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Comparative study of face recognition using HAAR algorithm and face SDK

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Abstract
Face recognition is a method of identifying human face by comparing digital images which are stored in the record for that person. Face recognition can be used for both verification and identification. In this paper we compare two techniques i.e. HAAR algorithm and Face SDK. In this Camera is used which will continuously fetch frames. Face detection and recognition will be done using HAAR algorithm which is proposed by Paul Viola and Michel Jones. In contrast, Face recognition can be done using SDK enables highly accurate recognition of human face from a frame or video.

Keywords: camera, HAAR algorithm, face detection, face SDK, frames

1. Introduction
Our study basically focuses on identifying human faces. The frames and the videos will be processed by Image Processing algorithms. Let us see what basically image processing is: An image may be defined as a two-dimensional function, f (x, y), where x and y are spatial coordinates and the amplitude off at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y and gray level of ‘f ‘are all finite, discrete quantities, the image is then digital image. The processing of digital images by means of a digital computer is called digital image processing. Digital image is composed of a finite number of elements, each of which has a particular value and location, called as pixels. The different stages for image processing are low-level, mid-level and higher-level processing [6].
Numerous face detection methods have been developed in past years. Paul Viola and Michel Jones has introduced Face Detection method based on HAAR like features [1]. Aim of the face detection method is to identify and locate all faces regardless of their positions, scale, orientation, lighting condition and expression [5].
Human faces are objects particularly hard to model because of their significant variety in colour and texture and there are no constraints on the background. The value of a two-rectangle feature is the difference between the sum of the Pixels within two rectangular regions. The regions have the same size and shape and are horizontally or vertically adjacent.
In contrast, Face SDK is a high-performance, multi-platform face identification and facial feature recognition solution. Face SDK is a perfect way to empower Web and desktop applications of face detection for user authentication, automatic face recognition, and identification. It is compatible with 32 and 64-bit environments. Face SDK is easy to integrate with new or existing projects, enabling developers to create a wide variety of applications. Face SDK will plot and process facial coordinates based on eyes, eye corners, eye brows, mouth, nose, nose tip [3].

2. Literature Review and Related Work
Many researchers have introduced Face detection methods but for achievement of fast and efficient image processing for extraction of human faces. The author Jock Barreto, Paulo Menezest and Jorge Diad proposed the different techniques to construct a framework for robust and rapid people learning, tracking and recognition in a human-robot interaction environment. This paper presents an approach for face recognition which can be very useful for human-robot interaction systems. The Face detection system works as a preprocessing stage to the Face recognition system [1].
Recently Viola et al. have proposed a multi-stage classification procedure that reduces the processing time substantially while achieving almost the same accuracy as compared to a much slower and more complex single stage classifier. This paper extends their rapid object detection framework in two important ways: Firstly, their basic and over-complete set of HAAR-like feature is extended by an efficient set of 45" rotated features, which add additional domain-knowledge to the leaning framework and which is otherwise hard to learn. These novel features can be computed rapidly at all scales in constant time. Authors Rainer Lienhart and Jochen Maydt proposed an novel and fast to compute set of rotated HAAR-like features as well as a novel post optimization procedure for boosted classifiers. It was shown that the overall performance could be improved by about 23.8% of which 10% could be contributed to the rotated features and 12.5% to the stage post-optimization scheme [2].
The author K.T. Talele and Sunil Kadamhas proposed two main face detection approaches: Image based methods and Geometrical based methods which focuses on a detector that processes images very quickly, while achieving high detection rates. This detection is based on a boosting algorithm called AdaBoost and simple HAAR

based features. The proposed system can be used for real-time application [5].

HAAR algorithm uses a set of weak classifiers, constructed by thresholding of one HAAR-like feature. Due to large number of weak classifiers, they can be ranked and organized into cascade [8].

Face biometric techniques can be used for both authentication and identification applications. The author Jackie Abbazio, Sasha Perez, Denise Silva, Robert Tesoriero, Frederic Penna, and Robert Zack proposed these applications which have a critical role in national and economic security. This study researched several face recognition software and tested Face SDK [3].

