

Real Time ‘Driver Drowsiness’ & Monitoring & Detection Techniques



Divyanshu Tyagi, Drishti Sharma, Rishabh Singh, Kaushal Kishor

Abstract: World has seen many of the accidents occur due to driver’s fatigue and a small scale distraction factor while driving the vehicle. Number of accidents has been increasing day-by-day during driving due to driver drowsiness playing as an implicating factor in many accidents. Goal of this thesis is to reduce these accidents and maintenance of transportation safety. The system are design such that it will precisely scrutiny the eye blink. Dissimilarity covering the eye will differ as per eye blink. If out-turn is high the eye is closed or else out-turn is low. It shows close or open area of the eye.

Keywords: Driver drowsiness detection, transportation safety, driver’s fatigue, eye blink

I. INTRODUCTION

Driver drowsiness is one of the major setbacks in growing economies like India, USA, etc. and has stopped outgrown growth of Human resources worldwide. Many of major accidents occur during the night shift when working people are returning to their residential areas after long tiring working day shift being in full of stress mode as per daily hectic routine mode without any day-off.

According to the National Highway Traffic Safety Administration, per annum nearly concerning a 100,000 police-announce crashes include fatigued driving. Those crashes put an end to wholly 1,550 victim and 71,000 wound. The real number feasible higher, however, as it is difficult to put off may or may not a driver was fatigued at the time of a crash. Study though AAA base for Traffic Safety measurable a certain 328,000 fatigued driving crashes occur yearly.

That’s wholly three times the police-reported number. According to analytical studies, about 109,000 of cases related to drowsy driving crashes which cause injury and about 6,400 were the death cases. As per the research prevalence of drowsy driving casualty is about 350% larger than rumoured [1] Driver’s who put off drowse at the wheel lose management of the vehicle, associate action which frequently leads in the hit with neither another vehicle nor stationary object, so as forestall these damaging accidents, the state of drowsiness of the motive force ought to be monitored. [2]

Real Time fatigue behaviours which is related to the exhaustion are design like eyes is closing, head incline and the brain task. We accordingly measure the changes in physical action like sagging posture, tendency of employee’s head and open/closed mode of the eyes.

And observing the drowsiness calculator developed by sleep all capability at Brigham health for the national safety council estimated that an average sized destiny about 500 company with approximately 52000 employee is losing about \$80 million per annum due to frazzled employees.

The development of technologies for police investigation somnolence at the wheel could be a major challenge within the field of accident turning away systems. Endangerment due to the somnolence present on road, strategies got modify for counteracting its affects. Driver basic cognitive process may well be the results of an absence of alertness once driving thanks to driver somnolence. Based on property of video taken from camera that before of driver’s achieve in the real-time operation associate degree arriving of video stream so this is the reason driver’s level of fatigue if the somnolence is Estimates then the output is send to warning the device and alarm is started.

II. RELATED WORK

The term “drowsy” is substitutable with asleep, that merely means that associate degree inclination to sleep off. Level of the sleep will categorized even as wake-up, non-rapid eye movement sleep (NREM), rapid eye movement sleep (REM). Second level, NREM, divided into the subsequent three stages:

- Stage I: Conversion from tuned in to asleep (drowsy)
- Stage II: Doze sleep
- Stage III: Deep sleep

As per the research driver drowsiness is fatigue phase and characteristics of the same are mentioned below: [2]

- Occur late in the dark /night [0:00 am-7:00 am] and throughout evening [2:00 pm-4:00 pm].
- Take place on high-speed roadways.
- Driver is typically solitary.
- Most of the driver are younger of age between 16 to 25 years.
- No drift or sign of braking.

III. SYSTEM OVERVIEW

Following are three driver detection techniques described with their respective overview as follows:

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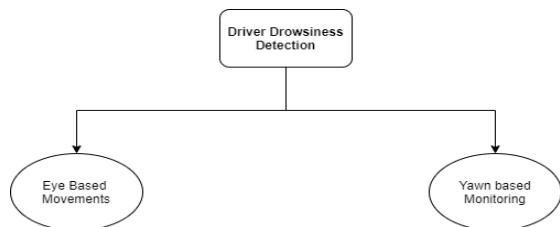
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A. EYE Movements:

The movements of eye along with the movement or shrinkage or expansion of pupil size will be monitored and will be measured as per the following criterion of 'Karolinska Sleepiness Scale'. For the critical situation an alarm will get activated as soon as it measures the shrinkage or wideness in pupil size of human as per the Euclidian's Formula.

