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Developing safety system for monitoring seat belt and controlling speed accordingly to avoid fatal injuries

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Abstract- Major causes of death in road accidents are carelessness in safety while driving. In 2012, more than half of all people who died on Utah's roadways weren't buckled [1]. Hence wearing seat belts might have reduced serious crash-related injuries and saved life.
Hence "Driver Assistive Safety System" (DASS) comprises of techniques which inculcate the mandatory safety precautions via alarm, visual indicator, ignition and speed control. This paper describes safety system which ensures that the driver and co-passenger wear safety seat belt while driving a car. The driver assistive safety system works on 'ignition interlocking" and "speed control" concept.

Index Terms: Driver assistive system, Ignition interlocking, Mandatory seat belt; System to avoid major injuries using seat belt;

I. Introduction

Research in the UK [2] has shown that wearing a seat belt reduces the risk of fatal injury to front seat passenger car occupants by 45%, and risk of moderate-to-critical injury by 50%. However as per Ontario Ministry of transportation [3], seatbelts are not required for the passengers engaged in work that requires them to exit from and re-enter the vehicle at frequent intervals (must travel less than 40kmph). Hence this paper includes city mode option which restricts the car at predefined minimum speed if person is not wearing seat belt.

TABLE 1: PROTECTION BY SEATBELTS [4]

Vehicle	Occupant	Protection Device	Effectiveness in Preventing Fatalities
Car	Driver	Lap/ shoulder belt	42 +/- 4%
Car	Right front passenger	Lap/ shoulder belt	39 +/- 4%
Car	Left rear passenger	Lap belt	19 +/- 10%
Car	Right rear passenger	Lap belt	17 +/- 9%

Despite of laws on the use of seat belts, a lot of people don't like wearing them due to various reasons. Following are the common reasons:

- Drivers and passengers think that wearing a seat belt is not that important, especially when driving in short distances or when the traffic is visibly light.
- Tends to forget to wear them, especially when they are on the rush.
- People don't make it a habit to wear seat belts.

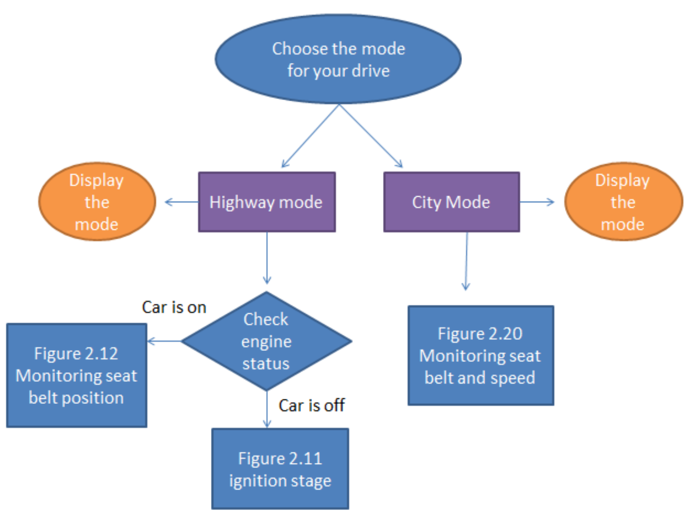
II. METHODOLOGY:

Impact force when car collides is given by:

$$F_{avg} = m*v^2/(2*d)$$

Where, F_{avg}: Impact force, m: Mass of vehicle, v: Velocity of vehicle, d: stopping distance

If seat belt is buckled up than the stopping distance of driver would be extended to amount of stretch of belt. Hence this would reduce the impact force.



At the beginning when passenger or driver enters the car, DASS asks to choose the mode. It would respond as per flow chart prescribed in figure 2.01
Figure 2.01: Flow chart for mode selection and execution

Inputs:

The whole DASS would be working on the DASS circuit shown in figure 2.02. Inputs to Arduino ATmega2560 microcontroller would be from load cell, photoresistor sensor and wheel speed sensor. After processing the inputs as shown in flow charts microcontroller would give different outputs. Microcontroller would be controlling and giving outputs to devices.

