A End Sem Project Report

Face Detection and Recognition Using LBP and SVM

Under the guidance of

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A Project report by
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CANDIDATES'S DECLARATION

This is to certify that this project report entitled **Face Detection and Recognition Using LBP and SVM** which is submitted by our group in partial fulfillment of the requirement for the completion of Mini Project for 6th semester B.Tech. in Information Technology , is anauthentic record of our original work carried out under the guidance of **Dr. B.S. Sanjeev** and due acknowledgments have been made in the text of the report to all other materials used. This report work was done in full compliance with the requirements and constraints of the prescribed curriculum.

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Cetificate from Supervisor

I hereby recommend that the Mini project report prepared under my supervision for examination by Abhinav Prakash, Ranju Panchariya, Anushka Jaiswal and Preshita Chaudhary entitled **Face detection and recognition using LBP and SVM** be accepted in partial fulfillment of the requirements for the Mini Project in 6th semester B.Tech in Information Technology.

Dr. B.S. Sanjeev

April 27,2017

Acknowledgement

Before we get into thick of things, we would like to add a few words of appreciation for the people who have been a part of this project from its inception. The writing of this project has been one of the significant academic challenges we have faced and without the support, patience and guidance of the people involved, this task wouldnt have been completed. It is to them we owe our deepest gratitude.

It gives us immense pleasure in presenting the project report on Face Detection and Recognition using LBP and SVM. It has been a privilege to have a project mentor who has assisted us from the commencement of this project. The success of this project is a result of sheer hard work and determination put in by all the group members. I hear by take this opportunity to add a special note of thanks for **Dr. B.S. Sanjeev** who acted as our mentor despite of his many other academic and professional commit- ments.His wisdom, knowledge and commitment to the highest standards inspired and motivated us. Without his insight, support, and energy, this project wouldnt have kick-started and neither would have reached fruitfulness.

Abstract

For years now, precise recognition of faces has been a long term goal of computer vision.It's research has rapidly expanded not only by engineers but also neuroscientists, since it has many potential applications in various fields such as biometrics and automatic access control system.With the advancement in technology, various new algorithms have been proposed which utilize the increasing processing power to the fullest.These developments have led to designing the desired system at low cost with great efficiency.

As human face is a dynamic object having high degree of variability in its appearance, it makes the detection and recognition of faces difficult. The main issue with the problem at hand is accuracy and speed of identification.To achieve the goal of this project, we have used template matching SVM-LBP method in which we recognize unknown test images by comparing it with the known training images stored in the database.The proposed approach has proven to work well even under robust conditions quite effectively.

Contents

1 Introduction

1.1 Overview

Human beings are the most intelligent species on the planet having extraordinary capabilities one of which is identifying individuals and differentiating them from one another. This plays a vital role in everyday interaction, communication and other routine activities that enables us to lead a normal, social life. With the advancement of technology and growing use of computers in our day-to-day life, it is essential to develop systems that can precisely detect and recognize human faces.

We aim to propose an approach that can achieve the desired goal of face detection and identification effectively.Since working with image intensities is computationally challenging, we have adapted the approach formulated by Viola and Jones that is based on Haar-like features. The cascading of a number of distinctive features using Adaboost results in a strong classifier that can efficiently extract features. This ultimately leads to precise spotting of faces. Our region of interest is then subjected to the popular Local binary patterns (LBP) for further processing. The original LBP operator labels the pixels of an image by thresholding the 3-by-3 neighborhood of each pixel with the center pixel value and considering the result as a binary number. Histograms are then extracted from each sub-region and are concatenated into a single, spatially enhanced feature histogram. This feature histogram is the key factor that along with the SVM classifier recognizes the target image.

Hence, the above stated approach serves our purpose of identifying and analyzing facial images for various applications.

1.2 Motivation

One notable aspect of face recognition is the broad interdisciplinary nature of the interest in it; within computer recognition and pattern recognition, biometrics and security, multimedia processing, psychology and neuroscience. It is a field of research notable for its richness in a wide variety of applications.

With growing usage of social networking sites, people belonging to almost all age groups want to snap pictures,upload videos and want to have their friends, family and acquaintances automatically recognized.

Besides auto-tagging, security is a primary concern today more than ever. Face recognition helps in keeping confidential data secure and maintaining privacy. Also, surveillance by such systems have given satisfactory results. Searching of image databases for licensed drivers, benefit recipients, missing children, immigrants and police bookings have been a matter of great concern. All these fields depend on systems that can efficiently and effectively detect and track faces which have motivated us to implement the same.

