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# Development of Vision Based People Counting Framework using Webcam

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**ABSTRACT:** Depending on the application domain, face detection algorithms are frequently utilized in computer vision because they produce quick and accurate outcomes. Here, a multi-view method for leveraging the VIOLA JONES algorithm to recognize frontal and profile poses of people's faces is described. Online detection and tracking systems now function in real time thanks to recent advancements in theory and practical application. The face detection and tracking system developed for this research combines methods from the fields of face detection and tracking. On live obtained photos from video, face detection is done. Color balancing, skin segmentation, and facial image extraction on face candidates are utilized procedures in the approach. This system constructs cascades of face classifiers using the AdaBoost algorithm and the Viola-Jones face identification method. The Viola Jones approach involves a number of processing steps and can reduce face detection errors. It can count the faces in the image and count their number. When applying the Viola-Jones approach in practice, MATLAB is used to identify faces in photographs.

**KEYWORDS:** Face Detection and Recognition, VIOLA JONES Method, skin color segmentation Algorithm

## I. INTRODUCTION

For a wide range of video applications to extract semantic data about human behaviour and scene activity, objects must be identified, tracked, and detected in a specific scene. The majority of video surveillance applications, in particular, rely on the recognition of human activity recorded by stationary cameras. Although cameras in this area are still largely addressed, several problems still arise. For instance, outdoor sceneries may have different lighting conditions (such as shadowing, sunshine lighting), common spaces may be frequently busy (such as subways, malls), and photographs may be captured at a low quality. Thus, it is still a sensitive undertaking to recognize and track things in such complicated surroundings. Although the methods described in the technology of this field produce excellent results, their effectiveness depends on the assessment context.

The detection and tracking of faces in videos is the main emphasis of this paper. The strategy is made to integrate face detection with a tracking algorithm, rather than trying to outperform advanced face detection systems. Tracking moving items that are coming in the vicinity of the camera watching them is equivalent to tracking only frontal images of people's faces. These trajectories exhibit unidirectional patterns of human movement and take place in constrained settings, such corridors. Yet, as a person walks within the field of vision of the camera, it's possible that both the frontal and profile views of his face will be recorded. The majority of security cameras are static, and observing static background images in the suggested approach enables relatively quick segmentation of 2D moving objects where faces are predicted to occur, thus limiting the face searching procedure. By incorporating the identified traits into a tracking framework, faces can be tracked.

## II. RELATED WORK

For face detection, a lot of people utilise the algorithm created by Viola and Jones [1-2] and made available through the OpenCv package [4]. They construct a cascade of quick classifiers using an Adaboost [5] algorithm and the Haar characteristics to represent faces.When Haar features and boosting methods for face detection are coupled, excellent results are typically obtained [6-7]. Haar features benefit from the variations in the amount of grayish on the face. Authors in [8] employ an SVM classifier on histogram equalized candidates to identify whether or not they are indeed

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face candidates after swiftly extracting face candidates using the most important face feature, the eyes. As discussed in the survey by authors in [9], there are numerous ways that, depending on the use and applications, offer performance that is generally equivalent. Authors in [10], for instance, filter out erroneous detections and speed up their method by identifying items of interest in regions of moving images. They extract the eigen postures of faces photographed under various rotation angles and lighting orientations with respect to the camera location using a Gabor Wavelet Transform to represent the facial characteristics. Authors in [12-14] provides a detailed overview of all types of face detection algorithms. Authors in [15-17] examined a few modern face detection techniques.

## VIOLA–JONES FRAMEWORK

Paul Viola and Michael Jones presented the Viola-Jones object detection structure in 2001 as a machine learning object detection framework. [1][2] Although it can be applied to the discovery of other object types, the challenge of face detection was the main inspiration. The algorithm has four steps: Haar-like features selection, producing an integral image, Adaboost training and Cascading classifiers. One need not apply object detection to every frame in films of moving things. Instead, prominent features can be found within detection bounding boxes using tracking techniques like the KLT algorithm, which can then be used to follow their movement over time. This not only speeds up tracking by eliminating the need to redetect objects between frames, but it also increases robustness because prominent features are more resistant to rotation and photometric changes than the Viola-Jones detection framework [3].

