Fundamental Concepts of Driver Drowsiness Detection

Kusuma Kumari B. M, Ramakanth Kumar .P

Abstract: *Drowsiness appears in situations when one feels stressed and fatigue. It is unexpected and unfortunate, that the drowsiness may be due to insufficient sleep over night, some types of medicines used, and even, boring for drive, for example, driving continuously over a period of time. Feeling sleepy while driving may decrease the level of alertness / focus resulting in possibility of road crash or accidents. In this paper we will discussed about characteristics of driver, causes and symptoms of driver drowsiness and effects of fatigue driver.*

Keywords: fatigueness, causes and symptoms, characteristics, effects

I. INTRODUCTION

The system used to detect the driver's fatigueness may be one of the significant factors to support protection of the driver's from drowsiness while driving. Driver falling asleep during driving can be detected in drowsy driver detection system. This mechanism of detecting the sleepiness of the driver shall be a warning bell to the driver.

The mechanism for assisting the driver has been an effort to thwart the accidents due to drowsiness of driver. In a long drive, the driver may lose his focus and concentration, due to which there is a possibility that he may be more prone to risk for accident. This mechanism helps to bring the attention of a driver by alerting him by a way of an alarm.

There are different reasons for road accidents, in that the negligence and lack of sense of responsibility of the driver plays an important role. A few reasons for road mishaps are drunken driving, over speeding, talking over mobile phone, poor road conditions, distracted driving, teenage drivers, rain, wrong way driving, improper turns, night driving , driving under the influence of drugs, snow, fog, driving in scorching conditions, driving under very cold conditions, windy conditions (Toofan, Aandhi), improper and unscientific

humps and bumpers, missing sign boards, narrow roads, missing of blinkers and marks, **DROWSY DRIVING** and so on.

Drowsiness appears in situations when one feels stressed and fatigue. It is unexpected and unfortunate, that the drowsiness may be due to insufficient sleep over night, some types of medicines used, and even, boring for drive, for example, driving continuously over a period of time. Feeling sleepy while driving may decrease the level of alertness / focus resulting in possibility of road crash or accidents.

The mechanism for assisting the driver has been an effort to thwart the accidents due to drowsiness of driver. In a long drive, the driver may lose his focus and concentration, due to which there is a possibility that he may be more prone to risk for accident. This mechanism helps to bring the attention of a driver by alerting him by a way of an alarm.

The main challenge in today's technology is to quickly detect the driver's drowsiness; otherwise there is always a threat for dangerous road accident. Therefore a counteractive approach becomes essential to establish a new mechanism to deal with such untoward accident and its effects aftermath.

The purpose of this research is to develop a pattern for sleepiness recognition system which helps to prevent road accidents on large scale.

II. LITERATURE REVIEW

Real time approach investigated by Arote, Chetna Bharti [1] to detect the driver's fatigueness using head movement and eye blinking of the driver. This prototype automatically controls the vehicle speed if driver drowsiness is detected. It is a safety real time online prototype to prevent driver's fatigueless.

The one of the proposed system used ARM-7 microcontroller to prevent the road accidents [2]. The undesirable conditions of the driver because of fatigueness are notified and make the vehicle more intelligent and interactive by using ARM-7 Microcontroller. The system considers driver's fatigueness, yawning of driver as detection. The system that is designed to monitor the driver's vigilance level is plays a role in that situation to prevent the road accidents.

The technologies with online and in-vehicle category systems, finds the fatigueness of driver during actual driving the vehicle. Categorically some bio behavioural dimensions such as face, eyes, heart, head reaction time, etc., are used and details are recorded. These technologies are classified in to three categories.

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In the first method Electro Encephalo Graph (EEG) measures are used and offline drowsiness monitoring equipment is developed. Another one is "mind switch" an online version used as headband device used to find the brain waves of the driver which is attached to driver's head with electrodes.

In the second method, visual measures are used to monitor the driver's fatigueness through online with greatest appropriate way. Different measures like eye blinking, pupil response, eyes closure and eye movements are used to develop the driver's fatigueness as visual based measures.

