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# Real Time Face Detection, Recognition and Tracking System for Human Activity Tracking

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**ABSTRACT**: Computer vision is the conversation of data from an image or video camera into either a decision or a new representation. Video analytics can be used for verification as well as identification of the person present or absent on a specific place and provides with a challenge of reporting a complete detail of the activities. Now days, video lookout was mainly a concern only for martial or large-scale businesses. However, increasing crime rate, especially in metropolis cities, necessitates taking better precautions in security-sensitive areas, like country borders, airports or government offices, schools and colleges. The objective of the project is to develop an automatic human activity monitoring system for detection of suspicious activity by the human. The application aims to provide an automatic scrutiny of video stream to identify suspicious events in real time. It can serve as an important tool for recognition and analysis of human behavior..This application will consists of the software tool running on the computer. It processes the real time video stream from the webcam mounted on the computer to recognise behaviour of the person in front of it .Human behaviour is mainly determined by analysing the head movements. The application will sound an alarm in case of any unusual behaviour of the Human.

**KEYWORDS**: -Face detection, boosting, Human sensing. Face recognition, Face tracking

## I. INTRODUCTION

The application aims to provide an automatic scrutiny of video stream to identify suspicious events in real time. It can serve as an important tool for recognition and analysis of human behaviour. Face Detection and Recognition System (FDRS) is a physical characteristics recognition technology, using the inherent physiological features of humans for ID recognition. The technology does not need to be carried about and will not be lost, so it is convenient and safe for use There are two general applications of FDRS, one is called identification and another one is called verification. Face identification means given a face image, we want the system to tell who he / she is or the most probable identification Face verification means given a face image and a guess of the identification, we want the system to tell true or false about the guess. Computer vision is the transformation of data from an image or video camera into either a decision or a new representation. Video analytics can be used for both verification and identification of the person present or absent on a specific place and provides with a challenge of reporting a complete detail of the activities. Until recently, video surveillance was mainly a concern only for military or large-scale companies. The application aims to provide an automatic scrutiny of video stream to identify suspicious events in real time. It can serve as an important tool for recognition and analysis of human behaviour. This application will consists of the software tool running on the computer. It processes the real time video stream from the webcam mounted on the computer to recognize behaviour of the person in front of it .

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## II. RELATED WORK

In [1] authors have described the machine mastering approach pertaining to visual item detection that is capable of processing photos extremely speedily and attaining high recognition rates. The work has been distinguished by simply three essential contributions. The 1st was the introduction of any new impression representation referred to as the Integral Image allowing you the features utilized by our detector to get computed rapidly. The next was the learning algorithm which is based on AdaBoost. In [2] authors have presented components architecture pertaining to face recognition based system on AdaBoost algorithm using Haar attributes. They get described the hardware style techniques which include image scaling, integral impression generation, pipelined processing along with classifier, and parallel processing multiple classifiers for you to accelerate the processing speed on the face recognition system In [3] author have proposed PCA method involves a mathematical procedure that transforms a number of possibly correlated variables into a number of uncorrelated variables called principal components, related to the original variables by an orthogonal transformation. This transformation is defined in such a way that the first principal component has as high a variance as possible (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to the preceding components. PCA is sensitive to the relative scaling of the original variables. In [4] author have improved fisher face method for face recognition which uses both principal component analysis and linear discriminant analysis which produce a subspace projection matrix, similar as used in the Eigen face method. However, the fisher face method is able to take advantage of within-class information, minimizing variation within each class, yet still maximizing class separation. Like the Eigen face construction process, the first step of the fisher face technique is take each (NxM) image array and reshape into a ((N*M)x1) vector. In [5] author describes automatic detecting, modelling and tracking faces in 3D. A closed loop approach is proposed which utilizes structure from motion to generate a 3D model of a face and then feedback the estimated structure to constrain feature tracking in the next frame. The system initializes by using skin classification, symmetry operations, 3D warping and Eigen faces to and a face. Feature trajectories are then computed by SSD or correlation-based tracking. The trajectories are simultaneously processed by an extended Kalman filter to stably recover 3D structure, camera geometry and facial pose. In [6] author states a first step towards a perceptual user interface. A computer vision color tracking algorithm is developed and applied towards tracking human faces. The algorithm is based on a robust nonparametric technique for climbing density gradients to find the mode of probability distributions called the mean shift algorithm. The mean shift algorithm is modified to deal with dynamically changing color probability distributions derived from video frame sequences. The modified algorithm is called the continuously adaptive mean shift (CAMSHIFT) algorithm. CAMSHIFT's tracking accuracy is compared against a Polhemus tracker.

