UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ON-ROAD TESTING PERFORMANCE OF AIR CONDITIONING SYSTEM BASED ON PRE-SETTING CLIMATE CONTROL AMBIENCE

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE TECHNOLOGY) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

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2022

DECLARATION

I declare that this thesis entitled "On-Road Testing Performance of Air Conditioning System Based on Pre-Setting Climate Control Ambience" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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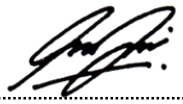
APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

Signature : 

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DEDICATION

This dissertation is dedicated to my beloved parents Zainal Abidin Bin Ghazali, and Mazlina Binti Mohamad, my family, and my friends whose unyielding love, support, and encouragement have enhanced my soul and inspired me to pursue and complete this research during a pandemic.

ABSTRACT

Temperature changes in the interior of a car may be influenced by changes in the climate. This may also affect the performance of the air conditioning system in car. This research aims to explore the temperature of the inside of an automobile in various locations around Malaysia by employing the On-Road Testing method. The process for this research began with design an on-road testing method to determine the car interior ambient temperature at diffent location. The location of the present work is divided by three categories, that is city, metropolitan city and highway. The experimental investigation is conducted through on-road testing in three different time which is morning, afternoon, and evening for every location except highway. The data analysis is presented in the form of a two-dimensional line graph that allows for comparison of temperature values across time and place. The study of the ambient indoor temperature is investigated to predict the right value to be set in car climate control system since the different surrounding temperature have an affect towards the performance of the car air conditioning system. The data can then be used as a guideline for drivers to utilise the proper AC system setting for most types of cars with climate control settings in every regions of Malaysia.

ABSTRAK

Perubahan suhu dalam bahagian dalam kereta mungkin dipengaruhi oleh perubahan iklim. Ini juga boleh menjejaskan prestasi sistem penghawa dingin dalam kereta. Penyelidikan ini bertujuan untuk meneroka suhu bahagian dalam kereta di pelbagai lokasi di seluruh Malaysia dengan menggunakan kaedah Ujian Atas Jalan Raya. Proses untuk penyelidikan ini dimulakan dengan mereka bentuk kaedah ujian atas jalan untuk menentukan suhu persekitaran dalaman kereta di lokasi yang berbeza. Lokasi kerja sekarang dibahagikan kepada tiga kategori, iaitu bandar, bandar metropolitan dan lebuh raya. Penyiasatan eksperimen dijalankan melalui ujian atas jalan dalam tiga waktu berbeza iaitu pagi, petang dan petang bagi setiap lokasi kecuali lebuh raya. Analisis data dipersembahkan dalam bentuk graf garis dua dimensi yang membolehkan perbandingan nilai suhu merentas masa dan tempat. Kajian suhu dalaman ambien disiasat untuk meramalkan nilai yang sesuai untuk ditetapkan dalam sistem kawalan iklim kereta memandangkan suhu sekeliling yang berbeza memberi kesan terhadap prestasi sistem penghawa dingin kereta. Data tersebut kemudiannya boleh digunakan sebagai garis panduan untuk pemandu menggunakan tetapan sistem AC yang betul untuk kebanyakan jenis kereta dengan tetapan kawalan iklim di setiap wilayah di Malaysia.

