Faculty of Electrical and Electronic Engineering Technology

Development of Blind Spot Warning System for Heavy Vehicles Using Microcontroller

LARKESH NAIR A/L INDRAN

Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

2021

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A project report submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

Faculty of Electrical and Electronic Engineering Technology
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Disahkan oleh:

LARKESH NAIR
(TANDATANGAN PENULIS)
Alamat Tetap:

16 LORONG MURNI 14
TAMAN DESA MURNI 13800 SUNGAI
DUA BUTTERWORTH PULAU PINANG

Tarikh: 10 JANUARY 2022

(COP DAN TANDATANGAN PENYELIA)
DR. FARA ASHIKIN BINTI ALI
Pensyarah
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
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Signature : LARKESH NAIR

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APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours.

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Supervisor Name : DR FARA ASHIKIN BINTI ALI

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DEDICATION

To my beloved mother, Subathy, and father, Indran,

and

To my mentor supervisor, DR. Fara Ashikin Binti Ali and

My fellow friends

ABSTRACT

A blind spot has been difficult and is a major concern for a driver neither for a car driver nor for a heavy good vehicle (HGV) driver. Generally, a blind spot is an invisible area for the drivers to glance at any vehicle or object. In Malaysia, statistic shows that the accidents occurred between HGVs and other vehicles or pedestrians or cyclists are due to the blind spot zone. Therefore, there are several blind spot detection systems and warning systems have been proposed to alert the HGV drivers of the presence of other road users in their surroundings. This paper proposes a low-cost warning system of a front view on the left and right corners of the HGV's blind spot area. This project utilizes Arduino Nano as a microcontroller to control the actions of a device, ultrasonic sensors to detect an obstruction in the specified blind spot area, DF player module for Arduino, which generate voice audio. This Audio sound player gives a precise calculated distance audio where helps the driver to understand the obstacle range in the blind spot of the HGV's. To support the driver capable to avoid the vehicle from the blind spot, the driver able to access the BLYNK application in their own Smart Phone to perceive the obstacle. The purpose of adding this application of giving a live feed, where the driver has troublesome to visual the obstacle. Based on the experiment conducted the result of it helps to analysis the precision and data to analyses the blind spot area. The warning system from the Ultrasonic sensor and ESP32CAM able to give the driver an early triggered and prepared driving on the blind spot zone. Thus, this project implies both warning and action plan for the HGV's driver to avoid collision and securing road safety.

ABSTRAK

Titik buta telah menjadi sukar dan menjadi perhatian utama pemandu baik pemandu kenderaan mahupun pemandu kenderaan berat (HGV). Secara umumnya, tempat buta adalah kawasan yang tidak dapat dilihat oleh pemandu untuk melihat kenderaan atau objek apa pun. Di Malaysia, statistik menunjukkan bahawa kemalangan yang berlaku antara HGV dan kenderaan lain atau pejalan kaki atau penunggang basikal disebabkan oleh kawasan buta. Oleh itu, terdapat beberapa sistem pengesanan titik buta dan sistem amaran telah dicadangkan untuk memberi amaran kepada pemandu HGV mengenai kehadiran pengguna jalan raya lain di persekitaran mereka. Makalah ini mencadangkan sistem amaran kos rendah dari pandangan depan di sudut kiri dan kanan kawasan buta HGV. Projek ini menggunakan Arduino Nano sebagai mikropengawal untuk mengawal tindakan peranti, sensor ultrasonik untuk mengesan halangan di kawasan titik buta yang ditentukan, Modul DF pemain bunyi audio untuk Arduino, yang menjana audio suara. Pemain bunyi Audio ini memberikan audio jarak yang dikira dengan tepat yang membantu pemandu memahami julat halangan di zon titik buta HGV. Untuk menyokong pemandu yang mampu mengalihkan kenderaan dari kawasan titik buta, pemandu boleh mengakses aplikasi BLYNK dalam Telefon Pintar mereka sendiri untuk melihat halangan tersebut. Tujuan menambah aplikasi ini untuk memberi suapan langsung, HGV adalah besar berbanding dengan kenderaan biasa di mana pemandu mempunyai masalah untuk melihat halangan. Sistem amaran daripada penderia Ultrasonik dan ESP32CAM mampu memberikan pemanduan awal yang dicetuskan dan disediakan di zon titik buta. Oleh itu, projek ini membayangkan kedua-dua amaran dan pelan tindakan untuk pemandu HGV untuk mengelakkan perlanggaran dan memastikan keselamatan jalan raya.

ACKNOWLEDGEMENTS

First, I would like to express my gratitude to my supervisor, DR. Fara Ashikin Binti Ali, for her great advice in this project. The encouragement given by DR. Fara able for to get through some difficulties on the project. The most help given by her in manner of technical to fulfil and achieve the success of the project.

My highest acknowledgment goes to my parents, younger sister and younger brother for their console and prayer during when making of my project. Besides, the stress and mental challenge I go through able to overcome with their full support.

Finally, I would like to covey my thanks to my friends and classmate for sharing their ideas how to progress in my project. The thoughts to provision me to conduct the project well. I am very appreciate for having a kind and caring friends around me.