3. Proposed Work

3.1 Face Detection using HAAR Algorithm

The following Fig. shows the working and detection of the face using the HAAR Algorithm. In the 1st part of the figure the face is categorized into rectangular sections, based on the lighter and darker regions of the skin. In the 2nd part the points are plotted on the graph and various HAAR Features are applied on it.

In the 3rd part of the fig 1. if the detected points plotted on the graph, matched with the geometry of the human face then it represents that a human face is detected.

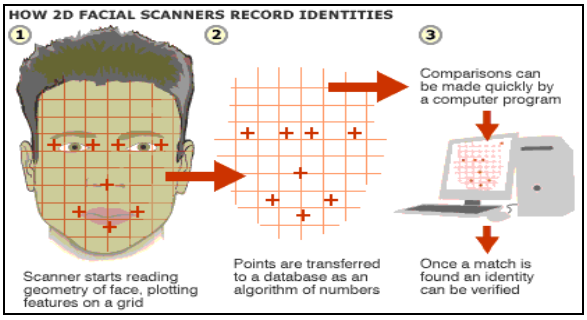

Fig 1: Face Identification Using HAAR algorithm & System Verification

HAAR algorithm uses a set weak classifier, they can be constructed by thresholding of one HAAR like feature. Due to large number of classifiers they can be ranked and organized into cascades. HAAR algorithm depends on light intensity which leads to incorrect and improper detection of human faces. Also it detects the non-living faces such as doll, which is the major flaw of the HAAR algorithm.

3.2 Face Detection using Face SDK

Face SDK is easy to integrate with new or existing projects, enabling developers to create a wide variety of applications. The system can work with entire faces or facial features, supports face recognition in still images and real-time video streams.

The SDK processes an image, detects human faces within it, and returns the coordinates of 40 facial feature points including eyes, eye contours, eyebrows, lip contours, nose tip, and so on. Morph, animate, or transform human faces with the SDK. The SDK is loaded with features, allowing developers to solve just about any face recognition, identification, or authentication task in a matter of minutes. Face SDK offers various features such as Fast and precise face recognition and identification, Stable recognition independent of lighting conditions, Face identification and recognition of facial features.

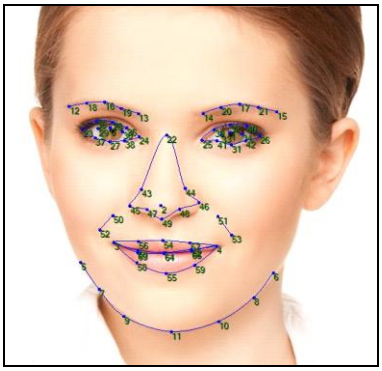

Fig 2: Point plotting in FSDK

The above figure represents the points plotted on the facial features for face recognition.

The geometry of the plotted points is compared with the general human face geometry and when the comparison between the two is near to the threshold value then the face is detected.

Face SDK provides the API to extract face templates and match them. A template extracted from a face can be stored in a database and can then be used to match faces using the FSDK_Match Faces function.

Using the FSDK_Get Face Template function, the created template will have higher accuracy, thus allowing for better overall recognition rates.

3.3 Results

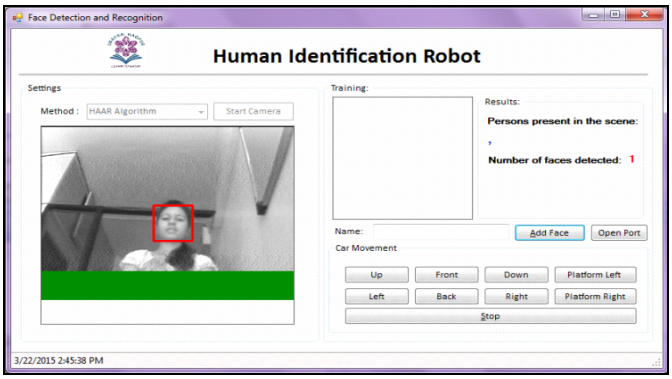

Fig 3: Human Face Detection using HAAR

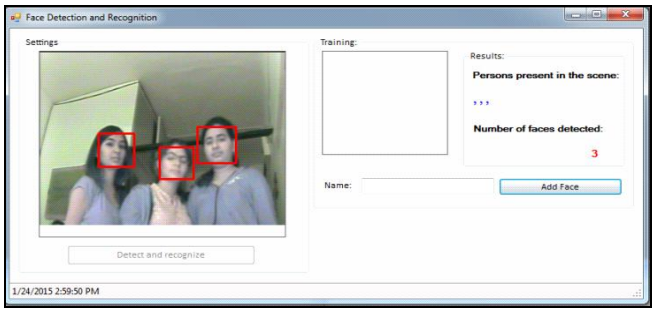

Fig 4: Human Face Detection using Face SDK

When a human comes in front of the camera, the face is detected and thus highlighted in a rectangular box.

