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Seat Belt Safety Features Using Sensors to Protect Occupant

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Abstract

Motor vehicle accidents have grown to be a major cause of death and injury since the first known crash-related occupant fatality occurred in 1895. Fortunately, statistics indicate that the death rate in terms of fatalities per 100 million vehicle miles traveled has declined from a peak of 24.1 in 1921 to the present 1.7 (NHTSA, NCSA, 1997). We are developed occupant safety feature with an intension to reduce accidental injuries to occupants. After studying number of design plans and research papers, we have concluded to design and develop seat belt safety mechanism using sensor. In case of accidents, passenger lives can be saved greatly by use of seat belts and airbags in the automobiles. The safety implications of these systems and the stringent safety regulations in the US and Europe have brought a growing market to these products. The purpose of developing the project is to design alternate method of seat belt safety mechanism without changing the available space in the car and also to provide safety to occupants in those cars in which air bags could not be implemented due to increase in cost. The actuating system design includes three point seat belt, sensors, and micro-controller and locking mechanisms.

1. Introduction

The recent steady reduction in the fatality rate has been the result of a combination of a variety of factors including vehicle crash safety, engineering developments, and1347 improved roadway design among others.

Seat belt is one of the primary safety feature used in vehicle to avoid major injuries to the driver driving the vehicle. Even after the government norm that is wearing of seat belt is mandatory, accidental injuries increase due to negligence of occupants in vehicle of wearing seat belt. If seat belt is not buckled correctly than the chances of accidental injuries increase. To avoid these, different companies found variety of seat belt systems such as passive seat belt system, automatic seat belt system, seat belt warning system and so on. So, in this project we have proposed better seat belt system than the present ones. This system comprises of sensor, micro controller and locking mechanism in wheel and seat belt. In this system vehicle propels only when seat belt and door are locked properly. According to our estimation this system can decrease fatality up to 70- 80% in comparison to present system.

2. Statistical Study

2.1 International

Table 1: Study of international automobile fatalities in a decade.

	1998 Fatalities	2008 Fatalities	Percent Change
United States	15,796	8,234	-47.9%
Great Britain	3,352	1,431	-57.4%
Canada	5,863	2,936	-49.9%
India	75,256	54,792	27.19%
Australia	3,508	1,715	-51.1%

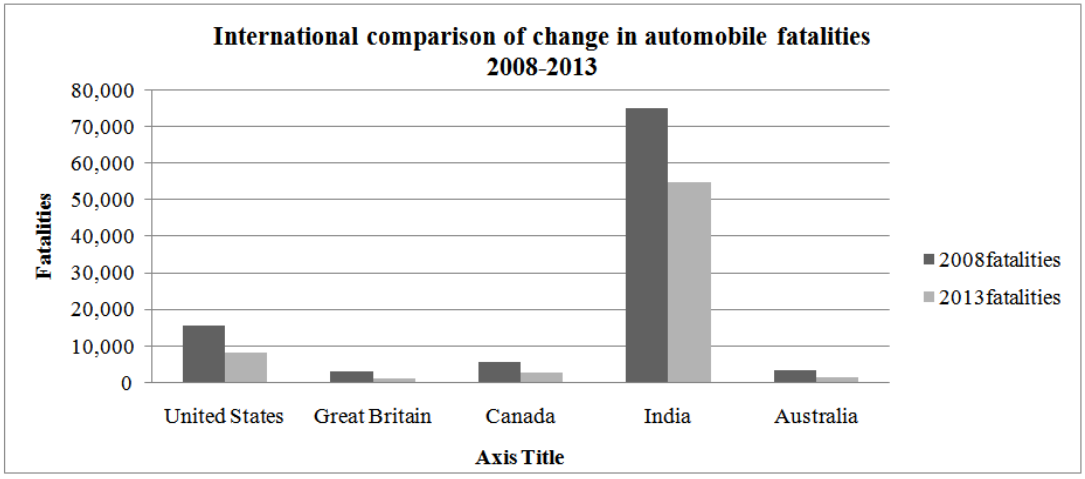


Fig. 1: international comparison of change in automobile fatalities.

3. Problem Statement

1) Passive seat belt is costly and needs skilled person for installation purpose.
2) Automatic seat belt systems generally offer inferior occupant crash protection.

3) If the vehicle door gets opened than automatic seat belt system leaves the occupant without belt protection causing greater injury or death
4) Automatic seat belt systems also present several operational disadvantages.
5) The sound from the warning system is so irritating to driver that it can cause serious accident.