Further, the third method is based on the behavioural measures and driver's facial expressions or facial muscles, head nodding and body postures are used as an important components to detect the driver's fatigueness.

Contextual information with visual clues like eye and head motion is used in the proposed probabilistic model. This system uses CCD cameras with infrared illuminators to actively monitor the driver while driving.

Now a day's many researchers have developed driver assistive system to detect the driver fatigueness. A wide range of techniques are used and mainly concentrated on driver fatigueness to find the driver inattention. In the field of medicine and psychology sleep is one of the main components for the researchers, and this component is used to accurately measure the drowsiness of the driver [3].

The system using Electro Encephalo Grams (EEG) [4] measures the behaviour of signals in the brain to place the gadgets of electrodes on the head. A tiny signal processed in the cortex of the brain is detected by electrodes. The various waves such as gamma waves, beta waves, theta and delta waves are the potential forms of wave with several frequencies, they are related to many mental and motor processes, containing fatigueness and the various sleep stages.

Electro Encephalo Grams (EEG) and Electro Oculo Graphy (EOG) find the eyes movements and to monitors muscular tone Electro Myo Gram (EMG) is used. These combinations are used by several drowsy driver detection systems combining with breathing rate and heart rate. There are several problems using these techniques which irritate the driver because the gadgets like electrodes, sensors and etc which are fasten on the head, chest & face. Recent researches introduced remote gadgets placed away from the driver to record his behaviour which as not produce desirable result.

Nevertheless, Electro Encephalo Gram is used for physiological measurement in some projects [5], and it is frequently used for testing the less invasive methods. By using contact less sensors and indirect measurements are used to check the driver's state of attention.

Certain commercial systems are commonly used, the basic model of the vehicle like steering wheel movement of the vehicle and line crossing timings. Which concentrate only on vehicle behavior and not the driver's conditions while he is driving.

In 2008 the Volvo car company introduces the DACS (Driver Alert Control System) i.e., Volvo Car Corp 08. This facility is available only at the higher end models. Camera is used in this system with different sensors to notice the locomotion of the vehicle on the road. Based on this driver drowsiness is detected. ATTENTION ASSIST i.e. (DaimerAG 09)

introduced by Mercedes Benz is to detect the driver drowsiness for its newest E-Class vehicles.

Detecting driver's physiological characteristics by operations & viewing the driver movement as a response at all movement. The vehicle atmosphere in and out varies to estimate the drowsiness of a driver approach using HRV by the steering wheel road grip [6].

To detect the driver drowsiness, Electro Encephalo Graphic (EEG) signals are used to measure the physiological sleepiness. EEG has been used to find the existence of drowsiness [7] [8].

The system used HARR algorithm to find the driver's fatigueness by detecting objects and use face classifier implementation using OpenCV libraries then they detect eye closure level to detect the eyelid [9][10] [11].

Day by day the technology is getting advanced and hence the number of vehicles and manufacturers are more. This has created in heavy traffics on road where the roads are not widen which may lead to more number of accidents. One of the reasons for accidents is lack of attention of driver while driving. To avoid accidents due to drowsiness, the system proposes Drowsy eye detection system using the Harr-like features cascading Adaboost as classifier. Eyes region are find out using ASM (Active Shape Models) search algorithm [12].

Android application is used to find the driver sleepiness based on deep learning method. This heavy baseline model to a lightweight model with compression is the main contribution for this work and the accuracy level is above 80 percent [13]. The system detects Driver Fatigueness with modified features to run on smartphones. The system uses Android SDK software and mobile camera. The video of the driver for processing the driver's eye is recorded and online video is also used to find drowsiness of a driver [14].

III. BACKGROUND AND CONTEXT

For safe driving driver attention is a fundamental psychological process. Drivers must focus and keep their attention on the surrounding stimuli all the times. When drivers shift their attention for a moment may cause dangerous risks on road and putting at risk their own safety and that of other road users.

