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Design and Implementation of Solar Tracking System for Solar Panels

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ABSTRACT

Solar energy is quick turning into significant methods for sustainable power source asset. With solar tracking, it will end up conceivable to create more energy since the solar panel can keep up an opposite profile to the beams of the sun. In this paper, we talk about the structure and development of a prototype for a solar tracking framework that has a solitary pivot of opportunity. Execution and attributes of solar panels are broke down experimentally. The increment in power is significant and accordingly worth the little increment in expense. Support costs are not prone to be high.

Keywords : Solar Tracker, DC Gear Motor, PLC, Magnetic Reed Switch, Solar Panel

I. INTRODUCTION

Solar energy is perfect and accessible in bounty. Solar innovations utilize the sun for the arrangement of warmth, light, and power. These are for modern and residential applications. With the disturbing rate of consumption of exhaustion of major customary energy sources like oil, coal and petroleum gas, combined with natural brought about by the way toward saddling these energy sources, it has turned into a pressing need to put resources into sustainable power sources that can control the future adequately. The energy capacity of the sun is tremendous. Notwithstanding the boundless asset, be that as it may, reaping it displays a test as a result of the restricted effectiveness of the exhibit cells.

The best productivity of most of the monetarily accessible solar cells extends somewhere in the range of 10 and 20 percent. This demonstrates there is still an opportunity to get better. This task tries to recognize a method for improving the productivity of solar panels. Solar tracking is utilized. The tracking component moves and positions the solar cluster with the end goal that it is situated for most extreme power yield. Different ways incorporate recognizing wellsprings of misfortunes and discovering approaches to relieve them.

With regards to the improvement of any country, energy is the fundamental driving element. There is a gigantic amount of energy that gets extricated, appropriated, changed over and devoured each and every day in worldwide society. Petroleum derivatives represent around 85 percent of the energy that is created. Petroleum product assets are restricted and utilizing them is known to cause a worldwide temperature alteration as a result of emanation of ozone-depleting substances. There is a developing requirement for energy from such sources as solar, wind, sea tsunamis and geothermal for the arrangement of practical and powerful.

Solar panels legitimately convert radiation from the sun into electrical energy. The panels are fundamentally fabricated from semiconductor materials, strikingly silicon. Their productivity is 24.5% on the higher side. Three different ways of expanding the proficiency of the solar panels are through the

increment of cell productivity, amplifying the power yield and the utilization of a tracking framework.

Greatest power point tracking (MPPT) is the way toward augmenting the power yield from the solar panel by keeping its task on the knee purpose of P-V qualities. MPPT innovation will just offer the most extreme power which can be gotten from stationary varieties of solar panels at some random time. The innovation can't anyway build age of intensity when the sun isn't lined up with the framework.

Solar tracking is a framework that is motorized to follow the situation of the sun to expand control yield by somewhere in the range of 30% and 60% than frameworks that are stationary. It is a more financially savvy arrangement than the buy of solar panels.

There are different sorts of trackers that can be utilized for an expansion in the measure of energy that can be acquired by solar panels. Double-pivot trackers are among the most effective, however, this accompanies expanded multifaceted nature. Double trackers track daylight from box tomahawks. They are the best choice for spots where the situation of the sun continues changing amid the year at various seasons. Single hub trackers are a superior choice for spots around the equator where there is no critical change in the obvious position of the sun.

The dimension to which the effectiveness is improved will rely upon the productivity of the tracking framework and the climate. Exceptionally productive trackers will offer more proficiency since they can follow the sun with more exactness. There will be a greater increment in productivity in situations where the climate is radiant and in this way ideal for the tracking framework [1].

The control circuit depends on a PIC microcontroller. It was modified to distinguish daylight by means of the LDRs before impelling the servo to position the solar panel. The solar panel is situated where it can get the most extreme light. When contrasted with different engines, the servo engines can keep up their torque at fast. They are likewise increasingly proficient with efficiencies in the scope of 80-90%. Servos can supply generally twice their evaluated torque for brief periods. They are additionally tranquil and don't vibrate or endure reverberation issues. Execution and attributes of solar panels are broke down tentatively.

