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Maximum Power Point Tracking Technologies applied Incremental Conductance in PV panel based on Grid system

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ABSTRACT: In recently year, India is growing very fast and so that electricity demand also be increase rapidly and only natural resources can not complete it. So that, renewable energy can use electricity demand. Renewable energy can generate electricity without any environment pollution generate. Photovoltaic cell is the one of best renewable resource in India and so that its utilization also be high. Photovoltaic cell can convert solar energy into electric energy. To increase the efficiency of PV panel, many techniques are available and of MPPT. MPPT can generate maximum power in any season. In which, Incremental conductance is use to generate the maximum power to use in dc to dc converter or boost converter. To increase the higher efficiency of the PV module and generate IV curve for maximum current and maximum voltage. Wind power generation can generate the wind energy to electricity. Wing are connect with shaft and shaft is connect with generator. The MPPT and DC-DC converter are implanted Matlab/simulink and all component are connected to each other and generate its result.

KEYWORDS: Electricity, Natural resources, Photovaltaic cell (PV cell), MPPT, Incremental Conductance, DC-DC Converter, MATLAB

I. INTRODUCTION

Sun and wind are an inexhaustible pollution free source of energy and solar cell have little to no operating cost with lifetime on the 30 years, and also same way of wind power energy have continuous flow of power, the only monetary investment is the initial manufacturing cost. By using photovoltaic effect, in which photons are converted into electricity, solar energy can be used for direct electricity generation. The efficiency of PV cell is affected by various atmospheric parameters like irradiance, temperature, humidity, dust, wind etc. However, solar energy is free and inexhaustible PV cell are not used commonly because of their initial cost and efficiency. Many engineers, scientists and researchers are trying to improve the solar cell efficiency by considering the effect of atmospheric parameter like radiation, temperature, humidity etc. and changing the material of PV cell such as Si, GaAS etc.

In this research work, an automated system has been developed for accurate and smooth plotting of I-V curve of solar cell over these parameters. Further, we analyzed the result; and then compare conceptual result to real experimental result to find out optimal condition for a particular photovoltaic cell. In this thesis, First chapter introduce an idea about world energy requirement, role of solar energy, motivation, objectives and survey of existing literature. Chapter 2 contains the theory of PV cell & the explanation of the various affecting atmospheric parameters like temperature, humidity, irradiation etc. Chapter 3 explains the detail of developed measuring instrument, including its hardware part like circuit construction, components, sensors etc. and software part like flow chart, programming, data logger, analyzing tools etc. Chapter 4 deals result analysis & explanations of the obtained graphs. Finally, chapter 5 concludes the work and suggests the future work, scope and aspects.

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The use of Photovoltaic energy for power generation achieved importance due to increase in efficiency and reduced in cost. Among the other renewable source the electrical energy from Photovoltaic are more useful, as it is abundant, clean, eco-friendly and free distributed over major portion of earth. It is estimated that solar energy incident on the surface of earth is of the order of ten thousand times greater than world energy consumption. The Photovoltaic module itself cannot deliver maximum power output, because it has nonlinear IV curve. Maximum Power Point Technique is used to track Maximum Power Point in IV curve.

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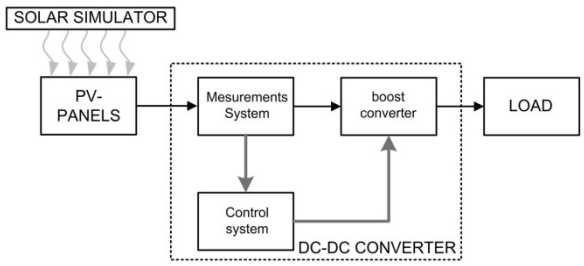

Fig. 1. MPPT based controller in PV system

MPPT algorithm can be applied to DC-DC converter to track the Maximum Power Point in the IV curve; control command is given to DC-DC converter by MPPT algorithm by measuring output voltage and current from Photovoltaic module.