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δ	-	Voltage angle
L	-	Distance
T	-	Time
C	-	Sonic Speed
μ	-	Micro
V	-	Voltage
°	-	Degree

LIST OF ABBREVIATIONS

HGV	-	Heavy Good Vehicle
LED	-	Light Emitting Diode
MCU	-	Microcontroller Unit
ANOVA	-	Analysis of Variance
GRA	-	Grey Relational Analysis
BSD	-	Blind Spot Detection
3D/2D	-	3 Dimensional / 2 Dimensional
DHM	-	Digital Human Modelling
LFMCW	-	Linear frequency Modulated Continuous Wave
ADAS	-	Advanced Driver Assistance System Architecture
FYP	-	Final Year Project

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CHAPTER 1

INTRODUCTION

1.1 Background

Blind spot is not human error that cause an accident. It un-precaution experience through a driver. Since the human introduced to automobile vehicle, accident became a common occurrence time to time. This doesn't make any difference for even Heavy Good Vehicle. The term that used for Heavy Good Vehicle (HGVs) is specular to circulate into a group of mean is Lorries, refrigerated trucks, tanker lorries and tractor trailer. This vehicle has some special dimension which not equal ordinary automobile vehicle. A standard dimension of HGVs in Malaysia measured with the length of 12m, width 2.4m and height of 1.5m. This dimension also provide a risk on the road which put dangers to some group of road user. Malaysian Institute of Road Safety Research (MIROS) has done a research which brings to the statement where blind spot accident occurs in Heavy Good Vehicle. Moreover, (Musa, 2017) reported that majority of the respondents perceived that they drove more cautiously when a motorcyclist was on their left side who are the lorry driver (mean score of 8.13). as shown in Figure 1.1

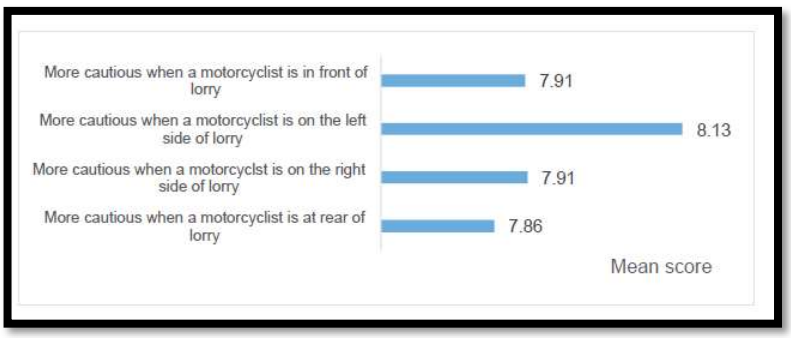

Figure 1.1 Mean score of the lorry driver cautions for the motorcyclist on the road (Musa, 2017)

This issues refers to the blind spot area for HGVs following to lorry as two criteria which, this blind spot area which been invisible when the driver turn the vehicle to a sharp corner, the driver could not see any passing vehicle. Outline of this issues because the Lorries has bigger height and length compare to a motorist or pedestrian. The side mirrors attached to the vehicle impossible to spot any obstruction. The Heavy Good Vehicle need to circulate with a few parameter because of the length, height and weight. As we know the HGVs is enormous in the road, the spectrum for the driver facing no visual spots its quite greater chance. The Figure 1.2 shows the blind spots found in HGVs this is based on the studies conducted by MIROS, (Musa, 2017). There is a few blind spot found in the HGVs but the aspect focusing in this project, based on Figure 1.2. The labelling from the Figure (a),(b) and (c) is critical spot for the driver to see vehicle in blind spot section, whereas the labelling spot such as (d), (g), (h) and (f) could be seen in side mirror of the HGVs.

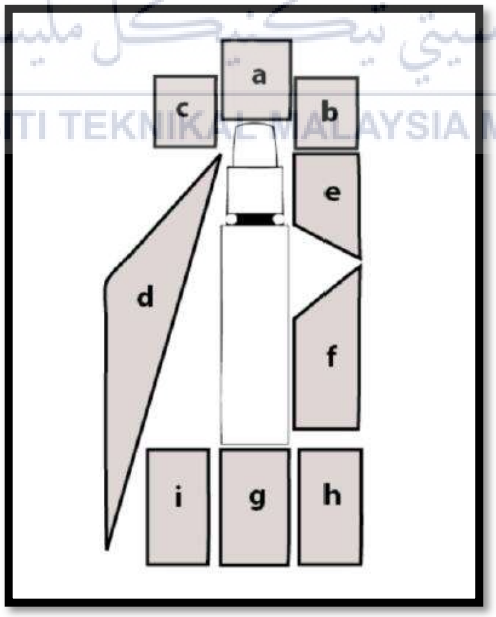

Figure 1.2 Blind spots area HGVs (Musa, 2017)

Visualizing it, a lorry makes a turning right or left on junction and at the same time a motorcyclist heading straight on junction precisely when the turning lorry unable to spot the motorist. Factor creates this length of Lorry crafted wider and height loftier made the driver invisible spot of object which unable see in the side mirrors. Figure 1.3 illustrate the HGVs blind spot view on turning junction(Chang et al., 2018)

