UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REDUCE CAR CABIN TEMPERATURE USING REVERSED AUTOMOTIVE BLOWER MOTOR POWERED BY SOLAR ENERGY

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 Systems) with Honours.

by

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DECLARATION

I hereby, declared this report entitled "**Reduce car cabin temperature using reversed automotive blower motor powered by solar energy**" is the result of my own research except as cited in references.

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Date : 9th DECEMBER 2016

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Refrigeration and Air-Conditioning System) with Honours. The member of the supervisory is as follow:

…….

(Puan Noor Saffreena Binti Hamdan)

ABSTRACT

Malaysia climate is categorized as equatorial which is being hot and humid throughout the year with the average temperature is 27°C. El-Nino phenomenon that hit Malaysia this year with the highest temperature record is 39°C. The problem when facing this extreme temperature is when a car parked directly under scorching sun, the car will experience a kind of greenhouse effect and this will lead to higher car cabin temperature up to 60°C. This extreme temperature is clearly not suitable for the human being. Various problem will arise due to this extreme temperature inside the car such as vulnerable to heat stroke, damage of interior compartment and etc. The aim of this project is to reduce car cabin temperature by creating a ventilation inside the car cabin by modifying the car blower motor itself into dual direction which is forward and backward direction powered by solar energy. This project will focused on car air conditioning blower system model PW530220 Proton Wira 1.5L. The project testing will be conducted at KLANG open parking area within 8.00 am to 5.00 pm. This project was divided into four difference cases which are normal condition with tinted window, adding aluminum front sun shade, using modified blower and combination of all cases. As a result, after using the modified blower, the temperature inside car cabin has been successfully reduced to 40ºC. Even though the temperature is still high, but it shows a huge temperature difference between not using modified blower and using the modified blower and has achieved the objective of this project which is to reduce the car cabin temperature when parked under the scorching sun.

ABSTRAK

Iklim Malaysia dikategorikan sebagai khatulistiwa iaitu panas dan lembap sepanjang tahun dengan purata suhu ialah 27°C. Fenomena El-nino yang melanda Malaysia tahun ini dengan rekod suhu tertinggi ialah 39°C. Masalah apabila menghadapi suhu yang melampau ini adalah apabila sebuah kereta yang diletakkan secara langsung di bawah matahari terik, kereta akan mengalami jenis kesan rumah hijau dan ini akan membawa kepada suhu kabin kereta yang lebih tinggi sehingga 60°C. Suhu yang melampau ini adalah jelas tidak sesuai untuk manusia. Pelbagai masalah akan timbul akibat suhu melampau dalam kereta seperti terdedah kepada strok haba, kerosakan bahagian dalaman dan lain-lain Tujuan projek ini adalah untuk mengurangkan suhu kabin kereta dengan mewujudkan pengudaraan di dalam kabin kereta dengan mengubah blower motor kereta itu sendiri kepada dua arah iaitu ke hadapan dan ke belakang arah yang dijana oleh tenaga solar. Projek ini akan memberi tumpuan kepada penyaman udara kereta model blower PW530220 Proton Wira 1.5L. Ujian projek akan dijalankan di KLANG kawasan letak kereta terbuka dalam 8:00am hingga 5:00pm. Projek ini telah dibahagikan kepada empat kes yang berbeza iaitu dalam keadaan normal dengan tingkap gelap, menambah pelindung matahari aluminium dihadapan, menggunakan blower diubahsuai dan gabungan daripada semua kes. Hasilnya, selepas menggunakan blower yang diubah suai, suhu di dalam kabin kereta telah berjaya dikurangkan kepada 40°C. Walaupun suhu masih tinggi, tetapi ia menunjukkan perbezaan suhu yang besar antara tidak menggunakan blower diubah suai dan menggunakan blower diubah suai dan telah mencapai objektif projek ini iaitu untuk mengurangkan suhu kabin kereta apabila diletakkan di bawah matahari terik.

DEDICATIONS

To my beloved parents, I acknowledge my sincere indebtedness and gratitude to them for their love, dream and sacrifice throughout my life. I am really thankful for their sacrifice, patience, and understanding that were inevitable to make this work possible. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams Lastly, I would like to send my gratitude to any person that contributes to my final year project whether it is directly or indirectly. I would like to acknowledge their comments and suggestions, which are crucial for the successful completion of this study.

