S.O.L.R - Self. Orienting. Light. Reflector.

Group 11: Jose Camacho, Kevin Cochran, Connor Duffy, Matthew Liffrig, Dante Marra, Connor Murray, Alden Zamorano

Abstract

Our modular heliostat was designed around the hedgehog concept of minimizing overall size while maximizing range of motion and using simplistic modular design to limit cost. The design utilizes four subsystems to maximize efficiency and address the customer needs: Mirror, Rotational Device, Modular Support Structure, and Protective Casing. The mirror was constructed from flat plexiglass to enable easy attachment by bolt and cleanability from a flat non-reactive surface. The rotational device uses stepper motors with metal worm gears to maximize torque and lifespan while limiting tracking errors and cost. A support structure, constructed from welded steel for easy assembly, was used to raise the heliostats slightly off the ground for protection. This structure is secured to concrete anchors buried in the ground which limits the assembly time on-site. The protective structure is made from ABS vacuum-molded plastic which seals well from the elements, increasing lifespan at a low cost.

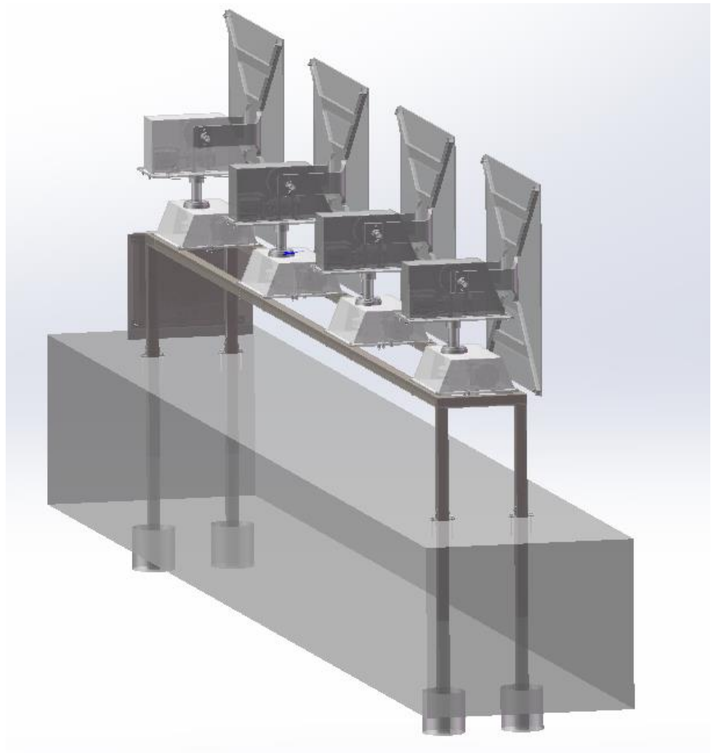
This design is unique due to the modularity as well as the safety and protective features. The design features four main components that can be constructed off-site and then assembled with ease on-site: mirror with bracket, elevation tracker, azimuth tracker, and support structure. The modularity allows for quick set up on-site with minimal labor required and easy replacement of broken parts. Finally, the protective casing, and electrical shutoffs combined with high-wind modes ensures longevity and safe use of each module.

