



**THERMAL COMFORT STUDY ON BABY STROLLER USING
FAN WITH FABRIC DUCT AS AIR DISTRIBUTION METHOD**



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**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
(REFRIGERATION AND AIR-CONDITIONING SYSTEM) WITH
HONOURS**

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**Faculty of Mechanical and Manufacturing Engineering
Technology**



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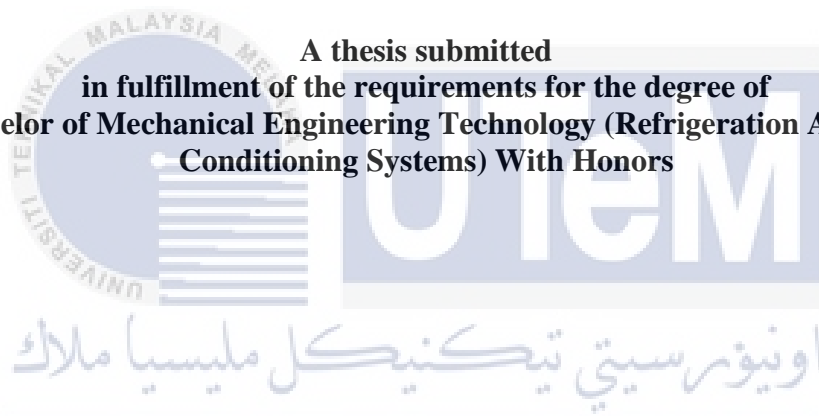
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MUHAMMAD AIMAN HAIQAL BIN WIRA

A thesis submitted
in fulfillment of the requirements for the degree of
**Bachelor of Mechanical Engineering Technology (Refrigeration And Air
Conditioning Systems) With Honors**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this project entitled “ Thermal Comfort Study On Baby Stroller Using Fan With Fabric Duct As Air Distribution Method ” is the result of my own research except as cited in the references. The project has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature

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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 (Refrigeration and Air-Conditioning System) with Honours

Signature :



Supervisor Name : Ts. Azman Bin Ibrahim

Date :

19 Jan 2023



DEDICATION

Toward my parents, Wira bin Jaafar and Mazlinder binti Abdul Razak.
The inspiration behind who I am now.
Whose support and encouragement me from the beginning to the end.
I appreciate their wonderful help and on-going concern.

Finally, I would want to express my gratitude and blessings to everyone who helped and support me in any way throughout the conclusion of the project.



ABSTRACT

In addition to Greenhouse Gases (GHGs), climate change can contribute to global warming. Global warming is defined as a change in climate that causes an increase in the earth's average temperature. Ambient temperatures that are too hot can be dangerous to one's health. Therefore, this hot ambient temperature is not good for a baby when they are indoors or outdoor because baby's skin is very sensitive and can cause heat-related illnesses. Therefore, most parents use baby strollers to take their children for walks outside or indoors to avoid exposure to direct sunlight. However, if the stroller is not monitored properly it can cause the baby to feel uncomfortable with the comfort temperature in the stroller. This comfort temperature can cause some illnesses to the baby such as heatstroke. This happens because there are some strollers that do not have good ventilation when the stroller is running or static. Due to that, this study will be conducted focusing on thermal comfort on baby stroller during outdoor activity. To achieve this focus, several studies have been done. Such as thermal comfort, fabric duct type and so on. In addition, to ensure that the temperature and velocity of the air is achieved well, the objective of this study will be implemented. Concept Screening and Concept Scoring methods are used to select the best design concept that adheres to the project's main idea in order to meet the objective. To achieve good air distribution in the stroller in this project, a 20 mm fabricated fabric duct was used. Two locations—the food court of *MITC Melaka* and *Tasik Ayer Keroh Melaka* Recreation Park (outdoors)—were used for the experiment (indoor). There are three tests, and measurements of the temperature and air velocity are made. Each temperature and air velocity at both locations reading will be taken every 30 seconds, within a 30 minutes and for the air velocity data experiment on comparison diameter size was taken for 15 minutes. The data values will then be compared using a fan with fabric duct and without. After comparison, the temperature for the fan with fabric duct can reach the baby's average temperature at 37.5 degrees Celsius. It shows that the performance of the fan with fabric duct is better than without inside the stroller.

ABSTRAK

Selain Gas Rumah Hijau (GHG), perubahan iklim boleh menyumbang kepada pemanasan global. Pemanasan global ditakrifkan sebagai perubahan iklim yang menyebabkan peningkatan suhu purata bumi. Suhu persekitaran yang terlalu panas boleh membahayakan kesihatan seseorang. Oleh itu, suhu persekitaran yang panas ini tidak baik untuk bayi ketika berada di dalam atau di luar rumah kerana kulit bayi sangat sensitif dan boleh menyebabkan penyakit berkaitan haba. Oleh itu, kebanyakan ibu bapa menggunakan kereta sorong bayi untuk membawa anak-anak mereka berjalan-jalan di luar atau dalam rumah bagi mengelakkan pendedahan kepada cahaya matahari langsung. Namun, jika stroller tidak dipantau dengan baik boleh menyebabkan bayi berasa tidak selesa dengan suhu keselesaan di dalam stroller. Suhu keselesaan ini boleh menyebabkan beberapa penyakit kepada bayi seperti strok haba. Ini berlaku kerana terdapat beberapa kereta sorong yang tidak mempunyai pengudaraan yang baik apabila kereta sorong itu berjalan atau statik. Disebabkan itu, kajian ini akan dijalankan dengan memfokuskan kepada keselesaan terma pada kereta sorong bayi semasa melakukan aktiviti luar. Untuk mencapai fokus ini, beberapa kajian telah dilakukan. Seperti keselesaan terma, jenis saluran kain dan sebagainya. Selain itu, untuk memastikan suhu dan halaju udara tercapai dengan baik, objektif kajian ini akan dilaksanakan. Kaedah Saringan Konsep dan Pemarkahan Konsep digunakan untuk memilih konsep reka bentuk terbaik yang berpegang kepada idea utama projek bagi memenuhi objektif. Untuk mencapai pengedaran udara yang baik dalam kereta dorong dalam projek ini, saluran fabrik fabrikasi 20 mm telah digunakan. Dua lokasi—medan selera MITC Melaka dan Taman Rekreasi Tasik Ayer Keroh Melaka (luar)—digunakan untuk eksperimen (dalaman). Terdapat tiga ujian, dan pengukuran suhu dan halaju udara dibuat. Setiap suhu dan halaju udara di kedua-dua lokasi bacaan akan diambil setiap 30 saat, dalam masa 30 minit dan untuk eksperimen data halaju udara mengenai saiz perbandingan diameter diambil selama 15 minit. Nilai data kemudiannya akan dibandingkan menggunakan kipas dengan saluran fabrik dan tanpa. Selepas perbandingan, suhu untuk kipas dengan saluran fabrik boleh mencapai suhu purata bayi pada 37.5 darjah Celsius. Ia menunjukkan bahawa prestasi kipas dengan saluran fabrik adalah lebih baik daripada tanpa di dalam kereta sorong.

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
CCPI	-	Change Performance Index
GHG	-	Greenhouse Gases
UV	-	Ultraviolet Radiation
ASHRAE	-	The American Society of Heating, Refrigeration, and Air Conditioning Engineers
ISO	-	The International Organization for Standardization
UPF	-	UV Protection Factor
SPF	-	Sun Protection Factor
BSA	-	Body Surface Area
H	-	Height
W	-	Weight
S	-	Surface
USB	-	Universal Serial Bus
HVAC	-	Heating, Ventilation, and Air Conditioning
TPU	-	Thermoplastic Polyurethane
PVC	-	Polyvinyl Chloride

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CHAPTER 1

INTRODUCTION

1.1 Background

For some countries, climate change poses a serious threat. The term "climate change" refers to a shift in the earth's environmental conditions. Furthermore, these climatic changes have a variety of effects on life on the planet. Climate change is having a variety of effects on the ecological system and ecology. According to figure 1.1, which shows the Climate Change Performance Index (CCPI) 2022, Malaysia has consistently dropped in the CCPI ranking, from 39th place in 2016 to 57th place in 2022. The CCPI rating of Malaysia is highly disappointing since it demonstrates a lack of political commitment and effort to reduce absolute carbon emissions. The CCPI ranks countries based on their performance in combating climate change. The countries that are ranked are liable for 90% of greenhouse gases (GHG) pollution. As a result, about a 25% of the world's countries, including Malaysia, are liable for 90% of Greenhouse gases (Jan Burck et al., 2022).

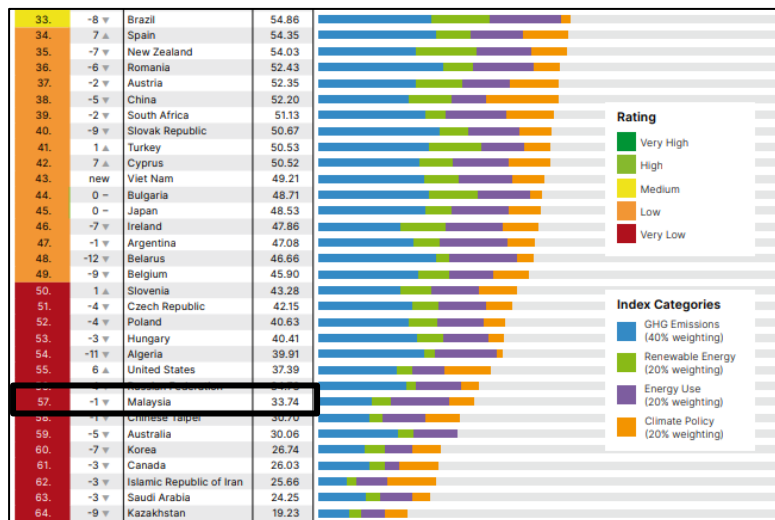


Figure 1.1 CCPI Rankings Around the World In 2022

Climate change, in addition to GHGs, can contribute to global warming. Climate change that causes an increase in the average temperature of the earth is referred to as global warming. Global warming is a rise in the earth's surface and atmospheric temperatures that has impacted various life forms. The equinox phenomena, or global warming, occurs twice a year in Malaysia in 2019 (March and September). In March, from Malaysian Meteorological Department state the greatest temperature recorded in Batu Berendam, Melaka, Malaysia was roughly 31.3 degrees Celsius, as shown in Figure 1.2. When the country was afflicted by the severe El Nino event in 1998, the hottest temperature ever recorded in Malaysia was 40.1°C (The Straits Times. 2016). High ambient temperatures can be hazardous to one's health. Heat-related illnesses can affect the body when the temperature is between 90 and 105 degrees Fahrenheit (32 and 40 degrees Celsius). Adults and infants can suffer from heatstroke, heat cramps, and exhaustion at this temperature.

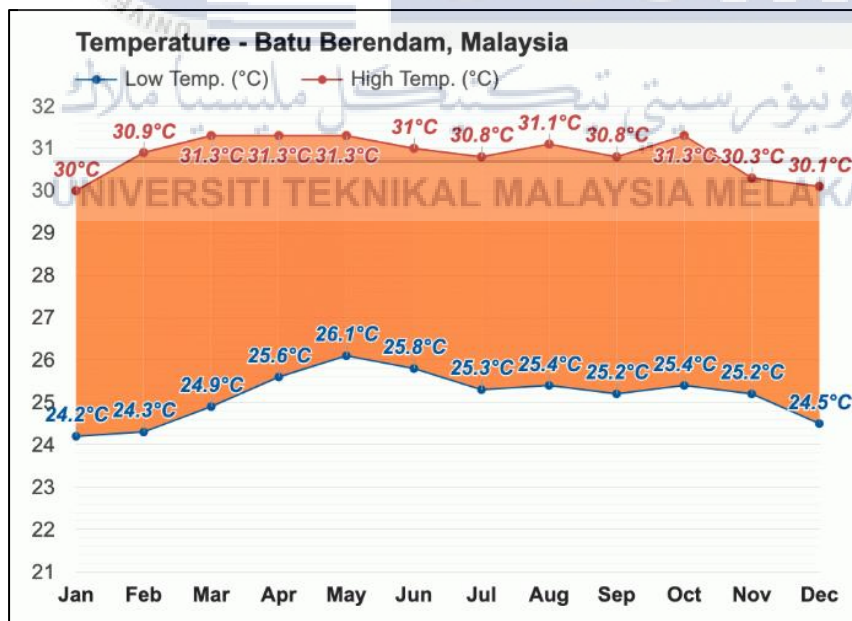


Figure 1.2 Batu Berendam, Melaka, Malaysia's Average Temperature

Thermal comfort is described as a state in which people do not want warmer or colder temperatures, but rather the ideal temperature. While neutrality temperature is the temperature at which individuals are at ease, preferred temperature is the temperature at which people choose to be (Staiger et al., 2012) . On other hand, "The state of mind that communicates happiness with the surrounding environment" (ANSI/ASHRAE Standard 55, 2004) defines thermal comfort. One of the aspects that might influence thermal comfort is temperature. Heat loss and thermal comfort can both be worsened by an increase in temperature.

When the temperature outside is high, adults can make better decisions than newborns. Babies will be carried in strollers and prams to avoid being exposed to the sun, which can cause heat-related diseases. Strollers have been around since the 18th century, when they were created for the children of the Duke of Devonshire. William Kent created a shell-shaped, wheeled carriage that allowed the infants to sit comfortably (Tal Ditye, 2004). A tiny pony or goat was intended to pull this. Over time, the fundamental design and safety features evolved into what we see today. A perambulator is referred to as a pram. Infants are commonly carried in prams. Strollers, on the other hand, are often used to transport tiny children under the age of three. Furthermore, parents and guardians use baby strollers to make travelling easier, whether outdoors or indoors, so that the baby is protected from the sunlight and UV radiation. However, some baby strollers fail to match the desired criteria, preventing the infant from reaching the optimal level of thermal comfort.

Malaysia is one of the countries that is reported to be fairly hot since it is situated on the equator and has two seasons throughout the year, namely humid and dry. The temperature in Malaysia, on the other hand, might make it difficult for newborns to attain thermal comfort. When the temperature is about 90 degrees Fahrenheit (32 degrees Celsius), the

infant should not be left outside for lengthy periods of time, since this might lead to heat-related diseases (Colleen de Bellefonds, 2021).

1.2 Problem Statement

In Malaysia, it is typical to see parents or guardians bringing their children on a stroll using a baby stroller to make travelling simpler. The canopy on the baby stroller may be opened to keep the child out of the sunlight or covered to keep the child safe. Swedish researchers, on the other hand, believe that covering a baby in a stroller with light cotton might raise the danger of heatstroke (Waller, 2021). The effects of heat-related disorders develop in infants because the ventilation system in the baby stroller is insufficient during outdoor and indoor activities. Moreover, parents or guardians also can utilise the fan attached to the stroller to keep the baby cool and preventing from heat-related illnesses. However, when the ambient temperature is too hot, the fan employed is unable to provide a comprehensive air supply to the infant in the stroller. Furthermore, when employing the fan, just the afflicted limbs are restricted.

1.3 Research Objective

This project focus on thermal comfort on baby stroller during outdoor activity. Specifically, the objectives are as follows:

1. To determine the optimum Fan with Fabric Duct design concept.
2. To fabricate fabric duct that can improve air distribution inside the stroller.
3. To evaluate the effectiveness of the Fan with Fabric Duct inside the stroller in both indoor and outdoor activities.

1.4 Scope of Research

The scope of this research are as follows:

- I. Fabricate of fan with a fabric duct is only available depending on battery powerbank lifetime usage.
- II. The static stroller is the subject of fabrication both outdoors and indoors.
- III. The high ambient temperature or the infants' metabolic heat rate may have an impact on cooling efficiency.

1.5 Expected Result

The project is expected to meet its goal of providing newborns with an option to being in the comfortable temperature of a baby carriage during both outdoor and indoor activities. This fan with fabric duct is also expected to reduce 15% of the temperature in the baby stroller.