1.1 Photovoltaic module modeling:

Solar cells are made of semiconductor that converts sunlight in to DC voltage process is known as photovoltaic effect. Silicon solar cells produces 0.5 to 0.6 volt depending on Temperature and independent of irradiance. The equivalent circuit of PV cell is shown in Fig-2

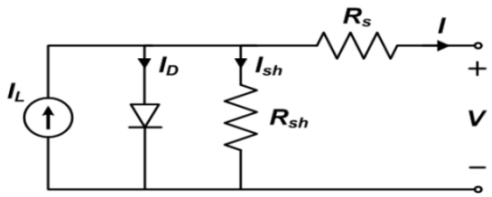

Fig.2. Equivalent model of Photovoltaic Module

Its mathematical equation

$$I = I_{pv} - I_0\left[\exp\left(\frac{V+R_sI}{V_t\alpha}\right) - 1\right] - \frac{V+R_sI}{R_P}$$

where V is the output voltage of PV; Iph Photon generated current; Ir Saturation current; q the electron charge (1.6* 10-^{19}C); η p-n junction quality factor; k the Boltzmann constant (1.38*10-^{23}J/k) and T the temperature (K)

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1.2 Cell, Module and Array:

The photovoltaic panel generate higher voltage when it is connected in series and when higher current required then it is connected in series. As respective, single cell generate 1.5 to 2.5 volt and when it is connected in series then it is able to generate 12 or 24 volts. As respective, for higher voltage use array.

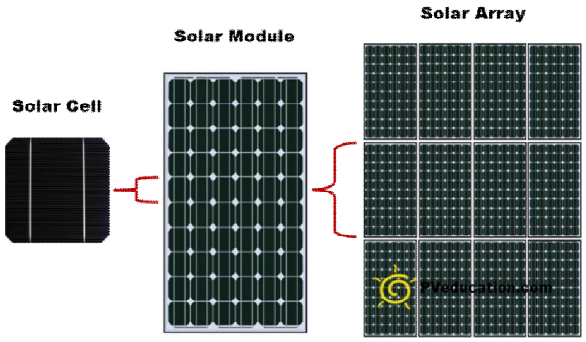

Fig. 3 PV Panel Module

Here, Solar cell convert radiation energy into electrical. It directly dependent on radiation and temperature here as same radiation, changing the temperature. As respective 0^0, 25^0 and 50^0 and solar radiation 1000 W/m^2
As same pattern below generate a table.

S.No	Symbol	Parameter	Value
1.	Mp	Max. Power	75
2.	Vmp	Voltage at Max. Power	17
3.	Imp	Current at Max. power	4.45
4.	Voc	Open Circuit voltage	21.08
5.	Isc	Short Circuit current	4.79
6.	α	Temperature co-efficient Isc	3.18x10-^{3}

In a PV system DC-DC converter are widely used to interface load with PV module. These converters must be selected carefully to boost the module output for MPPT operation. To increase the conversion the conversion of PV module proper selection of DC-DC converter is required. Since the system required step up DC-DC converter in which PV module is followed by Boost Converter. For the given input voltage output can be varied upto desired level by varying D (tON & tOFF)

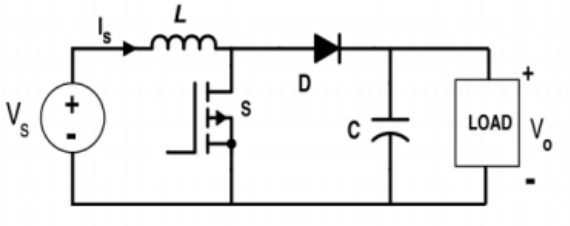

Fig. 4. DC-DC Boost Converter

Value of component can be calculated as

$$L = \frac{1.25 * D(1-D)^2 * R_{Load}}{2 * f_{sw}}$$

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$$C_o = \frac{D}{R(\Delta V_o / V_0) * f_{sw}}$$

$$V_{in} = V_{Mpp}$$

$$V_o = \frac{V_{in}}{1 - D}$$

II. MPPT TECHNIQUE

Solar PV Module are dependent on changing in operating temperature and irradiance. Radiation and temperature change with seasonal month. Parameter in which variation is observed are higher voltage or current by using of DC-DC boost converter. Maximum power point tracking applied on DC-DC boost converter for Maximum Power, Maximum Voltage, Open Circuit Voltage, Maximum Power Current & Short Circuit Current. MPPT algorithm proposed applied to DC-DC converter to extract maximum available power to solar PV module output under variation in operating temperature & irradiance.

MPPT technique is more efficient under following operating conditions-

- Cold and cloudy weather
- When battery is in deep discharge state
- Improved Efficiency

Some efficient power extraction algorithms are follows-

- Perturb and observe MPPT
- Fractional VOC and ISC based MPPT
- Incremental Conductance MPPT
- Scan based MPPT

Which have been examined and applied in field application giving high tracking efficiency.

