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Design and Development of Dual Axis Solar Tracking System using Arduino

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Abstract

This paper will incorporate the plan and improvement of double hub solar following structure by using Light depending resistor (LDR). The proposed following structure tracks light even more feasibly by giving PV board insurgency along two assorted rotate. The tracker is made out of four LDR sensors, two stepper motors and AT mega 328 microcontrollers. Two or three sensors and one motor is used to move the tracker in suns east-west course and the other pair of sensors and the motor which is fixed at the lower a piece of the tracker is used to move the tracker in the suns north-south bearing. Two stepper motors are altogether being utilized in this system. Upper board holder stepper motor tracks the sun straightly and base stepper motor tracks the logical evacuation of the sun. These stepper motors and sensors are interfaced with a microcontroller. The microcontroller gives the request to the motors dependent on sensors input. LDR sensors sense the light and passes on message to microcontroller. Solar trackers can assemble the yield of solar sheets by 20-30% which improves the capability of the solar board. A working structure will finally be shown to support the arrangement.

Keywords: Tracking, Dual Axis, Solar Panel, Light Detecting Resistor

1. Introduction

The current day circumstance, usage solar energy is rising and has a gigantic potential. The cost of solar energy has been diminished from 18.08 Rs/KWh to 9.1 Rs/KWh. Tremendous solar estates are being fostered all over India, with a restriction of 4MW to 16MW. A prevailing piece of these solar residences as of now use stop PV structures standing up to a single course for the length of the day, and appropriately has lesser capability than a twofold pivot solar tracker [1-3]. A languid change is being delivered utilizing the stop structures to the twofold and single hub solar trackers anyway a critical counteraction has been the irrational cost of the thing habitually going in the part of 20,000 to 60,000. The accompanying huge disturbance in the market will be a more moderate twofold hub solar tracker with no compromises on quality and productivity. The point of this double axis solar tracker study is to demonstrate that the exactness and consistency of the sun tracking is significantly more productive contrasted with other solar tracking frameworks, for example, single axis tracker. The precision of the

double pivot solar tracker will be demonstrated by utilizing a faker solar board. The sham solar board will be controlled by the azimuth-height points determined [4, 5].

Overall there are two fundamental gatherings that can order solar trackers: single or double axis trackers. Single pivot trackers independently follow the Sun's East-West (or even North-South) development, while the two-axis trackers follow the Sun's accurate development, regardless of what heading. The main sort of dynamic solar gathering is single axis tracking. This is will bring about a more prominent force yield than fixed PV boards, but on the other hand is all the more expensive to plan and execute. Single axis solar trackers can either have an even or an upward pivot. The second kind of dynamic solar gathering is double axis tracking. This outcomes in a lot more noteworthy force yield than a fixed PV board, but on the other hand is the most exorbitant and generally muddled to plan [6-9].

Obstruction of Light depending resistor (LDR)relies upon force of the light and it fluctuates as indicated by it. The higher is the force of light, lower will be the LDR opposition and because of this the yield voltage brings down and when the light power is low, higher will be the LDR obstruction and along these lines higher yield voltage is acquired. The LDR faculties the simple contribution to voltages between 0 to 5 volts and gives a computerized number at the yield which for the most part goes from 0 to 1023.Now this will offer criticism to the microcontroller utilizing the Arduino programming (IDE). The servo motor position can be constrained by this component which is examined later in the equipment model. The tracker at last changes its position detecting the greatest force of light falling opposite to it and stays there till it sees any further change. The affectability of the LDR relies upon point wellspring of light. It scarcely shows any impact on diffuse lighting condition [10-12].

The point of the undertaking is to keep the solar photovoltaic board opposite to the sun over time to make it more effective. The double axis solar photovoltaic board accepts cosmic information as reference and the tracking framework has the ability to consistently direct the solar exhibit to the sun and can be introduced in different areas with reflect adjustment. The vertical and level movement of the board is acquired by talking elevation point and azimuth point as reference. The Ardiuno microcontroller has been utilized to control the situation of Dc motor. The numerical reproduction control of double pivot solar tracking framework guarantees the highlight point movement of the DC motor while tracking the sun. The double pivot solar tracker is gadget which detects the light and positions towards the greatest force of light. It is made in such a manner to follow the light coming from any heading. Recreate the overall situation of the Sun's development, the absolute inclusion of the development of the tracker is considered as 120 in both the ways. The underlying situation of both the servo motors are picked at 90, for east-west servo motor just as for north-south servo motor. The situation of the tracker rises or plummets just when the edge esteem is over as far as possible. The fundamental objective is to keep solar PV board opposite to the sun for the duration of the day to build the energy age. Double pivot solar tracking framework can be a viable method to build the effectiveness of solar cells. The staggering issue on both biotic and abiotic segments of our home (for example contamination) can be decreased by utilizing solar energy as the significant hotspot for power age. The regular blessing like non-renewable energy sources, woods, and so forth which are restricted in sum can be saved from emergency and annihilation. For individuals, because of its more proficiency and less destructive effects double pivot solar tracking framework may be acceptable choice for the halfway future. Thus, this venture can