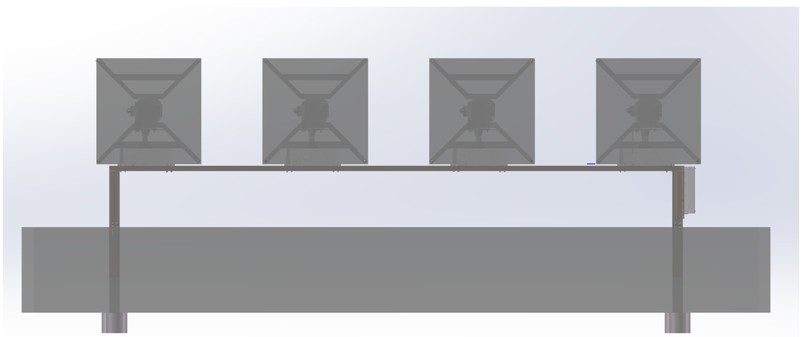
Product Functionality

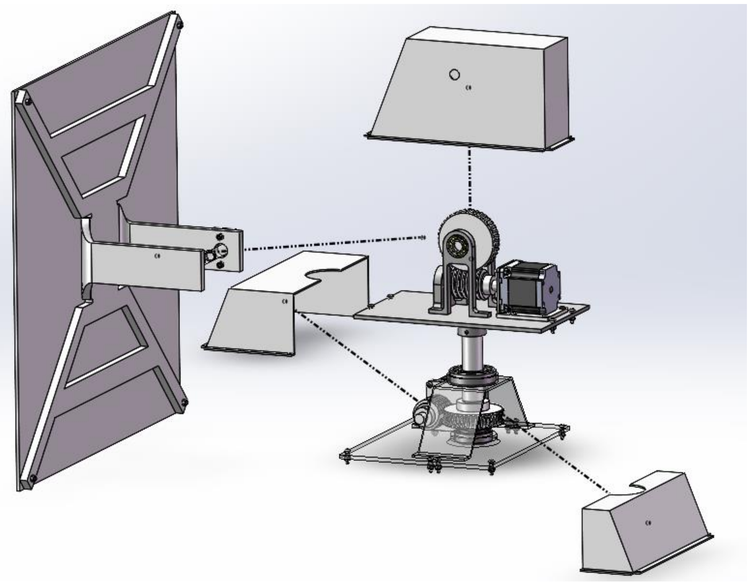
SOLR is a state-of-the-art small-scale heliostat module that is comprised of 4 identical individual heliostats mounted in-line on a rectangular steel support structure. There is one centralized raspberry pi computer that will receive an input command via WiFi and distribute it to each rotational device on each heliostat in order to move the mirror to the optimal position. SOLR is not only inexpensive to implement, but also inexpensive to maintain due to its modularity, accessibility of components, safety features for high winds combined with the emergency electrical shut-off switches.

Cost Overview

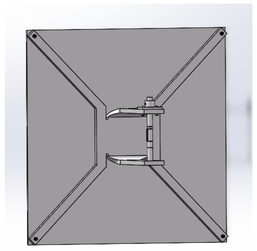
Subsystem	Cost
OTS Parts	$234.68
Modified OTS Parts	$59.36
Raw Materials	$160.55
Manufacturing Labor	$11.36
Assembly Labor	$34.50
Energy Consumption	$1.68
TOTAL	**$502.13**





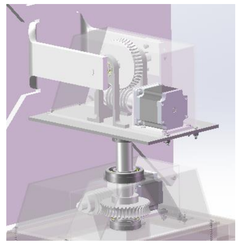


Subsystems



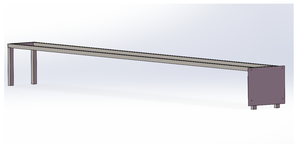
Mirror

- 0.25 m^2 square mirror
- Made of lightweight plexiglass with a reflective solar film which is very cost effective
- “X” shaped bracket on the back of the mirror made of ABS plastic for strong support and easy mounting with screws, washers, and a PVC mount



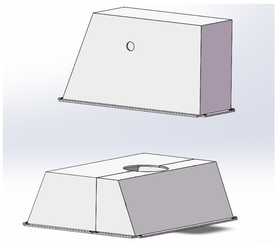
Rotational Device

- Motors, gears, shafts, bearings, snap rings, etc. made of durable metal allows for a long lifetime
- E-series NEMA 23 Bipolar Stepper Motors used to allow for 360° of rotation about the vertical axis.
- Safety mode for high winds to limit excessive stress on the motor, shafts, mirror, bracket, support structure, etc.



Modular Support Structure

- Welded steel rectangular frame with a corrosion resistant coating
- Four heliostat systems mounted in line limit interference
- Raises heliostats and electronics off the ground to limit damages
- Simplifies assembly with easy mounting of heliostats to the structure and the structure to the ground
- Central electrical box minimizes costs and protects the electrical components



Protective Casing

- Made from vacuum formed ABS plastic with a UV resistant add in to limit aging due to the UV light to limit cost
- Long lifetime due to UV resistance, high working temperature, and strong seal to minimize the wear from the elements on the rotational systems and electronics

G.A.T.O.R.S - Ground. Attached. Twist. Operated. Reflective. Surface.

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