

Drivers Drowsiness Measurement and the Indication of Eye Movements through Algorithmatic Approach to Avoid Accidents

L. Thomas Robinson, S. Manikandan

Abstract: Numerous accidents are caused by sleepy drivers. To avoid such mishaps, the sluggishness acknowledgment framework is built based on the acknowledgment of eye states. The primary thought behind this exploration is to build up a drivers Safety framework by demonstrating the auspicious cautioning. This framework will screen the driver's eyes utilizing camera and by building up a calculation we can recognize indications of driver fatigue. We propose an algorithm for knowing the drivers drowsiness by checking the width and height of the eye. It helps to indicate the driver's drowsiness by giving an alarm. A new formula has been used to check the measurements of eye and face detection. The number of eye blinking count can be measured to check the driver's drowsiness. The warning will be deactivated manually rather than automatically. Therefore, a deactivation switch will be utilized to deactivate warning.

Index Terms: auspicious cautioning, drowsiness, eye and face detection, sluggishness acknowledgment.

I. INTRODUCTION

Drowsiness is the fundamental origin of car crashes. There are numerous advances for drowsiness detection. They can be separated into three types: Biological indicators, vehicle behavior and face analysis. The main types estimates biological indicators, for example, cerebrum waves, pulse and heartbeat rate. Consequently, they are not down to earth. The next type estimates vehicle behavior, for example, speed, parallel position and turning edge.

These systems might be actualized non-rudely, however they have a few constraints, for example, the vehicle behavior, driver experience and driving conditions. Moreover, it requires exceptional hardware and can be costly. The third type is face analysis. In spite of the fact that it very well may be less exact than natural markers, this compose is non-meddling and effortlessly actualized. It tends to be utilized autonomous of driver experience and vehicle compose. It is both more pragmatic and precise than vehicle conduct investigation.

Distinctive highlights can describe a man's stage of attentiveness during driving, including eyelid development, pupil development and outward appearance. Eye state gives huge info and if such visual conduct can be estimated, at that

point it is doable to anticipate a driver's condition of sleepiness, watchfulness or mindfulness. Numerous frameworks have been projected to distinguish laziness dependent on eye state investigation [1]-[3]. Subsequent to distinguishing face region, eye area is identified. Eye finding is an imperative advance for eye state examination. Numerous chips away at eye identification utilized IR illuminators that may be unsafe for retina or required preparing information and utilized circle Hough change. Hsu et al. [6] decided eye district by building Eye Map. This strategy has great execution for eye area discovery in various luminosity circumstances and has brought down computational intricacy than the Hough change.

After eye discovery, eye state examination is performed in assurance of the eye is open or shut. There are a few techniques which decided open or shut eye dependent on separation between two eyelids. Orazio et al. [5] utilized preparing information for shut eye recognition. The developed strategy depends on brilliance and numeral highlights of the eye picture. The technique can decide open, halfway open and shut eye states with a high precision without utilizing any preparation informational collections. We contrast the strategy and the three past strategies for [4].

II. RELATED WORKS

At long last, we choose about sluggishness and reply warning messages for the lazy state. Eye squinting is one of the essential physiological estimates that have been concentrated to recognize languor. Percentage of eye conclusion after some time (PERCLOS) is the mainly prevalent strategy for estimating eye squinting in light of the fact that high PERCLOS scores are emphatically identified with sleepiness. Accordingly, we utilize PERCLOS parameter for laziness or drowsiness decisions. Segregation of face from picture foundation is required for precise eye recognition. We use a past work to identify confront district. Hsu et al. proposed a face recognition calculation for shading pictures within the sight of changing lighting conditions and in addition complex foundations. Even though our proposed technique focuses on eye detection and drowsiness of the driver, Face recognition and the detection plays a vital role in finding the proposed work. At the point when the eye is open or shut, the change protrusion bend is distinctive vertical way of the eye region. Then again, in open eyes, if the understudy is secured by the upper eyelid, the individual can't see anything. In this manner, examination of the eye state is done in two stages.

