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A Review on Face Recognition using Local Binary Pattern Algorithm

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Abstract - *Bio-metric term is used to define the individual's DNA, Hand Geometry, Face or Retinal scans etc or Human behaviour and characteristics like hand gestures, body language, voice tone, signature and handwriting and so on. These kind of characteristics makes a person unique in the entire world or universe. Thus Face Recognition topic becomes most popular in computer vision. It is also been applied to face detection, face recognition, facial expression analysis and several other application e.g. FaceId has been implemented in apple iPhone to unlock the phone. Local Binary Pattern or LBP is type of visual descriptor used for classification in computer vision. The human face recognition topic gained a lot of interest in the last decade since it have one of the major application in day-to-day life. The LBP pattern has received the increasing attention for facial description. This review article has done the comprehensive study of the LBP algorithm the context of the facial image analysis and face recognition. We have also studied some of the break-through in detection of face using Viola Jones algorithm, and Gabor Filter.*

Key Words: Local Binary Pattern LBP, Emotion Detection, Support Vector Machine, Face Recognition

1. INTRODUCTION

Over the last few years, organizations across public and private sectors started to use the face recognition widely. many face recognition algorithm have gained a lot of performance boost over the last decade. Recently with the advancement of camera technology and mostly the use of dual cameras on digital smart-phone, an increasing attention has been given to new application field of face recognition on mobile phones. The challenge of extracting the specific face structure which include eyes, lips, cheeks, nose, chin and ears becomes an important part to pre-processing and geometric normalization.

Face Recognition research is usually discussed by defining the techniques used. In traditional technique we can identify the facial features by extracting the landmarks, or features from an image of a person's face. E.g. databases for face recognition is limited.

1.1 Motivation behind Face Recognition

Given the requirement for determining people's identity, the obvious question is, what technology is best suited to we can create an algorithm to extract the position, size, shape of eyes, nose, cheekbones, and jaw. We can use these features later to search some other images with matching features. This technique is also called as adaptive template matching. If we care to look into 3-Dimensional recognition technique it uses 3D sensors to capture the facial shape information, which is then used to extract the information and to identify the distinctive features on the surface. And 3D technique have one main advantage where it is not affected by the changes in the lighting. In Skin texture analysis which is relatively new, captures visual details from standard digital and scanned images. Another technique used is Thermal Cameras which have completely different form of taking the input. By this way the cameras can only detect the body shape and not the external factor like makeup, glasses or hats.

1.2 Problem Statement

Meaningful data extraction from the images and based on it recognize the person using facial structure.

2. FACE RECOGNITION USING LOCAL BINARY PATTERN

The use of Local Binary Pattern technology is discussed for the fast face recognition system for mobile platform. Many face recognition algorithms have gained encouraging performance due to recent popularity of digital cameras in the mobile devices. People are more focusing on the new application field of face recognition on mobile phones.

Fig 1. shows the overview of activities in face recognition process. Pre-processing phase will involve the process of detecting the face from the raw image and get only the image which have facial characters line forehead, corner of eyes, cheeks, nose, lips and chin. Once such image is obtained it will be sent for processing to extract the Feature. and these Features are sent over for classification and matching. The matching can be done using the face database in this scenario I am calling it as Gallery. The features obtained from the processing is then matched

with the feature model and gives the output as a recognized face or in case of failure scenario unrecognized face.

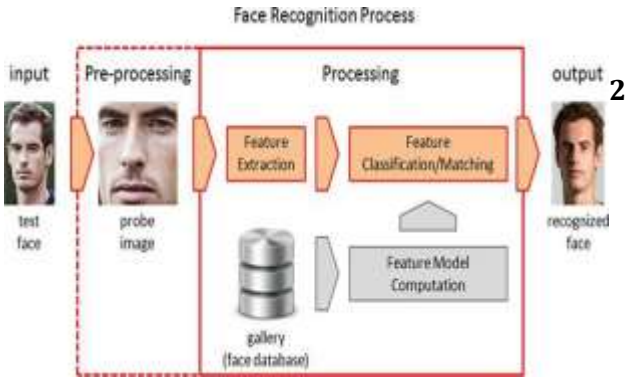

Fig -1: Overview of Face Recognition Process.

2.1 Structured Face Recognition Frame

In this section, the structured Face Recognition Framework is presented. Here discussion focuses on the flow in which mobile device can recognize the face with efforts applied on the implementation of the system. In **Fig 2.** depicts the process of identification of a person's face in an image or video which include several steps. The block diagram of face recognition system includes face detection, face extraction, and face matching.

