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Vehicle's Driver Face Recognition using Viola Jones and Support Vector Machine

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***Abstract* - Facial expressions are crucial features of non-verbal communication. Locating facial features in images has done through several techniques till now. The main objective of those techniques is to detect face from the complex backgrounds. However traditional techniques are not efficient enough in term of accuracy. Consequently, a new technique is presented in this paper which collaborate five different techniques such as laplace operator, elastic bunch graph matching, greedy algorithm, viola jones, and support vector machine to detect the expressions of the person from video streaming. Furthermore, extraction of frames has been performed to detect the mood of a person. Finally, quantitative analysis is performed on existing techniques and present technique through PSNR, SSIM, HVS and UIQI, which clearly shows that present work is better than existing technique.**

Keywords* - *Face recognition, laplace operator, elastic bunch graph matching, greedy algorithm, viola jones, support vector machine.

I. INTRODUCTION

The technology of face recognition has become mature within these few years. Systems, using the face recognition, have become true in real life. Face recognition has a high identification or recognition rate for huge face databases with well-controlled pose and illumination conditions. This high rate can be used for replacement of lower security requirement environment and could be successfully employed in different kind of issues such as multi-media [1]. Automatic recognition is vast and modern research area of computer vision, reaching from face detection, face localization, and face tracking, extraction of face orientation, facial features and facial expressions. Some possible applications include user authentication for ATM machines, facility access control, airport security, remote access to networks, and aiding in the recovery of missing children and fugitives. Real time face recognition systems are helpful in creating a more secure world, as person is recognized by its personal physical traits but it is less-invasive than other biometrics [2]. It can be used for security. It eliminates the need for multiple passwords, PINs, and access cards in the course of identification or authentication of a person. However, the corresponding means are potential being lost or forgotten, alternatively fingerprints and retina scans suffer from low user acceptance rate [3]. Face recognition system increases the security as well as authentication in real world problems.

Facial expressions play an important role in non-verbal communication and human interactions. Classification of facial expressions can be used as an effective tool in medical rehabilitation and in behavioral studies. The facial expression analysis also interacts with visually recognizing and analyzing different facial motions and facial feature changes [4]. Facial expressions give information about the emotional state of the person such as happy, sad, sleepy, surprise and disgust. These expressions also help in understanding the mood of the person.

The term facial expressions refer to movements of the mimetic musculature of the face and the majority of these muscles are innervated by the cranial nerve, emanating from the brainstem between the pons and medulla [5]. In the human body, a nerve includes a motor root which supplies somatic muscle fibers to the muscles of face, outer ear and scalp that enables movement of muscles that comprise facial expressions. The sensory part of the nerve enables and augments some aspects of taste and sound. The facial behaviours are used for various functions like speech illustration. For example, people often raise their eye brows when being inquisitive, and lower their eye brows when they lower their voices [6].

II. LITERATURE REVIEW

Principal component analysis (PCA) is an approach to reduce the computation steps. The principle of divide and conquer strategy had applied through image decomposition. Each image had divided into sub-images and then each one had tested separately by using a single fast principal component analysis processor [6]. In contrast to using only fast principal component analysis, the speed up ratio had increased with the size of the input image when using fast principal component analysis and image decomposition. Simulation results demonstrated that this method was faster than the conventional and fast PCA. The implementation of principal component analysis (PCA) was used for fast face detection [7]. The implementation was based on cross correlation in the frequency domain between the input image and eigen values (weights).

A comparative study of three methods for face recognition was described. One of the approach was eigenface, fisherfaces and other one was the elastic bunch graph matching. The main idea of eigenface was to get the features in mathematical sense instead of physical face feature by using mathematical transform for recognition [8]. The fisher face method of face recognition used both principal component analysis and linear discriminant analysis to produce a subspace projection matrix, similar to that was used in the eigen face method. Face recognition using elastic bunch graph matching was based on recognizing novel faces by estimating a set of novel features using a data structure

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called a bunch graph. An efficient algorithm was used that recognized the novel faces by first localizing a set of landmark features, approximates the landmark features, and then measuring similarity between these features [9]. The two classical methods and a typical face image database for standard testing were described. For the first approach, feature based algorithm called as EBGM (Elastic bunch graph matching) was used. For the second approach, the statistical based algorithm called as PCA (Principal component analysis) was implemented. The scenarios and performance benchmarking were compared for each of the algorithms. The recognition of human faces from abstract features using principal component analysis (PCA) and Laplacian faces were described [12]. The large and unnecessary features of human faces were eliminated through PCA. Efficient and robust results were achieved through Laplacian faces.