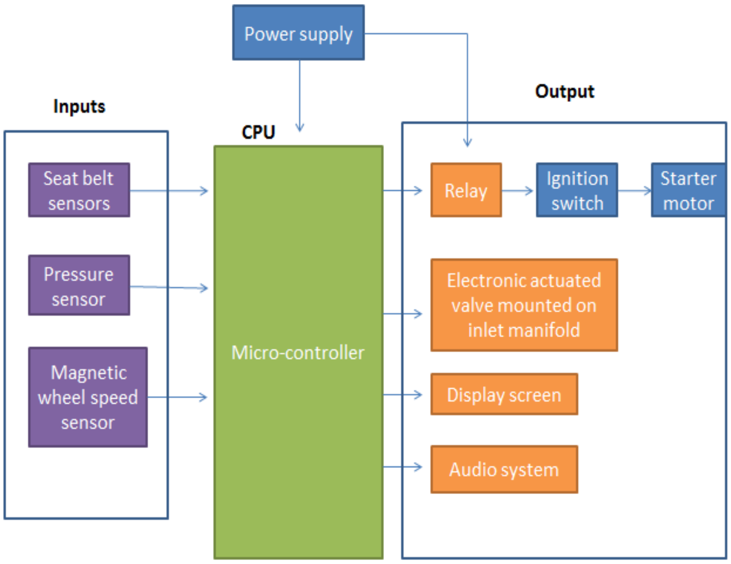
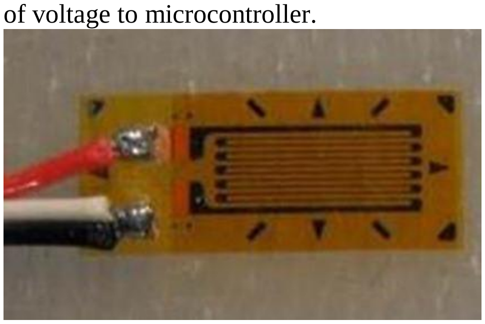
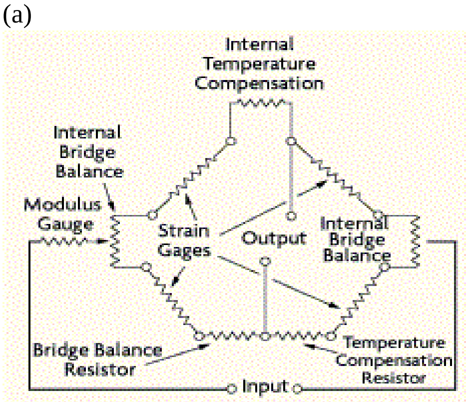


Figure 2.02: circuit of DASS

Figure 2.03 shows load cell. It is mounted below seat linings. Presence of co-passenger/s would give electric signal in form of voltage to microcontroller.



(a)



(b)

Figure 2.03: (a) load cell[6], (b) Wheatstone Circuit[7]

As shown in figure 2.04 wheel speed sensor would give speed of vehicle by calculating r.p.m of the wheel. For detecting whether seat belt is installed or not, photoresistor is placed. When person buckle up the seat belt, output is high, otherwise it is low. LEDs are installed in every circuit wherever sensor gives feedback. So it became easy to trace the faults.