III. PROPOSED PV CONTROL ALGORITHMS

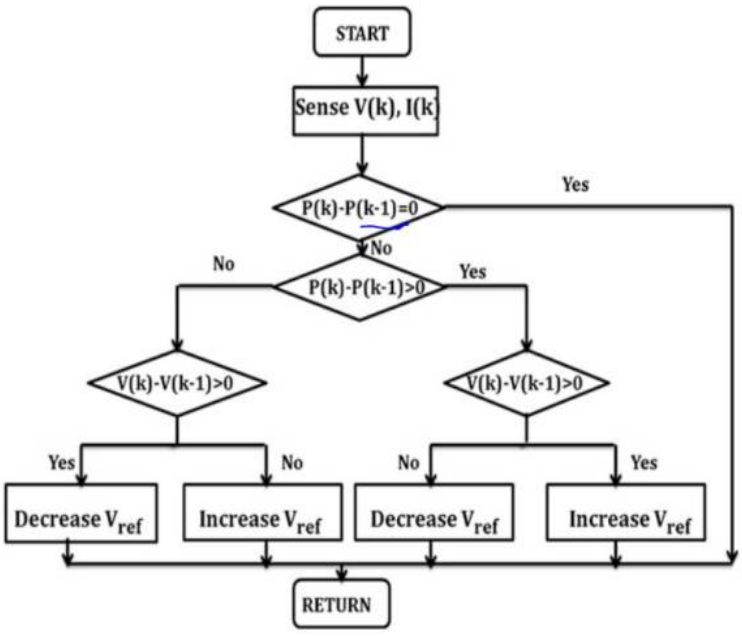

Fig 5: Incremental Conductance Algorithm of PV Panel

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Algorithm proposed in this section, it insures optimal operation of system under various condition. Fig 7 shows the proposed PV power control MPPT algorithm. Objective of MPPT algorithm is to automatically find the maximum operating voltage and maximum operating current on which PV module can operate at maximum power point under given Irradiance and temperature condition.
In P&O MPPT algorithm it starts from calculating of PV output power and its change in power by sampling both PV module current & voltage. The MPPT technique in this method periodically tracking increment or decrement in solar PV module voltage. If such perturbation generated in same direction and if its result in decrease in PV module power then perturbation is generated in opposite direction. The duty cycle is varied until the MPPT obtained, however the system oscillates around the MPPT point reducing perturbation step size reduces the oscillation but slow down its tracking.

IV. WIND TURBINE

Wind energy deployment has experienced growth in recent three decades. Wind turbine generators (WTGs) utilized a very simple wind turbine with stall control and it is directly connected induction generator. Wing is provide mechanical power and shaft are connected with wing so that wing are moving with shaft and Induction generator can generate energy. Affordable power converters, in the modern technology wing are design on the basis of advance aerodynamic theory.

