Multiple Face Detection Using Haar - AdaBoosting, LBP -AdaBoosting and Neural Networks

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Abstract. Multiple Face Detection may be a process of identifying or recognizing quite one face on a picture. Face detections have recently attracted increasing interests thanks to the multitude of applications that end in format. There are numerous methods for identifying the face on the image but here we are using 'Haar-AdaBoost', 'LBP-AdaBoost', and 'Neural Networks' for identifying the faces on the image. And also we are comparing each of the methods to urge which method is giving highly accurate results and which method is giving results very quickly. In humans, by seeing the positions of Eyes, Nose, and Mouth another person can identify the face. The neural mechanism within the brain controls these all and provides the result. We are implementing an equivalent concept on the machine so that the machine can identify the faces by using the positions of the Eyes, Nose, and Mouth. The machine will identify quite one face or multiple faces within the image by using this, and that we also can compare which algorithm will provide a good percentage of accurate results.

Keywords: Face Detection, Haar-AdaBoosting, LBP-AdaBoosting, and Neural network.

1. Introduction:

In humans, by seeing the positions of Eyes, Nose, and Mouth another person can identify the face. The neural mechanism within the brain controls these all and provides the result. We are implementing an equivalent concept on the machine so that the machine can identify the faces by using the positions of the Eyes, Nose, and Mouth. The machine can identify quite one face or multiple faces within the image by using this, and that we also can compare which algorithm will provide a good percentage of accurate results.[1] consistent with this context, we've established a comparative study between three methods (Haar-AdaBoost, LBP-AdaBoost, and Neural Network). These techniques vary according to the tactic during which they extract the knowledge and thus the adopted learning algorithms. Here LBP-Ada boost and Haar Ada Boost methods are Boosting algorithms which can be used for learning and selection of strong classifier. And therefore the last one is that the "Neural Network" uses the Gabor filter to extract the characteristics. [4]

The main objective of this specification is to supply a transparent view of the wants for Multiple Face Detection. This project aims to develop a system for users to upload and detect the multiple faces within the image. The system will identify the faces using Harr-AdaBoost, LBP-AdaBoost, and GF-NN and build a graph determining the face detection time and efficiency for every method.

Identifying human faces during digital images by using a device is named as Face detection. Face detection is one of the required instances of object class detection. during this model, a major importance is given to the highest face detection. In all the possible regions human eye areas are firstly detected and evaluated in this model. It aims to develop a system for users to
upload and detect the multiple faces within the image. The system will identify the faces using Harr-AdaBoost, LBP-AdaBoost, and Neural Network and build a graph determining the face detection time and efficiency for every method. During this project we start with an introduction, then we present within the first section, the detection methods supported Haar, LBP, and Gabor extraction techniques. Then within the second section, we expose the approaches of automatic learning Boosting and Neural Networks. [4] Then we are showing the results a comparison between the three methods (Haar-AdaBoost, LBP-AdaBoost, and Neural Network) consistent with the time interval of the test images and therefore the detection. Then the conclusion is that the last step.

We are implementing this idea on the windows OS using Python as a programming language and Pycharm as a tool for developing or editing the code. For identifying the faces we are using the Cascading files using a picture as an input.

2. Feature Extraction

2.1 Haar features

A. Haar method:

In real-time, efficiently detecting objects in an image viola and Jones method is the most important method. This method is particularly invented for face detection. Two or three rectangles of Haar features are composed and candidates' faces are searched and scanned for the current stage of Haar features By learning the algorithm the generated weights are constant. The value of each Haar feature is calculated by the area of multiplying each rectangle by their particular weights. For haar feature an example is given fig (1). [1, 8]

![Haar features example](image1)

Figure1. Haar features an example.

B. Integral image:

By calculating the values efficiently and quickly of a grid of rectangle subsets are known as Integral image or Summed area table which is an algorithm for random computation of Haar features the viola and Jones method is applied to the integral method. Following is the integral image construction. [1, 4, 12, 19]

2.2. LBP:

LBP is popularly known as a local binary pattern. It is a texture descriptor that has different applications such as environmental modeling, remote assessment, image recovery, motion analysis and face image analysis, medical image analysis, and face image analysis. The process implies dividing a facial image into collective regions where LBP exhibits
concatenated and extracted to features vector which is used for a further facial descriptor. [2, 4, 20]

A. LBP principle:
Ojala and al are the first users of the original LBP operators. LBP works on using a 3X3 window of a pixel in a neighborhood from the image and it will extract LBP code. It has three parameters on which LBP works the central pixel value used as a threshold. Value ‘1’ is assigned to a pixel when the neighboring pixel has a gray color when the central pixel has less value or it is assigned with '0'. The concatenations of the eight 1or0 counterclockwise or clockwise to a binary code which is produced by LBP code for the central pixel. The process of LBP is explained in fig (2) by labeling method. [6, 10, 11, 17, 18]

![Figure 2 LBP Labeling.](image)

Let \((x_c, y_c)\) be pixel positions, 8-bit word resulting in a decimal value that can be expressed as follows:

\[
\text{LBP} (x_c, y_c) = \sum_{n=0}^{7} S(I_n - I_c)2^n
\]

(1)

Where

- \(l_c\) = gray value for central pixel \((x_c, y_c)\).
- \(l_n\) = gray values of the 8 neighboring pixels.
- \(S(K)\) = \(1\) if \(K \geq 0\), 0 if \(K<0\).

