International Journal of Engineering Research and Development
eISSN : 2278-067X, pISSN : 2278-800X, www.ijerd.com
Volume 4, Issue 8 (November 2012), PP. 64-68

A Hybrid System (Solar and Wind) Energy System for Remote Areas

Mr. Sthita Prajna Mishra[1], Dr.S.M.Ali, Ms. Prajnasmita Mohapatra, Ms. Arjyadhara Pradhan
Research Scholar[1] Associate Professor Research Scholar Asst. Professor
School Of Electrical Engineering, KIIT University, Bhubaneswar, India

Abstract:—One of the primary needs for socio-economic development in any nation in the world is the provision of reliable electricity supply systems. This work is a development of an indigenous technology hybrid Solar -Wind Power system that harnesses the renewable energies in Sun and Wind to generate electricity. Here, electric DC energies produced from photovoltaic and wind turbine systems are transported to a DC disconnect energy Mix controller. The controller is bidirectional connected to a DC-AC float charging-inverter system that provides charging current to a heavy duty storage bank of Battery and at the same time produces inverted AC power to AC loads. In the designed model, solar PV module along with a wind turbine, the small prototype to create power. The hybrid setup could be operated in manual and automatic modes. The former mode consists of a RF transmitter and receiver setup and the latter is effectively controlled by means of a microcontroller. The entire setup can be extended for larger loads in order to electrify remote and inaccessible areas. Further, the project can be implemented in industrial and domestic sectors on a larger scale.
Keywords*:—*Solar PV tracking system, reflectors, wind sensor, Socio –Economic development, Nigeria, Hybrid system, Solar and Wind Power.

I. INTRODUCTION

One of the primary needs for socio-economic development in any nation in the world is the provision of reliable electricity supply systems. These rural dwellers are mostly farmers whose socio-economic lives can only be improved when provisions are made to preserve their wasting agricultural products and provide energy for their household equipment such as refrigerator, fan, lighting etc. There is also such a need to provide electricity for e-information infrastructures in our rural communities to service school, rural hospital, rural banking and rural e-library. Hence, there is the need to develop an indigenous technology to harness the renewable energies in Sun and Wind to generate electricity. Hence, there is the need to develop an indigenous technology to harness the renewable energies in Sun and Wind to generate electricity. In the recent years, photo voltaic power generation has been receiving considerable attention as one of the more promising energy alternative. The reason for this rising interest lies in the direct conversion of sunlight into electricity. Photo voltaic energy conversion is one of the most attractive non conventional energy sources of proven reliability from the micro to mega watt level. The wide spread use of PV generation is however mainly hampered by economic factors. Efforts are being made worldwide to reduce the cost/watt through various technological innovations. Wind energy also is equally and effectively used in large scale wind farms to provide electricity to rural areas and other far reaching locations. Wind energy is being used extensively in areas like Denmark, Germany, Spain, India and in some areas of the United States of America. It is one of the largest forms of Green Energy used in the world today.

II. IMPORTANCE OF RENEWABLE ENERGY

The global search and the rise in the cost of conventional fossil fuel is making supply-demand of electricity product almost impossible especially in some remote areas. Generators which are often used as an alternative to conventional power supply systems are known to be run only during certain hours of the day, and the cost of fueling them is increasingly becoming difficult if they are to be used for commercial purposes. There is a growing awareness that renewable energy such as photovoltaic system and Wind power have an important role to play in order to save the situation. Figure 1 is the schematic layout of Solar-Wind Hybrid system that can supply either dc or ac energy or both.

2.1 Solar Systems

There are two types of solar systems; those that convert solar energy to D.C power, and those that convert solar energy to heat.

2.2 Solar-generated Electricity – Photovoltaic

The Solar-generated electricity is called Photovoltaic (or PV). Photovoltaic are solar cells that convert sunlight to D.C electricity. These solar cells in PV module are made from semiconductor materials. When light energy strikes the cell, electrons are emitted. The electrical conductor attached to the positive and negative scales of the material allow the electrons to be captured in the form of a D.C current. The generated electricity can be used to power a load or can be stored in a battery. Photovoltaic system is classified into two major types: the off-grid (stand alone) systems and inter-tied system. The off-grid (stand alone) systems are mostly used where there is no utility grid service. It is very economical in providing electricity at remote locations especially rural banking, hospital and ICT in rural environments. PV systems generally can be much cheaper than installing power lines and step-down transformers especially to remote areas. Solar modules produce electricity devoid of pollution, without odour, combustion, noise and vibration. Hence, unwanted nuisance is completely eliminated. Also, unlike the other power supply systems which require professional training for installation expertise, there are no moving parts or special repairs that require such expertise.

