Analysis of A Solar Ventilation System for Parked Car

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Abstract— This paper present the study the performance of the existing solar car ventilation system by observing its effectiveness in reducing the temperature inside the car that is parked unroofed under the sun. The commercially available ventilator is only working as the exhaust fan and it was not cool down the temperature inside the car. So The developed design of car ventilation system is compared with the existing car ventilation system. The modified ventilation system cool down more temperature because of the cooling fan, and wet cloth mechanism which applied in it. This system is run with 12V DC battery.

Key words: Solar Ventilation, Parked Car

I. INTRODUCTION

In India most of the people drive car. While using their vehicles, sometimes the car has to be parked directly under the sun due to limited roofed parking area. So that because of the unroofed parking conditions the temperature inside the can is increased very much. Rise in temperature levels inside the car can be attributed to convection (volume of air inside), conduction (various metals and heat absorbing materials inside) and radiation (from the glass and body of the car), of which the most influencing factor in such heating is radiation [4, 5]. Because of the temperature increases inside the car it causes discomforted of passenger inside the car and also reduces the quality of plastic, rubber, seat cover, etc which is used in interior of the car [2]. Sometimes due to high temperature inside the car the glass of the car also brakes and also causes human health problem. As to reduce the heat inside the car, some drivers open a small gap of the car windows to provide some ventilation. However, study from [2] shows that the practice had minimal effect and it does not really improve the situation. That practice will also lead to safety and security issue due to theft and robbery [3,2].

Thus, there is a need to have a proper ventilation system inside a parked car. There are several tools that have been developed to assist the ventilation problem inside a parked car either via battery powered system or solar based system [3]. The use of solar based ventilation system sounds promising to be employed in India due to our present weather and sun radiation condition. In spite of the commercially available solar [5,6].

In this paper shows the analysis of the existing solar ventilation with different conditions and then compared with the developed car ventilation system. The setup for data collection for the purpose of analysis and observation will be also highlighted. Later the result and analysis from the finding are discussed. Finally the paper ends with conclusion supporting with recommendation for further research development [4].

II. EXISTING VENTILATION SYSTEM

The existing solar car ventilator shown in Figure 1 is run by solar energy. It can also be driven by energy supplied through the vehicle's battery. The ventilator can keep functioning when the vehicle is parked under the sunlight even if the vehicle engine is turned off since the ventilator is driven by the solar energy. When sunlight gets weak, the ventilator can be alternatively driven by energy supplied from the vehicle's battery. The battery can be charged using the sunlight [4,5].

Fig. 1: Existing solar ventilation system

A. Working of The Existing System

Simple ventilation system typically used single phase motor with fan to move air. Single phase motor (AC motor) normally operates at a fixed voltage, so their speed varies on the blades of the fan. Volume of air will flow by the fan into the air duct. The efficiency of the system will improve significantly when the air flow rate is maintained at a constant level. This portable fan is placed at the window of the car so that with help of the solar panel fan is started to rotating and air circulation will remove the heat which decreasing the interior temperature of the car [5,6].

In table 1 the specification of the solar panel and fan is given.

Power (W)	1.2
Operating Temp. (^{0}c)	-40 ^{0}c to 85 ^{0}c
Type of cell	polycrystalline
Dimensions of fan (mm)	54*54*1
Rated Voltage (V)	5 V
Rated Current (A)	0.21 A
Rated speed (rpm)	3000 rpm
Diameter (mm)	12 mm
Length (mm)	34 mm

Table 1. Speciification Of The System

B. Data Analysis Without Any Ventilation System

First of all we measure the temperature inside the car cabin without any auto fan is placed inside the car or we can say that without any ventilation. In this condition the car is placed direct in sunlight from 12:00 PM to 4:00 PM Dated at 24/2/2016. so that because of the direct sun light temperature inside the car is increased. This increased temperature is measured with the alcoholic base thermometer at front and the back side of the car. This graph shows the temperature increasing with respect to time but after some time temperature became constant and started to

decrease due to change in the direction of the sunlight Dated at 24/2/2016 [2].

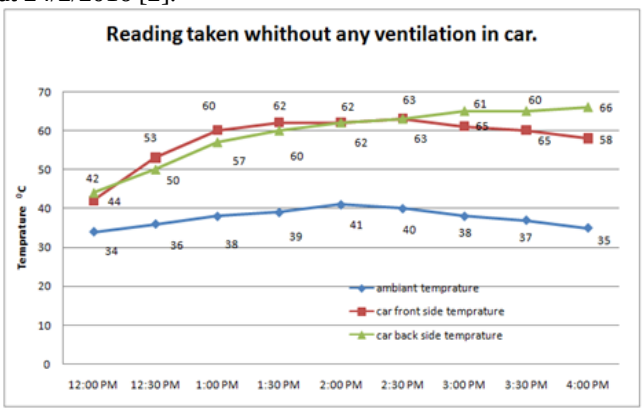

Fig. 2: Temperature inside the car cabin without any ventilation system

C. Data Analysis With Two Auto Fan Placed At Front Side Of The Window With Opposite Direction

In this condition two auto fan is putted in the car at front so that with the help of this two fan the temperature inside the car is decreasing. This fan is run with the solar PV cell and there is no requirement for any other power source But according to the sun direction speed of fan will vary.

