



PRELIMINARY DESIGN OF AN AUTOMATIC COOLING SYSTEM USING SOLAR PHOTOVOLTAIC (PV) SYSTEM

MOHD FAHIM BIN ILIAS (2007270988)
 BACHELOR ENGINEERING (HONS) (MECHANICAL)
 PROJECT SUPERVISOR: MR HAZRAN BIN HUSAIN
 MAY 2010

ABSTRACT

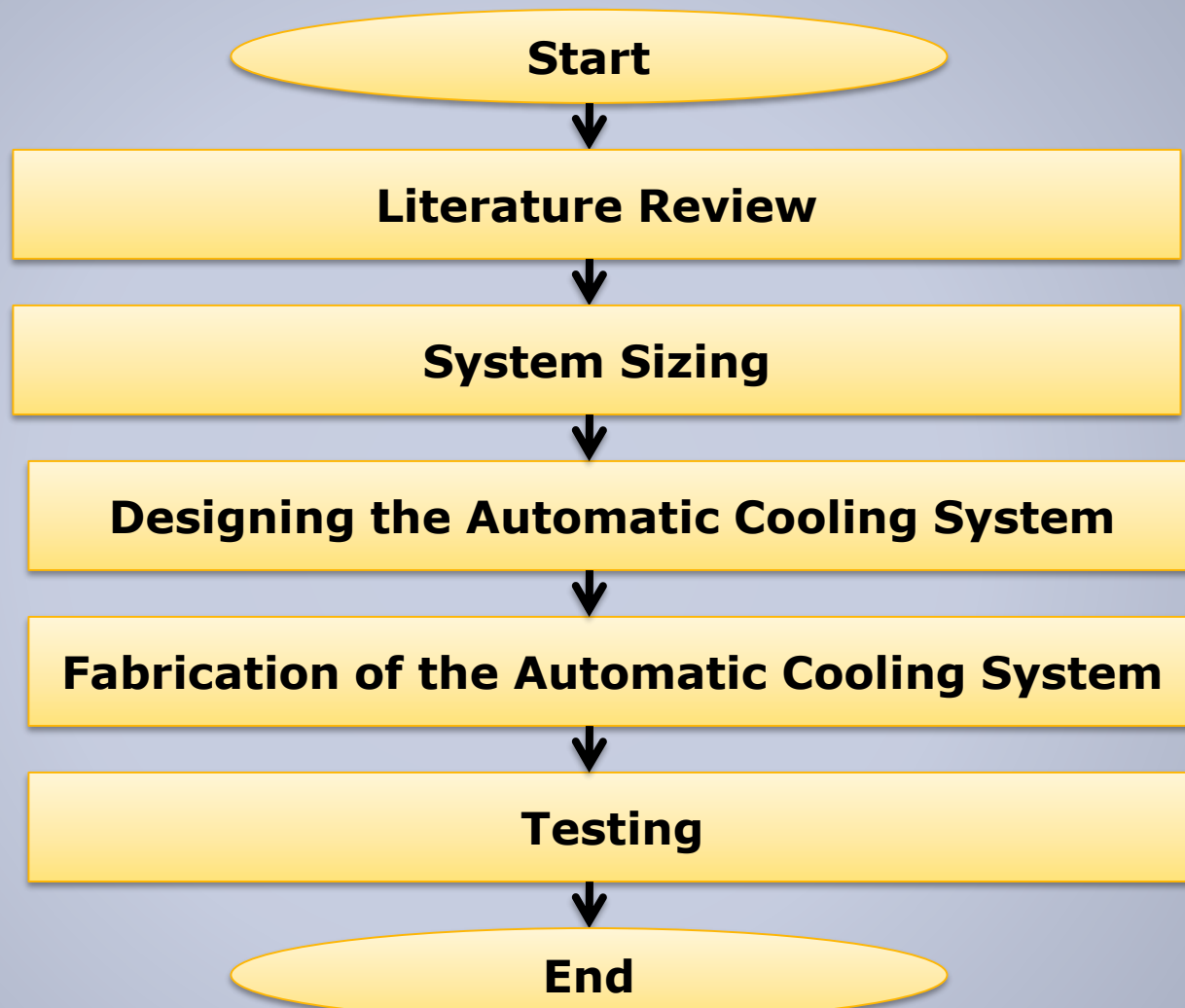
Automatic cooling system using solar photovoltaic system is a system that uses solar photovoltaic system as a source of electricity to generate the cooling system with the presence of controller to make the system to operate automatically. The aim of the project is to design the automatic cooling system inside car cabin. The purpose of the system is not for cooling the car cabin like an air conditioning system, but to reduce the temperature inside the car cabin when the car is being exposed to the hot sun. Temperature sensors detect the temperature inside and outside of the car and act as the input signal for the PIC (Programmable Interface Controller) microcontroller. PIC is used to control the system to operate automatically when the temperature inside car cabin above than the ambient temperature outside of the car. This project encompasses some literature review on the solar photovoltaic system and the ventilation inside car, sizing the PV system in order to determine the size of the PV module and the rechargeable battery to ensure the solar PV system operate efficiently with optimal costs, and also involves designing the automatic cooling system that provides ventilation inside car cabin by using solar photovoltaic energy as the source of electricity, fabricating the design to ensure the system function as desired, and testing to see whether it can reduce interior car temperature or not by installing the system into a car.

