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Comparatives Efficiencies Of Solar Photovoltaic Tracking System And Fixed Solar Photovoltaic Modules

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Abstract – Electricity plays a key role now in our daily lives but the energy sources to electric power has been used in wealth and so researchers were required to find an alternate source of power leading to the discovery of solar energy[1]. Solar energy is inexhaustible and eco-friendly and can be converted into electricity using photovoltaic panels. Photovoltaic modules are devices that directly and cleanly convert the sunlight into electricity and offer a practical solution to the problem of power generation in remote areas. They are especially useful in situations where the demand for electrical power is relatively low. These panels can be used in a fixed form or used in a solar tracking system for single axis as well as for dual axis. In a fixed form their efficiency is low since the panels will be tilted in a particular angle whereas in a tracking system the panel is made to move either in single axis or dual axis. In a single axis system, the panel is moved in east to west direction with respect to the sun and it has better efficiency than panels in fixed form. But in a dual axis system the panel is made to rotate in all four directions in accordance with the sun[2]. And dual axis has proved to have more efficiency than both fixed panels and single axis system. In this study, we have compared the solar tracking photovoltaic (PV) system with fixed system through data collection from AGAHOZO shalom solar company and making experiment in MUNYAX eco solar company limited. In this study, we have made comparison between fixed system; as our country is located at 2 degrees of altitude south of equator, the PV module must set at 15 degrees according to the position of the sun in order to maximize the efficiency of PV module. On other side the dual solar tracking system where light sensors, servo motor, the Arduino Uno are used to control the position of panel toward the sun through for making the Arduino program by using Arduino software as set of instruction to be executed by PV module[3]. It was clear that the solar tracking is more efficiency than fixed it has been observed that the efficiency increased about 24.16% in first day and 33.11% on second day of experiment [1]

Keywords – Electricity, Photovoltaic, Comparison, Efficiencies, Fixed, Tracking, Comparatives

I. INTRODUCTION

The citizens of Rwanda use Photovoltaic solar panels as one kind of generating electric energy, but their installations cannot provide the suitable energy because these solar panels don't track wherever the sun light is situated. Solar panel with maximum power point tracking will be used, the appropriate voltage will be achieved. Solar trackers are rising in popularity, but not everyone understands the complete benefits and potential drawbacks of the system[1]. Solar panel tracking solutions are more advanced technology for obtaining the maximum voltage and current. Compensating for this, solar trackers automatically move to "track" the progress of the sun across the sky, thereby maximizing add power output. Also, when the weather has been changed, it can affect the ways for getting the energy. Consequently, solar tracking is increasingly being applied as a sustainable power generating. Solar tracking system is a growing field, this has caused many universities to offer classes and programs in field of energy that combine elements of electrical and electronics engineering, mechanical engineering, and computer engineering. Renewable sources of energy acquire growing importance due to its enormous consumption and exhaustion of fossil fuel[3]. Also, solar energy is the most readily available source of energy, and it is free. Moreover, solar energy is the best among all the renewable energy sources since, it is non-polluting. Energy supplied by the sun in one hour is equal to the amount of energy required by the human in one year. Photovoltaic arrays are used in many applications such as water pumping, street lighting in

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rural town, battery charging, and grid connected PV system. The maximum power point tracker is used with PV modules to extract maximum energy from the Sun. In 24-h day, sunlight is only available for limited time and depends heavily on weather conditions. In most photovoltaic power systems, a particular control algorithm, namely maximum power point tracking (MPPT), is utilized to take full advantage of the available solar energy. Photovoltaic systems normally use a maximum power point tracking (MPPT) technique to continuously deliver the highest possible power to the load when variations in the isolation and temperature occur, Photovoltaic (PV) generation is becoming increasingly important as a renewable source since it offers many advantages such as incurring no fuel costs, not being polluting, requiring little maintenance, and emitting no noise, among others. PV modules still have relatively low conversion efficiency; therefore, controlling maximum power point Tracking (MPPT) for the solar array is essential in a PV system. The Maximum Power Point Tracking (MPPT) is a technique used in power electronic circuits to extract maximum energy from the Photovoltaic (PV) Systems[7]. The electrical characteristics of PV modules depend on the intensity of solar radiation and operating temperature. Increased radiation with reduced temperature results in higher module output. The aim of the tracker is to derive maximum power always against the variations in sunlight, atmosphere, local surface reflectivity, or to operate the module at MPP, a dc-to-dc power electronic converter is accompanied with the PV system. Solar Tracking System is a device for orienting a solar panel or concentrating a solar reflector or lens towards the sun. Concentrators, especially in solar cell applications, require a high degree of accuracy to ensure that the concentrated sunlight is directed precisely to the powered device. Precise tracking of the sun is achieved through systems with single or dual axis tracking[5].

II. Operation Of Solar Tracking System With Arduino

The maximum perpendicularity between the incident rays of the sun and the surface of photovoltaic panel. feedback controller is based on the Arduino uno platform, and the block of the sensors is based on the photodiode and operation amplifier8. The input to the comparator is the concentration of output received from the block of photodiode, which is improved and produce error voltage of feedback, being the variance between the response of the sensors north-south and west-Est the cause of this inequality. At this moment the comparator sensitive to variation of radiation two by two activate the servo motor as the actuator move clockwise and counterclockwise on both servo motor in order to obtain the maximum performance in elevation movement (north –south) and the effectiveness of the azimuthal movement (Est-West). Consequently, the controller maintains the photovoltaic panel, and solar radiation observed, sending the differential signal when the different occurs what allow positioning the solar panel until practical zero error voltage is achieved. Each pair of data (azimuth and elevation) is absorbed and stored by the Arduino platform regular, and after being interpreted, it active the movement of motors10.

