Solar Car Cooler

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Background
The main strategy for keeping a parked vehicle cool is using a sunshade and cracking the windows. Recently, there have been products developed to force the hot air out of the vehicle in an attempt to effectively cool the interior of a vehicle. Independent testing of these products shows that they are ineffective in keeping a vehicle cabin cool [1]. Our proposal is to build a consumer-friendly, affordable system that maintains a cooler, safer parked vehicle.

The Problem
Vehicles parked in environments that are exposed to direct sunlight can reach dangerous temperatures when the outside temperature is between 80-100°F [2]. Once vehicle cabin temperatures reach 110°F the vehicle occupants are in danger of suffering from heat-related illnesses [3].

Objectives
- Research optimum temperature range for the cabin of a vehicle parked in direct sunlight that will prevent any bodily harm to passengers entering the vehicle.
- Design a portable cooling unit that lowers vehicle cabin temperature to a safe level (ambient temperature).
- Device runs independent of the vehicle’s battery and other systems.
- Achieve a total run time of 8+ hours.

Using the measured heating and cooling rates from the experiments, our MATLAB model shows that the device will be able to keep a vehicle cabin near ambient temperature for an 8 hour period under moderate to high temperature conditions (29°C - 39°C). This is achieved by using thermostat style control logic to extend the battery life of the device.

Experimental Data
Our experimental results show that, even when air temperatures are moderate (29°C-31°C or 84°F-88°F), the temperature inside a parked vehicle can reach 46°C (115°F) in 30 minutes.

Our experimental results also show that, when air temperatures are moderate, the device is able to bring the vehicle cabin temperature down to the ambient temperature.

Solution
Our experimental results indicate that the device has a cooling capacity of 1.61 kW.

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<th>Device Components</th>
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<tr>
<td>1 8300mAh 12V Li-Ion Battery</td>
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<tr>
<td>1 Arduino Uno</td>
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<td>1 12V Thermostat</td>
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<td>4 52 CFM 80mm Axial Fans</td>
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Carbon Dioxide Studies
In a study by the Clean Air Act in 2014, carbon dioxide accounted for 81% of all greenhouse gas emissions in the U.S. Emissions from transportation accounts for 26% of all greenhouse gases produced in the U.S., which is equivalent to 1,737.6 million metric tons of carbon dioxide [4].

In a study by Texas A&M an average commuter spends 38 hours per year stuck in traffic. This congestion causes 5.5 billion extra hours of driving each year, requiring 2.9 billion gallons of fuel [5]. Running AC while driving reduces fuel economy by approximately 30%, depending on the type of vehicle.

Solar Car Cooler Solution
By replacing a vehicle air conditioning with a different cooling method, we hope to reduce the production of carbon dioxide. The Solar Car Cooler runs separate from the engine and does not affect fuel efficiency.

Sustainable Benefits
- Decrease carbon dioxide levels by approximately 3.9 million metric tons per year.
- Saves the consumer an average of ~109 gallons of gasoline per year.