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TABLE OF CONTENTS

		PAGE
DECLARATION		
APPROVAL		
DEDICATION		
ABSTRACT		**ii**
ABSTRAK		**iii**
ACKNOWLEDGEMENTS		**iv**
TABLE OF CONTENTS		**v**
LIST OF TABLES		**vii**
LIST OF FIGURES		**viii**
LIST OF SYMBOLS AND ABBREVIATIONS		**xiii**
LIST OF APPENDICES		**xiv**
CHAPTER 1	**INTRODUCTION**	**1**
1.1	Overview	1
1.2	Research Background	3
1.3	Aim	3
1.4	Objective	4
1.5	Scope of Research	4
1.6	Organisation of Thesis	5
CHAPTER 2	**LITERATURE REVIEW**	**6**
2.1	Introduction	6
2.2	Climate Change	7
2.2.1	Climate Control	8
2.3	Car Air-Conditioning System	9
2.3.1	History Background	9
2.4	Type of Car Air Conditioning System	10
2.4.1	Fixed Orifice Tube	10
2.4.2	Thermostatic Expansion Valve	11
2.5	Components of Car Air-Conditioning System	12
2.5.1	Compressors	12
2.5.2	Condenser	14
2.5.3	Receiver/Drier or Accumulator	16
2.5.4	Thermostatic Expansion Valve or Orifice Tube	17
2.5.5	Evaporator Coil	18

2.6 Car Air-Conditioning Performance in Various Time 19
2.6.1 Morning 19
2.6.2 Afternoon 21
2.6.3 Evening 24
2.7 Experiment Investigation 26
2.7.1 Maximum car cabin temperature 27
2.7.2 Factor of high temperature in car cabin 28
2.7.3 Effect of high temperature in car cabin 29
2.7.4 Effect of passenger to air conditioning system 30
2.8 Chapter Summary 31

CHAPTER 3 METHODOLOGY 32
3.1 Introduction 32
3.2 Research Planning 35
3.3 Concept Study 36
3.4 Experimental Set-Up 38
3.5 Location Selection for On-Road Testing 45
3.6 On-Road Testing 46
3.6.1 Category 1: On-Road Testing in City 46
3.6.2 Category 2: On-Road Testing in Metropolitan City 48
3.6.3 Category 3: On-Road Testing in Highway 51
3.6.4 Parameters 53
3.7 Summary 54

CHAPTER 4 RESULTS AND DISCUSSION 55
4.1 Introduction 55
4.2 Experimental Results 55
4.2.1 Results for Category 1: On-Road Testing in City 55
4.2.2 Results for Category 2: On-Road Testing in Metropolitan City 70
4.2.3 Results for Category 3: On-Road Testing in Highway 84
4.3 Discussion 87
4.4 Chapter Summary 88

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS 89
5.1 Project Highlights 89
5.2 Conclusion 90
5.3 Recommendations for Further Research 91

REFERENCES 92

LIST OF TABLES

TABLE	TITLE	PAGE
Table 3. 1: Properties of Hygro-thermometer		42
Table 3. 2: Fixed-Parameter variable list		53

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1: Car Air-Conditioning Compressor		14
Figure 2.2: Car Air-Conditioning Condenser		15
Figure 2. 3: Receiver/Drier		16
Figure 2. 4: Cabin temperature of Car A		20
Figure 2. 5: Cabin temperature of Car B (with only one front window opened by 15mm)		20
Figure 2.6: Average cabin temperature of Car A and Car B		21
Figure 2. 7: Cabin temperature of Car A		22
Figure 2. 8: Cabin temperature of Car B (with only one rear window open by 15mm)		23
Figure 2. 9: Average cabin temperature of Car A and Car B		23
Figure 2. 10: Cabin temperature of car A		25
Figure 2. 11: Cabin temperature of Car B (with one front window and one rear window open simultaneously by15mm)		25
Figure 2. 12: Average cabin temperature of Car A and Car B		26
Figure 3.1: Overall flow chart for the methodology of the project		34
Figure 3.2: Flow chart of on-road testing performance of car air-conditioning system		37
Figure 3.3: Process during the experiment		38
Figure 3.4: Honda CRV		39
Figure 3.5: Hygro-thermometer		40
Figure 3.6: Temperature and humidity sensor at driver-side		40