OBJECTIVES

The objectives of this project are:

1. To design an automatic cooling system that provides proper ventilation inside car cabin with the uses of solar photovoltaic system. The system is to ventilate air inside the car by pulling out hot air inside the car cabin to the surrounding.
2. To fabricate the design of the automatic cooling system using solar photovoltaic system to ensure the system function as desired.
3. To test the design of the automatic cooling system using solar photovoltaic system to make sure that the system can reduce temperature inside the car cabin.

PROJECT METHODOLOGY



SYSTEM SIZING

$$\text{Total Watt Hours per Day used by fan} = 3.36\text{Watt}(fan) \times 4\text{Hours (daily use)} = 13.44\text{Watt.Hours}$$

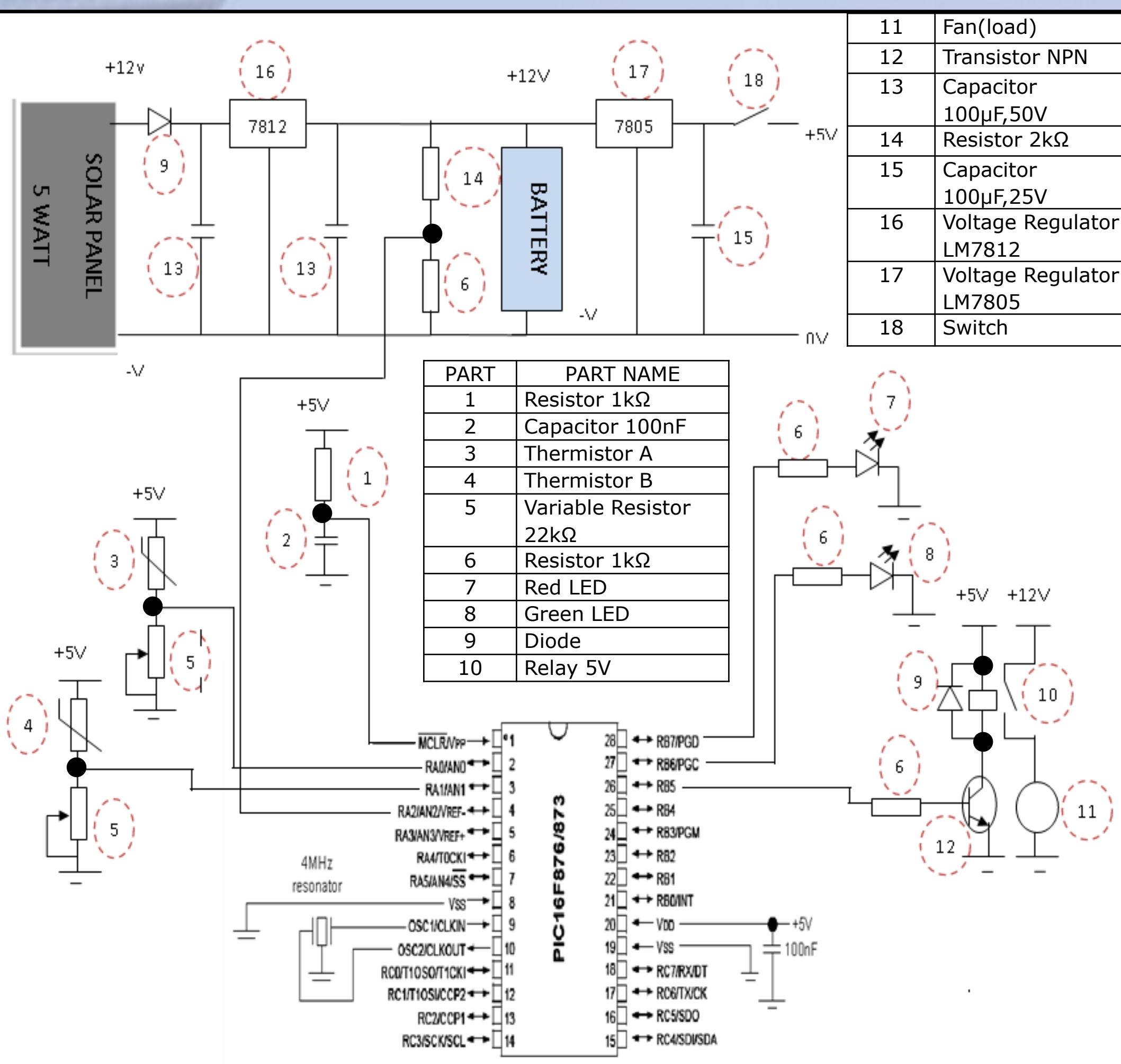
$$\text{No. of PV Panel} = \frac{\text{Total Watt Hours per day} \times 1.2 \text{ (Energy Lost in the System)}}{\text{Average Peak Sun Hours} \times 0.8 \text{ (inefficiency of the Battery)} \times \text{Total Watt Peak Rating of the PV Panel}}$$

