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Real time Face Detection and Recognition in Video Surveillance

Bhavani K[1], Dhanaraj V[2], Siddesh N V[3], Ragav Vijayadev[4], Uma Rani S[5]

Dayananda Sagar College of Engineering, Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru- 560078, Karnataka, India

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Abstract: *Face detection systems are capable of handling well-aligned images captured under controlled situations. However, objects in world and their images present before us varied orientations, mismatched expressions, and well or poor lit conditions. Traditional face detection and recognition algorithms display a below par performance on such images. In this paper, we present a method for face detection and recognition which is adapted to real-world conditions that can be trained using very few training examples and is technically efficient. Our method consists of performing a frontal image alignment process followed by classification using sparse representation techniques. We perform our face detection and recognition based on a realistically simple and feasible algorithm, which are implemented to extract the best performance.*

***Index Terms*: Face detection, Face Recognition, Training, LBP, Eigenface, Fischer, PCA. Viola-Jones, Histogram Of Gradients(HOG).**

I. INTRODUCTION

Face detection can be defined as a creative process that deals with scanning an object's image and taking the resultant datasets. It takes a high level of coding using an algorithm that

It requires a high level of coding using an algorithm that can detect moving images from a running video stream Fand capture the different poses that form it's dataset[7]. It is probably one of the most popular areas of research in image processing and has a wide range of real-world applications including surveillance, access control, identity authentication, and photo based image detection and recognition. Face recognition systems are generally conceived as image processing systems that try to capture the identity behind the running video images and tag them with an identity to complete this process. Recognition of images are performed through a pair of pictures using pattern matching of images belonging to the same individual or performing face identification or recognition wherein it puts a label on an unknown face with respect to some training set.

In this paper, we address how the same kind of detection and recognition can be utilized in campus surveillance. In modern day college or school premises, there is an increasingly high demand in the need of technology based monitoring. It creates a platform for a image processed detection to filter out unwanted and undesired individuals, by firing out warning messages to the user via an on-screen tagging that displays strangers and other unknown individuals as "Unknown" and helps in checking unauthorized individuals from gaining access to private data.

In the recent decades, the automatic face detection and recognition has seen considerable progression in the field of military and other top-secret organizations. It can be a very challenging problem when the training examples are few and the conditions are difficult to capture as images for the dataset. In a school environment, there are varied stages of monitoring student pupil activities. Our work towards face detection in an educational campus environment brings the student and teacher activities to one hemisphere of sight and the surveillance activities that govern the campus as another hemisphere. The algorithms that are used are of superior intensity and can cater to a group of 5 pupils at a single video capture to perform the recognition and tagging of names. In face images varying widely in orientation, expression, and illumination, we see a case, where in only frontal images are taken as a part of the dataset. In our work, we focus on the difficult problem of recognizing student images taken from a running visual stream [1], which we train them to give faces captured along with name tags and other personal information pertaining to the particular student. We encompass three modules in this study. Firstly, the data entity creation(detection). The training module and lastly the image recognition module which completes the scheme [4].

II. RELATED WORK

The earliest developed face recognition algorithms used individual features on the faces, such as organs i.e. eyes, mouth or nose region to perform identification. These were purely feature set based classifiers that held a huge impact on the use of face and classifier based datasets [4]. However, such methods did not lead to good results because of the variability and the low amount of information used.

The Viola–Jones[5] object detection framework is the first object detection framework to provide competitive advantage and was proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. This algorithm is implemented in OpenCV as cvHaarDetectObjects().

From the 90s, new methods that use global features of the faces were developed. Turk and Pentland proposed EigenFaces[5] that uses Principal Component Analysis (PCA).

Other methods like Fisherfaces or Laplacianfaces extract features from face images and perform nearest neighbor identification using Euclidean distance measure.Babacket al. use a Bayesian[6] approach where a probabilistic similarity measure is used to perform classification. Wright et al. applied the ideas of sparse coding to face recognition: they proposed the Sparse Representation based Classification (SRC) scheme, a dictionary learning basedapproach to recognize faces. This method, which can be seenas an improvement over the previous ones, is far more robust and is able to handle occlusions and corruption of face images.

LBP introduced and described in early 1994[8], is a visual descriptor used for classification in computer vision. LBP is the particular case of the Texture Spectrum model proposed in 1990. It has since been found to be a powerful feature for texture classification, it has further been determined that when LBP is combined with (HOG) Histogram of oriented gradients descriptor, it improves the detection performance considerably on some datasets.

PCA algorithm[4], which is based on the Eigen faces approach, extracts relevant information in a face image, and encodes that in a suitable data structure. It was first introduced in the early 1900's and probably is the most oldest algorithm. It was first introduced by Pearson(1901) and developed independently by Hotelling. The general idea of PCA is to reduce the dimensionality of the dataset in which there are large numbers of interrelated variables, while retaining much of the possible variation in the dataset.

These were the models to eliminate pose and expression variations. In the recent years, deep learning methods have been adapted to the face recognition problem. These methods achieve very good recognition rates and clearly outperform the "standard" algorithms. However, they generally require a considerable amount of data and specialized hardware to train and deploy in practice. This makes them hard to train and less suited for embedded and low power devices.

III. SYSTEM ARCHITECTURE

Fig1. shows the detailed architecture of the system with flows to the respective sub-modules. The captured face triggers a set of images that form a part of the dataset and each such individual datasets constitute a collection. The persons whose image is detected is passed in sets to be trained for the purpose of recognition. The person's individual images get collated together to be linked to a database for further recognition. The training sub-module goes through a .yml file which encompasses the individual images of a person dataset and produces the best of average among the compared images and assigns the value associated with it. The recognition sub-module takes both the compared values from the .yml file and the image set from the database and produces the corresponding match for the face recognition.

