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IMPLEMENTATION OF SOFT SWITCHED ONLINE SOLAR POWERED DC PUMP IN FARM FIELD

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ABSTRACT
The proposed work deals with the utilization of Solar Photovoltaic (SPV) energy in the DC motor driven water pump. A DC-DC boost converter, used as an intermediate power conditioning unit plays a vital role in efficiency enhancement of SPV array and soft starting of the DC motor with proper control. The speed control of DC motor is performed by the Arduino controller. No additional control or current sensing element is required for speed control. The behaviour of proposed pumping system is demonstrated by evaluating its various performances through MATLAB/simulink based simulation study. In this work the solar power is directly boosted using Boost Converter and there is no usage of batteries and other potential Storage Devices. In addition to that there is no step up and step down process held and transformers is not used in this work and no conversion of the Supply is held. In this work the properties of the DC supply Utilized by using IOT. From the IOT control we can able to turn on and turn off. In addition to that we set a particular time or the working time of the DC pump.

KEYWORDS:
Solar Photovoltaic, Embedded System, Hardware

INTRODUCTION

Solar power is pollution free and causes no greenhouse gases to be emitted after installation. Renewable clean power that is available every day of the year, even cloudy days produce some power. Return on investment unlike paying for utility bills. Virtually no maintenance as solar panels last over 30 years. Creates jobs by employing solar panel manufacturers, solar installers, etc. and in turn helps the economy. Ability to live grid free if all power generated provides enough for the home / building. Can be installed virtually anywhere; in a field to on a building. Use batteries to store extra power for use at night. Solar can be used to heat water, power homes and building, even power cars. It is safer than traditional electric current methodology. Efficiency is always improving so the same size solar that is available today will become more efficient tomorrow. Aesthetics are improving making the solar more versatile compared to older models; i.e. printing, flexible, solar shingles, etc.

A. Solar Water Pumping

Solar water pumping is based on photovoltaic (PV) technology that converts solar energy into electrical energy to run a DC or AC motor based water pump. The proposed work contains agricultural DC pump powered by PV modules. The conventional solar powered AC pumps have insulation failure, over heating problems. In addition to that the consumption of current is more. In AC motor while using in solar the consumption and requirement of parameters is more while compare to DC pumps. Though the initial cost is more for DC pumps it has the advantages of using lower number of components and high efficiency. Since the proposed worked is out of battery storage, maximum power point tracking technique (FUZZY LOGIC) is used to derive maximum power from PV module. This work deals with the utilization of solar photovoltaic (SPV) energy in the brushless DC (BLDC) motor driven water pump. A DC-DC boost converter, used as an intermediate power conditioning

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unit plays a vital role in efficiency enhancement of SPV array and soft starting of the BLDC motor with proper control. The speed control of BLDC motor is performed by PWM (Pulse Width Modulation) control of the voltage source inverter (VSI) using DC link voltage regulator. No additional control or current sensing element is required for speed control. The behaviour of proposed pumping system is demonstrated by evaluating its various performances through MATLAB/SIMULINK based simulation study. In this work the solar power is directly boosted using Boost Converter and there is no usage of Batteries and other potential Storage Devices. In addition to that there is No Step Up and Step Down process held and Transformers is not used in this work and no conversion of the Supply is held. In this work the property of the DC supply Utilized Based on the original nature and the Harmonics generated in the Boost is filtered to reduce the Problems and Difficulties arise in the proposed work. The Boost conversion can be shown using MATLAB/SIMULINK. The MPPT is implemented to obtain the Maximum solar energy from the Solar Panel.

B. Water Supply For Irrigation

Water is a major factor in successful production of greenhouse plants. An adequate water supply is needed for irrigation, pesticide application, evaporative cooling (if applicable), growing media preparation and clean-up. Plants require an adequate supply of moisture for optimum growth which is affected by many variables. Solar water pump motor, water can be supplied to locations outside the reach of power lines. For instance, this type of motor helps bring water to people in underdeveloped countries. It also works great for remote areas throughout the United States. Because this type of system can replace other pump systems, the benefits are social, economic, and environmentally based. Solar water pump system is designed with solar panels that collect energy from the sun. This energy can be stored and used to power the solar water pump motor, which then powers a surface or bore pump. Usually, the water is pumped from a nearby stream or from beneath the ground where, ultimately, it is stored in a storage tank. Because this provides a gravity feed, stored energy is not required. The amount of water needed depends on the area to be watered, crops grown, weather conditions time of year and the environment control system.

HARDWARE DESCRIPTION

C. Solar Panel

Photovoltaic directly convert solar energy into electricity. They work on the principle of the photovoltaic effect. When certain materials are exposed to light, they absorb photons and release free electrons. This phenomenon is called as the photoelectric effect. Photovoltaic effect is a method of producing direct current electricity based on the principle of the photoelectric effect. Based on the principle of photovoltaic effect, solar cells or photovoltaic cells are made. They convert sunlight into direct current (DC) electricity. But, a single photovoltaic cell does not produce enough amount of electricity. Therefore, a number of photovoltaic cells are mounted on a supporting frame and are electrically connected to each other to form a photovoltaic module or Solar panel. Commonly available solar panels range from several hundred watts (say 100 watts) up to few kilowatts.

Fig 1.Solar Panel

As the name suggest, in this type of solar power system, sun rays are concentrated (focused) on a small area by placing mirrors or lenses over a large area. Due to this, a huge amount of heat is generated at the focused area. This heat can be used to heat up the working fluid which can further drive the steam turbine. There are different types of technologies that are based on the concentrated solar power to produce electricity. Some of

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them are - parabolic trough, Stirling dish, solar power tower etc. The following schematic shows how a solar power tower works.

D. DC to DC Boost Converter

A DC-to-DC converter is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another. It is a type of electric power converter. Power levels range from very low (small batteries) to very high (high-voltage power transmission). A voltage regulator is used to regulate voltage level. When a steady, reliable voltage is needed, then voltage regulator is the preferred device. It generates a fixed output voltage that remains constant for any changes in an input voltage or load conditions. It acts as a buffer for protecting components from damages. A voltage regulator is a device with a simple feed-forward design and it uses negative feedback control loops. There are mainly two types of voltage regulators: Linear voltage regulators and switching voltage regulators; these are used in wider applications. Linear voltage regulator is the easiest type of voltage regulators. It is available in two types, which are compact and used in low power, low voltage systems. Let us discuss about different types of voltage regulators.

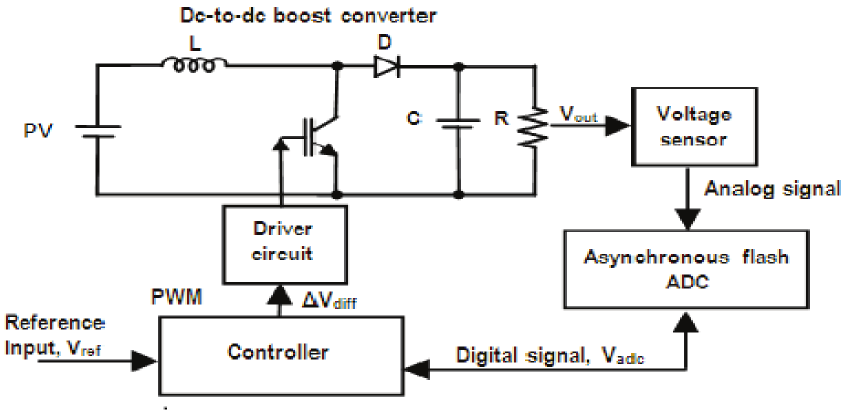

Fig 2 BOOST converter

The buck boost converter is a DC to DC converter. The output voltage of the DC to DC converter is less than or greater than the input voltage. The output voltage of the magnitude depends on the duty cycle. These converters are also known as the step up and step down transformers and these names are coming from the analogous step up and step down transformer. The input voltages are step up/down to some level of more than or less than the input voltage. By using the low conversion energy, the input power is equal to the output power. The following expression shows the low of a conversion.

