UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF REAR LIGHT SYSTEM WITH OPERATION INDICATOR FOR URBAN CAR CONCEPT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

by

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DEDICATION

This dissertation is decided to all my family members and friends. Thanks to my beloved parents Mr Jaimi Bin Nando and Mrs Dinar Binti Patu who support me with affection, trust and give motivate me through ups and downs. They remind me that I could not easily disappoint them and make me trying harder. All my fellow friends especially my supervisor mates and all my housemates for supporting me from the beginning until the end of this project. They also provided me a lot of miscellaneous aids and words of encouragement which make me to think in a positive manner when things go wrong. Lastly, I dedicate this dissertation to my best Supervisor, Ts Khairul Amri Bin Tofrowaih who willing to teach and assist me nicely and give many ideas regarding to complete this project.

ABSTRAK

Projek ini adalah untuk merekabentuk dan membangunkan sistem lampu belakang dengan operasi amaran untuk konsep kereta bandar. Lampu belakang adalah salah satu keselamatan jalan raya yang memberi amaran kepada pemandu lain untuk memperlahankan kereta mereka atau memberitahu anda berada di jalan raya. Malangnya, sesetengah pemandu cuai terhadap lampu belakang mereka kerana mereka tidak menyedari jika lampu belakang kereta mereka tidak berfungsi dengan baik. Dari penyelidikan, operasi amaran untuk mengingatkan pemandu jika lampu belakang rosak sukar dicari dan hanya didapati pada kereta moden sahaja. Matlamat projek ini adalah untuk mencipta operasi amaran dan membangunkan prototaip kerja yang akan memberi amaran kepada pemandu sekiranya sistem lampu belakang rosak. Dengan menggunakan Arduino yang telah diprogram dan diintegrasikan dengan ACS712 sensor yang akan mengesan aliran arus elektrik. Sekiranya, tiada aliran arus elektrik melalui lampu belakang ia akan menghidupkan operasi amaran. Terdapat tiga jenis lampu belakang perlu dipilih dan lampu trak telah dipilih untuk konsep kereta bandar. Proses imbasan 3D dilakukan untuk mendapatkan dimensi sebenar lampu tersubut dan permukaan lampu dibaiki dalam perisian CATIA untuk menjadikannya lebih terperinci. Kemudian, data CAD lampu dipasang ke kereta bandar “Tuah Concept 8”. Prototaip kerja untuk operasi amaran tleh digabung dengan lampu belakang kereta. Data seperti nilai arus semasa lampu hidup telah diambil untuk dimasukkan ke dalam Arduino untuk memastikan sistem operasi amaran berfungsi dengan baik. Konklusinya, objektif telah dicapai bahawa sistem ini boleh memberi amaran kepada pemandu jika lampu belakang tidak berfungsi dengan baik.

ABSTRACT

This project is to design and develop rear light system with operation indicator for urban car concept. Rear light is one of road safety which alert others driver to slow down their car or notify that you are on the road. Unfortunately, some of the driver is careless about their rear light because they did not notice if the rear light is not functioning well. From the research found that the operation indicator to alert driver for rear light malfunction is hard to find and it only for modern car only. Then, the aim of this project is to develop the operation indicator and develop the working prototype which will alert driver for the rear light system malfunction. The operation indicator had been designed by using Arduino that had been program and then integrate with ACS712 current sensor which it will detect current flow in circuit. If there is no current flow through the rear light it will trigger the indicator to on. There were three type of rear light need to be selected for the urban car concept and the caravan truck light is chosen. 3D scan process was performed to get the actual dimension of the caravan truck light and the surface was repaired in CATIA software to make it smooth. After 3D scan and repairing process, the CAD part of rear light was assembled into the rear of urban car "Tuah Concept 8". The working prototype for operation indicator had been integrated to the rear light. The data from rear light is taken especially the current when the rear light is working. The data will be setup in the Arduino to make sure the system is functioning well. As conclusion, the objectives were achieved that this system can alert driver if the rear light is not functioning well.

