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Persons Identification Tool for Visually Impaired - Digital Eye

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Abstract - One of the most difficult tasks faced by visually impaired persons is identification of people. Here presenting the design and implementation of a face detection and recognition system for the visually impaired through the use of mobile computing. This mobile system is assisted by a server based support system. Computer vision methods such as convolutional neural networks and cascade classifiers are used to further investigate performance. Experiment results show high face detection accuracy. Our project is based on face recognition system where there are pre-trained image in the datasets. The images are combined as a mixture from different datasets to combine the trained images for maximum accuracy, and post face recognition the outcomes are used to determine the Emotion, Age and Gender. Dataset used for this project consists of images from different datasets combined and trained to create a model wise accuracy. It was proved that in surroundings with maximum faces too it gives the maximum model accuracy up to 95.7%.

Keywords - Face Detection and Recognition, Emotion Detection, Gender Detection, Age Detection.

1. INTRODUCTION

Visual impairment, also known as vision impairment or vision loss, is a decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses. Living with visual impairment can be challenging, since many daily-life situations are difficult to understand without good visual acuity. Technology has the potential to significantly improve the lives of visually impaired people.

An individual is identified by his/her face. Face being the most important part, used for distinguishing a person from another. Each face has different features and has different characteristics of its own. So, face recognition plays a vital role in human behavior. These systems used for the blind can do a lot of help to the blind, so this is what proposing this new idea and a beginning for the disabled ones.

In this paper, the blind will be himself able to identify people due to face recognition and will get a audio message about the person, "This is so and so person" and the blind can be himself able to speak to them without having to wait for person from opposite to come to him and speak to him, just he has to identify the person (provided the person details saved in system database).

The new faces can also be added to the database. In actual, the idea is to bring the vision level of blind a bit more closer to the normal ones. Even they would be able to recognize people and their expressions, age and gender on their own with the help of face recognized from the image captured.

The model which is used for the Age and Gender classification contains approximately 600,000 parameters. It was trained on the IMDB gender dataset, which contains 460,723 RGB images where each image belongs to the class "woman" or "man", and it achieved an accuracy of 96% in this dataset. We also validated this model in the FER-2013 dataset. This dataset contains 35,887 grayscale images where each image belongs to one of the following classes {"angry", "disgust", "fear", "happy", "sad", "surprise", "neutral"}. Our initial model achieved an accuracy of 66% in this dataset. The organization of the paper is as follows: Section 1: Introduction to the Topic

Section 2: Literature Survey
Section 3: Implementation
Section 4: Results
Section 5: Conclusion

2. LITERATURE SURVEY

Face recognition is an evolving area, changing and improving constantly. Many research areas affect face recognition - computer vision, optics, pattern recognition, neural networks, machine learning, and psychology. Face recognition is a non-invasive identification system and faster than other systems since multiple faces can be analyzed at the same time. The difference between face detection and identification is face detection is to identify a face from an image and locate the face. Face recognition is making the decision "whose face is it?" using an image data.

This research is mainly focus on the Dlib Face recognition, age, gender and emotion Recognition techniques.

A. Face Detection [1]

The first process in automatic face recognition is

face detection. The accurate detection of human faces is much more important process. The face detection is a computer vision technology to detect the frontal faces of the human from digital images. This research uses frontal faces detection by facial landmark detection of nose and upper lips. Nose is the center point of the facial landmarks.

B. Face Feature Point positioning

In this research, the principle of face feature localization algorithm, the algorithm first use detector to get face detection box, and then the shape of the sample initialization. In the training, a stochastic forest model is established at the position of each feature point using the pixel difference feature, and then the built-in model is used to estimate the position offset of the training sample feature point, and the position offset of each feature point[1].The linear incremental least squares method is used to fit the shape increment of the training sample and the real shape increment to obtain a global optimization.

The research describes the process involved in the face recognition like face alignment and feature extraction and also emphasizes the importance of the face alignment, thus the accuracy is observed.

Eigen Face Recognizer: It uses PCA (Principal Component Analysis), for reducing the dimensionality of the data by projecting, it onto a lower dimensional subspace [2].

Fisher Face Recognizer: It uses LDA (Linear Discriminant Analysis), where the dimensionality reduction takes place such that the within class variance is reduced and between class, variance is maximized[2].

Local Binary Pattern Histogram: LBPH where the local structure of the image is summarized by comparing each pixel with its neighborhood[2].

Dlib is a Feature-based Approach, local features on the face such as eyes and nose are detected and based upon which recognition is performed[2].

C. Emotion, Age and Gender Detection [4]

Facial attribute recognition, including age, gender and emotion, has been a topic of interest among computer vision researchers for over a decade. Due to the release of large labeled datasets, as well as the advances made in the design of convolutional neural networks, error rates have dropped significantly. In many cases, these systems are able to outperform humans. In this work, we present an end-to-end system capable of estimating facial attributes including age, gender and emotion with low error rates. The contributions of this research are summarized below.

An end-to-end pipeline[3][4], along with novel deep networks, that not only are computationally inexpensive, but also outperform competitive methods on several benchmarks.