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In the primary stage, the closed eye is controlled by methods for the difference projection bends vertical way. In the next stage, the open eye is separated from the semi-open eye by looking at the separation between two eyelids and the iris range. The two periods of the eye state investigation can be clarified as pursues.

Eye developments can be estimated utilizing Electro Oculo Graphy (EOG). EOG is a system for estimating the corneoretinal potential. In any case, much the same as EEG, EOG has a shortcoming in the illogical situation of the gadget and the quantity of cathodes. Eyelid conclusion can be checked correctly and rapidly. Nonetheless, the utilization of the camera has a constraint of brightening; as the ordinary cameras don't function admirably around evening time when checking is more imperative. Likewise, the majority of the camera-based framework requires PCs, picture preparing calculations and highlight extraction procedures to extricate lazy indications [7].

Rather than the camera, the eyelid conclusion can be caught utilizing a versatile and minimal effort gadget dependent on IR sensors that guiding an IR pillar [8]. Be that as it may, solid IR shaft could be unsafe [9]. As an elective sluggishness recognition gadget, this section demonstrates the utilization of a minimal effort Electro-Myo-Graphy (EMG) to screen the eyelid strength, and calculate the length of the eyelid conclusion, at that point sound a notice when the span surpass the utmost.

As detailed by Wylie et al, controlling wheel changeability is identified with the measure of languor in drivers (fluctuation more noteworthy as driver turn out to be more lazy) in the wake of being balanced for street subordinate effects. The procedure which is utilized here depends on the way that human body conducts ebb and flow. Subsequently by utilizing a directing wire on non leading controlling wheel of Vehicle (as appeared in Fig .3) and by utilizing an Analog To Digital Converter (ADC) and associated through a Transistor which go about as a switch and when the driver hold the guiding firmly more momentum courses through base of Transistor as parallel protections made by our fingers include in parallel and accordingly net obstruction declines and base ebb and flow increments. Subsequently this variety is changed over by ADC into some limit and at whatever point yield is not as much as edge it shows Driver Drowsiness or Fatigue state.

III. PROPOSED WORK

Sleepy drivers are a noteworthy causal variable to auto collisions. It is demonstrated in numerous investigations, that there is a connection between drivers who are languid with car crashes. Keeping the driver from languor will have the capacity to lessen the event of mishaps. Languid driving is a noteworthy contributing element to an auto collision. This has been demonstrated by the numerous examinations that found an association between driver sleepiness and car crashes. Keeping the driver from laziness will have the capacity to diminish mischance. Conceivable measures are Electro Encephalo Graphy (EEG), eye developments, eye flicker and eyelid conclusion.

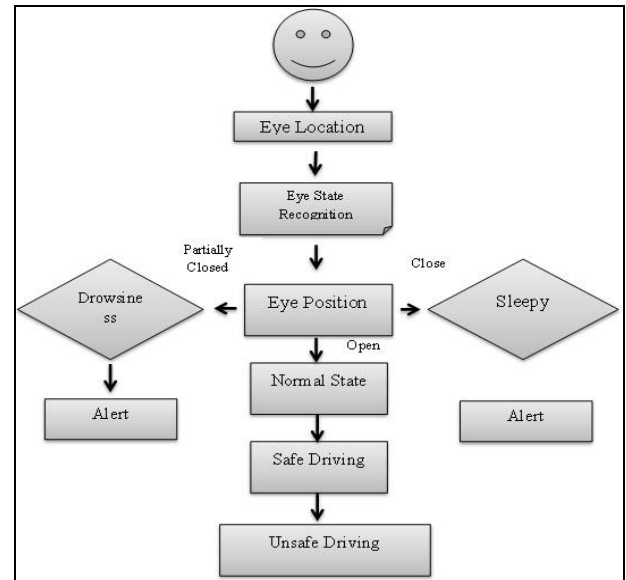


Figure 1 Flowchart of eye state recognition

EEG is an electrophysiological observing strategy to trace electrical movement of the cerebrum. EEG has appeared to be a solid marker of sluggishness. The measure of movement in various recurrence groups can be estimated to recognize the phase of sluggishness. The disservice of utilizing EEG are hard to quantify in field settings because of flag ancient rarity, are not promptly amiable to ongoing sign preparing and are not exceedingly prescient of impeded conduct because of laziness [10].

