SAFETY IN PUBLIC AREAS USING FACE RECOGNITION

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ABSTRACT

Face recognition systems are generally used for security purposes. Face recognition is a biometric method that compares a person's face that is live capture image or a video source with the stored images. Protecting the people from the criminals in public areas and at the same time accounting for law enforcement is a great challenge. Facial recognition is used for the very purpose. For any facial recognition system, there is a primary step that is ought to be done. Face detection is the preliminary step for face recognition. There are many algorithms and classifiers for face detection. Some of them are Segmentation algorithm, PCA, SVM, AdaBoost etc. Face detection itself is not sufficient. The detected face need to be accurate in various aspects like when the faces are rotated, under lighting conditions, complex backgrounds, variety of skin tones etc. These became challenging factors in face detection process. Many systems were proposed earlier for face detection. These existing systems ensure face detection in color images or background complexities or lighting conditions. Some common issues in these systems is that they have to go through many stages repeatedly leading to more time consumption, noisy output, less accuracy and efficiency levels. Hence this paper proposes a system for detection and recognition using Haar – cascade. Haar-cascade classifies the input into frames which for feature extraction. The proposed system detects faces in a group of people, variability in skin tones, variability in scale, in the presence of outliers. The recognition system recognises a suspect by comparing the face of the suspect with the faces that were stored in the database. The suspects face is automatically forwarded to nearby police station to catch the suspect. The proposed system provides a fast detection rate accounting for better accuracy and efficiency levels. This paper provides safety to the public in crowdy areas like railway stations, bus stands, market areas, shopping malls, parks and so-on.

Keywords—Face Recognition, Face Detection, HAAR-Cascade, Law Enforcement, Scaling, Security.

I. INTRODUCTION

Safety and security of the public is an important aspect to be considered. Protecting the publicfrom criminals and their offences is a great challenge. Safety of public can be provided through the laws of the government and its laws or it can also be done through the rapidly developing technology.

Face recognition is a biometric method which compares an input data (image or video source) with the training images that are already present in the store. Face recognition is been used for many commercial and law enforcement applications. Face detection is the primary step for face recognition. Face detection is a process of obtaining a face from the given image.

Many detection systems that were proposed earlier accounts for better accuracy, high confidence value, fast detection rate, less consumption time, spoof detection, background filtering, reduced training time, detection of various sizes of faces, reduction in complexity and dimensionality. The noticeable issues with these kinds of systems are noisy frames, inability to detect side poses, skin tones and yaw rotated faces, inefficiency in removing outliers from an image, complexity in false detection.

This paper proposes a system for face detection using Haar-cascade algorithm. Haar-cascade is a classifier that classifies the object into different frames. Classifier consists of a number of sample views of a particular face. Each of these sample views in other words the frames contains features of the original face.

The primary function of face detection is to pinpoint whether there is a face in the given image. This is done using Haar features.For example, features like nose, eyes, ears etc. If no face is detected, the image is neglected. Otherwise, if there is a face found, this face is taken as main image and is again further divided into frames for minute features. The detected face is returned within a rectangular box. Similarly, the eyes, lips etc. can also be detected for accuracy. Rectangular Haar-like feature can be stated as the difference of the sum of areas inside the rectangular box, which can be at any position and scale within the original image. Haar feature uses gray and gradient information of image. This feature helps in balancing accuracy and speed in object detection. Object is otherwise called as face which is to be detected. Haar-Cascading algorithm checks frame by frame for the features to locate.

Specifically, this paper focuses on feature extraction and feature selection

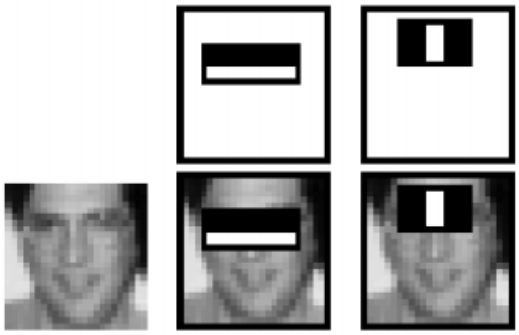

Fig. 1 Classical Haar Features

II. RELATED WORKS

Face recognition has been an active research area over the last 45 years. Face recognition has many applications in the fields of biometrics, security systems, surveillance systems, and access control and law enforcement. These are achieved using face detection either from still images or stream of input data from video sources.

Shruthi et al., (2015) used Video Based Face Recognition and Face Tracking Using Sparse Representation Based Categorization, focuses on reduction in residual error over the frames. In this paper, sparse

Representation classification algorithm uses l2 minimization approach to obtain a single co-efficient vector for all the frames in a video through which more spar-sity ratios can be obtained as well as residual error over the frames are reduced [1].

