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HYBRID POWER SYSTEM USING SOLAR & WIND

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ABSTRACT

Energy is fundamentally the ability to do work. The society came about to be as complex and modernized as it is due to evolutionary paths taken in energy conversion from one form to another. The world is however majorly concerned of the utilities to reduce the emissions from electricity generating plants by employing renewable energy and to supply and at a low cost electricity to remote areas. Hybrid power systems provide such solutions due to the employment of renewable energy (RE) that are freely available in nature, readily available and environmental friendly reducing greenhouse emissions. A remote area in western Kenya, Shinakotsi, is selected as a case study. The stand-alone hybrid power system employs solar and wind energy to generate electricity and batteries as a back-up system. The system components and specifications are arrived at after load assessment is done and the solar insolation and wind speed data are obtained. The micro grid is expected to provide stable electricity supply to the area throughout the year at minimal cost and be environmental friendly.

Index term: HYBRID POWER, SOLAR & WIND, Renewable Energey

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I. INTRODUCTION

Solar energy and wind energy have been deemed clean, inexhaustible, unlimited, and environmental friendly. Such characteristics have attracted the energy sector to use renewable energy sources on a larger scale. However, all renewable energy sources have drawbacks. Wind and solar sources is dependent on unpredictable factors such as weather and climatic conditions. Due to both sources, complementary nature, some of the problems can be overcome the weaknesses of one with the strengths of the other. This brings us to the hybrid solar-wind power plant concept. Hybrid energy station shave proven to be advantageous for decreasing the depletion rate of fossil fuels, as well as supplying energy to remote rural areas, without harming the environment. The main objective of this paper is to assess the feasibility and economic viability of utilizing hybrid Solar– Wind–battery based standalone power supply systems to meet the load requirements.

SOLAR ENERGY

Solar energy is energy from the Sun. It is renewable, inexhaustible and environmental pollution free. Nigeria, like most other countries is blessed with large amount of sunshine all the year with an average sun power of 490W/m2 /day. Solar charged battery systems provide power supply for complete 24hours a day irrespective of bad weather. Moreso, power failures or power fluctuations due to service part of repair as the case may be is nonexistent.

WIND ENERGY

Wind is a natural phenomenon related to the movement of air masses caused primarily by the differential solar heating of the earth's surface. Seasonal variations in the energy received from the sun affect the strength and direction of the wind. The wind turbine captures the winds kinetic energy ina rotor consisting of two or more blades mechanically coupled to an electrical generator. The turbine is mounted on a tall tower to enhance the energy capture.

HYBRID ENERGY SYSTEM

The Word hybrid means something which is made by the combination of more than one element. In energy system the electricity can be generated by more than one source at a time like Wind, solar, biomass etc. There are various module to generate hybrid energy like wind-solar hybrid, Solar-diesel, Wind- hydro and Wind–diesel. Among the above hybrid energy generation module the wind-Solar hybrid module are more important because it is abundant in nature and it is very much environment friendly. Hybrid energy generation is more important because the wind not floe continuously and sun radiation is only present approx. 8 to 10 hours in a day. So for continuous power it is important to hybridize the solar and wind power with the storage batteries. The hybridization in India has large prospect because over 75 % of Indian household face the problem like power cut specially in summer.

II. BLOCK DIAGRAM DESCRIPTION

The block diagram of the hybrid power generation system using wind and solar power includes the following blocks.
1. Solar panel
2. Wind turbine
3. Charge controller
4. Battery bank
5. Inverter

