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Design and Fabrication of Hybrid Solar Wind Power Generation System

M. Arun[1], V. Muthu Kumar[2], S. Ram Rithik[3] , V.D.S.Ashwin[4]

1, 2, 3, Students III BE DEPARTMENT OF MECHANICAL ENGINEERING,
4 Faculty of Mechanical Engineering, Jayamatha Engineering College Aralvoimozhi.

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ABSTRACT: Renewable energy sources that is, energy generated from solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller. It ensures the optimum utilization of resources and hence improves the efficiency as compared with their individual mode of generation. Also it increases the reliability and reduces the dependence on one single source. This hybrid solar-wind power generating system is suitable for industries and also domestic areas.

I. INTRODUCTION

With increasing concern of global warming and the depletion of fossil fuel reserves, many are looking at sustainable energy solutions to preserve the earth for the future generations. Other than hydro power, wind and photovoltaic energy holds the most potential to meet our energy demands. Alone, wind energy is capable of supplying large amounts of power but its presence is highly unpredictable as it can be here one moment and gone in another. Similarly, solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc. The common inherent drawback of wind and photovoltaic systems are their intermittent natures that make them unreliable. However, by combining these two intermittent sources and by incorporating maximum power point tracking (MPPT) algorithms, the systems power transfer efficiency and reliability can be improved significantly. When a source is unavailable or insufficient in meeting the load demands, the other energy source can compensate for the difference.

II. OBJECTIVE

To reduce reliance on fossil fuels and increase the share of renewable energy resources, including intermittent ones, thus increasing the eco-efficiency of energy production and energy security. To bring together different generation, storage, and consumption technologies in a single system, improving the overall benefits compared to a system that depends on a single source. It is type of hybrid energy system consist of a photovoltaic array coupled with a wind turbine. This would create more output from the wind turbine during the winter, whereas during the summer, the solar panels would produce their peak output. The PV-wind hybrid system suits to conditions where sun light and wind has seasonal shifts. In summer the daytime is long and sun light is strong enough, while in winter the days are shorter and there are more clouds. Inverters can also provide a utility inter-tie between the system and the utility grid.

SYSTEM COMPONENTS

- A photo-voltaic solar-cell array
- A mast mounted wind generator
- Lead-acid storage batteries
- An inverter unit to convert DC power to AC power
- Electrical lighting loads and electrical heating loads

CHARGE CONTROLLER REGULATOR

- It prevents the PV array and wind turbine from over- charging the battery.
- Most modern controllers maintain system voltage regulation electronically by varying the width of DC pulses they send to the batteries

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(this is called pulse width modulation or PWM).

- Another category called "shunt type" controllers divert excess energy into a "shunt load.“
- A new generation of PV controllers has "maximum power point tracking." They take advantage of the maximum power available in the module by adjusting current and voltage.

DESIGN OF HYBRID ENERGY SYSTEM

Data required for Wind System

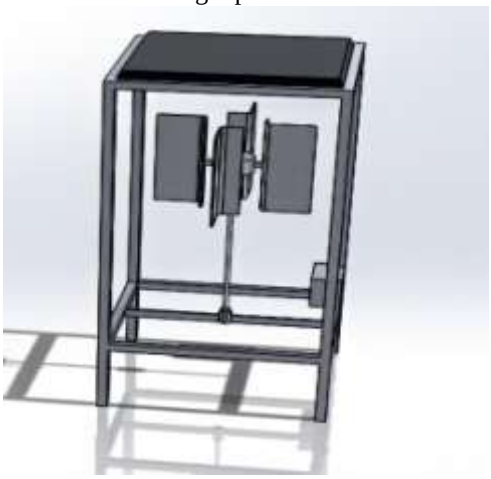
- Mean Annual Hourly Wind Speed (m/sec)
- Wind Power that can be generated from the wind turbine

This design includes following requirements.

- Solar panel
- Wind turbine
- Charge controller
- Battery bank
- Inverter

3D DESIGN

The design diagram of the hybrid system is done by CREO software the parts are first drawn separately and assemble into single part.



FABRICATION

The capacity of the panel are 20w and 18v , the alternator has 12v capacity and the battery has 12v capacity the frame of the hybrid system in made up of mild steel and the steels are weld jointed .The rest of the components are

S.No.	Description	Quantity
1	Motor	1 No
2	Rotor Gear	1 No
3	Solar Panel	1 No
4	Battery	1 No
5	Bolt & Nuts	10 Nos
6	Wires	15mtrs
7	Blades	10 Nos
8	Chassis Assembly	-
9	Miscellaneous Expenses	-

CALCULATIONS

The total power generated by this system may be given as the addition of the power generated by the solar PV panel and power generated by the wind turbine. Mathematically it can be represented as,

$$\mathbf{P_T = NW * Pw + Ns * P_S}$$

Where,

P_T is the total power generated

P_W is the power generated by wind turbines

P_S is the power generated by solar panels

N_W is the no of wind turbine

N_s is the no of solar panels used

CALCULATIONS FOR WIND ENERGY

The power generated by wind energy is given by,

Power = (density of air * swept area * velocity cubed)/2

$$\mathbf{P_W = ½.\ \rho\ (A_W)\ (V)^3}$$

Where,

P is power in watts (W)

ρ is the air density in kilograms per cubic meter (kg/m^3)

A_W is the swept area by air in square meters (m^2)

V is the wind speed in meters per second (m/s).

CALCULATIONS FOR WIND ENERGY

To determine the size of PV modules, the required energy consumption must be estimated. Therefore, the power is calculated as

$$\mathbf{P_S = Ins\ (t) * A_S * Eff(pv)}$$

Where,

Ins (t) = isolation at time t (kw/ m2)

A_S = area of single PV panel (m2)

Effpv = overall efficiency of the PV panels and dc/dc converters.

Overall efficiency is given by,

$$\mathbf{Eff(pv) = H * PR}$$

Where,

H = Annual average solar radiation on tilted panels.

PR = Performance ratio, coefficient for losses.

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III. RESULT ANALYSIS

According to the optimal solution the total energy required to satisfy the load demand by the hybrid combination. Below figures shows the monthly average electric production from wind energy and solar energy in graph format. Table shows the electric energy production from hybrid power generation using solar and wind.

	Hybrid Power Generation System PV & Wind
Period (sec)	0 to 0.3
Input Solar irradiations	20 W/m2
Input Wind Velocity	8 m/s
Voltage (V)	11.5
Current (A)	1.4
Power (W)	16

APPLICATIONS

- Hotels
- Business (Institutions and Government)
- Large Estate Houses
- Factories and manufacturing facilities
- Commercial Power generation

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