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Intelligent Two Axis Solar Tracking System with Mechanical Application

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Abstract— the present research work tracking solar panel mounts follow the path of the sun during the day to maximize the solar radiation that the solar panels receive. A single axis tracker tracks the sun east to west and a two-axis tracker tracks the daily east to west movement of the sun and the seasonal declination movement of the sun. We must admit that a tracking type of solar panel mount is the most efficient type solar power is the conversion of sunlight into electricity, either directly using photo voltaic (PV) or indirectly using concentrated solar power (CSP). CSP systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. PV converts light into electric current using the photoelectric effect. Solar power is the conversion of sunlight into electricity. Sunlight can be converted directly into electricity using photo voltaic (PV) or indirectly with concentrated solar power (CSP), which normally focuses the sun's energy to boil water which is then used to provide power, and other technologies, such as the sterling engine dishes which use a sterling cycle engine to power a generator. Photo voltaics were initially used to power small and medium-sized applications from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array. The only significant problem with solar power is installation cost, although cost has been decreasing due to the learning curve. Developing countries inparticular may not have the funds to build solar power plants, although small solar applications are now replacing other sources in the developing world. Belt conveyor is mechanical device used in Industries and Thermal power plants to transport the materials from one place to other place effectively.

Keywords: Solar, Motor, Tracking, System Belt Conveyor.

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1 Introduction

This chapter deals with the importance of solar energies as the renewable energy source because of their cost and availability.

Solar Energy is used as renewable energy source and is most unlikely to vanish. The technique of extracting electrical energy from solar energy is improving as renewable energy source.The downfall of the solar energy ended about 50 years ago when Bell Laboratories developed the first solar cell in 1954. And these solar cells were used as power source in satellites. In the end of 1970 scientists were able to develop silicon solar cells (Photo voltaic cells) on industrial basis, and these became more and more attractive. The main source of abundant energy in this world is sun. According to calculations the sun deposits 120,000 TW of radiation on the surface of Earth. The sun covers about 0.16% of the land on Earth. With 10% efficient solar conversion systems we can generate almost 20 TW of power, which is almost twice the world's consumption.The above comparisons show that solar energy have impressive magnitude, it provides more energy than present day human technology can provide. The main steps involved in utilizing solar energy are Capture, Conversion and Storage. The energy of sun reaches on earth in the form of radiations distributed across the colour spectrum (Infrared to Ultraviolet). This energy is in the form of excited electron hole so it must be captured as electron hole. This is a good sign that some solar energy technologies that may ultimately have significance for developing countries. Most of the solar technologies presented are possible and verified. So far most of these technologies are too expensive for use in the South. On the other hand, majority of the technologies existing are possible in remote areas and desert region of a country. In the developing countries, the availability of power can play a major role in development. As countries became richer and their populations increase day by day, demand for energy increases. Conventional sources of energy are often too expensive to fulfil this demand. There are also fear about the limited resources of fossil fuels and their environmental factors.

SOME CASES OF EARLIER CARRIED OUT MODEL:[1]STATIONARY FLAT PLATE SOLAR COLLECTORS: Solar Energy, Volume 47, Issue 4, 1991, Pages 245-252 J.M. Gordon, Jan F. Kreider, Paul Reeves ,For tracking and stationary flat plate (no concentrating) solar collectors, we develop easy-to-use, closed form, analytic formulae for yearly collectible energy as a function of radiation threshold. Primary applications include central-station photovoltaic systems. These correlations include the explicit dependence on: yearly average clearness index, latitude, and ground cover ratio (shading effects), and are in excellent agreement with data-based results for 26 U.S. SOLMET stations. They also incorporate appropriate functional forms that ensure accurate results for photovoltaic system design and, in particular,for systems with buy-back thresholds. Both beam and diffuse shading are treated properly and diffuse shading is found to represent a 2%–6% loss that has systematically been ignored in past studies. Sample sensitivity studies illustrate evaluation of the energetic advantage of tracking vs. stationary deployment and its significant dependence on ground cover ratio. The impact of isotropic versus anisotropic modeling of diffuse radiation is quantified and shown to give rise to non-negligible differences

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(up to 10%) in yearly collectible energy. We also determine an optimal tracking strategy for two-axis trackers which, however, is found to yield a 0%–2% energetic advantage relative to conventional normal-incidence tracking.

