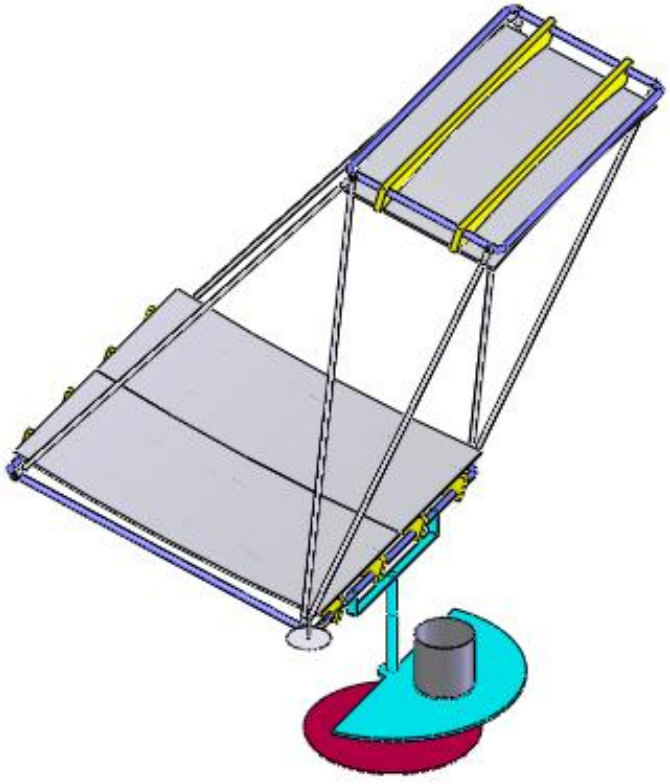
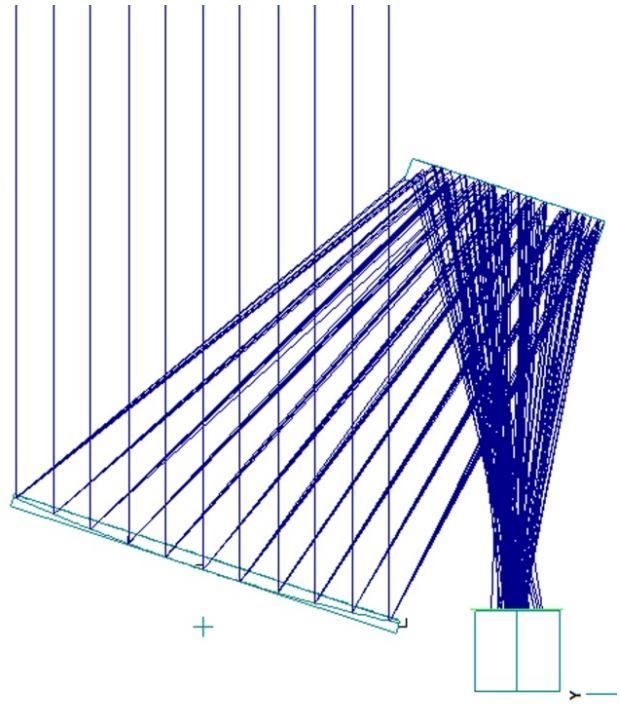
There are many high temperature (HT) solar cookers available, yet I have designed another one The most important reason for doing this is that after getting my master's degree in physics, I lived for four years in rural Nigeria and therefore understand some of the challenges and limitations of the manufacture, sale, and use of such a device in a developing country. The answer to what and why I have done this is:

Simplicity. All the HT solar cookers on the market are parabolic reflector designs. These require reflectors that either have compound curvatures, or a multitude of single curvature elements. In either case, the resultant structure is complex and difficult to manufacture, or assemble, or both. My design consists of just three planar mirrors, each of which has only one degree of curvature and that curve is circular, not parabolic. This results in a structure that is much more easily manufactured, and also more easily repaired if a problem arises after long and hard use. My professional experience is in optical design, and I have the design tools and a number of patents to provide the experience needed to get the job done.

