ISSN No. 0976-5697

Volume 4, No. 8, May-June 2013

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Smile detection : A simple Approach

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Abstract- Facial expressions analysis is applicable in various vision systems, new interfaces for television and other entertainment systems, diagnosis and monitoring of deceases, speech processing, modern smart digital cameras and perceptual man-machine interfaces etc. Smile is human's expression for happiness. Detection of smile by a machine is helpful to establish human machine interaction in many situations. Many researchers worked on facial expression recognition, but there is not much research about smile detection. In this paper we proposed a simple image-based approach to identify the smile.

Keywords: Face and gesture recognition, Computer vision, Smile Detector.

I. INTRODUCTION

In recent years, researchers have made considerable progress in developing automatic expression detection systems [1][2]. Many of these works concentrated on object based techniques, in which the facial expressions are identified using facial action coding system (FACS) [2]. Here the facial expressions are identified using visually observable activations of facial muscles. This requires a high level algorithm and it is quite complex to implement. In our proposed method we followed the natural method of smile identification. To detect the smile initially identifying the face is important.

Many face detection methods are already developed and used in many applications. The shape of the mouth changes when a person smiles. There are some similarities between any persons smile and we record these by collecting the common set of pixels which are identified from various smile samples. Each of these samples is then matched with the pixels of human face in the input image. If this comparison gives more than 75% matches then the image is considered as a smiley face. We are proposed this idea here and actual working of the algorithm has to be tested after implementing it.

The rest of this paper is organized as follows: In Section 2 we briefly present different face detection schemes any one of which can be adopted to extract face from the input image. Section 3 and 4 provide the discussion of smile detection algorithm and some of the key issues needed to implement it. Finally, summary and conclusions are in Section 4.

II. FACE DETECTION SCHEME

The human face is a dynamic object and has a high degree of variability in its appearance, which makes face detection a difficult problem in computer vision[3]. Face detection is a necessary first-step in face recognition systems, with the purpose of localizing and extracting the face region from the background. Detecting the face in input image becomes first step in any smile detection system. A wide variety of techniques have been proposed, ranging from simple edge-based algorithms to composite high-level approaches utilizing advanced pattern recognition methods.

A. Feature-Based Approach:

The method is based on face geometrical configuration. A face contains eyebrows, eyes, nose and mouth; a face image is sym-metric in the left and right directions; eyes are below two eyebrows; nose lies between and below two eyes; lips lie below nose; the contour of a human head can be approximated by an ellipse, and so on. By using the facial components as well as positional relationship between them we can locate the faces easily. The facial components can be identified by tracking the edges in the image. Different types of edge detection algorithm are available today. The steerable filtering in [4] consists of three sequential edge detection steps which include detection of edges, determination of the filter orientation of any detected edges, and stepwise tracking of neighboring edges using the orientation information. In edge-detection-based approach to face detection, edges need to be labeled and matched to a face model in order to verify correct detections.

Apart from edge details, the gray information within a face can also be used as features. Human skin colors differ more in brightness than in colors; and every texture is distinctive and distinguishable from one another. Therefore, the normalized GRB or texture models are considered to be capable of characterizing human face with less variance in color or texture. Terrillon et al. [5], used a skin color model based on the Mahalanobis metric and a shape analysis based on invariant Fourier-Mellin moments to automatically detect and locate human faces in two-dimensional complex scene images. A new technique was developed which replaced

threshold and connected components with the moments of color pixels weighted by a Gaussian density function. The paper [6] explored new ways of learning and retrieving the appearance of human faces in black, white and still images by gray-tone texture model. Gray information provides the basic representation for image features and color is a more powerful means of discerning object appearance so the approach which makes use of these methods will give better results in face detection.

Motion in moving objects is better information to identify the object in any video sequence. The frame difference analysis is a straight forward approach to track the motion information. Luthon and Lievin [7], employ frame difference to locate facial features. Estimation of moving image contours can also be used as another way of measuring visual motion. A spatio-temporal Gaussian filter has been used by McKenna et al. [8] to detect moving boundaries of faces and human bodies.

