

A Novel Algorithm for View and Illumination Face Recognition

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Abstract:

One of most relevant applications of image analysis is the Face recognition. Face Recognition deals with unique facial characteristics of human beings. It can be applied in various challenging fields like security systems, identity authentication and video retrieval. It involves the techniques of image processing, computer vision and pattern recognition. Face recognition is more complicated than classical pattern recognition since it deals with human faces. The human face is full of information but working with all the information associated with the face is time consuming and less efficient.

Face recognition includes analysis of an image and extracting its facial features which will help to discriminate it from others. Scale invariant feature transform (SIFT) to extract distinctive invariant features from images can be used to perform reliable matching. The features extracted are invariant to rotation, image scale and illumination.

Systematic investigation of face recognition using SIFT features has been done. Being highly distinctive features, every feature can be matched correctly with high probability against a huge database of features from many images. Result shows that SIFT is flexible recognition algorithm as compared to Contour matching algorithm for heterogeneous images.

Both the algorithms are experimentally evaluated on AT&T, YALE and IIT-KANPUR databases with moderate subject size. Though Contour matching provides computational simplicity, SIFT provides efficient face recognition technique under pose, expression and varying illumination condition. Experimentally it confirms that Contour matching outperforms when the database is small but for large databases Scale Invariant Feature Transform (SIFT) gives more than 90% recognition rate.

Real-time facial expression analysis is an important yet challenging task in human computer interaction. This paper proposes a real-time person independent facial expression recognition system using a geometrical feature-based approach. The face geometry is extracted using the modified active shape model. Each part of the face geometry is effectively represented by the Census Transformation (CT) based feature histogram. The facial expression is classified by the SVM classifier with exponential χ^2 weighted merging kernel. The proposed method was evaluated on the JAFFE database and in real-world environment.

Scale-invariant feature transform :

SIFT is an algorithm in computer vision to detect and describe local features in images. The algorithm was published by David Lowe in 1999. Applications include object recognition, robotic mapping and navigation, image stitching, 3D modeling, gesture recognition, video tracking, individual identification of wildlife and match moving.

Overview:

For any object in an image, interesting points on the object can be extracted to provide a "feature description" of the object. This description, extracted from a training image, can then be used to identify the object when attempting to locate the object in a test image containing many other objects. To perform reliable recognition, it is important that the features extracted from the training image be detectable even under changes in image scale, noise and illumination. Such points usually lie on high-contrast regions of the image, such as object edges. Another important characteristic of these features is that the relative positions between them in the original scene shouldn't change from one image to another.

For example, if only the four corners of a door were used as features, they would work regardless of the door's position; but if points in the frame were also used, the recognition would fail if the door is opened or closed. Similarly, features located in articulated or flexible objects would typically not work if any change in their internal geometry happens between two images in the set being processed. However, in practice SIFT detects and uses a much larger number of features from the images, which reduces the contribution of the errors caused by these local variations in the average error of all feature matching errors.

An extraction method for the facial area on a natural background using variable inter-frame subtraction and color information is presented in this paper. We have proposed a human-face extraction technique using the HSV color model and have confirmed the effectiveness of this method experimentally. However, the color black, which is expected to have a lower saturation in the HSV color model, can not be shown accurately. In a conventional system, this feature has some adverse effects on human-face extraction. To cope with this problem, a modified HSV color model was adopted.

In the proposed transformation, the saturation is defined as a distance from a chromatic color. This representation has the following advantage: (1) Black is represented as a color with lower saturation. (2) White human skin colors are conspicuous in the conventional system, but they will be emphasized in the proposed system. On the other hand, in terms of moving information, the variable inter-frame subtraction method was adopted for conforming to a natural office environment. However, an adequate frame interval must be evaluated for obtaining sufficient movement information between frames. The most adequate number for obtaining differential images between frames was set in this method.

From a computer simulation using 8636 images, 3764 images (97.84%) were correctly extracted. With respect to the extraction of facial parts such as: eyes, mouth, eyebrows, color information and its special mutual relationship were mainly used. Furthermore, the specific areas of a face which are used for feature extraction in order to understand facial expressions were extracted. This process must be executed on all faces taken from an arbitrary angle.