$$\text{No. of PV Panel} = \frac{13.44 \times 1.2}{4 \times 0.8 \times 5 \text{ Wp}} = 1$$

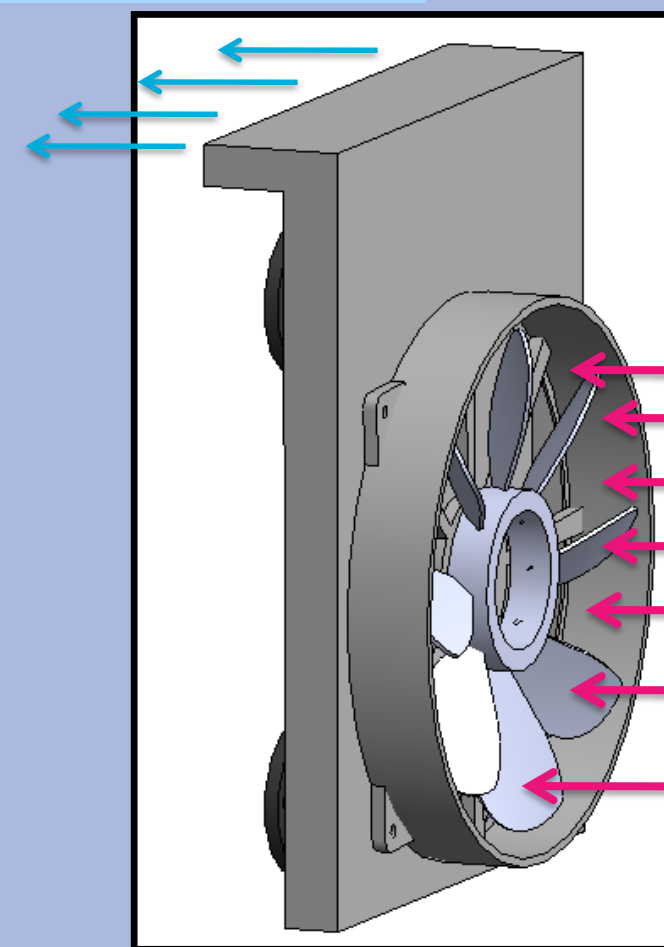
$$\text{Battery Capacity (Ah)} = \frac{\text{Total Watt hours per day used by loads} \times \text{Days of autonomy}}{0.8 \times 0.5 \times \text{nominal battery voltage}}$$

