A Review Paper on Driver Fatigue Detection & Warning System

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Abstract**—***The automobile industry has made a radical improvement over the last decade which made our vehicles more powerful, easier to drive, energy efficient and environment eco-friendly. Driver efficiency is a major problem resulting in thousands of road accidents each year. About 20% of deadly accident involves driver fatigue. Nearly 50% of this result in death or serious injuries due to these types of crashes. Adelaide Centre for Sleep Research conducted a study and concluded that a person who is not sleeping for 17 hours, shift workers and drivers with sleep disorder often feels drowsy. The estimation made by National Highway Traffic Safety Administration shows that nearly 100,000 crashes every year are related to driver fatigue. This causes nearly 2,000 deaths, 80,000 injuries and $13 billion of economical loss every year.Therefore, there is utmost need to develop a system which monitors the driver drowsiness and alerts the driver about danger. Already there are number of safety devices present in vehicles for driver safety such as seat belts, air bags, brake systems etc. But these devices always act after the accident has happened. There are few signs which usually exist before accident happens. Driver Fatigue is one such symptom which can be analysed and warned driver before accident occurs.The development of accident avoidance system to prevent or alert drowsiness at wheel is a challenging task. This research is to develop a non-intrusive driver fatigue detection system which accurately observes driver's state of eyes in the real-time using image/vision based technique.*

Keywords—warning system, driver fatigue detection

I. FACE DETECTION

The types of recognition involved in image processing discipline are, Face recognition, pattern recognition, speech recognition, object recognition, and data analysis, etc. The basic concepts, structure and ideas involved in this recognition are discussed in this section. In the last two decades, object detection and recognition has become most interesting and challenging research field for the researchers. Face detection is one such application. The need of Face recognition and detection arises due to demand of automatic surveillance system, Human Computer Interface (HCI), etc. The study and knowledge of Image processing, neuroscience, psychology, computer vision and machine learning, etc., are the disciplines on which researchers need to know while working on these recognition systems.

Researchers have published many research papers on face recognition techniques dealing with various factors (such as facial expression, lighting conditions, face orientation, pose variation) to reach better detection/recognition rate. Thedevelopment of robust technique for face recognition which can deal with all factors mentioned above is still far from reach of the researcher.

The main objective of object detection is to identify (1) whether a given image has human faces (2) location of faces in the given image. The expected output of object detection step is to know whether input image contains face or not. The detection/recognition rate of Face recognition system is improved by performing Face alignment to justify orientations and scaling on input images which makes the system more robust. Region of interest, image and video classification serves as the pre-processing steps for face recognition.

II. FACE DETECTION SYSTEM DESIGN PROBLEMS

While designing and developing a face recognition system, lot of design problems are taken into considerations apart from problems involved in psychophysics, neuroscience, and human face variations.

Robustness and execution speed of the face recognition system for real time service and the capability to handle large amount of data is the basic requirement of the system. Firstly, the practical problem of existing methods is detecting and identifying human faces by complex algorithms which take few seconds to minutes to read and process the input image.

Such methods are not efficient and cannot be used in real time applications. For example, now a day's digital cameras, electronic gadgets can detect and locate human faces while capturing an image and the whole process normally takes less than 0.5 second of time.

The recent papers on pattern recognition, the researchers have stressed more on execution speed of the algorithm and handling of large amount of data. The discussion and conclusions made by the researchers in these techniques also include comparison and execution speed with other techniques.

Second problem while developing face recognition system is training of the algorithm. More the training data size, more information can be extracted which improves the performance of the system. In most of the practical cases, the size of the training database is restricted due to difficulty in image acquisition and keeping human privacy in mind. If the size of the training date is limited, then the algorithm fails to predict and relate the missing and unseen data with the captured information.

Finally, how to make these face recognition systems independent of conditions such as lighting, background, etc. The face recognition system involves three major steps as shown in Figure 1. The input to this system is either an image or video stream. Face recognition system identifies certain image region as a face.

