A Review on Face Detection and Expression Recognition

Ms. Komal Domadiya[1], Mr. Vipul Gamit[2], Ms. Kajal Patel[3]

[1,2,3]Babu Madhav Institute of Information Technology, Bardoli, India

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Abstract - *The objective of this paper is to introduce of facial expression recognition. Our facial expressions are the fastest means of communication while conveying any type of information. These are not only exposing the sensitivity or feelings of any person but can also be used to judge his/her mental views. Face recognition is a computer application for automatically identifying or verifying a person from digital images. Facial expressions play an important role in human communication. It is use for known his/her mental views. FER technology detects the six basic or universal expressions.*

Key Words: **Face Recognition, Face Expression Recognition, PCA, LBP, Eigen Faces.**

1. INTRODUCTION

There are two types face expression.

(1) Facial

(2) Non-facial

In facial expression includes (Happiness, Sadness, Anger, Surprise, Fear, Disgust). In non-facial includes (Confidence, Helpless, Disappointment, Depression, Satisfaction, Tension, Excitement).
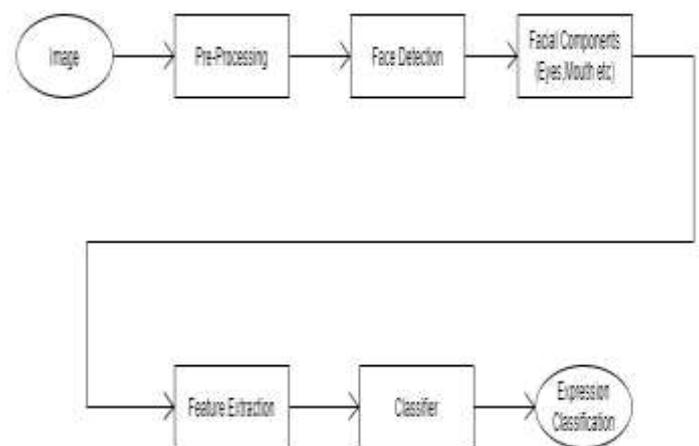
Face expression recognition is a computer application for identifying the facial expressions of any person using an image.

FER is use in security and access control such as eye IRIS scan.
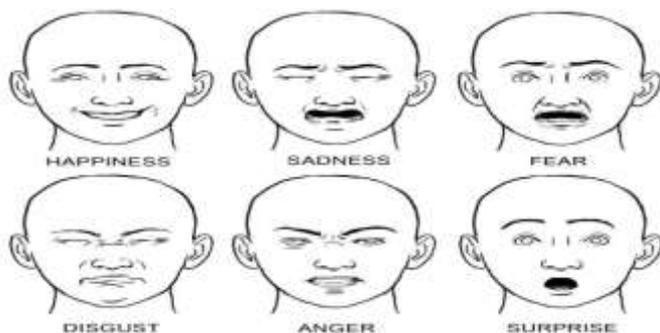
Facial expression recognition is composed of three major steps.

(1)   Face detection and pre-processing of image.

(2)   Feature extraction.

(3)   Expression classification.

In first step, the face detection involves methods for detecting faces in an image and perform pre-processing operations.

In second step, the feature extraction covert pixel data into face features like eyebrows, lips, eyes, cheeks etc.

In third step, the expression classification identify expression in person images.

2. PREPROCESSING

There are following pre-processing method.

(1) A wavelet transforms

Wavelet transform is mathematical functions. It uses for Image compression. Wavelet transform cut data into different frequency components and then study each components and match image with its scale. Wavelet transform work based on Time Frequency and this frequency can be low or high.

(2) Discrete cosine transforms

It converts image spatial domain into frequency domain. It transforms image data into its frequency value.

(3) Color normalization methods

In color normalization color space normalization [CSN] technique is used. In these pixels value divide into three color (RGB) component for remove effect.

3. FACE RECOGNITION

There are following preprocessing method

(1)   Knowledge-based method

Knowledge-based method is rule base. It tries to capture human knowledge and translate into set of rules.

Example of Knowledge-based method

- In human face has two symmetric eyes and center part of human face is uniform.

- These methods find the distance between eyes or color intensity value of eyes area.

- Result: - eyes are darker than cheeks or nose.

