Advanced Human Face Detection and Enhancement in Image based Personality Trait Identification

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Abstract— It is often difficult to make judgements on humans personality traits and intelligence even if we got a solid amount of Interaction with them. The main reason of this problem is that the humans unlike every other organisms, can fake the personality they exhibit with other beings. This proves that, it is even harder to detect ones personality and intelligence measures. In order to overcome this issue, we humans have decided to train the computers so that they can make accurate Judgements on humans without any delay. To perform this, the system should have a proper knowledge on human faces and should detect faces from images. Considering the improvement of technology, we are currently capable of taking standard images of humans. However, there are factors which could cause the face detection impossible such as noise, blurred edges and illuminance variations. The prime focus of this work is on the preprocessing stage of personality detection that is detecting and aligning human face from images. The Objective of this work is to propose face detection method and evaluate to perform some enhancement operations so as to improve the accuracy of personality trait detection algorithm.

Keywords: Personality trait Detection, Face detection, Face preprocessing, Haar Face detection

I. INTRODUCTION

Identifying the location of Human faces in the system is called the face detection. It is defined as a part of object detection and is also said to be part of pattern recognition. Since human face have the features of being unique stable, personate prevention and stable it is considered as one of the most reliable biological data. With all these key features, human faces can be used as a key security features for private access. Thus the main key of the whole system will be extracting the features and matching it with the admin of the owner of the specified file. This represents that facial images has an import role in human machine interaction and computer vision based applications.

However, face detection has always been a challenging problem. The entire face data in the image could vary due to shear illumination changes and uncertainities or any real world problems present in the image. Even if this crisis is solved, the computer wouldn't be able to recognize the human face due to moustache, glasses, beard etc.

Even with all these drawbacks in detecting the face, there are a lot of face recognition algorithm at present. In this proposed work, both Haar cascade and Histogram of Oriented gradients algorithms are implemented in respective stages to improve the overall accuracy in results.

II. RELATED WORKS

Even with all these drawbacks there many face detection algorithms implemented in recent years. Below are some of the interesting face detection works.

Jatin Chatrath [5], proposed realtime face detection system. It deals with real time human face detection that is instant human face detection can be done on a video format. The paper implements Viola Jones algorithm on frames or images to check the accuracy of detection. This algorithm is later implemented onto a real time network. The real time network consist of an Input, a face detection part and output. Input provides the video to be processed and the output contains the video with labelled results. Here the intermediate detection part intakes the video and divides into individual frames. Those individual frames are undergone processing by the cascade classifier thus generating labelled frames.

Ali Sharifara [3], proposed face detection with neural networking and haar classifier. The work mainly focused on surveillance procedures by including appearance based feature based, knowledge based and template matching interface. It basically performs the haar based classifier method and as an improvement, the proposed work includes a neural network at the end, which can improve the performance. A Multi-Layer Feed-Forward is used. There are 3 main steps. The initial step extracts face candidates from Haar-like features using which rough location of the centre point of faces is found. Finally it checks window by using neural network classifier.

Another related work [4] adds 3 classifiers with the Haar cascade classifier to make sure that the input image contains a face. As mentioned earlier there are many internal as well as external factors capable of keeping irregularities in the image. To overcome this, 3 additional classifiers are added on to the system namely Histogram matching, eye detection and mouth detection. The histogram matching means comparison of two histograms so as to measure the difference between a human face candidate's skin hue histogram and the prototype of hue histogram of training (real) human faces. The 3 of them acts as separate rejection nodes so that while passing through each of them the image will be rejected if the image doesn't pass the individual classifier test.

According to Juan Wan [2], the classic face recognition formula will be improved by Binary Morphology. It combines the standard face Detection formula with Morphology process formula. initial of all, the captured pictures can bear the YCrCb model detection to scale back the impact of brightness on the image. HSV model detection formula has been adopted to scale back the impact of lighting on the image. The detection image gained are reworked into the binary image. The denoising of binary morphology are

additionally conducted, therefore gaining the face recognition image.

As a new methodology, Bibi Somayeh [1] introduced Detection of faces from color images using Genetic algorithm by an optimized fuzzy system. According to the author the system comprised of 3 subsystems namely skin color segmentation, lip color segmentation, face blob selection subsystems. From the input the skin color regions are selected at the first stage. Lip pixels are identified by the second subsystem to find skin regions of face candidates. Utilizing these results and face shape information, the third subsystem is Face blobs has been generated. The final results have remarkable accuracy when compared with others.

