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“IOT Based Automatic Dual Axis Sun Tracking And Intimation System”

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Abstract

The main goal of this project is solar panel coupled to a stepper motor to track the Sun so that maximum sun light is incident upon the panel at any given time of the day and year. Implementation of new cost effective methodology based on IOT to remotely monitor a solar photovoltaic plant for performance evaluation. This will facilitate preventive maintenance, fault detection, historical analysis of the plant in addition to real time monitoring. Automatic Sun Tracking System is a hybrid hardware/software prototype, which automatically provides best alignment of solar panel with the sun, to get maximum output (electricity) ideate the design. Problems and possible improvements will also be presented. Along with the system an IOT based GUI (Graphical User Interface) was interfaced to track the records of tracking system with angle of movement. Also a GSM modem was interfaced to update the instant alert to user. Infrared Sensor (IR) was used to monitor the surface of the panel which intimates the user to clean the surface. Entire setup was interfaced with PC to monitor and control the solar tracker.

Keywords- IOT; LDR; Photovoltaic (PV) panel; Dual Axis Solar Tracking System.

1. INTRODUCTION

Solar energy is rapidly gaining notoriety as an important means of expanding renewable energy resources. As such, it is vital that those in engineering fields understand the technologies

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associated with this area. This project includes the design and construction of a microcontroller-based solar panel tracking system which interfaced with advanced IOT technologies. Solar tracking allows more energy to be produced because the solar array is able to remain aligned to the sun. This system builds upon topics learned in this course. To make solar energy more viable, the efficiency of solar array systems must be maximized. A feasible approach for maximizing the efficiency of solar array systems is sun tracking. This is a system that controls the movement of a solar array so that it is constantly aligned towards the direction of the sun. Solar modules are devices that cleanly convert sunlight into electricity and offer a practical solution to the problem of power generation in remote areas. The solar tracker designed and constructed in this project offers a reliable and affordable method of aligning a solar module with the sun in order to maximize its energy output.

II. SOLAR TRACKER

Tilt: the angle between the plane of the collector (or aperture)and the horizontal.Denoted by the symbol beta, ββ.

Azimuth: the planar rotation East or West that an aperture will have. Denoted by the symbol gamma with no subscript, γγ.

Angle of Incidence: the angle between the vector perpendicular to the collector plane, called the normal of the plane, and the projection of the Sun's central beam to the collector surface. Denoted as theta with no subscript (θθ).

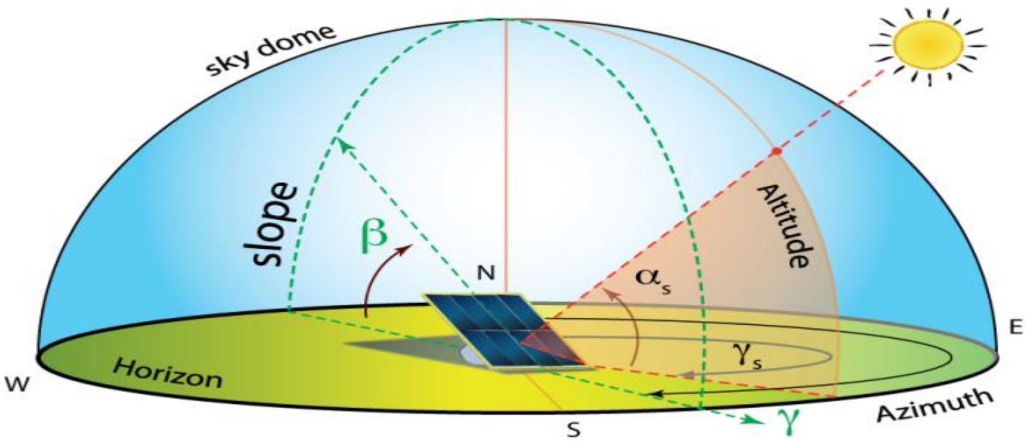

Figure 1. Illustration of Azimuth and Altitude angle of the Sun

There are three main design mechanisms that will increase the solar utility of a SECS for a client or group of stakeholders.

