Road Safety Mechanism to Prevent Overtaking Accidents

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Abstract *-- Road traffic accidents are being recognized as a major public health problem in numerous countries with alarmingly increasing fatalities in developing countries. Careless driving as a result of excessive waiting and blind corners is attributed as one of the most important factor for all road accidents. An estimated 1.2 million people lose their lives in road traffic crashes every year, and another 20 to 50 million are injured. A docile, economical mechanism to prevent these road accidents is the need of the hour. It is hoped that the mechanism presented in this article would help in alleviating this concern especially in correspondence with large vehicle accidents on highways by being easily implemented in low and middle income countries.*

Keywords — *Road accidents, Safety, Signaling Mechanism, Driver Behaviour*

I. INTRODUCTION

The huge number of human deaths and injury reveal how important it is to deal with this menace. Although there are laws to prevent road accidents decrease in the number of fatalities is not to be seen. Road collisions are the second leading cause of death for people between the ages of 5 and 29 and third leading cause for people between 30 and 44. With the major players being large sized vehicles such as trucks, buses or mini-buses, (bus & minibus 33%,trucks 27%) and in fatal accidents their shares are 35%and 29% respectively. This group of vehicles is particularly over involved in pedestrian accidents accounting for about 68 percent (bus/minibus 38%,trucks 30%). For the case of death due to road traffic accident, the share of buses and trucks are nearly 70 percent (bus/minibus 36%, trucks 24%) and for pedestrian about 72 percent (bus/minibus 40%, trucks32%) [1].

TABLE I
Vehicle Types and their associated fatalities

Vehicle Type	Percent Deaths	Percent pedestrian deaths
Large: Bus/Minibus/Truck	60%	62%
Average sized: Car/Jeep/MUV/ Auto-rickshaw	26%	17%
Small sized: Motorcycle/Bi-cycle	9%	3%
Others	5%	8%

II. Overview of the existing systems

Currently automobiles running on the roads are equipped with features intended to ensure safety like Automatic Braking System, Steering Pattern detection, Night Vision assist etc. These systems essentially work when the driver gets close to a prospective accident.

A. Automatic Braking System

Automatic Braking System has obstacle sensors fixed at different positions on the vehicle. When the driver reaches too close to another and is almost about to collide, this system senses that an accident may take place. Depending on the distance between both the vehicles, brakes are automatically applied by the electronic control system.

B. Steering Pattern Detection System

In steering pattern detection system, the vehicle is provided with an electronic monitoring system which records the movements of the steering wheel and alarms the driver if any abnormal behaviour is detected by the pre-programmed system.

C. Night vision assistance systems

Night vision assistance systems help the driver by providing an image of the road on a screen to a distance that is substantially away from the vehicle using night vision infrared cameras. This eagle eye view of the road after day light enables the drivers to make better decisions while driving at night and be careful.

D. EBD (Electronic Brake-Force Distribution)

Electronic brake-force distribution (EBD or EBFD), Electronic brake-force limitation (EBL) is an automobile brake technology that automatically varies the amount of force applied to each of a vehicle's brakes, based on road conditions, speed, loading, etc. always coupled with anti-lock braking systems.[2]

E. Drawbacks of the current systems

Though the above mentioned systems are effective in their own individual functions, they are not comprehensive yet. One of the main factors that leads to accidents on roads among automobile drivers is distraction. Current systems rely only on the data that is inferred from the vehicle dynamics but not on the driver's condition. Besides, all these systems are designed to assist only to ensure safety of the driver that may meet with an accident. But there is no provision to warn or alarm other passersby on the road to be careful. In many cases fatal accidents can be averted by alarming the drivers of both the vehicles that a collision may take place. The proposed system has the functionality to warn both the parties before collision and ensure safety.

