Face Detection and Recognition

Meet Gandhi

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Various Methods and Algorithms used for Face Detection

Problem Definition & History

Year	Authors	Method
1973	Kanade	First automated system
1987	Sirovich & Kirby	Principal Component Analysis
1991	Turk & Pentland	Eigenface
1996	Etemad & Chellapa	Fisherface
2001	Viola & Jones	AdaBoost + Haar Cascade
2007	Naruniec & Skarbek	Gabor Jets

Major milestone that reinvigorated research.

Codes and Concepts

- How computers detect faces or separate other things from human faces?
- By Skin Colour (Colour Detection).
- Motion(Blinking of Eyes).
- Head shape and other unique features of the face.
- All of the above combined.

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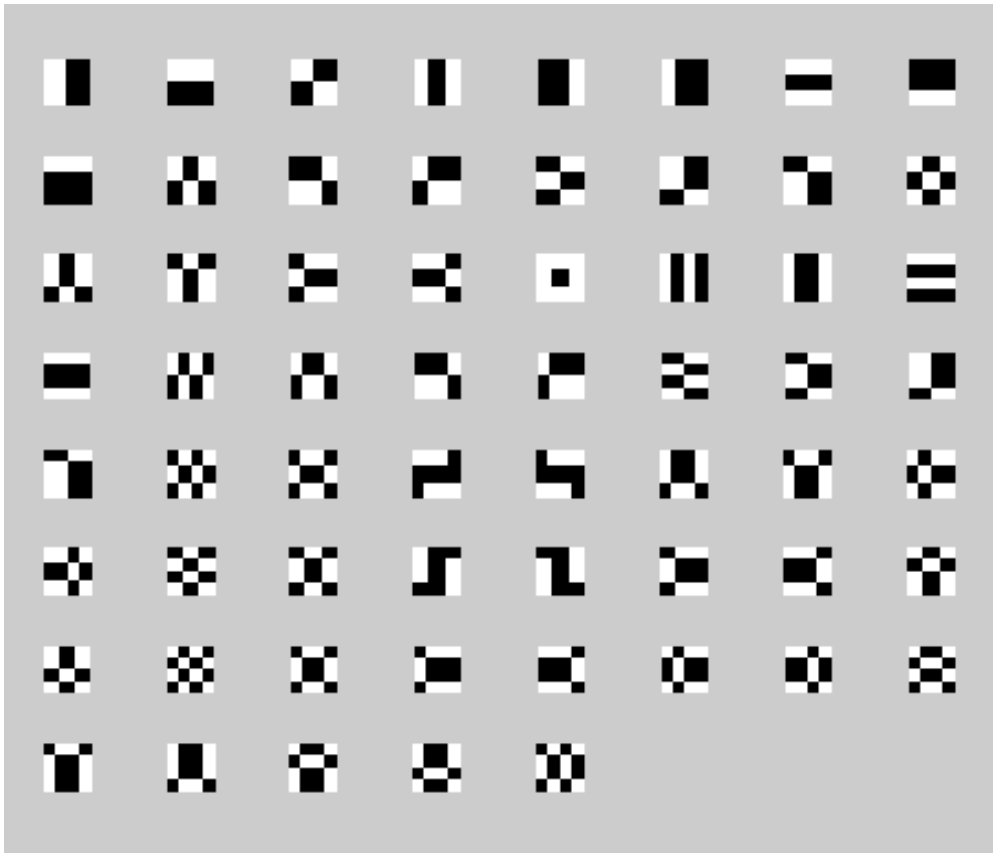
What is a **Haar Cascade ?**

- Haar Cascade is a collection of Haar like features included altogether to form a classifier.
- Haar like features:



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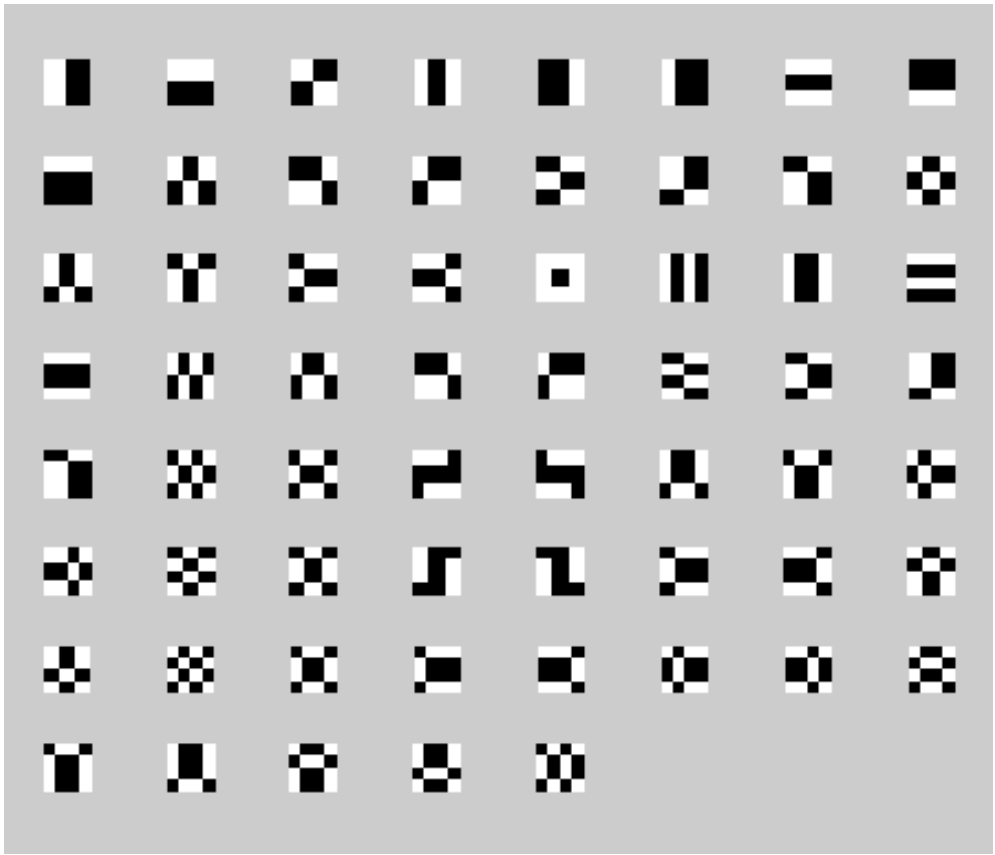

