Maestría en Ingeniería en Automatización de Procesos Industriales

Title

Driver torso restrain through seatbelt

Author

Jesús Macuilt Macuilt

Contributor

Antonio Benítez Ruíz

Ernesto Castellanos Velasco

Luis Ignacio Olivos Pérez

May-August 2016

Driver torso restraint through seatbelt

Jesus Macuilt Macuilt, Antonio Benitez Ruiz, Ernesto Castellanos Velasco, Luis Ignacio Olivos Pêrez

Maestria en Ingenieria en Automotización de Procesos Industriales

{jesus.macuilt,antonio.benitez,ernesto.castellanos,luis.olivos}@uppuebla.edu.mx

Tercer Carril del Ejido Serrano S/N, San Mateo Cuanalá, Juan C. Bonilla, Puebla, México

1. Introduction

Modern cars come equipped with devices designed to prevent accidents and protect passengers when they occur [1]. These devices generally fall under two categories: active driving safety and passive driving safety.

Active driving safety refers to devices and systems that help keep a car under control and prevent an accident. These devices are usually automated to help compensate for human error: the single biggest cause of car accidents.

Passive driving safety refers to systems in the car that protect the driver and passengers from injury if an accident does occur.

The most important part of passive driving safety is the seatbelt system. Nowadays, no car exists that does not have the seatbelt system. From the standard seatbelt system, other safety systems have emerged, for example, the load limiter, the retractor, the airbag, and the pretensioner [1], which is the purpose of this project.

2. Objectives

2.1. General objective

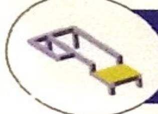
To avoid angular displacement the torso of a driver during deceleration of a vehicle

2.2. Specific objective

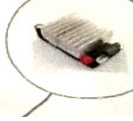
- To analyze a rigid body simulation of a driver who decelerates a vehicle in order to understand force, angular displacement and torque that affect the torso
- To design a frame and a mechanism that will allow the seatbelt to automatically tense over the torso as a function of angular displacement
- To implement the restraints control process of the torso

3. Method

To develop the driver deceleration simulation



To design the frame and mechanism in CAD



To integrate the motor and driver for restraints control process of the torso

$$I_G = m(k_G)^2 \quad \text{(Ec 1)}$$
$$\sum F_x = m(a_G)_x \quad \text{(Ec 2)}$$
$$\sum F_y = m(a_G)_y \quad \text{(Ec 3)}$$
$$\sum M_A = \sum (M_K)_A \quad \text{(Ec 4)}$$
$$\sum M_G = I_G \ddot{\theta} \quad \text{(Ec 5)}$$

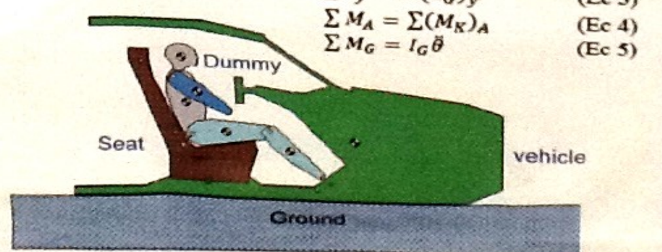


Figure 1. Model Simulation [2], [3], [4]

4. Results

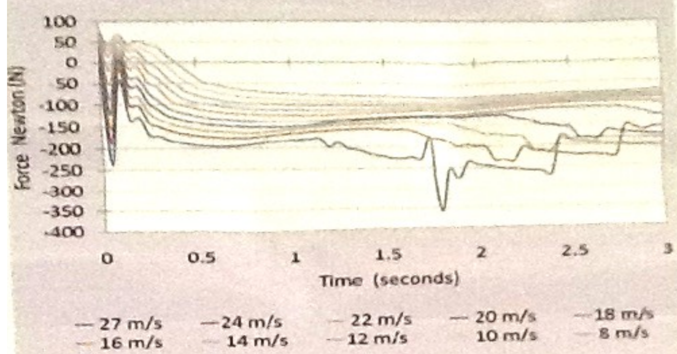


Figure 2. Generated forces by the torso during deceleration of a vehicle

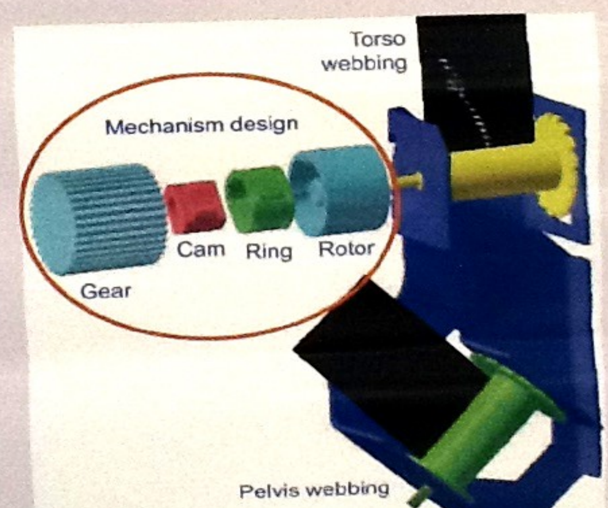


Figure 3. Mechanical design for the seatbelt that use two webbing which will allow tense only the torso webbing [5]

