Elephant Detection System

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Feature Extraction

- Haar Like Features
- HOG Features
- SIFT Features and lot more ..

Mainly use Haar Like Features and HOG features for Object Recognition

Haar Features

- Intuitively similar to Haar Wavelets
- Haar wavelet is a sequence of rescaled "square-shaped" functions which together form a wavelet family or basis.

$$\psi(t) = \begin{cases} 1 & 0 \leq t < \frac{1}{2}, \\ -1 & \frac{1}{2} \leq t < 1, \\ 0 & \text{otherwise.} \end{cases}$$

Haar Feature continued..

- A Haar-like feature considers :

  - Adjacent rectangular regions at a specific location in a detection window

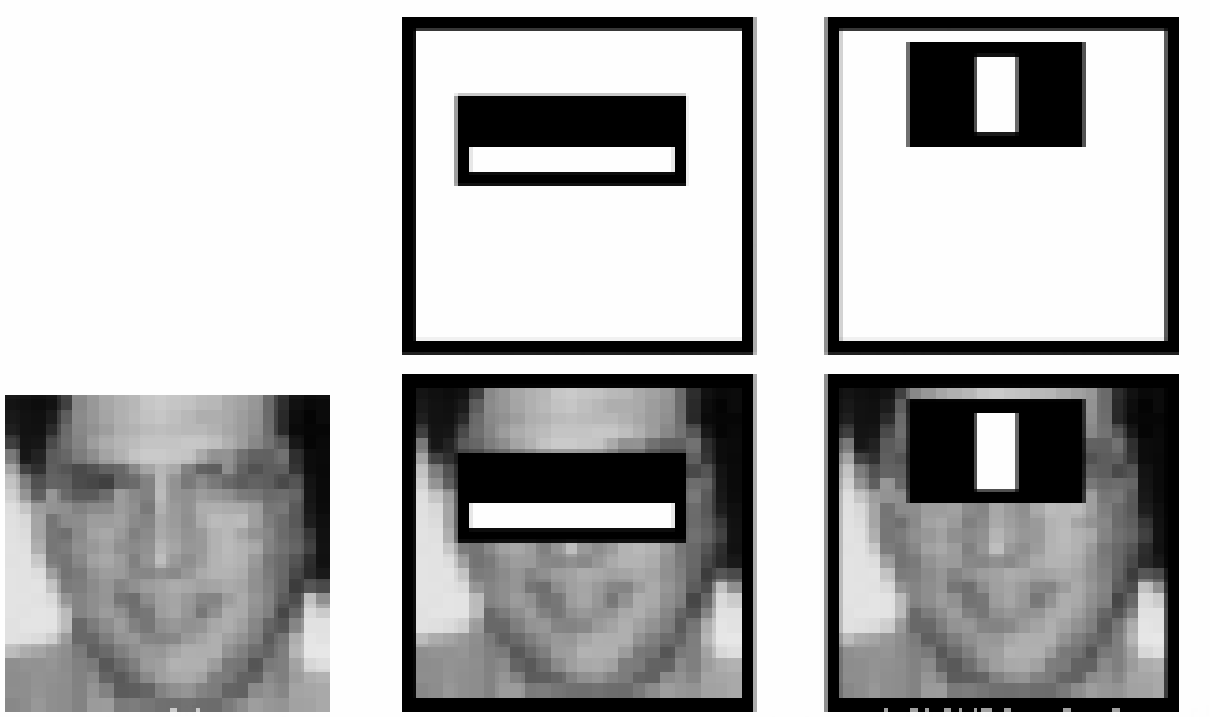
  - Sums up the pixel intensities in each region and calculates the difference between these sums.

  - This difference is then used to categorize subsections of an image.

Haar Feature Human Face Detection

- It is a common observation that among all faces the region of the eyes is darker than the region of the cheeks.
- So a common haar feature for face detection is a set of two adjacent rectangles that lie above the eye and the cheek region.
- The position of these rectangles is defined relative to a detection window that acts like a bounding box to the target object (the face in this case).

