Smart PV: Mechanical Design Modifications to the Second Prototype

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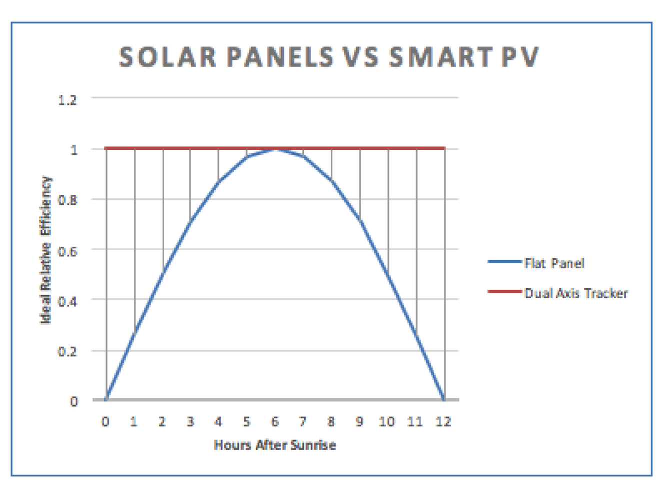
Abstract

There are many developing nations in our world today that do not have a constant and reliable source of electricity. Citizens of these regions rely heavily on kerosene lamps or wood burning stoves/fires for light at night due to a lack of electrical sources as it is too costly for the average family. The Smart PV project's goal is to provide the average household, in a developing nation, a few hours of light at night from an LED light bulb or two. The challenge is to design and build a sturdy product that can withstand many conditions in addition to costing less than $150 US dollars per unit to mass produce.

Introduction

Smart PV utilizes a Fresnel lens to concentrate rays from the sun onto a triple-junction photovoltaic cell. The triple-junction photovoltaic cell supports a broader spectrum of wavelength absorption from the sun's rays than a traditional flat solar panel. Smart PV employs a dual-axis tracking system that allows for movement in the azimuth as well as the vertical direction. This dual-axis tracking is a crucial element in Smart PV's design which allows it to track the sun's movement across the sky throughout the day. Smart PV is estimated to be able to produce approximately four times more Watts per hour than a traditional flat photovoltaic panel of the same size because of its ability to follow the sun throughout the day.



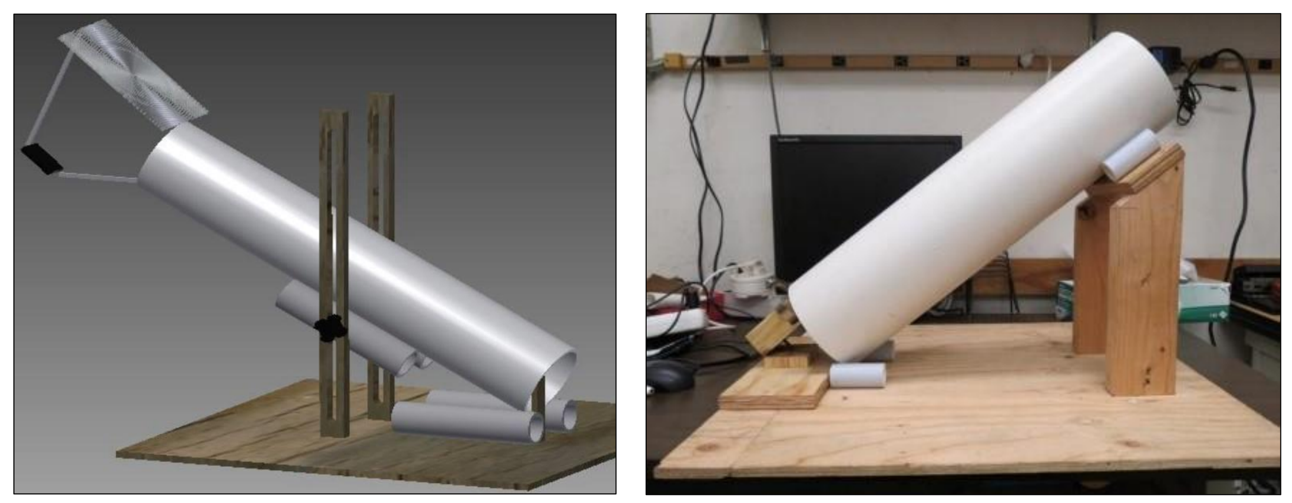
Smart PV Unique Aspects

- Fresnel Lens
- Triple-Junction Photovoltaic Cell
- Dual-Axis Tracking
- Arduino Uno Microcontroller
- Two Steeper Motors
- Four Mini Photocell Light Sensors
- Wind Sensor Rev. P.
- Peltier

