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Comparison of Different Car Cooling Systems with Portable Car Cooling System

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Abstract: *Until now, car owners especially in ASEAN (Association of Southeast Asian nations) 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. For comparison, the temperature inside the car can achieve up to 80°C without the proposed system. This will make the driver and passenger uncomfortable while entering the car. Moreover, the car can also have car aging problem and bring damage to the goods present 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 the temperature is reduced. Furthermore, the proposed system provides comfort to users due to its capability in improving the quality of air and decreasing the cabin temperature.*
Keywords: *portable car cooling system, different methods of cooling systems*

I. Introduction

Nowadays, car is one the most important transportation for each individual compare to public transport. 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 increase approaching 60-80 degree Celsius (°C). 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. 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. In this situation, temperature inside the car increases proportional to the outside hotness and it gets worst in the afternoon especially when the car owners leave their car for hours. 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 leaves the car at the open area that is exposed to the scorching sun. This causes the car to heat up and introduces an uncomfortable situation for the driver and passenger when they get inside the car later.

Fig 1: Vehicals parking system

Consequently, the temperature inside the car increases and the vehicles owner has to wait until it is 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 is capable

to cool the passenger cabin without operating 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 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. This process reduces the fuel consumptions and expenses.

II. Alternative way of reducing car cabin temperature

The car ventilation fan as shown in fig 2 is using solar system and it can easily found in the market. This product was created for the purpose to keep car cool whenever it is overheated by the sunlight or hot surrounding, but there are differences between this product and portable car cooling system proposed in this paper in terms of the product functions, structure of the product, system used, durability and many more. The car ventilator fan shown in Fig uses a solar panel and battery as a source of energy to run the ventilation fan, while portable car cooling system, uses rechargeable cell as its source of energy. Besides that, the drawback of the car ventilator is it can be placed only 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.

III. Ventilation system

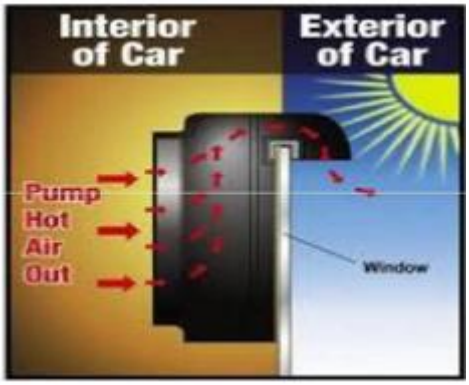


Fig 2: Ventilation System

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 products, and the portable car cooler looks more solid and durable. Other alternative methods include window tint and sunshades. Window tints help prevent the radiation from entering the car cabin and sunshades prevent the car from prolonged exposure to sun.

Fig 3: sunshades

IV. Development of Portable Car Cooling System

- The GI sheet is cut into required dimensions with provisions for two fans (6inch diameter) and is supported by a wooden frame.
- Two fans are clamped at the rear.
- Two 12v batteries are fitted at the rear end corners.
- A 12v dc pump is introduced at the centre of the base provided with PVC piping at outlet.
- A cloth is introduced which is attached to water reservoir which in turn has the provision for pump inlet.

Fig 4: Portable Car Cooling System

V. Working of Portable Car Cooling 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.
- The pump circulates the water and sprays the same on cloth.
- Then, the hot air will hit the cloth that is wet and cold. Thus, the hot air is eliminated and the air with vapours of cold water is discharged into the car cabin.

VI. Functionality Testing

The functionality testing activities were conducted at an open place under a hot and scorching sun condition. Initially, the test vehicle was parked under a shaded parking space. At approximately 9:15 am, the test vehicle was driven away to the test area and parked under direct sunlight. Infrared thermometer is used to measure the temperatures at various points. At approximately 09:30 am, the data acquisition started and it stopped at about 4:00 pm. This procedure was repeated for two different cases, which are:

A. Base Case

Bare test vehicle without any temperature-reducing methods

B. Case 1

With portable car cooling system included.

