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Solar Tracking using Arduino

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Abstract: ***Solar energy is one of the most popular renewable energy sources. In this era, every country is trying to push its boundaries for more efficient renewal energy source. Every nation is concerned to minimize their carbon emission especially the develop countries like USA, Europe, Japan etc. Energy is everyone's need and clean source of energy is important for no pollution. Solar trackers has been gaining popularity all around the world because of its maximizing efficiency of solar energy. Solar trackers have simple mechanism and easy to operate. It is able to track the sun in the sky for maximum sunlight throughout day. Sun is an ultimate source of energy to the earth and also a green source of energy. It is important and can wisely use to solve our energy crisis. Solar trackers can be best alternative to this. The power generated by panels can be used for domestic works and the rest can be transferred to the grid for energy distribution. The hardware of this project can be implemented by using few components like LDR (Light Dependent Resistor),motor, Arduino microcontroller and battery. .There are so still many villages that do not get any electricity supply. This project help to provide electricity in rural areas.***
Keywords: Solar Tracker, Efficiency, LDR Arduino

I. INTRODUCTION

As a developing nation where technology is blooming there always need of energy. Energy has become a basic need of human society. Energy can be produced by using conventional energy sources like coal, petroleum etc. But as a part of advancement in technology we cannot neglect nature. Limitless use of fossil fuels has led to the degradation of nature and causing pollution. Climate change is one of the factors of it. Melting of huge ice burgs in Atlantic Ocean and in antarctica is one of the leading examples of climate change.

These things have led the scientist to think of alternative ways. Renewable energy sources can help to solve the energy crisis and at the same point it is clean and green source of energy causing no harm to nature. Sun is ultimate source of heat and light to earth from thousands of years. We can use solar energy to produce electricity. Solar energy is present in large amount and it is inexhaustible source of energy. More often it is most popular renewable energy source.

Solar panels are used to produce electricity from sun light during day time. Advancement in technology has led to make solar tracker. Solar tracker able to move panel according to movement of sun in the sky. The aim of this project is to develop solar tracker which can increase the efficiency of solar energy and has easy mechanism at low cost.

II. TYPES OF SOLAR TRACKERS

A. Dual Axis Solar Tracker

Dual axis solar tracker is able to track the sun in two directions. One is elevation and other is azimuth. It is developed to move in four different directions to capture the maximum sun rays. The azimuth axis allows panel to move in left and right direction. And the elevation axis allows panel to turn up and down. Four LDR's are used which makes the panel to move in all four directions. Dual axis can increase the intensity by 35% to 40% over fixed solar panel.

B. Single Axis Solar Tracker

Single axis solar tracker can track the sun in one direction only. It is able to move from East to West by vertical axis.

Two LDR's are used on the panel to receive sun rays. The intensity of sun rays is compared and panel move according to that having greater intensity of light rays. Single axis can only increase the intensity by 27% to 32% over fixed solar axis.

III. TYPES OF SOLAR TRACKING TECHNIQUE

A. Active Solar Tracking

In active solar tracking technique, the tracker works continuously and does constant monitoring of the sun's position throughout the day till the sun visible in the sky. As the sunsets, the tracker stops working. Active solar tracker involve LDR's, microcontrollers and motor.

B. Passive Solar Tracking

In passive solar tracking compressed gas fluid of low boiling point is used. As the sun rises in the sky, the solar panel starts receiving sun rays. The fluid gets heated and creates gas pressure that results in pressure imbalance which moves the panel position in the direction of sun having maximum intensity of light.

IV. CHRONOLOGICAL SOLAR TRACKING

Chronological solar tracker is based on earth's rotation which turn at an equal rate as the earth; but it turns in opposite direction. The rate of rotation of both are not quite equal because the earth goes around the sun. The position of sun changes with respect to earth by 360º every year. This method is simple and accurate.

V. HARDWARE DESIGN

In this proposed project for its implementation two LDR (Light Dependent resistor), one servomotor, an Arduino board and two other resistors are required that rotate the solar panel.

Two LDR of same intensity is used on the board. When sun changes its position from west to east, the intensity of light falling on LDR also changes. This change in voltage is compared with in-built comparator of microcontroller. The motor rotates the solar panel in the direction of maximum intensity of light.

Servo motor is used for this application. It has good energy efficiency and small in size. A positional shaft is fitted with a gear. Servo motor can turn 90ºin one direction means total 180º movement can be done.

Microcontroller is an integrated circuit device is used to control various portions of an electronic system. A microcontroller is available in various length like 4bit, 8bit, 16bit, 32bit, 64bit and 128bit.