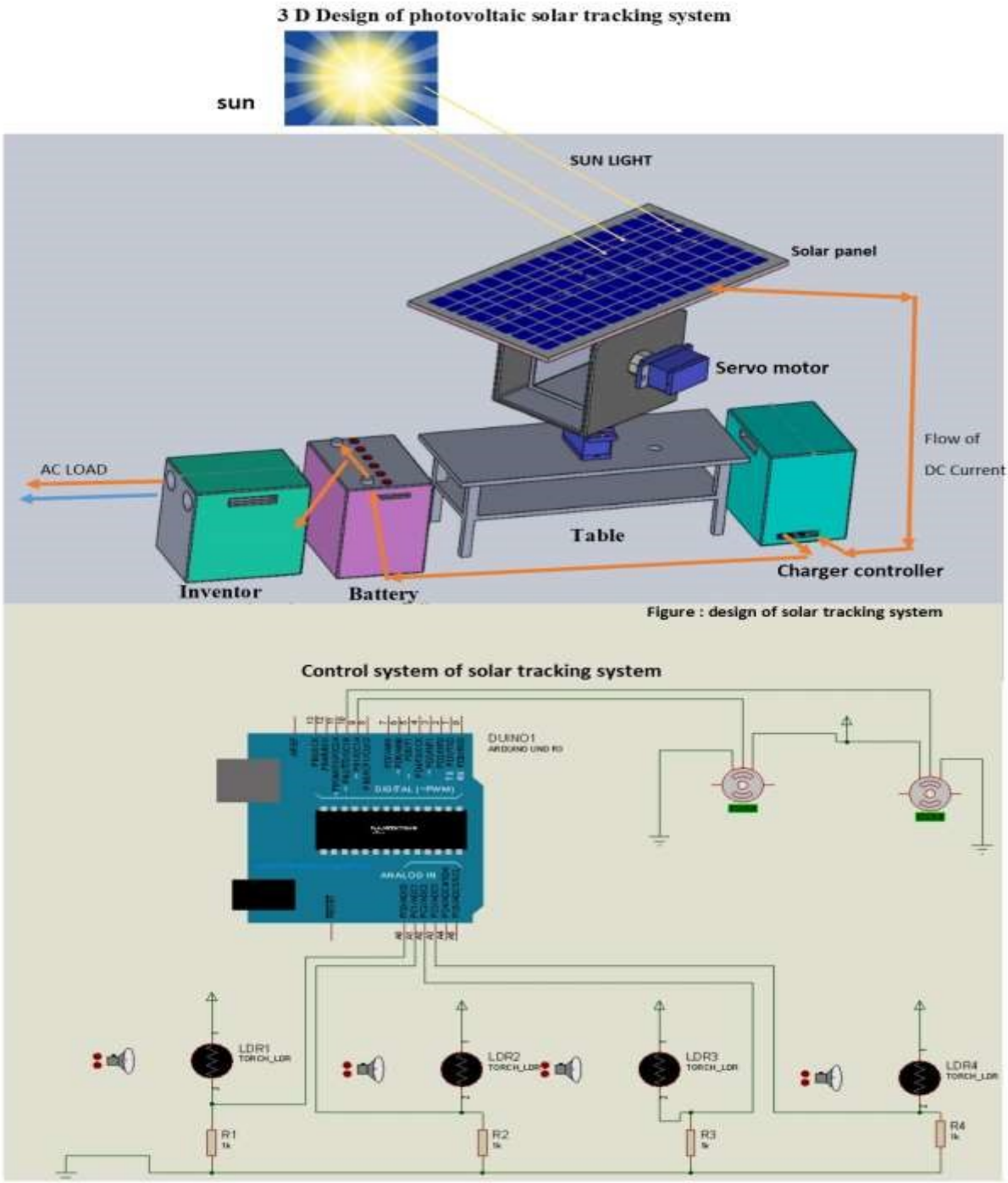

Figure : design of solar tracking system

2.1. How does this system of solar tracking work?

Solar rays received by solar panel are converted into dc voltage for charging battery. dc voltage from this battery is converted by inventor then it produces ac voltage for using in home installation at proper amount of voltage and current. Charger controller is for protecting the battery for over voltage and over discharged also it switch off the system when battery is full charged. If you've installed solar panels on a camper van to provide you with electricity on your camping trip or at home to

supplement your electricity usage or take your home completely off grid, then you probably know that the panels work the best when they are aligned directly towards the sun[6].

This sounds simple enough, except that the sun moves throughout the day. Therefore there are now a number of different mechanisms which work on a range of principles with the purpose of aligning your panel or array of panels directly towards the sun, they are called solar trackers.

Therefore, in this project the solar panels are fixed on a structure that moves according to the position of the sun. LDRs (photo resistors) are used as the main light sensors. Two servo motors are fixed to the structure that holds the solar panel. The program for Arduino is uploaded to the microcontroller. The working of the project is as follows.

LDRs sense the amount of sunlight falling on them. Four LDRs are divided into top, bottom, left and right. For east – west tracking, the analog values from two top LDRs and two bottom LDRs are compared and if the top set of LDRs receive more light, the vertical servo will move in that direction. If the bottom LDRs receive more light, the servo moves in that direction.

For angular deflection of the solar panel, the analog values from two left LDRs and two right LDRs are compared. If the left set of LDRs receive more light than the right set, the horizontal servo will move in that direction. If the right set of LDRs receive more light, the servo moves in that direction.

