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Design of Deep Learning Algorithm for Application by Image Based Face Recognition

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ABSTRACT: For recognizing the face of any person, the most prime feature is the face, face recognition method is the best method for recognizing an individual than any other biometric methods. In face recognition, system can identify a person from video or image but in this proposed system, the face is identified only from real-time images. The process for authenticating face is partitioned into two steps, first step is to detect face usingHaar Cascade algorithm which is a machine learning object detection algorithm, it does object detection using haar feature based cascade classifiers which is an effective object detection method purposed by Paul Viola & Michael Jones. The second step is to recognize an individual's face using LBPH (Local Binary Patterns Histogram) algorithm. The main purpose of this research is to recognize and detect an individual's face in real-time camera-based image capturing.

KEYWORDS-:LBPH(Local Binary PatternHistogram) Algorithm,Haar Cascade Algorithm.

I. INTRODUCTION

Biometric authentication is immensely popular these days because it is a very good way of authenticating someone providing access control, detecting fraud, and identifying criminals and this is possible because it utilizes what makes a person unique like their DNA, their fingerprint it is for the face. Face detection and recognition in biometrics have become immensely relevant these days because of how easy it is to use and implement. All you need is just a high-quality camera and a good algorithm. Both of these things can be easily installed on any system. In this paper,implementation of face detection and recognition is done. Some common face recognition algorithms are Eigenfacewhich uses principal component analysis and Fisherfaces which is an improvement over eigenface and then another method is LBPH(Local Binary Pattern Histogram) which is used in this project, this is very different from the first two algorithms because it doesn't look at the training image as a whole instead it chooses to look at individual part of each and early image, so it looks at every single pixel throughout the image and it focuses on the central pixel in one spot and it then compares itself to the neighboring pixels and it considers the result as a binary number and converts it in a histogram. Another classifier that used is the Haar cascade classifier, so Haar Cascade is essentially an ML based approach where a cascade function is trained from a lot of positive and negative images. It is used to detect an object in other images, so this essentially has features like the Haar feature selection creating integral images and cascading classifiers.

Face recognition system have a lot of applications. Well-planned face recognition can help in various sectors like authentication system, recognizing a person's individuality, security system, information security, smart cards, education, healthcare, and many more.

II.PROPOSED SYSTEM

In an E-authentication system, the main steps are face detection and face recognition along with OTP verification as an alternate approach. Face detection is recognizing a person's face and face recognition based on the person's features that uniquely describe that person. During face detection person's face is extracted, then according to requirement it is cropped, resized, and converted into grayscale. During face recognition, the detected face is compared with the face stored in the database by applying a face recognition algorithm. Here for face detection, the Haar cascade algorithm is used and for face recognition, LBPH algorithm is used.

1)Haar Cascade Algorithm:

Haar Cascade Algorithm is a machine learning based algorithm proposed by Paul Viola and Michael Jones in which the cascade image is trained by providing a lot of positive and negative images,that is used to detect the object in images. This algorithm needs a lot of positive images (images of faces) and negative images i.e. images without faces to train the classifier.

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Haar features are used to extract the features from images.

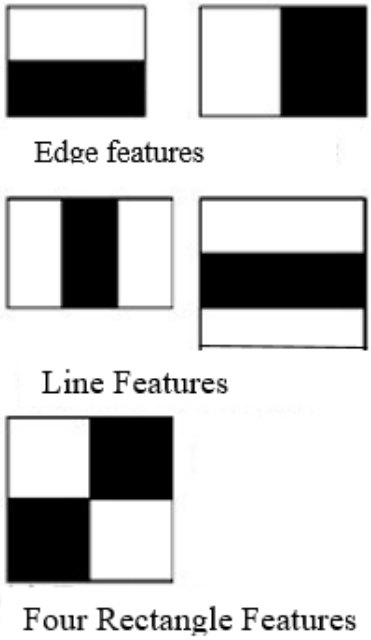

Fig 1.Haar Features

First set of two rectangle features is responsible for finding out the edge, Second set of 3 rectangle features is responsible for finding out if there is a lighter region surrounded by the region and the same if implementedconversely.

Third set of 4 rectangle features is responsible for finding out the change of pixel intensity across diagonal. Every feature has a single value which is obtained by subtracting the sum of the pixel under the white rectangle from the sum of the pixel under the black rectangle. All possible locations of every kernel are used to calculate the feature. To calculate each feature we need to find sum of the pixel under the white and black rectangle for solving these integral images are introduced. It makes the calculation of the sum of the pixels simple.

Fig -2: HaarFeatures

Among all the features calculated, many features are irrelevant. If we take the following example first feature focuses on property that describes a region of the eye that is often darker than the region of nose and cheeks. The secnd feature

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focuses on the eye region is darker than the bridge of the nose ,but if the same window when applied on cheeks or any other place is irrelevant, so to minimize such irrelevance AdaBoost is used. To minimize the irrelevance in a feature ,we apply every feature on every training image. For each feature, we get the best threshold value which discriminates faces into positive and negative. We select the feature which has a minimum error rate. The final classifier is the weighted sum of these different weak classifiers .It is called weak because it alone is not able to classify an image but together with others, they form a strong classifier. The final setup has 6000 approximate features. But implementation of 6000 features is a time-consuming process, so the further process is carried out. In an image, most of the part is non-face part.So we check if a window has a face region. If it is not then it gets discarded and no further process will be carried out on that region.So the possibility of finding face increases. Cascade classifier is used for this, instead of implementing 6000 features on a window. A group of features are applied step by step. If window fails at first stage window gets discarded. If it is passed then second stage of features is applied and it continues the process, and the face gets detected.

