PARKED CAR SOLAR VENTILATION SYSTEM

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Abstract: *In India typically very high ambient temperature especially during summer season. During Sunny day if the cars are parked directly under the sun, cabin inside the car will experience a kind of greenhouse effect this will lead to higher cabin temperature. The high temperature prevailing inside the vehicle parked under the sunlight is definitely unreceptive to the occupan¹ts when they arrive to take a drive. This paper demonstrates a temperature measurements carried out inside a car which was parked under the sunlight to study the temperature pattern inside a parked car. Investigation was carried out to minimize the temperature rise inside a parked car. A simple ventilation system was developed and tested uses two fans which drove out the hot trapped air and a secondary fan to cool down the temperature inside the model by providing fresh air for limited time. A solar photovoltaic panel was used to drive the ventilation system which made the ventilation system completely independent additional power source. Experiment were done on a model of a car-cabin, which was designed and fabricated based on the simulation performed using SOLIDWORKS and ANSYS.*

Index Terms *- Cabin Air Temperature, Parked Car, Radiation, Solar Photovoltaic and Ventilation*

I. INTRODUCTION

In summer you all have faced a common problem when you parked your car in a sunny day and go for long time like for office or for marketing purposes or with your family for picnic etc. For all this purposes you have to park your car in a very hot day when you not get any shade space for parking and when you come after a long hour and enter in you're the car temperature is very high, it not just high temperature the air that is trapped in the car when you lock the door also becomes heated and all interior like sit, steering, heated at very high temperature than the ambient temperature.

The Sun heat the car through radiation and it conducted in all parts of the body through conduction and the air inside the car is heated through convection. All these processes running continuously in the car. Simultaneously another process is also take place Greenhouse effect.

Therefore, sunlight falls on the carpet and plastic parts within the car and then they re-radiate that energy in infrared spectrum. Now, water vapour and CO_2 in the air within your car will absorb this re-radiated IR energy and thus, the heat gets accumulated continuously. This heat is trapped inside the car as there is no exit point and the temperature rise continuously. [2]

If you try to remove this heat from your car by air conditioner at full capacity it will produce the load on your engine and that increase fuel consumption. Researchers have said that it is better to start you air conditioner after some distance. It is not good for us in many ways.

Sudden changes in temperature of body will affect our brain function. Literally for small children it is very dangerous. The central nervous system is not fully developed in children, and this makes their changes, according to the Mayo Clinic. Children have difficulty remaining hydrated for this same reason. And a child's core body temperature can rise five times more quickly than that of an adult. When body temperature rises, heatstroke may occur. Also referred to as hyperthermia and heat illness, it can cause alterations in consciousness and lead to permanent brain, heart and kidney damage. In a worst-case scenario, heatstroke places a person -- child or adult -- at risk of death.

To design a ventilation system we will design a model having same spacious as car for which we have to design the ventilation system. The model contains two fans one will blow the ambient air inside and other will blow the hot air outside. The position of the fans will decided by simulating the model on ANSYS software. Once the position is decided by analysing the data we go through further change in model if it will need and try to find the efficient position. Once the position decided will construct the model. When the model is constructed we will set the fans. Now will analyse the power requirement for running of fans according we will installed the solar panel.

A microcontroller based circuit is used which control the system and run for one hour and stop for ten minutes.

Efficiency of the system will determine by plotting graph between ambient temperature and considering both cases when fan are installed and not installed in the model.

A. Temperature Variation inside Hyundai i20 Car and Alto

The variation of temperature inside a car was studied by conducting a preliminary experiment on a car Hyundai i20 using thermostat. The temperature variation inside the car was measured for 5 hours and compared with those of ambient temperatures. The results are shown in Figure1. We can see that the temperature rises significantly in first 2 hours and then 49.2 in 5 hours. It is concluded that high temperature was observed compared to the ambient temperature when the car was parked.