In future, observing the gesture of a driver when person will drive and alerting the person when is drinking, sleepy mood will quite useful.

III. PRESENT WORK

The present work handles the problem of indiscipline among the people while driving that cause road accidents. It also overcome the shortcomings of feature tracking for face recognition using Elastic Bunch Graph Matching, Greedy algorithm, Viola Jones and Support Vector Machine.

The results of existing methods were not accurate enough because of the following factors:

i. In existing methods, the de-noising has not performed on the extracted face image due to which the extracted frames were not visibly smoothing. Whereas in the present technique, the Laplace operator is used which, removes the noise from extracted frames for clearer image.

ii. Greedy algorithm is used to select the clearer images from number of extracted frames. So that only required images are stored. Comparatively existing technique do not follow such process due to which it needs to process individual image in order to acquire relevant images.

iii. Accuracy obtained by the present technique is better than the existing methods as the present work is giving 95% accuracy whereas the existing method has 92.12 % accuracy.

IV. METHODOLOGY

At the first stage the video is loaded and divided into frames. The de-noising is through Laplace operator and Face detection by using Elastic Bunch Graph Matching algorithm. The Greedy algorithm, Viola Jones, and Support Vector Machine are used for quality optimization, face localization and classification of facial expressions respectively.

Following algorithm shows the working of present technique:

1. Load the video as input.
2. Extract the frames from video.
3. Apply Laplace Operator for de-noising the extracted frames.
4. Apply Elastic Bunch Graph Matching (EBGM) algorithm for face detection from de-noised images. Steps described below shows the generalized steps in order to implement EBGM algorithm where initialization of jets starts the process and further mentioned as:

   i. Jets are selected by hand to serve as examples of facial features.

   ii. After selection of jets, now create a bunch graph. Each node of the bunch graph corresponds to a facial landmark and contains a bunch of model jets extracted from the model imagery. For example Bunch created after selection of jets is like:

   $$B1 = \{J11, J21, J31.....\} \quad ...(1)$$

   $$B2 = \{J12, J22, J32.....\} \quad ...(2)$$

   $$B3 = \{J13, J23, J33.....\} \quad ...(3)$$

   $$B4 = \{J14, J24, J34.....\} \quad ...(4)$$

   $$B5 = \{J15, J25, J35.....\} \quad ...(5)$$

   iii. Landmark points are located for every image. First, a novel jet is extracted from the novel image. The novel jet's displacement from the actual location is estimated by comparing it to the most similar model jet from the corresponding bunch.

   iv. A face graph is created for each image by extracting a jet for each landmark. The graph contains the locations of the landmarks and the value of the jets. Consequently original image is discarded.

   v. Face similarity is computed as a function of landmark locations and jet values.

5. Select the frame with the clearest face image of the driver using the quality optimization based Greedy algorithm.
6. Apply Viola Jones to detect the features of face like eyes, lips and nose of the image. Viola Jones describes the step which are required to detect the features of the face such as:

   1. Extract rectangle filters in terms of pixels value as:

      Value = Σ (pixels in white area) - Σ (pixels in black area) ...(6)

   2. Now evaluate integral image by computing each pixel (x, y). Consequently, evaluate row sum with respect to integral image.
   3. Compute sum within a rectangle.
   4. Now select features using 24x24 detection region and then produce rectangle features.

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5. Lastly compute classification using classifier of different face images detected in the previous step.

7. Classify the localized data to recognize the gesture of driver's face using the Support Vector Machine (SVM).

8. Display the final image.

The flow chart for the present work is shown in Figure 1.

