Solar PV Array Employing Zeta Converter Based MPPT Controlled BLDC Motor

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Abstract

Drastic reduction in the cost of power electronic devices and annihilation of the fossil fuels in near future invite to use the solar photovoltaic (SPV) generated electrical energy. The ultimate aim of this paper is to drive a BLBC motor at a high speed with a reduced switching losses which is used fort various purposes including the irrigation pumping systems. To maximize the output power a technique called Maximum Power Point Tracking (MPPT) is utilized in photovoltaic systems regardless of the ceaselessly varying weather conditions electrical at tributes of the PV array output is specifically used to control the DC-DC converter, hence diminishing the intricacy of the system.

Keyword- Solar Panel, Arduino, Battery, Inverter, Zeta Converter, BLDC Motor

I. INTRODUCTION

In present scenario global attention is towards non-conventional energy sources to meet the electrical load demand for the consumer and to supply the electricity for rural areas. Solar photovoltaic array system is one among the non-conventional energy source helpful in various applications like lightning load, water pumping and fan etc. Optimization of photovoltaic system is performed by using Maximum Power Point Tracking (MPPT) algorithm for maximum efficiency. In this work zeta converter is preferred compare to the other conventional DC-DC converters due to the advantages of soft starting continuous output current, boundless region for MPPT , low ripple input and output currents. The solar photovoltaic array, zeta converter and BLDC motor ratings are selected to suit for different atmospheric conditions and operating conditions of the BLDC motor. The power required to run the BLDC motor is supplied by the solar photovoltaic array, the maximum power is extracted by the zeta converter through the MPPT algorithm. The BLDC motor has high reliability, high efficiency and high torque/inertia ratio, improving cooling, low radio frequency interference and noise requires practically no maintenance. The BLDC motor is controlled by the VSI operated through the commutation of BLDC motor, 6 switching pulses are generated.

II. COMPONENTS

A. Battery

It is the power source for the system. The power is supplied to the zeta converter. The battery used in this PV systems are rechargeable. The solar panels collect energy from the sun and turn it into electricity, which is passed through inverter and zeta converter and then to the BLDC motor.

B. Arduino

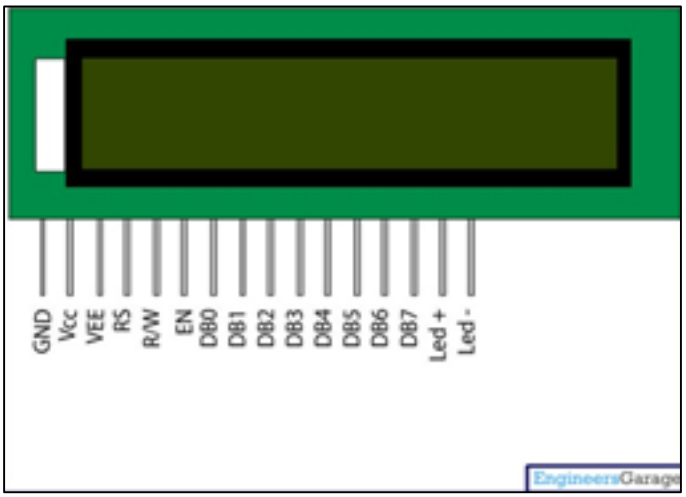
An Arduino is an open-source physical computing platform based on a simple I/O board and a development environment that language. A microcontroller is a simple computer that can run one program at a time, over and over again. It is very easy to use.

The Arduino Mega 2560 R3 also adds SDA and SCL pins next to the AREF. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), 16MHz crystal oscillator, a USB connection, a power jack, an ISCP header, and a rest button.

C. LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The data register stores the data tyo be displays on the LCD. The data is tge ASCII value of the character to be displayed on the LCD.



LCD

III. METHODOLOGY

In this paper, controlling is employed in two stages, one to generate pulse for zeta converter to trace the peak power point through MPPT algorithm, another is to generate pulses for VSI through hall sensors. This algorithm is very simple to implement to track the maximum power and thus it is most commonly used MPPT technique. The power required to run the BLDC motor is supplied by the solar photovoltaic array, the maximum power is extracted by the zeta converter through the MPPT algorithm.

A. PV System

Renewable energy is the only solution to meet the energy crisis. Among them solar energy's potential is high which exceeds the world's aggregate demand. Solar energy has the most noteworthy capability of 1016 watts on earth's surface.

The sun's solar energy is changed over specifically into electrical energy under the event of photoelectric impact. The advanced system is implemented by solar PV array fed BLDC motor employing zeta converter.

B. Zeta Converter

The zeta converter belongs to a buck-boost converter family functioning as a non-inverting buck-boost converter is the closest to the solar PV array to pull out the peal available power henceforth encouraging the delicate beginning of BLDC motor. The three phase inverter which is fed by the output of zeta converter.

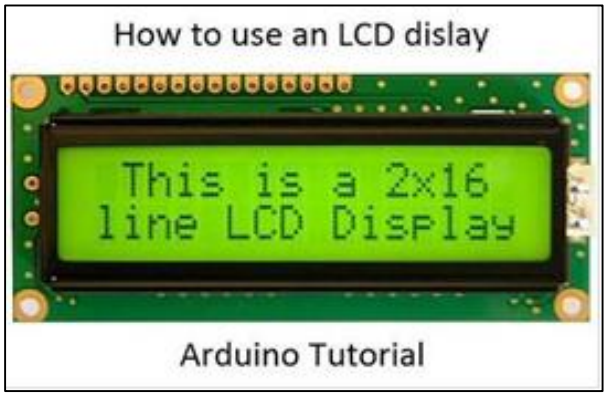
The mathematical model of the zeta converter circuit operating in the continuous conduction mode in state-space form is presented.

