Design and Development of Efficient Solar Tracking System

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Abstract—Sun based vitality is essential methods for extending sustainable power source assets. In this paper is depicted the plan and development of a microcontroller based sun powered board following framework. Sun oriented following enables more vitality to be deliver on the grounds that the sunlight based exhibit can stay adjusted to the sun. The paper starts with exhibiting foundation hypothesis in light sensors and DC engines as they apply to the venture. The general population are changing from regular vitality sources to sustainable power sources. The utilization of sun based photovoltaic is expanding step by step as there is a plenteous measure of vitality which is being gotten from sun on earth. The photovoltaic framework when put as a settled structure at a specific edge is wasteful in light of the fact that this framework can't extricate most extreme power from sun. In this paper, the light sensors (LDR) are utilized to track the sun and to begin the operation (Day/Night operation). Time Delays are utilized for engine and achieving the first position of the reflector. The sun based following framework is developed with both equipment and programming usage. A solitary pivot sun powered following framework has been utilized. The control calculation for sun oriented tracker can move the board in both the bearings i.e. east to west and west to east in a stage work. The DC engine is exchanged on at normal interims of thirty minutes attributable to which there is diminishment in utilization of energy when contrasted with that of a consistently run engine in traditional sunlight based following frameworks. The yield control, got from the setup is higher than those announced in writing.

Keywords-*Microcontroller,Driver,Solar Panel, Motor, LDR*

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I.   INTRODUCTION

The consistent development of the innovation decided a managed increment of the change proficiency of PV boards, yet regardless the most piece of the business boards have efficiencies close to 20%. A consistent research distraction of the specialized group associated with the sun powered vitality outfitting innovation alludes to different answers for increment the PV board's change effectiveness. Among PV productivity enhancing arrangements we can specify: sunlight based following, improvement of sun oriented cells geometry, upgrade of light catching capacity, utilization of new materials, and so on. The yield control delivered by the PV boards depends unequivocally on the episode light radiation.

The nonstop alteration of the sun-earth relative position decides a persistently changing of occurrence radiation on a settled PV board. The purpose of greatest got vitality is achieved when the course of sunlight based radiation is opposite on the board surface. In this manner an expansion of the yield vitality of a given PV board can be acquired by mounting the board on a sunlight based GPS beacon that takes after the sun direction. Not at all like the established settled PV boards, the portable ones driven by sunlight based trackers are kept under ideal in solation for all places of the Sun, boosting therefore the PV change proficiency of the framework. The yield vitality of PV boards outfitted with sun based trackers may increment with several percents, particularly amid the late spring when the vitality saddled from the sun is more critical. Photograph Voltaic or PV cells, referred to regularly as sun oriented cells, change over the vitality from daylight into DC power. PVs offer included points of interest over other sustainable power sources in that they emit no commotion and require for all intents and purposes no upkeep. A following framework must have the capacity to take after the sun with a specific level of precision, restore the authority to its unique position toward the day's end and furthermore track amid times of cover over.

II.   LITERATURE REVIEW

An Prabhakar R. Holambe , Prof.D.B.Talange ,Assistant Prof. V. B. Bhole "Motorless Solar Tracking System" International Conference on Energy Systems and Applications (ICESA 2015) Dr. D. Y. Patil Institute of Engineering and Technology, Pune, India 30 Oct - 01 Nov, 2015" Mathematical modeling and simulation of an single axis motor less solar tracker is described with proper results. The MATLABTM/Simulink TM model of the fixed solar panel, passive solar tracker and optimal solar tracker is simulated. Simulated result used to determine the voltage, current and power given by solar tracker during particular time over the ¿xed solar panel and optimal solar tracker. The comparison between the Motor less Solar Tracking System and Active Solar Tracking System shows that it consumes zero energy from the produced or stored energy and therefore it improves overall efficiency. It can be concluded that Motor less Solar Tracking System is more efficient than Active Solar Tracking System. Motor less Solar Tracking System is very cheap, require unskilled worker, easy for maintenance and can be placed at hilly areas, remote or dusty to develop heat energy or to produce electrical energy for different applications.

BandamAbhilash,Ashish K Panchal, "Self-Cleaning and Tracking Solar Photovoltaic Panel for Improving Efficiency.International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB16)Explains the efficient self-cleaning and tracking mechanism and obtains the results of the panel for the different conditions such as cleaned panel without tracking, dusty panel without tracking, dusty panel with a tracking and Cleaned panel with tracking, dusty panel without tracking, dusty panel with tracking and cleaned panel with tracking. Two algorithms were studied one for cleaning and ne for tracking of the solar panel. The self-cleaning and tracking mechanism has been implemented. Several cases were experimentally implemented and came to the conclusion. By the above results it can be observed that the tracking is best suited then the fixed one, only when the dust on the panel is cleaned. If we implement the tracking system without cleaning the panel the efficiency is less than of the panel which is fixed and cleaned. Moreover the efficiency of the panel is decreased by 50% even though it is tracking without cleaning. It is also concluded that from the Table V the efficiency of the panel has been improved when we are going with the tracking as well as cleaning system. This system can extend to dual axis tracking by that we can achieve more efficiency.
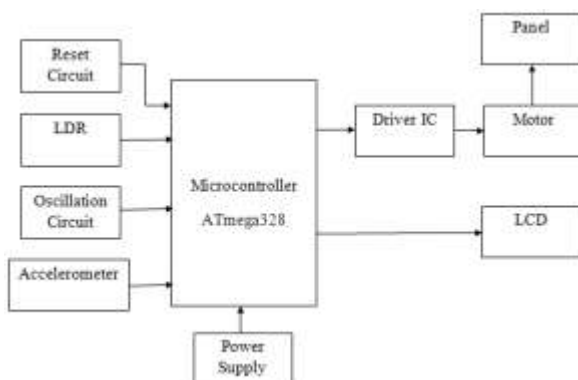
III.   PROPOSED WORK

