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Implementation of Facial Parts Detection Using Modified Viola Jones Algorithm

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Abstract **- Face recognition has become a popular research topic in recent years. It is a technique that is used to individually recognise or authenticate a person by equating and detecting patterns based on the person's face features. Face recognition methods are using a system that predicts if there is a match based on multiple locations on an individual's face. The face biometric is the only valid biometric feature to be employed in surveillance systems for subject identification because to its non-contact and distant sensing capabilities. Incorporating facial recognition capability into surveillance systems will suggestively increase the security of the monitoring region. Face recognition has emerged as a key topic of research in computer vision during the last 10 years or more, and it is also one of the most profitable applications of picture analysis and comprehension.**

This paper demonstrates how to recognise faces in images and detect facial characteristics in images. The identification of facial features such as the eyes, nose, mouth, and face is a critical role 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

Facial expression is one of the most important, spontaneous and instant ways for an individual to express emotions. Facial expression plays a crucial role in identifying the emotions and cognitive state of a person. The expressions of the face from a particular language whose study is crucial in the field of behavioral sciences, computer sciences, psychology and the signs language.

Automating the system to identify the facial expressions and cognitive states help us to understand and prevent many situations such as traffic accidents by detecting drowsiness, social interaction, perception, social intelligence, educational scenarios, and e-learning environments. Ekman et. al [1] described six elemental facial expressions which are anger, fear, surprise, sad, happy and disgust. These expressions are similar in all the people irrespective of gender, age, and culture.

Further, the emotions are also recognized from one's speech, body language, facial expressions, bio-potential signal, breathing patterns, etc. By combining such multiple emotions recognition modalities, a robust signal recognition model is created to eliminate the ambiguity and uncertainty during decision making. The integration of the corresponding, redundant or contradictory data extracted from the multimodal emotion recognition model, gives a unique description of the natural emotions and also processes this information to predict the future behavior of the person [2]. Hence, an efficient computing approach enhances the level of interaction, detection, and modeling of the emotions to maximize the human-machine interaction.

The motivation of choosing this research work is to make the human computer interface more intelligent through mutual interaction on visual information methods. Facial Expression is one of the visual information methods. It involves mood, emotions, attitude etc. Hence a computer can act intelligently and extract more information from this natural interaction than other methods. We proposed a model by applying Viola-Jones face detection algorithm, firstly to detect faces, secondly to separate the faces from the rest of the parts, which are considered non-faces. Moreover, we employed Discrete Wavelet Transform (DWT) on face images to extract features.

Automatic facial expressions recognition system is performed in three main steps:

1. Face and facial parts detection.
2. Facial image enhancement and features extraction.
3. Expression Classification.

II. LITERATURE REVIEW

The challenge bonded to facial expression recognition may differ between several reps similar as clarification; pose invariant and revolution, etc. There are numerous inquiries rested on the finding of face and people tracking and counting the number of peoples in either an image or videotape similar as [1] and [2]. But detecting facial region in several images is a demanding task as the exactness 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	Chandrappa D N et.al [2]	2011	Skin Segmentation and Skin-Color model	This was by using MATLAB to identify the face with age.
4	Vikram et.al. [4]	2017	Viola-Jones Cascade Object Detector	Face, eyes, nose and mouth of a human is detected in a random set of samples and further tested.
5	Nehru et.al [5]	2018	Viola-Jones algorithm and detection	In this viola-jones algorithm used by Matlab tool to identify faces in different angles with results.
6	Srikrishnaswetha et. al. [6]	2018	Comparison of three techniques	Discussed various existing techniques (skin color method, viola jones, & PCA) based on their accuracy.
7	Sikder et. al. [8]	2021	Viola jones with Haar cascade	Implemented on real images with Faces94, Faces95, Faces96, and grimace databases.

III. VIOLA JONES ALGORITHM

The Viola-Jones face finding method is the first framework based on object detection that delivers decent detection rates in real-time is given by Paul Viola & Michael Jones in the year of 2001. This procedure has been executed in software 'Matlab' by the method vision CascadeObjectDetector. The Viola-Jones contains of 3 methods 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 technique for detecting the face. The term 'boosted' defines the classifiers that are multifaceted in it at each stage, which are erected of simple classifiers using any one of the four improving 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.

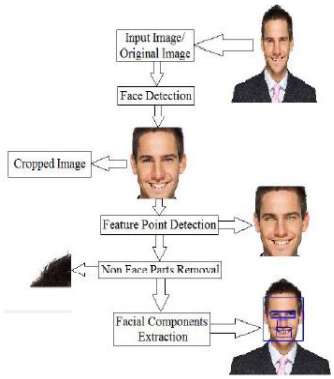

Figure1: Flow Chart

a) 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 particulars of the head and the shoulder area have been encrypted 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 perceive the higher body by means of the cataloguing 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.

b) Viola-Jones Face objects Detection algorithm

In the primitive dais the face detection in the images was a grueling job. As it have numerous interpretations of lighting conditions, acts and colorful factors on it. But latterly it was enforced in all of the recent technological products like camera to descry a face object wherever we move the camera with a region of the box. The face objects detection algorithm then consists of interpretations like clarification, acts and indeed revolved faces on it. This is detected by learning several window classifiers on the Viola Jones algorithm.

c) Viola-Jones Eye Detection Algorithm

The demesne of the eye is darkish bonded to other parts of the look, so chancing the areas of the eye is grounded on segmenting a slight area of the image which is defined as a darkened region. The central portion of the eye area is lightless than the distant area rested on this miniature the eyebrow region has been doffed. After the region of the named eye region is done applying 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 concluding continence then, so that the two eye regions corresponds to the identical line.

d) 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 arrive over the acolyte and then it permits over the lens, and at latter it is fixated onto the retina. There may be some information loses 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.

e) 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 grounded on the two regions of holes on the nose, which represents the black pixels and the central 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 veritably coequal. These properties have been considered as a similarity on both the sides of the region.

f) Viola-Jones Mouth Detection Algorithm

The delicate classifiers may be categorized in these mouth detection algorithm in which the detection and birth of the features from the mouth region is predicated on a representative conclusion residual that uses the features of Haar to render the particulars of the mouth. Developmental conclusions show that the region of the mouth may be detected based on the position of the eyes, nose and alike lips that we will determine using these algorithms. This operation can be employed in a broad lea of features and it's efficient, for the complicate backdrop based on the mouth detection.

IV. RESULTS

This chapter presents the various experimental results for our proposed approach. Experimentation mainly covers evaluations of correct functionality, performance, efficiency and suitability to run proposed approach in real time. Proposed algorithm is a combination of modified Viola Jones algorithm for face detection and modified DCT based face recognition. Experimentation and testing is done to analyze performance improvement/enhancement at each and every stage of proposed algorithm to understand what is the performance gain achieved at each and every stage.

Result	Face detected	Hit Ratio
	1	1
	10	1
	6	1
	5	1
	10	1
	3	1
	14	1

Figure 2: Results generated for various datasets

V. CONCLUSION

Proposed algorithm based on combined haar features based on 6 rectangle window features has yielded improved detection rate in uncontrolled environment thereby improving the overall recognition rate. Experimental results in section 4 has proven that first limitation is taken care by proposed algorithm which is tested with broader range of database. Proposed algorithm is integrated with illumination normalization technique to optimize the impact of illumination on overall face recognition system. Proposed algorithm uses reduced number of features for feature search in an image window and hence provides enhance speed. Average accuracy achieved in this simulation is around 99% which can be further improved.

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