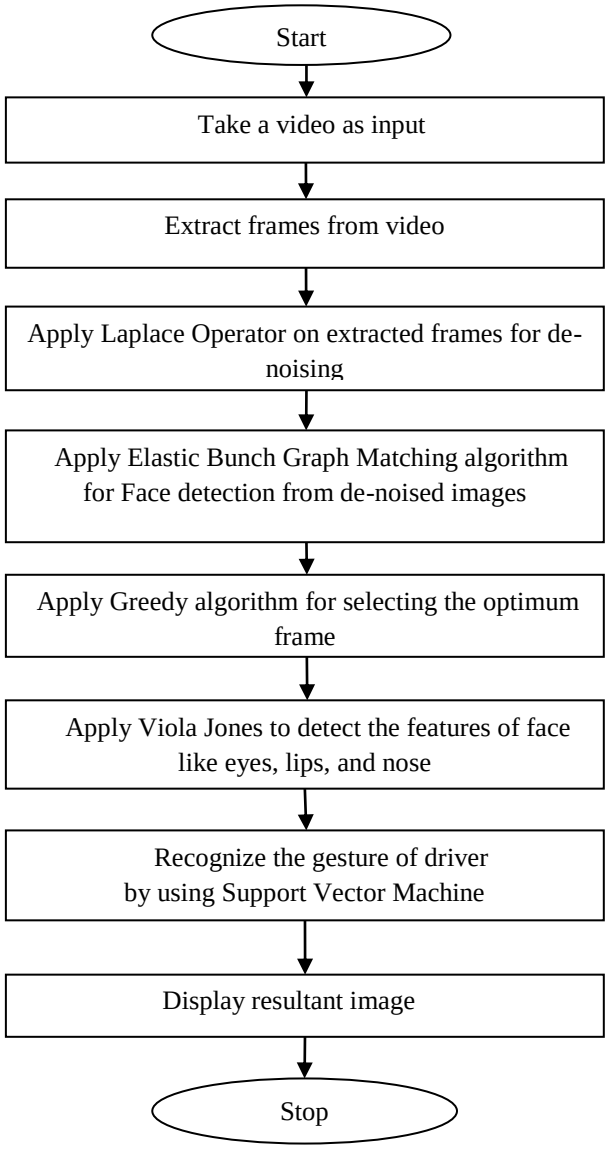

Figure 1: Flow chart of present work.

V. RESULTS AND DISCUSSIONS

Present work uses five algorithms to provide efficiency of the system. Every te0chnique gives the appropriate result with respect to reach the objectives of the present system. The following result defines the present technique which has been used in order to extract facial expressions of the human and to detect the mood on the basis of the parameters extracted.

The video can be saved through live streaming and is used for face recognition. The present system provides the facility of live streaming that is through graphical user interface (GUI). This window has the buttons and popup menus.

Video can also be selected from storage devices. The next step is to extract frames from the video. The present work is extracting 500 frames from a video of 23 seconds. A message is appeared after the extraction of frames.

After frame extraction, face detection process is done. The extracted frames may have the non face area. So, elastic bunch graph matching algorithm is used to detect the face from an image. This is done by the selection of jets, positioning of jets, estimation of jets, positioning of face with respect to jets and identification. A jet describes a small patch of grey values in an image.

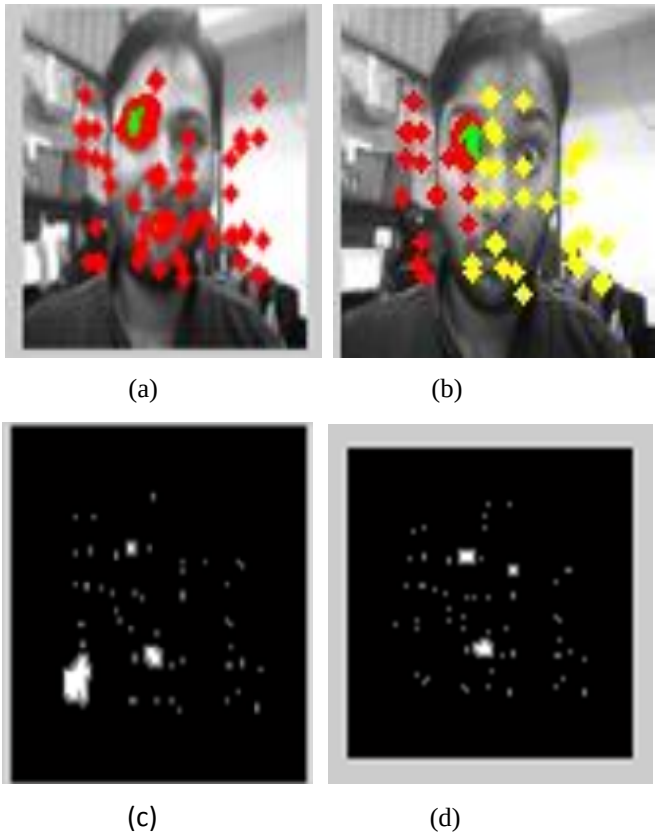

Figure 2: (a) Selection of jets, (b) Positioning of jets, (c) Jets estimation, and (d) Face positioning with respect to jets

After positioning of jets, extraction of features is performed and face is detected as shown in Figure 3, in which the eyes, mouth and face are detected from the image.