4. Methodology for Solution

There are four touch sensors placed on door edges. One load sensor is placed at the bottom of the seat to detect the occupancy. One variable reluctance sensor is placed near the roller of the seat belt webbing. One touch sensor is placed at the buckle of the seat belt. Ones all doors are locked, occupancy is detected, ones the belt webbing is stretched and buckled the respective sensor sends signal to the micro controller placed under the seat , which passes current to the wheel locking mechanism. Due to which wheel lock is removed, which leads to activation of buckle lock and hence the seat belt buckle gets locked. An electromagnetic phenomenon is used for locking mechanism.

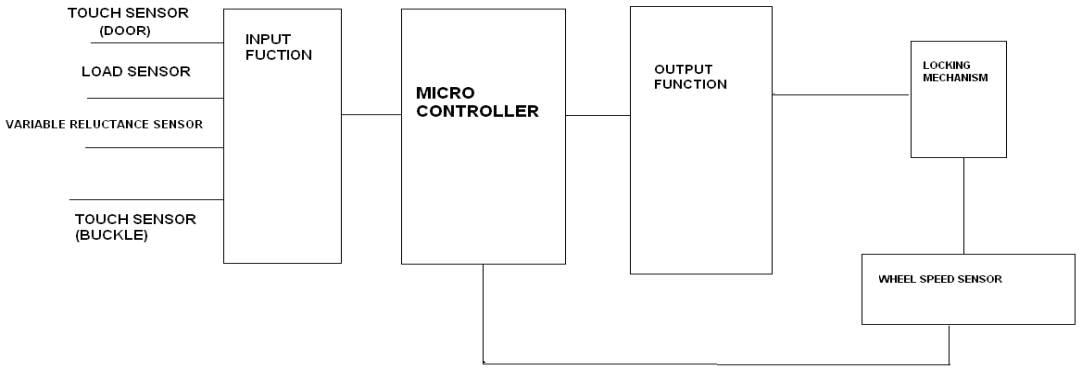


Fig. 2: block diagram of proposed system.

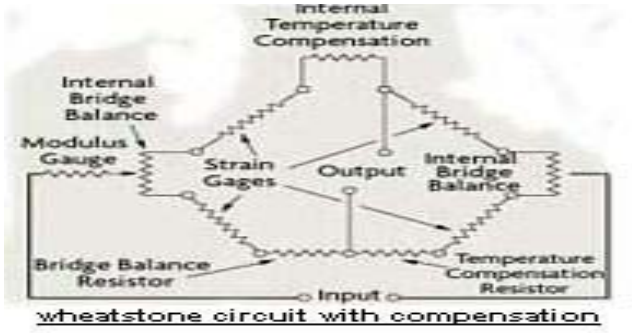


Fig. 3: Load sensor.

There will be one speed sensor place at the wheel, which will continuously give feed back to micro controller about the speed of the vehicle. If speed is above zero and seat belt is locked than vehicle will move ahead. And if speed is above zero and seat belt is unlocked than wheel lock will be activated and vehicle will not move ahead.

There will be load sensor placed at the front and rear bumpers and side skirt of the vehicle. During collision these sensors will be activated. As these sensors get activated current will be stopped due to which seat belt lock with be removed and wheel lock will be activated. Due to which injured occupant can get out of the vehicle without any difficulty.

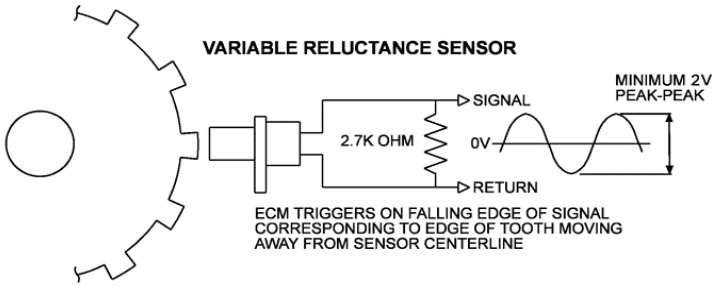


Fig. 4: Position sensor.

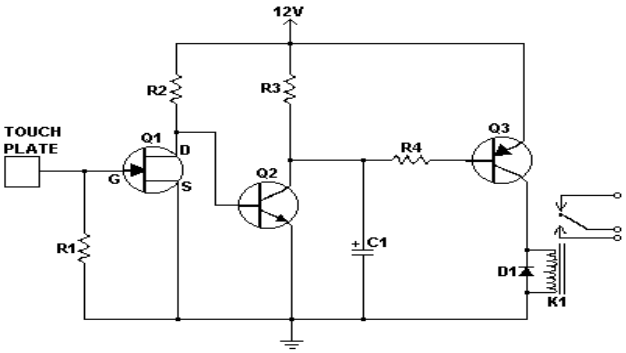


Fig. 5: Touch sensor.