A. Decrease The Cosine Projection Effect:

This is done by tilting the collector toward the Sun's average annual noontime position. The higher the latitude of the locale, the more tilt a collector will need. Seasonal tilt changes can also slightly

improve the solar gains. We also direct the collector toward the equator, although there is significant flexibility in both tilt and azimuth.

B. Minimize The Angle Of Incidence:

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This is a refinement of the first mechanism over the course of a given day, particularly relevant to solar tracking systems. By "pointing" the collector normal at the Sun during the day, the angle of incidence is minimized, and more light can be collected.

C. Minimize Or Remove Shading Effects From The Collector:

We will cover this in the next few pages. It should make sense that when shadows cover a collector, then the majority of the Sun's light for that unexposed area is no longer providing power. Photovoltaic will be much more susceptible to shading issues than solar thermal systems, due to the near instantaneous generation of charge carriers in PV vs. the slower reaction from thermal response of fluids.

III. DUAL AXIS TRACKING SYSTEMS

Dual axis tracking is typically used to orient a mirror and redirect sunlight along a fixed axis towards a stationary receiver. But the system can also gain additional yield on your PV cells. LINAK can provide you with quality actuators that move these panels on dual axis.

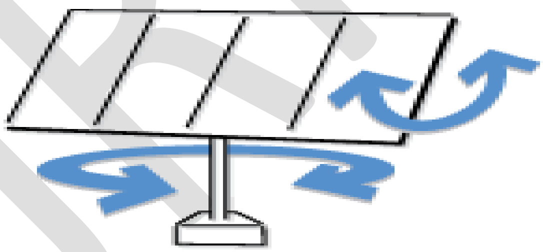

Figure 2: Customer solution with a Dual axis tracking system

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A. Performance Method

At the present time, climate change on the world is at a delicate level. Climate change can be divided into two classes, human and natural causes. Natural causes of climate changes are ocean current, solar variations and earth orbital changes. The major part of climate changes caused by human is man-made greenhouse gases emission.Solar energy is the energy derived from the sun in the form of solar irradiation. Solar energy is the most inexhaustible, renewable source of energy known to humanity. In order to increase the efficiency of solar energy systems, solar tracker is added at the expense of system's complexity and cost. The two basic categories of trackers aresingle axis and dual axis.

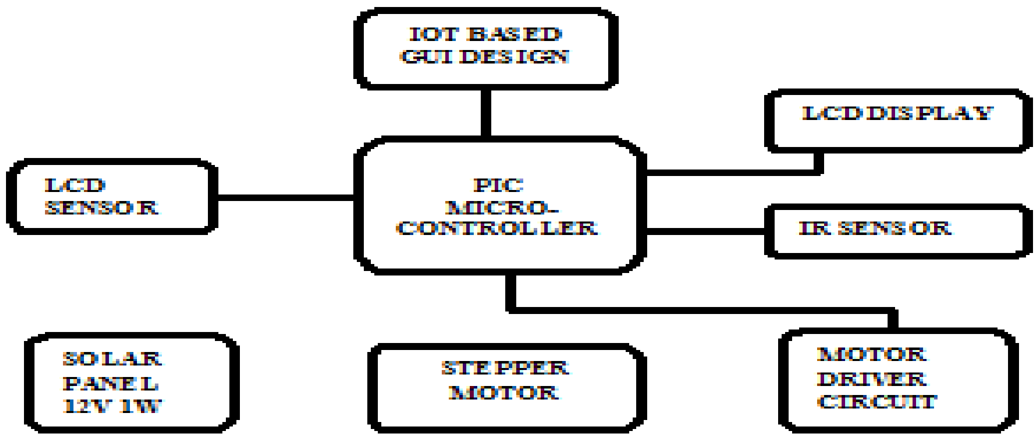

Figure 3: block diagram

VI. SUN SOLAR TRACKING SYSTEM WORKING

In this method two light dependent resistors are used. LDRs are separated with the help of sheet Metallic sheet or wood shield .One on the left hand side of sheet and other on the right hand side of shield. This is main part of this project. Two Light dependent resistors measure intensity of light with the help of microcontroller . Now the question come into mind, how these light dependent resistors rotate solar panels with the help of solar panel. I will explain it later. If you don't know how to measure intensity of light using pic16f877a microcontroller.

