ROBUST VISUAL ANALYSIS OF EYE STATE

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Abstract - *In this system, we proposed to reduce the number of accidents caused by driver fatigue and thus improve road safety. This system treats the automatic detection of driver drowsiness based on visual information and artificial intelligence. We locate, track and analyze both the driver face and eyes to measure PERCLOS (percentage of eye closure) with SoftMax for neural transfer function. Driver's fatigue is one of the major causes of traffic accidents, particularly for drivers of large vehicles (such as buses and heavy trucks) due to prolonged driving periods and boredom in occupied conditions.*

Key Words: PERCLOS, SoftMax, artificial intelligence, driver fatigue, driver drowsiness.

1. INTRODUCTION

The increasing number of traffic accidents due to a diminished driver's vigilance level has become a serious problem for society. Statistics show that 20% of all the traffic accidents are due to drivers with a diminished vigilance level. Furthermore, accidents related to driver hypo-vigilance are more serious than other types of accidents, since sleepy drivers often do not take correct action prior to a collision. For this reason, developing systems for monitoring driver's level of vigilance and alerting the driver, when he is drowsy and not paying adequate attention to the road, is essential to prevent accidents. The prevention of such accidents is a major focus of effort in the field of active safety research. People in fatigue show some visual behaviors easily observable from changes in their facial features like eyes, head, mouth and face. Computer vision can be a natural and nonintrusive technique to monitor driver's vigilance. Faces as the primary part of human communication have been a research target in computer vision for a long time. The driver fatigue detection is considered as one of the most prospective commercial applications of automatic facial expression recognition. Automatic recognition (or analysis) of facial expression consists of three levels of tasks: face detection, facial expression information extraction, and expression classification. In these tasks, the information extraction is the main issue for the feature based facial expression recognition from an image sequence. It involves detection, identification and tracking facial feature points under different illuminations, face orientations and facial expressions.

2. RELATED WORKS

Some works have already been done in this field which is as follows:

[1]Automatic Detection of Driver Fatigue Using Driving Operation Information for Transportation Safety [2] Bus Driver Fatigue and Stress Issues Study [3] Potential causes of driver fatigue: a study on transit bus 2 operators in Florida [4] Bus Driver: Factor that influence Behavior [5]Fatigue Factors Affecting Metropolitan Bus Drivers: A Qualitative Investigation.[6] Occupational Health Hazards: A Study of Bus Drivers [7]Bhowmick et Kumar [6] use the Otsu thresholding [7] to extract face region. The localization of the eye is done by locating facial landmarks such as eyebrow and possible face center. Morphological operation and Kmeans is used for accurate eye segmentation. Then aset of shape features are calculated and trained using non-linear SVM to get the status of the eye.

Tianet Qin [9] builds a system that checks the driver eye states. Their system uses the Cb and Cr components of the YCbCr color space. This system locates the face with a vertical projection function, and the eyes with a horizontal projection function. Once the eyes are located the system calculates the eyes states using a function of complexity.

3. THE PROPOSED SYSTEM

The proposed system is a driver face monitoring system that can detect driver hypo vigilance (both fatigue and distraction) by processing of eye and face regions.

After image acquisition, face detection is the first stage of processing. Then, symptoms of hypo vigilance are extracted from face image. However, an explicit eye detection stage is not used to determine the eye in the face, but some of important symptoms related to eye region (top-half segment of the face) are extracted reforming the face detection algorithm for all frames is computationally complex. Therefore, after face detection in the first frame, face tracking algorithms are used to track driver face in the next frames unless the face is lost.

(A) Eye And Mouth Detection

The first step is the detection of the eye. For the eye detection we are using the Euclidian distance algorithm. The distance is computed using the following formula:

$$d(\mathbf{p},\mathbf{q}) = \sqrt{(p_1-q_1)^2+(p_2-q_2)^2+\cdots+(p_i-q_i)^2+\cdots+(p_n-q_n)^2}.$$

The library contains both procedures and functions to calculate similarity between sets of data. The function is best used when calculating the similarity between small numbers of sets. The procedures parallelize the computation and are therefore more appropriate for computing similarities on bigger datasets.

