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MULTIFUNCTIONAL AUTOMATED SYSTEM FOR MONITORING PERFORMANCE OF SOLAR PV PANEL

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***Abstract*— The utilization of sun energy into electrical or thermal energy is possible only through the help of panels. Solar panel is now widely used for a variety of industrial and domestic applications. A photovoltaic panel converts the sun's radiation to electricity. It is often necessary to monitor health of a solar panel. But it is very difficult to measure the solar parameters manually as every time we need to go on the terrace and measure them using the multimeter. We have implemented the solar panel parameter measurement system. This project helps us in getting those parameters directly on Mobile through GSM and reduces human efforts. Dust will effect on the output parameter of solar panel. This system automatically cleans the dust on the Solar panel. Bidirectional solar panel tracks the sun to harness maximum power. Also this system helps us for detecting any failure in the system as we will come to know within short time due to remotely acquired parameters. This system automatically displays the various parameters of solar panel such as voltage, current, power, sun irradiance and dust level. For this we are using the PIC18F4520 controller for controlling I/O blocks like relays, motors, display, GSM, different sensors like(temperature sensor, dust sensor, light sensor) There is also the voltage divider circuitry along with the controller. We have driven the two loads at the output of system using the backup battery which will be charged by solar panel.**

Keywords— PV panel, dust sensor, efficiency, parameters.

I. INTRODUCTION

At present, there is a great interest towards solving the energy problems faced by the world. This has led to research on alternative energy source that would complement the conventional fossil fuel. Solar is a natural energy source. Solar energy is the energy generated by harnessing the power of the solar radiation. It is the cleanest source of energy whose use can contribute to saving exhaustible energy sources. Such systems are based on a solar collector, designed to collect the sun's energy and to convert it into either electrical power or thermal energy. [1]

Now a day's solar panels are widely used in many industrial and domestic applications. Solar panel does not have a system which can show different parameters of panel and also can automatically clean the dust on the panel. For addressing this need we propose to develop an effective system meet these requirements. For that we have use PIC controller, GSM module, Relays, DC motors, Battery, PV cell, various sensors and DC load.

Developing the panel efficiency by increasing the conversion of solar energy is essential to harness more energy. Photovoltaic cells or panels are one way of generating electricity from solar energy. They are not the most efficient, but they are the most convenient to use on a small or medium scale. PV cells are mostly made from silicon, similar to that used in computer "chips". Usually a number of panels will be connected in parallel to give an increased current. [2]

II. LITERATURE SURVEY

Earlier People were not much aware of the renewable sources and conservation of non-renewable sources but later solar panels were developed for the use of renewable sources. Then systems were developed to clean the panel manually, as the cleaner the system the efficient it is. But nowadays automatic PV panels cleaning systems are available. These systems include timely cleaning and washing of the panels. Companies like Heliotex, Sunpower provides with such cleaning systems. Our system doesn't operate in timely manner instead it includes dust sensors for sensing the dust and then cleaning it and not on the basis of time. So stop worrying about climbing the roof top every time.

The current PV solar panels in the market do not come with any automatic parameters measurement facility, measuring the parameters is possible with the help of a multimeter. If our solar panel is on the roof top and if we need to measure its parameters then we need to measure it by going on the roof top taking the multimeter. Our project includes an automatic system for the measurement of its parameters. This system automatically sends the data on the mobile by using a GSM modem. Also a display has been provided there on the panel itself.

Along with cleaning the efficiency also

depends on the sun. We know that during the rainy season people usually face the problems regarding the panels, their efficiency decreases. Previously the panels were fixed so such problems were more and then unidirectional panels were available and now Bidirectional panels are available which helps in tracking the sun. This helps in gaining maximum efficiency. Companies like MicroLogix provides with such trackers. Two types of tracking are possible time based and sensor based, our system use sensor based tracking which is more efficient. Computers can be used to give command to the trackers to move accordingly but as it's a sensor based system we use LDRs for detection of sunrays.

No PV solar system in market comes with all the three facilities mentioned above that includes parameters measurement, automatic cleaning and Sun tracking. We need to buy them separately according to the choice of manufacturer if we want all three of them. In this project all the three facilities have been implemented at much lower cost. Following are some research works on the relevant topics of the project.