essentially show impact of this variety to individuals [13-15].

Solar tracker is a device which follows the advancement of the sun as it abandons the east to west reliably. The guideline limit of all following structure is to several degrees of chance being developed. Trackers are used to keep solar specialists/solar board arranged directly towards the sun as it goes through the sky every day. Using solar trackers increase the proportion of solar energy yield of the glow/power which is created. Solar trackers can fabricate the yield of solar sheets by 30-40%, which improves the monetary issue of the solar board project.

Solar board bearing is changed by the light edification. We can acquire useful power from solar board. The proposed following system tracks sunlight even more feasibly by giving PV board turn along two assorted rotate. The tracker is made out of four LDR sensors, two stepper motors and AT mega 328 microcontrollers. Several sensors and one motor is used to move the tracker in suns east-west heading and the other pair of sensors and the motor which is fixed at the lower some portion of the tracker is used to move the tracker in the suns north-south bearing. Two stepper motors are altogether being utilized in this system. Upper board holder stepper motor tracks the sun straightforwardly and base stepper motor tracks the figurative movement of the sun. These stepper motors and sensors are interfaced with a microcontroller. The microcontroller gives the request to the motors dependent on sensors input. LDR sensors sense the light and passes on message to microcontroller.

2. Design of Dual Axis Solar Tracking System

Figure 1 shows the square graph of dual axis solar tracking framework. This task is to control the situation of a solar board as per the movement of sun. This venture is planned with solar boards, LDR, position sensor, Micro regulator, motor and its driving circuit. Sustainable power is quickly acquiring significance as an energy asset as petroleum product costs change. As the sun gets across the sky during the day, it is worthwhile to have the solar boards track the area of the sun, with the end goal that the boards are consistently opposite to the solar energy emanated by the sun. This will in general amplify the measure of force consumed by PV frameworks. The LDR sensor activities the daylight force as a source of perspective information signal. Four LDR sensors utilized. It is utilized to recognize the radiation level and vertical way. This solar move toward any path (level just as vertical). The LDR (light ward resistor had been utilized to detect the power of light and sent the information to the regulator. This regulator will analyze the information and pivot the motor to right course. Position sensor is utilized to distinguish the situation of solar board. The sun tracking is performed by changing the solar board direction even and vertical way by two motors. The motor course is constrained by driver unit. Driver we utilized ULN2003. It is utilized to drive the motor in forward and invert course through hand-off. A functioning framework will eventually be exhibited to approve the plan.