2.2. Sensors:

The LDRs (light dependent resistors) or PRs (photo-resistors) change resistance with changing light, therefore they need to be connected in such a way that the changing resistance is converted into a changing voltage signal which the Arduino understands.

2.3. Processor:

Here we used the Arduino as the heart of the whole project, so it accepts analog value from the light sensors and use those data to control the actuators thus setting the solar panel to the direction of maximum light intensity.

2.4. Actuators:

In our projects we used the servo motors as actuators for setting the panel to the required position. Hence, they are controlled with the Arduino.

III. Formula Used To Calculate Maximum Power

According to the input current generated from panel as photocurrent and open circuit voltage, we have calculated maximum voltage and maximum current at any operating point on both fixed and tracking PV solar modules.

Therefore, the maximum power is given by the following formula

$$\boldsymbol{Pmax} = Imax\ X\ Vmax$$

IV. Data Collected From AGAHOZO Shalom Solar Company

4.1. Table Data in May 1, 2021

Times	Active energy feed in [wh]	Environment/Ambient Temperature in ^{0}C	Pyranometer irradiation in [W/m2]
5/1/2016 0:00	13691219968	18.2	0.28
5/1/2016 1:00	13691219968	17	0.07
5/1/2016 2:00	13691219968	17.1	0
5/1/2016 3:00	13691219968	16.9	0.03
5/1/2016 4:00	13691219968	16.9	0

5/1/2016 5:00	13691219968	16.9	0
5/1/2016 6:00	13691219968	17.3	5.44
5/1/2016 7:00	13691639808	17.7	126.86
5/1/2016 8:00	13693660160	18.9	681.87
5/1/2016 9:00	13695869952	20	252.78
5/1/2016 10:00	13697829888	20.9	150.13
5/1/2016 11:00	13699340288	19.9	287.11
5/1/2016 12:00	13703409664	22.1	522.07
5/1/2016 13:00	13707689984	23.3	818.75
5/1/2016 14:00	13712499712	26.4	912.84
5/1/2016 15:00	13719140352	27.4	1031.02
5/1/2016 16:00	13723830272	26.5	540.17
5/1/2016 17:00	13727850496	23.5	392.43
5/1/2016 18:00	13728369664	19.9	0
5/1/2016 19:00	13728369664	18.8	0
5/1/2016 20:00	13728369664	19.2	0
5/1/2016 21:00	13728369664	18.7	0
5/1/2016 22:00	13728369664	18.5	0
5/1/2016 23:00	13728369664	18.9	0

The Above table display that temperature decreased from 00:00 to 5:00, and started to increase from 6:00 to 16: 00.and decrease also from 17:00 to 00:00. The variation of irradiance effect on the temperature. Due the change of atmospheric condition, the relation between temperature cannot be specified. It changes irregularly**.** and active feed energy was increase as time change.

4.2. Table Data in June 1, 2021

Times	Active Energy Feed in [Wh]	Environment/Ambient Temperature in ^{0}C	Pyranometer Irradiation [W/m2]
6/1/2016 0:00	14940980224	20	0
6/1/2016 1:00	14940980224	19.4	0
6/1/2016 2:00	14940980224	18.6	0
6/1/2016 3:00	14940980224	18.1	0
6/1/2016 4:00	14940980224	18.4	0
6/1/2016 5:00	14940980224	18.7	0
6/1/2016 6:00	14940980224	18.8	3.26
6/1/2016 7:00	14941400064	20.9	170.9

6/1/2016 8:00	14943380480	22.6	404.85
6/1/2016 9:00	14947649536	26.2	514.58
6/1/2016 10:00	14950039552	25.1	289.68
6/1/2016 11:00	14954290176	28.9	609.11
6/1/2016 12:00	14959040512	28.4	258.78
6/1/2016 13:00	14960969728	26.3	195.42
6/1/2016 14:00	14964610048	30.9	1072.12
6/1/2016 15:00	14968150016	23.9	153.73
6/1/2016 16:00	14972199936	27.7	367.19
6/1/2016 17:00	14974680064	25.6	35.44
6/1/2016 18:00	14974730240	22.8	0
6/1/2016 19:00	14974730240	22.5	0
6/1/2016 20:00	14974730240	22.9	0
6/1/2016 21:00	14974730240	20.2	0
6/1/2016 22:00	14974730240	21.1	0
6/1/2016 23:00	14974730240	21.1	0

The Above table display that the varied temperature and irradiance was irregularly due to change of atmospheric conditions as maximum temperature per day was 30.9 ^{0}C and maximum irradiance was 1072.12 W/m2 and obtained at 14:00 pm. and active feed energy was increased as time changed.

AGAHOZO Shalom solar company is located at RWAMAGANA district, East Province in Rwanda country. This company use single tracking system, table above indicate the amount of active energy feeding per unity time, change of temperature, and change of irradiance with respect to time.

On both days **(**May 1, June 1/ 2016) the data collected are changing with respect to time as the irradiance increases, the temperature increases and amount of energy increases where on first day at maximum temperature of 27.4^{0}C. there is maximum amount of irradiance as it was 1031.02 W/ m^2 and on second maximum temperature is 30.9 ^{0}C, where the Maximum irradiance was 1072.12 W/ m^2**.**

V. Experiments Made In Munyax Eco Solar Company

Site location:

- **Name of company:** MUNYAX Eco solar company
- **Road**: avenue Paul 6
- **City:** Kigali- Rwanda
- **Latitude:** - 2^o (- means southern to equator)
- **Longitude:** 30 ^{0}Est

During this experiment, the interested thing was to know when there is a good performance between the tracking and fixed solar panel system according to the different parameters such as open circuit voltage, short circuit current, the maximum power point voltage and current, maximum power point.

In order to achieve on results from experiment, PV module set on angle 15^0 from flat ground according to the position of the sun radiation in structure of solar system. During this experiment, also the different measurement instrument has been used. Those are: ammeters, digital multimeters, Thermometer, power box (contain charge controller, battery, and inventor).

5.1. **Table of photovoltaic Specification Performance at 1000 W/m^2 and 25^{0}c**

1	**Maximum Power (Pmax)**	**200 Wp**
2	**Maximum variation**	**+/-3%**
3	**Current maximum power point (Impp)**	**5.7 A DC**
4	**Voltage maximum power point (Vmpp)**	**35 V DC**
5	**Open circuit voltage (Voc)**	**43.2 V DC**
6	**Short circuit current (Isc)**	**6.5 A DC**

Safety: Maximum system voltage 715 V DC

5.2. Table below illustrate the data recorded on each 20 minutes for tracking system on Friday 1 september,2020.

Hours	**Temperature (^{o}c)**		**Voc (v) on tracking solar P system**	**Impp(A) on tracking solar P system**	**Vmpp(V) on tracking solar P system**	**Power in watt on tracking solar PV system**
10:20	35		31.5	2.1	27.4	57.54
10:40	45		30.2	2.2	27.1	59.62
11:00	51.6		29.7	2	26.5	53
11:20	49.7		30.8	2.1	27	56.7
11:40	56.43		29.2	2.1	26.3	55.23
12:00	60.8		28.5	2	25.3	50.6
12:20	57.8		29.27	2.36	25.8	60.888
12:40	64.57		28	2.85	25.8	73.53
14:00	59.45		29.27	2.15	26.8	57.62
14:20	60.8		29.5	1.75	26.5	46.375
14:40	58.58		30	2	26.2	52.4
15:00	64.78		28.5	1.37	26.38	36.1406
15:20	67.4		27.7	1.48	25.22	37.3256
15:40	52.8		27.6	1.5	26.43	39.645
16:00	43.78		30	1.67	25.54	42.6518
16:20	35.87		31.5	1.2	26.06	31.272
16:40	29.67		30.05	1.3	25.5	33.15
17:00	27.75		29.6	1.1	25.5	28.05

Total		530.89	33.23	471.33	871.738
Average		29.49389	1.846111	26.185	91.76189

The table above illustrate the measurement of parameters taken on tracking solar system which are temperature in ^{0}C, open circuit voltage, intensity of maximum power point in A, maximum power point voltage in V, power generated in W.

According to the measurement taken above, it shows that maximum voltages increase or decrease slightly as panel oriented in high intensity of irradiation. Therefore, the tracking system try to retain in its value. Those make temperature on PV module to remain in its range and temperature increase in solar current increase, and as temperature decrease, current decrease. Those cause the power to be increase where the current increase as voltage remains in its range.

5.3. The table below illustrate the data recorded on each 20 minutes for fixed system on Friday 1 October 2022

Hours	**Temperature (^{o}C)**	**Voc of fixed solar PV module**	**Impp on fixed solar PV module**	**Vmpp on fixed solar PV module**	**Power in watt on fixed solar PV module**
10:20	30	29.7	1.9	25.6	48.64
10:40	42	28.35	2	25.25	50.5
11:00	47.2	27.88	1.8	24.68	44.424
11:20	45.2	28.98	1.9	24.49	46.531
11:40	52.43	28.39	1.9	24.2	45.98
12:00	60.8	27.8	1.8	23.9	43.02
12:20	53.8	28.57	2.09	25.1	52.459
12:40	61.48	27.3	2.3	25.1	57.73
14:00	51.45	29.04	1.93	26.57	51.2801
14:20	57.8	29.27	1.2	26.27	31.524
14:40	54.58	29.77	1.8	25.97	46.746
15:00	60.29	27.8	1.1	25.68	28.248
15:20	64.4	27	1.15	24.52	28.198
15:40	49.8	26.9	1.12	25.73	28.8176
16:00	40.68	28.03	1.24	23.59	29.2516
16:20	31.57	29.55	0.95	24.11	22.9045
16:40	23.89	28.1	1.03	23.55	24.2565
17:00	24.4	27.54	0.92	23.44	21.5648
Total		509.97	28.13	447.75	702.0751
Average		28.33167	1.562778	24.875	39.00417

The table above illustrate the measurement of parameters taken on fixed solar system which are temperature in ^{0}C, open circuit voltage, intensity of maximum power point in A, maximum power point voltage in V, power generated in W.

According to the measurement taken above, it shows that maximum voltages will be at 14: 00 where the irradiance is perpendicular to the PV module. And from morning the voltage increase as the irradiance tend to be perpendicular to PV, from 14:00, the voltage decrease due to irradiance tend to go away from the perpendicularity.

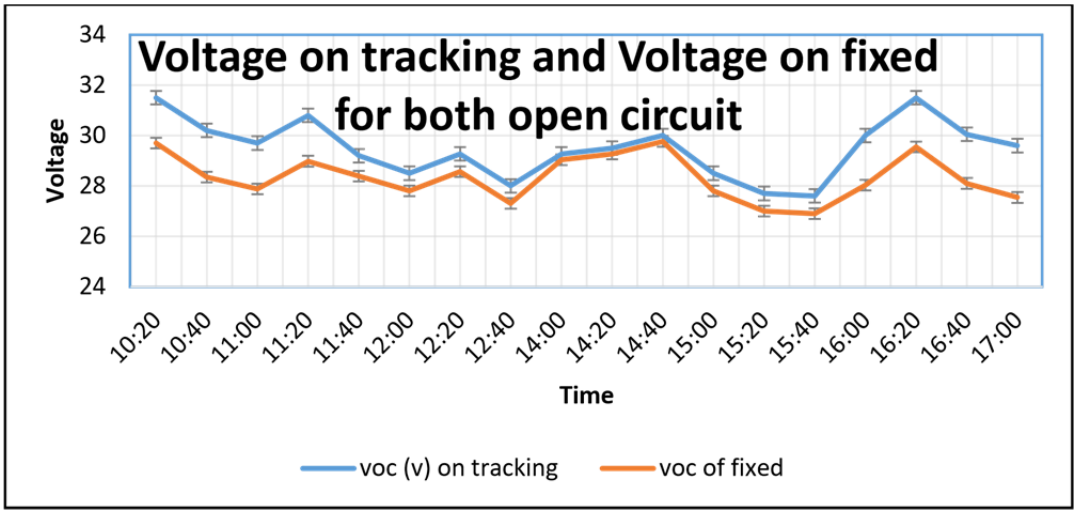

Fig1.The open circuit voltage on tracking and fixed solar panel

This graph shows that the open circuit voltage at any operating point in the fixed solar panel is less than the open circuit voltage at any operating point on tracking solar panel with the change of time. The data have been recorded in each 20 minutes, from 10:20 to 17:00 and at maximum open voltage at 16:20, on tracking, the amount of open circuit voltage was 31.5 V where on fixed was 29.55 V.

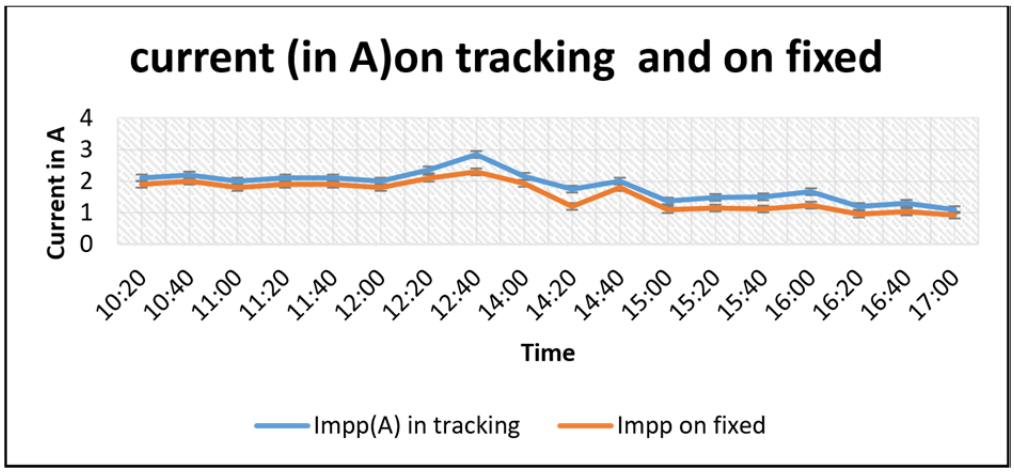

Fig2.The current on tracking and fixed solar panel

This graph shows that the current operated at any point on the fixed solar panel is not raised by comparing with the current operated on the tracking solar panel through the variation of time. at maximum current at 12:40, on tracking, the amount of current was 2.85 A where on fixed was 2.3A.

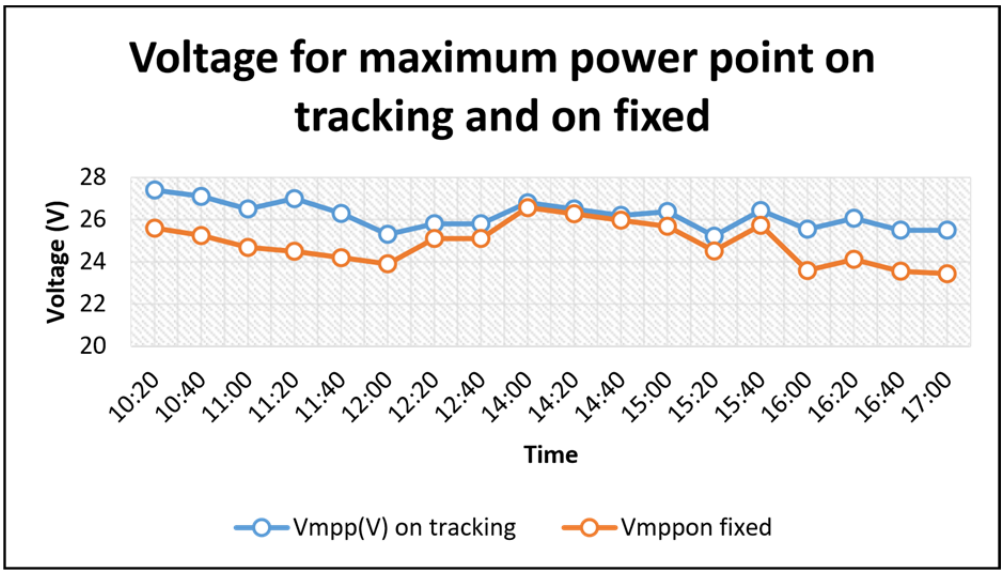

Fig3.The voltage for maximum power point on tracking and fixed solar panel

Here this graph describes that the maximum power point voltage is occurred at any operating point on the tracking solar panel is greater performance than the fixed solar panel. Also, the fixed solar panel 'graph show us the voltage is well from 14h00 to 15h00. This parameter is changed by the variation of temperature. Consider on this graph above, the maximum voltage will still have varied towards to the position of the sun .it means that the maximum voltage still occurs at the solar tracking system where as on fixed solar system, the maximum voltage will occur when the incident rays are perpendicular to the PV module**.**