Product Description:"Solar Trackers" are devices that provides orientations to various payloads toward the sun.(In this case the payloads are Solar Panels) but otherwise they can be used for reflectors, lenses or other special optical devices.

In flat-panel photo voltaic (PV) applications, trackers are used to minimize the angle of Incidence between the incoming light from the sun and a photo voltaic panel,which increases the amount of energy produced from a fixed amount of installed power generating capacity. In standard photo voltaic applications, it is estimated that trackers are used in at least 85% of commercial installations, which are grid connected.It not only increases efficiency but also with increased efficiency lesser number of Panels can be used thus saving cost of the panels as well as lesser space requirements for the project. Generally, Single Axis Trackers can increase the energy production typically by 25%, whereas Dual Axis Trackers can increase up to 40%,if correctly installed.

It seems you can't walk down the street these days without coming across a solar panel. You can find them lighting up crosswalk signs, mobile power for construction, as well as simple little sidewalk path lights. Solar is easy to use, readily available, and inexpensive. For the most part our common every day solar cells run at an efficiency of 18-20%, meaning they convert 18-20% of the every they receive into electricity. While this is far better than the 3-6% efficiency that most green plants end up with, it doesn't quite meet our power needs. To bring in enough power we either need to improve the efficiency of our panels or find ways of getting more from our current solar panels. Every panel you see in your day to day life is in a fixed position, most likely facing south at a 45 degree angle. While this approach is extremely simple and meets the needs of most small applications, it isn't producing as much energy as it could be.

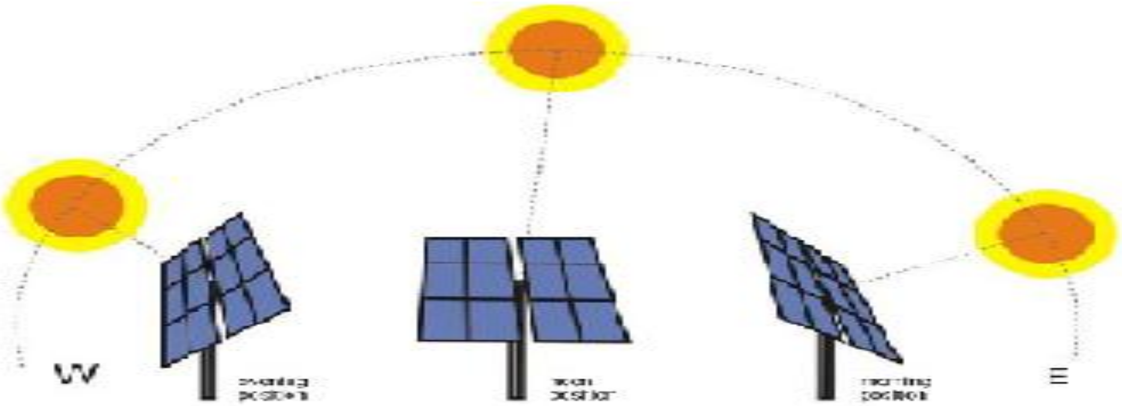

Figure 4: orientation of solar panels

The single most simple way of getting more energy out of a solar panel is to have it track the sun. In fact solar panels that track the sun create around 30% more energy per day than a fixed panel. With that kind of power increase you'd think everyone would be doing it, but there are some good reasons why it's not overly common. First, the initial cost of setup is higher since it requires moving parts. Second, it also require maintenance and upkeep since they'd be exposed to outdoors conditions year round. Third, you'd need to power this equipment in order to keep it running and moving which then takes away from your output.

For most applications and home use, tracking is overkill. We typically don't see tracking used unless it's in large industrial power generation systems. Though that doesn't mean you can't make your own version at home.

A. Solar tracking system description

Solar energy begins with the sun. Solar panels (also known as "PV panels") are used to convert light from the sun, which is composed of particles of energy called "photons", into electricity that can be used to power electrical loads.Solar panels can be used for a wide variety of applications including remote power system for cabins, telecommunicatios, equipment,remote sensing, and of course for systems for the production of electricity by residential and commercial solar electric systems. Efficiencies of solar panel can be calculated by MPP (Maximum power point) value of solar panels. It is a capacity of the solar panel and the higher value can make higher MPP. These panels are designed for the most rugged off grid applications.