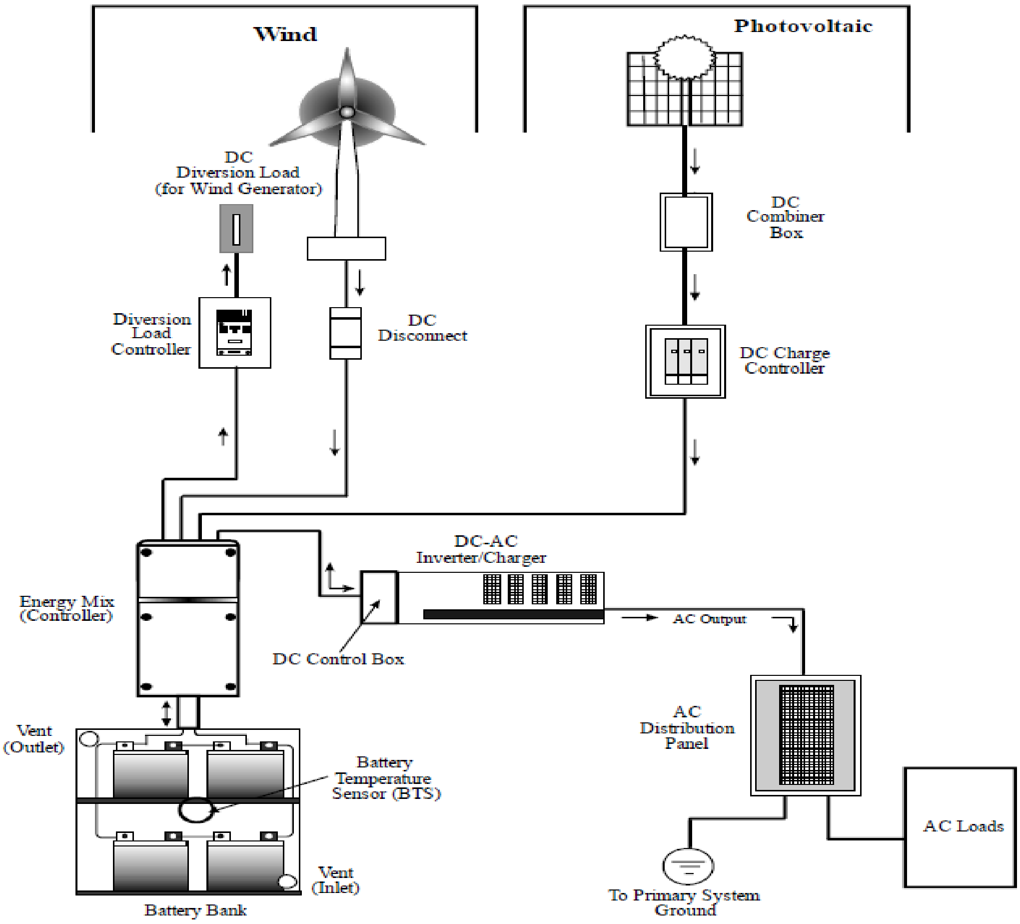

Figure 1: Schematic diagram of Hybrid (Renewable) Solar – Wind Power Source

Its advantages are:

1. Absence of moving part
2. Ability to function unattended for long periods
3. Modular nature in which desired current, voltage and power level can be obtained by mere integration
4. Long effective life and high reliability

The wide spread use of PV generation is however mainly hampered by economic factors. Efforts are being made worldwide to reduce the cost/watt through various technological innovations.

In the past 30 years, solar photovoltaic cells have increased in efficiency and the price levels have improved dramatically. Today the theoretical efficiency of a solar PV cell can be 25% - 30 % and a practical efficiency around 17%. Any improvement in efficiency of solar energy system will make a big difference in the use of solar panel. Developments are also taking place in finding new PV cells which can withstand high concentration of light and heat and produce more output per unit area. Small concentrating reflectors of a few cms across provide considerable concentration on cells made of special material and a number of such small concentrating units can be assembled to form a bigger panel. The panel as a whole is mounted suitably and tracking arrangements are made. In this work a simpler system of only one reflector on either side positioned at optimum angle is used which is found to enhance the light collection of conventional panels considerably and can be readily adopted in a wide scale. The elevation angle of sun remains almost invariant in a month and various very little in a year. Therefore single axis position control scheme may be sufficient in most of the application where economy and ease of maintenance are important

2.3 Basic Components of Solar Power

The major components include P.V modules, battery and inverter. The most efficient way to determine the capacities of these components is to estimate the load to be supplied. The size of the battery bank required will depend on the storage required, the maximum discharge rate, and the minimum temperature at which the batteries will be used. When designing a solar power system, all of these factors are to be taken into consideration when battery size is to be chosen. Lead-acid batteries are the most common in P.V systems because their initial cost is lower and also they are readily available nearly everywhere in the world. Deep cycle batteries are designed to be repeatedly discharged as much as 80 percent of their capacity and so they are a good choice for power systems. Figure 2 is a schematic diagram of a typical Photovoltaic system.