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First and foremost, all praise to Allah the Almighty for giving me the strength, health, knowledge and patience to successfully complete this Final Year Project report in the given time. I have to thank my parents for their love and support throughout my life. Thank you for giving me strength to climb the stairs and walking towards the paths of life. I would like to address my deepest appreciation to the supervisor, Madam Noor Saffreena Binti Hamdan for his encouragement, comments, guidance and enthusiasm through the time developing the report. Special thanks to the friends that have been through thick and thin throughout the completion of this project. This project report might be impossible to complete without all of your help. Last but not least, thank you to everyone that directly and indirectly involved in helping me finishing this Final Year Project report. Thank you.

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CHAPTER 1

INTRODUCTION

1.0 Problem background

Nowadays car is very important in life because they provide a common means of transportation whether it is longer commute to work or shorter trip to run errands around town. It is great when the car makes the passengers comfortable from the minute they get inside the car until they are going out from the car. As a human being, we need to work to survive in the future. Malaysia's standard office hour is from 8.00 am until 5.00 pm. During that period, car that parked under scorching sun can be easily exposed to extreme temperature.

Malaysia's climate is categorized as equatorial which is being hot and humid throughout the year with the average temperature is 27 °C. Temperature inside the car is very important to provide comfort to the car passenger. Temperature inside the car can be control by using air conditioning system that can be operated when the car engine is in operation. However, when a car is left or parked under direct scorching sun. There will be zero ventilation inside the car. This can lead to the temperature inside the car will be tremendously increase. Many research has been done due to this problem. There are some product to reduce car cabin temperature can be easily find in the market. However, this project focusing on modification on a car air conditioning blower motor to creates a ventilation inside a car when parked under direct scorching sun.

1.1 Problem statement

Extreme temperature can occur inside the car cabin when left or parked under scorching sun. With all window was closed, there are no ventilation occur inside a car when left unused. This can lead to heat trapped inside the car and temperature will increase up to 60 °C. This extreme temperature is clearly not suitable for human being and can lead to many bad consequences such as volatile organic compound emitting from the interior that indirectly can harm the consumer and etc. A conventional way to reduce sun radiation is using tinted window and also aluminum sunshade. In this project, several cases will be tested to compare the effectiveness of reducing car cabin temperature.

1.2 objective

- To create an air ventilation inside a car when left unused.
- To modify blower motor into dual direction powered by solar energy.
- To reduce car cabin temperature when parked under scorching sun.
- To study the effectiveness of temperature control between all cases.

1.3 Work scope

The implementation for this project is focusing on Malaysia's climate which is being hot and humid throughout the year. The testing location is at open parking area in Taman Sentosa, Klang Selangor Darul Ehsan. The duration for testing is during Malaysia's standard office hour which is from 8.00 am until 5.00 pm. The blower motor used in this project is model PW530220 proton wira.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Nowadays car is very important in life because they provide a common means of transportation whether it is longer commute to work or shorter trip to run errands around town. As a human beings, we need to work to survive in the future. The Malaysia's standard office hours is between 8.00 am until 5.00 pm. Thus, during that period, car can be easily exposed to the extreme weather when parked under direct scorching sun at the open parking area. In this chapter it will discuss about how and source of heat trapped in a car. The effect of extreme car cabin temperature. The methods to reduce car cabin temperature and etc. Focusing on a new type of method in creating a ventilation inside a car when left unused.

2.1 Extreme car cabin temperature

Located near the equator. Malaysia's climate is categorized as equatorial which is being hot and humid throughout the year. The average temperature is 27 °C as shown in figure 2.1. The highest temperature was recorded is 40 °C at Chuping, Perlis on 9th April 1998.("Temperatures in Malaysia could soar to 40°C: Officials - Channel NewsAsia," n.d.) El Niño phenomenon that hits Malaysia this year is the worst in the history of Malaysia's with the highest temperature was recorded is 39 °