Tools for Modifications

- Utilize Solidworks to update and modify the second prototype design while incorporating parts purchased by previous interns
- Research cheap alternative solutions for custom parts on www.mcmaster.com, www.amazon.com, and www.acehardware.com
- Purchase parts from www.mcmaster.com and Ace Hardware.

Prototype Designs and Modifications



Figures 1 & 2: Original Concept Design of Smart PV and Partially Assembled Prototype

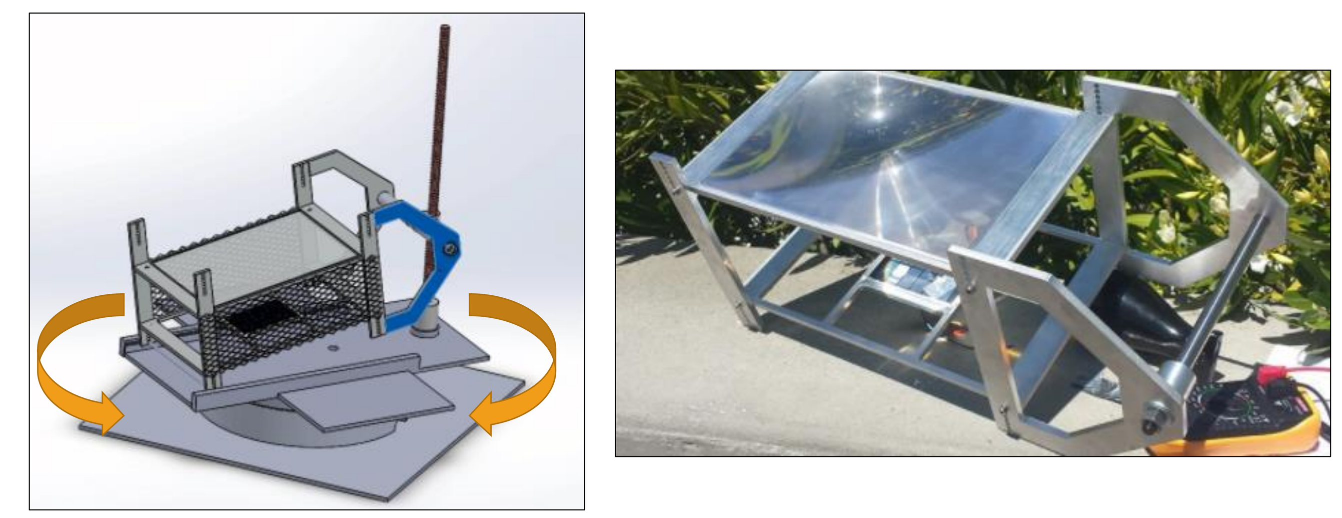


Figure 3 & 4: Second Concept Design of Smart PV and First Assembled PV Rack