A generalized method by combining two or more of above method can be used in face detection. [9] proposed that machine vision systems should begin with pre-attentive low-level computation of generalized image properties. In [11] Jebara and Pentland described a real-time system initialized by using skin classification, symmetry operations, 3D warping and Eigen faces to find a face. The face detection method presented in [12] used a structural model to characterize the geometric pattern of facial components. The texture and feature models are used to verify the face candidates detected before. The center and the radius of the eyeballs of a person's eyes were detected using the face detected and from that the structural information is extracted.

B. Holistic Approaches:

a. Eigenface-Based Method:

This method uses the whole face region as the raw input to a recognition system. The goal of an appearance-based face recognition algorithm is essentially to create low-dimensional representations of face images to perform recognition. The low-dimensional representation of faces in the Eigenface approach is derived by applying Principle Component Analysis (PCA) to a representative dataset of images of faces. The system functions by projecting face images onto a feature space that spans the significant variations among known face images. These significant features are termed "Eigenfaces" because they are the principal components of the set of training face images[13]. Face images are then classified within the low-dimensional model using a nearest-neighbor classifier.

A face can be reconstructed utilizing a small collection of eigenpictures and their corresponding projections, called coefficients, along each eigenpicture. In [14] Zhu et al. proposed a subspace approach to capture local discriminative features in the space-frequency domain for fast face detection. Based on orthonormal wavelet packet analysis, the discriminant subspace algorithm was developed to search for the minimum cost subspace of the high-dimensional signal space, which led to a set of wavelet features with maximum class discrimination and dimensionality reduction. Figure 1 in [14] illustrated the detection process. The system decomposes an entire input image into subband images which contain the different features. Multiple sliding windows within different subbands are aligned to the same spatial location. Features are selected from multiple subbands to calculate the likelihood ratios. Face locations are reported where the likelihood ratios exceed a fixed threshold.

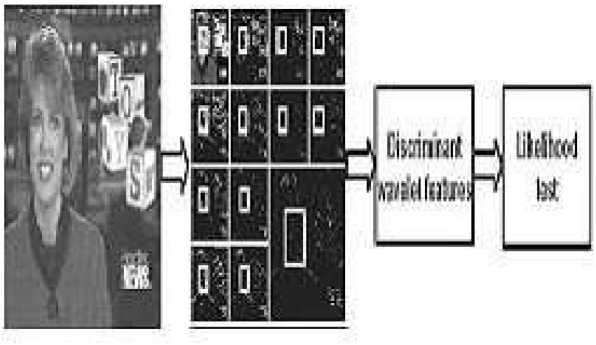

Figure 1 Detection process

b. Neural Networks:

Neural networks have become a popular technique for pattern recognition problems, including face detection. In [15] the new neural network model proposed, the Constrained Generative Model performed an accurate estimation of the face set, using a small set of counter-examples. The neural network layers in [15] were shown in Figure 2. The use of three layers of weights allows evaluating the distance between an input image and the set of face image.

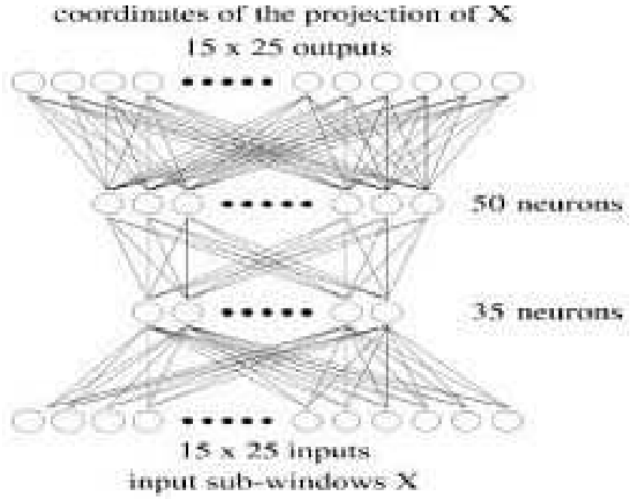

Figure 2 Neural network layers

Apart from above mentioned methods many other technologies are proposed and published in many journals. The fuzzy approach is one which is applied in most of the computer science fields. The fuzzy face recognition system presented in [16] is based on the Gath-Gheva fuzzy clustering method and the Abonyi and Szeifert classification scheme showed a good classification performance on different face image databases. Any of these methods, which suits best according to the dataset of images of faces can be adopted in smile detection system.

