Driver Alert System to Detect Drowsiness and Distraction

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Abstract - Road accidents have been increasing largely due to drowsiness or distraction of drivers. The driver tends to drive in an inappropriate manner when he feels sleepy or gets distracted when he is talking with someone, watches something on the phone, etc leading to an accident. This is because when the driver is not able to control his vehicle on the road. We have created a project that can generate a model which can prevent such accidents. In this we would be detecting faces by Brf SDK (Beyond reality face SDK) to check if the driver is distracted or not and locate the landmarks and facial features including eye and mouth. We would be detecting the drowsiness in the driver's eye by calculating blink rate and eye closure time. The Yawning detection would be with the help of an edge detector. These data are stored which can be used for further analysis.

Keywords: ***Android, Haar-cascade, Image Processing, Machine Learning***

1. INTRODUCTION

The aim of this project is to develop an feasible and user friendly project, which can alert the driver via this system. The driver faces our monitoring system in a real-time that proposes the driver's physical and mental condition based on the processing of driver face images. The driver state can be calculated from the eye closure, eyelid distance, blinking, gaze direction, yawning, and head position. This system will alarm in the states of tiredness and diversion. In this method, Driver's fatigue will be based on the indication related to face, mouth and eye regions. Head position is a sign to detect diversion that is extracted from the face region then it will assign an evaluative head position above a specific amount of time. The data collected from eye region are percentage of eye closure, eyelid distance changes with respect to the normal eyelid distance, and eye closure rate. The information reclaimed from the mouth region is mouth open and closure distance which will detect the yawning state. All these facial characteristics are taken into account in order to alert the driver.

2. LITERATURE REVIEW

G. Kong et. al. [19] described 'Visual Analysis of Eye State and Head Pose for Driver Alertness Monitoring', in June 2011.

In this paper, alertness is based on two factors which are eye region and head pose which conclude as drowsiness and distraction. Driving precautions rely on eye closure and head nodding. This methodology monitors physical features like eye index, pupil contraction and expansion activity and various head positions and all this critical information is extracted to implement the system. A support vector machine defines a series of video portions into alert or non-alert driving activity. This system offers more accuracy with less number of errors and precautions are provided by keeping track of data of activities and also multiple real road driving conditions are considered.

Behnoosh Hariri, Shabnam Abtahi, Shervin Shirmohammadi, Luc Martel described 'A Yawning Measurement Method to Detect Driver Drowsiness', in May 2016.

The drowsiness is detected by yawning. This involves a few steps which includes the real time detection and tracking of the driver's face, detection and mouth contour is continuously captured in the form of video stream with the help of this, face is detected through a series of frame slots and then the location of mouth region is seized. We have chosen to detect and track the face above mentioned to track the mouth as this makes the mouth tracking procedure more strong against false detections. After detection of the mouth, the yawning state is detected.

3. IMPLEMENTED METHODOLOGY

Beyond Reality Face SDK (BRFv5): It is a real-time face detection and face tracking SDK. It examines the image data which can be in terms of camera stream, video stream or a static image and then it returns facial landmarks and data to place 3d objects on a face. It looks for faces (rectangles) in image data (camera stream, video or still image). For tracking the face, it finds total 68 facial landmarks/features as the figure given below.

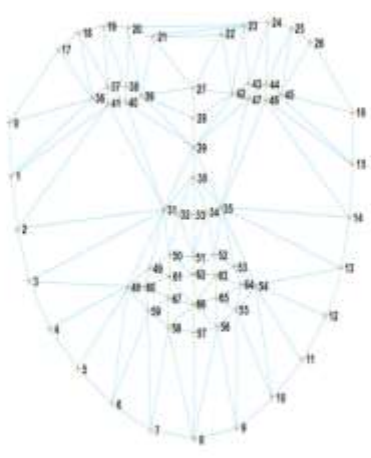


Fig.1 Face detection and face tracking sdk

Eye Blinking Detection: Each eye is represented by 6 (x, y)-coordinates, starting at the left-corner of the eye (as if looking at the person) and then working clockwise around the remainder of the region.

Eye Aspect Ratio:

$$\frac{||P2 - P6|| + ||P3 - P5||}{2||P1 - P4||}$$

Where p1, p2...p6 represent two dimension facial landmark locations.