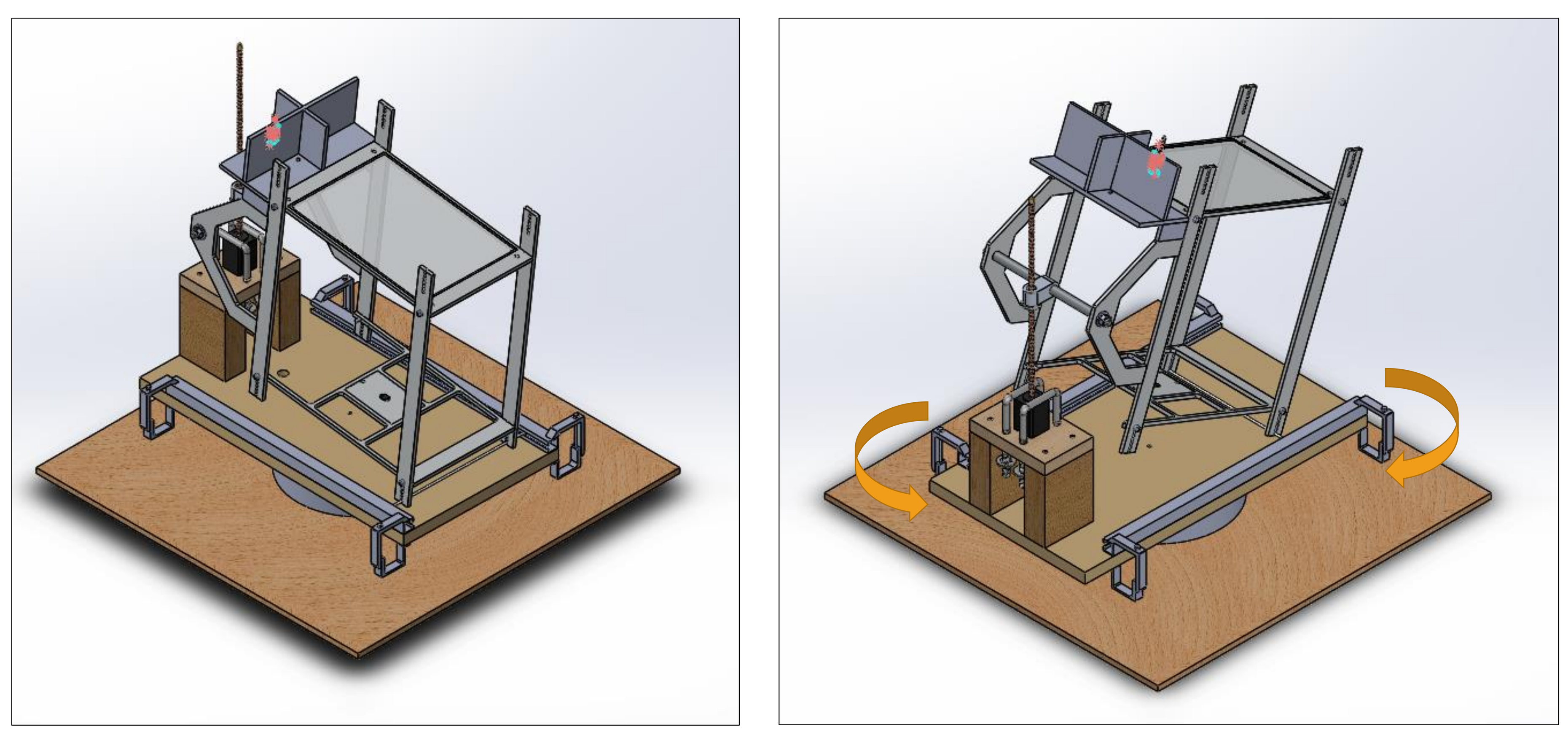


Figure 5 & 6: Modified Second Concept Design

The modifications made between **Figures 3 & 4** and the current model in **Figures 5 & 6** were: the legs of the PV rack were extended, part of the PV rack was removed, the tray for the turntable was redesigned, and the stepper motor and sensor platform were designed. Some of the parts purchased for the modified design were: U-bolts, an aluminum rod, bearings, c-clamps, a Wind Sensor Rev. P, and several sets of various screws.

