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Dual Axis Solar Tracking System with Weather Sensor

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ABSTRACT: This paper presents the outline and execution of simple, easy, and cheaper automatic dual axis solar tracking system using Arduino UNO as the control element and light detecting sensors (LDRS) as the sensing element. This project involves advanced level of technology to capture maximum amount of energy using sun's radiations. The main purpose is to increase the efficiency of tracking system which can rotate in all four directions continuously according to intensity of radiations and for energy conversion. In this, the voltage from panel is calculated from time to time in an interval of 1hr and this voltage is used to sense the weather conditions and display the climatic temperatures.

KEYWORDS: Solar panel, Arduino UNO, Light detecting resistors (LDRs), servo motors, temperature sensors, humidity sensors, rain drop sensors.

I. INTRODUCTION

As sun is a major source of this renewable energy, a dual axis solar tracker which can track the radiations from the sun in all the directions with maximum intensity is found. This dual axis solar tracker takes the sun radiations as the input and converts to electrical energy this electrical energy which is obtained fulfil majority of the country needs. Energy absorption is maximum when the panel is perpendicular to the sun. Hence we are using a solar tracker to maximize the energy generation and improve the efficiency 40% more than the fixed panel. In general, during the day the single axis tracker moves from east to west with one degree of freedom. While the modem tracker tracks east west and north south movement of the sun. In this project we are integrating dual axis solar tracking.

The demand for reliable source of energy has been increasing day by day. So, government improved the usage of renewable energy sources there by curtailing the usage of conventional source of energy. By using photovoltaic cell we can harness solar energy and later photovoltaic effect can be used to convert solar energy into electrical energy and this energy can be used in wide applications like solar thermal energy, solar heating, photovoltaic, solar architecture etc. The output of photovoltaic cell directly depends on the intensity of light and sun's positions changes continuously in a day. In general, during the day the single axis tracker moves from east to west with one degree of freedom. While the modern tracker tracks east west and north south movement of the sun. In this project we are integrating dual axis solar tracking. The project is designed and implemented using simple dual axis solar tracker system. In order to maximize energy generation from sun, it is necessary to introduce solar tracking systems into solar power systems. A dual-axis tracker can increase energy by tracking sun rays from switching solar panel in various directions.

II. LITERATURE SURVEY

The first solar tracker was a mechanical system by C. Finster, invented in 1962. Though the Finster solar tracker realized insignificant energy gains, years of testing and research have led to improvement of the conversion output of the PV system and consequently the emergency of different tracking technologies and applications (e.g. concentrator and non-concentrator). In short, improved solar cells have been developed and the use of solar tracking system over the use of conventional fixed PV system has grown. In fixed photovoltaic system the solar receiver (PV module) is in a stationary position facing the true north. However, with mechanical or electro-mechanical systems, the orientation of the collector change continually in reference to the azimuthal directions (east-west) and also in its elevation. This is dependent on the tracker's geometrical capacity.
Classification of solar tracking system Mousazadeh et al, (2009) carried a review study, which resulted in the general categorisation of solar tracking systems (2) according to two main typologies, namely, Energy source (i.e. passive,

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active and manual), and Degree of freedom (i.e. single or dual axis). Passive tracking systems- designate all devices that position solar collectors for optimum capture of energy using mechanical potential and thermal energy principles. Passive systems do not use of electrical energy. Some of the typical mechanical working principles are Shape Memory Alloy (SMA), Thermo-fluids, Mechanical potential system (lever, weight and springs).

In Shape Memory Alloy, cylindrical actuators to change the shape the SMA receivers through mirrors until an optimum orientation is achieved (3) Recent developments, among others by Kusekar et al (2015), have seen the use of high pressure fluids to convert the potential energy in the mechanical structure that hold up the PV panel into kinetic energy, which is then used to move the panel toward the sun. (4) Active tracking systems- use electrical energy as their source. A number of categories exist such as; Electro-optical based tracker, Auxiliary bifacial solar cell and chronological (time and date based) tracker. At some instances, a combination of these different systems may be released and the resulting system will be referred to as Hybrid.

