ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.10

A Review Paper on: Optimal Utilization of Solar Energy using MPPT and Wiper arm

Manojkumar Singh[1], Dr. Harikumar Naidu[2]
PG Student[1], HOD[2]
Department of Electrical Engineering
TGPCOE, Nagpur, India

Abstract:
Nowadays, due to a growing global population, domestic and industrial energy demands are on the rise. We are dependent on fossil fuels energy sources but the future energy demands a sustainable and clean energy source. To overcome these problems, solar energy is the best alternative as it reduces dependence on fossil fuels. The performance of solar power can be influence by increasing the efficiency of PV panel. However, the power produced by PV modules varies widely during the day. Major factors that affect power output include amount of direct light (irradiation), cell temperature and dust present in the atmosphere. The power produced by PV modules varies widely during the day. So, Maximum Power Point Tracking is used to the better charge controllers and to extract maximum available power from PV modules. The main aim of the project is realization of Maximum Power Point Tracking and cleaning of PV panel to maximize the output power from the panel and to charge the battery efficiently. So that, the photovoltaic cells works efficiently and there will be no ageing effect on photovoltaic cell as well as panel which make reliable, durable and long life. This system will provide a stable dc power supply.

I. INTRODUCTION:

Solar energy is a safe alternative which can replace current fossil fuels like coal and gas for generation of electricity that produce air, water, and land pollution. Electricity generation from fossil fuels causes pollution of air leading to acid rain, damaged forest areas, and affected agricultural production leading to loss of billions of Rupees. Use of solar energy will eliminate these unsafe, unclean consequences from using conventional fossil fuels. Solar energy's greatest attraction is that it can be produced on a small scale directly by the end consumers in contrast to large centralized conventional energy sources controlled by large corporations. Solar energy is suitable for heating and electricity generation using photo-voltaic cells installed on roof-tops of individual buildings. This is useful as decentralized sources of electricity for households and commercial businesses. The decentralized nature of solar power makes it a practical and viable energy source in remote areas located far from the electricity grid. This is crucial for agribusiness in farms for running irrigation, greenhouses, and crop and hay dryers, making agriculture risk-free. Pristine forests are destroyed for mining raw materials like fossil or nuclear fuels. Trees constantly remove and use carbon dioxide from the air to make their food, and this carbon is then stored in them. When forests are cut for mining raw materials for conventional energy, this major carbon sink disappears and also increases climate change. It leads to loss of animal habitats that diminishes their population. Switching to solar power is important to keep these habitats intact for the animals that live there as well as continue to keep the air clean. Solar panels produce electricity by converting the sun's energy into high temperature heat. How it does this is through various mirror configure. Rations. From there, the heat is then channeled through a conventional generator. When paired with greenhouses, solar power plants could even grow vegetables and crops by using seawater evaporators to provide humidity and ideal growing conditions. Although many homeowners find the expense of installing solar panels too daunting, it should be noted that using solar power to even partially provide your energy needs will also result in savings on your electrical bill. The great thing about solar power is that you can use it for a wide array of different objects. Solar power is also known as being "eco-friendly" since it doesn't emit toxic gases into the environment. In order to recommend solar power energy as a viable alternative it is important that the system is composed of sustainable components for ease in operation and maintenance. Solar Energy is simply an energy provided by the sun. In these, electricity can be directly produced from photovoltaic cell or photovoltaic panel. Solar Energy is nothing but an energy which converts the light energy directly into electrical energy. Solar Power is broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.

II. LITERATURE SURVEY

Presently, most of the world’s energy is derived from fossil fuels, but their efficiency and environmental effects hold it back from being a preferred energy resource. PV modules still have relatively low conversion efficiency; therefore, controlling maximum power point tracking for the solar array is essential in a PV system. The amount of power generated by a PV depends on the operating voltage of the array. Maximum Power Point Tracking is an electronic system that operates the photovoltaic modules in a manner to extract the maximum power from the system. The voltage at which PV module can produce maximum power is called ‘maximum power point’. The efficiency of PV cell is increased by the mean of wiper to avoid dust and moisture stagnation over the panel surface. It can be used in many fields where there is inadequacy of

sunrays due to geographical differentiations hence; tracking of sunrays and cleaning of the PV panel can be done simultaneously. Solar energy has the potential to become a major renewable energy resource. The performance of solar power can be influence by increasing the efficiency of the Photovoltaic panel. Maximum Power Point Tracking is used to improve the performance of PV panels. Maximum power point tracker is a modern approach over conventional PWM solar charge controller. The efficiency of PV cell is increased by the mean of wiper to avoid dust and moisture stagnation over the panel surface. Brushless DC motor is use for rigorous work with proper output characteristics with the help of PWM controller to move the PV panel in both the directions, in which a motor driver circuit is used to give the step count to rotate the brushless dc motor as directed by the microcontroller according to the sunlight using LDR, hence absorption of sun light will be enhanced by the PV cells. The wiper arm is moved with the help of a threaded shaft mounted on the PV panel to which a DC motor is connected which is operated at a regular interval manually and is driven by the DC motor driver. The initial value of the LDR, battery voltage, and panel voltage, direction of panel and direction of wiper arm rotation are being represented on the display unit. The duty cycle which gives the step count of rotation to the brushless dc motor is set to fixed value with the help of potentiometer knob. The initial value of duty cycle in percentage is also represented on the display unit. Limit switches is used to limit the rotation of panel so that at the end of the day panel will come to its starting position that is from west to east direction.