Table: Karolinska Sleepiness Scale Description of Driver. [9]

<i>Karolinska Sleepiness Scale (KSS)</i>	<i>Description</i>
1	Extremely Attentive
2	Highly Attentive
3	Attentive
4	Impartially sleep
5	Neither Attentive nor Sleepy
6	Indication of Sleepiness
7	Sleepy, but no effort to keep attentive
8	Sleepy, some effort to keep attentive
9	Very sleepy, great effort to keep attentive

Euclidean space is initially invented by Greek mathematician Euclid throughout 300 B.C.E. to study correlation connecting angles and distances. Structure of geometry is remain applied these days and one that high school students study commonly. Mathematically, this is shown as $|x_1 - x_2|$ where x_1 initial coordinate of initial point and x_2 is initial coordinate of the next or you can say following point. The distance between two points is hypotenuse. Suppose we have pair of points P and Q in two dimensional Euclidean space. We will express P with the coordinates (x_1, y_1) and Q with the coordinates (x_2, y_2) . Now draw a line division with end points of P and Q. This line segment of right triangle will construct the hypotenuse. Increasing the results obtained, we note that lengths of legs of this triangle are specify by $|x_1 - x_2|$ and $|y_1 - y_2|$. Length across two points will be called as length of the hypotenuse. [3]

B. Canny edge detection:

Canny edge detection is a footing observing operator is uses a multi-phase algorithmic rule to cover a large vary of edges with in pictures. It had been establish by John F. Canny in 1986.

Canny conjointly invent machine thesis of edge detection describing why the technique works.

1. Noise depletion.
2. Exploring strength of the Gradient of the Image.
3. Extreme Supression.
4. Hysteresis blink. [12]

IV. FEATURE EXTRACTION

A. Methodology

• Machine learning

Machine learning (ML) is the scientific learning of algorithms and applied in math models that systems use to carry out a specific task whereas not victimization particular directions, counting continuously patterns and logical thinking rather seen as a collection of computing. Machine learning data construct a mathematical model support the selected data, called "training data" and to form projection or alternatives although not being expressly programmed to do the task.

Machine learning data are employed in a good kind of applications, like email filtering and laptop vision, neither it's tough nor unworkable to grow a standard algorithmic program for successfully activity the task.

Machine learning exist thoroughly related to machine statist that focuses on making forecast victimization computers.

Improvement in delivers methods, thesis and application estate to the domain of machine learning will exist given by mathematical theory. Data processing can be a field of study inside machine learning, and focuses on analytic knowledge of analysis by unattended learning. In its application covering business matters, machine learning is additionally mention as prognosticative analytics

Machine learning is that the entirely programming which provides computers the potential to mechanically learn from information while not being explicitly programmed. This implies in alternative words that these programs modification their behavior by learning from information.

Python is clearly one in all the most effective languages for machine learning. Python will contain special libraries for machine learning specifically scipy, pandas and numpy that nice for algebra and about to grasp kernel strategies of machine learning. The language is nice to use once operating with machine learning algorithms and has simple syntax comparatively.

• OpenCV

OpenCV stands for Open supply laptop or computer Vision. It's an Open supply BSD accredited library that features many advanced laptop Vision algorithms that are optimized to use hardware acceleration. OpenCV is often used for machine learning, image process, image manipulation, and far additional. OpenCV includes a standard structure. There area unit shared and static libraries and a CV Namespace.

In short, OpenCV is employed in our application to simply load ikon files that contain landscaping footage and perform a mix operation between 2 footage in order that one image may be seen within the background of another image. This image manipulation is definitely performed in a very few lines of code exploitation OpenCV versus alternative strategies.

OpenCV.org may be a should if you would like to explore and dive deeper into image process and machine learning normally.

a. Physiological Level Approach

This technique is an intrusive method where electrodes are used to obtain pulse rate, heart rate and brain activity information.

ECG is used to compute the variations in heart rate and also detect different conditions for drowsiness. The relationship between different signals such as ECG (electrocardiogram), EEG (electroencephalogram) and EMG (electromyogram) are made and then the output is generated whether the person is drowsy or not.

b. Behavioral based approach:

Through this technology eye blinking frequency, head pose, etc. of someone is monitored through a camera and also the person is alerted if fatigue symptoms are detected.