Regarding the face alignment, Ying Zheng[6] proposed a stereo based Model matching method. Here, he implemented a traditional face alignment technique created a reference 3D face to use as an intermedium for correspondence calculations and implemented a traditional face alignment technique. Using face alignment technique the known values of the virtual image is fetched and extended according to the input stereo images.

Due to generalization problem in Conventional Active Appearance Models, Xiaoming Liu [7] introduced a discriminative face alignment procedure to overcome this. He treated the iterative image problem as a process of maximizing score of a trained two class classifier that is able to distinguish correct alignment (positive class) from incorrect alignment (negative class). Here a boosting-based classifier and Point Distribution Model (PDM) designed as an appearance Model. By extensive experimentations, its proved that their proposed work did showed a great improvement in robustness, accuracy and efficiency in face alignment.

Yi Zhou [8] uses face aligning procedure on their work on localization of eyes. This was performed by using Adaboost classifier for eye detection and a novel method based on face alignment. 6 Landmarks surrounding each eye is used to detect the eye region. The key applications were fatigue driving detection and eye tracking.

Based on locality principle and Local binary features for, Shaoqing Ren[9] proposed a regression approach. The highly discriminative local binary feature are adjusted by the locality features for each landmarks respectively. This joinly learns a linear regression for the final output. Since operating on local binary features is very cheap and efficient, this work was effective compared to others. Unlike other algorithms, this work checks for several face detectors and perform qualitative evaluations on their effects. At the end an alignment friendly face descriptor is chosen which in turn greatly boosts the accuracy of alignment method, reducing the error up to 16%.

Andre St¨ormer[10] introduced a multi-step alignment scheme for face recognition. Here, PCA based classification and Iterative Closest Point alignment will be joined to create aligned and normalized patches. By implementing these patches in suitable face recognition algorithms, face detection can be improvised.

III. PROPOSED WORK

We perform Haar cascasde classifier algorithm to efficiently detect various part of the face. Even though there are algorithms like Histogram of Oriented Gradients (HOG) and the addition of Neural network to their proposed algorithms, Haar cascade is considered as the most effective algorithm that would detect faces accurately. Due to the use of integral images, a Haar-like feature of any size can be calculated in constant time period. Before moving the images to Haar Cascade classifier, denoising is done to remove the uncertainities present in the image. Along with Haar cascade face detection, Histogram of oriented gradients is also implemented right before the alignment procedure to make sure that the image does contain a face. The steps include (1) Preprocessing (2) Feature extraction and (3) Rotation Correction.

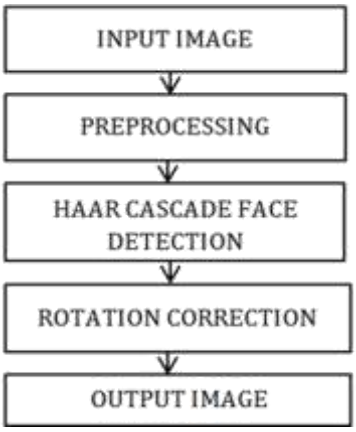

Fig. 1: Overview of the proposed system

A. Preprocessing

The preprocessing stage comprises of initial stages of the proposed work whose sole purpose is to enhance the image and make it suitable to perform detection. This part comprises of techniques that are capable of removing the uncertainities present in the image. The uncertainities as mentioned could be internal or external. To remove all kinds of irregularities in the image we implement preprocessing. The preprocessing stage performs denoising to remove noises and sharpening for making the edges sharper thus obtain an accurate image for feature extraction.

1) Denoising

Mathematically, the denoising works on Three factors. The observed noisy image represented y, the unknown clean image x and the additive noise represented by n, with standard deviation σn. This can be detected in practical applications.

$$y=x+n$$

The main purpose of noise reduction is to reduce the irregularities present in the image without compromising the original features and data in the image and improving the signal-to-noise ratio (SNR). The major challenges are:

- flat areas should be smooth,
- edges should be protected without blurring,
- textures should be preserved, and
- new artifacts should not be generated.

Since the median filter is capable of reserving the edges in the image by successfully eliminating the noise, median filter seems to be accurate to use in this process. The median filter calculates the median of pixel intensity of center pixel in the nxn kernel which them be replaces the value at

the center pixel. It keeps a good job at removing the salt and pepper noise than the mean and Gaussian filters.

2) Sharpening

The sharpening part inputs the smoothened image and sharpen its edges. By sharpening the objects in the image will be much sharper and can be easily extracted from the background. It makes transition between various stages present in the image rather than being smooth. A traditional sharpening technique is used in this work. As the image passes through the sharpening filter the brighter pixels are boosted as relative to its images. The two main steps are

- Sharpen the Blurred image
- Increase the weight of the edges.

