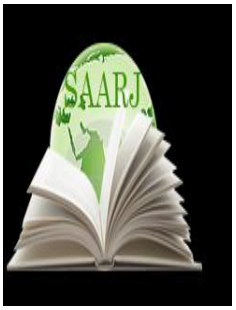

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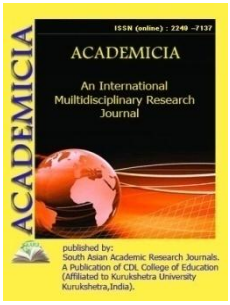

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A RESEARCH PAPER ON SOLAR TRACKING

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ABSTRACT

Solar energy is a very effective method to increase the supply of renewable energy. The design and development of a microcontroller-based Solar Panel Tracking System is discussed in this article. Sunlight is a non-conventional energy source, since the author has erected solar panels to meet our electrical needs. The solar source, i.e. the sun, does not constantly face the plate due to the earth's rotation, resulting in less power being generated. The energy panel will face the SUN until the SUN appears, which should happen within a day. The block diagram below shows the device design, which contains an LDR sensor that provides maximum solar power to the microcontroller through an ADC that digitizes the LDR's performance. The controller then makes a decision based on the algorithm and tilts the panel in the direction of the LDR's greatest energy with the aid of a DC Motor. As a DC geared motor driver, the system is controlled by two relays, while the main processor is a microcontroller. A single axis protects this project, which is designed for low-power and home applications. The system can monitor and follow the Sunlight intensity from the hardware test regardless of motor speed to get maximum solar power at the output. This solar tracker system may be updated in the future using new technologies such as the Internet of Things (IOT) and utilized at home.

KEYWORDS: *LDR, Microcontroller, Motor Driver, Photovoltaic Cell, Solar Panel.*

1. INTRODUCTION

Energy is the most important component in a country's development. Every day, a tremendous amount of energy is generated, transferred, transformed, and consumed in the worldwide civilization. 85 % of energy is produced from fossil fuels. Fossil fuel supplies are finite, and their usage contributes to global warming by releasing greenhouse gases into the atmosphere. To ensure a sustainable power supply and a healthy environment for future generations, there is a

rising need for energy from renewable sources such as solar, wind, geothermal, and ocean tidal waves[1]. The sun is the major source of power and the fuel for most renewable energy systems, whether directly or indirectly. The photovoltaic system is one of the many renewable energy technologies that have the potential to replace traditional energy sources. A solar panel converts sun energy into electricity directly. Solar panels are mostly composed of semiconductor-based materials. Si is the primary component of solar panels, with a maximum efficiency of 24.5 %. The only method to boost a solar panel's output if high-efficiency solar panels are created is to increase the light intensity falling on it. Solar trackers are the most effective and well-tested technique for improving solar panel performance by keeping them aligned with the sun's position[2].Solar trackers have recently gained popularity across the world as a more effective way to collect solar energy. This is a far more cost-effective alternative than purchasing extra solar panels.

The practice of designing a specific manual and/or automatic system that meets the demands of the client is known as Mechatronics system design. A designer considers and evaluates numerous elements and product designs for specific requirements that may differ from those currently in use. Certain criteria, such as size, shape, material, load, and application type, are required for every electronic/mechanical component[3]. Sensor type, rotation technique, motor weight, kind of photovoltaic panel, type of microcontroller utilized, component selection, and other aspects all impact the design of a solar tracking system.

India is a developing country that gets its energy from a range of commercial and non-commercial sources. In recent years, it has been highlighted that fossil fuel supplies are fast decreasing and that the era of fossil fuels, particularly oil and natural gas, is gradually coming to an end. The most severe issue with traditional energy sources is their negative environmental impact[4]. It is also the primary contributor to the global warming problem, which is becoming a major worry. According to the latest assessment from the Intergovernmental Panel on Climate Change (IPCC), increasing methane and nitrous oxide concentrations have caused global surface temperatures to rise. Solar energy, which is renewable in nature, is being employed increasingly frequently to address these concerns.

