Vehicle Driver drowsiness detection system using Raspberry pi

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Abstract : *Now a day's traffic is a main problem on roads and causes many accidents. Driver's drowsiness is one of the major causes of traffic accidents, particularly for drivers of large vehicles. It causes heavy loss of civilians. In this paper, we propose a vision-based fatigue detection system for bus driver monitoring, which is easy and flexible for deployment in buses and large vehicles. This project reduces those types of accidents. By using sensors and microcontroller we can detect driver fatigue state. In this project we are using raspberry pi, camera, relay and buzzer as hard ware components and open CV as software component. The experimental output shows the advantages of the system on accuracy and robustness for the situations used for driving state monitoring.*

***IndexTerms* - webcam, relay, Raspberry Pi, Buzzer, Rasbian OS, Python.**

1. INTRODUCTION

Currently, transport systems are an essential part of human activities. We all can be victim of drowsiness while driving, simply after too short night sleep, altered physical condition or during long journeys. The sensation of sleep reduces the driver's level of vigilance producing dangerous situations and increases the probability of an occurrence of accidents. Driver drowsiness and fatigue are among the important causes of road accidents. Every year, they increase the number of deaths and fatalities injuries globally. In this context, it is important to use new technologies to design and build systems that are able to monitor drivers and to measure their level of attention during the entire process of driving. In this paper, a module for ADAS (Advanced driver assistance System) is presented in order 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 propose an algorithm to locate, track and analyze both the driver face and eyes to measure PER- CLOS (percentage of eye closure).The remainder of this paper is organized as follows, Section 2 presents the related works, Section 3 presents the proposed system and the implementation of each block of the system, the experimental results are shown in section 4 and in the last section conclusions and perspectives are presented.

2. LITERACY SURVEY

Now-a-days, mobile phone is used almost by all people with internet usage are also at all. so these mobile phone also provide communication platform as they are equipped with 2G or 3G network .There are lots of cause of accident of car and they are drunkenness of driver, drowsiness of driver, unconsciousness of driver, and many time what happen driver is not responsible for accident but their (car) neighboring car behavior also have made role to enforce accident. There are also some system have been implemented to avoid accident but that do not give proper solution to implement in car to avoid various accidents that they are normally being happen. For example when driver at speed suppose 80 km/h suddenly stop ignition system may lead to chances of dangerous accident.

One method presents a driver-monitoring systems that contains both drowsiness detection method Drowsiness involves a driver closing his eyes because of fatigue, and. Here an eye-detection algorithm is designed which combines adaptive boosting, adaptive template matching, and blob detection with eye validation.

Other method is a demo which presents a vision-based smart environment using in-car cameras that can be used for real time tracking and monitoring of a driver in order to detect the driver's drowsiness based on yawning detection.

Other proposes a method for monitoring driver safety levels using a data fusion approach based on several discrete data types: eye features, bio-signal variation, in-vehicle temperature, and vehicle speed. The driver safety monitoring system was developed in practice in the form of an application for an Android-based Smartphone device, where measuring safety-related data requires no extra monetary expenditure or equipment.