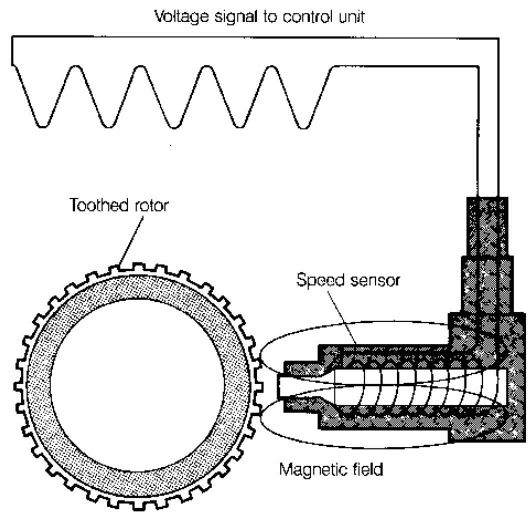


Figure 2.04: Wheel speed sensor [8]

Outputs

Electronic actuated motorized valve mounted on inlet manifold would be used to control the flow by quality or quantity governing. The microcontroller would be receiving feedback from different sensors. Other output devices are display screen and audio system.

2.1 HIGHWAY MODE:

System only allows car to get started if driver and co-passenger (if present) buckle up the seat belt in highway mode.

Figure 2.11 displays the flow chart of Highway mode when the engine is off. Initially the ignition circuit would remain open. The connection between starter motor and battery would be connected by relay which would idly keep circuit open. Relay would be operated by microcontroller. Microcontroller would be getting various inputs and would process as per flow chart shown in Figure 2.11. Driver would be only able to start the car if he/she and co-passengers (if present) wears seat belt.