Figure 3.7: Temperature and humidity sensor at the passenger side 41

Figure 3.8: Temperature and humidity sensor 41

Figure 3.9: Sensor positioning in the car 42

Figure 3.10: Car air-conditioner switch 43

Figure 3. 11: Reading of air blower setting 44

Figure 3.12: Route for Ayer Keroh, Melaka 46

Figure 3.13: Route for Taiping, Perak 47

Figure 3.14: Route for Sungai Petani, Kedah 48

Figure 3.15: Route from KL Specialist Hospital to Terminal Bersepadu Selatan 49

Figure 3.16: Route from Amari Johor Bahru to Sultan Ibrahim Stadium 49

Figure 3.17: Route from Concorde Hotel Shah Alam to Setia Alam Central Park 50

Figure 3.18: Route from Ayer Keroh Toll to Sungai Besi Toll 51

Figure 3.19: Route from Jalan Duta Toll to Ipoh Toll 52

Figure 3.20: Route from Ipoh Toll to Sungai Dua Toll 53

Figure 4.1: Graph of Temperature vs Time (Ayer Keroh, Melaka) (Morning) 56

Figure 4.2: Graph of Temperature vs Time (Ayer Keroh, Melaka) (Afternoon) 57

Figure 4.3: Graph of Temperature vs Time (Ayer Keroh, Melaka) (Evening) 57

Figure 4.4: Graph of temperature taken by sensor 1 for all experiments in every 5 minutes (Ayer Keroh, Melaka) 58

Figure 4.5: Graph of temperature taken by sensor 2 for all experiments in every 5 minutes (Ayer Keroh, Melaka) 59

Figure 4.6: Graph of temperature taken by sensor 3 for all experiments every 5 minutes (Ayer Keroh, Melaka) 59

Figure 4.7: Graph of temperature taken by sensor 4 for all experiments for every 5 minutes (Ayer Keroh, Melaka) 60
Figure 4. 8: Graph of Temperature vs Time (Taiping, Perak) (Morning) 61
Figure 4. 9: Graph of Temperature vs Time (Taiping, Perak) (Afternoon) 61
Figure 4. 10: Graph of Temperature vs Time (Taiping, Perak) (Evening) 62
Figure 4. 11: Graph of temperature taken by sensor 1 for all experiments every 5 minutes (Taiping, Perak) 63
Figure 4. 12: Graph of temperature taken by sensor 2 for all experiments every 5 minutes (Taiping, Perak) 63
Figure 4. 13: Graph of temperature taken by sensor 3 for all experiments every 5 minutes (Taiping, Perak) 64
Figure 4. 14: Graph of temperature taken by sensor 4 for all experiments every 5 minutes (Taiping, Perak) 64
Figure 4. 15: Graph of Temperature vs Time (Sungai Petani, Kedah) (Morning) 66
Figure 4. 16: Graph of Temperature vs Time (Sungai Petani, Kedah) (Afternoon) 66
Figure 4. 17: Graph of Temperature vs Time (Sungai Petani, Kedah) (Evening) 67
Figure 4. 18: Graph of temperature taken by sensor 1 for all experiments every 5 minutes (Sungai Petani, Kedah) 68
Figure 4. 19: Graph of temperature taken by sensor 2 for all experiments every 5 minutes (Sungai Petani, Kedah) 68
Figure 4. 20: Graph of temperature taken by sensor 3 for all experiments every 5 minutes (Sungai Petani, Kedah) 69
Figure 4. 21: Graph of temperature taken by sensor 4 for all experiments every 5 minutes (Sungai Petani, Kedah) 69

Figure 4.22: Graph of Temperature vs Time (Kuala Lumpur) (Morning) 71

Figure 4.23: Graph of Temperature vs Time (Kuala Lumpur) (Afternoon) 71

Figure 4.24: Graph of Temperature vs Time (Kuala Lumpur) (Evening) 72

Figure 4.25: Graph of temperature taken by sensor 1 for all experiments in every 5 minutes (Kuala Lumpur) 73

Figure 4.26: Graph of temperature taken by sensor 2 for all experiments in every 5 minutes (Kuala Lumpur) 73

