

## Flexible Face Detection with Haar-like Features

Department of Information and Intelligent Systems (Prof. Ayumi Shinohara)  
Matthew Barga (Purdue University)

### Introduction

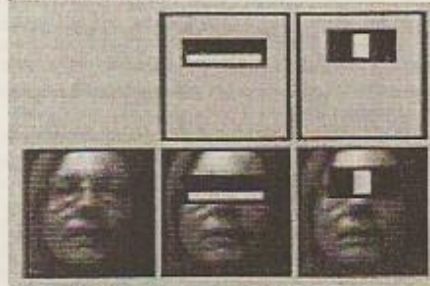
Face detection has come a long way and there are currently many algorithms and techniques in practice that can consistently and successfully detect faces from a frontal view. This success is due much in part to the use of Haar features introduced by Viola et al. [3]. However, there is still progress to be made in the creation of more flexible methods, capable not only of frontal face detection, but efficient detection from any pose or angle.

### Methods

All programming was performed using the OpenCV library in C language. The method that OpenCV uses for detection is based on the Viola-Jones method [3]. The method works based on Haar features, which are calculated by subtracting average dark-region pixel values from average light-region pixel values [2]. The calculated difference is compared with a threshold, and if the difference is large enough, the feature is present. Many of these features have been collected in a cascade. An image is passed to the cascade and each feature is checked against the image. If the image fails one of the features, a face is said to be not present. In this way, if an image passes a number of these features, a face is said to be present.

There are also methods in practice to detect faces not only from the frontal view, but from any angle or pose [4]. The successful detection rate of these methods however is much lower. In order to create a flexible algorithm capable of detecting faces from a wider range of poses, many techniques can be used. This can include inclusion of a wider range of Haar-features used to detect a profile face [4].

Fig. 1: Example of basic Haar-features used in face detection.



I have looked into the effect of adding simple methods to a basic face detection algorithm that can detect the widest range of faces, without a large affect on processing time. One of these methods is rotation of an image through a range of angles and then successive checks for Haar features [1]. In this way rotated faces can be successfully detected.

### Conclusion

The rotation method has proved to be fairly effective and the detection rate of rotated faces is comparable to that of a normal vertical frontal face detection. In the future, I would like to investigate the effect of implementing new Haar features for detection of a range of poses.

### Reference

- [1] Zhaomin Zhu, et. al.  
*Multi-view Face Detection and Recognition using Haar-like Features*
- [2] Robin Hewitt  
*Seeing With OpenCV: Finding Faces in Images* (2007)
- [3] P. Viola and M. Jones  
*Rapid object detection using a boosted cascade of simple features* (2001)
- [4] Geovany A. Ramirez, et. al  
*Multi-pose Face Detection with Asymmetric Haar Features*