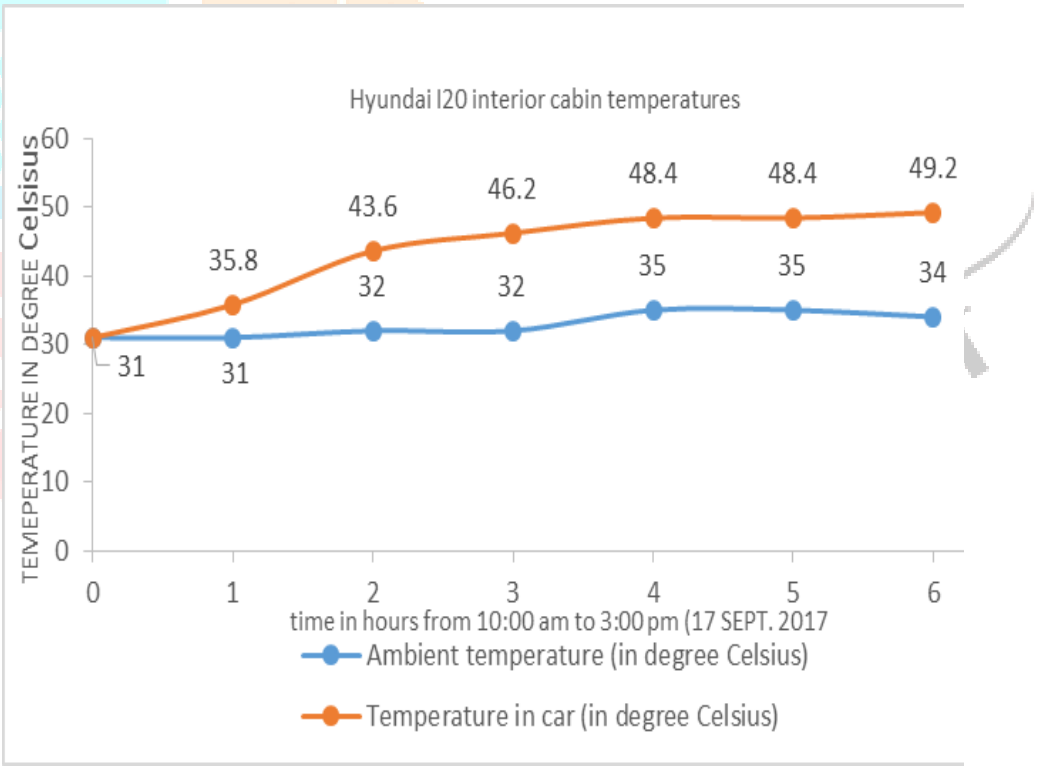

Fig.1 Temperature variation inside Hyundaii20

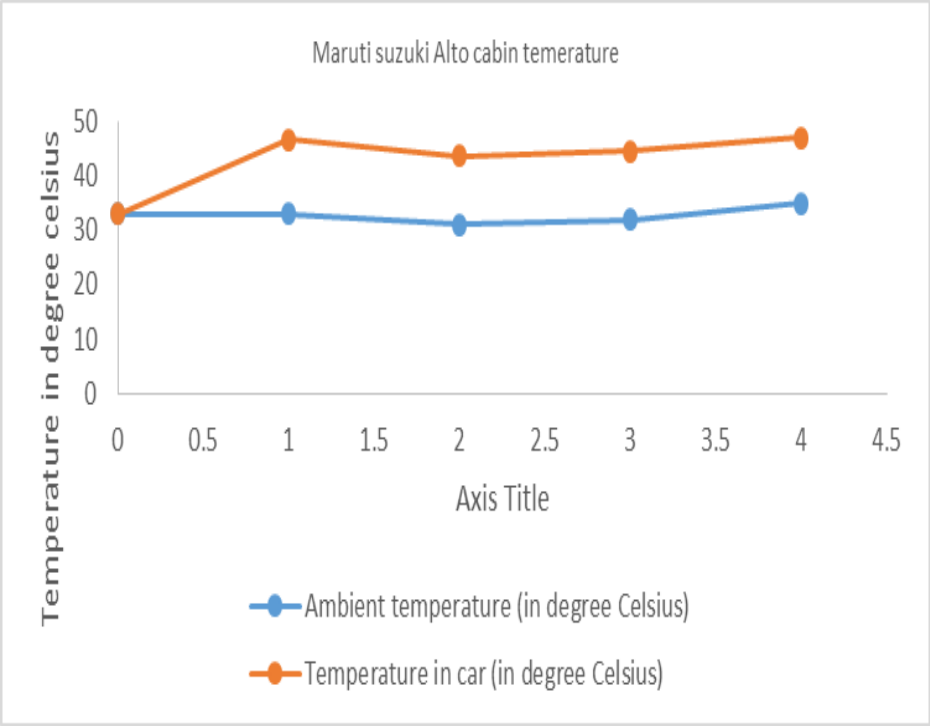

Fig.2 Temperature inside Maruti Suzuki Alto

B. Design and flow analysis of the model

There are two ducts in the model one for exhaust and for inlet. The position of the fan will be decided by air flow analysis using ANSYS 19 CFD software. The dimension of the model are Length=332mm, Breadth=242mm, Height=242,Diameter of inlet and outlet 90mm .The model is considered to be made of mild steel with various material properties as follows: Density = 7.9g/cc; Young's modulus =205GPa,Thermal conductivity = 51.9 W/mk, Specific heat capacity = 0.486 J/g°C; Poisson ratio= 0.29. [1] Heat transfer occurs at the channel wall. Laminar flow develops an insulating