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Optimization Solar Panels Orientation Using Calculated Solar Irradiance

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ABSTRACT

In this work the city of Jabalpur solar power that must be considered and used effectively. Firstly, the work started with an overview of the topic of solar radiation. Next, a study was conducted using equations to calculate the rays of the sun in the city of Jabalpur. In this work a comparison between the mathematical model and two different satellite data (NASA-SOURCE & PVGIS) is compared to evaluate the accuracy of readings. the NASA-SOURCE AND PVIGIS represent the huge difference in readings with each other about 358.92 kw/year/m2 specially in rainy and winter season for same year (2016) and location Jabalpur(23.1815°,79.197). so, the mathematical modelling looks more accurate as compare to online software. This step requires the input of many of the statistical calculations, which are described in full in the paper

INTRODUCTION

Among the essential benefice of the sun are the irradiations that are transmitted to the earth. Those irradiations are used by humans in order to create energy: either heat or electricity. The irradiations that are used are mainly the ones with a wavelength that varies from 0.25 to 3 μm . Therefore, it is important to know how the calculations are done in order to estimate the irradiations. However, using manual calculations with the equations that are presented below is a very long process it is important to have an idea about the different instruments and software that are used in order to get the solar irradiance immediately.

The solar irradiance that the Earth is receiving is a combination of three types: the direct beam radiations, the reflected radiations, and finally the diffused radiations. Each has a specific percentage in the global solar irradiance. The following is a summary of the contribution of each. We can see that 30% of it is reflected either by the atmosphere, the surface of the earth, or the clouds. In addition, some of the energy is absorbed by the ocean, the clouds or by the atmosphere. Before reaching the Earth, the solar irradiance is approximatively equal to 1367 W/m^2. It is called the solar constant. Throughout its transfer to the Earth, the radiations are confronted to a number of particles in the atmosphere that affect it. What makes it decrease considerably depending on its path? Before knowing how to calculate each type, it is important to know that the position of the earth and the sun is indispensable in order to do the calculations; they can be represented by a number of angles.

LITERATURE SURVEY

Solar Photovoltaic Forecasting of Power Output Using LSTM Networks. By Maria Konstantinou, Stefani Peratikou and Alexandros G. Charalambides 2021

In this paper,as tacked long short-term memory network, which is a significant component of the deep recurrent neural network, is considered for the prediction of PV power output for 1.5 h ahead. Historical data of PV power output from a PV plant in Nicosia, Cyprus, were used as input to the forecasting model. Once the model was defined and trained, the model performance was assessed qualitative (by graphical tools) and quantitative (by calculating the Root Mean Square Error (RMSE) and by applying the k-foldcross-validationmethod). The results showed that to our model can predict well, since the RMSE gives a value of 0.11368,where as when applying thekfoldcross-validation,the mean of the resulting RMSE values is 0.09394 with a standard deviation 0.01616.

Solar Irradiance Forecasting Based on Deep Learning Methodologies and Multi-Site Data. By Banalaxmi Brahma and Rajesh Wadhvani 2020

In this work is to develop forecast models based on deep learning (DL) methodologies and multiple-site data to predict the daily solar irradiance in two locations of India based on the daily solar radiation data obtained from NASA's POWER project repository over 36 years (1983–2019). The forecast modeling of solar irradiance data is performed for extracting and learning the symmetry latent in data patterns and relationships by the machine learning models and utilizing it to predict future solar data.

Inverter Efficiency Analysis Model Based on Solar Power Estimation Using Solar Radiation. Chul-Young Park , Seok-Hoon Hong , Su-Chang Lim , Beob-Seong Song , Sung-Wook Park , Jun-Ho Huh , and Jong-Chan Kim , 2020

In this study, solar power was estimated using a univariate linear regression model. The estimated solar power data were cross-validated with the actual solar power data obtained from the inverter. The results provide information on the power generation efficiency of the inverter. The linear estimation model developed in this study was validated using a single PV system. It is possible to apply the coefficients presented in this study to other PV systems, even though the nature and error rates of the collected data may vary depending on the inverter manufacturer. To apply the proposed model to PV systems with deferent power generation capacities, reconstructing the model according to the power generation capacity is necessary.

Multi-step ahead forecasting of global solar radiation for arid zones using deep learning Deeksha Chandolaa, Harsh Guptab, Vinay Anand Tikkiwala, Manoj Kumar Bohrac 2020

In this work, a model for multi-step hourly time series forecasting using LSTM is proposed for forecasting solar irradiation for four different locations of the Thar Desert region. The LSTM model is optimized in terms of the number of neurons to achieve high accuracy and is evaluated using standard forecasting performance measures: RMSE and MAPE. For 3-hours ahead forecasting, best RMSE values of 0.099 and MAPE 4.54% have been achieved for the Bikaner region. For 6-hours ahead forecasting best RMSE and MAPE values of 0.129 and 6.79 % have been achieved for the Jodhpur region. Similarly, for 24-hours ahead forecasting best RMSE is 0.117 and MAPE is 6.19% for the Jaisalmer region. Thus, GHI values available at these four locations of Thar desert regions can be timely forecasted with high accuracy using the proposed model. High accuracy in forecasting solar radiation indicate, that the proposed models could prove to be efficient in designing optimized solar based energy systems, particularly, in the arid zones.