Further, rather than utilizing EEG, mechanical advancement has empowered more nitty gritty estimation of eyelid developments continuously. Introductory reports recommend that the speed and abundance of eyelid developments give helpful pointers of sleepiness and that the utilization of various eyelid conclusion measurements may enhance the rediction of tiredness [11].

Driver checking frameworks has been examined generally lately, to identify driver laziness and to send to the driver reasonable cautions to maintain a strategic distance from conceivable issues. There are a few methods to driver laziness and weariness identification. Head position location is a technique to distinguish changes in head position tilt [12], or, in other words late to caution the driver since it is the last advance of nodding off.

The other path is to recognize anomalous driver conduct in which the framework initially takes in driver's social qualities and thinks about his typical and ebb and flow response times to give an alarm if there should arise an occurrence of laziness discovery which is driver subordinate and the framework should be prepared [13, 14]. Additionally voice discovery techniques can be utilized to distinguish a conceivable exhausted voice in the auto, however these strategies are confounded. Also driver's biometrics can be identified and followed utilizing diverse sensors in the auto and weakness can be recognized dependent on imperative signs, however these strategies are to some degree meddling and can irritate the driver.

We propose an algorithmic approach to find out the drivers drowsiness. The maximum blinking count of the eye can be a best intimation to find the drowsiness of the driver. The proposed technique and the formula help to identify the width & height of the eye position. The width of the face also calculated to know the exact projection of the head movements. We simulated the driver's drowsiness by showing the status with the help of the diagram. At the time of drowsy driving, automatically the alarm will indicate the driver and to the control room.

Eye detection and the level of drowsiness will be finding out in numerous ways. The face recognition, blinking count of the eyelid, color change of the eye, position of the eye, open eye / closed eye differences, iris positioning and so on. Usually blinking maximum times of eyelid is normal for many persons. So we couldn't judge the maximum blinking of eyelid leads to drowsiness. For that we went through an experiment by checking the drivers' drowsiness by the eyelid count. The maximum count within a minute had been under test for a driver. As a result the drowsy driver has the maximum count of blinking of eyelid.

When the driver under such condition he tries to awake himself by opening his eye in various position. While he tries to open the eye intentionally the count of the eyelid varies according to the situation. In another case the sleepy driver has automatically have the maximum blinking count unknowingly. In both conditions the warning messages or alarm will indicate the driver or the central pool.

The calculated eye positions [mm] were changed to angular eye position θ [deg] by the subsequent condition.

$$\theta = 2 \sin^{-1} \frac{d}{2r}$$

Where d is the differentiation in eye positions [mm] and r is the radius of the average adult eye ball i.e., 11mm. Head movements were calculated as follows.

$$e_{rot}(t) = e_{rot j}(t) + e_{rot k}(t)$$

$e_{rot k}(t)$ is the sign-reversed head pitch rotational velocity.

$$e_{rot j}(t) = \frac{d}{dt} 2 \sin^{-1} \frac{y(t)}{2L}$$

Where $y(t)$ is vertical head displacement and L is the distance between the eye and the obsession position.

Eye Position	Maximum Count	Minimum Count	Status
Open	10	7	Normal
Semi Open	18	8	Drowsy
Closed	0	0	Sleepy

Figure 2 Blinking count for Open, semi-open & Drowsy state

In this way, for a few cases, shutting the eyes isn't straightforwardly identified with drowsiness. It is important to watch the propensity before wearing this instrument. In this way, a difference in example from shutting the eyes all of a sudden and frequently can be an indication that there is languor or drowsiness.

Finding drivers drowsiness by detecting Eye position
Input: (x_e, y_e) are the coordinates of the top left corner of eye.