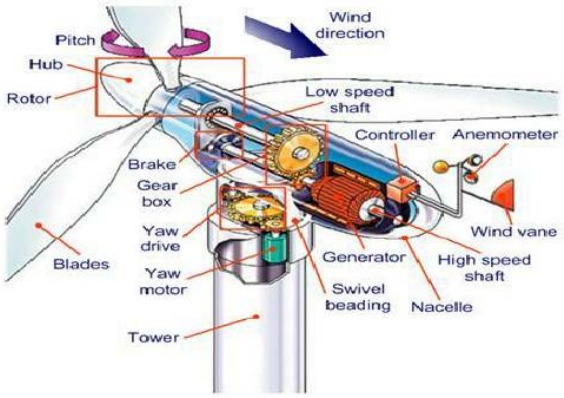

fig 6: function of wind turbine

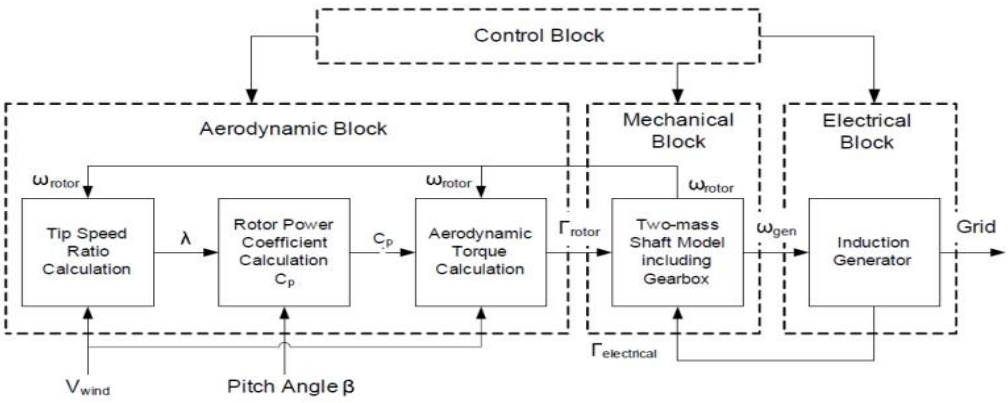

Fig 7: Block Diagram of Wind Turbine

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IV. RESULT

In this paper, we are discuss above about the our project which completed its seprate part. Solar panel is main to port of the system. Here, we are represent Incremental Conductance algorithm and also be use wind turbine.

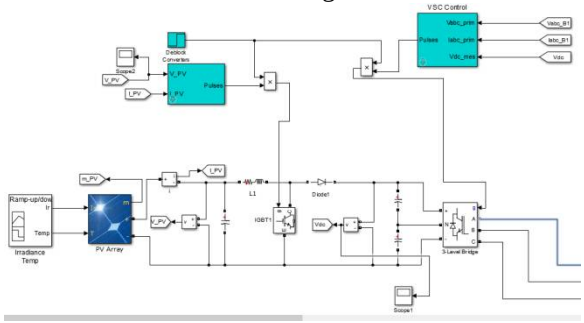

fig 8: PV panel with Incremental Conductance

Here, PhotVoltaic cell are require only solar energy but here we can not provide its. So that we take a signsl builder block and attach with PV panel. PV panel can generate dc voltages and its attach with dc-dc Boost converter. Boost converter has ability to convert minimum to higher voltage. Boost conveter is a swithing device so that for controlling the Boost converter we are use a incremental conductance.
Solar panel is attached array in series (66*10). It is generate low voltage 300,325and 350 volt and current is 4000 Amp. Total power generate by PV panel is 1.2 Mega Watts. It is fulfil the remain rest power consumpsion. The DC-DC Boost converter can convert 350 to 750 volt.