## HAAR-LIKE FEATURES

Digital image properties that resemble Haars are employed for object recognition. Some characteristics of the human face are ubiquitous, such as the nose region being brighter than the eye region and the eyes region being darker than its neighbouring pixels. The pixel values of the two regions can be added up and compared to determine which region is lighter or darker. In the darker area, the total number of pixels will be less than in the lighter area. In some cases, the centre piece may be shinier than the surrounding boxes, which can be perceived as a nose if a part is whiter than the other.Using Haar-like features, we may achieve this and use them to analyze the many components of a face.For the detection of edges and lines, separately, edge features and line features are helpful. Diagonal features are discovered using the four-sided characteristics. The total of the pixel values in the black area less the sum of the pixel values in the white area is used to determine the value of the feature. A plain surface with identically coloured pixels that don't offer any valuable information has a value of 0.Since our faces are of complicated forms with darker and brighter regions, a Haar-like characteristic provides you a significant number when the areas in the black and white rectangles are very varied. By using this value, we can extract some useful data from the image. The areas in the black and white rectangles are substantially different since a Haar-like feature needs to provide you with a large number in order to be useful. It is commonly recognised that certain traits are particularly effective at identifying human faces.

## INTEGRAL IMAGES

The term "integral image" refers to both a data structure and the process that creates it. It is also employed to refer to a summed-area table. It is employed as a rapid and effective method of computing the total number of pixels in an image or rectangular region of a picture.

## ADABOOST

Each Haar-like feature in the Viola-Jones method represents a weak learner. AdaBoost evaluates the performance of each classifier that you feed it with in order to determine the kind and size of a feature that will be included in the final classifier. All the subregions of all the training images are utilised to evaluate a classifier's performance. Certain subregions will give the classifier a significant reaction. Those will be labelled "positives," which indicates that the classifier believes it to include a human face. The classifiers believe that subregions without a strong response do not contain a human face. They will be categorised as adverse effects.The classifiers with the best performance are given more weight or relevance. In the end, the strongest weak classifiers are combined to generate a strong classifier, also known as a boosted classifier.In order to train the AdaBoost to recognise essential features, we must first provide it with training data in order for it to learn from it and make predictions. Therefore, in the end, the algorithm establishes a minimal criterion to decide whether or not something qualifies as a useful feature.

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## III. PROPOSED METHODS

Fig 1 shows the workflow of the proposed method.

