Task Driven Low-Light Image Enhancement for Dark Image Face Detection

Steven Curtis (1657041), Dr Hairong Wang
University of the Witwatersrand, Johannesburg, South Africa

WITS UNIVERSITY

Introduction

Face detection is becoming increasingly more important and is being used for multiple different applications such as security surveillance, search and rescue and many more. Face detection in images with low-light can lead to faces being detected inaccurately due to the low contrast and detail in the image. Improving the low-light illumination of an image may help face detection methods to run more accurately and therefore be more successful.

Is there an improved accuracy in face detection when the illumination of the input image is first improved?

Aim

Task-driven low-light image enhancement for face detection. This means that we are improving the low-light issue of images to improve the accuracy of detecting faces in them. This accuracy is then compared to the accuracy of the face detection in low-light images to see if there is a significant improvement.

Low-Light Image Enhancement

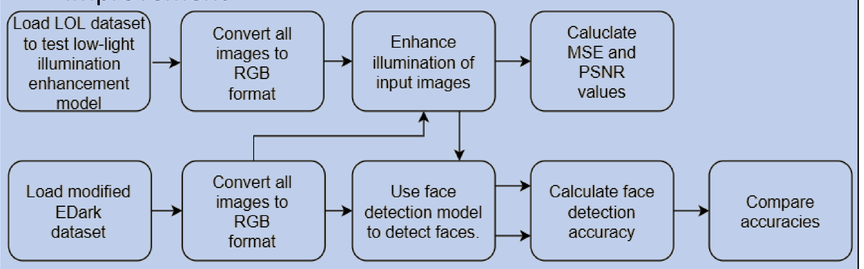
To perform the low-light image enhancement, a method based on the "Low-light Image Enhancement" (LIME) model is implemented [1]. It estimates the illumination of each pixel by looking for the maximum value in the R, G and B channels of the image. This estimation map is refined and gamma correction is performed on the map. The original image is then divided by this map to produce the enhanced image.

Face Detection

To perform the face detection, a method based on Viola-Jones is used [2]. It is a hand-crafted method that uses Haar-like features to detect faces by using rectangular features in the image. This implementation for face detection uses the integral image, AdaBoost, and the attentional cascade to detect the faces accurately.

Process

- Perform low-light enhancement on the modified ExDark dataset that contains images with faces.
- Perform face detection on these enhanced images and find the accuracy of the detection.
- Perform face detection on the modified ExDark dataset without enhancing the images and find the accuracy of the detection.
- Compare these two accuracies to see if there is an improvement

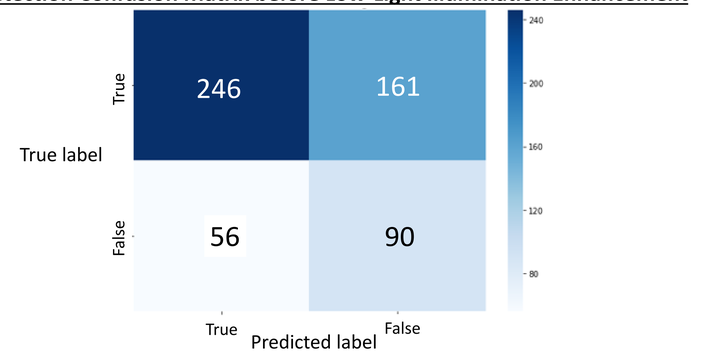


Results

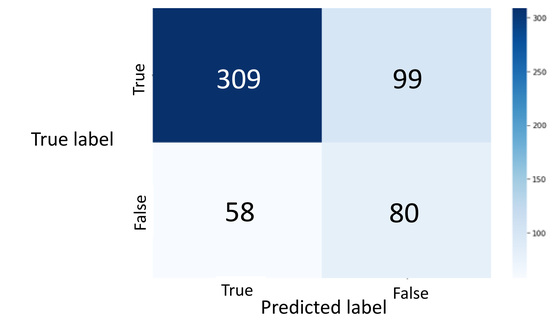
The following results were obtained from the confusion matrices after the execution of the face detection model on the two sets of images. It can clearly be seen that there is a major increase in both Accuracy and Recall after the images have had their illumination enhanced.

Face Detection	Accuracy	Precision	Recall
Before low-light enhancement	60.69%	81.46%	60.44%
After low-light enhancement	71.48%	84.19%	75.92%

Face detection Confusion Matrix before Low-Light Illumination Enhancement



Face detection Confusion Matrix after Low-Light Illumination Enhancement



Example of face detection before and after low-light illumination

References

1. X. Guo, "LIME: A method for low-light image enhancement," in Proceedings of the 24th ACM international conference on Multimedia, May. 2016, pp. 87–91,
2. P. Viola and M. Jones, "Rapid object detection using a boosted cascade of simple features," in Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition. CVPR 2001, vol. 1, Feb 2001, pp. I–I