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Enhancement of Face Recognition using Deep Learning

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Abstract: ***Our aim in this paper is to increase the accuracy of existing facial recognition system on a comparative smaller dataset as per the requirements of present day. Namely in sensitive regions. The methodology that has been adopted is by combining more than one algorithms. The feature detection capability of harr cascade along with Ada boost to fetch to Bilinear CNN so that on a comparative smaller dataset can produce comparative result as on bigger dataset.***

Key Words: Deep Learning, CNN, Bilinear CNN, RNN, PCA.

I. INTRODUCTION

Facial Recognition has been an area of interest for a long time in the computer vision community due to its abundant uses. Especially the practical uses for facial recognition are many, like, security cameras, attendance systems and surveillance systems [7]. Due to all these uses many different companies and research centers have put a lot of work in developing this. In the past we have been detecting faces with the help of human interaction or "manually". Here, in the project, we will be implementing a system to measure human face detection [23].

A. Literature Review

Facial Recognition although a fairly simple task for human eyes and brain, because of our cognitive prowess, still remains a very tedious task for machines due to the “unconstrained” nature of the task, ergo, it remains an active and open field of research [2]. Facial recognition remains a very useful field doe to its uses in fields such as surveillance, access control and even finding missing persons in a group or a crowd [11]. Facebook, in the recent past has shown the amazing accuracy of scanning images and identifying people’s faces in them, so much so that the results can be seen in even unclear images, an intuitive yet uncanny ability which comes very handy in their “tagging” function and the person is automatically tagged in the images [7].

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B. Previous challenges

The key problem area in this field are multi-pose images and images with occlusion problems [5].
The solution of these a forementioned problems has been given in a part to part solution, for example, the solution implementing a part CNN for piece by piece facial detection implementation and then using a Bilinear CNN to combine the above part-solutions [7]. Though the solution works best with part faces only but its implementations can be many. The failure of the method could be seen in non-occlusion cases of facial images [20].

II. METHODOLOGY

B. Data-Set Generation

For data set generation we propose the method to generate a large number of synthetic images by compositing the images that are already present in our dataset. This method has been observed to being capable of producing as many as 5, 00,000 images for training models from about only 10,000 images. This helps to train a good model from a lesser number of images [11].

C. Facial Features

Currently there have been 65 recognizable features as of now in the Deep Learning facial recognition method. All this features are then traced using CNN and deep convolutional networks [10]. These features allow to create vector values which are then used to compare the new face with stored values.

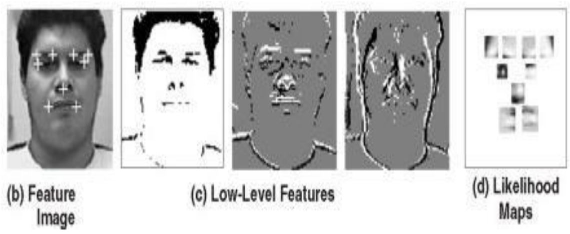
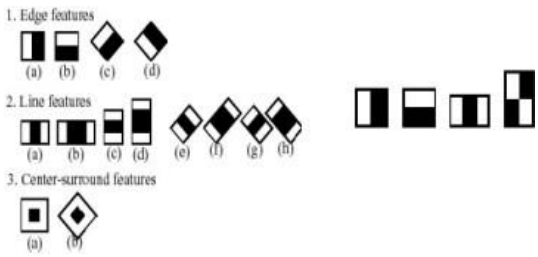


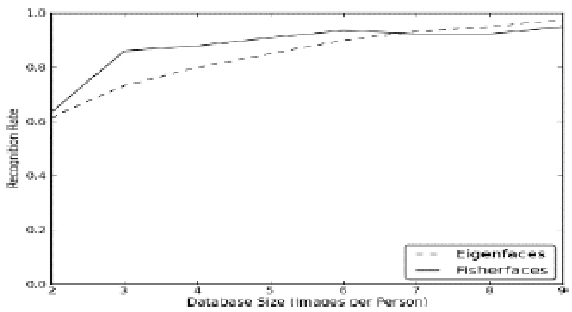
Fig: 1. Feature Extraction

III. PROPOSED APPROACH



The working procedure of our algorithm is as follows at first we take the face image and obtain a framed face from it this procedure gives us freedom from all the noisy background then after it we get the extracted face from the image, this is termed as the processed image which is free from all sorts of noise and disturbance and then we get query image which is the fuel for the recognition process. The results are processed and the output is given. Eigen Faces drawback is it based on raw power and works on each and every pixel, converting it into its equivalent Eigen values, regardless of its usage also it has flat mathematical function. Accuracy dataset 78% for medium dataset [3].

In LBPH the dataset should be very clean and organised and as blurry image, damaged image are not considered for evaluation and reduce the overall accuracy of the algorithm. Although it has non flat mathematical function but on a larger dataset it tends to fail. Accuracy is 82% for medium dataset [7].



In Fisher Faces variation of lightning can cause a lot problems in accuracy. Flat Mathematical function which leads to loss of feature vectors. Accuracy is 86% [23].