How does Haar like feature function?

- Fix a scale for Haar like feature (For example: 24 X 24 pixels).
- Starting from the topmost left, slide the Haar-like feature across the whole image.
- Calculate the average pixel values in white and black area of the Haar-cascade.
- If the difference of these values is greater than some threshold, the Haar-like feature matches with the portion of the image Haar-like feature is acted upon.

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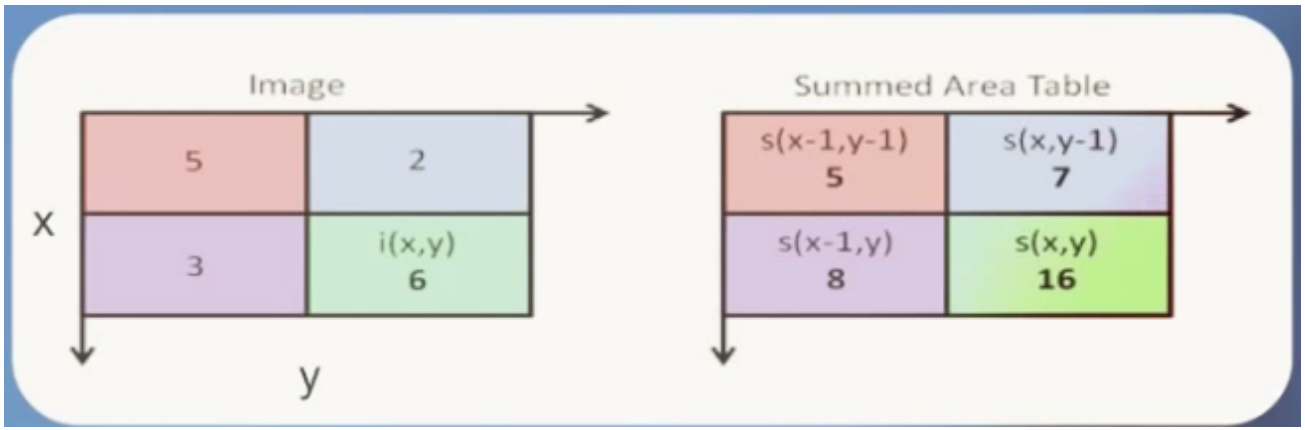
Integral Image- A technique to compute the sum of pixels in a given area

- Let the computed pixel values obtained by acting the convoluted kernel on an area of an input image be:
- Summed-Area Table can be computed by adding all the pixel values which are to the left and also up of the given pixel.



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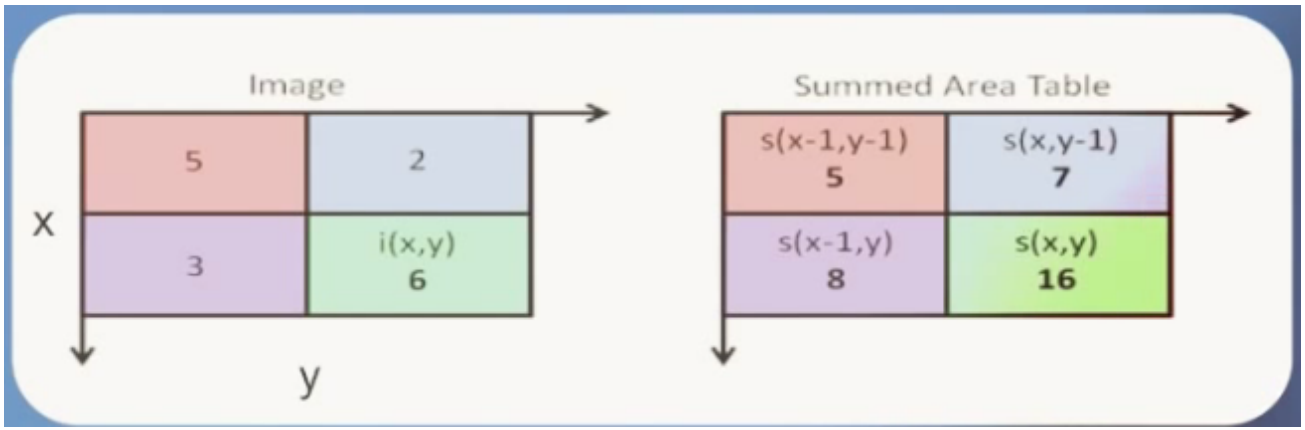