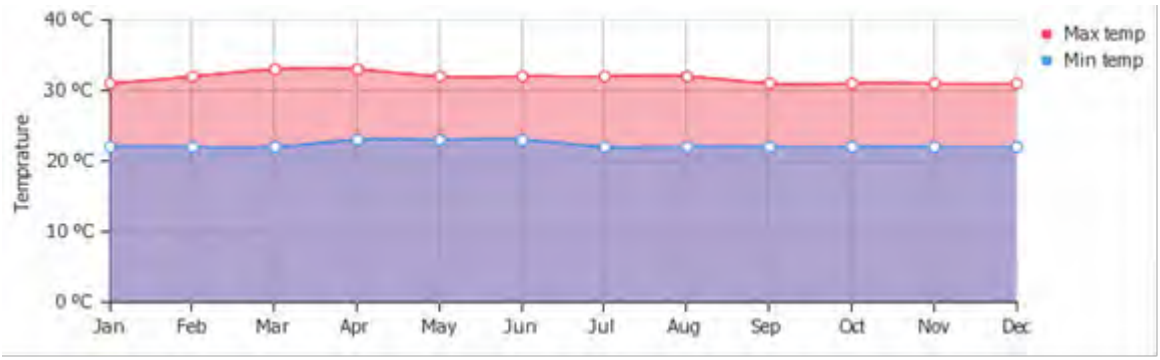

Fig 2.1: The average minimum and maximum temperature in Malaysia in 2015. ("Weather and Climate: Kuala Lumpur, Malaysia, average monthly min and max Temperature (celsius)," n.d.)

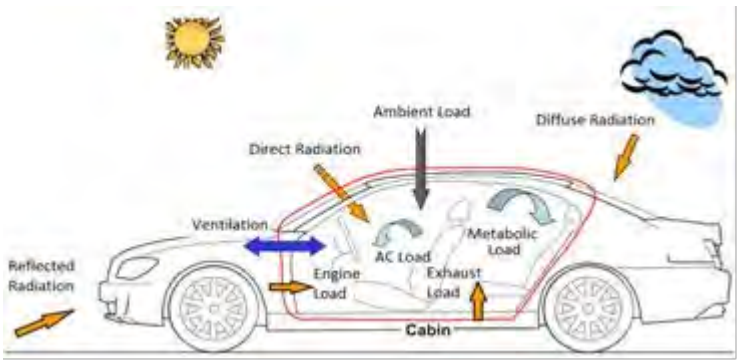

Fig 2.2: source of heat that trapped in a car
(Manning & Ewing, 2009)

There are several source of heat that trapped in a car such as direct radiation from sun, reflected radiation from road, diffuse radiation, engine load, exhaust load and ambient load as shown in figure 2.2. The main source is from sun. The Malaysia's standard office hours is between 8.00 am until 5.00 pm. Thus, during that period, car can be easily exposed to the extreme weather when parked under direct scorching sun. Normally car ventilation system will be zero ventilation when left unused. This can lead to the temperature increase inside the car cabin when parked under scorching sun. The heat that generated from the scorching sun will trap inside the car cabin when no ventilation is applied into the car.

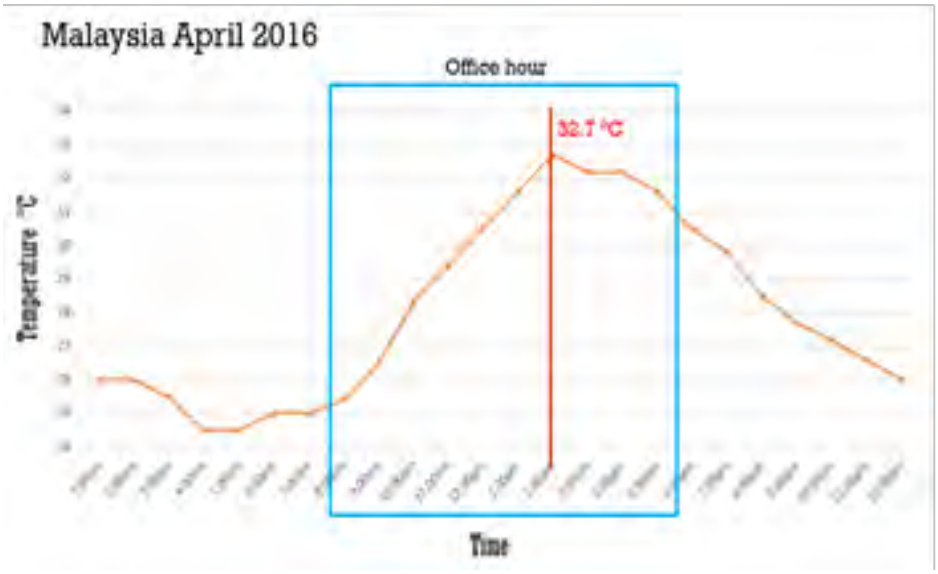

Fig 2.3: Temperature versus Time graph
("Temperatures in Malaysia could soar to 40°C: Officials - Channel NewsAsia," n.d.)