Silicon solar cells created effectiveness of 20% without precedent for 1985. Though there has been an unfaltering increment in the effectiveness of solar panels, the dimension is still not getting it done. Most panels still work at under 40%. Thus, the vast majority are compelled to either buy various panels to fulfill their energy needs or buy single frameworks with enormous yields. There are kinds of solar cells with moderately higher efficiencies yet they will, in general, be in all respects exorbitant.

One of the approaches to expand the productivity of solar panels while lessening costs is to utilize tracking. Through tracking, there will be expanded introduction of the panel to the sun, causing it to have expanded power yield. The trackers can either be double or single-pivot trackers. Double trackers are progressively proficient in light of the fact that they track daylight from the two tomahawks.

A solitary tracking framework was utilized. It is less expensive, less unpredictable and still accomplishes the required proficiency. Regarding expenses and whether the framework should be executed by those that utilize solar panels, the framework is suitable. The expansion in power is significant and along these lines worth the little increment in expense. Upkeep costs are not prone to be high.

II. LITERATURE REVIEW

We have dissected a few papers beneath.

This overview study reveals the organized work that has been done to date on the purpose of Solar Tracking. N. Othman, M. I. A. Manan, Z. Othman, S. A. M. AlJunid has delineated a two-turn sun tracking framework with the use of five LDRs and an Arduino UNO controller [1]. The objective of this investigation is to blueprint and construct the programmed twofold center solar tracker for most prominent sun energy use. The fundamental motivation behind pressure is that this framework should eat up energy as least as possible so the complexity between controls changes and power usage would augmentation and along these lines the net advantage of the framework. Arduino UNO controller has been used and it is changed in C vernacular. LDRs are used to recognize the most outrageous sunshine position in the sky and the program made performs calculations and drives the servo engines to make PV panels inverse to the sun [1]. The sun makes an excursion from east to west just as there is a distinction in edge in the north to south bearing as well. So the north and south orientation should in like manner be managed. Twofold turn trackers do that. These trackers track the sun on an even and also vertical turn. Because of this working limit, the twofold rotate trackers have more yield control than the single center trackers. Light Dependent Resistors are used to find the most splendid spot of the sun in the sky. LDRs are related to Arduino UNO controller which turns out to be progressively familiar with the circumstance of the sun in the sky and in this manner turns the engines towards the sun. Two Servo engines are used for panel turn which in like manner fulfills the simplicity and lightweight criteria [1]. Md. Tanvir Arafat Khan, S.M. ShahrearTanzil (2010) have created and built up a microcontroller based solar tracking framework using LDRs to distinguish the intensity of sunshine and stepper engines to move the Photo-Voltaic (PV) panels according to the sun [2].

Fabian Pineda and Carlos Andres Arredondo (2011) have created and executed a two-rotate sun module arranging by identifying the most extraordinary magnificence point in the sky. A geodesic vault based sensor has been worked for the mind-blowing point tracking [3]. Authors Salabila Ahmad et al. have arranged and fabricated an open circle two tomahawks sun tracking framework with a point controller. The gear is picked, for instance, it will help the power accumulated and limit the power used as the capability parameter lies amidst these two power parameters [4]. Solar tracking in like manner causes in transmitting light to a dull area like tempest basement. Makers Jifeng Song et al. have executed the high precision tracking framework in light of a blended method for concentrated sunlight transmission through strands [5]. Maker CemilSungur (2008) has shown the multi-tomahawks sun tracking framework with PLC control. The azimuth and rise purposes of the sun are figured for a period of 1 year at 37.6º degree where Turkey is found.

As shown by these edges, an electromechanical framework which tracks the sun according to azimuth and tallness point is created and executed [6]. Makers A.chaib et al (2013) have shown the heliostat presentation framework in light of PLC robot controller. It is shown that by mounting certain no. of heliostats and standing up to them towards central power tower water can be warmed and turbines can be driven for energy change reason. By applying MATLAB program for choosing the sun's circumstance for heliostat presentation and by using PLC robot controller it is shown that the most extraordinary proportion of energy gets changed over from solar to control. Concentrated Solar Power (CSP) is used as a piece of this examination [7].