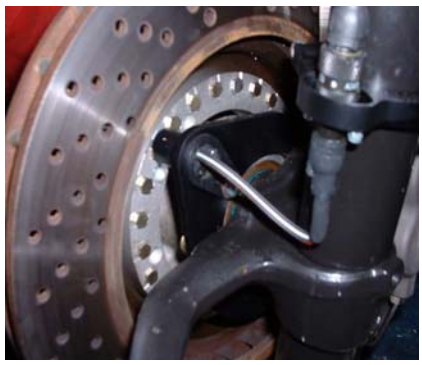


Fig. 6: Wheel speed sensor.

5. Construction

1) A 12v/1.3Ah dry cell battery is the main power source for the system.
2) The controlling board compromises of 3 relays, 2 are used for the lock and 1is used for the vehicle movement.
3) 12v lines are connected to alternative poles of two relays, hence for moving the motor in clock wise direction, both relays are turned on.
4) Relays are driven aptocouplers which isolates the 5v logic at the microcontroller to that of 12v logic.
5) A LDR sensor is used for sensing the insert of seat belt, when belt is on. Output of LDR is high, otherwise it is low.
6) A 100rpm geared motor based sample vehicle is used to demonstrate the movement.
7) Open source arduino board is used for controlling the entire system. It is powered by ATMeg328 micro-processor.

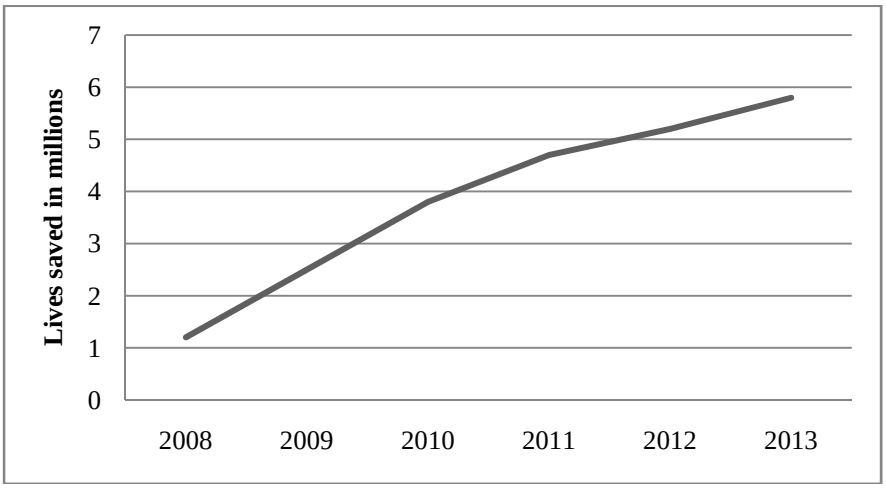
Base consists of a chassis with 3 wheels and 1 geared motor with 100rpm.the motor poles are connected to each other with anode ground poles are shorted. When anode is supplied with 12v these motors moves anticlockwise otherwise clockwise. The same principle is applied to all other assembly motors. The reason for selecting DC motor for the chassis is geared motor takes more load and start and stop are without jerk which is important for the base of the motor.

Advantage

- The system brings more safety to driver and occupants of the vehicle.
- The system provides option of coming out of vehicle without ignition being turned off.
- The system gets the supply through 12v battery which can be easily put inside any vehicle.
- The system response time is barely 2ms which makes it respond faster.
- The system allows the driver to operate AC,musical system and other electrical equipments without wearing the seatbelt wearing seat belt which is not possible in those vehicle which operates on similar systems.
- This system makes seat belt wearing mandatory.

6. Results

In above seat belt mechanism using sensor, micro controller and locking mechanism, where in the vehicle does not move until and unless seat belt is locked. The locking mechanism works on the principle of electromagnetism.The wheel lock mechanism is placed near the disk. Whenever wheel lock will be activated, it will hold the disk due to which vehicle will not move ahead. Seat belt lock mechanism is placed inside the buckle of the seat belt. Whenever current is passed the seat belt lock will be activated and hence the occupant will not be able to withdraw the seat belt from the buckle.



Lives saved using seat belts

7. Conclusions

In modern automobiles, all the vehicles come equipped with microcontrollers and DSP processors for various sensing and control operations. Taking advantage of this phenomenon. We have developed a mechanism for providing drive with more security through an extra layer of lock near the seat belt buckle. The driver is not permitted to drive without the seatbelt. This reduces the risk of fatality to the driver and the occupants. The ignition locking is available in several high end vehicles but additional locking system near the seat belt buckle, which does not permit driver to remove the lock while driving is missing in such systems. Through our testing we have provided mechanism for safety even during conditions where a driver applies break, the system can be further tested by incorporating the same in real vehicles.

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