Figure 1.3 Blind spot area faces on the HGV (Chang et al., 2018)

Developing a system which a capable avoiding Blind Spot errors. This type of technology is existed in current state. In Heavy Good Vehicle Blind Spot system is infrequent, emerging this system in Lorries is going to new which going be helpful to driver has assistance. Microcontroller growth help us to create a small budgeted system with sensor indication to the driver which going give awareness to the driver. On the other hand (Musa, 2017) stated the number of accident (motor vs. lorry) by road geometry in year 2011. The straight and curvy roads have the most frequent numbers of a road accident, T/Y junction and cross-junction, which considered risky when referring to the blind spot related crashes. The data presented in figure 1.4 data on the risk involving blind spot.

Figure 1.4 tabulate data the risk involving blind spot referring road geo-metery (Musa, 2017)

	Fatal	Serious	Slight	Damage only	Total
Straight	285	130	167	910	1492
Curve	64	22	29	115	230
Roundabout	0	1	2	15	18
Cross-junction	39	10	23	131	203
Junction T/Y	77	46	66	478	667
Staggered junction	1	0	1	5	7
Gradient intersection	0	0	1	4	5
Unknown	5	3	3	6	17
Total	471	212	292	1664	2639

Therefore, based on the referencing factor developing the blind spot detector can be priory help to HGVs driver. This system, which conducted to develop the scope of blind spot awareness in HGVs.

1.2 Problem Statement

In this era, technology has been fast increase among human race. Technology has been helping humans for many types of assistance so does for accident occurrence. Relating accident to one common error that is not from human perspective, which is blind spot. Blind spot in HGVs is vary questions can be drawn, is it from the driver error or is implied on the vehicle because of the enormous size. Fixtures of technology can applied to this type of vehicle to avoid Blind Spot errors or accident. Stating the problems is developing blind spot system not seeing such a new system or technology, which applicable already existed in this era. Developing this system for HGV will be new, studies and research shows most blind spot area that is invisible for the driver valid in lorries and trucks. There are many blind spot

areas in HGVs that need to be concern and need to selected cautions can be helpful for the driver. Figure 1.5 shows the area of blind spot in HGVs.

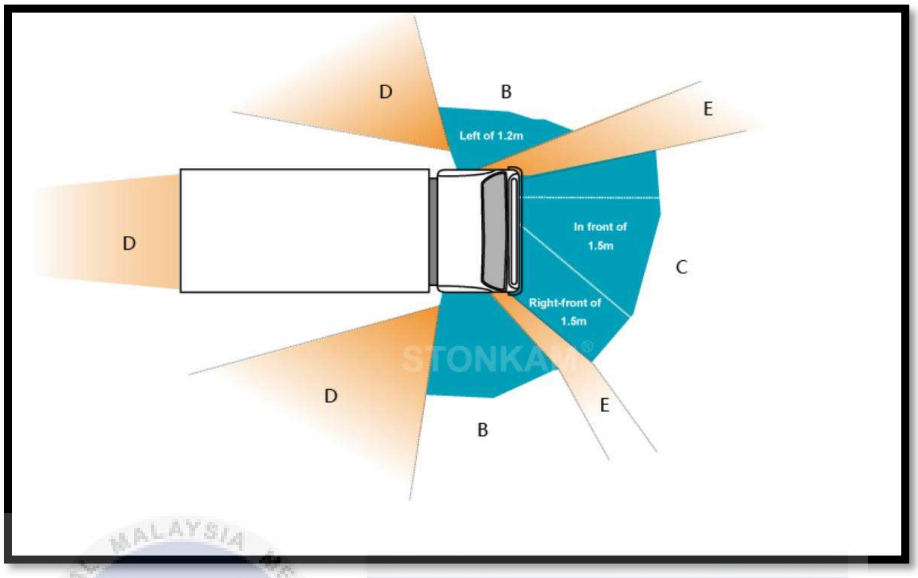

Figure 1.5 blind spots area of HGVs

Based on figure 1.5, different spots give dissimilar impact for the driver to see. Selecting one particular spot will be challenging thus, need to see its reliability. From the previous studies, particular area of blind spot which most difficult for the driver to be visible is when turning on junction. Figure 1.6 demonstrates the blind spot occurs between HGVs and cyclist.

Figure 1.6 Blind spot occurs between HGVs and cyclist.

The main concern of the blind spot has been issued, which is when HGV making turn on junction. The execution for HGVs turning on junction is more critical blind spot to other area which the vehicle imposed. The statistics collected in Malaysia, smaller vehicle have collision with Lorries on T-junction. The factor causing that can imposed to blind spot. Decisions of selecting the correct blind spot area should be effective to develop.

1.3 Project Objective

The objectives of this project are as follows:

a) To develop a system that could give a warning to HGV driver if other road user in the blind spot area.

b) To validate on the obstacle detection on the blind spot area and resolving it using this system.

c) To provide visual for the driver to avoid their HGVs away from the obstacle on blind spot area.