Solar Based Variable Frequency Drive- A Review

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Abstract -Human beings are depending on agriculture for food. As irrigation process is totally depending on electricity therefore farmers are facing big problem because of power cut. Nowadays solar based pump systems are used to overcome this problem. Existing system uses open loop configuration and different techniques to control the speed of motor. In comparison to dependency of farmers on fossil fuel and electricity for existing pumping system the proposed system in the reviewed paper are finding out the best solution to help the farmers for irrigation. Comparison of different papers on existing solar pump system is provided to find out best method for pumping systems.

Key Words: *PHOTO VOLTAIC CELLS, VARIABLE FREQUENCY DRIVE, DC-DC BOOST CONVERTER, DC-DC BUCK CONVERTER, SPWM, THREE PHASE INVERTER, MICRO-CONTROLLER, BLDC MOTOR, MPPT (MAXIMUM POWER POINT TRACKING).*

1. INTRODUCTION

In this era of industrialization and urban civilization India is the country where the solar technology has proved the best. Solar based VFD is an aid to the solar civilization in India and has been designed to attain maximum efficiency for irrigational purposes. The limited resources and high cost of conventional energy sources like oil, gas, coal as well as the continued environmental pollution are some of the main reasons for their widespread introduction in electrical power system. The development and usage of these alternative energy technologies are still restricted. Solar energy has the greatest potential of all the sources of renewable energy. In India solar energy is available in abundant form. Most of villages in India are facing continuous power cut problem. By using solar energy the system can be made less expensive and highly efficient. This system will help the farmers for irrigation by providing solar based water pump.

2. METHODOLOGY

There are some papers who have laid the different methodology for solar based variable frequency drive.

[1] International Journal of Innovative and Emerging Research in Engineering Volume 2,Issue 3,2015 on " Speed control of Ac motor using VFD" by Sumedh Tonapi,Piyush Chopade, Tanmay Kadam, Junaid Julaha and Priti Tyagi.

In the proposed system AC single phase is used. Before applying AC supply to rectifier circuit line filtering is used to reduce the noise. The rectifier AC converts the bidirectional Ac into pulsating DC voltage. The capacitor is used which accepts this voltage from rectifier and delivers a smooth voltage to inverter block. Voltage regulator is used which provides a stable voltage to the inverter .IGBT is used in inverter as it can switch on and off for several times in a second. The driver circuit uses TLP250 (IGBT gate drive opt coupler) consisting of LED and photo-detector and IR2110 which is IGBT driver. Inverter is used in 120 degree conduction mode. Output of inverter is used to drive the motor.

[2] International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 3, Special Issue 2, April 2014 on "PV Powered Direct Torque Controlled Induction Motor without AC Phase Current Sensors" by Muthamizhan. T, Ramesh R

This paper proposes a low cost and high performance induction motor drive. In this paper the shunt resistor is used in series with lower side switches of conventional 3 phase inverter which draws the current and acts as a current sensor to measure the stator current. This is the best alternative for a Hall Effect Sensor in terms of cost.Dc link voltage is sensed using voltage divider network. Hill Climbing MPPT algorithm is used. This algorithm disturbs the voltage in one direction and evaluates the corresponding difference the power. To decrease the volume and weight of DC to DC converter higher switching frequency is chosen. To reduce the losses due to high switching frequency soft switching is used in current fed full bridge DC to DC converter. Soft switching is achieved using ZCS(Zero Current Switching). The solar panel output is fed to DC to Dc conveter.The Dc output voltage is filtered with bulk capacitor and the DC voltage is given to 3 Phase inverter which drives the induction motor.

[3] International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol.2, Issue 11, november.2013 on "Analysis and simulation of solar

powered pump using three phase induction motor" by K Pawan Kumar, Kasturi Saikishore.

In this paper PV array is used to convert the solar energy into DC voltage. That DC voltage is converted into constant high DC voltage with the help of DC-DC boost converter. Then Three phase inverter is used to convert to convert that high constant DC voltage into three phase AC which is controlled by SPWM technique. SPWM technique is designed to provide the gate pulses to inverter MOSFETs which drives the three phase induction motor. In this system PI controller with PWM control is used to get constant DC voltage. The system is simulated using MATLAB simulink. In this case problem may come to step up DC voltage to higher level with minimal ripple.

