Face Recognition by CNN Using Hog and Bow Feature Extraction Approach

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Abstract: As we saw that there is a continuous development of Computer Vision and Artificial Intelligence, also we know that the Authentication play a vital role nowadays. And for this purpose Face is considered to be a most appropriate component. Face Recognition is technique that we use to compare the capture live or digital image from the stored image that we have in our database. Face Recognition is a technique which can easily contrived by intrinsic and extrinsic conditions. And in this situation we unable to get a desired result by using orthodox face recognition. This project helps us to recognize the face in any investigation department. In CNN, we can directly put the original image as an input which makes image processing quite simple. CNN perform 2-D transformation such as translation, Rotation and scaling. The overall approach is that we take a query image and divide the image into two set namely: Training image and tested image. On this image we apply BOW approach mainly used for feature Extraction. By feature extraction we remove all the unnecessary information and we get the output image in compact form which is compatible to our database (For example – Input Image = 64x64 reduces up-to 9x9). Put it into classifier for Recognition and after that we will get our recognized image.

Keywords: ANN, LDA, LBPH, HMM Human Face Recognition; Distance Methods, PCA,

1. Introduction

Face Recognition is basically a technique which is used to identify a person by their Facial expression either taken from video- frame or digital images. The sole purpose of this research is to perform a comparison- study between various faces Recognition technique namely:-HOG, BOW feature extraction approach. With the help of real – database images measure the effectiveness and efficiency. The Aim of CNN is expanded from artificial intelligence. Neural network identify by Non- Linear, Robust-ness and having high Fault tolerance.

Because having all these characteristics, CNN is widely used in recognition of pattern- processing and in processing an image and some other aspects also. Basic idea, behind using the neural network is that it scrutinizes the relationship between input and output. This entire process of learning or analyze the process in the network is basically termed as Training. In CNN we can directly put the original image as an input which make image-processing quite simple. CNN perform 2-D transformation such as translation, rotation and distortion- invariance.

CNN basically applied to Computer Vision which involves image classification and object-recognition. Before the existence of CNN, the recognition done manually. As the emergence of CNN completely changing the recognition of pattern.

Directly or indirectly this research solves various issues related to face-recognition such as blurry image, Low Resolution Images, Facial Expression. The Entire process of face Recognition consists of namely three steps:-

1. Face Detection
2. Feature Extraction
3. Face Classification

Face Detection technique used to detect that there is human face present in an Image or video but it cannot identify the human face. For human face identification Face Recognition Technique came in used. Face Recognition technique used to recognize the human face tell whose image it is.Face Classification is last step in face recognition process. This technique basically used for determine various characteristics of human-faces such as male/female, person wear glasses or not and many more. Basically, they used two approaches for face extraction first one is Hog another one is Bow.

2. Survey on Different Articles

Dr. Eyad .I. Abbas proposed an approach to recognized a face using different classifier methods such as:-

Squared Euclidean distance, Euclidean distance and City-block distance method. It helps to give a desired output by keeping the report of identifying details. The very first step is to form a transformation matrix using the training human face images. Secondly, arrange the face images into the vectors form with the help of matrix.

In the end, face image recognized by initiating the image into sub-spacing of Eigen-Face-Domain. This proved that Face recognition technique work well with the Squared Euclidean Distance up to- 100% while the remaining technique also produces a good result, Euclidean distance – 98% another City-block distance- 95%.

Huang G Liu Z Proposed an approach for Face recognizing, ANN developed from Artificial-Intelligence CNN model having high fault-tolerance's ability Work well even in the failure which makes it able to deal with certain circumstances. Due to having these features ANN model used to recognize the pattern and image processing.it can perform various transformation such as translation(so that we can increase or decrease the size), rotation etc. They proved that ANN play a vital role in face recognition. It's difficult to collect a large data set; that we used to study has some curb in some aspect.

Purnawarman Musa proposed introduce an approach for Human face Recognition Application Using PCA and Eigen-Face Approach.