Here in fig. 3 shows the position of the auto fan placed in the car and fig. 4 shows the Temperature chart with above condition from 12:00 PM to 4:00 PM Dated at 25/2/2016.

Fig. 3: Auto fan placed at opposite direction of each other

In this condition after 1:30 PM one fan was stopped because in that direction solar PV sell not able to absorbed sun radiation. So in fig.4. shows temperature chart.

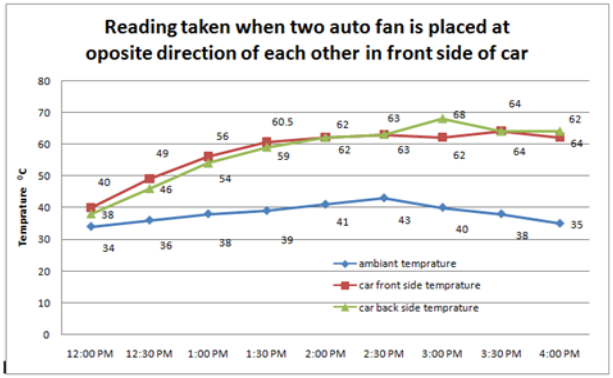

Fig. 4: Temperature inside the car cabin with two fan placed at front side of the car window

D. Data Analysis With Both Fan Placed At Front Side Of The Window In Same Direction

In this condition the fan is placed in the car at same direction beside to each other in fig.5. shows the arrangement of the fan in car.

Fig. 5: both fan placed at same direction

In fig.6. shows the temperature chart when both auto fan is placed in the same direction from 12:00 PM to the 4:00 PM Dated at 27/2/2016

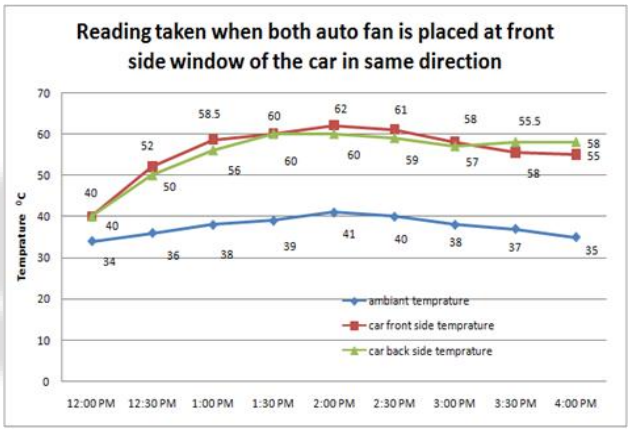

Fig. 6: temperature inside the car cabin when both fan placed at same direction

III. NEW VENTILATION SYSTEM

Above section shows the performance of the existing ventilation system which is available in market but it is not more efficient and not decrease much temperature inside the car cabin. So the new designed ventilation system which main focused on decreased the temperature inside the car cabin. It run on additional 12V battery and compact in size.

A. Components Used In Improved Ventilation System

1) Casing

The new system include casing which worked as water reservoir and whole system is employed on that casing it also has holding stand for placing all movable and non movable components. In this casing there is one window which is used for air ventilation process. It also has small holes to circulate air behind the cooling fan.

2) Cooling Fan

It is used for circulating air and increased the flow rate of the air. It will run on 12V battery with speed of 3000 revolution per minute. When car is parked in direct sun light the fan will start with manually operated switch.

3) Cloth Rotating Mechanism

In this system the cloth is submerged in water and the cloth is rotate continually in front of the fan so that air pass from the fan became cool which decreases the temperature inside the car. It has one 12 V motor which RPM is 30. And that motor is connected with shaft where whole cloth is introduced.

4) Battery And Stand

There is 12 V battery which is used for drive motor and the cooling fan. It produced 1.5A direct current. This whole system is mounted on the wooden stand.

B. Specification Of New Ventilation System

In this section of the paper shows the all specification of the all components which are used in new ventilation system. The table II shows the dimensions any many useful data.

Power required in Fan and Motor (W)	3.0 W
Type of Battery	Alkaline 13 V DC
Dimension of Fan (mm)	38*38*1
Diameter of fan(mm)	12 mm
No of blades in fan	7
Voltage of fan and motor(V)	12 mm
Current required in fan (A)	0.12 A
Current required in motor (A)	0.50 A
Speed of fan (RPM)	1500 rpm
Speed of motor (RPM)	30 rpm
Length of shaft(inches)	6 inches
No of shaft required	2
Distance between two shafts (inches)	6 inches
Diameter of shaft (mm)	6 mm
Volume of casing (inches)	15*8*6
Length of cloth (inches)	13 inches
Cloth rpm	12 rpm

Table 2. Speciification Of New System

C. Working Of New Ventilation Syste Applie In Car

In fig. 7 shows the installation of the new ventilation system when car is parked under the direct sun light. This ventilation is mounted on the wooden stand placed at front side of the car.

