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Modeling of Hybrid Renewable Energy System

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Abstract: ***Wind power generation (VAWT) and solar power (PV) generation are combined to make a Modeling Of hybrid Renewable Energy Systems. A On Grid and 24v, 100Ah lead-acid battery is used to store solar power and charging is controlled by a charger circuit which has been discussed here. Power output of this hybrid system is depends on wind flow and power generated by solar cells. Today, the world is progressing at quit fast rate with the use of conventional source of energy. Now a day's electricity is most needed facility for the human being. All the conventional energy resources are depleting day by day and having disadvantages of using them are environmental pollution created by its use. So we have to shift from conventional to non-conventional energy resources. Many types of clean and renewable energy sources can be used in production of electrical energy. In this project the combination of two energy resources is takes place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system.***
Basically this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy into electricity and wind turbines are used for converting wind energy into electricity.
This electrical power can utilize for various purpose. Generation of electricity will be takes place at affordable cost. This project deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance.
Keywords: hybrid renewable energy systems; modeling and simulation; system dynamics; solar; wind.

I. INTRODUCTION

Energy is playing an important role in human and economic development. On of the driving forces for social and economic development and a basic demand of nation is energy. Most of the energy production methods are one-way, which requires change of form for the energy. In parallel to developing technology, demand for more energy makesus seek new energy sources.

In parallel to developing technology, demand for more energy makes us seek new energy sources. Researches for renewable energies have been initiated first for wind power and then for solar power. Efficiency of solar power conversion systems is ca. 18%, whilst that of wind power is ca. 55%. These efficiencies could be increased by 50% with beam tracking, beam focusing and wind direction adaptive motion methods. Reaching the non-electrified rural population is currently not possible through the extension of the grid, since the connection is neither economically feasible, nor encouraged by the main actors.

Further, the increases in oil prices and the unbearable impacts of this energy source on the users and on the environment, are slowly removing conventional energy solutions, such as fuel genets based systems, from the rural development agendas.

This problem can overcome by using "Modeling Of hybrid Renewable Energy Systems". Hybrid systems have proved to be the best option to deliver "high quality" power.

II. OBJECTIVE

The aim of this work is design and implementation of a solar-wind hybrid energy system. This work is expected to help to understand the basics of solar-wind hybrid power generation. A small part of the daily electricity consumption with an efficient utilization of solar and wind power. Here we made a hybrid system where the solar power is stored in a battery and the combination of battery output and wind power output fed to the load. Because of the availabilityof wind is through-out the day & night whereas solar power is only available in daylight and fora limited time, here we are not storing the wind power.

In brief, the objectives are:

1) Wind power generation
2) Solar power generation
3) Storage of generated solar power
4) To Design a suitable charger for battery
5) Make a wind-solar hybrid power system
6) Display electrical power output using a LED lighting.

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III. METHODOLOGY

A. Wind Power Generation:

There are basically two types of wind turbine available-

1) Vertical Axis Wind Turbine (VAWT)

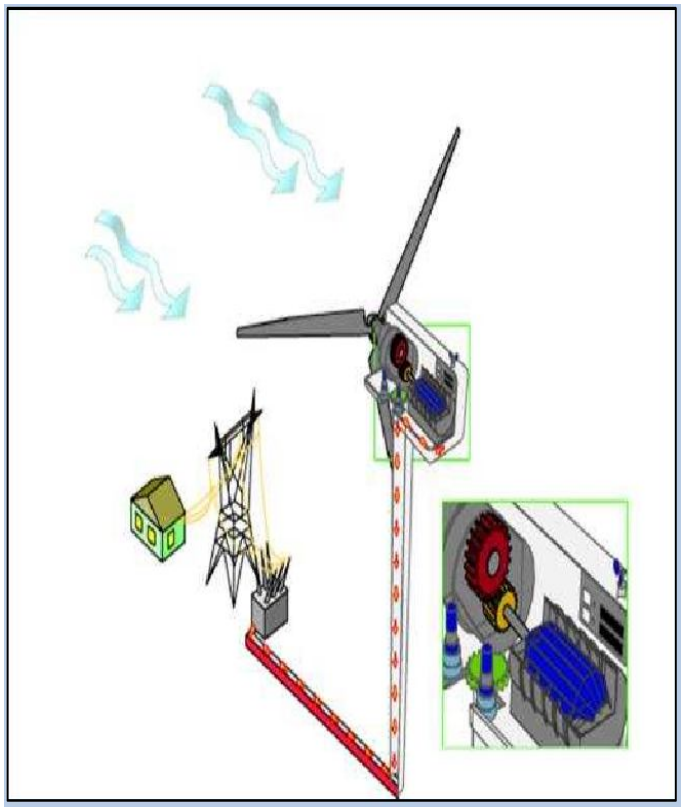
2) Horizontal Axis Wind Turbine (HAWT)

For wind power generation in our project we are using VAWT type wind mill.A very brief detail on VAWT has been highlighted here:

- Differential heating of the earth surface and atmosphere induces vertical and horizontal air currents that are affected by the earth's rotation and contours of the land and generates WIND.