Figure 4.27: Graph of temperature taken by sensor 3 for all experiments every 5 minutes (Kuala Lumpur) 74

Figure 4.28: Graph of temperature taken by sensor 4 for all experiments for every 5 minutes (Kuala Lumpur) 74

Figure 4. 29: Graph of Temperature vs Time (Johor Bahru, Johor) (Morning) 75

Figure 4.30: Graph of Temperature vs Time (Johor Bahru, Johor) (Afternoon) 76

Figure 4. 31: Graph of Temperature vs Time (Johor Bahru, Johor) (Evening) 76

Figure 4. 32: Graph of temperature taken by sensor 1 for all experiments in every 5 minutes (Johor Bahru, Johor) 77

Figure 4. 33: Graph of temperature taken by sensor 2 for all experiments in every 5 minutes (Johor Bahru, Johor) 78

Figure 4. 34: Graph of temperature taken by sensor 3 for all experiments every 5 minutes (Johor Bahru, Johor) 78

Figure 4. 35: Graph of temperature taken by sensor 4 for all experiments for every 5 minutes (Johor Bahru, Johor) 79

Figure 4. 36: Graph of Temperature vs Time (Shah Alam, Selangor) (Morning) 80

Figure 4. 37: Graph of Temperature vs Time (Shah Alam, Selangor) (Afternoon) 80

Figure 4. 38: Graph of Temperature vs Time (Shah Alam, Selangor) (Evening) 81

Figure 4. 39: Graph of temperature taken by sensor 1 for all experiments in every 5 minutes (Shah Alam, Selangor) 82

Figure 4. 40: Graph of temperature taken by sensor 2 for all experiments in every 5 minutes (Shah Alam, Selangor) 82

Figure 4. 41: Graph of temperature taken by sensor 3 for all experiments every 5 minutes (Shah Alam, Selangor) 83

Figure 4. 42: Graph of temperature taken by sensor 4 for all experiments for every 5 minutes (Shah Alam, Selangor) 83

Figure 4. 43: Graph of Temperature vs Time (Ayer Keroh Toll to Sungai Besi Toll) 84

Figure 4. 44: Graph of Temperature vs Time (Jalan Duta Toll to Ipoh Toll) 85

Figure 4. 45: Graph of Temperature vs Time (Ipoh Toll to Sungai Dua Toll) 86

LIST OF SYMBOLS AND ABBREVIATIONS

km	-	Kilometre
CO_2	-	Carbon Dioxide
DOE	-	Design of Experiment
HC	-	Hydrocarbon
R12	-	Dichlorodifluoromethane
	-	
	-	
	-	

LIST OF APPENDICES

APPENDIX	TITLE	PAGE

CHAPTER 1

INTRODUCTION

1.1 Overview

Climate change is the most serious threat to the environment and mankind facing us in the twenty-first century. Climate change refers to the fact that the yearly temperature of the planet has fluctuated by several degrees Celsius up and down during the past one million years. Warming tendencies have been observed in most areas, including Malaysia, during the past 30 to 50 years, according to temperature data. Extreme weather events such as droughts, storms, and floods may become more frequent and intense as a result of climate change, according to some scientists. The ramifications of global climate change are numerous and diverse (Haliza, 2009). Climate Change can be defined as changes in the state of a climate that can be identified (for example, using statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period, typically decades or longer, as opposed to natural variability (IPCC, 2007).

According to the United Nations Framework Convention on Climate Change (1992), climate changes are defined as any change in climate that can be attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to natural climate variability observed over comparable periods (Haliza,2018). Malaysia has witnessed warming and rainfall abnormalities, notably in the previous two decades, and as a result, the country has received a great deal of interest in the study of climate trends and their

consequences. Several regions in Malaysia have had their historical annual mean daily temperatures as well as their historical annual precipitation measured and analyzed (Sammathuria and Ling, 2009). In addition, models of temperature and rainfall anomalies were included in the research. Malaysia is a tropical country with daytime temperatures that reach extreme highs of 40^{o}C.