blanket around the channel wall and restricts heat transfer. Conversely, turbulent flow, due to the agitation factor, develops no insulating blanket and heat is transferred very rapidly. [5]

So we can say that if more turbulence inside the more heat transfers. Therefore it is important to find the optimum position for that the fan. In figure 2 fans are placed on the same side but at different levels and the CFM of fan was 38.6 and velocity of air was 2.54 m/s. The result is shown below,

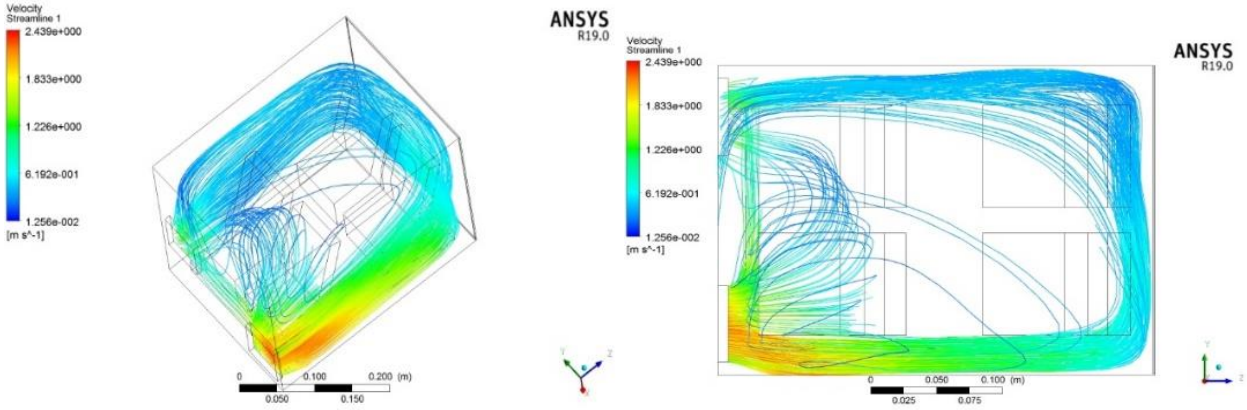

Fig.3 velocity profile when ducts are on the same side at different level

In the Fig.3 we can see that the centre is hollow which is not efficient for heat transfer. When the position fan set diagonally to each the other the result is shown below:

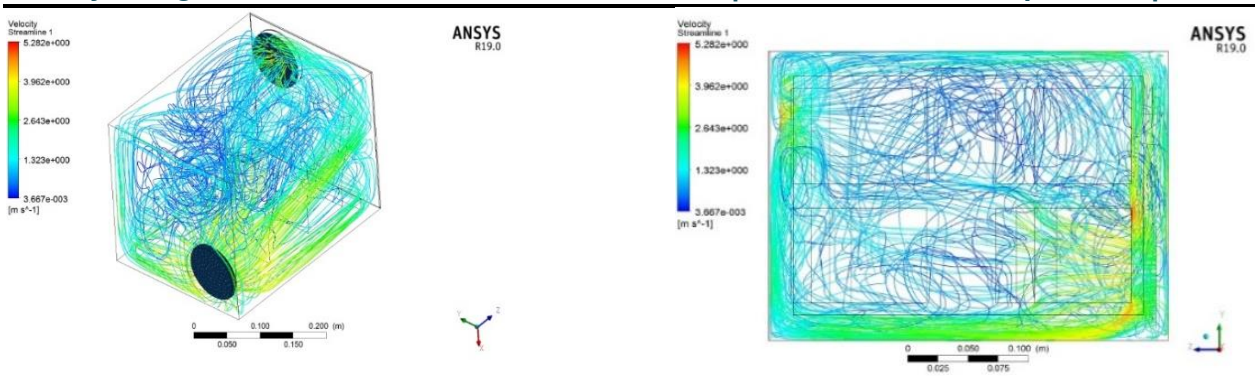

Fig.4 velocity profile when the position fan set diagonally to each the other

Here we have two view of our model one is isometric view and other is top view .We found that modifying the air inlet/outlet configurations can significantly modify the presence of zones of low air circulation in the Cabin. [6]

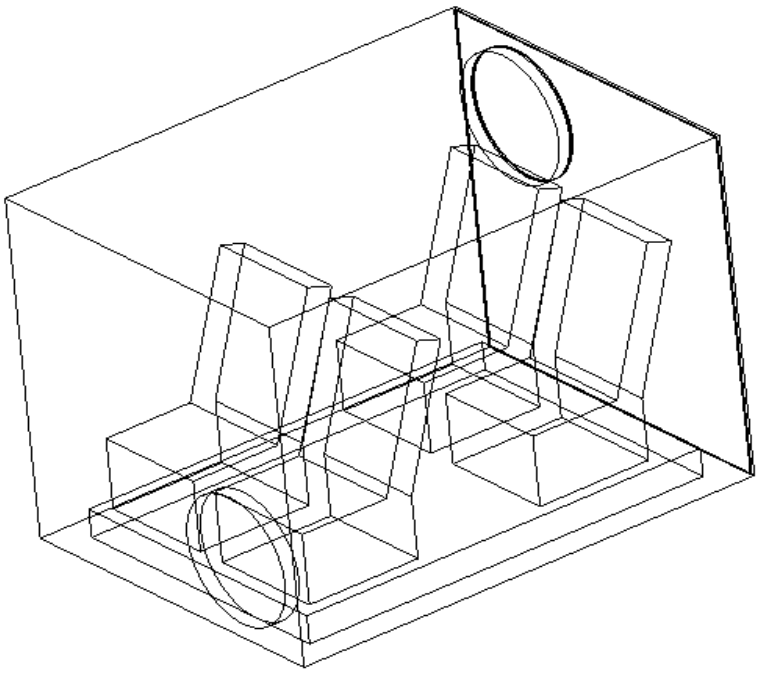

Fig.5 Geometric model with right duct configuration

Assumptions and it is an approximate solution or simulation of the model. The finite element analysis is always gives approximate solution. If we go for exact solution the cost of doing this for model is increase. All industries compare the of finite element analysis result with analytical result. Due to lack of resources we have not done this check Also there analytical data or result approximately matches with actual result i.e. 80-90 % result is correct. So the above simulation of fluid inside the model is approximately correct. [5]

II. EXPERIMENTAL SETUP

A. Fabrication of geometric model

The experimental investigation is performed on a model with various dimensions and material properties as mentioned in previous section. The blower and the exhaust fans are fitted at the locations of the ducts as identified in the simulation**.**

Fig.6 Actual model

Devices used in electronic circuit unit are shown below and other running components.