Euclidean similarity is only calculated over non-NULL dimensions. When calling the function, we should provide lists that contain the overlapping items. For the face detection we are using the dlib library. The dlib library ships with a Histogram of Oriented Gradients-based face detector along with a predictor. The facial landmarks produced by dlib are an indexable list, as I describe here:

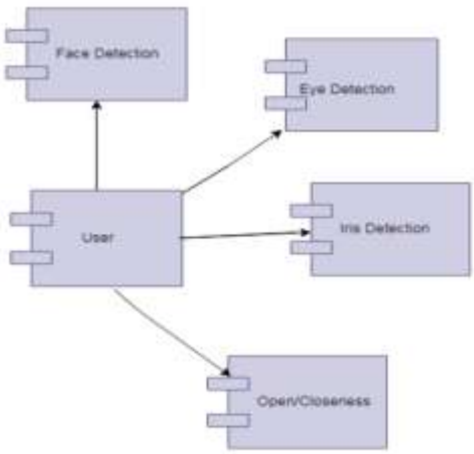
Fig: Visualizing the 68 facial landmark coordinates

After detection of face using the dlib library and extracting the eye part then the distance between the eye led is calculated and if the computed value is less than the threshold value then a alarm is given.

Similarly for mouth if the amount of mouth opened is greater than the threshold value then alarm is given.

(B)Out of Frame Detection

In this segment if the driver's eye is not on the road then a alarm will be given. The out of frame detection is based on the fact that if within the frame the face is detected using the face detection algorithm then no alarm or else there will be a alarm given. For the detection of the face we are using the dlib library and to extract the facial landmark imutils library is utilized.



4. RESULT AND TEST CASES

We have performed the following test cases:

Test case Id	Test case	Test case I/P	Actual Result	Expected Result	Test case criteria(P/F)
001	Camera is working properly	Execute the project and check if camera is working	Camera starts as project runs	Camera should start as project runs	P
002	Check if video is not blur	Execute the code and check if video is clear	Video is not blur	Video should not be blur it should be clear	P
003	Check by detection of drowsiness alarm is generated or not	Camera detects if the driver is sleepy	If driver is sleepy alarm generates	If driver is sleepy alarm should be generated	P
004	Check if alarm generated is audible to the user	Alarm is generated when drowsiness is detected by the system	Alarm is audible to the user	Alarm should be audible to the user	P

005	Check if alarm is generated quickly or it takes time when the system detects the drowsiness of the driver	Close your eyes in front of the system	Alarm is generated quickly and do not takes time as the system detects the drowsiness of the driver	Alarm should be generated quickly and not take time as the system detects the drowsiness of the driver	P

Fig1: Eye Detection and mouth detection

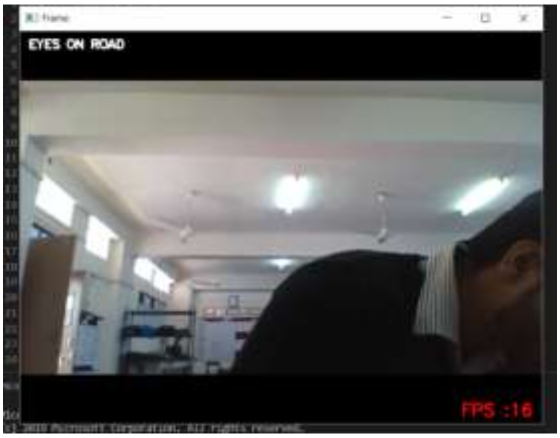


Fig2: Out of frame detection

5. CONCLUSION

The increasing number of traffic accidents due to a diminished driver's vigilance level has become a serious problem for society. Statistics show that 20% of all the traffic accidents are due to drivers with a diminished vigilance level. Furthermore, accidents related to driver hypo-vigilance are more serious than other types of accidents, since sleepy drivers often do not take correct action prior to a collision. For this reason, developing systems for monitoring driver's level of vigilance and alerting the driver, when he is drowsy and not paying adequate attention to the road, is essential to prevent accidents.

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