Solar energy is a clean, sustainable form of energy that is abundant in nature[5]. The sun is a huge sphere of very hot gases heated by fusion reactions of many kinds. The sun has a diameter of 1.39 106 kilometers. When the sun is high, it subtends the earth's surface at an angle of 32 minutes (0.53°C) due to its expanded reach. Therefore, the earth's sun's beam radiation is almost identical. The brightness of the sun changes from top to bottom. The amount of energy that the earth receives from the Sun is hundreds of times more than the entire amount of commercial energy produced on Earth today. Therefore, solar energy, rather than conventional sources of energy such as fossil fuels, may be used for thousands of years. Each year, India receives 4000-5000 hours of sunshine, enough to generate hundreds of times the country's current power consumption. Photovoltaic panels must be maintained perpendicular to the direction of sun motion throughout the day for optimal energy extraction/generation from solar energy.

The goal of this article is to create an automated solar tracking system that can capture all of the available solar energy and convert it to electrical energy[6]. Natural processes in the earth’s crust that take millions of years to complete create nonrenewable sources. Once they have been burnt to generate electricity, they are gone for good. Burning fossil fuels releases unwanted by-

products that pollute our environment, change the planet's temperature, and put ecosystems in jeopardy. Solar power, on the other hand, is unlimited and free of harmful toxins. The problem statement for this thesis is to monitor the movement of photovoltaic (PV) panels in response to sunlight using Light-Based Resistors, microcontrollers, and DC motors in order to collect the most amount of solar energy and convert it into electrical energy. The main goal of this project is to develop the idea of a sun-tracking solar system, which is a device that tracks the movement of the Sun regardless of motor speed. Furthermore, the goal is to increase total power production while also offering residential architecture utilizing a single-axis sun tracking system. Because the LDR, or light-based resistor, is extensively used in sun-tracking systems, it was selected as the sensor.

Because LDR is light-sensitive, this is the case. The resistance of LDR will decrease as the light intensity of events increases[7]. The AT89S52 was chosen as the controller. ATMEL's programming will provide the driver the signal to turn on the motor. With the relay to the driver, bidirectional DC motor control was employed. The motor controller was chosen because it allows the engine to revolve in both clockwise and counterclockwise directions with ease. The DC geared motor, which has a holding torque of upto 24 kg.cm and a low rpm, is another option. Last but not least, the LM7805 is utilized to convert the input voltage from the source to the 5 V output required by the integrated circuit.

1. *Benefits:*

A method for solar tracking is a technique for permanently guiding photovoltaic panels towards the sun, allowing you to get the most out of your PV system investment. They are helpful since the position of the sun in the sky may vary throughout the day and year as the seasons change. They are most effective in places with low horizons and no shadow from sunrise to dusk each day. The tracking array will be able to take use of the open access to the sun all year to capture every available electron. Therefore, energy production is at an all-time high, but energy consumption increases all year.

Solar panels that stand alone are a cost-effective and low-maintenance method to produce electricity. Photovoltaic panels may be constantly oriented toward the sun using solar tracking devices, which will help you get the most out of them. This is essential since the sun's position in the sky can vary slowly over the course of a day and through the seasons over the course of a year. The effectiveness of a tracking device will be determined mainly by how well it is positioned to analyze how well the panels can improve their performance. As a rule, they work best in places with low horizons and areas where there is no shade from sunrise to sunset. The tracking array will be able to take use of the open access to the sun all year to capture every available electron. Therefore, energy production is at an all-time high, but energy consumption increases all year. This is particularly true during the summer, when there are so many long bright days to enjoy.

