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Face Recognition for Authentication in Real-Time Scenario

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Abstract: With the increasing fraud and no guarantee of security in many applications and systems has become the promising issue in the recent past. To address this issue many security algorithms have been projected, of them Face Recognition is used as best identity verification. Face Recognition has replaced the authentication of password and fingerprint. In this paper, three algorithms have been discussed which can identify the faces in real-time from the given input with the accurate results. All these approaches involves extracting the facial characteristics and then comparing them with the model to recognize whether it is a face or not. This paper gives the readers the basic knowledge of face recognition where they have encountered the face recognizers.

Keywords: HOG; LBP; Convolution Kernel; Viola Jones;

I. INTRODUCTION

In the interconnected world, it is highly hard to maintain security. As the time passes, we hear lots of news about credit or debit card fraud, breaking banking systems. In present day technology none of them truly authenticate us. They only verify using pin, full name of user, birthdate , a security question. This gave way to hackers. If they imitate the credentials, they can easily access the data. So to address this a "true individual identity validation" called "biometrics" has come. This biometrics technology verify the user using few physiological characteristics like fingerprint scanning, face recognition, handwriting. Among which face recognition is stable. Face recognition detects the facial features the user. Face recognition is the booming technology which has a good percent of accuracy.

Face recognition can act as the major security authentication, which replaces fingerprint scanning and passcode verification. It can besides be used for security system access, verifying the identity, surveillance systems, law enforcement and social networks. Let us take the example of facebook or any social network if we upload any picture it suggests us to tag the person which is nothing but face recognition. Accessing the computers in offices, ATMs, mobile phones etc. come under access control. In places such as airports, personal identification is major verification. So in such places, face detection may be potentially used to avoid risk of fake travellers. Surveillance systems helps to spot out the criminals if they are not found. This surveillance systems can detect the face of the criminals using the face recognition algorithms with the given input database full of faces.

In general steps involved in recognizing a face are face detection, facial expression, facial features and designing a model. It seems to be very easy to detect face but it is difficult from the computer point of view. When a image is given as input model should be able to differentiate facial parts from non-facial parts considering all the illumination variations.

There are many algorithms such as PCA, LDA, FCNET face database and Sony T300 which detects the faces and has given the good results. These face detecting algorithms were designed by giving the images containing faces including non-faces as input and training the classifier to detect the faces. For example, we show some images of faces to alien who has no previous knowledge of human faces and train it that those images are faces. Similarly, we show small no. of the non-faces and train the alien that those are non-faces. Then if any image is shown it can classify it as face or not-face. In the similar way we train the computer to classify the faces. Once the computer is trained it will extricate the facial features from images and save them in a separate file. If any new picture is given as input computer compares and detect it as a face or non-face.

II. HISTOGRAM ORIENTED GRADIENT(HOG)

In this algorithm to identify the face, first we decolour the image into black & white as we are no way concerned with the colour of the image. As the image is collection of many pixels, we start analysing each and every pixel once. For any pixel we analyze, histograms are drawn and surrounding pixels should also be considered. Compare the pixel which is being analysed with the surrounding pixels. Sketch out how dark is the surrounding pixels compared to present. Then draw a arrow in the direction where pixel is getting darker.

Fig 1 shows the HOG pattern of several faces detected.

Repeat the algorithm for every pixel and at the end we come up with arrow at each pixel. Such arrows are known as Gradients. But in computer point of view, to store the arrow direction for every pixel, it seems to be a little difficult task as it requires more space to store.

Fig: 2 shows the HOG visualization of given image as input.

So we break down the image into small pixel squares of size 8x8 and repeat the algorithm which makes the task easier for computer to analyze. Then compare the part of HOG image (face marked with gradients) with image already analyzed.

III. LOCAL BINARY PATTERN(LBP)

This algorithm is to extricate the facial characteristics and recognize the face. Ojala et al developed LBP algorithm in the year 1996. LBP is one among the excelling method for face detection with accurate results and speed. In this algorithm, facial characteristics can be extracted by breaking down the image into small pieces and it can also be possible to outline the texture and shape of the digital image. These extracted features contain the binary patterns of the pixels which outline the pixel surrounding the regions.

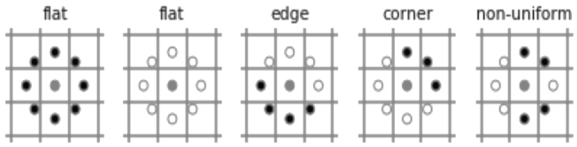

Fig: 3 Shows the Local Binary Patterns of pixels at various locations.

Even though the face in the images have different facial expressions, lighting variations and aging of persons, this algorithm is quite robust. Ojala et al also developed LBP operator. By using this operator, current pixel value is considered as threshold and is compared with 8 neighbouring pixels. Then a value(0 or 1) is assigned to neighbouring pixels(1 if gray code is higher or same else 0).

Binary code= 10001111

Fig: 4 showing LBP operator.