III. Results of Previous research

A. Citations from previous research

Researchers at Nottingham University determined the following statistics when studying police records of overtaking accidents :

- 35% hit a vehicle turning right as the overtaking vehicle was attempting to pass
- 16% hit a vehicle travelling in the opposite direction
- 10% side swiped the vehicle being overtaken
- 8% lost control during whilst overtaking or returning to the nearside lane
- 6% hit a vehicle that was turning or crossing at a junction
- 14% involved 'undertaking' (passing on the left)
- 5% resulted from evasive action taken by a driver when attempting to avoid someone else's risky overtaking manoeuvre.[3]

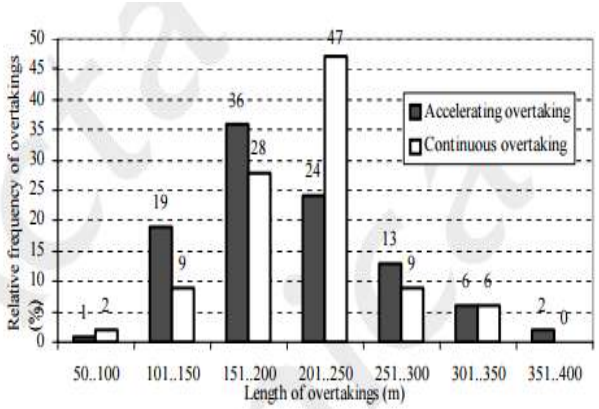

Fig. 1 The above bar graph shows the relative frequency of overtaking with respect to the length of overtakings in Hungary.[4]

B. Data on reduction of rate of accidents after providing additional safety enhancements

The graphs below show the reduction in accidents in Japan after installing a system called Vehicle Stability Control (VSC) system,[5]

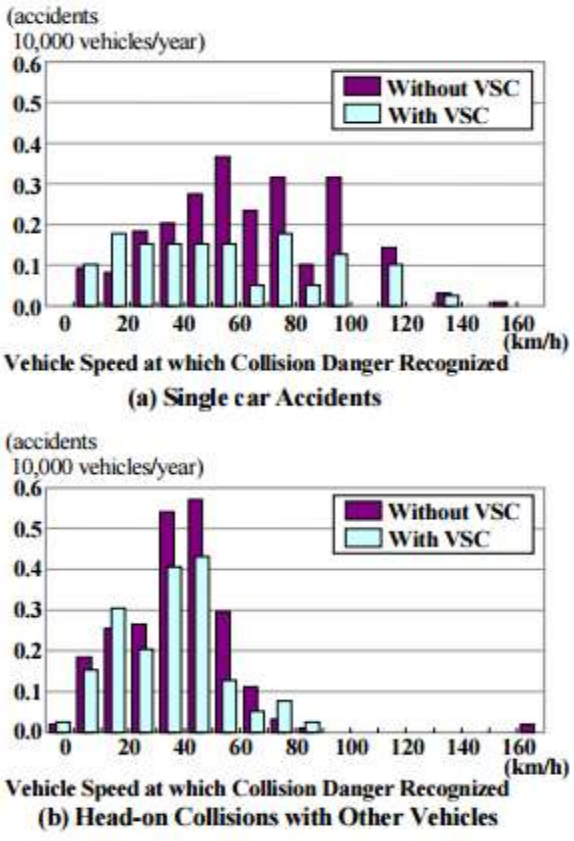

Fig. 2 Improvement in collision recognition after using VSC

According to The Wall Street Journal, Safety Gears help reducing U.S. traffic deaths,[6]

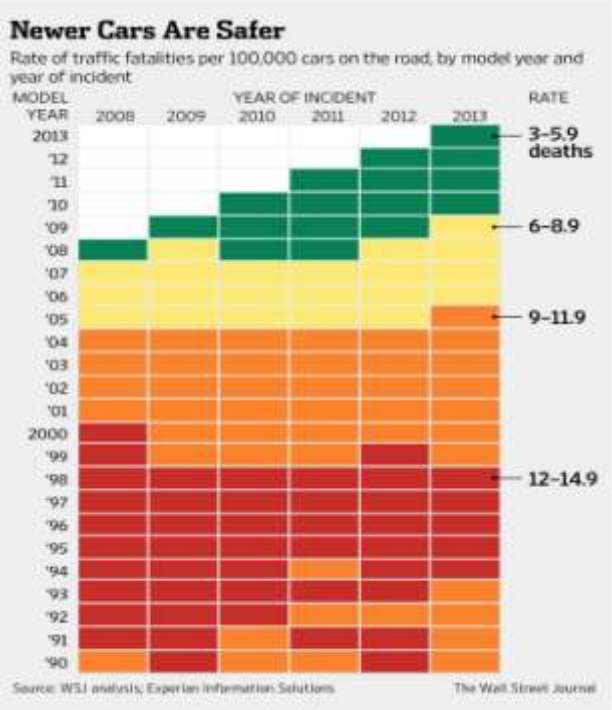

Fig. 3 The Wall Street Journal article on safety in new cars in the U.S.

