The Hardware Store Solar Tracker

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Always work and act in a safe manner

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What profit hath a man of all his labour which he taketh under the sun?

The sun also ariseth, and the sun goeth down, and hasteth to his place where he arose.

Ecclesiastes 1:3,5

It can be done, build a solar tracker than can control the right ascension of a solar array or solar furnace, and do it without messing with circuit boards, soldering or component level electronics.

Instead, this design relies on simple parts found in the lighting section of the hardware store. The main control component is a dusk to dawn control module for a light fixture. I found the 150 watt light control at Wally World for $4. Other parts are plug-in outlet adapter, a socket plug body and two extension cords.

The actuator motor is a barbecue rotisserie motor found at a garage sale for $2. All parts are rated for 120 volts. Some care may be needed with the components because they are not rated for outside duty so they will have to be mounted in a rain tight enclosure. A 1 quart paint can provide adequate protection if all the parts can fit inside.

It is necessary to find light controls that work instantaneously, most of the cheaper devices perform without a time delay, so they should be easy to find. The light control must turn on as soon as illumination falls below a certain point, and most important, it must shut off as soon as illumination is restored.

Essentially this combination of parts uses the output of the photo control to drive a slow turning rotisserie motor that turns anything that needs to face the Sun. When the photo control darkens, the motor turns the solar collector until the photo control, which is mounted to turn with it, becomes illuminated once more, and turns off.

The solar collector needs to be in an equatorial mounting whose primary axis is aligned parallel with the rotation of the Earth. As the declination of the Sun changes with the seasons, the altitude of the device needs to be adjusted, probably every week .

Position the sensor of the light control so that it will be darkened as the Sun moves east to west. To do this, you may employ a collimator tube or other various baffles to cut off the sensor from the incoming light of the Sun as it travels across the sky. The important thing to remember is that the control needs to travel with the movement of the array, and that a limit switch needs to be at the extreme end of the travel to the west. Should the Sun darken from a passing cloud to the point that the sensor turns on, the array will keep on turning until it crashes or breaks.

This device is meant to control any type of solar energy collector by keeping it in line with the ever changing position of the Sun as it traverses the sky daily and through the seasons. It is meant to be a one axis controller for daily movement, so a builder experimenter will have to adjust the attitude as the seasons change. It is meant to turn heavier loads slowly through and east to west rotation.

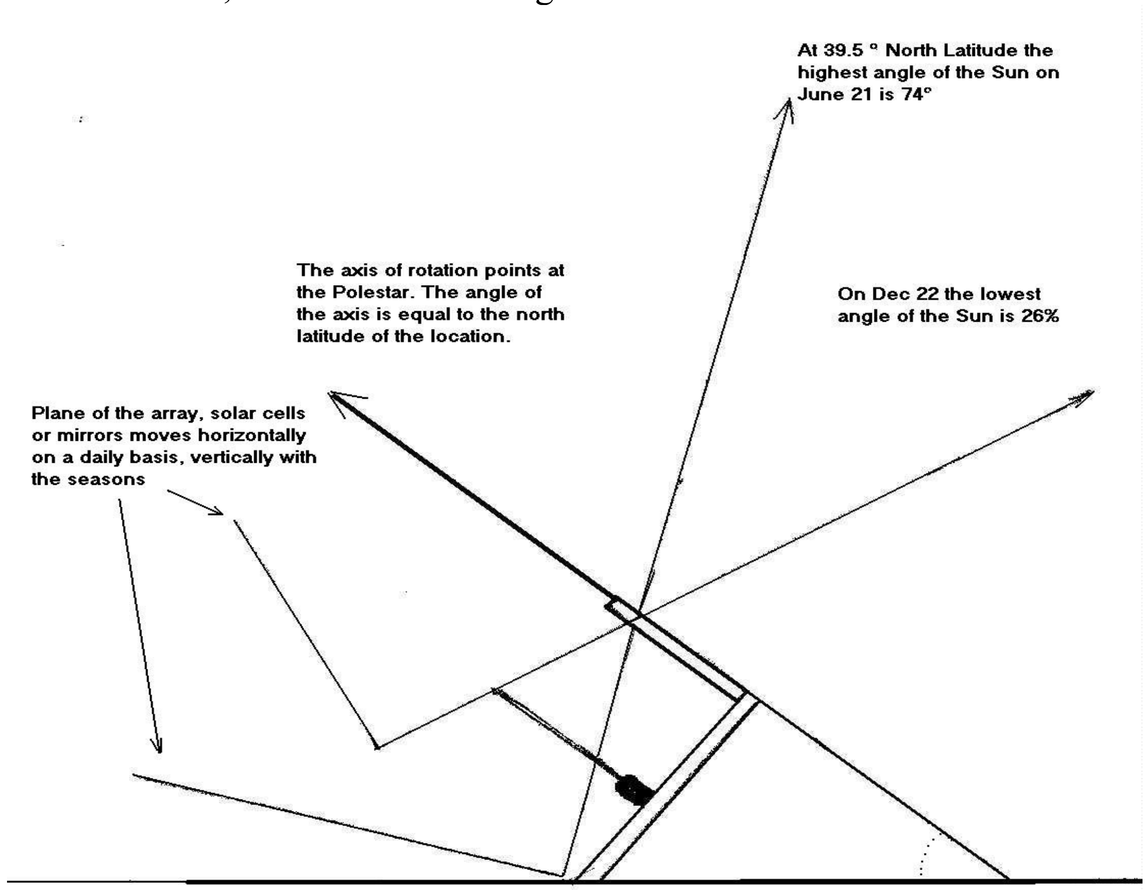
To do this, a heavy geared down motor of up to 150 watts can be used to actuate periodic movement east to west. In this case, a rotisserie motor used to drive a barbecue spit can be used. This type of drive has several advantages. It can exposed to outside conditions and is used to extreme heat.

