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Detection of Drivers Distraction While Driving – A Study

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ABSTRACT

In this paper, we review the scientific field technologies for driver distraction detection, which can be categorized into the following two main classifications: 1) distraction and 2) fatigue. Driver distraction is a key factor in the most traffic accidents. The goal of precisely determining the drivers' state of mind has been actively carried out for decades in research and development. In this paper, we summarize these approaches by apportioning them into the following three different types of measures: 1) driver physical measures; 2) driving performance measures; and 3) hybrid measures. The hybrid measures are believed to give more trustworthy solutions compared with single driver physical measures or driving performance measures. We also discuss some nonlinear modeling techniques commonly used in the literature.

KEYWORDS | Driver Distraction, Fatigue, ANN, SVM

I. INTRODUCTION

The total number of road accidents increased by 2.5 per cent from 4, 89,400 in 2014 to 5, 01,423 in 2015. The total number of persons killed in road accidents increased by 4.6 per cent from 1, 39,671 in 2014 to 1,46,133 in 2015. [1]

Driver distraction is a crucial safety problem. Between 13% and 50% of crashes are attributed to driver distraction, resulting in as many as 5000 fatalities and $40 billion in damages each year. Increasing use of in-vehicle information systems (IVISs) such as cell phones, GPS navigation systems and satellite radios are exacerbated the problem by introducing additional sources of distraction

A study by the American Automobile Association Foundation for Traffic Safety (AAA FTS) utilized the following five categories for the driver attention status [2]:

1. attentive;
2. distracted;
3. looked but did not see;
4. sleepy;

In this paper, we suggest the succeeding two categories for inattention: Distraction and Fatigue.

II DISTRACTION AND FATIGUE EFFECTS ON DRIVING BEHAVIORAL PERFORMANCE

A. Effects of Distraction

Performing a cognitively demanding task while driving influences both the driver's visual behavior and driving performance (as indicated by braking behavior).

1. Driver Behavior Patterns: With an increase in the cognitive demand, many drivers changed their inspection patterns on the forward view. Angell et al. [3] indicated that the eye-glance pattern could be used to discriminate driving while performing a secondary task from driving alone and could be used to discriminate high- from low-workload secondary tasks. More facts associated with cognitive distraction driving can be found in [4] and [5]: Drivers narrowed their inspection of the outward view and spent more time looking directly ahead. They reduced their inspection of the instruments and mirrors and reduced their glances at traffic signals and the area around an intersection. Rantanen and Goldberg [5] found that the visual field shrank by 7.8% during a moderate-workload counting task and by 13.6% during a cognitively demanding counting task. Drivers had fewer saccades per unit time, which was consistent with a reduction in glance frequency and less exploration of the driving environment, and in some cases, drivers completely shed these tasks and did not inspect these areas at all [6].

2. Driving Performance: Significant changes were observed in a driver's vehicle control as a consequence of performing additional cognitive tasks while driving. Ranney [8] found that distraction may be associated with lapses in vehicle control, resulting in unintended speed changes or allowing the vehicle to drift outside the lane boundaries. Zhou et al. [9] found the influences on the lane-changing behavior when a secondary task was performed, which included a reduction in the frequency of the checking behavior (check a side mirror or speedometer), a delay in the checking behavior, and a longer time to perform the checking behavior.

B. Effects of Fatigue

When a driver is fatigued, certain physical and physiological phenomena can be observed, including changes in brain waves or EEG, eye activity, facial expressions, head nodding, body sagging posture, heart rate, pulse, skin electric potential, gripping force on the steering wheel, and other changes in body activities.

1. Driver Behavior Patterns: Eskandarianet al. [10] found that the following actions were correlated with fatigue.

1. Drivers exhibited a reflexive head nod after checking the side mirrors.
2. Drivers were inclined to turn their head to the left to relieve muscular tension in the neck.
3. Eye-blinking activity radically increased.
4. Episodes of yawning were more frequent.
5. Drivers tended to adopt more relaxed hand positions on the steering wheel.

2. Driving Performance: It has been reported that sleep- deprived drivers have a lower frequency of steering reversals (every time the steering angle crosses zero degrees) [11], a deterioration of steering performance [12], a decrease in the steering-wheel reversing rate [13], more frequent steering maneuvers during wakeful periods, no steering correction for a prolonged period of time followed by a jerky motion during

drowsy periods [14], low-velocity steering [15], large- amplitude steering-wheel movements, and large standard deviations in the steering-wheel angle [16]. Variables such as the times of lane departures, SDLP, and maximum lane deviation were found to highly be correlated with eye closures [17]. The mean square of lane deviation, mean square of high-pass lateral position, and SDLP showed good potential as drowsiness indicators [18].

III CURRENT METHODS OF DETECTING DRIVER DISTRACTION

Author	Parameters	Fusion Technique
A.Eskandarian et al[10]	Vehicle Parameter Data and eye closure data	ANN
M. Miyaji et al[7]	eye gaze, head orientation, diameter of pupils, heart rate(RRI)	SVM and Adaboost
A.Sathyanarayana et al[21]	leg and head motions, CAN signals	K-Nearest Neighbors classifier
A.Sathyanarayana et al[22]	Audio signal and CAN signals	GMM/UBM
A.Doshi and M.Trivedi[23]	head orientation and the surround salience map	Direct Matching
G. Weller and B. Schlag[24]	gaze variables, driving data and road geometry	ANOVA and binary logistic regression
Y.Liang et al[19]	eye movement and vehicle parameters	SVM
J.Lee et al [20]	eye movement and vehicle parameters	Baysian Network
G. Markkula and M.Kutila et al[25]	head/eye and vehicle parameters	SVM
F.Tango[26]	vehicle and environment parameters	ANFIS
L.Fetcher and A.Zelinsky[27]	eye gaze, blink, head pose and environment parameters	Region Matching
C.Tran and M.Trivedi[28]	head dynamics, facial features, upper body posture information and vehicle dynamics	In Developing

CONCLUSION

In this paper, the current state of the knowledge about driver distraction detection has been reviewed. Driver distraction increases driving risk and has become a major factor in a considerable percentage of traffic accidents. In summary, distraction means that drivers can pay attention, but their attention is loosened away from the primary driving task to some ancillary task or tangled by some attractive object/event. Fatigue means that drivers have exhausted their attention energy and cannot maintain adequate attention to driving. The causes of distraction and fatigue are different, and they impose diverse influences on the driver and driving performance.

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