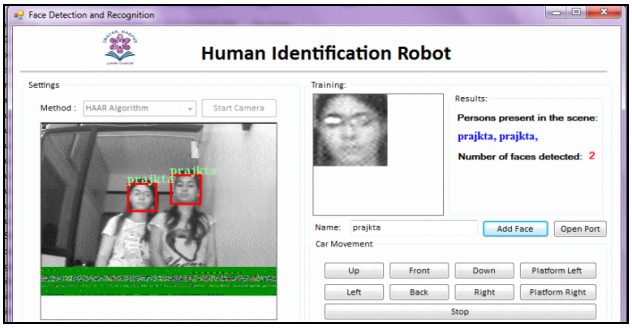

Fig 5: Particular Face Recognition using HAAR

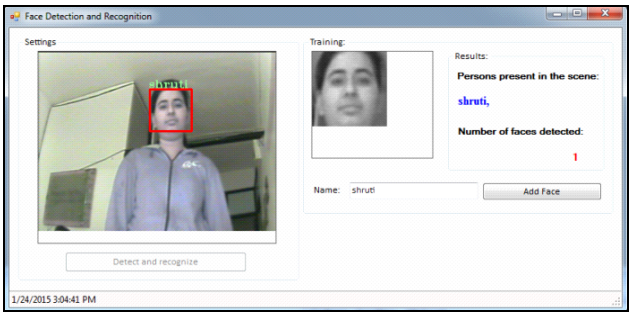

Fig 6: Particular Face Recognition using FSDK

If the name of a specific person is inserted into the database and when that person comes in front of the camera, the person is detected with its name on the screen.

Fig 7: Non-Living Thing Detected using HAAR

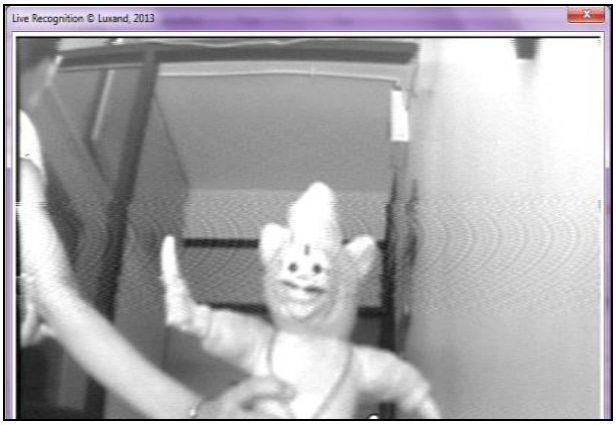

Fig 8: Non-Living Thing using FSDK

In Face SDK, non-living thing is not detected. But drawback of HAAR algorithm is that non-living thing is also detected if it has a facial geometric structure of two eyes, one nose and one mouth.

Accuracy of two techniques ie. HAAR Algorithm and FaceSDK is given on the bases of Human being and Non-Living thing.

Table 1: Non-Living Thing using FSDK

Type of Images	Accuracy (%)	
	HAAR Algorithm	FaceSDK
Human Being	91 %	98 %
Non-Living Thing	73 %	92 %
Average	82 %	95 %

4. Conclusion

There are different techniques for face detection and recognition. HAAR Algorithm and FaceSDK are two of them. Thus the comparison between HAAR algorithm and Face detection using Face_SDK is done. The accuracy of face detection in HAAR algorithm is 82 % as compare to FSDK which has average accuracy of 95%. FSDK is more efficient and high detection rates are achieved as it is not dependent on light intensity and surrounding conditions as compared to Haar algorithm.

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