

Fabrication of Smart Ventilation System for Parked Vehicles

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Abstract: The temperature inside a car can rise up to 30°C more than the outside temperature and pose a serious threat for children or pets left in the car, when it is parked outside during summer. The increase in temperature of the car cabin is due to various modes of heat transfer such as conduction, convection and radiation. However, radiation along with the absorption is the main use of this dramatic rise in temperature. This paper mainly focuses on regulating the internal temperature of the car. A new ventilation system has been designed that employs exhaust fan and blower, temperature sensors and electronic control circuitry to automatically control the temperature inside the car cabin under the constraint that ignition system is off. Experimental investigation is performed on a four-wheeler vehicle parked under direct sun to observe temperature variation inside the car to understand the temperature difference between the inside and outside of the car

Keywords: Automatic control, Parked vehicles, Regulating temperature, Ventilation system.

I. Introduction

Generally, in sub-continent countries like India where the temperature rises up to 35-45°C in summer, re-entering a car parked directly under the sun can be a difficult exercise owing to the drastic temperature rise inside the cabin. Even the air conditioning system takes some time to bring temperature back to desired level. We some time park our vehicles directly under the sun due to limited roofed parking area. So that because of unroofed parking conditions the temperature inside the car is increased very much.

Such drastic rise in temperature levels inside the cabin can be attributed to conduction (volume of air inside), convection (various metals and heat absorbing materials inside) and radiation (from the glass and body of the car). However, radiation is considered to be the most influencing factor in such heating. The temperature variation inside the car depends on the thermal radiation exchanged between the environment and body of the car and also the radiation absorbed and emitted by the interiors of the cabin. Aim is to be able to regulate the temperature inside the car cabin in the absence of a driver with the help of our smart ventilation system to avoid untoward incidents.

II. Literature survey

In modern era, most people drive cars and during driving sometimes the cars are needed to park in the open area where it is directly exposed to the sunlight. If the car is parked for too long time exposing the sunlight, the air inside the car becomes very hot. The temperature inside the car can easily rise to 60°C. Even in fairly cloudy day, the temperature inside the car can easily reach 55 °C. It is difficult to get on a car having exposed several hours to solar radiation. The hot temperature inside the car absolutely makes the driver feel uncomfortable in the first 10 minutes. In a sunny day, the conditions of comfort inside a car depend closely on the exchanges of thermal radiation between the vehicle and its environment as well as internal radiation inside the car compartment. The radiation is undoubtedly the most instantaneous phenomena of energy transfer. To convince one, it is sufficient to consider the immediate feeling or relief which one experiences when one takes a shady road after having driven a long time in a sunny day.

The solar radiation heats up the equipment inside the car. This equipment will absorb heat and will make the car compartment hard to be cooled down within a short period of time. As a result, the driver needs to run the air-conditioning before starting to drive. This will increase the fuel consumption of the car. If the thermal load on the passenger compartment can be reduced, the power consumption of an air conditioning (AC) compressor can be reduced as well. Consequently, a reduction in individual vehicle's fuel consumption could lead to enormous fuel savings worldwide. The potential technique for reducing fuel consumption of the car is to reduce the vehicle climate temperature. Minimizing the heat gain inside the car compartment by a ventilator was noted as an efficient method for reducing the soak temperature.

The literature review reveals that many researchers carried out CFD work (Mezrhab and Bouzidi, 2006; Kaynakli et al., 2002). Intelligent solar-powered automobile-ventilation system was studied by David et al.,(2005). Mezrhab and Bouzidi (2006) developed a numerical model to study the behavior of thermal comfort inside the passenger car compartment according to climatic conditions and materials that compose the vehicle. Available thin films on the glass window cannot maintain comfortable temperature inside the car existing

ventilation is not enough to meet the required comfort. The main objectives of these work is to identify compartment. This investigation also found that the key point of the vehicle compartment and placed the ventilation system for optimum performance