Blockdiagram :

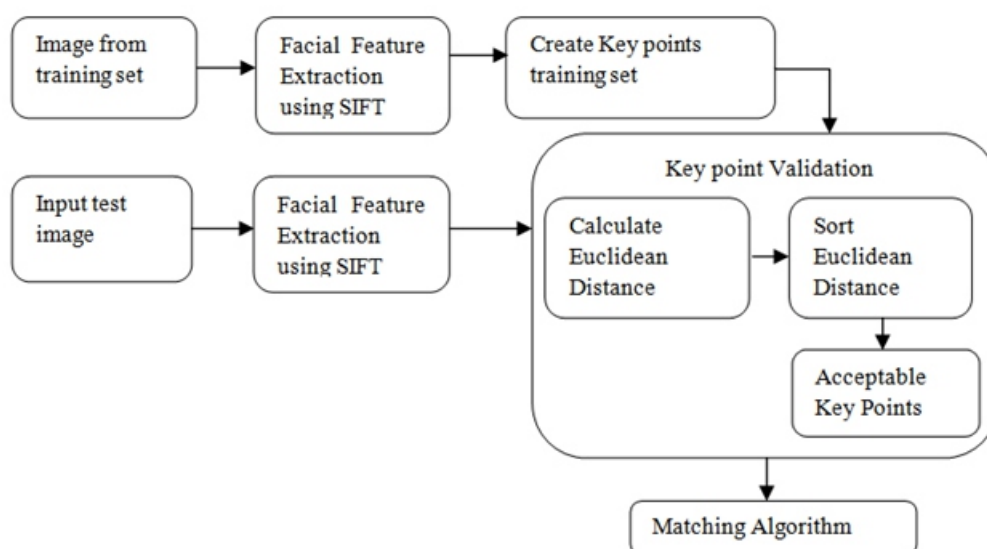
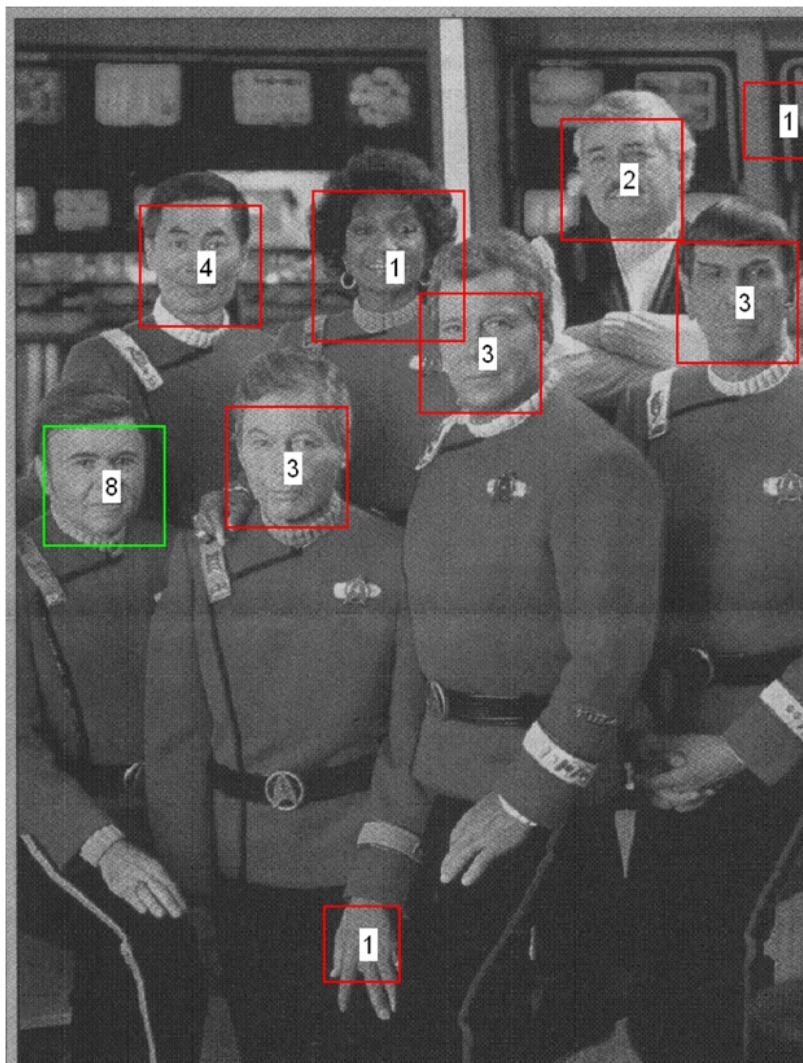
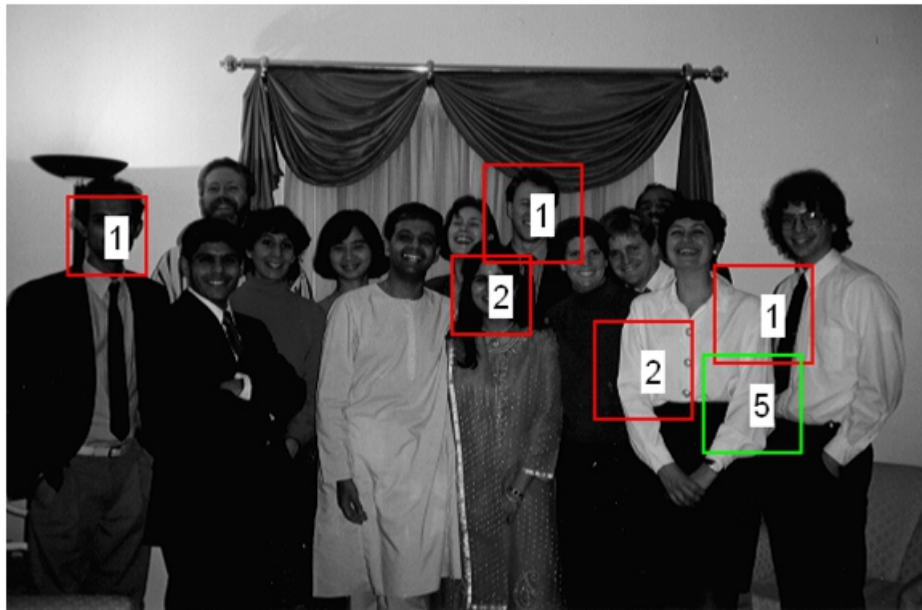
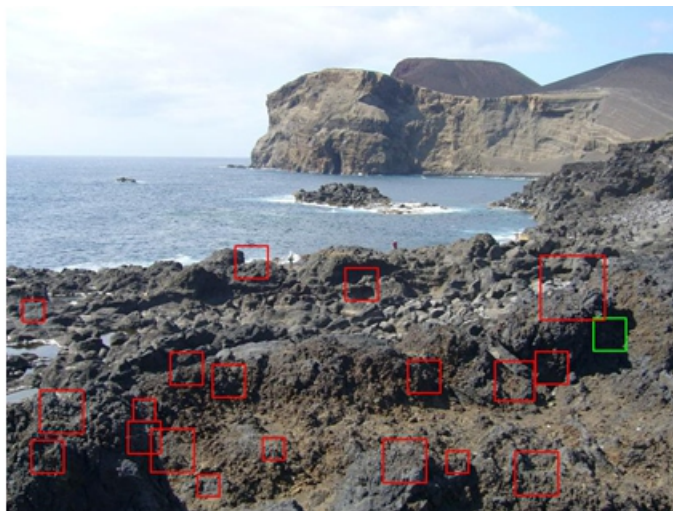