By writing all the gray code together as binary code current pixel LBP code is found. Applying this algorithm to images containing faces and separating the uniform patterns(maximum of two transitions 0-1/1-0 in binary code) from other patterns. Uniform patterns keep the background as it is because the gray code is same for background pixels. After evaluating the LBP for every pixel, a vector containing the features can be constructed. To accelerate the performance of the algorithm to recognize faces image is broken down to squares of K. Feature vectors(histogram) for the small regions are constructed and then combined as a whole.

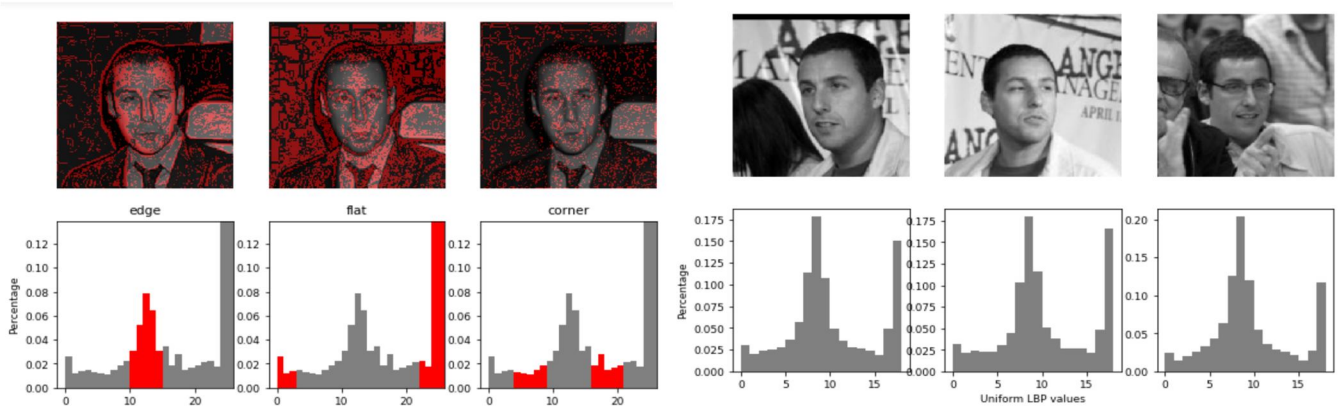

Fig:5 shows LBP values of each image using histograms and detecting the faces.

IV. VIOLA JONES ALGORITHM

Michael Jones and Paul Viola developed this algorithm in the year 2001 so the name Viola Jones. It is one of the algorithm used in real-time scenario to identify the faces.

This algorithm involves the following : Haar features, Adaboost, Integral image and Cascading. If a image with full of random lines is given as input to detect the edges we compare the image with Convolution Kernel(combination of higher and lower values in particular region) and outline the output depending on convolution kernel.

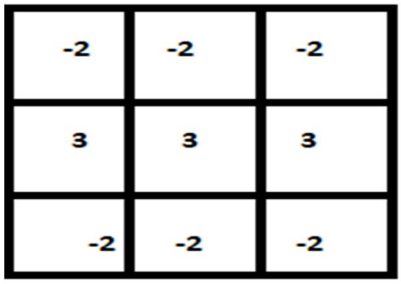

Fig 6 shows Convolution Kernel.

Haar features resembles these convolution kernels which we use to identify the existence of desired feature. Each Haar feature is a value obtained by taking off pixel values under white region from pixel values under black region. There are 5 types of Haar features used in this algorithm. All these 5 haar features are used to detect various parts on face.

Fig 7 showing kinds of Haar Features.

These haar features resembles the characteristics of a face. This algorithm break down the image into 24x24 sub window and calculate the feature value for whole image. FInally we end with large number of redundant features. It is tough to calculate the area large pixel, so we integrate the small pixels together using Integral Image. To calculate the integral image value at the point with (x,y) as coordinates, we sum up the pixel values to the above of the point to left of the point. The advantage of converting given input image into small Integral image values is that it allows to calculate sum of pixels in any given area of rectangle by using 4 values at the corner of rectangle. In haar features we outline many redundant features but all these may not be useful, so to eliminate

redundancy Adaboost is used. It separates relevant feature from irrelevant features to identify a face. Adaboost after identifying the relevant features, it gives weight to those features(weak classifier) and linear combination of these features will give a strong classifier.

$$A(y) = \beta_1 a_1(y) + \beta_2 a_2(y) + ...$$

The outcome of weak classifier is either 0/1. Generally 2500 features are used to form a powerful classifier. For each and every 24x24 window after performing Adaboost 2500 features are evaluated.

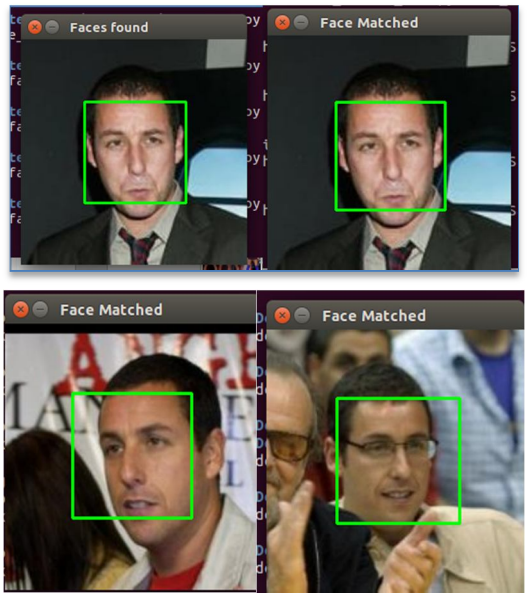

Fig 8 shows how this algorithm has detected the faces and matched them.