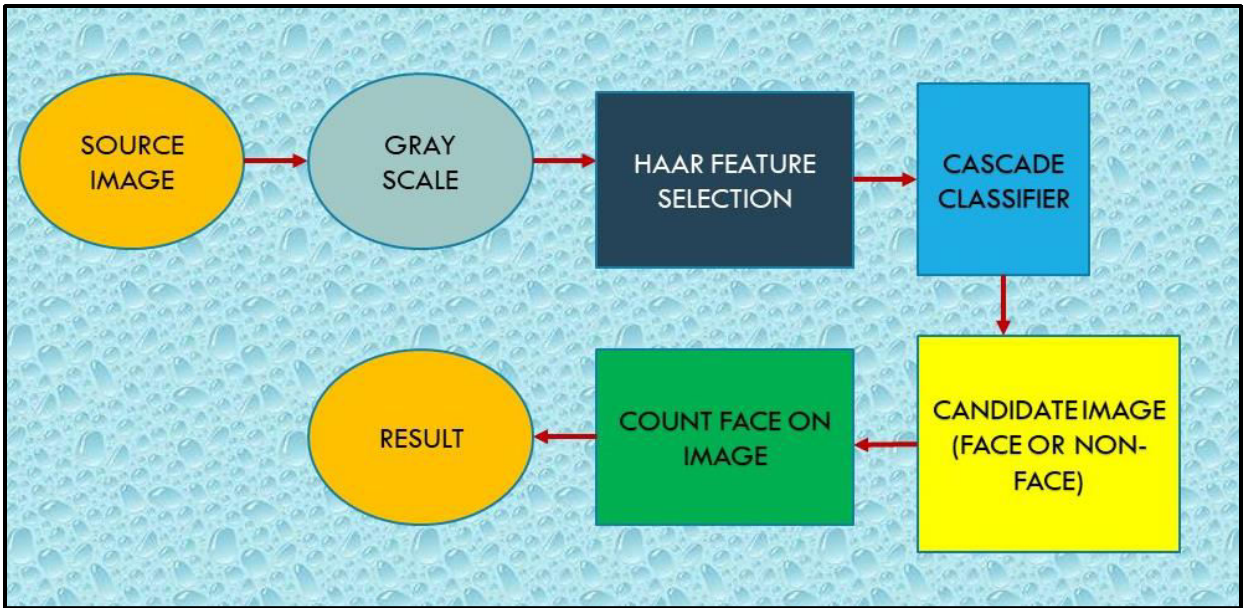


Fig 1: Workflow of the Proposed Method

**Face Detection**

The face detection process detects and retrieves facial images from the currently playing video frame. Figure 2 displays a block diagram of the face detection system utilized in this research.The initial phase of the face detection process is color balance adjustment after scanning a video frame. The worldwide adjustment of color intensity requires color balance. The adjustment's primary objective is to accurately depict certain hues. For this reason, color balance ought to be used prior to face segmentation [11]. The mean values of red, green, and blue colors from a picture are determined along with the mean value of gray color for the aim of color balance adjustment. RGB and HSV color spaces are evaluated for skin-like color in skin segmentation. HSV's distinct color and intensity shifts make it less responsive to changes in light than RGB. The RGB color space yields the greatest results for our implementation, though. Skin segmentation will produce a grayscale picture. Skin areas are seen to be brighter than non-skin areas. The final image is used to correct for faces' pointed placements, and the findings are submitted to the following stage. The outcome of skin segmentation on the captured image is shown in Figure 4.

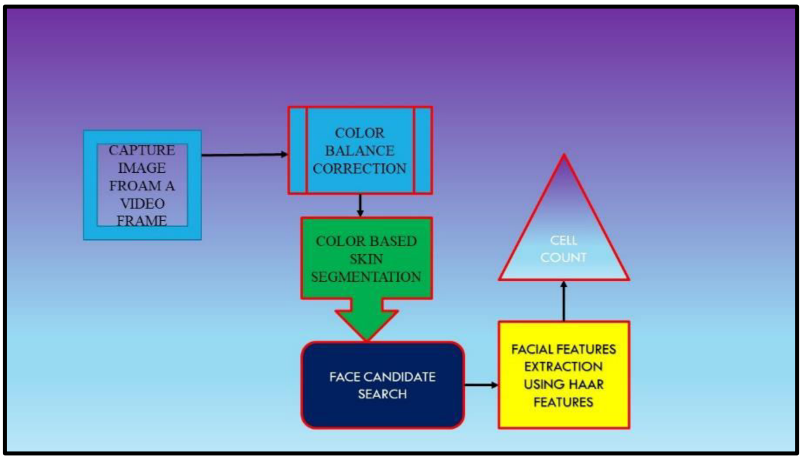


Fig 2: Detection of Faces and Cell Count

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Result of cell count is shown in fig 3.