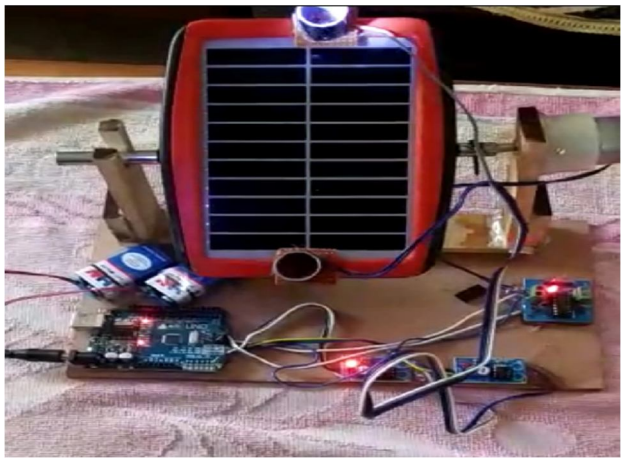

Fig 4.1 Hardware set up of the system

VI. CIRCUIT DIAGRAM

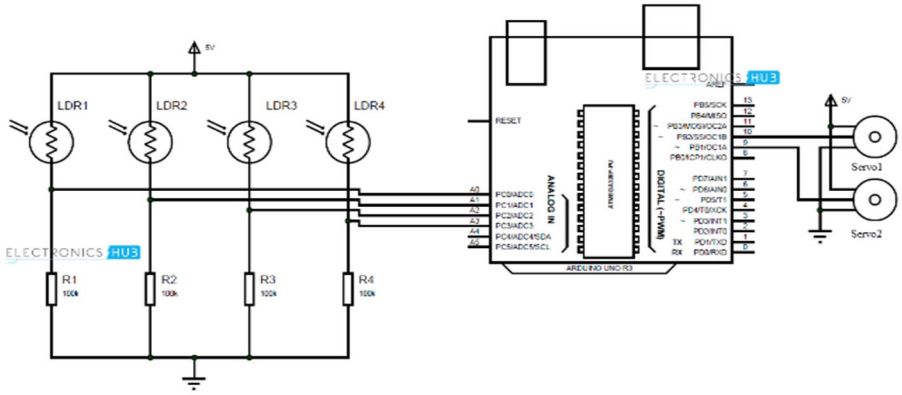

Fig 4.1 Equivalent circuit of model (4)

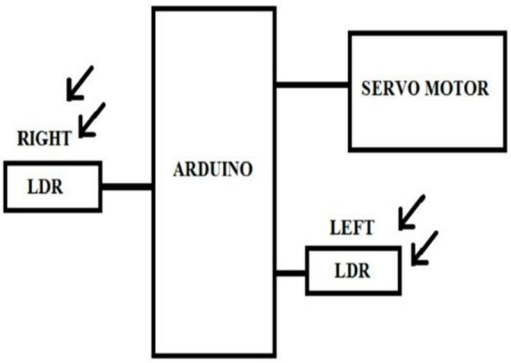

Fig 4.2 Block diagram of model (8)

VII. OBSERVATION TABLE

Time of the day	Open circuit voltage(v)	Closed circuit voltage(v)	Current at fixed angle 0º(A)	Variable angle (degree) for maximum current	Maximum current at variable angle 0º(A)
8:00AM	19.07	15	0.59	-30	0.76
9:00AM	19.08	15	0.71	-15	0.72
10:00AM	18.74	15	0.65	-15	0.70
11:00AM	18.66	15	0.64	0	0.69
12:00Noon	18.80	15	0.69	0	0.67
1:00PM	18.78	15	0.60	0	0.66
2:00PM	18.74	15	0.64	0	0.63
3:00PM	18.54	15	0.63	0	0.60
4:00PM	19.12	15	0.59	+15	0.59
5:00PM	18.97	15	0.44	+30	0.57
			6.18		6.59

Digital Multimeter is used for collect data at maximum current at variable angle and data of current at fixed angle. (19)

VIII. CALCULATION ANALYSIS OF TRACKING SYSTEM

In this project we have used DC geared motor of 4 R.P.M, 12 VDC, for the rotation of the solar panel. The circuit takes 24 mA at 12 VDC.

Power Required = 24 mA × 12V

= 288mw/sec

For 5 sec, The Required Power = 288×5

=1440mw

=1.4 w

In a day the solar panel moves east to west and then again back to east.

For 30º displacement the panel takes (167×3) msec

For 4 rotation motor takes

1min/60sec

For rotation the motor take

(60/4) = 15sec

For east to west rotation motor takes 3sec
So, for 10º displacement
(3000ms×10º)/180º = 167 msec
The panel moves east to west
180 degree = 12hours or 720min
For 10º displacement
720/180
= 40 mins
So, in 2hrs sun travel = 30º
=501 msec. (11)

IX. EFFICIENCY

Efficiency = (maximum current at variable angle – current at fixed angle 0º)/current at fixed angle 0º

X. RESULT AND ANALYSIS

The result was taken for one day.The reading was taken of fixed solar panel and solar tracker. The reading was calculated and result was given.

The observation started from 8AM in the morning and ended at 5 PM in the evening. Both results were compared and efficiency was taken out.

Efficiency = 6.59 – 6.18/6.18×100
= 6.64%

This result clearly shows that solar tracker is more efficient and it can improve the efficiency of solar panel. It will bring change in region of renewable energy sources.

XI. CONCLUSION

The objective of this is to enhance the efficiency of solar panels using tracking mechanism, LDR sensors are used to sense the intensity of light falling on it and send signal to the Arduino microcontroller. It compares the intensity and gives command to the motor to rotate. An Arduino coding is written in C- program on Arduino TDE. Present day study shows solar tracker plays an important role to improve the efficiency of solar panels. Solar trackers are cost efficient and reliable. These can be used in rural areas. Solar tracker definitely increases the efficiency of solar panels.

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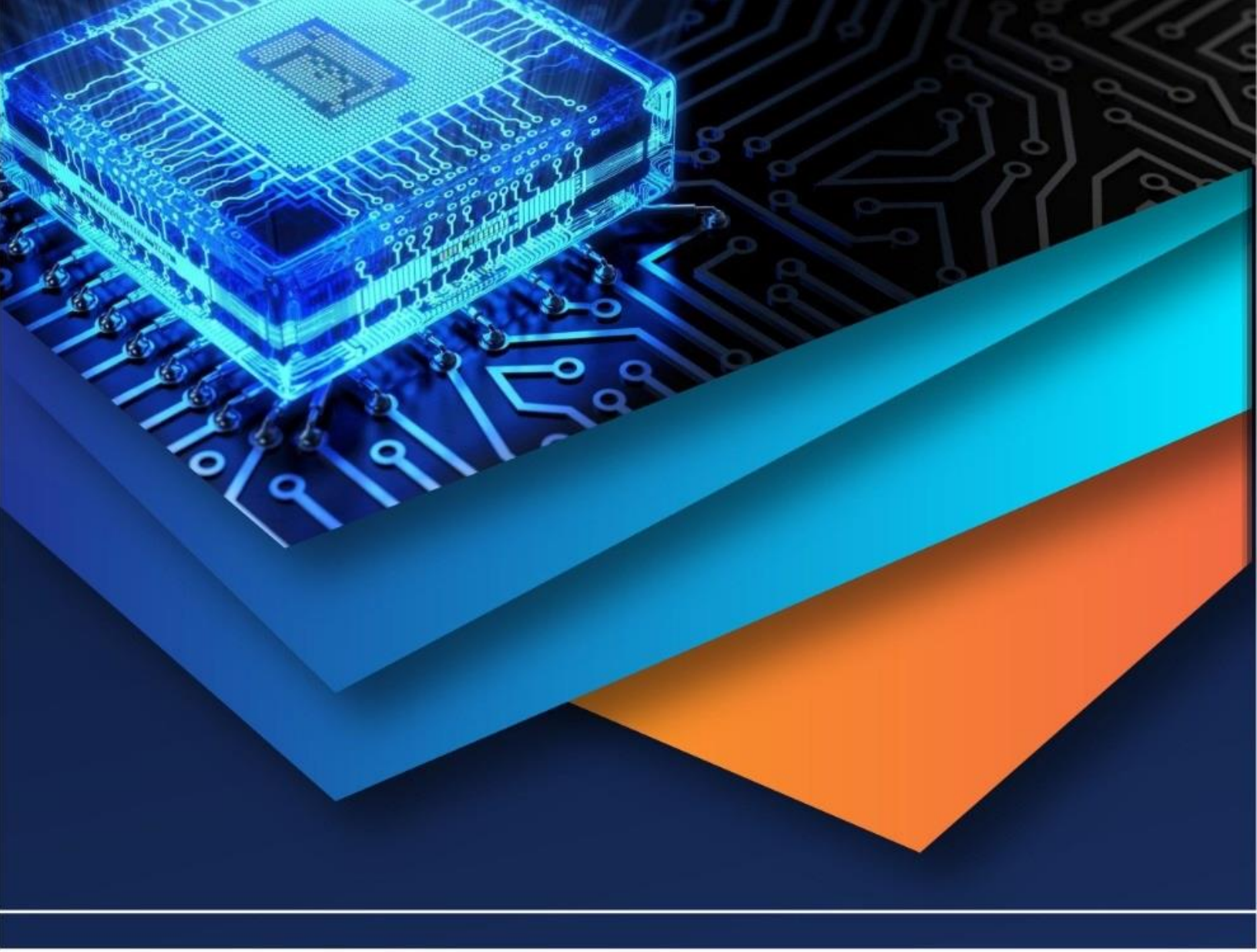

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