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DESIGN AND IMPLEMENTATION OF A DUAL AXIS SOLAR TRACKER FOR MAXIMUM POWER

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Abstract- *The aim of this paper is to produce maximum power of solar energy by using photovoltaic cell. Solar energy is plethora source of energy which can be converted into electrical energy by photovoltaic cell. By proper alignment of Photo voltaic cell augmenting efficiency at a particular angle using control system according to sun's movement. This paper illustrates the comparison between single axis system and dual axis system. The designed system consist of sensor, microcontroller, two servo motor, and stepper motor.*

1. 2.1

Keywords: Solar energy, Double column, Times New Roman, References and Nomenclature (maximum 5 key words)

INTRODUCTION

Population is growing day by day in the world now a days. As a result there is dearth of electricity of fulfilling public and industrial demand. Most of the plant depend on fossil fuel which is limited, however Renewable energy such as solar energy, wind energy is opulent source of energy. Solar energy plays enormous role for producing power among renewable energy. Photovoltaic cell absorb solar radiation that build from silicon and converted into electrical energy. Maximize solar radiation gain can be achieved using sun tracking mechanism [1].In sun tracking system photovoltaic cell stand at an optimum position on the presence of sun's movement where the efficiency increase up to 40% [2]. There are two sort of solar tracker such as single axis solar tracker and Dual axis solar tracker [3].In Bangladesh there are large number of fixed plate mounted on road side as well as in roof which can't be produced maximum power. So in this paper I develop a propose design of solar tracker using Light dependent resistor as sensor of the solar tracker.

2. SOLAR TRACKING SYSTEM

Solar Tracking is an automated system which is developing nowadays to get maximum power according to sun's movement. Fixed flat panel collect high energy at noon time, but there is available energy in early morning and late afternoon that cannot be collected because of misalignment of panel. So it is essential for tracking the sun to obtain maximum power. The aim of this paper to design a tracking system and compare with efficiency.

Single Axis Solar Tracker

Single axis solar have one degree of freedom which rotates axis of rotation. Single axis solar tracker basically mount with a fixed plate which is at east to west direction to absorb radiation of sun.

2.2 Dual Axis Solar Tracker

Dual axis solar tracker have two degree of freedom which use as axes of rotation. The axes are normal to each other that east to west at zenithal and North to south at azimuthally [4].]. Dual axis solar tracker rotates with horizontal and vertical with direction of sun movement. Dual axis tracking system have more efficiency comparing with static axis rotation [5]. In previous publisher found that the efficiency of dual axis solar tracker in ideal condition is more than 15-20% than fixed solar cell [6]. Another publisher built the system has a power gain of 52.78% compared to a single axis solar panel [7].

3. Proposed design

The proposed tracker composed of 10 watt panel, four LDR sensor, two servo motor and stepper motor. Two LDR used for east to west direction and other two LDR used for north to south. The horizontal axis movement which is north to south direction control with one motor and the vertical movement which is east to west direction control to other motor.

3.1 Light Dependent Sensor

A light dependent resistor or cadmium Sulphide(Cds) cell main objective is to decrease resistance by raising severity of light. Basically this sensor used for detecting the angle of azimuth and altitude. LDR is a part of voltage divider circuit because it is a variable resistor which varied with intensity of sun light. Two pair of LDR are connecting with series and output from light comparison are input of microcontroller which control the movement of motor either on horizontal or vertical axis.

Figure 1: LDR arrangement

3.2 Servo Motor

Two servo motor are chosen for the proposed design. Servo motor are used for various purpose because of its size and high efficiency. In this proposed design CYS S8203A servo motor are used which give 28 kg-cm torque. It speed 0.16sec/60degree for 6V [8].In this project I use two servo motor for rotating the panel.

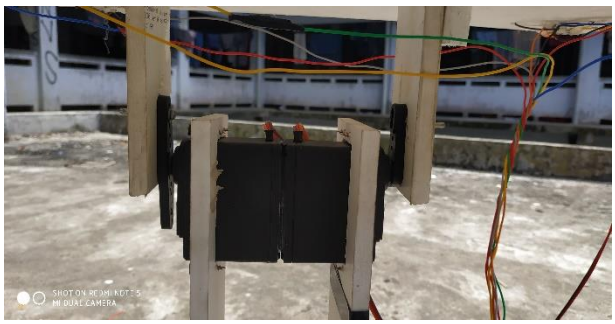

Figure 2: Servo motor mounting

3.3 Stepper Motor

In this project 42BYGH202A has been used. This motor mounting on the ground which rotates the base of panel. It step angle 1.8 degree for full step and 0.9 degree for half step which holding torque is 2000g-cm and Voltage 12V at 0.4A [

Figure 3: Stepper motor on the ground

3.4 Microcontroller

3.5 Hardware Implementation

The proposed system consists of two section, one is ground part and another is panel part. On the ground stepper motor rotates the base as well as panel moves according sun's direction. Servo motor mount below the panel which helps to move the panel at east to west direction. In figure 6 shows the whole arrangement of setup.

Figure 6: Experimental Setup

4. Experimental result and Data Analysis

Table 1: current and voltage value of single and dual axis

Time of the day	Single axis		Dual axis	
	voltage (V)	current (A)	Voltage (V)	Current (A)
9.00am	16.6	0.32	18.7	0.39
10.00am	17.4	0.37	19.3	0.41
11.00am	19.1	0.39	21.2	0.48
12.00pm	20.2	0.41	21.7	0.49
1.00pm	20.7	0.43	21.5	0.47
2.00pm	19.6	0.41	21.3	0.43
3.00pm	18.8	0.37	21.1	0.41
4.00pm	18.1	0.31	20.8	0.39

Table 2:

Time of the day	Single axis Power(watt)	Dual Axis power(watt)	Percentage of power gain
9.00am	5.312	7.293	38%
10.00am	6.438	7.913	23%
11.00am	7.449	10.176	36%
12.00pm	8.282	10.633	28%
1.00pm	8.901	10.105	14%
2.00pm	8.036	9.159	13%
3.00pm	6.956	8.651	25%
4.00pm	5.611	8.112	45%

Average power obtained from solar panel without tracking is 7.123 watts; Average power obtained from solar panel with tracking is 9.00525 watts. The improved efficiency is 26.42% neglecting the power consumption motor. It is observed that the proposed dual axis tracking system presents a efficient system to harness solar energy which ensures more energy conversion than the existing fixed orientation of solar module system.

7. REFERENCES

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8. NOMENCLATURE

Symbol	Meaning	Unit
T	Temperature	(K)
P	Pressure	(Pa)
A	State transition matrix	Dimentio-nless