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Solar Tracking And Panel Position System

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ABSTRACT:

The proposed project work is designed to detect the presence of the sun and can position the solar panel towards sun's direction automatically, i.e., the system rotates the panel automatically according to the sun position, so that maximum solar power can be utilized. Provision is made in this system, so that during daytime, if the sky is clouded and the panel is not receiving any sunlight, then the system itself will be switched off automatically, by which precious energy of the sun, which is stored in the rechargeable battery can be saved. When the clouds are cleared, system energizes automatically and drives the panel towards the direction of sun.

The solar lamp post consists of Solar panel, battery, lamp dome with high glow LED's, logic circuit, charging circuit, etc and is designed as totally automatic to track the position of sun. One more DC motor built in with reduction gear mechanism is used for the movement of the solar panel that tracks the sun automatically. The sun's position is tracked by the maximum panel voltage at all the positions of the panel. The output of solar panel voltage sensing circuit is fed to ADC (Analog Digital Converter) for converting the analog information into digital information and this digital information is fed to the micro-controller chip. According to the digital information received from ADC, the micro-controller controls the DC motor for moving the solar panel. This DC motor rotates the solar panel from west to east and again from east to west for tracking the sun and will be placed at a point where maximum sun light is present. When the panel is positioned towards the sun, the micro-controller de-energizes the motor automatically. The battery is charged at constant voltage so that it is protected from over charging.

In this Paper, for the demonstration purpose, a small solar panel is used and this plate is coupled to the motor shaft using proper mechanism. The total system including the DC motor that drives the 10 Watts solar panel is designed to operate at 12V DC, this voltage is derived from the a 12v and 1.3Ah rating battery.

Index Terms—Solar Power,Solar Panel,Voltage.

INTRODUCTION:

Solar power is the conversion of sunlight into electricity, either directly using photovoltaic's (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic's convert light into an electric current using the photovoltaic effect.

Concentrating Solar Power (CSP) systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. The concentrated heat is then used as a heat source for a conventional power plant. A wide range of concentrating technologies exists: among the best known are the parabolic trough, the compact linear Fresnel reflector, the Stirling dish and the solar power tower. Various techniques are used to track the sun and focus light. In all of these systems a working fluid is heated by the concentrated sunlight, and is then used for power generation or energy storage. Thermal storage efficiently allows up to 24-hour electricity generation.For several years, worldwide growth of solar PV was driven by European deployment, but has since shifted to Asia, especially China and Japan, and to a growing number of countries and regions all over the world, including, but not limited to, Australia, Canada, Chile, India, Israel, Mexico, South Africa, South Korea, Thailand, and the United States.Worldwide growth of photovoltaic's has averaged 40% per year since 2000 and total installed capacity reached 139 GW at the end of 2013 with Germany having the most cumulative installations (35.7 GW) and Italy having the highest percentage of electricity generated by solar PV (7.0%).Concentrated solar power (CSP) also started to grow rapidly, increasing its capacity nearly tenfold from 2004 to 2013, albeit from a lower level and involving fewer countries than solar PV. As of the end of 2013, worldwide cumulative CSP-capacity reached 3,425 MW.

Existing System:

The continuous evolution of the technology determined a sustained increase of the conversion efficiency of PV panels, but nonetheless the most part of the commercial panels have efficiencies no more than 20%. A constant research preoccupation of the technical community involved in the solar energy harnessing technology refers to various solutions to increase the PV panel's conversion efficiency. Among PV efficiency improving solutions we can mention: solar tracking, optimization of solar cells geometry, enhancement of light trapping capability, use of new materials, etc. The output power produced by the PV panels depends strongly on the incident light radiation.

The continuous modification of the sun-earth relative position determines a continuously changing of incident radiation on a fixed PV panel. The point of maximum received energy is reached when the direction of solar radiation is perpendicular on the panel surface. Thus an increase of the output energy of a given PV panel can be obtained by mounting the panel on a solar tracking device that follows the sun trajectory. Unlike the classical fixed PV panels, the mobile ones driven by solar trackers are kept under optimum insolation for all positions of the Sun, boosting thus the PV conversion efficiency of the system. The output energy of PV panels equipped with solar trackers may increase with tens of percents, especially during the summer when the energy harnessed from the sun is more important. Photo-Voltaic or PV cells, known commonly as solar cells, convert the energy from sunlight into DC electricity. PVs offer added advantages over other renewable energy sources in that they give off no noise and require practically no maintenance. A tracking system must be able to follow the sun with a certain degree of accuracy, return the collector to its original position at the end of the day and also track during periods of cloud over.

Proposed System:

Automatic positioning of solar tracker normal to the incident solar radiation throughout the day. Achievement of Solar tracking sensing the panel voltage.The Controller is to switch off itself after sunset and automatically switch on and reposition towards the sun the next morning.DC Motor built in with reduction gear mechanism is used to drive the Solar Panel.