Fig .1 Block diagram of efficient solar tracking system

A.   Microcontroller

A microcontroller is a solitary chip that contains the processor, non-unpredictable memory for the program, unstable memory for information and yield, a clock and an I/O control unit additionally called a PC on a chip, billions of microcontroller units are implanted every year in a horde of items from toys to apparatuses to cars. For instance, a solitary vehicle can utilize at least 70 microcontrollers. The accompanying picture portrays a general square chart of microcontroller. A microcontroller (or MCU formicrocontroller unit) is a little PC on a singleintegrated circuit. In present day phrasing, it is a framework on a chip or SoC. A microcontroller contains at least one CPUs (processor centers) alongside memory and programmable information/yield peripherals. Program memory as Ferroelectric RAM, NOR blaze or OTP ROM is regularly included on chip, and also a little measure of RAM. Microcontrollers are intended for implanted applications, rather than the microchips utilized as a part of PCs or other universally useful applications comprising of different discrete chips.

ATmega328

The Atmel 8-bit AVR RISC-based microcontroller consolidates 32 kB ISP streak memory with read-while-compose capacities, 1 kB EEPROM, 2 kB SRAM, 23 broadly useful I/O lines, 32 universally useful working registers, three adaptable clock/counters with look at modes, inside and outer intrudes on, serial programmable USART, a byte-arranged 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-diverts in TQFP and QFN/MLF bundles), programmable guard dog clock with inward oscillator, and five programming selectable power sparing modes. The gadget works between 1.8-5.5 volts. The gadget accomplishes throughput moving toward 1 MIPS per MHz.

B.   Solar Tracker

Sun oriented Tracker is fundamentally a gadget onto which sun powered boards are fitted which tracks the movement of the sun over the sky guaranteeing that the most extreme measure of daylight strikes the boards for the duration of the day. Subsequent to finding the daylight, the tracker will attempt to explore through the way guaranteeing the best daylight is distinguished. The outline of the Solar Tracker requires numerous parts. The plan and development of it could be partitioned into six principle parts that would need to cooperate agreeably to accomplish a smooth keep running for the Solar Tracker, each with their primary capacity. They are:

- Methods of Tracker Mount
- Methods of Drives
- Sensor and Sensor Controller
- Motor and Motor Controller
- Tracker Solving Algorithm
- Data Acquisition/Interface Card

a)   Methods of Tracker Mount
1.   Single axis solar trackers

Single pivot sun based trackers can either have an even or a vertical hub. The level sort is utilized as a part of tropical areas where the sun gets high at twelve, yet the days are short. The vertical sort is utilized as a part of high scopes where the sun does not get high, but rather summer days can be long. The single hub following framework is the least complex arrangement and the most widely recognized one utilized.

2.   Double axis solar trackers

Twofold pivot sun based trackers have both an even and a vertical hub thus can track the Sun's obvious movement precisely anyplace in the World. This kind of framework is utilized to control galactic telescopes, thus there is a lot of programming accessible to naturally foresee and track the movement of the sun over the sky.By following the sun, the productivity of the sun powered boards can be expanded by 30-40%.The double pivot following framework is additionally utilized for concentrating a sun powered reflector toward the concentrator on heliostat frameworks.

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c) Methods of Drive

1. Active Trackers

Dynamic Trackers utilize engines and apparatus trains to coordinate the tracker as summoned by a controller reacting to the sun based bearing. Light-detecting trackers regularly have two photograph sensors, for example, Diodes, designed differentially so they yield an invalid while getting a similar light flux. Mechanically, they ought to be omnidirectional and are pointed 90 degrees separated. This will cause the steepest piece of their cosine exchange capacities to adjust at the steepest part, which converts into greatest affectability.

2. Passive Trackers

Passive Trackers use a low boiling point compressed gas fluid that is driven to one side or the other by solar heat creating gas pressure to cause the tracker to move in response to an imbalance.

d) Sensors

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.

