Segmentation of Facial Features based on Human Face configuration for Facial Expression System

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Abstract

Mouth and eye plays very virtual role in the analysis of human mood. The proposed method focus on segmentation of these potential features. In this paper, an approach to the problem of facial feature detection based on human face configuration is presented. To recognize facial features from given image. Applying appropriate threshold value to find Facial feature such as eye, and mouth are extracted using statistical features, such as right array division and right array multiplications operations. Experiments are carried out on JAFFE facial expression database [12] and obtained better performance of the proposed approach in terms of accuracy.

Keywords: Feature Extraction, segmentation, Facial Expression Recognition

1. Introduction

In everyday life the facial expression plays very important role to understand the human being. In this study, we mainly concentrated on detection of eye position and mouth position using Major axis length and minor axis length. Facial expression can be identified in six different classes.

Facial expression recognition is the base of emotion understanding. At the same time, it is an effective way for understanding human emotion. Human brain can recognize facial expression just by facial features [1]. Shape features have some characteristics: - the dimension of feature vector is small and the computational complexity of training and recognizing is low. There have been more than 20 years since the facial expression recognition was primarily is research subject for computer science [2].

The method of facial expression recognition based on shape feature is always an important research subject.

An attempt is being made to develop a mind-implemented robot that can carry out intellectual conversation with humans. As the first step for this study, a method for the robot to perceive human emotion is investigated. Specifically, a method of human motion recognition from facial expressions by a neural network[3].

The result of this modelling method is a collection of fuzzy if-then rules obtained from input-output data. The input data consists of measurements of the movement of facial parts associated to different facial expressions. While the modeling results are satisfactory the initial recognition results are limited, due in part to the absence of the models for the remaining facial expressions[4].

Methodology for facial expression recognition from a single static image using line-based caricatures. The recognition process is completely automatic. It also addresses the computational expensive problem and is thus suitable for real-time applications. The effectiveness of the their technique has been evaluated and promising results are obtained. This work has proven the proposed idea that facial expressions can be characterized and recognized by caricatures[5].

Especially head pose variations are difficult to tackle and many face analysis methods require the use of sophisticated normalization procedures. Data-driven shape

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and motion-based face analysis approaches are introduced that are not only capable of extracting features relevant to a given face analysis task, but are also robust with regard to translation and scale variations. This is achieved by deploying convolutional and time-delayed neural networks, which are either trained for face shape deformation or facial motion analysis[6].

Representation of facial expressions based on a spatially-localised geometric facial model coupled to a state-based model of facial motion yields relatively little degradation in recognition rate, when faces are partially occluded, or under a variety of levels of noise introduced at the feature tracker level[7].

Development of an automatic facial expression analyzer was proposed in [8]. Multistate face and facial component models are proposed for tracking and modeling the various facial features, including lips, eyes, brows, cheeks, and furrows. During tracking, detailed parametric descriptions of the facial features are extracted. With these parameters as the inputs, a group of action units (neutral expression, six upper face AU and 10 lower face AU) are recognized whether they occur alone or in combinations[9].

For face portion segmentation and localization, morphological image processing operations are used. Permanent facial features like eyebrows, eyes, mouth and nose are extracted using SUSAN edge detection operator, facial geometry, edge projection analysis[10].

Automatic recognition of facial action units (AUs) and their temporal models developed from long, profile-view face image sequences. Particle filtering to track 15 facial points in an input face-profile sequence, and facial-action-dynamics recognition from continuous video input using temporal rules were proposed [11].

The combination of SUSAN edge detector, edge projection analysis and facial geometry distance measure is best combination to locate and extract the facial feature for gray scale images in constrained environments and feed forward back-propagation neural network is used to recognize the facial expression [13].

SUSAN algorithm designed to extract facial features such as eye corners and center, mouth corners and center, chin and cheek broder, and nose corner etc[14].

Most of them use face segmentation to initialize the face location but not as a constraint during the online fitting. Fits an Active appearance model to a pre fits an AAM to preprocessed image containing only the segmented face region. This approach relies on a very accurate segmentation [15].