Face is one of the most unforgettable parts of the body in factual life that makes it an important variable. This research uses a primary data taken in the form of picture from RGB i.e. (Red, Green, Blue) format that will obtain through surveillance, or through video or digital image. By using a cascade classifier method which has a good and fast ability to distinguish the human face. Using various 2-D transformations such as translation, Rotation and scaling help in balancing the contrast and brightness.

Mohammed Kabiru Halidu introduces to recognize Face with the Image Enlargement Technique by using different Interpolation Methods like nearest neighbor, Bilinear, Bicubic. Well- known Resolution enhances Prominent Image Intent technique that is nearest neighbor bilinear and bicubic used to expand a number of images from data set. With the help of nearest neighbor we can enlarge the image.

TA (%): Image resolution 1024x1572 down sampled to:	**Interpolation methods**		
	Nearest Neighbour	***Bilinear***	***Bicubic***
512x786 resolution	69.23	69.23	69.23
256x384 resolution	69.23	68.46	69.23
128x192 resolution	69.23	68.22	68.46
64x96 resolution	68.46	65.39	66.92
32x48 resolution	56.72	49.23	56.15
16x24 resolution	26.15	22.31	25.39

Dr. R.K. Gnanamurthy introduces an approach to contrast the performance up gradation in recognition rate of different face recognition methods. Various face recognition techniques namely : 1-D PCA, 2-D PCA , K-PCA. Generally, use Euclidean distance and in some cases they use cosine similarity functions. Instead of using orthodox classification and distance measurement method. Support vector Machine Classifier is used for classification of an image. For classification- purpose use SVM Classifier. SVM uses the result that obtained from featured extracted through different face recognition method.

1-D PCA

It consist of two major steps, First one is formed a train- set and test-set from the given face database. Then 2-D image regroup into 1-D image.

Let an Eigen-Vector be 'V'. Calculate from the matrix , Equation can be written as follows:

$$L = A^T A \qquad (1)$$

Where A= Training-Set. And T= Test-Set.

2-D PCA

For Direct conversion of 2-D image into 1-D image that we obtained after performing the above calculation on training-set and test-set.

$$\Omega_k = u^T\left(\Gamma_k - \psi\right), k = 1 \ldots N_c \qquad (2)$$

By Using Linear SVM classifier doesn't yield an effective result it results to a poor recognition rate. With the intention to modify the result will combine the SVM with different techniques such as:

i. Using SVM along with the ICA i.e. Independent component Analysis (SVM+ICA) yield an effective result up to = 92%.

ii. Using 1-D PCA along with SVM i.e. SVM+1-D PCA yield an effective result up to = 85.33%.

iii. Using LDA along with PCA i.e LDA+SVM produces an effective result up to = 86.73%.

Sujata G. Bhele and V. H. Mankar introduce a Face Recognition Techniques using Statistical and Artificial Neural Network Methodology Used:- Principal Component Analysis (PCA) Linear Discriminant Analysis (LDA) Face Recognition, Independent Component Analysis (ICA)Artificial Neural Networks (ANN). ANN approach work only with the images that are small in size. Images are expensive too still not give an effective result. Translation not uniform, we can't use the previous weight once after performing any kind of translation such as shifting, rotating.

Hildebrandt, M., Neubert, T., Makrushin proposed an approach Extended StirTrace benchmarking of biometric and forensic qualities of morphed face images. Methodology used:-Automated face morphing, FMF realizations (face morphing forgery)

Especially passport scaling 15 kB and noise has more impact on forensic quality of the morphed face images than on biometric quality. Only the passport scaling 15 kB and noise operators have a significant influence on the biometric quality.

This approach seems to be very benefial in forensic image recognition. Faces Morphing is basically technique in which we are create two identification into one individual.

