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A NOVEL APPROACH OF HARDWARE AND SIMULATION IMPLEMENTATION OF AN AUTOMATED DUAL-AXIS SYNCHRONOUS SOLAR TRACKERS.

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Abstract

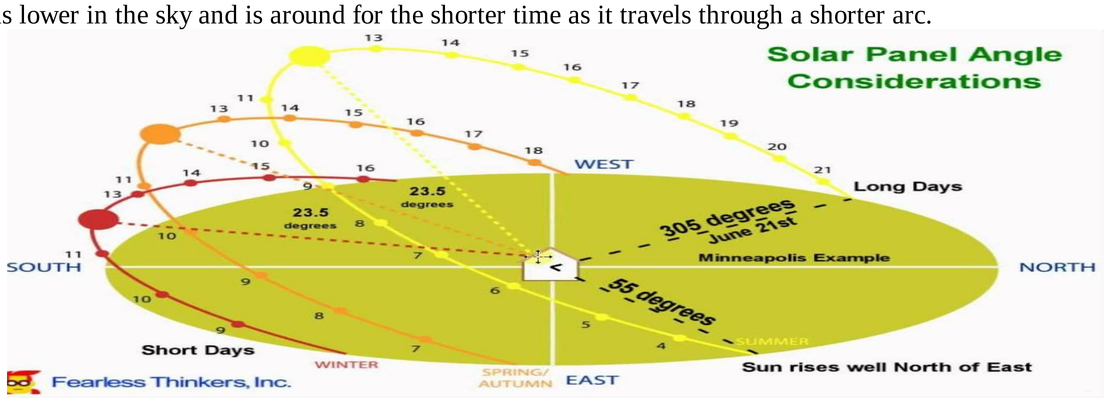
There has been a growing global demand for environmentally friendly energy for quite some time now and solar power is one of the definite answers. It is required that solar power becomes more cost efficient in order to compete with the conventional energy resources. Even though the greatly declined cost of PV cells during 2009 when the market saturated the prices are still too high. The aim of this paper has been to take the dual-axis solar tracker concept closer to our finished product. Here we have tried to focus on synchronously moving two dual-axis solar trackers while using only a single control circuit. The project has been made keeping in mind the design optimization of electrical components to maximize the movement range and the load capacity of the tracker. The project has also delivered a functional prototype to showcase and verify the optimized design. This will serve as the proof of the stated, calculated and simulated azimuth elevation movement range. The prototype also highlights the product in a practical way and it is planned to be exhibited in different SKF offices, customers and conferences around the globe. This paper is implementation of my final year project. I am acknowledging to my entire project group.

Keywords: Solar Tracker, Single Axis, Dual Axis, Software Implementation, Payback period

1. INTRODUCTION

A solar tracker is a device that tracks the position of sun across the sun exposing the PV cells to the maximum intensity of sunlight, hence produces more electricity. As the sun traverses from the West to maximum zenith to the East horizon, thus the upper hemisphere, the solar tracker makes the PV cell rotate to get the maximum sunlight.

In summers the sun is high in the sky and is also in the sky for longer as it travels through a longer length. In winter the sun is lower in the sky and is around for the shorter time as it travels through a shorter arc.



HOW DOES A SOLAR TRACKER WORK?

Solar tracker is the mechanical device that works by following the position of the sun on its path during the day time. Solar Trackers are mainly of two types: Active Trackers and Passive Trackers. Active Trackers are directed towards the sun by electrical circuitry in the form of light sensing photo sensors. Motors and Gears are then employed to direct the tracker as commanded by the photo sensors. Active trackers contain electrical components and hence use small amount of power. Passive trackers use a hydraulic mechanism that responds to the heat of the sun. A low boiling point compressed gas fluid is driven to one side or the other by the sun's heat, creating gas pressure and thereby moving the mechanism along. Passive trackers generally do not consume power. Typically Active trackers are more accurate than

Passive trackers but somehow in case of PV cell functioning Passive tracker performance is more than sufficient.

WHAT HAPPENS WHEN THE SKY IS OVERCAST WITH CLOUD?

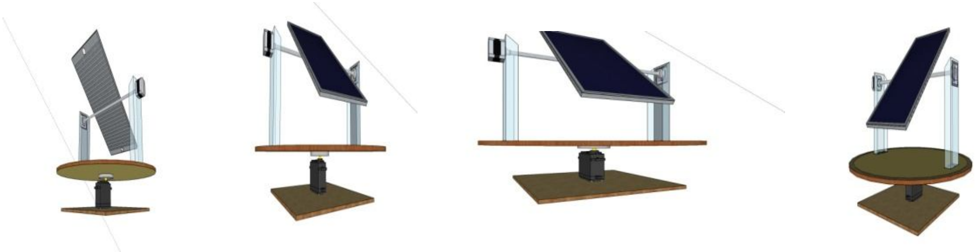
On cloudy days solar cells keep on producing energy since light is still present, though their performance get reduced. In such situations the solar tracker will be acting on the same principles that is orient itself optimally to pick up the most reflected ambient light. As soon as the sun shines again, the solar tracker will re-orient itself to face it again. So dual Axis Solar tracker is most important in today's need.

