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Ignition Interlocking Seat Belt

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Abstract - *In the current era safety is a must for all. But still, we all never pay attention to the safety features which were installed in our cars. Some smart people think that they have fooled the system which is meant for their safety, but they do not know that they are compromising their safety. But as to follow all the rules, they try to avoid them. This is the main reason that out of 45 deaths in road accidents, more than 50% of deaths due to not wearing a seat belt. Many technologies exist and some of them are under use also, but every system has its own limitations. The system which we have proposed surpasses the limitations of the pre-existed systems. The proposed system aims to utilize the full potential of seat belts so that, the safety of the passenger is ensured. The system proposed here uses various sensors to collect data of various parameters to detect occupant and track the status of the seat belt. Sensors like load cell and IR temperature sensor confirm a human presence in the vehicle by sensing the human body's weight and temperature. While sensors – reed switch, RFID tag and reader, and IR sensor monitors and track the status of the seat belt and ensures that it is used properly. All data from these sensors are sent to a microcontroller, which only lets the ignition of the engine occur if the occupant present properly buckles the seat belt. An additional security feature is included in this system that is owner authentication that captures the image of the driver and compares it to the others that are present in the database if the match found then it let ignition otherwise warn the owner and lock the ignition.*

Key Words: **Ignition Interlocking System, IOT, Seat Belt, Passenger Safety, Seat Belt Monitoring, etc**

1. INTRODUCTION

In the present era the safety while driving any four or more wheeled vehicles every 10th person never pays attention to the safety features that the car manufacturers had installed to maintain the safety of the user. Even after so much of awareness programs the same mistake of not wearing the seatbelt repeats. Many laws are being formed in order to keep vehicle passengers safe and increase survivability in any case of accident. But due to insufficient enforcement of these laws and lack of self-awareness many safety features are undermined and under-utilized by vehicle owners. This leads to fatal injuries and, in some case, loss of lives in an accident. In order to reduce the death toll, which increased, due to underutilization of safety feature like seat belt, we have tried to design a system, IoT based, that encourage vehicle user to wear seat belt properly throughout the ride. It will encourage people to abide the laws that are formed for their own safety. If we take a look at the compliance rate for using seat belts, in compare to European Nations and US where the rate is 98 per cent and 85 per cent respectively, in India that stands at a disappointing rate of 25 per cent only. According to the research from New Delhi, by MARUTI SUZUKI that those 75% passenger vehicle users India don't wear seat belts leading to 15 deaths every day [1]. According to the ministry of road transport and highways, in 2016, 1.5 lakh people died in road accidents. A total of 5,638 people died in 2016 due to non-usage of seat belts [7][8]. Looking at the trends of seat belts usage and present scenario of road safety, it can be said that there is an obvious need of some arrangements that can help to enforce the rules and also appeal drivers to use seat belts more often.

Main objectives of our project are to design a hardware system/setup that can be easily integrated into the frame of the vehicle during time of manufacturing or after vehicle is being bought by owner. And also, it aims to improve the safety and survivability rate of passengers and effectiveness of the seat belts of vehicles.

2. RESEARCH AND FINDINGS

In order to understand the problem domain in a better way we carried out research, in which we studied various cases, research papers, previously developed systems and also that are currently in use. Many accident cases were examined by us. Reasons behind injuries that happened during these accidents and failure of safety features were investigated [5]. Further, factors for underutilization of seat belt were classified which includes weak legal enforcement, negative image perceptions, some don't consider seat belts as a safety device and others don't use it as their family and friends don't wear or don't encourage its usage.

While evaluating research papers, we came to know that there were some ideas and also some research had been done in this area to make cars safer. But those ideas and systems that were proposed in those papers were neither implemented nor tested in real and practical world [2][3]. Some had just carried out some theoretical studies and researches. While some were only proposed theoretically only for study and research purpose [3][4]. Among those few had tested partial functions of their proposed systems by either making a prototype or using any simulation software [1][6]. In our research we came to know that around 1970 some car manufacturers tried to implement ignition/transmission interlocking system to make drivers wear seat belt. But due to lack of advancement in sensors and micro controller back then, these systems did not work well in real time situations [5].