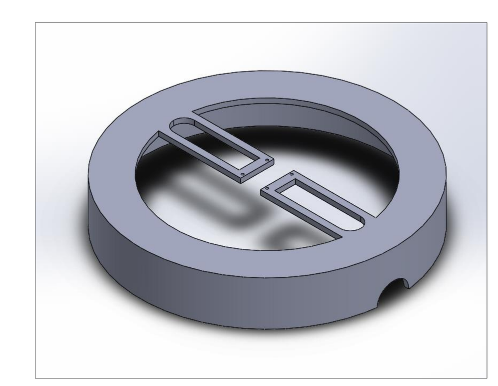


Figure 11: Original Tray Design

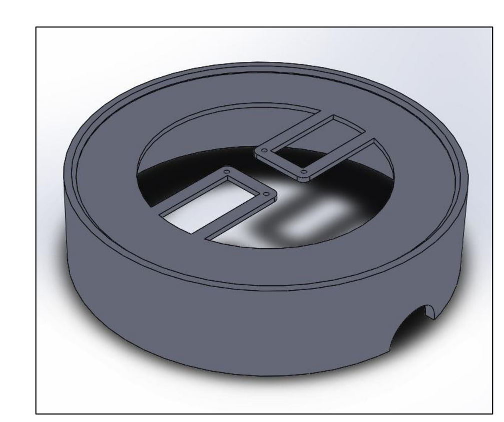


Figure 12: Modified Tray Design

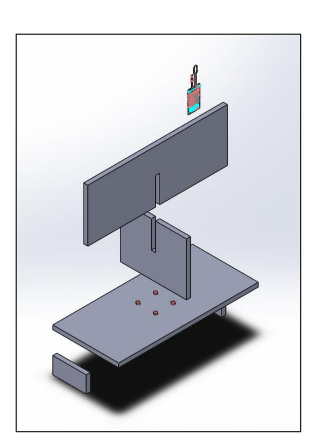


Figure 16: Exploded Assembly of Sensor Platform

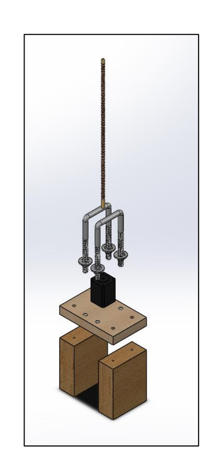


Figure 15: Exploded Assembly of Vertical Stepper-Motor Stand

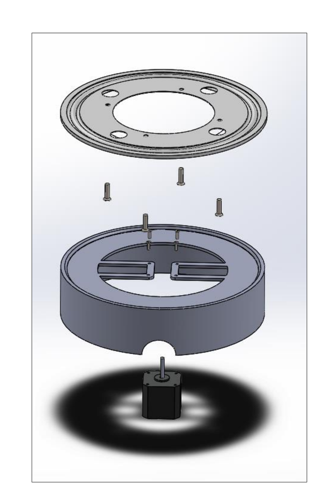


Figure 14: Exploded Assembly of Turntable, Tray, Azimuth Servo-Motor

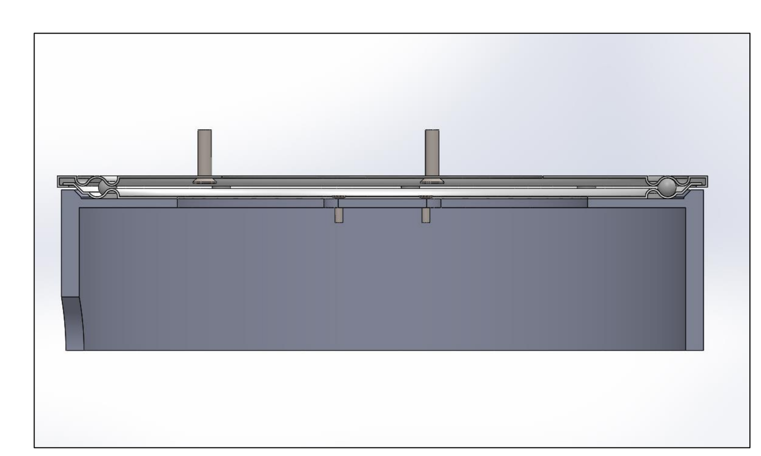


Figure 13: Modified Tray Design Section-View with Turntable Included

Future Work

1. 3D Printed Modified Tray
2. Assemble Modified Second Prototype
3. Finish writing code for Sensor in Arduino then upload to Arduino Uno Microcontroller
4. Test Modified Second Prototype
5. Research Limit Switch and Current Sensor options
6. Choose Peltier & Battery
7. Research and Design covering for Wind Sensor Rev. P & components

Next Prototype Phase Changes

1. Scale project: 1/2 Meter x 1/2 Meter Prototype
2. Integrate the Sensor Platform into the PV rack
3. Research new Motors if necessary for Larger Scale Prototype

References

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