**Face Detection**

Face detection is a technology which has the purpose of localising and extracting regions on images containing faces from the background. [survey paper]

Research of this field can be dated back to early 1970s, where a number of techniques were proposed, such as simple heuristic and anthropometric techniques.[Survey paper] However these previous techniques were not very adaptable as a change of environment required further tweaking and in some cases complete redesign of systems.

Face detection can be broken down into two separate groups, feature-based approach and images-based. [suvey] Feature-based approach tends to make use of facial features as one would expect, they tend to make use of facial geometry and other information such as skin colour. An example of a feature based approach could be Haar-like features, which uses contrast variances between adjacent rectangular groups of pixels to classify objects and faces by combing them to make features. Image-based face detection does not have knowledge regarding features etc. presented to it, but rather uses training and mapping techniques to build detection systems. An example of an images-based approach could be a neural network which uses training samples to build up a classification system to identify faces.

Within this assignment we considered two particular methods of face detection. One of the methods is known as blob detection which uses a method to extract regions close by of the same colour to distinguish as an object. The other method which we eventually used was Haar cascades, face detection using Haar-like features. The way in which this classifier works is by using the change in contrast values between adjacent rectangular groups of pixels opposed to using intensity values of a pixel. [phillip ian wilson]. Contrast variances between pixels groups allow relative light and dark areas to be determined, where two or three adjacent groups with a relative contrast variance form a Haar-like feature. The way in which the contrast variances are calculated is by subtracting the number of pixels in the white region of the rectangle from the number of pixels in the grey region of the rectangle. [voila and jones]. Due to the large number of features which can be derived, a system can be trained to find the best combination of features which can then be combined in order to produce a classifier cascade.[voila and jones] In the detection phase for a face, a specified sized window is moved over the input image, and for each subsection of the image the classifier cascade is applied which contains all of the Haar-like features. This can then be used to detect the presence of a face amongst the background.

Haar-like features