- A wind turbine obtains its power input by converting the force of the wind into torque(turning force) acting on the rotor blades.

- The amount of energy which the wind transfers to the rotor depends on the density of the air, the rotor area, and the wind speed.



$P = 0.5 \times \rho \times A \times V3$

ρ = Air Density (kg/m)

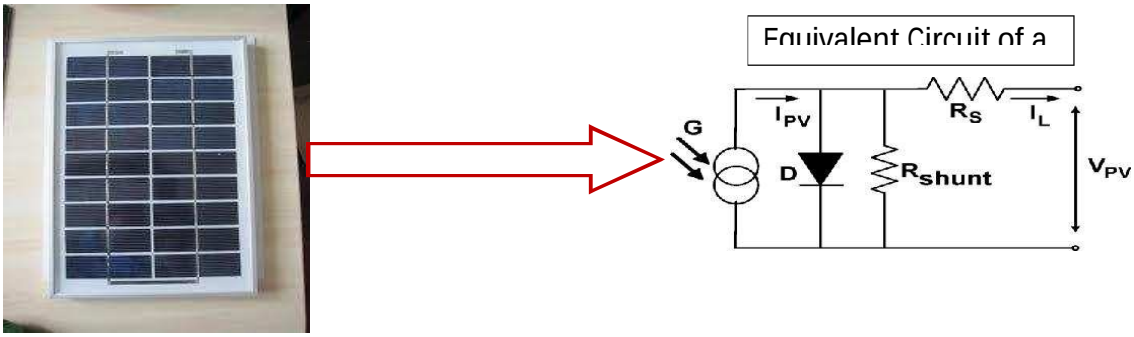
A = Blade Area -turbine (m)

V = Wind velocity (m/s)

P = Power

B. Solar-Power Generation:

The Solar Cell block represents a solar cell current source.The solar cell model includes the following components:

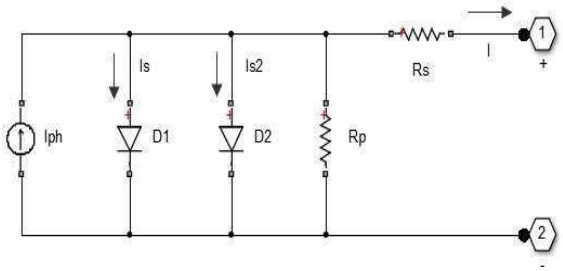


- Solar-Induced Current
- Temperature Dependence
- Thermal Port

1) Solar-Induced Current

The block represents a single solar cell as a resistance R_S that is connected in series with aparallel combination of the following elements:

- Current source
- Two exponential diodes
- Parallel resistor Rp



The output current I is:

$$I = I_{ph} - I_s * \left(e^{(V+I*R_s)/(N*V_t)} - 1\right) - I_{s2} * \left(e^{(V+I*R_s)/(N_2*V_t)} - 1\right) - \left(V + I*R_s\right)/R_p$$

where: Iph is the solar-induced current:

$$I_{ph} = I_{ph0} \times \frac{I_r}{I_{r0}}$$

where:

- Ir is the irradiance (light intensity) in W/m^2 falling on the cell.
- $Iph0$ is the measured solar-generated current for the irradiance $Ir0$.
- I_S is the saturation current of the first diode.
- I_{S2} is the saturation current of the second diode.

- *Vt* is the thermal voltage, *kT/q*, where:
- *k* is the Boltzmann constant.
- *T* is the Device simulation temperature parameter value.
- *q* is the elementary charge on an electron.
- *N* is the quality factor (diode emission coefficient) of the first diode.
- *N2 is the quality factor (diode emission coefficient) of the second diode.*
- *V is the voltage across the solar cell electrical ports.*
- *The quality factor varies for amorphous cells, and is typically 2 for polycrystalline cells.*
- *The block lets you choose between two models:*
- *An 8-parameter model where the preceding equation describes the output current.*
- *A 5-parameter model that applies the following simplifying assumptions to the preceding equation*
- *The* saturation current of the second diode is zero.

