WHERE'S WALLY?
DISSERTATION PROJECT

Introduction

The intention of this project is to develop a system which will find Wally in the classic puzzle books, ***Where's Wally***, using current machine learning and facial recognition techniques. This presents an excellent opportunity to test current object recognition algorithms as Wally's appearance and size varies greatly from scene to scene.

The **Viola-Jones** object detection framework was used to find Wally [1]. This uses **Haar-like features,** shown in Figure 1 to describe light and dark regions of the image. First, Haar-like features are extracted from the image. This operation is sped by calculating an **integral image** described by Figure 2. Then a **cascade classifier** whittles down the search space by rejecting sub-windows of an image which are unlikely to contain Wally as shown in Figure 3.

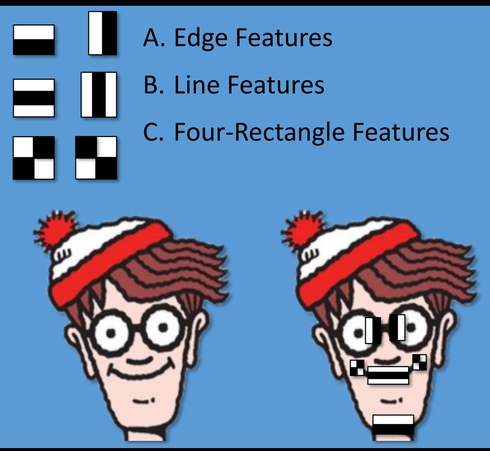

Figure 1: Haar-like features

Original Image

5	5	21	25
9	9	22	26
7	9	25	24
5	8	23	27

Integral Image

5 A	10	31 B	56
14	28	71	122
21 C	44	112 D	187
26	57	148	250

$$i(x', y') = I(A) + I(D) - I(B) - I(C)$$

Figure 2: An integral image is calculated by summing all the pixel values above and to the left of the current pixel. Thus the sub-region of an image at *i(x',y')* can be calculated with a constant time as demonstrated by the equation above.

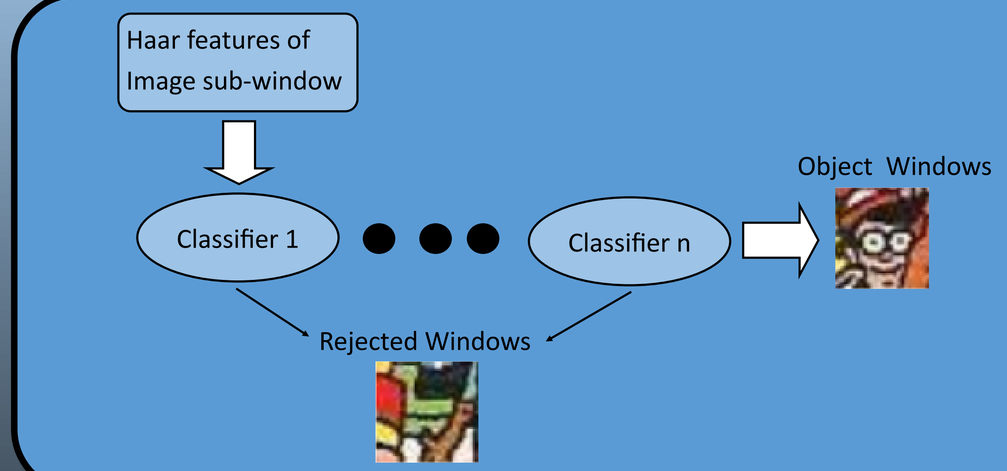

Figure 3: Cascade Classifier

Results and Future Work

Having training the framework on images of Wally, the framework has successfully found him in every test image. However, along with Wally, it also finds a lot of **false positives** such as those shown below. The next step will be to train a **convolutional neural network** to identify Wally from the false positives.

References:

1. 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)*, vol. 1,2001, pp. 511–518. DOI:10.1109/CVPR.2001.990517

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