Haar Cascade

The primary parts of the classifier are harr-features. The presence of any features in the given images can be detected from this classifier's help [10]. The results of each feature is collected in the following manner, the sum of pixels both under the white and black rectangles is calculated and their difference, which produces a single numeric value. This helps also in detection process for images in various orientations. The scanning for features in an image starts from the top-left corner and scans the whole image for these features to find a face [18]. This process is run multiple number of times in order to get the best possible result.

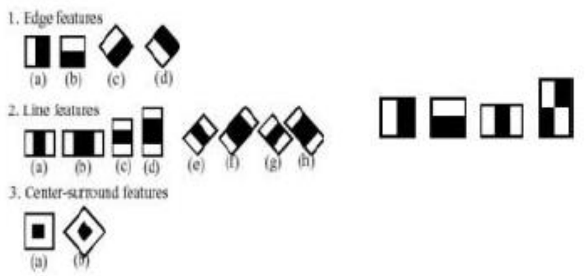


Fig.2 Harr Features

The way in which Harr cascade works is they begin by scanning the image from top left pixel to the bottom right corner of the image. The procedure is repeated many times [19]. In every iteration we get some results which are amplified in the next round but the overall results are compiled altogether when the features have to be submitted [17]. The results which we are obtaining overall will fetch the desired accuracy only when we are dealing with monochrome set of image structure. The features lend by the monochromatic.

Ada Boost

Adaptive boosting also known as ada boost, does exactly what it sounds like. For our project, we used ada boost alongside with harr features, thereby improving the overall accuracy and performance rate for our model [3]. The only drawback of this process is that the process is extremely sensitive to outliers and noisy data. To take the weak learnings of the model and use them to form a highly correct prediction rules using the features calculated by repeatedly calling the weak learner on the processed training samples, this is the basic idea of boosting. Basically what we are doing through this is that we are taking multiple weak classifiers and converting them into one strong classifier. This process in itself is called as boosting [2].

It can be seen as a recursive process of building a classifier and building the next classifier on top of it to straighten out it's shortcomings. This can be done until the results according to our needs aren't met. It works sequentially on weighted data [19].

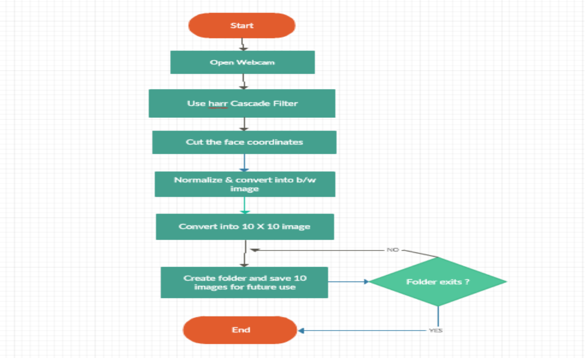


Fig.3. Principal component analysis

The PCA algorithm involves the projection of an image into a new co-ordinate space, the original image is modified in order to be projected. The initial phase is to selection and using on an image from the database and converting it into its greyscale equivalent [16]. The last phase includes the converting of the 2D image into a 1D image vector group.

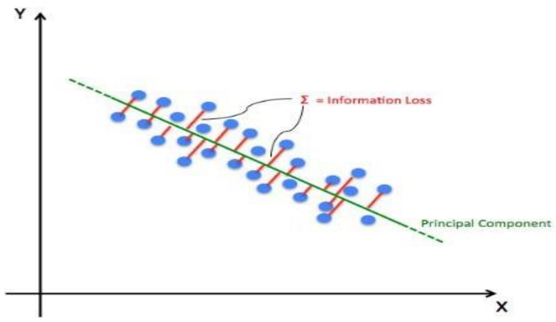


Fig. 4. PCA Graph

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FAST PIXEL BASED MATCHING USING EDGE DETECTION

Contour detection has been used for the sole purpose of marking the points where there are abrupt changes in light intensity are occurring in a digital image. These abrupt changes indicate either an event or some major change in the physical world. This can be the physical changes in the material's properties or discontinuous depth fields of the surface. The variations in the lighting conditions can also lead to these changes.

DESIGN OF STUDY: PROCEDURE OF DATA COLLECTION

Data is an important factor for learning a deep face representation, several research groups have been collecting datasets with images ranging from 90,000 to 2,600,000 labeled images. To achieve this, the researchers have collected images from some very specific websites, one at a time. Websites include IMDB, Facebook, and Instagram etc. There are many existing facial images collecting methodology but they mostly contain two major flaws. Firstly, and most importantly, these data sets are limited to visible spectrum only, there are no infrared images that can be caught through this method. Secondly these methods more often than not expensive and time consuming. The reason behind this is that the automatically collected image are noisy and have to be manually cleaned which is a very time consuming and tedious process. The difficulty of collecting large datasets in some domains, e.g. for infrared imaging, motivates the work presented in this paper. To address this issue we propose a data synthesis method that we describe in the next section.

To alleviate this serious scarcity of data in this facial recognition tasks, some methods such as data augmentation have been used to add more data samples from the already existing images. Horizontal mirroring, cropping and small rotations are some examples of such transformations. Since it is not always clear in advance which (combinations of) transformations are the most effective to generate examples that improve the learning the most.