B. Algorithm

1. Image sequence input to camera.
2. Face detection.
3. Locating eyes.
4. Edge detection method and binary pattern method are used to recognize eye state.
5. If eyes are closed and continues to be closed for predefine threshold, fatigue state is detected.
6. Else normal process.
7. Repeat the process.

C. Fast Eye Movement Detection

Fast eye movement detection based on fast eye blink patterns or movements based on EOG signals. A flicker can be detected into following ways: [4]

a. Detecting potential blinks:

Potential flick's are going to be exposed by setting associate magnitude threshold to think about all summit of $V'(n)$
 $V'(n) > th_{vel}$

Later on, around all accepted summit, three consecutive sign changes area unit probe. The mention point explain start, middle and finish points of a flick's as a, b, c respectively. Constructive to deconstructive transitions of $V'(n)$ area unit outlined by a and c, whereas deconstructive to constructive transitions by b.

b. Blink amplitude definition:

Following sleuthing all potential flicks, the flick amplitude is withdraw. For traditional flicks, the distinction the middle of closing and opening amplitudes, specifically $[B - A]$ and $[B - C]$, is trivial. In order to define flick amplitude, the flick amplitude of I^{th} flick is defined as:
 $Amp_i = \min(B_i - A_i, B_i - C_i)$

D. Recognition of Eye's State

The characteristic feature of the attention is extracted to acknowledge the eye's state. In general, the state of left eye is up to right one at identical time. In this step, two schemes area unit adopted: (1) binary pattern and (2) the Canny's edge detection.

The eye image is regenerate to binary pattern based on the threshold value T. $T = \{\sum X_i^{n_i=1}\}^{1/n}$
(Here n is that the range of elements within the eye region and xi is that the pixel value of the position i in the region. There are n pixels within the eye region. If the element price of Pis

larger than the threshold T, P are going to be set as white, 1. Otherwise P are going to be set as 0.)

$$f(x) = \begin{cases} 1, & grey(x,y) \geq \tau \\ 0, & grey(x,y) < \tau \end{cases}$$

Binary pattern : (a)-(b) open eye and (c)-(d) closed eye

The Canny's edge detection algorithm is documented for its ability to come up with continuous edge. First, the image is smoothed by Gaussian convolution.

$$g(x,y) = l(x,y) * G_\sigma(x,y)$$

$$G_\sigma(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{(x^2+y^2)}{2\sigma^2}}$$

(Where σ could be a scale parameter. Differential filter is used to calculate extent and direction of the edge. Edge information of multiple scale σ used to obtain final edge image.)

E. Distance Calculation:

Distance is a mathematical explanation of however way entity from each other. Further step, we discover distance of the centre from point look at lower eyelid. With the help of Pythagorean Theorem we can calculate distance between two or more points, (X1, Y1) and (X2, Y2) is given as: [3]

$$d = \sqrt{(\Delta x)^2 + (\Delta y)^2} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

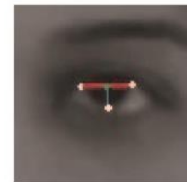


Fig. 11. Line segment that joins mid point to the point at the lower eyelid

F. Eye State Determination:

Ultimately, the choice for the eye state is formed on idea of distance 'd' premeditated within the early step. Either gap is zero or is about to zero, attention situation is classified as "closed" or else the eye state is identified as "open". [3]

V. IMPLEMENTATION

For road safety measurement and to avoid road accident risk government provide few given instruction. Following are:

A. Transportation Policies:

The National Centre on Sleep Disorder Research and NHTSA specialist panels on drivers fatigue endorse three estate for an educational approach campaign:

- Educate young males [16-24] regrading drowsiness and harsh driving and how to lower accidental risks.
- By raising public consciousness regrading drowsy driving risks and harms promoting shoulder rumble strips as an effective measure.
- By giving safety measure to shift workers about drowsy-driving



Fig. 10. (a) Line Segment drawn between two upper corner points. (b) Midpoint between the corner points shown in green.