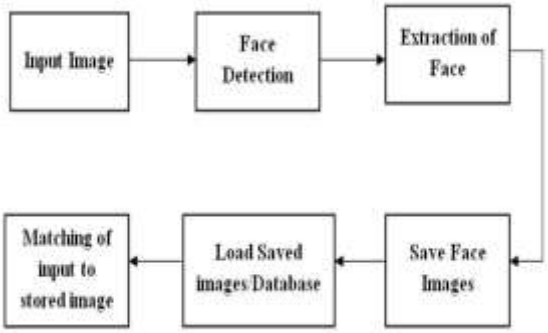

Fig -2: Blocked diagram of Face recognition system.

Whereas **Fig 3.** shows the step by step architecture for face recognition.

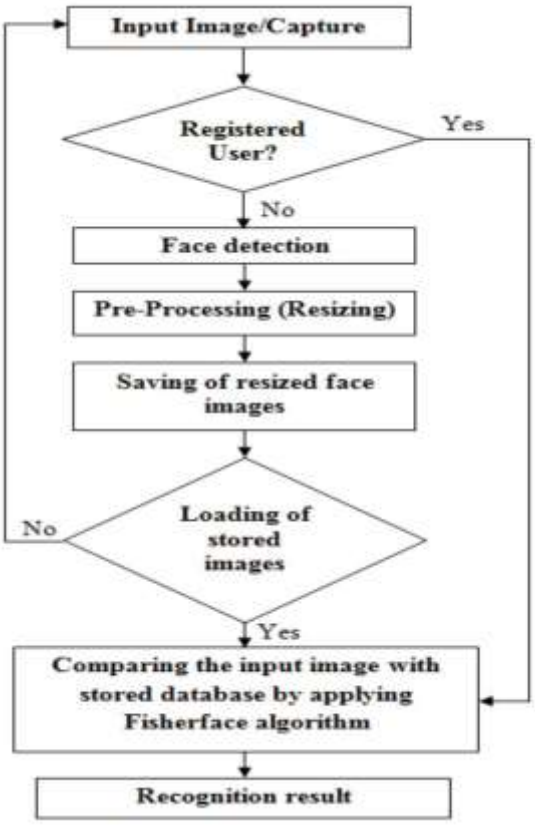

Fig -3: Structured Face recognition Framework.

2.2 Local Binary Pattern

Local Binary pattern is a type of visual descriptor used for classification in computer vision. LBP is the particular case of texture spectrum model.

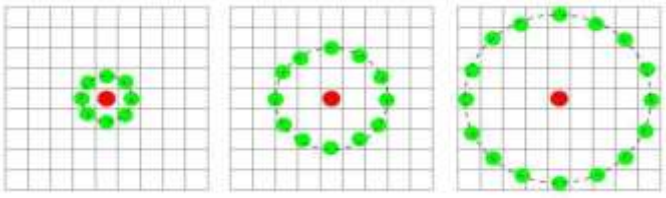

Fig -4: Local Binary Pattern Algorithm.

The Local Binary Pattern LBP feature version can be created in the simplest form in the following manner.

- Divide the examined window into cell.
- For each pixel in a cell, compare the pixel to each of its 8 neighbour, Follow the pixel along a circle.
- Where the center pixel's values is greater than the neighbour's value, write 0 otherwise write 1.
- Compute the histogram, over the cell as such the frequency of each number occur-ring.
- This gives a 8-digit binary number.
- Optionally normalize the histogram.

To understand more on Local Binary Pattern Algorithm consider the following example.

The original LBP operator labels the pixels of an image by keeping the 3x3 neighbourhood or it can be also said as a Matrix. Each pixel have value which can be vary depending upon the image and pixel quality.

If a middle pixel "168" is chosen which have eight neighbour.

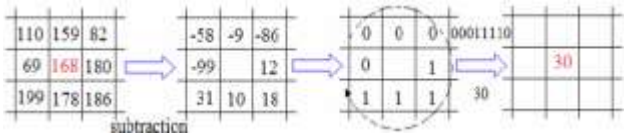

Fig -5: Example of Basic Local Binary Pattern Operator.

