INTEGRATED MULTI UTILITY HYBRID MODULE FOR ISOLATED HOUSEHOLDS IN REMOTE VILLAGES

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ABSTRACT

India will be the 3rd largest energy consumer in the world by 2030. The present power position in India is alarming as there are major power shortages in almost all the states and grid failures occur due to overdraw of power by the interconnected grids. There is a huge widening gap between demand and supply. The resources like coal, oil utilized till date are depleting at a rapid rate and costs increasing with global price rise in terms of dollars. In addition there are concerns of global warming. In isolated terrains and hilly areas laying of transmission towers and lines could be difficult and costly.

To improve the standard of living and to ensure better quality power to isolated households in inaccessible areas, renewable sources like wind & solar are to be exploited to their full potential. India being a tropical country, most of the areas receive 4 to 7 kWh/m2 energy 9 months of the year. Hence solar based PV systems are proving more attractive with their lower payback periods. In general, as the most of the household utilities work on ac system, there has been an inversion from the dc power produced by the solar PV panel and then utilized, which reduces the overall efficiency of the system by more than 20%. In this direction, we developed an integrated model which can provide an efficient electric supply system by connecting dc based utilities.

Keywords: Solar PV Panel LED Light, Dc Fan, Inversion.

I INTRODUCTION

Energy plays an important role in the development of any Nation**.** The standard of living of any economy is reflected by its per capita energy consumption. Per capita power consumption of India is 778.71 Kwh whereas it is 8000-10000Kwh in developed nations. India has 80,000 villages that need to be electrified and 25000 have no chance of being connected to power grid in conventional way. Electricity in the modern century is the most important infrastructure which contributes to the economic activities, development in agriculture and industrial sector. Population and industrial growth have led to significant increases in power consumption over the past 3 decades. Natural resources like coal, petroleum and gas that have traditionally driven our power plants, industries and

vehicles for many decades and are becoming depleted at a very fast rate [1]. This is the serious issue which motivated us to think about the alternative forms energy.

II HISTORY AND REVIEW OF LITERATURE

Solar energy conversion using photovoltaic effect was discovered by Edmund Becquerel in 1839. For the maximum efficiency, the solar panel located in the northern hemisphere should be faced towards south and a solar panel that is located in the southern hemisphere should be faced towards north. Angle of inclination of panel should be equal to latitude of area for the maximum efficiency in winter [1a]. As the solar power is available for a limited period of time it is necessary to store the energy for later usage of power [2][3]. The solar power being stored in a battery should not exceed the limits which may lead to reduction in battery life, therefore a charge controller is employed. [4.]

At present the led lighting system is preferred for its advantages such as low power consumption, reliability, long life (50,000 hrs), and high efficiency in terms of low heat loss. Led consumes dc power due to which the conversion of energy from ac to dc is avoided [5]. The wide usage of lead acid battery for storage is due to its features such as wide operating temperature range, long life, maintenance free [6]. DC motors have excellent speed and torque response but they have inherent disadvantage of commutator and mechanical brushes, which undergo wear and tear with time. With the technological developments and reducing costs in Photo voltaic panels, it has been possible to collect energy from sunlight using solar panels. To utilize this power with household AC based appliances inversion is essential [7]

In this context, we developed an efficient integrated solar module. To serve the lighting needs we incorporated a LED bulb, for cooling –dc motor based fan and for communication needs a radio connection and meet any other ac load of consumer by an inverter.

III DESCRIPTION OF COMPONENTS.

3.1. Solar Panel

Normally PV modules are available for the sizes from 5watt to 300watt. Single cell can generate only about 0.1 to 3 watt of power depending on its size. Larger the size of the solar cell, larger will be the power output. In a panel 36 cells are connected together to give 12volt output. The process of converting sunlight into electricity is called the photovoltaic (PV) process. A combination of PV cells makes a PV module, a set of PV modules form a PV panel or commonly called solar panel. Even greater powers can be achieved through a collection of PV panels put together in an Array.

3.2. Battery

A battery, which is actually an electric cell, is a device that produces electricity from a chemical reaction. Benjamin Franklin first coined the term battery in 1748.And French inventor Gaston Plante developed the first practical

storage lead acid battery in 1859.The lead acid battery is the preferred choice for hospital equipment, wheelchairs, emergency lighting and UPS systems. Because of its advantages and low cost, we have used "Deep cycle Lead Acid Battery". A deep cycle battery is capable of surviving prolonged, repeated and deep discharges which are typical in renewable energy systems.

3.3. Battery Charge Control Circuit

As the voltage from the solar panel hugely varies depending on the incident sun rays and also the current varies due to the same, a charge controller circuit is required to charge the battery. A charge controller is a main component of solar battery charging system. Its main function is to fully charge the battery without permitting the overcharge or reverse current flow (generally during night) if the solar panel is connected to a battery with no overcharge protection, the battery life is adversely affected.

3.4. Inverter

DC power is steady and continuous, with an electrical charge that flows in only one direction. When the output of DC power is represented on a graph, the result would be a straight line. AC power, on the other hand, flows back and forth in alternating directions so that, when represented on a graph, it appears as a sine- wave, with smooth and regular peaks and valleys. A power inverter uses electronic circuits to cause the DC power flow to change directions, making it alternate like AC power. These oscillations are rough and tend to create a square waveform rather than a rounded one, and in our project also we have designed an inverter whose output is a square. filters are required to smooth out the wave, allowing it to be used by electronic devices.