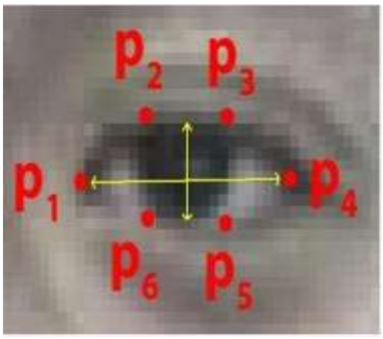


Fig.2 Eye Region

Yawning Technique: If we observe a wide open mouth, we can see three or four main components. These are skin, lips, a dark region corresponding to the openness degree, and sometimes teeth. This prominent structure enables us to remove the edge of the wide open mouth from notable intensity variations between the dark region and the lips or the teeth. Our edge detector considers pixels x with a gray scale intensity lower than a maximum threshold in order to handle only with the pixels that can belong to the dark region. This threshold is calculated from the mean intensity of the mouth image. For each x, a neighbourhood containing n pixels at the top and the bottom of x is specified. The n value is proportional to the number of image columns. The intensity differences between x and its n top and bottom neighbours are then calculated.

Top (resp., bottom) edge: if at least n-1 top (resp., bottom) neighbours provide a high difference and also if at least n-1 bottom (resp., top) neighbours are close to x, we deduct that x is a top (resp., bottom) edge pixel and we put it at 1.Explanation: when x is related to the top edge, its top (resp., bottom) neighbours pixel's intensity is very higher (resp., similar). Inversely, when x belongs to the bottom edge, the bottom (resp., top) neighbours pixel's intensity is very different (resp., similar).some edge components having circular form are detected in closed or slightly opened mouths by classic edge detectors, while our edge detector did not identify such component. An interesting property of our edge detector is its ability to detect only wide open mouths. This property allows us to identify yawning without puzzling it with talking, laughing, or singing, which corresponds to small mouth openings.

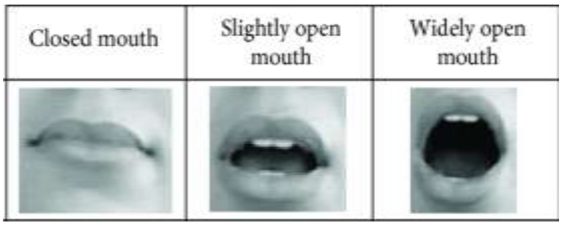
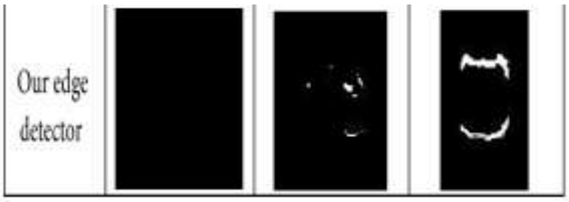


Fig.3 Yawning detection

Head Position Technique: After face detection using HAAR technique, if the driver is out of frame for a certain amount of time (i.e. 15seconds) then alarm will be buzzed in the form



of alert.

Data Modelling: The driver's database model has been trained according to vehicle dynamic point of view and also human features are included. Modelling and training the behaviour of a driver is done by this two steps:-

(i) Modelling Driver Behaviour: For modelling the behaviour of the driver, by setting up the data based on the human driving aspects which are fairly differentiated into 3 cases: parameter identification, nonparametric identification, and semi parametric identification.

(ii) Recognizing the Characteristics of Driver Behaviour: After the model has been established, it needs to be trained and should be able to characterize the behaviour. Here, many driving scenarios and tasks are described with many mathematical methods adopted.

Based on this, we will train the dataset which was extracted from the videos. In our dataset each entry has 3 video

i.e.

In 1st driver is fully awake

In 2nd here's somewhat sleepy

In 3rd driver is very sleepy (Alarm is rung).

Using these parameters in our app we detect the state of the driver. So the data get extracted from here, termed as output from the Machine learning model.

3.1 Algorithm

Step1: Start process
When the driver starts driving the car the camera is on.

Step2: Capturing driver image
The driver's face is captured using the camera that is placed on the dashboard.

Step3: Face recognition
It means locating the face in a frame or in other words finding location of facial characters through a technology.

