

Facial Recognition for Identification of Criminals by using 'HAAR' Classifier

¹S Delfin, ²Saran Reddy Ch, ³Aravind Yalla, ⁴Ajay Krishna G

¹Assistant Professor (O.G.), ²Student, ³Student, ⁴Student

¹Department of Computer Science and Engineering,

¹SRM Institute of Science and Technology, Chennai, India

Abstract : — Facial recognition is one of the most challenging topics in computer vision today. Facial recognition software is useful in Banks, Airports and other institutions for screening customers. Criminal identification is the primary concern of this project. The availability of police personnel is limited. In this paper, we proposed a facial recognition system using machine learning, specifically support vector machines (SVM). The first step required is face detection which we accomplish using a widely used methods called the HAAR Classifier and Viola-Jones algorithm. A Haar Cascade is basically a classifier which is used to detect the object for which it has been trained for, from the source. The Haar Cascade is by superimposing the positive image over a set of negative images. The Viola-Jones algorithm is the algorithm which highly used in high detection rate and fast processing time. Once the face is detected, feature extraction on the face is performed using a histogram of oriented gradients (HOG) which essentially stores the edges of the face as well as the directionality of those edges. HOG is an effective form of feature extraction due to its high performance in normalizing local contrast

Index Terms - facial recognition, Viola-Jones, Haar classifier

I. INTRODUCTION

The face is crucial for human identity. It is the feature which best distinguishes a person. Face recognition is an interesting topic and it is the most challenging problem and it impacts important applications in many areas like identification for law enforcement, authentication for banking and security system access. Face recognition has become popular research recently due to increases in security as well as the high development of mobile devices. Automatic face recognition is all about extracting those meaningful features from an image, putting them into a useful representation and performing some classifications on them. Face recognition based on the geometric features of a face is probably the most instinctive approach for Human Identification. The whole process can be divided into three major steps where the first step is to find a good database of faces with multiple images for each individual. The next step is to detect faces in the database images and use them to train the face recognizer and the final step is to test the face recognizer to recognize faces it was trained for. Nowadays, face detection is used in many places especially the websites hosting images like Picasa, Photo bucket and Facebook. It gives the idea to other people about who the person is in the image. In our project, we have studied and implemented a pretty simple but very effective face detection algorithm which takes human skin color into account. Our aim, which we believe we have reached, was to develop a system that can be used by police or investigation department to recognize criminal from their faces. The method of face recognition used is fast, robust, reasonably simple and accurate with a relatively simple and easy to understand algorithms and techniques. And lastly, facial recognition has surfaced in social media applications on platforms such as Facebook which suggest users tag friends who have been identified in pictures. It is clearly shown that there are many applications for facial recognition system face such as detection, feature extraction, and lastly training a model.

II. RELATED WORKS

2.1 Existing System

In the existing system there are problems in detection of faces there are four problems mainly they are

2.1.1 Ageing

Existing age estimation algorithms work only for determining a few ages. In 2 to 18 years is largely depends on shape variations, while for adults it depends on shape and texture variations .when ever the age changes facial muscles changes then wrinkles form on the face results in the change of face.

2.1.2 Pose

Comparing faces under different pose is another fundamental challenge for face recognition system. Some unavoidable problems appear in this practical applications such as the people are not always frontal to the camera, so the posed problem is a big problem for the face recognition system to be an occurrence. In essence, the difference between the distinct persons under the same poses, it is difficult for the computer to do the face detection when the poses of the query and gallery images are different. Pose variation still presents a challenging for face recognition.

2.1.3 Illumination

Differentiating two faces with different illumination is one of the fundamental problems for face recognition system. Facial images of the same person can be taken under different illumination conditions such as the position and the strength of the light source can be modified like the ones.

2.1.4 Expressions

Differentiating faces with different facial expression is another problem for some face recognition applications. Faces undergo large deformations under facial expressions. The human can easily handle this variation, but the algorithms can have problems with the expression databases. Face detection under extreme facial expression still remains an unsolved problem, and temporal information can provide significant additional information in face recognition under expression. The efficiency of the face detection system significantly decreases when there is a dramatic expression on the face. Therefore, it's important to automatically find the best face of a subject from the images

2.2 Literature Review

A facial recognition system is a software capable of identifying or verifying a person from a video are through an image source. It is also described as a Biometric Artificial Intelligence-based application that they can uniquely identify a person by analyzing patterns based on the person's facial textures, shape, and variations.