Our design of Solar Tracker is to develop and implement a simplified diagram of a horizontal axis and active tracker method type of solar tracker fitted to a panel. It will be able to navigate to the best angle of exposure of light from the torchlight. A pair of sensors is used to point the East and West of the location of the light. A scaled-down model of a prototype will be designed and built to test the workability of the tracking system. The center of the drive is a DC motor. Figure shows a schematic diagram of a horizontal-axis solar tracker. This will be controlled via microcontroller program. The designed algorithm will power the motor drive after processing the feedback signals from the sensor array

The Microcontroller program will also include monitoring and display of light intensity output from the photodiodes. The light detected by the Eastward-facing sensor is at a lower intensity to that detected by the Westward-facing sensor. Hence, the sensor must be turned westwards (by the motor controlled by the solar tracker circuit) until the levels of light detected by both the East and the West sensors are equal. At the point of the solar panel will be directly facing the light and generated electricity optimally. Obviously real world

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solar trackers are not so simple. A solar tracker must be able to reset itself at sunset so it is ready for sunrise, it must cope with heavy cloud, and it. In addition a mount for the solar panel must be constructed which can cope with strong winds and a suitable motor found.

Solar Panel

Solar panels can be used to exploit solar energy that, when absorbed, can be an efficient source of energy for electricity and heating. In addition, the power that is produced by solar panels can be used for many other things. Here in our module we are using the solar panel to generate electricity to glow the outdoor lights. The panel used here is a 10W panel. For real applications this can be increased to generate more power depending on the number of lights used.

Photovoltaic power is a usable form of the sun's energy. A module absorbs the sun's rays and converts them into electricity that we can use. Approximately 17% of sunlight can be transformed into usable electricity through conventional silicon panels. That may not seem to be a great deal; and this is why silicon panels were upgraded in 2008 to new and updated models. A solar panel that utilizes new cells transforms 22% of sunlight it absorbs into electricity. Hypothetically, the maximum that the solar panel cells can convert is considered to be approximately 27% of absorbed sunlight. Details about the solar panels are explained in a separate chapter in the further chapters.

Battery

Battery is a device that converts chemical energy into electrical energy, consisting of a group of electric cells that are connected to act as a source of direct current. The term is also now commonly used for a single cell, such as the alkaline dry cell used in flashlights and portable tape players, but strictly speaking batteries are made up of connected cells encased in a container and fitted with terminals to provide a source of direct electric current at a given voltage. A cell consists of two dissimilar substances, a positive electrode and a negative electrode, that conduct electricity, and a third substance, an electrolyte, that acts chemically on the electrodes. The two electrodes are connected by an external circuit (e.g., a piece of copper wire); the electrolyte functions as an ionic conductor for the transfer of the electrons between the electrodes. The voltage, or electromotive force, depends on the chemical properties of the substances used, but is not affected by the size of the electrodes or the amount of electrolyte.

Batteries are classed as either dry cell or wet cell. In a dry cell the electrolyte is absorbed in a porous medium, or is otherwise restrained from flowing. In a wet cell the electrolyte is in liquid form and free to flow and move. Batteries also can be generally divided into two main types-rechargeable and non-rechargeable, or disposable. Disposable batteries, also called primary cells, can be used until the chemical changes that induce the electrical current supply are complete, at which point the battery is discarded. Disposable batteries are most commonly used in smaller, portable devices that are only used intermittently or at a large distance from an alternative power source or have a low current drain. Rechargeable batteries, also called secondary cells, can be reused after being drained. Applying an external electrical current, which causes the chemical changes that occur in use to be reversed, does this. The external devices that supply the appropriate current are called chargers or recharges.

Panel Voltage Sensing Circuit

The module continuously monitors the solar panel voltage. For this reason voltage sensing circuit has been designed for the solar panel. The panel sensing circuit is designed using a variable resistor. The panel voltage is measured using ADC to track the position of the sun. The output of this sensing circuit is fed to the micro-controller that monitors the voltage and performs the operation defined in the program to rotate the DC motor and position the panel towards the sun's direction.This voltage sensing circuit will be providing voltage signals to the ADC that are converted into digital and are fed to the controller. So depending on

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the point where the high voltage is received by the panel, the controller tracks and places the panel in that particular direction by which maximum light can be focused on the solar panel for generating maximum power. When light intensity is present some voltage will be coming from the panel which is given to the controller by which the controller will know that sunlight is present. And when there is no light intensity no voltage will be coming from the solar panel due which the controller will know that it has become dark and stops the DC motor by which the tracking will be stopped.

Power Generation in the solar Panel

The rated power is maximum power that can be used under continuous operation at a specified ambient temperature. The current and power output of photovoltaic solar panels are approximately proportional to the sun's intensity. At a given intensity, a solar panel's output current and operating voltage are determined by the characteristics of the load. If that load is a battery, the battery's internal resistance will dictate the module's operating voltage.A solar panel, which is rated at 18 volts will put out less than its rated power when used in a battery system. That's because the working voltage will be between 12 and 17 volts. Because wattage (or power) is the product of volts multiplied by the amps, the module output will be reduced. For example, a 50-watt solar panel working at 13.0 volts will products 39.0 watts (13.0 volts x 3.0 amps = 39.0 watts). This is important to remember when sizing a PV system.