A large datasets for age, emotion and gender recognition that are used to train state-of-the-art deep neural networks.

This Research, validates models by creating a real-time vision system which accomplishes the tasks of face detection, gender, age classification and emotion classification simultaneously.

3. IMPLEMENTATION

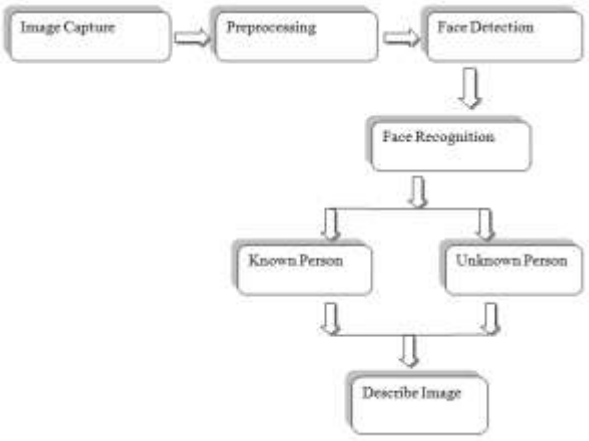

Figure 1 - System Work Flow Architecture of Person Identification and Persons Description

Image Capture: Image capture is clicking of image using camera and Photo gallery Images will be considered for the Face recognition and image description purpose.

Preprocessing: It is also possible to use the facial landmarks detector, which is available inside the dlib. The landmark detector has been trained to recognize 68 specifics points on a face which is shown in figure. This method has been trained with many pictures, which have been manually labeled before for each landmark.

Figure 2: Preprocessing process[1]

Face Recognition:

This step includes the preprocessing stage. In this stage for Face recognition, dlib used for identifying the image from the region of interest (RoI). As shown in figure.

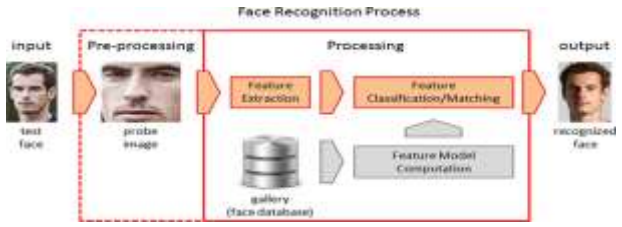

Figure 3. Face Recognition[6]

Image Description: Image Description is the process of generating textual description of an image. This figure shows the pipeline of our system. Images are collected from different sources and labeled for different tasks. Over 4 million images of more than 40,000people are collected for the task of facial recognition. All images are labeled with their corresponding gender label and part of the data is annotated with emotion. These images are later pruned using a semi-automated process with a team of human annotators in the loop. The images are pre-processed next to extract the faces and align them. The aligned images are then fed to our proprietary deep network for training. The model which is used for the Age and Gender classification, contains approximately 600,000 parameters. It was trained on the IMDB gender dataset, which contains 460,723 RGB images where each image belongs to the class "woman" or "man", and it achieved an accuracy of 96% in this dataset. We also validated this model in the FER-2013 dataset. This dataset contains 35,887 grayscale images where each image belongs to one of the following classes {"angry", "disgust", "fear", "happy", "sad", "surprise", "neutral"}. Our initial model achieved an accuracy of 66% in this dataset[3].

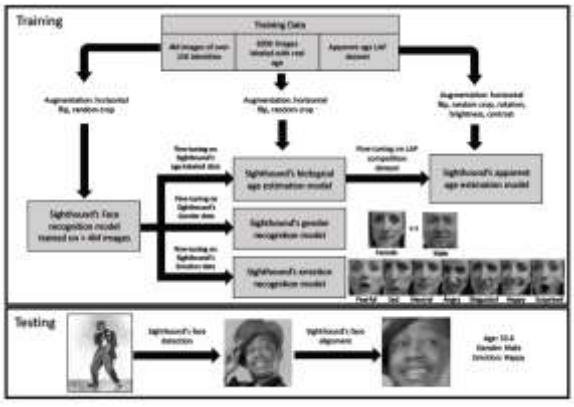

Figure 4: Model of Image Description[3]

4. RESULTS

For the Pixel based face recognition algorithms comparisons, each face has 50 images. Three applications were written to iterate through the parameters of each algorithm. On each iteration, the algorithm is trained using different parameters and tested against a photo. The resulting data is plotted at the after finishing the tests. Creates ID for each person is added in dataset.

The face as ID-17 and the rest are between ID-20 and ID-21, which is the same person. The first test image and the plots are analysed below. The resulting ID change is plotted below in figure 5. Note when components were 1, it identified.

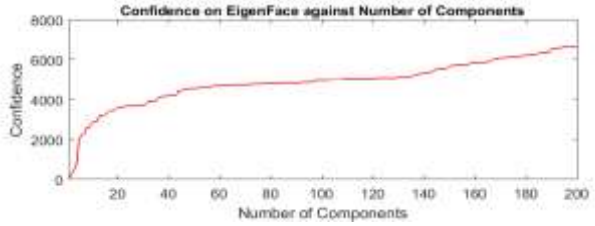

Figure 5: The ID from the face recogniser changes between two classes

Confidence is plotted in figure 6, increasing with components. From this plot it appears the best is when components are below 20.