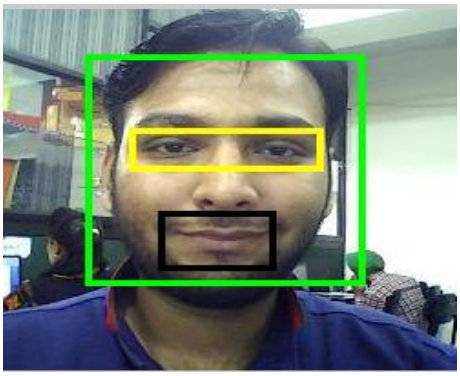

Figure 3: Identification of face

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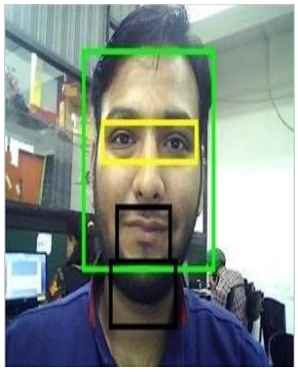
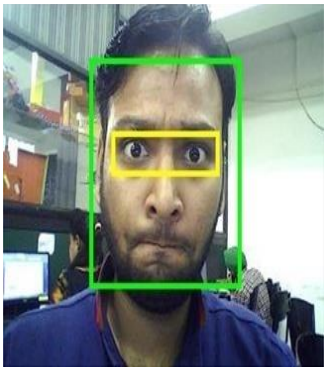
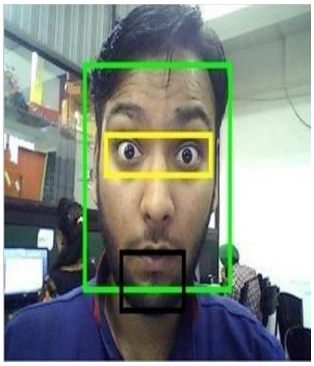
Facial expressions are recognized by support vector machine (SVM). The method is used to classify the expression of the face like disgust, happy, sad, surprised, and fear etc. are identified by the present technique. After detecting the face by using elastic bunch graph matching, and greedy algorithm to choose the best quality images, the support vector machine method is applied for classification of different mood samples of the person.



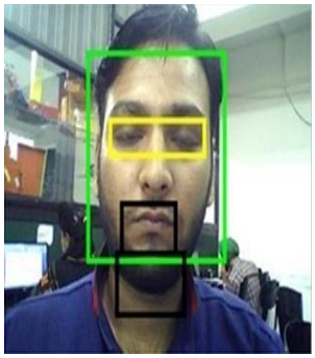
(a)



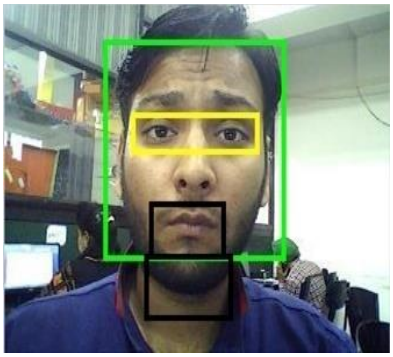
(b)



(c)



(d)



(e)

Figure 4: Recognition of Different moods (a) Happy, (b) Disgust, (c) Surprise, (d) Sleepy, and (e) Sad mood

Table 1: Comparison of existing technique and present work on first sample video

Parameters	Existing Technique	Present Work
PSNR	36.8598	48.7749
SSIM	0.78	0.9082
HVS	1.04	2.3083
UIQI	0.93	1.000

Table 2: Comparison of existing technique and present work on second sample video

Parameters	Existing Technique	Present Work
PSNR	36.8598	57.9695
SSIM	0.78	0.9269
HVS	1.04	2.2971
UIQI	0.93	0.9692

Table 1 and Table 2 show that the results of present system are better than the existing techniques. As the higher value of PSNR, SSIM, HVS, and UIQI are always considered good.

In Figure 5, the comparison of present values with existing values shows that the result of present system is better than existing.

