Automatic Sun Tracking Panel Using Arduino UNO

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Abstract- *The energy from the sun has more electricity power, but it doesn't affect the human nature. And the sun energy is further can stored by use of solar cell. Tracking of sun energy is an advanced technology and it means of renewable energy source. The approximate of sun rays is parallel to hits on the LDR directly, when high intensity of light from the sun that's the LDR observe and it works the stepper motor to move the direction of solar panel where the rays of light is more. Basically, heart of control circuit of this solar tracker is Arduino UNO. Arduino UNO control all the parts of the circuit. Additionally, digital meter is used in this projectto know the voltage received per second.*

Keywords- LDR, Stepper motor, Arduino UNO, Digital meter, Solar panel.

I. INTRODUCTION

Solar tracking system from the name itself we analysis or predict what we are done in this project. Achieving balance between power consumption and power generation is an acceptable challenge today. The best way to solve this imbalanced nature is use the power generation from nature like solar system. The problem in the usage of solar energy is with solar panel should be needed to maximum concentration to the sun light. In case solar panel is fixed in a particularly one direction but the sun light intensity varies from morning to evening so the power generation is low compared to use motors to track sunlight. Moving the solar panel in the direction of sun can increase the solar energy generated from the solar cell. His needs only maximum sunlight to generate power and it is stored in battery for further uses. This system expressed for power generation by setting the components to get maximum intensity from sun automatically. This system acquires maximum intensity of light. When there is lag in power generation, this system automatically changes its position to get maximum intensity of light.

We are using two sensors in two different and opposite location to acquire the direction of maximum intensity delivered by the sun. The difference between sensors gives some output and it's given to micro-controller.

Here we are using the micro-controller for tracking sunlight and generating power from sunlight. It will process the input voltage from the oscillators circuit, that is made by step down the transformer from 220V a.c. to 5v d.c. and control the direction of the stepper motor to sense maximum intensity of light from the sun to process huge power generation

A photovoltaic system plays a major role in sun tracking system that has been built, and it's experimentally analyzed that the previous proposition of solar tracking system tracks the sun direction with the tracking error of 0.11° which can be a lesser amount than the tracking errors of both systems based on sensor and sensor-free solar trackers.

Payloads are usually solar panels, Fresnel reflectors, parabolic trough senses or the mirrors of a heliostat. Practically, reliability is sometimes harder to specify than many major performance characteristics and is certainly harder than most probable measurements. The accurate extraction of the reliability of a system in use is often difficult because it requires long process and takes its own comfortable time period and the large number of samples are required so on realize statistical confidence within the examination.

In this project, already we know the Sun tracker designed by using some basic electronic components like Light Dependent Resistances (LDR), microcontroller (ATmega328), comparator using OPAMP's, a crystal oscillator, transformer, stepper motor and stepper motor driver. The flow process behind this work is that the intensity of sunlight will be sensed by the LDR's separated by a certain angular distance, the comparators will compare the incident light intensity with the intensity of perpendicular incidence from the sunlight. The micro-controller will rotate the stepper motor by the desired angle depending on the maximum energy delivered by the sun and it gives to comparators via a stepper motor driver circuit to increase the efficiency. Owing to the change in the position where the device is placed and weather conditions, the intensity of sunlight changes, for which we have made a process of changing the threshold voltage value by using variable resistances.

II. RELATED WORK

Most of the authors in this field system done their related work to overcome the existing method by step by step process. The idea innovated by the authors are related to our project is used to develop the efficient solar tracking system and it helps to attain the high-power source from the sunlight and backup it for further usages

- Simple Implementation of Solar Tracking System Dual Axis with Four Sensors
- Solar Tracking System Using Microcontroller
- Construction and Design of an Automatic Sun Tracking System

2.1. Simple Implementation of Solar Tracking System Dual Axis with Four Sensors

Falah I. Mustafa*, SarmidShakirFaiz F. Mustafa, Athmarthamernaiyf has state that increasing the efficiency is to get the maximum power from the solar panel .The project is to mainly implemented for simple and cheap price sun tracker system with two angles (altitude angle and azimuth angle) using Light Dependent Resistor (LDR) with real two dimensions the project composed of solar panel, microcontroller ATmega328, servo motor and ball-joint, LDR module and basic electronic circuits. This project is compared with Stepper free solar panel and finally the results shows that the solar tracker gives more output power than fixed solar panel. The project is divided into two segments; electronic and hardware. Hardware part generally coordinates of solar panel, two-DC motors with gearbox and LDR sensor. Second part is electronic circuit. In this work sensing of the sun position carried out in two stages, one is direct sensing performed via group of LDR sensors as output turning to trims the azimuth and altitude angles. Another is, when the weather is cloudy rain or dusty, the tracking system will stop the Operation, so the system stay in the position of the sun without move but according to Kelly cosine relation there is decrease in power according to Iraq - Baghdad city weather because we have about 15-20 rainy days that every day have (3-4) hours have cloudy and rain. The energy acquired from photovoltaic(PV) or any solar collector cells depends on solar irradiance. For maximum capitulation of energy from the sun, the solar panel should always be normal to the incident radiation by the sun. Solar trackers move the solar Panel to follow the suns way and keeps the angular moment of the solar panel at an optimally tilt. Solar tracking system improves gradually the energyefficiency of photovoltaic (PV) panel. In this paper, an automatic dual axis solar tracker system is designed and implemented using Light Dependent Resistor (LDR) and servo motors on a mechanical model with gear arrangement. The results indicated that the automatic solar tracking system is easier and more efficient than fixed one.