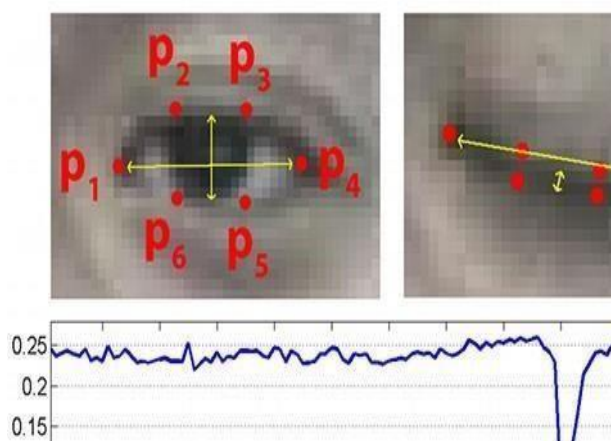


B. Fatigue Detection Techniques:

Also including to transportation strategies, dependable and appropriate drowsy-driving detection system used to help detection drowsiness. Researchers endure developing number of inconsistent drowsiness-detection methods, which can be particular in terms of their specific procedure and make use of detect fatigue and have encapsulate the detection techniques based on:

- Physiological gesture, measuring pulse rate also EEG.
- Physical transform, including transformation of head area eye closure rate also eye lid movements.
- Driver-vehicle detail including steering wheel, throttle/brake capture, and speed.
- Derivative tasks that periodically request responses from drivers.

Fig:- A Visualization of eye marker's when eye is open. Bottom: Planning eye aspect ratio period of time. [8]



VI. RESULT

First, we will arrange a camera that monitors stream for faces and after that if a face is found we will put in facial landmark detection and take out the eye domain.

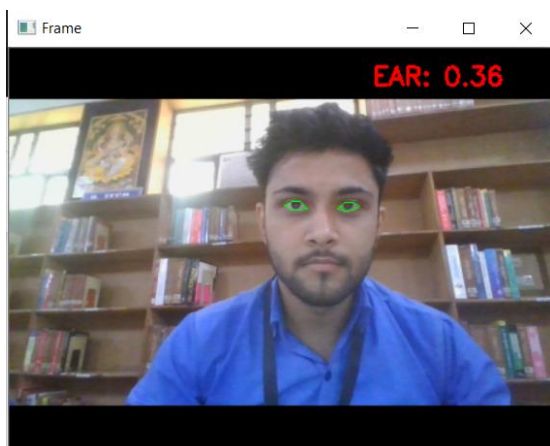


Fig1(a):-Look for faces in the capture video stream and put facial landmark detection to take out the eye domain from face.

Currently we have eye domain we can compute the eye aspect ratio to decide if the eyes are closed. If eye aspect ratio specify that the eyes have been closed for a long amount of time, we will sound an alarm to awake driver.

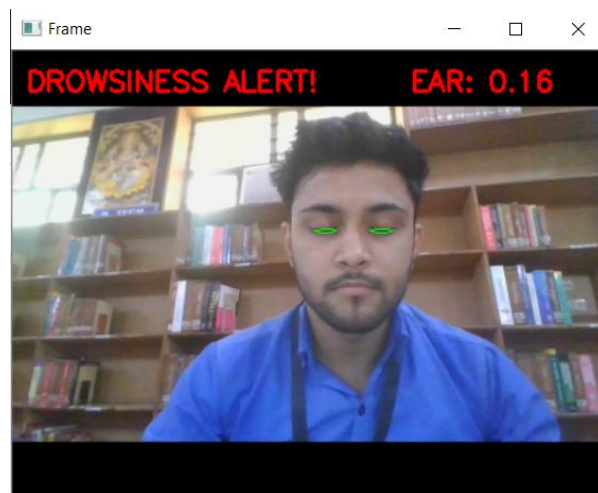


Fig1(b):- Compute the eye aspect ratio to decide if the eyes are close. Sound an alarm if the eyes have been closed for sufficiently long amount of time.

VII. ADVANTAGES

The various advantages of the implemented method or system are mentioned below:

1. Detection of drowsiness.
2. Decreasing road accidents.
3. This method is practically applicable

VIII. APPLICATION

The fatigueness detection system can be indulge in different applications. Specially for big vehicles like buses, trucks etc., because truck drivers have being driving for long hours. These can be run or used for commercial vehicles. Lots of people usually uses public transport facility for travelling. That's why this system is proposed to be used in public vehicles for their safety. Cranes are used to lifted heavy things and transporting them to other places and for those overloaded cranes this system can be used to avoid accidents related to fatigueness of driver's. So for overloaded cranes this system

IX. CONCLUSION

Driver drowsiness is study to discover the driver's fatigue also to design the alert system. Through this paper, we try to communicate the avoidance of accidents due to fatigueness, consider eye blink and arise the comparable system. With the help of advanced ICs and successfully completion of this project is examine with the help of growing technologies like GSM and GPS project has been successfully executed.

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