# Facial Parts Detection Using Modified Viola Jones Algorithm

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***Abstract-*** *Face detection is one of the utmost extensively researched topics in recent times and is at the rudder of the computer vision technology. This paper describes the necessity and adopted methods to detect a human face. Since the data is computed by the computer, many algorithms are developed to detect a face. Some of the key challenges for the process of face detection are discussed. This paper presents to detect the faces in an image and locates the facial features in an image. The detection of the facial parts such as eyes, nose, mouth and face is an important task in this process. This system is used to recognize and detect the parts of the human facial factors in an image.*

***Keywords***- Image Processing, Feature Extraction, Viola Jones Algorithm, CNN.

## I. INTRODUCTION

In the past 10 years, there has been an exponential development in the field of image processing. New generation computers are becoming smarter and faster to process Terabytes of data. Object recognition is a field which has gained attention because of its utility in industries such as manufacturing, packing etc. A common example is supermarket that uses barcode to identify a product. A manufacturing unit employs a device that needs to accurately find the position of an object. For example, a bottle filler robotic arm needs to know the relative position of the bottle in which the liquid is filled. Object recognition needs computer vision to detect the structural nature of the object. Computer vision allows the computer to sense the object and process the desired information at blazing speeds. Just like eyes are the source for human, a camera is the undisputed source for computer.

Face of a person is unique in a manner that it possesses a set of features which might resemble with the other face in some or the other way. It is the skin color luminescence which makes a difference in the recognition of a face from a gallery of images (including the background). Face detection is the foremost and necessary stride towards facial recognition it encompasses a variety of intermediate steps such as facial analysis algorithms, alignment, remodeling and etc. The hurdles encountered in this path can be accredited to intensity of skin color, location, size of the facial image, occlusions, pose (out of plane rotation), orientation (in plane rotation). Innumerable advances were made to cease the purpose of detecting and recognizing a facial image by the research scholars across the globe.

Face detection is also a part of object detection [1]. Face detection can be classified into two classes (face and non-face). Most applications are based on face recognition and tracking. These applications need to locate the position of the face in the image or video. Moreover, face detection has added a much needed aspect of security in the recent years. Biometric systems, a front sided camera (Selfie) of a smart phone, human presence detection are some of the key implementations of face detection. Basically face detection senses the presence of the face in a 2D frame. Hence the detection of human face is possible [2]. Several methods and approaches are developed for face detection.

To evaluate the performance of the face detectors some parameters are used as a standard. Some of them are:

1. Learning time
2. Samples needed for training
3. The ratio between detection rate and false alarm
4. Execution time

## II. LITERATURE REVIEW

The problem related to facial expression recognition may vary between several factors such as illumination, pose invariant and rotation, etc. There are many researches based on the detection of face and people tracking and counting the number of peoples in either an image or video such as [1] and [2]. But detecting facial parts in several images is a challenging task as the accuracy won't be good for every images. Table 1 shows the literature review of some papers:

**Table 1: Comparison of face detection techniques**

| S. No | Author | Year | Methodology | Remarks |
|---|---|---|---|---|
| 1 | Yang,wang et.al[1] | 2008 | 2DPCA(displaced phase center algorithm) | This is a combination of DPCA and template method |
| 2 | Wei Chen et.al[2] | 2009 | template matching | This paper was about identifying faces according to the structure of every part of a face. |
| 3 | Chandrappa D N et.al [4] | 2011 | Skin Segmentation and Skin-Color model | This was by using MATLAB to identify the face with age. |
| 4 | Huajun Fan et.al [4] | 2011 | PCNN(Pulse-coupled neural network) mode | It is a model of identifying a face in the light as well as dark regions |
| 5 | Kenji Muta et.al [5] | 2013 | Color Transfer | In this, the face is identified by skin color even though the face was on makeup or color transformed it can identify the face. |
| 6 | Ma. Christina D. Fernandez et.al [6] | 2015 | Artificial Neural Networks and Image Processing | Here the process is done by using artificial neural networks, it was an activated function of calculating the measures of face |
| 7 | Nehru et.al [7] | 2018 | Viola-Jones algorithm and detection | In this viola-jones algorithm used by Matlab tool to identify faces in different angles with results. |

