Flower Power

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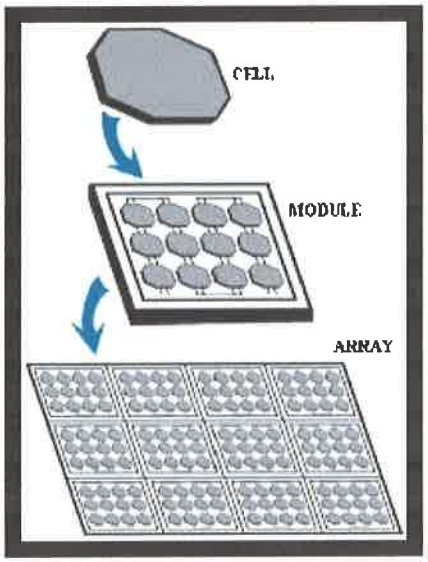
Table of Contents

The Need/Purpose

The purpose of this project is to create a non-electrical system that increases the efficiency of solar panels or photovoltaic cells, by allowing them to move with the sun. In nature, the sunflower, tracks the sun's movement throughout the day. I want to design a device that can track the movement of the sun without consuming electricity by mimicking the phototropic qualities of the sunflower.

Background Research



In my research I studied a few different topics: solar panels or photovoltaic cells, their efficiency, and isopropyl alcohol.

The history of solar energy started when William Grylls Adams along with a student of his, Richard Day, discovered that when selenium was exposed to light, it produced electricity

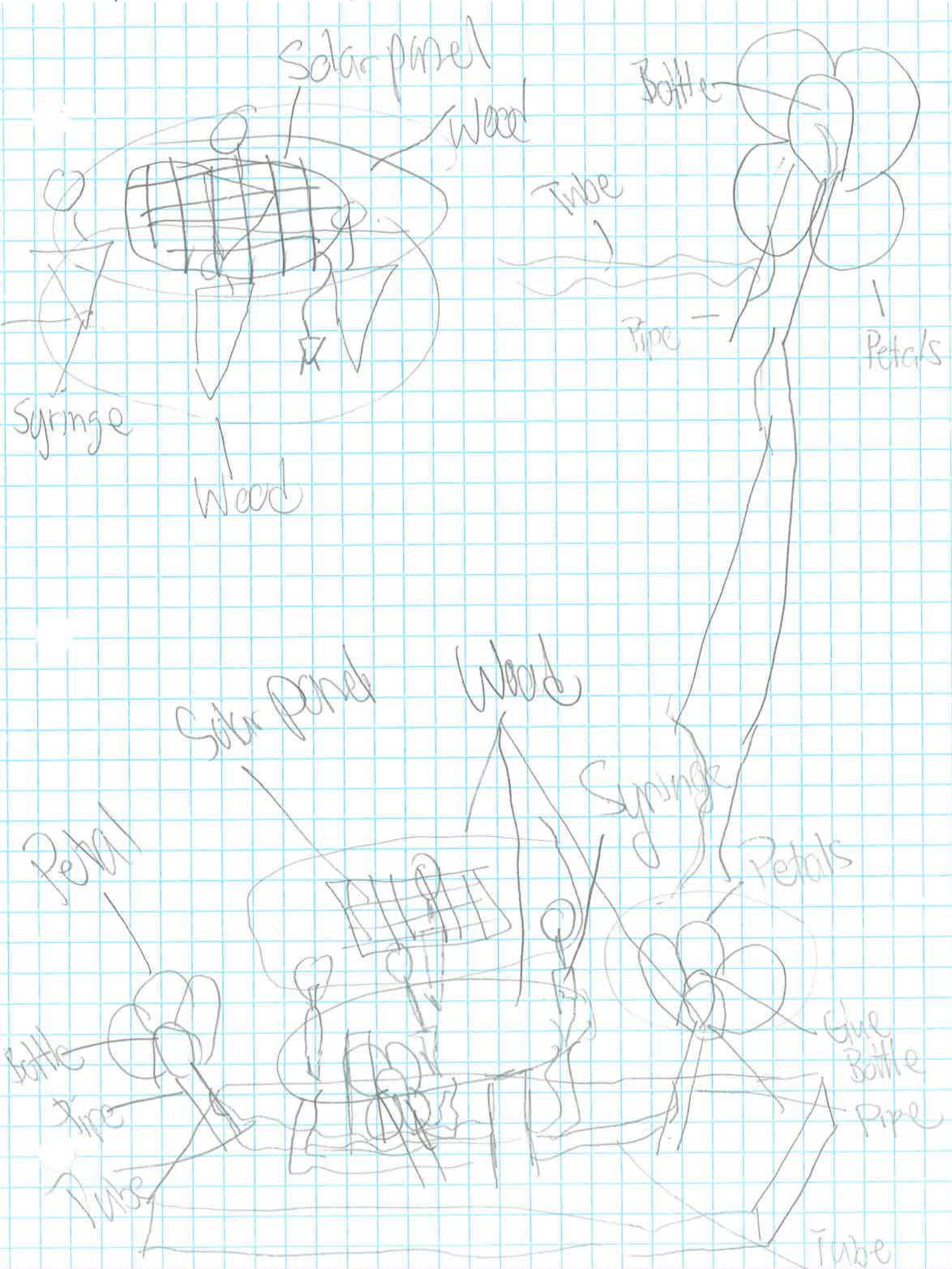
Solar panels are also known as photovoltaic cells. They come in cells, modules, and arrays. Solar panels use light energy from the sun to generate electricity through the photovoltaic effect. The photovoltaic effect is the creation of voltage or electric current in a material upon exposure to light. They are used in some models of airplanes, lasers and vehicles. Scientists also incorporate solar panels into space craft. They use them in space stations and laboratories.