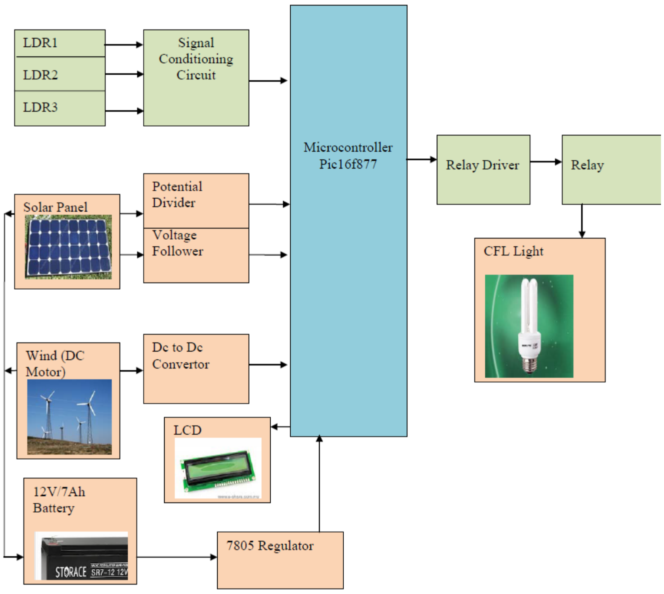

Fig 1. Block diagram

1. Solar panel
Solar panel is use to convert solar radiation to the electrical energy. The physical of PV cell is very similar to that of the classical diode with a PN junction formed by semiconductor material. When the junction absorbs light, the energy of absorbed photon is transferred to the electronproton 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.

2. 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.

3. 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 dumpload 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

4. Battery Bank
We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load for calculating the battery bank size we need to find following data
1.Find total daily use in watt-hour (Wh).
2.Find total back up time of the battery For increase in battery bank size we need to connect cell in series so that we can get the larger battery bank size.

5. Inverter
We have to choose greater rating inverter than the desired rating .The pure sign wave inverter is recommended in other to prolong the lifespan of the inverter. Inverter is need to convert DC power into AC power. As our load working on the AC supply so we need to convert DC power. The input voltage Output voltage and frequency, and overall power handling depends on the design of the specific device or the circuitry. The inverter does not produce any power. The power is provided by the DC source.

III. METHODOLOGY AND CALCULATION

1. Wind and solar resource assessment

2. Determination of system load and energy input required

3. Design of PV system

4. Design of WTG system

5. Determination of the battery storage required

6. Coupling of the PV and WTG systems

Calculation:

Circuit Component Details

Step Down Transformer – 9V,500A
Bridge IC
Voltage Regulator IC 7805.
C1 = 1000uF/25V- Electrolytic Capacitor
C2, C4 = 0.1uF- Ceramic Capacitor
C3 = 220uF/25V - Electrolytic Capacitor

Transformer Design

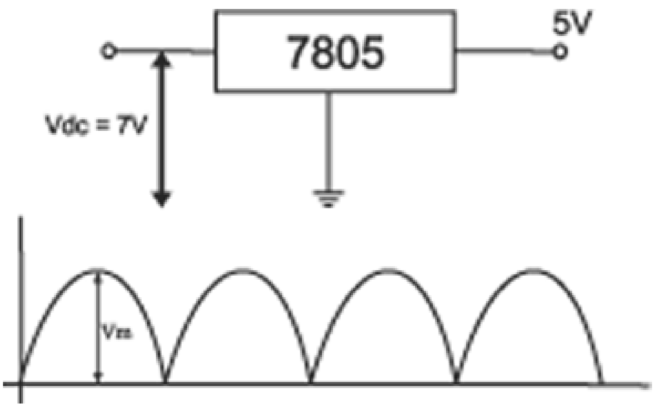

Fig. Waveform of Transformer Design

We require 5V at the o/p of the regulator.
The drop out voltage of the regulator is 2V as per the data sheet.

VDC = 5+2 = 7V

So at the regulator input, the voltage applied should be of 7V.
According to the formula,
VDC = 2Vm/Pi
Assuming there is no ripple Capacitor from

Vm= Vdc .pi/2
=7 x 3.14)/2
=10.99V

Vm= 10.99V
During one cycle, two diodes are conducting.
Drop out voltage of one diode = 0.7V
Drop out voltage of two diode = 1.4V
Vim = Vm+ 1.4V
=10.99+1.4
= 12.39V
Vim=12.39V
Vrms = Vim/sqrt (2)
= 12.39/sort (2)
= 8.76V
Vrms = 8.76V
So we select transformer of 9V.
Similarly,
Im=Idc x pi/2
Im=400m x 3.14/2
= 628A.
Irms= Im/sqrt (2)
= 628mA/sqrt (2)
= 444.06A
Irms = 444.06A
So we select the transformer of current rating 500A.

