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IEEE Orlando Section

Application For Funding

Project Addressing Climate Change:

A.S.H.E.

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2022 - 2023

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Project Description:

With summer temperatures reaching record highs and average temperatures rising globally, the need to manage heat in our transportation is both a comfort and safety issue. Within an hour, a car in 95 °F weather can reach temperatures of up to 138 °F [1], which is unsafe for human life and potentially damaging to items and components in the vehicle.

Table 1 - Estimated Vehicle Interior Air Temperature v. Elapsed Time [1].

Elapsed Time	Outside Air Temperature (F)									% of 1-hr Rise 43° Rise
	70	75	80	85	90	95	100	105	110	
0 minutes	70	75	80	85	90	95	100	105	110	
10 minutes	89	94	99	104	109	114	119	124	129	44%
20 minutes	99	104	109	114	119	124	129	134	139	67%
30 minutes	104	109	114	119	124	129	134	139	144	79%
40 minutes	108	113	118	123	128	133	138	143	148	88%
50 minutes	111	116	121	126	131	136	141	146	151	95%
60 minutes	113	118	123	128	133	138	143	148	153	100%
> 1 hour	115	120	125	130	135	140	145	150	155	
								Estimated		

Intended for use in vehicles frequently parked in hot, unshaded environments, the Automated Solar Heat Exchange or A.S.H.E. is a device that makes use of vent shade mounts, solar cells, an MCU, sensors, and optimized airflow to significantly cool down the vehicle's interior while parked. Automobile vent shades will be semi-permanently mounted to the vehicle. A battery, set wiring, sensors, wireless communication circuitry, and an array of 40mm DC axial fans will be mounted to the interior of the vent shades.

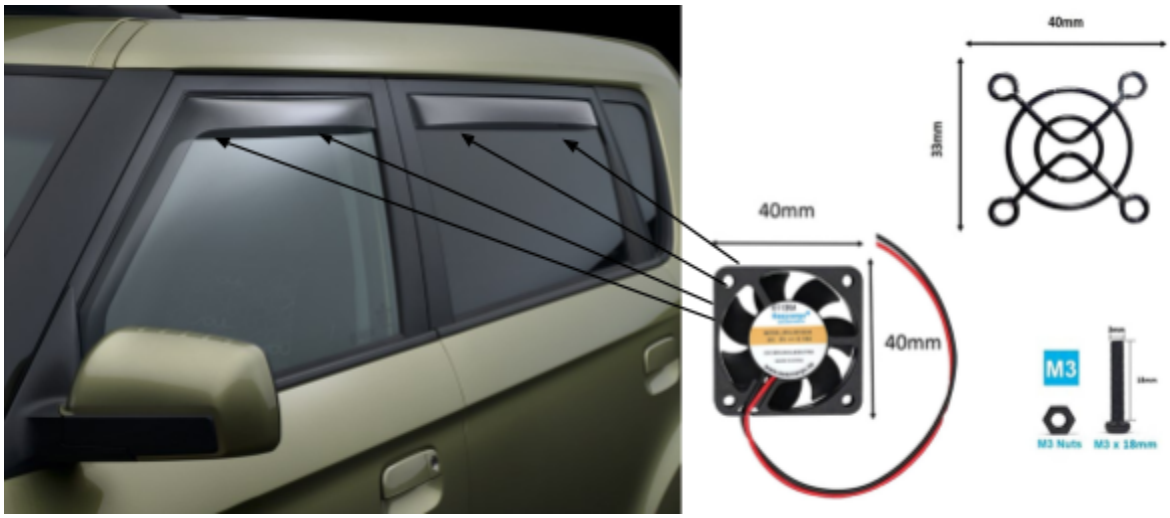

Figure 1 - Vent shade cooling concept [2]

Batteries will provide the power required for the fans and MCU. The battery life will be significantly extended by a solar PV panel mounted to a sun shield on the windshield interior. The batteries of the fans may also be charged through the 12V DC Port of the vehicle while it is running.

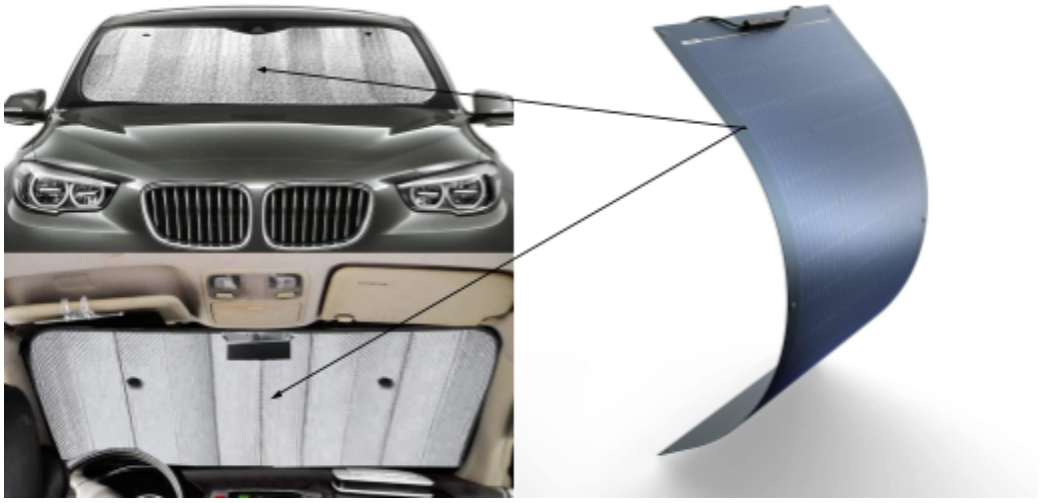

Figure 2 - Flexible Solar Panel and Sunshield [3]