Makers Tao Yu and Guo Wencheng (2010) have displayed programmed sun-tracking control

framework in light of Concentrated PhotoVoltaic (CPV) age. CPV age works suitably when light panels pursue the sun accurately. Stepper tracking control development is used. This control relies upon control circuit with ARM and camera which can give skilled computational capacity [8].

III. PROPOSED WORK

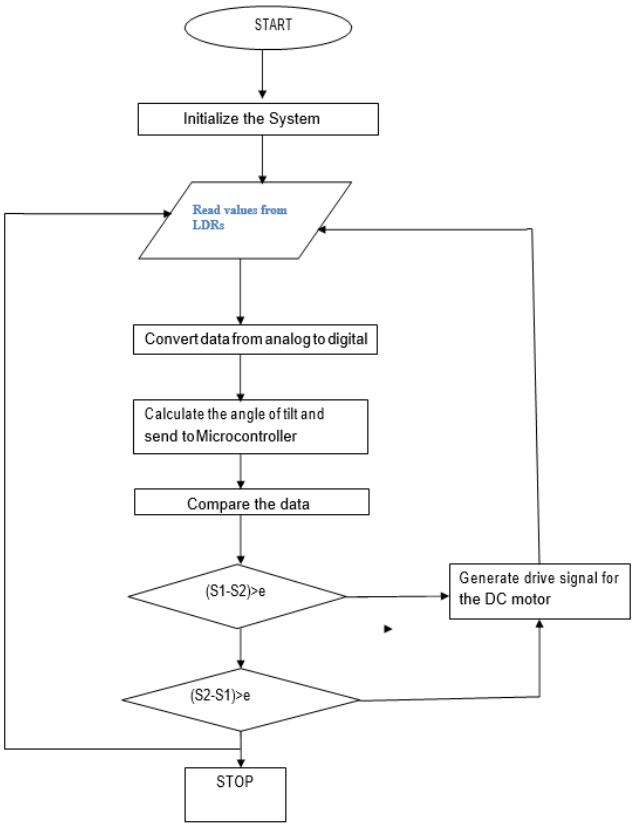

Figure 1. Block Diagram for Proposed System

In this implementation, a PLC-based Automatic Solar Tracking System is realized. 4 LDRs are used to distinguish the intensity of the sunshine. LDR has the property of reducing its assurance as to the light falling on it augments. Recollecting this standard a microcontroller program is made for tracking reason. LDRs are related with Analog to Digital Converter (ADC) in light of the way that the Microcontroller understands the propelled lingo and the yield of LDR is a basic sum. Three equipped DC engines are used to move the solar panels. Out of them, two are of 30 Revolutions for every Minute (RPM) speed and one is of 10 RPM speed. A temperature sensor LM 35 is moreover used to screen PV panel yield execution with a change in temperature. A remote show ZigBee (XBee) is moreover executed to trade the data from the certifiable spot of hardware mounted (plant) to (PC/directing locale). Zigbee (XBee) has elbowroom of low power usage and besides has the extent of 10 to 100 meters. In light of the composition review and current circumstance of solar tracking, it was picked to develop an Automatic Solar Tracking System as showed up in Figure1. In this framework, 4 LDRs and one temperature sensor are related to ADC. Four LDRs are mounted on PV panel. In figure 1, the numbered 1, 2, 3, 4 are the four LDRs. The arrangement and portrayal of the framework are with the ultimate objective that the PV panel moves towards the course of LDR which has the least insurance appeared differently in relation to the next three. The power supply is given to ADC, Microcontroller and DC engines.

Three DC engines are related to the microcontroller and after that to the PV panel. XBee transmitter gets signals from the microcontroller and transmits those signs to the XBee recipient side at the PC end. These signs are each LDR's security regard, PV panel Output voltage, present and encompassing temperature. The transmitted banners by XBee will be gotten by XBee beneficiary module and will be shown on and set away in PC. A single 16*2 Liquid Crystal Display is also used to show the recently referenced parameters.

IV. ALGORITHM FOR MOTOR CONTROL

The algorithm gives the description of the general steps undertaken for the project:

1. There is input of the voltages from the two LDRs.
2. The inputs are analog. They are converted to digital values that range between 0-1023.
3. The two digital values are compared and the difference between them obtained.
4. The difference between the values obtained is the error proportional angle for the rotation of the servo motor.

