IoT BASED SOLAR TRACKING, MONITORING AND LOAD SHARING FOR SMALL POWER APPLICATION

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Abstract: This paper presents the process of solar tracking with the help of LDR sensors and attains maximum efficiency. Sensor unit sends information to the microcontroller which controls the speed and direction of the dc gear motor attached to the solar panel. The solar energy is stored in the battery and electric supply given to the load. If there is any detect in a particular solar cell it will send information to the microcontroller through voltage sensor which send the message to the LCD. IOT based automation set up in this project. The project includes load sharing by switching over to the solar based unit from the EB unit. Solar panel gets charge from the battery during the night time in order to increase the life time of the panel.

Key Words:- *Solar tracker, IOT, LDR, Maximum Power Point Tracking(MPPT)*

I. INTRODUCTION

The world population is increasing day by day and the demand for energy is increasing accordingly. Since oil and coal are getting depleted and it cannot be replenished, we option for an alternative source of energy. Renewable energy is derived from natural processes that are replenished constantly. Renewable energies are inexhaustible and clean. The energy comes from natural resources such as sun, wind, tides, waves and geothermal heat. Solar energy is quite simple. Solar tracking system which can be used as a power generating method form sunlight. There are two ways to track the energy by time and by using sensors. By using time we can't able to get accurate results sometimes there may be a sudden windy day so we can't predict the weather. But by using the sensors we can get accurate results and more energy. We are now opting for Light Dependent Resistor **(LDR)** sensor technique.

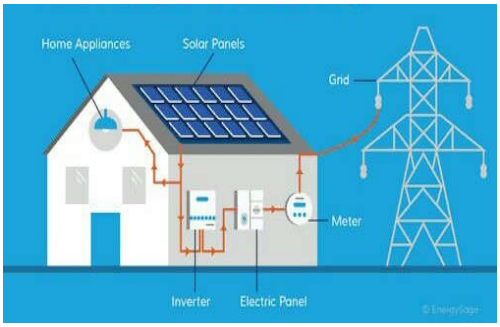


Figure 1.Solar panel for Home Application

LDR is a light controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; In other words, it exhibits photoconductivity. The main function of DC

gear motor is used to rotate the approximate position of the panel. The motor driver and microcontroller PIC 16F877A controls the system. The proposed dc gear motor is fully adjustable in term of speed and torque. Permanent Magnet DC Motors **(geared motor)** used in axis direction. Used to transmit torque to the panel arrangement. Detecting fault on a set of solar panels using voltage sensor. In order to detect faults within solar panels which affect considerably the energy produced by the solar panels. Information sends to the microcontroller PIC 16F877A through voltage sensor which then sends message to the main unit in order to replace the panel. MPPT is the charge controllers used for extracting maximum available power from PV module under certain condition. MPPT checks output of PV module, compares it to battery voltage then fixes what is the best power that PV module can produced to charge the battery and converts it to the best voltage to get maximum current into battery it can also supply power to the DC load which is connected directly to the battery. A PV inverter, converts the variable direct current (DC) output of a photovoltaic solar panel into a utility frequency alternating current that can be fed into a commercial electrical grid or used by a local.

II. OPERATION

LDR sensor senses maximum solar power which is being given to the microcontroller PIC 16F877A through the ADC which digitizes the LDR output operate the geared motor to control the angle of rotation of the solar panels acquire the maximum energy from the light source by the conversion of electrical energy into mechanical energy. Light energy stored the acquired energy into battery. Battery collects the energy and turns it into direct current (DC) electricity. The DC electricity is passed through the device called an inverter to convert it to the alternating current (AC) used for the future purpose to supply the current to the load. Voltage sensor senses the voltage value of the solar panel for monitoring purpose. If resistor value achieve less than 5kohm valve the inverter supply the current to the relay 1. In case resistor value high as 2000kohm the relay is disconnect that time EB unit current flow through the relay 1 for supply current to the load. Current store in the battery energized the solar panel when the resistor value is high. It helps to increase the life time of the solar panel.

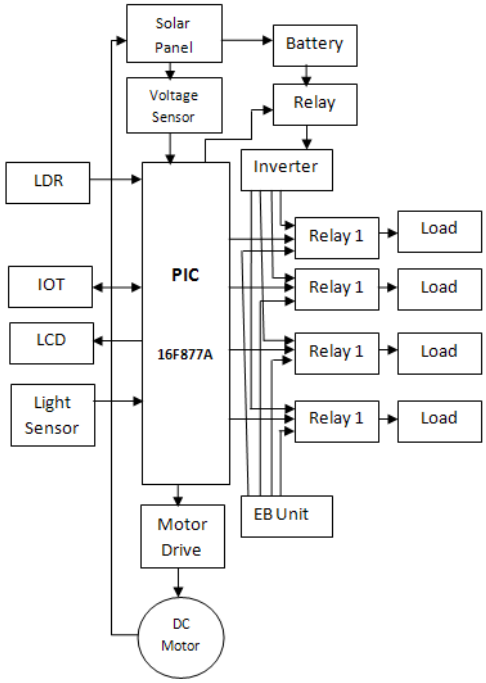


Figure 2.Block Diagram

Voltage generated by the panel as per the individual tilt time is display on the Liquid Crystal Display(LCD). LCD is used for display unit.LCD is specialized for being used with the microcontroller shown in fig 2.