C. MPPT Algorithm

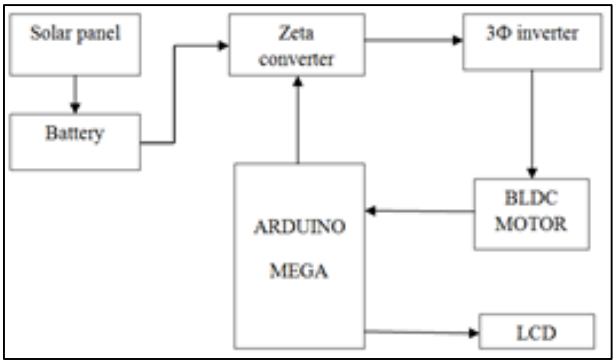
An efficient and commonly used MPPT technique in various SPV array based applications is utilized in order to optimize the power available from the SPV array and to facilitate the soft starting of BLDC motor.

D. LCD Display

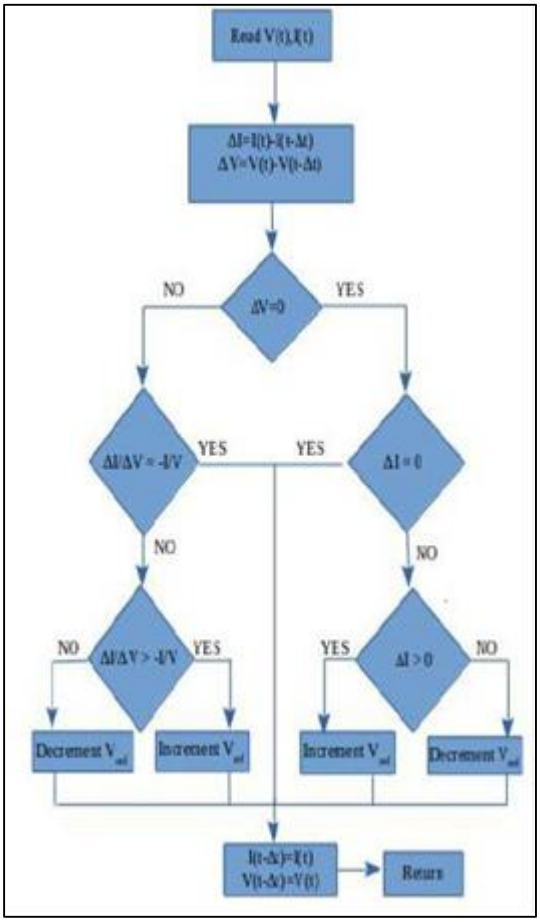
A 16*2 LCD display is very basic module and it is very commonly use in various devices and circuit. These modules are preferred to seven segments and other multi segments LEDs. The reason being: LCDs are economical; easily programmable; have no limitation of displaying special and even custom characters (unlike in 7 segments), animations and so on. A 16*2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5*7 pixel matrix. This LCD has 2 registers, namely command and data.



IV. BLOCK DIAGRAM

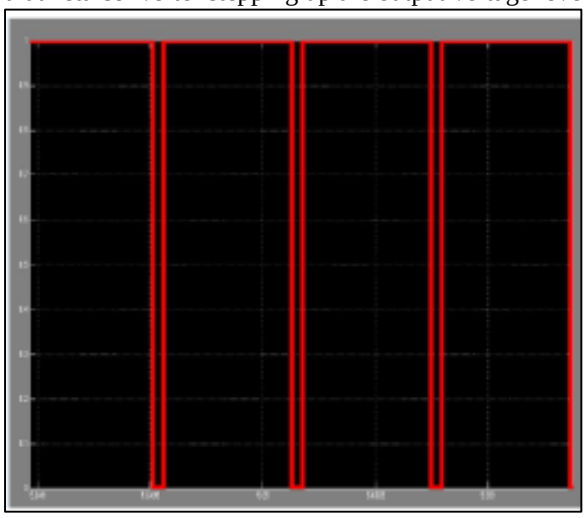


A. Flow Chart

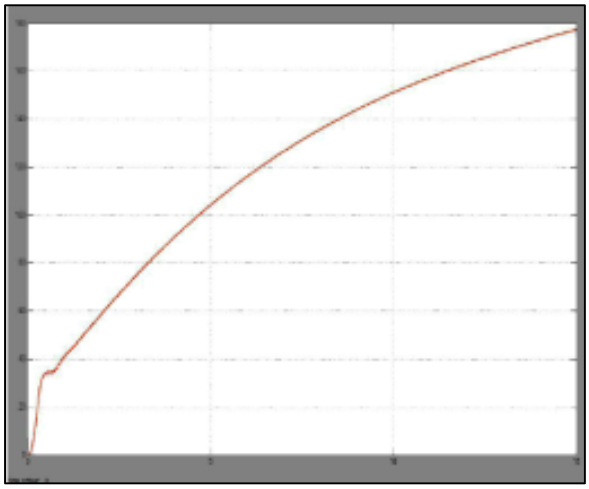


B. Graph

The graph, shown above can observe that zeta converter stepping up the output voltage level than input voltage level.



A) Gate pulses of zeta converter



B) Simulation results of converter output voltage

V. CONCLUSION

The software implementation of PV model with a zeta converter based on MPPT controller, predictive current controller with three phase inverter and load as BLDC motor has been simulated with MATLAB/SIMULINK. From the result it should be noted that stress switches is diminished and operates at high frequency. In advance it can provide an effective energy in PV system implemented in remote areas. The performance of BLDC motor with zeta converter shows satisfactory results and is suitable for fan load which can be used for agriculture and small industries.

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