DUAL AXIS SOLAR TRACKING SYSTEM USING AURDINO UNO

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Abstract - As a future inexhaustible and non-polluting energy sources, solar energy is advancing to meet our ever-growing energy requirements. The automated solar tracking system based on the Arduino prototype is mainly built using the Arduino Microcontroller, four LDRs and three stepper motors. A mixture of hardware and firmware programming is used to run the machine. Four light basedresistors (LDRs) are used for the capture of maximum incident light in hardware production. To shift the solar panel according to the extent incident light operated by LDRs, three stepper motors are used. The software controls the solar panel's vertical tilt angle and horizontal rotation. Thus, according to the incident sunlight on the solar panel, it can follow the direction of the Sun, not only the vertical rotation, but also the horizontal rotation. This device can also achieve optimum illumination and reduce the cost of generating energy by requiring a minimum number of solar panels.

Key Words: Solar energy, Automatic solar tracking system, Arduino microcontroller, LDRs, stepper motors, maximum illumination, reduction in cost, maximum efficiency.

INTRODUCTION

The solar tracking system plays a major role in which it is used to capture the maximum power from the sunlight. During those days, the power generation method is not great as now because there are many types of power generation system like Nuclear power plant, hydroelectric power plants, geo thermal power plants, other non-renewable and also renewable energy source power generation methods. In this paper, the solar power generation is one of the pollution free and zero-emission process rather than non-renewable energy source.

In these trackers allow photovoltaic systems to decrease the angle of incidence between the incoming sunlightand the sensor in the solar tracking device, decreasing the amount of electricity. All focused solar systems have trackers in an effort to produce energy from direct sunlight into solar panels. These solar trackers have been shown to have dual axis tracking technology designed to combine solar modules and reduce the cost of devices. These kinds of solar tracking systems is also ideal in rural areas where electricity production is inadequate. The solar panel, which transforms solar energy directly into electricity, is one of the key components. Here the Solar panel, which is used is made up of semiconductors material. The solar panel placed in one direction does not get maximum power due to climate change. So, the Maximum Power Point Tracking (MPPT) is a technique for maximizing the generation of power from solar panels by maintaining the working of P-V solar panels.

1. **Literature Survey**

1.1 Shreyasi Chakraborty. Nilanjana Mukherjee. Rashmi Biswas in 2017. Due to their many benefits, renewable energy sources are becoming one of the top priorities for today's world. In particular, to meet our ever-increasing energy needs, solar energy is emerging as a potential source of inexhaustible and unpolluted energy. However, solar panels, which are fundamental components of the conversion of solar energy, are installed at a certain angle and with diurnal and seasonal shifts, are unable to track the direction of sunlight. Using a microcontroller combination, we built a solar tracking system.

1.2 Ankit Anuraj Rahul in 2018. As an important tool for renewable energy, solar energy is increasingly rising,

Solar tracking helps to collect more solar energy, since a profile that is perpendicular to the sun's rays can be maintained by the solar panel. Whilst initial costs are high for the implementation of a solar tracking device, this paper offers a cheaper solution. The control circuit of the solar tracker relies on an ATMega16 microcontroller. It is intended to sense sunlight through the LDR, and then switches with the stepper motor to align the solar panel where maximum sunlight can be obtained. The stepper motor is more controllable, more energy-intensive, more powerful and has good precision tracking and little environmental impact compared to any other motor type.

1.1   Rathika Kannan. Kavitha S in june 2017 Solar tracking system was made with stepper motor tracking system to increase the efficiency of output power of the PV plate. Solar energy is becoming ever more analternative energy source. It is a device that tracks a solar array's rotation, so it is always associated with the direction of the sun Developed and mounted in this article, the solar tracker offers a safe and inexpensive way to align a solar panel with the sun to optimize its energy output. In the proper orientationthe solar monitoring system is configured to align the photovoltaic solar panel with the sun for direct radiation.

OBJECTIVE:

Limited sources of fossil fuels, such as petroleum and coal, which are available now leads to global warming due to CO_2 emissions. The alternate source of energy is needed to reduce this type of emission.