Car owners in Malaysia require an air conditioning system in their vehicles since the weather is hot and humid throughout the year. The thermostat level (temperature knob setting) position is adjusted by the passenger in order to manage the temperature of the cold air delivered to the cabin. The air conditioning system in a car is quite important for keeping the passengers and the driver cool during the whole driving session. The purpose of the air conditioning system in a car is to provide comfort for the driver and passengers. The air conditioning system will produce a comfortable atmosphere by regulating the temperature and humidity levels in the air (Shah, 2006).

Many fatalities have been reported in the last several years as a result of interior automobile heat, according to the latest statistics. When a car is parked in direct sunlight and the temperature in the cabin becomes too high, it might cause serious problems. The trapped and stored heat causes the temperature inside an automobile to rise to as high as 36^{o}C degrees and even 50^{0}C (Mansor *et al*., 2014). Many academics believe that when a car is parked in indirect sunlight, the heat generated in the cabin may reach temperatures of up to 80^{o}C in the inside (Al-Kayiem *et al*., 2010). It is common for drivers to suffer an unpleasant sensation in the first ten minutes after getting into a car that has been sitting in the sun for an extended amount of time (Grundstein *et al.*, 2010). Consequently, drivers must operate an air

conditioner at maximum capacity in order to minimize the high temperature and preserve comfort in the car interior (Grundstein *et al.*, 2009).

1.2 Research Background

Climate change, a major environmental concern of the twenty-first century, has been recognized as one of the most significant topics of the modern era. As a result of this predicament, Malaysian drivers are required to have an air conditioning system installed in their vehicles due to the high temperatures and humidity that prevail throughout the country year-round. The performance of an air conditioning system while being tested on the road is the subject of this investigation. The experiment will be carried out by collecting data on the temperature of the automobile cabin at several different locations throughout Malaysia. This experiment will be carried out three times at the same location, once in the morning, once in the afternoon, and once in the evening, with each session involving a different group of participants.

1.3 Aim

This research aims to explore the temperature of the inside of an automobile in various locations around Malaysia by employing the On-Road Testing technique. Experiments for this research will be conducted at a variety of times and locations with the temperature in the automobile as the primary focus of the investigation. Throughout the day, the temperature changes, being hot in the afternoon and cool at night. Based on the data collected, the present research can identify the thermostat level (temperature knob setting) of the vehicles in specific places.

1.4 Objective

The objectives of this research are as follows:

a) To design an on-road experimental techniques that determine the car interior ambient temperature based on pre-setting climate control conditions.

b) To collect the temperature of the interior car at specific times, which include morning, afternoon, and evening at different locations that is cities, metropolitan cities and highway.

c) To analyze the collected ambient temperature that was influence by the interior car temperature.

1.5 Scope of Research

The investigation of the present work was carried out by utilizing an on-road testing method to determine the temperature of the inside of the car. This experiment is carried out by traveling to several locations in Malaysia which the location that will be highlighted in Chapter 3. This investigation is carried out by employing the same type of car to demonstrate the differences in interior temperature at different locations. Through the use of the same amount of air conditioning between different areas at the same time, the information required were obtained.

1.6 Organisation of Thesis

The remainder of this thesis is compromised of four further chapter as summarised below.

Chapter 2: A review of literature relevant to the present study about performance of car air conditioning, climate change in Malaysia, and ambient outdoor and interior temperature of car.

Chapter 3: The new methodology, proposed through the approach for discussing the processes involed in this research will be explained. The process for this research began with design an on-road testing method to determine the car interior ambient temperature.

Chapter 4: The temperature of interior car is collected through experiment that has been design in methodology. The data analysis is present as two-dimensional line graph to compare the temperature between times and location. Moreover, the bar graph is present to shows the reading between sensor.

Chapter 5: Conclusions are drawn from the overall findings of the research along with recommendation for future work.