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RESEARCH ARTICLE

SOLAR TRACKING SYSTEM A DESIDERATUM USING LDR AND MICROCONTROLLER PACKAGE.

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Abstract

The renewable-energy sector is fast gaining ground as a new growth area for numerous countries with the vast potential it presents environmentally and economically. Solar energy plays an important role as a primary source of energy, especially for rural area. This paper presents the design and development of high-efficiency dual-axis solar tracking system using Arduino platform. Furthermore, the ultimate objective of this project is to trace the maximum sunlight source to power the solar panel. The project is divided into two stages, which are hardware and software development. In hardware development, four light dependent resistor (LDR) has been used for capturing maximum light source and two servo motors have been used to move the solar panel at maximum light source location by sensing LDR. Moreover, the code is constructed using C programming language and targeted to Arduino UNO controller. Therefore, the system has been proven working for capturing the maximum sunlight source for high efficiency solar harvesting applications.

Introduction:-

The world population is increasing day by day and the demand for energy is increasing accordingly. Oil and coal as the main source of energy nowadays, is expected to end up from the world during the recent century which explores a serious problem in providing the humanity with an affordable and reliable source of energy. The need of the hour is renewable energy resources with cheap running costs. Solar energy is considered as one of the main energy resources in warm countries.

In general, India has a relatively long sunny day for more than the months and partly cloudy sky for most of the days of the rest two months. This makes our country, especially the desert sides in the west, which include Rajasthan, Gujarat Madhya Pradesh etc [1]. Many projects have been done on using Photovoltaic cells in collecting solar radiation and converting it into electrical energy but most of these projects did not take into account the difference of the sun angle of incidence by installing the panels in a fixed orientation which influences very highly the solar energy collected by the panel.

As we know that the angles of inclination ranges between -90˚ after sun rise and +90˚ before sunset passing with 0˚ at noon. This makes the collected solar radiation to be 0% at sun rise and sun set at 100% at noon. This variation of solar radiations collections leads the photovoltaic panel to lose more than 40% of the collected energy [2].

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Solar Tracker

Solar tracker is a device which follows the movement of the sun as it rotates from the east to west every day. The main function of all tracking systems is to provide one or two degrees of freedom in movement. Trackers are used to keep solar collectors/panels oriented directly towards the sun as it moves through the sky every day. Using solar trackers increases the amount of solar energy which is received by the solar energy collector and improves the energy output of the heat/electricity which is generated. Solar trackers can increase the output of solar panels by 20-30% which improves the economics of the solar panel project [3].

Single Axis Tracker

The sun travels through 360 degrees east to west per day, but from the perspective of any fixed location the visible portion is 180 degrees during an average 1/2 day period (more in spring and summer; less, in fall and winter). Local horizontal effects reduce this somewhat, making the effective motion about 150 degrees. A solar panel in a fixed orientation between the dawn and sunset extremes will see a motion of 75 degrees to either side, and thus, according to the table above, will lose 75% of the energy in the morning and evening. Rotating the panels to the east and west can help recapture those losses. A tracker rotating in the east-west direction is known as a single-axis tracker. The single axis tracking systems realizes the movement of either elevation (or) azimuth for a solar power system, which is one of the technologies used on the tracker as well as the space that it is mounted on.

A single axis –tracker can only pivot in one plane-either horizontally (or) vertically. This makes it less complicated and generally cheaper than a two-axis tracker but also less effective at harvesting the total solar energy available at a site. Trackers use motors and gear trains to direct the tracker as commanded by a controller responding to the solar direction. Since motor consume energy one wants to use them only as necessary [4].

Single axis trackers have one degrees of freedom that acts as an axis of rotation. There are several common implementations of single axis tracker. These include horizontal single axis trackers (HSAT) and vertical single axis trackers (VSAT).

Dual Axis Tracker

The sun also moves through 46 degrees north and south during a year. The same set of panels set at the midpoint between the two local extremes will thus see the sun move 23 degrees on either side, causing losses of 8.3%.But our tracker will account for both daily and seasonal motion. So this type of solar tracker provides dual axis tracking.

To track the sun's movement accurately dual axis tracking system is necessary. The active/continuous tracking system tracks the sun for light intensity variation with precision. Hence, the power gain from this system is very high. But to achieve this power gain the system uses two different motors continuously for two different axes. As a result it always consumes a certain amount of extra power compared to time-based tracking system. Therefore, in order to reduce this power loss a combination of active and time-based [5].

To track the sun's daily motion, that is, from east to west direction, pair of light sensors are used and to track the seasonal motion of the sun real time clock (RTC) is used to create the accurate azimuth angle from some predetermined parameters. The light intensity is compared by microcontroller and it generates the suitable control signals to move the motors in proper direction. So a driver circuit is used to increase the voltage and current level for the operation of the motors. Two full geared servo motor are used for rotating the solar module in two different tracking could be the suitable alternative to this system axis. This type of solar tracker also has another feature that if it is used indoor it can find the brightest light source [6].