A. Definition of Drowsiness

The term "drowsy" states that the impaired awareness is associated with an inclination for sleep, which simply means feeling to fall asleep. It is also referred to as "sleepiness".
It is a reduced level of focus which is characterized for sleepiness and making it all the more cumbersome in remaining focused.

B. Drowsiness while Driving

Drowsiness of a person is a state where he is almost about to sleep or in a dormant state. It is an indication referred to as an inability to be awake or an indication to sleep [15].

The other factor commonly referred is fatigueness. It is an indication of complete worn out physical situation resulting in the state of physically and mentally being tired. They both occur due to complete physical exhaustion. The fatigueness may also be one of the metric for alertness or observant. The alertness is the state of being not sleepy.

The observant is state of being watchfully focused [16].
To measure the wakefulness of the driver several factors have been considered. Most obvious factors are how much time consumed to complete the task and how much rest / sleep has the driver taken [17][18]. Additional factors considered for wakefulness are sound, temperature, oxygen content and the amount of light. Including this boredom of the task and motivation also has causes on the metric of wakefulness.

Drowsy driving is one of the most perilous combinations of driving in sleepiness or fatigue. Drowsiness throughout the driving has been an increased risk of an accident, usually this happens when the driver has not slept properly, alcoholic effect, few medicine effects and also driving continuously during day and night. Due to driving long distance without rest the driver is bound to fall drowsy, which raises an alarm for the possibility of an accidents when compared to normal regular driving for short distance. Nowadays it is very difficult to know the exact time when the driver would go to sleep. This could happen more during night driving.

C. Driver Reaction during Drowsiness

- Drivers may not be focused or may have less concentration on the road.
- If the driver have to apply brake or control the steering suddenly, his reaction time may be very slow.
- It also reduces the ability to take sudden decision to avoid accident.

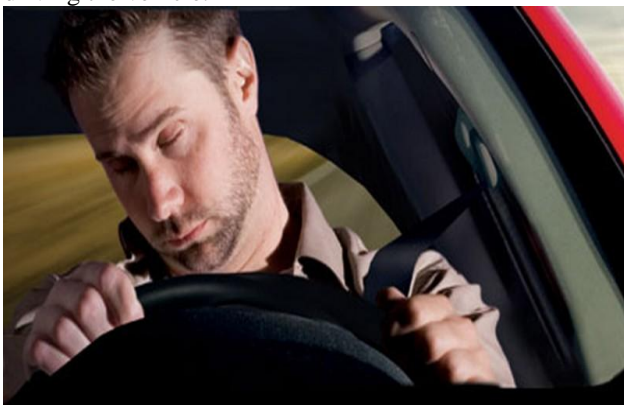The Fig. 1 displaying the drowsy state of the driver while driving the vehicle.

Fig 1. Drowsy Driver

Different terms are interchangeably used for driver fatigueness like drowsiness, sleepiness and are frequently used [19]. Generally if an activity is continued for too long a period then it's not possible to resume the same activity vigorously and it is referred to as fatigueness [20]. Fatigueness is the general term and its one of the main sub component is the sleepiness. Even they are related to the similar thought but they should be measured separately.

Overall decrease in both the physical or mental activities is defined as fatigueness. The result of fatigueness is less performance because of decreased capability in focusing to performing a task [21]. On the other hand, the physiological behaviours that are motivating to sleep are defined as Sleepiness [22]. The main factor for the sleepiness is being awake for more than normal time. There are several reasons for fatigueness and it is from physical, mental, perceptual, boredom to lack of interest [23]. Sleep is the only factor for countermeasure for sleepiness. A driver while driving may be fatigued without being sleepy, but a driver will be sleepy when he is fatigued.

There are many factors to countermeasure the fatigueness. It is very important to find the fatigueness of the driver. Many researches, algorithms and several studies have concentrated to gauge / calculate the driver fatigueness. Many of them used the data to detect the driver fatigueness based on simulators, but now the data are collected from real time environment to detect the driver's sleepiness. Many methodologies are used to categorize as indicators or to combine the indicators to get both sensitivity and specificity.