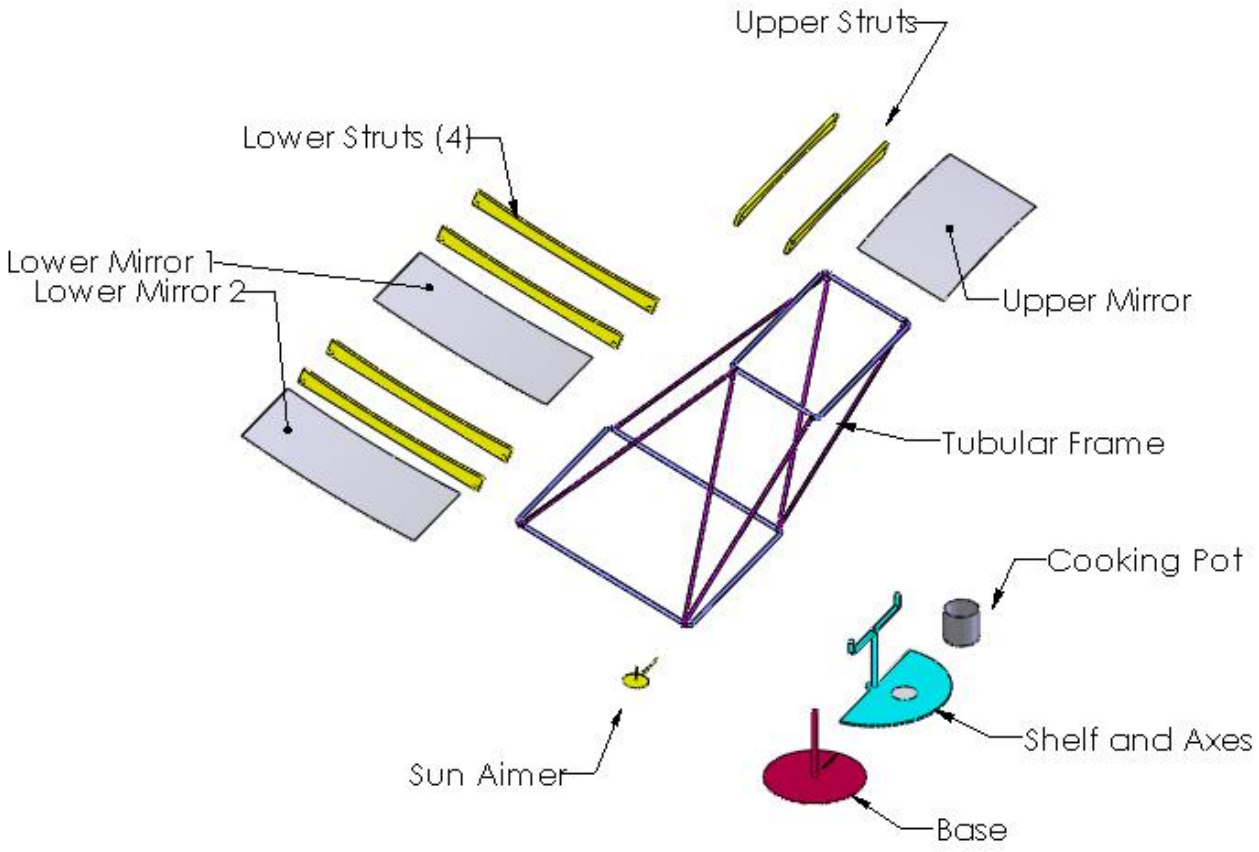
The optics of the Crossed Mirrors Cooker consists of three thin,planar, rectangular mirrors each 2 ft. by 4 ft in size. Two of them form the base and are bent into a shallow circular arc. (*It should be noted that when the curvature is shallow the difference between a circle and a parabola is very small.*) Notice that the top mirror is bent in a direction at right angles to the bottom mirrors. In this sketch, assume the sun is directly overhead, then upper and lower mirrors are tilted at a 19 degree angle from the direction of the sun's rays. This is done so the upper mirror does not shadow the lower ones.



