

Various Methods for Driver Drowsiness Detection : An Overview

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Abstract— This paper presents survey and review of research and development in the field of drowsiness detection which occurs due to unsteady state of drivers. Road accidents are a major cause of death nowadays. The death ratio has increased due to the road mishaps. Sometimes driver’s inattentiveness while driving vehicle may lead to a major loss of life. Drowsiness detection of drivers is a secure and safety technology which helps prevent accidents in a car. Research is going on massively in this field in order to lessen the accidents. This paper presents a comprehensive review of various methods/technologies that have been developed and used over the last few years for the detection and classification of drowsy state and mainly concentrate on following methods and their implementation for drowsiness detection such as, Steering pattern monitoring, Vehicle position in lane monitoring, Driver eye/face monitoring, Physiological measurement: EEG, EOG and ECG, Optical Detection, Yawning based Detection, Eye open-closer and Eye Blinking based technique and Head Position Detection.

Keywords - Driver Drowsiness detection; Blink pattern; Face Detection; EOG; ECG; EEG; LBP; SVM; ASM; HMM; ICA; PCA.

I. INTRODUCTION

Tiredness non specific importance is Sleepiness. It is a circumstance amongst rest and half rest. The significant purposes for driver's lazy state are late night driving, nonstop driving and over tiredness. One reason for street accidents is a tired state. As of late, the demise proportion has expanded immensely because of street mishaps. [1] The World Health Organization (WHO) reported that 1.3 million individuals passed on and 50 million individuals were harmed in street car accidents every year [1]. The street mischances are created because of fast, drink - drive, sleepy state, mechanical part disappointment, awful street conditions and so on. [2] The National Highway Traffic Safety Administration of the United States of America (USA), reports says that beginning from 2005 the police reported around 1,00,000 crashes for each year which were brought about by driver tiredness. This, indeed, brought about around 1550 passings, 71000 wounds, and \$12.5 billion budgetary misfortune. The drivers who more often than not have to work extra minutes, the danger of being lazy altogether increments. In this manner, a driver sluggishness identification framework is wanted for enhancing the wellbeing of the general population on streets [2]. In past, to beat these issues of unmindful driving by drivers different canny methods/innovations including artificial-neural-network (ANN), fuzzy-based methods, neuro-fuzzy approach, and support vector machine (SVMs) based approach were produced and connected for sleepiness identification framework.

This paper addresses different methods created as of late for driver laziness discovery.



Figure 1. Block Diagram of Drowsiness Detecting system [3]

II. FACTORS CAUSING DROWSINESS TO DRIVERS

Laziness identification is a hotly debated issue in research field these days. Individuals lost their lives through street mischance. Languor is brought about significantly rest, persistent working hours, physical tiredness and so on. In this time life of individual has turned out to be excessively occupied. One has no time for himself. Because of such strict timings and furious timetables individuals are not ready to take least hours rest and consequently for the duration of the day they feel tired. Individuals regularly remain alert by having tea or espresso to finish work

in endorsed due date. Thus, such tumultuous timetables are in charge of one's absence of rest lastly the individual nods off. The human body and cerebrum is prepared in a manner that it needs least 6 - 7 hours of rest. In the event that one doesn't rest for least hours, it will at long last influence the body. One ought to have a sound rest between midnights. In the event that this time is reached out for more couple of hours then it will prompt to body slamming. Another essential calculate to be taken thought is one's physical condition. At the point when individuals are taking meds then it is likely that they feel sluggish. Also, being candidly pushed will bring about the body to get exhausted faster [3].

III. RELATED STUDY

Drowsiness detection can be categorized into three main aspects such as: - (1) Vehicle based (2) Behavioral based (3) Physiological based [3]. Drowsiness detection is based on the above mentioned categories. A detailed review on the above mentioned categories will provide insight on the present systems, its related issues with them and the enhancements that need to be done to make a robust system [3].

A. Vehicle based

This category is based on different mechanical parts of the vehicle such as steering wheel movement, deviation from the lane position, speed of the vehicle etc. All these mechanical parts are observed continuously and if these parts cross a specified threshold value then it is predicted that the driver is in drowsy state [3].



Figure 2. Vehicle based Drowsiness Detection Category

B. Behavioral based

This category is based on different behaviors of head such as head pose changing, eye closure or blinking, yawning, etc. All these behaviors are constantly observed and monitored through a camera. The driver is alerted if any of these symptoms are detected [3].