During our research, we found that good systems exist and are also implemented in the cars in order to provide safety assurance to user [9]. But many users of the cars always try to fool these systems in many ways as they don't want to wear the seat belt all the time. The current beeping system which beeps on not wearing a seat belt still has limitations; the seat belt can be buckled up by passing it between the spaces of seat and the back side of passenger. If the seat belt is passed and bucked from behind the system is fooled. Due to like this limitation a better, intelligent and full proof system is required to counter the laziness of the car users. Our system is based on one aim that by any means necessary the car user must wear seat belt or else system won't allow the ignition of car's engine. As per our research and data collected, we had tried to cover all limitations of the pre-existed system. And for this we understood the working principle of it, seat belt. Various sensors to monitor status of belt and its proper use are being search over internet by studying there working principle.

3. WORKING METHODOLOGY

A prototype is being made to imitate the working of the proposed system. This prototype helps to better understand the working principle of the proposed system. It takes inputs in real time and process these inputs on the go and provide essential instructions for drivers and other occupants. Various physical parameters are measured to provide necessary inputs to the system.

Firstly, load cell and temperature sensor detect that a human has sat on the seat by collecting and processing data, by a microprocessor, like weight and body temperature of occupant. After confirming a human on seat, different sensors- reed switch, Radio-frequency IDentification (RFID) tag and reader, and InfraRed (IR) sensor combined together, monitors and tracks the status and proper engagement of the seat belt. Data of different parameters collected through these sensors is examined and processed by an on-board microprocessor. Based on the data system confirms occupant presence and proper use of seat belt. If occupant don't buckle seat belt or try to fool the system by buckling it in false way, then the system won't let occupant to start the engine. The system will give warning and will instruct the occupant to wear the seat belt in proper way. Only after when occupant has put on the seat belt over them properly this device will let the driver turn on the ignition and start the engine.