3. Proposed Model

In this section we are going to propose an approach for Face Recognition. Our proposed model using the technique namely CNN. CNN is machine learning approaches. Some algorithm such as Bow(bag of words), Hog(Histogram of oriented Gradient) are used for extracting the Our Project going to be an important central structure, which review about the fact that we can perform various transformation on an image such as Translation, rotation, and scaling.

CNN make use various layers to identity the feature. The combination of thousands of pixel forms an image. Let pixel be as P(x). Our brain capture the pattern of the image or recognize and classifying the object. CNN help us to capture the pattern of the image and then classify the object in an image accordingly, this entire process is known as Feature detector or kernel or Filter. Feature detection is simply the combination of weight.

Convolution Operation:- Images are depicted through the number because computer see the images as number.

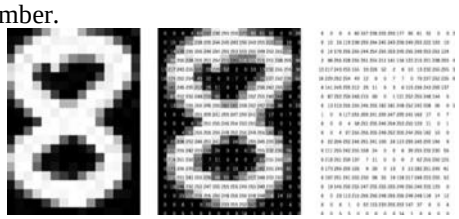


Fig.1 Representation of Image in Computer

Perform the multiplication from Left to Right one by one. The way in which we move is known as Stride. If Stride = 1, then the image will reduce a bit. If Stride = 2, then image will reduce more. This process moving Left to Right repeat at every location slide over. Therefore, by this we convert the 2-D image into another 2-D image with reduced size. Stride is the number of pixel by which we slide over filter matrix over the input matrix.

Larger the size – The smaller feature map, known as Convolution Operation.

The shape of input image is modified by Feature Detector thereby, detecting a particular feature from input image and kept the information about the feature this is known as Feature Map.

Now the question is that why do we make the size of image small why we are not going to process that image as it is , So here the reason for this is quite simple that is because it is easier to process the small- image in faster manner.

Example – Let if we take the image are of 256x256 pixel as a input – Its difficult to process the image.

Feature Detector having Stride to reduce the image significantly. While doing this process we lose some information due to less value in Resulting matrix. We still get a lot of Feature from image such as nose, eyes from the image of the face.

By using Detector we get a rid from unsuccessful information. If we have color Image then:-

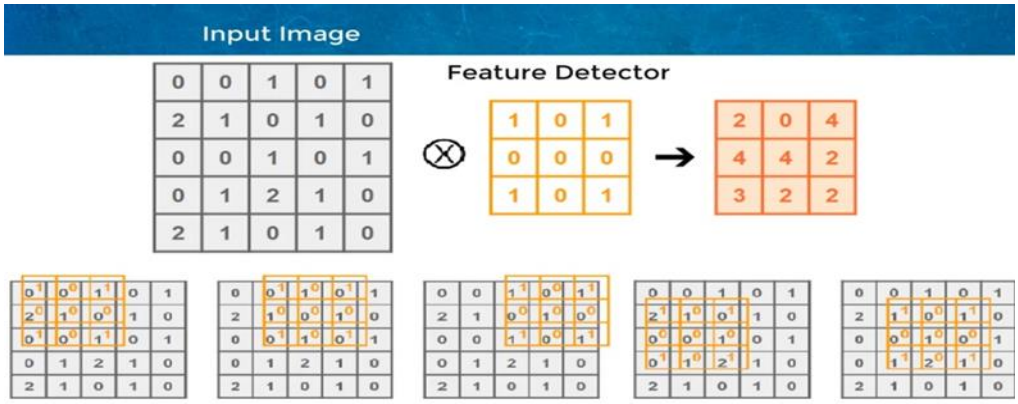


Fig2. Convolution Operation

The number of Feature detected tells about the depth of the output image.