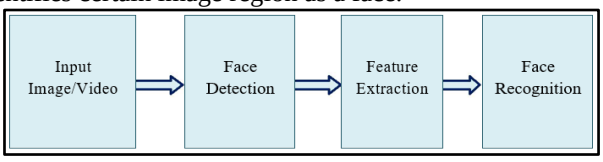

Fig. 1: A Generic Face recognition system

III. FATIGUE

Fatigue is referred as tiredness, restlessness, exhaustion and lethargy which describe physical and/or abstract state of being tired or weak. Fatigue can be physical or intellectual. Fatigue is considered as symptom rather than a sign because it is a subjective feeling. Driver fatigue is one of the causes for accidents on road. Tired fatigue driver often fails to break the vehicle at right time which leads to crash. Statistics show that nearly 20% of vehicle accidents are because of driver fatigue. Most of the driver fatigue crashes occur during normal hours.

IV. DRIVERS AT RISK

A driver who has not slept for 17 hours faces the similar risk of accident when a person who has Blood Alcohol Content (BAC) reading of 0.05 g/100ml. Hence, a fatigued driver is at a risk of twice as that of a person with zero BAC. The driver who has not slept for 24 hours is having a similar driving performance to a person with 0.1g/100ml of BAC. They are having 7 times of more chances of risk of accidents. The group of drivers who are at risk due to fatigue are teenagers, rotation workers and drivers with insomnia.

V. CAUSES OF DRIVER FATIGUE

Fatigue is caused due to improper sleep over a period of time. Minimum of seven to eight hours of sound sleep is necessary for an individual in a day. Drivers with insufficient sleep make wrong decisions while driving which increases the possibility of accident. The major causes of driver fatigue are:

1) Lack of quality sleep
2) Driving overnight
3) Sleep disorders
4) Circadian rhythms
5) Time spent on driving task
6) Physical fitness
7) Improper diet
8) Level of experience in meeting demands on the job
9) Traffic
10) Personal motivation and worries

VI. EFFECTS AND CONSEQUENCES OF DRIVER FATIGUE

The consequences of driver fatigue can be disastrous; because it affects the decision making abilities of driver which leads to crossing of lane and colliding with other objects. This crash not only leads to damage of vehicle but the driver who is driving the vehicle and other persons sitting inside will be at a risk of life apart from damage of vehicle and property.

About 50% more likely results in death or serious injury in these types of crashes where a driver fails to break the vehicle. Fatigue reduces reaction time, reduces vigilance, alertness and concentration and decision making abilities. In most cases, the drivers are aware when they are feeling sleepy and can make a decision about whether to continue driving or take rest but they generally choose to ignore the risks (Jackson, P., Hilditch, C., et.al., 2011).

A. Driver Fatigue Detection & Warning System

Driver fatigue is a major factor for road accidents. It is major requirement for driver safety to detect driver fatigue quickly and efficiently. The following are the methods followed by researchers to detect fatigue before an accident can happen.

1) Measuring of Physiological signals – EEG, ECG
2) Measuring lane deviation & steering wheel angle
3) Driver's face expressions – Yawning & Tired eyes
4) Observing slower reaction times
5) Observing driving speed which creeps up or down
6) Impatience
7) Observing changes in driving performance such as gear changes

VII. DRIVER FATIGUE DETECTION SYSTEM

Driver fatigue at wheel is a major reason for road accidents. The problem is severe to Commercial vehicle drivers. A typical fatigue crash occurs due to drifting off the roadway without brake application. These accidents normally occur early morning i.e., in between 3:00AM and 5:00AM. Estimation of driver fatigue and alerting the driver is a challenging task faced by many researchers. Driver fatigue reduces the decision making abilities of driver and within a fraction of seconds the accident may happen, so the fatigue detection system should be more accurate, efficient and fast enough to alert the driver as early as possible

Development of driver fatigue detection system is a challenging task because the system needs to be placed in vehicle and should take care of size, speed, cost, and compatibility and moreover it should not distract and annoy the driver at wheel. The basic assumptions and requirements of Driver Fatigue Detection System are:

- DFD system should not promote the use of "snooze alarm".
- DFD should provide timely notification about drowsiness.
- The alarm system used in DFD system should not produce nuisance alarms.

The Driver Fatigue monitoring system should manage structure and promote an understanding of drowsiness at wheel. The common threads for addressing driver fatigue are circadian rhythms and sufficient amount of sleep. The alert and performance levels are optimized if the driver gets sufficient sleep in a day. Otherwise, the performance levels and decision making abilities of the driver will get reduced.