Fig.1 Proposed Model



Results:

For synthetic investigation of SIFT algorithm experiments have been conducted on ATNT, YALE and IIT Kanpur databases, executed on an Intel core 2 Duo CPU running on 2.26 GHz with 8 GB RAM with windows OS (64 Bit) and OpenCV 1.1 (Visual studio 2008). With the mentioned hardware response time is 0.4 secs for ATNT, YALE and IIT Kanpur database, there are 20 subjects and each subject has 5 different facial views representing different poses, varying lighting conditions and expressions. Each image is digitized and stored as 92 X 112 pixel array. The file is in JPEG format. For conducting the experiments on three different databases, three separate training and test set has been set. Each person which includes 60 images totally and the testing set consist of the remaining. In the experiment, highly distinctive key points are extracted for all the images in the training data set. Corresponding coordinates of these key points are maintained in the array. Corresponding extracted highly distinctive key points.

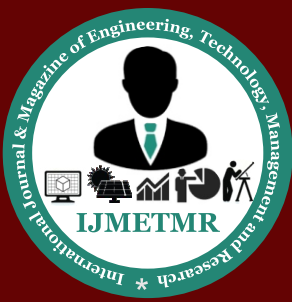


Face recognition using SIFT algorithm and Contour matching has been studied. Face recognition based on Contour matching method is easy to implement due to its simplicity. But in contour matching shape of the contours get affected by titling or panning of a face. Similarly the varying lighting condition or two images with different expression of a same person also give the false contour lines, which in turns lower the recognition rate. Face recognition using Scale Invariant Feature Transform outperforms in many aspects. SIFT provides efficient face recognition results under varying lighting condition, scale, pose and expression. Our proposed efficient SADK matching algorithm of face recognition based on SIFT has given better results in terms of accuracy and efficiency.

We experimented with three challenging data bases. Experimental results show that our SIFT based face recognition method is robust to illumination changes (YALE), changes in facial expressions (ATNT) and partial head movements including frontal, +45° and -45° (IIT Kanpur). In our experiment images with +90° and -90° and non ideal images taken by the camera are not included. Though the effect due to these are not examined, but left open for further study. The experimental results show that the approach yields a high recognition rate and is applicable in real-time facial expression analysis.

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