Figure 1. Block Diagram of Dual Axis Solar Tracking System

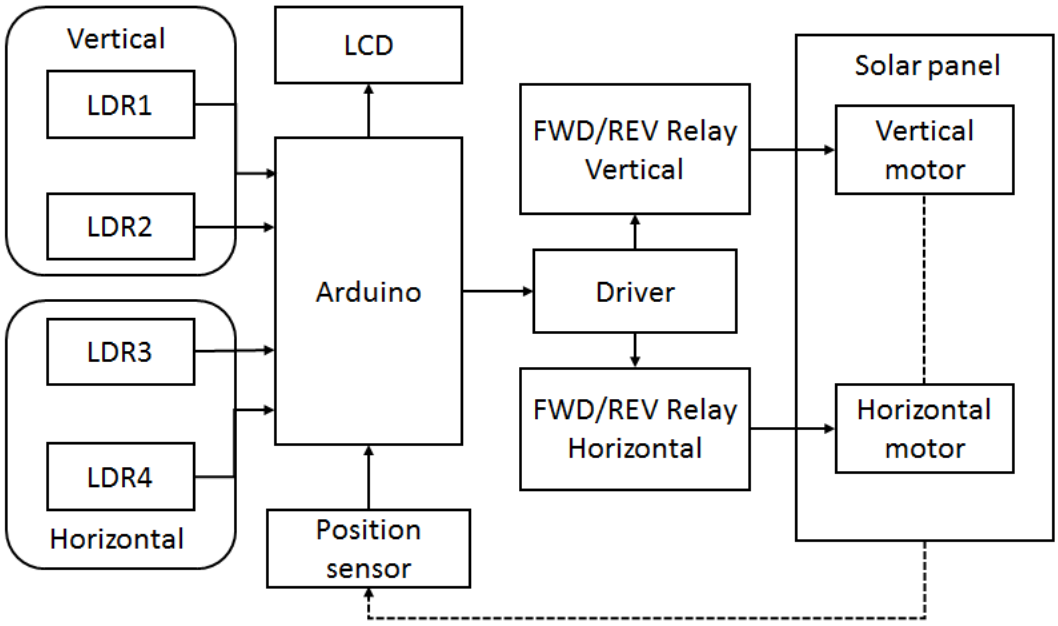
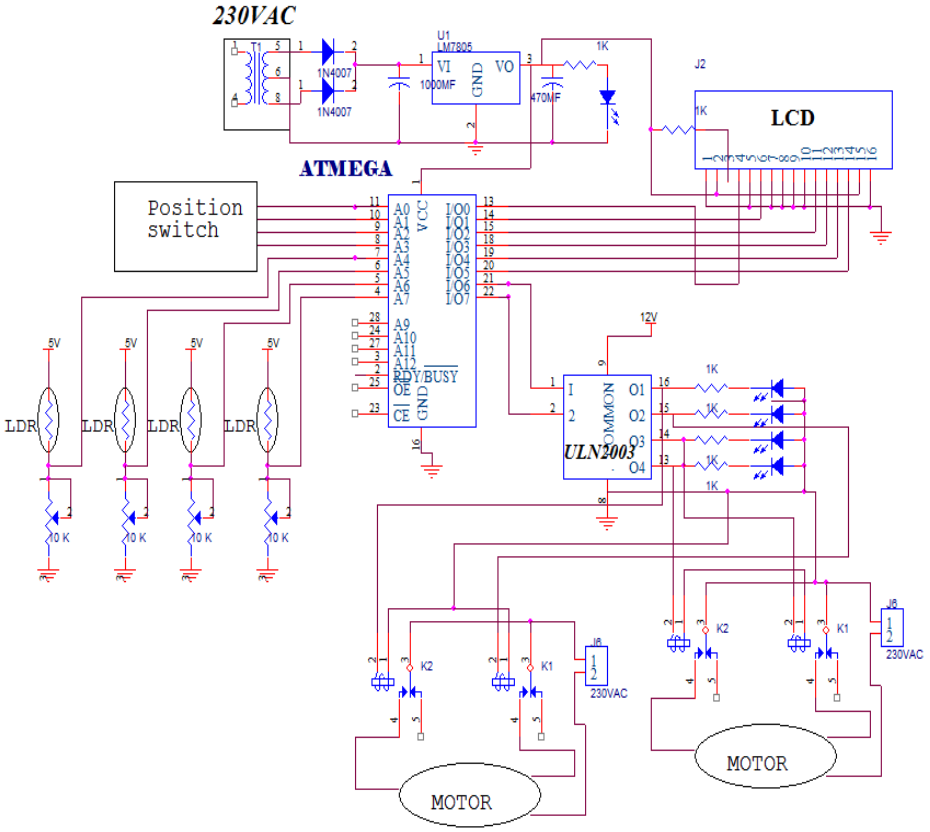


Figure 2. Circuit Diagram of Dual Axis Solar Tracking System



In this venture we use Arduino atmega328 regulator. Solar board position is location by utilizing position switch. It is associated with regulator port A0 to A3. In this framework we utilize four LDR sensors. LDR (light ward resistor) used to detect the force of light from sun. These LDRs are associated with regulator port A4 to A7. Regulator get the sensor information and to control the motor through driver unit, Driver we use ULN2003 is associated with regulator. Driver used to drive the motor through transfer. Transfer is go about as a switch. Four transfers are utilized. Two transfers are utilized to control the motor in forward and invert course in vertical. Another two transfers are utilized to control the motor in forward and invert heading in flat. Motor is associated with hand-off. LCD is additionally interfaced to regulator. It is utilized to show the short messages. The progression associated with the execution of the proposed work are given as follow.