B. Facial Representation of LBP:
Micro-pattern compositions that are effectively identified by the LBP operators are considered from an individual face of the image. To represent facial recognition Ahonen and al introduced a face-based LBP representation. Shape information of the faces is probed by dividing the faces in the image into \(M\) and regions \((R_0, R_1, \ldots, R_M)\) small non-overlapping. Histogram of the single spatially enhances into sub-regions. [3, 4, 10, 16]

\[
H_{i,j} = \sum_{x,y} I(f_i(x, y) = i)I \left((x, y) \in R_j\right)
\]

(2)

With

\(i=0\ldots L-1\),
\[ j = 0 \ldots M - 1. \] The overall shape and the local texture are described by the histogram of the extracted features of the face images.

### 2.3. Neural Network

Neural networks use the Eigen faces through a classification of the coefficients calculated. The database of the network is competent in the pictures first, later it will recognize the given picture faces. Eigen's faces represent the facial characteristics that are used in persons face recognition. In this technique, a set of images are tested and trained to determine the eigenvectors of the covariance matrix. Eigenvectors do not correspond directly to face features like mouth, eyes, and nose as they are Ortho normal to each other. The ghostly face is displayed when the eigenvectors are shown and Eigen's faces are termed. In fig (3) Network Architecture is explained clearly. [5, 7, 13]

![Network Architecture](image)

**Figure 3** Network Architecture

#### 2.3.1 Classification of the neural network:

The face recognizer is planned for recognition after the training data is trained. The face detection unit from the image sequence detects the face and Eigen face space is calculated on its projection. In the neural network unit output signals are given by the new face descriptor \( \Omega \), it produces the number 'T' produces the index number of the training set of the person by the following equation. [1, 5, 14]

\[
\text{Index Number} = \log_{10} \left( \frac{T}{\log_{10} (2.0)} \right).
\]

(3)

Confirmation of the capable name is confirmed by the back propagation error if the index number is from the person list. If the comparison method is finished the name of the person is generated if identified.

### 3. Classifications

#### 3.1. AdaBoost Learning:

AdaBoost on learning algorithm of the Adaboost of a machine learning algorithms also known as a weak learner by using the output of weighted classification algorithms. The only better way to be randomly is convenient for the right orientation is a weak learner. In the same way, strong learners are also represented to a set of classification algorithms that have more correlated with the perfect orientation. So, that poor learners can change to minimize errors in subjects, but they are not classified. By doing this way other images except human images are detected. In the formulation process, the AdaBoost learning algorithm can be explained in the following way. [1, 3]
Let us consider \( n \) images in a set \((x_1, \ldots, x_n)\) and associated with labels \((y_1, \ldots, y_n)\). If \( x_i \) is a negative example then \( y_i = 0 \) and if \( x_i \) is an object to detect example then \( y_i = 1 \). \( T \) is the number of boosting algorithms contained, \( t \) is iteration, \( j \) is characteristics, \( h_j \) is constructed as a weak classifier and \( h \) is sample classifier.

\[
y_i = h(x_i) \forall i \in \{1, \ldots, n\}
\]

(4)

When the error is produced and the classifier is not found then in practice it is given by:

\[
E_j = \sum_{i=1}^{n} w_i |h_j(x_i) - y_i|
\]

(5)

3.2. Cascading Classifier:

The impact of the cascade structure will also have on the training process of an image. Face detection has a detection task rarely. The detection algorithm of the organization is an important idea of the method to reduce the cost in a cascade of classifiers. Consequently, the classifiers will decide on acceptance. The example is passed to the next classifier when the window contains the object, or it may be rejected, when the window does not contain an object and for this case this process is clearly explained in fig (4), the example is commonly not appeared. [9]

![Cascade Architecture](cascade architecture)

4. The Testing Results:

In the testing process, the results obtained by giving an image to these three methods are different based on the type of the algorithm. The accuracy and time are taken by each method are calculated.

4.1 Haar-AdaBoosting Method: By using this method 11 faces are identified in the given fig (5).
Finding multiple faces by using the Haar-AdaBoosting method.

4.2 LBP-AdaBoosting Method: By using this method 9 faces are found in a given fig(6).

Finding multiple faces by using the LBP-AdaBoosting method.

4.3 Neural Network Method: By using the neural network method the 13 faces are identified in the given image fig (7).
Figure 7 Finding multiple faces by using the Neural Networks method.

4.4 Accuracy and Time Graph images: Based on the faces identified in the image by each method the graph is plotted using results obtained from each method. And the time graph is drawn by the time taken for each algorithm to identify all faces in the image are explained in fig (8) and fig (9).

Figure 8. Accuracy Graph Image
5. Conclusion

In this paper, we find that Face detection is currently an active area of research. Recent years have shown great advances in algorithms handling complex environments, a number of the simplest algorithms are still too expensive in terms of calculation to be applicable in real-time, but this is often likely to vary with upcoming improvements in hardware. During this project, we present in-depth research on face detection methods, all methods have their advantages and drawbacks, for instance, the characteristics of Haar utilized in the trouble by Viola and Jones are very simple and effective for the detection frontal of the face, but they're less ideal for random faces. The foremost direct direction to return is to further improve the algorithms and learning features. It's interesting, to ascertain face detection techniques increasingly utilized in real applications, for instance, most digital cameras today have built-in face sensors, which may help the camera to raised focus or autofocus and auto exposure, which is additionally a crucial technique for interfaces. Man-machine, to permit a more natural interaction between a person's and a computer.

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