UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT AND ANALYSIS OF CAR SAFETY BELT ALARM SYSTEM USING INDUCTIVE SENSOR TO DETECT BELT LENGTH

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Refrigeration and Air-Conditioning System) with Honours.

by

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ABSTRAK

Dalam meniti arus kemodenan kini, dunia diperkenalkan dengan pelbagai jenis hasil pemikiran manusia yang begitu kreatif dan inovatif dari segi sains dan teknologi. Ini bertujuan untuk memudahkan sesuatu beban dan meningkatkan lagi tahap keselamatan dalam sesebuah kenderaan. Projek ini memberi tumpuan dari aspek teknologi berkaitan dengan keselamatan dalam kenderaan iaitu dengan menggabungkan tali pinggang keselamatan dan sensor induktif. Seperti yang sedia maklum, tali pingang keselamatan ini direka bentuk untuk memastikan pengguna kenderaan boleh mencegah bahaya yang boleh disebabkan daripada pelanggaran atau berhenti secara tiba-tiba. Ia juga sistem keselamatan yang sangat penting dan dikategorikan sebagai keselematan pasif dalam sesebuah kenderaan. Masalah utama berkaitan dengan tali pinggang keselamatan ini adalah kebanyakan pegguna tidak memakainya semasa memandu dan ianya boleh menyebabkan penggunanya mendapat kecederaan parah atau kematian jika berlaku kemalangan. Sesetengah orang menghiraukan bunyi penggera keselamatan sehingga beberapa waktu sistem itu akan berhenti sendiri, membuat tipu helah seperti memakai tali pinggang keselamatan di belakang penggunanya dan hanya memasang plat besi tanpa tali pinggang keselamatan. Projek ini dilakukan untuk mengatasi masalah tersebut. Metodologi projek ini dibuat berdasarkan susunan carta aliran. Pemilihan bahan untuk besi sebagai medium untuk sensor induktif kesan ialah aluminium, keluli tahan karat dan tembaga. Projek ini akan direka dengan mengunakan perisian SolidWork and akan di fabrikasikan utuk dibuat ujian percubaan. Ujian percubaan akan lebih difokuskan untuk pemilihan besi, lokasi sensor, ketepatan dan keupayaan untuk sensor induktif mengesan besi yang telah dipasang pada tali pinggang keselamatan. Ini juga dibuat hanya untuk kereta yang terpilih sahaja iaitu model Perodua seperti Myvi, Viva dan Axia. Daripada ujian percubaan yang telah dibuat, keputusan yang baik telah dicapai seperti ketepatan dan keupayaan daripada gabungan sistem tali pinggang keselamatan dan sensor induktif. Secara ringkasnya, gabungan tali pinggang keselamatan dan sensor induktif ini membantu untuk meningkatkan tahap keselamatan dalam kenderaan dan boleh mengelakkan seseorang yang selalu menghiraukan bunyi penggera keselamatan dan membuat tipu helah seperti yang disebut diatas untuk menghentikan bunyi penggera keselamatan.

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ABSTRACT

In pursing modernization now, the world is introduced with variety of human's idea that so creative and innovative in term of science and technologies. The aim is to facilitate a burden and increase more safety level in a vehicle. This project focused on the aspect related to the safety in vehicle which is seat belt alarm system and inductive sensor. As we already know, seat belt system is designed to secure the car's user against harmful movement that may result from the collision or sudden stop. It is also the most important safety system and its category is passive safety system for a vehicle. The main problem that always happen related to the seat belt is most of the occupant did not wearing seat belt during driving and it will cause the occupant getting more serious injuries or death when accident happen. Some person is ignoring the seat belt alarm system until a certain time the alarm will automatically stop and other doing trick to stop alarm system such as fastened the seat belt behind the occupant and only installed the latch plate to the buckle. This project is done to overcome this seatbelt problem. The methodology of this project is done by following the project flowchart. The material selection for metal as a medium to inductive sensor is aluminium, stainless-steel and copper. The project will be design by using SolidWork software and will be fabricate to do testing process. The testing is more focuses on metal selection, sensor location, accuracy and performance of the inductive sensor to detect the metal installed at seat belt webbing. It also be done to only selected car which are Perodua model such as Myvi, Viva and Axia. From the testing, the good result such as performance and accuracy are shows from the combination of seat belt system and inductive sensor. In the nutshell, the combination of seat belt system and inductive sensor is helping in order to increase safety level in vehicle and can avoid the person who always ignoring the alarm system and doing trick as mentioned above to stop seatbelt alarm system from sounded.