## III. SYSTEM ARCHITECTURE

Typical construction of this systems consists of three phases: face detection and recognition/verification and tracking. Prior to a recognition session, users must register themselves in the system. In this paper, face images of users have been taken. For every user 10 images were captured, among the 10 images, 7 images were used for training purpose and 3 images were used for testing purpose. Thus distinct database has been created for training and testing

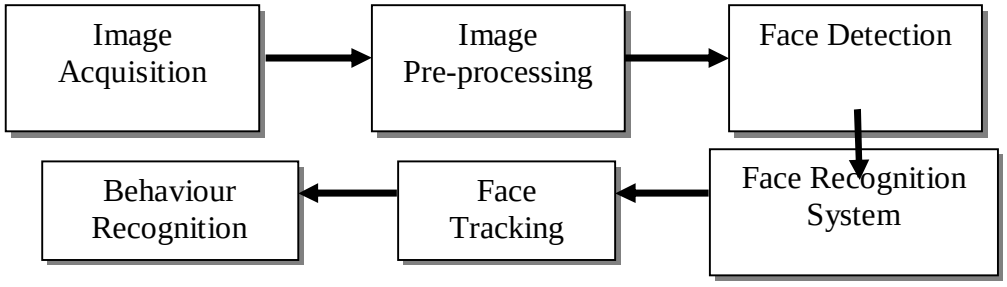


Fig 1: Block Diagram of Proposed System

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## IV. FACE DETECTION

Face detection proposed by Viola and Jones is most popular among the face detection approaches based on statistic methods. This face detection is a variant of the AdaBoost algorithm. which achieves rapid and robust face detection. They proposed a face detection framework based on the AdaBoost learning algorithm using Haar features. Therefore, this constitutes a bottleneck to the application of face detection in real time.

### A. Haar-Like features

Each Haar-like feature consists of two or three connected "black" and "white" rectangles. Each feature results in a single value which is calculated by subtracting the sum of pixels under white rectangle from the sum of pixels under black rectangle.

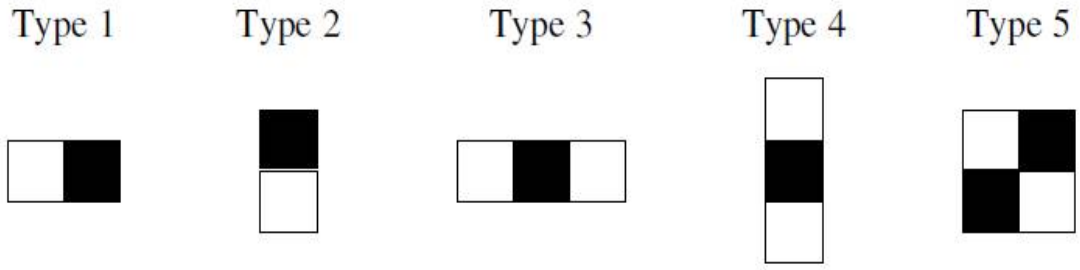
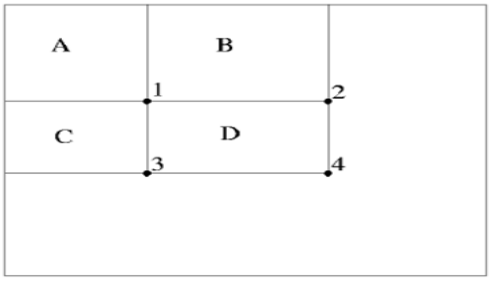