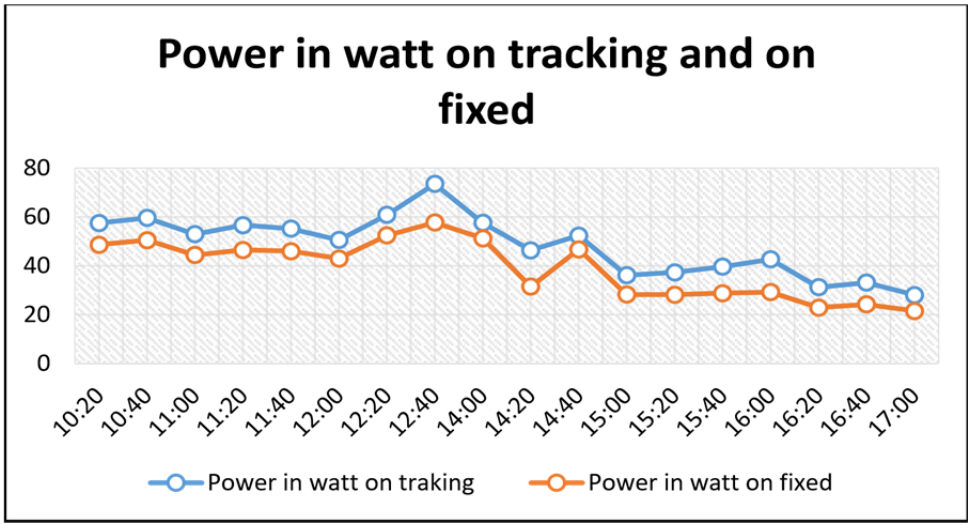

Fig4.The power on tracking and fixed solar panel

This graph shows that the tracking solar panel carried out the maximum power(watt) for comparing with the fixed solar panel system. This maximum power is maximized by the controlling of the position of the sun on tracking solar panel and the inclination angle on the fixed solar Panel system. As power depend on the current, voltage, the maximum power in this experiment was reached on tracking system at 12:40 was 73.53W where on the fixed solar panel was 57.73W.

5.4. Data for Second day on Monday 04, October, 2020 on tracking system in each 30 minutes

Time	Temperature in degrees Celsius	Voc (V) on tracking solar PV system	Vmpp(V) on tracking solar PV system	Current (A) on tracking solar PV system	Power watt in tracking o solar n system PV
8:00	29	38.8	33.5	2.5	83.75
8:30	35	35.4	30.7	2.2	67.54
9:00	48	31.5	27.1	1.5	40.65
9:30	58.8	30.4	25	1.35	33.75
10:00	40	30.75	25.5	1.1	28.05
10:30	45	30	25.4	1.6	40.64
11:00	73	29.6	25.4	1.8	45.72
11:30	70	30	25.6	1.85	47.36
12:00	75	30.5	25.7	1.9	48.83
12:30	68.5	30.2	26	1.7	44.2
14:00	57.6	30.48	26.2	1.2	31.44
14:30	51.1	29.6	26	1.1	28.6
15:00	43	32	29.5	1.7	50.15
15:30	38	28.17	25.4	0.75	19.05
16:00	30	27.2	25	0.3	7.5
Total		464.6	402	22.55	617.23
Average		30.97333333	26.8	1.50333333	41.14867

The table above illustrate the measurement of parameters taken on tracking solar system which are temperature in ^{0}C, open circuit voltage, intensity of maximum power point in A, maximum power point voltage in V, power generated in W.

Refer to the specification of PV module, the open circuit voltage is 43.2V so that according to the measurement taken above, it shows that on starting point the temperature was close to Performance of 25^{0}c, and as temperature increase voltage start to decrease. While from 12:00 the measurements are changing irregularly. Those also affect the power generated as power depend on amount of currents and maximum power point voltage.

5.5. Data on 05, October, 2020on fixed solar PV system

Time	Temperature in degrees Celsius	Voc (V) on tracking solar PV system	Vmpp(V) on tracking solar PV system	Current (A) on tracking solar PV system	Power in watt on tracking solar PV system
8:00	29	37	31.7	2.15	68.155
8:30	35	33.6	28.9	2	57.8
9:00	31	29.7	25.25	1.3	32.825
9:30	58.8	28.6	23.15	1.1	25.465
10:00	40	28.93	23.68	0.71	16.8128
10:30	45	28.18	23.58	1.1	25.938
11:00	73	28.79	24.59	1.4	34.426
23:30	70	29.19	24.79	1.5	37.185
12:00	75	29.8	25.4	1.53	38.862
12:30	68.5	29.5	25.3	1.3	32.89
14:00	57.6	30.25	25.97	0.8	20.776
14:30	51.1	29.37	25.77	0.76	19.5852
15:00	43	31.3	28.8	1.19	34.272
15:30	38	27.47	24.7	0.58	14.326
16:00	30	25.25	23.05	0.19	4.3795
Total		446.93	384.63	17.61	463.6975
Average		29.79533	25.642	1.174	30.91317

The table above illustrate the measurement of parameters taken on tracking solar system which are temperature in ^{0}C, open circuit voltage, intensity of maximum power point in A, maximum power point voltage in V, power generated in W. the parameters on fixed system, was high on starting point, we have the maximum voltages on this day. This is due to the change of atmospheric condition, because during our experiment, they were presence of cloud in the sky.

