Gaussian blurring to anonymize sensitive information in images. While challenges like varying face angles, distances, and complex backgrounds impacted the accuracy of the detection, the algorithm was generally successful in blurring eyes. Further refinements, including the use of deep learning models or advanced classifiers, could improve the reliability and accuracy of the process in more complex scenarios.

**References**

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