As an extension of the work, hybrid ARIMA-LSTM models could be developed and explored for possibly better forecasting of solar radiation.

An innovative learning approach for solar power forecasting using genetic algorithm and artificial neural network. By *Debasish Pattanaik, Sanhita Mishra, Ganesh Prasad Khuntia, Ritesh Dash and Sarat Chandra Swain* 2020

In this paper a comparative analysis of different solar photovoltaic forecasting method were presented. A MATLAB Simulink model based on Real time data which were collected from Odisha (20.9517 N, 85.0985 E), India. were used in the model for forecasting performance of solar photovoltaic system.

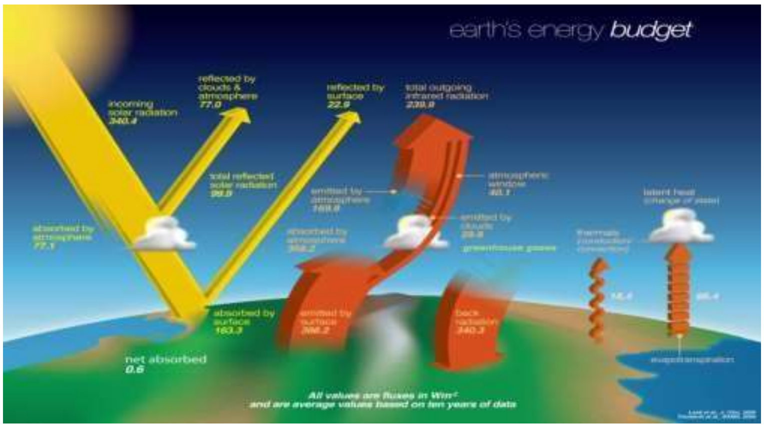
An Assessment of the Solar Photovoltaic Generation Yield in Malaysia using Satellite Derived Datasets. By Tofael Ahmed, Saad Mekhilef, Rakibuzzaman Shah, and Nadarajah Mithulananthan 2019

This work assesses the average annual PV yield (kWh/kWp/y) in Malaysia for the installed capacity in 2015. Meteorological data from Photovoltaic Geographic Information System (PVGIS) is utilized for yield evaluation. The comparative yield estimation based on PVGIS and yearlong-recorded data for installed PV system at the University of Malaya is conducted first. A little error is observed between the field measurements and the yield studies based on PVGIS data. Then, the expected average yield for the individual region in Malaysia is estimated from PVGIS. Finally, based on the obtained results the individual region in Malaysia is ranked for PV availability.

SOLAR IRRADIANCE CALCULATIONS

Among the essential benefice of the sun are the irradiations that are transmitted to the earth. Those irradiations are used by humans in order to create energy: either heat or electricity. The irradiations that are used are mainly the ones with a wavelength that varies from 0.25 to 3 μm . Therefore, it is important to know how the calculations are done in order to estimate the irradiations. However, using manual calculations with the equations that are presented below is a very long process it is important to have an idea about the different instruments and software that are used in order to get the solar irradiance immediately.

SOLAR IRRADIANCE CALCULATIONS: -



Earth's Energy Budget

THE FOLLOWING REPRESENTS A DESCRIPTION OF EACH ANGLE:-

Longitude (L) : It represents the position with respect to the West of Greenwich

$-180° \leq L \leq 180°$.

Latitude (φ): It represents the position with respect to the Equator $-90° \leq \varphi \leq 90°$.

The solar declination (δ) is the angle formed between the position of the sun at noon and the plane of the equator. It can be calculated by the following:

$$\delta = 23.45 \sin\left[\frac{360}{365}(n-81)\right]$$

The altitude angle or the slope (β_N) is the angular position of the sun and the horizontal position where the sun is directed .

$$\beta_N = 90^\circ - L + \delta$$

The following is a summary of each type of solar radiation.

DIRECT BEAM RADIATION

The distance that the radiations have to go through plays a major role. It is called the air mass

ratio m. It can be calculated by the following: m = ⅟co s ( ) Or m = 1⁄sin (β) . Where θ_Z is the Zenith angle : the angular position between the vertical line and the line that comes directly from the sun [2]. The air mass ration can also be calculated by the following

$m = \sqrt{}(708 * sin\ \beta) + 1417) - 708 \times sin\beta$.