The idea behind this approach is scanning the same image several no. of times with altering the magnitude of image each time. So this algorithm concentrates on eliminating quickly the regions not containing faces and drain more time on face regions. Calculating 2500 features every time is difficult, so we use Cascading. Cascade classifier is combination of stages consisting of strong classifiers. All features which are extracted are classified into several stages and each stage contains certain features.As each stage grows the complexity increases. Task of every stage is to identify whether the window contains a face or not. In any stage, if it fails to identify the face, subwindow is discarded immediately.

V. CONCLUSION

In present paper we have described HOG, LBP and Viola Jones algorithms to identify faces. All these approaches gave the good results in detecting the given input image and the basic principle is inspecting the image by dividing it into small pieces. In all the above algorithms, faces can be detected, considering all the lightning effects in the image. Now-a-days because of security in personal identification and in various fields, Face identification being the major research area for many of the researchers.

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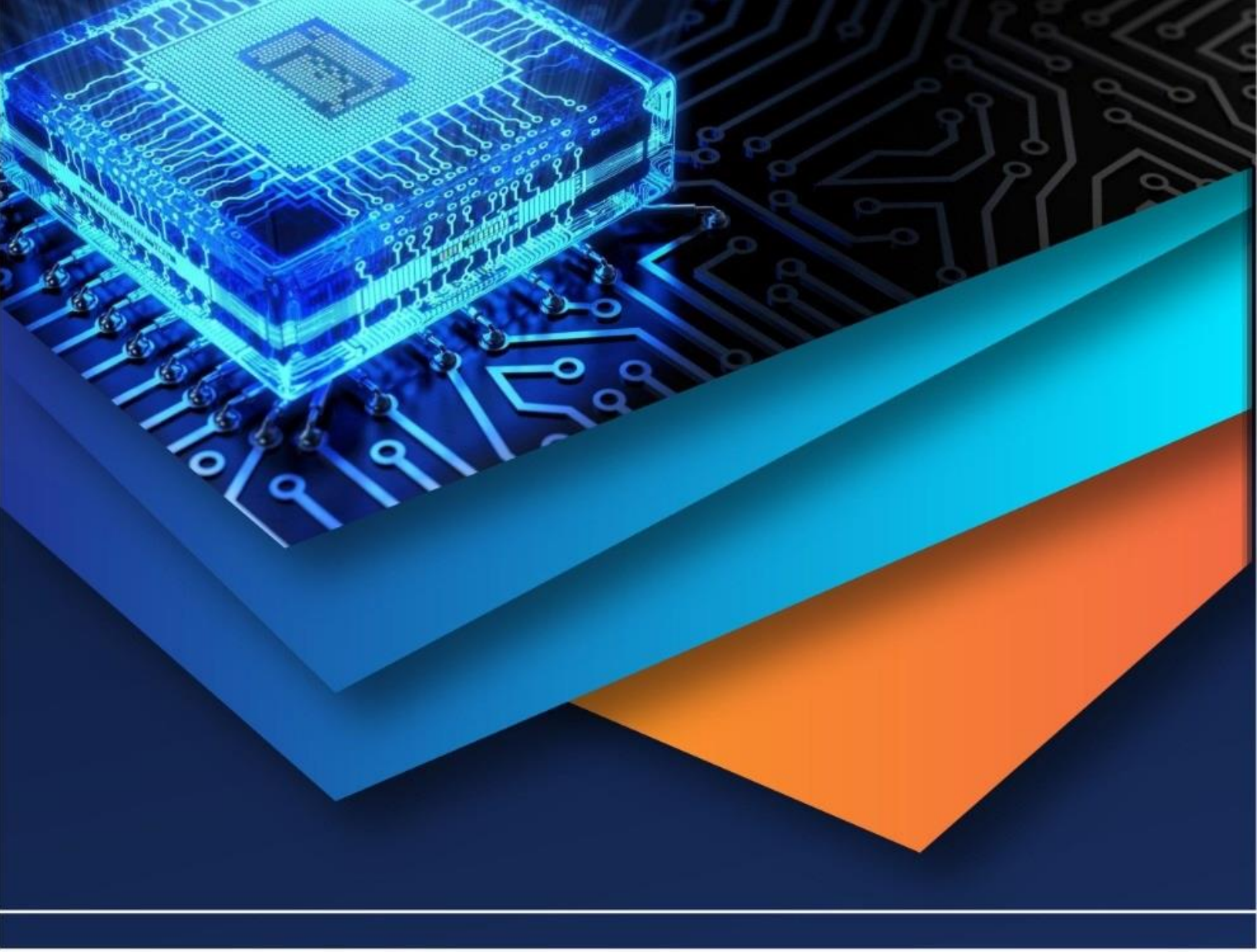

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