Figure 1:-Block Diagram

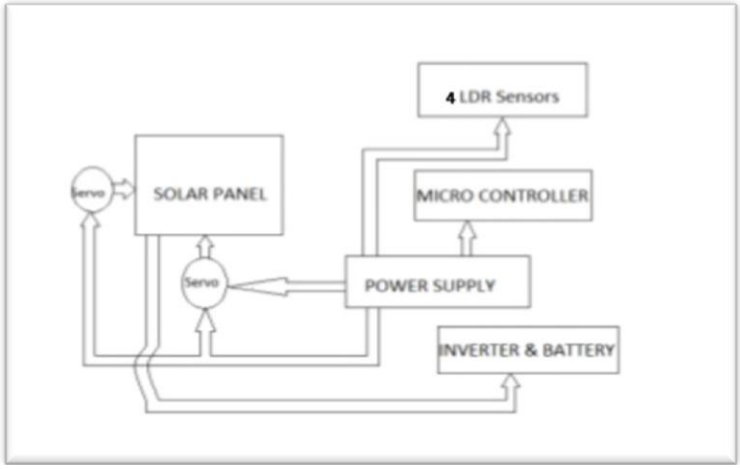
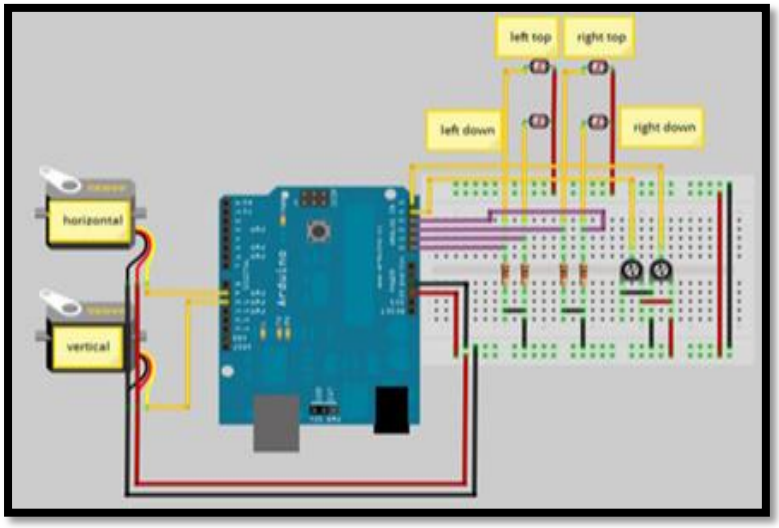
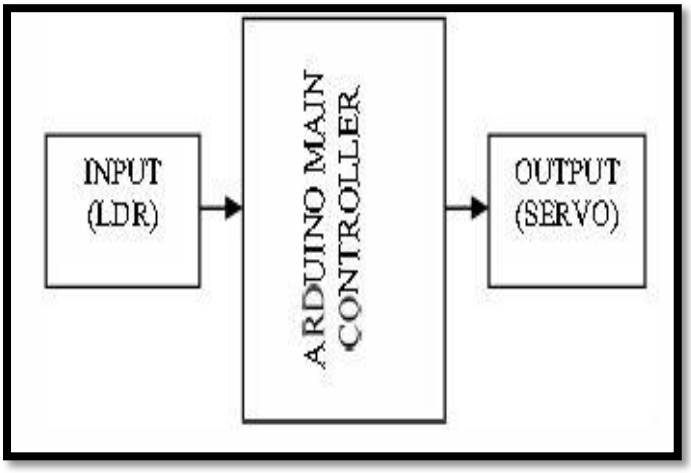


Figure 2:-Circuit Diagram



Methodology:-

The main intention of this project is to design a high quality solar tracker. The project is divided into two parts; hardware and software. The inputs are from analog value of LDR, Arduinos the controller and the servo motor will be the output.



Microcontroller

A microcontroller (sometimes abbreviated µC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory is either in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications [7].

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Arduino

Arduino is a single board micro controller intended to make the application of interactive objects or environments more accessible. The hardware consists of Open source hardware. Arduino is a micro controller that is capable of converting analog data to digital. The data that is received from the flow meter is in the form of analog data so the arduino has to convert it .It is in the form of analog pulse arduino converts it into digital pulses so that raspberry pi can read it.

In order to program Arduino we must have Arduino IDE (i.e.) Arduino programming platform installed in a Windows, Linux or Mac Pc. The program will be written in the Arduino IDE and then uploaded to the Arduino with the help of a serial cable USB directly connected to the pc. The program is written debugged and then uploaded to Arduino. Arduino can be written re-written (RAM, EEPROM). Now the Arduino will read the data from the flow meter and convert it as it is programmed.

There are many types of Arduino available. For our project we are using the ARDUINO UNO REV3 model.The Arduino Uno is a micro controller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started [8].

