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# Face Detection Methods[+]

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**Abstract.** Human face detection plays a major role in face recognition systems and has gained much attention in recent years. Various methods were proposed to detect faces in different orientations. The aim of this paper is to introduce a comparative study of four detection methods regarding the detection rate. These methods are : SMQT Features and SNOW Classifier (SFSC) method, Efficient and Rank Deficient Face Detection (ERDFD) method, Gabor-Feature Extraction and Neural Network (GFENN) method and An efficient face candidates selector Features (EFCSF) method. The experimental results of the methods have been performed on the wild data set (FDDB) using MatLab 7.9. SFSC method achieved higher detection rate.

**Keywords:** one, face detection, feature extraction, detection rate, neural networks, data set.

## 1. Introduction

In the recent years, face detection has become a popular area of research in computer vision and one of the most successful applications of image analysis and understanding [1,2,3,4,5]. There has been much progress in frontal face detection. State of the art face detection systems can reliably detect frontal faces at video rate. Various face detection algorithms have been proposed [6,7,8,9,10,11,12,13,14].

Most face detection algorithms use a face recognition approach. A classifier that can discriminate face parts from background non-face parts is trained from a set of training examples. When a new test image is presented, parts of all possible sizes and positions are extracted and scaled to the same size as the training samples. The trained classifier then decides whether a part is a face or not. This brute-force search strategy is used in most of the face detection methods.

This paper performs a comparative study of the four popular face detection methods in term of rate of detection. These methods are : SMQT Features and SNOW Classifier Method(SFSC), Efficient and Rank Deficient Face Detection Method (ERDFD), Gabor-Feature Extraction and Neural Network Method (GFENN) and An efficient face candidates selector Features Method (EFCSF).

This paper is organized as follows. Section 2 gives an overview of face detection methods. Section 3 introduces experimental results. Finally, a conclusion is given in Sec. 4.

## 2. Methods

In the following subsections, the face detection methods will be introduced.

### 2.1. SMQT Features and SNOW Classifier Method

This method consists of two phases. The first phase is face luminance. The operation of this phase is being performed to get pixel information of an image and further implemented to detection purpose. The second phase is detection. In this phase, local SMQT features can be used as feature extraction for object

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detection. The features were found to be able to cope with illumination and sensor variation in object detection. The split up SNOW is proposed [15] to speed up the standard SNOW classifier [16]. The split up SNOW classifier requires only training of one classifier network which can be arbitrarily divided into several weaker classifiers in cascade. Each weak classifier uses the result from previous weaker classifiers which makes it computationally efficient.

### 2.2. Efficient and Rank Deficient Face Detection Method

All This method introduces a new reduced set for support vector machines (SVMs) in image processing, which creates sparse kernel expansions that can be evaluated via separable filters. The user-defined rank (the number of separable filters into which the reduced set vectors (RSVs) are decomposed) provides a mechanism to control the trade-off between accuracy and speed of the resulting approximation. The performed experiments show that for face detection, the use of rank deficient RSVs leads to a significant speedup without losing accuracy. The rank deficient RSVs can be used together with unconstrained RSVs or SVs using the same canonical image representation. This approach allows the use of off-the-shelf image processing libraries for separable convolutions. The method can well be used to train a neural network, i.e. to go directly from the training data to a sparse, separable function as opposed to taking the SVM 'detour' [17].

### 2.3. Gabor-Feature Extraction and Neural Network Method

This method is based on Gabor-Feature Extraction and Neural Network which has the following steps [18,19]:

1- Prepare images in face and non-face folders for network training phase.
2- Extract Gabor features.
3- Train the network based on image features
4- Scan the whole image for faces.

### 2.4. An efficient face candidates selector Features Method

The main goal of this method is to detect eyes based on an efficient face candidates selector proposed for face detection tasks in still gray level images. This method acts as a selective attentional mechanism. Eye-analogue segments at a given scale are discovered by finding regions which are roughly as large as real eyes and are *darker* than their neighborhoods. Then a pair of eye-analogue segments are hypothesized to be eyes in a face and combined into a face candidate if their placement is consistent with the anthropological characteristic of human eyes [20].

## 3. Experimental Results

The face image data set used in the experiments is FDDB: Face Detection Data Set and Benchmark [21], which consists of single and multiple faces in one image. Some samples of images from this data set is shown in Fig. 1. These face images vary in facial expression, illumination, face orientation and background.

Fig. 1: Sample images of FDDB data set.

The images used in the experiments are divided into two groups. The first group (Single) consists of 200 pictures. Each picture contains only one person. The second group (Multiple) consists of 300 pictures. Each picture contains multiple faces in one picture. Fig. 2 shows the results of four methods for a single face and Fig. 3 shows the results of three methods for multiple faces.

The detection results of the methods are presented in Table 1.

Table 1. Detection rate of the methods.

| Image Type | Single | Multiple |
|---|---|---|
| SFSC Method | 95% | 93.30% |
| ERDFD Method | 85.50% | 84% |
| GFENN Method | 86.50% | 56% |
| EFCSF Method | 75% | 14% |


Fig. 2: Face Detection results of the four methods for frontal single faces


Fig. 3: Face Detection results of the three methods for the images of multiple faces

## 4. Conclusions

This paper presented a comparative study of four face detection methods regarding the detection rate for single and multiple faces in an image in complex background. The SMQT Features and SNOW Classifier (SFSC) method performed excellent results and achieved higher detection rate.

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