[4] International Journal of Engineering Research & Technology, Vol. 2, Issue 10, October 2013 on "Design of Solar Power Based Water Pumping System" by M.Bala Raghav, K.Naga Bhavya, Y.Suchitra G.Srinivasa

This paper provides a solution for farmers to power cut. A solar panel with a charge control regulator charges the battery. They have used 6 solar panels in parallel which provides 1500W power. Output voltage of solar panel is given to the DC-DC buck converter. Buck converter drives the DC motor. A buck converter is used in the system to supply initial high current for starting the motor. DC motor and centrifugal pump are used for water pumping A microcontroller based solar tracking system is included in system to effectively use the solar energy. In addition to this a tank is provided to store the water which can be used even in the absence of sunlight or if the battery is discharged.

[5] International Journal of Computer and electrical engineering, volume.4,No.2,April 2012 on "Application of Solar Powered Automatic Water Pumping" in Turkey by Mahir Dursan and Semih Ozden.

In this paper an automatic photo irrigation system was designed at Zile District of Tokat Province of Turkey with two BLDC motors because of their high operating efficiency, brushless construction, maintenance free operation than the others. One of motor was used for driving deep well pump which has been utilized for the purpose of water storing to a pool. The other one was used for driving centrifugal pump which has been utilized for the purpose of transferring of water waited in pool to drip irrigation. Optimum power of motors and solar panels were selected According to calculated maximum power consumption. Moreover BLDC motors, 48 PV arrays, a 100 tone water storage tank, 8 batteries and DC/DC converter were applied to irrigation of 1000 dwarf cherry trees has been realized with drippers each having a capacity of delivering 2 liters and kept under 3 bars pressure. Batteries are used in most of PV systems to perform two essential functions: power buffer between the arrays and load, and energy storage. A DC-DC buck converter has been developed to feed motor and charge the batteries safely. Designed system was provided site-specific management of irrigation

systems with solar powered wireless acquisition stations. Portable 3 units and software named ValCon were developed. These units consist of a base station unit, solenoid valve unit and sensor unit. All of these units involve UDEA brand RF module, omnidirectional antenna, 7 V-1.8 W solar panel and low power Microchip PIC18F452 micro controller
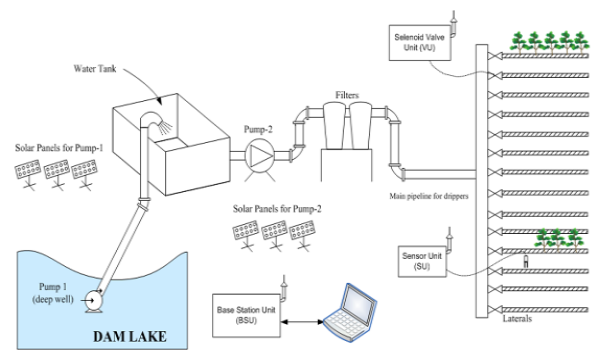

Fig. 1. Application of the system

Fig-1 Automatic Photo irrigation system

3. CONCLUSIONS

After going through literature survey, DC motors are very expensive. Additionally, regular maintenance of the brushes is necessary. Therefore, three phase induction motor was chosen as the initial torque of three phase induction motor is significantly higher than that of a single phase induction motor. Also the starting current in three phase motor has less severe effects than a single phase motor. Comparatively variable speed control technique is useful than other technique because of earth rotation the power generated by the stationary PV cells varies accordingly. Batteries are not needed which increases a cost. Generally farmer use pump at daytime in summer season. Three phase inverter is needed to convert dc from solar to ac. All reviewed papers designed open loop system. To make system automated a closed loop is necessary which take feedback from various parameters like speed of motor, voltage from solar panel , current from inverter, etc. We can also display all these data to compare performance. Thus a closed loop system will help farmers for irrigation purpose.

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