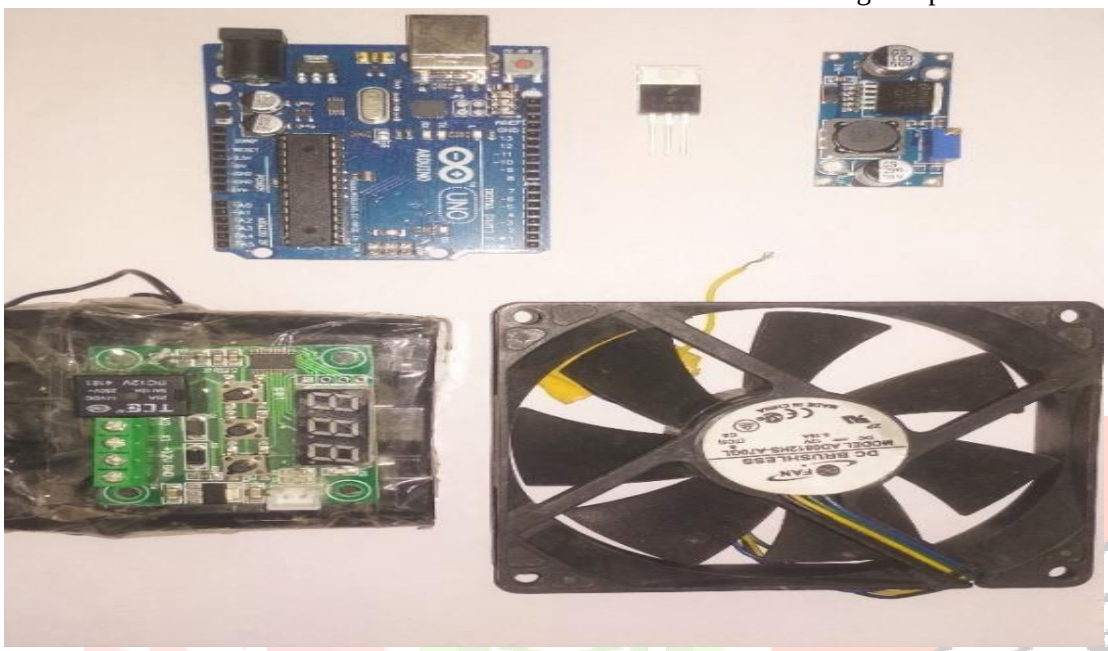

Fig.7 Components used in system

1. ARDUINO UNO R3 board with DIP ATmega328P(microcontroller)
2. LM2596 Based Step Down Dc To Dc Adjustable Voltage Regulator 3A Output
3. 2V L7912 CV Negative Voltage Regulators LW
4. KA7812 Voltage Regulator 12V 1. 5A
5. DDA AD0812HS-A70GL DC-12V 0.25A DC Brushless.