2. *Applications:*

It controls movement in both the azimuthal and zenithal directions, regardless of whether a photovoltaic (PV) or concentrated solar power (CSP) plant is needed. Regardless of the sun's location, the components or mirrors are precisely aligned with the angle of the sun's rays to maximize solar energy. Solar tracking systems produce up to a third more energy than stationary

PV systems, and the closer and installation is to the equator, the more effectively the PV tracking systems work, depending on the intensity of the sunlight at the installation site. Solar units must be precisely tracked in order to focus sunlight on the target medium in concentrated photovoltaics and concentrated solar power applications. Solar trackers are used to align photovoltaic panels, lenses, reflectors, and other optical equipment to the sun. Because the position of the sun in the sky varies with the seasons and time of day, trackers are used to coordinate the collecting system in order to maximize energy production. When deciding whether to use trackers, many considerations must be taken into account.Solar panels are often installed in direct sunlight in the middle of the day, either south in the Northern Hemisphere or north in the Southern Hemisphere. Therefore, the panels are struck at an extreme angle in the morning and evening, limiting the total amount of electricity that may be generated each day. A solar tracker is a system with solar panels that follow the sun's movement across the sky during the day, ensuring that the most amount of sunlight hits the panels. In comparison to the cost of PV solar panels, the cost of a solar tracker is quite cheap. They are patented solar tracking devices with single and double axes that are very efficient[8].

2. LITERATURE REVIEW

Suneetha Racharla et al. discussed a review on Solar tracking system[8].The greatest problem for the next half-century will be generating power from the decrease of fossil fuels. When compared to other renewable energy sources, the notion of turning solar energy into electrical energy using photovoltaic panels is at the top of the list. The watts provided by solar panels are reduced by the constant shift in the relative angle of the sun with respect to the earth. In this case, the greatest option for increasing the efficiency of the photovoltaic panel is to use a solar tracking system. Throughout the day, solar trackers bring the payload closer to the sun.The advantages and disadvantages of various types of tracking systems are discussed in detail in this paper. In comparison to other tracking systems, the azimuth and altitude dual axis tracking system is more efficient, according to the results presented in this review. However, from the standpoint of cost and versatility, a single axis tracking system is more practical than a dual axis tracking system.

Prof. Vaibhav J. Babrekar et al. discussed a review on automatic system of solar radiation tracking[9].Because fossil fuels are a rather short-term energy supply, an alternate energy resource is required. Solar energy is being increasingly widely used as a renewable energy source. Solar modules are commonly used to convert solar energy into electricity, although the solar energy is not entirely utilized. The efficiency of solar array systems must be increased to make solar energy more usable. Solar radiation tracking is a viable method for increasing the efficiency of solar array systems. A system that regulates the movement of a solar array so that it is always aligned with the direction of the sun is known as an automatic solar radiation tracker.For the implementation of such systems, several technologies are utilized across the world. Some of these technologies are discussed in this publication.

Mahipal Soni et al. discussed an analysis of solar tracker system[10].This report offers a research analysis of a solar tracker system for increasing solar panel efficiency. The act or practice of following something or someone is referred to as tracking. So, an automated solar tracker system is a device that follows the sun's light to extract the most amount of energy from it. Solar panels are always in perpendicular profile with regard to the sun light to maximize efficiency or obtain maximum energy. Solar tracking with mirror booster and automatic cleaning system are two

technologies being investigated to improve the efficiency of solar panels. Microcontroller, LDRs, stepper motor, solar panel, mirror booster, and automatic cleaning machine comprise the solar tracker system.With the aid of a stepper motor, the LDR sensor detects the sun light falling on the solar panel and spins the solar panel according to the intensity of the light. To increase efficiency, a mirror is utilized as a booster. The system is controlled by a programmed microcontroller that communicates with a sensor and a motor driver dependent on the movement of the sun.

Research Questions:

- How this system of solar tracking is better than the existing systems?
- Explain the components used in this solar tracking system?

3. METHODOLOGY

3.1 Design:

This electrical device's main component is a microcontroller. This is where all of the operations are managed. With the help of a microcontroller, you may position the solar panel according to the strength of the sunshine. The rechargeable battery, which is utilized to store energy by the panel, is another component. The charging control's purpose is to regulate battery charging. The battery state is received by the microcontroller unit via the control panel for charge. It features two LDR sensors, one on each side. On the unit, four LDRs form and are located in the four corners of the panel. The controller receives the output from the LDR, which detects the intensity of sunlight. The Control unit determines which way the panel should be turned to obtain the most sunlight. LDRs are also utilized in another section of the sensor, which is employed to adjust the lighting load. The server motor can rotate the panel in the desired direction. In this study, the author employed a solar panel to convert light energy into electrical energy. The Sun varies its position during the day, so the author couldn't use all of the light energy, so they created a monitoring mechanism that rotates the solar panel when the sun alters its position.

An embedded system consists of a combination of computer hardware and software, as well as perhaps external mechanical or other elements, all of which are designed to serve a specific function. Embedded systems are frequently a component of a larger, more sophisticated system. Dedicated applications are developed and embedded in systems that are intended to carry out specialized tasks. These embedded programmers must communicate with the rest of the enclosed system's components. The application's embedded components often connect with the outside non-human environment. They utilized four LDR sensors to detect light, and if the sun's position changes, the sensor changes as well. Each LDR sensor's voltage readings are sent to the microcontroller and compared to the LM324. The microcontroller compares each LDR output to each LDR output after receiving the voltage signal from any I/O pin on the controller. The motor is told to spin the solar panel on a single axis in the direction of the LDR sensor that provides the greatest voltage output when the controller discovers the highest voltage level of any LDR sensor. Figure 1 illustrates the block diagram of the solar tracking system.

