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An Efficient Method for Recognizing Facial Expression by using PCA-LDA Fusion

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ABSTRACT: The facial detection and recognition method is an attractive tool for automatically detecting faces and capturing emotions by using certain methods. Emotion recognition is focused on recognizing discrete, basic emotional states from posed data obtained in the datasets. In this project, the aim is to develop Face detector and Emotion Recognizer system based on the “Affective Computing approach”.

KEYWORDS- Face recognition, Principal Component Analysis, Artificial Neural Network, LDA, SVM, Feature Extraction

I. INTRODUCTION

Face detection and recognition system has been one of the fast developing systems due to its wide range of application. It includes mainly emotion analysis, image retrieval, affective interface, vision systems for autonomous robots, human computer interaction systems (HCI), surveillance systems, biometric based authentication systems etc. Many research efforts have been made in the area of facial expression recognition under different environments such as illuminations, and orientations. The facial detection and recognition method is an attractive tool for automatically detecting faces and capturing emotions by using certain methods. Emotion recognition is focused on recognizing discrete, basic emotional states from posed data obtained in the datasets.

In this project, the aim is to develop Face detector and Emotion Recognizer system based on the „Affective Computing approach‟. The affective computing is a human- computer interaction system in which a device has the ability to detect and respond to the user's emotions. A web camera captures the images of a user, and face detection and recognition methods are used to process the data to yield meaningful information. The system is used for extracting features by using feature extraction methods. A classifier is combined with the feature selection methods to recognize the emotions

II. LITERATURE SURVEY

Face detection and recognition has obtained an increasing amount of attention in machine learning and computer vision over the past few years. This technology can be applied in a wide range of fields, such as identity authentication, access control etc. Facial detection and recognition system is different from conventional detection and recognition system in two aspects. Firstly, in the construction of color images database: many face databases contain gray scale images only. It is restricted for the applications that require skin detection, which often relies on color-based analysis. Secondly, the difference lies in terms of high accuracy as their traditional approaches were not accurate.

We have observed that PCA, ICA, LDA, Neural networks, Geometric feature matching, SVM, HMM, AdaBoost and Gabor jets are available for face detection and recognition. AdaBoost and Gabor jets have been performed consistently over different datasets whereas other methods such as PCA, LDA SVM etc., behave very randomly. These methods for facial detection and recognition do not involve the issues, such as purely color image databases, difficulty in automatic feature detection, high degree of correlation between the test and training images and do not perform effectively under a large variation in pose, scale and illumination, etc. For face detection, we have explored many algorithms amongst which AdaBoost algorithm seems to be best suitable and on the other side, Gabor jets for face recognition. AdaBoost along with Gabor jets may reduce a high degree of correlation between the test and training images.

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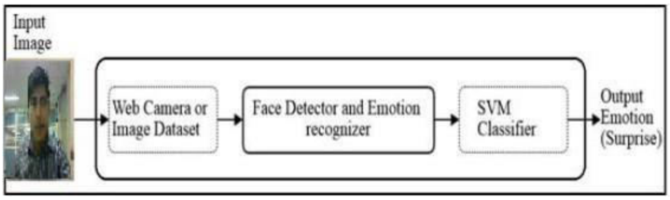
III. EXISTING METHOD

There are many methods exist for feature extraction and classification such as PCA, ICA, LDA, Neural Networks, Geometric feature matching, SVM, HMM, AdaBoost and Gabor jets. The SVM and Gabor jets behave consistently over various datasets whereas Neural Networks, ICA and HMM behave randomly. It has been observed that the HMM require a one-dimensional observation sequence; however, the images are two-dimensional and it also requires extra computing effort. Neural Networks and ICA methods does not involve the issues such as purely color image datasets and difficulty in automatic feature detection. Also, these methods do not perform effectively under a large variation in pose, scale and illumination, etc. For face and emotion recognition, we have

tried to explore some methods amongst which Gabor jets for feature extraction seems to be the best suitable method to overcome the above mentioned issues and SVM to classify them.