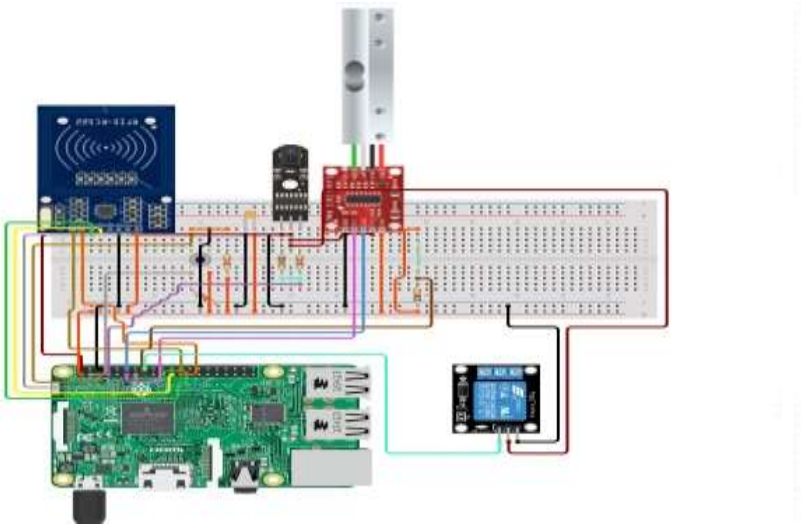

Fig -1: Circuit Design

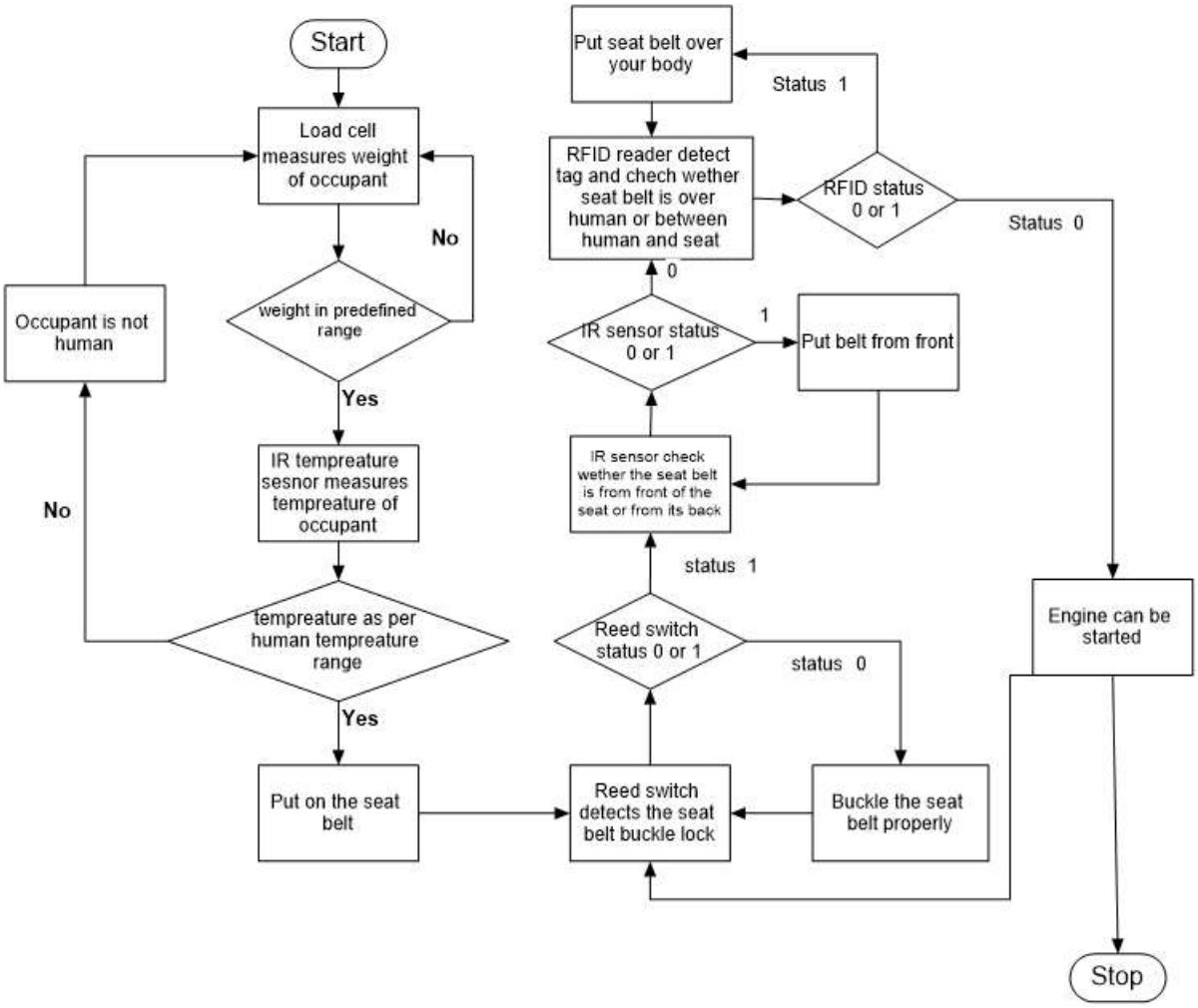

Fig -2: Flowchart

Following are the hardware components that are being used to make this prototype and to explain the working of the proposed system in a practical way. Here are some sensors and a single board microcomputer that is used for prototyping.