[2] FEASIBILITY STUDY OF ONE AXIS THREE POSITIONS TRACKING SOLARPV WITH LOW CONCENTRATION RATIOREFLECTOR: Energy Conversion and Management, Volume 48, Issue 4, April 2007, Pages 1273-1280 B.J. Huang, F.S. Sun, A new PV design, called "one axis three position sun tracking PV module", with low concentration ratio reflector was proposed in the present study. Every PV module is designed with a low concentration ratio reflector and is mounted on an individual sun tracking frame. The one axis tracking mechanism adjusts the PV position only at three fixed angles (three position tracking): morning, noon and afternoon. This "one axis three position sun tracking PV module" can be designed in a simple structure with low cost. A design analysis was performed in the present study. The analytical results show that the optimal stopping angle β in the morning or afternoon is about 50° from the solar noon position and the optimal switching angle that controls the best time for changing the attitude of the PV module is half of the stopping angle, i.e. $\theta_H = \beta/2$, and both are independent of the latitude. The power generation increases by approximately 24.5% as compared to a fixed PV module for latitude $\varphi < 50°$. The analysis also shows that the effect of installation misalignment away from the true south direction is negligible (<2%) if the alignment error is less than 15°. An experiment performed in the present study indicates that the PV power generation can increase by about 23% using low concentration ($2X$) reflectors. Hence, combining with the power output increase of 24.5%, by using one axis three position tracking, the total increase in power generation is about 56%. The economic analysis shows that the price reduction is between 20% and 30% for the various market prices of flat plate PV modules.

2. EXPERIMENTAL SETUP

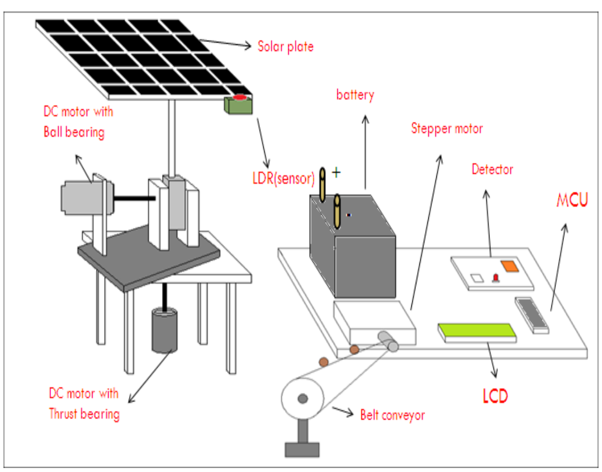
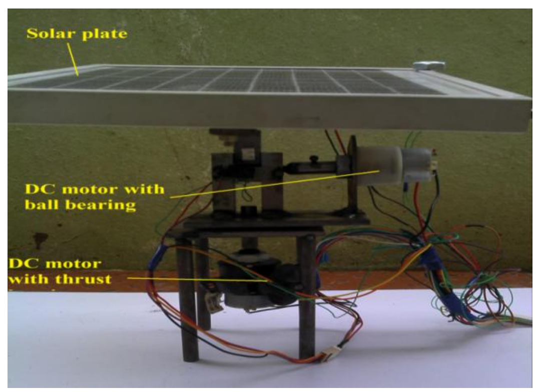
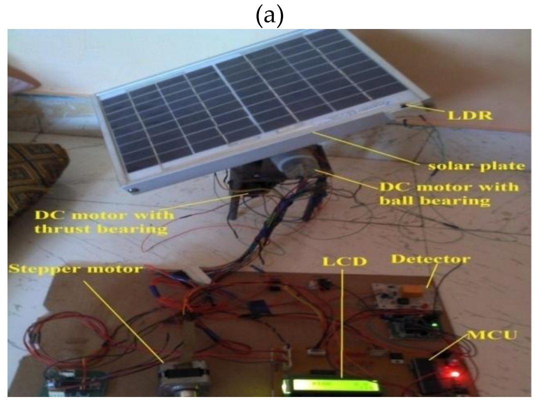


Fig 2.1 Design experimental setup

This is the disign of experimental setup that we planed before manufacturing of comonents. Detailed specification of each components is earlier discussed in pervious chapter.According to our design we almost manufactured and exicuted project. Experimentation we have carried out for comparing the power output of fixed and tracking solar system and analyzing the efficiency increased in tracking solar system. And also found the load carrying capacity of belt conveyor. Before starting the experimentation we assembled all the components and wire then we kept the model in sunlight. In order to compare our model with fixed solar system we brought the solar plate of same specification and we kept it with our tracking system. With the help of multi meter we started taking the readings from morning 7AM to evening 6PM with the time interval of every one hour from the date 24th may to 28th may 2012. Here we had taken readings of current and voltage. From the above all different readings of voltage and current for the different days and different plates we found the power for each days and average power for one hour. From the above average power for both fixed and tracking solar system we found the efficiency increased in the fixed solar system. In the analysis of belt conveyor we found that it can be operated in four different speeds and capacity of load carring is veries based on speed and it's aound 50 to 80gms.