IV. EXPERIMENTS AND RESULTS

Hypothesis:-

Traditionally facial recognition systems implemented on CNN apply a direct approach without much modulation of data. This leads to a lot of wastage of processing power and space. By pre-processing the data we can remove some of the unnecessary parts of the data. In our project we have focused on the above mentioned approach, which includes modulation of data in a way such that the data while retaining the important feature of the data discards the unnecessary ones. This includes b/w conversion, normalisation and finally dimensionality reduction. These methods significantly improves the quality of data, ergo, increasing the efficiency of the process as the whole.

V. RESULTS AND DISCUSSION

By using Bilinear CNN for feature extraction or by using a combination of Haar Cascade & Ada Boost we can increase the efficiency and better the performance of the algorithm. The extremely efficient method of extracting feature from given dataset, analysing the different component separately and the efficient mathematical function which even preserves the feature vectors of the image around the edges all contribute to overall accuracy.

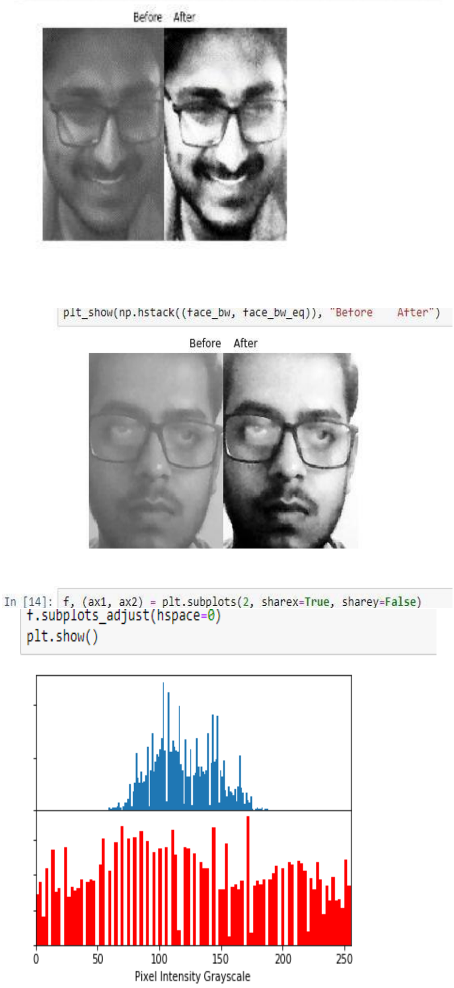
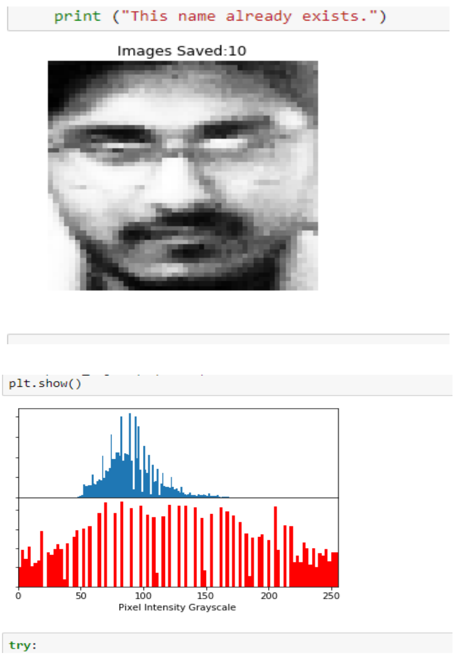


Fig.5. Implementation phase



VI. VARIABLES IN THE STUDY:

The first image is a two part image showing the difference between the actual and the normalised image. The process clearly enhances the image to a point where we can see the facial features clearly and the algorithms can detect the features better. The second image shows the image now brought down to a 10x10 pixel format, greatly reducing it's size while still retaining the attainability of the features with due help from the previous step. The decrease in size helps to keep more images in dataset hence increasing the efficiency by many folds.

VII. FUTURE SCOPE, LIMITATIONS AND POSSIBLE APPLICATIONS

One of the best scope is in the medical case where facial recognition is used. Initially Viola-jones detector algorithm was used in OpenCV and Matlab. But the problem with them was features. The Image Database contain many false positive results in the images but if better algorithm is used like deep learning (which reduce false positive) produces better accuracy up-to 96%. By combining these two techniques Viola jones and deep learning we are able to increase thesystem precision considerably, without the need to manually construct a large dataset.

- Smart cameras for security purposes identifying the facial feature on a moving video and matching it in the database.

-Automatic attendance system in schools and colleges. Detecting the faces in a controlled environment.

-Increasing the number of layers as well as information per class will result in the ability of neural network distinguishing between people with higher similarity in faces twins.

VIII. CONCLUSION

The change in size or orientation of a face during 3D face recognition is not an issue as it can use a representation purely curvature based. The real problem occurs when the enrolment image & the new image to be recognized have a change in the facial expressions. It's a given for a facial recognition system that it should be able to handle changes which includes change in expressions. This project focuses on that problem as well as implementing a good enough system on a normal machine.

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