1) Raspberry Pi

The Raspberry Pi is a small single-board computer developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools [10]. Here it is used to gather data from all the sensors. Every sensor is connected to pi using its General Purpose Input Output (GPIO) pins. Sensors and Raspberry Pi communicate with each other using serial mode for data transfer. Relay is also connected to board through these GPIO pins. After processing data from sensors, it plays instructions as per need of situation. When all parameters checked and they are as per rules then board send signal to the relay and let the driver start the engine.

Fig -3: Raspberry Pi 3 with all sensors connected through GPIO

2) Reed Switch

The reed switch is an electrical switch operated by an applied magnetic field. In its simplest and most common form, it consists of a pair of ferromagnetic flexible metal reeds contacts in a hermetically sealed glass envelope. The contacts are usually normally open, closing when a magnetic field is applied [11]. The reed switch is placed on the female buckle end and a magnet on the male buckle end. When seat belt is not buckled, the switch would be in open state and thus its output would be '0'. But while seat belt is buckled, the magnet on the male buckle end will induce magnetic effect on the switch and the contacts will be closed which returns '1' as an output. This way proper engagement of seat buckle can be confirmed.

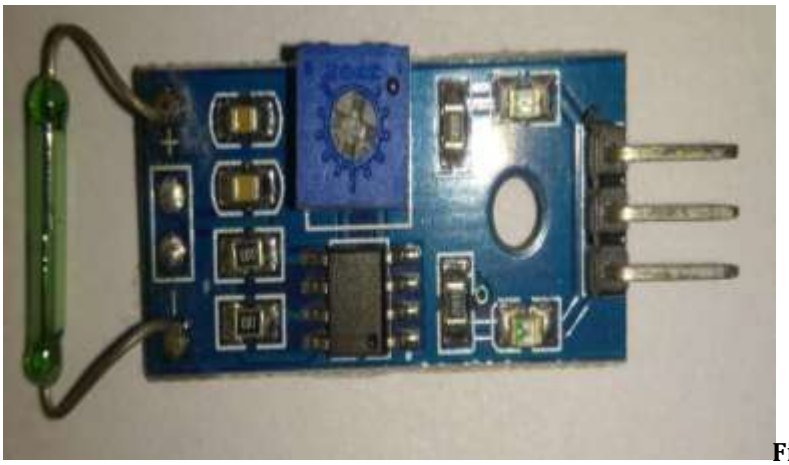

Fig -4: Reed Switch

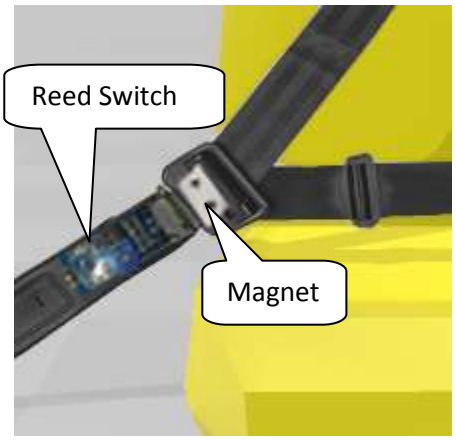

Fig -5: Reed Switch and Magnet on Seat Belt Buckle

3) Load Cell

A load cell is a type of transducer, specifically a force transducer. They convert a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally [12]. It is used to gather the data regarding the weight of the driver or occupant, here it measures weight through compression. It would be placed in the bottom part of the seat so that measured quantity would be more accurate. But being an analog sensor and having an output of mV, it needs an amplifier and analog to digital converter. For this purpose, we used a HX711 amplifier and converter board to connect load cell with raspberry pi board.

