A Solar Powered Brushless Dc Motor Drive For Water Pumping System

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Abstract- *In this paper describes solar PV system worn for pumping system in order to gain the maximum benefits from solar source along with also gives soft starting of BLDC motor.*

The model is inured study manifold parameter alternative effects upon the PV array in conjunction with operating temperature along with solar irradiation level. This paper accommodates an analysis regarding the photovoltaic system's interpretation in real time in addition to the factor disturbing it such Temperature along with Irradiation. BLDC Motor speed is regulated all the way through inverter. The VSI is regulated via fundamental frequency switching, escaping the losses owing to high-frequency switching, in regulate to augment the efficiency of the proposed system.

Keywords- (Ppv) Photovoltaic System, (Voc) Open Circuit Voltage, (Iph) Photo Current, (Irev) Reverse saturation current of the module

I. INTRODUCTION

Renewable energy is generally defined as the energy collected by naturally reproduced resources of human period like tides, rain, sunlight, and wave geo-thermal heat and wind. Renewable energy regularly delivers energy in four major areas: generation of electricity, water heating and cooling and air, rural energy services and transportation. Solar energy, receives heat from the sun, is harnessed using technologies such as concentrated photovoltaic, solar heating, photovoltaic, artificial photosynthesis and solar architecture.From the above various technologies, the photovoltaic scheme takes advantage of the photo-voltaic effects and changes to the light into electrical direct current. Solar PV has changed to a multi-billion, fast increasing industry, which improves efficiency [1].

Generation and consumption of electricity or power play very important role in well-being of country and economic growth. The existence and development of sufficient organization is necessary. For the first country to become a developed country, continuous growing of the economy of Indian is essential. With these passing years, the demand for electricity has increased in the nation and is predictable to increase further in the years to come [2].

II. PV SYSTEM

Photovoltaic Technology

The device or elements capable of transforming photons light into an electrical voltages and current energy is called photovoltaic. Electrons in photovoltaic materials are formed due to small-scale wavelength and high-energy photon, so that they are atoms free. Electrons around the electrical field will be attracted towards metallic contact where they can flow as electrical current. The driving force to power photovoltaic comes from the sun, and it is interesting to note that the total energy demand of the earth's surface takes like 6000 times more energy.

Photovoltaic began in 1839, when the Nineteen year old French physicist, Edmund Becquerel published a diluted electrolyte solution (Becquerel, 1839) on the metal electrode, voltage could be seen. Almost 40 years later, Adams and Day Solids (Adams & Day, 1876) were the first to study photovoltaic influences. They were able to create selenium-made cells that are 1% to 2% active. The emerging photography industry quickly accepted Selenium cells for photographic light meters; In fact, they still use it for the purpose [19].

$$I_d = I_0 \left(e^{\frac{q V_d}{k T}} - 1 \right)$$

Where,

I0 - Diode saturation current

Q - Electron charge (1.602×10-16 C)
Vd - diode voltage

K - Boltzmann constant value is 1.3806×10-10 J/K

III. MPPT ALGORITHM

For tracking the maximum power from PV system, various methods have been developed over the decade which involves simple voltage and current relations. For this research work, Incremental Conductance algorithm is chosen due to its superiority over other algorithms.

Incremental conductance

This MPP algorithm is based on the fact that at the Maximum power point, the P-V curve slope is zero. The power obtained from the PV is differentiated with respect to voltage.

$$\frac{dP}{dV} = \frac{d(VI)}{dV} = I + V\frac{dI}{dV}$$

At MPP, the rate of change of power w.r. to voltage is zero

$$\frac{dI}{dV} = -\frac{I}{V}$$

The algorithm of the Incremental Conductance works by comparing the incremental conductance $(\frac{dI}{dV})$ with instantaneous conductance $(-\frac{I}{V})$. Achieving the $\frac{dP}{dV} = 0$ is the control aim to achieve MPP of the array. Positive value of dP/dV refer that the operating region lies on the left hand side of MPPT and increase in array voltage would yield increase in power. Alternatively, negative value of dP/dV infers that the operating region had exceeded the MPPT and increase in voltage would reduce the power as shown in figure 2.11.