III. Methodology

A. Theory and construction

We are making a car cabin structure with four wheels looking like a car will not have any drive. This will have temperature heating system and glass panel to view the internal section, the exhaust fan, a battery and a control circuit with temperature sensing device and indication of the temperature. The base structure made of metal with axles holding the plastic wheels as required. a base cover for the outside car shape cover is made which makes a bottom sheet of the car on which the top portion of car shape sheet is fixed. These are made out of zinc steel sheet in car shape. A exhaust fan is fixed at the sides of the cover to force out the hot air inside the car. This exhaust fan is the one which is used in machines for cooling purpose, here in this we are using 125mm square model exhaust fan which is powered by 230VAC supply. The window and front and rear view is cut which is closed by acrylic sheet to have the easy view of the inside parts.

Two set of heaters are provided inside the cabin to create the heat inside the cabin now which are connected to the control circuit. The control circuit is in turn connected to the temperature display. The exhaust fan is placed below the windows and their ducts pointing outside the vehicle, the duct is perforated. The inside air is sucked out through exhaust fan and diagonally vents can provided for the fresh air to get in.



Figure1: Prototype model

B. Working of control circuitry

Circuit is divided into two sections

1) Temperature sensor and controller with seven segment digital display to display the present actual temperature. This unit can be set for any temperature range by pressing the button, for up or down of the temperature range. We have set it for 35 degree C. if temperature is less than 35 degree C will connect the second section control circuit to put on the heater and if when reaching the 35 degree C will put off the heater automatically. This unit is commercial factory made module which is bought from the market of which the data's are enclosed.

2) Second set of circuit is a control circuit or the driver circuit which connects the heater and the fan when required. Here the temperature when less than 35 degree C gives a output from first section circuit J1 to this circuit which gives the input at pin number 7 of IC UM-606 which is a inverted output giving IC which receives a high state voltage at pin number 7 and gives a inverted output of low state at pin number 6 to trigger a transistor BC-547 to connect the relay to connect the heater. Relay contact is given with 12VDC for trigger but for the output it connects the heater of 230VAC. And again when the temperature is reached to 35degree C the input to this circuit will be high state by which the output from the IC will be low which disconnects the relay to disconnect the heater and connecting the next stage of circuit or next set of IC which is giving a low state input at pin number 7 of second set of IC UM-606 which gives the inverted output at pin number 6 to trigger the transistor BC-547 to connect the relay to connect the exhaust fan to be able to cool the area. This will continue to be connected till the area is cooled and the temperature sensed is 33 degree C as set in the first section controller.