Of all active trackers, electro-optical basedtrackers are is generally more popular.For improved photosensitivity, the sensor can be mounted on a pyramidal structure (in the figure 2b outlines the photo-diode mounted on pyramid) or use of collimator tube might be vital as it prevent diffuse irradiation from reach the sensors therefore ensuring precise measurement of the position of the sun. Fig.1c is a system made up of four mini- solar module positioned on the North-south and east-west that detect the light intensity, this is system also use the Programmable Logic Controller (PLC) manipulate the two positioning mechanism through two DC motors (5)

III. BLOCKDIAGRAM

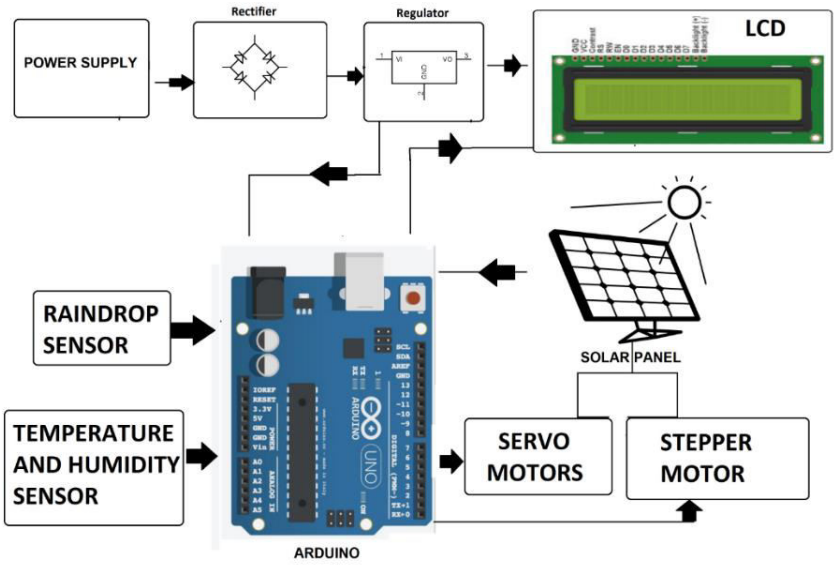

Fig.1 Block diagram

Humidity & Temperature Sensor:

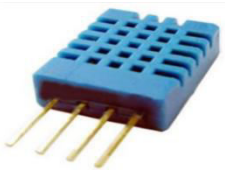

Fig.2Humidity & temperature sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing

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technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a highperformance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

LCD Display:

Fig.3 LCD

The term liquid crystal is used to describe a substancein a state between liquid and solid but which exhibits the properties of both. Molecules in liquid arrange themselvesuntil they all point in the same specific direction. This arrangement of molecules enables the medium to flow as a liquid. Depending on the temperature and particular nature ofa substance, liquid crystals can exist in one of several distinct phases. Liquid crystals in a nematic phase, in which there is no spatial ordering of the molecules, for example, are used in LCD technology. Here this used to display the password entered by us to ON/OFF the circuit breakers.

Solar panel:

Fig.4Solar panel

The term solar panel is used for a photo-voltaic module. A PV module is an assembly of photovoltaic cells mounted in a framework for installation. These cells are arranged in a grid-like pattern on the surface of solar panels. Solar panels are those devices that are used to absorb the sun's rays and convert them into electricity or heat. This electricity can then be used to supply renewable energy to your home or business. You can find here the World's Smallest Solar Powered Car, Vibrating Black Cockroach Bug, and Solar Panel of different dimensions.

Servo motor

Fig.5 Servo motor

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction) and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware

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Rain drop sensor:

Fig.6Rain drop sensor.

A rain sensor or rain switch is a switching device activated by rainfall. There are two main applications for rain sensors. The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers.

Arduino Uno:

Fig.7 Arduino Uno.

Arduino is an open-source electronics prototyping platform based on flexible and easy-to-use hardware and software. Arduino can sense the environment by receiving input from a variety of sensors that can affect its surroundings. Arduino projects can be stand-alone, or they can communicate with software running on a computer. In this development, Arduino is used as the main controller for the project. There are many types of Arduino boards but for this project, Arduino UNO was selected. This is because it satisfies these conditions: a) Microcontroller board based on the ATmega328. b) 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.

LDR (Light Dependent Resistor)

Fig.8 LDR.

