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LDR BASED SOLAR TRACKING SYSTEM

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ABSTRACT

The goal of this thesis was to develop a laboratory prototype of a solar tracking system, which is able to enhance the performance of the photovoltaic modules in a solar energy system. The operating principle of the device is to keep the photovoltaic modules constantly aligned with the sunbeams, which maximizes the exposure of solar panel to the Sun's radiation. As a result, more output power can be produced by the solar panel. The work of the project included hardware design and implementation, together with software programming for the microcontroller unit of the solar tracker. The system utilized an ATmega328P microcontroller to control motion of two servo motors, which rotate solar panel in two axes. The amount of rotation was determined by the microcontroller, based on inputs retrieved from four photo sensors located next to solar panel. At the end of the project, a functional solar tracking system was designed and implemented. It was able to keep the solar panel aligned with the sun, or any light source repetitively. Design of the solar tracker from this project is also a reference and a starting point for the development of more advanced systems in the future. In this project we propose single axis solar tracking system by which it is possible to catch maximum amount of solar energy by using Arduino as main processing unit. This project we implemented using LDR, dc motor and Arduino Microcontroller.

Keywords: Solar tracking system, Photovoltaic modules, LDR.

1. INTRODUCTION

Solar energy is an unlimited source of energy which if harnessed properly will get the mankind devoid of using the conventional sources of energy he has been long using. This project has been designed keeping this in view to make the harnessing of solar energy more efficient. A photovoltaic module is a packaged, connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. There are a few commercially available solar modules that exceed efficiency of 22% and reportedly also exceeding 24%. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnection wiring, and optionally a solar tracking mechanism.

In the present scenarios the variation in the climatic changes have reached the critical level. The main reasons for climatic changes are due to natural causes and man-made destructions like global warming and greenhouse gases are effecting the climatic conditions around the world. In the past decade of years there is increase in demand for reliable and abundant electrical energy derived from renewable energy sources renewable energy plays important role in energy crisis of country. The government started to decrease the usage of conventional energy sources and encouraging people to use renewable

energy sources like hydro and solar. One such example of renewable energy is solar power. Solar energy is a very large, inexhaustible source of energy. The reason is sun is only source we can find anywhere it anywhere. The solar power received by the earth is approximately 1.8*1011MW.The system will tend maximize the amount of power Absorbed by Photo voltaic systems. It has been found that making the use of a Dual axis tracking system, over a fixed system, can increase the power output by 40% - 60%. Solar energy systems have emerged as a possible source of renewable energy over the past two or three decades and are now utilized for a variety of household and industrial applications. Such systems are based on a solar collector, it designed to collect the sun's energy and to convert it into either electrical power or thermal energy.

In general, the power developed in such applications depends upon the amount of solar energy captured by the collector, and thus the difficulty of developing tracking schemes capable of following the trajectory of the sun throughout the course of Arduino is an open-source computer hardware and software company, project, and user community that designs and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License or the GNU General Public License permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The name Arduino comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduino of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

Solar energy is a clean, easily accessible and abundantly available alternative energy source in nature. Getting solar energy from nature is very beneficial for power generation. Using fixed Photovoltaic panels extract maximum energy only during 12 noon to 2 PM in Nigeria which results in less energy efficiency. Therefore, the need to improve the energy efficiency of PV solar panel through building a solar tracking system cannot be over-emphasized. Photovoltaic panels must be perpendicular with the sun in order to get maximum energy. The methodology employed in this work includes the implementation of an Arduino based solar tracking system. Light Dependent Resistors (LDRs) are used to sense the intensity of sunlight and hence the PV solar panel is adjusted accordingly to track maximum energy. The mechanism uses servo motor to control the movement of the solar panel. The microcontroller is used to control the servo motor based on signals received from the LDRs. The result of this work has clearly shown that the tracking solar panel produces more energy compared to a fixed panel.

2. LITERATURE SURVEY

This chapter aims to provide a brief knowledge of Solar Panel, Solar Tracker and the components which made up Solar Tracker. A solar cell is a device which converts light energy to electrical energy through photovoltaic effect. Solar cells are the building blocks of photovoltaic modules known as solar panels. In solar tracking system, the module's surface tracks the position of the sun automatically as the day runs by. The position of the sun varies as the sun moves across the sky. For a solar powered equipment to work best, it must be placed near the sun and the solar tracker can increase the efficiency of that equipment at any fixed position. Based on sophistication, costs and performance. One common type of tracker is the heliostat, a movable mirror that reflects the position of the sun to a fixed location. A solar trackers accuracy depends on the application. Concentrators, especially in solar cell applications, require a high degree of accuracy to make sure that the concentrated sunlight is directed exactly to the powered device, which is close to the focal point of the reflector or lens. Without tracking, concentrator systems will not work at all, therefore single-axis