- Initially, both the servos are proclaimed and object is made to control the servo motors.
- The factors posx and posy are utilized to store the reference servo positions.
- The ADC input pins for LDRs are chosen for dual bearing development and one for reference.
- A resistance or a steady worth is chosen to set up the working of the motors.
- The servos are appended on advanced pins to the servo item.
- The necessary simple pins are chosen as info utilizing pin Mode (pin, mode)
- The servos are sets to mid-point or unique situation with a 1000ms or 1sec postponement to find the client.
- Three factors are picked to peruse the simple qualities and guide it into number worth somewhere in the range of 0 and 1023.
- If the distinction between the two factors is not exactly the resilience esteem then It will stays to its or unique area else it shows development towards the heading of most extreme power of light by augmenting or decrementing the upsides of posx and posy.
- The position is then kept in touch with servo and the circle rehashes till it experience any progressions in the upsides of info more prominent than the base resilience.
- If the position gets more prominent than 150 then position will be set to 150 just and on the off chance that the situation of the motor is under 30, it would be kept at 30 in particular. As the lower and furthest breaking point points are picked to be 30 and 150 separately.

3. Experimental Setup and Results

In this double hub solar tracker, when source light falls on the board, the board changes its circumstance as shown by most prominent power of light falling inverse to it. This was refined through using light sensors that can distinguish the proportion of sunshine that shows up at the solar board. The characteristics got by the LDRs are taken a gander at and if there is any basic difference, there is

incitation of the board using a servo motor to where it is essentially inverse to the light emissions sun. This was refined using a system with three stages or subsystems. Each stage has its own work. The stages were a data stage that was liable for changing scene light over to a voltage. Figure 8 shows the control period of double hub solar following structure. A control stage that was responsible for controlling incitation and dynamic. Figure 3 shows the driver period of double hub solar following system. A driver stage with the servo motor. It was responsible for certified improvement of the board.

The information stage is arranged with a voltage divider circuit so it gives needed extent of illumination for splendid lighting up conditions or when there is weak lighting. The potentiometer was adjusted to give food to such changes. The LDRs were found to be by and large sensible for this endeavor because their obstacle changes with light. They are instantly available and are monetarily canny. The control stage has a microcontroller that gets voltages from the LDRs and chooses the action to be performed. The microcontroller is adjusted to promise it passes on a message to the servo motor that moves. The last stage was the driving equipment that contained generally of the servo motor. The servo motor had adequate power to drive the board. Servo motors are without upheaval and are moderate, making them the best choice for the undertaking.