Energy from renewable sources such as solar, wind, geothermal and ocean tidal waves is being increasinglyrequired to provide a reliable power supply and a safe environment for future generations

The solar energy plays a vital role among all this energy now. As it has a drawback that it can only generate power against the solar panel until the intensity associated with the incident of solar radiation. We developed the solar panel system to overcome this which shift in accordance with the direct intensity associated with theevent of solar ra

This can be accomplished by controlling the solar through the stepper motor, the correct algorithm and the best mechanical configuration and the Arduino microcontroller.

Problem Identification

Solar power, which is available only in fixed installations, is the major problem. The ability of power that can be generated is restricted as part of this issue. The other factor is that the solar tracking system's purchase price is very high for a family that uses more electricity than normal, so more than one solar panel will need to be installed to generate enough power. So, this concept is all about solving the problem that is going on at 180 degrees, this solar tracking system will detect rotation. So, compared to where the solar panel stays in just onedirection, the solar panel mentioned here is extremely large. [2]

Solar energy faces another problem. Usually fixed solar energy panels would not be directly oriented towards sunlight as a result of the continuous motion of the Earth. If the consequence of this system is that it does not achieve the highest efficiency. The solar tracking device is the larger solution for achieving full output powerdue to this method. This is the primary reason that why the project for the solar tracker is implementes. The solar tracker must obey the sunlight in order to get additional power output. The cost of purchasing more solar panels is, indirectly, likely to be reduced. In order to manage sunlight, these devices also slowly take the timeusers need to change the position of solar energy.

System Specification

- Arduino microcontroller
- Stepper motor
- LDRs
- LCD
- Solar panels
- Portable USB charge

Methodology

In this solar tracking system, LDRs (Light Dependent Resistor) as known as Photo resistors plays a major role

[4] These are sensitive to light, so these are used in Light or Dark detector circuit. Two LDRs are installed and the stepper motor used to move towards solar power. The stepper motor moves towards the LDR,which the resistance to be high i.e. towards the LDR on which the light is falling, and will continue to obey the sun. If both the LDRs had the same amount of light falling, the

stepper would not rotate. This method is done by using Arduino microcontroller to interface with other components

LIST OF ABBREVIATIONS

MPPT	Maximum power point tracking
LCD	Liquid Crystal Display
LDR	Light Dependent Resistor
USB	Universal Serial Bus
PIC	Peripheral Interface Controller
CSP	Concentrated solar power
IC	Integrated Circuit
ADC	Analog to Digital Converter
PV	Photovoltaic
DAST	Dual-Axis Solar Tracker
ICSP	In-circuit serial programming
PCB	Printed circuit board
DC	Direct Current
AC	Alternating current
US	United States
LCB	Linear Current Booster
CPU	Central processing unit
RTC	Real Time Clock
SRAM	Static random-access memory
EEPROM	Electrically Erasable Programmable Read-Only Memory

Algorithm of Dual axis solar system

Step 1: Start the program

Step 2: Declare the variables for each set of components.

Step 3: Initialize the declared variables to the input and output ports to the predefined i/o port patterns.

Step 4: Make the microcontroller to read the values which we taken from the light dependent sensors and

toperform the further actions.

