International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

Design and Simulation of Photovolatic Water Pumping System by using Matlab

Mohit Patil[1], Prasad Rathod[2], Prof.Praful A Desale [3]

UG Student, Department of Electrical Engineering, G.H. Raisoni Institute of Engineering and Management, Jalgaon, Maharastra, India[1,2]

Assistant Professor, Department of Electrical Engineering, G.H. Raisoni Institute of Engineering and Management, Jalgaon, Maharastra, India[3]

ABSTRACT: This paper presents the analysis, design, and implementation of most wall plug chase (MPPT) system for domestic load using stand-alone photovoltaic (PV) power generation. MPPT is not a mechanical chase system that "physically moves" the modules to make them purpose additional directly at the sun. MPPT may be a totally electronic system that varies the electrical operational purpose of the modules so that the modules square measure able to deliver most obtainable power. The thesis decides on the output sensing direct control method because it requires fewer sensors. This allows a lower cost system. Each subsystem is modeled in order to simulate the whole system in MATLAB. It employs SIMULINK to model a DC pump motor, and the model is transferred into MATLAB. Then, MATLAB simulations verify the system and functionality of MPPT. Simulations also make comparisons with the system without MPPT in terms of total energy produced and total volume of water pumped per day. The results validate that MPPT can significantly increase the efficiency and the performance of PV water pumping system compared to the system without MPPT.

KEYWORDS:MATLAB/Simulink, PSpice, MPPT, Photo Voltaic(PV), Solar Energy, DC-DC Converter,water pump

I.INTRODUCTION

A water pumping system needs a source of power to operate. In general, AC powered system is economic and takes minimum maintenance when AC power is available from the nearby power grid. However, in many rural areas, water sources are spread over many miles of land and power lines are scarce. Installation of a new transmission line and a transformer to the location is often prohibitively expensive. Today, many stand-alone type water pumping systems use internal combustion engines. These systems are portable and easy to install.At present electrical phenomenon (PV) connected systems area unit experiencing fast market growth. this can be as a result of the regularly downward trend in PV price beside government support programs. though PV energy has received goodly attention over the previous couple of decades, the high installation price of PV systems and the low conversion potency of PV modules area unit the foremost obstacles to victimization this energy source on an outsized scale. Therefore, many studies area unit being developed so as to attenuate these drawbacks.

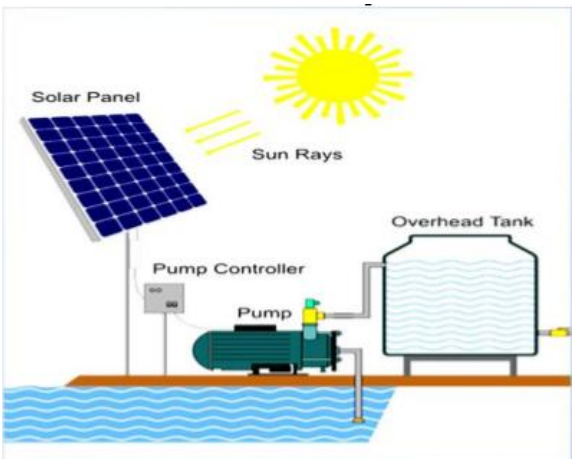


Figure 1: diagram of solar pumping system By Using MATLAB

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

In order to overcome this drawback a MPPT function has developed which increase the charging efficiency up to 30% when compared to PWM (pulse width modulation) technique. This paper presents an MPPT system supported the parallel affiliation of a dc–dc converter. With this configuration, solely a neighborhood of the energy generated is processed by the dc–dc converter, making it potential to obtain a rise within the total efficiency of the PV system as compared with the series configuration. Apart from the central water supply, households have independent groundwater deep wells from which water is to be lifted for consumption. In residential areas ground water from bore well is being used, hence there is need for pumping water to overhead tanks. In the current situation water pumps in every household are driven by electric motors and these electric motors uses conventional electricity.

II.PV SYSTEM COMPONENTS

A. *PHOTOVOLTAIC SYSTEM*

The sun rays (energy) called photons, which then falls on the solar panel and strikes the electron and we know motion of electron means production of current this process is nothing but photovoltaic effect. Each panel in it produce small or the huge amount of energy, but it can we increase further just by connection them in combination of series and parallel. The electricity produces from a panel or an array is in the form of direct current. A photovoltaic system employs solar modules, each comprising a number of solar cells, which generate electrical power. PV installations may be ground-mounted, rooftop mounted, wall mounted or floating. The mount may be fixed or use a solar tracker to follow the sun across the sky.

B. *DC-DC CONVERTER*

The Solar energy plays an important role in renewable energy generation systems since it is clean, pollution-free sustainable energy as well as the increasing cost-of-electricity which causes high-growth demands amongst utility customers. This paper presents various circuit topologies of DC-DC converters in solar photovoltaic (PV) applications. There are three types of DC-DC converter presented in this paper that can be integrated with solar PV system which are buck, boost and buck-boost converter in various applications. This paper also presents the application on DC-DC converter in solar PV system for maximum power point tracking (MPPT) feature.

C.WATER PUMP

Water pumps may be classified into three types according to their applications: surface, submersible, and floating water pumps. The surface water pump is placed outside the well. This type is efficient if used to draw water from Motor. A submersible pump is submersed in the water and draws water from deep wells. A floating water pump is placed on the water surface and draws water from reservoirs with adjusting height ability. The pumps are categorized according to their pumping principle screw pumps, where a screw movement traps the water in the suction side of the pump casing and forces it to the outlet.The static head represents the vertical distance from the water surface level to the point of discharge as shown in Figure 1 (A + B). During the pumping process, the water level drops (drawdown), this is represented by height C in Figure 1. Furthermore, there is another component that represents the frictional losses owing to pumping water through the pipe.

III.MAXIMUM POWER POINT TRACKER (MPPT)

Maximum power point tracking (MPPT) or sometimes just power point tracking (PPT) is a technique used commonly with wind turbines and photovoltaic (PV) solar systems to maximize power extraction under all conditions.Although it primarily applies to solar power, the principle applies generally to sources with variable power: for example, optical power transmission and thermophotovoltaics.Controllers. First, digital controllers are programmable thus capable of implementing advanced algorithm with relative ease. It is far easier to code the equation, $x = y \times z$, than to Design an analog circuit to do the same. For the same reason, modification of the design is much easier with digital controllers. They are immune to time and temperature drifts because they work in discrete, outside the linear operation. As a result, they offer long-term stability.

They are also insensitive to component tolerances since they implement algorithm in software, where gains and parameters are consistent and reproducible. They allow reduction of parts count since they can handle various tasks in a single chip. Many of them are also equipped with multiple A/D converters and PWM generators, thus they can control multiple devices with a single controller. Next, DC pump motor is modeled. SIMULINK is chosen for this purpose because it offers a tool called “SimPowerSystems” which facilitates modeling of DC motors with its DC machine tool

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

box. The model is then put into the MATLAB simulation designed in the previous section, replacing the resistive loadAnalog controllers have traditionally performed control of MPPT. However, the utilization of digital controllers is apace increasing as a result of they provide many benefits over analog controllers. First, digital controllers are programmable so capable of implementing advanced algorithm with relative ease. it's way easier to code the equation, x = y × z, than to design an analog circuit to do constant. For constant reason, modification of the design is much easier with digital controllers. They're immune to time and temperature drifts as a result of they add distinct, outside the linear operation. As a result, they provide long stability. They are also insensitive to element tolerances since they implement formula in software system, where gains and parameters are consistent and reproducible. They allow reduction of components count since they can handle numerous tasks in an exceedingly single chip. Several of them also are equipped with multiple A/D converters and PWM generators, so they can management multiple devices with one controller

IV.MPPT POWER CIRCUIT OPERATION

The bidirectional converter operates as a buck converter in the battery charge mode and as a boost converter when the battery must supply the load (RL) or when the load energy demand is higher than the energy generated. The converter duty cycle is generated by the same control algorithms that are used in the series-connected MPPT. The operation analysis of the proposed converter is presented for use with hard-switching pulsewidth modulation. However, it must be highlighted that the power circuit efficiency can be improved by using soft-switching techniques.

A. BUCK OPERATION MODE

The basic operation of the buck converter has the current in an inductor controlled by two switches (usually a transistor and a diode). In the idealised converter, all the components are considered to be perfect. Specifically, the switch and the diode have zero voltage drop when on and zero current flow when off, and the inductor has zero series resistance. Further, it is assumed that the input and output voltages do not change over the course of a cycle (this would imply the output capacitance as being infinite). The conceptual model of the buck converter is best understood in terms of the relation between current and voltage of the inductor. Beginning with the switch open (off-state), the current in the circuit is zero. When the switch is first closed (on-state), the current will begin to increase, and the inductor will produce an opposing voltage across its terminals in response to the changing current. This voltage drop counteracts the voltage of the source and therefore reduces the net voltage across the load.

B. BOOST OPERATION MODE.

The key principle that drives the boost converter is the tendency of an inductor to resist changes in current by creating and destroying a magnetic field. In a boost converter, the output voltage is always higher than the input voltage The greatest advantage of the proposed MPPT system with a bidirectional power circuit, is the integration of multiple functions in a single cost effective converter, which mixes simplicity, reliability, and low cost. The multiple functions of the proposed system are as follows: battery bank charger, which is when the energy generated by the PV array is higher than the load consumption; MPPT controller, which is so as to extract the maximum energy from the PV arraya nd step-up dc–dc converter, which is when the energy of Design And Simulation Of Solar Powered Photovoltaic Water Pumping System With Different MPPT the PV array is not enough to supply the load. The control algorithm ensures the operations of the PV module at the MPP, implementing the MPPT perform. The battery charge state is also observed by the digital control system, which avoids battery overcharge or excessive discharge in order to prolong the battery life time.

V. RESULT AND DISCUSSION

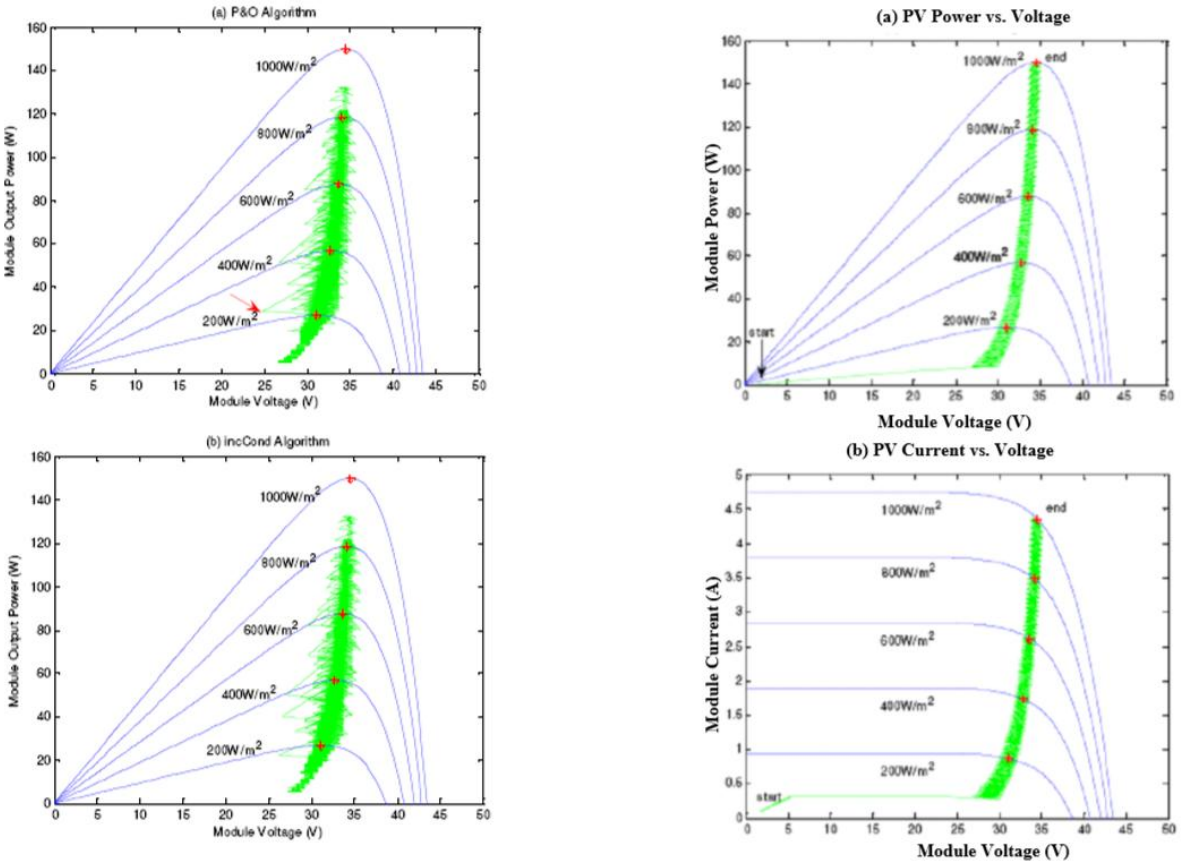
The location of the MPP in the I–V plane is not known beforehand and always changes dynamically depending on irradiance and temperature. Therefore, the MPP needs to be located by tracking algorithm. There are a number of methods that have been proposed. Among different algorithms are the Perturb & Observe and Incremental Conductance (incCond) discussed here. On a sunny day, the irradiance level changes gradually since there is no influence of cloud. MPP tracking is supposed to be easy. As shown in Figure 11, both algorithms locate and maintain the PV operating point very close to the MPPs without much difference in their performance.

A close inspection of Figure 12 reveals that the P&O algorithm has slightly larger deviations overall and some erratic behaviors (such as the large deviation pointed by the red arrow). The simulation results show the efficiency of 99.3%

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

for the P&O algorithm and 99.4% for the incCond algorithm. The experimental results show 96.5% & 97.0%, respectively, for a partly cloudy day.



The permanent magnet DC motor with a constant field was modeled and simulated with SIMULINK as illustrated in Figure. The parameters of DC machine that correspond to the actual pump motor are unknown, thus they are chosen by modification of the default values and estimation.

VI.CONCLUSION

This paper presents a simple but efficient photovoltaic water pumping system. It models each component and simulates the system using MATLAB and SIMULINK. Simulation of the developed model of the system shows that the PV model using the equivalent circuit in moderate complexity provides good matching with the real PV module. Further, simulations were also performed to compare two MPPT algorithms using actual irradiance data in the two different weather conditions. The incCond algorithm shows narrowly but better performance in terms of efficiency compared to the P&O algorithm under the cloudy weather condition. However, due to cost constraint, the P&O control method was chosen. Simulation with SIMULINK to model a DC pump motor which was then incorporated into MATLAB verifies functionality and benefits of MPPT. Lastly, simulations of the model were then compared against the system without MPPT in terms of total energy produced and total volume of water pumped a day. The results validate the benefits of the MPPT which can significantly increase the efficiency of energy production from PV and the performance of the PV water pumping system.

REFERENCES

[1] UNEP "Water Policy and Strategy" (viewed on www.unep.org/dpdl/water/ , August 2005)
[2]. UNESCO The UN World Water Development Report, 2003 (viewed on www.unesco.org/water/wwap/wwdr/, August 2005)
[3]. Texas Instruments "Converting Analog Controllers to Smart Controllers with TMS320C2000 DSPs" Application Report, June 2004 (downloaded from dspvillage.ti.com/)
[4]. Rashid, Muhammad H. Editor-in-Chief Power Electronics Handbook Academic Press, 2001

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

[5]. Kyocera Solar Inc. Solar Water Pump Applications Guide 2001 (downloaded from www.kyocerasolar.com)
[6]. Thompson, Marry A. Reverse-Osmosis Desalination of Seawater Powered by Photovoltaics Without Batteries Doctoral Thesis, Loughborough University, 2003
[7] Rashid, Muhammad H. Editor-in-Chief Power Electronics Handbook Academic Press, 2001 [H. Power Electronics - Circuits, Devices, and Applications 3rd Edition Pearson Education, 2004 [6] Hua, Chihchiang, Jongrong Lin &Chihming Shen "Implementation of a DSPControlled Photovoltaic System with Peak Power Tracking" IEEE Transactions.