International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

System to Detect Driver Drowsiness

Dhairyav Shah[1], Sidharth Nair[2], Mithil Shetty[3]

[1,2,3]Student, Dept. of Electronics & Telecommunication Engineering, KJSIEIT, Mumbai, India.

---***---

Abstract - *In today's fast-moving world, every other person owns a vehicle which is followed by an increase in the number of road accidents. Drowsiness and fatigue of drivers contribute to a significant number of these accidents. The amount of deaths and injuries due to drowsiness increase every year. In this project, a module for Advanced Assistance to Driver Drowsiness (AADD) is presented to reduce the number of accidents due to driver's exhaustion and hereby strengthening road safety; the proposed system approaches automatic driver drowsiness detection based on Computer Vision and AI (Artificial Intelligence). We propose an algorithm to record, detect and study the driver's face and eyes to compute PERCLOS, a scientifically supported measure of drowsiness associated with eye closure.*

***Key Words*: Advanced Assistance to Driver Drowsiness (AADD), PERCLOS, Eye Region of Interest(eRoi), Eye Aspect Ratio, Haar Cascade Algorithm.**

1. INTRODUCTION

In today's fast moving world, people depend on their means of transport excessively. Feeling drowsy and fatigued during a long drive or after a short night's sleep is common among everyone. This physical feeling of tiredness brings down the level of concentration of the driver. Such conditions are not favoured while driving and result in the increase of accidents. Driver drowsiness and exhaustion are prime contenders in the cause of road accidents.

The cases of car accidents caused by driver drowsiness is increasing at a shocking pace. Recent numbers indicate 10% to 40% of all road accidents are due to drivers feeling exhausted and sleepy. In the trucking industry, about 60% of fatal accidents are caused by driver fatigue. For the reasons stated above, developing systems to continuously monitor the driver's concentration on the road and level of drowsiness and alerting them is important.

Researchers and innovators have been working on producing such systems for the betterment of the human race. From years of research, the best way of predicting such behaviour is from the physical factors like breathing, heart rate, pulse rate, brain waves, etc. Such systems never made it to public use as they required attachment of sensors and electrodes onto the bodies of the drivers, causing frustration. Some representative projects in this line are the MIT-Smart Car, and ASV (Advanced Safety Vehicle) project performed by Toyota, Nissan and Honda. Some other systems proposed included monitoring the movement of pupils and movement of head using specialised helmets and optical lenses.

Such systems were not accepted even after not being disturbing as production costs were challenging. Some indirect methods were also introduced to detect the drowsiness in a driver by reading the maneuvering of the steering wheel, positioning of the wheel axles etc. These systems were also not entertained as they had other difficulties such as the type of vehicle, environmental conditions, driver experience, geometric aspects, state of the road, etc. Contrarily, the time taken to analyse these user behaviours is too much and thereby it doesn't work with the blinking of eyes or micro-sleeps.

In this line we can find an important Spanish project called TCD (Tech CO Driver) and the Mitsubishi advanced safety vehicle system. People with exhaustion or fatigue show some visual behaviours easily notable from changes in their physical features of the face like eyes, movement of the face and head. Computer Vision is free from disturbance and a natural approach to monitor the driver's vigilance.

In this context, it is critical to use new and better technologies to design and build systems that are able to monitor the drivers and to compute their level of concentration during the whole process of driving.

In this project, a module for Advanced Assistance to Driver Drowsiness (AADD) is presented in order to control the number of accidents caused by driver drowsiness and thus improve transport safety. This system will manage to detect the driver drowsiness using machine vision and artificial intelligence automatically.

We present an algorithm to capture, locate and analyse both the driver's face and eyes to measure PERCLOS (percentage of eye closure).