B. Solar Panel Interfacing With Micro Controller

A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring. A single solar module can produce only a limited amount of power, most installations contain multiple modules. The majority of modules use wafer-based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon.

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Figure 5: Solar Panel Interfacing With Micro Controller

In our solar tracking system design, any light sensitive device can be used as input sensor unit to detect and track the sun position. Based on the light intensity of sun sensor values should be change. Initially sensor values are analog value, these values are convert analog into digital by using microcontroller. Then the digital sensor readings are transmit to the control unit of the controller. Based on sensors readings the control unit generates the voltage used to command the circuit to drive the motor, that outputs the rotational displacement of electric motor, which is the motion of solar tracking system. Thus the solar tracking system consists of mechanical part and electrical part.

C. LCD Interface with Microcontroller

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology.

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Flat screen LCD and plasma screens work in a completely different way. In a plasma screen, each pixel is a tiny fluorescent lamp switched on or off electronically. In an LCD television, the pixels are switched on or off electronically using liquid crystals to rotate polarized light

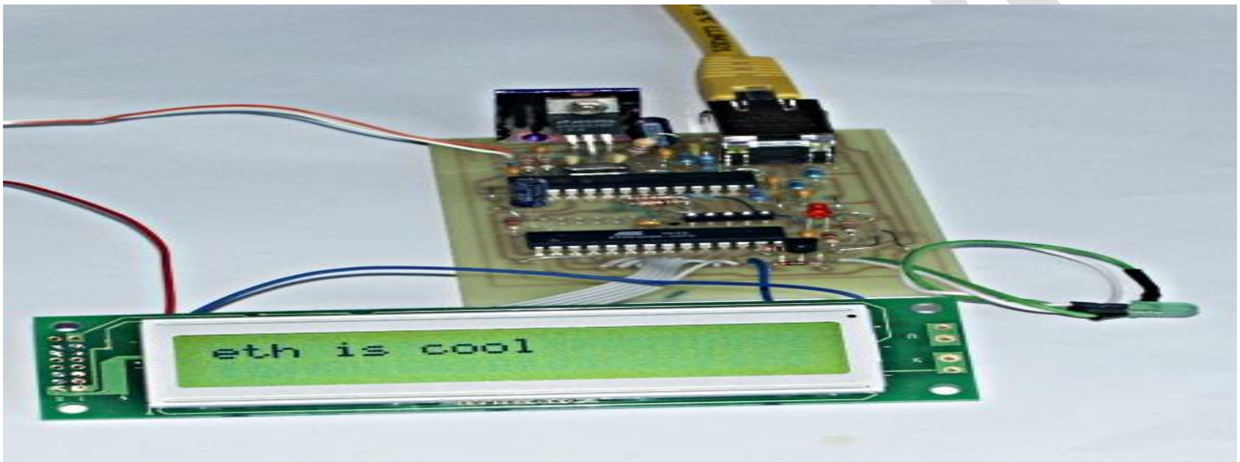

Figure 6: LCD Interface with Microcontroller

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E-blocks Multi programmer or a 5V fixed regulated power supply.

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a solar panel generates more energy when facing the sun directly, but the sun is a moving target in the sky, For this reason, solar panels tend to be more productive at noon when they receive sunlight head-on, but suffer diminished production during the early morning or at the end of the afternoon.

V. CONCLUSIONS

Use of IoT for monitoring of a solar power plant is an important step as day by day renewable energy sources are getting integrated into utility grid. Thus automation and intellectualization of solar power plant monitoring will enhance future decision making process for large scale solar power plant and grid integration of such plants. In this paper we proposed an IoT based remote monitoring system for solar power plant, the approach is studied, implemented and successfully achieved the remote transmission of data to a server for supervision. IoT based remote monitoring will improve energy efficiency of the system by making use of low power consuming advanced wireless modules thereby reducing the carbon foot print. Web Console based interface will significantly reduce time of manual supervision and aid in the process of scheduling task of plant management. A provision of advance remotely manage the Solar PV plants of various operations like remote shutdown, remote management is to be incorporate with this system later.

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