tracking is mandatory. Non-concentrating applications require less accuracy, and many are likely to work without any tracking. However, tracking with great effect can improve both the amount of total output power produced by a system and that produced during critical system demand periods (usually late afternoon in hot climates). Research have been done to improve the energy production of solar panels. These researches include; double-sided panels, conversion stages improvement, building panels integration geometrically and so on. Maximum energy is produced by a solar PV panel when it is positioned at right angle to the sun. For this reason, several researches developed different types of solar panel tracking systems. Therefore, the primary purpose of this work is to develop a solar panel tracker based on Arduino advances so as to enhance the energy production of solar panel.

2.1 Technology of Solar Panel

Solar panels are devices that convert light into electricity. They are called solar after the sun because the sun is the most powerful source of the light available for use. They are sometimes called photovoltaic which means "light-electricity". Solar cells or PV cells rely on the photovoltaic effect to absorb the energy of the sun and cause current to flow between two oppositely charge layers. A solar panel is a collection of solar cells. Although each solar cell provides a relatively small amount of power, many solar cells spread over a large area can provide enough power to be useful. To get the most power, solar panels have to be pointed directly at the Sun. The development of solar cell technology begins with 1839 research of French physicist Antoine-Cesar Becquerel. He observed the photovoltaic effect while experimenting with a solid electrode in an electrolyte solution. After that he saw a voltage developed when light fell upon the electrode.

According to Encyclopedia Britannica the first genuine for solar panel was built around 1883 by Charles Frits. He used junctions formed by coating selenium (a semiconductor) with an extremely thin layer of gold. Crystalline silicon and gallium arsenide are typical choices of materials for solar panels. Gallium arsenide crystals are grown especially for photovoltaic use, but silicon crystals are available in less expensive standard ingots, which are produced mainly for consumption in the microelectronics industry. Norway's Renewable Energy Corporation has confirmed that it will build a solar manufacturing plant in Singapore by 2010 - the largest in the world. This plant will be able to produce products that can generate up to 1.5 Giga watts of energy every year. That is enough to power several million households at any one time. Last year the world as a whole produced product that could generate just 2 GW in total.

2.2 Evolution of Solar Tracker

Since the sun moves across the sky throughout the day, in order to receive the best angle of exposure to sunlight for collection energy. A tracking mechanism is often incorporated into the solar arrays to keep the array pointed towards the sun. A solar tracker is a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. When compare to the price of the PV solar panels, the cost of a solar tracker is relatively low. Most photovoltaic solar panels are fitted in a fixed location- for example on the sloping roof of a house, or on framework fixed to the ground. Since the sun moves across the sky though the day, this is far from an ideal solution.

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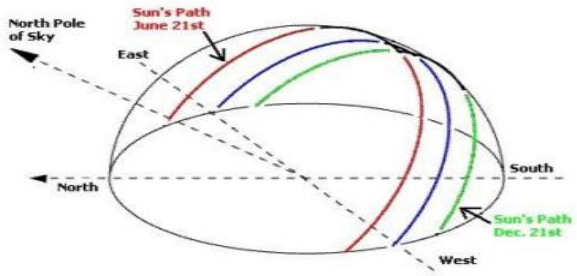

Fig. 1: Sun's apparent motion.

Solar panels are usually set up to be in full direct sunshine at the middle of the day facing South in the Northern Hemisphere, or North in the Southern Hemisphere. Therefore, morning and evening sunlight hits the panels at an acute angle reducing the total amount of electricity which can be generated each day.

During the day the sun appears to move across the sky from left to right and up and down above the horizon from sunrise to noon to sunset. Figure 2.1 shows the schematic above of the Sun's apparent motion as seen from the Northern Hemisphere. To keep up with other green energies, the solar cell market has to be as efficient as possible in order not to lose market shares on the global energy marketplace. The end-user will prefer the tracking solution rather than a fixed ground system to increase their earnings because:

The efficiency increases by 30-40%.

- The space requirement for a solar park is reduced, and they keep the same output.
- The return of the investment timeline is reduced.
- The tracking system amortizes itself within 4 years.
- In terms of cost per Watt of the completed solar system, it is usually cheaper to use a solar tracker and less solar panels where space and planning permit.
- A good solar tracker can typically lead to an increase in electricity generation capacity of 30-50%.

3. PROPOSED SYSTEM

The principle of the solar tracking system is done by Light Dependent Resistor (LDR). Four LDR's are connected to Arduino analog pin AO to A4 that acts as the input for the system. The built-in Analog-to-Digital Converter will convert the analog value of LDR and convert it into digital.