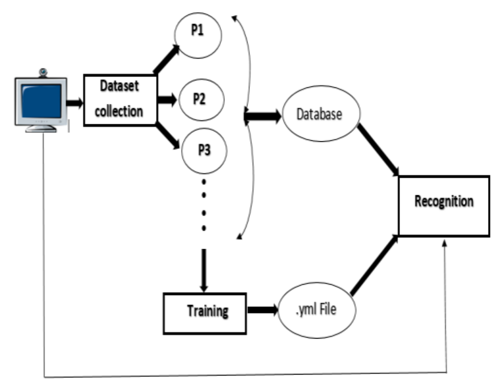

Fig1. System Architecture

IV. DESIGN AND IMPLEMENTATION

Design and Implementation:

Dataset collection for an individual person: -

In this phase, we collect the images for an individual person. Firstly, we start the camera and detect the person's frontal face. We use the Viola-Jones algorithm to perform the above action. We use haarcascade_frontalface.xml file to detect the frontal face of the focused person. A

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rectangular box is put on the person's detected face. It is of dimension 130 x 100 pixels. It is further converted into a greyscale image, and then resized into a smaller dimension. We then capture around 30 different orientations of the frontal face and then store them in the named dataset of the person. We then repeat this exercise for other individual datasets captured likewise.

A. Training and Face Recognition: -

We import all the person's detected images from their individual datasets. Live streaming via the camera is initiated. We use LBPHFaceRecognizer() [2] to train the images. We now create a FisherFaceRecognizer() in the camera's live stream to detect the faces which uses haarcascade_frontalface.xml file. We then put a rectangular box around the detected face and convert the face to greyscale image. Now we extract the frontal face feature set and give a value to it. This value is then compared with the trained image set contained in the dataset. We use predict method to choose or match the image contained in dataset with that of the detected image. It results in the following two consequences:

If in case the condition is "TRUE", i.e. there exists a closely matched image, it will return the value of the detected image, and similarly in case of a "FALSE" condition, i.e. there exists no close matches, it would return a "Not recognized" value.

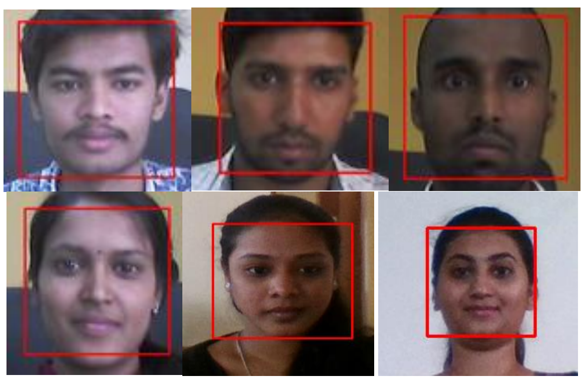

Fig1. Face detection using images

Fig2. Gray scale images

EXPERIMENTAL RESULTS AND PERFORMANCE:

Our approach gives a good overall recognition rate, the recognition rate entirely depends on the camera resolution. We did our experiments using the integrated web-cam in the laptop. For a dataset of 30 images of a person, the recognition rate is around 75-80% for the captured frontal face image orientation. If there exists is a different orientation other than the image stored in the dataset, the face is not recognized.

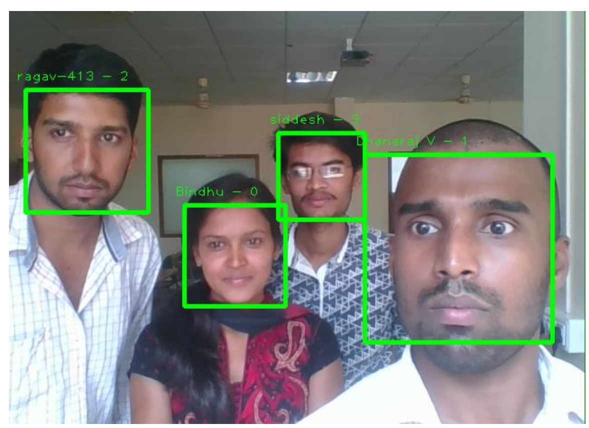

Fig3. Recognized Faces in the live stream

Fig.3 shows how the faces get recognized from a live video stream. It encircles the recognized faces within rectangular frames along with the values assigned to them.

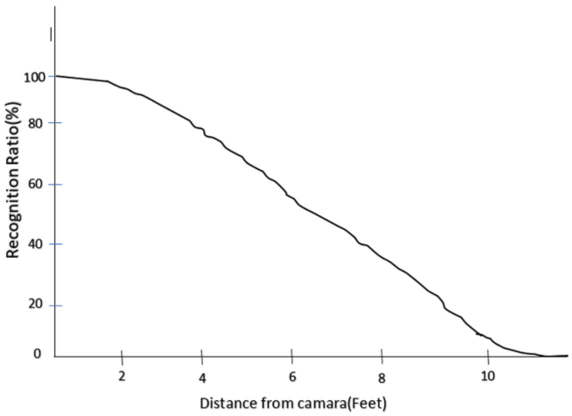

Fig4: Performance graph with respect to distance

From fig4, we observe that as the distance between camera and human face increases, the recognition rate decreases. In order to overcome this, we use a better resolution camera and improved illumination.

CONCLUSION:

This paper presents an approach to detect and recognize the faces which in turn can be effectively used inside a campus for surveillance purpose. This approach can be further enhanced for an Automated-Attendance-Tracking-System with a few code deviations and some hardware modifications. It can also be used to track and find the location of a person in the campus. Compared to existing methods, it gives us a much effective and simple solution in the live streaming arena. We can nearly double the recognition rate while halving the computational runtime by giving more training dataset images of each person and by using a very high resolution camera.

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