Block diagram

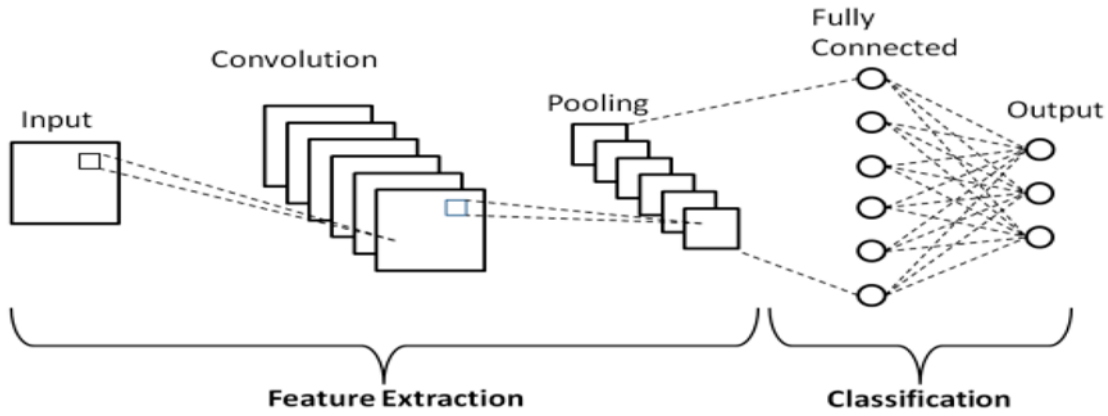


FIG. 3 BLOCK DIAGRAM OF CNN

Some fundamental terms we are going to use here:-

1. Kernel
2. Stride
3. Pooling

Kernel: CNN help us to capture the pattern of the image and then classify the object in an image accordingly known as Feature Detector or kernel or Filter.

Stride- Filter moved over the image top to both left to right with one-pixel column change horizontal the one pixel row change on vertical movement.

Amount of motion between application of filter to the input image it is referred to as stride and mostly always uniform in height. By default, the value of Stride is 2-D is (1, 1).

Pooling: Pooling layers are used to reduce the proportion of the Feature Maps. So, the computation and complexity to be reduce up to some extent.

In pooling Layer sum-up all the features that are present in the sector of the feature map bring-out by Convolution layer.

Feature Extraction Approach (HOG and BOW)

HOG: - It stands for Histogram of Oriented Gradients. The step to perform this algorithm is as follows:

1. Take the Image as an input are of 8x8 pixels. Zoom-In the image and divide the image into cells. After dividing the image into various cells each cell consist of a large number of pixels. The output we get from this stage as a zip file in which all unnecessary details are removed generate the output image as in very compact form.

Now after getting output from the above stage we calculate the value of gradient in both X and Y direction. Gradient means we calculate the value of slope.

2. By (8x8) 64 gradient vectors we can draw the histogram.
3. Each cell divided into angular-bin, each of them have a gradient direction (9 bin 0-180) (20 each bin)
4. This reduces the 64 vectors up-to 9 values.

For Example-

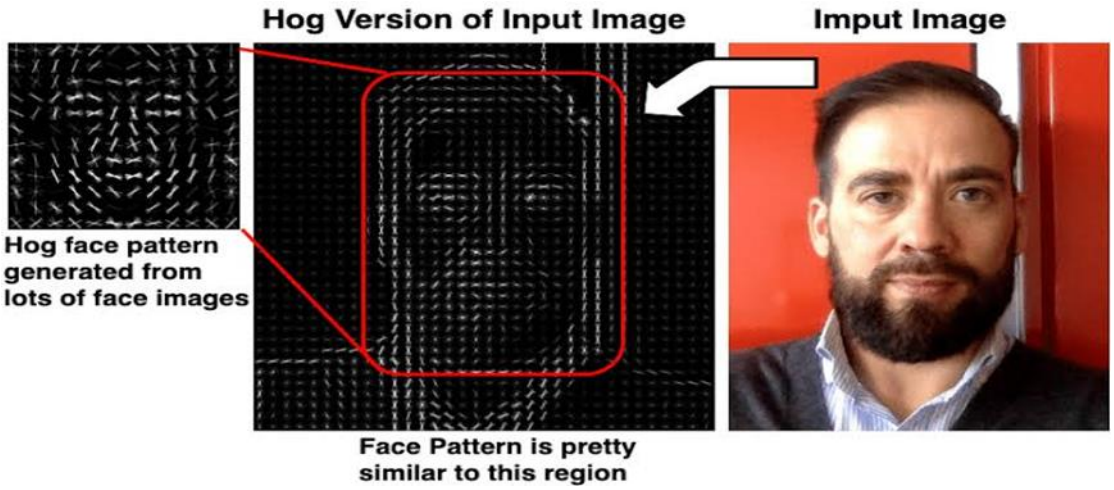
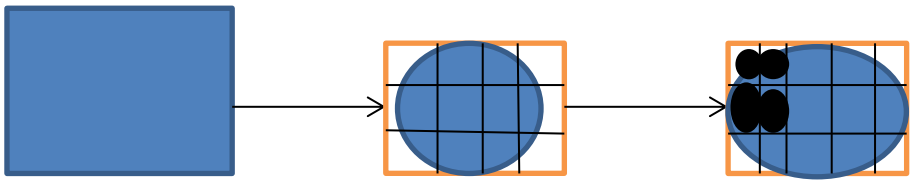