For monitoring propose we use automated IOT based system to monitor a solar panel parameters. The output power transmit to IOT system over the internet. This makes remotely monitoring of solar panels very easy and alerts the user to control the power supply to the load very easy.

III. RELATED WORK

This project is applicable for automation in the area of solar energy is sun tracking system in which control theory is employed to drive the solar collector toward sun in all time. These can be used in home to power the appliance using solar panel. These can be used in industries as more energy can be saved by rotating the panel. Development of solar cells that captured the sun's energy and turned it into electricity. Since then, the technology has evolved and solar power system now provides incredibly attractive financial benefits for homeowners, businesses. We can use that electricity in your home, store it with a solar battery.

IV. SCOPE OF RESEARCH

Best suited energy source for India in future. Most of the power plant in India is carried out by coal and mineral oil which contribute heavily to greenhouse gas emission. But the major problem is that they are limited and Non-Renewable. Solar energy has got tremendous potential to meet the energy requirement and bridge the energy demand supply gap.

Due to shortage of Non-Renewable sources of energy, solar energy sector of India has been growing rapidly from past few years. The geographical location of a country stands to its benefit for generating solar energy. The Government has set an ambitious target of generating 175GW power by 2022 for Renewable sources which includes 100GW form solar.

V. PROPOSED METHODOLOGY AND DISCUSSION

Solar energy system (or) PV system, we all made possible thanks to the phenomenon called Photovoltaic Effect. The conversion from solar energy to direct current electricity in certain types of semiconductors. The full understanding of the process requires understating of different physics concepts such as photons and solar radiation semiconductors, structure conversion between solar radiation, chemical energy and electrical energy.

5.1. PHOTO VOLTAIC EFFECT

Fig 3.shows when connecting two types of doped semiconductor we have a P-N junction. These are n type semiconductors contain extra amount of loose electrons from donor and p type semiconductors lack some electrons in covalence bands. This makes electron the major charge carriers in n type and hole the major carrier in p type. Some n side electrons diffuse to the p side and vice versa for p side holes. Creating a depletion region in between the depletion region contains positive charge part of n type and negative charged part of p type semiconductor. This creates an electric field that prevents further diffusion of electrons and holes reaching and equilibrium. When exposed to the sunlight electrons and holes to N side and P side respectively. Connecting an external circuit allows electrons (from n side) to travel through and recombine with holes at the other end (p side).This process produces an electric current to drive the load.

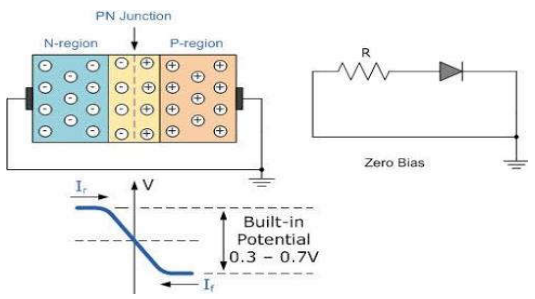
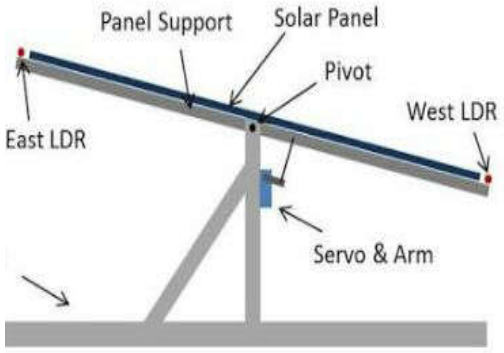


Figure 3.PN Junction

5.2. SOLAR TRACKING SYSTEM

5.2.1. SOLAR TRACKERS

A solar tracker is a device for rearranging the position of solar PV panels face towards the sun to make close possible right angle to sun rays. The position of sun varies in the sky both with of day as the sun move across the sky and season. The maximum efficiency of solar powered equipment depend on the right angle incident of sun rays element photon. In one solar power station there are many number of solar cells, we can't keep sensor on all the cells, it will increase the cost. So we are going to maintain a single sensor unit which covers all the cells. It can increase the efficiencies of such equipment over any fixed position solar system at the considerable case for additional system complexities shown in fig 4.