Haar Features continued..



HOG features

- It is similar to that of edge orientation histograms, scale-invariant feature transform descriptors (SIFT), and shape contexts.
- It is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.

Theory behind HOG features

- Local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions.
- This can be achieved by dividing the image into small connected regions, called cells, and for each cell compiling a histogram of gradient directions or edge orientations for the pixels within the cell. The combination of these histograms then represents the descriptor.

HOG Algorithm Used

- **Gradient Computation** : Same as Edge Detection
- **Orientation Binning :** Each pixel within the cell casts a weighted vote for an orientation-based histogram channel based on the values found in the gradient computation. As for the vote weight, pixel contribution can either be the gradient magnitude itself, or some function of the magnitude; in actual tests the gradient magnitude itself generally produces the best results.

HOG Algorithm Contd..

- **Descriptor Blocks :** The gradient strengths must be locally normalized, which requires grouping the cells together into larger, spatially connected blocks.
- **Block Normalization :** Blocks can be normalized via L1 or L2 norm

Which one is better ?

- Since the HOG descriptor operates on localized cells, the method upholds invariance to geometric and photometric transformations, except for object orientation. Such changes would only appear in larger spatial regions.
- HAAR can detect specific stuffs not generalized that is HAAR is only suitable for face or eye detection (specific). For whole body shape HOG would be a better choice.
- Haar gives a lot of false positive

Implementation Details

- Implemented in python
- SVM classifier is used
- HOG features are selected
- Positive Data Sets : 80 images
- Negative Data Sets : 99 images
- Test Data Sets : 20 images (10 positive and 10 negative)

Results

- Gave 85% accuracy that is out of 20, 17 images were detected correctly
- False positive : 2 images (10%)
- False negative : 1 image (5%)
- Code is opensourced and available online at : https://github.com/tusharmakkar08/elephant_detection

Results continued ..

- Gave correct results in images like :
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Results continued ..

- Wrong results given in images like

References

- Stack Overflow : http://goo.gl/N4AbYr
- Quora Question on HAAR vs HOG : http://qr.ae/L1IWI
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- Dabarera, Ranga, and Ranga Rodrigo. "Vision based elephant recognition for management and conservation." Information and Automation for Sustainability (ICIAFs), 2010 5th International Conference on. IEEE, 2010.
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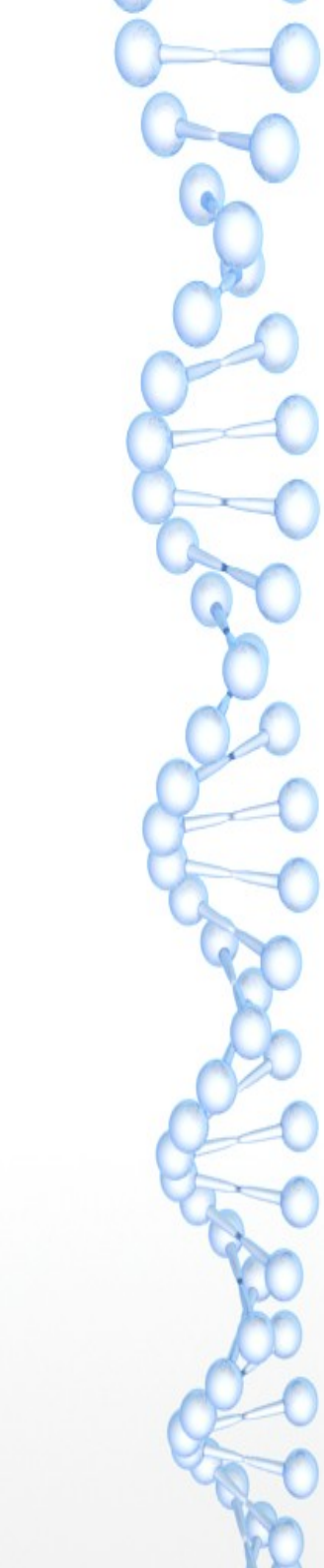

Thank You ..