Fig.4 Feature Exaction By Hog

5. The output image we get from this entire algorithm is of (50, 50) Feature Vector. Feature Vector means information about the characteristics of an object.

1.



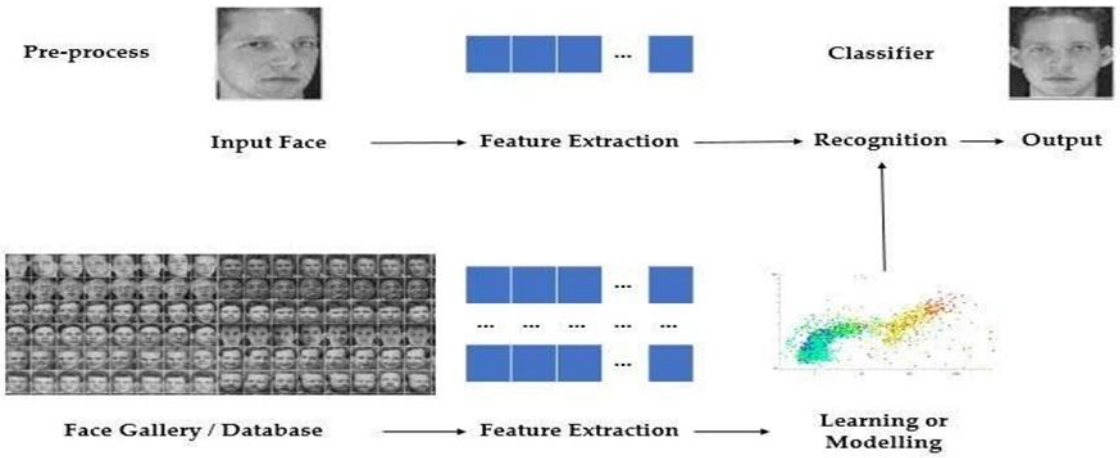
Input Image **Zoom-In** **(Divide the** **zip file (remove all unnecessary detail)**

Image into cell)