Fig 2 : Haar features used in viola Jones

### B. Integral Images

If we consider all possible parameters of the hair features like position, scale and type we end up calculating about 160,000+ features in this window. Since it is clear that huge number of these rectangular hair features have to be evaluated each time Viola Jones have come up with a neat technique to reduce the computation rather than summing up all pixel values under the black and white rectangles every time. They have introduced the concept of integral image to find the sum of all pixels under a rectangle with just 4 corner values of the integral image Integral image allows for the calculation of sum of all pixels inside any given rectangle using only four values at the corners of the rectangle. In an integral image the value at pixel (x,y) is the sum of pixels above and to the left of (x,y)




Sum of all pixels in
D = 1+4-(2+3)
= A+ (A+B+C+D)-(A+C+A+B)
= D

Fig 3 : Intergal image generation

### C. Cascading

For fast processing, the algorithm should concentrate on discarding non-faces quickly and spend more on time on probable face regions. Hence a single strong classifier formed out of linear combination of all best features is not a good to evaluate on each window because of computation cost. Therefore, a cascade classifier is used which is composed of stages each containing a strong classifier. So all the features are grouped into several stages where each

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stage has certain number of features. Each stage determines whether a given sub window is definitely not a face or may be a face. A given sub window is immediately discarded as not a face if it fails in any of the stage.

D. Ada Boost Machine Learning Method

As stated previously there can be approximately160,000 feature values within a detector at 24x24 base resolutions which need to be calculated. But it is to be understood that only few set of features will be useful among all these features to identify a face. Ada Boost is a machine learning algorithm which helps in finding only the best features among all these 160,000+ features. After these features are found, a weighted combination of all these features in used in evaluating and deciding any given window has a face or not.

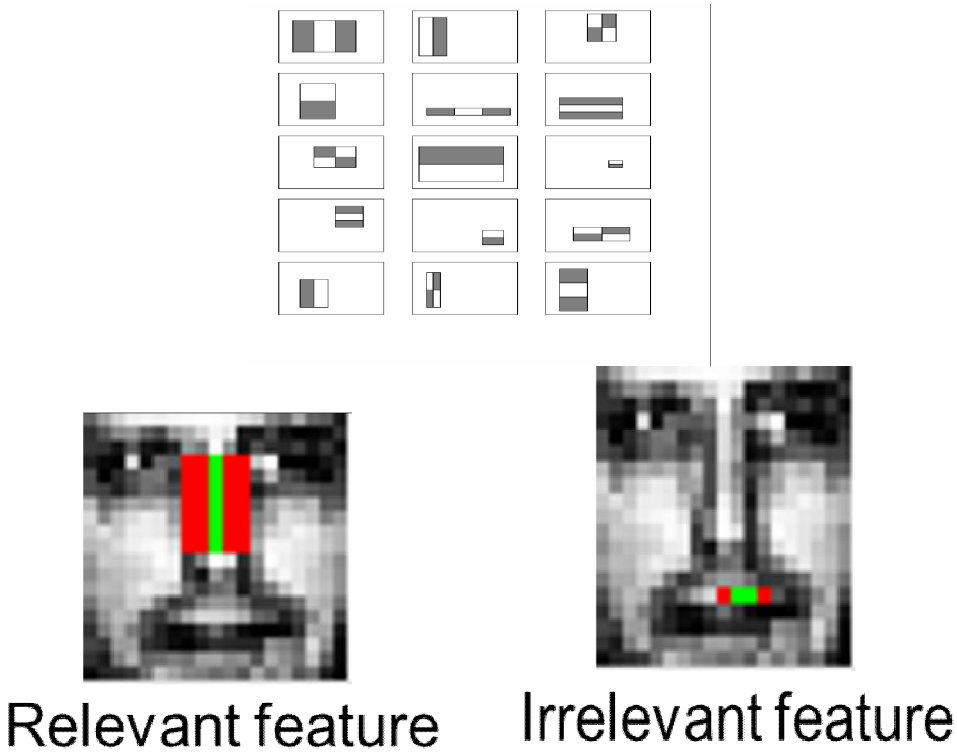


Fig 4 : Examples of Ada Boost method

For the task of face detection, the initial rectangle features selected by Ada Boost are meaningful and easily interpreted. The first feature selected seem to focus on the property that the region of the eyes is often darker .This feature is relatively large in comparison with the detection sub-window, and should be somewhat insensitive to size and location of the face. The second feature selected relies on the property that the eyes are darker than the bridge of the nose.

