

Design of Solar Powered based Water Pumping System

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ABSTRACT

The demand of electricity is increase day by day, which is generated by fossil fuel resulting into the emission of carbon in the atmosphere, which leads to use of renewable energy sources for generating the electrical energy. Due to continuously decrease in cost of a solar cell, solar energy is used in a wide application. Solar power based water pumping system is one of the most interesting applications for energy generation. The aim of this paper is the simulation of solar power based water pumping system which is able to fulfill the power demand in standalone condition and in an isolated location. The system consists of various component like solar PV panel, single phase inverter connected to the load. The MPPT technique is used for increasing the effectiveness and improving the efficiency of the system. The battery will use on cloudy days and at night time. The simulation will perform in MATLAB SIMULATION software.

Keyword: Solar panel, single phase inverter, SPWM technique, MPPT technique, IGBT.

I. INTRODUCTION

There are two huge problems for which the use of solar energy is the best option. First, the non-renewable energy resources like coal are mostly used for the generation and supply of electrical energy which demands in the world [1]. This generation of electricity will increase carbon content in the climate, which lead to increase the pollution environment and global warming. Hence the use of renewable energy source is increased like wind energy, geothermal energy and solar energy etc.

Second, the lack of electrical energy is the main problem in the development of rural India. India's grid system is considerably under development, hence the most of the areas are not connected to the grid system. The solution to this problem is to use of standalone photovoltaic system [2]. Because many sunny days are accessible throughout India.

There are mainly two types of the photovoltaic system first, grid-connected photovoltaic system and second, standalone photovoltaic system.

One of the most important applications of the standalone photovoltaic system is for the water pumping, especially in the rural areas that have a lot of amount of solar radiation and very far from the national grid. So in that areas solar photovoltaic water pumping system can be used for the supply of water. Particularly an effective solution must ensure that the PV generator run at the maximum power point (MPP) and that the pump which is driven by the single-phase induction motor run at the high efficiency and give the maximum output [3-4].

MPPT is very important in the solar power system because it will force the panel to work at the maximum point and extract the maximum power from the photovoltaic module under certain condition. MPPT will force the PV module voltage

and current closed at maximum power point to draw maximum available power. Hence it will help to reduce the cost of the solar array by decreasing the number PV panels needed to obtain the desired output power.

In the PV pumping system, there are usually utilize low power pumps and they are widely used in small-scale irrigation as well as for domestic purpose. Because the main input to this type of system is the solar radiations. The PV pumps have recently achieved everyone attention due to large development in the field of solar cell material and technology. Here, the PV pumping system based on induction motor is more reliable and maintains free as compare to the DC motor drive. There a large number of DC motor driven PV pumping system are used in different countries but they are suffering from the maintenances problem due to commutator and brushes [5].

The output voltage and current from the panel are DC quantities, which are converted into AC quantities by using the inverter which is connected to the load or grid connected system. In the grid-connected system PV system will supply the power to connected grid along with the load connected to it [6].

II. PROPOSED PLAN OF WORK

The solar photovoltaic water pumping system mainly consists the component such as solar panel, single phase inverter, pump. The block diagram of solar power based water pumping system is shown in figure 1. Where inverter will convert the DC input quantities obtained from inverter into AC quantities and the pump will drive on that output.

The system parameters like dc voltage and current or inverter output voltage and current will change as the input parameters like temperature and the radiation from the sun as well as the load connected to the inverter. The pump output will higher at afternoon because solar radiation will be high. The pump output

will low in the morning and at evening because the solar radiation will low. At the night time battery will use to drive the pump and this battery will charge at the daytime.

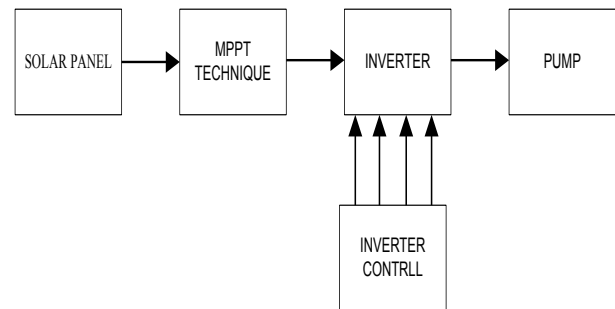


Figure1. Block diagram of Solar Power Water Pumping System

Solar Panel

The most important factor of the solar system is the solar panel, the solar panel is made from a solar cell connected in series and parallel. The solar cell is manufactured different types like crystalline, polycrystalline, monocrystalline, thin film solar cell, amorphous silicon solar cell, bio-hybrid solar cell, cadmium telluride solar cell, concentrated PV cell. The thin film solar cell is portable and light weighted but it has several disadvantages. The polycrystalline cell is less efficient than the monocrystalline cell, but it has the significant cost advantage over the monocrystalline cell.

When the solar radiation will increase voltage and current from the panel will also increase, when cell temperature increases, voltage decrease but current increases slightly. At the maximum power point cell will produce the maximum power. The solar cell can produce power from the combination of voltage and current and this power can be limited by maximum voltage and maximum current a cell can produce.

Mppt Technique

The MPPT algorithm is used in the MPPT controller. The MPPT controller ensures that the solar cell or panel will operate at its maximum power point. There are different types of MPPT technique like Perturb

and Observe, incremental conductance, Fuzzy logic method, Constant voltage methods etc. The Perturb and Observe technique are simple and easier than other technique but the incremental conductance is the more accurate technique than perturb and observe.

The MPPT extract the maximum power from the solar panel, but it will vary at the different operating point. It will force the solar panel to operate at maximum point. The MPPT use between the solar panel and load.

Inverter

The inverter will the PV system when the connected load is AC because inverter will convert the DC input from the solar panel into AC which will use to drive the pump. The type of the inverter will depend on the load connected to it i.e. When the load is three phase the inverter will be three phase or for single phase load the single-phase inverter will use. DC/AC inverter is different types of half bridge inverter, full bridge inverter, frequency commutated current source inverter etc.

Here, the single-phase inverter will use for the conversion purpose. The inverter consists of the four IGBT switch because it is available in the wide range and more efficient than other in less size as well as cost, also it has lower switching losses and small snubber circuit than other power electronics switches.

For controlling the operation of the inverter input pulses to the gate terminal of the IGBT switch are required. The pulses are generated by using the different pulse width modulation technique such as single pulse modulation, multiple pulse width modulation, and sinusoidal pulse modulation. The use of sinusoidal pulse width modulation will reduce the harmonics

Pump Load

The pump motor size depends on the required amount of water. A higher amount of power is

required for the high rated motor. Here, the single-phase induction motor is used as a load for experimental purposes because the cost is less and mostly used load.

III. APPLICATIONS

- **For water supply**
 - a) Villages, rural area, remote areas.
 - b) Homes, hospitals, schools
 - c) Animal farms and poultries
 - d) Farmhouses, resorts, and hotels etc.
- **For Decoration**
 - a) Water parks
 - b) Fountains
 - c) Filter inlet pump

IV. CONCLUSION

In India, the standalone photovoltaic system is gaining interested and they are become popular and become a competitive solution for other systems because many sunny days are available in India. One of the important application of the photovoltaic standalone system is for water pumping where a large amount of solar radiation is available and no access to the national grid. So, solar-based water pumping system is studied and presented

V. REFERENCES

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