## III. VIOLA JONES ALGORITHM

The Viola-Jones face detection method is the first framework based on object detection that provides good detection rates in real-time is given by Paul Viola & Michael Jones in the year of 2001. This algorithm has been implemented in a software 'Matlab' using the method vision.CascadeObjectDetector. The Viola - Jones contains of 3 techniques for the facial parts detection:

1. The Haar like features for the feature extraction is of a rectangular type which is determined by an integral image.
2. Ada boost is a machine-learning method for detecting the face. The term 'boosted' determines the classifiers that are complex in itself at each stage, which are built of basic classifiers using any one of the four boosting techniques.
3. Cascade classifier used to combine many of the features efficiently. The term 'cascade' in a classifier determines the several filters on a resultant classifier.

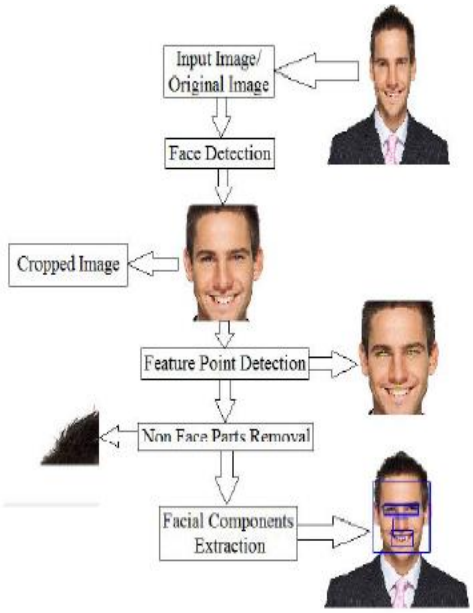


**Figure1: Flow Chart**

### Viola Jones Upper Body Detection

The upper body parts can be detected using this method in the still images based on the successful object detection framework on it that also contains the model for detecting the near and frontal upper bodies. This model has been used to detect the part of the upper body of the human and also it observes the face object detection.

The upper body detection in this model detects the upper body region, which consists of the head as well as the region of the shoulder combining with the face. These details of the head and the shoulder region has been encoded using the Haar features and the object detection. Since the object in the head and face uses more type of features, this model is more robust against the pose or the changes in the image, e.g. rotating head/blinking eyes with a tilt. To detect the upper body using the classification model we have 3 properties:

1. Create a detector object and their properties.
2. Input image given is read and detects upper body.
3. Show the detected upper bodies in a bounding box.

### Viola-Jones Face objects Detection algorithm

In the early stage the face detection in the images was a challenging task. As it has many variations of lighting conditions, poses and various factors on it. But later it was implemented in all of the recent technological products like camera to detect a face object wherever we move the camera with a region of the box. The face objects detection algorithm here consists of variations like illumination, poses and even

rotated faces on it. This is detected by getting several window classifiers on the Viola Jones algorithm.

**Viola-Jones Eye Detection Algorithm**

The region of the eye is darker related to other parts of the face, so finding the regions of the eye is based on segmenting a small region of the image which is specified as a darker region. The center part of the eye region is darker than the other region based on this model the eyebrow region has been removed. After the region of the selected eye region is done using the histogram analysis, as the region of eye exhibits two peaks whereas the region of eyebrow shows only one peak. The 2 major axis has the alignment of which is the final constraint here, so that the two eye regions corresponds to the same line.

**Iris Pupil Detection Recognition System**

The iris present in our eye has many properties based on the biometric recognition. Pupil is the center part of the darker region pixels in an eye circled by the iris (colored part of the eye). The light may enter through the pupil and then it passes through the lens, and at last it is focused onto the retina. There may be some information lose surrounding the pupil since the boundary region of the pupil is not always a circular part and there may be a small error in the detection of this boundary. When the head or the eye is also rotated, there occurs some problem in the segmentation of iris part.

**Viola-Jones Nose Detection Algorithm**

The nose has different properties on it to detect easily,

a) Dark White Dark Pixels: When an image is taken and it is convolved with these Dark White Dark Pixels the nostril region will be identified. This is based on the two regions of holes on the nose, which represents the dark pixels and the center region of the nose describes the white pixels.
b) Similarity of region on both the sides: The nostrils has the region of black areas on both the left and right side of the nose which is very same. These properties have been considered as a similarity on both the sides of the region.