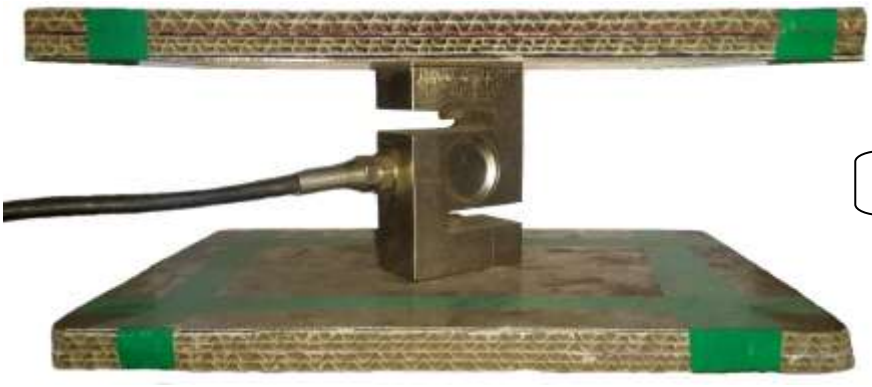

Fig -6: Load Cell

Fig -7: Load Cell's respective position

4) IR Temperature Sensor

IR temperature sensors sense electromagnetic waves in the 700 nm to 14,000 nm range. These sensors work by focusing the infrared energy emitted by an object onto one or more photo detectors [13]. It is attached on the upper anchoring point, that is at the height of the head rest, in a 3-point seat belt. From this place it is aimed at the occupant's face to measure the body temperature of the occupant and send that directly to the micro-processor in order to verify the presence of a human on the seat.

Fig -8: IR Temperature Sensor

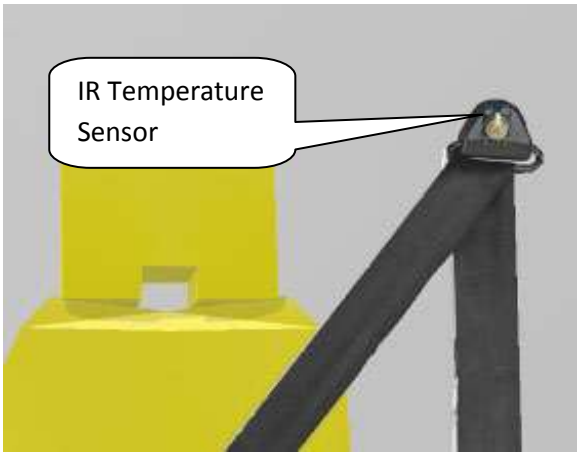

Fig -9: Temperature sensor attached in car

5) IR Sensor

An IR sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of detecting an object and distance between sensor and object [14]. It's sensitivity to detect any object at different distance can set through a variable resistor. It is placed on the shoulder of the seat, facing backward so that it can detect the seat belt when it is buckled over the back of the seat. If seat belt is pulled over from the back of the seat, the IR sensor detect it and pass '1' as output to the board.

Fig -10: IR Sensor

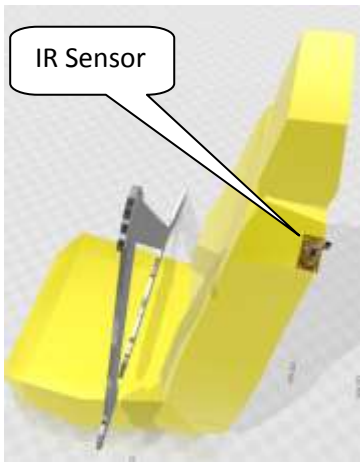

Fig -11: IR Sensor on Seat

Fig -12: Falsely buckled seat belt

6) RFID Tag and Reader

RFID uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. RFID is one method of automatic identification and data capture (AIDC) [15]. A combination of RFID reader and tag is used to confirm that belt is worn in proper way. While reader is placed in back rest of seat, the tag is placed on the seat belt itself. When any occupant tries to fool the system and buckle the seat belt by pulling it from between his back and seat, then that tag on belt is detected by the reader and this information is then sent to micro-processor for further action.