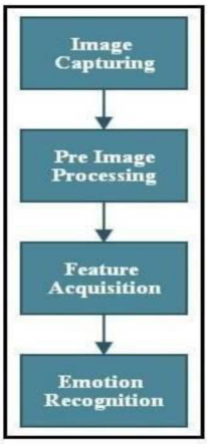
ABSTRACT MODEL



IV. METHODOLOGY

The face and emotion recognizer system consist of four layered phases as depicted below. These layered phases include image capturing, pre-image processing, feature acquisition and emotion recognition. The first phase is responsible for continuous image capturing in the real time environment. The pre-image processing phase detects the face and crops the image so that the facial features are aligned. In the feature acquisition phase where the features of interest are acquired from the cropped image. In the final phase, the emotion recognition phase classifies these features as one of several emotions. We have explained the functioning of each phase in subsequent sections.

MAJOR PHASES



V. PROPOSED SYSTEM & ARCHITECTURE

In previous section, it has been observed that the traditional face and emotion recognition system suffers from various pitfalls such as low recognition rate, difficulty in creating color image datasets and recognizing emotions in complex backgrounds. Thus, we hereby proposed a robust and reliable Real Time Face and Emotion Recognizer (RTFER) to overcome all these flaws. The phases of face and the emotion recognizer system which were explored and need to be

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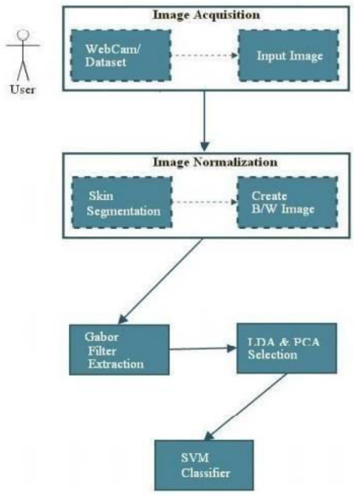
further divided into sub phases to efficiently develop abstract model of RTFER system. The abstract model of the RTFER system is revealed below. It shows system captures color image from web camera or select image from dataset. To extract emotions, we require feature extraction, feature selection and classification method. We intend to perform this activity in real time, especially, for the recognition of emotions, namely; happy, anger, neutral and surprise.

ARCHITECTURE



1. Image Acquisition

Image acquisition is the first phase of the system, which is responsible for continuous image capturing in real time environment. In this phase, the system parameters and resources are initialized. It includes appropriate installation of web camera and capturing images. The web camera must be placed in front of the user (such as mounted on top of the monitor). The low cost web camera is used to test the robustness of the system. The web camera driver software must be installed and the web camera must be connected with a computer before using the system. In this phase, configuration of web camera and image capturing takes place. At first, we create camera object, namely emotion for capturing images. The captured images are comprised of RGB color format with 320 pixels in width and 240 pixels in height, i.e. the size of the image is [320*240] pixels. The configuration of the camera includes the initialization of parameters such as brightness (145-175 Lumens), frame rate (30 frame/Sec) and frame interval (1 or 3) which convert the 14 captured images into digital frames. Every first (or third) frame is extracted from the input image frame buffer and the RGB image.

2. Image normalization

The choice of color space can be considered as the primary step in image normalization. The RGB color space is the default color space for most available image formats. Any other color space can be obtained from a linear or a non-linear transformation through RGB. The color space transformation is assumed to decrease the overlap between skin and non-skin pixels. Therefore, this transformation is used in skin pixel classification. Many color spaces exists for skin segmentation such as RGB, HSV, YIQ and YCbCr. Out of these color spaces, it has been observed that the YCbCr color space is effective in skin segmentation. The YCbCr color space is used in our experiment because the skin-color is more centralized in the YCbCr color space. In YCbCr color, Y stands for luminance and is computed from non-linear RGB. It is constructed as a weighted sum of the RGB values. Cr and Cb are calculated by subtracting luminance from RGB red and RGB blue respectively.