It illustrates that the temperature inside the car can reach up to 80 degrees Celsius approximately at 1 o'clock in the afternoon. According to the experimental works, it is proven that the portable car cooling system is capable to decrease the temperature inside the car cabin effectively compared to already existing methods.

VII. Results and discussions

The temperature readings are taken at five different locations inside the car cabin. Readings are taken at dashboard, steering, ambient front, ambient rear and boot space. The following table shows the results at base case when the car is exposed to hot sun.

WITHOUT PORTABLE CAR COOLING SYSTEM

TEMPERATURE IN DEGREE CELCIUS

TIME	DASHBOARD	STEERING	AMBIENT FRONT	AMBIENT REAR	BOOTSPACE
9:30	54.7	38.5	34.1	32.3	36.6
10:00	56.8	46.8	40.3	41.3	49.9
10:30	67.8	50.8	44.5	46.4	59.0
11:00	72.7	52.3	42.5	47.6	59.5
11:30	82.4	56.0	51.3	52.2	64.6
12:00	84.9	58.3	53.0	55.2	66.1
12:30	84.1	56.9	55.8	56.4	71.4
1:00	73.0	58.7	58.0	56.8	60.0
1:30	77.3	58.3	58.8	57.4	60.8
2:00	76.2	58.9	56.6	57.8	61.3
2:30	71.5	56.2	56.9	56.4	59.3
3:00	68.0	54.2	56.1	53.2	58.1
3:30	68.0	55.9	57.2	55.1	56.6
4:00	64.2	54.6	51.4	55.2	57.2

Table1: Temperature readings without portable car cooling system

Clearly from the table it can be observed that the temperature tends to increase as the time passes by until 1:00 pm and then tends to decrease. The maximum temperature is recorded at the dashboard and is 84.9^{o}c. In a similar way the readings are noted down for case 1, i.e with portable car cooling system inside the car.

WITH PORTABLE CAR COOLING SYSTEM

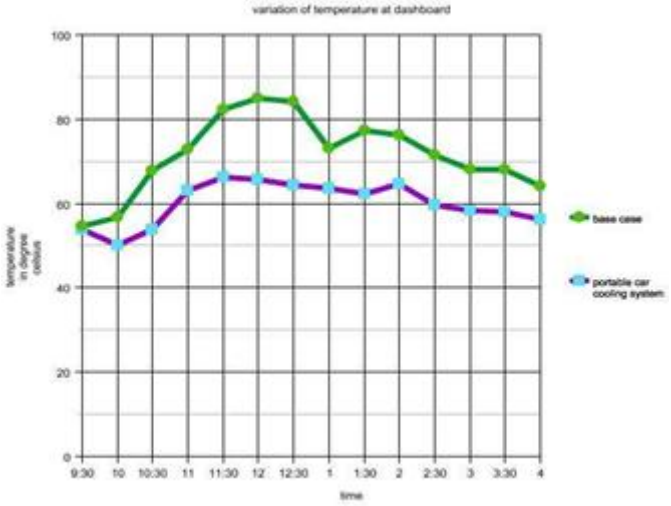
TIME	DASHBOARD	STEERING	AMBIENT FRONT	AMBIENT REAR	BOOTSPACE
9:30	53.8	38.0	36.0	30.9	38.4
10:00	50.0	37.9	34.0	28.6	38.0
10:30	53.7	39.0	38.1	31.2	40.3
11:00	63.0	45.3	40.2	35.4	44.0
11:30	66.3	47.9	44.0	37.9	50.7
12:00	65.7	51.0	45.3	40.2	48.1
12:30	64.3	50.2	47.2	42.7	40.3
1:00	63.7	52.3	50.3	44.6	39.8
1:30	62.4	52.1	51.2	49.7	40.1
2:00	64.6	52.0	49.3	48.6	41.3
2:30	59.6	49.8	48.4	46.2	38.6
3:00	58.2	44.6	48.2	44.2	37.4
3:30	58.1	45.3	49.1	45.7	35.2
4:00	56.3	42.7	41.6	45.3	35.1

