**FACE RECOGNITION SYSTEM**

**A PROJECT REPORT**

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**BONAFIDE CERTIFICATE**

Certified that this project report titled **“ COMPUTER VISION TECHNOLOGY ( FACE RECOGNITION SYSTEM)”** is the bonafide work of “**Rishita Srivastava(19BCE10121), Soumya Singh(19BCE10159), Kanika(19BCE10165) and Prakhar Jain(19BCE10415) ”** who carried out the project work under my supervision. Certified further that to the best of my knowledge the work reported here does not form part of any other project / research work on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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The Project Exhibition I Examination is held on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**ABSTRACT**

Face recognition systems are being applied widely in real life such as tracking, managing employees, finding information about celebrities, and so forth. There are many approaches to design a face recognition system, but such systems are frequently affected by light, non-frontal faces, resolution of cameras, etc. Thus, each method has specific challenges. Overall, our project has two main stages which are **face detection** and **face recognition**.

The goal of face detection is to determine whether the image exists in the dataset and that of the Face recogniser is to recognize the face and provide information about the image . If multiple faces are present, each face is enclosed by a bounding box .

Human faces are difficult to model as there are many variables that can change for example facial expression, orientation, lighting conditions etc. As a result of this the existing face detectors and recognizers recognize faces only when partial occlusions such as sunglasses, scarf, mask caps are not present.

Our project can detect Human faces also when partial occlusions such as sunglasses, scarf, mask caps are present.

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Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

It is a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on  datasets.

In this system we are using Haar feature- based cascade classifiers .It is an effective object detection method proposed by Paul Viola and Michael Jones.It is a machine learning approach where a cascade function is trained from a lot of positive and negative images.It is then used to detect objects in other images.

We are first using OpenCv for creating a database in the computer.It will take 30 images consecutively. And then store in a folder under the name of that particular candidate. This procedure will be done only once.

Next step would be “recognizing” the person. The algorithm designed is context-aware.

We can access all patterns of images with this facial recognition module which helps in maintaining security of devises. OpenCv always proves beneficial in face recognition and eye detection module.

**ROLE OF EACH TEAM MEMBER:**

|  |  |
| --- | --- |
| Prakhar Jain | Work on the theorical aspects of the project like researching about algorithms we can use , existing solutions , novelty, real time usage , future scopes |
| Kanika | Worked on landmark detection section in the face detection part, and used flask API for recognition part |
| Rishita Shrivastava | Worked on creating datasets and other elements in the face detection and training models for face recognition |
| Soumya Singh | Implemented Local Binary Pattern (LBP) and Histogram Oriented Gradient(HOG) and HAAR Cascade classifier algorithm |

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**INTRODUCTION**

The procedure simply requires any device that has digital photographic technology to generate and obtain the images and data necessary to create and record the biometric facial pattern of the person that needs to be identified.

Unlike other identification solutions such as passwords, verification by email, selfies or images, or fingerprint identification, Biometric facial recognition uses unique mathematical and dynamic patterns that make this system one of the safest and most effective ones.

The objective of face recognition is, from the incoming image, to find a series of data of the same face in a set of training images in a database. The great difficulty is ensuring that this process is carried out in real-time, something that is not available to all biometric facial recognition software providers.

**MOTIVATION FOR DOING THIS PROJECT**

We know facial recognition are used in security systems, but it’s also used for marking attendance in schools, college , etc.

So here are some points which motivated people to use face recognition:

1. It’s a Non-Contact process.
2. Quite inexpensive when compared to other biometrics.
3. Increasing demand for fast and accurate authentication/identification.

**LITERATURE REVIEW**

Automated facial recognition was pioneered in the 1960s. Woody Bledsoe , Helen Chan Wolf, and Charles Bisson worked on using the computer to recognize human faces. Their early facial recognition project was dubbed "man-machine" because the coordinates of the facial features in a photograph had to be established by a human before they could be used by the computer for recognition. In 1970 Takeo Kanade publicly demonstrated a face matching system that located anatomical features such as the chin and calculated the distance ratio between facial features without human intervention.

Real-time face detection in video footage became possible in 2001 with the Viola–Jones object detection framework for faces. Paul Viola and Michael Jones combined their face detection method with the Haar-like feature approach to object recognition in digital images to launch AdaBoost, the first real-time frontal-view face detector.

**EXISTING WORK**

The goal of face detection is to determine whether the image exists in the dataset and that of the Face recogniser is to recognize the face and provide information about the image . If multiple faces are present, each face is enclosed by a bounding box .

Human faces are difficult to model as there are many variables that can change for example facial expression, orientation, lighting conditions etc. As a result of this the existing face detectors and recognizers recognize faces only when partial occlusions such as sunglasses, scarf, mask caps are not present.

WE DECIDED TO TAKE THIS ONE STEP AHEAD…..

Our project can detect Human faces also when partial occlusions such as sunglasses, scarf, mask caps are present.

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighbourhood of each pixel and considers the result as a binary number.

It is a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on datasets.

**MODULE WORKFLOW EXPLANATION**

1. **FACE DETECTION**

Before the face recognition stage, we need to detect faces in a image and bound the high-level regions to eliminate effects, such as hair, background. The face detector proposed used Haar-Like features and AdaBoost algorithm train cascaded classifiers, which achieve good performance with real-time efficiency. However, a few works show that Haar-Like feature may degrade considerably in real world applications with larger visual variations of human faces even with more advanced features and more training images. Besides the cascade model, introduce deformable part models (DPM) for face detection and achieve remarkable performance. However, they need a high computational expense and may usually require expensive annotation in the training stage.