IV. Proposed System

According to a study conducted by Nottingham University, 35 % of the vehicles in the United Kingdom hit a vehicle turning right as the overtaking vehicle was attempting to pass. This can be prevented when the driver of the vehicle going behind the large vehicle to be overtaken is warned about the vehicles coming in the opposite direction. In order to accomplish this task, this system is proposed for large sized vehicles and has an automated sub-system that works with a microcontroller and a manual human controlled switch which needs to be operated by the driver upon requirement. The functioning of these systems is explained as follows :

A . Automated Sub-System :

i. Set-up :

Six electromagnetic proximity sensor's are fixed to the rear end of the truck or trailer which are connected to the control unit. There is a video camera which is also mounted at the rear end of the end truck or trailer as per the video camera used i.e surface, flash, license or custom. The Control unit consists of one input and 2 outputs. The display feed from the camera is mounted in the rearview mirror or dashboard. The tweeter can be placed anywhere in the driving room.

ii. Working :

The proximity sensors at the rear end of the vehicle are always activated, when a vehicle comes in the vicinity of the sensors they give an output signal to the control unit The control unit then performs two operations simultaneously, it gives an output signal to the video camera to start recording and forwards an activation signal to the tweeter. In this step, Two actions take place simultaneously, the tweeters produce an alarm sound, as a result of the input received from the control unit, because of which the driver then looks at the monitor which by then would have received an input signal from the video camera at the back.

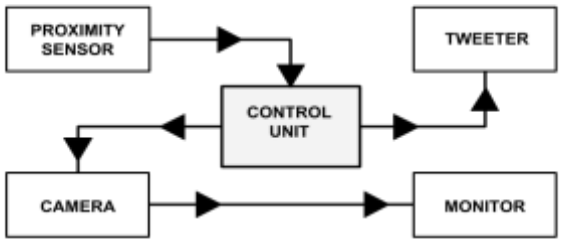

Fig. 4 Block diagram of the Automated Sub-System

Fig. 5 Monitor attached to rear view mirror, Fig. 6 Monitor attached to the dashboard

Fig. 7 License mount camera

B. Human part :

i. Setup :

There will be two push buttons near the dashboard, one red and one green. There will be a casing at the

rear end of the truck which would house two lights red and green. These two push buttons will be connected to their respective lights via two mechanical switches.

ii. Working :

After checking the display of the rear camera in the screen the driver will check for oncoming traffic and if the coast is clear he will press the green button which would in turn illuminate the green light at the back and the driver will overtake safely. If there is oncoming traffic then the driver would press the red button which will inturn illuminate the red light at the rear and the driver will not overtake.

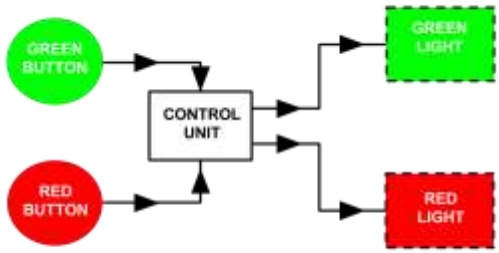

Fig. 8 Block diagram of the Human controlled part

C. Additional effort to provide more safety

This system uses Digital Image Processing Techniques implemented using MATLAB® software. The camera that is fixed in the dashboard of the car can be used to constantly monitors the image of the driver's face and sends the frames captured in the video to the micro-computer present in the car that operates the Electronic Control System in the car. Using Viola-Jones object detector algorithm implemented using MATLAB®, the presence of opened eyes in the image is checked. If it is detected that the driver's eyes are open while driving, it means that the driver is awake and is concentrated on driving. On the other hand, if no open eyes are detected in the image, then it is understood that the driver is not awake. On detection of drooping eyes, the system immediately rings alarm to warn the driver.

Fig. 9 Multi-Display functionality

Fig. 10 10 Night vision in dark

Fig. 11 Surface Mount Camera

CONCLUSIONS

It is due to blind corners while overtaking that many of the trailer truck road accidents take place. This mechanism aims to provide an economical, docile way to prevent such accidents from happening and also facilitate ease of implementation so that it can used in middle and low income countries without incurring heavy costs.

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