Design of the control circuit

The system requires a control circuit for operation and control. The control circuit is designed by taking into consideration the parameters discussed in the previous chapter like rotation, movement of panel surface etc. The electrical-electronic components required are explained in detail in this chapter along with the block diagram, circuit diagram and other features.

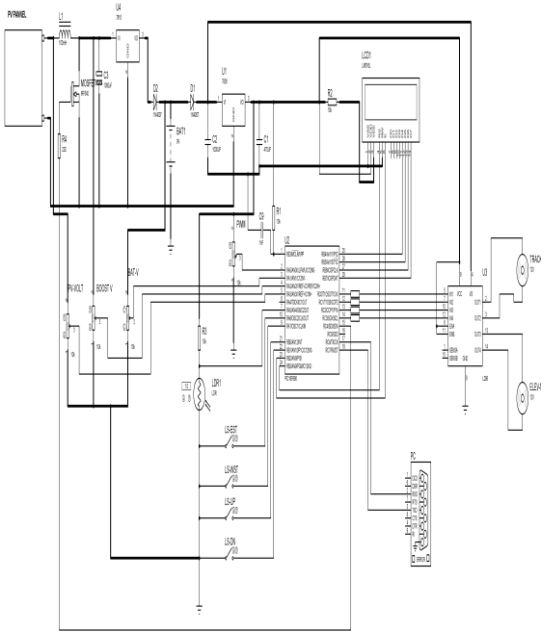

Figure.1. Circuit diagram working prototype

Working of prototype:

SOLAR PANEL 12V 20W

If we are using solar panel rating 12V 20W polycrystalline type. Whenever a full radiation condition arises from sun, the panel gives maximum open circuit voltage of 21V and maximum short circuit current will be of 1.8A. The basic aim of my project is to improvise the output of solar power to the best optimal result. Most of the times, it observed that the radiation of sun is not constant; hence output generated by a photo voltaic panel is also not constant. Sometimes it falls below the required charging voltage for the battery i.e 12V in my project and sometimes it exceeds the 12V. As the second aim is to charge the battery at required voltage i.e between 12V to 14.2V, all the systems is monitored and controlled by the microcontroller. Initially, microcontroller detects the panel voltage, battery voltage. If the controller observes the voltage coming from photovoltaic panel is less than 12V, and greater than 8V, controller starts to give the PWM pulses on post C.1 which is further connected to boost conversion circuit comprising of one MOSFET series inductor (100mA) diode and capacitor. Reason of using the boost conversion circuit is to amplify the input voltage two to three times whenever radiation is low and the output falls below 12V (whenever PV voltage is 8V-10V, the output of the boost converter is almost 3 times and whenever it is 10V-12V, the output of the boost converter is almost 2 times). The amplification ratio is directly proportional to the PWM signal duty cycle. Boost conversion will not take place if voltage is smaller 8V or greater than 12V. As we know, the inductor stores magnetic energy if the signal is of changing in nature. In my project, inductor (100mH, 2A) is used in boost converter, which amplifies the DC voltage to twice and thrice. The charging voltage from a DC source is obtained by using a static switch (MOSFET) which is controlled by on/ off signal of PWM.

III. MOSFET

We are using MOSFET to switch an 8-12V DC input from PV panel and microcontroller is being used to control the MOSFET gating signal. As microcontroller operates on 5V and gives a maximum 5V in its output in the form of PWM pulses to protect the microcontroller from reverse effect, in case of short circuit of MOSFET, I am using a current limiting current resistor (100Ω) between MOSFET gate and microcontroller. Diode D_3 is used to prevent the reverse flow of charge from capacitor. This capacitor is used to store charge (65V, 1000µF). The output of boost converter is higher than charging voltage, hence regulates (LM7812) of a 12V 2A (U4) is used, which stabilizes the output voltage to 12V which is fed to further circuit using D_2 in forward bias. The voltage of a battery is of 12V and the PIC microcontroller requires 5V only. Hence to convert 12V to 5V a regulator IC 7805 is used. The capacitor C, is used as storage capacitor which can maintain a 5V in case of any loading effect otherwise a low voltage may result in malfunction of microcontroller. Initially microcontroller requires reset; because a lot of garbaged data reside in RAM location and must of executions are performed inside the RAM locations only hence initially all the RAM location has to be flushed out I.e reset. To reset a microcontroller, reset pin 1 is used which can be reset manually giving a transient from 0 to 1 or low to high but I am using automatic power or reset by using a resistance R_1 and capacitor C_9 connected in the differentiation mode. As capacitor C_9 is connected to ground and initially C_9 is connected is discharged hence input impedance is also minimum (about 0Ω) As soon as power supply the 5V which is given to the reset pin using resistance R_1 goes to ground through the low impedance capacitance C_9 hence the reset pin 1 has zero volt, but the capacitor gradually charges and acts open due to high impedance. Hence, the voltage coming from