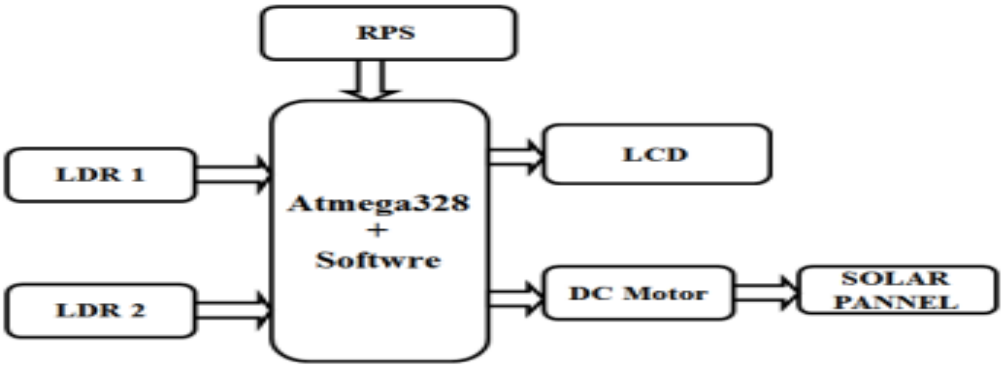

Fig. 2: Project model.

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The inputs are from analog value of LDR, Arduino as the controller and the DC motor will be the output. LDR1 and LDR2 are taken as pair. If one of the LDR in a pair gets more light intensity than the other, a difference will occur on node voltages sent to the respective Arduino channel to take necessary action. The DC motor will move the solar panel to the position of the high intensity LDR that was in the programming.

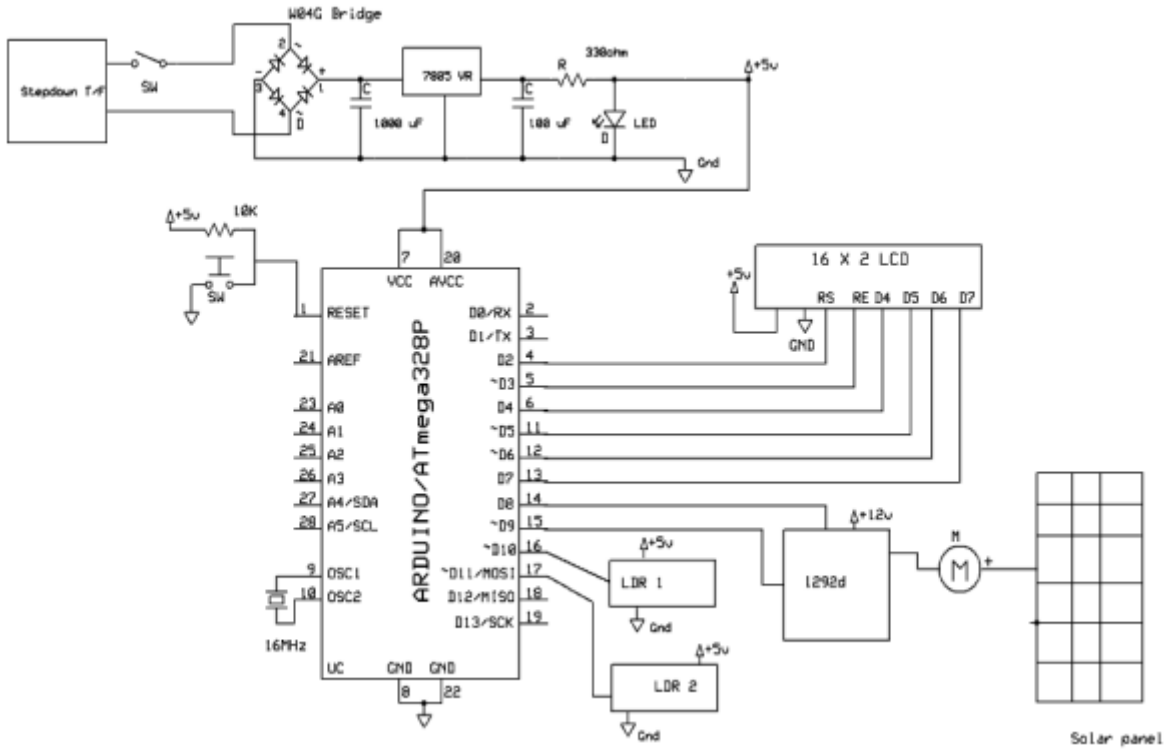

Fig. 3: Block diagram.