1.3 Problem Definition

The problem of face recognition can be stated as identifying an individual from others in a set of given images. There are many factors that lead to variations in the images of a single face which add to the complexity of recognizing faces accurately. To identify the target images correctly, these factors need to be taken care of:

1.Physical changes: Changes in facial expressions,aging,appearance such as with or without glasses etc.

2.Acquisition geometry changes: Changes in scale, location and in-plane rotation of the face.

3.Imaging changes: Lighting variation; camera variations.

Taking all these aspects into account, we can analyze the unique features that differentiates one individual from another creating a feature vector per sample. The test images or the target images are then processed and compared against these feature vectors obtained from the training database. The one with the maximum similarity is the desired label that is assigned to the queried image.

1.4 Objectives

Our objective is to make a system that will use computer vision techniques to automatically detect and identify faces from the digital images which are extracted from the input video. The identification and recognition is based on prominent facial features such as region of the eyes,face shape etc. The main objectives of this project are stated below:

1.We are trying to build a fast and efficient face recognition system that detects faces very quickly in cluttered backgrounds. Using a learning-based approach, namely haar-cascade classifier, we want to minimize the effects of unwanted objects in the real time environment.

2.Once the face detection part is done, our next motive is to train our system with sufficient images.For each image, a feature vector is to be computed using Local Binary Patterns(LBP) where histograms are extracted concatenated for all subregions in an image.

3.With these feature vectors we wish to label the target images using SVM classification.

4.We aim to compare various recognition techniques and present a tradeoff between accuracy and speed for each of them.

2 Literature Survey

S.no	Title	Year	Journal/conferences	Objectives	Method	Challenges
1.	*Introduction to Face Detection and Face Recognition.*	2010	Robotics & computer vision technologies.	To detect and recognize face.	Viola-Jones method for detection and Eigenfaces for recognition.	Less accuracy in preprocessing and recognition.
2.	Face Detection using Neural Networks	2014	Meng Electronic Engineering School of Electronics and Physical Sciences.	To determine whether the original input image is thought to contain a face or not.	Using feature based and image based approach for face detection.	Problems of different light condition and background.
3.	A MACHINE LEARNING APPROACH TO DETERMINING TAG RELEVANCE IN GEOTAGGED FLICKR IMAGERY.	2012	CLARITY Centre for Sensor Research Dublin City University Ireland	Classifying tags describing commonly photographed.	Machine learning based approach	Metric performs poorly on this dataset due to the high distribution.
4.	Object Detection, Tracking and Recognition for Multiple Smart Cameras	2016	Aswin C. Sankaranaraya, Student Member IEEE, Ashok Veeraraghavan, Student Member IEEE,andRamaChellapp Fellow IEEE.	Detection, tracking, and recognition of objects, specifically using distrib-uted networks of cameras.	Distributed visual Distributed visual sensing algorithms.	Challenges for optimizing for power,energy, and/or bandwidth constraints, distributed function estimation, distributed processing, mobile camera control.
5.	REAL-TIME FACE DETECTION AND TRACKING	2012	Thu-Thao Nguyen MEng Field Advisor: Bruce Robert Land,.	To implement a real-time system on an FPG.A board to detect and track a human's face.	Algorithm involved color-based skin segmentation and image filtering.	In the presence of three or more people, the system could only detect the faces but failed at tracking them.

6.	Object Detection using Haar-like Features.	2010	Visual Recognition and Search,Harshdeep Singh.	To detect face Features.	Using boosted cascades Of Haar-like Features.	Training classifiers is slow.
7.	Training support vector machine:an application to face detection	1997	Center for Biological and Computational Learning and Operations Research Center Massachusetts Institute of Technology.	Training polynomial, neural network, or Radial Basis Functions Classifiers.	Detects faces by exhaustively scanning an image for face-like patterns at many possible scales, by dividing the original image into overlapping sub-images.	SVM produces multiple solutions based on local minima, which makes them not trustable over different samples.
8.	Local Binary Patterns and Its Application to Facial Image Analysis.	2010	Di Huang, Caifeng Shan, Mohsen Ardebilian, Yunhong Wang, and Liming Chen	Exploited for facial representati on in different tasks containing face detection, face recognition, facial expression analysis, demographic (gender, race, age,etc.) classification	Local Binary Pattern(LBP)	LBP operator is that its small 3x3 neighborhood cannot capture dominant features with large scale structures.
9.	Face Recognition Using LBP, FLD and SVM with Single Training Sample Per Person.	2014	Mustafa Zuhaer Nayef Al-Dabagh	Face recognition system using single training sample per person.	local binary pattern (LBP) for pre-processing, Fisher's linear discriminant (FLD) for features extraction and support vector machine (SVM) for	visual stimulus due to illumination conditions, viewing directions, facial expressions, aging, and disguises

