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College of Engineering
Mechanical Engineering Department

Design and Development of Solar Photovoltaic Smart Tracking System

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Abstract

Energy crisis is the most important issue in world. Traditional energy resources have an adverse impact on the environment. Saudi 2030 Vision aims to decrease oil dependency, focusing on increasing and renewable energy resources. PV solar panels used to convert solar energy to electrical energy. In order to maximize the conversion from solar to electrical energy, the solar panels must be positioned perpendicular to the sun. This project aimed at design, develop, and test of solar PV dual-tracking system. Hence, a study of available solar radiation (GHI) and the solar window at PSAU, the analysis of the loads, wind profile, the static analysis, the mechanical design of the system. The test results from 1 kW tracking system exhibits a 37% increase in output power in comparison to the fixed system.

Load Analysis

For calculating the wind load, the equations below are used, where *F* is the wind force or wind load, A is the area, P is the wind pressure, V is the speed.

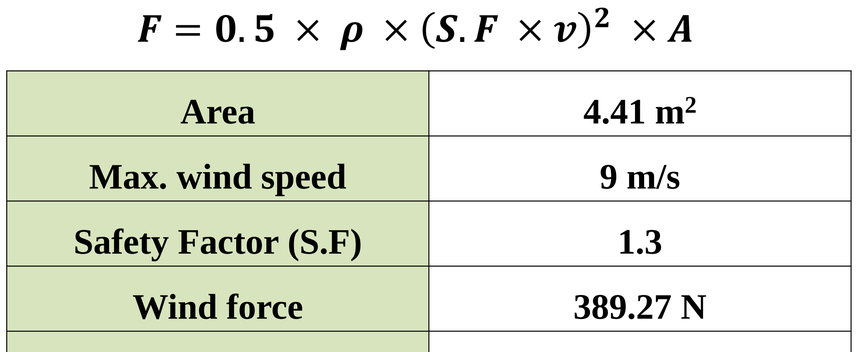
$$F = A \times 0.613(V^2 \times S.F)$$

$$F = 0.5 \times \rho \times (S.F \times v)^2 \times A$$

Area	**4.41 m²**
Max. wind speed	**9 m/s**
Safety Factor (S.F)	**1.3**
Wind force	**389.27 N**
Wind load	**40 kg**

The panels weight is 47 kg, the frame 15 kg, S.F is 20% so, the Total load of the system about 120 kg (1200N)

Wind Profile Analysis



Design of the shafts

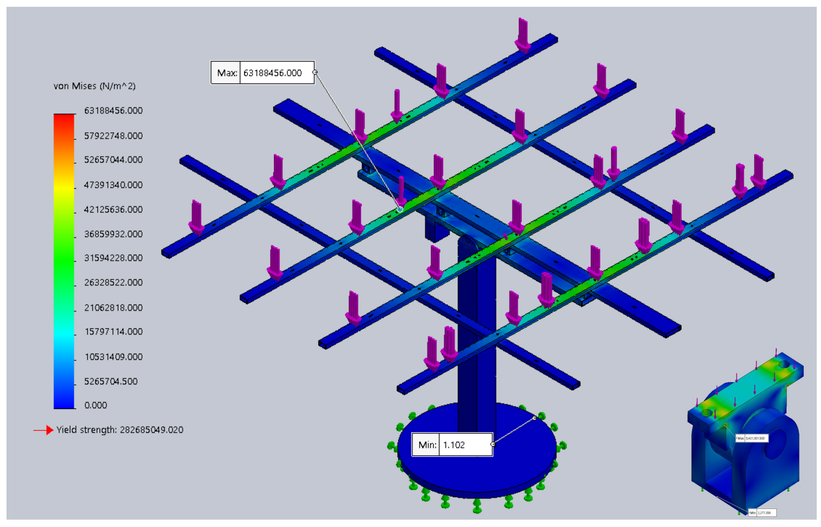
$$M = \frac{\pi}{32} \times \sigma_b \times d^3$$

The calculated bending moment = 3000 N-mm, the bending stress = 350 MPa, the force = 300 N and the minimum dimeter = 6 mm.