Using a sophisticated commercial ray-tracing computer program coupled with modeling provided by an industry leading CAD program, I performed an optical anaysis of the design. Here is a ray-trace of the sun's rays. (In this example the sun is directly overhead.) The rays reflect off the bottom mirrors, focusing them in one direction,then reflect off the top mirror which focuses them in the second direction (perpendicular to the first direction). The result is a symmetric beam of concentrated light sent into the top of the cooking pot. Yes, the ***top*** of the pot. This cooker cooks ***upside down***! There are important advantages for this method which will be discussed later in this paper.

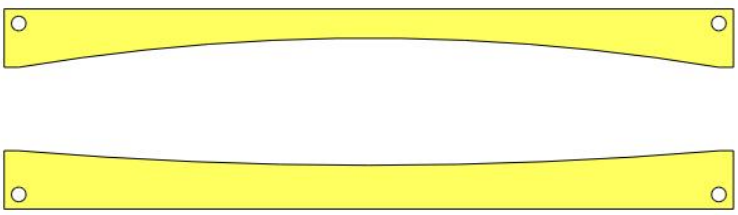


The next page shows an "exploded" view of the cooker. One important detail is the mechanism for tilting the structure so that it can follow the sun's sky-traverse. This feature is not yet completed and therefore not shown, but should be finished soon.



This particular design was to be tested in a parking lot and the base was to be bolted onto the concrete. In a more likely setting, the base would consist of a steel pipe buried into the ground with the shelf/Axes portion attached to a pipe of slightly larger diameter and placed over the smaller pipe. One axis would be of rotation alligning the cooker to “east and west”. The other axis would allow the entire structure to tilt up and down to track the sun throughout the day as it traverses the sky. (This is the feature not yet finished).

Here is a detailed view of the struts upon which the mirrors are attached. Notice that the curvature of the upper strut is greater than the lower struts. This is necessary to have the focal region at the pot to be approximately symmetric. The holes in the struts are used to attach the struts and mirrors to the tubular framework.



The sun aimer is shown in the exploded view. It consists of a straight rod attached to the center of a horizontal disk. When there is no shadow of the rod on the disk, every thing is copacetic! The sun-aimer will rotate with the structure when the sun’s angle changes. (It will require a willing child to keep things alligned.)

Some advantages of the Crossed Mirrors Cooker

1. Flat plastic or metal mirrors are readily available and relatively inexpensive.
2. The mirrors need only bend in a one dimensional curve whereas typical parabolic reflectors require either a compound curve or a large number of elements.
3. The correct curvature of the mirrors is determined by the struts. These have a circular curve which is easily manufactured using simple tools, thus allowing a local craftsman to make the struts without the need of complex math required of a parabola.
4. Because of the double reflection of the crossed mirrors design, the pot, which can be quite heavy when full, is placed on or very near the ground.
5. The sunlight is moving in a downwards direction as it becomes more concentrated near the pot. Because of this there is little chance of the cook looking into the concentrated sunlight and thus incurring eye injury.
6. The sun aimer allows a simple but effective way to position the cooker for maximum efficiency.
7. Most cooking in third world countries is done in boiling water. Examples of such foods are: rice, yams, gari, beans, grains, etc. Meat is often tough, and is therefore usually cooked in a stew with tomatoes, oil, and spices or other liquid. How the liquid is heated is of little concern, whether from the bottom of the pot or from the top.
8. A considerable advantage of cooking from the top is that we can place insulation around the bottom and sides of the pot thus minimizing heat loss and shortening the cooking time when compared to a parabolic cooker.
9. For fried foods, we heat the empty greased griddle first, the add the food, and now cook it on both sides simultaneously.
10. BTW, if the cook wants to reduce the heat (from a boil to a simmer), she only needs to toss a piece of cloth onto the lower mirrors, covering them enough as needed. (Then remove the cloth for maximum heat again.)

For further information or questions, please contact me at: jfuthey@sonic.net

Thanks,

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