(a)



(b)

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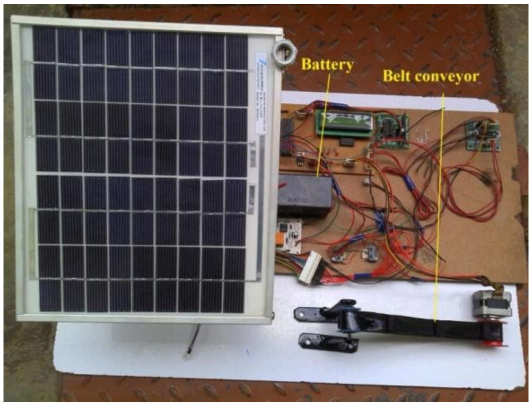

(c)

Fig 2.2 Experimentation of model

3. EXPERIMENTATION & ANALYSIS

3.1 Solar system reading on date 24/034/2012

Total power produced in Fixed solar system = 47.90 W
Average power produced per hour = P = 3.99 W/h
Total power produced in Tracking solar system=60.46 W
P = 5.039 W/h, Efficiency (η) = 26.30%

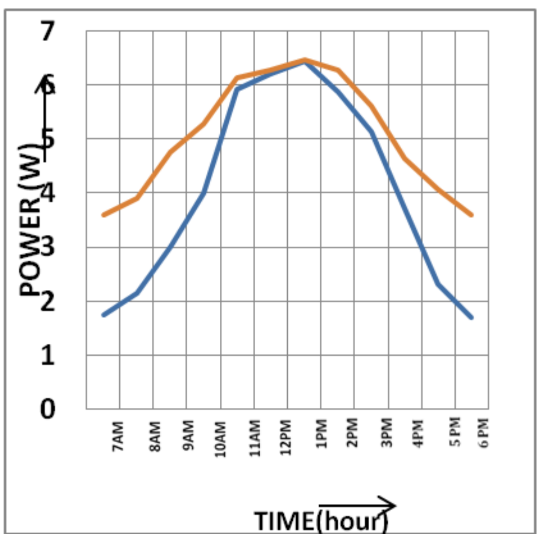

Fig 3.1.Power comparison between fixed and tracking solar system

From the above graph and calculation we conclude that power output between fixed and tracking solar system is increased especially in morning and evening. And the overall efficiency is increased 26.3% on the particular day 24/04/2012.

3.2 Solar system reading on date 25/04/2012

Total power produced in Fixed solar system = 49.99W, Average power produced per hour = P = 4.16 W/h, Total power produced in Tracking solar system = 65.43 W, Average power produced per hour = P = 5.452 W/h, Efficiency (η) = 31.05%

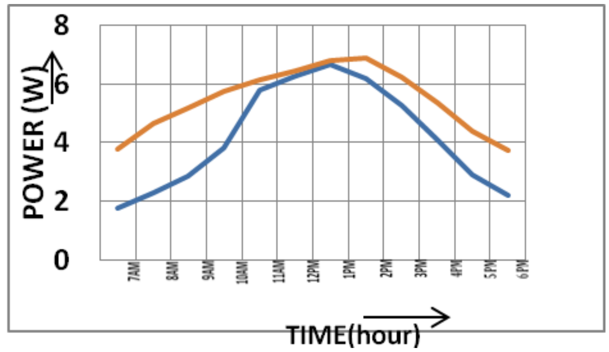

Fig .3.2 Power comparison between fixed and tracking solar system

From the above graph and calculation we conclude that power output between fixed and tracking solar system is increased especially in morning and evening. And the overall efficiency is increased 31.05% on the particular day 25/04/2012.

3.3 Solar system reading on date 26/04/2012

Total power produced in Fixed solar system = 50.43 W
Average power produced per hour = P = 4.20 W/h
Total power produced in Tracking solar system = 69.51 W
Average power produced per hour = P = 5.79W/h
Efficiency (η) = 37.91%

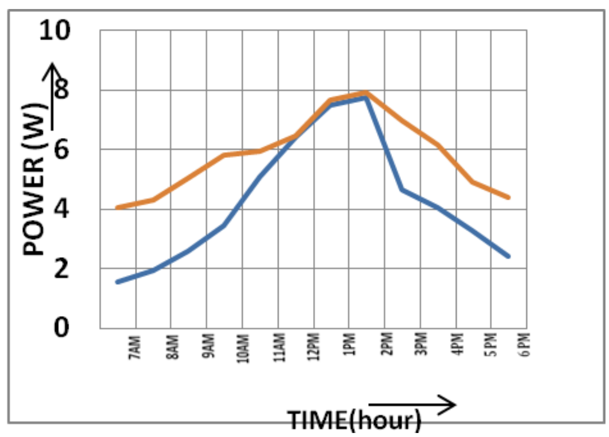

Fig 3.3. Power comparison between fixed and tracking solar system

From the above graph and calculation we conclude that power output between fixed and tracking solar system is increased especially in morning and evening. And the overall efficiency is increased 37.91% on the particular day 26/04/2012.