2. PROPOSED MODEL

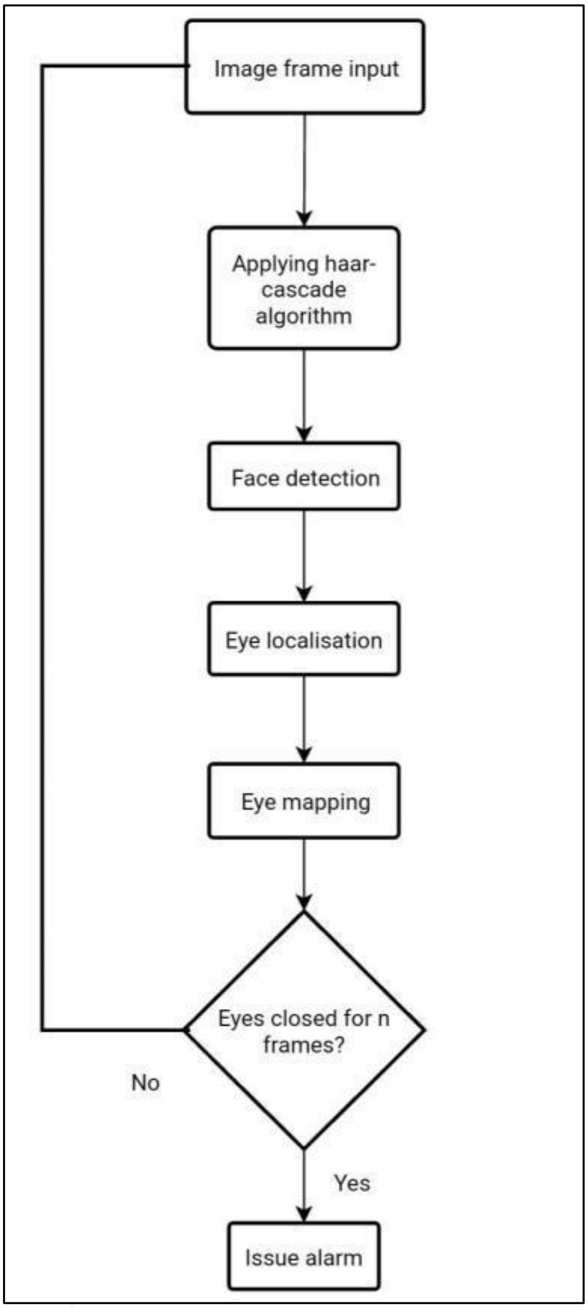

Fig 1: Flowchart representing the proposed model.

The driver's face is continuously recorded using a webcam that is installed above the dashboard. From the live input, each frame is monitored to detect whether the eye is closed for some particular amount of frames.

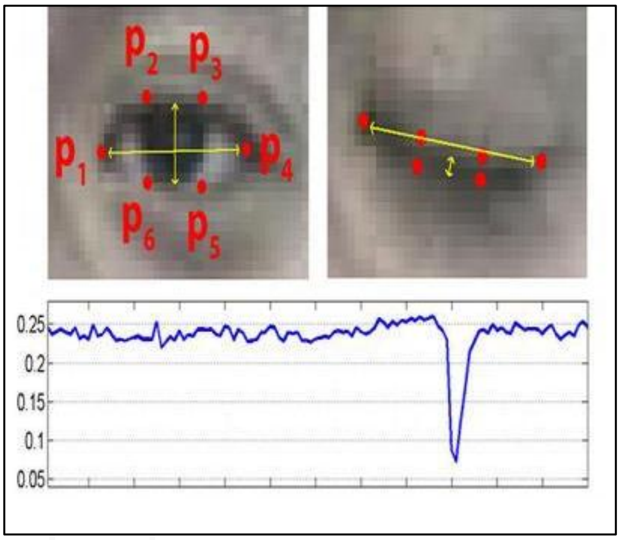

Fig 2: *Top-left:* A visualization of eye landmarks when the eye is open. *Top-right:* Eye landmarks when the eye is closed. *Bottom:* Plotting the eye aspect ratio over time. The dip in the eye aspect ratio indicates a blink

In this section, we elaborate our presented system which detects driver drowsiness.

2.1 Face Detection:

The basic idea or flow of our face detection system is as follows:

First, we set up a camera on the dashboard of our car just behind the steering wheel such that it doesn't hinder the driver's line of sight but at the same time records the whole face of the driver. This camera collects visual information of the driver and his surrounding area. Every frame collected by the camera is resized, converted to grayscale and then used for the actual face detection of the driver.

