Automatic Solar Tracking System

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Abstract

Solar energy is very important means of expanding renewable energy resources. In this paper is described the design and construction of a microcontroller based solar panel tracking system. Solar is a nonconventional source of energy, considering this we have developed solar panels so that we can fulfill our electricity need. But due to revolution of the earth, solar source i.e. sun does not face the panel continuously hence less electricity is produced. The energy panel should face the SUN till it is present in a day. The problem above can be solved by our system by automatic tracking the solar energy. The block diagram below shows system architecture it consist of a LDR sensor senses max solar power which is being given to the Microcontroller through the ADC which digitizes the LDR output. Controller then takes the decision according to then algorithm and tilts the panel towards the direction of the max energy given by LDR with the help of DC Motor.

Keyword- Solar Energy, LDR, ADC, Solar Tracking System, DC Motor, Automatic Solar Tracking System (ASTS)

I. INTRODUCTION

In remote areas the sun is a cheap source of electricity because instead of hydraulic generators it uses solar cells to produce electricity. While the output of solar cells depends on the intensity of sunlight and the angle of incidence. It means to get maximum efficiency; the solar panels1 must remain in front of sun during the whole day. But due to rotation of earth those panels can't maintain their position always in front of sun. This problem results in decrease of their efficiency [1]. Thus to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. The Automatic Solar Tracking System (ASTS) was made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun until that is visible. The unique feature of this system is that instead of take the earth as in its reference, it takes the sun as a guiding source. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum. In case the sun gets invisible e.g. in cloudy weather, then without tracking the sun the ASTS keeps rotating the solar panel in opposite direction to the rotation of earth. But its speed of rotation is same as that of earth's rotation2 [2]. Due to this property when after some time e.g. half an hour when the sun again gets visible, the solar panel is exactly in front of sun. Moreover the system can manage the errors and also provides the error messages on the LCD display. In manual mode, through the software (GUI) at computer, the solar panel can be rotated at any desired angle [3].

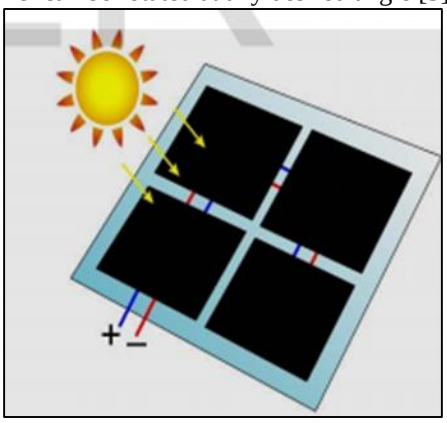

Fig. 1: Solar panel

A. Working Principle of the Tracker

Figure shown here is the tracking device in out prototype. It is the one which follows the sun's movement throughout the day and provides uninterrupted reflection to the solar panel. The sun rays will fall on the solar panel in two ways, which is, they will fall directly on the solar panel and also the reflector will reflect the incident rays on the solar panel. Suppose at the time of sun rise the sun is in extreme east the reflector will align itself in some position by which the incident rays will fall on the solar panel. Now when the earth rotates and the sun gets shifted form its earlier position the reflection of the incident rays will also change. Thus as

a result the light will fall on the sensors kept on each side of the solar panel [4]. The tracking circuit is so designed that when reflection falls on say the sensor attached to the right of the panel, the tracker will move towards the left, and visa-versa.

Similar is the case when the reflection falls on the sensor attached at the top of the panel, circuit will make the tracker to move downwards. We here have tried to bring two simple principles together. One being, the normal principle of incidence and reflection on which our tracker works. And the other is the principle on which the solar panel works, which is on the incidence of the solar rays the photovoltaic cells, will produce electricity. This both principles are combined there and as a result of which we are able to fetch nearly double the output which the panel gives normally. Precisely speaking the tracker is liable for two kinds of rotations, on is on the vertical axis and other is on the horizontal axis. The earlier is for the right-left movement of the reflection and the latter is for the up-down movement of the reflector, for aligning reflection on the panel [5].