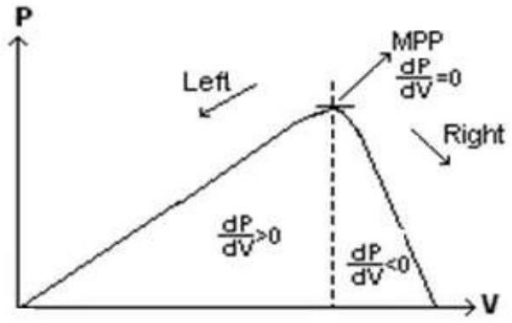

Figure 3.1 : P-V curve for IC

IV. BLDC MOTOR

A BLDC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. early all types of BLDC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

BLDC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A BLDC motor's speed can be controlled over a wide range, varying either a variable supply voltage or by changing the strength of current in its field windings. Small motors are used in tools, toys, and appliances.

The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger BLDC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of BLDC motors with AC motors possible in many application.

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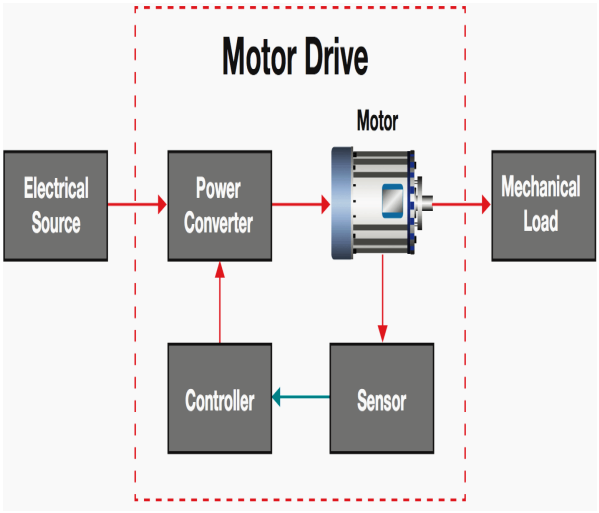


Fig. 4.1 Block Diagram Of Motor Energy

V. SIMULINK MODEL

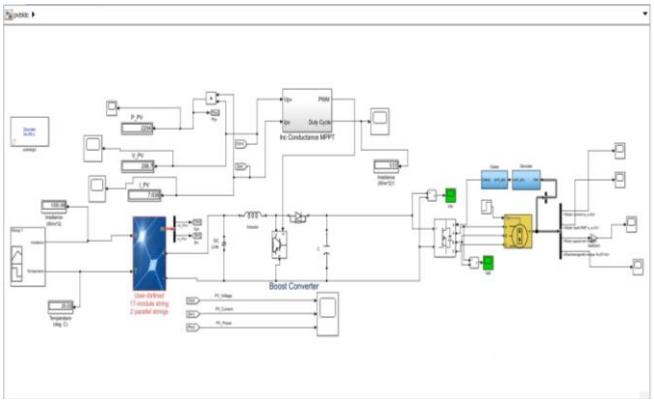
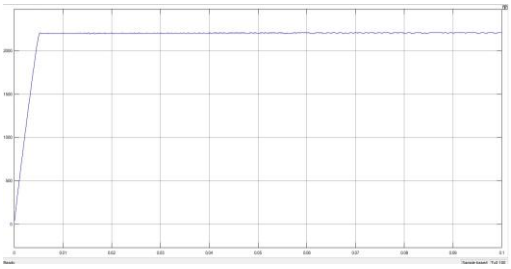


Fig.4.1 Simulink model for solar powered brushless dc motor drive for water pumping system