3 Proposed Approach

For the problem domain described above,we have followed the approach given by Voila and Jones in 2001, which is a boosted cascade of simple features for object detection.For the recogintion of the image,Local Binary Pattern(LBP) is used for feature extraction and preprocessing.Support Vector Machine(SVM) is applied for classification of the face.

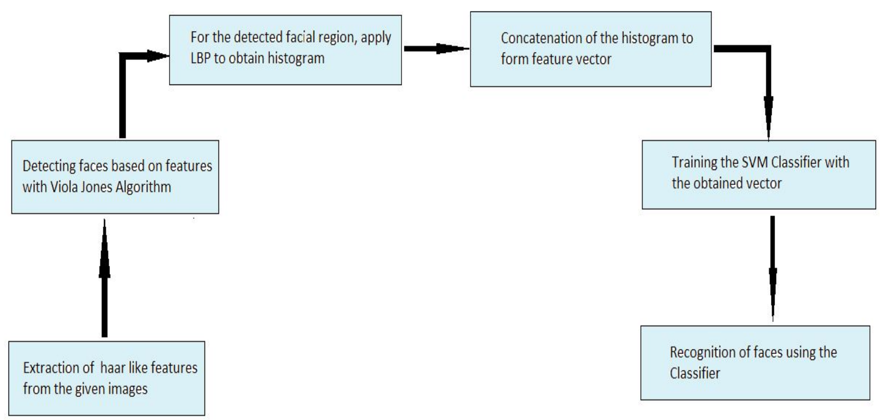


Figure 1: Proposed Approach

3.1 Techniques Used

3.1.1 Face Detection Using Haar Cascade

Generally, Viola and Jones face detection algorithm is a four step process which includes:Haar Features selection,Integral Image,Adaboost and cascading:

Haar feature selection

Feature selection is very significant to face detection algorithm.Basically, there are a lot of features, such as eyes, nose and can be used for face detection.Haar feature-based classifier is an effective learning based approach where a cascade function is trained from a lot of positive and negative images.

Since, we are dealing with faces, the algorithm requires a lot of positive images i.e. images of faces and a lot of negative images i.e. images of other objects or non-face images to train the classifier. The preprocessing of the images is done such that they are of the same dimensions and also they are converted from RGB to grayscale images.

After the preprocessing is done, we need to extract essential features from it. For this, haar features are used. They are digital image features and are similar to haar wavelets.In the past, working with image intensities made the task of feature calculation computationally expensive. So, Viola and Jones used the idea of haar wavelets to create haar-like features.

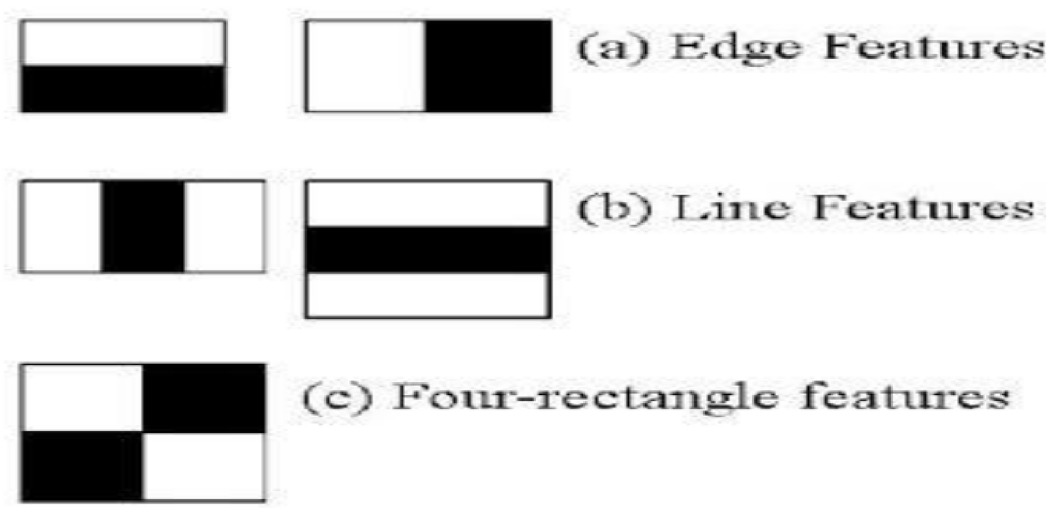


Figure 2: Feature types used by Viola and Jones

Figure 3: Haar Feature applied onto the face

Value = $\sum(pixelinblackarea)$ - $\sum(pixelinwhitearea)$

Each feature is a single value obtained by subtracting sum of pixels under white rectangle from sum of pixels under black rectangle . This difference is then used to categorize subsections of an image.