2.2. Solar Tracking System Using Microcontroller

Lokesh, Anup Surahonne, Adithya N Simha, Arjuna C Reddy has delivered a word that a renewable resource is a source that can be continuously used and yet be recovered from natural resources that are present in our proposed tracker system, some of the renewable energy source are O2, sunlight, water, etc. Solar energy is one of the main renewable sources of energy which has a higher importance thanbefore. Since the solar energy is available forever, , if we make them better accusation and efficient use of it, we will be able to solve the draw bags by reduction in fossil fuels. Increasing power output from a solar tracking system is to increase the efficiency of power generation. In order to develop power output from solar panels, the panels must be aligned in order to capture the sun. To develop a system that tracks the sunlight is required. But having an ordinary solar panel, might not be the most effective process for conversion of solar energy into electrical energy. By using solar panels that can be rotated along the angle with respect to the position of the sunlight occurs, we can improve the efficiency of conversion by at least 40-45%. This paper deals with the design and implementation of solar tracking system by using a micro-controller, stepper motor, motor driver and solar panel. The main component of this tracker is micro-controller is MSP430 which is implemented to track the sunlight and to make sure that the LDR in solar panel is made to receive a higher volume of sunlight and help in generating a reliably large amount of power.

2.3. Construction and Design of an Automatic Sun Tracking System

Md. Tanvir Arafat Khan, S.M. ShahrearTanzil, Rifat Rahman, S M ShafiulAlam analyses that the energy demand is the most important issue in today's world. Conventional energy resources are not only limited but also the major culprit for environmental pollution. Renewable energy resources are getting some orders in the whole world to lesser the dependency on conventional energy resources. Solar energy is continuously gaining the concentration as an important means of expanding renewable energy uses. Different mechanisms are applied to increase the usage of the solar cell to reduce the cost. Solar tracking system is the easier and common technology to increase the efficiency of the solar cells by tracking the sun. A microcontroller-based mechanism of an automatic solar tracking system is presented in this paper. Light dependent resistors LDRs are used as the sensor for solar tracker. The designed tracker has effort less control

mechanism which will provide three ways of controlling system. A small prototype of solar tracking system is also invented to implement the design methodology presented here.

III. PROPOSED MODELLING

3.1.BLOCK DIAGRAM

In the figure 3.1 shows the block diagram of the proposed system. It consists of ATmega328 microcontroller to control the electronic equipment's used in this project. When a a.c.supply is activated, it will be converted to d.c for small electronic components to perform operation by using MCB(Miniature Circuit Breaker). Stepper motor is used to rotate the solar Panel to attain the direction of sunlight where maximum efficiency occurs. Through LDR (Light Dependent Resistance) acquires the light energy by the use of solar panels converted the extracted solar energy into electrical energy and stores in a battery for lateral use. Using digital meter, we able to find amount power attained per unit time.

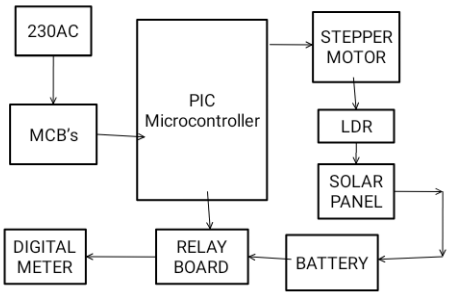

Figure 3.1 Block diagram

3.2. HARDWARE DESCRIPTION

3.2.1. ARDUINO UNO ATMEGA328:

It is a microcontroller unit and based on Atmega328p. Arduino is a open source platform to develop a innovation project in the area of embedded systems. Arduino boards are widely used in robotics, embedded systems, and electronic projects where automation plays an vital role of the system. Its main features, pin out, working, applications and everything you need to know. Here's the list of other Arduino boards: Arduino UNO is a microcontroller board, developed by Arduino.cc and based on AT mega 328p/Atmega168.It comes with an operating voltage of 5V, the input voltage may vary from 5 to 12V depends on the source of equipment .There are 14 digital pins which can be separated as input or output and 8 analog pins in build on the board. More or less all these analog pins can be used and performed exactly the same way as digital pins.

3.2.2.SOLAR PANEL:

Solar panel is a device which is used to extract the sun's rays and convert the energy into electricity. A solar panel is actually a group of solar (or photovoltaic) cells, which can be used to generate electrical energy through photovoltaic effect. Photovoltaic solar panels absorb sunlight as an input energy and generate electricity. A photovoltaic (PV) module is a integrated, connected assembly of typically 8×10 photovoltaic cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and industrial applications. Solar PV modules (top) and two solar hot water panels (bottom) mounted on rooftop. The most common application of solar energy collection outside agriculture is solar water heating systems produced from crystalline silicon (c-Si) solar cells made of multi crystalline and mono crystalline silicon. Crystalline silicon accounted for more than 90% of worldwide PV module production, while the remaining overall market is made up of thin-film technologies using cadmium telluride. They produce a comparatively high-efficiency conversion for the low cost compared to other PV cell technologies.