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LIST OF SYMBOLS

lm	-	Luminous Flux
W	-	Watt
lm/W	-	Lumens per Watt
Kg	-	Kilogram
mA	-	Milliampere
A	-	Ampere
mm	-	millimeter
V	-	Voltage

LIST OF ABBREVIATIONS

3D	3 Dimensional
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CATIA	Computer Aided Three-Dimensional Interactive Application
CHMSL	Center High Mounted Stop Light
GaAsP	Gallium Arsenide Phosphide
GPIO	General Purpose Input and Output
LCD	Liquid Crystal Display
LDR	Light Dependent resistors
LED	Light Emitting Diode
NHTSA	National Highway Safety Administration
NHTSB	National Highway Traffic Safety Board
PDS	Product Design Specification
SEM	Shell Eco Marathon
SSL	Solid-State Lighting

CHAPTER 1

INTRODUCTION

1.1 Background

Rear light is very important because it provide greater safety when we are in road traffic especially in the dark. Generally, rear lights consist of taillights, brake or stop lights, reverse/back up lights, turn signal light, third brake light or center high mounted stop light (CHMSL), rear reflector light, license plate light, and rear fog lights.

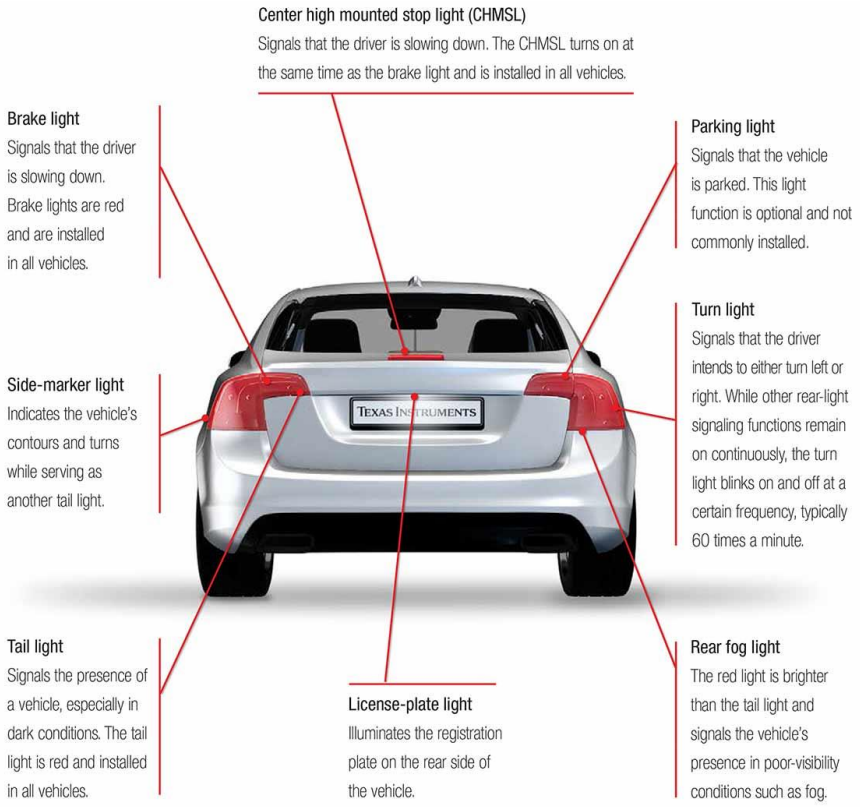

Figure 1.1 Arun T. Vemuri. (2019). Components of rear-lighting system [photograph]. Retrieved from https://e2e.ti.com (Vemari, 2019)

Commonly, urban car concept known as a small city car that is in early stage of production of car and mainly to showcase styling creativity and capability as well as to

demonstrate technological advancement of the car marker. So, to minimize the number of rear-end collision, design and develop of Rear Light with Operation Indicator for Urban Car Concept is a must. The function of Rear Light with Operation Indicator is to alert or notify the driver about the condition of their rear light. It will notify that the rear light is functioning or not by sensing the current/voltage using sensor that passes through the circuit of rear light system. Design and Development of Rear Light with Operation Indicator is needed to be installed in the urban car concept to ensure the driver is safe while driving.

1.2 Problem Statement

National Highway Traffic Safety Administration (NHTSA) state that, 6% causes fatal from the crashes due to rear-end collisions in United States and one per four in total of car accidents make them the most frequent of car accidents (Ryan, 2016). More than six million accidents that arise every year and nearly 2.5 million are the result of rear-end collisions state by National Highway Traffic Safety Board (NHTSB) (LOWMAN LAW FIRM, 2018). When it comes from rear-end collision, the common causes of the collision must be, distracted driving, speeding, heavy traffic, weather conditions and mechanical failure (LOWMAN LAW FIRM, 2018).