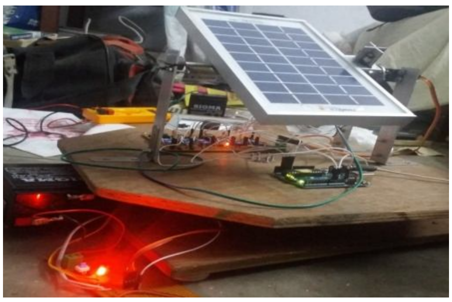
In our project we have used a wide variety of electronics components as well as mechanical components in the process of completion of our project. We have design different types of circuit to develop this project in lab.

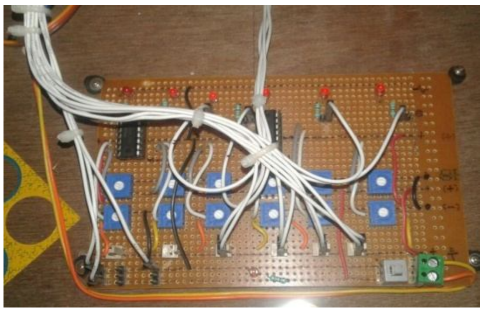
Hardware Development:

Software called Google Sketchup® is used to develop the mechanical design of the hardware. Following pictures are taken from the 3 Dimensional design of the setup.

Figure: Actual Photo of Sensor Circuit







These designs are reviewed and redesigned according to the terrain and weather conditions where it will be used. During the design the cost constraints and availability of material from local markets are also kept in mind. It is made keeping in mind that Indian customers always prefer products which are reliable, rugged and pocket-friendly. After integrating all the hardware components and optimizing the designs through software analysis and synthesis, our final setup is made.

The final outcome of the project, where two solar trackers are working synchronously:

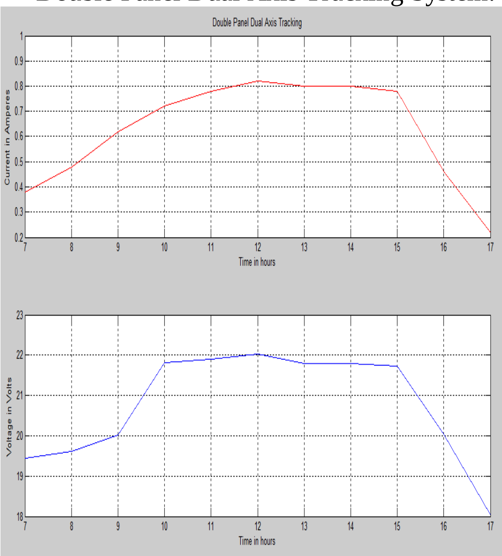
As in our project we are using two panels synchronously, if both the panels are used as an independent source then the power output doubles. Following is the chart given of our observation been conducted over a period of time.

Data Table:

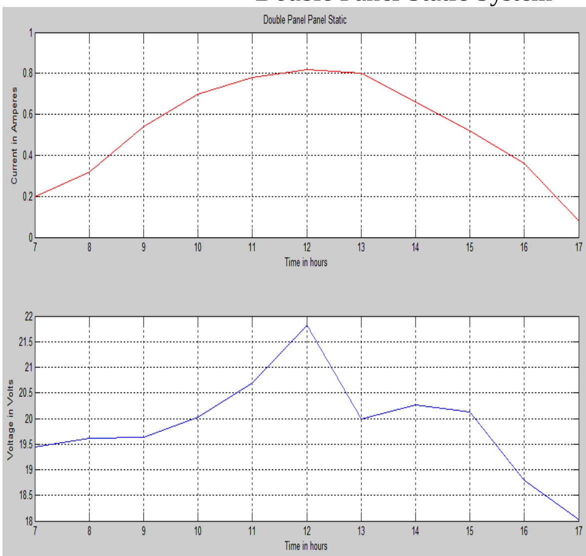
Time (Hours)	Current (Amperes)	Voltage (Volts)
07:00	0.38	19.00
08:00	0.48	19.40
09:00	0.62	20.02
10:00	0.72	21.82
11:00	0.76	21.82
12:00	0.82	21.84
13:00	0.80	22.00
14:00	0.80	21.80
15:00	0.78	21.72
16:00	0.46	20.04
17:00	0.22	18.04

Results:-

Double Panel Dual Axis Tracking System:



Double Panel Static System



From the above trends obtained from MATLAB® clearly shows that there is a clear improvement of trends while using solar tacking systems.

Future prospects:
Solar trackers are rising in popularity but not everyone gets the complete benefits and potential drawbacks of the system. Solar panel tracking solutions are more advanced technology for mounting photovoltaic panels. Stationary mounts which hold panels in a fixed position, can have their productivity compromised when the sun passes to a less-than-optimal-angle. Compensating for this, solar trackers automatically move to "track" the progress of the sun across the sky, thus maximizing the output.

It's a fantastic system for energy output, but there are a few considerations to hear in mind before pursuing one for a particular jobsite.

Overall, solar trackers are highly efficient installations and are great fit for both large and small project sites given the project location and site condition.

2.CONCLUSION

A solar tracker is designed employing the new principle of using smaller cells to function as self-adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output. By using this method, the solar tracker was successful in maintaining a solar array at a sufficiently perpendicular angle to the sun. The power increase gained over a fixed horizontal array was in excess of 30%

The solar trackers are a mean of controlling a sun tracking array with an embedded microprocessor system. Specifically it demonstrates a working software solution for maximizing solar cell output by positioning a solar array at the point of maximum light intensity.
The experiment is done successfully to achieve our preset objective by obtaining the torque output, MATLAB trends of voltage output and current output and payback period.

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