Table 2: Temperatures readings with portable car cooling system

The maximum temperature recorded at the dashboard when portable car cooling system is used is 66.3^{o}c. Portable car cooling system reduced the maximum temperature by 18.6^{o}c at dashboard, 6.6^{o}c at steering, 7.6^{o}c at ambient front and 8.1^{o}c at ambient rear. The following observations are recorded

a) At dashboard:

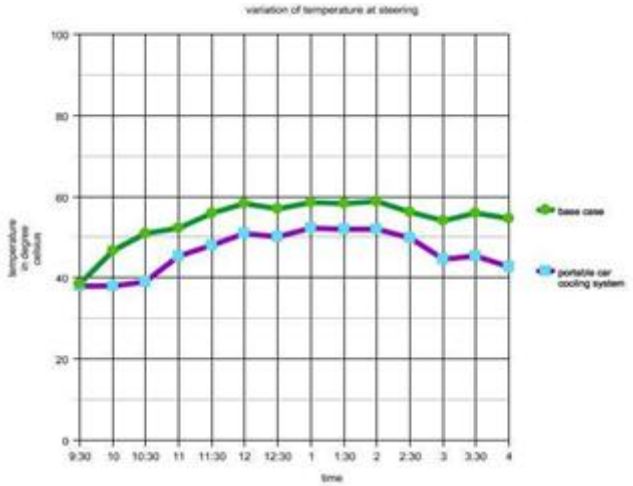
When a car is exposed to scorching sun for long time,as per the observation,the maximum temperature attained at the dashboard is 84.1^{o}C. with portable car cooling system,maximum temperature recorded is 66.3^{o}C.



Graph: 1 Temperature Vs Time(at dash board)

b) At steering:

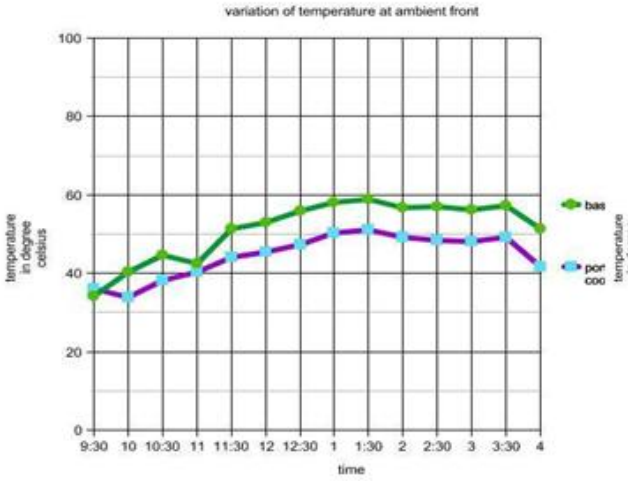
The temperature inside the car cabin increased gradually from morning 9:30AM,attained maximum temperature at 2:00PM and then gradually decreased. The maximum temperature recorded at steering is 58.9^{o}C and with portable car cooling system in it,it is 52.3^{o}C. A reduction of 6.6^{o}C is observed.



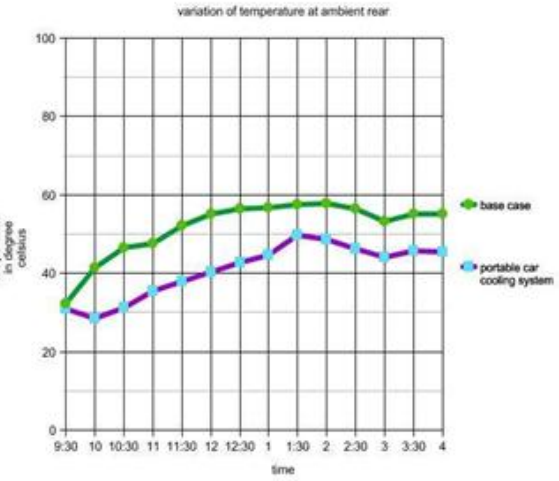
Graph2: Temperature vs time(at steering)

c) At ambient front and ambient rear:

At ambient front and ambient rear,the maximum temperature recorded at base case is 58.8^{o}C and 57.8^{o}C respectively. It is observed that portable car cooling system recorded a maximum reduction of 7.6^{o}C and 8.1^{o}C respectively.