The following is the equation of the direct beam radiation

$$I_B = Ae^{-km}$$

Where A is the extraterrestrial flux, m is the air mass ratio and k is the optical depth . The optical depth k and the extraterrestrial flux A can be calculated using the following equations:

$$A = 1160 + 75 \sin\left[\frac{360}{365}(n-275)\right] \qquad (\mathrm{W/m^2})$$

$$k = 0.174 + 0.035 \sin\left[\frac{360}{365}(n-100)\right]$$

DIFFUSED RADIATION

$$I_{DC} = I_{DH}\left(\frac{1+\cos\Sigma}{2}\right) = C\, I_B\left(\frac{1+\cos\Sigma}{2}\right)$$

Where c is the sky diffuse factor and is equal to:

$$C = 0.095 + 0.04 \sin\left[\frac{360}{365}(n-100)\right]$$

Σ represents the collector tilt angle.

When the collector tilt angle is equal to 0°, that means that the collector is flat; therefore it receives the radiations horizontally. The equation will therefore be equal to $I_{DH} = C \times I_B$. However, it is rare to found horizontal collectors. In order to optimize the collector tilt angle to collect the maximum radiation, a lot of researchers have been done.

REFLECTED RADIATION

It can be calculated by the following:

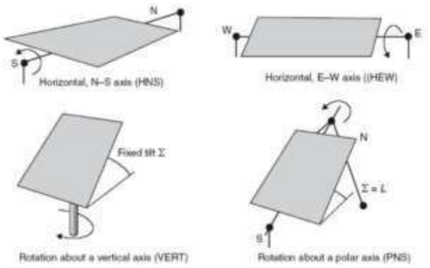
$$I_{RC} = \rho(I_{BH} + I_{DH})\left(\frac{1-\cos\Sigma}{2}\right)$$

Where ρ is the ground reflectance. It ranges from 0.1 to 0.8, depending on the ground components [2]. For example, when the snow is still fresh the reflectance is equal to 0.8. ρ starts to become lower, depending on the freshness of the snow. The total clear sky insolation is the sum of the three types of radiation cited above:

$$I_C = I_{BC} + I_{DC} + I_{RC}$$

ONE AXIS SOLAR TRACKER :

It is a collector that has either the azimuth or the altitude angle β fixed. The following figure is representations of the different position that can a one axis solar tracker have.



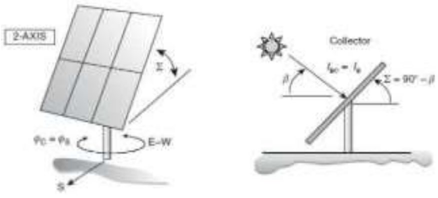
One Axis Solar Tracking System].

In order to calculate the solar irradiance of one axis solar tracking systems, the following equations are used. I_{BC} is representing the direct beam insolation, $I_{RC}$the reflected insolation, and I_{DC} the diffused insolation.

$$I_{BC} = I_B \cos \delta$$
$$I_{DC} = C I_B \left[\frac{1 + \cos(90^\circ - \beta + \delta)}{2} \right]$$
$$I_{RC} = \rho (I_{BH} + I_{DH}) \left[\frac{1 - \cos(90^\circ - \beta + \delta)}{2} \right]$$

TWO AXIS SOLAR TRACKER

The most efficient one as it can change both the angular positions of the azimuth and the altitude angle β depending on the position of the sun. The following figure is a representation of the different positions that can a two axis solar tracker have.



Two Axis Solar Tracking System .

In order to calculate the solar irradiance of the two axis solar tracking systems, the following equations are used. I_{BC} is representing the direct beam insolation , I_{RC} reflected insolation, and I_{DC} the diffused insolation.

$$I_{BC} = I_B$$
$$I_{DC} = C I_B \left[\frac{1 + \cos(90^\circ - \beta)}{2} \right]$$
$$I_{RC} = \rho (I_{BH} + I_{DH}) \left[\frac{1 - \cos(90^\circ - \beta)}{2} \right]$$

One of the purposes of this project is to be able to measure the performance of each of those tracking systems. Therefore, an implementation of the above equations was done in EXCEL to gather the solar irradiance.

POWER Data Methodology:-

National Aeronautics and Space Administration (NASA), through its Earth Science research program, has long supported satellite systems and research providing data important to the study of climate and climate processes. These data include long-term climatologically averaged estimates of meteorological quantities and surface solar energy fluxes. Additionally, mean daily values of the base meteorological and solar data are provided in time series format. These satellite and model-based products have been shown to be sufficiently accurate to provide reliable solar and meteorological resource data over regions where surface measurements are sparse or nonexistent. The products offer two unique features: the data is global and generally contiguous in time. These two important characteristics tend to generate very large data archives which can be intimidating for users, particularly those with little experience or resources to explore these large data sets. Moreover, the data products contained in the various NASA archives are often in formats that present challenges to new users. To foster the usage of the global solar and meteorological data, NASA's Earth Science Division Applied Sciences Program supports the development and release of user-friendly data sets formulated specifically for designated user communities with access to these data via a user friendly web based mapping portal.

MEASURE OF THE SOLAR IRRADIATION : IN The 1st step that I used in order to achieve that is to do the calculations through Excel. This can be done by the execution of the equations already the calculations were done on 365 days and then in order to do a evaluation between the irradiance capacities of each month we calculated the monthly solar irradiance. In the 2nd step In order to make, a comparison with the results gathered using calculation applying MS-EXCEL, with NASA-SOURCE-sources and the PVGIS software was done. NASA-SOURCE & PVGIS is software that enables the user to get all the solar irradiation in few minutes without having to spend too much time in the implementation of the equations. In addition, NASA-SOURCE & PVGIS is directly calculating the optimal collector tilt angle

MATHEMATICAL MODELING BY "MS-EXCEL

The following table is a summary of the data gathered using calculation:

Data gathered using calculation

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
IC	962	854	1088	976	1056	1139	1106	1142	1136	1061	946	980
IBC	882	779	1020	880	975	1053	1030	1061	1105	993	865	895
IDC	81	75	68	87	81	87	76	81	31	68	81	86
IRC	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.3 : Monthly Solar Irradiance-calculated

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
MONTHLY IRRADIANCE WITHOUT A TRACKER	238.62	191.2021	269.869	234.3	261.852	273.467	274.404	283.27	272.7266	263.12	227.1577	243.079	**3033.0623**

The following is a graph summarizing the monthly irradiance.

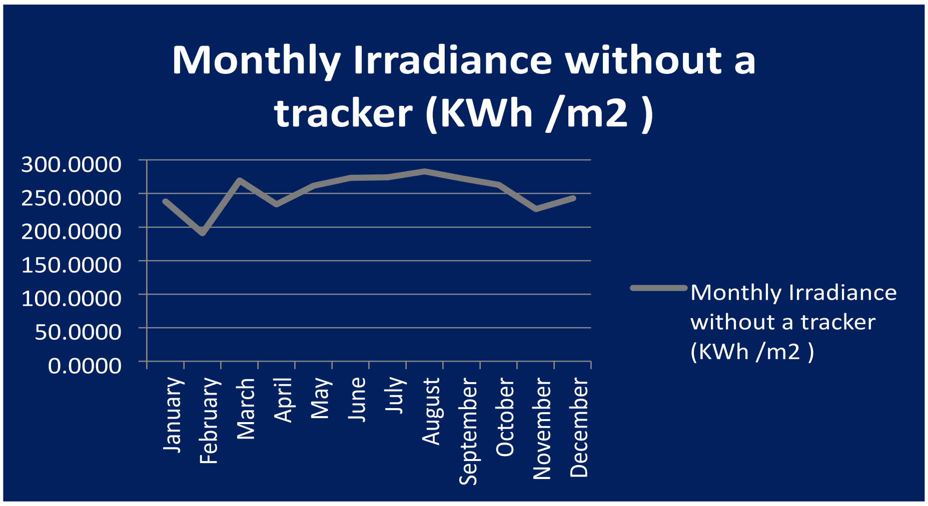
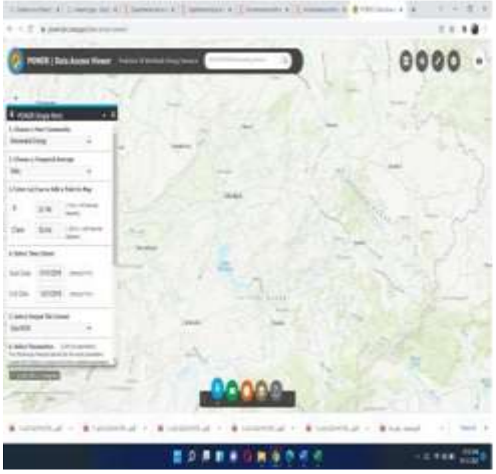


Figure 5.1 : Graph Representing the Monthly Insolation

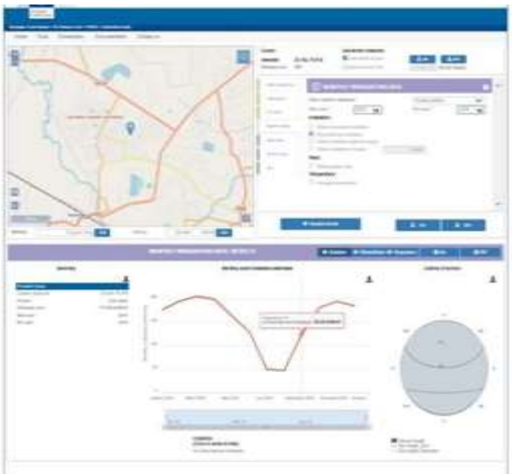
The annual solar irradiance that can be collected using mathematical modeling is equal to **3033.0623** kWh/m^2. The peak 272.7266 - 283.2699 kWh/m^2 is during June, july, August as it is the period when the Summer is at its peak & rainy season is coming in Jabalpur. On the other hand, the minimum solar irradiance calculated is equal to 191.2021 kWh/m^2 and it is during February. This is mainly due to the fact that this month is in the end of the Winter season.

PVGIS & NASA-SOURCE - SOURCE SOFTWARE

The monthly solar irradiations that were collected previously by using mathematical modelling were using 23.1815° as tilt angle. Therefore, the angle chose using PVGIS & NASA-SOURCESOURCE for the optimum angle is also 23.1815°. This is done in order to get an accurate comparison.



Nasa source software viewers



Pvgis software

The following is a summary of the monthly global solar irradiance using PVGIS & NASASOURCE-source

Table 5.4 : Monthly irradiance using PVGIS

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	
PVGIS	176.2	195	205.1	198.9	163.6	129.2	49.94	47.03	125.5	181	194.3	184.9	**1850.5**	**(kWh /m2)**
NASA-SOURCE	138.4	155.5	200.6	222.7	231.9	208.9	212.2	208.5	180.7	172.6	143.1	134.4	2209.42	**(kWh /m2)**

The following is a graph summarizing the monthly irradiance.

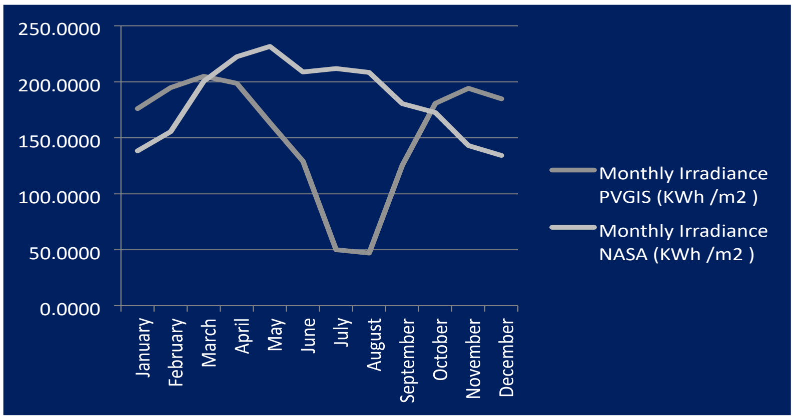


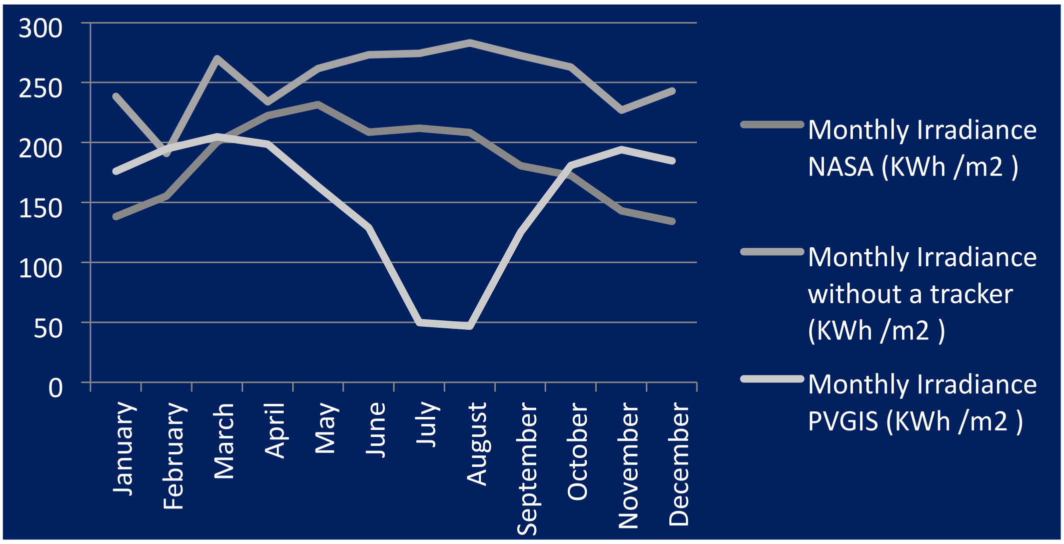
Figure 5.2 : Graph Representing the Monthly Insolation using PVGIS

Using PVGIS, the yearly solar irradiance that can be collected is equal to **1850.500** kWh/m^2. May is the month where the highest solar irradiance was calculated. It is equal to 205.0600 kWh/m^2. On the other hand, JULY & AUGUST is the month where the lowest solar irradiance was calculated. It is equal to 47-50 kWh/m^2. Due to rainy season Or cloud cover due to monsoon. Using NASA-SOURCE , the yearly solar irradiance that can be collected is equal to 2209.42 kWh/m^2.m a y is the month where the highest solar irradiance was calculated. It is equal to 231.85 kWh/m^2. On the other hand, DECEMBER &JAN is the month where the lowest solar irradiance was calculated. It is equal to 134.35- 139 kWh/m^2.due to winter season.

COMPARISON BETWEEN EXCEL AND PVGIS RESULTS :

Table comparison

	COMPARISON				
Month	**NASA**	**MATHEMATICAL**	**PVGIS**	Mathematical V/S PVGIS	Mathematical V/S NASA
January	138.42	238.6198	176.17	26.1713	41.9914
February	155.54	191.2021	195.02	-1.9968	18.6515
March	200.58	269.8687	205.06	24.0149	25.675
April	222.69	234.297	198.88	15.1163	4.954
May	231.85	261.8517	163.57	37.5334	11.4575
June	208.91	273.4665	129.2	52.7547	23.6067
July	212.15	274.4039	49.94	81.8005	22.6869
August	208.51	283.2699	47.03	83.3975	26.3917
September	180.71	272.7266	125.49	53.9869	33.7395
October	172.63	263.1195	180.97	31.2214	34.391
November	143.08	227.1577	194.27	14.4779	37.0129
December	134.35	243.079	184.9	23.9342	44.7299
TOTAL	2209.42	**3033.0623**	**1850.5**	**36.8677**	**27.1073**
	(kWh /m2)	**(kWh /m2)**	**(kWh /m2)**		



Comparison between NASA-SOURCE- PVGIS and* Mathematical *Calculated results

SOLAR TRACKERS

In order to optimize the collection of the solar irradiation, tracking systems can be added to the collector. It is true that they are expensive, but on the other hand they increase the collected solar irradiation considerably. The two types of solar tackers that will be presented in this project are the following:

5.4.1 ONE AXIS SOLAR TRACKER

It is collectors that have either the azimuth or the altitude angle β fixed. The following figure is representations of the different position that can a one axis solar tracker have.

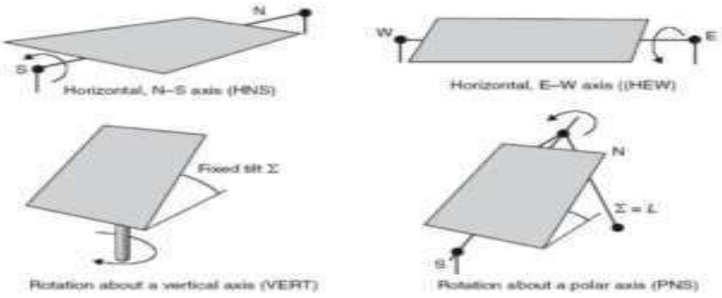


Figure 9 : One Axis Solar Tracking System.

In order to calculate the solar irradiance of one axis solar tracking systems, the following equations are used. I_{BC} is representing the direct beam insolation in watt/hr,

$$I_{BC} = I_B \cos\delta$$

$$I_{DC} = CI_B\left[\frac{1+\cos(90^\circ - \beta + \delta)}{2}\right]$$

$$I_{RC} = \rho(I_{BH} + I_{DH})\left[\frac{1-\cos(90^\circ - \beta + \delta)}{2}\right]$$

$I_{RC}$the reflected insolation in watt/hr, and I_{DC} the diffused insolation in watt/hr.

Table calculation for single axis

SINGLE AXIS												
M	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
I_C	**910.42**	**847.03**	**1054.74**	**951.93**	**1020.89**	**1136.28**	**1083.60**	**1093.50**	**1024.90**	**1036.48**	**887.04**	**975.88**
I_{BC}	**823.41**	**756.41**	**975.01**	**859.88**	**964.38**	**1052.81**	**1010.71**	**1044.10**	**980.11**	**949.78**	**798.51**	**889.61**
I_{DC}	**41.96**	**43.82**	**38.25**	**45.90**	**26.58**	**40.02**	**35.28**	**24.21**	**21.59**	**41.83**	**43.39**	**42.88**
IRC	**45.05**	**46.80**	**41.48**	**46.14**	**29.92**	**43.45**	**37.60**	**25.19**	**23.20**	**44.87**	**45.14**	**43.39**

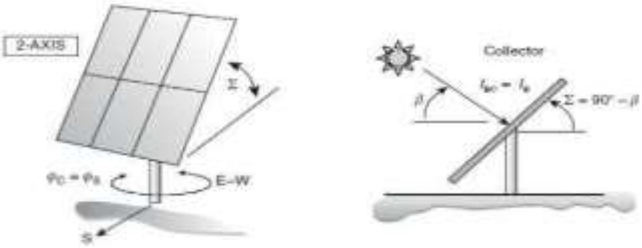


Figure 5.3 : Two Axis Solar Tracking System

In order to calculate the solar irradiance of the two axis solar tracking systems, the following equations are used.I_{BC} is representing the direct beam insolation in watt/hr , I_{RC} reflected insolation in watt/hr, and I_{DC} the diffused insolation in watt/hr.

$$I_{BC} = I_B$$

$$I_{DC} = CI_B\left[\frac{1+\cos(90^\circ - \beta)}{2}\right]$$

$$I_{RC} = \rho(I_{BH} + I_{DH})\left[\frac{1-\cos(90^\circ - \beta)}{2}\right]$$

One of the purposes of this work is to be able to measure the performance of each of those tracking systems. Therefore, an implementation of the above equations was done in MS EXCEL to gather the solar irradiance.

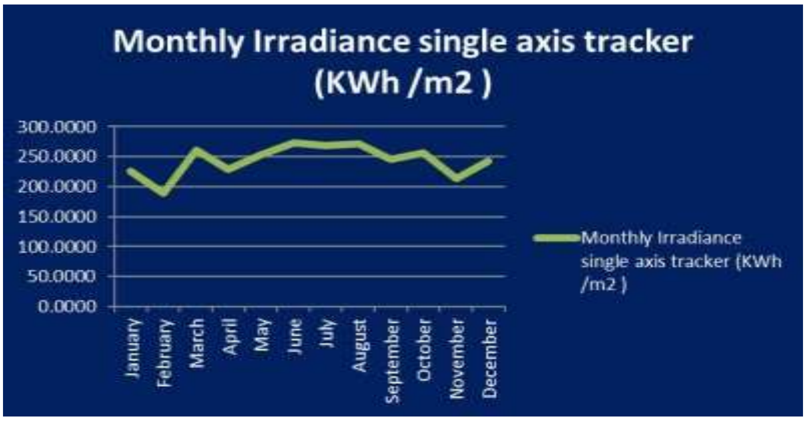
Calculation for two axis

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
I_C watt	965	856	1091	980	1062	1146	1110	1146	1141	1063	956	983
I_{BC} watt	882	789	1020	880	975	1053	1030	1061	1105	993	865	895
I_{DC} watt	61	52	49	77	65	61	53	58	19	46	68	66
I_{RC} watt	23	25	22	24	22	32	27	27	17	24	23	22

For the one axis tracking system, the monthly total irradiance is equal to the following:

Monthly Irradiance single axis tracker

Monthly Irradiance single axis tracker (KWh /m2)													
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	**Total**
IRRADIANCE	226	190	262	228	253	273	269	271	246	257	213	242	**2929.2928**

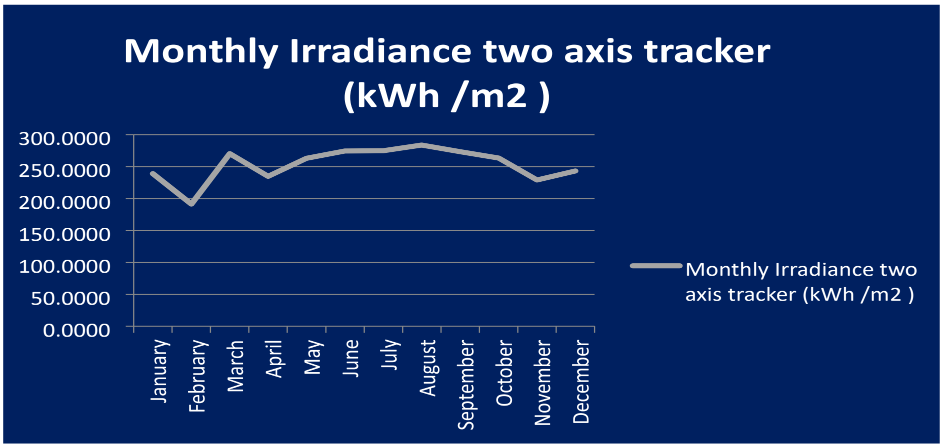


Graph 5.4 the monthly irradiance of one axis tracking system

For the two axis tracking system, the monthly total irradiance is equal to the following:

Table 5.9 Monthly Irradiance two single axis tracker

Monthly Irradiance two axis tracker (kWh /m2)													
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	**Total**
Irr	239	192	271	235	263	275	275	284	274	264	230	244	**3045.6824**



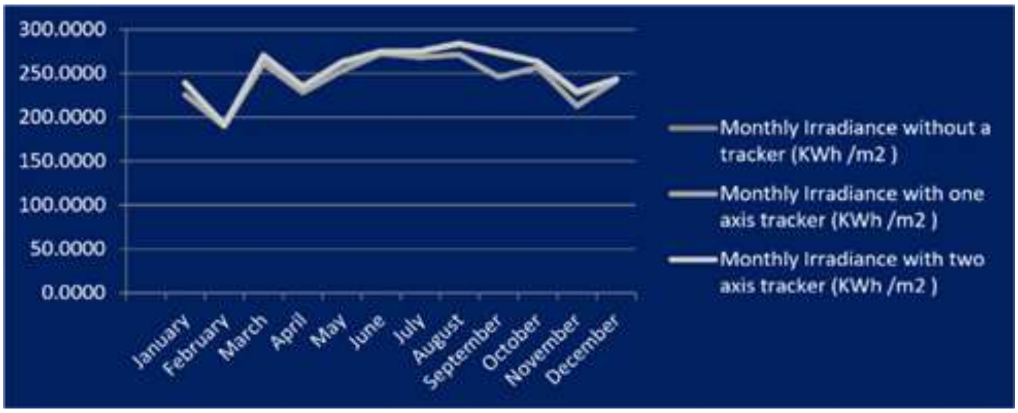
Graph 5.5 monthly irradiance two axis tracker