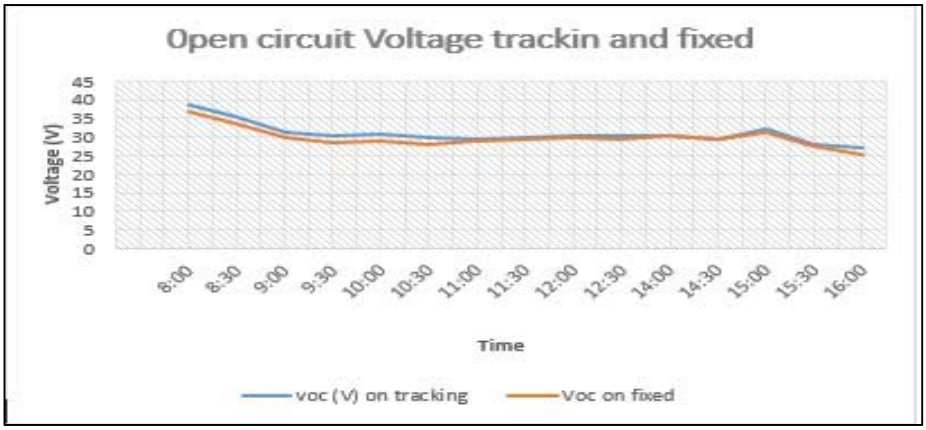

Fig5. The open circuit voltage for tracking and fixed solar panel.

This graph shows that the open circuit voltage at any operating point in the fixed solar panel is less than the open circuit voltage at different operating point on tracking solar panel with the change of time but from 11:00 to 14:30 the open circuit voltage tends to be the coincident on both systems. this was Caused by the movement of the earth across the sun, voltage The data have been recorded in each 30 minute, from 8:00 to 16:00 and at maximum open voltage at 8:00, on tracking, the amount of open circuit voltage was 38.8v where on fixed was 37V.

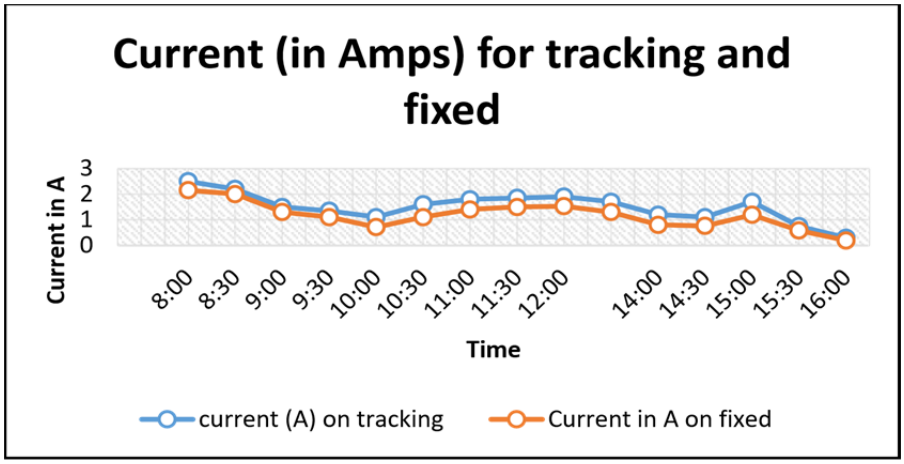

Fig6. The current for tracking and fixed solar panel.

This graph shows that the current operated at any point on the fixed solar panel is not raised by comparing with the current operated on the tracking solar panel through the variation of time. at maximum current at 8:00, where it was 2.5 A on tracking while on fixed was 2.15A.

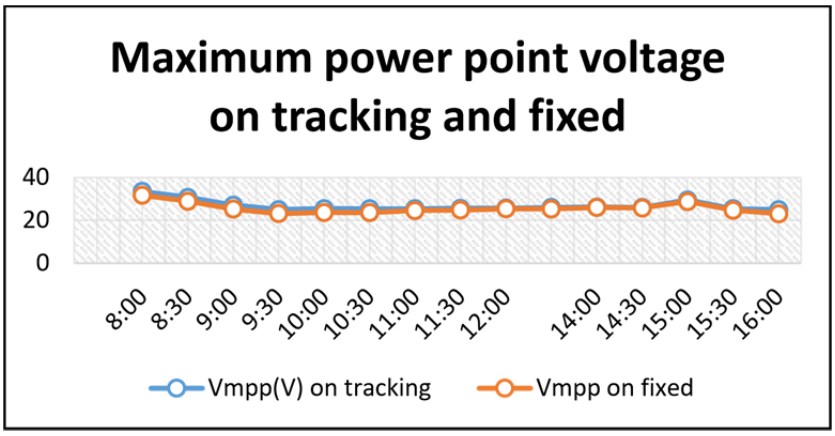

Fig7.The maximum power point voltage on tracking and fixed solar panel.

On this graph describes that the maximum power point voltage is occurred at any operating point on the tracking solar panel is greater performance than the fixed solar panel. Also the fixed solar panel 'graph show us the voltage is well at 8:00. From 9h30 to 14h30, the maximum voltage was tending to close to constant value on both fixed and tracker system. This due to the position of the sun and cloud in atmosphere. Therefore, the maximum power point voltage was reached at 8:00 as it was 33.5V on tracking system and 31.7 V on fixed system.