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DEDICATION

I dedicated this project to the Almighty God for the guidance, strength, power of mind, protection and skills and for giving me a healthy life in order to finish this project successfully. He has been the source of my strength throughout this program and on His wings only have I soared. I also dedicate my disquisition work to my family whose word of encouragement support me, listen to my problem and help to provide budget for me along my project period. Next, I dedicate this project to my supervisor and co-supervisor for their willingness to guide me to the success of project for my degree. Last but not least, I also want to dedicate this disquisition to all my friend and classmate who always helping, monitoring and giving idea throughout the process without feeling any disturbance.

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LIST OF ABBREVIATIONS

ABBREVIATIONS		MEANING
cm	-	Centimetre
mm	-	Millimetres
V	-	Voltages

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CHAPTER 1

INTRODUCTION

1.1 Briefing

In this chapter introduction is made of some general information about the car's safety belts with alarm system, research study on this project, the essential information of the seat belt dimension, part involved and the inductive sensor working principle. This project also focussed to increase the safety of the seat belts system because of the number of people involve in the road crash need to be reduced even though the current seat belt system is installed in the vehicle.

1.2 Project Background

The seat belt system is the most important safety system that installed in the car and it can be categories as passive safety system (Żuchowski & Jackowski, 2011). These seat belt systems are designed to secure the car's user against harmful movement that may result from a collision or sudden stop. Even though the designed is simple but it play an important role in the safety during the operation of the vehicle and these seat belt system is the oldest automobile safety device that are still used until now (Cloutier, 2011). Victoria, Australia was the first country that set the world's seat belt law in 1970 and it is compulsory for passenger and driver.

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These seat belt systems can be categories to many types according to its point such as 2-point seat belt, 3-point seat belt, 4,5,6-point seat belts and 7-point seat belts. The 2-point seat belt also can be called as lap belt which is a strap that goes over the waist and deliver the impact force to pelvis area and it usually can be found in aeroplane seat and train seat. For 3-point seat belt it is designed with Y-shaped that spread out the energy of the moving body over the chest, pelvis and shoulder. In these projects the main focussed is more to the 3-point seat belt because it is commonly used in the automobile industry. The other type of the seat belt is negligible and typically can be found in racing car and child safety seat.

Seat belt is designed to hold the occupant and prevent it from moving forward strike the dashboard or the steering. Seat belt system also installed with alarm system that functioned to remind the occupant to wearing the seat while driving. This alarm system can be categories to 3 types which are blinking, dinging and both. With these system combinations the rate of road's crashes should be reduce for every year. The improvement of the safety belt alarm system should be done to increase the safety level of the occupant and to ensure the occupant to wearing the seat belt properly while driving.

Besides that, some research about the sensor has been done. There are many type of sensor and this project is focussed on inductive proximity sensor. These inductive proximity sensors act to detect the metal material and commonly used in tactless measurement of object and position in numerous system. The inductive sensor also come with many detection range and the suitable detection range for metal should be known. The type of metal that need to be used in these projects also should be identified to ensure the metal is suitable.

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1.3 Problem Statement

Nowadays, the seat belt system that installed in the vehicle to prevent the occupant from getting fatal injuries and deaths during collision. In Malaysia, there are 6,706 people involve in road fatalities during year 2015 and only 85% of driver and 75% of front passenger are wearing a seat belts (OECD, 2017). The number of road's crash fatalities can be reduced if the occupant follows the law to wearing a seat belt properly. The main problem now is many of the occupant do not wearing the seat belt during driving and this will be caused the individual getting more serious injuries when accident happen. Many occupants did not take serious about the benefit to wearing a seat belt. There is also some car's user used some tricks to make the safety belt alarm system stop dinging and blinking. This situation become one of the problem that should be solve. So, this project should be done to overcome the problems that has been stated above. Finally, this project is focussed to combine the seat belt system with inductive sensor to ensure the occupant to wearing the seat belt with no excuses. The inductive sensor will stop dinging if the occupant wears the seat belt properly. By implement this innovation, the occupant will not be able to use the trick to stop alarm system from sounded. So, this project aims to solve the trick issues and to ensure the occupant to wear the seat belt properly.