(2)   Future-based method

These methods find some invariant features from human face such as angle, position etc. It recognizes width of nose, shape of cheeks bones, depth of eyes sockets.
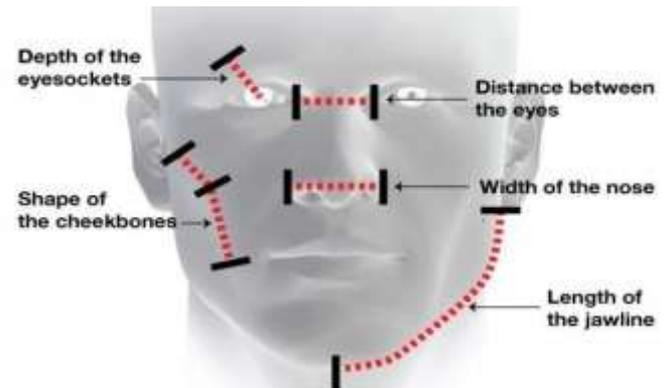
(3)   Template-matching method

Template-matching method compare input images with stored patterns of human faces. It is use for finding small parts of faces and match it with template or pattern.
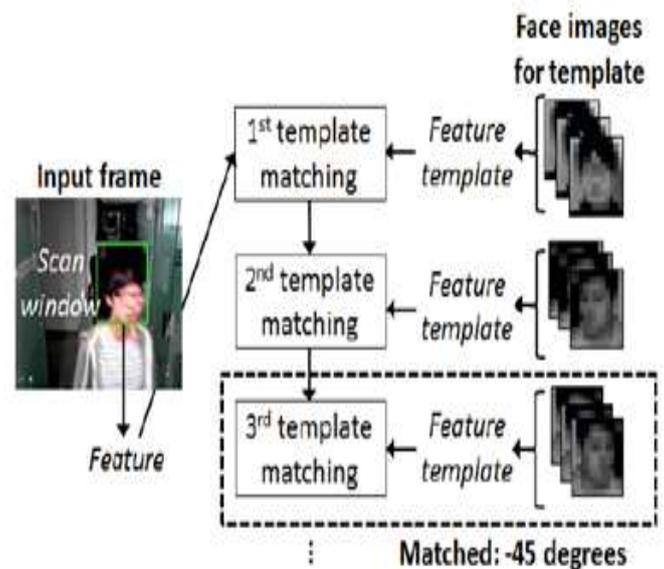

(4)   Appearance-based method

These methods are also used in feature extraction for face recognition. It performs statistical analysis and finds characteristics of face images.

3. FACE EXPRESSION RECOGNITION

(1)   Local binary pattern [LBP]

The LBP robust method for texture description. The LBP deals with eight neighbors of a pixel. It performs by image Thresholding.

LBP operator assigns a label to every pixel of an image by "Thresholding" the 3*3 neighborhood of each pixel with the center point value and these result as a binary number.

3x3 pixels   Threshold 90   Binary 10001101
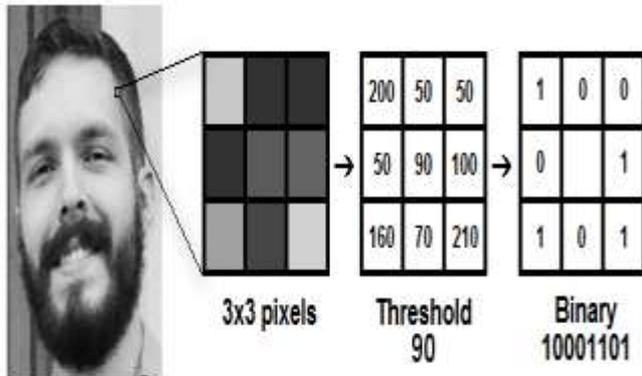
Example: -

Here three types of weighted in image. gray pixel (1.0) white pixel (4.0), black pixel (0.0).

A neighbor pixel has a greater or equal value to the center pixel, then a logic high bit "1" is allocated to that pixel, otherwise, it gets the logic bit "0" and produce binary output.

LBP method describes three different level texture information of face.

- LBP labels contain information about on pixel-level.

- LBP produce information about small region-level.

- The small regions are to build a global description of the face.

Below image represent the regions.


LBP work with small regions and it is slower than PCA.

(2)   Principle component analysis [PCA]

PCA is a mathematical procedure that transforms a number of correlated variables into a smaller number of uncorrelated variables called principal components.

Main purpose of PCA is to reduce the large dimensionality of variable to the smaller dimension of feature space without losing much information.

The main objective of PCA is below.

- Data Dimensionality Reduction

- Clustering (Noise Reduction)

(a) PCA basis   (b) PCA reduction to 1D
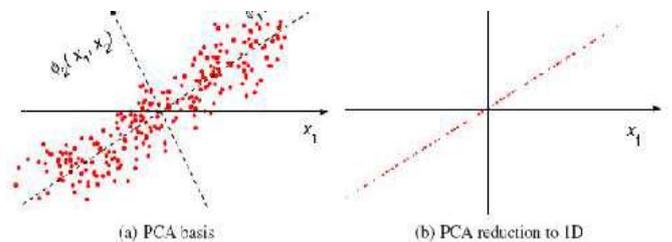
Goal Of PCA: -

(1) Extract the most important information from the data table.