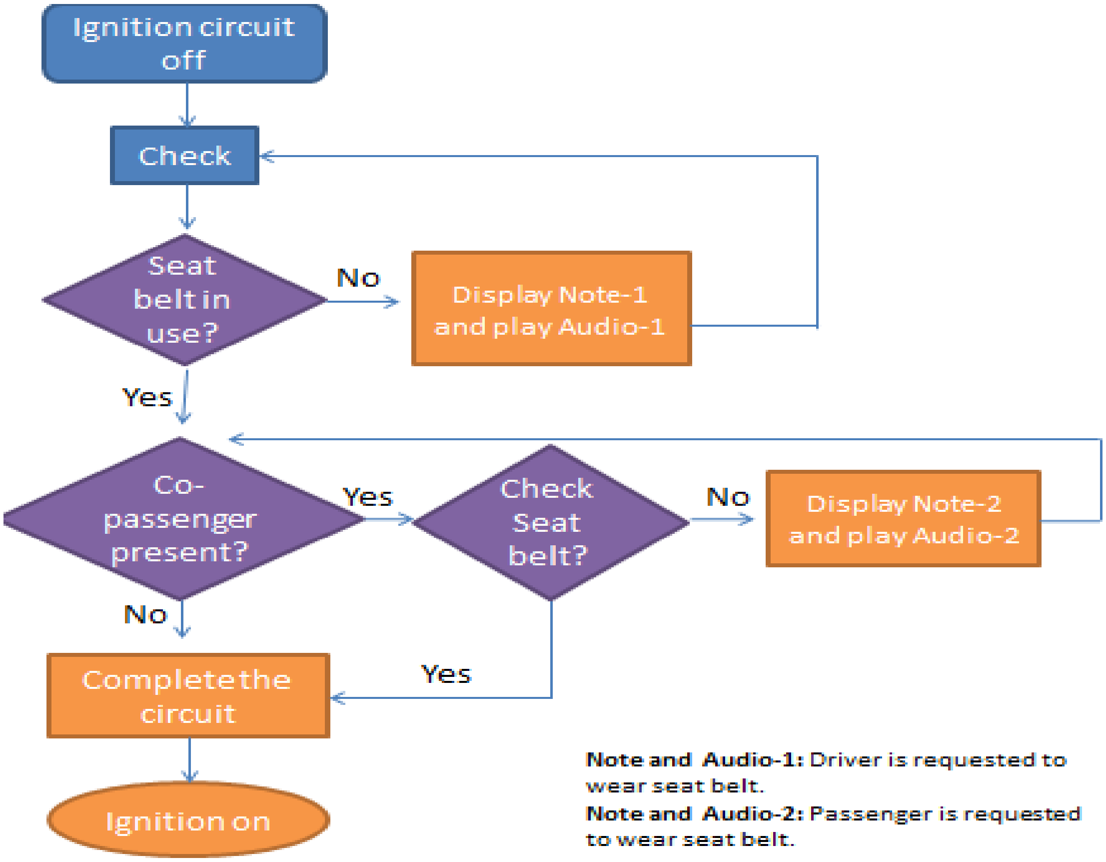


Figure 2.11: Flow chart of Highway mode when engine is off

To check the seat belt during running condition, DASS follows the flow chart as shown in figure 2.12. If they unbuckle the seat belt, DASS would alert driver through display screen and audio system. A timer of 60 seconds would be provided in which driver or co-passenger or both have to buckle up their seat belt. Failure to do so would result into limiting car's speed to specified speed of 20 km/hr [5] if found above it. The speed would be limited by actuating valve mounted on inlet manifold. Microcontroller would be getting feedback from speed sensor. Parking light would alert the surrounding vehicle about slowing down of car. Though driver tries to accelerate the car, motorized valve will automatically adjust the quality and quantity of fuel to keep car within limit.

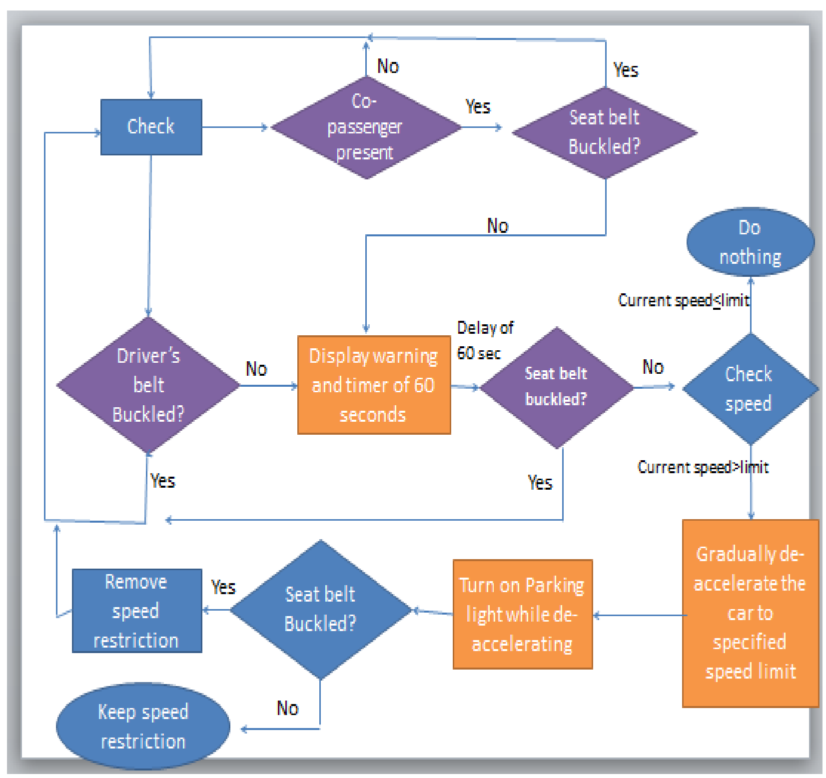


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Figure 2.12: Flow chart during ignition stage

2.2 CITY MODE

In some case person have to travel short distance or have to frequently enter and exit the car, or travel in traffic areas. In the entire situation car is driven slowly. A study suggests [5] arm resisted motion reduces injuries of occupant rather than seat belt at low speed (20km/hr). Hence seat belt is not required at low speed. So Driver Assistive Safety System provides city mode.

City mode system limits the speed of the car to specified speed of 20 km/hr by controlling quality and quantity of fuel into engine. It allows car to start without buckling seat belt. Driver can shift to highway mode by buckling up the seat belt any time.