II. BLOCK DIAGRAM

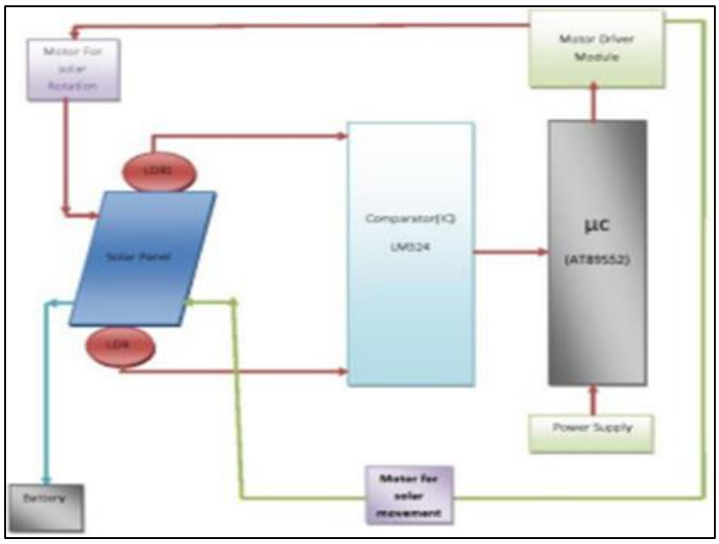

Fig. 2: Block diagram

The major part of this electronics system is the micro controller. All the operations are controlled by it. With the help of micro controller, you can align the solar panel according to the intensity of the sunlight. Another component is the rechargeable battery which is used to store energy which is received from the panel [6]. The purpose of the charge control is to control the charging of the battery. Micro controller unit receives the status of the battery by the charge control unit. It has two sensors, each made up of LDR. Four LDRs constitute on unit and are placed at the four corners of the panel. LDR senses the intensity of sunlight and controller receives the output. Control unit decides in which direction the panel has to be rotated to get maximum sunlight. Another unit of the sensor also consists of LDRs and used for the control of lightning load. The panel can be rotated in the desired direction by the server motor.

III. SCHEMATIC DIAGRAM OF THE PROJECT

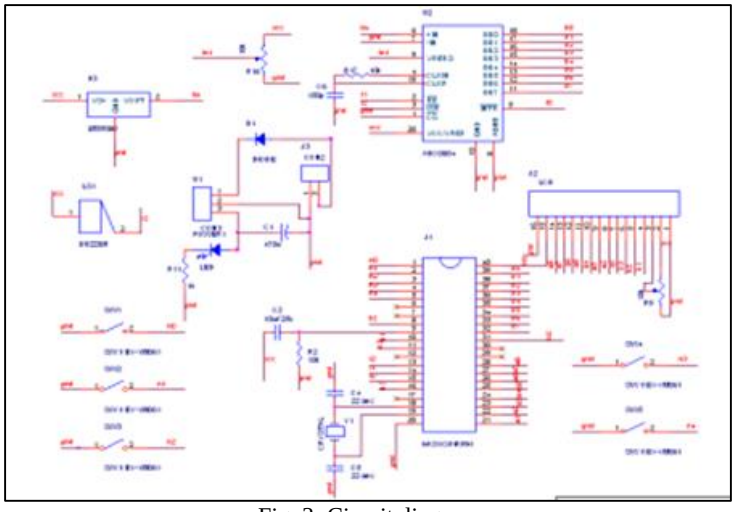

Fig. 3: Circuit diagram

In our project we have use solar panel to convert the light energy into the electrical energy. The Sun change its position throughout the day that's why we can't able to utilize the whole light energy so we have made a tracking system in which solar panel can be rotate as per the sun changes its position. We have use the Four LDR Sensor to sense the light and if the sun change its position then respective LDR Sensor sense the light and generate the highest Voltage signal and this highest voltage signal fed to the comparator IC as well as remaining sensors also give its generated voltage level to the Comparator IC. All Voltage signal of the each LDR sensor that are compared by the LM324 are fed to the microcontroller. Microcontroller receive the voltage signal from the any i/o pin of the controller and compares the each LDR output signal to with each LDR sensor output. When the controller find the Highest voltage level of any LDR sensor gives the instruction to the motor through the motor driver circuit to rotate the solar panel on the single axis in the direction of the LDR sensor which are generating highest voltage output. so the Battery can recharge appropriately through the Solar panel and we can run the any electronic devices here we can rotate the 12 v dc fan regularly. By using external two motor and by making connection in parallel we can move the solar penal in any direction. As by rotating the solar panel in the direction of the sun we utilize the maximum energy of the sun.

IV. RESULT & DISCUSSION

The system is focusing on the controller design. The constructed system has been tested and some data from hardware measurement have been collected and discussed. Typical solar panel has been used and the purpose only to prove the designed system is able to operate accordingly. Therefore the surrounding effects, for instance, weather condition are not seriously considered during hardware testing [7].

A. Advantages

Solar tracking systems are used to continually orient photovoltaic panels towards the sun and can help maximize your investment in your PV system. They are beneficial as the sun's position in the sky will change gradually over the course of a day and over the seasons throughout the year. They can be used most effectively in areas with low horizons and locations that are shade free from dawn to dusk each day.

B. Disadvantages

High cost during development, difficult to control motor speed and difficult to design. By adding a solar tracking system to your solar panels, we are adding moving parts and gears which will require regular maintenance of your solar system and repair or replacement of broken parts. If we are electronically controlled tracker stops working and you don't have a manual control, an option you can choose at the time of purchase, you can manually position your array to solar south to ensure that you will continue to capture as much solar energy as possible. Solar tracking systems do not come without their disadvantages though. The standalone PV home kit system is a very reliable and uncomplicated source of energy production; the panels don't move and require little maintenance.[8,9]

V. CONCLUSION

Single Axis Solar Tracking System prototype model is successfully developed. The designed system is focuses on designing controller part and the main concern is to design appropriate circuits and the circuits supposed to be able to control DC-gear motor rotation direction without considering motor speed. The system is able to track and follow Sunlight intensity in order to collect maximum solar power regardless of motor speed. The unique of developed system, motor speed is not critical consideration because the DC-geared motor offers low output rated speed and high output rated torque. Therefore any types of DC-geared motor can be used for this system regardless of motor speed controller unit as long as the speed and torque of the motor are following the given specification. The constructed system model can be applied in the residential area for alternative electricity generation especially for non-critical and low power appliances.

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