Facial structure is calculated using the Open CV's haar cascade algorithm along with HOV + Linear SVM algorithm of dlib python library. These libraries are pre-trained libraries and are used as it is by just importing them to our system. For better accuracy we can train such libraries manually for a specific driver. But this will limit the scope of the system only for that specified driver. Therefore, we are using pre-trained libraries as it won't compromise the range of operation of our system and at the same time will maintain optimal efficiency and quality.

Using OpenCV's haar cascades we detect the face that will be used as the bounding box or as the Region of Interest (RoI) for our application. Other parts of the frame besides the RoI are excluded. Eye localisation, mapping points on the localised region and implementing the algorithm is done on the RoI.

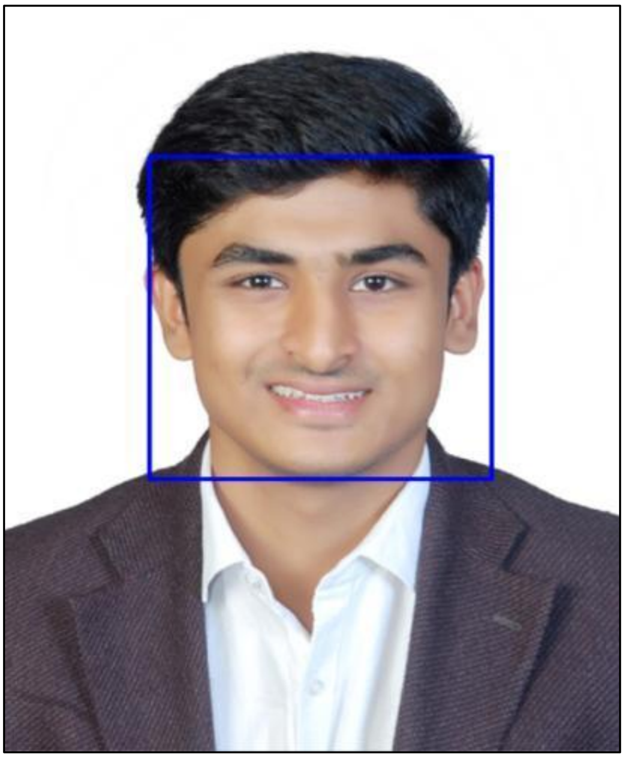

Fig 3: Detecting facial landmark using haar-cascade classifier

2.2 Eyes Localization

After successfully detecting the face of the driver (RoI), we search and map the eye region. For localisation of the eye region we use the iBUG 300-W dataset. As our eyes are always in a defined area in the face (facial anthropometric properties), we limit our search in the bounding box. We call the eye region extracted from RoI as the Eye Region of Interest (eRoI). From the bounding box (RoI) we use facial landmark predictors to mark 68 different coordinates which can be used to localise eyes, nose, mouth and jawline. Using these coordinates (37 to 48) eRoI is found.

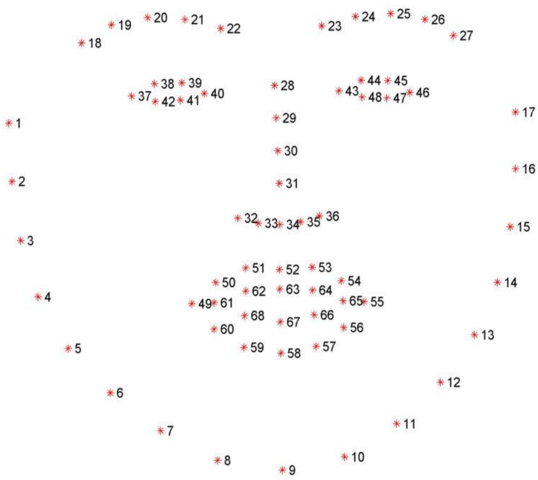

Fig 4: Visualizing the 68 facial landmark coordinates from the iBUG 300-W dataset