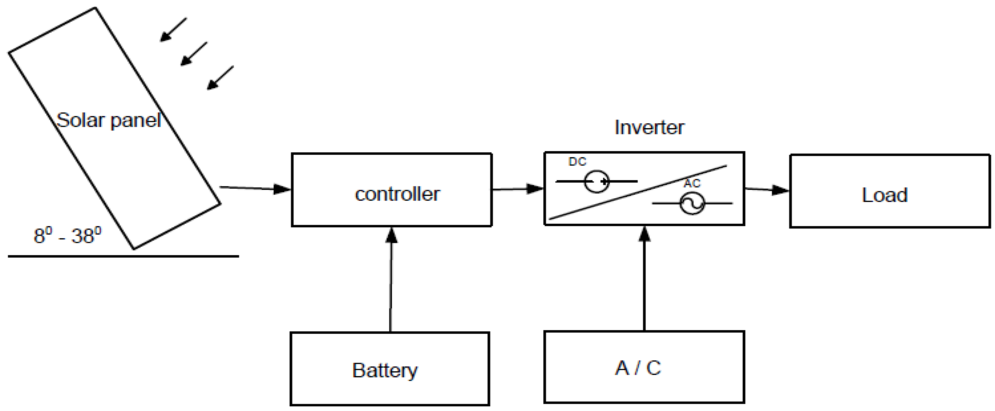

Figure 2: *Photovoltaic System*

2.4 Design of the Reflectors

Each reflector is inclined at 60 degree to the plane of the panel. The width of the reflector is equal to the width of the solar panel and the length matches that of solar panel. The tracking ensures that the plane of the panel is always perpendicular to the sun's rays. This arrangement enables the light falling at the tip of the reflector to reach the edge of the panel and the all other reflected rays falling within the width of the panel. Thus there is no wastage and the collection efficiency is maximized. Theoretically this should double the light collection. It enables realization of the full potential of the panel.

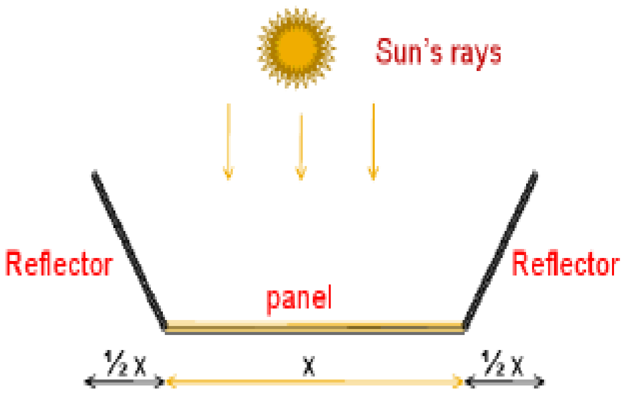

Fig:3 *Reflector Design*

III. WIND POWER

Wind Power is energy extracted from the wind, passing through a machine known as the windmill. Electrical energy can be generated from the wind energy. This is done by using the energy from wind to run a windmill, which in turn drives a generator to produce electricity [6]. The windmill in this case is usually called a wind turbine. This turbine transforms the wind energy to mechanical energy, which in a generator is converted to electrical power. An integration of wind generator, wind turbine, aero generators is known as a wind energy conversion system (WECS)

3.1 Wind tracking system

The distinguishing factor of wind tracking system is the usage of a wind sensor that identifies the direction along which the maximum intensity of the wind flows. The sensor itself is a small windmill whose output is in terms of milli volts. The maximum output value of the sensor is considered as the point of higher intensity of wind flow by the microcontroller and the wind mill is shifted toward the required direction. Thus the wind mill is rotated along the direction where maximum wind flows. A model of wind turbine is chosen, the model is an upwind and three blades turbine.