Graph3: Temperature vs time (at ambient front)



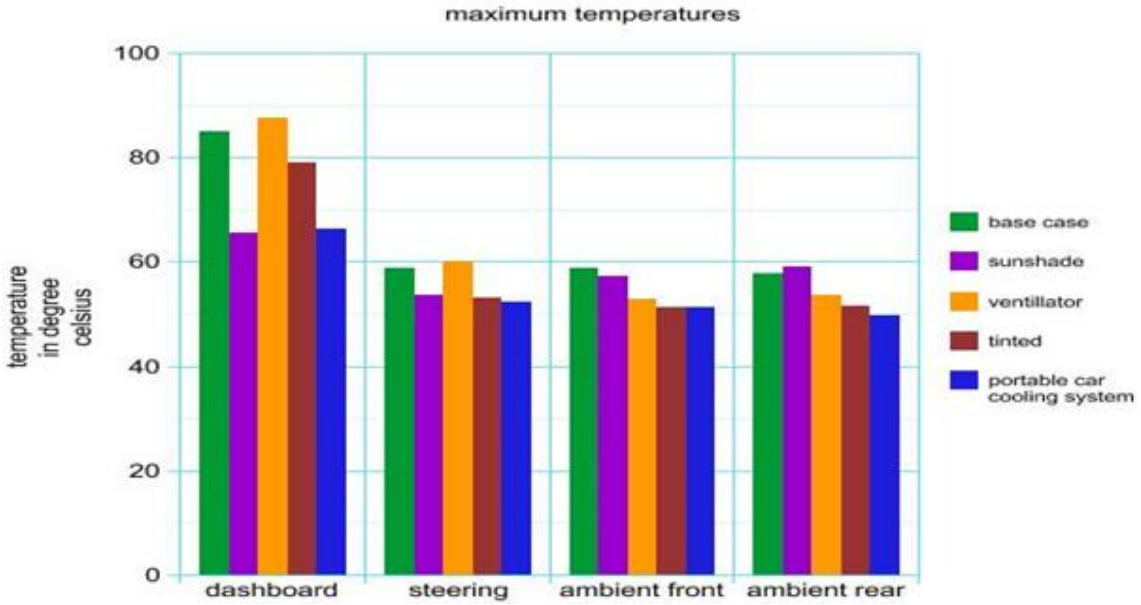
Graph4: Temperature vstime (ambient rear)

These results are compared with the existing data relevant to previously mentioned methods of reducing car cabin temperature[2]. It is proved that at all locations, portable car cooling system application is the most effective method in reducing temperature. The following table shows the reduction in maximum temperatures with different methods.

EXPERIMENT	REDUCTION IN MAXIMUM TEMPERATURE (°C)			
	DASHBOARD	STEERING	AMBIENT FRONT	AMBIENT REAR
SUNSHADE	18.1	4.0	-1.0	-2.3
VENTILLATOR	-3.9	-2.5	3.3	3.2
WINDOW TINT	4.7	4.4	4.8	5.3
PORTABLE CAR COOLING SYSTEM	18.6	6.6	7.6	8.1