The proposed following framework does following of daylight all the more adequately by giving PV board revolution in two diverse pivot. DC engines are essentially performing capacity of sun following. Upper board holder dc engine tracks sun directly and base stepper engine tracks the allegorical uprooting of sun. These dc engine and sensors are interfaced with a microcontroller which is controlling dc engines based on sensors input. LDR sensor sense the light and sends flag to microcontroller. Microcontroller is doing correlation of signs got from LDR sensors and based on more grounded signals it is choosing pivot heading of dc engine. Double hub tracker control is clarified with the assistance of piece chart appeared in figure. The square outline demonstrating that LDR sensors subsequent to detecting the light forward the flag to Arduino.

Arduino is astute gadget which is taking activities based on sensor information and initiating engine drivers circuit as needs be. Presently assume if sun changes its area and moves from east to west, it will make light force be diverse on one sensor when contrasted with other one. Based on light force contrast on sensor, controller enacts driver circuit and moves dc Motors new position where light falling on sensor sets is same. A similar procedure is keep on with on changes suns area in the sky. Therefore, this proposed demonstrate can catch more sun beams and frameworks sun powered vitality transformation ability is enormously improved.

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4. RESULTS

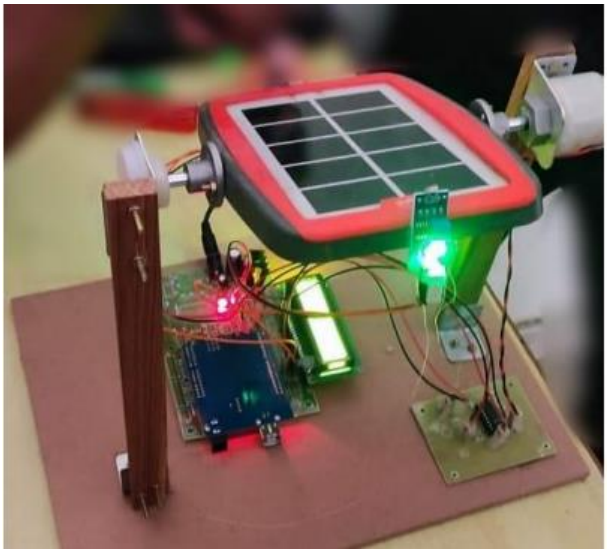

Fig. 4: 15 LDR based solar tracking system.

5. CONCLUSION AND FUTURE SCOPE

The proposed dual axis solar tracker automatically tracks position of sun and maximize the solar power with help of Arduino. The main aim of this work is to develop Single axis solar tracker system that uses four sensors (LDR's) to predict the sun position. Secondly, program is dumped on to Arduino (AT mega 328 p) so that rotation of servo motor can be controlled by employing the microcontroller. The programming part consists of 5 cases which has been stated and analyzed. Thirdly, to investigate the voltage differences from the sensor (light depending resistor LDR) based on intensity of light received by the sensor. The output has plotted into a graph and compared with static system. And proposed system is eco-friendly, and widely used.

Future Scope

As India is gradually increasing the use of solar and wind energy, the CEA stated that renewable energy generation might increase from 18% to 44% by 2029-30 in the country. In the future, India aims to portray a "green" environment with rooftop solar systems in all Indian households.

Recently, India stood 4th in solar PV deployment across the globe as on end of 2021. Solar power installed capacity has reached around 61.97 GW as on 30th November, 2022. Presently, solar tariff in India is very competitive and has achieved grid parity.

Generation of solar energy has tremendous scope in India. The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine. This is equal to more than 5,000trillion kWh. Almost, all parts of India receive 4-7 kWh of solar radiation per square metres. This is equivalent to 2,300–3,200 sunshine hours per year. States like Andhra Pradesh, Bihar, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, and West Bengal

have great potential for tapping solar energy due to their location. Since majority of the population live in rural areas, there is much scope for solar energy being promoted in these areas. Use of solar energy can reduce the use of firewood and dung cakes by rural household. Many large projects have been proposed in India, some of them are: i). Thar Desert of India has best solar power projects, estimated to generate 700 to 2,100 GW, ii). The Jawaharlal Nehru National Solar Mission (JNNSM) launched by the Centre is targeting 20,000 MW of solar energy power by 2022, iii).Gujarat's pioneering solar power policy aims at1,000 MW of solar energy generation, and Rs.130 billion solar power plan was unveiled in July 2009, which projected to produce 20 GW of solar power by 2020.Apart from above, about 66 MW is installed for various applications in the rural area, amounting to be used in solar lanterns, street lighting systems and solar water pumps, etc. Thus, India has massive plan for Solar Energy generation that may not only fulfill the deficit of power generation but also contribute largely in Green Energy Production to help to reduce the Climatic Changes globally.

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