## V. FACE RECOGNITION USING EIGEN FACES

The face recognition system is based on the Eigen-faces method introduced by Turk et al. (Turk and Pentland, 1991). Eigenvector-based methods are used to extract low-dimensional subspaces which tend to simplify tasks such as classification. The Karhunen-Loeve Transform (KLT) and Principal Components Analysis (PCA) are the eigenvector-based techniques we used for dimensionality reduction and feature extraction in automatic face recognition. The built system that will be used in a human-robot interaction application is able to robustly detect and recognize faces at approximately 16 frames per second in a 1GHz PentiumIII laptop.

This article is structured as follows: Section I presents to the face detection mechanism that uses classifiers based on Haar-like features. Section II refers to the Eigen image based recognition of faces. Section presents the tracker

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mechanism which is based on a Kalman filtering approach. Section presents the architecture of the on-line face recognition system whose results are presented on section In this latter section some real data results are presented where it can be seen that multiple faces are detected in images but only one is recognized as the interacting one.
The face recognition system is based on Eigen space decompositions for face representation and modelling. The learning method estimates the complete probability distribution of the face's appearance using an eigenvector decomposition of the image space. The face density is decomposed into two components: the density in the principal sub- space (containing the traditionally defined principal components) and its orthogonal complement (which is usually discarded in standard PCA) (Moghaddam and Pentland, 1995).

A. Principal Component Analysis
Principal component analysis (PCA) was invented in 1901 by Karl Pearson. PCA involves a mathematical procedure that transforms a number of possibly correlated variables into a number of uncorrelated variables called principal components, related to the original variables by an orthogonal transformation. This transformation is defined in such a way that the first principal component has as high a variance as possible (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to the preceding components. PCA is sensitive to the relative scaling of the original variables. Depending on the field of application, it is also named the discrete Kärnten Love transform (KLT), the Hotelling transform or proper orthogonal decomposition (POD). The major advantage of PCA is that the Eigen face approach helps reducing the size of the database required for recognition of a test image. The trained images are not stored as raw images rather they are stored as their weights which are found out projecting each and every trained image to the set of Eigen faces obtained

## VI. TRACKING ALGORITHM

A computer vision color tracking algorithm is developed and applied towards tracking human faces. The algorithm is based on a robust nonparametric technique for climbing density gradients to find the mode of probability distributions called the mean shift algorithm. The mean shift algorithm is modified to deal with dynamically changing colour probability distributions derived from video frame sequences. The modified algorithm is called the continuously adaptive mean shift (CAMSHIFT) algorithm. The new algorithm developed is based on a robust nonparametric technique for climbing density gradient to find the mode (peak) of probability distributions called the mean shift algorithm. They want to find the mode of a color distribution within a video scene. The mean shift algorithm is modified to deal with dynamically changing color probability distributions derived from video frame sequences. The modified algorithm is called the Continuously Adaptive Mean Shift (CAMSHIFT) algorithm. CAMSHIFT's tracking accuracy is compared against a Polhemus tracker CAMSHIFT is then used as a computer interface for controlling commercial computer games and for exploring immersive 3D graphic worlds.

## VII. RESULTS

Face images of users have been captured and for every user 10 images are captured. Out of those 10 images, 5 images are used for training purpose and 5 images are used for testing purpose. The system shows effectiveness of results with accuracy around 95.37% for face detection and 96.68% for face recognition and 97.94% with face tracking.