B. Feature Extraction

It is the core part of the entire work. The preprocessed image is passed onto this stage, where we use a Haar Cascade classifier to detect face from the image. There has been a lot of algorithms similar to Haar such as Histogram of Oriented gradients etc.,. However, Haar seems to be the one that is much more efficient in spoting human face from shear images. To improvise the working of Haar, preprocessing was implemented.

1) Haar Cascade Classifier

Object detection using Haar feature based cascade classifier is one of the most effective object detection method proposed by Paul Viola and Michael Jones. In machine learning a cascade function is trained from a lot of positive and negative images. It is then used to detect other images.

Initially the algorithm requires a lot of positive that is the one with facial images and negative which are the ones that doesn't have any face to train the classifier. After this, features are extracted from it. For this the following structures are used.

Each feature is a single value obtained by substracting sum of pixels under the white rectangle from sum of pixels under the black rectangle. Now, all possible locations and dimensions of each kernel are used to calculate a number of features. This could take a lot of time. In order to resolve this matter, an integral image is introduced which makes the calculation of a given pixel to an operation involving just 4 pixels.

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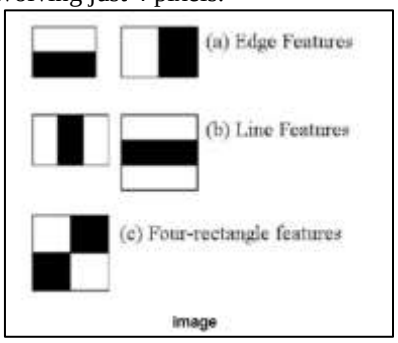

Fig. 2: Feature windows of Haar Classifier

However, there could be irrelevant calculations after the calculations. Consider an example of integral image on fore head. The part above the nose to the forehead is considerably lighter when compared to eyes. This can be represented by the image below.

The same windows couldn't be applied onto any other parts of the head because it doesn't match. The proper solution to this problem can be done by implementing adaboost.

In this case, each and every feature is applied to the training images. For each feature best threshold is found which will classify the faces to positive and negative. Since certain features aren't capable enough to distinguish between the images a minimum error rate is kept, so that the features that satisfies the rate will be only ones taken.

The final classifiers will be the weighted sum of these weak classifiers that is the classifiers that aren't capable to classify an image alone.

Now to the main step. In order to preserve time of applying all the features to a faceless image, the haar cascade classifier implements an algorithm to check whether present window does have a face or not. Also in order to avoid pushing all the features into a window at once, the features are divided into stages in such a way that each of the stages will be implemented if and only if the previous stage features are successful.

C. Rotation Correction

Once the face is identified in the image, it is moved onto the next part which is the alignment part. The two main steps are

- Identifying the geometrical structure of faces,
- Performing canonical alignment in the face using transition, scale and rotation.

Here Normalized rotation is performed to get the image aligned. For that, translation and scaling is done, which when compared to the current works, helps to develop higher accuracy in face recognition. The output after rotation correction will be the face centered image, which will be rotated so that the eyes lie in the horizontal line and scaled, if in case there are two or more faces in the image and needs the output representations to be in similar size. In short Affine transformation is performed, which combines rotation, scaling and translation and develops a rotation matrix.

1) Face Aligner

This part deals with the facial landmarks such as Eyes, Eyebrows, Nose, Mouth, Jawline. The two main steps involves localize face in the images and detect the facial attribute. The pre-trained facial landmark detector inside the dlib library is used to estimate the location that map to facial structures on the face.

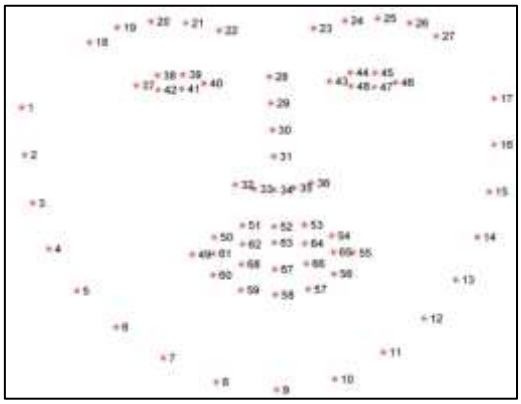

Fig. 3: Visualizing the 68 facial Landmarks

Dlib's Facial Landmark predictor is converted into Numpy format. Respective Left eye and Right eye values are taken, these are the end points covering the whole eyes. From these end points, left and right eye points are extracted, by which the center of each eyes will be determined. Once the center is found, angle between each centroids is taken. This angle later serves as a key component for aligning the image. Once the angle is found, the next step is to figure out the scale value, which represents the distance between the eyes in current image to the distance between the eyes in the desired image. The current distance will be obtained by Euclidean distance measure. Performing suitable divisions, the scale value is found.