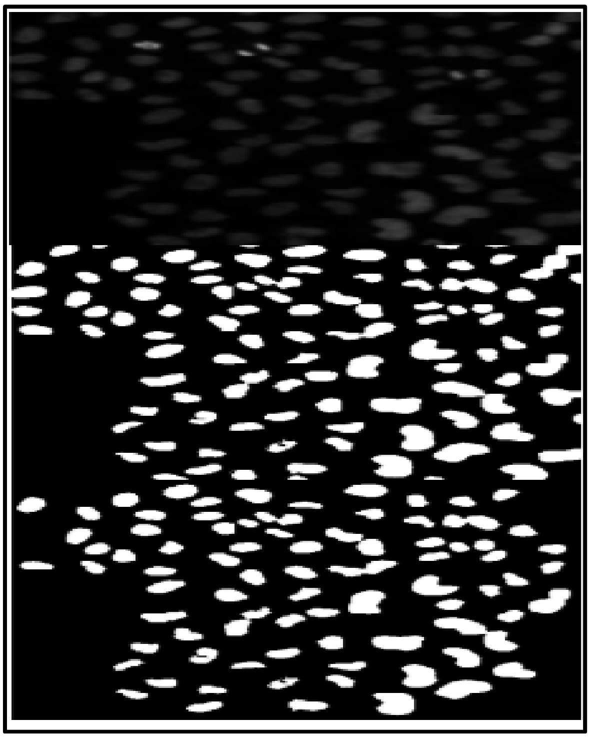

Fig 3: Cell Count in an Image

A feature extracting technique akin to Haar is employed to use the skin segmentation output. The skin segmentation images are used in this method to extract five different Haar-like attributes. The change in contrast values between neighbouring rectangular groups of pixel values is the basis for these attributes. the five different Haar-like feature templates that were employed in this work (fig 5). For the aim of identifying lips, eyes, and noses, these five categories of feature templates are utilized. An interim description of the picture known as the integral image is used to determine the straightforward rectangular Haar-like features of a picture [18]. The sums of the intensity values of the pixels directly to the left and above the pixel at location make up the array that makes up the integral image (x, y). It is simple to compute the integral image, also known as the summed area table, in a single pass over the image. The area of any rectangular region (P, Q, R, or S) across the image may be estimated in constant time once the integral image has been calculated.Procedure of people count has been shown in fig 4. Fig 6 and 7 illustrates how number of faces counted by the proposed method.The proposed procedure has been executed in the MATLAB programming program for various types of calculations that far reach cell count, human counting and vehicle calculations. The possible results of the transfer of the final results are displayed as numbers and in this way it has been exhibited. Figures 8 to 11 show the process of capturing an image through webcam and then counting the number of peoples in this.The extraction of Haar-like characteristics comes next, following the calculation of the summed area table. Haar features are combinations of two or four rectangles, as shown in Figure 5. The value of each Haar-like feature is determined using a Haar feature classifier using the summed area table. A stage comparator adds together each frame's findings for the Haar feature and compares them to a phase threshold. The weak classifier yields a constant called the threshold as well. Viola and Jones give a data set that is utilised for the training step and has 5000 faces and 10,000 non-face sub-windows. Over the integral image, each Haar feature is connected to the relevant image sub-window. When the end of a row is achieved, each sub-window is applied over the integral image both horizontally and vertically. Up to five different types of Haar-like characteristics may be recovered in this case, and they are used sequentially.

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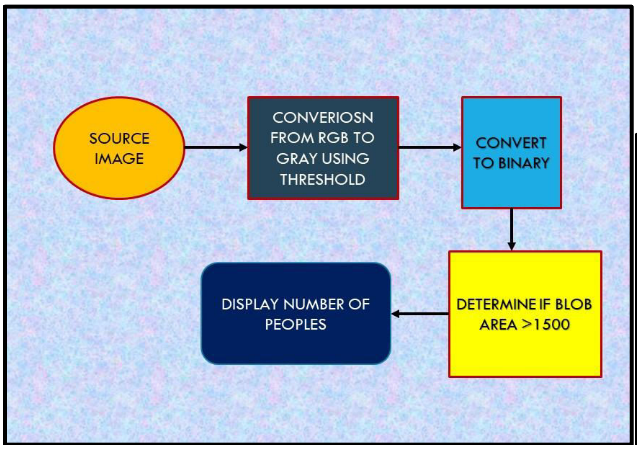


Fig 4: Counting of People in An Image

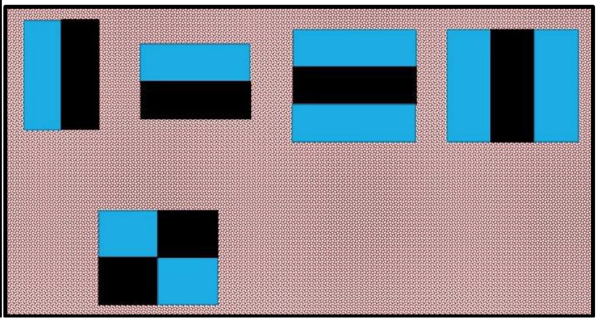

Fig 5: HAAR like Features

Using a series of phases, the Viola and Jones face detection method swiftly eliminates non-face. Every face applicant must successfully complete each stage.