5. If the LDR voltages are the same, the servo stops. Otherwise, the servo rotates until the difference is the same.

The flow chart of figure is an illustration of how the algorithm is implemented. The inputs into the system are the two LDR voltages into pins 23 and 24 of the Atmega 328. There is then the conversion of the analog voltages into their digital values. The larger of the two signals is sent to the circuit which drives the DC motor to the direction with more light intensity. The block diagram of the solar tracking system is shown below.

After that, all the components are assembled as is illustrated in the diagram below. The input stage comprises the LDRs which feed the voltage outputs to the microcontroller. From the LDRs are potentiometers that are used for varying the resistance. When there is plenty of sunshine, the potentiometers are adjusted to their maximum value that is 10K. For days when the weather is not very sunny, the resistance is reduced by varying the potentiometer to ensure readings are more easily taken. The LDRs are connected to pins 4 and 5.

The embedded software design has the C code loaded into the Atmega 328P. The code that was used is shown at the appendix of the report. The resistor R1 is a pull up resistor for preventing the microcontroller from continually resetting.

Pins 8 and 22 are grounded as specified by the specifications of the microcontroller. Digital pin 9 is connected to the signal pin of the servo motor and serves to control the movement of the servo. There is also the power pin of the servo that is connected to power. The last servo pin is grounded. Pins 9 and 10 are for the quartz crystal. There are various switches that control the powering of different components. The LED indicates when the circuit is powered and the entire system is functional.

There is a reset button for positioning the panel to an initial position which is at an inclination of 40 degrees. This is done preferably in the evening after the sun has set. It makes the LDR go back to an initial position, ready for tracking sunlight on the next day. There is also a push button for initializing the servo motor. It switches it on, leaving it on standby mode.

Pins 7, 20 and 21 are for powering the microcontroller. It requires 5V. The inputs to the LDR are simulated. The hardware schematic diagram is shown in figure.

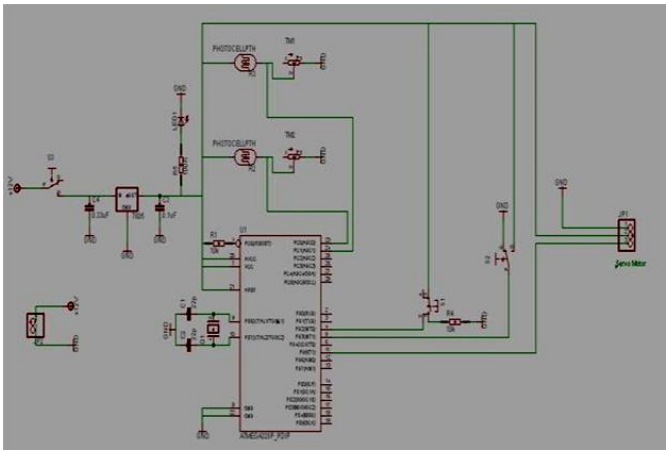

Figure 2 : Hardware Schematic Diagram

V. CONCLUSIONS

A solar panel that tracks the sun was planned and executed. The required program was composed that predetermined the different activities required for the undertaking to work. Thus, tracking was accomplished. The framework planned was a solitary hub tracker. While double pivot trackers are increasingly effective in tracking the sun, the extra hardware and unpredictability were not required for this situation. This is on the grounds that Kenya lies along the equator and in this manner, there are no noteworthy changes in the obvious position of the sun amid the different seasons. Double trackers are most appropriate in districts where there is an adjustment in the situation of the sun. This venture was executed with the least assets. The hardware was kept basic while guaranteeing proficiency isn't influenced.

With the accessible time and assets, the target of the undertaking was met. The undertaking can be actualized on a lot bigger scale. For future activities, one may think about the utilization of progressively

proficient sensors, yet which are financially savvy and expend little power. This would additionally improve productivity while decreasing expenses. On the off chance that there is the likelihood of further diminishing the expense of this undertaking, it would support a lot. This is on the grounds that whether such ventures are grasped is subject to how shoddy they can be.

Shading effects affects the task of solar panels. Shading of a solitary cell will affect the whole panel on the grounds that the cells are generally associated in arrangement. With shading along these lines, the tracking framework won't probably improve effectiveness as is required.

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