1.4 Proposed Solution

Information above lead to the proposes of this project. This project focused to develop and analysis of car safety belt alarm system by using inductive sensor to detect the webbing length and to make sure the occupant really wearing the seat belt properly.

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1..5 Objective

There are a few targets to achieve in this project. These objectives should be achieved in the end of the project. Therefore, the following below are the objectives that has been considered:

1. To develop the safety belt alarm system with inductive sensor.

2. To study the length of the webbing seat belt when it is used and not used.

3. To determine the correct position to install the inductive sensor.

1.6 Scope

This project focuses on designing the combination of the car safety belt system with inductive sensor to ensure the occupant used the seat belt properly while driving by using detection method of the metal that installed at the webbing seat belt. Several limitations have been analysed and determined through this project. For this project, the national car with PERODUA's brand is chosen. The type of the PERODUA's car used is more focussed on Viva, Myvi and Axia. and installed with the functional safety belt alarm system. This is because, this type of car is commonly used and more famous among the user in our country which is Malaysia. The type of seat belt used for the selected car's brand is three-point seat belt.

Next, the limitation of waist size needs to be considered. Based on Ministry of Health Malaysia, the ideal waist size for male should be less than 35 inch and for female should be 31 inch. Above the waist size is considered as obesity. So, for this project the waist size should less than 35 inch.

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Besides that, the sensor used is more on Proximity Inductive Sensor that will installed along the seat belt system in order to detect the length of the seat belt webbing. Besides that, the fundamental, design and dimension of the seat belt and inductive sensor was need to be understood.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A review of literature was performed to identify the studies which relevant to the topic of research. The author has found a good representative literature discussing the utilization of safety seat belt system in a car and the type of alarm sensor used in a car in order to improve the safety of the vehicle. However, there was a study in detail about the seat belt and sensor used for increase the safety for the application of domestic or industries.

2.2 Safety in Vehicle

All the explanation about safety in vehicle is explain in journal that written by (Liščák & Moravčík, 2013). Vehicle is the most popular transport today. In order to develop a new vehicle, the safety for the vehicle is required. The main purpose of vehicle safety is to ensure the life and the health of the driver, passenger and other road users. Vehicle safety also help to minimize the rate of accident occur and also the death statistic due to accident cases. This vehicle safety can be divided into two basic categories which active and passive safety.

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For the active safety, it acts to prevent the accident which involve with the wheel's guidance, suspension, steering feedback and brake stability. There are four components of active safety which are travel safety, conditional safety, perceptual safety and operator safety. Firstly, travel safety. This is about how to manage with wheel chassis, suspension, steering and brakes. Any change of this system that lead to problem can be detect and sense by the driver. Secondly, conditional safety is about the comfortabilities, vibration, visibilities, noise and impact of the climate. All of this can be affect the driver psychologies. The visibility for driver is very important because it can decrease the unexpected situation that lead to accident. So, the better of the driver vision, the safety of the journey will become increase. The vibration and noise also can lead to accident happen because of the driver feel uncomfortable or disturbance the concentration of the driver. To prevent, the good sound insulator should be installed in the vehicle system. The climatic condition such as the air temperature, humidity, air pressure and air flow can affect the safety journey. Good heating, ventilation and air condition system are important to ensure the driver condition while driving especially at a long journey. Thirdly, perceptual safety more to identified on simple equipment or devices such as lighting, audio warning, the view of the car which direct and indirect view. Next, the design and the safety need to be identify in order to increase the operator safety. The operator or driver need to driving without stress to ensure the journey or the trip is safe and also it can help to be more focuses. Figure 2.1 below shows some example of a safety system which Anti-Lock system, Automatic Dimming system, Adaptive Light Control system, Run-plate tyre system, and Electronic Stability Control.