Considering the above transformer rating.
We take the transformer of 0-9V/500mA

TRANFORMER –0-9V/500mA Step- down transformer.

Rectifier Design

PIV of diode = Vm = 12.39V
Im= 628mA

BRIDGE RECTIFIER -So, we select the bridge IC of 1A rating.

Filter Capacitor Design

Fig. Waveform of Filter capacitance Design

R = Vdc/Idc
= 7 / 400m
= 17.5Ω

Vr = 2(Vim – Vdc)
= 2(12.39 – 7)
= 10.78V
C = Vdc/ (FxRxVr)
= 7/ (100x17.5x10.78)
= 371.05uF

So for Safe working we select capacitor of 1000uF
C = 1000uF / 35V
C1= 1000uF/35V Electrolytic Capacitor.
C2, C4 = 0.1uF Ceramic Capacitor C3 = 220uF/25V Electrolytic Capacitor.

IV. CIRCUIT DIAGRAM

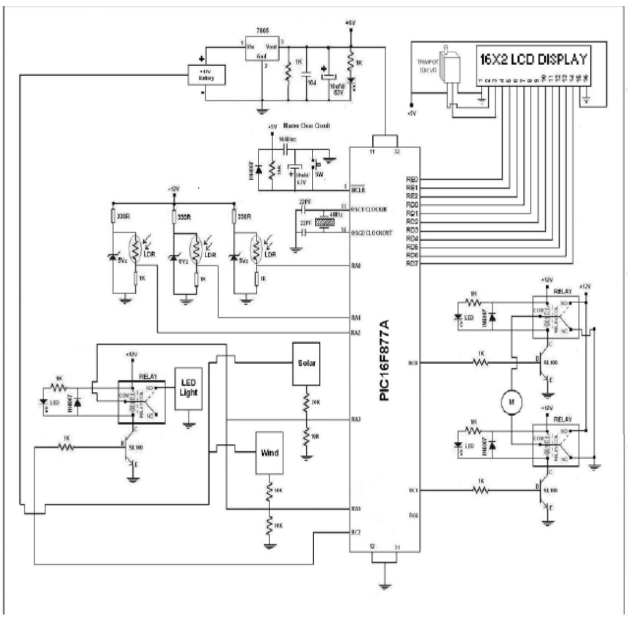

Fig 2. Circuit diagram

V. RESULT AND DISCUSION

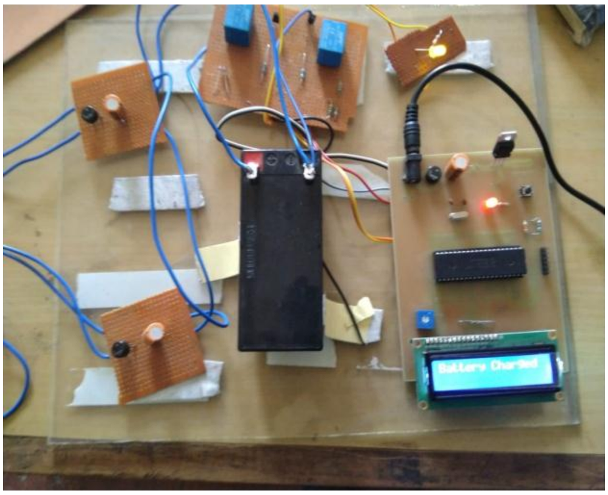

Fig. 3. Charging circuit

Fig 4. Project setup

VI. FUTURE SCOPE

India ranks fifth in the world in wind power generation at 9600 MW. The coastal region and some parts of Gujarat and Rajasthan in India witness very favourable wind regime, and therefore, the wind power development in these areas has been significant. For commercial exploitation of wind energy, wind velocity at a site should be more than 6 meter per second and corresponding wind power density more than 200 watt per meter sq. In Northern India such high wind velocities are found only on high hilly regions where installation of large scale wind power projects is itself not feasible due to lack of infrastructure. Haryana has a very limited sub mountainous region on the foot hills of the Shivalik range in the northern part of the State and in south Haryana there are mainly the Arawali hills.Wind monitoring carried out by Haryana Renewable Energy Development Agency (HAREDA) through Centre for Wind Energy Technology(CWET) during 1998-99, indicated that the wind velocity at Morni(Panchkula) and Abheypur (Gurgaon) at 25 meter above ground level was 14.9-20.9 kmph and 12.5-17.12 kmph for for considerably long period in a year. Promoting wind energy in Haryana was a real challenge with technological barriers in such low wind speed areas. It was then mooted that Haryana should go for a small wind energy system which requires average wind velocity of 4 m/s.

VII. CONCLUSION

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 user and on the environment, are slowly removing conventional energy solutions, such as fuel genset based systems, from the rural development agendas. Therefore, infrastructure investments in rural areas have to be approached with cost competitive, reliable and efficient tools in order to provide a sustainable access to electricity and to stimulate development. Renewable