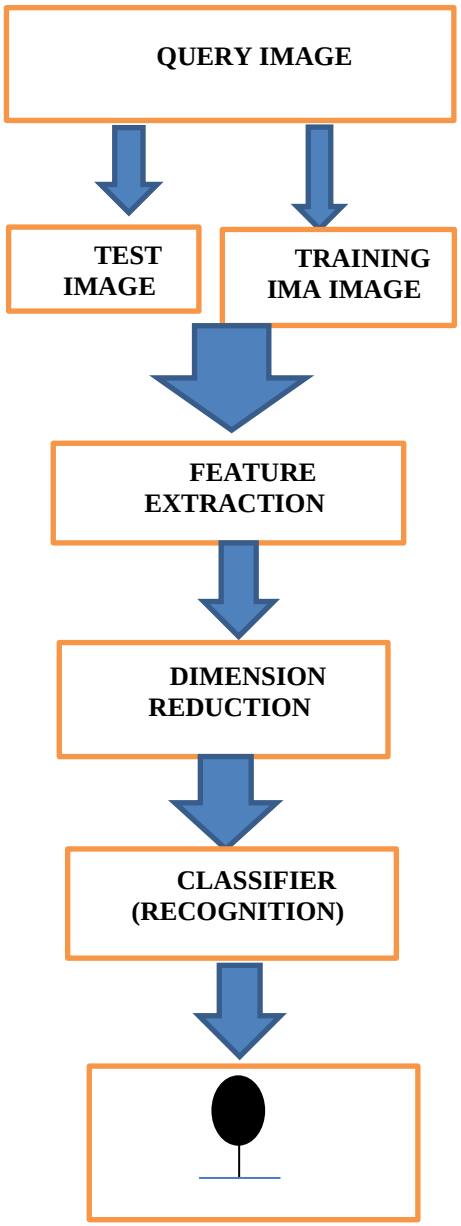
BOW: - This is another feature extraction algorithm namely BOW it stand for Bag of Word. There are some following

Steps to perform this which are as follows:-

1. Let we have the collection of images in our database and each image contain some unique features. For example: we are having 5 unique feature, 4 unique feature, 3,6 7,.. up to so on.
2. These entire unique features are store in BOW (Bag of Word). And, Represent the image in the form of vector.
3. Represent, the image in from of vector we calculate the frequency of feature.
4. Select the Target Image (for Recognition).
5. If any feature occurring so many time. In that case Features Go very high and it suppress the effect of that feature. So, we need to normalize it.
6. Finally, we get the extracted Feature as an output.



Diagrammatical Representation of Proposed mode



4. Conclusion

System has the successful outcome of face Recognition it will reduce the recognition of untold- faces as one of the known face in the system. It works well when the image is perfectly clear and not hazes.

Our project can work in partially connected layers and the size of connection will depend upon the filter we use.

It can work on any image it is flexible in nature. As we using CNN approach it will reduce the dimension by which we can perform less computation, less costly and efficient too we get the desired output from the CNN as the higher layer are formed through combining the lower layer which help to identifying the pattern more effectively than any other technique. Translation is uniform as we can reuse the weight even after rotating the image.

References

2. E.I Abbas “Face Recognition Rate Using Different Classifier Methods Based on PCA", IEEE (2017).
3. Salah NASAR “Face recognition System using Bag of Features and Multi-Class SVM for Robot Applications", IEEE(2017)
4. Md. Sabbir "Implementation of PCA on Masked and Non -Masked Face recognition", ICASERT(2019)
5. Sujata G. Bhele1 and V. H. Mankar2” Face Recognition Techniques using Statistical and Artificial Neural Network”, IJARCET
6. Hildebrandt, M., Dittmann, J.: ‘Stirtracev2.0: enhanced benchmarking and tuning of printed fingerprint detection’,IEEE (2017)
7. Makrushin, A., Neubert, T., Dittmann, J.: ‘Automatic generation and detection of visually faultless facial morphs’.
8. Alkandari, and S. J. Aljaber, “Principle Component Analysis Algorithm (PCA) for Image Recognition”, Second International Conference on Computing Technology and Information Management, IEEE, 2015.
9. M. P. Gawande, and D. G. Agrawal, “ Face recognition using PCA and different distance classifiers”, Journal of Electronics and Communication Engineering (IOSR-JECE) 2018.
10. C. Han, “Modular PCA Face Recognition Based on Weighted Average”. Modern Applied Science, Vol. 3, No. 11, November 2019.
11. The ORL database, Available: http://www.cam-orl.co.uk/face
12. J. Hai Qiang LONG, Tai the TAN. Computer Simulation, 2017