C. LDR

The resistivity of photograph resistor diminishes when the power of episode light increments. In the d dim, a LDR can have a high resistance like few super ohms ((Mω). In the light, it can have low resistance like a couple of hundred ohms. When we apply a consistent voltage over the LDR and the power of light is expanded, the present begins expanding. There are four LDRs in the proposed framework. The resistivity of the LDRs will differ as indicated by the power of light fall on them. LDR sensors are light touchy. In this way, we orchestrated the LDRs in the proposed framework in such a position, to the point that when the episode light is on the LDRs of one side (east), the LDRs of opposite side (west) are shaded. W When it is evening and the sun goes towards the west, step by step y the light power on the LDRs of the west will be high and the east LDRs will be in the shaded bit. It is a variable resistor whose esteem diminishes with expanding episode light force.

Fig.2 LDR

A LDR is made of a high resistance semiconductor, regularly cadmium-sulfide. On the off chance that light falling on the gadget is of sufficiently high recurrence, photons consumed by the semiconductor give limited electrons enough vitality to hop into the conduction band. The subsequent free electron (and its opening accomplice) direct power, in this way bringing down resistance.

D. LCD

A Liquid Crystal Display is an electronic gadget that can be utilized to indicate numbers or content. There are two fundamental sorts of LCD show, numeric show and alphanumeric content showcases. The show is comprised of various molded 'precious stones'. In numeric presentations these precious stones are formed into 'bars', and in alphanumeric showcases the gems are basically orchestrated into examples of "spots".

Fig. 3 LCD Display

Every precious stone has an individual electrical association so every gem can be controlled freely. At the point when the precious stone is "off" i.e. at the point when no current is gone through the gem, the precious stone mirror an indistinguishable measure of light from the foundation material, thus the gems can't be seen. However when the precious stone has an electric current went through it, it changes shape thus assimilates all the more light. This makes the precious stone seem darker to the human eye - thus the state of the spot or bar can be seen against the foundation. It is essential to understand the distinction between a LCD show and a LED show. A LED show regularly utilized as a part of clock radios is comprised of various LEDs which really radiate light thus can be found oblivious. A LCD show just reflects light, thus can't be found oblivious.

E. Motor

Traditional DC engines utilize a stationary magnet with a pivoting armature consolidating the replacement sections and brushes to give programmed substitution. In examination, the brushless DC engine is a turned around plan: the changeless magnet is pivoting though the windings are a piece of the stator and can be empowered without requiring a commutator-and-brush framework.

Fig 4. Motor

In any electric engine, operation depends on straightforward electromagnetism. A current-conveying conductor creates an attractive field; when this is then set in an outer attractive field, it will encounter a constrain corresponding to the current in the conductor, and to the quality of the outside attractive field. As you are very much aware of from playing with magnets as a child, inverse (North and South) polarities draw in, while like polarities (North and North, South and South) repulse. The inside arrangement of a DC engine is intended to outfit the attractive communication between a current-conveying conductor and an outer attractive field to produce rotational movement.

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IV. RESULT

Table 1:- Output of Project

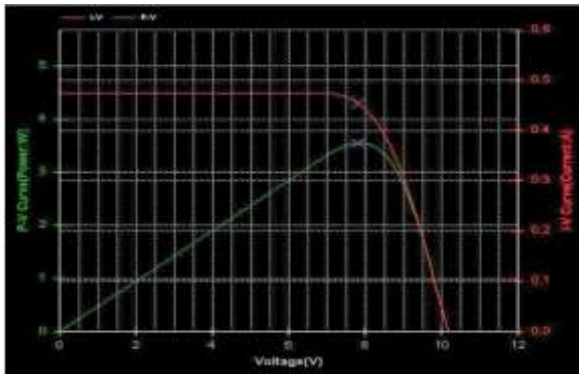| Sr no.	System	Voltage (V)	Current (A)	Power (W)
1	Without tracking	9.57	0.24	2.29
2	With tracking	9.61	0.3	2.88
3	Sun simulator	7.81	0.45	3.5

Fig.5 PV and VI characteristics

Calculation

Fill Factor:-FF is defined as the ratio of maximum power obtained from solar cell to the product of O.C. voltage and S.C. current.

- ➡ $V_{oc}=9.61$, $I_{sc}=0.3$
- ➡ Fill factor $=V_{oc}-\ln(V_{oc}+0.72)/(V_{oc}+1)$
- ➡ $=9.61-\ln(9.61+0.72)/(9.61+1)$
- ➡ $=0.68$

V. CONCLUSION

From the outline of exploratory set up with Micro Controller Based Solar Tracking System Using Stepper Motor If we think about Tracking by the utilization of LDR with Fixed Solar Panel System we found that the productivity of Micro Controller Based Solar Tracking System is enhanced by 30-45% and it was discovered that every one of the parts of the test setup are giving great outcomes. The required Power is utilized to run the engine by utilizing Step-Down T/F by utilizing 220V AC. In addition, this following framework tracks the sun in a persistent way. Also, this framework is more proficient and practical in long run. From the outcomes it is discovered that, via programmed following framework, there is 30 % pick up in increment of productivity when contrasted and non-following framework. The sun oriented tracker can be as yet upgraded extra elements like rain insurance and wind assurance which should be possible as future work.

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