Block diagram
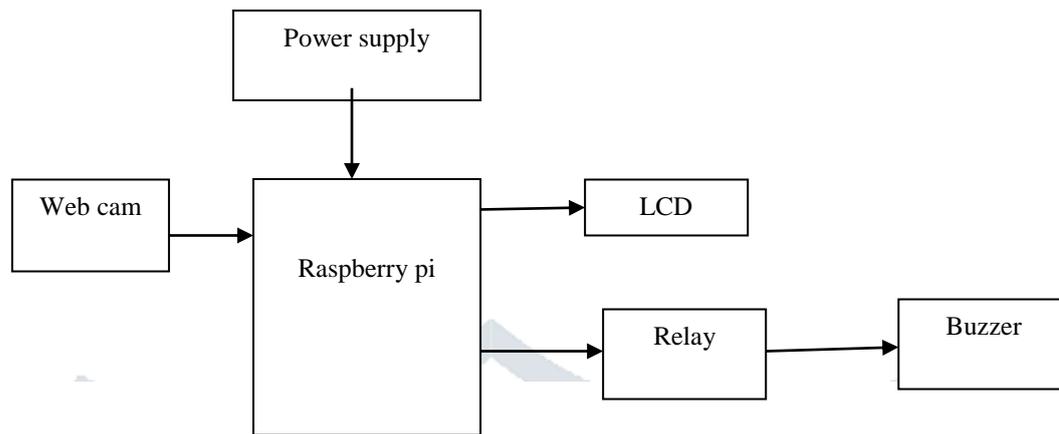
Figure 1: block diagram

Under the light of what has been mentioned above, the identification of the driver drowsy state given by the PERCLOS is generally passed by the following stages:

1) Face detection,
2) Eyes Location,
3) Face and eyes tracking,
4) Identification of the eyes states,
5) **Calculation of PERCLOS and identification of driver state.**

Figure 2 : Flowchart of the proposed system.

3. PROPOSED SYSTEM

In this project we are using raspberry pi and webcam. Web cam will continuously capture the driver's eyes in real time and sends the information to the raspberry pi. Raspberry pi will verify the frames sent from the webcam whether the driver opened or closed his eye. If the driver closes his eyes it will detects the person is drowsy and sends buzzer indication to alert the driver.

3.1 Face Detection

The symmetry is one of the most important facial features. We modeled the symmetry in a digital image by a one-dimensional signal (accumulator vector) with a size equal the width of the image, which gives us the value corresponding to the position of the vertical axis of symmetry of objects in the image. The traditional principle to calculate the signal of symmetry is for each two white pixels which are on the same line we incre- ment the value in the medium between these two pixels in the accumulator vector. (The algorithm is applied on an edge image, we called a white pixel: the pixel with value 1).

We introduce improvements on the calculation algorithm of symmetry into an image to adapt it to the detection of face, by applying a set of rules to provide a better calculation of symmetry of the face. Instead of computing the symmetry between two white pixels in the image, it is calculated between two windows (Z1 and Z2).

For each window Z1, we sweep the window Z2 in the area determined by the parameters S_min, S_max, and H. We increment the signal of symmetry between these two windows if the sum of white pixels is located between two thresholds S1 (maximum) and S2 (mini- mum).

Then we extract the vertical region of the image contours (Region of Interest ROI) corresponding to the maximum index of the obtained signal of symmetry. Next, we take a rectangle with an estimated size of face (Because the camera is fixed and the driver moves in a limited zone so we can estimate the size of the face using the camera focal length after the step of camera calibration) and we scan the ROI by searching the region that contains the maximum energy correspond- ing to the face .
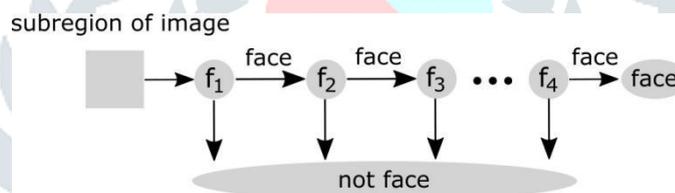

Figure 2. Face (and eye) detection using Viola-Jones method

3.2 Eyes Localization

Since the eyes are always in a defined area in the face (facial anthropometric properties), we limit our research in the area between the forehead and the mouth (Eye Region of Interest 'e ROI') (Figure 3). We benefit from the symmetrical characteristic of the eyes to detect them in the face.

First, we sweep vertically the e ROI by a rectangular mask with an estimated height of height of the eye and a width equal to the width of the face, and we calculate the symmetry.

The eye area corresponds to the position which has a high measurement of symmetry. Then, in this obtained region, we calculate the symmetry again in both left and right sides. The highest value corresponds to the center of the eye.
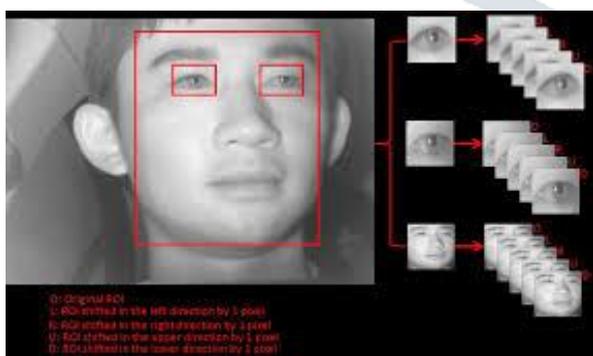

Figure 3– Eyes localization using symmetry.