Step 5: Check out for the outputs on the LDR and read the analog values and analyzing it for the position ofthe solar panels.
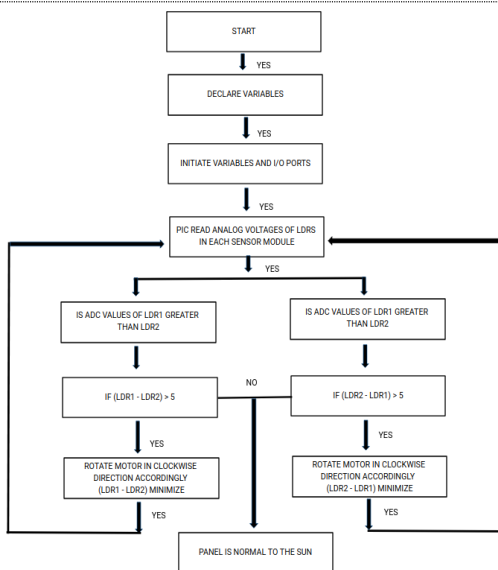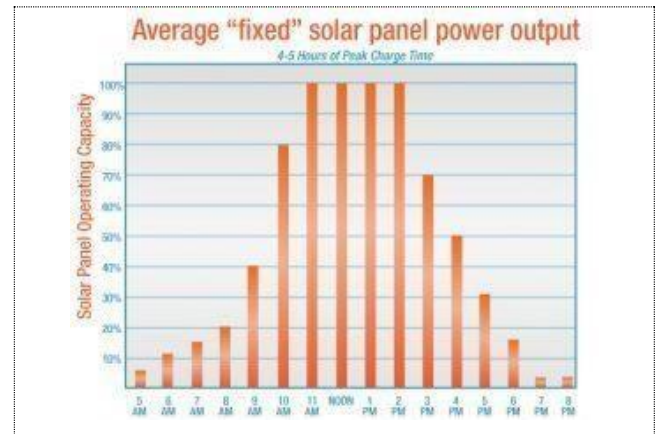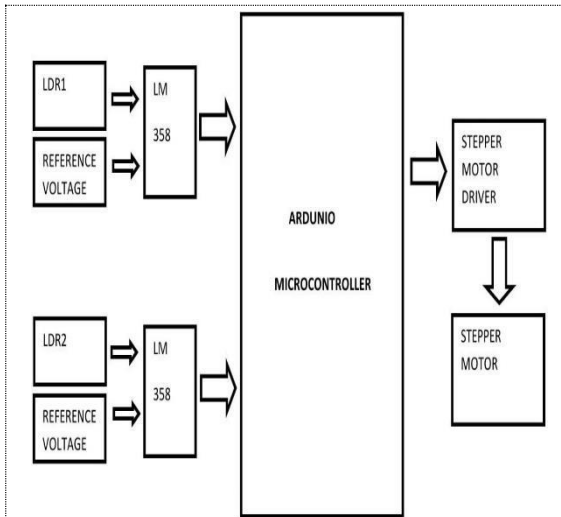
Step 6: Check the voltages of the fixed in the design setup and perform the tilting operation according to itStep 7: Check the difference between the voltages of LDR sensors.

Step 8: If the voltage is greater in the left direction then the panel will rotate in clockwise direction.

Step 9: If the voltage doesn't differ much it remains in the same position.

Step 10: If the voltage is greater in right side of the LDR then the panel will be adjusted in anticlockwisedirection.
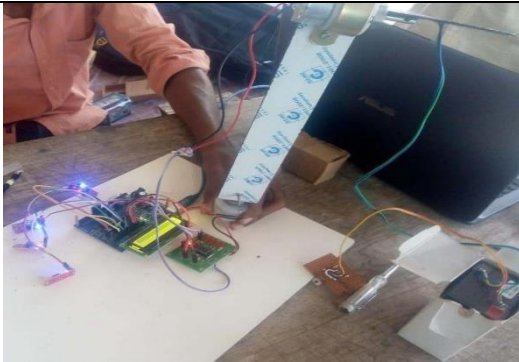
HARDWARE IMPLIMENTATION:

Working of Exciting System

Once photons hit a solar cell, as conductors are connected to the positive and negative side of a cell, they shake loose electrons from their atoms, forming an electrical circuit. We produce electricity as electrons travel through such a circuit. Several cells form a solar panel, and to form a solar array, several panels (modules) can be wired together.

PV solar panels produce electricity by means of direct current(DC). For DC electricity, electrons migrate around a circuit in one direction. In this example, a light bulb powered by a battery is shown. The electrons travel through the appliance, from the battery's negative side, and return to the battery's positive side.