resistance is of 5V as reset pin 1. As we know that the microcontroller executes various functions inside its memory locations i.e. store/ erase some data in form of 0 or 1in various memory locations comprising of flip flops. To perform erasing and storing the data, the clock pulse is required for the flip flop. As number of operations requires a number of clock pulses, same can be generated by using an oscillator circuit. In PIC, there is a provision of internal as well as external oscillator. The area of operation is not huge in my project; hence the internal oscillator of 4MHz is used. In the project, solar panel tracking is also performed by using a tracking motor and elevation motor which is used of 12V 8W and geared type (3rpm). As the motor requires 12V for its operation and the direction of motor is controlled by microcontroller which can maximum provide 5V and motor requires to be operated (12V supply, and a driver IC LM 298 is used.). Basically LM298 is the full bridge dual driver maximum of 4A. The direction of motor and rotation of motor depend upon the solar radiation. If the panel voltage is greater than 12V and radiation of a solar is greater than 1005lux, in that case only, tracking motor starts rotating from east to west by checking west limit switch. When west limit switch (A4 pin of microcontroller) is activated, microcontroller gives command to motor to rotate from east till east limit switch is activated (A5 pin of microcontroller). All the collected data like panel voltage, battery voltage, booster voltage, radiation level, direction of rotation and status of panel and battery is displayed on alphanumeric LCD which is of 16 characters and 2 lines R_2 is used to adjust the contrast level of LCD by keeping 1.2V at pin no.3 of LCD. The monitored date like battery voltage, panel voltage, boost voltage, and radiation level is further sent to through serial port to the Laptop/PC by using USB to TTL at 9600 band rate (9600bits/sec). Band rate is communication speed on which a high speed laptop processor communicates to the low speed microcontroller. Limit switch is used of single SPDT type having maximum contrast tracking is of 6A. Radiation level is measured with the help of LDR which is of 10kΩ, connected with a R_3 as a divider network. Pull up resistor R_5 and R_6 which is connected with limit switch in pulled down which ensures the known status of 0 or 1. R_{15} and R_{16} of 100Ω is used to protect microcontroller against the reverse flow from H - bridge driver in case of internal short circuit.

IV. CONCLUSION:

This system can prove to be a helping hand in controlling the increasing problem related to solar tracking and self-cleaning of the panel head. The system is efficient as it uses solar power for controlling operation and still output power is available to serve as constant dc source. Also it can be effectively used in the tie grid system.

V. REFERENCES:

[1]. M. A. Farahat Zagazig University, zagazig, egypt "improvement the thermal lectric performance of a photovoltaic cells by cooling and concentration techniques" IEEE xplore.

[2]. I. M. Abdel-Halim, H. *G.* Named and M. A. Al- Ahmar, "Effect of Cell Temperature on The Performance of a hotovolatic Generator *I* DC Motor System", Sixth Middle-East Power System Conference (MEPCQN *98),* Mansoura niversity, Mansoura, Egypt, Dec. 15-17, 1998, pp. 706 - 710.

[3]. Ioulia T. Papaioannou, Minas C. Alexiadis, Charis S. Demoulias Member, IEEE, Dimitris P. Labridis Senior Member, IEEE, and Petros S. Dokopoulos Member, IEEE "Modeling and Measurement of Small Photovoltaic Systems and Penetration Scenarios". IEEE 2009.

[4]. Weidong Xiao, Student Member, IEEE, William G. Dunford, Senior Member, IEEE, Patrick R. Palmer, Member, IEEE, and Antoine Capel "Regulation of Photovoltaic Voltage" IEEE TRANSACTIONS ON INDUSTRIAL ELECT RONICS, VOL. 54, NO. 3, JUNE 2007

[5]. Chihchiang Hua, Chihming Shen "Study of Maximum Power Tracking Techniques and control of DC/DC Converters for Photovoltaic Power System" IEEE 1998.

[6]. Weidong Xiao, Student Member, IEEE, Nathan Ozog, Student Member, IEEE, and William G. Dunford, Senior Member, IEEE "Topology Study of Photovoltaic Interface for Maximum Power Point Tracking" IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 54, NO. 3, JUNE 2007.

[7]. Parve S.Y, Atram R.R, Batra A.A, Bisen V.B "Optimal utilization of solar energy using MPPT and wiper arm", SPANDAN 2017 YCCE , NAGPUR,1st April, 2017.