However, some of the user of the vehicle still not concern about the safety on the road. To prevent any unwanted thing happened the driver need to check on their car condition first to make sure everything is fine. But, some of the drivers are careless about the rear light of the car. When going through the dark road, strong notification system is essential (Wood & Sawyer, 2016) which mean rear light is very important because it can notify another driver that you are on the road, to alert other driver to slow down the car and to give information to other driver when you make any turn. Specifically, the main problem that need to be solved is malfunction of rear light can cause hazard to the driver, passenger of the car and

others road user. It might seem not like a big problem when the rear light does not function, but it will give bigger impact when unwanted things might happen such as an accident caused by sudden stop. Sometimes, other road user face difficulties to notify the driver about the rear light condition.

In response to this problem, we must put safety first while driving to ensure that everything is fine. So, the design and development of rear light with operation indicator for urban concept car must be developed to alert the driver if the rear light is not functioning and notice about the condition of the rear lighting of the car.

1.3 Objective

The objectives of this project are:

1. To design rear light system with operation indicator to indicate driver if rear light malfunction for the use of urban car concept using Arduino and ACS712 current sensor.
2. To develop a proof of concept model of the rear light system with operation indicator for the use of urban car concept.

1.4 Scope

Design and Development of Rear Light with Operation Indicator for Urban Car Concept:

- It only consists of two red rear running light, two red brake lights in the rear and two rear turn indicators.
- Use off shelf part available in the market then install to the urban car concept.
- The malfunction is detected through no current flow to the rear light, the system will notify.
- Build electrical system for the operation indicator system by adding of microcontroller Arduino and current sensor.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of Literature Review

In this chapter, it will discuss and explore about the theories and concepts of the project that will be used to achieve the objectives of this project. This chapter will cover about various work on item listed below:

- Vehicle Lighting System
- Rear Light System
- Light Emitting Diode (LED).
- Sensor
- Microcontroller
- Urban car concept
- Benchmarking
- 3D Scanning

2.2 Vehicle Lighting System

Vehicle's lighting systems are very important specifically from road safety considerations. The most important features in vehicle lighting system is the lights (Guides & Industries, n.d.). Vehicle lighting system consists of a headlamp and indicator light or known as signaling device. Usually, it mounted in front, rear and sides of the automotive vehicle.

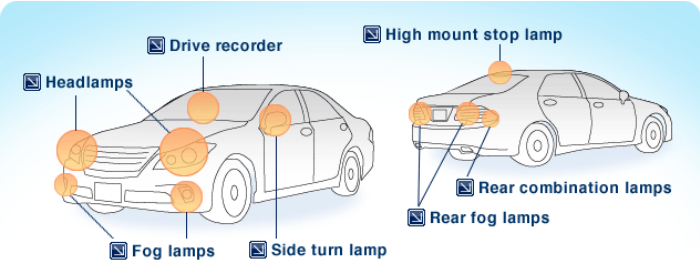

Figure 2.1 (2013). Lighting system of automobiles [photograph]. Retrieved from https://mechanizerr.blogspot.com (Mechanizerr, 2013)

The purpose of the system is to light the roadway during low visibility of light and to increase the sight of the driver to the road. Lights are necessary on vehicle to ensure the driver to see, and to be seen in conditions either darkness or lack of visibility (Hillier, 1996). Finally, the both system front and rear must be functional because it can alert others road user such as other driver and pedestrians to locate the vehicle's presence, the direction of the vehicle move and the vehicle position on the road.

2.3 Rear Light system

According to Cambridge Dictionary, rear light is defined as a red light at the back of a road vehicle that makes it possible for the vehicle to be seen in the dark. Early generations of motor vehicle was born about 1890 and Rear lighting is probably one of the systems that have changed the least over these generations (Moore, 1999). Mostly cars had no rear lamps during early 1890 and after a few years later on 1900 some of the car had electric lamps, dynamo or accumulator (Moore, 1999). In 1940, most of the car already had their own rear light system. Figure 2.2 shows, the timeline of development of rear-end lighting from year 1949 to 1972: