International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-3 Issue-3, August 2013

Alternative Way in Reducing Car Cabin Temperature Using Portable Car Cooling System (Car-Cool)

M.F. Basar, M. Musa, M.Y. Faizal, N.H.A. Razik

Abstract*— Until now, car owners especially in ASEAN countries are facing problems where the temperature is too hot in the car when they park their cars under the scorching sun. Various problems will arise caused by this situation. In this paper, the design and development of portable car cooling system is described briefly. Electrical Motor, rechargeable battery, Peltier cell, rotating cloth; these are the components that have been combined in order to complete a simple cooling system. Based on the experimental activities' result, it is proven that the conducted research has a positive impact where it has successfully maintain the temperature inside the car at room temperature. For comparison, the temperature inside the car can achieve up to 70°C without the proposed system. Furthermore, the simple proposed system provides comfort to users due to its capability in improving the quality of air and moisture in the car's cabin.

***Index Terms*—About four key words or phrases in alphabetical order, separated by commas.**

I. INTRODUCTION

Nowadays, car is one the most important transportation for each individual compare to public transport. In the year of 2012, statistic shows that, there are almost 700,000 registered private vehicles in Malaysia. The high demand of the private transportation has caused so many problems. For instance, the needs of parking space are getting critical especially at the shopping area. Therefore, alternative choice for those who are unable to get indoor parking or even prefer low fee parking will looking for open parking space. It creates another problem to the car where the temperature inside the cabin will tremendously increased approaching 60 degree Celsius (°C) [1]-[2]. This will make the driver and passenger become uncomfortable while entering the car. Moreover, the car can also having car aging problem and bring damage to the goods found in the car. As a result, the need of portable car cooling system is really necessary so that the hot air inside the car shall be dissipate/remove and reduce the temperature.

Manuscript published on 30 August 2013.
*****Correspondence Author(s)
M.F. Basar, Electrical Engineering Technology Department, Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka, Ayer Keroh, Melaka, Malaysia.
M. Musa, Electrical Engineering Technology Department, Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka, Ayer Keroh, Melaka, Malaysia.
M.Y. Faizal, Electrical Engineering Technology Department, Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka, Ayer Keroh, Melaka, Malaysia.
N.H.A. Razik, Science and Physics Department, MARA Junior Science College, MRSM Terendak, Sungai Udang, Melaka, Malaysia.

II. RESEARCH PROSPECT

This research is based on the regular problem faced by drivers in South East Asia region especially when they have to park their car under the scorching sun.

As the number of vehicles on the road increased day by day, drivers are having difficulty to get an indoor or roof parking space especially during peak hour. As a result, they have no choice except to leave their car in open space parking as shown Fig. 1. In this situation, temperature inside the car increases proportional to the outside hotness and it getting worst in the afternoon especially when the car owners leave their car for hours.

Figure 1: Cars parked under the scorching sun

It is good when the car makes the passengers comfortable from the moment they get inside the car until they are going out from the car. The problem comes when the driver left the car at the open area that exposed to the scorching sun. The situation causes the car to heating up and introduces an uncomfortable situation for the driver and passenger when they get inside the car later on [3]-[6]. Consequently, the temperature inside the car increases and the vehicles owner have to wait until it cooled by itself for a moment.

In order to solve the problems associated with the overheating in the car, a product called Portable Car Cooling System is created. The purpose of the car cooling system is to help cool off the parked car under those hot sunny days. Thus, the aim of this research is to propose a system that capable to cool the passenger cabin without operates the car's engine. Materials used are also low cost and has high durability.

This portable car cooling system is used to control or maintain the temperature inside the car at room temperature even under a very hot conditions. As a result, once the user starts the car, the air conditioner doesn't have to work too hard in order to bring the temperatures at comfortable level [7]-[8]. This process reduces the fuel consumptions and expenses. Besides that, the product is a green product because it used the Peltier cell to charge the battery.

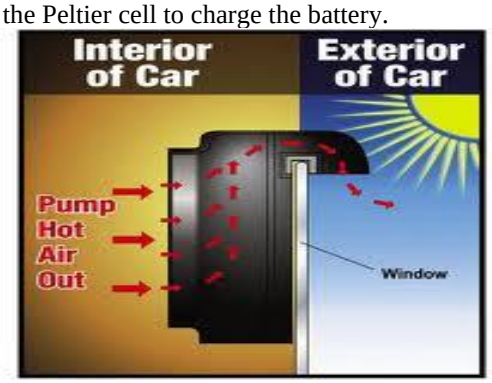

Figure 2 : Mechanism for reducing temperature

The car ventilation fan as shown in Fig. 2 is using solar system and it can easily find in the market. This product was created for the purpose to keep car cool whenever it is overheat by the sunlight or hot surrounding, but there are differences between this product and portable car cooling system proposed in this paper in term of the product functions, structure of the product, system used, durability and many more. The car ventilator fan shown in Fig. 2 used a solar panel and battery as a source of energy to run the ventilation fan, while portable car cooling system as shown in Fig. 3, applying Peltier cell as it source of energy. Besides that, the drawback of the car ventilator is only can be placed if the window's glass is slightly opened and this action can actually cause the things that are not desired to happen such as car theft.

Figure 3 : Portlable, lightwieght and easy to carry

In addition, the portable car cooling system also easy for transportation and has a smart design with medium size so that it can be put anywhere in the car. These are the features that will make this research product to be the people's choice. From reliability point of view, the proposed cooling system is more durable compared to the solar car ventilation fan, it can be seen from the appearance of the two product, the portable car cooler looks more solid and durable as we can seen in Fig. 4. Overall, the total weight of the portable car cooling system is 2.3 kilograms.

III. DEVELOPMENT OF PORTABLE CAR COOLING SYSTEM

In order to obtain the optimum performance of the product, the design of the product is the most important. Due to that, Table II demonstrates the function of the component in the system and Figure 4 illustrates the proposed cooling system. The materials used for hardware development is white derlin because this type of material is cheap, lightweight, easy to handle and it easy for manufacturing purposes.

The primary 12VDC motor is used to drive the fan blades at the speed of 5 meters per second. Simultaneously, the 6Vdc secondary motor will drive the rotating cloth which has damp after immersion in water compartment. Interesting here, this system is able to produce wind with water vapors that creates coziness in the car. The primary button and secondary button are used for switch on the primary and secondary motors respectively.

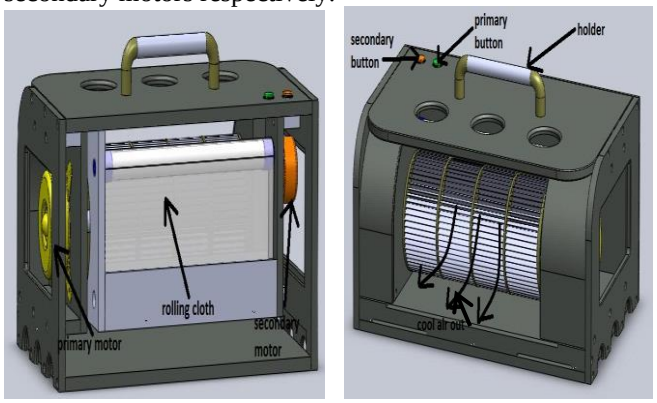

Figure 4 : Concept drawing of Portable Car Cooling system

No doubt, temperature and global warming is increasing. This happens when the past, people use a lot of pollutants in their everyday lives, including in power generation activities. Currently, the awareness to protect the environment is getting better, ie use of green energy such as solar power, wind and pico hydro [9]-[12]. For this product, it uses a Peltier cell as a alternative source of electrical energy.

This system operates using 12Vdc battery power type lithium polymer where it is rechargeable [13]. The battery can be charged either using a charger or more attractive using the Peltier cell. There are several Peltier cell placed in the left and right as shown in Figure 5. Peltier cell will produce electricity when one of the surfaces is imposed with hot air and other surface with cold air. The greater the temperature difference felt by the Peltier cell, the more electricity is produced. Arguably, it does not work as expected because the current produced is as low as milimpere (mA). However, it is believed that it can be a source of alternative energy that can be considered.

TABLE I. Function Of The Compenent In Portable Car Cooler

Component	Function
Primary motor	control the main fan in the system
Secondary motor	control the rotation of rolling cloth
Rolling cloth	produce cool air when it starts to rotate

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Primary button	control the main motor (on/off)
Secondary button	control the activation of secondary motor
Water compartment	small water reservoirs and place for cloth moistened

For the mechanism of this system, the hot air will be sucked into the portable cooling system due to low air pressure in the system. This is caused by the high velocity of the propeller blades' rotation. Then, the hot air will hit the Peltier cell before the hot air is absorbed by the rolling cloth that has been wet and cold. Thus, the hot air is eliminated and the air with vapors of cold water is discharged into the car cabin.

Based on the results from the conducted experiment, the portable car's cooling system is able to reduce the temperature inside the car. It will be discussed in detail later.

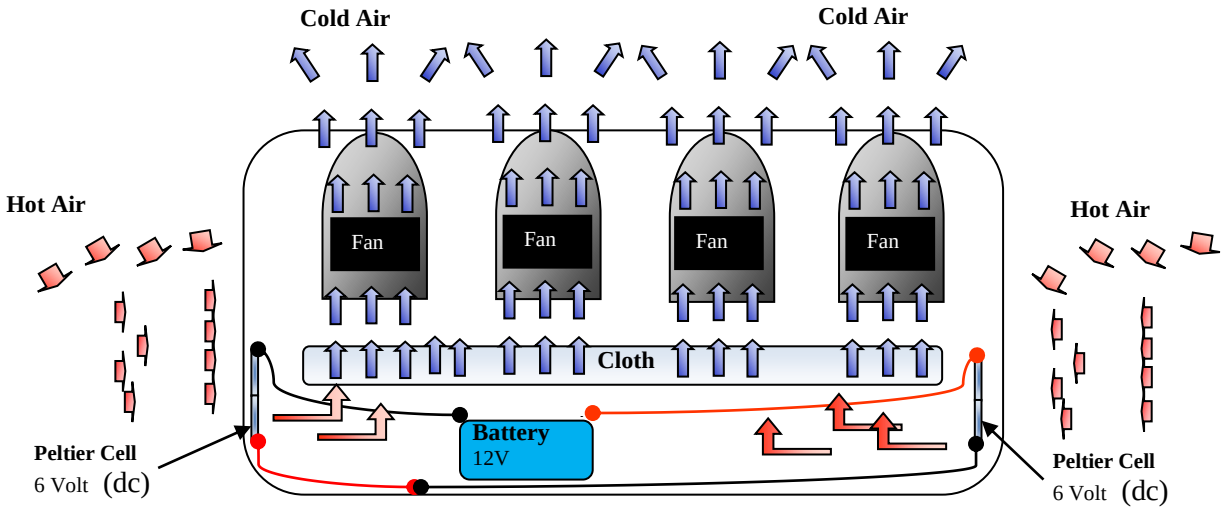

Figure 5 : Mechanism for reducing the car cabin temperature

IV. FUNCTIONALITY TESTING

The functionality testing activities was conducted at an open place under a hot and scorching sun condition. Refer to the Fig. 6, it illustrates that the temperature inside the car can reach up to 62 ºC approximately at 1 o'clock in the afternoon.

According to the research experimental works, it is proven that the portable car cooling system is capable to maintain the temperature inside the car in the range of 25ºC to 30ºC as shown in Fig. 7. As a result, this product has improved the quality of air and moisture inside the car's cabin significantly.

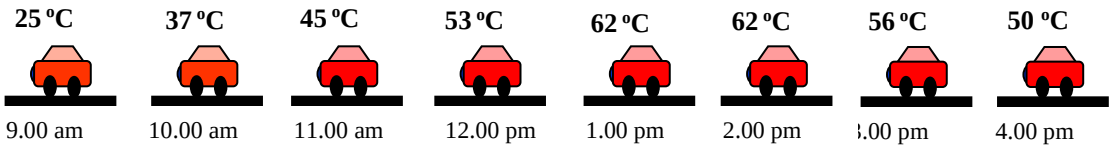

Figure 6 : Temperature is high before using the portable car cooling system

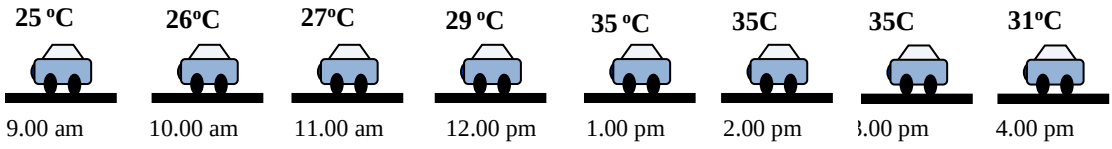

Figure 7 : Temperature is low after using the portable car cooling system

Figure 8 shows the temperature in the car with and without the proposed system taken from 9 in the morning until 4 in the evening. What can be observed, the temperature inside the car cabin was at its peak between the hours of 1 o'clock and 2 o'clock in the afternoon. Furthermore, readings taken from 9 o'clock in the morning slightly increase until 12 o'clock in the afternoon. However, an hour later, the temperature readings obtained is rapidly increased. Unfortunately, after 2 o'clock until 4 o'clock in the afternoon, the temperature readings decreased at a slower rate.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

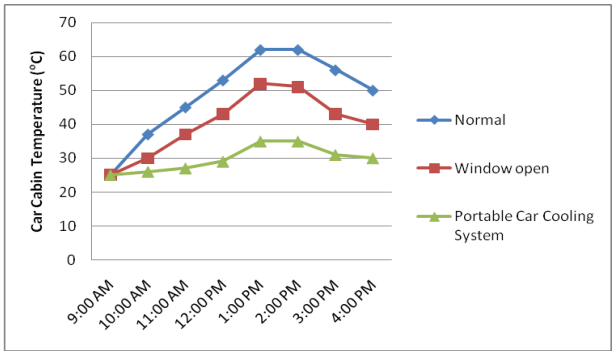

Figure 8 : Temperature difference in the car cabin

V.CONCLUSION

As a conclusion, the portable car cooling system was successfully developed and it is functioning very well. The main objective of the research is to propose a cooling system that able to control and maintain temperature inside the car at the range of 25 to 30 when parked under very hot condition. The results of testing shows that the vehicle's owner whom using this product capable to maintain the cabin car temperature approaching room temperature. Besides that, the developed portable car cooling system is in a medium size and the design is suitable for all type of vehicles in Malaysia. It was proved that this system has good features, high performance with simple and effective way in reducing the car's cabin temperature.

VI. ACKNOWLEDGMENT

The authors would like to thank Universiti Teknikal Malaysia Melaka (UTeM) for the financial support of this project and the permission to publish the work.

REFERENCES

1. R. Saidur, H.H. Masjuki, M. Hasanuzzaman. (2009). Performance of an Improved Solar Car Ventilator. *International Journal of Mechanical and Materials Engineering (IJMME)*, Vol. 4, No. 1, pp 24-34, 2009
2. M.A. Jasni and F.M. Nasir. (2012). Experimental Comparison Study of the Passive Methods in Reducing Car Cabin Interior Temperature. *Proceedings of the International Conference on Mechanical, Automobile and Robotics Engineering (ICMAR'2012)*, pp. 229-233, December 14-15, Penang, Malaysia.
3. M.H. Salah, T. H. Mitchell, J.R. Wagner and D.M. Dawson. (2009). A Smart Multiple-Loop Automative Cooling System – Model, Control and Experimental Study. *IEEE/ASME Transactions on Mechatronics*, Vol. 15, Issue 1, pp. 117-124.
4. A. Mezrhab, M. Bouzidi (2004). Computation of Thermal Comfort Inside a Passenger Car Compartment. *Applied Thermal Engineering*, 26 (14-15), 1697-1704.
5. N. Hasim, M.F Basar, M.S.M. Aras,"Design and Development of Water Bath Control System: A Virtual Laboratory Experiment," *2011 IEEE Student Conference on Research and Development (SCOReD)*, pp. 403-408, ISBN: 978-1-4673-0099-5, Cyberjaya, Malaysia, 19-20 December 2011.
6. N.A.G. Martinho, M.C.G. Silva, J.A.E Ramos. (2004). Evaluation of Thermal Comfort in a Vehicle Cabin. *Proceedings of the I MECH E Part D, Journal of Automoblie Engineering*, 218 (2), 159-166.
7. H.H. Al-Kayiem, M.F. Sidik, Y.R. Munusamy (2010). Study on the Thermal Accumulation and distributin inside a Parked Car Bin, American Journal of Applied Science, 7(6):784-789
8. Kaynakli, O., Unver, U., Kilic, M. (2002). Simulation of thermal comfort heating and cooling periods in an automobile compartment. *Proceedings of the Automotive Technologies Congress*, pp. 127-135, 24-26 June, Bursa, Turkey.
9. M. F. Basar, A. Ahmad, N. Hasim and K. Sopian, "Introduction to the Pico Hydropower and the status of implementation in Malaysia," *IEEE Student Conference on Research and Development (SCOReD)*, pp. 283-288, ISBN: 978-1-4673-0099-5, Cyberjaya, Malaysia, 19-20 December 2011.
10. M.B.Farriz, A.N. Azmi. N.A.M. Said, A. Ahmad, "A Study on the Wind as a Potential of Renewable Energy Sources in Malaysia," *2010 International Conference on Electrical Engineering/Electronics Computer Telecommunications and Information Technology (ECTI-CON)*, pp. 651-655, ISBN: 978-1-4244-5607-9, Chiang Mai, Thailand, 19-21 May 2010.
11. M.B.Farriz, J.M. Herman, A. Jidin, A.M. Zulkurnain, "A New Source of Renewable Energy from Lightning Return Stroke : A Small Scale System," *2010 International Power Electronics Conference (IPEC)*, pp. 1490-1493, ISBN: 978-1-4244-5394-8, Sapporo, Japan, 21-24 June 2010.
12. M.F Basar, A. Rahman,"Design and Development of Green Electricity Generation System Using Ocean Surface Wave," *PEA-AIT International Conference on Energy and Sustainable Development Issues and Strategies (ESD 2010)*, pp. 2-4, ISBN: 978-1-4244-8563-5, Chiang Mai, Thailand, 02-04 June 2010.
13. M.Shahrieel M. Aras, H.A. Kasdirin, M. Herman Jamaluddin, "Design and Development of an Autonomous Underwater Vehicle (AUV - FKEUTeM)," *2009 Malaysian Technical Universities Conference on Engineering and Technology (MUCEET)*, Kuantan, Malaysia, 02-04 June 2009.

AUTHOR PROFILE

M.F Basar was born in Kuala Lumpur, Malaysia on 09 November 1979. He obtained his Degree in Electrical Engineering from Universiti Teknologi Malaysia, Skudai, Johor in 2001. His major field of study is renewable energy technologies. He has an experience as Research and Development (R&D) Engineer in electrical power industries about 5 years from 2001 until 2005. Now he is working as a Lecturer in Universiti Teknikal Malaysia Melaka (UTeM), Malaysia from 2005 until now. Currently, his research is focussing in renewable energy techonologies especially in pico hydro generation system.

M. Musa was born on 26 September 1974 in Marang, Terengganu, East Malaysia. He obtained his degree in Mechanical Engineering from Science University of Malaysia in year 1997. In year 2006, he had finished his master degree in Innovation and Engineering Design from Universiti Putra Malaysia. Mr. Masjuri has an experience working in semiconductor industries for about five years as a Mechanical Design Engineer. He had involved in designed of tape and reel machines for the semiconductor industries purposes. Currently Mr. Masjuri is working as a lecturer in Department of Design and Innovation, Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka. Until now he has published few conference papers and currently his conducting few researches which are related to the renewable and sustainable energy especially in pico-hydro technologies.

M.Y. Faizal was born in Muar, Johor, Malaysia in 1981. He received his Bachelors Degree in Electrical-Electronics Engineering in 2004 from Universiti Teknologi Malaysia and his Masters Degree in Electrical Engineering from Universiti Tun Hussein Onn Malaysia in 2013. He joined Universiti Teknikal Malaysia Melaka as a Teaching Engineer in 2009 and became as a lecturer in 2013. Previously, he worked in STMicroelectronics for more than 5 years as a Senior Product Engineer involved in Test and Development for various automotive ASIC related to Robert Bosch GmbH. His areas of interest are Multilevel Inverters, Electronics System, Renewable Energy and Power Electronics.

M N.H.A. Razik was born in Pahang, Malaysia on 15 January 1979. She obtained her Degree in Petroleum Engineering from Universiti Teknologi Malaysia, Skudai, Johor in 2001. His major fields of study are in Physics Science and Petroleum Refinery Technologies. From 2002 until now, she is work as a Physics Teacher at MARA Junior Science College, MRSM Terendak, Melaka, Malaysia. Currently, her research is focussing in applied physics technologies especially in product innovation development.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)