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3D Human Face Recognition Using 3D Point Signature

A Report for the Evaluation 3 of Project 2

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I. Abstract

Facial expression conveys non-verbal cues, which plays an important role in interpersonal relations. The Facial expression recognition system is the process of identifying the emotional state of a person. The facial recognition is presented based on the point signature-a representation for free-form surfaces. The rigid parts of the face of one person are extracted after registering the range data sets of faces having different facial expressions. These rigid parts are used to create a model library for efficient indexing. For a test face, models are indexed from the library and the most appropriate models are ranked according to their similarity with the test face. Verification of each model face can be quickly and efficiently identified. The facial expressions under examination were defined by psychologists as a set of six basic facial expressions (anger, disgust, fear, happiness, sadness, and surprise).This system is based on image processing and machine learning. For designing a robust facial feature descriptor, we apply the Local Binary Pattern. Local Binary Pattern(LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighbourhood of each pixel and considers the result as a binary number.

Keywords --- Facial recognition, point signature, image processing, machine learning.

II. Introduction

The human face provides a number of social signals which are essentials for human interpersonal communication in our everyday life. The human face also holds very important quantity of attributes and information about the person, such as facial expression, ethnic, age and gender. Facial expression is a movement of facial muscles by a human involuntarily when they feel something like anger, happiness and fear, etc. Various approaches have already been attempted towards attending the problem, but the complexities added by some circumstances and inconsistency of acquisition conditions have made the task quite complicated and challenging. However, the recent advancements in the area of image analysis and pattern recognition have opened up the possibility of automated measurement of facial signals.

A facial expression is a visible manifestation of the affective state, cognitive activity, intention, personality and psychopathology of a person and plays a communicative role in interpersonal relations. Though much progress have been made, facial recognization remains to be difficult due to the complexity and varieties of facial expressions.

On a day to day basis, humans commonly recognize emotions by characteristic features, displayed as a part of the facial expression. For instance, happiness is undeniably associated by a smile or an upward movement of the corners of the lips. Similarly, other emotions are characterized by other deformations typical to a particular expression. The system classifies facial expression of the same person into the basic emotions namely anger, disgust, fear, happiness, sadness and surprise.

Often, in the offices, schools, hospitals and in other public places, it might happen that a person has an identical looking face or eyes of a person working in the same organization. It becomes difficult for the machine to recognize the person correctly. Hence, through this model, it will be easier to recognize the person in a much easier way. To make this model, it is required to have a data set of each individual containing several photos with different facial expressions. With the help of the data set, the rigid parts of the face of one person are extracted.

The changes in the facial expression can be either based on minor deformations in wrinkles/bulges or based on major deformations (in eyes, eye-brow, mouth, nose, etc.). Some of the feature extraction techniques and facial expression categorization includes, Geometric based and Appearance based, Action Unit (AU) of individual/group of muscles and Non-AU based, Local versus Holistic. In geometric based methods, the position and deformation/displacement information of the facial components are considered, whereas appearance methods simply apply a filter. Facial emotion are categorized into six namely, anger("combination of brow lowerer, upper lid raiser, lid tightened, lip tightened"), disgust("combination of nose wrinkle, lip corner depressor, lower lip depressor"), fear("combination of inner/outer brow raiser, brow lowerer, upper lid raiser, lid tightened, lip stretcher, jaw drop), happy("combination of cheek raiser, lip corner puller"), sad("combination of inner brow raiser, brow lowerer, lip corner depressor"), surprise("combination of inner/outer brow raiser, upper lid raiser, jaw drop"). There is still research scope in this area depending on the regional behaviour (for e.g., in Indian scenario even eyes alone can tell about anger, surprise and other emotions).

The main purpose of this system is efficient interaction between human beings and machines using eye gaze, facial expressions, cognitive modelling, etc.

Some of the scopes of facial recognition are:

1. The system can be used to detect and track a user's state of mind.

2. The system can be installed at busy places like airport, railway station or bus station for detecting human expression and human faces of each person.

3. The system can also be used for education purposes such as one can get feedback on how the student is reacting during the class.

4. Law enforcement application and commercial application, especially Mug shot albums and video surveillance.

5. Static matching of photographs on credit cards, ATM cards, passports, driver's licenses, and photo ID to real-time matching with still images or video image sequences for access control.

III. Existing system

Approach of face recognition aims to detect faces in still image and sequence image from video have many method such as local, global, and hybrid approach. The main problem of face recognition are intensity, illumination, pose, difficult to controlling and large occlusion. In 3D capture creates larger data files per subject which applies significant storage requirements, slow processing, most new devices can be capture in 3D. This is the problem for our future work that want to solve and create accuracy gain for widely accept in 3D face recognition system. In order to make the recognition procedure more standardized, a set of muscle movements known as Facial Action Units (FAUs) that produce each facial expression, was created, thus forming the so-called Facial Action Coding System (FACS). These FAUs are combined in order to create the rules responsible for the formation of facial expressions.