Face recognition is ought to be accurate and genuine. Faseela and Jayasree (2016) proposed spoof face recognition in videos using K-means SVM which analyzes moire patterns that occur due to recapturing and replaying of videos or photos on digital screen. However, division of video into different frames for feature extraction, ranking the input image running KSVM on ranked list and finally fusing all output frames and following a voting method to find whether the video is spoof is done repeatedly for each and every frame which leads to more time consumption [3].

GPU based face detection system introduced by Vaibhav and Patel (2016) used a GPU Based Implementation Of Robust Face Detection System" takes three stages into account like scanning an image with a window for feature extraction, integral imagination calculation, cascade classification which are used for parallelization and run as kernals on GPU. But this approach cannot be recommended for side poses [2].

Accurate face detection and location are very important in face recognition systems. For this very purpose, Jing et al., (2015) implemented the feature binding which projects test image for feature spaces, so the faces can be detected and located according to these features [4].

Feature extraction is a principal step in face detection which extracts facial features. A combination of PCA with RBFN can reduce complexity and dimensionality was implemented by Rao and Srinivas [8].

Backgrounds may become lagging factor for any detection systems. "Robust face detection using local CNN and SVM based on kernel combination proposed by Qin-Qin et al., (2015) implemented a system to filter out the backgrounds and increase detection rate the system uses local CNN and SVM using kernal combination algorithm for learning and extracting discriminate visual features and training background filter [5].

Color images can become a conflict in this context as detection of dark and bright skin tones is a bit difficult task. Rein-Lien et al., (2002) proposed Face localization and facial feature detection are useful in detecting faces of different sizes with wide range of facial variations [7].

Faizan et al., proposed a system that uses Ada boost which inturn uses Haar for robustness and fastening interferences [9].

Any face detection system is expected to be highly efficient and accurate, Hong et al., (2013) proposed a system to support this [6].

Face recognition is applied in many fields for security purposes. It uses many methods. Divyarajsinh et al., proposed Face recognition methods and applications, which uses holistic matching method, structural method works more on feature extraction while hybrid method concentrates on positioning angle of image, its dimensionality, converting template into code and so on. But, the only drawback is that 2D input is to be converted into 3D. However, database recovery can be handled [10].

III. Problem Definition

In all the existing and above mentioned systems, the detection part and the recognition parts are implemented separately. Even if the same system provides both detection and recognition, it is neither useful for public safety nor to help the government. Existing systems are not social centric. That is, it is not useful for the public. At the same time, they consist of many stages to reach an end result which is time consuming.

In this paper Haar-cascading is implemented. Haar-cascade is a classifier that classifies the object into different frames in order to capture various features of the object. To overcome the existing drawbacks of this aspect, Haar-cascading accounts for less time consumption. As this paper aims to improve the safety of the public, the recognition system spots criminal, if any, is entered into an area of this system and forwards the suspects image to the nearby police station for immediate action. In this way, this paper stretches its hand to the public and helps in law enforcement.

IV. Scope Of The Proposed Work

The main objective of the proposed system is automatic facial recognition of the criminals whose images were stored in the database and forwarding it to nearby police station. The system will account for public safety, help the government in tracking criminals in less time as the location is known. This reduces the crime rate significantly providing secured surroundings to the society. The face that is detected is accurate as it is generated by checking all the features of the object.

V. Proposed System Architecture

The proposed system consists of three modules namely enrolment module, database module and verification module. Enrolment module does the work of detection. It captures the input signals from a camera and detects a face from it. Database module is a store of still images or training samples that are to be used in recognition process. Verification module does the work of recognizing a face by comparing the detected face with the faces/images stored in the database. The first and third modules are continuously running modules as the system must not leave any person behind which may be helpful for the criminals to escape.

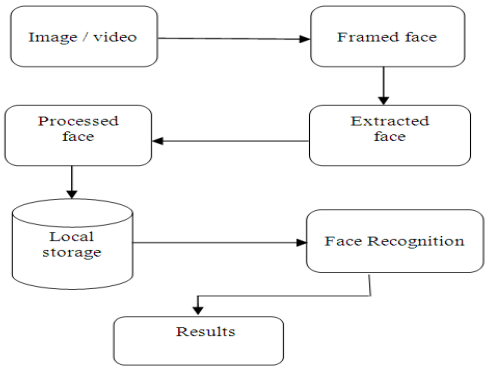

Fig. 2 System Architecture

VI. Proposed System Implementation

A. *Enrolment Module*

The proposed system starts at detecting a face. Initially, an image or stream of video is taken as input. We propose Haar-Cascade algorithm for detection of human face. This is done through sequence of steps.

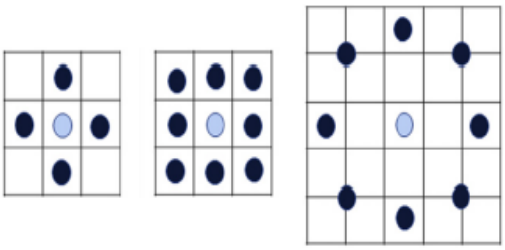

Fig. 3 Examples of Neighboring Pixels

Firstly, algorithm is applied to the input data. It checks whether there is a face in the input image or the video. In case if there is no face present, the input is automatically rejected. If there are any faces found, it produces a bounding box around the detected face.

