www.ijecs.in
International Journal Of Engineering And Computer Science ISSN: 2319-7242
Volume 5 Issue 11 Nov. 2016, Page No. 18928-18932

Implementation of Solar Power Ac Motor Pump Set on MPPT With Battery Backup For Agriculture System

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ABSTRACT

Solar water pumping systems are a modern but field proven means of pumping water in locations where access to grid power is not available, or where the grid is not reliable. These systems use photovoltaic (PV) cells to convert sunlight into electricity to power DC pumps which can be used to pump groundwater or surface water.This system provide the power at all time even at cloudy days.To increase the efficient irrigation in agriculture.This system to achieve dc supply to ac supply which can be used for pumping application. Dc-Dc Buck boost converter used in pumping system is to stabilize the voltage for induction motor. The buck boost converter is used to stepup and stepdown the input voltage. A solar photovoltaic water pumping system (SPWPS) consists of PV array, motor-pump set, associated electronics and an On/OFF switch.

KEYWORDS: MPPT, Photovoltaic, SPWPS, Universal Motor.

1.INTRODUCTION

Solar water pumping systems are a modern but field proven means of pumping water in locations where access to grid power is not available, or where the grid is not reliable. These systems use photovoltaic (PV) cells to convert sunlight into electricity to power DC pumps which can be used to pump groundwater or surface water.

A solar powered water pumping system is made up of two components,

1. Solar panel

-Photovoltaic module

2. Pumps Centrifugal -Submersible

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar Photovoltaic panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few commercially available solar panels available that exceed 22% efficiency and reportedly also exceeding 24%. A single solar module can produce only a limited

amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

Centrifugal pumps are a sub-class of dynamic axisymmetric work-absorbing turbomachinery. Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber (casing), from where it exits.

A submersible pump is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

2.SOLAR WATER PUMPING SYSTEM

The solar-powered pumping system can be used anywhere but it is appropriate for rural areas of India which is facing energy crisis like other developing countries of the world. However due to geographical position, India has ample sunshine through the year which makes it ideal location for utilization of solar energy. Small farms, villages, and animal herds in developing countries require hydraulic output power of less than a kilowatt. Many of these potential users are too far from an electrical grid to economically tap that source of power, and engine-driven pumping tends to be prohibitively expensive as well as unreliable due to the high cost of purchased fuel and insufficient maintenance and repair capabilities. Though the installation cost of solar powered pumping system is more than that of gas, diesel, or propane-powered generator based pumping system but it requires far less maintenance cost. However by comparing installation costs (including labor), fuel costs and maintenance costs over10 years with other conventional fuel based pumping system, the solar PV water pumping system can be a suitable alternate option. This system has the added advantage of storing water for use when the sun is not shining, eliminating the need for batteries, simplicity and reducing overall system costs.

Solar water pumps are designed to use the direct current (DC) provided by a PV array, although some newer versions use a variable frequency AC motor and a three-phase AC pump controller that enables them to be powered directly by the solar modules. Since solar cell is expensive and its electricity production is of intermittent nature therefore solar pumps need to be as efficient as possible i.e. they need to maximize the gallons of water pumped per watt of electricity used. The long-term cost analysis makes the solar PV pumping system comparable to most other remote watering options in the rural areas. The lifetime of solar water pump is usually 20 years, which ultimately is lower than the life span period cost compared to the conventional pumps. By using solar PV pumps, load on the grid system can be reduced and the subsidy on the diesel can be lowered.

