Modelling of Safe Driving Assistance System for Automotive and Prediction of Accident Rates

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ABSTRACT

This research article attempts to analytically determine the factors, significant for safety, in connection with driving of automotives as well as to develop a conceptual model of the driving assistance system, using the knowledge about such factors. Millions of casualties due to road accidents, happen worldwide every year and the annual average of lives lost in India alone is about hundred and fifty thousand. The causes of such accidents are attributed to road characteristic and condition, driving faults, driving conditions or traffic environmental factors and defects or functional failure in vehicle mechanism. Studies have focused primarily on these factors without associating the ‘weather’ which has been reported as in a work but as an isolated factor without including the above three. This work includes all the four stated factors in modelling the driver assistance system for automatic speed control with warning system module. Further, to predict accident rates in a particular region a model using adaptive neuro fuzzy inference system (ANFIS) is proposed in this work, which may be used by the vehicle manufactures to select the right product variant to minimise accidents.

KEYWORDS

Automatic Speed Control, Driver Assistance System, Road Accident in India, Road Safety, Transmission Control

1. INTRODUCTION

Vehicle safety is a major issue in vehicle design and speed control is directly related to the vehicle safety. As an economically growing country the number of vehicles in Indian road is increasing exponentially and the number of road accidents are also increasing proportionally (Bhattacharjee, Bhola, & Dan, 2017). Five major category of vehicle accident cause can be observed in the available literatures and they are (a) Road condition (Norrmann, Eriksson, & Lindqvist, 2000) (b) Drivers fault (Häkkänen & Summala, 2001) (c) weather (Edwards, 1999) (d) traffic environment (Treat, Tumbas, McDonald, Shinar, & Hume, 1977) (e) mechanical fault (Larson, et al., 1980). The available research is tabulated and summarized in Table 1. Present article focusses majorly upon the articles considering road safety condition in Indian context. Majority of the articles consider bad road conditions of Indian roads

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Table 1. Causes of road accidents

<table>
<thead>
<tr>
<th>Cause of Road Accidents</th>
<th>Research Articles</th>
</tr>
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<tbody>
<tr>
<td>Driver’s fault</td>
<td>Mohan, 2009; Ansari et al., 2000; Mirkazemi and Kar, 2014; Sevitt, 1973; Singh et al., 2015; Stutts et al., 2003; Kashani, Mohaymany and Ranjbari, 2012; Kanchan, 2012; Kar et al., 2015; Narayan et al., 2012; Watkins, 2012; Jain, Singh, and Parida, 2011; Dinu and Veeraragavan, 2011; Odero, Khayesi &amp; Heda, 2003; Thurfjell et al., 2015; Zhang et al., 2013</td>
</tr>
<tr>
<td>Weather</td>
<td>Mohan, 2009</td>
</tr>
</tbody>
</table>
| Traffic environment              | Mohan, 2009; Kanchan, 2012; Kar et al., 2015; Kumar and Toshniwal, 2015; Padmanaban, Rajaraman, Narayan, Ramesh, & Stadter, 2010; Grimm & Treibich, 2013; Mannering & Bhat, 2014; Chikkakrishna, Parida, & Jain, 2013; Watkins, 2012; Jain, Singh, & Parida, 2011 (Dinu & Veeraragavan, 2011; Odero, Khayesi, & Heda, 2003; Stutts, Wilkins, Osberg, & Vaughn, 2003; Abdullah & Zamri, 2012; Singh, Sachdeva, & Pal, 2016; Molla, Stone, & Lee, 2015). Next to the bad road condition, drivers fault contribute to the road accident in Indian roads (Ansari, Akhdar, Mandoorah, & Moutaery, 2000; Kanchan, Kulkarni, Bakkannavar, Kumar, & Unnikrishnan, 2012; Mirkazemi & Kar, 2014; Singh, Singh, Kumaran, & Goel, 2015; Kar, Das, Tiwari, & Pharveen, 2015; Chikkakrishna, Parida, & Jain, 2013; Narayan, et al., 2012; Watkins, 2012; Jain, Singh, & Parida, 2011; Dinu & Veeraragavan, 2011) (Zhang, et al., 2013). Traffic environment and behavioural fault of the driver (Mohan, 2009; Kanchan, Kulkarni, Bakkannavar, Kumar, & Unnikrishnan, 2012; Kar, Das, Tiwari, & Pharveen, 2015; Kumar & Toshniwal, 2015; Padmanaban, Rajaraman, Narayan, Ramesh, & Stadter, 2010; Kharola, Tiwari, & Mohan, 2010; Grimm & Treibich, 2013; Thurfjell, Spong, Olsson, & Ericsson, 2015; Zhang, et al., 2013; Saleh, 2016) (Abdullah & Zamri, 2012; Singh, Sachdeva, & Pal, 2016; Molla, Stone, & Lee, 2015) are the other two significant causes of road accident. In some articles mechanical faults are reported as the cause of the road accident (Mohan, 2009; Kharola, Tiwari, & Mohan, 2010; Kashani, Shariat-Mohaymany, & Ranjbari, 2012; Molla, Stone, & Lee, 2015). According to few articles the weather condition also has a contribution in road accidents (Mohan, 2009). Among these five reported causes “weather” is an uncontrollable factor. The factor like “Drivers fault” and “Mechanical fault” can be neutralised with strong regulation and regular maintenance. Recent articles emphasise on these two causes and provided some interesting statistics about the road accidents. For example, Kar’s article shows cars are involved in 37% of the road accident while trucks contribute 19.1% to the total number of accidents (Kar, Das, Tiwari, & Pharveen, 2015) while according to Padmanabam, 27% passenger cars are involved in accidents (Padmanaban, Rajaraman, Narayan, Ramesh, & Stadter, 2010). So from the above three statistics it can be stated that passenger four wheelers are more accident prone compared to the commercial vehicle. Narayan observes 35% of the total accidents are head on collision (Narayan, et al., 2012). This evidence shows that in Indian roads, driving assistance
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