Photo resistor or a light dependent resistor (LDR) is a resistor whose resistance decreases withincreasing incidentlight intensity or exhibits photoconductivity. LDR output voltages for lightintensity.The light intensity is measuredin lab experiments. The resistance of an LDR is extremelyhigh, sometimes as high as 1M ohms. The light resistances will drop dramatically when illuminated.

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IV. CIRCUIT DIAGRAM

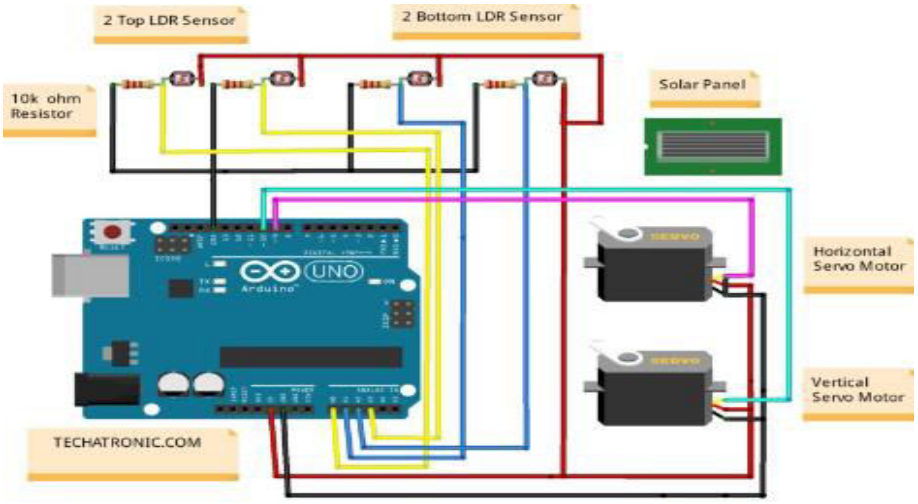

Fig.9Circuit diagram

V. WORKING

The project is divided into two parts; hardware and software. The main constituents of the tracking system are shown in Figure2. Hardware part generally composed of solar panel, two- DC motors with gearbox, LDR sensor module and electronic circuit. Software part represents the thinking behavior of the system, that is how the system acting under several weather conditions.

Sun position sensing method used in the control circuit To track the sun it is vital to locate the position of the sun accurately. In this work sensing of the sun position carried out in two stages primary and secondary. Primary stage or indirect sensing performed via sun-earth relationship as a coarse adjustment and second stage or direct sensing performed via set of LDR sensors as output tuning to trims the azimuth and altitude angles.
If the weather is cloudy or dusty, the tracking system uses primary stage or sun-earth geometrical relationships only to identify the location of the sun; so the system tracks the position of the sun regardless the weather condition. LDR sensor module consists of four light dependent resistor or cadmium sulphide cell; LDR is a resistor whose resistance decreases with increase in light intensity. These four LDR are placed on a circular plate and separated by 90 degree space rotation through perpendicular rectangular plastic sheet.

VI. ADVANTAGES

- It can adjust the panels in all 4 directions according to the sun's position.
- The sensors and algorithm keep a record of the seasonal changes and lay timing for accurate panel positioning.
- It increases solar energy generation all around the year.
- Dual-axis trackers follow the Sun continually and provide constant power output throughout the day.

VII. APPLICATIONS

- Dual Axis Tracker for Solar Photovoltaic (PV) Panel Applications
- Dual Axis Tracker for Solar Thermal Dish/Engine Applications

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VIII. CONCLUSION

As solar energy is considered one of the main sources of energy in the near future, In this paper, we give a simple and concise overview of the solar tracking mechanism to improve the solar gain energy, also the costs of the solar tracker operation and cost maintenance is relatively low. In this paper, Design and implementation of solar tracker with two axes that Use in motor satellite dish to track the sun accurately and use LDR sensor to determine the intensity of falling sunlight. We found that the solar tracking system is more effective than the fixed solar panel. The energy gained from the solar panel with the dual tracker exceeds 35% of the energy gained from the fixed solar panel, In analyzing the data, the energy gained from the solar tracker is mostly in the morning and in the evening because at noon time there is little difference and this proves that the fixed solar panel is efficient during noon time only. The dual-axle solar tracking system is efficient as it can be placed anywhere and ensure a high energy gain.

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