Single Stage Solar PV Fed Brushless DC Motor Driven Water Pump

Abstract:

In order to optimize the solar photovoltaic (PV) generated power using a maximum power point tracking (MPPT) technique, a DC-DC conversion stage is usually required in solar PV fed water pumping which is driven by a brushless DC (BLDC) motor. This power conversion stage leads to an increased cost, size, complexity and reduced efficiency. As a unique solution, this work addresses a single stage solar PV energy conversion system feeding a BLDC motor-pump, which eliminates the DC-DC conversion stage. A simple control technique capable of operating the solar PV array at its peak power using a common voltage source inverter (VSI), is proposed for BLDC motor control. The proposed control eliminates the BLDC motor phase current sensors. No supplementary control is associated for the speed control of motor-pump and its soft start. The speed is controlled through the optimum power of solar PV array. The suitability of proposed system is manifested through its performance evaluation using MATLAB/Simulink based simulated results and experimental validation on a developed prototype, under the practical operating conditions.
**Existing System:**

- The foreseen global energy crisis in near future due to the rapid depletion of conventional fossil fuel resources and a consistently diminishing costs of solar photovoltaic (PV) modules, power electronic devices and microprocessors, motivate the researchers and industrialists towards an effective utilization of solar PV technology.

- Among the various applications of solar PV energy, a standalone PV powered water pumping system seems to be the most promising and attractive in various areas such as rural farm irrigation, urban street watering, and fish farms.

- Modernization of human community and developing utilization of electric motors have exponentially enlarged the need for electrical energy.

- The motors comprise more than 40% of overall electric power expenditure.

- Therefore, a motor plays prominent role to realize a solar PV based energy efficient and cost-effective water pumping.

- An efficient motor drastically minimizes the number of solar modules for a given power demand and hence its capital cost.
Disadvantages:

- Increased cost
- Increased size
- Increased complexity

Proposed system:

- The proposed BLDC motor driven water pumping based on a single stage solar PV generation has been validated through a demonstration of its various steady state, starting and dynamic performances.
- The system has been simulated using the MATLAB toolboxes, and implemented on an experimental prototype. The topology of the proposed system has provided a DC-DC converter-less solution for PV fed brushless DC motor driven water pumping.
- Moreover, the motor phase current sensing elements have been eliminated, resulting in a simple and cost-effective drive.
- The other desired functions are the speed control without any additional circuit and a soft start of the motor-pump.
- A detailed comparative analysis of the proposed and the existing topologies has ultimately manifested the superiority of the proposed work.
**Circuit Diagram:**

**Advantages:**

- Reliable
- Rugged
- Maintenance-free with better efficiency and offers more flexibilities for control in comparison.

**Reference:**