IV. BLOCK DIAGRAM

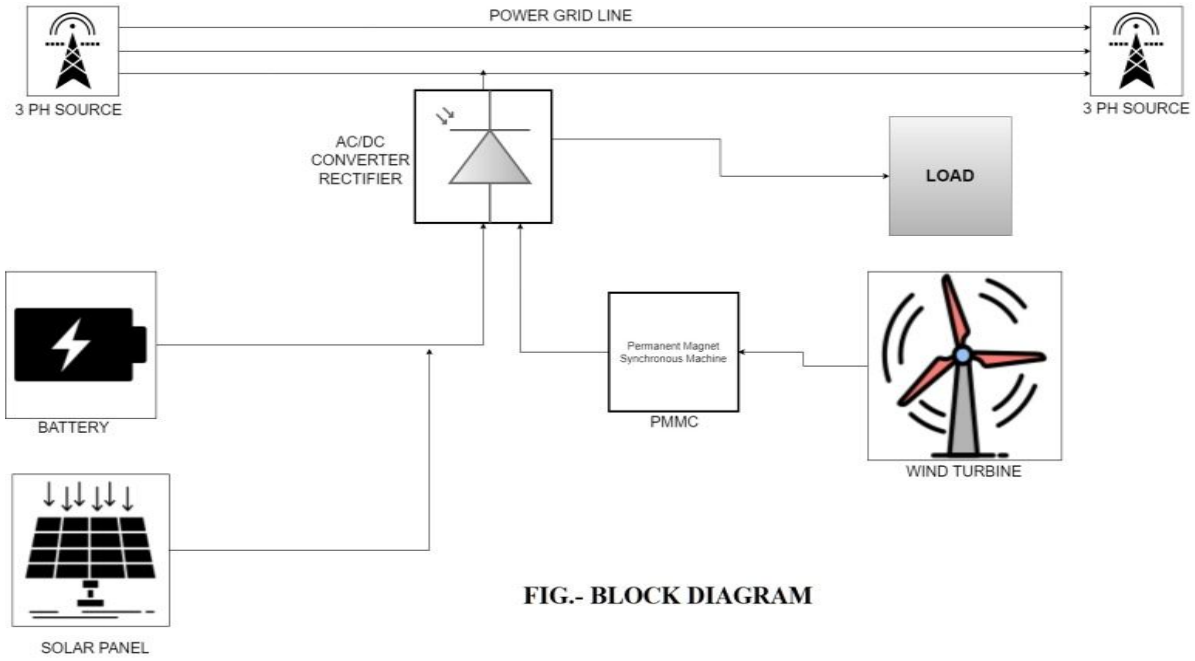


FIG.- BLOCK DIAGRAM

V. CALCULATION

A. Calculation For Wind Power Plant:-

When wind turbine start to rotate, Number of revolutions obtained=1
Average output Voltage = 12 V
Average output current = 0.15 Amp

Total power generation When wind turbine start rotate, Number of revolutions obtained =1
For 1 revolution, electricity generated = 12 V, 0.15 Amp

∴ For 1 revolution = 12 V x 0.15 Amp = 1.8 W
Consider, in one minute 5 times wind turbines are
rotated = 1.8 x 5 = 9 Watt.

∴ In 1 hour = 9x 60 = 540 watt
Consider that in a day, door is operated for 16 hours
∴ Power generated in a day
= 540x 16 = 5760 watt = 5.76 KW.

B. Calculation For Solar Power Plant:-

Maximum power of the solar panel is = 3WRated voltages=8.95 V, Rated current=0.34A
Therefore, generation can be obtained from solar power plant is 3.043W/min.We are getting the following result: 1.5 to 2.5 KW generation can be obtained from wind turbine power plant.

VI. WORKING

A. Solar Power Plant

Solar panel is use to convert solar radiation to the electrical energy. When the PV cell absorbs light, the energy of absorbed photon is transferred to the electron-proton system of the material, creating charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field, and circulate as current through an external circuit. Solar array or panel is a group of a several modules electrically connected in series parallel combination to generate the required current and voltage. Solar panels are the medium to convert solar power into the electrical power.

B. Wind Power Plant

In construction of wind power plant wind turbine, chain and sprocket, gear box, DC generator, shaft take very important role.
Wind energy is also one of the renewable energy source that can used for generating electrical energy with wind turbine coupled with generator. These system mainly consist of wind turbine, gear box and dc generator. Overall, when the wind is blowing, turbine are rotate, emf is induced which will cause a current flow. When shaft is rotate mechanism is rotate because mechanism is fixed on shaft. These rotary motion is converted into maximum rpm of the gear box, the generator is directly connected to the gear box, which is directly converted into electrical energy orgive the output.

C. Wind Turbine

Wind turbine is that system which extracts energy from wind by rotation of the blades of the wind turbine. Basically wind turbine has two types one is vertical and another is horizontal. As the wind speed increases power generation is also increases. The power generated from wind is not continuous its fluctuating. For obtain the non-fluctuating power we have to store in battery and then provide it to the load.

D. Dc Generator

Dc generator is a electrical machine that converts mechanical energy into an electrical energy. The principle is that whenever flux is cut by conductor, an emf is induced which will cause a current flow if the conductor circuitis closed.