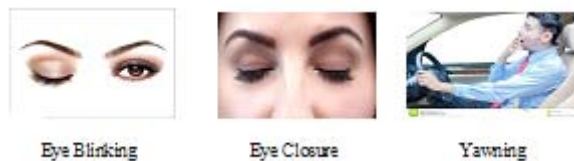


Figure 3. Behavioral based Drowsiness Detection Category

C. Physiological based

This category is based on physiological signals like ECG (Electrocardiogram) and EOG (Electrooculogram). Driver drowsiness detection can be done through pulse rate, heart beat and brain information [3].



Figure 4. Physiological based Drowsiness Detection Category

IV. DRIVER DROWSINESS DETECTION METHODS : LITERATURE SURVEY

The most commonly used techniques which try to detect driver drowsiness are as below:

A. Steering pattern monitoring

Measured utilizing controlling point sensor and it is a generally utilized vehicle-based measure for identifying the level of driver languor. Utilizing a point sensor mounted on the controlling segment, the driver's controlling conduct is measured. At the point when languid, the quantity of miniaturized scale revisions on the directing wheel lessens contrasted with ordinary driving. To dispose of the impact of path changes, the scientists considered as it were little guiding wheel developments, which are expected to change the parallel position inside the path. All in all, guiding conduct is impacted by attributes of the driving assignment (e.g. speed, ebb and flow, and path width), driver characteristics (e.g. driving background), and driver states (e.g. remissness, diversion or exhaustion). Drivers are continually judging the circumstance ahead and applying little, smooth, guiding changes in accordance with right for little street knocks and crosswinds by turning the controlling wheel in little increases.

B. Vehicle position in lane monitoring

In this monitoring of lane keeping behavior is of prime importance. Vehicle position should be in proper lane else with multipurpose camera (MPC) the deviation of vehicle in lane can be tracked at real time [4].

C. Driver eye/face monitoring

Driver confront observing framework is a constant framework that can identify driver exhaustion and diversion utilizing machine vision approaches. In this another approach is presented for driver hypo watchfulness (exhaustion and diversion) discovery in view of the side effects identified with face and eye areas. In this technique, confront format coordinating and level projection of top-half portion of face picture is utilized to concentrate hypo watchfulness side effects from face and eye, separately. Head revolution is an indication to distinguish diversion that is separated from face area. The extricated manifestations from eye locale are rate of eye conclusion, eyelid separate changes concerning the ordinary eyelid separation, and eye conclusion rate. The first and second manifestations identified with eye district are utilized for weariness discovery; the last one is utilized for diversion recognition. The driver confront checking framework is a constant framework that examines the driver physical and mental condition in light of the preparing of driver face pictures. The driver state can be evaluated from the eye conclusion, eyelid remove, flickering, look course, yawning, and head turn. This framework will caution in the hypo vigilance states including exhaustion and diversion. The real parts of the driver confront checking framework are imaging, equipment stage, and the smart programming [5].

D. Physiological measurement: EEG, EOG and ECG

Physiological techniques offer a target, exact approach to quantify drowsiness. They are based upon the way that physiological signs begin to change in the prior phases of laziness, which could permit the potential driver sluggishness recognition framework a tad bit of additional opportunity to caution a lazy driver in an auspicious way and thereby anticipate numerous street mishaps. Few of the strategies used to quantify physiological parameters are as per the following:

ECG (Electrocardiogram): It recognizes electrical action of human heart.

EEG (Electroencephalogram): It records electrical movement of human mind.

EOG (Electrooculogram): It records the electrical potential distinction between the cornea and retina of human eye.