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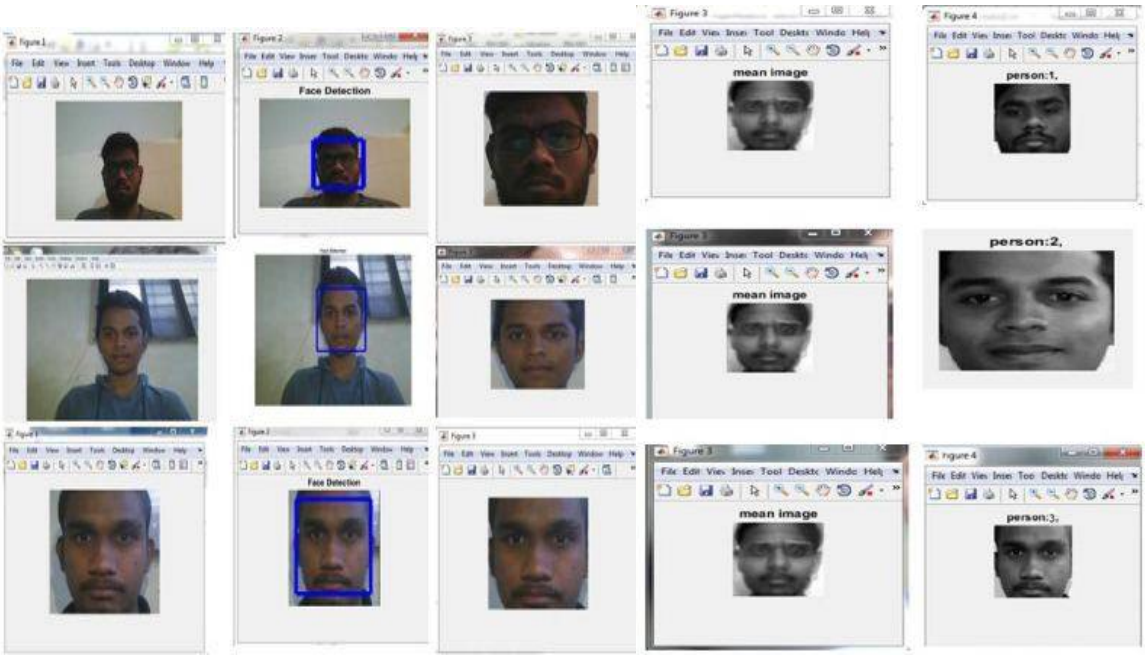


Fig 5 : Experiment result of Face detection systemFig 6 :Experiment result of Face recognition system

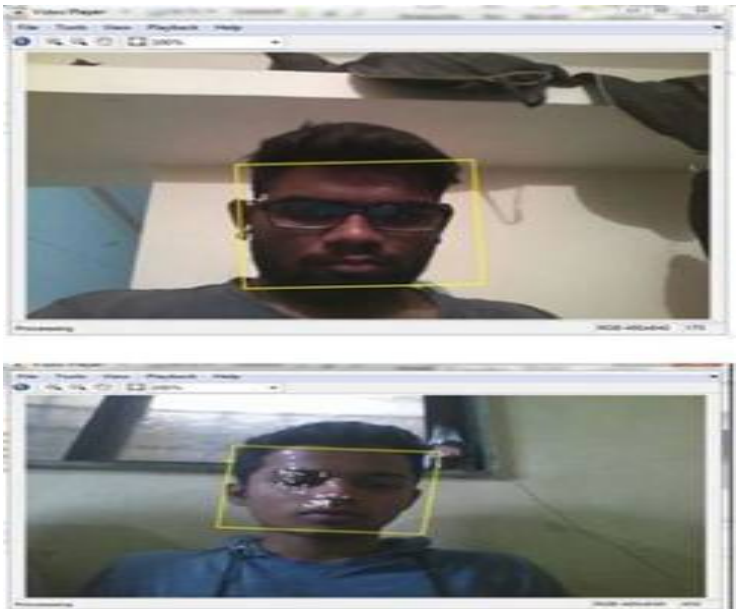

Fig 7 : Experiment result of Face detection system

## VIII. CONCLUSION

In this paper three methodologies viz. face detection and face recognition and face tracking have been implemented and verified to be effective as per the results obtained through the simulations. Among these methodologies, results show, The Haar features used inthe effort by Viola andJones are very simple and effectivefor frontal face detection, but they are less ideal for facesat random poses. Another interesting idea to improve facedetection performance is to consider

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the contextualinformation.The Eigen face used in face recognition depends on many things for accuracy as ittakes the pixel value as comparison for the projection, theaccuracy would decrease with varying light intensity. The camshift used in face tracking will be in to larger, more complex, higher MIPs-demanding modules that provide more robust tracking, posture understanding, and gesture

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