Jhen-Hong Chen, Hao-Chiao Hong and Kuo-Hsing Cheng et.al.proposed a system in 2016 "Low-Voltage Indoor Energy Harvesting Using Photovoltaic Cell", this work presents that a photo-voltaic cell is used for low voltage energy harvesting. Elimination of large external capacitors and inductors as . A rechargeable battery is connected to the output for storing the energy. Nt does not use a dc-dc converter to boost the output voltage. A test chip is implemented using a 0.18um CMOS process with a chip area of 0.85×0.85mm2 and a power consumption of 272uW.[2]

"Smart Solar Tracking and On-Site Photovoltic Efficiency Measurement System" was proposed by B. A. D. J.
C. K. Basnayake, W.A.D.M.Jayathilaka, Y.W.R.Amarasinghe, R.A.Attalage, et.al. in 2016 — PV efficiency measuring system and smart solar tracking is used on-site to measure power efficiency of panel and other parameters.At a given location while to find solar potential PV efficiency is of great importance. The device mentioned is able to measure PV efficiency, ambient temperature, humidity level, light intensity level and temperature of panel. A 24 V DC supply is required for the operation of device. All the data measured is stored in memory card and is transferred to other devices by using Bluetooth. Atmel Mega 2560 controller was used. [3]

ShahriarBazyari, Reza Keypour, ShahrokhFarhangi, Amir Ghaedi, KhashayarBazyari et.al.in 2014 proposed a system "A Study on the Effects of Solar Tracking Systems on the Performance of Photovoltaic Power Plants". In this system, from the received solar radiation point, different PV systems are compared installed on the Qeshm Island. The relation between solar components and single, double axis tracking effects are studied by solar component extraction. . The results of the analysis show that the energy received by single axis tracker was 1.35 times greater than that of a fixed panel system, for double axis tracker system receives only times of single axis tracker. So single axis trackers are more beneficial in Qeshm Island. [4]

Amit Kumar Mondal and Kamal Bansal, et.al.in 2015 proposed a system in which, solar irradiance and spectral content are the factors on which the efficiency of SPV is dependent which have economic and environmental benefits. SPV degradation factors are dust, snow, air-pollution, etc.An automatic robotic arm is used for the cleaning purpose of the panel with 4 degrees of freedom along with a water sprinkler, air-blower and a wiper. This system is "Structural analysis of solar panel cleaning robotic arm". [5]

III. BLOCK DIAGRAM

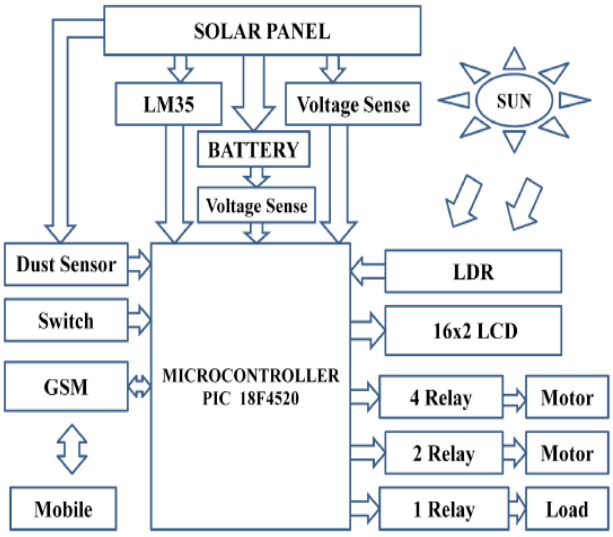

Fig.1: Block diagram

This project is to measure the parameters automatically along with dust cleaning and tracking facility so that maximum sun energy is harnessed. Initially the position of panel is set by using the switches. Six LDR sensors are used to sense the sun irradiance and then the panel is rotated accordingly. PV solar panel converts the solar energy into electricity. Temperature sensor is used to sense the temperature of the panel. Voltage divider circuitry is used to obtain the output voltage of battery as well as the PV panel. Dust sensor is used to sense the dust on the PV panel and according to that wiper will clean the dust. We are using PIC18F4520 for controlling all the blocks. Four relays and two DC motors are used for the movement of the PV panel whereas one motor and two relays are used for the movement of the wiper to clean the dust. 16x2 LCD Display is used to display all the parameters. We also obtain the parameters on the mobile through GSM.