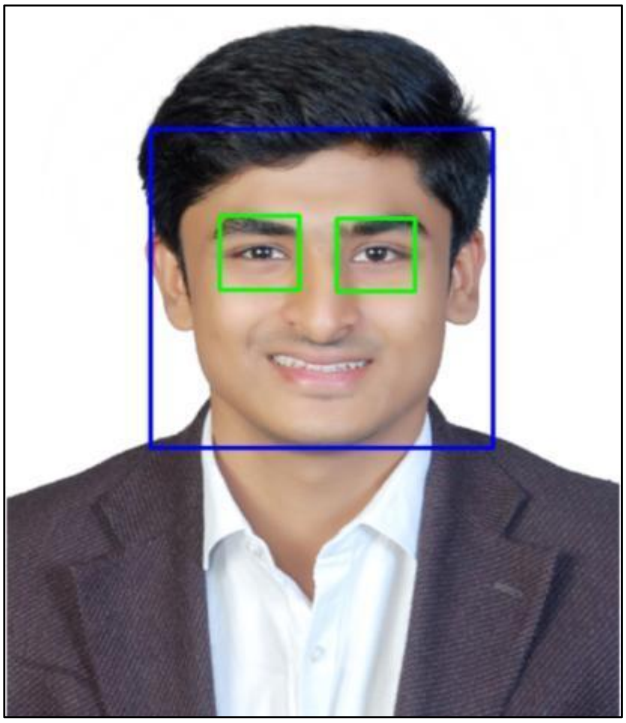

Fig 5: Eye localization using haar-cascade classifier

This can also be done using dlib's default HOG + Linear SVM face detector. While HOG + Linear SVM detectors are significantly more accurate than Haar cascades, the cascade method is much faster than HOG + Linear SVM detection algorithms and to run our driver drowsiness detection algorithm on Raspberry Pi we have to swap out the default dlib face detector and replace it with OpenCV's Haar cascade face detector as it takes less memory.

2.3 Eye mapping

To detect whether the driver is drowsy or not we have to check whether his eyes are open or close for a certain period of time and for that we first have to find the Eye aspect ratio. In the localised eye region (eRoI) we plot six coordinates for each eye. They are marked from point 37 to 48 of facial landmark (figure 3) accordingly
For every video frame, the eye landmarks are detected and the eye aspect ratio (EAR) between height and width of the eye is computed.

$$\mathrm{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}, \qquad (1)$$

Here p1, . . . , p6 are the 2D landmark locations, depicted in Fig.3. The EAR is mostly constant when eyes are open and approaches zero while closing an eye. To some extent it is insensitive to a person's head pose. EAR of the open eye has a very small variance among individuals and it is totally invariant to any type of uniform scaling of the face and in-plane rotation of the image. Since both the eye closes synchronously, the EAR of each eye is calculated and then averaged.

Fig 6: Mapping of PERCLOSE

3. SYSTEM ELEMENTS

3.1 Raspberry pi 3:

The Raspberry Pi is a small credit-card sized computer, it is connected to the computer-monitor or a television and is operated using keyboard and mouse. Raspberry Pi is a little device that allows people of all ages to explore computing, and also help people learn programming in Python and Scratch. It can do everything you expect from a normal desktop computer to do, like browsing the net, preparing spreadsheets, watching HD videos, games and word processing.

3.2 Logitech C920:

It is a full HD 1080p hd camera at an affordable price. Full HD is made possible by H.264, an advanced compression technology.
H.264 eliminates time-consuming compression, so that you get fast, smooth uploads with less demand on your computer.

3.3 Lenovo LT1421 USB monitor:

The 7 Inch Monitor Display Screen module is designed especially for FPV and outdoor operation purposes. The monitor has a very bright image(adjustable) and a very wide power supply range(7-12V). The monitor also has a very important feature for FPV users.
It doesn't have the "blue screen" problem when the signal gets weak.