This is a normal issue for all car user around the world. The temperature inside a car can be tremendously increased approaching 60 °C. (Basar, Musa, Faizal, & Razik, 2013) As a result, user will feel uncomfortable for the first 10 minutes when they entering the car later on. As a solution, mostly car user had to open all the window for 2 to 3 minutes to allows the heat that trapped inside the car cabin to be removed. For some driver, they let the car air conditioning system runs for several minutes before starting to drive and this can lead to higher fuel consumption and a waste of time. (Sudhir, Marhoon, & Dhali, 2015)

2.2 Effect of temperature increase in car

There are some bad consequence will occur when car is exposed to extreme temperature. With all the window closed, the inside of a car is just like a greenhouse. (Vishweshwara, Marhoon, & Dhali, 2013) Light from the sun comes in through the glass and is absorbed as heat on the seats and dashboard. Since glass doesn't transmits that heat nearly as well as transmits light, so energy pours into the car and gets trapped and continuously increased the temperature inside a car.

2.2.1 Effect to human

It has been reported that every year, many children die from heat stroke after being left unattended inside a car. (Ozcetin, Arslan, Yilmaz, & Yildirim, 2012) Heat stroke will occur when the human body temperature reach more than 40 °C. (Case & Harrigan, 2015) At this temperature, human body will enters survival mode and stop perspiring and with only three more degree higher, at 43 °C, the body cells start to do not function. This causes the internal organ to begin falling and death can occur soon after. These life-threatening temperatures can be reached quickly when someone back inside a car in the heat. Symptoms of heat stroke is throbbing headache, dizziness, excessive sweating, nausea, vomiting, unconsciousness and etc. (Pryor, Casa, Holschen, O'Connor, & Vandermark, 2013)

2.2.2 Effect to car interior

Beside dangerous to human, extreme temperature inside a car can also damage the interior of the car itself as shown in figure 2.4. Degradation may shorten the life span of the various components inside the car. (Al-Kayiem, Sidik, & Munusammy, 2010) The combination of ultraviolet radiation from the sun alongside the terrific heat that can build up inside the car can cause a lot of damage, which is likely to cost a lot of money to repair.

The car's dashboard gets some of the longest exposure to sunlight, and the heat on the dash is intensified by the windshield. The dash can become faded relatively quickly, and can also lose its flawless appearance. Some materials that are commonly used in the dash can split or crack leaving the whole area looking very unsightly. Hence, the leather seat of a car also can quickly become dry, stiffen, crack and the color is likely to fade, which can be very noticeable on black or dark seats. ("Sun damaged car and motorcycle seats | Fibrenew," n.d.)

Fig 2.4: High temperature damage the interior of car

2.3 Reducing car cabin temperature

Through all this issues, there are some research that has been done to overcome this problem. The conventional way is using tinted window and also aluminum sunshade. Hence, some method of reducing car cabin temperature to give comfort to user such as Kulcar system, Portable Car Cooling system and etc.

Window tinting as a permanent measure was claimed to be more effective in reducing interior cabin temperature, provides privacy to the users and enhance the esthetical value of vehicle. (Isa, n.d.) Window tinting become most favorite choice of consumer due to less expansive and have lots of choice. Window film will help prevent sunburn and skin cancer as well as the brief daily UV exposures that accelerate skin aging over time. (Trade, 2013)

Other method of reducing car cabin temperature is using sun shade. Sun shade can be easily get in the market. There are several type of sun shade which is front aluminum sun shade, side sun shade and etc. Based on figure 2.5, Kulcar system used solar generated fan that hanging at the car window to create a ventilation inside the car cabin when parked under scorching sun so that the temperature inside the car cabin can remain the same as ambient temperature.

Fig 2.5: Mechanism for reducing temperature
(Basar et al., 2013)

Portable car cooling system as shown in figure 2.6 is a system that applying peltier cell as it source of energy. This system is able to produce wind with water vapors that creates coziness in the car. This system operates using 12V dc battery power type lithium polymer where it is rechargeable. According to the research experimental works, it is proven that the portable car cooling system is capable to maintain the temperature inside the car at range of 25 °C to 30 °C. (Basar et al., 2013)

Fig 2.6: Concept drawing of Portable Car Cool system
(Basar et al., 2013)

However, all these product act as auxiliaries to the car. Indirectly, this will be a burden to the consumer and also take up space in the car. In other way a ventilation system inside a car can be created using the originally part of the car itself such as car air conditioning blower to reduce the temperature inside the car. Hence, this system will not takes up space in the car in the same time to give comfort to the consumer.