IV. FLOWCHART

Flowcharts for parameters measurement system, automatic dust cleaning and bidirectional solar tracking are shown in figures below:

A. Flowchart of Parameter Measurement System

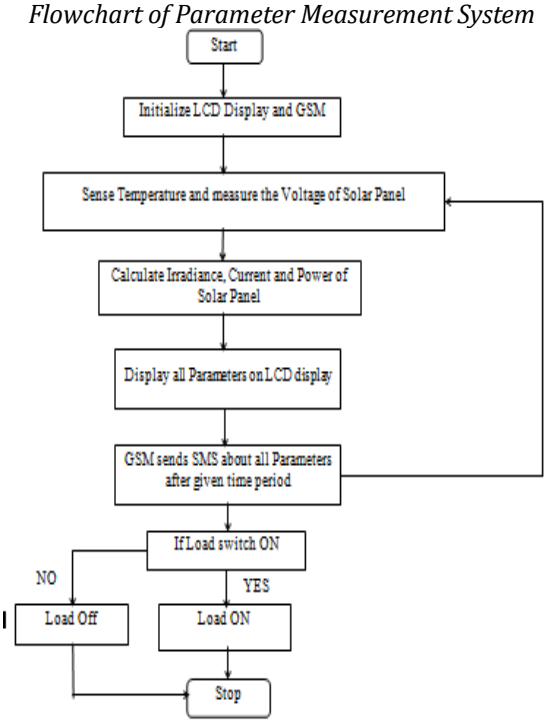

Fig.2: Flowchart of Parameter Measurement System

B. Flowchart for Automatic Dust Cleaning

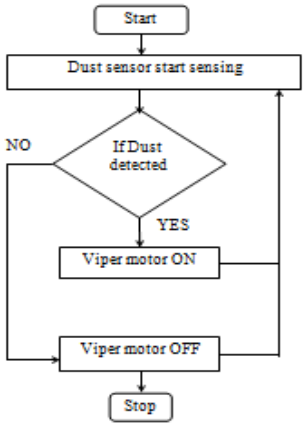

Fig.3: Flowchart for Automatic Dust Cleaning

C. Flowchart for Bidirectional Solar Tracking

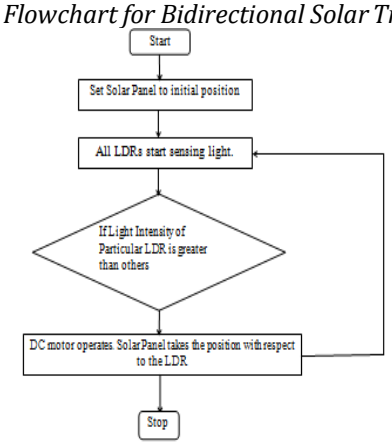

Fig.4: Flowchart for Bidirectional Solar Tracking

V. RESULTS

We have experimentally proved that when dust is spread over the panel then dust sensor detects it and the washer is turned on automatically and the dust is washed out.

Fig.5: Use of washer for dust cleaning

Also according to the position of the sun the LDRs will operate and the panel is rotated in the required direction. Various directions of the panel are as shown below.

Fig.6: Left tilt

When light detected by LDRs to move the panel left is more than the panel is tilted towards left.

Fig.7: Front tilt

When light detected by LDRs to move the panel in front direction is more then the panel is tilted to the front.

Fig.8: Backward tilt

When light detected by LDRs to move the panel in back direction is more then the panel is tilted to the back. A system has some advantages such as, to reduce human efforts, parameters are obtained on mobile through GSM also dust is cleaned automatically. Maximum power is harnessed throughout the year due to bidirectional tracking.

VI. DISCUSSION

In spite of above advantages a system has few limitations such as, in our system we are able to implement DC load only, so solar energy panels require additional equipments (inverters) to convert direct electricity (DC) to alternating electricity (AC) in order to be used on the power network. In rural areas where GSMs don't work effectively, such systems fail to provide data on the mobile.

Such solar panels can be used in various applications basically for domestic purpose. It will be beneficial to use such solar panels in satellites for better efficiency. Another important application is its use for business purpose.

VII. CONCLUSION

In this project we have achieved automatic system for parameter measurement, sun tracking & dust cleaning to reduce human efforts. In case of any failure in the system we will come to know within short time due to remotely acquired parameters. The efficiency of the system has increased due to automatic dust cleaning. Maximum power is harnessed due to dual tracking.

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