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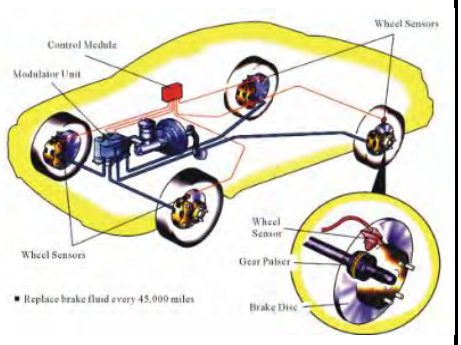
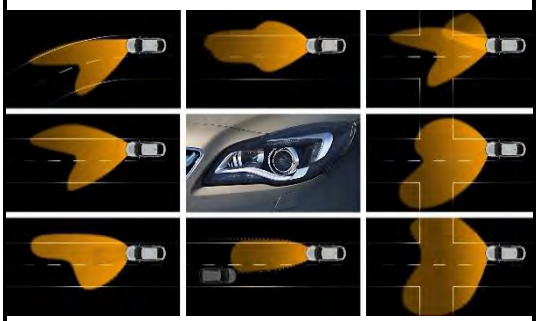
Safety system	Diagram
ABS (Anti-Lock Braking) system -Prevent the wheels from locking while braking. -To maintain the vehicle	 Source: *http://www.autojunction.in/car-technology/Anti-lock-Braking-System-ABS-114-34101.html*
ADM (Automatic Dimming Mirror) system - Prevent the glare in the rear-view mirror that caused by the light from the moving vehicle behind.	 Source:*https://www.alibaba.com/product-detail/GERMID-car-rear-view-mirror-1080p_60191784845.html*
ALC (Adaptive Light Control) system - Allow to adjust the beam or light according to the driver's needs and the orientation is controlled by reflector by bending and the slope of the road.	 Source:*http://autonationdrive.com/wp-content/uploads/eye-tracking-headlights-technology-from-opel-currently-in-development_5.jpg*

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Run-flat tyre system - One of the tire types that allow to drive with safety with a puncture.	 Source: https://upload.wikimedia.org/wikipedia/commons/0/0f/Sicherheitsreifen_BMK.jpg
Electronic Stability Control - Is a computerized technology that improves a vehicle's stability by detecting and reducing loss of traction.	 Source: https://www.slideshare.net/shubhamthakurmech1/adaptive-cruise-control-electronic-brake-force-distributiontraction-control-system-electronic-stability-control-crd-fitdiairbag

Figure 2.1: Example of active safety system with its function

The passive safety in the vehicle is about all the features and measured that have in the car. It is very important when the driver cannot handle the active safety anymore. This passive safety in vehicle can be categories into two type which are external safety and internal safety. External energy can be defined as a reaction or act in order to reduce the rate of accident happen in the road and outside of the vehicle. Factor that involve with

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external safety are the behaviour of the vehicle body during deformation and its external shape of the car body. Internal safety is about the protection of the vehicle with the way minimize the acceleration of the vehicle and the internal force to passengers if accident occurs and provide enough space for survival and ensure the operability of the critical components of the vehicle to rescue passengers from the vehicle. There is some example of the passive safety which Airbag, Active head restraints, safety belts and parking assist system. Figure 2.2 below shows the example of the passive safety with its function of each passive system and also in diagram.

Passive safety system and its function	Diagram
Airbag system - Restrain the body of driver and passenger from collide or being hit against the steering wheel, instrument panel or windshield by a severe impact to the front of the vehicle. The air bag will immediately inflate if any huge impact applied on the vehicle (Breed, 2014).	 Source: *https://carfromjapan.com/wp-content/uploads/2017/10/Airbags-in-your-car-%E2%80%93-good-or-bad.jpg*

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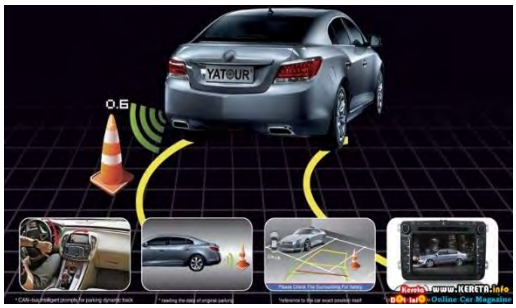
Parking assist system - Help the driver in cheeking the rear and the steering to ensure the area is safe and clear when backing the vehicle (Sakiyama et al., 2010).	 source: *http://kereta.info/wp-content/uploads/2011/10/parking-assist-system.jpg*
Active head restraints system - The objective to cushion the head and the neck if some collision happens from the back of the vehicle. So, the headrest will move in order to adjust to the safe position after impact happened (Shone, 2015).	 Source: *http://www.jeeppatriot.com/forum/5-jeep-patriot-general-discussion/112093-active-head-rest-deployed-wont-reset_jeep-patriot.html*
Safety belts system - Protect the driver and the passenger from suffering from collision due to inertia in the vehicle by binding the body of the driver and passenger to his seat (Larson, 1991).	 Source: *https://www.pinterest.com/pin.jpg*

Figure 2.2: Example of passive safety system and its each function.

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