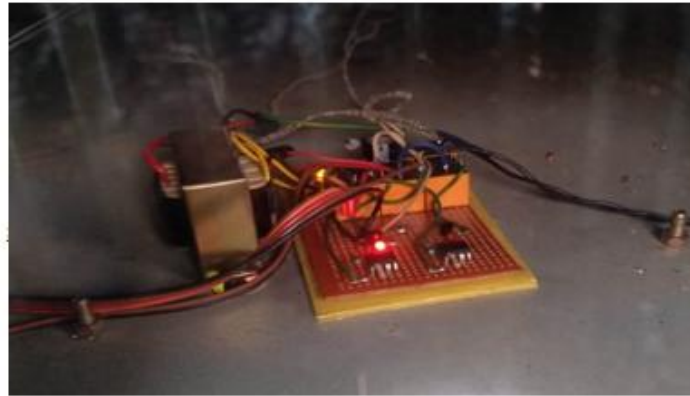


Figure2: Parts of control circuitry

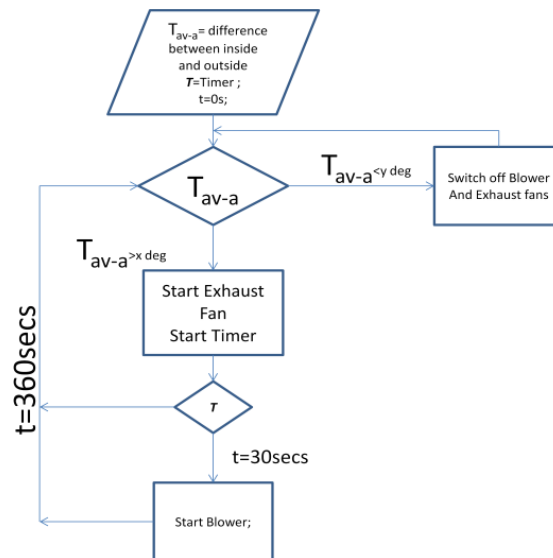


Figure3: Block diagram for working of microcontroller

IV. Theory of heat analysis in cars based solar radiation

analysis of the increase of heat in the car is based on the average estimate model sunny days, General equation for heat increase is :

$$Q_w = As [FI_t + U (T_o - T_i)]$$

Where ;

As = Area of the window surface expose to sunlight, ft^2

F = Film coefficient of heat transfer

I_t = Transmitted intensity

U = The average heat transfer coefficient through the window framed

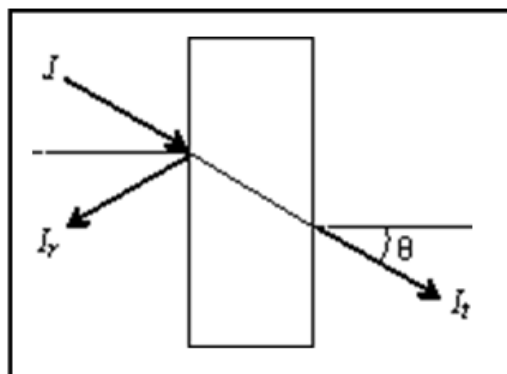


Figure4: Light radiation through the glass

Figure 4 shows the radiation of light through glass or glass that will be taken into the analysis to be carried out.

$$I = \tau I_i$$

$$I_i = I \cos \theta$$

$$I_r = \alpha I \cos \theta$$

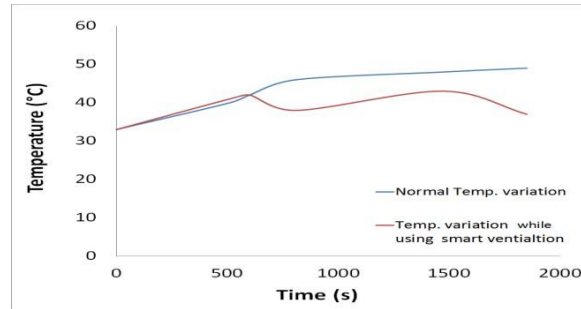


Figure5: Temperature variation on mildly sunny day

V. Results And Discussion

It was noticed that the smart ventilation was switched off once the temperature difference, T_{av-a} , reached the targeted difference and then the system was restarted automatically once the temperature difference increased above the targeted temperature. It can hence be seen that the smart ventilation system provides much reduction in temperature once the smart ventilation was activated.

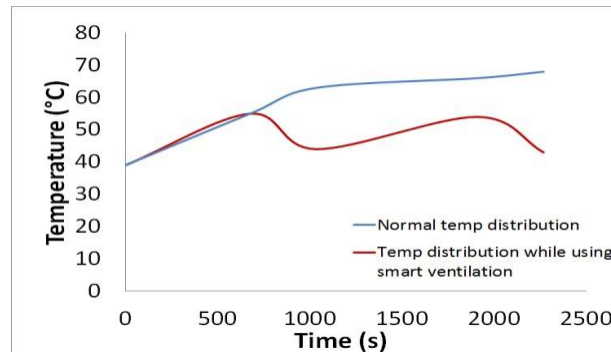


Figure6: Temperature variation on hot sunny day

VI. Conclusion

A new ventilation system aimed at regulating temperature inside a parked car was designed that employs exhaust fan, temperature sensor and electronic control circuitry, under the constraint that ignition system is off. Experimental investigations were made on prototype of car cabin, which was designed and fabricated accordingly. It was observed that the temperature inside the car dropped significantly when the smart ventilation system was powered on, considering the experimental result and data. the target of cooling the fabricated cabin in the ambient conditions within a condition time was achieved.

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