Subtract these neighbour values with 168 if the value is less than zero put it as zero and if the value is more than zero put it as one.Starting from the top-left corner pixel you will get the binary number as 00011110 i.e. 30 in decimal system. The overall resulting LBP can be expressed as

$$LBP(Xc, Yc) = \sum_{n=0}^{7} s(in - ic)2^n$$

where n runs over the 8 neighbour of the center pixel, ic and in are gray-level values of the central pixel. and this

$$s(x) = \begin{cases} 1 & if \ x>=0 \\ 0 & if \ x<0 \end{cases}$$

function can be defined as.
But there are some limitation to basic LBP operator that its small 3x3 matrix method can not capture the dominant features with large scale structure. As a result, to deal with the texture at different scales, the operator can be extended to use neighbourhoods of different size.

2.3 Face Description using Local Binary Pattern

In the LBP approach for texture classification, the occurrences of the LBP codes in an image are collected into a histogram. The classification is then performed by computing simple histogram similarities. However, considering a similar approach for facial image representation results in a loss of spatial information and therefore one should codify the texture information while retaining also their locations. One way to achieve this goal is to use the LBP texture descriptors to build several local descriptions of the face and combine them into a global description. Such local descriptions have been gaining interest lately which is understandable given the limitations of the holistic representations. These local feature based methods are more robust against variations in pose or illumination than holistic methods. The facial image is divided into local regions and LBP texture descriptors are extracted from each region independently. The descriptors are then concatenated to form a global description of the face, as shown in Figure 3.

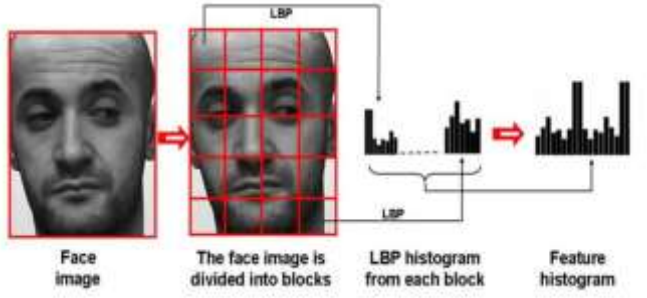

Fig-6: Face Description using Local Binary Pattern.

This histogram effectively has a description of the face on three different levels of locality: the LBP labels for the histogram contain information about the patterns on a pixel-level, the labels are summed over a small region to produce information on a regional level and the regional histograms are concatenated to build a global description of the face. It should be noted that when using the histogram based methods the regions do not need to be rectangular. Neither do they need to be of the same size or shape, and they do not necessarily have to cover the whole image. It is also possible to have partially overlapping regions.

2.4 Face Recognition using Local Binary Pattern

The Local binary Pattern (LBP) was originally proposed for texture description and has achieved promising result in texture classification. But for face recognition using LBP, firstly the face image is divided into R non-overlapping blocks of same size. Secondly, for every block the histogram of LBP codes are calculated. and Third, This R number of histogram are concatenated into global histogram as the description of the face image. Lastly a nearest-neighbor classifier is used for face recognition by chi-square distance. This histogram can be further used for face recognition, emotion detection etc.

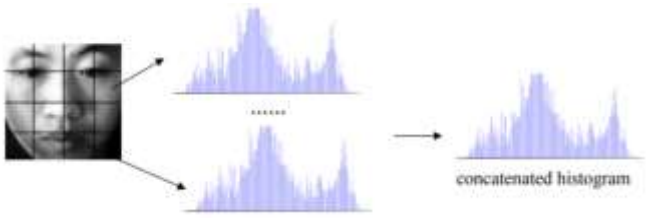

Fig-7:Histograms created using LBP.

3. CONCLUSIONS

In this review article, a framework for Facial Recognition using Local Binary pattern has been discussed. With the advancement in the field of the face recognition it will help to identify the person i.e. identification and authentication purpose can be achieved. The facial recognition system presented in this review article contributes a resilient face recognition model based on the Local Binary pattern which captures the behavioural characteristics with the physiological biometric characteristics. The local binary pattern and its various types can be very helpful in the ongoing development on this topic forward. Over the decade the LBP algorithm has evolved faster as compared to the other face recognition algorithm which makes it perfect and efficient one. Also the advancement of hardware technology is making the execution of this algorithm more faster as compared to its predecessors. In this review article we also have studied the Viola Jones algorithm, Gabor filters using Haar-like features, OpenCV and Adaboost algorithm.

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