The more surface area aimed towards the energy source, the more electricity is produced. In this project the purpose is to increase the surface area of the solar panel that's getting light, so the efficiency of the solar panel is at its max.

Solar energy is a renewable source. Other sources like oil can run out but the sun will always be around so as long as we have solar panels, the sun is and unlimited resource. I learned that one of the major reasons solar energy is not used as often is that it is not as efficient as other sources of energy. I feel that developing a way to increase efficiency while not consuming more energy could help solar energy become a more competitive source of energy.

Background Research

I will be using Isopropyl alcohol to move the syringes in my experiment. The molecular formula for isopropyl alcohol is: C_3H_8O or C_3H_7OH or $CH_3CHOHCH_3$ depending on which kind you get. It is a colorless, flammable, chemical compound with a strong odor. Isopropyl alcohol is miscible in water, alcohol, ether and chloroform. It will dissolve ethyl cellulose, polyvinyl butyral, many oils, alkaloids, gums and natural resins. Isopropyl alcohol expands when heated at a constant rate which is why I chose to use it in my experiment.


Solar panel
Wood
Syringe
Wood
Bottle
Tube
Pipe
Petals
Petal
Bottle
Pipe
Tube
Solar Panel
Wood
Syringe
Petals
Glue
Bottle
Pipe
Tube

Design Process

List of materials:

- ¼" vinyl tubing
- Solar panel
- 2 8" pine 2 x 2s
- 1 7" x 11" plywood board
- 1 9"x14" Pine oval
- 5 ½ "x7" plywood board.
- 4, 10mL syringes
- Duct Tape
- Cardboard
- 8 4ft pieces of 14 gauge wire.
- Tin Foil
- Screws
- Twine
- Door Stopper
- 320 mL 91% Isopropyl Alcohol
- ½" Plastic Pipe
- Empty Glue Bottles
- Hot glue
- Voltmeter
- Black spray paint

Procedure:

1. Cut out a piece of wood that is 14" by 23"
2. Take a piece of cardboard and cut out pieces that are 15" by 4", cut them out in the shape of two tear drops connected with a one inch space in the middle.
3. Straighten the wire out and cut 2 pieces that are 4ft long.
4. Take those pieces and take out the wires from the insulator.
5. Twist the wire about three inches in so it makes a circle.
6. Bend the wire into the shape of the cardboard and duct tape it there. Make sure to put the wire as close to the edge as possible.
7. Bend the cardboard into a parabolic shape facing the center of the cardboard, and cover it in tin foil.