MATERIAL AND FABRICATION

Solar Panels

These are a form of active solar power, a term that describes how solar panels make use of the sun's energy: solar panels harvest sunlight and actively convert it to electricity. Solar Cells, or photovoltaic cells, are arranged in a grid-like pattern on the surface of the solar panel. These solar voltaic cells collect sunlight during the daylight hours and convert it into electricity.

A photovoltaic module or photovoltaic panel is a packaged interconnected assembly of photovoltaic cells, also known as solar cells. The photovoltaic module, known more commonly as the solar panel, is then used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications.

Because a single photovoltaic module can only produce a limited amount of power, many installations contain several modules or panels and this is known as a photovoltaic array. A photovoltaic installation typically includes an array of photovoltaic modules or panels, an inverter, batteries and interconnection wiring. Photovoltaic systems are used for either on- or off-grid applications, and for solar panels on spacecraft.

Solar panels are typically constructed with crystalline silicon, which is used in other industries (such as the microprocessor industry), and the more expensive gallium arsenide, which is produced exclusively for use in photovoltaic (solar) cells. Other, more efficient solar panels are assembled by depositing amorphous silicon alloy in a continuous roll-to-roll process. The solar cells created from this process are called Amorphous Silicon Solar Cells, or A-si. Solar Panels constructed using amorphous silicon technology is more durable, efficient, and thinner than their crystalline counterparts.

WORKING OF SOLAR PANEL

Solar panels collect solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells. These solar cells function similarly to large semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-n junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, and electric fields in the solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. The more solar cells in a solar panel and the higher the quality of the solar cells, the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed the Photovoltaic Effect. The photovoltaic effect arises from the properties of the p-n junction diode; as such there are no moving parts in a solar panel.

As we previously mentioned, solar panels collect solar radiation from the sun and actively convert that energy to electricity. The solar cells on these solar panels make use of the extremely small fraction of the sun's energy that passes through earth's atmosphere and strikes the cells on the solar collector. The efficiency of these solar panels, and the resultant energy produced is dependent on many climatic, geographic, and weather-related factors. Arid climates are ideal for solar panels, and they will produce more energy in areas where they are exposed to direct sunlight under clear skies. But even at optimal efficiency, solar panels only convert a small percentage of the energy that strikes it into usable energy. The efficiency factors are in the teens for most solar cells. Advanced solar cells, like those used on the Voyager spacecraft, have much higher efficiency ratings, but are much too expensive to produce en masse for general purposes.

World of Microcontrollers

The situation we find ourselves today in the field of microcontrollers had its beginnings in the development of technology of integrated circuits. This development has enabled us to store hundreds of thousands of transistors into one chip. That was a precondition for the manufacture of microprocessors. The first computers were made by adding external peripherals such as memory, input/output lines, timers and others to it. Further increasing of package density resulted in creating an integrated circuit, which contained both processor and peripherals. That is how the first chip containing a microcomputer later known as a microcontroller has developed.

Microcontroller versus Microprocessor

A microcontroller differs from a microprocessor in many ways. The first and most important difference is its functionality. In order that the microprocessor may be used, other components such as memory must be added to it. Even though the microprocessors are considered to be powerful computing machines, their weak point is that they are not adjusted to communicating to peripheral equipment.

Simply, In order to communicate with peripheral environment, the microprocessor must use specialized circuits added as external chips. In short microprocessors are the pure heart of the computers. This is how it was in the beginning and remains the same today.

On the other hand, the microcontroller is designed to be all of that in one. No other specialized external components are needed for its application because all necessary circuits which otherwise belong to peripherals are already built into it. It saves the time and space needed to design a device.

CONCLUSIONS

Renewable energy solutions are becoming increasingly popular. Photovoltaic or solar systems are one good example of this. In order to maximize power output from the solar panel, one needs to keep the panel aligned with the sun. This project develops an automatic tracking system which will keep the solar panels aligned with the sun in order to maximize efficiency. The use of the PCB drastically reduced the size of circuitry in the project and made it more reliable as there were no more connection problems. This project can be converted to a dual axis tracker fairly easily. The components and circuitry are already present in the finished tracker. The rear sensor can be converted to a tracker for the second axis with some wiring changes. All that is needed is a second gear motor or linear actuator. To conclude, this project turned out well and met the original requirements and functionality. Although there were many problems and more work on the mechanical side than originally expected, overall it was an enjoyable experience completing this project.

The project work "Solar Tracking and Panel Positioning System" is successfully designed, tested and a demonstration unit is fabricated. For the demonstration purpose prototype module is constructed & results are found to be satisfactory. While designing and developing this proto type module, I have consulted few experts, these professionals working at different organizations belongs to Hyderabad helped me while building this module. Since it is a prototype module, much amount is not invested, the whole machine is constructed with locally available components, and they are not up to the requirement, some of the modifications must be carried out in design and is essential to make it as real working system. The total system is designed to operate at 12V DC, for this purpose 12V, 1.3AH lead acid battery can be used and this battery can be charged using solar panel. But in our module we are deriving the required power supply directly from the mains i.e., single-phase supply only. For further development, this proto-type module can be integrated with PC 'or' Micro –processor.

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