$$\text{Battery Capacity (Ah)} = \frac{13.44 \text{ Watt.Hours} \times 1/6 \text{ Day of autonomy}}{0.8 \times 0.5 \times 12} = 0.47 \text{ Ah}$$

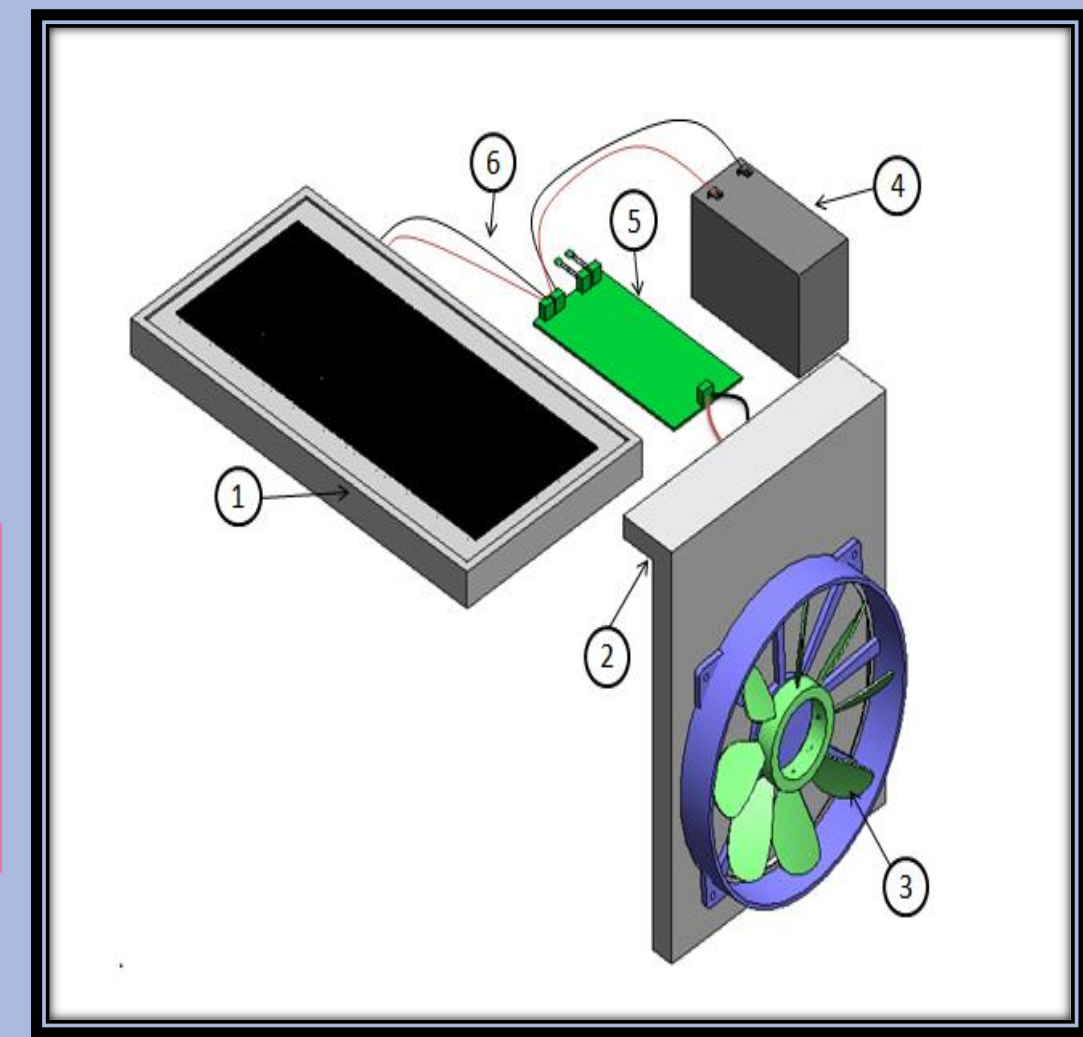