For example, let us say we have an image database with human faces. It is a common observation that the region of the eyes is often darker than the region of the nose and cheeks.Also, the eyes are darker than the bridge of the nose. Therefore a common haar feature for face detection is a set of two adjacent rectangles that lie above the eye and the cheek region.

Integral Image

A Haar-like feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums.To make the computation of sum of pixels easier, integral image process is used for which contains sum of all left and upper pixel.Then sum of boundary pixel of primary diagonal is subtraced from sum for boundary pixel of secondary diagonal which will return sum of whole path.It evaluates rectangular features in constant time, which gives considerable speed advantage over more sophisticated alternative features.

The integral image at location (x,y), is the sum of the pixels above and to the left of (x,y), inclusive.

Adaboost

AdaBoost training process selects only those features known to improve the predictive power of the model, reducing dimensionality and potentially improving execution time as irrelevant features do not need to be computed.After applying features on all the training images. We select the features with the minimum error rate, that are the features that best classify the face and non-face images.

For this, firstly, the image is given an equal weight in the beginning. After each classification as the face and non-face image, weights of misclassified images are increased. Then again the process is repeated. Thus, we are able to determine the features that are best suited for the face detection purpose. We continue the process until we reach a required accuracy.

The final classifier is a weighted sum of these weak classifiers. The individual classifiers are called weak because it can't classify the image as one but together forms a strong classifier. The key advantage of haar-like feature over most other features is its calculation speed due to the use of integral images.Haar-like feature of any size can be calculated in constant time.

Cascading

Face candidate images are eliminated by using a cascade of stages. The cascade eliminates candidates by making stricter requirements in each stage with later stages being much more difficult to pass. If all the stages are passed then the image is detected as the positive image and is detected as the desired result.

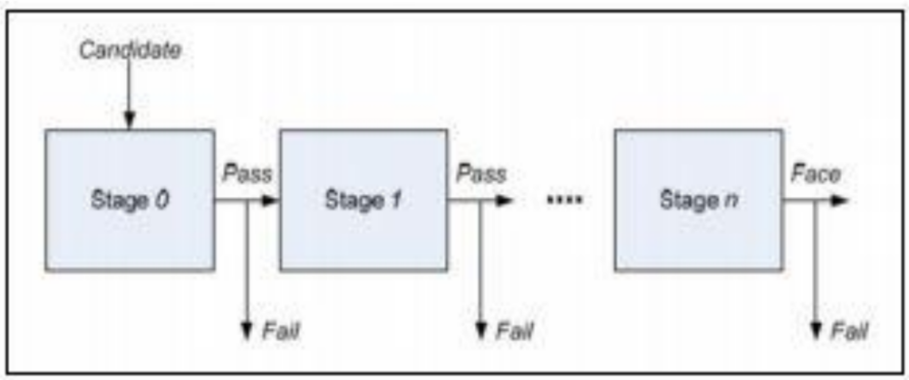


Figure 4: Cascade of stages. Candidate must pass all stages in the cascade to be concluded as a face

3.1.2 Face Recoginition using LBP and SVM

Local Binary Pattern (LBP)

Features are extracted using Local Binary Pattern (LBP) method.In this method, image is divided into several small regions from which we can extract features.These features consist of binary patterns that describe the surroundings of pixels in the regions.The LBP operator works with the eight neighbors of a pixel, using the value of this center pixel as the threshold. If a neighbor pixel has a higher gray value than the center pixel (or the the same gray value) than a one is assigned to that pixel, else it gets a zero. The LBP code for the center pixel is then produced by concatenating the eight ones or zeros to a binary code.This extracted feature measures the similarity between images.[4]

The occurrence of each possible pattern in the image is kept up.Then histogram of these patterns, also called labels, forms a feature vector, and is thus a representation for the texture of the image. These histograms can then be used to measure the similarity between the images, by calculating the distance between the histograms.[4]