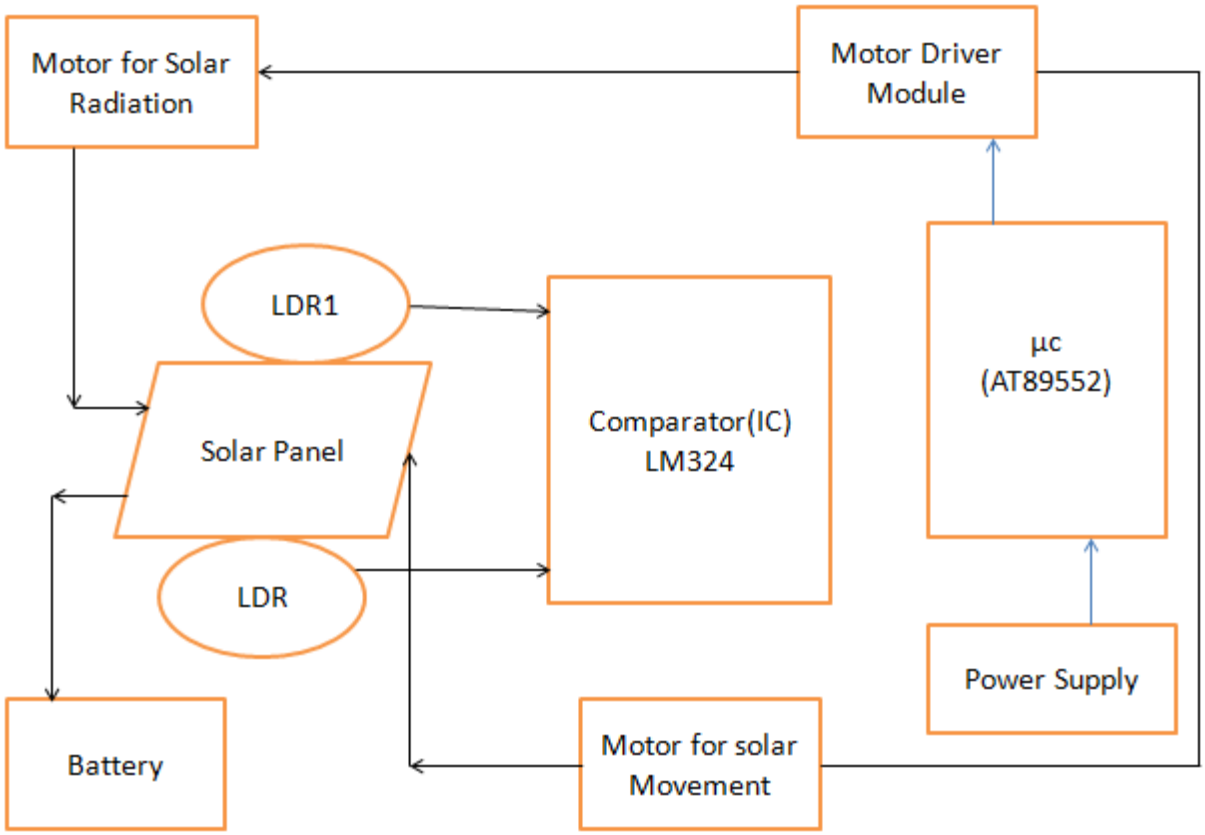

Figure 1: Illustrate the Block Diagram of solar trackingsystem

As a result, the battery may be recharged properly using the Solar Panel, and the author can use certain electrical equipment to rotate the 12 V DC fan on a regular basis. Using two external motors and connecting them in tandem, the author can move the solar penal in any direction. By orienting the solar panel towards the direction of the sun, the whole energy of the sun is harnessed. The LDR sensor detects light and creates the highest voltage signal, which is sent to the comparator IC, as well as other sensors, to determine the voltage level generated by the comparator IC.

3.2 Instruments:

3.2.1 Micro-controller:

In an embedded system, a microcontroller is a small integrated circuit that governs a certain operation. On a single chip, a microcontroller has a CPU, memory, and input/output (I/O) peripherals. It can be used in many machines like keywords, ovens, dryers, security systems and electrical machines.

3.2.2 Solar Panel:

A solar panel, also known as a photovoltaic (PV) module, is an installation of photovoltaic cells set in a framework. Solar panels create direct current electricity using sunlight as a source of energy.

3.2.3 LDR Sensor:

A photo resistor or a cadmium sulphide (CdS) cell is another name for a Light Dependent Resistor (LDR). A photoconductor is another name for it. LDRs are used to detect light levels in automated security lighting, for example. Their resistance reduces as the light intensity increases: an LDR's resistance is high in the dark and at low light levels, and only a small amount of current may flow through it.

4. RESULT AND DISCUSSION

The machine centers on designing the controller. The designed system was checked and some data from measuring hardware were collected and discussed. The typical solar panel was used and the intention was only to show that the built system is capable of working accordingly. For example, weather conditions are not seriously considered during hardware testing therefore the surrounding effects. In this research, researcher proposed thedesign and development of a microcontroller-based Solar Panel Tracking System.The device design is depicted in the block diagram, which includes an LDR sensor that supplies maximum solar power to the microcontroller through an ADC that digitizes the LDR's performance. The controller then makes a choice based on the algorithm and tilts the panel with the help of a DC Motor in the direction of the LDR's highest energy. Two relays manage the system as a DC geared motor driver, and a microcontroller controls the system as the primary processor. The future of this solar tracking system is bright as it can be used for home purposes and further, it will be modified by adapting new technologies.

5. CONCLUSION

The Axis Solar Tracking System has a single prototype model that has been successfully developed. The designed system focuses on the controller part, with the primary concern being to design appropriate circuits that can control the direction of rotation of the DC-gear motor without taking the motor's speed into account. Regardless of the motor speed, the machine is capable of monitoring and following Sunlight intensity in order to obtain full solar power. The motor speed is not a significant issue as distinctive of the proposed system because the DC-geared motor has a low output rated speed and a high output rated torque. As a result, any DC-geared motor can be used in this system, regardless of the motor speed control unit, as long as the motor's speed and torque meet the specifications. In the future, the built system concept may be used to develop alternative energy sources in the home, especially for non-critical and low-power appliances.

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