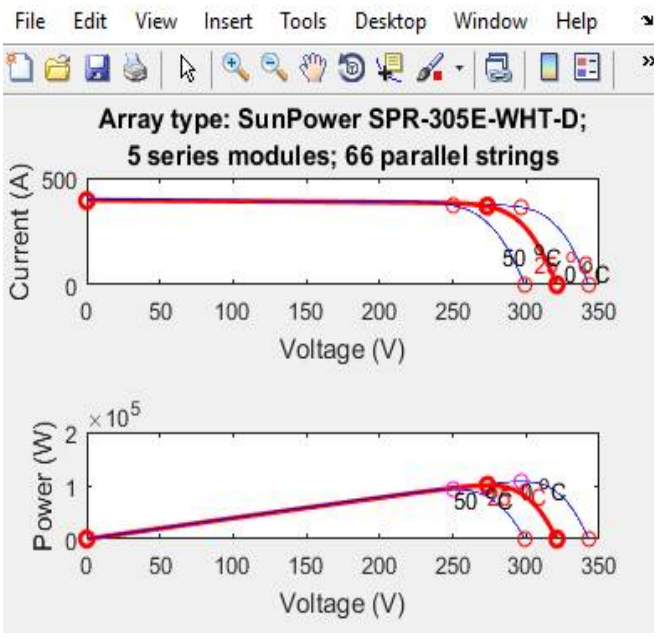

Fig 9: Graph of variation of the temprature and irradiation

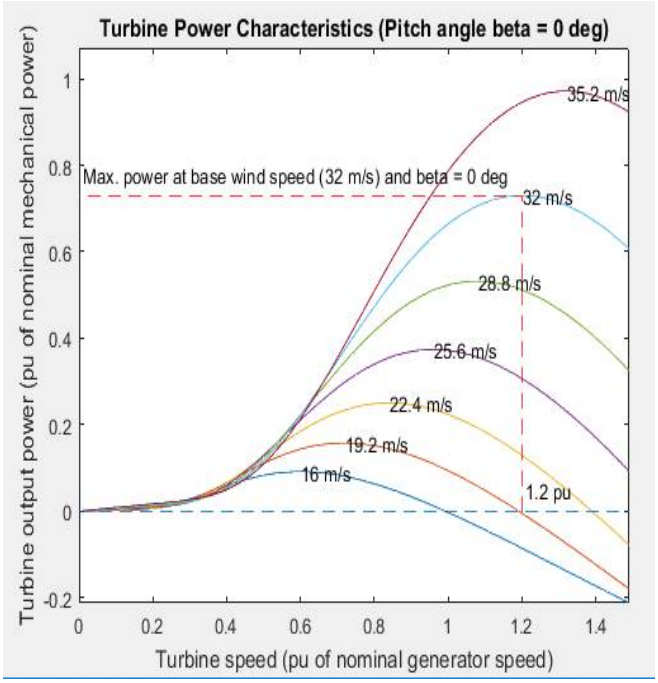

Fig 10: Graph of variation of the Wind Turbine Speed

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This System consists of a plant and it has carry very large distane 400 km. The main Transmission line is transmit the supply naminal power 100 KVA and also rest demond complete by Solar panel and Wind Turbine. Here two different type of load connected first is a domestic type load connected and second is a plant type load connected. The source rms volatge rating is 100KVrms. Transmission losses is, resistance 0.3864 ohm/km, inductance 4.12mH/km and 7.75 nF/km. wind turbine is description, Nominal machanical output power 1.5MN and base wind speed 32 and max. power at base speed (pu of nominal mechanical power)=0.73. base rotational speed=1.2