The mid point between the eyes are taken for the rotation matrix calculation, which is situated at the top of the nose. To perform, I use get Rotation mtrix of open cv which required all the three factors which are, eyeCenter, angle, scale respectively. The translation component is updated alongside. Affine transformation is utilized here. In this transformation, the parallel lines will remain parallel in the output image. We need three points from the input image and their corresponding locations in the output image to find the transformation matrix.

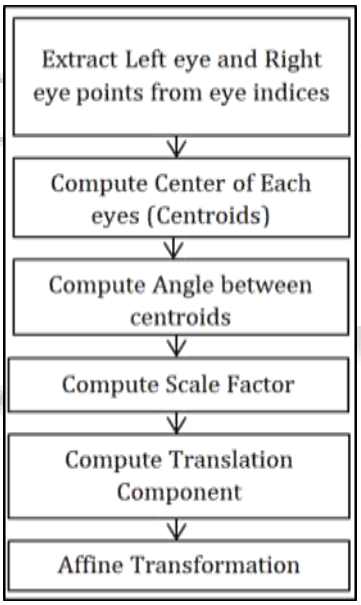

Fig. 4: Face Aligner

2) Executing and Displaying Results

This module deals with loading the input image and displaying the outputs accordingly. With necessary packages imported and using get_frontal_face_descriptor all the landmarks from the Dlib has been successfully Imported. By using –image, an input image is introduced and resized into 800 pixels accordingly. The input image is converted into grayscale image.

By using Dlibs face detectors, the human face is detected from the input image, which is cropped and represented within a rectangle. By performing iteration on rectangle by means of face aligner, the image is successfully rotated by means of affine transformation. The final output will be displayed accordingly.

IV. EXPERIMENTAL RESULTS

A. The original image:

Fig. 5: Test Image

B. Image after Preprocessing:

Fig. 6: Preprocessed Image

The above figure represents the image after Preprocessing that is Smoothening, Sharpening, and Denoising.

C. Image after Haar Cascade face detection:

Fig. 7: Face detected Image

D. Result after face alignment

Cropped image before alignment,

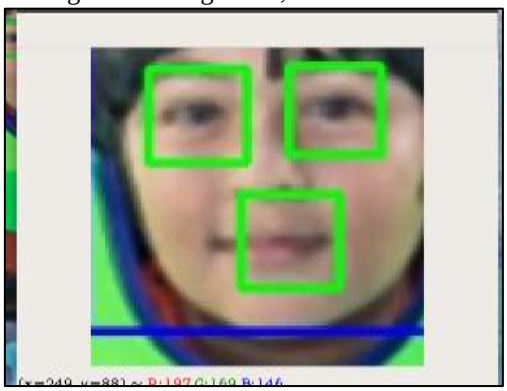

Fig. 8: Cropped Image

E. Cropped image after alignment,

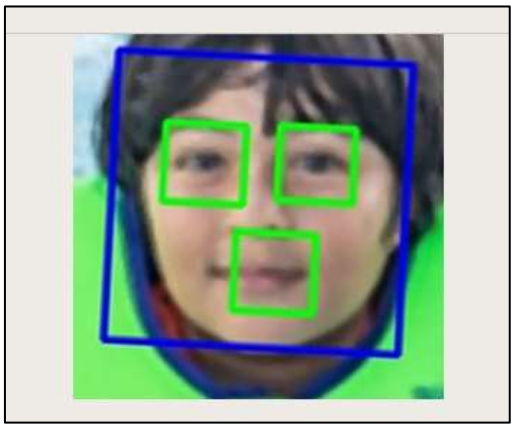

Fig. 9: Transformed Image

V. CONCLUSIONS

This work depicts a new approach for detecting, framing and aligning faces in an image. This paper focuses on preprocessing techniques in order to improve the accuracy of personality trait detection algorithm, upon which we are working. Experiments were performed over face images captured under wide range of conditions including varying illumination, scale, and pose and camera angle. The algorithm is flexible enough to adjust according to the changing conditions. Our experiments shows that the method is promising in the detection of Personality traits from the images. Apart from personality detection, this work may be useful for applications like, Head pose estimation, Face swapping, and Blink detection, Eye Tracking and so on.

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