2)LBPH Algorithm:

Face recognition includes verification and identification. In verification or authentication, a person's face is compared with the face in the database in order to give him access ,and in identification, we have to find if the person's face is present in the database ,so it is compared with n number of faces.

LBPH algorithm is a combination of LBP(Local Binary Patterns) and HOG (Histogram Oriented Gradient) descriptors. It is a very powerful way of efficiently labeling the pixel of an image.
In face recognition ,unique face is detected and then matched with the particular person. It can be achieved using a training and testing model by providing a set of images LBPH uses radius, neighbour's axis x, and axis y parameters.
Radius is the distance from the center pixel to the circumference
Neighbor's is the number of data points circular local binary pattern.
Grid x is the number of cells horizontal direction.
Grid y is the number of cells vertical direction.

First dataset is made by taking pictures Using a Camera and providing personal information.
Following steps are done during face recognition using the LBPH algorithm:
First we have to train the algorithm. For that we need to provide a dataset that has images with their unique id .It is because when a match is done algorithm will show the output with id.
In the first step, computation is done and an intermediate image is created which represents an original image. Image is created using the sliding window concept which is based on radius and neighbors.

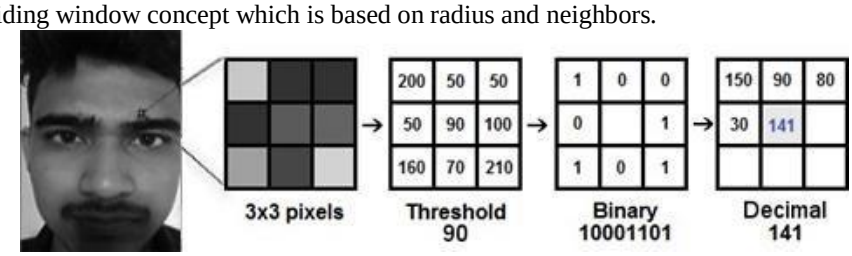

Fig 3.LBP algorithm for a face

Consider we have the above image. We can take 3x3 part of an image for understanding. This matrix has pixels of different intensities, we take the central value as a threshold value and this threshold value is used to define the new values from all 8 neighbour's. If neighbour value is greater than that of threshold value it is set to 1and for a neighbor having less value than the threshold, it is set to 0. The central value is created by converting binary numbers to decimal numbers. We will get an image that better describes the original image. When we get the intermediate image next step is extraction and creation of histogram. We use grid x and grid y to divide the obtained image into multiple grids.

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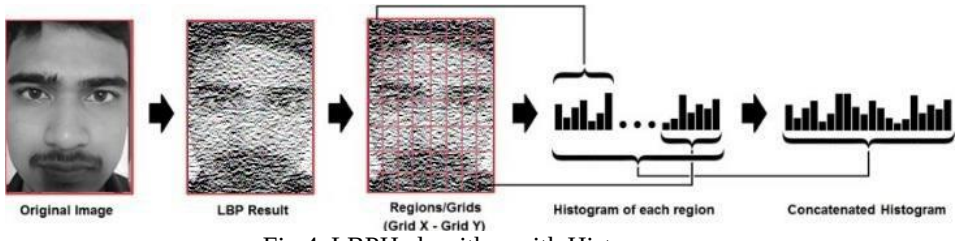

Fig 4. LBPH algorithm with Histogram

After this process ,we can extract the histogram of each region .Our image is in greyscale every histogram i.e. the histogram in every grid will contain around 256 positions which represents the intensity of the pixel.
After getting the histogram of all the grids, we need to concatenate them and a final histogram is get created .this final histogram gives characteristics of the original image .now the algorithm is trained and histograms are created. When we give an input image, we perform the same steps and create the histogram of an input image, and if we want to find if the face is present in the dataset we just compare the input image's histogram with a histogram of images in the dataset. We can use chi-square, Euclidian distance, the absolute value approaches to compare the histogram. We use threshold and the 'confidence' to estimate if the algorithm has correctly recognized the image. We can say that the algorithm has successfully recognized if the confidence is lower than the threshold defined.
OTP:
OTP is an alternative approach in the login system. OTP (One-Time Password) is the password that is valid for only one login session. It is valid in a certain limit. OTPs are the combination of 4 to 6 numeric digits or they can be alphanumeric. In this system when the user clicks on "Send OTP" then OTP will be sent on the user's Email.ID and access is given by verifying OTP.

III.LITERATURE SURVEY

There are different approaches towards safety through facial recognition. LBP was introduced by Ojala.This method describes and defines the texture and shape of a digital image.LBPH is a Local Binary Patterns Histogram is used for facial recognition. LBPH is a combination of LBP and Histograms of oriented gradients descriptors. Machine learning Algorithms helps to make facial security authentication system.ML is a subpart of Artificial Intelligence. Local Binary Pattern Histogram is used to extract features and likewise, many algorithms can be used in ML. Facial recognition will help interact with robots in human-machine interaction. It also tells us about how an individual's skin colour is picked and converted to binary for further process. Haar Cascade classifier is an ML object detection program.Various Machine learning algorithms like LBPH (Local binary pattern Histogram), PCA combined with KNN, support vector machines, and linear discriminate analysis for face recognition system. The program flow starts from face detection, feature extraction, and face recognition using LBPH.

VI.CONCLUSION

In this paper, we have implemented face detection and face recognition using the haar cascade algorithm and LBPH algorithm respectively. Our algorithm successfully detects and recognizes a face from real-time camera-based images. We have implemented this algorithm on so many real-time images and found that it effectively detects and recognizes faces with different facial expressions. As machine learning is very crucial these days, there are so many sectors where this work can be elongated.

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