Objectives

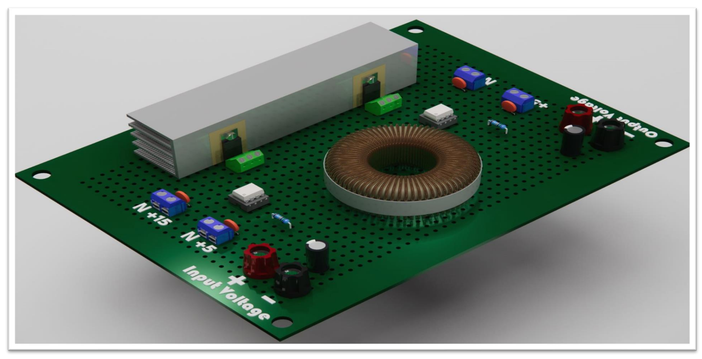
- Analyze the available Solar radiation at PSAU.
- The mechanical design of the photovoltaic smart tracking system.
- The electrical design of the photovoltaic smart tracking system.
- Build the tracking and non-tracking systems.

Static Analysis

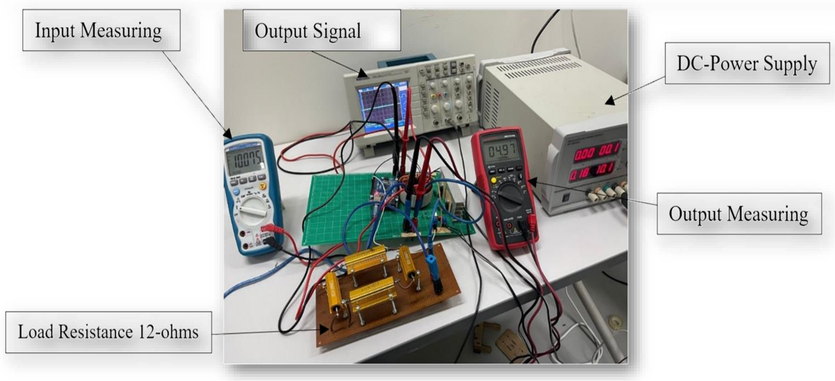


Mechanical Structure

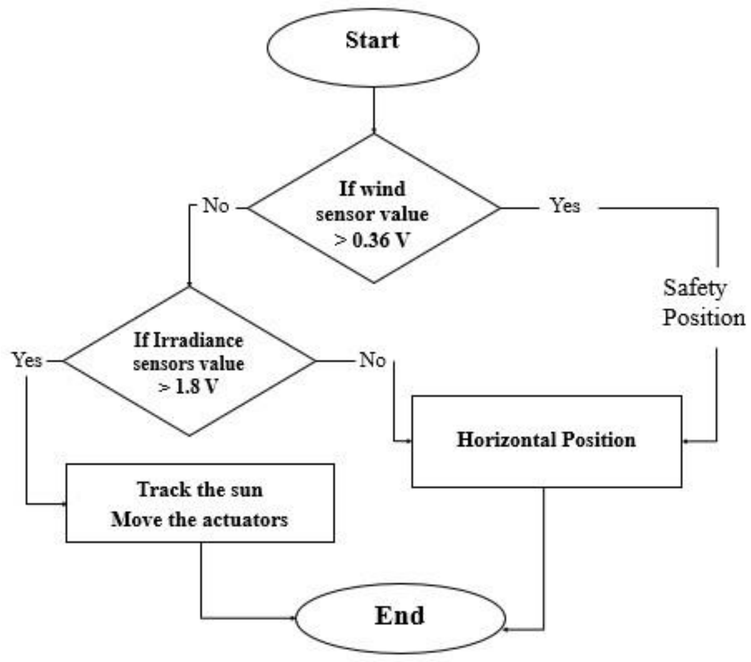
BDC Circuit Diagram



BDC Implementation and Testing



Control Flow Chart



Experimental Results

Conclusion

The design and development of dual-axes solar PV tracking system was conducted. It involved mechanical design of the system, the electrical design include the implementation of bidirectional converter and control system. The tracking system exhibits a 37% increase in output power in comparison to the fixed system and the total energy consumption for daily tracking is about 11 Wh.

DRAFT PUBLICATION

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