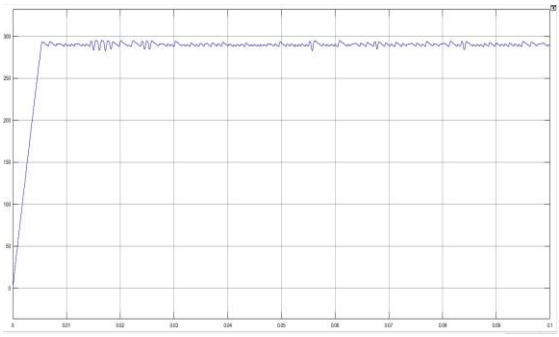
the proposed system configuration, in which BLDC motor is used for pumping system , BLDC motor is operated by voltage source inverter of DC-link.the proposed system gives energy from solar PV based boost converter for pumping load. Solar PV array generates energy gives to the boost converter; the switch of the boost converter is operated by MPPT algorithm such that maximum benefits from solar PV array is optimized and also gives smooth performance of BLDC motor for pumping application. The hall sensors are used in order to sense rotor position of motor. Hall sensors are electronically commuted circuit used for inverter switching.

Performance of the simulated system is shown below. The proposed system is simulated in MATLAB; following results are obtained, as shown below. The proposed system consist output of solar PV array, inverter, converter and BLDC motor pumping output. Each section results is extracted from proposed system by using MATLAB /Simulink. The simulated results are shown below

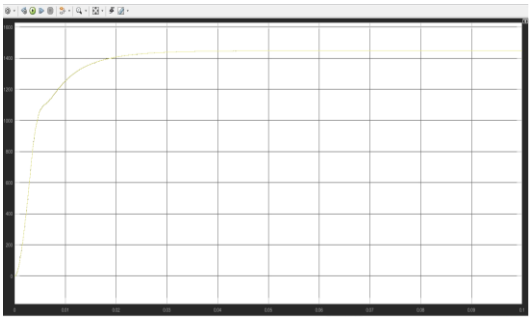
Solar PV System Power Output



Solar PV System Volatage

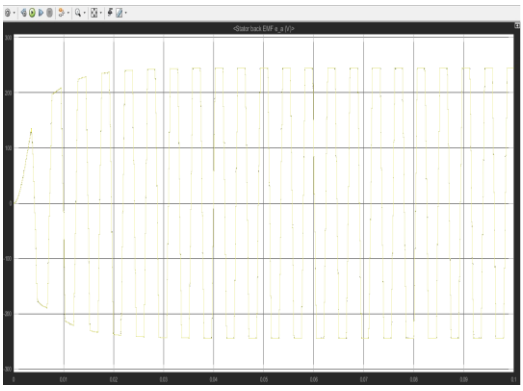


SIMULATION RESULTS FOR SPEED CONTROL OF BLDC MOTOR :



The following proposed system gives benefits of solar PV based application driven by BLDC motor for water pump as shown infig.1.There are various ways to control speed of BLDC motor like hysteresis control and other control scheme are used. But following configuration is simple, low cost, noise free and having least component of the system; make configuration is suitable for water pumping system.

SIMULATION RESULTS FOR OVERVOLTAGE CONDITION :



In this waveform Generally boost converter is used to operate system at higher voltage level. Proper design of converter helps for proper utilization of the system. As due to the only switch of boost converter had extremely excellent renovation efficiency. Boost converter helps to determine maximum power from solar PV array. Voltage of SPV array at

maximum point is V Vpv ≡ 5.248 ,as source of input voltage, and Vdc is dc output voltage of boost converter, the input–output relationship of boost converter.

VI. APPLICATION

- Industrial machinery
- House hold items like TV, refrigerator, AC
- Agriculture Motors
- Water pumps
- Protection of sensitive electronic devices

VII. ADVANTAGES

- Highly sensitive
- High output
- Low cost and reliable circuit
- Can handle heavy loads up to 15A

VIII. FUTURE SCOPE

- Solar PV system worn for pumping system in order to gain the maximum benefits from solar source along with also gives soft starting of BLDC motor.
- The model is inured study manifold parameter alternative effects upon the pv array in conjunction with operating temperature along with solar irradiation level.

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