Arduino Uno Rev 3

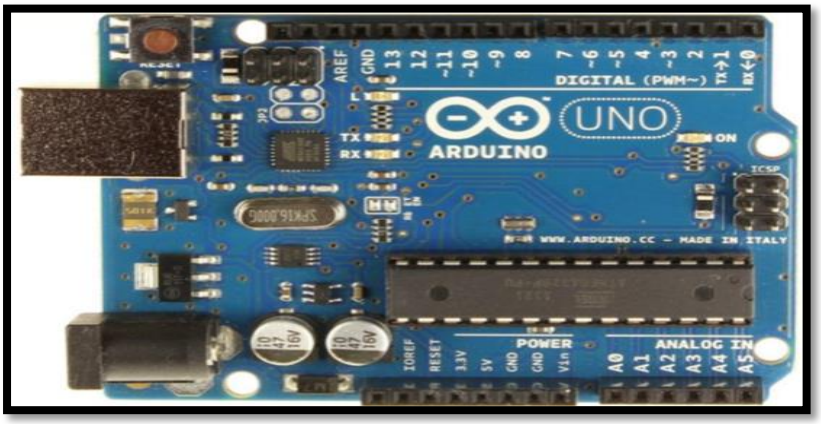
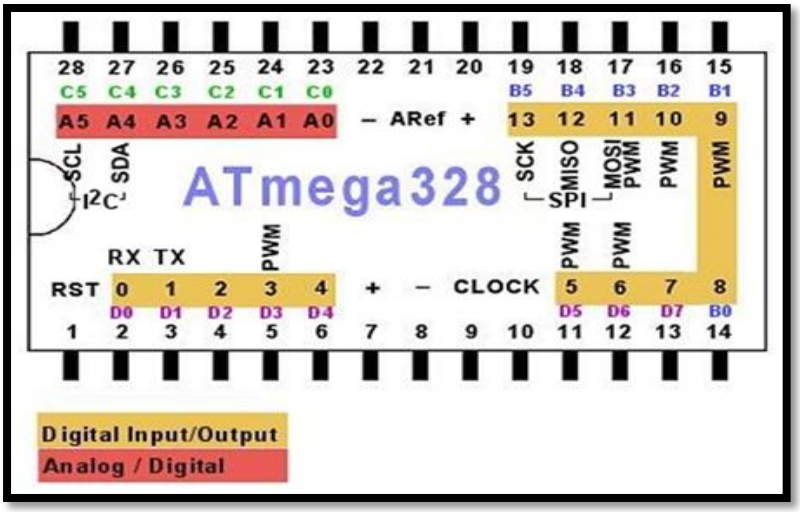


Figure 3:-Atmega 328 Pin Diagram



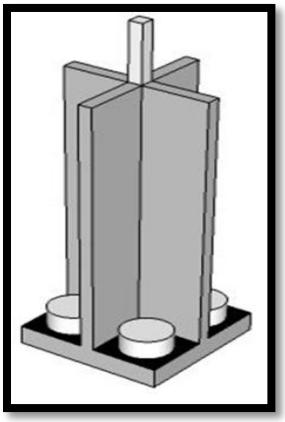
LDR

A photo resistor or light dependent resistor (LDR) or photocell is a light controlled variable resistor. Here we are using 4 LDR to track the sun and to find the brightest light source.

LDR Setup Arrangment

Light sensors are used for measuring light intensity and generating a corresponding analog voltage signal into the input of the analog to digital converter of the microcontroller. Since this is a hybrid dual axis solar tracking system so, to track the sun's daily motion continuously, that is, from east to west, a pair of light dependent resistors (LDR) is used as light sensors. On the other hand, the sun's annual motion, that is, from north to south, is tracked by the real time clock (RTC) device and position sensor [9].

A light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity.



Servomotor

A Servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotor.

Continuous Rotation Servomotor

Continuous rotation servo motors are actually a modified version of what the servos are actually meant to do, that is, control the shaft position. The 360° rotation servos are actually made by changing certain mechanical connections inside the servo. However, certain manufacturer like parallax sells these servos as well. With the continuous rotation servo you can only control the direction speed of the servo, but not the position.

Conclusion:-

Solar energy plays an important role as a primary source of energy, especially for rural areas. Solar trackers can increase the output of solar panels by 20-30% which improves the economics of the solar panel project. Therefore, the system has been proven working for capturing the maximum sunlight source for high efficiency solar harvesting applications.

Reference books:

1. G.Deb and Roy, "Use of solar tracking system for extracting solar energy". International Journal of computer and Electrical Engineering.
2. Handbook on Energy conscious Buildings by J.K. Nayak.
3. Solar Electricity Handbook- 2013 Edition.
4. Solar Tracking system: Leonard: L. Northrup .Jr
5. "Arduino software Release Notes:Arduino projects
6. "Atmel's self-programming Flash microcontroller" by odd Josteinsivendsli 2003
7. "Brushless PWM servo Amplifier"- Advanced Motion Control"
8. "Upson, A.R: Batchelor J.H. Synchro Engineering Handbook. Beckenham; MuireheadVactric components
9. Divya, V &Sashanka, P. April 30, 2010. -Renewable Energy. Retrieved June 5, 2012