PV BASED WATER PUMPING SYSTEM FOR AGRICULTURAL SECTOR*

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Abstract

In this paper evaluates ways in which can be made efficient water pumping system based on photovoltaic (PV). Battery is incorporated to makes system more reliable. There will be increasing of interest and needs in PV system applications following standard of living improvements will be there due to continuous decreasing of solar cells cost. In both agriculture and domestic, water pumping system powered by solar-cell generators are one of the most important applications. To entrains the pump through control action of motors by developing new efficient and flexible modes, this can be done by considering the solar energy fluctuation and solar energy optimizing necessities. Photovoltaic-battery hybrid system feds the vector control of an asynchronous motor, this vector control is discussed in this paper. PV generator, converter of DC-DC, battery, converter of DC-AC, an induction motor controlled by a vector and the centrifugal pump are investigated in this paper. By perturbed and observe (P & O) algorithm which integrated with boost converter control, a PV generator can be operated at maximum power. At all isolation conditions, the motor supply is also ensured. The effectiveness and feasibility of this approach is shown by the simulation results. Extensive results are presented based on MATLAB/SIMULINK.

Keywords: Vector Control; Induction Motor; Solar Power; PV System; P&O algorithm and Water Pumping System.

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1. INTRODUCTION

The modern industrial society leads to increase of world energy demand and for better improvement of energy efficiency and power quality, population growth is highly investing in alternative energy solutions. Moreover, in the isolated sectors as the islands and the rural zones, the use of the renewable energy such as photovoltaic (PV) [1-3] and PV-battery based hybrid systems [4-7] are better solution to produce the needed electric energy for such applications as both the domestic and agricultural systems. At tropical and temperature regions, the density of solar may equal to 1000 W/m² so the primary resource is photovoltaic energy. High initial cost and photovoltaic cell conversion efficiency is very low, these are the two main drawbacks of solar power. But now in present modern world, low cost power electronic systems and photovoltaic cells are arrived and helps for new installations. Continuously changing of operating point, solar intensity, temperature and dynamic loads influences the performance due to this maximum energy of a PV system changes. So, that for extraction of maximum power from PV, maximum power point trackers (MPPT) are required and then the system efficiency can be improve [1-10]. For initial investments, it is necessary to optimize PV water pumping system. This can be done by adapting electrical impedance dynamically to PV generation for various operations with the usage of power electronics converters[1-3].

The electrical motors drives the water pumping system by utilizing PV energy, it is one of the widely used application of it. PV power is depends on solar irradiance and temperature, therefore PV alone cannot operate system effectively; battery is connected to increase the reliability of system. The proposed photovoltaic water pumping system setup consists of photovoltaic generator, battery, converter(s) of power, and also an electric motor coupled to load of pump. For water pumping system there are two types of pumps they are, volumetric pump is one and centrifugal pump is the other. Volumetric pump utilizes more PV power when compared to centrifugal pump, also the time during operation is higher for centrifugal pump even for insulation level at low and for PV system maximum power locus should be in closer proximity to load characteristics, generally MPPT is used by controlling through online to obtain output operating point at maximum for various conditions of operating such as, insulation and temperature of PV water pumping system. For improving overall efficiency various optimization methods have been discussed. Presently, for power conditioning, PV generator works as a DC-DC converter for MPPT. There are several types of converters used for MPPT, they are boost converter, buck converter and boost-buck converter. Many different motors are used in PV water pumping system. Initially, DC motors were used because; they give easy implementation by conversion of cheap power. Many pumping systems which are now in use shows that these methods are affected from a drawback of maintenance problems. To reduce this effect permanent magnet motors without brush have been suggested [11]. But this process only valid for low power PV systems. PV pumping system with induction motor gives another way for a more reliable and no maintenance system [12]. For the usage of DC motor in PV water pumping system various coupling modes are maintained [2-6, 13]. Different control methods should be used for Permanent Magnet Synchronous Motors (PMSM). Because of the superior advantages of induction motors over DC motors and PMSM [14-16], in this paper, induction motor is used for water pumping system. In Induction motor (IM), an indirect method of motor field control method regarding water PV pumping system is presented by the authors. For driving centrifugal water pump system is presented in this proposed paper. Water pumping system with proposed photovoltaic battery is shown in Fig. 1. A large simulation work is done for obtaining required results. For showing the performance of the system, the obtained results are talk over and proved that how the suggested process is a best functioning procedure of water PV pumping system control.

![Fig.1. The suggested Induction motor photovoltaic pumping system configuration](image-url)

2. PV SYSTEM

The PV system considered in this paper contains single PV array as shown in Fig. 2(a). In this paper a PV model is considered from [1-16]. The modeling is attempted by (1), PV current and PV voltages are given as $I_{pv}$ and $V_{pv}$...
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