3.4 Solar system reading on date 27/04/2012 (Cloudy day)

Total power produced in Fixed solar system = 23.22 W Average power produced per hour = P = 1.935 W/h
Total power produced in Tracking solar system = 37.27 W
Average power produced per hour = P = 3.10 W/h
Efficiency (η) = 60.6%

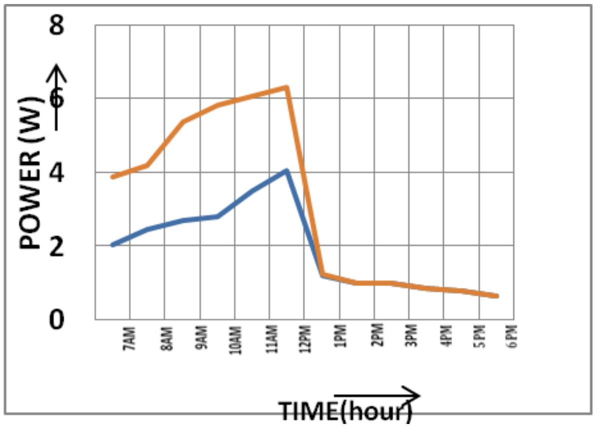

Fig 3.4. Power comparison between fixed and tracking solar system

From the above graph and calculation we conclude that power output between fixed and tracking solar system is varies based on the weather and in cloudy day the drop in power. And the overall efficiency is increased 60.6% which is too more because of the cloudy weather day 27/04/2012.

3.5 Solar system reading on date 28/04/2012 (Rainy day)

Total power produced in Fixed solar system = 17.88 W
Average power produced per hour = P = 1.49 W/h
Total power produced in Tracking solar system = 27.58 W
Average power produced per hour = P = 2.29 W/h
Efficiency (η) = 53.69%

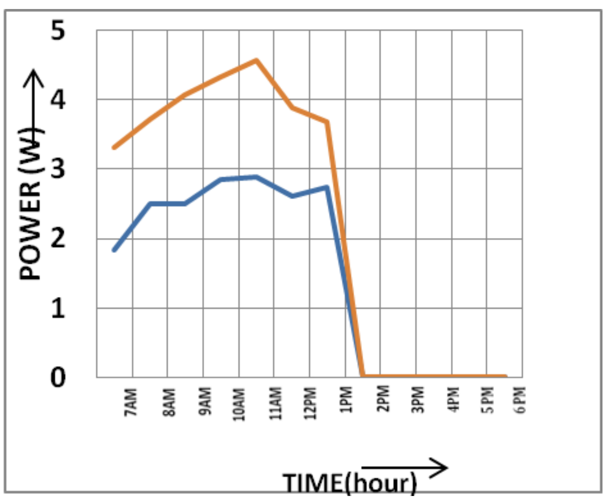

Fig 3.5. Power comparison between fixed and tracking solar system

From the above graph and calculation we conclude that power output between fixed and tracking solar system is varies based on the weather and in rainy day the drop in power. And the overall efficiency is increased 53.69% which is too more because of the rainy weather day 28/04/2012.

3.6 CONCLUSION

1. Intelligent two axis solar tracking system with mechanical application has been designed and fabricated successfully.

2. Detailed experimentation & analysis has been carried out.

3. The two solar plate position namely fixed solar plate and tracking solar plate readings from morning 7AM to evening 6PM are recorded.

4. Analysis graphs time vs power for five different days have been plotted.

5. From the calculation readings indicates that the power efficiency of tracking solar plate in normal days increased 26 to 38% compaired to fixed plate. And during cloudy days it's varies at any level and we got 61%. And during rainy days also it's varies at any level and we got 53%.

6. Belt conveyor analysis shows that it can be operated in four different speeds and capacity of load carring is veries based on speed and it's aound 50 to 80gms.

3.7 FUTURE RECOMMENDATION

Actually, a lot of weakness from the project can be taken as future works but as we know that in future there is the shortage of renewable power source so that the improved system will be better in terms of performance. So that, there are several recommendations or suggestions that we can take to increase performance in this project. The performance of intelligent two axis solar tracking system with mechanical application can be increased based on some recommendations which are:

a. In our prototype the size of the solar plate is limited so that power generation per hour for this size plate is less so it can be increase and by adding some more soar plates the big tracking solar plate can be implemented and produce a very good power output which can be used in above mention application.

b. Stepper motor capacity and belt conveyor length & width is limited in our project based on the power output so by generating a large power from the above recommendation any capacity of belt conveyor in industry can be operated whenever power is available. But during rainy days the alternative source is required.

ADVANTAGES:It will track the maximum rays of sun,More power,Utilization of full sun (whole day),No need to change the direction every time.

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DISADVANTAGES:Not effective in cloudy day .
APPLICATIONS:Domestic purpose,Belt Conveyor(Industry purpose),Street lamps,Traffic signals.

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