# M2.03 - Solar Panel Automation

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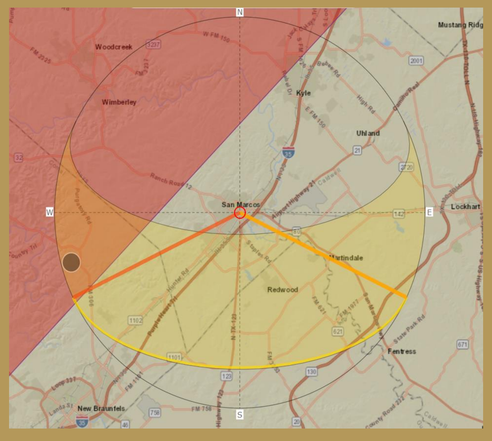
## Project Background

One challenge with stationary solar panels is that they are not consistently positioned at an optimal angle to the sun throughout the day. While they still generate energy, their efficiency remains relatively low. The goal of this project is to design and manufacture a self-adjusting solar panel system. By doing this we hope to accomplish maintaining an ideal angle with the sun and significantly improving energy collection efficiency and overall performance.

## Challenges

- Azimuth mobility.
- Rotational assembly redesign.
- Calculating optimal positioning.
- Proving increase in collection efficiency.

## Sun Path

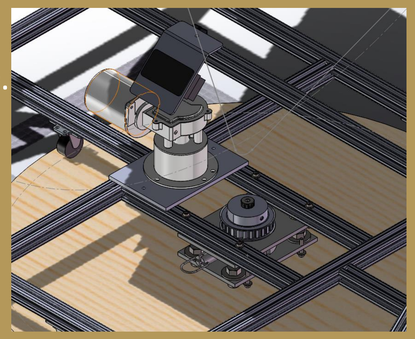


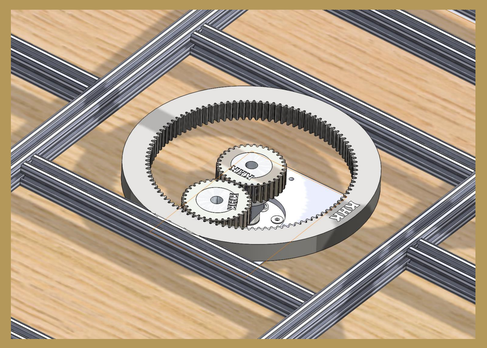

## Azimuth Redesign

Current Design

Current Design Problems

- Due to mounting location motor cannot turn frame.
- Belt Slipping.
- Pulley design forced turn table to unscrew.





New Design

- Planetary Gear train.
- Motor mounted on bottom plate.
- Slight frame redesign.

Transmission Ratio = $Z_a/Z_e + 1$

$Z_a$ = Sun Gear
$Z_e$ = Ring Gear

Output Gear RPM = $Input\ RPM/Transmission\ Ratio$

Input RPM = 6 RPM
Transmission Ratio = 4.125
Output Gear RPM = 1.45 RPM

## Solar Calculator

Key Variables:

Local hour angle: $\gamma = 15° \times (T - 12)$

T = local time in 24-hour format

Declination angle: $\delta = -23.45° \times \cos[\frac{360}{365}(d + 10)]$

d = day number of the year

Equations:

Altitude angle: $\alpha = \sin^{-1}[\sin\delta \sin\theta + \cos\delta \cos\theta \cos\gamma]$

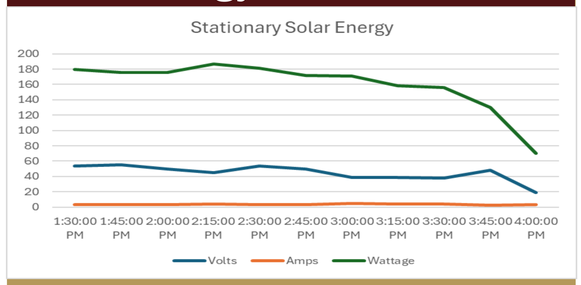
Θ = latitude

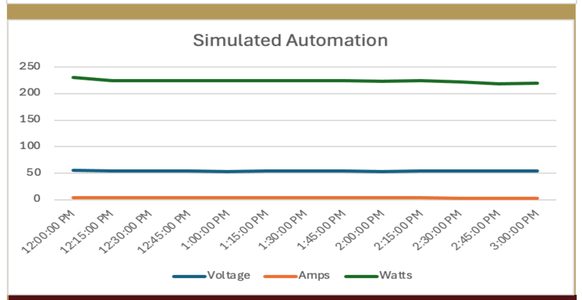
Azimuth angle: $\beta = \cos^{-1}[\frac{\sin\delta \cos\theta - \cos\delta \sin\theta \cos\gamma}{\cos\alpha}]$, if $\gamma < 0°$

$\beta = 360° - \cos^{-1}[\frac{\sin\delta \cos\theta - \cos\delta \sin\theta \cos\gamma}{\cos\alpha}]$, if $\gamma \geq 0°$

These equations gives us an approximation of the Sun's position as there are other factors needed for better precision.

## Energy Collection




## Future Goals

- Apply the scientific method to the planetary gear train design.
- Program a controller for both the tilt and rotation of the assembly.
- Improve accuracy of the solar calculator for the solar panel to follow.

## The Team