Planning the Solar Tracker Mounting

Start out by reading everything available about telescope mountings, because that is essentially what has to be built in order to insure that the array points at the Sun. For a solar array, the best way to go is with a clock drive without the clock, something that will turn the array into the Sun as it moves through the sky. That is what the trackers job is about. The declination does not have to be adjusted in real time, but the right ascension does.

Find the extreme angles of declination for the solstices, then draw up a plan of what the array will look like. I found the angles for my location on page 69 in ***Solarizing your Present Home*** published by Rodale. For the planned location these declination angles are 26 to 74 degrees from the horizontal.

Draw a rough plan of what the array rigging will look like at its extremes of summer and winter, it should serve as a guide for the dimensions.



Its at this point the builder must understand that certain decisions in the design must be made, and those decisions must be set in stone at that time to continue the project in a productive fashion.

First decision: solar cells or solar furnace? The decision to mount PV cells makes the rest of the design process automatic. If the more spectacular version, solar furnace is chosen, the decision making process becomes more complicated.

The next decision for the solar furnace must be to decide on the receiver position, which can either be fixed or move with the array. A movable receiver is simpler, but complicates any connections to piping, and if the furnace is to be used to melt metal, takes a chance of spilling the molten metal on the ground during times when the array is at high declinations in the summer. The weight of the receiver will also counterbalance the weight of the array.

A receiver mounted on the axis of rotation will greatly simplify pipe connections, as they don't have to move, and any crucible for melting metal can stand upright on a pedestal until its ready to be cast. The axis mounted receiver has one problem, as the seasons progress and the declination of the Sun moves up, the fixed focal point of the mirrors stays the same as it moves back from the axis of the mount and the receiver.

If the array is a fixed parabolic mirror, it will have to be moved closer to the receiver to maintain focus. Another alternative is to adjust individual mirrors and move the focal point forward as the season changes from winter to summer. This is the approach Bill Beatty advocates for his ***Infinitely Large Solar Furnace*** project on his ***Amazing Science*** website.

The designer must make his decisions and stick to them. Thats because certain parameters become fixed and can't be changed once certain parts are built. The parameters of this device depend on ones location. A fixed location would not have the same angles and geometry if it were placed north or south of its particular location.

One solution is the Dobson mount, which can become an equatorial mount if its supporting plane is tilted to match the latitude. To avoid stresses, the primary angle of the Dobson should be small, the rest of the setting could be taken by tilting the platform.

Some schematic should be drawn, to avoid the moving parts bumping onto or jamming into one another. One that should be particularly avoided is scraping the platform during the high angles of the sun during summertime. Plan to see if the fixed focal length of 4 feet makes sense in proportion with the rest of the device.