X_k is the x coordinate of the mouth region

w_g is the width of the face region

Y_k is the x coordinate of the face region

i_j is the height of the face

h_e determines the height of the eye

Output : Width and Height of the Eye //Easily find the initial eye position is in three stages according to our research

Case 1:

If the eye position is open then

$$(x_e, y_e) = (x_k - 0.16 w_g, y_g + 0.16 i_j + 20)$$

then

{

Normal mode //Driver in normal state

}

}

Case 2:

{

If the eye position is closed then

$$(x_e, y_e) = (x_k - 0.14 w_g, y_g + 0.13 i_j + 20)$$

//closed

then

{

Closed mode //Driver in Sleepy mode

}

}

Case 3:

{

If the eye position is Semi Open then

$$(x_e, y_e) = (x_k - 0.15 w_g, y_g + 0.16 i_j + 20)$$

// Semi Open

then

{

Drowsy mode //Driver in drowsy mode

}

}

The width and height of the eye can be defined as

$$W_e = 1.8 X 0.15 X w_g \text{ //Width of Eye}$$

$$h_e = 0.16 i_j \text{ respectively // Height of the eye}$$

End

The shortcoming of this model is that the observing can't keep running progressively, on the grounds that there is dependably a period slack when on the web, (i.e.) when information is sent to the web each moment, the presentation will dependably show a period interim of over 1 minute. The height and the width of the face and eye can be defined by the above algorithm. The values mentioned as a height and width is an approximate value. For the most cases the value resides below the prescribed above values. There will be a slight variation in the width and height. It won't give a major difference.



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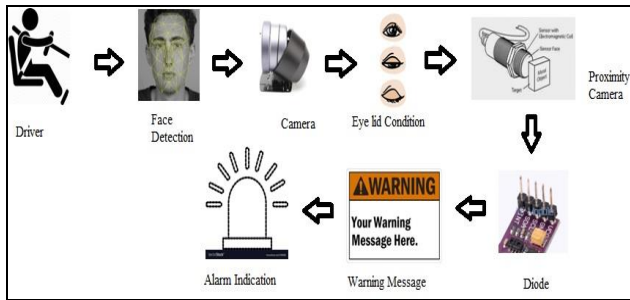


Figure 3 Proposed mechanism

In this mechanism flows the driver driving a car followed by checking the face detection. There are plenty of car cameras in usage. In our research we use a “Cara negra 60 mm universal de 2.5” camera. The camera detects the eye lids count as well as the condition of the eye (mentioned in the proposed technique). The proximity camera helps to convert the signal into messages. It may be a audio or text. If we want text image the detailed will be connected to GPS through net. After checking the eye lids condition the sensor gives a warning message with an alarm. So driver can alert himself in the first stage.

IV. EXPERIMENTS AND RESULTS

The various projection of the eye can be described in the below diagram. The normal mode, Drowsy mode and the sleepy mode can be detected and indicated by the help of sensors & cameras attached in front of the driver. At the time of drowsiness and the change of eye position automatically the alarm indication will be done. It helps to wake up the driver and to indicate the emergency of the driving to the control room. The measurement of the eye can be calculated with the help of above proposed algorithm. The width and height of the eye & face can be measured through the above said formula to avoid the emergency. Thus the driver drowsiness can be found out easily.