Moreover, Facial recognition software has problems. Illumination, expression, pose and noise during face capture can affect the performance of facial recognition systems. Data privacy is the main problem when it comes to storing biometrics data in companies. Data stores about-face in biometrics can be accessed by the third party if not stored properly it can be hacked. In the Techworld, Hackers will already be looking to replicate people's faces to trick facial recognition systems, but the technology has proved harder to hack than fingerprint or voice recognition technology in the past

III. PROPOSED MODELLING

3.1 Broader Overview of Face Detection Classification

Taking all the facts and classifications related to future and present approach we classify different Approaches:

3.1.1 Feature Based Approach

This approach based on extraction of facial features to recognize the face.

3.1.1.1 Low Level Analysis:

It uses all the concepts regarding pixel analysis, edge detection in image (using Sobel or Canny) and gray scale. It also uses the concepts of finding local maxima which is used to detect nose and local minima to detect eyebrows pupils and lips.

3.1.1.2 Feature Analysis:

It improves the result of Low Level Analysis. It incorporates the fact that all the parts of face such as eyes, nose, mouth, chin, head-top are at somewhat at relative positions with respect to each other. Prominent features are determined and they in result help in identifying potential face.

3.1.2 Geometry Based Detection

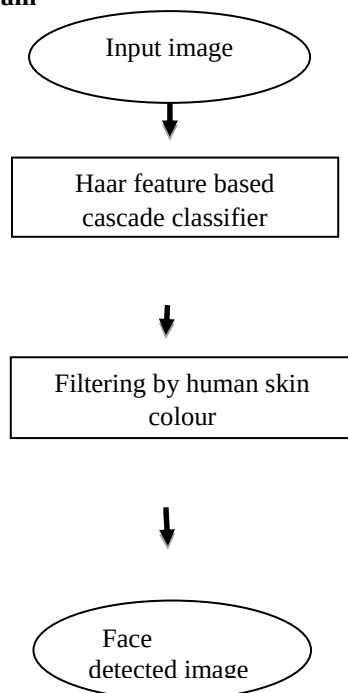
It uses the concept of Edge Detection using the concept of gradient analysis. All the important features/specific location of image is divided into blocks and each block consists of a corresponding pixel at centre. All the central pixels of blocks are connected to a nearby central pixels with a goal to span the face.

3.1.3 Appearance Based Approach

This approach dependent on extraction of facial features to detect face. All the characteristics which extracted are termed as features. In order to identify the face from the given image we would be required to match only those above features that correspond to the features of human face like nose, eyes, mouth etc. To extract the feature vector, Principal Component analysis (PCA) and Independent Component Analysis (ICA) is used. We are using PCA because as the name suggest it would only compute or retain important variables and would reject the ones that do not contribute to any new information. This results in reducing computing and Time Complexity.

3.1 Architecture flow Diagram

3.2 Architecture flow Diagram



3.3 Module Identification

3.3.1. Haar Like Features

Initially to detect a face we directly use pixels. These features are highly computationally not viable as in an HD image it would result in $1920 \times 1080 = 2 \times 10^6$ pixels (2k pixels). Entire human race consists of some humans having same facial features similarities such as size, contrast, intensity, positioning of eyes. These uniform features can be identified and distinguished by using a feature known as Haar-like Feature. A Haar-like feature consists of adjacent rectangular boxes which divide the whole face into boxes. It adds the pixel intensities in each region and then calculates the difference of both regions. This concept is used for identification of eyes, mouth, and bridge of nose.

3.3.2. Haar Classifier Algorithm

The face detection algorithm looks for specific Haar features and not pixels of a human face. When one of these features is found, the algorithm allows the candidate to pass to the next stage of detection. A face candidate is a rectangular section of the original image which is called as a sub-window. These sub-windows which have a fixed size of typically 24×24 pixels. This sub-window is often scaled in order to obtain different size faces. The algorithm scans the entire image with this window and denotes each section a face candidate.

3.3.3. Haar Cascade

HAAR Cascade is used to identify objects by machine learning object detection in an image or video based. These features proposed by Paul Viola and Michael Jones in their paper.