Electrons are pushed and pulled for AC (alternating current) energy, changing direction periodically, just like a car's engine cylinder. Generators generate AC electricity while spinning a coil of wire next to a magnet. The handle will be changed by the generator from several different energy sources, such as gas or diesel fuel, hydroelectricity.

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Drawbacks of Existing System:

Generally, by using the traditional dollar per watt rate, fixed-mount systems initially cost less. Fixed-mount solar can also be a good choice due to geographical and site constraints, such as soil type and unit location [5]. The production of solar energy is much more costly than traditional energy sources, partly due to the cost of manufacturing PV modules and partly due to the conversion performance of the equipment. Solar installations can produce no power at all at any stage, which could lead to a shortage of energy if too much of the electricity in a region comes from solar power.

Proposed System:

Solar tracker offers two ways of using the software written in microcontroller to run and control mechanism

8.1.1 Normal day fight condition:

For calculating output voltages from two junctions, two LDRs are used in the solar tracker. In the daytime, thesun rotates from east to west direction. To feel the sun's rotation, AINO might have a higher voltage than AINI. This state is referred to as the normal daylight condition and after every 15 minutes, the tracker rotates the direction of the panel 3.75 degrees.

Prototype

Result and Discussion

HOUR	POWER FOR FIXED MOUNT(W)	POWER FOR DUAL-AXIS(W)
0700	14.575	38
0800	23.987	49.728
0900	43.876	52.701
1000	47.94	54.9519
1100	52	52.974
1200	57.6666	59.6156
1300	57.96	58.0488
1400	56.412	56.5687
1500	54.6883	55.3151
1600	48.174	54.8562
1700	36.96	52.3698
1800	27.72	52.668
1900	12.69	33.22

Comparison between Static and Dual axis setup

Discussion

From the above comparison shows that the Automatic Solar Tracker Systems are more beneficial and low-cost system while comparing with the Fixed Solar System.[12-30] There are many other applications thatare improvised with the help of Arduino microcontroller by controlling stepper motors. For example, the timetaken to change in position of stepper motor is seen in serial monitor. In the place of Arduino microcontroller, we could improvise with IoT based setup, which data will be stored in cloud for up to date information. Tracker setup is done with the accurate location so that the direction of the Sun and the tracker movement willbe same. In the proposed system can be made as low cost when it is setup with IoT based techniques.

10   Conclusion

This paper presents an interesting and easy attempt to implement Dual Axis Solar Tracker using LDR with Arduino UNO. The use of stepper motor rather than linear actuator helps to improve the overall tracker performance. The architecture assists by monitoring using a dual axis sensor to draw the full power from the solar radiation. This is possible because the solar panel is still correctly aligned with sun's incident rays. Thisis well adapted from the idea of the solar tracking device for harnessing more energy than a fixed solar panel. It is tried to develop a easy and low-cost tracking system. In recent years, solar radiation tracker has played a critical role in rising the performance of solar panels, thereby proving to be a better technical feat. A dual axis solar tracker's clinical significance lies in its better efficiency and durability to produce higher performance compared to a fived solar panel or solar tracker with one single axis. The tracking system is planned so that the solar energy can be trapped in any possible direction.

In general, the maximum solar energy can't be tracked in a single axis tracker that travels only along a single axis. If the solar rays are perpendicular to the panel over the whole year in the case of dual axis trackers. As a result, it generate much energy as possible than it lost in the day as is throughout the year. Therefore, the performance increases suggesting that the efficiency is greater than a fixed solar panel

(around 30-40% more) or a single solar tracker axis (around 6-7% more)

FUTURE SCOPE:

With a modifications in the design and development, the paper work can be enhanced further, Real Time Clock (RTC) can be interfaced rather than sensors used for seasonal tracking here. Using more powerfulmotors, the tracking capability and lifetime can be increased, but it will be a little bit costly. But in place of the microcontroller board, using Arduino will make it cheaper, although it will be complicated. Solar trackers,whether single-axis or dual-axis, will help to achieve the optimum solar energy level. Today, it seems very right when it comes to the future of the solar tracker industry

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