2.3.1 Blower system

Air conditioner blower or fan is one of the key components that needed as part of the air conditioning system. The function of the blower is to produce air movement to the space that being conditioned. There are basically four type of fan that are commonly used in the HVAC equipment. They are the Propeller fan, Vane-axial fan, Tube-axial fan and Centrifugal fan.

2.3.1.1 Propeller Fan

Propeller fan has a disk type wheel mounted on a plate with a direct drive or belt driven motor connected to it. When it is operating, it is noisy and is only used in applications where noise is not a factor. ("Air Conditioner Blower," n.d.) In HVAC system, propeller fan is commonly used in outdoor unit at condensing unit as shown in figure 2.7, where it is function to supply air to the condensing unit to remove the heat and reduce the temperature of the refrigerant. It is used in application where low pressure differentials but large volume of air movement is required. It is also known as axial fan as the air flows parallel to the axis of the rotation of the fan.

Fig 2.7 : Propeller fan in outdoor unit

2.3.1.2 Centrifugal fan

Centrifugal fans is mechanical device used for create moving air or other gases. The terms “blower” and “squirrel cage” are frequently used as synonyms due to the centrifugal fan looks like a hamster wheel as shown in figure 2.8. The rotating impellers increase the speed of air stream. Centrifugal fans use the kinetic energy of the impellers or the rotating blade to icrease the pressure of the air stream which in turn moves them against the resistance caused by ducts, dampers and other components. Centrifugal fans accelerate air radially and changing the direction of the airflow.

Centrifugal fans can be a constant displacement devices and also a constant volume devices. At a constant fan speed, a centrifugal fan will pump a constant volume of air rather than a constant mass. The air velocity in a system is fixed even though the mass flow rate through the fan is not constant. Centrifugal fans are not positive displacement divices. Centrifugal fan is one of the most widely used fans. (Singh, Kannan, Khilwani, & Sreenivasulu, 2011) It is the most prevalent type of fan used in the HVAC industry today. They are often cheaper than axial fans and simpler in construction. It is used in transporting air in ventilation system for buildings. They are also well-suited for industrial processes and air pollution control systems. It has a fan wheel composed of a number of fan blades, or ribs, mounted around a hub, the hub turns on drive shaft that passes through the fan housing. The air enters from the side of the fan wheel in horizontal direction then turns 90 degrees and accelerates due to centrifugal force as it flows over the fan blades and exits the fan housing. Centrifugal fan blade can be arranged in different ways such as Forward curved fan, Backward curved fan and etc.

Fig 2.8: Centrifugal fans

2.3.1.2.1 Forward curved fan

Forward curved fans operate a lower speeds and pressures compared to backward curved fans, which permits lighter construction of the impeller, shaft, bearing and housing. The light constructio results in a low cost fan with a relatively high airflow at low static pressures. Forward curved fans is very low noise level and high power density. (“Centrifugal Fans,” 1999)

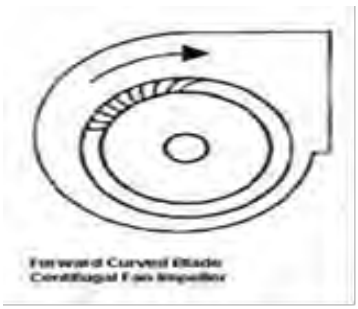

Fig 2.9: Forward curved fan

(“Two types of centrifugal fans,” n.d.)

2.3.1.2.2 Backward curved fans

Backward curved fans is curve against the direction of the fan wheel's rotation. Smaller blowers may have backward-inclined blades, which are straight and not curved. Larger backward-inclined have blades whose backward curvatures mimic that of an airfoil cross section. However, bth designs provide good operating efficiency with relatively economical construction techniques. These types of blowers are designed to handle air streams with low to moderate particulate loadings. They can be easily fitted with wear protection but certain blade curvatures can be prone to solid build-up.

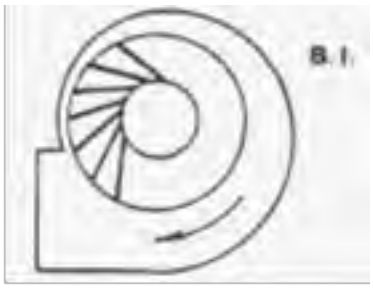

Fig 2.10: Backward Curved Fan

("Two types of centrifugal fans," n.d.)