Adjustable Automobile Sun Shield
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Abstract
Sun shields prolong the life and preserve the appearance of car interiors. However, most commercially available products are difficult and time-consuming to deploy and bulky to store. The Sun Screen can be assembled and disassembled quickly and easily and takes 15% less storage space than the benchmark product.

Technical Challenges: Thermal Properties
A flexible fabric provides the base of the Sun Shield, allowing the product to be stored in a much smaller collapsed form. Most commercial sun shields are much thicker and stiffer.

The thin material of our Sun Shield does not make it less effective than other sun shields. Heat is transferred through three processes: radiation, conduction and convection. Because the sun shield is inside a closed car, the main source of heat transfer is radiation. The reflectivity of the material, not its mass, is the important consideration. The difference in mass between our Sun Shield and the competitor’s is negligible compared to the mass of air in the car.

Design Goals
Our aim was to design a sun shield that:
- was easy to assemble and disassemble.
- took minimal storage space in the car.
- could be adjusted to different-sized windshields.
- performed the basic sun shield function of preventing excess heating of the car.

Technical Challenges: Adjustability
Our Sun Screen can be adapted to most windshields smaller than approx. 58 in. x 34 in. Four magnetic strips are applied to the frame of the car’s windshield. The four magnets of the Sun Shield can then be connected to those. The Sun Shield’s cord can be tightened or loosened to adjust the Sun Shield’s perimeter to the specific car.

Technical Challenges: Materials
Most common market sun shield products retain their shape due to being made of stiff materials. This material choice is one of the major factors in making the products difficult to assemble and hard to store. They must be folded or rolled into a large, bulky form before being stored.

We chose to use a lighter, flexible fabric painted with a reflective coating to allow for easier maneuverability and storage. Magnetic connections at each corner of the rectangular shield allowed our product to keep its shape. Several magnetic strengths were tried before an effective magnet was found.

Challenges: Thermal Properties, cont.
Metallic paint was applied to the material to make it more reflective. In future iterations, an even more reflective paint could be applied.

The thermal effectiveness of our finished product and the unpainted prototype were compared by placing each device in a car for three hours in the sun. The painted screen was much more effective, providing nearly as much protection as the benchmark.

Technical Challenges: Materials
Assume opaque surface.

The reflectivity of the shield directly affects how much heat is absorbed as opposed to bouncing back.

Figure 1. When collapsed, the Sun Shield takes up significantly less space than the benchmark product shown on the left/right.

Figure 2. Graph depicting the temperature of the air behind our Sun Shield (both with reflective paint and without) and a basic commercial product.

Figure 3. This shows the full extension of the Sun Shield. It has been sprayed with a reflective metallic paint to discourage heat gain through radiation.

Acknowledgments
Steve Laguette, Dave Bothman, Trevor Marks, Greg Dahlen.

The benchmark used was the HeatShield Advanced Windshield Reflector (Honda Civic model).