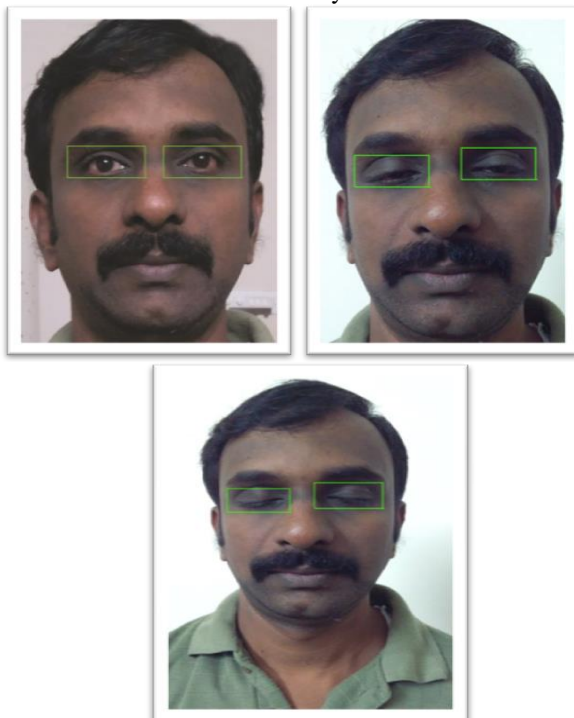


Figure 4 Various projection of Eye (a) Normal mode (b) Drowsy mode (c) Sleepy mode

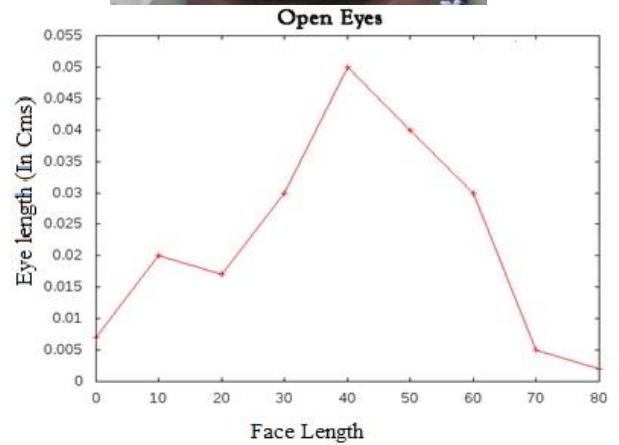
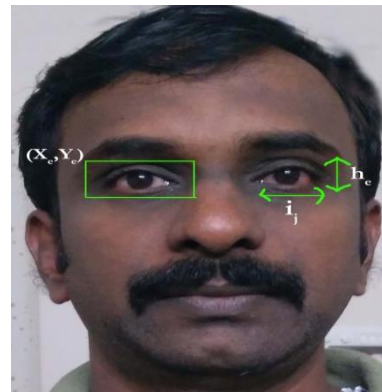


Figure 5 Open eyes or Normal mode and its measured graph

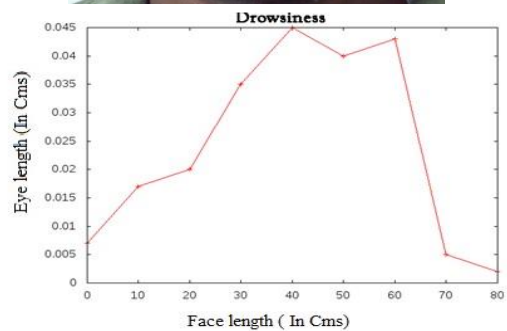


Figure 6 Drowsy eyes or semi-opened and its measured graph



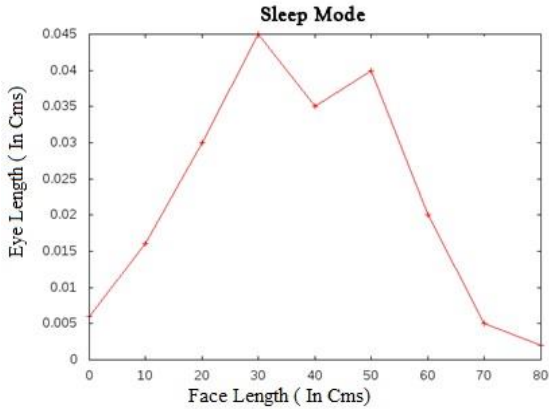
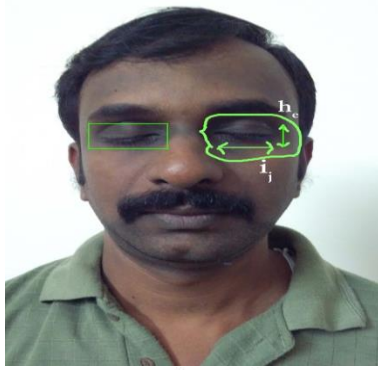