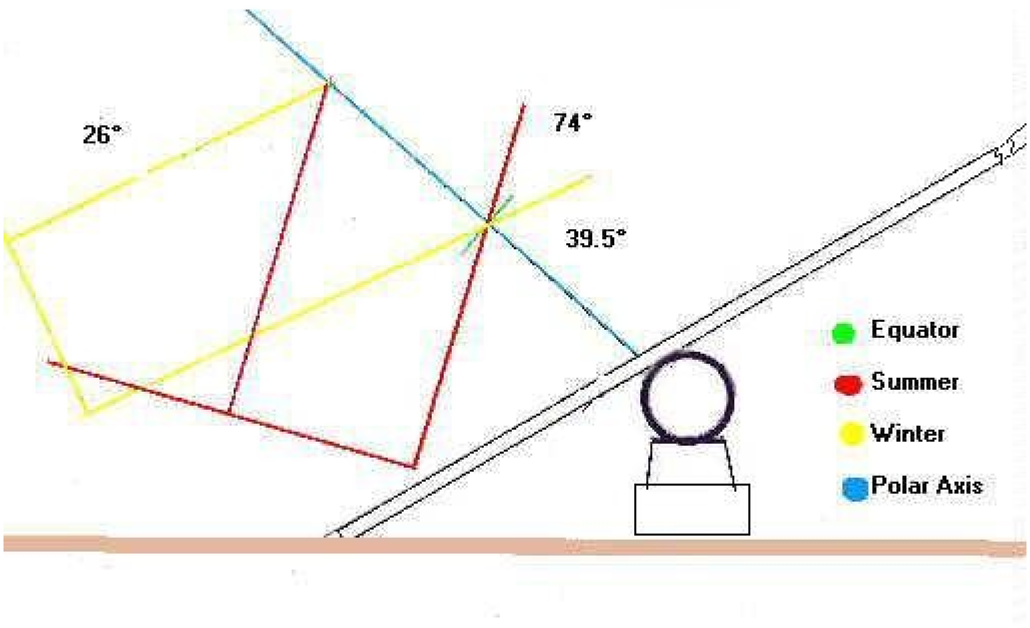
After a lot of drawing the dimensions can be fixed

Decision Time

What this design will incorporate:

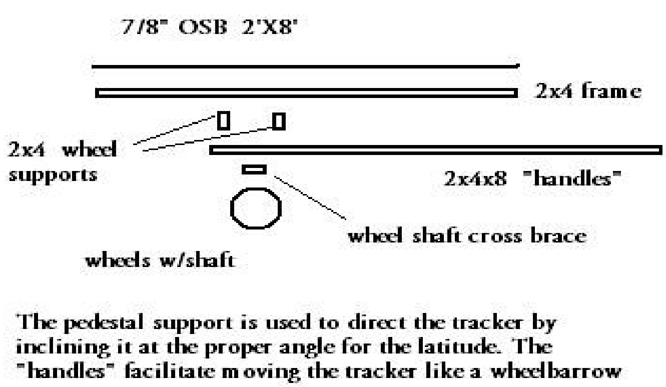
1. It will be a solar furnace
2. The receiver will be immovable
3. The focal point will be moved by moving the reflector as the declination increases.
4. The entire assembly will be portable and fit on a 2X8 sheet.
5. The mounting will be a Dobson equatorial mount, which can be made parallel to the Earths rotational axis by partially tilting its mounting platform. Because the

platform itself can be tilted, it eliminates the need to have the primary mount at the angle of the north latitude. This means less stress on the legs of the mount. The setup should look something like this:

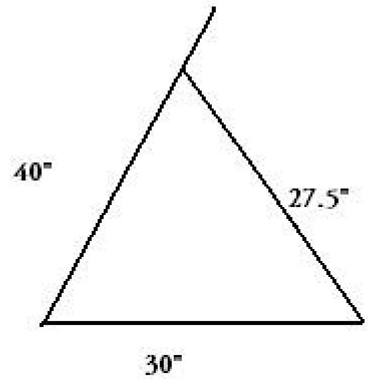


Building the Base

The base of the tracker is not much more than a flat wheelbarrow. It is made of plywood and 2x4 lumber. It has handles to make moving the tracker easier than dragging it through the dirt. The base supports that sit on the base are angled at 30°. The rotating table of the Dobson mount will only have to be tilted about 20º to get the correct inclination which is parallel to equator.