Once the Local Binary Pattern for every pixel is calculated, the feature vector of the image can be constructed . For an efficient representation of the face, first the image is divided into K^2 regions.Face image is divided into $8^2 = 64$ regions. For every region a histogram with all possible labels is constructed. This means that every bin in a histogram represents a pattern and contains the number of its appearance in the region. The feature vector is then constructed by concatenating the regional histograms to one big histogram.[4]

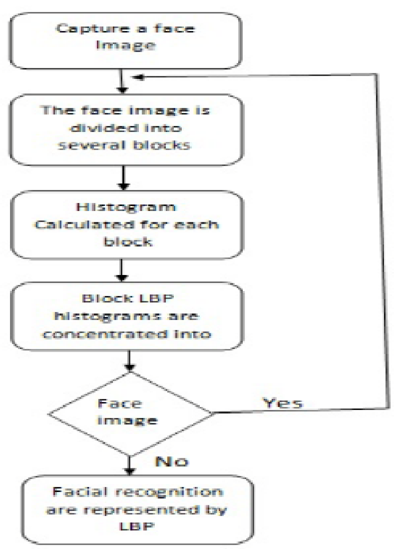


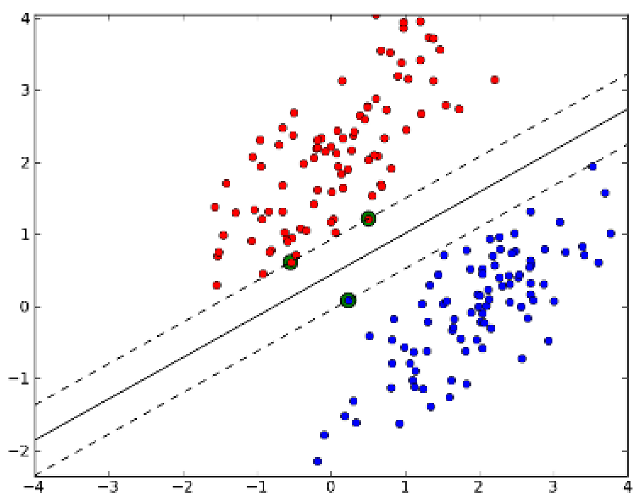
Figure 5: Flowchart of the LBP Process

Support Vector Machine(SVM)

SVM is a supervised learning model which analyzes data used for the classification.For the given training set, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns one category or the other for the test set.

$$f(x) = \sum_i \alpha_i y_i (\mathbf{x}_i{}^\top \mathbf{x}) + b$$

Where, x_i^T is Feature Vector. α_i is Hyper Parameter.



[12]

Figure 6: SVM Classification

From the training data we train the Support Vector Machine classifier with linear kernelization to classify our images.This gives us better accuracy then Polynomial and Gaussian kernel.

4 Hardware and Software Requirements

4.1 Software Requirements

1.Opencv 2.0

2.Python 2.7

4.2 Hardware Requirements

1.Web camera

4.3 Data Set

1.Dataset created by group of people manually.