3.2 Component of a wind energy project

Modern wind energy systems consist of the following components:

- A tower on which the wind turbine is mounted;
- A rotor that is turned by the wind;
- The nacelle which houses the equipment, including the generator that converts the mechanical energy in the spinning rotor into electricity.

The tower supporting the rotor and generator must be strong. Rotor blades need to be light and strong in order to be aerodynamically efficient and to withstand prolonged used in high winds.

3.3 Wind Turbine

A wind turbine is a machine for converting the kinetic energy in wind into mechanical energy. Wind turbines can be separated into two basic types based on the axis about which the turbine rotates. Turbines that rotate around a horizontal axis are more common. Vertical-axis turbines are less frequently used. Wind turbines can also be classified by the location in which they are used as Onshore, Offshore, and aerial wind turbines.

3.4 Wind Power Modeling

The block diagram in figure 3 shows the conversion process of wind energy to electrical energy.

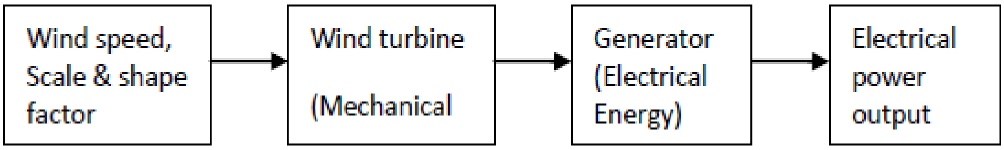

Figure 3: Energy conversions from Wind to Electrical

IV. APPLICATION AND FUTURE SCOPE

APPLICATIONS:

- Islanded system (remote areas)
- Hybrid vehicle (fuel less)
- Industrial power saver
- Distributed power generation

ADVANTAGES:

- Green, environment friendly
- Efficiency improvement
- Higher output power
- Economical benefits
- User friendly control
- Less interrupted continuous power

V. CONLUSION

In this work the collection of the solar panel was enhanced by 68.5% from that of the single panel with the help of reflectors and tracking. Further energy obtained using the windmill with addition of dedicated wind sensor and altered design together adds to an increase in the efficiency by an overall margin of above 50%. The working model of the hybrid system was successfully implemented and demonstrated. It is shown to be highly attractive economically. There is a strong case for providing new solar panel installations with reflectors and tracking arrangement along with the windmill with sensors in view of the above advantage. The provision of hybrid solar -wind energy system to power ICT infrastructures, banking and hospitals in rural and the unreached communities that are not connected to National Grid Power supply system is very important so as to maintain a continuous electricity supply.When considering the cost and overall efficiency, it is advisable for all the stakeholders who have concern for the rural community development to embrace solar and wind power.

REFERENCES

[1]. I. A. Adejumobi, A. A. Esan, and A. B. Okunuga "Discovering Potential sites for Small Hydro Power (SHP) in Nigeria", *Journal of Advanced Material Research*, Trans Tech Publication, Switzerland. **18-19,** 93- 97(2007) ; (online at {http://www.scientific.net).

[2]. L, Fagbile ."Estimation of Total Solar Radiation in Nigeria Using Metrological, Nigeria *Journal of Renewable Energy* **1**,1-10. (1990)

[3]. M.B. Olajide and J.O. Oni "Application of Solar Energy for offices and homes,Workshop Seminar Paper, International Training School and Workshop on Solar Energy, organized at University of Agriculture, Abeokuta,9th-11th June, 18-29. (2009),

[4]. E.E. Iheonu, F.O. A. Akingbade, M. Ocholi Wind Resources Variations over selected sites in the West African sub-region. *Nigerian J. Renewable Energy*, **10**, 43-47(2002).

[5]. B.K. Gupta . Wiebull Parameters for Annual and Monthly Wind Speed Distributions for Five Locations in India, *Solar Energy*. **37**, 469-477. (1986)

[6]. C.G. Justus, W.R. Hargraves, and A. Yalcin, Nationwide assessment of potential output from wind power generators, *J. Appl. Meteor*. **15**, 673-678. (1976)

[7]. S.O. Enibe. A Method of Assessing the Wind Energy Potential in a Nigerian Location. *Nigerian Journal of Solar Energy*. **6**, 14-20. (1987)

[8]. Piao, Z.G.Park, J.M.Kim, J.H.Cho, G.B.Baek, H.L.,(2500) "A study on the tracking photovoltaic system by program type," page(s):971-973 Vol.2

[9]. Pritchard,"Sun tracking by peak power positioning for photovoltaic concentrator arrays," IEEE Control Systems Magazine, Volume3, Issue 3, August 1983, pp.2-8