III. SMILE DETECTION SCHEME

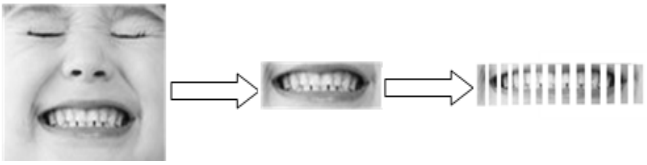

Figure 3 Extraction of smile features from the image

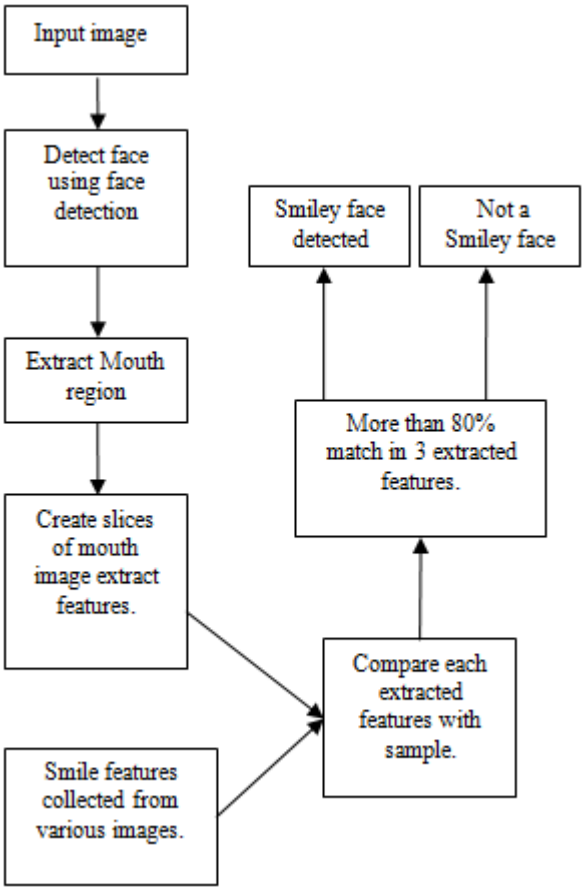

Figure 4. Block diagram of the proposed system.

Many of expression research to date have focused on understanding how underlying muscles move to create expressions [15] [18]. Much of previous works used facial action coding system (FACS)[3] as a frame-work for classification. This approach assumes no categories, but rather assigns an emotional value to a face using a combination of the key action units that create the expression. This requires a high level algorithm and it is quite complex to implement. In our proposed method we followed the natural method of smile identification. The block diagram of the system is given in the fig.5

Here we initially collect a number of different types of human smile pictures represented in gray scale format. From collected images the mouth regions of all the images are cropped and further we make small slices of these mouth images. These slices are saved in the database in an order. For a sample image the creation of mouth image slices is shown in the fig.4. Once these slices are generated we compare the features extracted from it with the features which we collected previously.

Our smile detection algorithm is as follows:

a. Collect different types of human smiley mouth images and extract the smile features by making them into small slices.
b. Detect the human face in the input image frame and clip the face region.
c. In every face image, clip the mouth region and create slices of clipped mouth image.
d. Extract the features from the sliced images.
e. Now each slices starting form left corner is compared with our previously collected image slices.
f. If more than 80% match is found in more than three features we consider it has a smile.

IV. CONCLUSION

A simple approach to smile detection is proposed in this paper makes use of existing face detection algorithm to detect face and from the identified face mouth is detected and features are extracted from that. The extracted features are then compared with actual smile features to identify the smile. The idea proposed here can be implemented by selecting an approach to extract the features. The Principal Component Analysis or fuzzy approach can be applied to extracted image slices to reduce the dimensionality of the image data.

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