3.3 Tracking

The tracking is done by Template Matching using the SAD Algorithm (Sum of Absolute Differences).

$$SAD(x, y) = \Sigma\ \Sigma\ |\ I(x + i, y + j) - M(i, j)\ | \qquad (1)$$

$$j=1 \quad i=1$$

We proposed to make a regular update of the refer- ence model M to adjust it every time when light condi- tions changes while driving, by making a tracking test:

$$Tracking \begin{cases} good & if\ SAD \leq Th \\ bad & if\ SAD\ \Sigma\ Th \end{cases} \qquad (2)$$

3.4 Eyes States

The determination of the eye state is to classify the eye into two states: open or closed. We use the Hough transform for circles [10] (HTC) on the image of the eye to detect the iris. For that, we apply the HTC to the edge image of the eye to detect the circles with defined rays, and we take at the end the circle which has the highest value in the accumulator of Hough for all the rays. Then, we apply the logical 'AND' logic between edges image and complete circle obtained by the HTC by measuring the intersection level between them "S".

Finally, the eye state "State eye" is defined by testing the value "S" by a threshold:

$$State_{eye} = \begin{cases} Open & if\ S \leq Th \\ Closed & if\ S \in Th \end{cases} \qquad (3)$$

3.5 Driver State

We determine the driver state by measuring PER- CLOS. If the driver closed his eyes in at least 5 succes- sive frames several times over a period of up to 5 seconds, it is considered drowsy.

4. EXPERIMENTAL RESULTS

To validate our system (Figure 6), we test on sever- al drivers in the car with real driving conditions. We use an IR camera with infrared lighting system operates automatically under the conditions of reduced luminosity and night even in total darkness.

The results of the eye states are illustrated in Ta- ble1, where the percentage error is the number of frames that have a false state of eye divided by the total number of frames multiplied by 10.
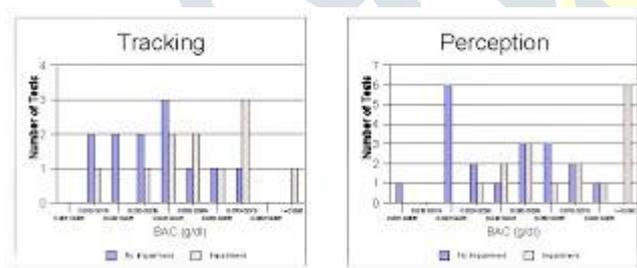
(a)   (b)

Figure 4-Behavioural test result, by behavioural area

TABLE 1 – RESULTS OBTAINED FROM THE SYSTEM.

Driver	frames Number	False Eyes sates		false rate
		Open	Closed	
D1/day	420	17	0	4 %
D2/day	430	15	0	3.5 %
D3/day	245	7	1	3.2 %
D1/night	200	3	1	2 %
D2/night	200	1	0	0.5 %
D3/night	200	6	3	4.5 %

According to the obtained results, our system can determine the eye states with a high rate of correct decision.

5. CONCLUSION ANDPERSPECTIVES

In this paper, we presented system Driver Drowsiness Detection using visual information in vehicles. Exploratory outcomes demonstrate that our proposed strategy can recognize the recreated languid and sluggish states from the typical condition of driving. Hence, our system might be able to effectively monitor bus driver's attention level without extra requirements. This system is able to determine the driver state under real day and night conditions using IR camera. Face and eyes detection are implemented based on symmetry. Hough Transform for Circles is used for the decision of the eyes states. The results are satisfactory with an opportunity for improvement in face detection using other techniques concerning the calculation of symmetry .Moreover, we will implement our algorithm on a DSP (Digital Signal Processor) to create an autonomous system working in real time.

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