Automated Dual Axis Solar Tracking System using LDR Sensors

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Abstract-- The aim of this paper is to present a novel design of an automated dual axis solar tracking system using a four quadrant light dependent resistor (L.D.R) and simple electronic circuit to provide a sinewy system performance. The proposed system uses the tracker to actively track the solar radiation and accordingly adjust the panel to maximize the power output. The project focuses on the simulation and implementation of the most efficient algorithm on the dual axis solar tracker which rotates in azimuth and elevation direction. This simulation positions the panel in a hemispherical rotation absorbing maximum solar irradiation thus increasing the total electricity generation.

Keywords-- Solar panel, Solar Tracker, LDR Sensor.

I. INTRODUCTION

As the energy demand and the environmental problems increases with population and economic developments, the problem of energy crisis and global warming effects are today a cause of increasing concern. It is the need of the hour to utilize conventional energy resources which are copious that is collected from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides and geothermal heat, etc. Solar energy is one of the most promising renewable energy resource which is abundant in nature generally in warm countries.

In general India has relatively long sunny days for more than 10 months and partly cloudy sky for most of the days of the rest two months. Also worldwide many projects have been done using photo voltaic cells (PV) in collecting solar radiation and converting to electrical energy, but most of these projects did not take into account the difference of sun angle of incidence by installing the panels in fixed orientation which very highly influences the solar energy collected by the panel.

Solar cell (Also called photo voltaic cell) is an electrical device that converts energy of light directly into electricity by photovoltaic effect. Solar cells are building blocks of photovoltaic modules, otherwise known as solar panels. Solar panel is a set of photo voltaic modules which is electrically connected and mounted on supporting structure to absorb sun rays as a source of energy for generating electricity or heating.

This design consists a working experimental model which focuses on the use of solar panel which would follow sun’s motion viz. Azimuth altitude, automatically adjusting itself every time without human intervention. To serve this purpose, we are using Light Dependent Resistors (L.D.Rs - 4 Nos.) which will trace the sunlight every time and would give signal to main circuit for the motion of the panel. The motion of the panel would be done by means of gears and D.C motor. All the electrical components would be controlled by means of 8051 microcontroller which would be programmed accordingly. Dual axis tracking makes sure that panel is always in the most accurate position for better output. The photo voltaic cell (PV) cell of solar panel will convert this solar energy to electrical energy which we can store in batteries for further use Small prototype model can be installed in schools, home use, offices, etc. as standard power source and this would help reduce the energy cost substantially.

The Main components of our system are:

A. Solar Panel
The solar panel of 20W which is a collective form of photovoltaic modules is the main component of the system which is the reason for the conversion of solar energy into electrical energy.

B. Sensors
The main aim of LDR is to sense the higher density range of sunlight give command to relay circuit which will direct the direction of our solar panel.

Fig.2 DC Motor.
II. SOLAR TRACKER

The Solar Trackers are used to continuously direct the solar panel towards the sun rays, thus assisting in maximising the expectation towards this system. This system efficiently tracks sun’s position in the sky and generate more electricity than their counterparts because of increased direct exposure to the sun light. There are two kinds of solar tracker single axis and dual axis trackers. Solar tracker generates more electricity in roughly the same amount of space needed for fixed tilt systems, making them ideal optimising land usage [11]. Also very necessarily, it emphasizes on not only on increasing the production of energy, but also ameliorates the way power output is delivered.

C. DC Motor

It gives gradual yet accurate motion to the panel thus we can obtain precise motion of the tracking system. DC motor consists mainly of a gear reduction unit, a position sensing device and a control unit. It receives a control signal that represents a desired output position of the servo shaft and apply power to its DC motor until its shaft turns to that position [11].

Sunlight has two components, the direct beam that causes about 90% of the solar energy, and the diffused sunlight that carries the remainder. The diffused portion is the sky on a clear day which increases proportionately on a cloudy day. As the majority of the energy is in the direct beam,
The microcontroller is the main control unit of the whole system, which determines the direction of movement of the motors in both azimuth and vertical axis. The implementation of the LDR is based on shadow effect. If the solar panel is not perpendicular to the sun’s rays the shadow will cover only one or two LDRs, this causes different light intensity to be received by the sensing device.

The output signal from the microcontroller is supplied to the DC motor which gives step motion to the panel accordingly to the incident radiation.

V. PERFORMANCE ANALYSIS AND RESULTS:
The performance carried on our working model showed improvement in the output performance against the static panel and single axis solar panel. The following two graphs show the values of the output obtained on our model. The first graph as shown in Fig.4 gives performance throughout the day and the second graph as sown in Fig.5 gives the comparison of output between the various tracking systems mentioned above.

Fig.5 Comparator Circuit Diagram [6]

Fig.6 Total Circuit Diagram [6]

Fig.7 Day based output obtained
maximum power from the solar radiation by tracking using a dual axis tracker. This is possible if the solar panel is always in proper alignment with incident rays of sun. The proposed methodology presents the following features:

- A simple and economic implementation.
- An ability to simultaneously adjust panel along both the axes.
- Ability to adjust the tracking accuracy. Provides efficient tracking even under diffuse weather conditions.

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REFERENCES

IV. COMPONENTS
The main operating components of this system are:

- 20 W Photovoltaic Solar Panel
- Microcontroller 8051
- Comparator LM324
- Sprocket Gears-4
- LDRs – 4
- Motor driver IC L2930
- Stepper motor-2

Other auxiliary components are:

- Resistors (10k, 1k)
- Capacitors (10F,33f)
- Crystal oscillator(11.0592 MHz)
- 12 V power supply

Except these components the connecting wires, circuit board and a universal programmer to turn the clip to load program are used.

From the above two diagrams, it is clear that this dual axis tracking system shows increase in the output by 11.56% w.r.t single axis tracking system and considerable increase of 42.056% w.r.t static solar panel. Thus this proves that the dual axis solar tracking system is much better and efficient in comparison with its counterparts.

VI. FUTURE SCOPE
Similar to this model, various changes can be made and can be implemented in schools, offices, etc as a secondary source of energy. Street Lightning system can also be replaced by this tracking system which would store enough energy throughout the day and be used at night. Efforts should be taken to implement this on a large scale for future purpose so as to meet increasing energy requirements.

VII. CONCLUSION
This paper presents an interesting and simple attempt to implement Dual Axis Solar Tracker by using LDR and Microcontroller. The use of gears instead of linear actuator helps in increasing the efficiency of the overall tracker. The design assists to extract