In this paper, we mainly concentrated on detection of eye and mouth of “Neutral face”. The detection of eye has been calculated by array multiplication of major axis length and minor axis length, as well detection of mouth has been calculated using right array division of major axis length by minor axis length.

The rest of the paper is organized as follows. Section 2. highlights on Data collection, Section 3. presents methodology followed, Section 4. presents conclusion and feature scope.

2. Data Collection

Data required for experimentation is collected from JAFFE database. JAFFE stands for the Japanese Female Facial Expression Database [12]. The database contains 213 images of 7 facial expressions (6 basic facial expressions + 1 neutral) posed by ten different Japanese female models. Sixty Japanese subjects have rated each image on 6 emotion adjectives.

The photos were taken at the psychology Department in Kyushu University. Database contains images of various facial expressions such as Angry, Disgust, Fear, Happy, Neutral, Sad and Surprise. Sample images of the database are shown in Fig.1

![Sample Images of JAFFE Database](image)

3. Methodology

Block diagram of the proposed method is show in Fig2.

In this paper 213 JAFFE[12] database image size is 256x256. Images from JAFFE database are taken as input. The images are first pre-processed in which, Sobel filter is applied on the Original image and then converted into Binary image, The binary image resulted after morphological operation needs to be labeled so that each clustered group of pixels can be identified at a single region so that each region can be analyzed further to determine whether it is a face region or not.

![Block Diagram](image)
That is instead of 1 and 0, each region is labeled as 1, 2, 3 and so on. Pixels with 0 values are unchanged.

The regions of eye and mouth are extracted from the face region. Next, the method searches for each outline of the extracted regions and finds feature points of each region on the outline. The figure shows that the eyes and mouth are the most critical areas of the face for determining facial expressions.

The upper right of Fig. 3(d) plots discriminant vector component magnitude averaged over all frequencies locations and expressions as a function of spatial orientation.

The lower right of Fig.3(d) plots discriminant vector component magnitude averaged over orientation, location, and expression as a function of spatial frequency. Firstly, width, height, orientation , ratio of major and minor axis and centroid of binary region under consideration has to be computed.

Image is partitioned into 2 regions i.e upper and lower part on the basis of processed image as shown in Fig.3(c) assuming the fact that lower portion eyes are present in the upper part of the face and higher portion mouth are present in the lower part. Smaller segments within the region are eliminated by applying appropriate threshold value -10 to 10.

A) If a portion is a lower portion if its value is greater than x and y coordinates of center of the image then it is assumed that mouth is present in this area. For mouth portion certain threshold for values of x and y is considered for eliminating segments. In lower portion, potential mouth is detected provided whose ratio of right array division of major axis length by minor axis length is maximum shown in Fig 4(a).

B) If a portion is a Upper portion if its value is less than x and y coordinates of center of the image then it is assumed that eye is present in this area. For eye portion certain threshold for values of x and y is considered for eliminating segments. In upper portion, potential eye is detected provided whose ratio of right array multiplication of major axis length by minor axis length is maximum as shown in Fig 4(b).

This process is repeated until we get two segments such as mouth and eye for each image.

Experimental results are shown in the following Figure 3 and Figure 4. Performance of the proposed method with respect to JAFFE database is tabulated in the Table1. Mouth is well detected as compared to eye and both features are used for facial expressions in feature work.

4. Conclusion and Future Scope

In this paper, segmentation of eye and mouth of face has been proposed, as a pre-processing step for facial expression recognition. In future work, we will concentrate on all type of face expressions recognition.
Table 1: Recognition Accuracy

<table>
<thead>
<tr>
<th>Features</th>
<th>No. Of Images</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth Detected</td>
<td>137</td>
<td>64.3%</td>
</tr>
<tr>
<td>Eye Detected</td>
<td>07</td>
<td>0.03%</td>
</tr>
<tr>
<td>Both Detected (Mouth &amp; eye)</td>
<td>46</td>
<td>21.5%</td>
</tr>
<tr>
<td>Miss Detected</td>
<td>23</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

JAFFE Database
213 Images (our approach)

An attempt can also be made for other facial expression data base images.

References