Step4: Data captured
Data are extracted for visual distraction detection, pupil and mouth detection.

Step5: Process the captured data of the driver.
The captured data of the driver i.e. yawning, pupil and head pose is being processed.

Step6: Check the mode
Check whether the driver is sleepy or not.

Step7: Detect Normal mode or sleeping mode
There can be two possible mode i.e. Normal mode and sleep mode.

Step8: Normal mode
Then there will be no buzzer as the driver is not distracted.

Step9: The driver in sleeping mode
The warning is given in the form of buzzer

Step10: Stop the process
The process of detection is stopped.

4. RESULT ANALYSIS

This system will help overcome accidents due to drowsiness and distraction with the help of this system to some extent.

Sr. no	Users	Face Detection	Eye closure/Blink	Yawning	Off screen	Accuracy
1.	user 1	✔	✔	✔	✔	100%
2.	user 2	✔	✖	✔	✔	85%
3.	user 3	✔	✔	✔	✔	100%
4.	user 4	✔	✔	✔	✔	100%
5.	user 5	✔	✔	✔	✔	100%
6.	user 6	✔	✖	✔	✔	85%
7.	user 7	✔	✔	✔	✔	100%
8.	user 8	✔	✔	✔	✔	100%
9.	user 9	✔	✖	✔	✔	85%
10.	user 10	✔	✔	✔	✔	100%

Overall Accuracy of the system: 89.5%

5. OUTPUT

1) Identifying and locating the presence of human faces in video.

Fig.4 Implementation diagram of face detection

2) We are applying facial landmark detection to localise important regions of the face, including eyes, eyebrows, nose, ears, mouth and chin. This implies that we are extracting facial features that are being traced.

Fig.5 Face tracking

3) Detecting the eyes closed and opening (i.e. blinking) and counting the number of blinks.

Fig.6 Implementation of blinking detection

4) Yawning is detected by mouth movement and if it exceeds more than 40 percent that will count as a yawn factor.

Fig.7 Implementation of yawn detection

5) If the head is in certain angle irrespective of road and surpassing the setup time (i.e. 40 sec) leading to alertness.

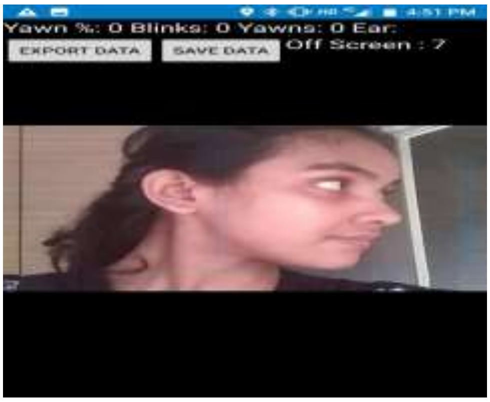


Fig.8 Distraction from head pose

6) These results are stored as data in the form of a csv file.

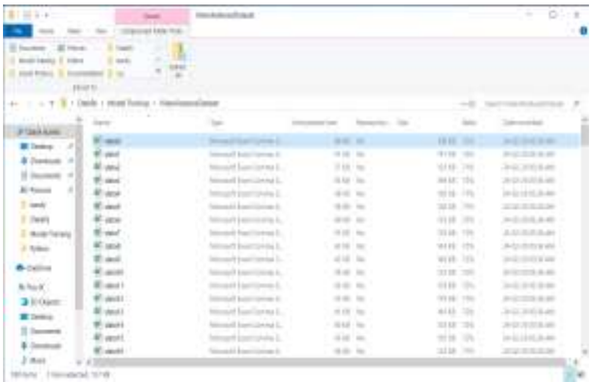


Fig.9 Results stored

6. CONCLUSION

In order to reduce the number of road accidents, this project detects the first signs of fatigue, drowsiness and distraction by the given above methods which will notify the driver in the form of alarm. Once the alert is given by detecting the eye (which is assumed to be found sleepy when it meets the threshold) or/and a mouth which is yawning (which is detected by our edge detector), the driver can take safety measures to avoid them further. Also if the driver is distracted for any reason then he/she is alerted by this method. And eventually this will lead to lesser chances of accidents and these results are stored.

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