The physiological signs (i.e., heart rate, heart rate variety, breathing and eye blinking) will be used to recognize the onset of driver weariness, pivotal for opportune applying sleepiness counter measures. Exhaustion driving is a standout amongst the most critical elements bringing about car crashes. Facility investigate has discovered physiological signs are great pointers of languor. A routine bio electrical flag estimation framework requires the anodes to be in contact with human body. This meddles with the typical driver operation, as well as is not doable for long haul observing reason. With fragile sensor hardware plan, the bioelectrical signals connected with electrocardiography (ECG), breathing and eye blinking can be measured. The present sensor can recognize the Electrocardiography (ECG) signals with a successful separation of up to 30 cm far from the body. It likewise gives delicate estimation of physiological flags, for example, heart rate, breathing, and eye blinking and so on. The sensor execution was approved on a high constancy driving test system. Computerized flag handling calculations has been produced to obliterate the flag clamor and robotize flag investigations. The attributes of physiological signs demonstrative of driver exhaustion, i.e., the heart rate (HR), heart rate variability (HRV), breath frequency and eye blinking frequency, can be resolved. A hearty sluggishness pointer is being created by coupling the different physiological parameters to accomplish high dependability in sleepiness recognition. [5]. Electroencephalogram (EEG) technique for mental fatigue, which is a critical premise in the evaluation of changes in the focal sensory systems [11-13], has been broadly investigated. For instance, Murata and Takasawa [14] used the sufficiency of event-related potential P300 and the length of inactivity for the investigation of mental fatigue, they found that as the levels of mental fatigue expanded, the hatching time frame augmented and the abundance diminished. Jung and others [15] broke down the level of mindfulness utilizing EEG power spectral, and discovered EEG power range mirrored the vacillations in the condition of the cerebrum sharpness. Another technique is proposed to decide the level of fatigue. To start with, the EEG signs were pre-handled, and Fast Fourier Transform (FFT) was utilized for power range examination. At that point, relative vitality estimations of δ -wave, θ -wave, α -wave and β -wave were gotten which are the four fundamental rhythms. At last, the fatigue index F, which was presented as a pointer of the fatigue degree, was figured. The trial comes about demonstrate that the technique can decide the degree of fatigue better [7].

E. Optical Detection

The most widely recognized usage of an optical sensor framework utilizes infrared or close infrared LEDs to light the driver's understudies, which are then observed by a camera framework. PC calculations dissect squint rate and span to decide languor. The camera framework may likewise screen facial elements and set out position

toward indications of sleepiness, for example, yawning and sudden head gestures. Portrays the utilization of an optical identification framework [6].

F. Yawning based Detection

Yawning discovery is performed in two fundamental strides: in the initial step we recognize the yawn segment in the face free of the mouth area. This segment is fundamentally the gap in the mouth as the consequences of wide mouth opening. In the second step we will utilize mouth area to check the legitimacy of the recognized part. After skin division, the biggest gap situated inside the face is chosen as the contender for a yawning mouth. This gap is really identified with a non-skin zone inside the face that can be identified with eyes, mouth or open mouth. It can be accepted that the open mouth will be the biggest of the three in a yawning state. Along these lines a contender for yawning mouth is found. We will then utilize the data from the identified mouth to check the identified yawning mouth. The verification criteria are the quantity of pixels situated in the yawning mouth as for the quantity of mouth pixels and additionally the relative area of the open mouth as for the lips [8].

G. Eye open-closer and Eye Blinking based technique

Eye open-closer – In this method, Firstly, the eye-territory is separated from the pictures which are taken from a video arrangement and afterward sent to the PC. Furthermore, the component amount is computed utilizing HLAC. The measurements of HLAC highlight are then lessened utilizing PCA. At long last, the eye is open or shut is distinguished utilizing SVM [9].

Eye Blinking – In this technique eye blinking frequency is calculated. An input is fed into the Drowsy Driver Detection System from a colour video camera which is attached in front of the driver and then input is processed. The eye of driver is constantly checked by detector system which is composed of a video camera and software to detect the eye blink duration. First, the face is detected using the Viola Jones face detector which is available in the OpenCV library. Then, the neural network-based eye detector was used which is available in the STASM library to locate the positions of the pupils. A variation of the Active Shape Model of Coote's implementation is STASM. The Rowley's eye detection code was derived for real-time speed constraints from the STASM library which is a group of neural networks that provides eye positions. After the eye detection, the estimation of face orientation was done using the vertical positions of both eyes. If both the eyes are not in the same position, then the angle between these two pupil points was computed. Thereafter, orientation of the face was corrected by rotating the whole frame in the opposite direction. Here, the origin of the rotation is the face centre. Thus the elimination of left and right rolling effect of the face up to ± 25 degree was done. Finally, a rectangular area from the pupil area of the eye was extracted [10].

H. Head Position Detection

Head Position Detection is another technique presently utilized. In this innovation the head tilt edge is resolved first and if the head edge goes past a recommended edge, a caution is transmitted to the driver.

V. CONCLUSION

As portrayed all through the paper, numerous advancements exist to identify driver exhaustion. This paper tries to take a gander at the developing advances and decide the best methodologies in attempting to keep the main source of lethal vehicle crashes. At present, the main offering item in the market is the market is just a reed change to recognize head point tilt. This item is to a great degree constrained and not exceptionally compelling. The item made by BMW and incorporated into their top of the line autos to recognize driver exhaustion conduct is somewhat more compelling is discovery yet need appropriate notice to caution a driver. The present market and innovations is in its early stages mode. New innovations keep developing utilizing distinctive procedures.

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