DESIGNING THE AUTOMATIC COOLING SYSTEM



Hot Air release to surrounding

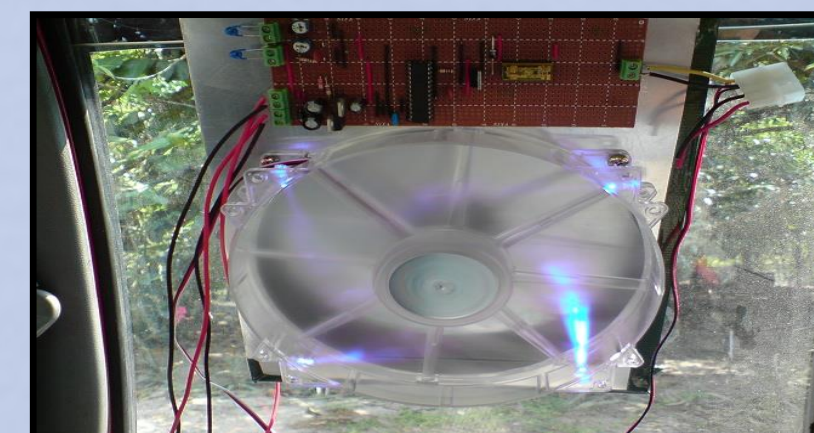
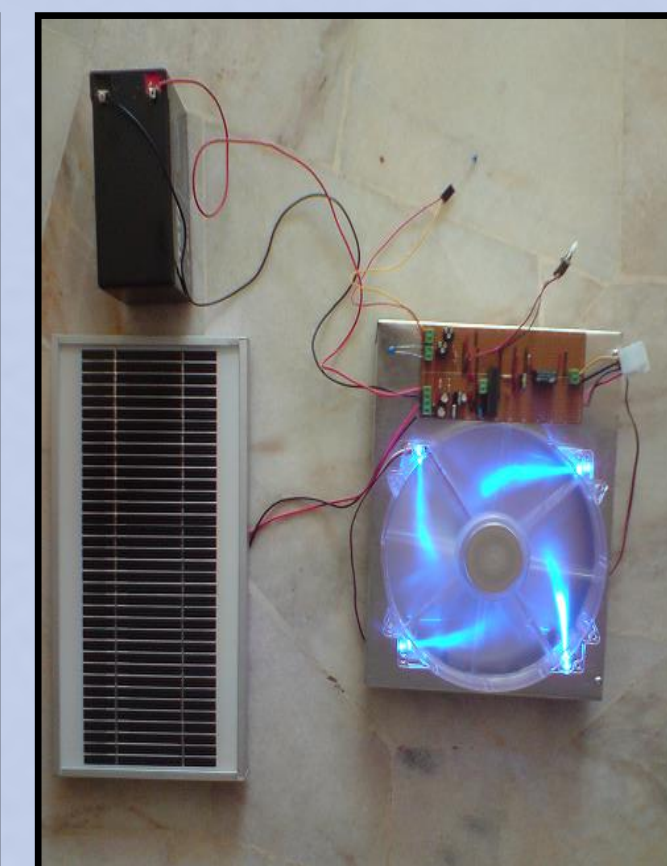