Fig -13: RFID Tag and Reader

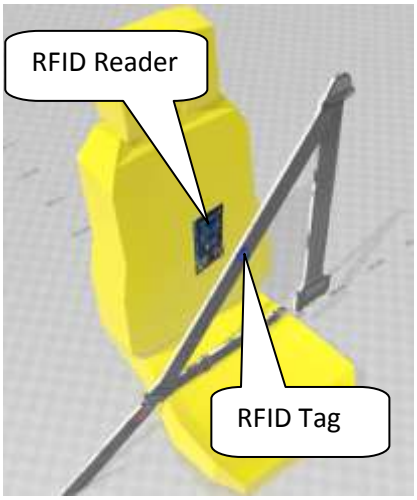

Fig -14: RFID integrated in seat

7) Relay

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal [16]. This relay is placed in between the ignition circuit of the vehicle. Due to the relay the ignition circuit remains in open state unless the micro-processor sends a signal to the relay to close the circuit so that engine can be started.

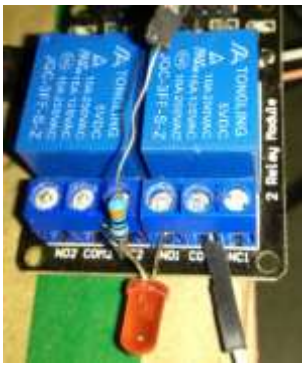

Fig -15: Relay

4. CONCLUSIONS

Advantages of the proposed system:

- Encourage drivers to use seat belts.
- Reduce chances of fatal injuries at time of accident.
- This will help to increase the survivability rate of the passengers in time of an accident.

Our system takes data from sensors and encourage occupant to properly wear the seat belt. It will help to reduce life threatening injuries during accidents. Our system will also have an ability of systematically slowing down vehicle if an occupant removes seat belt when vehicle is cruising at high speed on the highway. This subsystem will slow down vehicle at a threshold speed which is pre-determined in the system.

REFERENCES

[1] Sengupta, Ramarko, 2018. 75% vehicle users in India don't wear seat belts leading to 15 deaths evry day: Study [online] (Updated 22 August 2018) Available at: https://timesofindia.indiatimes.com/business/india-business/75-vehicle-users-in-india-dont-wear-seat-belts-leading-to-15-deaths-every-day-study/articleshow/61660232.cms

[2] Bhardwaj, D.R., and Jogdhankar, S.R., 2014. Seat Belt Safety Features Using Sensors, International Review of Applied Engineering Research 4(4), pp. 349-354.

[3] Nandakumar, C., Muralidaran, G. and Tharani, N., 2014. Real Time Vehicle Security System through Face Recognition, International Review of Applied Engineering Research 4(4), pp. 371-378.

[4] Hawas, Y.E., and Alam, M.D., 2009. Evaluation of Seatbelt and Airbag Effectiveness in Reducing Severe and Fatal Injuries in the UAE, Journal of Traffic and Logistics Engineering 3(2), pp. 87-93.

[5] Vyas, M., Rajee, M.K., Warghade, S.S. and Arunkumar, K.R., 2017. Active Seat Belt System, IEEE 3(17), pp. 1-5.

[6] Afify, M., Abuabed, A.S.A. and Alsbou, N., 2018. Smart engine speed control system with ECU system interface, IEEE International Instrumentation and Measurement Technology Conference (I2MTC), pp. 1-6.

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

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

[9] Autoliv. Autoliv seat belts fitted to new Renault Megane. AutoTechnology, August 2002.

[10] https://en.wikipedia.org/wiki/Raspberry_Pi, [04 October 2019].

[11] https://en.wikipedia.org/wiki/Reed_switch, [04 October 2019].

[12] https://en.wikipedia.org/wiki/Load_cell, [03 October 2019].

[13] https://www.surecontrols.com/infrared-temperature-sensors/, [05 October 2019].

[14] https://www.azosensors.com/article.aspx?ArticleID=339, [03 October 2019].

[15] https://en.wikipedia.org/wiki/Radio-frequency_identification, [04 October 2019].

[16] https://en.wikipedia.org/wiki/Relay, [06 October 2019].