**Viola-Jones Mouth Detection Algorithm**

The weak classifiers may be classified in these mouth detection algorithm in which the detection and extraction of the features from the mouth region is based on a typical decision stump that uses the features of Haar to encode the details of the mouth. Experimental results show that the region of the mouth may be detected based on the location of the eyes, nose and also lips that we will detect using these algorithms. This application can be used in a wide range of features and it is effective, for the complex background based on the mouth detection.

## IV. RESULTS

To implement the system, we used MATLAB and Python both. Various types of database i.e. Simulated emotional database like FacesdB is used and second one is natural database is used to check the efficiency of the work.

| Result | No of Faces | Detected |
|---|---|---|
| Database: FacesDB | | |
|  | 1 | 1 |
|  | 1 | 1 |
|  | 1 | 1 |
|  | 1 | 1 |
|  | 1 | 1 |
| Accuracy | 100% | |

| Result | No of Faces | Detected |
|---|---|---|
| Database: Personal | | |
|  | 11 | 11 |
|  | 8 | 8 |
|  | 7 | 7 |
|  | 8 | 8 |
|  | 7 | 7 |
| Accuracy | 100% | |

| Result | No of Faces | Detected |
|---|---|---|
| Database: Group Images | | |
|  | 6 | 6 |
|  | 6 | 6 |
|  | 7 | 6 |
|  | 6 | 6 |
|  | 11 | 10 |
| Accuracy | 95% | |

| Result | No of Faces | Detected |
|---|---|---|
| Database: Wedding Images | | |
|  | 6 | 6 |
|  | 6 | 6 |
|  | 6 | 6 |
|  | 6 | 6 |
|  | 9 | 9 |
| Accuracy | 100% | |

| Result | No of Faces | Detected |
|---|---|---|
| Database: Politicians | | |
|  | 12 | 11 |
|  | 6 | 6 |
| Accuracy | 95% | |

## V. CONCLUSION

Above results shows the accuracy is 98%, which is more than base paper [8]. Once the face is detected, facial features that express the human emotions are to be extracted. In future, viola jones algorithm of face detection technique will have used in one of the application i.e. Electronic Voting Machine based on face recognition. So that during election entire selection process should be transparent.

## REFERENCES


[1] Xiaoguang Chen, Xuan Yang, Maosen Wang, Jiancheng Zou. "Convolution neural network for automatic facial expression recognition", 2017 International Conference on Applied System Innovation (ICASI), 2017.

[2] L. Wiskott, J. M. Fellous, N. Kuiger, and C. V. Malsburg, ”Face Recognition by Elastic Bunch Graph Matching”, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 19, no. 7, pp. 775- 779,1997.

[3] M. S. Bartlett, J. R. Movellan and S. Sejnowski, ”Face Recognition by Independent Component Analysis”, IEEE Transactions on Neural Networks, vol. 13, no. 6, pp. 1450-1464, 2002.

[4] Chandrappa, D. N., M. Ravishankar, and D. R. Ramesh Babu. "Face detection in color images using skin color model algorithm based on skin color information." 3rd International Conference on Electronics Computer Technology (ICECT), Vol. 1. IEEE, 2011.

[5] Fernandez, Ma Christina D., et al. "Simultaneous face detection and recognition using Viola-Jones Algorithm and Artificial Neural Networks for identity verification." Region 10 Symposium, IEEE, 2014

[6] Vikram, K., and S. Padmavathi. "Facial parts detection using Viola- Jones algorithm." 4th International Conference IEEE on Advanced Computing and Communication Systems (ICACCS), 2017.

[7] Nehru, Mangayarkarasi, and S. Padmavathi. "Illumination invariant face detection using viola jones algorithm." 4th International Conference IEEE on Advanced Computing and Communication Systems (ICACCS), 2017.

[8] Kone Srikrishnaswetha et. al., Comparison Study on Various Face Detection Techniques, International Conference on Computing Communication and Automation (ICCCA) IEEE 2018

[9] Bendjillali Ridha Ilyas ; Beladgham Mohammed ; Merit Khaled ; Abdelmalik Taleb Ahmed ; Alouani Ihsen “Facial Expression Recognition Based on DWT Feature for Deep CNN”, 6th International Conference on Control, Decision and Information Technologies (CoDIT), 2019