Many management structures have been proposed to manage safety and responsibility of the driver. Since, fatigue is not well defined which makes these management structures as qualitative. This confused decisions makers with fewer facts and more options. Researcher designed many ways to detect and monitor driver fatigue at early stage based on different approaches. Hence, the Driver Fatigue Detection (DFD) system is classified into following types as shown in Figure 2.

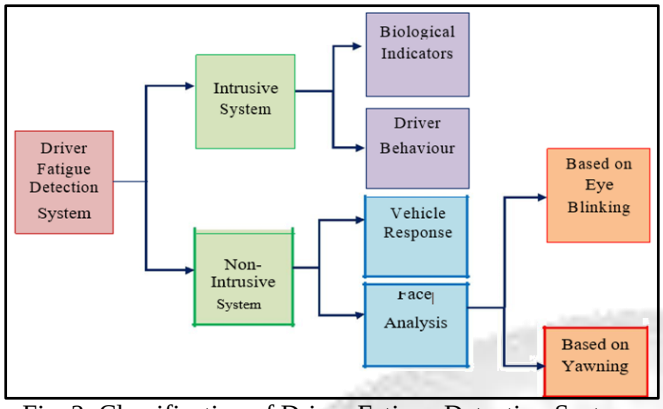

Fig. 2: Classification of Driver Fatigue Detection System

Mainly DFD system is classified into two types

- Intrusive System
- Non-Intrusive System

VIII. OBJECTIVES

Driver Fatigue is an alarming threat to road safety and the condition is more worse for people who work for 24 hours, exposure to challenging environmental conditions. Monitoring driver fatigue and sending the feedback such that an appropriate action will be taken before accident occurs is a major challenge. Currently, the scientific and technical activities are underway to address driver fatigue for road safety.

Technological advances in electronics, sensors, camera, machine vision algorithms, data acquisition devices are making it possible to develop a real time system which can monitor for 24-hour a day. The main aim of this work is to design and develop a non-intrusive Driver Fatigue Detection system using image and visions based technique and develop a system which is installed in a vehicle for continuous monitoring of driver's condition. Following are the goals to be met while developing DFD System

1) The system should monitor driver's eye and calculate eye blinks.
2) The system is aimed to monitor driver's behaviour in real time under different environmental conditions.
3) The performance of the system must be steady all time and measure the same for all drivers.
4) The system should be accurate, fast and reliable diurnal conditions.
5) The alert system should be audible and the volume should be adjustable in human audible range.
6) The system must withstand temperature, humidity and vibration conditions of vehicle.
7) The device should be able to minimize false negatives.
8) The device should be reliable, robust, power consumption should be less, cost should be less and should be small in size such that it can be installed easily

REFERENCES

[1] Yogesh Chellappa, NarendraNath Joshi, and VaishnaviBharadwaj Department of Computer Science and Engineering "Driver Fatigue Detection System" 2016

[2] Henane, R., et al. "Variations in evaporation and body temperatures during sleep in man." Journal of Applied Physiology 42.1 (1977): 50-55.

[3] Bunde, Armin, et al. "Correlated and uncorrelated regions in heartrate fluctuations during sleep." Physical Review Letters 85.17 (2000):3736.

[4] Li, Gang, and Wan-Young Chung. "Detection of driver drowsiness using wavelet analysis of heart rate variability and a support vector machine classifier." (2013).

[5] Monitoring based on physiological factors: http://www.popsci.com/article/cars/smart-seatbelts-detect-drowsydrivers

[6] Viola, Paul, and Michael J. Jones. "Robust real-time face detection. "International journal of computer vision (2004).

[7] Viola, Paul, and Michael Jones. "Rapid object detection using a boosted cascade of simple features." Computer Vision and Pattern Recognition, 2001. CVPR 2001. Proceedings of the 2001 IEEE Computer Society Conference on. Vol. 1. IEEE, 2001.

[8] "Optical feedback image intensifying system." U.S. Patent 3,154,687, issued October 27, 1964.

[9] Provine, Robert R. "Faces as releasers of contagious yawning: An approach to face detection using normal human subjects." Bulletin of the Psychologic Society (1989)

[10] Saper, Clifford B., Thomas E. Scammell, and Jun Lu. "Hypothalamic regulation of sleep and circadian rhythms." Nature (2005).