Solar Radiation Tracker for Maximum Energy

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Abstract— This system is designed to maneuver the position of Photo-voltaic panels according to the motion of sun. Renewable energy sources are rapidly gaining importance as an energy substitute for exhaustible or non-renewable energy sources. It is therefore critical for human beings to have an understanding and appreciation of the technologies associated with renewable energy. The major disadvantage of the fixed type solar panel is the efficiency, as the sun travels from east to west the amount of light incident goes on varying, hence generated solar energy also varies and hence give lesser efficiency. The design of the proposed project is to counter this problem and generate maximum amount of solar energy and hence achieve maximum efficiency.

Key words: Solar energy, Solar Energy tracking, Servo motor based solar tracking, Solar radiation tracker, Solar radiation for maximum energy

I. INTRODUCTION

Solar energy is one of the energy sources which are not utilized to the full extents. It is one of the cleanest sources of Energy. There exist many methods which can be used for maximum utilization of the solar energy. One such method is to employ a system which tracks motion of the sun based on tracking system using microcontroller system. Solar energy tracking system will help to generate more energy than fix type of solar panels because the solar panel in this system is always able to maintain a perpendicular face or perpendicular angle of incidence for maximum absorption of the solar energy through solar panel in microcontroller based solar energy tracking system. As the sun travels east to west across the sky during the day, it is fruitful to have solar panels that track the approximate location of the sun based on sensing devices, such that the panels then always will be directly incident to the solar energy radiated from the sun. This will help to maximize the amount of power absorbed by solar panel tracking systems. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 30% - 60%. The increase is significant enough to make tracking a viable preposition despite of the significant system cost.

The sun's position in the sky varies both with the seasons and time of day as the sun moves across the sky. Dynamically oriented solar panels can track the sun throughout each day to greatly enhance energy collection. The required accuracy of the solar tracker depends on the application.

Concentrators, especially in solar cell applications, required high degree of accuracy to ensure that the concentrated sunlight is directed precisely to the powered device.

II. BLOCK DIAGRAM

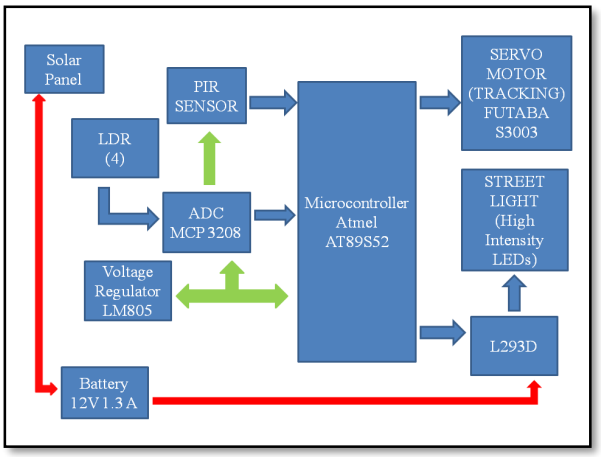

Fig. 1: Block diagram

III. DESCRIPTION

The objective of this system is to control the position of a solar panel according to the motion of sun. The proposed system is designed with solar panels, LDR, ADC, Microcontroller, Servo Motor and its driving circuit. In this project four LDRs are fixed

on the solar panel at four distinct points. LDR (Light Dependent Resistor) varies the resistance depending upon the light fall. The varied resistance is converted into an analog voltage signal. The analog voltage signal is then fed to an ADC. ADC is nothing but analog to digital Converter which receives the four LDR voltage signals and converts them to corresponding digital signal. Then the converted digital signal is given as the input of the microcontroller. Microcontroller receives the two digital signals from the ADC and compares them. The LDR signals are not equal except for normal incidence of sunlight. When there is a difference between LDR voltage levels the microcontroller program drives the servo motor towards normal incidence of sunlight.

The major components of this system are as follows.

1) Input photo transducer (LDR).

A light-dependent resistor (LDR) is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity.

2) Analog to digital converter.

The MCP3208 12-bit Analog-to-Digital Converter (ADC) combines high performance and low power consumption in a small package. The MCP3208 features 100k samples/second, 8 input channels, low power consumption (5nA typical standby, 400 µA max.active), and is available in 16-pin PDIP and SOIC packages.

3) Microcontroller.

The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry.

4) Output mechanical transducer (Servo motor).

A servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

5) PIR Sensor.

SB0061 is a pyroelectric sensor module which developed for human body detection. A PIR detector combined with a fresnel lens are mounted on a compact size PCB together with an analog IC, SB0061, and limited components to form the module. High level output of variable width is provided

IV. WORKING

As the name suggests the main objective of the proposed system is to get maximum power out from PV solar panels, simultaneously controlling the street light automatically as the application of stored energy. Microcontroller 89S52 acts as a main control block to the proposed system. LDR a light transducer provides the information about the light intensity in that particular direction. LDR is used as a potential divider network with the fixed resistors. As the light varies the voltage across LDR varies. This variation in voltage is sensed by ADC. MCP 3208 is an ADC, providing 12 bits of resolution with 8 single ended input channels. Communication of ADC with microcontroller is serial via SPI protocol.

Micro-controller continuously reads the LDR, and based on the light variation it controls the movement of Servo motor. Servo motor used is FUTABA S3003. It is controlled via PWM technique. As the Servo moves, solar panel gets perpendicular to the sun rays, hence providing maximum efficiency. This power from the solar panel is stored in a battery which can be used by the application street lights.

Further the street lights too, plays a role in saving the charge. Street light are controlled automatically using light information from the LDRs. If the natural light is good enough the lights are made off automatically. Also a PIR sensor is interfaced to the system. If no vehicles are found for a long time, even if the natural light is less, street lights are made off.

V. CIRCUIT DIAGRAM

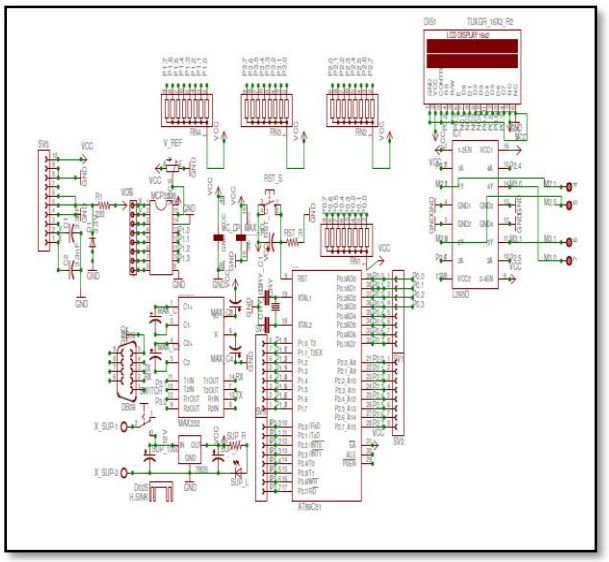

Fig. 2: Circuit Diagram

The proposed system is designed with solar panels PV, LDR, ADC, Microcontroller, Servo Motor and its driving circuit. In this project four LDRs are fixed on the solar panel at four different and equidistant points. LDR (Light Dependent Resistor) varies the resistance depending upon the light fall. The varied resistance is converted into an analog voltage signal since variation in the resistance will cause variation in current or voltage aspects. The analog voltage signal is then fed to an ADC. ADC is nothing but analog to digital Converter which receives the four LDR voltage signals and converts them to corresponding digital signal. Then the converted digital signal is given as the input of the microcontroller.

Microcontroller receives the digital signals from the ADC and compares them with preprogrammed values in the memory. The LDR signals are not equal except for normal incidence of sunlight. When there is a difference between LDR voltage levels the microcontroller program drives the servo motor towards normal incidence of sunlight

VI. ALGORITHM

1) Step 1: Start
2) Step 2: Initialize I/O ports.
3) Step 3: Initialize timers.
4) Step 4: Initialize ADC in single mode.
5) Step 5: Read L1, L2, L3, L4.
6) Step 6: Add L1 and L3 and store in R1.
7) Step 7: Add L2 and L4 and store in R2.
8) Step 8: Compare R1 and R2.
9) Step 9: If R1>R2 Increment the servo angle else Decrement the servo angle.
10) Step 10: Take average of L1, L2, L3, L4 and store as AVG_L.
11) Step 11: If AVG_L <150 and PIR output is 1 on the Street lights else off.
12) Step 12: Go to step 5.
13) Step 13: Stop.