E. ARDUINO

Fig 3Arduino

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt

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battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes pre-programmed with a bootloader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.

F. DC Pump

All pumps use basic forces of nature to move a liquid. As the moving pump part (impeller, vane, piston etc.) begins to move, air is pushed out of the way. The movement of air creates a partial vacuum (low pressure) which can be filled up by more air, or in the case of water pumps, water. This is similar to sucking on a straw. A partial vacuum is created in your mouth when you suck on the straw. The liquid is pushed up the straw because of the pressure differences between your mouth and the atmosphere.

Fig 4 DC pump

Pumps are not intended to run continuously, and they don't start each time you open a tap or flush the toilet. In order to provide consistent water pressure at the fixtures, the pump first moves water to a storage tank. Inside a modern tank is an air bladder that becomes compressed as the water is pumped in. The pressure in the tank is what moves the water through the household plumbing system. When the pressure reaches a pre-set level, which can be anywhere from 40 to 60 psi, a switch stops the pump. As water is used in the home, pressure begins to decrease until, after a drop of about 20 psi, the switch turns on the pump and the cycle is repeated. You'll find the pressure gauge mounted on the tank with wires leading to the switch that controls the pump. Pump efficiency is defined as the ratio of the power imparted on the fluid by the pump in relation to the power supplied to drive the pump.

SIMULATION RESULTS

Therefore it is analysed from MATLAB is that the work or connection of the device is shown using the MATLAB/SIMULINK. From this simulation the efficiency of the work is shown therefore it gives the final result in the screen.

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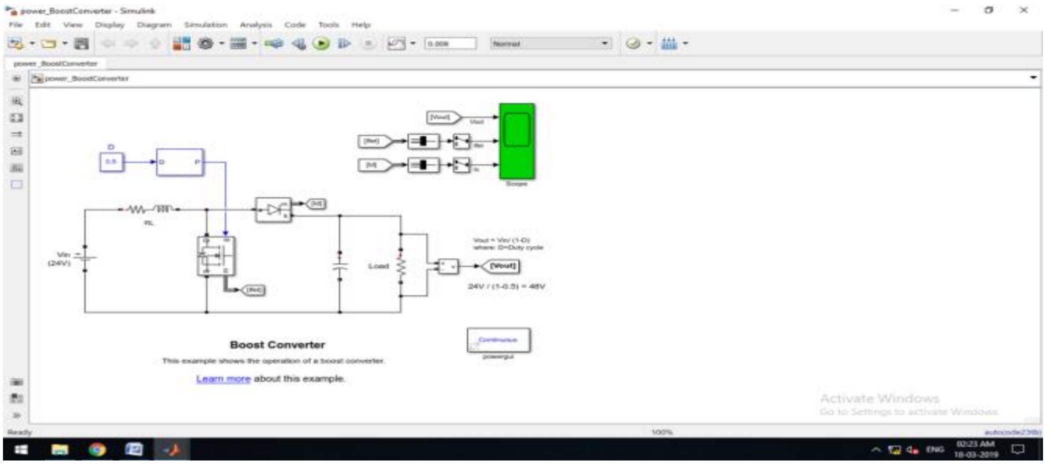

Fig 5 BOOST converter in MATLAB

These can also represent the result in the form of wave. By using the scope the resultant and working of the can be known. If there is any rectification needed based on the harmonics generated it can be seen from the wave output of the simulation.

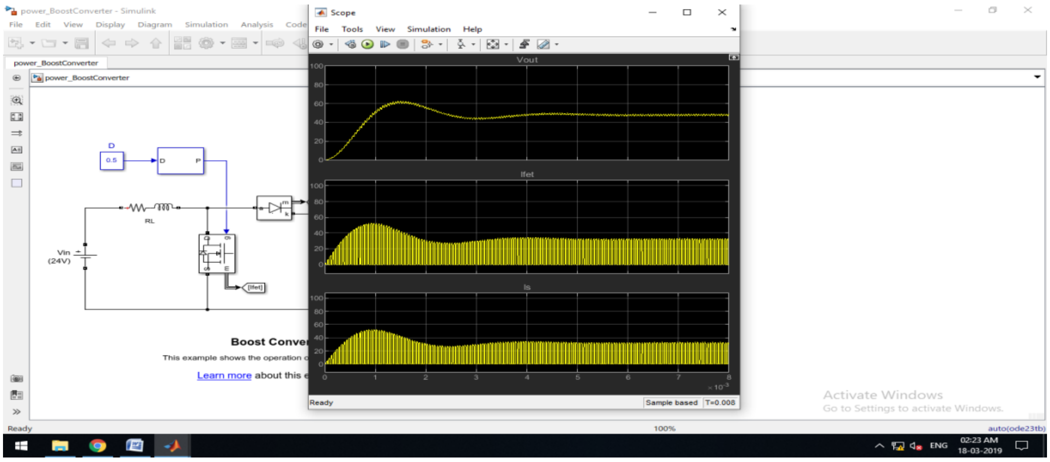

Fig 6. Waveform analysis

For this MATLAB tool the required input can be also be acquired on the basis of programming also. The pumps used for the transport of the water are equipped with solar cells. The solar energy absorbed by the cells is then converted into electrical energy via a generator which then feeds an electric motor driving the pump. From programming we can compile and run those codes and we will obtain the result.

HARDWARE SETUP

In the initial stage the input supply from the solar panel or solar cell can be obtained and the DC supply is about (12V,5A). Then it is not supposed to run a high rating solar pump (24V, 5A) then they obtained input DC is stepped up. The stepped up process can be carried out through the BOOST converter. This converter can be used to change the fixed DC supply to variable DC supply. Fixed DC cannot be stepped. Therefore it is changed or converted to variable DC supply. The BOOST process or stepping process can be carried out in the chopping or switching process. This chopping or switching is carried out using a triggering switch which it is a MOSFET, IGBT, and THYRISTOR etc. In these proposed work the firing pulse or triggering pulse for switching operation is carried out by controlled. Here it is made with Arduino. It gives the triggering pulse to the switch which it performs switching operation. In this chopping process some order of harmonics gets generated this harmonics can be reduced by using the FUZZY LOGIC. This FUZZY LOGIC controller can be used to show the harmonics can be generated or not in chopping process. Then what is the order of harmonics produced in the process.

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Fig 7 Hardware Setup

In addition to that the solar panel obtains the solar energy where it is not efficient then the MPPT technique is used. While using this technique the solar panel gives more energy to the load. The MPPT energy can be varied based on locations. This makes lots of confusion so software is preferred to know the maximum efficiency of the solar panel which it is named SOLAR PVSYST. This software shows and gives the maximum efficiency of the solar energy at various regions and various times. In addition to that based on the season the direction of the sun towards earth changes so the software is used to know or measure this maximum energy. Finally the output is efficient and the system or process can be controlled by switching. Therefore the DC pump can be able to control in IOT. From IOT we can turn ON and turn OFF the pump. In addition to that we can set the working time of pump

CONCLUSION

It has to be concluded that the proposed work has successfully completed with some difficulties. Therefore the result or output got from the work is beneficial and it is compared to the conventional method it is more effective. In case we using a storage device this reduce the efficiency of the work. In case we use some other renewable resource the efficiency or obtaining energy is less compare to the implemented work. Therefore solar energy was more efficient and it gains more energy radiation from the sum. In addition to that the process of rectification and inversion is absent because of using solar energy because in solar panel the semiconductor used in the panel was the acting device. So it generates DC energy supply. So the rectification and inversion process is absent in it reduces the operating cost and manufacture cost. If the implementation cost is reduced for DC pumps. Therefore the operating cost is reduced it automatically increases the efficiency. It has been prove that while compared to stored device usage and absence of storage device it gives 30% more optimizing energy and it is conveniently used. Whereas direct usage of solar energy in a converted manner increases the utilizing energy and it can more efficiently used in pumping operation.

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