energy sources are currently one of the most, if not the only, suitable option to supply electricity in fragmented areas or at certain distances from the grid. Indeed, renewable are already contributing to the realization of important economic, environmental and social objectives by the enhancement of security of energy supply, the reduction of Green house gases and other pollutants and by the creation of local employment which leads to the improvement of general social welfare and living conditions. Hybrid systems have proved to be the best option to deliver "high quality" community energy services to rural areas at the lowest economic cost, and with maximum social and environmental benefits. Indeed, by choosing renewable energy, developing countries can stabilize their CO2 emissions while increasing consumption through economic growth.

REFERENCES

[1] J. BhagwanReddey, D.N. Reddy, "Probablistic Performance Assessment of a Roof Top Wind, Solar Photo Voltaic Hybrid Energy System", Engineering Science and Education Journal, Vol. 2, No. 4, pp. 281-298, February 2008.

[2] Stanley R. Bull, "Renewable Energy Today and Tomorrow", Proceedings of the IEEE, vol. 89, no. 8, pp. 316-381, August 2001.

[3] R.Chedid& H. Akiki, "A decision Support Technique for the Design of Hybrid Solar -Wind Power System", IEEE Transaction of Energy Conversion, Vol. 13, No.1,pp. 154-176, March 1998.

[4] RiadChedid&SafurRahman, "Unit Sizing and Control of Hybrid Wind Solar Power Systems", IEEE Transaction of Energy Con version, Vol. 12, No. 1, pp. 181-195, March 1997.

[5] Rajesh Gopinath, Sangsun Kim, Jae-Hong Hahn, Prasad No. Enjeti, Mark B. Yeary and Jo W. Howze, "Development of a Low Cost Fuel Cell Inverter System

with DSP Control", IEEE Transaction on Power Electronic Vol 19, No. 5 pp.654-854,Sept. 2004.

[6] Jin Wang, Fang Z. Peng, Joel Anderson, Alan Joseph and Ryan Buffen Barger, "Low System for Residential Power Generation", IEEE Transaction on Power Electronics, pp.660-687, Vo. 19, No. 5, Sept2009.

[7] Dr. RecayiPecen, Dr. MD Salims, Dr. Marc Timmerman, "A Hybrid Sola-wind Power Generation System as an Instructional Resource for Industrial Technology Students", Vol. 16, No. 3, pp. 565-600, May/July 2000.

[8] Sunny W. Y. Tam and Tom Chang, , "Kinetic Evolution and Acceleration of the Solar Wind", Geophysica l research letter, Vol. 26, No. 20, pp. 3189- 3192, October 1999.

[9] Yvonne Coughlan, Paul Smith, Alan Mullane, Member, IEEE and Mark OMalley, " Wind Turbine Modelling for Power System Stability Analysis –A system operator Perspective", IEEE Transaction on Power System, Vol. 23, No. 3, pp. 345-375, August 2007.