As shown in figure 2.20, microcontroller processes the signals. If passenger wish to speed up the car than he can put on the seat belt and highway mode option gets activated on the screen. So he can choose it and would be directed in highway mode.

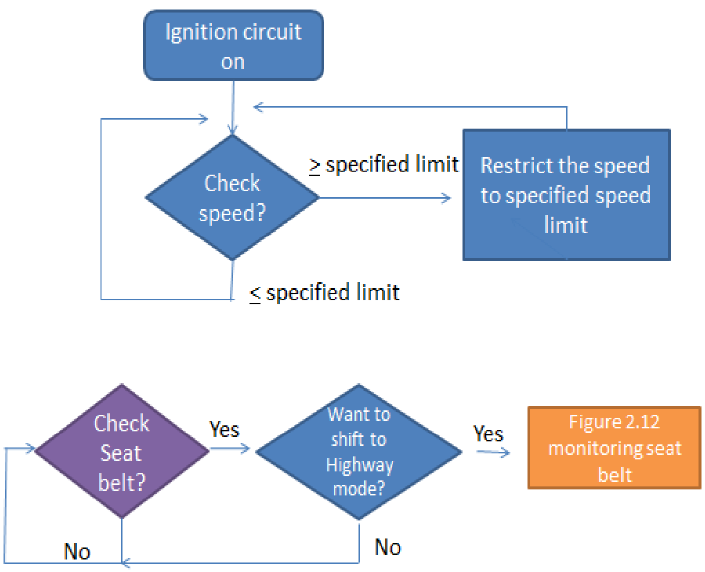

Figure 2.20: Flow chart of city mode

IV. ADVANTAGES:

- DASS can be installed in any existing car without making major changes.
- DASS consists of two modes which give flexibility to the driver and also overcomes few reasons of not wearing seat belt.
- DASS has warning system which alerts driver and give 60 seconds before taking any action. Hence it gives time to driver to take decision and doesn't abruptly takeover the control.
- While decelerating it switches on parking lights which indicate that car will be slowing down, hence would alert surrounding vehicles.
- It has continuously monitoring system, that monitor the conditions of seat belt, even during drive.
- It has the ability to shift between two modes.
- Apart from visual display, it also interacts through voice messages.
- System consists of troubleshooting, which displays the instructions and have backup for any failure.
- System is very simple and economical. It can be incorporated in any car.

V. CONCLUSION:

Seat belt as a safety feature reduces chances of major injuries or even loss of life in an accident, hence to make sure that people wear seat belt; Driver Assistive Safety System has been proposed. Considering type of traffic prone to accident, two mode of Driver Assistive Safety System have been devised.

VI. FUTURE SCOPE

ECU can be directly programmed replacing microcontroller in newly developed car which would further make system economical by removing requirement of motorized valve

REFERENCES:

[1] Statistics of Utah's roadway accident. http://ut.zerofatalities.com/prevention_buckling.php

[2] Article showing that seat belt reduces fatal injuries. http://timesofindia.indiatimes.com/india/Gopinath-Munde-Gopinath-Mundes-death-rear-seat-belts-Harsh-Vardhan/articleshow/36069870.cms? As per TOI article published on Jun 5, 2014.

[3] Ontario Ministry of transportation rules. http://www.mto.gov.on.ca/english/safety/safe-driving-practices.shtml

[4] Leonard Evans, "The Science of Traffic Safety", The Physics Teacher 26, October 1988, Page 431, Table I.

[5] Yongchul Kim, Chulhue Park, Youngil Youm, Sungchul Choi, Sungjun Han, Hanil Bae "BIOMECHANICAL MODEL OF HUMAN-LIKE ARM FOR A CRASH TEST"

[6] Image of load cell. http://engineeringsport.co.uk/2012/08/16/how-does-a-smart-floor-work/

[7] Image of load cell. http://www.omega.com/literature/transactions/volume3/load.html

[8] Image of speed sensor, http://picsant.com/314073083-magnetic-speed-sensors.html

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