3.2.3. LDR (LIGHT DEPENDING RESISTOR):

Alight dependent resistor supported the principle of photo conductivity. When light falls on the device, photon is generated. The electrons within the valence band of the semiconductor material are excited to the conduction band when photons are generated. Photo conductivity is an optical sensor function within which the conductivity of the material is increased when photons are absorbed by the material. These photons in the incident light should have energy higher than the band gap mode of the semiconductor material to create the electrons jump from the valence band to the conduction band. Hence when light having enough amount of energy fall on the device, more electrons are excited to the conduction band which results in large number of charge carriers occurs in the device. The result of this process is huge current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased gradually.

3.2.4. SERVO MOTOR:

Servo motor is works on the principle PWM (Pulse Width Modulation), the duration of pulse is controlled by activate the control PIN. Generally, servo motors are made up

of DC motor which is dominated by a variable resistor (potentiometer). A servomotor is a rotary actuator that allows you to control of angular or linear position, acceleration and velocity. It consists of a suitable motor paired to a sensing the position feedback. Servomotors are not a specific class of motor although the term servomotor is often used to refer the servo motor. A servomotor is a closed-loop stepper mechanism that uses to change position feedback to control its final position of the panel. The input to its control is a of signal it may be analog or digital representing the position preferred for the output. The motor is with some type of encoder to provide position and speed feedback. In the normalized case, only the position to be measured. The position measured at the output is compared to the command position. As the positions approach, the error signal returns to zero and the motor will halt.

3.3. SOFTWARE DESCRIPTION

3.3.1. PROTEUS:

The software is used mainly by designed by electronic engineers and technicians to create graphical and electronic prints for manufacturing PCBs.

History:

The first version of Proteus Design is named as PCB and was written by the chairman, John Jameson, for DOSin 1988. Shape based on automatically routed system was added in 2002 and 2006 saw another major product update with high precision is 3D Board Visualization. More recently, developed an IDE for simulation was included in 2011 and MCAD import/export was in 2015. It supports for fast speed design.

3.3.2. PRODUCT MODULE:

The Proteus module is a Windows application for graphical capture, simulation, and PCB (Printed Circuit Board) layout design. It can be purchased in many specifications, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products like router and basic SPICE simulation capabilities.

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3.3.3.MICROCONTROLLER SIMULATION:

The micro-controller simulation in Proteus developed by encoding either a 16-bit file or a debug file to the microcontroller unit on the system based on GUI. It's the simulated along with any analog and digital electronic equipment's connected to it. This enables its use in a broad module of project prototyping in areas such as control motors, user design interface and temperature control. It also finds use in the general loyal community and, since hardware is not required, is less complicated to use as a training or teaching tool.

IV. RESULTS AND DISCUSSIONS

The Power generated by the solar tracking system has been executed. By this process we acquire the electrical energy from the sun and the voltage per unit time is displayed in digital meter.In this project, the 220v a.c. supply is step down to 12v d.c. supply and given as input for Arduino UNO through which the supply is given to remaining components to perform the power generation. By this hardware schematic diagram, we conclude that the resultant energy is displayed int digital meter.

Figure 4.1 Hardware

From the figure 4.2, we can analysis how the solar panel gets rotated due to the influence of stepper motor. This function is done by the Arduino program and gives the instructions to stepper motor to align its angle depends upon the signal given by the LDR. The rotation is possible in four direction namely north, south, east and west. By this LDR instruct the motor to acquire the maximum intensity.

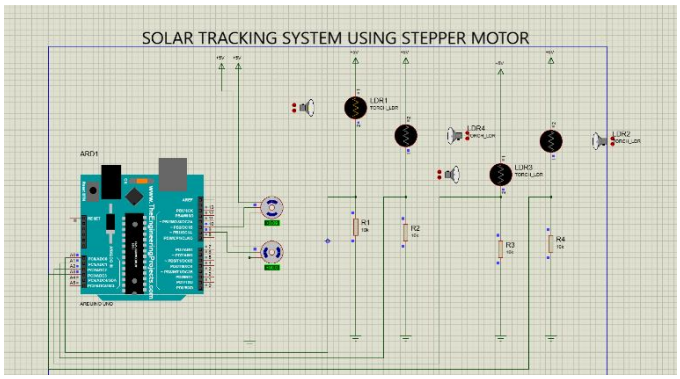

Figure 4.2 Simulation output for solar tracking system

V. CONCLUSION

The various types and methods of operations are studied. The paper describes about the simple and attractive features of tracking system. The main points of this project, to track the sun and receive energy by solar panel, further it is stored in battery. The proposed theme is, dual axis control of rotating the solar panel and receiving electrical energy is calculated by digital meter approximately as well. The paper concludes that embedding the tracking system with solar panel can response accurate and applicable to meet out the power demands at different operational conditions.

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