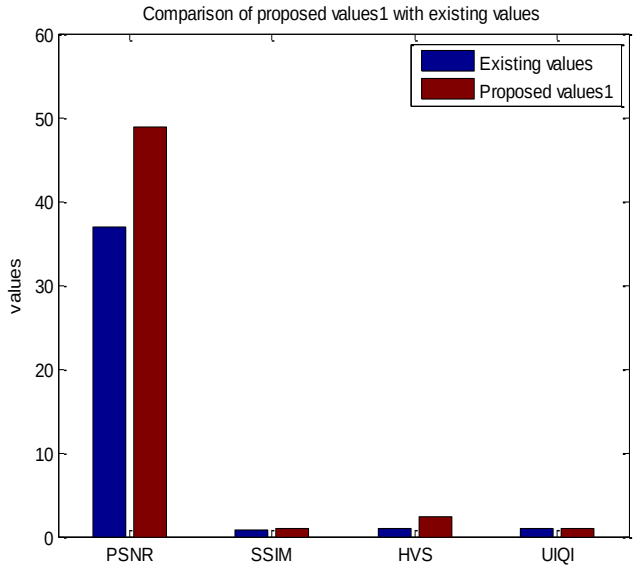


Figure 5: Qualitative Analysis of existing technique and present work based on first sample video

Figure 6 shows the graphical representation of comparison of existing system with proposed values based on second sample video. It is clear from the graph that the present work is more efficient than the existing system.

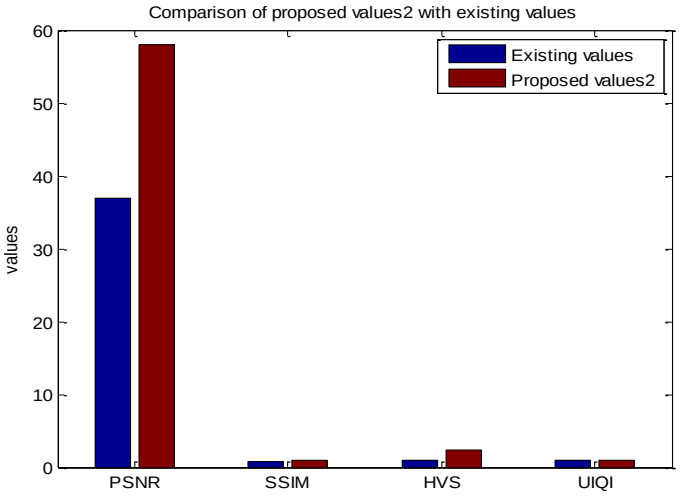


Figure 6: Qualitative Analysis of existing technique and present work based on second sample video

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VI. CONCLUSION AND FUTURE SCOPE

Present work describes the problem of facial expression recognition in the field of computer vision. Firstly, face is detected, expressions are extracted and recognition is performed at the end. In order to perform these steps several techniques has presented.

Face extraction method has been proposed to recognize the mood of the person. Owing to these five algorithms have been presented such as laplace operator to perform de-noising, elastic bunch graph matching to identify the face from the frames, greedy algorithm to select relevant images from the set of images taken, Viola Jones for extraction of features and lastly support vector machine for the classification purposes. Collaboratively these algorithms are used to extract the features in an efficient and in less time. Simulation has been performed using present technique and comparison has been done to compare existing and present technique.

The present system provides the two ways to use this system. The first one is to load the predefined video from the system and then recognize the face. Means, by loading the predefined video into this system, the facial features and expression can be recognized. Another one is the live streaming. In live streaming, the user can record the live video and then present techniques can recognize the face. Live streaming is helpful for finding the causes of road accidents. If the present system is used for video surveillance, then it can more helpful for identifying the exact reason of accidents. The technique support vector machine is used for expression of recognition of the face of the driver. Laplace operator at pre-processing stage is used to clear the face image, so that support vector can easily identify the cause of accidents.

Accuracy can be used to proven the fact that present technique is better, efficient and accurate as compared to existing technique. Quantitative analysis represents that the present technique is 95% accurate in comparison with traditional technique which is only 92.12% accurate. Thus present technique extracts features of face like eyes, mouth and face. So it can be extended further for recognition of multiple facial expressions or changes occur.

The technology face recognition plays an important role in real life. This is used in various fields and for different purposes. The most important role of face recognition in real life is security. In this work, the face recognition is used for causing the road accidents. It can play better role in future if more techniques will apply with the present techniques. The whole work is depends on the quality of video and on the quality of camera that captures the video. Because the recognition results will only be good if the video has the best quality.

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