Hot Air from inside Car Cabin

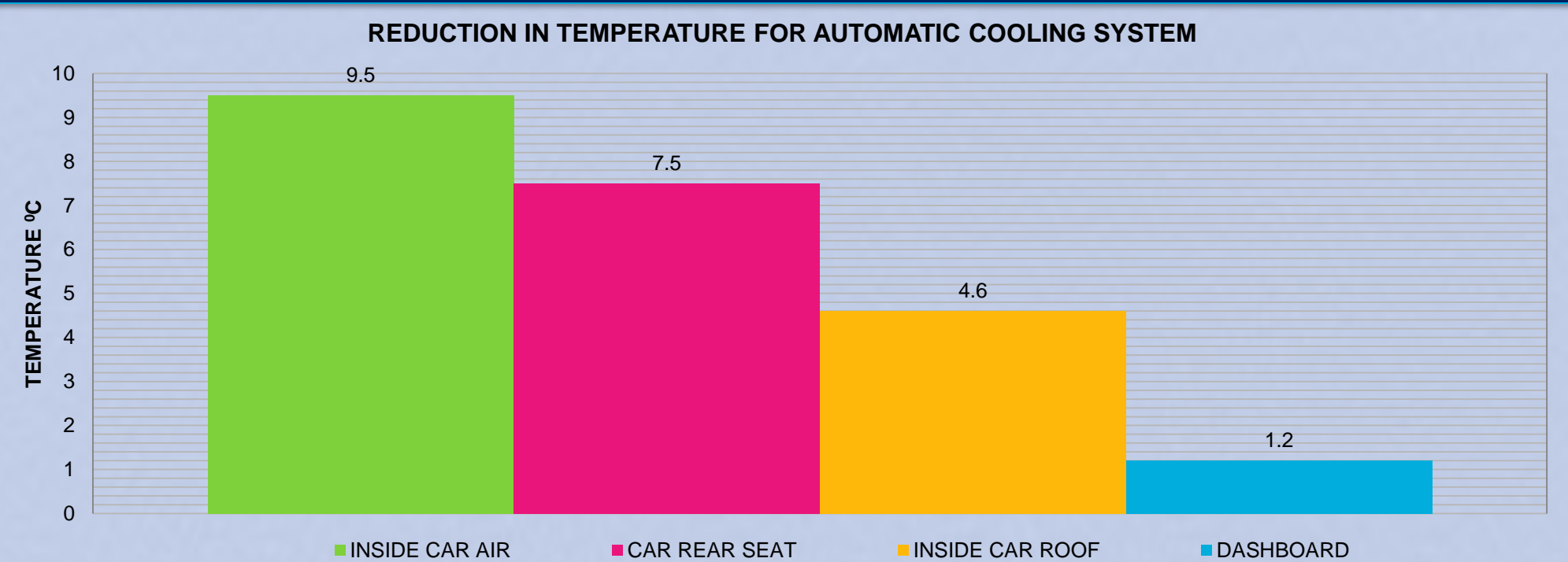


Entire Design of the Automatic Cooling System using Solar Photovoltaic System

TESTING



TESTING RESULT



DISCUSSION

1. Temperature of the inside car air, car rear seat and the inside car roof were reduced 9.5°C, 7.5°C, and 4.6°C respectively with the presence of the automatic cooling system. This was because the hot air has been pulled out of the car by the exhaust fan and the cooler air from the environment was pulled in into the car through air conditioning duct and any other natural body leakage areas. The temperature reductions were also due to convection heat loss driven by the interior airflow. Temperature of the car rear seat, inside car air, and the inside car roof still not reached the surrounding temperature because have been heated by the hot interior mass such as dashboard which was directly exposed to the sunlight.
2. Meanwhile, the temperature of the dashboard was reduced 1.2°C. The temperature reduction of the dashboard was significantly lower. Because of the windshield was not solar reflective, and the dashboard was directly exposed to the sunlight and it has been heated by the hot sun, the solar load was still high on the dashboard. Therefore, the temperature reduction was only due to convection heat loss driven by the interior airflow. Even with the presence of the automatic cooling system, temperature of the dashboard still high and could be more than 67°C.

CONCLUSION

As the conclusion, the objectives of this project are achieved. The automatic cooling system using solar photovoltaic system has been designed properly and work only when the temperature inside car above than the temperature outside of the car. The automatic cooling system was capable of providing passage so that the excessive heat inside car cabin can be removed to the surrounding. From the test that has been conducted, the results showed that with a little motion of the air inside the car cabin could reduce the temperature inside the car. This system is a concept of automatic cooling system using solar photovoltaic system which focuses on using exhaust fan to cool a car compartment and can be modified to automatically control the ventilating system inside a building to provide a condition which has a proper comfort level of human.