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A Study of Facial Expression Recognition by Hybrid Technique

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Abstract: This study gives the knowledge about facial expression recognition by using hybrid technique. Hybrid technique is nothing but unifying two techniques to increase the recognition rate. Human expressions are fundamentally categorized by six classes, such as happy, neutral, sad, anger, surprise, and disgust. The implementation includes for finding facial expressions are local binary pattern used for face recognition and Haar-cascade classifier for face detection. Joint and transfer learning approaches will produce best outcomes and it will further increase the results. In this paper two techniques are used local binary pattern and local binary pattern histogram with haar cascade classifier. By using these techniques it will detect the facial expression and as well as it will differentiate the recognition rate between LBP and LBPH. This paper will notify the recognition rate of the respective image and it will also show the time taken for training the image. If we employ single technique the recognition rate will be low similarly if we combine two techniques then the recognition rate will be high. Face expression recognition is most effective and these are used in many real time applications by many apps for security purposes.

Keywords: Hybrid technique, facial expression recognition, feature extraction, face detection, face recognition, local binary pattern, haar-cascade classifier, local binary pattern histogram.

1. INTRODUCTION

The computer examines the faces and facial feature with reference to facial expression, it has become very commercial. In the last decade, the main target application is the human computer interface (HCI). One basic low level task for HCI is to detect the mood of the user sitting infront of the machine. For a human this can be a challenging task. The ability to recognize emotions correctly depends on some premises that have large impact to the classification rate:

- Familiarity with the face of the observed person,
- Familiarity with the personality and the usual mimics of the observed person,
- General experience with different types of expressions

A very much required factor for human communication is facial expression that will help us to have a clear idea about other emotions. There are some basic expressions like happy, anger, disgust will infer the emotional state of the other people. Since the application of smart phone has been moving to reach its milestone and started the security for unlocking the mobile. In such a way that it has crossed the paths from pattern to unlocking by the person's face. This made us surprising and influences us to learn, and inspired to study about face expressions and how it can be recognized. In the earlier days for detecting face expressions we are using gray images but the improvement of technology in image processing inspired us to prefer colour images of a person expressions i.e., happy, anger, sad, neutral, disgust, surprising, etc. increasing demand for better customer experience and satisfaction. This will helps us to improve customer experience for many companies to understand human emotions and adjust to increase overall satisfaction and happiness.

1.1 Problem statement

Certainly, expression plays a main role not only in our relations with other people but also in the way of using computers. The automatic recognition of human expression is a challenging problem in a research field involving more and more scientists specializing in different domains such as computer vision, physiology, psychology, and artificial intelligence, etc. Its commercially arises from huge areas of possible applications. The main problem in facial expression recognition is by using individual image processing technique to find facial emotions the accuracy will be less. In order to overcome this we go for hybrid technique.

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1.2 Existing system

Existing system done with the facial expression recognition using face region methods with SVM (support vector machine) classifier, LBP (local binary pattern), CLBP (compound local binary pattern), and dynamic LTP. Also CNN, SVM, VGG-166, ResNet50, Transfer Learning, Ensemble learning, CNN and LBP with an SVM classifier.

1.3 Limitations

Limitations and research gap in this existing works are, they found expression only using gray scale images, and our proposed work is implemented for even colour images and a video stream as well.

2. SYSTEM DESIGN

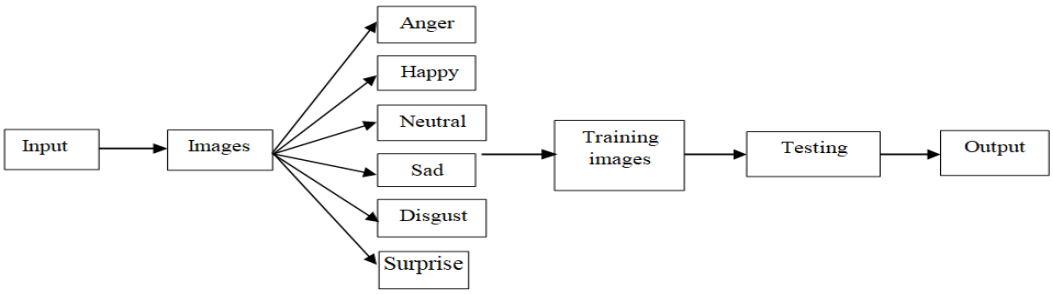

Figure -1. System architecture

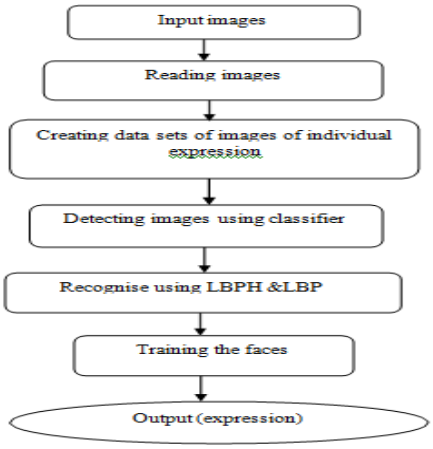

Figure-2. Flow chart of the proposed work

2.1 Working of LBPH (local binary pattern)

- **Face detection:** it has the objective of finding the faces (location and size) in an image and probably extracts them to be used by the face recognition algorithm.
- **Face expression recognition:** with the facial images already extracted, cropped, resized and usually converted to gray scale, the face expression recognition algorithm is responsible for finding characteristics which best describe the image.