3. PCA-LDA Fusion

The main objective of PCA-LDA fusion is to improve the performance and robustness of recognizer. The above methods are based on the decision-level fusion that is the combination of the outputs of the individual PCA and LDA

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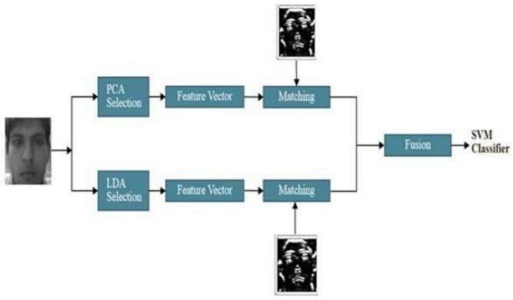
more or less simple fusion rules. In PCA-LDA Selection, Due to the large number of features extracted in the previous sub phase it was necessary to reduce the number of features as they are unrelated. We chose PCA-LDA for selecting features and tried to remove the false dimensions. The PCA is one of the best known techniques for feature extraction. Effectively, it projects the measurement space on a plane such that the variance of the data is optimally preserved. This analysis transforms the input data so that the elements of the input vector set will be uncorrelated. In addition, the size of the input vectors may be reduced by retaining only those components who contribute more than a specified fraction of the total variation in the data set. PCA is responsible for the reduction of the dependence on the environmental conditions with respect to the best individual recognizer.

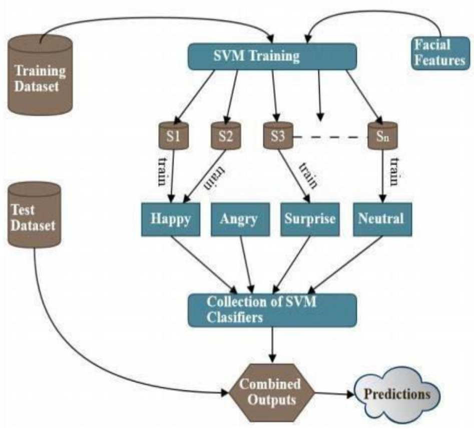
PCA–LDA FUSION



4. SVM Classification

Support Vector Machine classification is sub divided into two phases, namely SVM training and SVM classifier. The training data set provides sample images and selected feature comes from the fusion of LDA and PCA selection phase of RTFER to SVM training phase. SVM training phase create 4 classes of emotion; happy, anger, surprise and neutral. Each sample image belongs to the above mention category of emotion which will provide iteratively learning to the SVM classifier using selected facial feature. Afterwards, SVM classifier takes input image from the test data set which is classified into one emotion class (happy, anger, surprise, neutral) whose threshold value is nearest to the image feature value through learning experience. Machine learning methods are the systems that receive data as input during a training phase and build a model of the input and output, a hypothesis function that can be used to predict future data.

CLASSIFICATION



VI. PROPOSED OUTPUT

In our experimentation, the datasets comprised of around 400 images in frontal faces are used. The entire face dataset is divided into two parts; training and testing datasets. Two hundred twenty images have been used to construct training dataset whereas most of all the images have been utilized for testing. The images are cropped to get the desired face part of a person (from forehead to the chin). All the images are adjusted so that both eyes coordinates of an individual are aligned in the same horizontal line. Similarly, the dimension for each image is set to 128 x 128 pixels

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VII. CONCLUSION & FUTURE WORK

In this project, the Gabor filter and SVM classifier have been used for multiclass classifications of Emotions in order to classify and recognize facial expression. The methods which have provided the best results were applied to our dataset. We extracted the features from the Gabor wavelet to test the accuracy of the classification methods which was applied on the dataset. Although the system was studied in detail during the project, however, there is still some further work required to improve the existing methodologies. First and foremost, during feature extraction, we found that the feature extraction methods that were providing the best classification results were often found as low frequency components of the Gabor wavelets. We propose to include the visualization of the Gabor wavelets along with the Haar wavelet coefficients which would give the highest recognition rates. Secondly, for the feature selection, the PCA-LDA fusion was used and we found that it was working slow when the large number of features are applied to the PCA-LDA fusion selection method. Therefore, to decrease the overall time of the training dataset, usage of other feature selection algorithms may be considered.