(2) Compress the size of the data set by keeping only this important information.

(3) Simplify the description of the data set.

Example for eigenface

Eigenfaces look somewhat like generic faces.
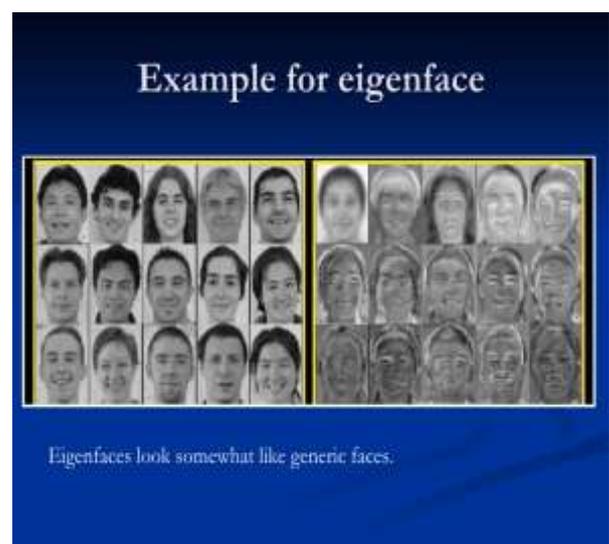
Principal component analysis (PCA) PCA is a statistical dimensionality reduction method.

PCA also is used to remove redundant information.

A face contains certain set of features and these characteristic features are called Eigen faces.

PCA Method uses Eigenvectors (store the features) and Eigenvalues (store value) for representing Eigen face in image.

4. IMPLEMENTATION

Face recognition system recognize faces.it detect human faces and represent with square frame.

Face recognition implemented in python.

Demo.py

```
import cv2

import sys

import logging as log

import datetime as dt

from time import sleep

cascPath = "haarcascade_frontalface_default.xml"

faceCascade = cv2.CascadeClassifier(cascPath)

log.basicConfig(filename='webcam.log',level=log.INFO)

video_capture = cv2.VideoCapture(0)

anterior = 0

while True:

    if not video_capture.isOpened():

        print('Unable to load camera.')

        sleep(5)

        pass

    # Capture frame-by-frame

    ret, frame = video_capture.read()

    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)


    faces = faceCascade.detectMultiScale(

        gray,

        scaleFactor=1.1,

        minNeighbors=5,

        minSize=(30, 30)

    )

    # Draw a rectangle around the faces

    for (x, y, w, h) in faces:

        cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)

    if anterior != len(faces):

        anterior = len(faces)

        log.info("faces:        "+str(len(faces))+"        at "+str(dt.datetime.now()))

    # Display the resulting frame

    cv2.imshow('Video', frame)

    if cv2.waitKey(1) & 0xFF == ord('q'):

        break

    # Display the resulting frame

    cv2.imshow('Video', frame)

# When everything is done, release the capture

video_capture.release()

cv2.destroyAllWindows()
```

RESULT OF ABOVE IMPLEMENTATION

5. COMPARISION

Principle Component Analysis	Local Binary Pattern
PCA focus on Magnitude Information.	LBP not focus on Magnitude Information
PCA reduce image feature dimension.	LBP divide image feature in small regions.
PCA is better than LBP because is capture the feature of face without losing important information.	LBP is capture only limited texture information about face.

6. LITERATURE REVIEW

Facial expression presents key mechanism to describe human emotion and Happiness, Sadness, Surprise, Fear, Disgust, and Anger as universal emotions [1].

An automatic face recognition usually begins with the detection of the face pattern, and then pro-ceeds to normalize the face images using information about the location and appear-ance of facial landmarks such as the eyes [2].

The Local Binary Pattern (LBP) operator is a signified robust method of texture description [3].

Pre-processing is the next stage after entering the data into the facial expression recognition system [4].

PRINCIPAL component analysis (PCA) is a powerful technique for extracting a structure from potentially high-dimensional data sets, which corresponds to extracting the eigenvectors that are associated with the largest Eigen values from the input distribution [5].

Principle component analysis (PCA) and linear discriminant analysis (LDA) are two powerful tools used for data reduction and feature extraction in the appearance-based approaches [6].

Wavelet transform technique is a new field in face recognition and it has an impact on some old and new disciplines [7].

He PCA is applied to extract features from images with the help of covariance analysis to generate Eigen components of the images and reduce the dimensionality [8].

7. CONCLUSIONS

In these papers, review about the problems and challenges of recognizing the face. Various factors are challenging like human different expression. Therefore, this paper recommends that these set of limitations be further investigated and improved.

In future work, we will present more efficient face expression recognition method, which will be more accurate than the existing system.

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