With the rise of data-model, convolutional neural networks (CNN) achieve considerable accuracy in the number of computer vision tasks, especially face detection task. Face alignment also attracts extensive interests. Regression-based methods and template fitting methods are two popular approaches. However, most of the available face detection and face alignment methods ignore the correlation between these two tasks. Though there exist several works attempt to jointly solve them, there are still limitations in these works. But, the handcraft features used limits its performance. From those previous experiments, we choose a new approach which integrates these two tasks using unified cascaded CNN by multi-task learning called Multi-task Convolutional Network which is also face detector used in FaceNet model in section.

**2.) FACE RECOGNITION**

Local Binary Pattern Histogram (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighbourhood of each pixel and considers the result as a binary number.

It is a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets.

Using the LBPH combined with histograms we can represent the face images with a simple data vector. As LBPH is a visual descriptor it can also be used for face recognition tasks.

**ALGORITHMS USED**

This project uses LBPH (Local Binary Patterns Histograms) Algorithm to detect faces. It labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

1. LBPH uses 4 parameters :  
   (i) Radius: the radius is used to build the circular local binary pattern and represents the radius around the  
   central pixel.  
   (ii) Neighbors : the number of sample points to build the circular local binary pattern.  
   (iii) Grid X : the number of cells in the horizontal direction.  
   (iv) Grid Y : the number of cells in the vertical direction.
2. The model built is trained with the faces with tag given to them, and later on, the machine is given a test data and machine decides the correct label for it.

**LBPH ALGORITHM**

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

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Using the LBP combined with histograms we can represent the face images with a simple data vector. As LBP is a visual descriptor it can also be used for face recognition tasks.

The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameters radius and neighbors.

**HAAR CASCADE CLASSIFIERS**

Haar Cascade classifier is an effective object detection approach. This is basically a machine learning based approach where a cascade function is trained from a lot of images both positive and negative. Based on the training it is then used to detect the objects in the other images.

So how this works is they are huge individual .xml files with a lot of feature sets and each xml corresponds to a very specific type of use case. There is a particular xml file containing the feature set to detect the full body, lower-body, eye, frontal-face and so on.

To detect the face of individuals we are using the haarcascade\_frontalface\_default.xml.

**STEPWISE ALGORITHM EXPLANATION**

Step 1: Import cv2 and numpy and also use the CascadeClassifier function of OpenCV to point to the location where we have stored the XML file, haarcascade\_frontalface\_default.xml in our case.

Step 2: Load the image and convert it into gray-scale. When OpenCV reads the RGB image, it usually stores the image in BGR (Blue, Green, Red) channel. For the purposes of image recognition, we need to convert this BGR channel to gray channel. The reason for this is gray channel is easy to process and is computationally less intensive as it contains only 1-channel of black-white.

Step3: Now try to locate the exact features in our face. We are using the face\_classifier which is an object loaded with haarcascade\_frontalface\_default.xml, we are using an inbuilt function with it called the detectMultiScale. This function will help us to find the features/locations of the new image. The parameters that we will pass to this function are:

The gray scale variable — gray in our case

scaleFactor — Parameter specifying how much the image size is reduced at each image scale.

minNeighbors — Parameter specifying how many neighbors each candidate rectangle should have to retain it.

Step 4:The function detectMultiScale returns 4 values — x-coordinate, y-coordinate, width(w) and height(h) of the detected feature of the face. Based on these 4 values we will draw a rectangle around the face.

**MODULE DESCRIPTION**

In this system we are using Haar feature- based cascade classifiers .It is an effective object detection method proposed by Paul Viola and Michael Jones.It is a machine learning approach where a cascade function is trained from a lot of positive and negative images.It is then used to detect objects in other images.

We are first using OpenCv for creating a database in the computer.It will take 30 images consecutively. And then store in a folder under the name of that particular candidate. This procedure will be done only once.

Next step would be “recognizing” the person. The algorithm designed is context-aware.

To find similar images Convolutional Neural network is being used.We can access all patterns of images with this facial recognition module which helps in maintaining security of devises. OpenCv always proves beneficial in face recognition and eye detection module.

**HARDWARE AND SOFTWARE REQUIREMENTS**

1. HARDWARE:
   1. Web camera
2. SOFTWARE:
   1. Python libraries:
      1. OpenCv (cv2)
      2. Sys
      3. Numpy
      4. Os
      5. Time
      6. PIL (python image library)

**CONSTRAINTS**

**1) Model Complexity**

Existing state-of-the-art facial recognition methods rely on ‘too-deep’ Convolutional Neural Network (CNN) architecture which is very complex and unsuitable for real-time performance on embedded devices.

**2)Expressions**

Face is one of the most crucial biometrics as its unique features play a crucial role in providing human identity and emotions. Varying situations cause different moods which result in showing various emotions and eventually change in facial expressions.

**3)Pose**

Facial Recognition Systems are highly sensitive to pose variations. The pose of a face varies when the head movement and viewing angle of the person changes.

**FUTURE SCOPE**

**Emotion Reading :**

Facial recognition technology is continuously improving with every passing day. With machine learning algorithms, now the systems are able to read facial expressions and detect emotions. The technology is proving to be very helpful for the legal authorities.

**A Parameter for Secure Growth**

Security and customer experience are the two main factors that drive the secure growth of the business. Facial recognition is a competitive technology that is facilitating industries to effectively meet both the factors without compromising the other. Face verification authenticates the users in real-time based on their unique facial features. The best part is that it eliminates the effort of remembering or changing the password every other day. The authentication is as secure and quick as taking a selfie.

**CONCLUSION**

Facial recognition technology has many applications in day care, residential security, voter verification, banking using atm and in many other fields.

Face recognition technologies have been associated generally with

very costly top secure applications. Today the core technologies

have evolved and the cost of equipment is going down dramatically due to the integration and the increasing processing power. With the proper implementation of programming fundamentals and computer programs,, we were able to complete this project.

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