CENTRIFUGAL PUMP MODEL

The Flow-Head characteristic of a centrifugal pump can be approximated by quadratic form using P fleider-Peterman model in which the rotor speed ω is a parameter:

$$H = a_0 . \omega^2 + a_1 . \omega . Q + a_2 . Q^2$$

where the motor speed ω is expressed as :

$$\omega = \left(1 - \frac{\omega_{sl}}{\omega_s} \right) . \omega_s$$

DOI: 10.18535/ijecs/v5i11.36

a0, a1 a2 are constants depending on the pump dimensions.The pump efficiency is defined as the ratio of the hydraulic power imparted by the pump to the fluid to the shaft mechanical power and is given by :

$$\eta_p = \frac{\rho g H Q}{C\left(1-\frac{\omega_{sl}}{\omega_s}\right)^3 \omega_s^3}$$

The Q-H characteristic of the pipe network can be expressed by

$$H = H_g + \psi Q^2$$

Ψ is a constant which depends on conduit diameter and on all frictional losses of the pipe network.

3.SOLAR PANEL AND ARRAY:

There are different sizes of PV modules commercially available. For the proposed system, solar panels are used. The
specifications of the solar panels are provided below:
Rated Current: 7amps
Rated Voltage: 24volts
Short Circuit (SC) Current: 8.07amp
Open Circuit (OC) Voltage: 42volt
Cell Temperature: 25°c
Six 250Wp solar panels have been
used to provide DC power supply for the water pumping system. Such 6 solar panels supply1500Wp power during the normal condition.The solar panels are connected in two arrays, the first, second arrays and 6 panels. All six panels are connected in parallel to provide power supply to the pumping system.

RATINGS OF SOLAR PANEL

- 1500W
- Inverter set
- Charge regulators
- FF~70%
- Efficiency =15-20%
- Tolerance =-3 to +15
- V max =34v
- Vo c =42v
- Imax =7A
- Is c =7.05A
- UPS back up
- Battery of 1800 Ah

4.MPPT

Maximum Power Point Tracking, frequently referred to as MPPT, is an electronic system that operates the Photovoltaic (PV) modules in a manner that allows the modules to produce all the power they are capable of. MPPT is not a mechanical tracking system that "physically moves" the modules to make them point more directly at the sun. MPPT is a fully electronic system that varies the electrical operating point of the modules so that the modules are able to deliver maximum available power. Additional power harvested from the modules is then made available as increased battery charge current. MPPT can be used in conjunction with a mechanical tracking system, but the two systems are completely different.

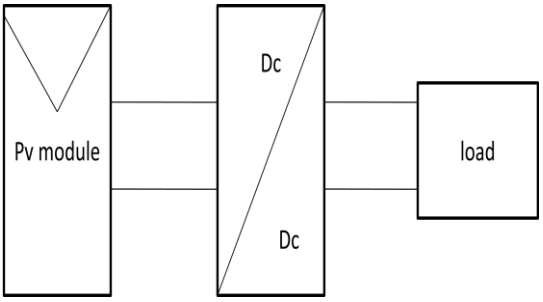


Fig. 1: Block diagram of Typical MPPT system

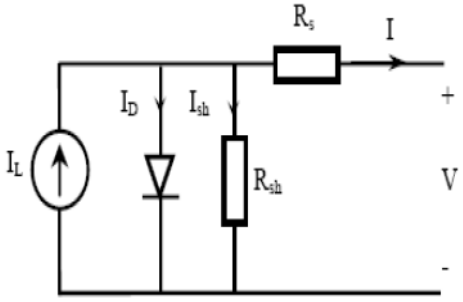
The fuzzy logic method used in this paper. fuzzy logic is a form of many valued logic in which the truth values of variable may be any real number between 0&1 considered to be "fuzzy" .By constrast , in Boolean logic, the truth values of variables may only be 0 or 1,often called "crisp"values. fuzzy logic has been employed to handle the concept of partial truth, where the truth value may range between completely false. furthermore, when linguistic variables are used, these degrees may be managed by specific (membership)functions.