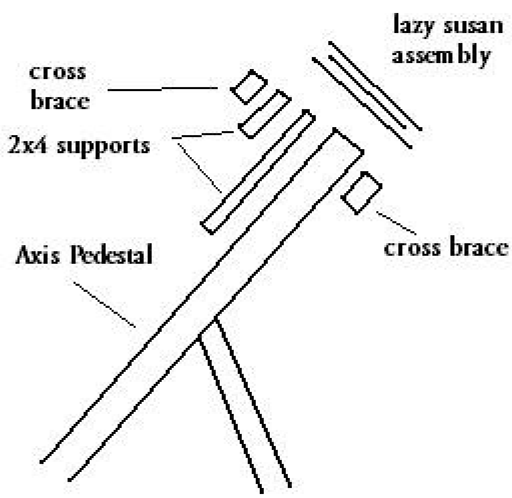


The Dobson sits on top of two “almost “ equilateral triangular frames.



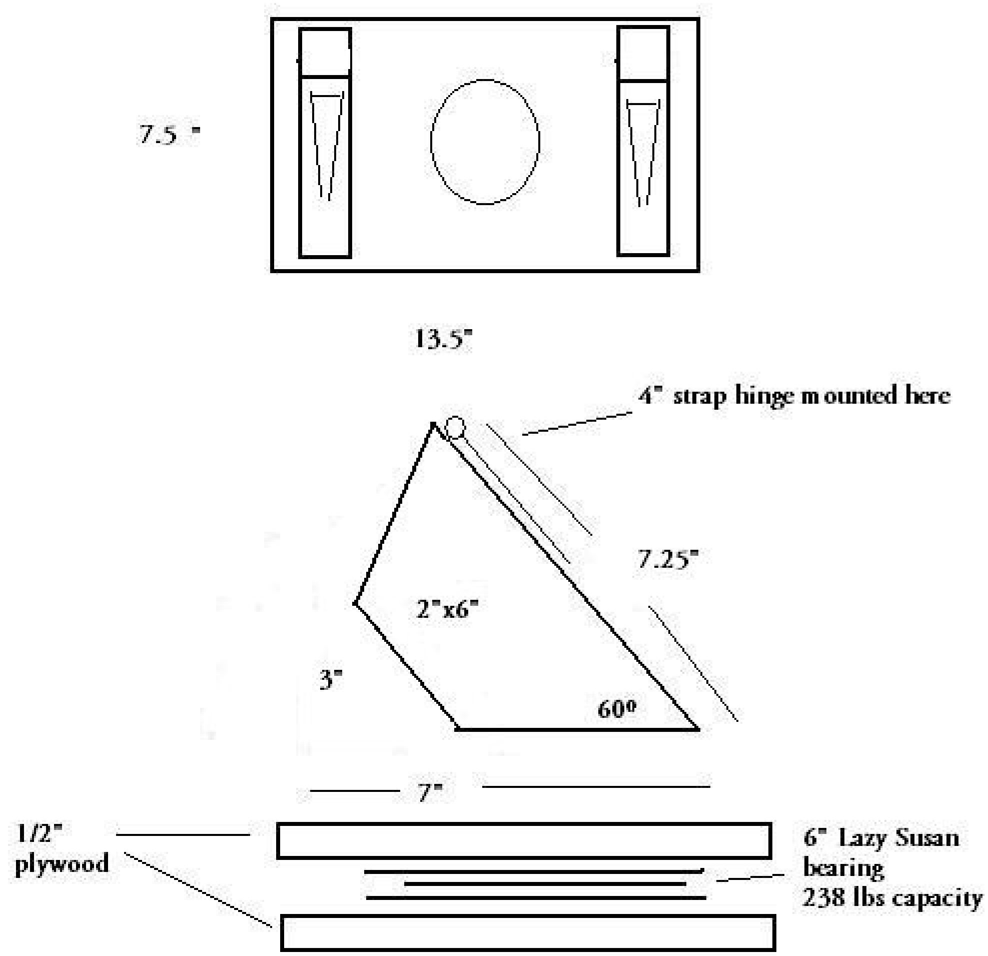
Pedestal built from 2X4 is an equilateral triangle
one of the strongest structures

On top of the pedestal sits the rotating Dobson assembly, made from two pieces of 5/8 “ plywood and a six inch Lazy Susan bearing.



On the top of the plywood, piers are mounted to support the arms of the frame that hold the mirrors, or whatever else might need to be pointed at the Sun.

Top mount assembly



When all of this is put together and tilted at the correct angle to make the base of the Dobson parallel to the equator of the Earth, the arms of the tracker will follow the course of the Sun through the sky on a daily basis. Periodic adjustments to the angle of the support arms as the seasons progress will be necessary as needed . This adjustment may be as much as 3° per week during the equinoxes.