The face recognition system can operate basically in two modes:

- **Verification or authentication of a facial image:** it basically compares the input facial image with the facial image related to the user which is requiring the authentication. It is basically a 1*1 comparison.
- **Identification or facial expression recognition:** it basically compares the input facial image with all facial images from a dataset with the aim to find the user that matches that face expressions. It is basically a 1*N comparison.

Suppose we have a facial image in gray scale. We can get of this image as a window of 3*3 pixels. It can also be represented as a 3*3 matrix containing the intensity of each pixel (0~255). Then, we need to take the central pixel value of the matrix to be used as the threshold. This value will be used to define the new values from the 8 neighbourhood pixels. For each neighbour of the central value (threshold), we set a new binary value. We set 1 for values higher or equal than the threshold and 0 for values lower than the threshold.

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Now the matrix will contain only binary values ignoring the central pixel values. We need to concatenate each binary value from each position from the matrix line by line into a new binary value. Then we convert this binary value to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image. At the end we will get a new image which represents better the characteristics of the original image. Now using the image generated in the last step, we can divide the image into multiple grids. Based on the image above, we can extract the histogram of each region as follows: as we have an image in gray scale, each histogram will contain 256 positions representing the occurrence of each pixel intensity. Then, we need to concatenate each histogram to create a new and bigger histogram. Suppose we have 8*8 grids, we will have 8*8*256 = 16.384 positions in the final histogram. The final histogram represents the characteristics of the image original image.

2.2. Working of haar-cascade classifier:

Haar cascade classifier is a productive way of object detection. In haar-cascade classifier there are two types of images they are positive and negative images which are used to train the classifier, and this is a machine learning based approach.

- A positive image is nothing but it contains the images which we want our classifier to identify.
- A negative image is nothing but the image which do not contain the object we want to detect

2.3. Working of local binary pattern:

Local binary pattern is a simple yet very efficient texture operator which labels the pixel of an image by thresholding the neighbourhood of each pixel and considers the result as a binary number. LBP is a visual descriptor so it can also be used for face recognition tasks.

3. RESULT & EXPERIMENTAL ANALYSIS

The experimental results are obtained by open CV library by developing a real time computer vision platform. The result will obtain face expression with recognition rate in both techniques i.e,. LBP and as well as LBPH and the comparison result is tabulated below.

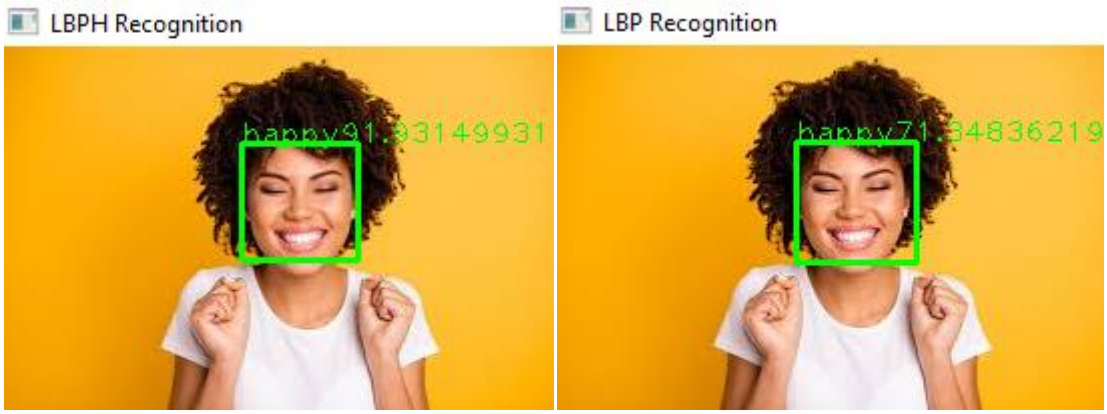

Figure -3. Shows sample data output image for happy expression with recognition rate for LBP and LBPH techniques.

Table 1: comparative results for expression recognition

SI.NO	Expression	Recognition rate for LBP in %	Recognition rate for LBPH in %
1	Happy	71.34	91.93
2	Disgust	64.69	83.72
3	Neutral	73.57	94.31
4	Sad	71.93	94.34
5	Surprise	70.11	87.15
6	Anger	58.63	71.42

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CONCLUSION

The outcome of the paper is to design simple method for recognising facial expressions with recognition rate of the respective image. In this paper we recognise expressions in two techniques that are for Local binary pattern and local binary pattern histogram. By using hybrid technique the recognition rate will be more such as for LBP the recognition rate is low compared to LBPH.

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