Drowsy driving can be as deadly as drunken driving. Driver's drowsiness not only puts themselves in danger, but they are also risky to everyone who is on the road.
Drivers who are tired and sleepy have delayed reaction time and more often than not make bad decisions. The reviewed and discussed facts about driver drowsiness with different methods connected to sleepiness are detected.

D. Characteristics of Driver Drowsiness

Inclination to fall asleep is the physiological state of drowsiness. Technically The word drowsiness is totally different from the fatigue, it means that to continue the activity is difficult and lack of willingness to perform any activity. Performing the task using the same muscle groups with very high repetition rate of adopting forced postures may cause fatigue like monitoring the screen continuously [24]. Without drowsiness a person may be fatigue, but driving vehicles with long distance may cause the fatigue and expose the presence of physiological drowsiness.

Reaction time, psychomotor coordination of the driver with wakefulness is drastically lowered because of the effect of being sleepy and automatically decreases the information processing. Attention on road, traffic and signaling withdrawal progressively from the drowsy driver with low driving performance may cause accidents [25]. Frequent eye blinking, continuously yawning, rubbing eyes, head tilt and interruptions are the most important signs of driver inducing drowsiness.

IV. CAUSES SYMPTOMS AND EFFECTS OF DRIVER DROWSINESS

Fatigued driver significantly affects the driving and increases the chances of a crash. If a dangerous situation arises it impairs our ability to respond quickly and safely. It also indicates the driver drowsiness with reduced level of performance happening on the road.

Fundamental Concepts of Driver Drowsiness Detection

A. Main causes of Driver Fatigueness

- Not adequate sleep.
- Sleep / Rest deprived during driving or driving overnight without taking any rest.
- Sleep disorders means a sleeping condition that causes tiredness throughout the day.

B. Symptoms of Driver Fatigueness

- Rubbing the eyes, yawning repeatedly
- Frequent blinking, or heavy eyelids
- Slower reaction times
- Probably not concentrating on driving or daydreaming on your driving
- Driving speed creeps up or down
- Impatience
- Diminished driving routine such as reduced gear changes
- Difficulty and contractions in driving
- Loss of enthusiasm in driving

Finally the driver not getting sufficient sleep, which can lead to a great risk of a crash. The only way to compensate this is by sleeping or else it will have a higher problem of having a fatigue related accident.

C. Effects of Fatigue Driver

The fatigueness of driver has dangerous effects. The decision making ability and mental processing capacity are impaired due to fatigue, in this situation thus the driver may get in to a short sleep without realizing what would happen next if there is a sharp turn or a red signal in front. All this are the criteria for an accident to happen.

Generally fatigueness affects the performance while driving. It automatically reduces reaction times. The problem of memory and poor psychometric condition are also capable in processing the information. The fatigueness may effect to motivate the driver to drive. Fatigue impacts driving behaviour in specific way. There are several studies which show as follows:-

- Reaction times slower: The time taken for reaction for the complex situation increases due to driver fatigue.
- Less attention: The fatigue drivers will have a reduced amount of concentration when they detect any risks condition such as curving or any obstacles on the road and etc.
- Less data processing: The processing information automatically decreases when the driver become drowsy and reduces the accuracy of the memory.

Totally 51% youngsters feel drowsy while driving and 17% are actually fallen asleep according to National Sleep Foundation (NSF), more than 30% road accidents are due to driver's sleepiness or fatigue.

Sleepiness and tiredness can frequently affect driving ability. Long before the driver could identified due to tiredness when compare to others the road accidents are more fatal because of driver's fatigueness as he has very less reaction time and cannot avoid the accidents from happening.

V. CONCLUSION

Driver's drowsiness is an emerging problem in the universe. It creates risk and dangerous problem to an individual as well as for the nation. According to a study, 20% of the crashes are due to the driver drowsiness. Therefore, development of system for driver drowsiness detection is not only legitimate but also it is very necessary. In this paper we discussed about fundamental concepts of drowsy driver.

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