ROLE OF MPPT IN SPV SYSTEM

DOI: 10.18535/ijecs/v5i11.36

Photovoltaic systems normally use a maximum power point tracking (MPPT) technique to continuously deliver the highest possible power to the load when variations in the isolation and temperature occur, Photovoltaic (PV) generation is becoming increasingly important as a renewable source since it offers many advantages such as incurring no fuel costs, not being polluting, requiring little maintenance, and emitting no noise, among others. PV modules still have relatively low conversion efficiency; therefore, controlling maximum power point tracking (MPPT) for the solar array is essential in a PV system. The Maximum Power Point Tracking (MPPT) is a technique used in power electronic circuits to extract maximum energy from the Photovoltaic (PV) Systems. In the recent days, PV power generation has gained more importance due its numerous advantages such as fuel free, requires very little maintenance and environmental benefits. To improve the energy efficiency, it is important to operate PV system always at its maximum power point. Many maximum power point Tracking (MPPT) techniques are available and proposed various methods for obtaining maximum power point. But, among the available techniques sufficient comparative study particularly with variable environmental conditions is not done. This paper is an attempt to study and evaluate s60e main types of MPPT techniques namely, Open-circuit voltage and Short-circuit current, P&O, IC etc.

A solar cell basically is a p-n semiconductor junction. When exposed to light, a dc current is generated. The generated current varies linearly with the solar irradiance. The standard equivalent circuit of the PV cell is shown in Fig.1.



The basic equation that describes the I-V Characteristics of the PV model is given by the following equation:

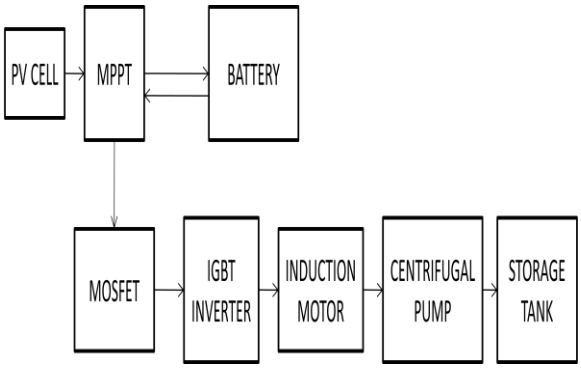
$$I = I_L - I_o\left(e^{\frac{q(V + IR_s)}{kT}} - 1\right) - \frac{V + IR_s}{R_{sh}}$$

Where

I	Cell Current (A).
I_L	Light Generated Current (A).
I_o	Diode Saturation Current.
Q	Charge of Electron = 1.6x10-19 (Coul).
K	Boltzmann Constant (J/K)
V	Cell Output Voltage (V)
R_s , R_{sh}	Cell Series and Shunt Resistance (Ohms).

This equation shows the dependence of PV current on temperature and hence the dependence of power drawn from thePV array.

5.PROPOSED APPROACH



In this proposed system we used MOSFET,IGBT Inverter and battery backup system. The mosfet is used in this system to provide the constant dc voltage.The IGBT inverter

is used convert dc to ac voltage.This system is used three phase squirrel cage induction motor for pumping application.The battery backup method is used in this system store the energy in day time and used for night times.

Maximum power point tracking (MPPT) is a technique used commonly with wind turbines and photovoltaic (PV) solar systems to maximize power extraction under all conditions. The fuzzy logic method used in this paper. fuzzy logic is a form of many valued logic in which the truth values of variable may be any real number between 0&1 considered to be "fuzzy" .By constrast , in Boolean logic, the truth values of variables may only be 0 or 1,often called "crisp"values. fuzzy logic has been employed to handle the concept of partial truth, where the truth value may range between completely false. furthermore, when linguistic variables are used, these degrees may be managed by specific (membership)functions.

Battery backup method is to provide power at all time even at cloudy days. The main aim of the system is to achieve dc supply to ac supply which can be used for pumping application.In this three phase ac supply is used for pumping application.

6.CONCLUSION:

Solar powered water pumping system have become commercially popular due to proper financing schemes by the government. MPPT techniques are being used to improve the performance of Solar powered water pumping systems during fluctuations in solar intensity. The following major limitations of Solar powered water pumping systems are identified. The main aim of the system is to achieve dc supply to ac supply which can be used for pumping application. In this three phase ac supply is used for pumping application.

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