Panel power rating: 6V & 5W

Figure 4. Single Axis Solar tracker

5.2.2. TRACKING USING LDR

This project is designed with solar panels, micro controller, dc gear motor and its driver motor. In this project 4 LDR are fixed on the solar panel at distinct points In one solar power station there are many number of solar cells, we can't keep sensor on all the cells, it will increase the cost. So we are going to maintain a single sensor unit which covers all the cells.. LDR varies the resistance depending upon the light intensity. This Sensor unit will track the position of the sun and sends information to the microcontroller which is connected to each row of the solar cells. From that information all the solar cells will turn into the same direction.

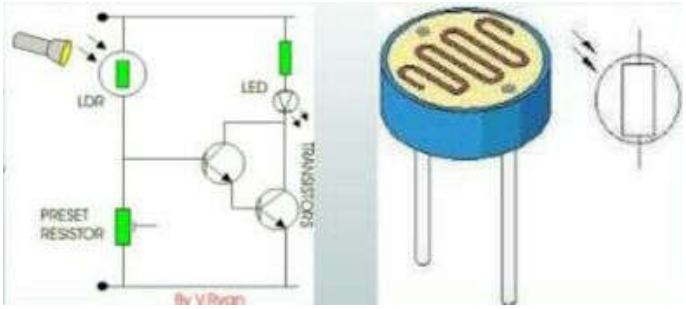


Figure 5. LDR

5.3. PANEL MONITORING

Maintaining and monitoring the voltage of solar panel is important in power station and also household too. So here we discuss on how to monitor solar panel voltage. Voltage measurement of solar panel is done by voltage sensor which is range upto 5 volts. If the voltage level is more than 5 volts then we have to use some additional circuitry like voltage divider. In this circuit there is no need for any additional circuitry. Just connect the solar panel output voltage to micro controller. The output voltage of the solar panel is in analog form. Using ADC which digitizes the panel output voltage is given as the

input of the microcontroller and display result on LCD. If there is any detect in a particular solar cell it will send information to the microcontroller through voltage sensor which then sends the message to the main unit

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Figure 6. Voltage Sensor

5.4. MAXIMIZE THE LIFESPAN OF SOLAR PANELS

For Mono Crystalline Silicon the most commonly used for commercial and residential PV. Solar panels in extreme climates showed high degradation rate. Solar panels subjected to heavy wind and snow, loads suffered the most. In order to increasing the life time of solar panel. We are using PID Technology. In this project, the relay is connected between the inverter and battery. LDR is given as the input of the relay. LDR is used to differentiate the day time and the night time. The solar panel gets charged during the day time and gives supply to the load. In night time, the solar panel gets charged from the battery in order to increase the lifetime of solar panels to 10 years.

5.5. COMBINATION OF EB UNIT AND SOLAR PV

Solar panels get charged and it's stored in the battery with the DC current. In order to power a load the DC current is converted into AC using inverters. In this project, for maintaining a constant power we are using DC-DC Buck-Boost converter is a combination of the buck and boost converter and can thus convert an input voltage to both higher or lower output voltage. In case of voltage failure can serve the load, the system can perform one of critical tasks of an EB unit providing energy.

Load sharing involves switching over from the EB power line to the inverter for supplying the load after getting adequate energy in the battery from the solar panels. It could be done by the users using IOT via Internet. If the battery supposed to have low amount of power, the trimpot connects to the controller will sense it and the loads will be switch over to the EB by the users using IOT.

VI. EXPERIMENTAL RESULTS

The result of our project is solar tracking is done by DC gear motor to track the sun light .The solar energy is stored in the battery and the electric energy is given to the load through the inverter. If the battery supposed to have low amount of power, the trimpot connects to the controller will sense it and the loads switch over to the EB unit by the user using IOT. In night time, solar panel gets charged from the battery in order to increase the lifespan of panels. If there is any fault in a particular panel, it will send information to the microcontroller through voltage sensor.

VII. CONCLUSION

Thus the solar panel that tracks the sun was designed and implemented. This system was designed using single axis tracks. This paper aims basic applications of home automation. It will provide improvement in energy saving techniques. The solar panel vertically focus sunrays onto the PV panel. It tracks the sun position using software. Software sun tracks provides maximum efficiency with minimum cost. New MPPT method which is suitable for low power PV panel has been proposed and tested. Now a days renewable energy solutions are increasing popularity so it can be applied in wide range of DC energy harvesting devices. During day time the average output power delivered by the solar tracking device increased. For larger installation solar tracking device is cost effective wireless power transfer technique is used to charge the battery.

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