1. High-Definition Display
2. Supports Composite Video RCA Input
3. Display Resolution up to 1024×600 Pixels
4. 16:9 or 4:3 Adjustable Display Ratio
5. Designed for FPV Application
6. Application to FPV or Wireless Composite Video Camera in making Movies.
7. Full-colour display
8. Low power consumption
9. Anti-glare surface treatment.
10. 3S Li-Po Battery power supply recommended
11. Weak signal with snow spot, signal lost with a blue screen

3.4 The Raspberry Pi Traffic HAT:

The Raspberry Pi has a disadvantage that it doesn't have an inbuilt speaker, hence we cannot play sirens or alarms to give an alert to the driver but Raspberry Pi is highly versatile hardware as it supports a large number of hardware addons. The Traffic HAT Comes as a half soldered, half kit package. The 40-way header, HAT EEPROM Circuit and resistors for the button are pre soldered on the bottom side. You will be required to solder the 3 LEDs, Button and Buzzer.

4. RESULTS

1. The raspberry pi initializes the program, camera and the sound module. From the captured video frames eye aspect ratio is calculated.

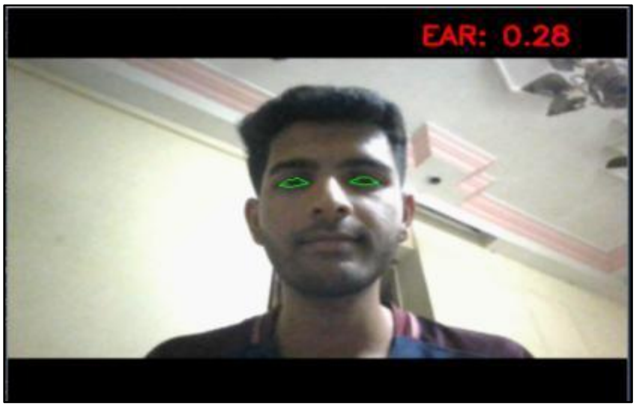

Fig 7: Result part 1

2. The eye aspect ratio is continuously monitored to check whether it falls below the threshold for a certain amount of time.

Fig 8: Result part 2

3. Whenever the driver/user feels drowsy and closes his eyes above the maximum threshold limit the alarm goes off to alert the driver/user.

5. CONCLUSION

1. In this paper, we have presented the concept and implemented a system to detect driver drowsiness using computer vision which focuses to notify the driver if he is drowsy.
2. The proposed system has the capability to detect the real time state of the driver in day and night conditions with the help of a camera. The detection of the Face and Eyes applied based on the symmetry.
3. We have developed a non-intrusive prototype of a computer vision-based system for real-time monitoring of the driver's drowsiness. It is a hardware-based system; for real time acquisition of driver's images using raspberry pi, and its software implementation for real time eye tracking, and facial landmark estimation.

6. FUTURE SCOPE

For future work, the objective will be to reduce the percentage error, that is, reduce the amount of false alarms. To achieve this, development of additional entities or experiments will be done, using better drivers and incorporating new analysis modules, for example, facial expressions(yawns).

Also, in the future we have the intention to test the system with more users, in order to generalize drowsiness behaviours, and to improve it for users with eyeglasses.

REFERENCES

[1] L. M. Bergasa, J. Nuevo, M. A. Sotelo, and M. Vazquez. Real-time system for monitoring driver vigilance. In IEEE Intelligent Vehicles Symposium, 2004.

[2] M. Chau and M. Betke. Real time eye tracking and blink detection with USB cameras. Technical Report 2005-12, Boston University Computer Science, May 2005.

[3] T. Danisman, I. Bilasco, C. Djeraba, and N. Ihaddadene. Drowsy driver detection system using eye blink patterns. In Machine and Web Intelligence (ICMWI), Oct 2010.

[4] H. Dinh, E. Jovanov, and R. Adhami. Eye blink detection using intensity vertical projection. In International Multi-Conference on Engineering and Technological Innovation, IMETI 2012.

[5] J. Cech, V. Franc, and J. Matas. A 3D approach to facial landmarks: Detection, refinement, and tracking. In Proc. International Conference on Pattern Recognition, 2014.

[6] A. Asthana, S. Zafeoriou, S. Cheng, and M. Pantic. Incremental face alignment in the wild. In Conference on Computer Vision and Pattern Recognition, 2014.

[7] Tereza Soukupova and Jan ´ Cech ˇ Center for Machine Perception, Department of Cybernetics. Real-Time Eye Blink Detection using Facial Landmarks. Rimske Toplice, Slovenia, February 3–5, 2016.