E. Charge Controller

Charge controller has basic function is that it control the source which is to be active or inactive. It simultaneously charge battery and also gives power to the load. The controller has over-charge protection, short- circuit protection, pole confusion protection and automatic dump load function. It also the function is that it should vary the power as per the load demand. It add the both the power so that the load demand can fulfill. And when power is not generating it should extract power from battery and give it to the load.

F. Battery Bank

We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load.

VII. APPLICATION OF PROJECT

This project demonstrates the utilization of the renewable resource in an efficient way.

1) This type of generation can be used in remote places or for rural village Electrification where conventional power supply is uneconomic.
2) The power so generated can be effectively used for Street/domestic lighting and domestic appliances.

VIII. CONCLUSION

This project model can be implemented in rural areas where the power cut-off isregular. With some modification in wind-turbine part and increasing the no. solar panel andwattage this model can be utilized as stand-alone system specially in offshore- onshore where the speed of wind is adequate. By using a Power Converting Unit (PCU) this model can be utilized as a Grid-tiepower system.

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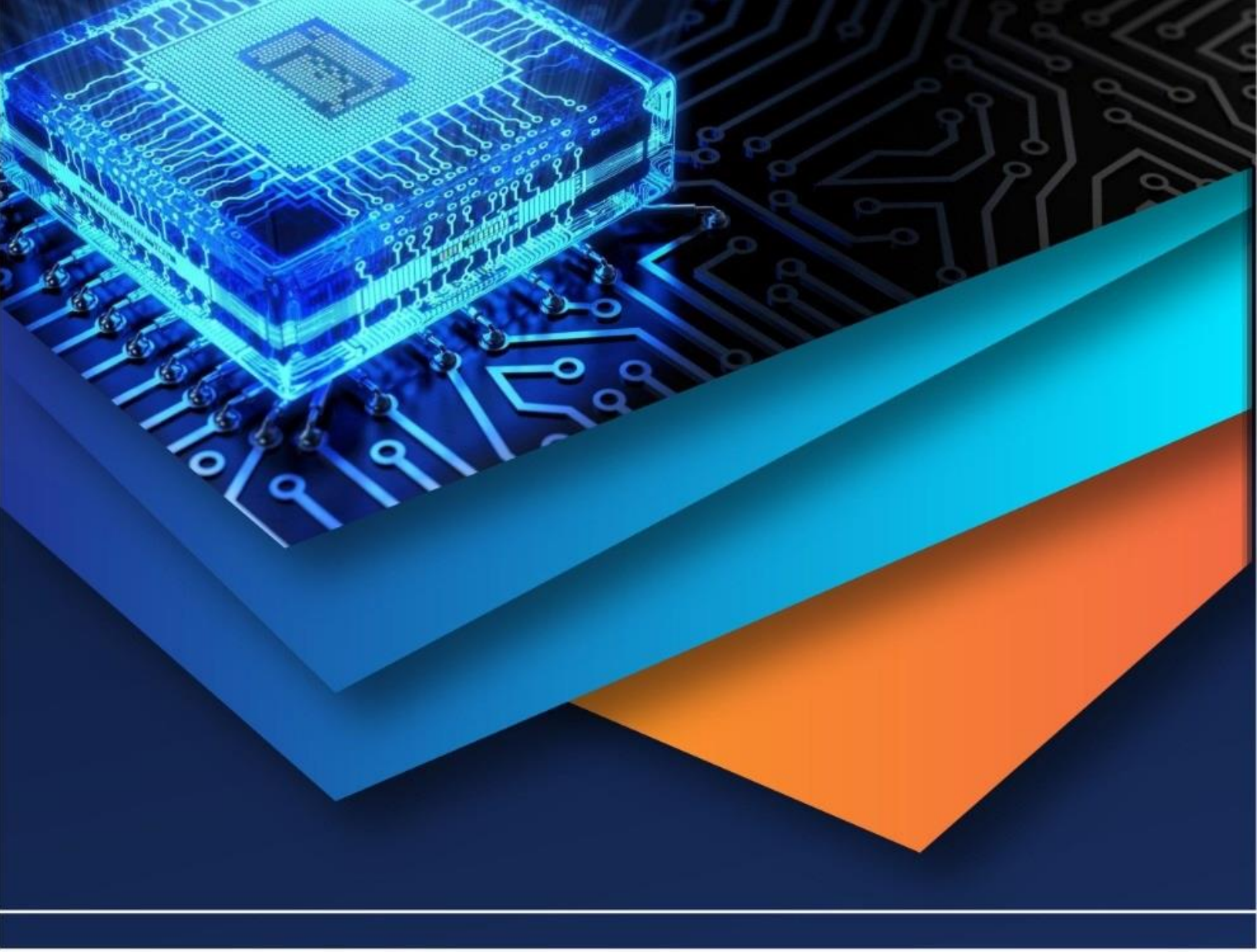

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