IV DESIGN

Estimation of watt hour rating: To run a LED LAMP,DC FAN, CFL BULB,RADIO FOR 5 hours a day.

LED lamp: 11w*5=55watt hour

Dc motor based fan: 40*5=200 watt hour,

Provision for any radio/ ac socket 20*5=100 watt hours,

Total watt hour rating requirement= 355 watt hours

Estimation of PV panels required

Total power output of 1 pv panel of 75w=75*0.75(operating factor)=56.25w

Efficiency of system=0.81,

Actual output= 56.25*0.81=45.5 watts,

Assuming 8 hours per day of sunshine= 45.5*8=364.24 watt hours,

Total solar panels required= 355/364.24 =1

The specifications of solar panel are as follows: 75W,Voc=24, Isc=4.5A

Cost benefit: Compared to the diesel based generators solar PV based systems are cheaper and maintenance free with no pollution.

V DESCRIPTION

5.1 Operation of Inverter Circuit

We used The IC1 Cd4047 which as an astable multivibrator, in the inverter circuit which produces two 180 degree out of phase pulses. Pin 10 & Pin 11 are connected to gate of Q1 & Q2 respectively (IRF540). Resistors of value 220ohm prevent the loading of IC by respective MOSFET. When the output of Pin 10 is high Q1 conducts and current flows through the upper half of the transformer primary which accounts for the positive half of the output voltage. When the output of Pin 11 is high Q2 conducts and current flows through the lower half of the transformer primary in OPPOSITE direction and it accounts for the negative half of the output AC voltage. And hence it is able to produce a square wave. The output is filtered using a capacitive filter and stepped up using a Step up transformer (12V/230VAC).We are able to light a CFL of 33 W / Incandescent bulb 100W with our inverter circuit.

VI RESULTS & DISCUSSIONS

Small prototype model with a battery of 4.5AH, 6V from the solar panel of 5W, 12V using a charge control circuit was tested for charge controller circuit. Inversion prototype was also tested. A radio was connected directly across the 6 volts output of battery and could be run for over 8 hrs. 75AH battery was charged with PV Panel of 75 watts, inversion was done and CFL of 11/33 W rating was able to drive Fan and LED lamp for more than 5 hrs a day. Testing was continued for over 3 months in summer and rainy season. One minor problem occurred due to battery voltage rise to 15V, which made our transformer output to 300V and burnt the CFL. To correct it a voltage regulator at the input was added.

Fig:1 Charging of 6V, 4.5AH battery

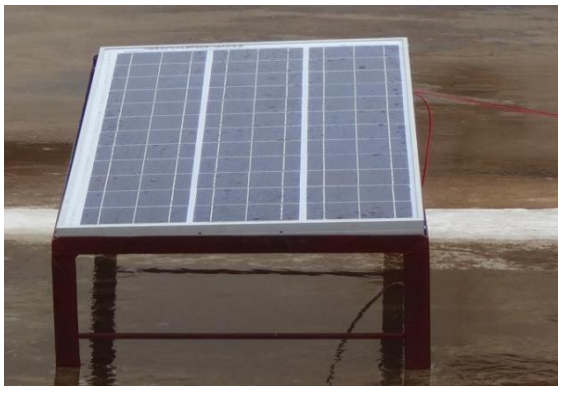

Fig:3 Solar Panel of 75AH

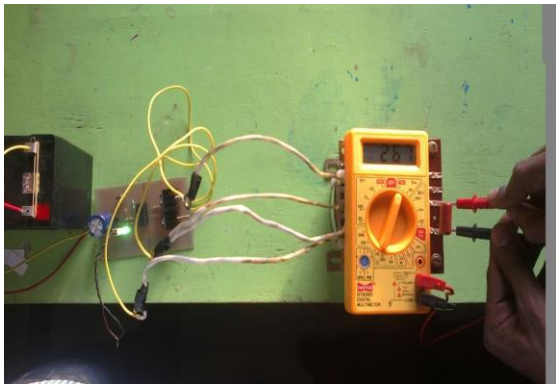

Fig2: Testing of Inverter circuit

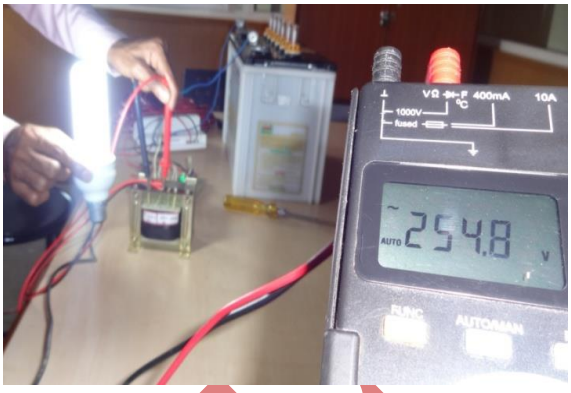

Fig4:CFL of 33 W being tested with inverter circuit.

Fig:5 LED Bulb, Dc Motor Based Fan

VII CONCLUSION & FUTURE SCOPE

Renewable energy applications based on solar PV panel operate with minimum maintenance, high efficiency due to absence of any moving part. These models are cost effective with payback period around 7 years. The designed model worked satisfactorily for more than 6 months without any major trouble. In future Harmonic minimization techniques can be explored for electronic based applications.

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