COMPARING THE PERFORMANCES: HORIZONATAL, WITH ONE AXIS, WITH TWO AXIS TRACKER

Table 5.10 Monthly Irradiance single axis tracker

Month	**Monthly irradiance horizontal**	**Monthly Irradiance 1 AXIS**	**Monthly irradiance WITH 2 AXIS**	**Horizontal & 0ne axis % difference**	**Horizontal & 2 axis % difference**	**One axis & two axis % difference**
JAN	238.62	225.785	239.441	-5.68	0.34	5.7
FEB	191.202	189.735	191.749	-0.77	0.29	1.05
MAR	269.869	261.576	270.545	-3.17	0.25	3.32
APR	234.297	228.462	235.226	-2.55	0.39	2.88
MAY	261.852	253.18	263.331	-3.43	0.56	3.85
JUN	273.467	272.707	275.032	-0.28	0.57	0.85
JUL	274.404	268.732	275.361	-2.11	0.35	2.41
AUG	283.27	271.187	284.213	-4.46	0.33	4.58
SEP	272.727	245.975	273.946	-10.88	0.45	10.21
OCT	263.12	257.046	263.656	-2.36	0.2	2.51
NOV	227.158	212.889	229.514	-6.7	1.03	7.24
DEC	243.079	242.018	243.67	-0.44	0.24	0.68
Total	**3033.06**	**2929.29**	**3045.68**	**-3.57**	**0.42**	**3.77**

The following graph is representing clearly the difference between the three types of collectors. COMPARING THE PERFORMANCES: HORIZONTAL, WITH ONE AXIS, WITH TWO AXIS TRACKER



***A Gaph Comparing the three tracking systems*.**

The table above summarizes all the work, as we have the sun's rays of the moon using these 3 different systems. Very effective, and it is not surprising that the collector has a 2axis tracking system. Changing both angles has great benefits as it enables the collector to be guided in the sun regularly. This system allows an estimated increase of 0.42 % in average percentage of monthly solar irradiance compared to a non-tracking system with an axis tracking system. The total of average annual solar irradiance of the system without a tracking system is equal to **3033.0623** kWh /m2, single axis tracker system is **2929.2928** kWh / $\boldsymbol{m2}$ and two axis tracker system is equal to **3045.6824** kWh / $\boldsymbol{m2}$. Subsequently, comparisons between a single-axis tracking system and two axis show that the system is more efficient for two-way tracking system as it generates an estimated 116.3895 kWh /m2 and a increase in solar radiation. **HORIZONTAL axis & 0ne axis** percentage **difference -3.57 %, HORIZONTAL & two axis** percentage **difference 0.42% & one axis & two axis** percentage **difference 3.77%**

Conclusion:

In this work a comparison between the mathematical model and two different satellite data (NASA-SOURCE & PVGIS) is compared to evaluate the accuracy of readings. the NASA-SOURCE AND PVIGIS represent the huge difference in readings with each other about 358.92 kw/year/m^2 specially in rainy and winter season for same year (2016) and location Jabalpur(23.1815°,79.197). so, the mathematical modeling looks more accurate as compare to online software. This step requires the input of many of the statistical calculations, which are described in full in the report.

The second step is to compare the statistical calculations of solar radiation using online software. This is done to ensure that the information collected is not so accurate. Proposed information from online software: PVGIS & NASA-SOURCE. Comparisons show that there is a more than 10% difference between these caused by an error that is not considered normal. Metals used to collect sunlight can be affected by many things, especially in winter and summer. Measurement tools can be tools such as pyranometer or pyrheliometer or satellites. The final step reached, is to compare the performance of three types of solar collectors: A collector that does not have a tracking system, one that has a single axis tracking system, and finally a two-axis tracking system. This study has shown us that in order to get full sunlight in Jabalpur, it is best to use a two-axis tracking system either horizonal system instead of single axis system. Because the irradiance collected in single axis system is lesser (3.57%) then horizonal system by And research shows that instead of single axis system the horizontal and double axis tracker shows better results for Jabalpur.

FUTURE WORK

To improve the overall performance of AI and Regressive techniques to cope with dynamic nature of metrological conditions and exogenous variables on PV output strength.

- To enhance the overall performance of forecast models for the duration of distinctive days including clean day, cloudy day and wet day for in addition application use.
- It's far essential to reduce the impact of higher fluctuations in correlated variables inclusive of sun irradiation and temperature for accurate prediction.
- In future, accurate PV output forecast may be utilized to layout and increase green power control system of rooftop PV included smart homes

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