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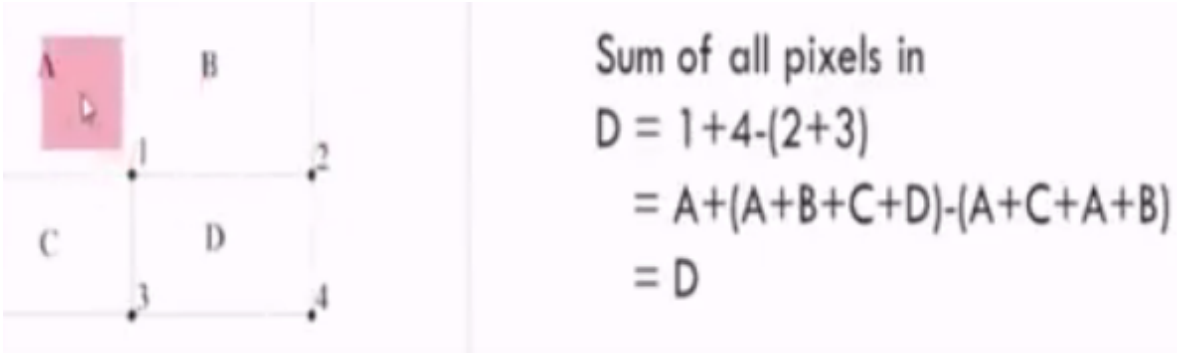

- As a result, Integral Image computation allows to calculate the sum of pixels in a given rectangle by only knowing the pixel values at the corners of the rectangle.

Role of Adaboost

- Adaboost is a machine learning algorithm that eliminates the redundant features and finds only the best features which can describe the face among 160,000+ features.
- After these features are found, a linear combination of these features is used to decide whether a window or a photograph has a face or not.These features are known as **Weak classifiers.**
- Adaboost forms a **Strong classifier** which is a linear combination of weak classifiers.
- Negative value of weighted constant means that the image possesses the opposite feature to that of the Haar-like feature, to some extent which is decided by its magnitude.

$$F(x) = \alpha_1 f_1(x) + \alpha_2 f_2(x) + \alpha_3 f_3(x) + \ldots$$

Strong classifier Weak classifier

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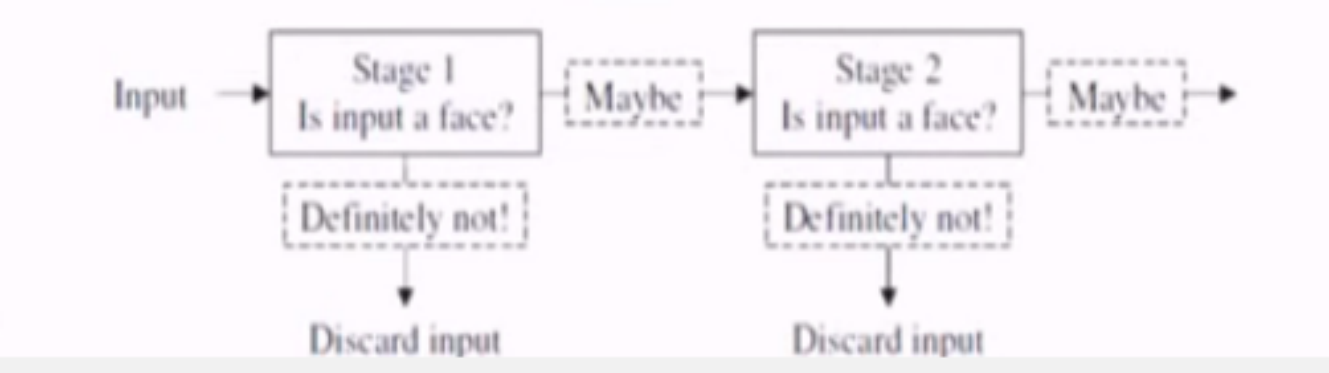
Cascading

- Cascade classifier is made up of stages. Each stage consists of strong classifiers which is the collection of the most covariant features.



Applications of Face Detection and Recognition

- Attendance System
- Traffic Regulation at 4 Way crossing by counting the number of people through Face Detection and depending on it controlling the green signal
- Modern Digital and Smartphone cameras use Face Detection techniques for autofocus.
- Face Detection and Recognition is used in Biometrics, video surveillance and image database management.

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