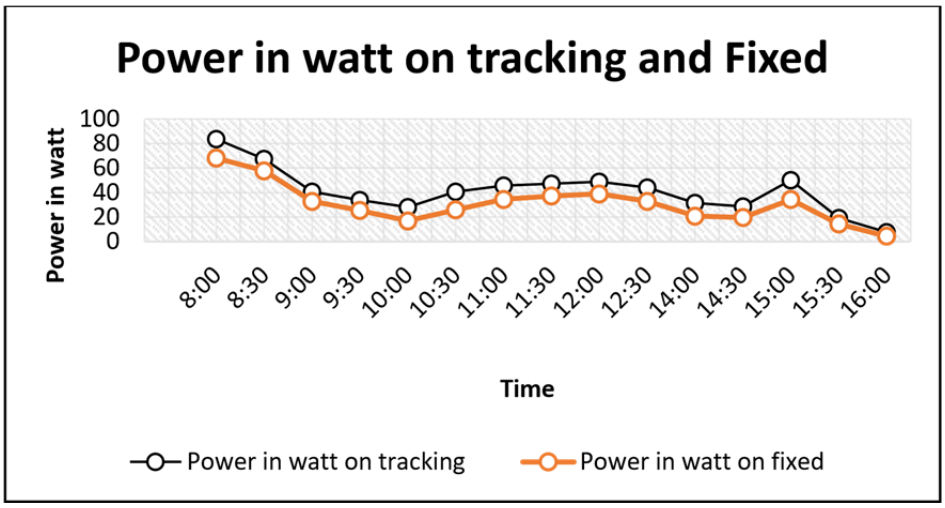

Fig.8The power on tracking and fixed solar panel

This graph on second day shows that the tracking solar panel carried out the maximum power(watt) for comparing with the fixed solar panel system. This maximum power is maximized by the controlling of the position of the sun on tracking solar panel and the inclination angle on the fixed solar Panel system. As power depend on the current and voltage, amount of irradiance received on PV Module, in this experiment the maximum power was reached on tracking system at 8:00 was 83.75 Watt where on the fixed solar panel was 68.155 Watt.

PV module simulation in mat lab on tracking PV module and Fixed PV solar tracking

- **On Fixed System**

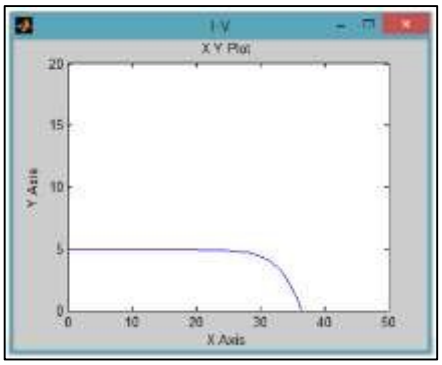

Fig9.I-V Curves where X is voltage, Y current,

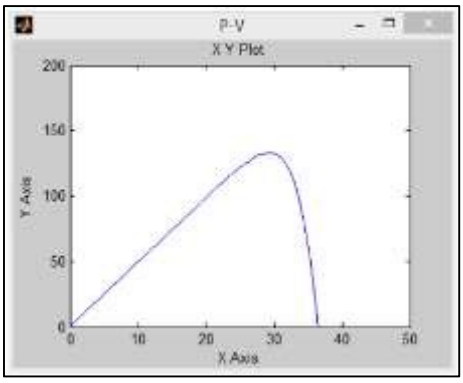

Fig10:P-V where X is Power, Y is voltage

From figure above, the short circuit current is increase according to the amount of irradiance. On this graph show that the open circuit voltage will be maximum for zero current and maximum current (short circuit current) will be achieved on zero voltage. The power generated will be less as compare with tracking due to fixed system does not track the sun position on all time.

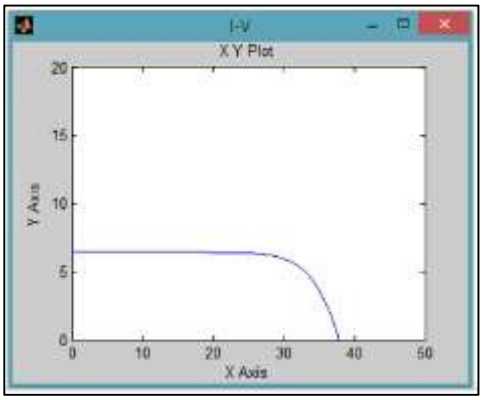

Fig11. I-V Curves where X is voltage, Y current,

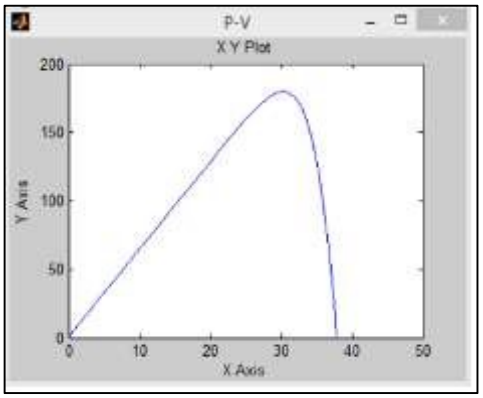

Fig12 P-V where X is Power, Y voltage

VI. Conclusion

From figure above, solar tracking system will generate high amount of current compare to fixed solar PV system due to solar tracking system will track the sun position, and receive high intensity of irradiance and cause temperature on PV module. When the temperature increase, it increases slightly current and decrease slightly voltage.

From plot b of power (P) against voltage for this graph b, show that there is a unique point of power on the P-V Curve at which solar panel based on average open circuit voltage will be maximum. According to the comparison of tracking PV system and fixed PV module, it observed that tracking system is more efficiency than fixed system.

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