To ensure cooling is maximized, temperature sensors will be placed within the vent shade of each window to compare the relative temperature difference between the sides of the car. This is done so that the coolest air is brought in from outside and the hottest air is exhausted while providing a consistent stream of airflow through the vehicle, thus removing or displacing the greatest amount of heat.

These sensors will communicate with an MCU via Bluetooth or similar wireless means. The determination of which fans will pull in air and which will exhaust will be made by a program contained within the MCU which will automate the ventilation process, ensure the fans are only running when necessary, monitor battery level, track whether the vehicle is running, and determine where power needs to be delivered by the solar panels and vehicle.

Expected Outcomes:

The fuel consumption of a car can be increased by up to 20% due to AC usage. Over 10 years, the fuel burned by the AC can produce up to 4,600 kg of CO_2 over 10,000 km per year [4]. The AC's efficiency is especially diminished when the car first starts up after being parked in sunlight for extended periods, as it must work harder to remove the trapped heat from the car. In an attempt to avoid discomfort, some people turn on the car and run the AC for a few minutes before getting in. Others open the windows while they run the AC as they begin driving to ventilate out the trapped heat. A.S.H.E. attempts to alleviate the extra stress on the AC by ventilating the car while parked, thereby lowering the internal temperatures before startup and saving people from wasting fuel to cool the car before entering. In this way, A.S.H.E. has the potential to save fuel and reduce CO_2 emissions.

Trapped heat also damages the vehicle's interior, causing the dashboard, leather seats, steering wheel, and more to dry out and crack [5]. Electronics in the vehicle are also subject to wear and eventual failure [6]. These damages serve to shorten the vehicle's lifespan and call for excessive repairs. This leads to increased consumption of vehicle parts and electronics, and even new vehicles; all of which take a toll on the climate by increasing emissions.

As the climate continues to warm, hot vehicle interiors become even more dangerous. Approximately 38 children die from heat stroke each year in the U.S. [7]. In most cases, this occurs when a child is unwittingly left behind in a parked vehicle. The same can be said for hundreds of pets each year [8]. Not even the driveway is a safe place to keep a hot vehicle when left unlocked, as any children that can get access to the vehicle are at risk of heat stroke. According to a study from the Journal of Applied Physiology, young fit adults could no longer maintain their core body temperatures starting at ambient temperatures of 86 °F to 87.8 °F in warm-humid environments [9]. Heat stroke can occur when body temperatures rise to 104 °F [10], and a parked car can reach 104 °F in just 30 minutes with outside temperatures of 70 °F according to *Table 1*. A.S.H.E. aims to help vehicle owners adapt to the rising climate by reducing internal vehicle temperatures. Though ventilation may not eliminate the possibility of injury or death, it may reduce the frequency of such occurrences.

Expected Budget:

This project requires a large quantity of small DC fans. These will constitute a solid portion of the budget. A 100 W solar panel is also necessary to keep the batteries discrete and small enough for the design while increasing battery life. The full proposed budget is broken down in *Table 2* below.

Table 2 - Proposed Budget

Item	Unit Price	Qty.	Vendor	Subtotal
Automobile Vent Shades (4-Pack)	$45.62	1	Amazon	$45.62
GDSTIME 12V 60mm x 60mm x 25mm DC Fan (2 Pack)	$15.99	16	Amazon	$255.84
HQST 100W 12V Flexible Monocrystalline Solar Panel	$146.99	1	Amazon	$146.99
Grove SHT40 Temperature and Humidity Sensor	$5.50	1	SeedStudio	$5.50
AKZYTUE 3.7V 10000mAh Lithium Polymer Ion Battery	$24.99	4	Amazon	$99.96
GA2.2K3A1IA Thermistor	$8.43	4	TE Connectivity	$33.72
Big Ant' Windshield Sunshade (55" x 27")	$25.99	1	Amazon	$25.99
Raspberry Pi Pico H - Pico with Headers Soldered	$5.00	1	AdaFruit	$5.00
5PCS HC-05 Wireless Bluetooth Receiver RF Serial Transceiver Module (5-Pack)	$18.99	1	Amazon	$18.99
PowMr 10A Waterproof Solar Charge Controller - 10A 12V Charge Controller	$17.00	1	Amazon	$17.00
Total Cost				$654.61

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