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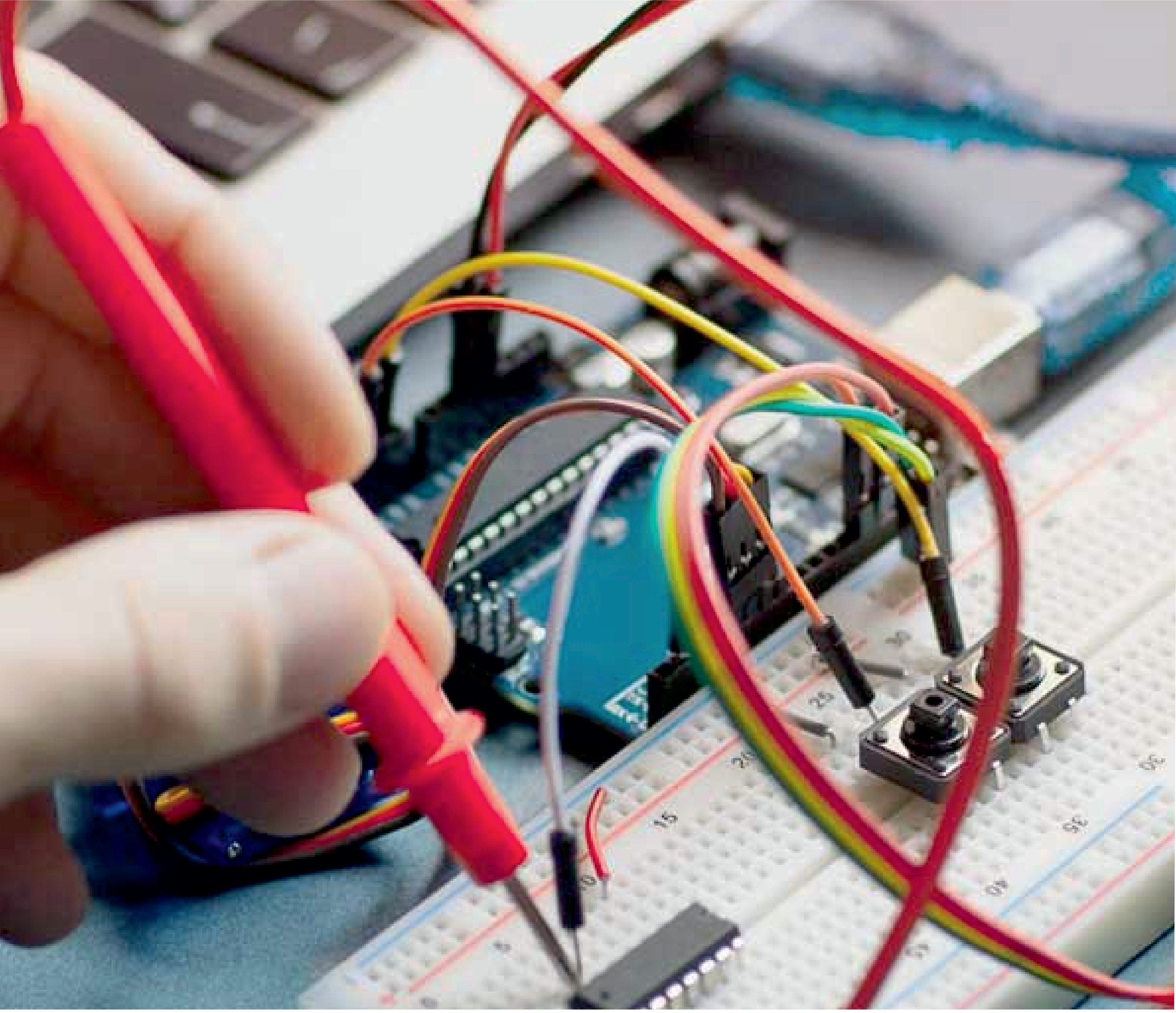

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