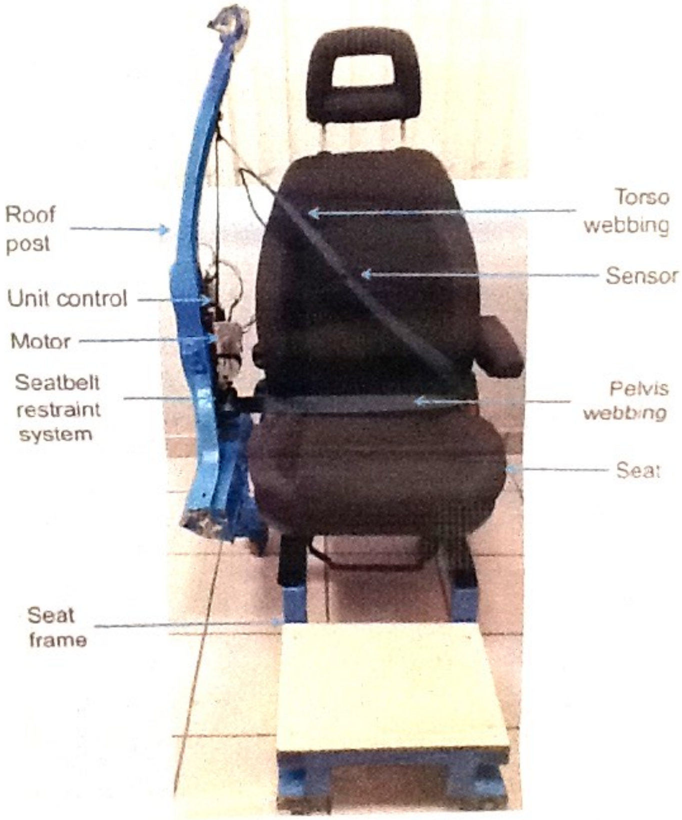


Figure 4. Prototype finished

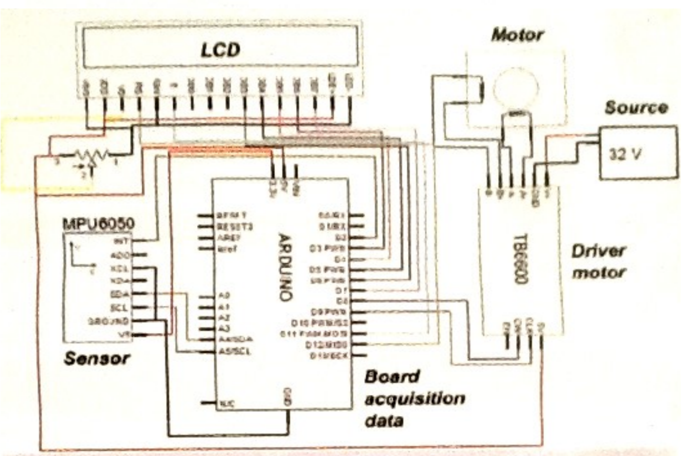


Figure 5. Electronic circuit of prototype of the restraint system for the torso

Figure 6. Normal driving position

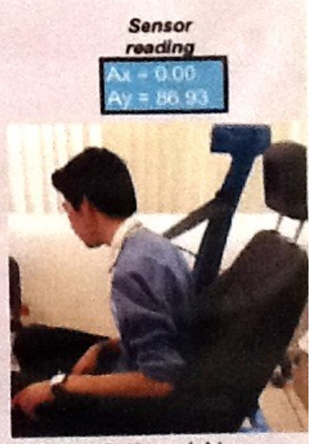


Figure 7. Normal driver movement during car deceleration [5]

5. Conclusion

- ➢The simulation was used to determine the tension force that the mechanism must support
- ➢The simulation shows that in the period of time 0.5 to 1 second the device could act, due to the behavior torso is almost linear with a maximum force range of 200 N
- ➢The simulation was used to determine the motor parameters
- ➢The mechanism showed that it can be improved, to be able to properly tense the torso webbing
- ➢The prototype shows that it is possible to have an electric pretensioner that operates in active driving safety, as a preventive action against a possible crash.
- ➢The prototype shows that could be implemented this system on the vehicles, in order to improve the driver and passengers safety.
- ➢The prototype shows that it is possible to know the position of the driver at any time through the seatbelt.
- ➢The first objective is 100% complete
- ➢The second objective is 100% complete
- ➢The third objective is 80%

6. References

[1] O. Barrera, J. Antoni, *Sistemas de Seguridad y Confortabilidad*, Madird, España: Paraninfo, 2012

[2] R.C. Hibbeler, *Ingenieria Mecánica Dinamica, 7ª edición*, Nueva York: Prentice Hall, 1995

[3] Ewout van der Laan, *et al*; "Control-oriented Modelling of Occupants in Frontal Impacts," International Journal of Crashworthiness; vol. 14, no. 4, pp. 323-337, 2009

[4] Mohannad Murad, Manohar Das, Ka C Cheok, "Modeling and Simulation of an advance Intelligent Restraint System", *IEEE SysCon 2009 3dr Annual IEEE international System Conference* 2009, Vancouver, canada, March 23-26, 2009

[5] TRW, "Active seatbelt retractor," March 2017. [Online]. http://www.autobeatdaily.com /articles/active-seatbelt-retractor

[6]Autoliv, "Active Seatbelt," March 2017. [Online]. https://www.autoliv.com/products ProductsAndInnovations/PassiveSafetySystems/Pages/Seatbelts/ActiveSeatbelts.aspx

Acknowledgements

To CONACYT, for the scholarship of Master of Engineering in Industrial Process Automation at the Universidad Politécnica de Puebla, awarded to Ing. Jesus Macuilt Macuilt with No 348118

2016