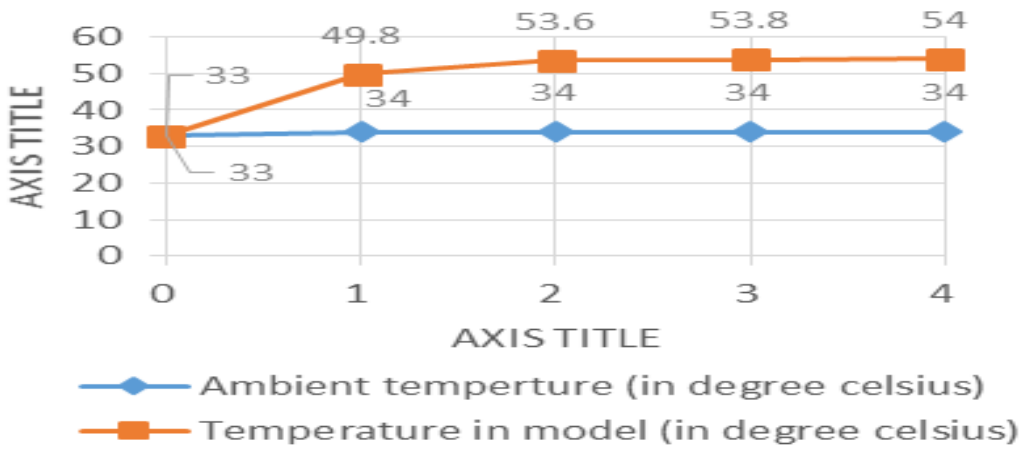

Fig.8 Temperature rise in the model

The time based transient temperature inside the model is presented in Figure 8. The results for transient temperature inside the model compartment indicate that it is necessary to use the ventilator in order to obtain more effective ventilation system. The rise of temperature inside the model depends on the intensity of the Sun.

In fig 1 temperature inside the model was measured in a hot sunny day with a temperature interval of 15 minutes. For the first 15 minutes the temperature rise to 49.8 and becomes slow. The model was totally sealed with no air ventilation only radiation was coming through the glass of the model.

B. Experimental Investigation

An exhaust fan device powered by a solar cell is proposed to remove the heat from the cabin. The dimensions of the CFD model in this study were based standard k-ε turbulence model was employed.

The power of solar panel will fluctuate so MOSFET is as a voltage regulator. The arrangement in Figure 12 shown the circuit connection of the system a thermostat is used to read the temperature the position of thermostat is placed inside the model is such a way that there will negligible convection so the reading will not be affected. The system will run for one hour and will stop for 10 minutes. Microcontroller automatically control the system according to its code.

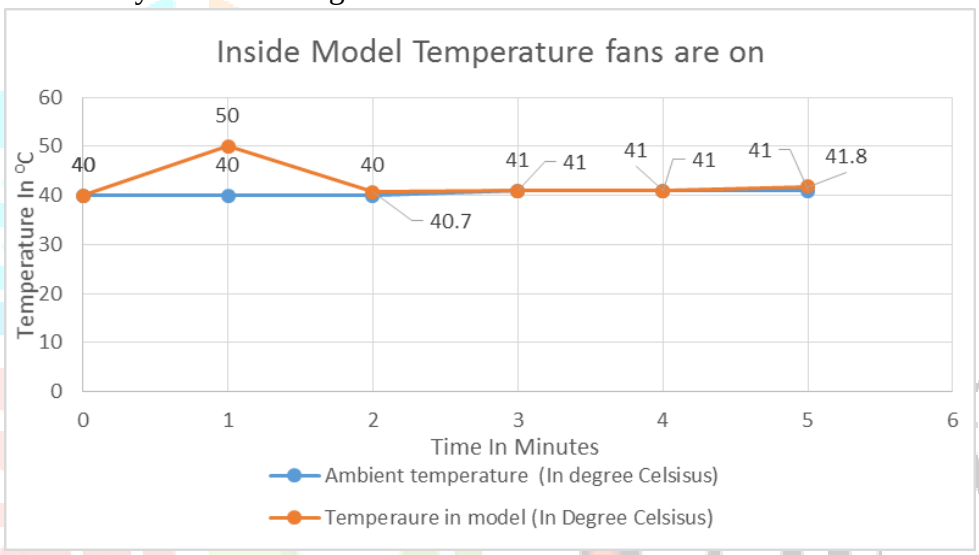

Fig.9 Inside model Temperature

In Figure 9 when model of temperature was measured for first 15 minutes from 0 to 1 points the temperatures rises to 50°C. After that when the fans are on temperature start decreasing. The experiment was done with ant interval of 15 minutes. The temperature reaches to ambient temperature and at some point it is higher by some point. The efficiency of model is only because of the right installation of fans at right positions.

Fig 10 Showing electric circuit and model

Every company should install park car ventilation system it not only decrease inside temperature but also decrease suffocation inside the car cabin. So when you come to drive your car after a long time of parking you never feel uncomfortable. This type of system does not has higher cost. Also it will run with solar powered and it will not cause any load on battery. The installation of the this system will also increase your inside cabin life of interiors and other devices whose reliability decreases by high temperature and also will retard the deterioration of the aesthetic look of the interior parts.

IV. REFERNCES

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