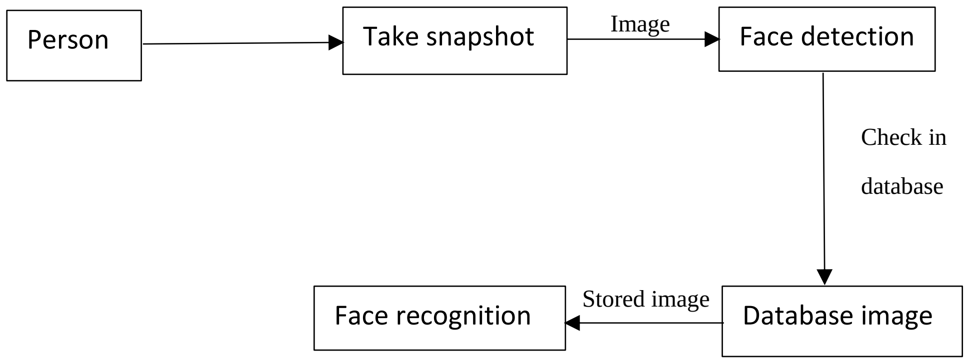
Spectral dimensions from human tissue, for example, have been used for numerous years for characterization and observing applications in biomedicine. In remote sensing, scholars have shown that hyperspectral data are operative for material identification in scenes where other sensing modalities are unsuccessful. The introduction of hyperspectral cameras has led to the expansion of methods that syndicate spectral and spatial information. As hyperspectral cameras have become accessible, computational methods developed primarily for remote sensing problems have been moved to biomedical applications. Since the vast person-to-person spectral variability for different tissue types, hyperspectral imaging has the capability to expand the capability of automated systems for human identification.

IV. Proposed System

Most research and system in facial expression recognition are limited to six basic expressions (joy, sad, anger, disgust, fear, surprise). It is found that it is insufficient to describe all facial expressions and these expressions are categorized based on facial actions. Detecting face and recognizing the facial expression is a very complicated task when it is a vital to pay attention to primary components like: face configuration, orientation, location where the face is set.

Facial Expression recognition can be categorized in to two major approaches. 1) Appearance based and 2) Model based recognition techniques. I presented a method for facial expression recognition using eigenfaces in which PCA is used to extract features from input image and test out with training dataset but based on the idea, I divided the training set into six basic classes according to universal expression. In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for edge detection. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. The Gabor filters are self-similar: all filters can be generated from one mother wavelet by dilation and rotation. Gabor filters are efficient in reducing image redundancy and robust to noise. Such filters can be either convolved with the whole image or applied to a limited range of positions. In such a case, a region around a pixel is described by the responses of a set of Gabor filters of different frequencies and orientations, all centered at that pixel position. The results indicated that, surprisingly, classifying features from the whole face yields greater accuracy despite the additional noise that the global data may contain.

V. Implementation/Architectural Diagram



In this system, a clear photo of a person is taken for the face detection. In the database, six different photos of six facial expressions (happiness, sadness, surprise, disgust, angry and fear) of each person is contained. These facial expressions bring rigidness in the different parts of the face, hence identification and accuracy of the facial recognition increases. The rigid parts of the face of a person are extracted after registering the range data sets of faces having different facial expressions. These rigid parts are used to create a model library for efficient indexing. For a test face, models are indexed from the library and the most appropriate models are ranked according to their similarity with the test face. If the image taken of a person matches with the photos of the database, the person is recognized.

VI. Output

The system for detecting FACs action units based on Haar features and the Adaboost boosting algorithm was developed. This method achieves equally high recognition accuracy for certain AUs but operates two orders of magnitude more quickly than the Gabor+SVM approach. In order to capture the dynamical characteristics of facial events; we design the dynamical HAAR-like features to represent the temporal variations of facial events. Inspired by the binary pattern coding, we further encode the dynamic HAAR-like features into binary pattern features, which are useful to construct weak classifiers for boosting learning. Finally the Adaboost is performed to learn a set of discriminating coded dynamic features for facial active units and expression recognition. The algorithm implements Radial Symmetry Transform and further uses edge projection analysis for feature extraction and creates a dynamic spatiotemporal representation of the face, followed by classification into one of the expression classes. The algorithm achieves an accuracy of 81.0% for facial expression recognition from grayscale image.

Investigation on different feature representation and classification schemes was done to recognize 6 expressions (happy, angry, disgust, sad, fear, and surprise) and obtained 95.71% recognition rate using 2D-LDA (Linear Discriminant Analysis) and SVM (Support Vector Machine) and it will take 0.0357 second to process one image of size 256 × 256.

VII. Conclusion

Facial Expression recognition has increasing application areas and requires more accurate and reliable FER system. This paper has presented a survey on facial expression recognition. Recent feature extraction techniques are covered along with comparison. The research is still going on:

- to increase the accuracy rate of predicting the expressions,
- to have applications based on dynamic images/sequence of images/videos,
- to handle the occlusion.

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