Design Process Continued

8. In the middle of the cardboard cut a hole the size of the plastic pipe. Make 8 of those.
9. Take the plastic pipe and cut it so it's 3½" tall.
10. 3cm from the bottom cut a 1" hole going vertical for the pipe to run through. Make 4 pipes.
11. Take the vinyl tubing and cut off 18" Cut 4 tubes.
12. On the pine oval drill a 5/8 inch hole 2" in from the end.
13. 2" away from where the syringe holes are attach the 2x2s by screwing them in.
14. Connect the pipe to the syringe by sliding it over the nozzle.
15. Hot glue the plastic pipes on the board close to the edge.
16. Put the syringes in the hole on the pine oval by putting the tube through first and pulling till the syringe can't go further.
17. Thread the tube through the plastic pipe on the opposite side that the syringe connects to it, and tape it down with duct tape.
18. Slide two of the cardboard petals onto each pipe and hot glue under it so it stays as close to the top as I can get.
19. Take the small glue bottles and slide the tube sticking out of the pipe inside the bottle till the tip of the bottle is inside the plastic tube.
20. In the middle of the pine oval screw on the door stopper.
21. In the middle of the 5 1/2 "x 7" board screw it on top of the door stopper.
22. Drill 2 small holes in the board and thread a 6" piece of twine through and tie it to the solar panel on top.
23. Fill up the tubes and bottles with isopropyl alcohol.
24. Connect the voltmeter to the solar panel.

Testing and Re-Design

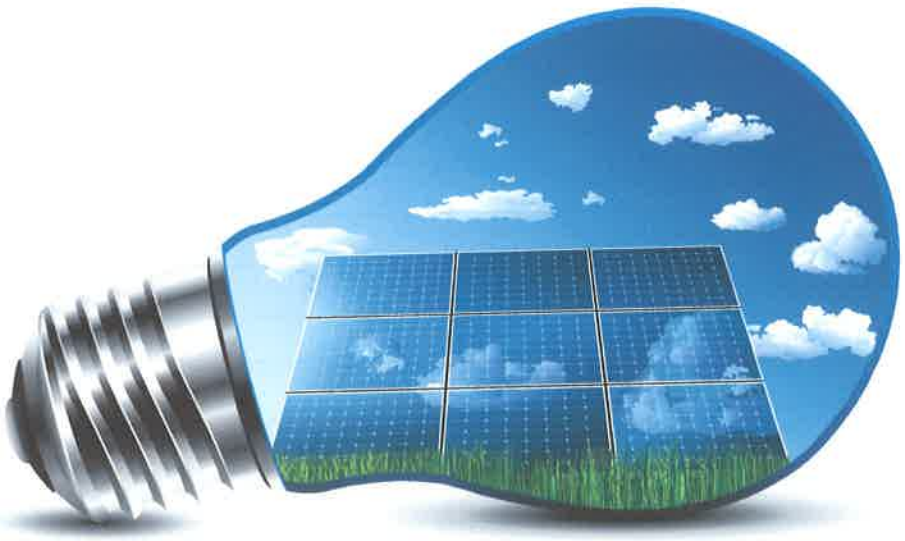
When I was building the prototype it was hard to do the wood work. It took a long time to sand the wood and it also took long to make the cardboard flower petals. Bending the wire to the exact shape was time consuming, as well as finding the right thickness of cardboard to use in the design. Putting the tubes in the glue bottle was challenging due to the fact that I had to hold the flower petals in place as the glue dried. However, I am pleased with the final product and I feel that it will gather the maximum amount of light as it tracks the source just as the sunflower does in nature.