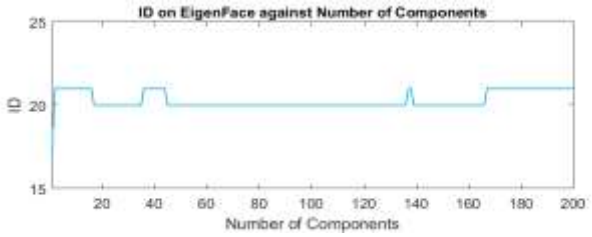

Figure 6: The Confidence increasing with No. of components

The ID results from Fisherface are more stable than Eigenface and is on ID-21 as seen in figure 7.

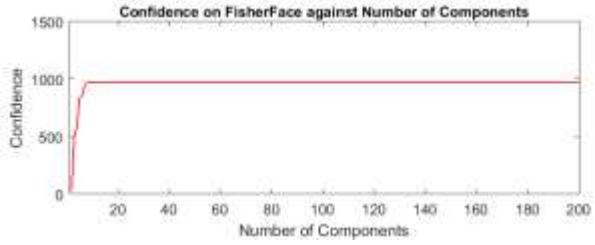

Figure 7: Fisherface ID is stable

Fisher face confidence increase in figure 8 until the number of components is 10 and will be used as the ideal value. LBPH has more than one parameter to change. All are incremented to the maximum limit and the results are shown below.

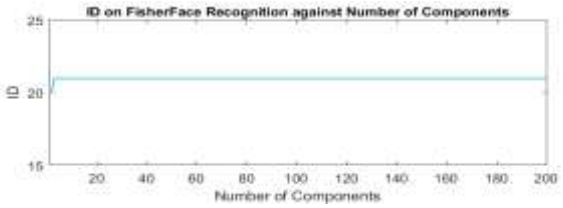

Figure 8: Stable confidence after 10 components

The first is the radius from the centre pixel and since the image size is 110 X 110, maximum radius is 54. The ID is steady all the way to 50 as can be seen in figure 9.

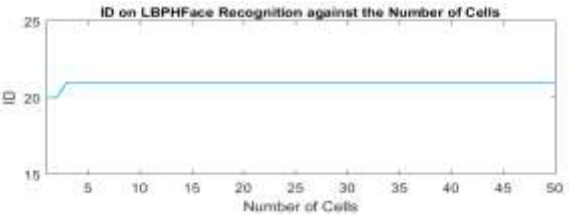

Figure 9: The ID returned from LBPH

Confidence level is graphed against the radius in figure 10. The confidence is fluctuating after 40. The lowest confidence level is at 2.

Figure 10: The confidence returned from LBPH

Distance threshold

To find the optimal value for the face verification performance must be evaluated on a range of distance threshold values. At a given threshold, all possible embedding vector pairs are classified as either same identity or different identity and compared to the ground truth. Since we're dealing with skewed classes (much more negative pairs than positive pairs), we use the F1 score as evaluation metric instead of accuracy.

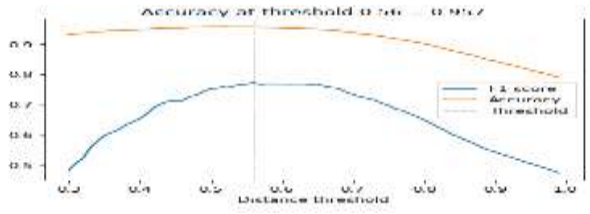

Figure 11: Dlib Accuracy Results

The face verification accuracy at r= 0.56 is 95.7%. This is good given a baseline of 89% for a classifier that always predicts different identity (there are 980 pos. pairs and 8821 neg. pairs)

Comparative Study of Different Algorithms

As Shown in Table 3.1 the Dlib Algorithm gives comparatively high accuracy, high precision and recall. Because of this is used for the Face detection and recognition Process. The most straight forward future direction is to further improve the learning algorithm and features. The point based features used in the effort by Dlib are very simple and effective for frontal face detection and Recognition.

Table 1. Comparative Study of Different Algorithms

Algorithm	Accuracy	Speed
1. Dlib	High	High
2. Local Binary Pattern (LBP)	Medium	Medium
3. Fisher Face	Low	Low
4. Eigen Face	Low	Low

5. CONCLUSION AND FUTURE WORK

The current implemented system shows that a face detection procedure has been initialized over a pre-trained dataset and for a limited number of images. Also a comparative approach on the recent algorithms has been made to get efficiency and accuracy. In this research, the person's images are taken as a data to perform operations and for the processing. In this work dlib algorithm is giving 95.7% accuracy. As per system work flow architecture Known and unknown person modules implemented i.e Feature description (Emotion, age, gender) for Unknown Person and Person Identified with name for Known person. This is important since the visually impaired people get haptic output and it provides a description of the person as well as person's identification.

6. ACKNOWLEDGMENT

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