Figure 7 Closed Eyes or Sleepy mode and its measured graph

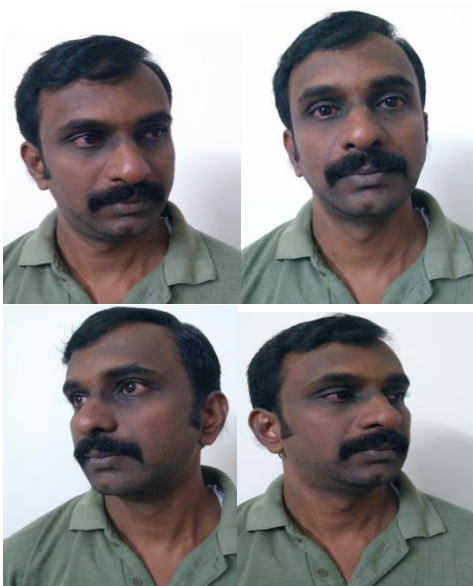


Figure 8 Various head movements and eye position while driving

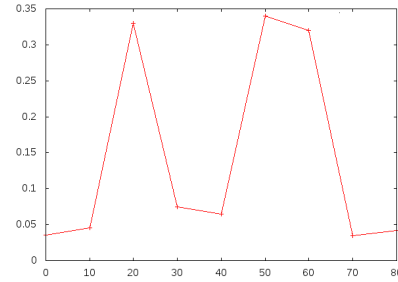
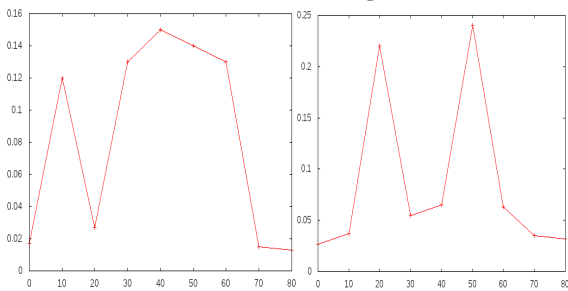


Figure 9 Various Levels of Drowsiness Head movement's simulation (X axis denotes Eye Length in Cms and Y Axis denotes Face Length in Cms)

Figure 10 explains about the driver's status. X axis focus the face length of the person and the Y axis focuses the length of the eye. The figure explains the clear view of the normal state because in normal stage the eye lid will open and the measurement will be above 1.2 cm or 1.3 cm. It indicates the driver is in normal stage and his eye will be open. In the above diagram the eyelid opens upto 1.6 cm of length.

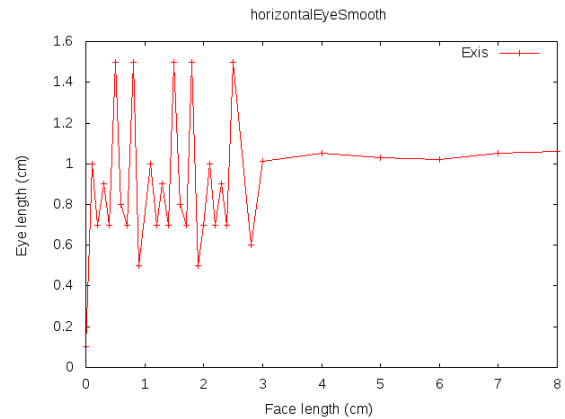


Figure 10 Driver's status in Normal mode

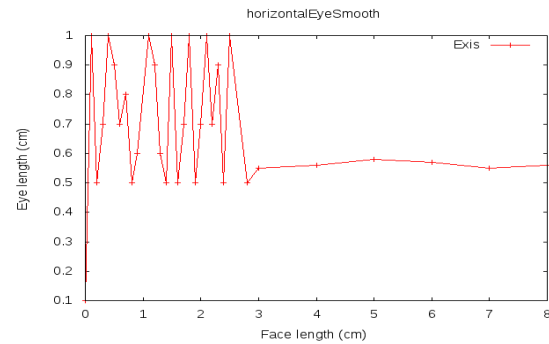


Figure 11 Driver's status in drowsy mode

In figure 11 it clearly defines the semi sleepy driver i.e., drowsy drivers. The eye length varies from the normal condition of the eye. The eye lid will open below 1.2 cm and the minimum of 1 cm, then the driver is in drowsy mood. It may cause accidents and unnecessary problem. We couldn't judge all the drivers in such condition. The possibility of drowsiness level may lead from the above measurements. The above graph clearly defines the drowsiness of the driver. The sharp upper curve represents the normal mode and the variation of the graph (minimum value curve) represents the drowsiness state.