Test 1: I decided tested my heliotracker by putting it on the dining room table and turning all the lights off. Then I took a flood light and put it on a box looking over the table pointed at one end of the heliotracker. Then I turned it on and let it sit. After the first 20 minutes I discovered that there was very little movement of the solar panel. After evaluating this problem I decided to paint the bottles black so that the maximum amount of heat from the light would be absorbed and expand the isopropyl alcohol as quickly as possible. Also, I discovered that the syringes were difficult to move with the maximum amount of alcohol that I had in them. Therefore I removed 3mL of alcohol from each syringe to help the panel move easier.

Test 2: I set up the heliotracker exactly the same way as test one with the new revisions that I had made. After turning on the light source and angling it at one end I took measurements of how much the solar panel had moved every twenty minutes. As the light hit my "flower petals" it would reflect down onto the bottle filled the isopropyl alcohol. As the isopropyl alcohol expands and contracts it causes the pistons to move up and down allowing the solar panel to angle itself more directly aligned to the light source.

Testing and Re-Design

My design worked and the solar panel was able to follow the sun using no external power source! The heliotracker was able to move approximately 5 degrees every 30 minutes as it tracked the light source. The solar panel continued to move until the maximum surface area was exposed to the light source. I then moved the light source to the opposite end, facing a new set of petals. Within, 30 minutes the panel was back to lying flat. This seemed to be a faster time but I released that the reason it was moving so quickly was from the cooling of the alcohol now away from the light source. The panel continued to rotate itself towards the new location of the light source; moving approximately 5 degrees every 20 minutes. As the light was reflected off the parabolic petals and heated the bottle of alcohol.



Conclusions

A solar panel's efficiency is based on how much of its surface area is exposed directly to the light source. The sun moves constantly throughout the day and therefore most solar panels only have maximum direct exposure to the light source for a limited time. Our nation is in an energy crisis and we are in need of developing alternative forms of energy to meet our needs. Solar panels proved a great way to gather energy from a natural source.

My idea was to increase the efficiency of a solar panel by allowing it to track the light's movements. By increasing the surface area of the solar panel exposed to the light the maximum amount of energy will be generated. I wanted to do this without consuming energy to move the solar panel. If I used energy to move the panel then any increase in efficiency would be wasted on the energy spent moving the panel.

In my research I learned about the phototropic qualities of plants, the sunflower in particular. The sunflower follows the light through the day, which is exactly what I wanted my heliotracker to do. My design was successful in tracking the light and allowing for the maximum surface area of the solar panel to be exposed to the light for the longest amount of time. The parabolic flower petals, which mimic the idea of a sun flower, allowed for the light to be reflected and trapped which heated the bottles of alcohol allowing the pistons to move.

The design of my heliotracker successfully allowed the solar panel to move with the light while not consuming any energy. The maximum exposure to the light will increase efficiency as well as the fact that no energy is being used. I feel that this idea has money applications in society today. Solar energy is a renewable resource and increasing the efficiency of a renewable resource will allow us to decrease or dependency on non-renewable resources.

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Abstract

For this project I made a Heliotracker. First I did research on solar panels, solar panel efficiency, and isopropyl alcohol. I learned that solar panels are also known as photovoltaic cells and come in cells, modules, and arrays. I also learned that solar panels are more efficient if you turn them towards their energy source. I decided to use isopropyl alcohol in this project because it expands at a constant rate.

Next I drew a sketch of what I wanted the prototype to look like. Then I set to building it. First I made the cardboard petals and wrapped them in tin foil. Then I shaped and sanded the wood. Next I connected the tubes and put on the solar panel. Them I tested and revised it.

I did this project to create a non-electrical system that increases the efficiency of a solar panel by turning it towards its energy source. By increasing the efficiency of a solar panel, it will become a more reliable energy source.