5 Activity Chart

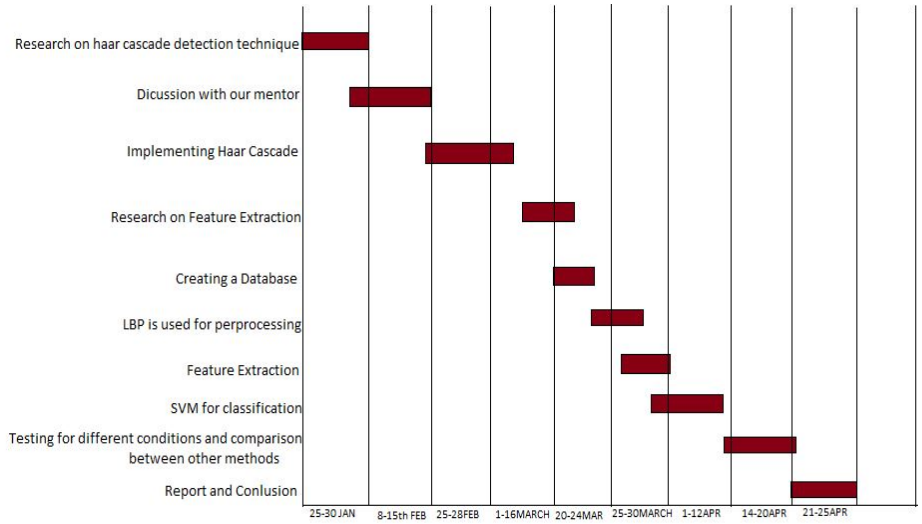


Figure 7: Activity Chart

6 Result and Analysis

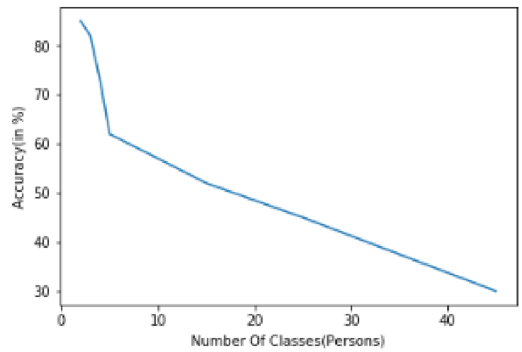


Figure 8: Number of Classes(Persons) vs. Average in (%)

2- Class	90%
4-Class	80%
45-Class	60%

Figure 9: Result

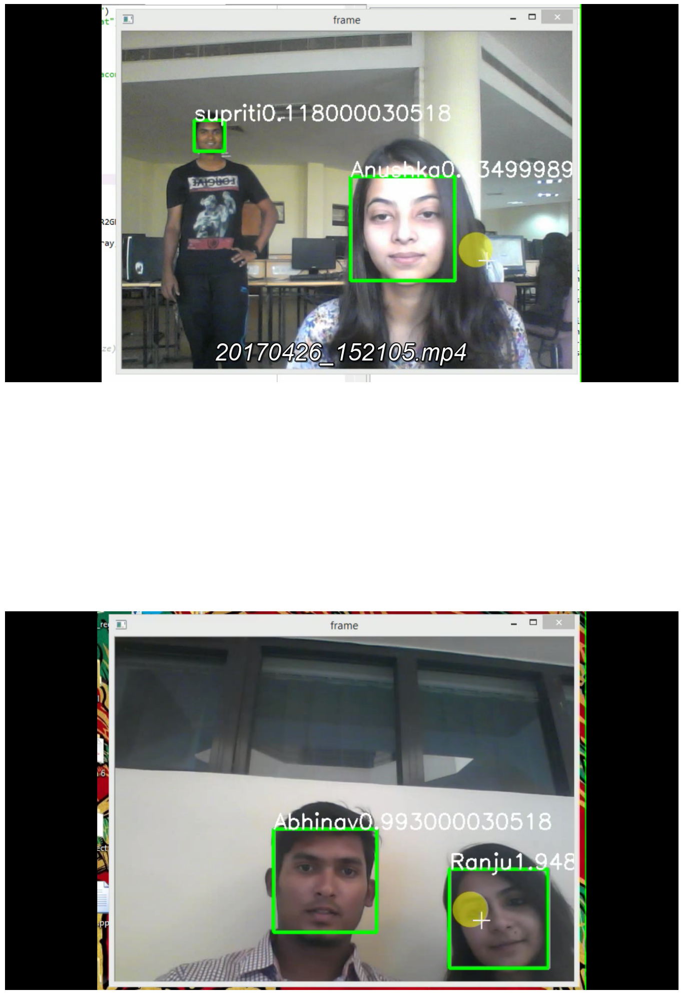


Figure 10: Result

7 Conclusion and Future Scope

7.1 Conclusion

In this work we have been able to implement Haar cascades for face detection along with LBP by which we created feature vectors essential for the process of face recognition. We used the feature vectors to train our SVM classifier by which we are recognizing our target images. By running our algorithm for various datasets, we came to a conclusion that the detection and recognition of faces becomes challenging as the variation in illumination increases or when thephysical appearance of an individual changes due to changes in postures or aging.

We trained our classifier for various number of classes that served as the basis for our analysis. For 2-class classifier, we used 15 samples/class and obtained and accuracy of about 90%. As we gradually increased the classes, accuracy started declining steadily.For 3-class classifier, it was 80-82%.When the number of classes was increased to 45, the accuracy decreased to around 60%.

7.2 Future Scope

Face recognition has its applicability in various fields. On the basis of results obtained in our analysis, the future scope can be stated as :

1. Room for improving accuracy:

The accuracy for multiclass classifier can be improved. Various other techniques can be implemented and compared to obtain better accuracy results for a large database.

2.On getting a better accuracy we can use it in different fields for the purpose of security , data extraction etc.

8 References

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9 Remarks and Suggestions