Figure 3. Dual Axis Tracking System

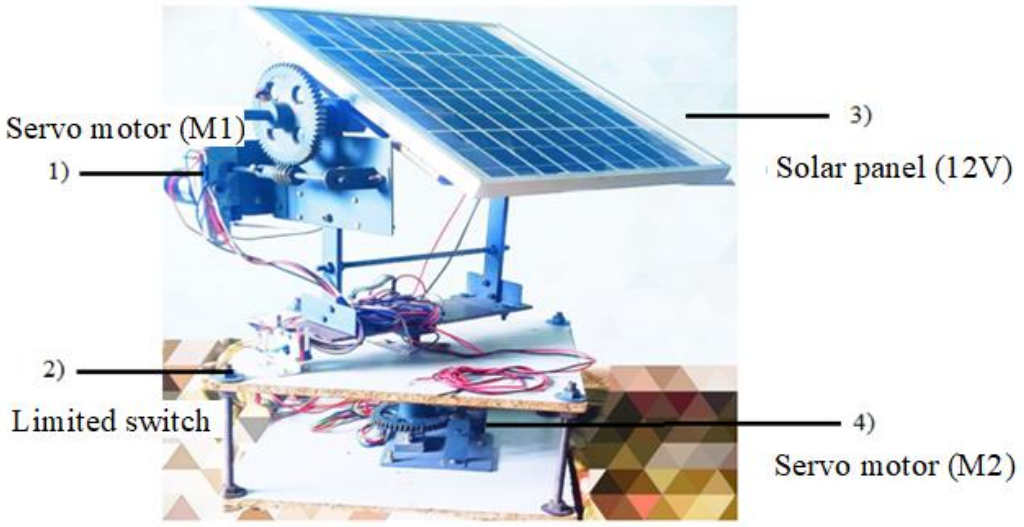


Figure 4. Experimental Setup of Dual Axis Solar Tracking System

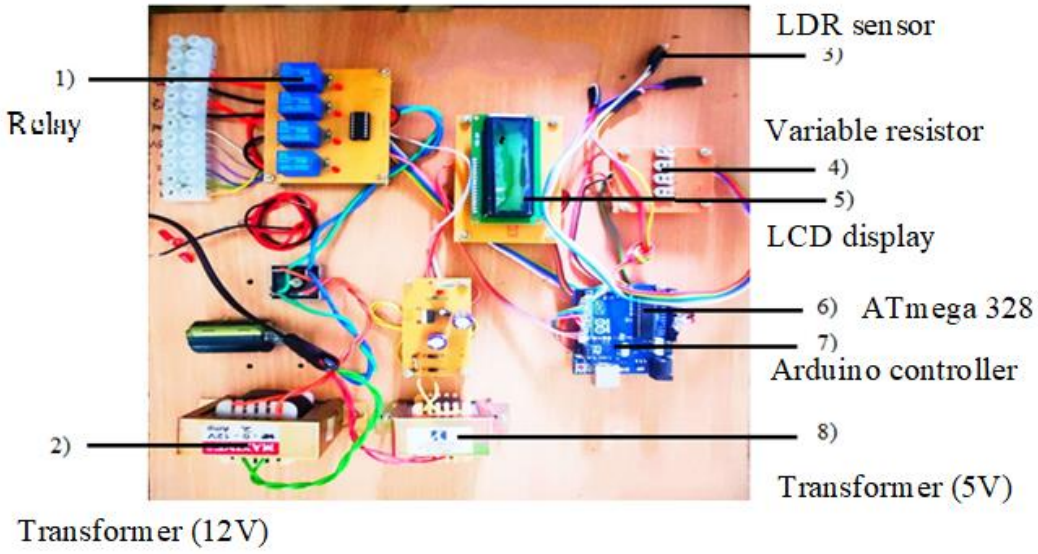


Table 1. Experimental Results

Time (hrs)	**Fixed (volts)**	**Dual axis (volts)**
7 am	8.5	9.5
8 am	8.8	9.8
9 am	9.3	10.5
10 am	11	13
11 am	12.8	13
12pm	14.5	14.5
1 pm	13.2	14.5
2 pm	12	14
3 pm	11.5	13.5
4 pm	10.3	12

Table 1 shows the testing aftereffect of dual axis tracking framework. Here think about the fixed voltage and dual axis voltage. The dual axis voltage is more contrast with the fixed one. The end client will favor the tracking arrangement instead of a fix ground framework in light of the fact that in dual axis framework, 30-40% expanded proficiency brings about more procuring contrasted with 20-25% in fixed board. The space necessity for a solar park is diminished, and they keep a similar yield. The arrival of the speculation timetable is decreased. Tracking the sun from east toward the beginning of the day toward the west in the evening will builds the proficiency of the solar board by 20-62% relying upon whom you ask and where you are on the planet. Close to the equator, you will have the most noteworthy advantage of tracking the sun.

4. Conclusion

Both single-pivot and double hub are extraordinarily capable to the extent the electrical energy yield when diverged from the fixed mount system. Difference with single hub solar tracker, the double hub tracker is having greater efficiency. The standard responsibilities of this work are the progression of a two hub solar tracker model that uses four sensors to predict the sun clear position. By using the AutoCAD and Proteus programming, it helps with arranging the draft for the gear double pivot solar tracker. Sketch Up is in like manner writing computer programs being used for insistence of this explanation. With this item, 3D arrangement about the model ought to be conceivable. It helps with improving the sketch and more exact. The Arduino helps with making the circuit not too inconvenient, which save a huge load of time and energy. In this paper, as a matter of first importance, to design a model of double pivot solar tracker by using programming (Proteus). The arrangement has been showed up and separated. Additionally, to program the smaller than expected controller on Arduino (ATmega328) so turn of DC motor can be obliged by microcontroller and H-associate. The programming part contains 5 cases which has been communicated and explored. Thirdly, to investigate the voltage contrasts from the sensor LDR taking into account power of light got by the sensor. The yield has been plotted into a graph and has been explored.

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