The algorithm has four stages:

1. Haar Feature Selection
2. Creating Integral Images
3. Ada-boost Training
4. Cascade Classifier

3.4. Cascade Classifier

The cascade classifier consists of many stages, where each stage has a weak learner. The weak learners are simple classifiers. They are called decision stumps. Boosting is a technique trained in each stage. Boosting provides the ability to train a highly accurate classifier by taking the weak learners and making the weighted average of the decisions. Each stage of the classifier labels the region defined by the current location of the slide window as either positive or negative. If an object is found, it is positive, and no objects were found indicates negative. The classification of this region is complete if the label is negative, and the window slides the detector to the next location. If the label is positive, the classifier passes the region to the next stage. The negative samples were rejected as fast as possible. Conversely, Positive which is true is rare and worth taking time to verify. A true positive occurs when a sample which is positive is correctly classified.

3.5. Haar Cascade Working

Let's take face detection as an example. Initially, the algorithm needs a lot of positive and negative images without faces to train the classifier. Then we need to extract features from it. Collecting of Haar features is the first step. A Haar feature considers adjacent rectangular regions at a specific location in a detection window, the difference between these sums calculated by sums up the pixel intensities in each region and Integral Images are used to make this super fast. Some of them are prevalent. For example, Two good features were shown by top rows. This feature seems to focus on the property of the region of the eyes is often darker than the region of the nose and cheeks. The eyes are darker than the bridge of the nose is the second feature that selected depends on the property. This selects the best features and trains the classifiers that use them with a concept called Adaboost. The target size of a window is moved over the input image, and for each subsection of the image and Haar features are calculated during the detection phase. This difference is then compared to a learned threshold value that Differentiating non-objects from the objects. Because each Haar feature is only a "weak classifier of Haar features are necessary to describe an object with sufficient accuracy and are therefore organized into cascade classifiers to form a strong classifier.

Cascade classifier training requires a set of positive samples and a set of negative image. With regions of interest, a set of positive images specified to be used as positive samples

IV. RESULTS AND DISCUSSION

The use of spherical canonical images allows us to perform matching in the spherical harmonic transform domain, which does not require preliminary alignment of the images. The errors introduced by embedding into an expressional space with some predefined geometry are avoided. In surface cropping measurement of large positions of distances between all the points using a parallelized parametric version is utilized. Having examined techniques to cope with expression variation, in future this facial expression recognition setup, end-to-end processing comprises the face surface acquisition and reconstruction, smoothening, sub sampling to approximately 2500 points. Facial it may be investigated in more depth about the face classification problem and optimal fusion of color and depth information.. The genetic property evolution framework for facial expressional system can be studied to suit the requirement of different security models such as criminal detection, security breaches for government confidentials etc. The Resultant facial recognition software works with the minimum error and works as efficient as possible.

V. CONCLUSION

This system uses our implementation of face recognition system using features of a face including colors features and distances. Using its two degrees of freedom, our system allows two modes of operation, one that results in very few false positives and another result in very few false negatives. We have demonstrated various concerns related to face recognition process, such as lightning and background conditions in which the facial images are taken. Our system could be improved in the future through the development of a facial detection algorithm which is less prone to incorrectness, failure, and performs well regardless of the skin color. A more extensive feature set would also prevent the chance of tricking the system through alteration of facial features. In this project, we are able to detect and recognize faces of the criminals in an image and in a video stream obtained from a camera in real time. We have used Haar feature-based cascade classifiers in OpenCV approach for face detection. A cascade function is trained from a lot of positive and negative images by a machine learning based approach. Objects in other images are used to detect. Also, we have used Local Binary Patterns Histograms (LBPH) for face recognition. Several advantages of this algorithm are: Efficient feature selection, Scale and location invariant detector, instead of scaling the image itself, we scale the features. Such a generic detection scheme can be used to train for detection of other types of objects (e.g. cars, signboards, number plates etc). LBPH recognizer can recognize faces in different lighting conditions with high accuracy. Also, LBPH can recognize efficiently even if a single training image is used for each person. Our application has some disadvantages like Detector is most effective only on frontal images of faces, it can hardly cope with 45° face rotation both around the vertical and horizontal axis.

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