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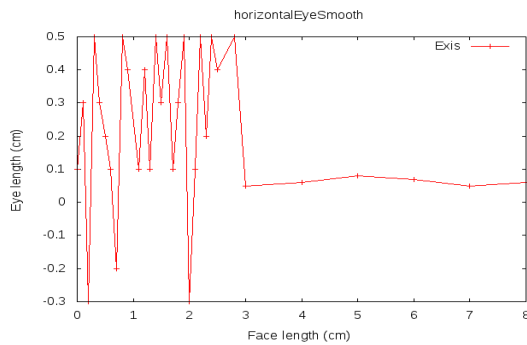


Figure 12 Driver's status in sleepy mode

Figure 12 defines the driver's sleepy status. The eye lid is below 0.5 cm to the negative values then the driver is in sleepy mode. When the eye length of the driver is from 0.5 to the minimum then the driver is not in a normal condition. He is in sleepy mode, so it is very dangerous to drive in his way. Our proposed technique proposes the variation of the drivers condition by projecting their eye length and the eye blinking count.

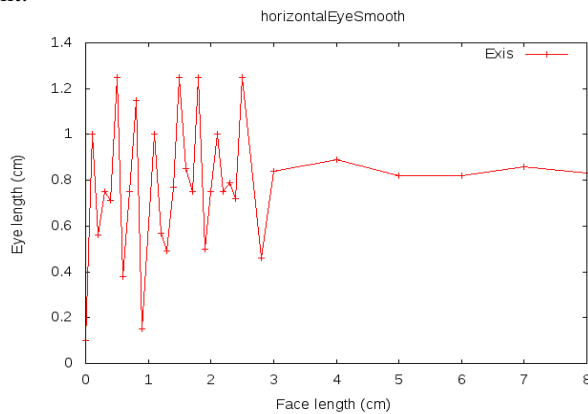


Figure 13 (a) Driver's status in between Normal & Drowsy mode

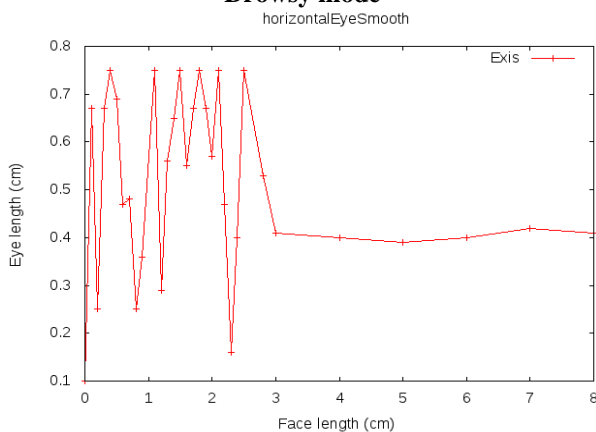


Figure 13 (b) Driver's status in between Drowsy & Sleepy mode

The above figure 13 (a) the graph variations lies between the normal mode to the drowsy condition. The eye length value lies between 1.3 to 1 cm . The figure 13 (b) the graph variations lies between 0.7 cm to 0.5 cm that indicates the condition is between drowsy to sleepy condition. Both the condition is not safe to drive the vehicle.

V. CONCLUSION

The Warning arrangements help to avoid major accidents. The algorithmatic formula's and the table help to get a clear

picture about driver's condition. Automatically the indication will alarm at the time of drivers sluggy mode. Our proposed algorithm helps to get a clear image about the safety and security of the driver.

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