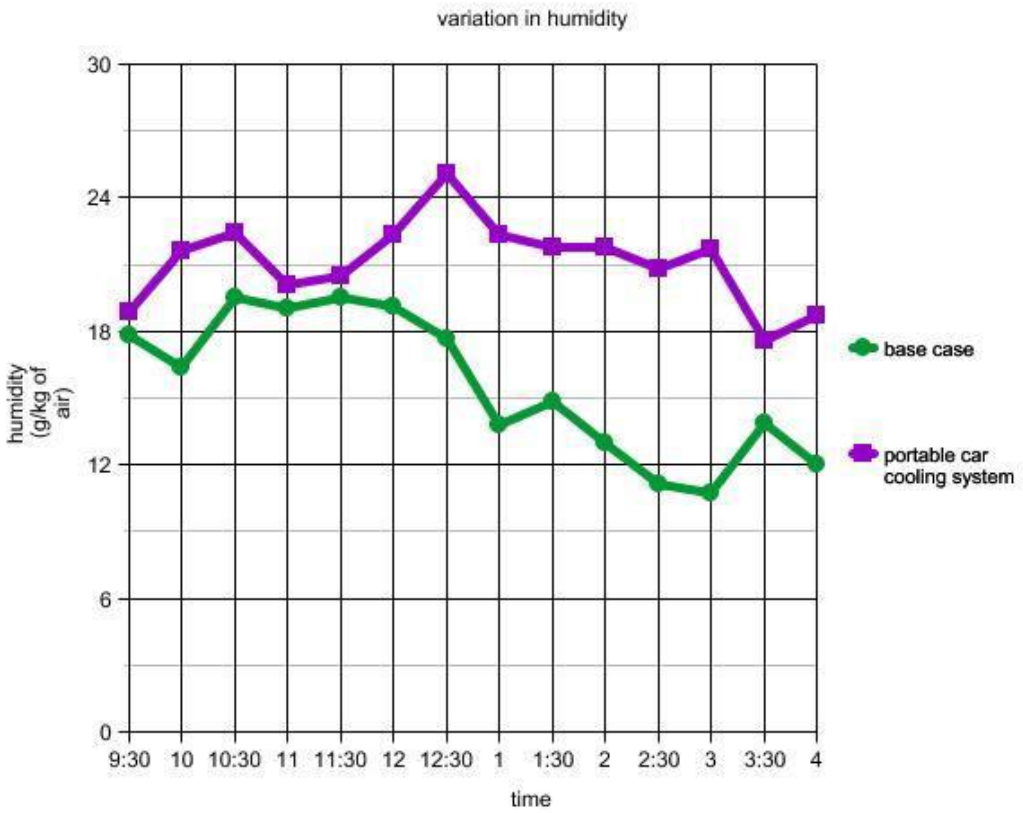
Table3: Reduction in maximum temperature by using different methodologies

The maximum temperatures attatined in all cases are compared. At dashboard and steering,ventilator method recorded a maximum temperature of 87.5^{o}C and 60.1^{o}C respectively. At ambient front and ambient rear,sunshade method recorded a maximum temperature of 57.2^{o}C and 59.1^{o}C respectively.



Graph 5: maximum temperature conditions different methodologies graph

From the above graphical comparssion it is proved that sunshade method is best suitable for reducing the temperature at dashboard and bootspace. The portable car cooling system was observed to be useful in reducing the ambient temperature and steering temperature.



Graph 6: Humidity comparisation of base case and portable car cooling system

Future scope:

- It is observed that the designed model eats up a lot of space. This can be rectified by compact design of portable car cooling system.
- Usage of plastic material for exterior instead of galvanised iron sheet will show better results as the heat is absorbed by G.I sheet.
- Moreover,the methodology involved in portable car cooling system is evaporation. A slight increase in humidity is observed inside the car cabin which is not appreciable, anyway this can be prevented by installing mini humidifier within the portable car cooling system.

VIII. Conclusion:

- The portable car cooling system treatment has achieved an overall good performance in reducing the average maximum temperature at all interior locations of the test vehicle, with higher percentage of reduction at steering, front and rear ambient locations.
- The usage of sunshades only manages to reduce the maximum temperature by 18.1^{o}C at the dashboard and 4^{o}C at the steering wheel. It has insignificant effect on the ambient air.
  The ventilators enhance the convection heat transfer inside of the car. Hence they are capable of reducing the average maximum front and rear ambient air temperatures by 3.3^{o}C and 3.2^{o}C respectively. They have insignificant effect in cooling of the car interior surfaces' temperatures.
- The usage of ventilators is found to reduce the average maximum temperature for the ambient air inside the car by as much as 3.3^{o}C. Although their performance is more or less similar with that for the window tints, their application is impractical.

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