VII. FLOW CHART

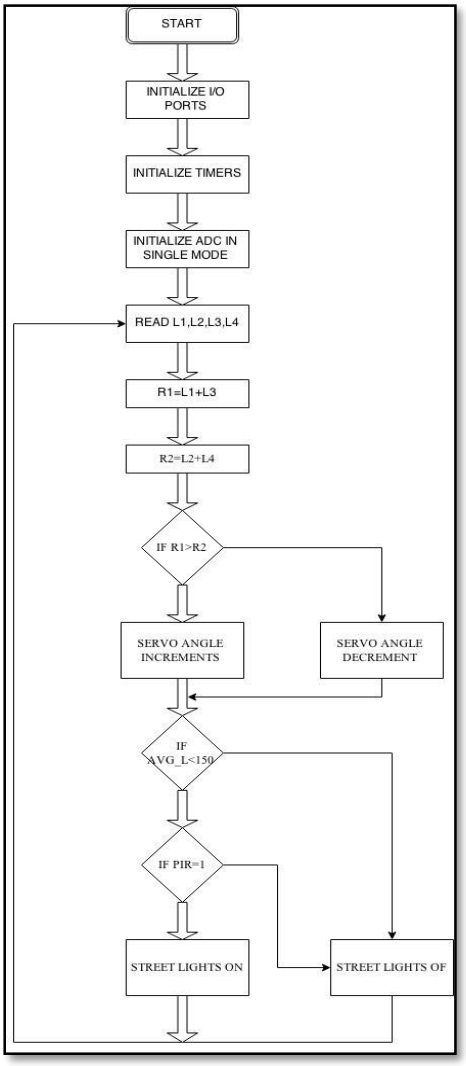

Fig. 7.1: Flow chart

VIII. RESULT

The main function of the designated project was to track motion of the sun using PV panel, LDR, and servo motor was successfully achieved. This design helped to achieve maximum exposure of sun and hence generate more Energy. The design is kept a minimal to achieve higher cost efficiency.

This standalone project will be able to handle itself with minimum human interference or interference from external world A minimum of energy consumption, due to the fact that the panel movement is carried out only in justified cases, eliminating unnecessary consumption of energy, and due to the cutting of the power circuits supply between the movement periods of the PV panel. A maximum amount of output energy produced by the PV panel, through a dynamic positioning of panel is executed only for sufficient and preset value of generated voltage values of light signal intensity. A guarantee of the panel positioning starting from any initial position of the PV panel.

The elimination of unnecessary movements, at too small intensities of the light signals or at too small differences between the signals received from the two LEDs. The possibility of centralized monitoring and diagnosis of the system operation. Based on the obtained results we can affirm that proposed solution is effective and presents interesting advantages from the point of view of practical applicability to larger power PV structures

IX. ADVANTAGES

Solar power is pollution free during use. Production end wastes and emissions are manageable using existing pollution controls. Facilities can operate with little maintenance after initial setup. Solar electric energy generation is economically superior where grid connection or fuel transport is difficult, costly or impossible. When grid-connected, solar electric generation can displace the highest cost electricity during times of peak demand can reduce grid loading. Grid-connected solar electricity can be used at consumer level and hence there exists significant reduction in transmission as well as distribution losses. Once the initial expenditure of building a solar power plant has been done, operating costs are extremely low compared to existing power technologies. The power obtained by solar tracking is almost constant over a period of time when compared with the output obtained by a panel without tracking.

X. DISADVANTAGES

Electricity generated by the solar panels is costlier compared to electricity generated by other renewable energy sources.

Solar electricity is not available at night and is less available in cloudy weather conditions. Therefore, a storage or complimentary power system is required.

The amount of exposure during daytime goes on varying and hence we achieve limited power density.

Solar cells produce DC which must be converted to AC, when used in currently existing distribution grids which uses added instrumentation which increases overall cost of project

XI. CONCLUSION

The major disadvantage of the fixed type solar panel is the efficiency, as the sun travels from east to west the amount of light incident goes on varying, hence generated solar energy also varies and hence give lesser efficiency. The design of the proposed project is to counter this problem and generate maximum amount of solar energy and hence gives maximum efficiency. Based on the obtained results we can conclude that the proposed solution for a solar tracking system offers several advantages concerning the movement command of the PV panel. Also a maximum value cost/performance ratio, which is achieved via the simplicity of the design, approach and the flexibility of the intelligent command strategy, is achieved.

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