In this module, an auxiliary image I_a is calculated from the original image I_o. The value of auxiliary image I_a (i, j) equals the sum of pixels above or to the left of original image Io. At constant time, the sum of pixel intensities are obtained from auxiliary image. Candidate window is fed into cascaded classifier. The sum of series of feature responses fj (w) at each stage gives classifier response c (w) for each and every window (w).

$$c(w) = \sum_{j=1}^{ni} fi(w)$$

where

$$f_j(w) = \begin{cases} k_{j1}; & f_j(w) < t_j \\ k_{j2}; & \text{otherwise} \end{cases}$$

k → feature weight coefficient

t → threshold

This can also be done in a photo where there are a group of people near the targeted person. Haar-Cascade extract face features irrespective of background, color and outliers. Initially, it converts the image into frames in order to extract the face out of the image. The obtained face is processed.

B. *Database Module*

This processed face is stored in local storage for any future use or development.

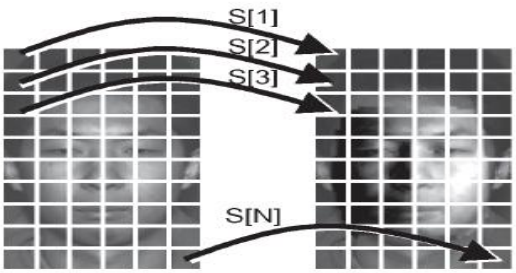

Fig. 4 Enrolled Image and Input Image

In this way there will be a number of faces stored in the database. This is the necessary requirement for any recognition system.

C. *Verification Module*

Recognition module compares the targeted face with the faces that were stored in the local storage for recognition purposes. When the faces are recognized, they are obtained as results. The recognized face means when the targeted face is matched with the any of the faces stored in database, it is said that the face is recognized. This module performs the following steps:

- Images of faces are obtained from the database.
- If a face is found, calculate its weight.
- Features like face, forehead, eyes are extracted.
- Finally, it is verified that the input image corresponds to the image stored in the database.

Whenever a face is recognized, it is understood that the face is of a suspect as the database consists of only criminals. So, this face is forwarded to the nearby police station for any criminal proceedings.

VII. Results And Discussions

The current system provides better accuracy and detection rate when compared with existing systems. It helps the government in tracking the criminals and prevents their malicious behavior in public. This paper successfully opts 85% efficiency.

TABLE I. Efficiency Comparison of Various Techniques

Techniques	Efficiency (%)
RSRC	78%
HAAR	85%
SVD	70%

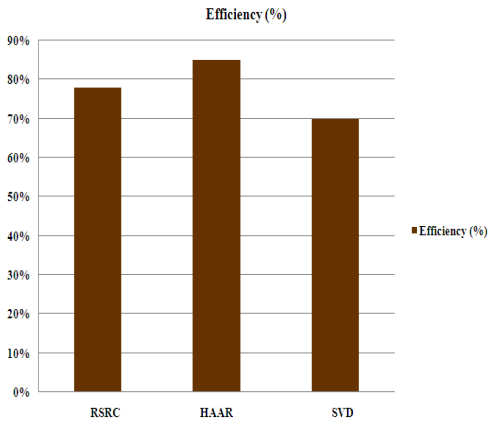

Fig. -5: Efficiency Comparison

Compared to the papers referred [1, 5], noisy frames are relatively reduced in proposed system. This helps in law enforcement. Provides safety to the public which is important part in this paper.

TABLE II. Effect of Noisy Frames in Different Methods

Methods	Effect of Noise	% of Noise
RSRC	High	63.80
LS-KC-SVM	Medium	35.60
HAAR	Low	15.75

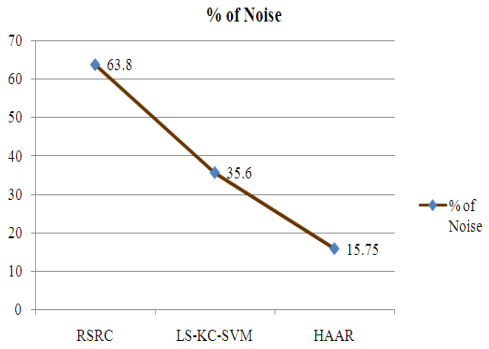

Fig. 5 Effect of Noise Frames

VIII. CONCLUSION

This paper proposed a face detection and recognition system which consists of three modules such as enrolment, database and verification modules. Facial detection part is done in enrolment module, criminal images are stored in the database module and the facial recognition part is done in verification module. This system provides better detection rate, image scaling, improved accuracy and efficiency compared to other systems. It can detect a face from a group, skin tones, under complex backgrounds, removes outliers. This system shows a great impact on community services and social contributions. In future, we consider the detection of faces when the faces are rotated.

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