Fig. 7: New ventilation system

This fig.7 is the model of car ventilation system Which has one cooling fan and one cloth rotating mechanism with motor of 30 rpm and one 12 V battery behind the wooden stand. All this cooling fan and water rotating mechanism placed inside the casing.

The cooling fan and cloth rotating mechanism connected with 12 V battery one end of the cloth connected with motor with the help of the shaft and the other end of the cloth is submerged in water. When we switch on the battery the cooling fan is start rotating with the speed of 1500 rpm and also motor at 30 rpm. When motor is started to rotate the shaft is connected with the motor is also rotate and with the help of shaft rotation cloth is also start rotation at the speed of 12 rpm. The second shaft is submerged in water and upper and lower shaft is connected with cloth. So when upper shaft is rotate, the lower shaft also start to rotate with the same speed. By rotating lower shaft cloth also start to rotate. In this rotation some part of the cloth is submerged in water and it became wet after some time. So that air comes from the fan pass through the wet cloth and temperature of the air will decreases.

D. Data Analysis With New Ventilation System Placed In Front Side Of Car

When new ventilation system is placed at front of the car the temperature is decreased inside the car cabin so that we can say that new system is more efficient than existing. Here fig. 8 shows the temperature graph in side of car when new ventilation system placed at front of the car from 12:00 PM to 4:00 PM dated 30/2/2016.

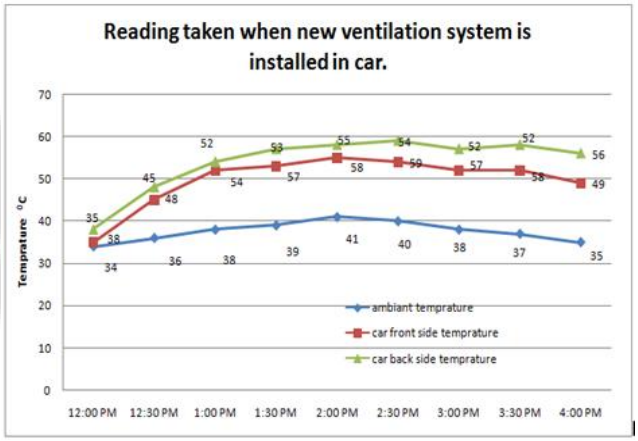

fig. 8: Temperature inside the car with new ventilation system

This fig.8. shows the temperature chart when new ventilation system is applied in the car. This chart shows that the temperature scale comes down than the existing one.

E. Comparison Between New Ventilation And Existing Ventilation System

This section of the paper shows the comparison between the existing ventilation system and the developed ventilation system. So that in table III we identify the with use of new ventilation system how much temperature will decreases.

Time (PM)	Temperature inside front of car without any system (°C)	Temperature inside front of car with existing system (°C)	Temperature inside front of car with New system (°C)	Difference of temperature (°C)
12:00	42	40	35	5
12:30	53	52	45	7
1:00	60	58.5	52	6.5
1:30	62	60	53	7
2:00	62	62	55	7

2:30	63	61	54	7
3:00	61	58	52	6
3:30	60	58	52	6
4:00	58	55	49	6

Table 3. Comparison Between New Ventilation And Existing Ventilation System

In this comparison table we can see that the new ventilation system can decrease more temperature than existing system. The new system decrease maximum 9 oC with respect to temperature without any ventilation system. In fig.9 shows the comparison temperature chart between existing system and new ventilation system.

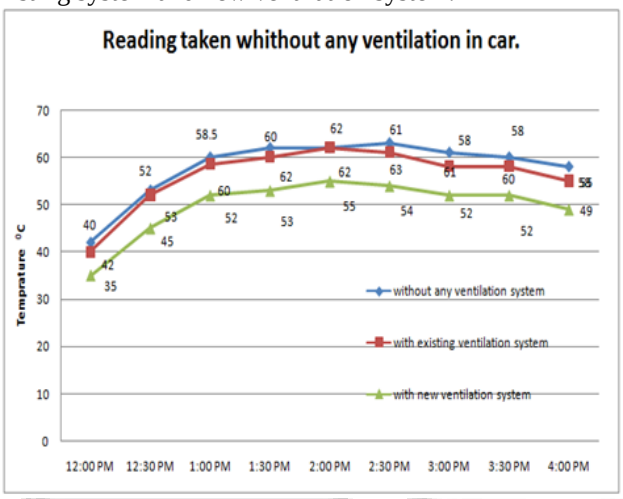

Fig. 9: Comparision of temperature with different ventilation system

IV. CONCLUSION

The new car ventilation 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 front and rear ambient locations. The new ventilation system reduced temperature inside the car cabin up to 9 oC at front of the car.

The usage of wet cloth rotating mechanism is found to reduce the average maximum temperature for the ambient air inside the car. It is best for temperature reduction and very economical.

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