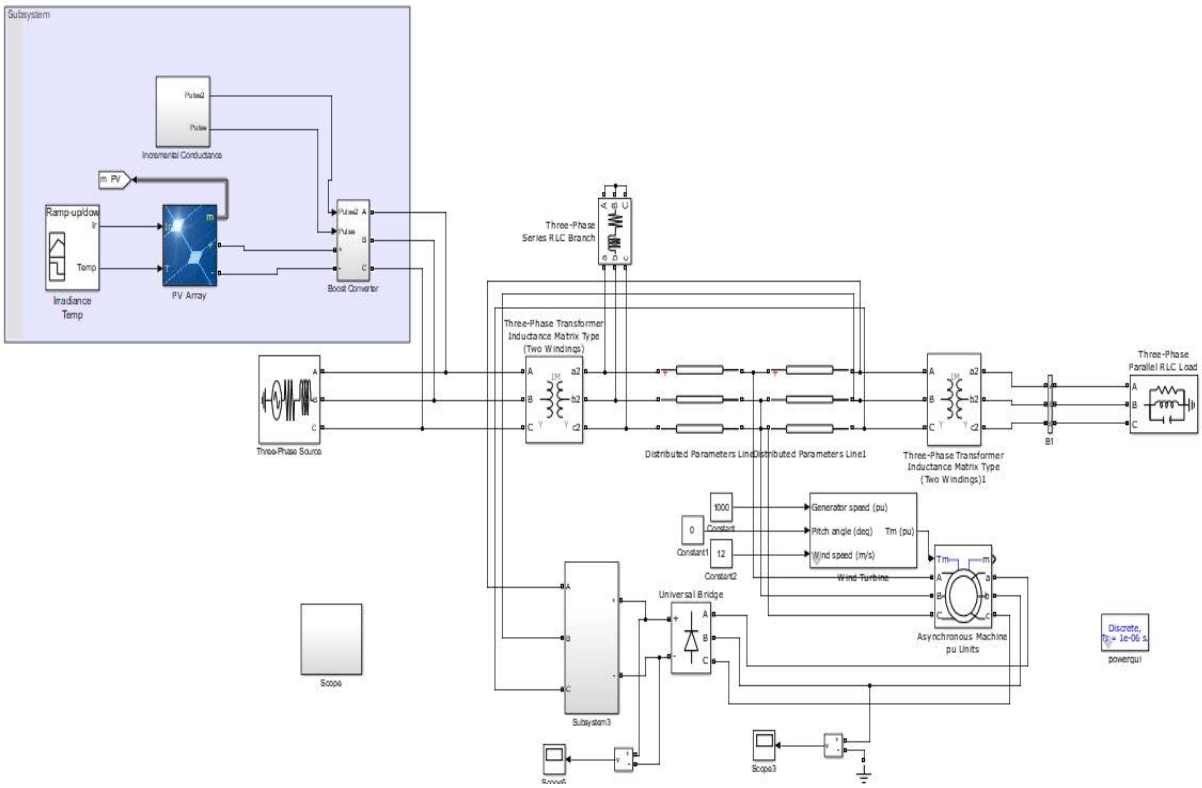

Fig 10: Simulation of Solar System and Wind Turbine

6.1 Three phase AC Voltage on Bus Bar (B1)

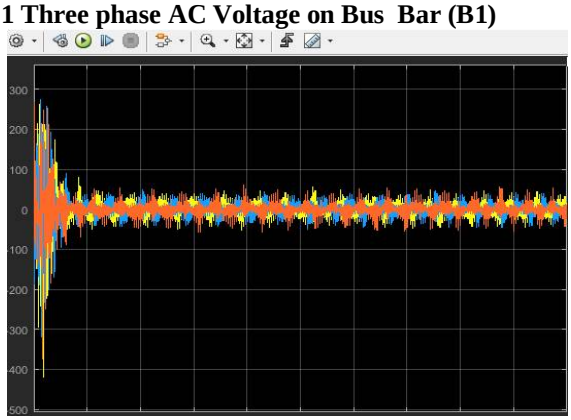

Fig 11: Three phase ac source voltage

6.2 PV panel Output

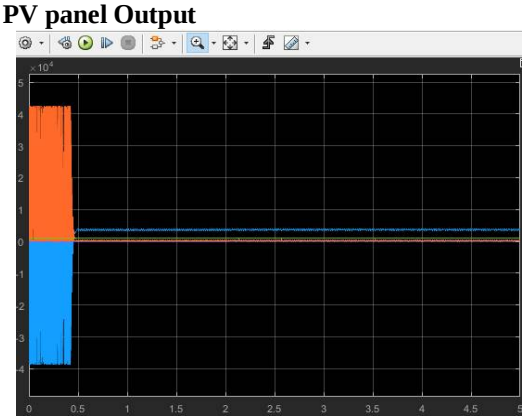

Fig 12: PV panel output

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6.3 Single phase AC voltage Asynchronous Machine

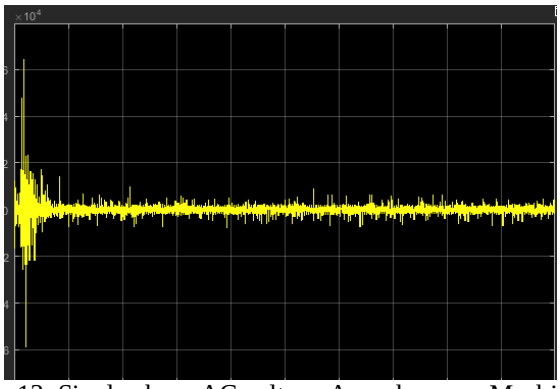

Fig 13: Single phase AC voltage Asynchronous Machine

6.4 PV panel Voltage Output

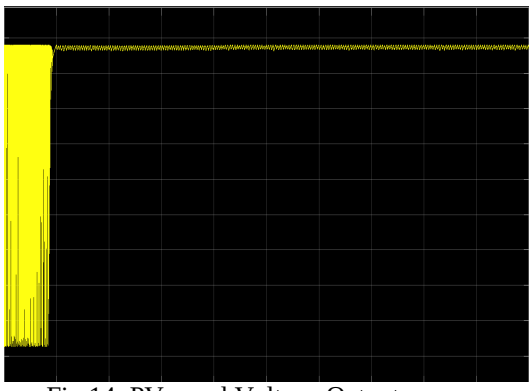

Fig 14: PV panel Voltage Output

V. CONCLUSION

Here, in this paper, we are fulfilling the requirement of the industry and domestic load. Main supply are coming from the thermal power plant who continuously flow supply. But Industry and domestic demand are higher than supply so that only main power supply can not fulfill its demand so that we are using wind turbine. Wind turbine can fulfill the demand but wind is not flowing always. When air flow in good speed then power can fulfill to require demand but some times air is not flowing in good speed. So that we are working on a solar system can fulfill the rest demand. Solar system can ability to fulfill_demand.

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