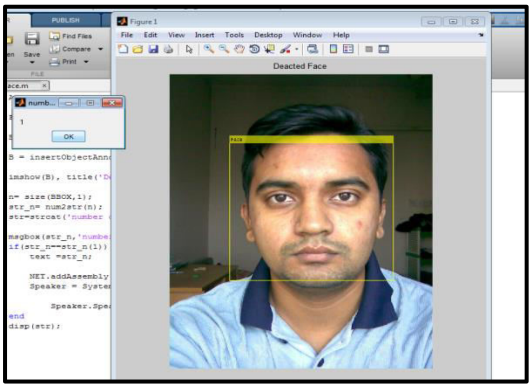

Fig 6: Single Face Detected

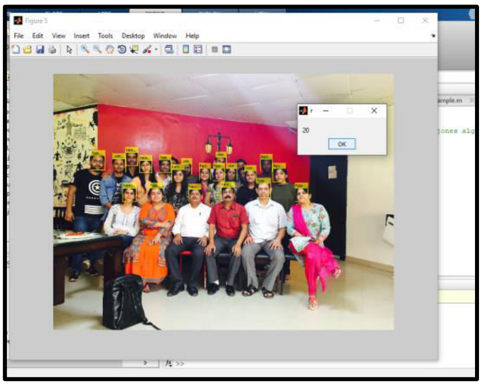

Fig 11: Twenty Peoples Detected in the Image

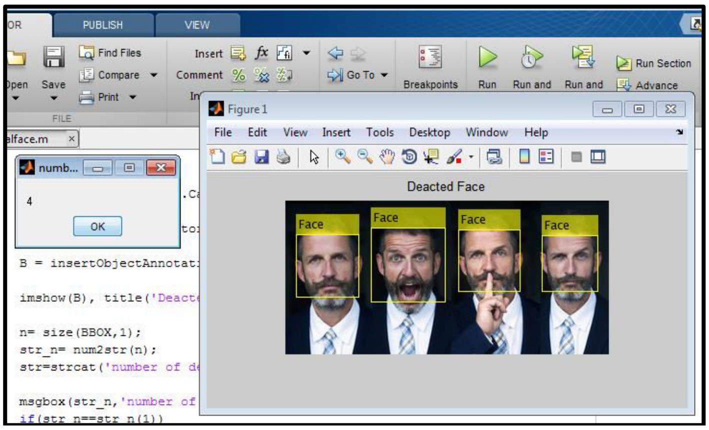

Fig 7: Face Identified using Skin Segmentation

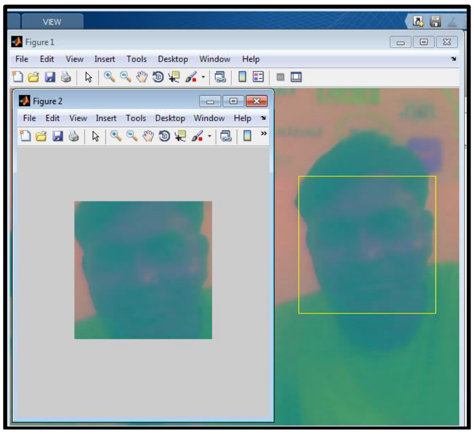

Fig 8: Face Capture and Identification Through WebCam

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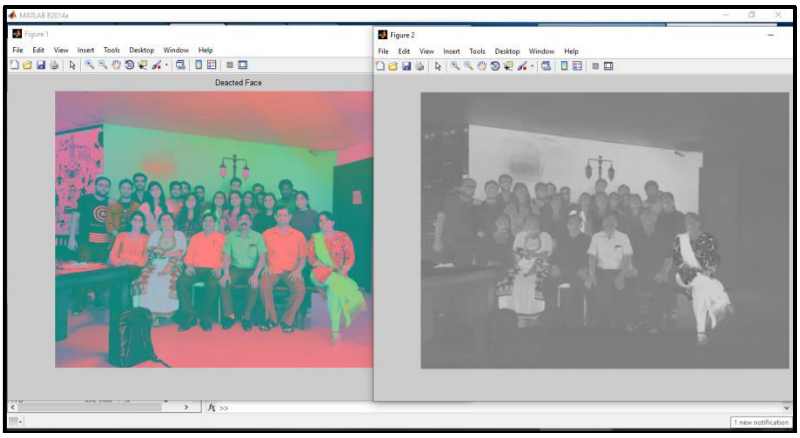


Fig 9: Multiple Peoples in a Video Frame

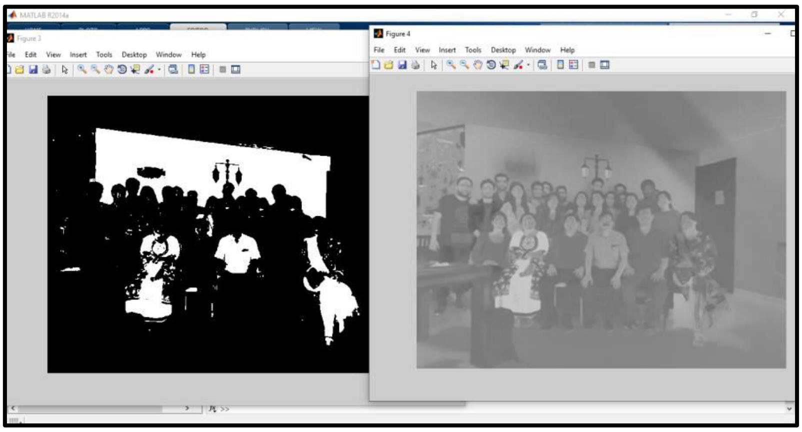

Fig 10: Peoples Classification using HAAR like Features

## III. CONCLUSION

The best algorithm for real-time facial object detection is the Viola-Jones approach. When used in the detecting process, it is effective since it is quick and reliable.Our system has been implemented with our initial results that have tried extraordinary to execute most of this extraordinary part in conclusions, people who calculate the accuracy of ninety-three % cycles. In our upcoming work, we imagine to expand our device to more tangled settings, close to outside were edification changes widely. In addition, the grouping of face pads will roam in each extraordinary setting that is almost certain through electronic data to get and change more land classifier.

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