ABSTRACT:

With rising global energy demand, there will be a severe shortage and inflation of nonrenewable energy supplies in the near future. As a result, all nations are making every effort to switch from fossil fuels to renewable energy sources as their primary means of producing electricity before the critical period arrives. One of the most effective renewable energy sources that can help address the energy crisis is solar energy. By tracking the movement of sun, photovoltaic panels can be positioned in such a way that it captures the most solar radiation possible. PV panels output power improves when they are placed perpendicular to the angle of the sun's rays. The goal of this research is to design and build a dual-axis solar tracker (DAST) to boost the output power of a PV panel. This basic mechanism is highly efficient and adjusts the PV panel based on solar radiation by moving on two axes at the same time. For its control system, an analog controller is used. DAST is a closed-loop system that employs light-dependent resistors (LDRs). This work is divided into two parts hardware and software system. In hardware part, four light dependent resistors (LDR) are used to detect the utmost light source from the sun. Two servo motors conjointly used to move the solar panel to maximum light source location perceived by the LDRs. In software part, the code is targeted to the Arduino UNO controller. The outcome of the solar tracker system has analyzed and compared with the fixed or static solar panel found better performance in terms of voltage, current and power. Due to enhanced direct exposure to sun rays, dual trackers create more electricity than standard static solar panels, resulting in 25% more than a single-axis tracker and 51% more than a fixed tilt panel.

INTRODUCTION:

The solar tracking system plays an essential role in ensuring that the sun's energy is utilized to its full potential. Since there are so many different kinds of power production systems now, including nuclear power plants, hydroelectric power plants, geothermal power plants, and other non-renewable and renewable energy source power generation techniques, the power generation methods used back then were not as good as they are now. In contrast to non-renewable energy sources, solar power generation is one of the pollution-free and zero-emission processes discussed in this study. By reducing the angle of incidence between the sensor in the solar tracking device and the incoming sunlight, these trackers enable photovoltaic systems to produce less power. Trackers are a feature of all concentrated solar systems that try to convert direct sunlight into solar panel electricity. Dual axis tracking technology in these solar trackers has been demonstrated to integrate solar modules and lower gadget costs. These solar tracking devices are also perfect for remote locations with little power output. One of the essential parts is the solar panel, which converts solar energy straight into electricity. Here, the material utilized to make the solar panel is composed of semiconductors. Climate change prevents a solar panel positioned in one direction from receiving its full power. Thus, by keeping P-V solar panels operating, the Maximum electricity Point Tracking (MPPT) approach maximizes the amount of electricity generated by solar panels.

LITERATURE SURVEY:

DAST is a closed-loop system that employs the Wheatstone bridge circuit function as well as light-dependent resistors (LDRs). To validate the proposed system, a tiny DAST was created and built, and its performance was tested. The trials yielded the I-V and P-V specifications. Finally, the output power of the PV panel utilizing the sun tracker was determined to be greater than that of the fixed panel. [1]

Solar energy is one of the renewable energy sources that may be utilized as a replacement for fossil fuels, which will ultimately run out. As Indonesia is located near the equator and receives an abundance of sunshine throughout the year, using solar energy as an alternative source of energy is seen prudent. However, the sun's movement during the day may diminish solar energy absorption. As a result, the solar panel must be connected with a tracking mechanism in order to monitor the sun and capture as much solar energy as feasible.The first stage in tracing this problem is detecting energy absorption in the solar panel, the second is shifting the solar panel in the direction of the sun, and the third is estimating if there is a change in time of day or season. Recurrent Neural Network (RNN) is the approach used to enhance sun tracking. This strategy is used to assist in determining the optimal selection for the solar panel movement. [2]

To promote research, a center model of a sun-oriented global positioning system, which may improve the display of photovoltaic modules in sunlight, is being developed. The device's operating standard is to maintain the photovoltaic modules always aligned with the sunbeams, which increases the openness of the solar panel to the Sun's radiation. As a result, the sun-powered board can generate more electricity. The document featured an equipment layout and an execution, as well as programming for the sun-oriented tracker's microcontroller unit.An ATmega328P microprocessor was utilized to control the movement of two servo motors, which pivot the solar panel in two tomahawks. How much is still up in the air by the microcontroller, based on data gathered from four picture sensors located near the solar panel. A utilitarian sun-oriented global positioning system is devised and accomplished toward the conclusion of the program. [3]

The developed system offers a clever method for properly tracking the sun while using a minimal power budget, hence increasing the overall efficiency of PVpanels. The proposed model is developed and empirically evaluated in the Middle East area of Baghdad, IRAQ, using 50 W PV panels. It is also evaluated further using simulated tracking data acquired from three distinct regions: Berlin, Singapore, and Sydney. This was accomplished by choosing cities above the Tropic of Cancer, below the Tropic of Capricorn, and inside the tropical zone around the Equator. The results indicated that the devised system can follow the sun in every location on the planet. [4]

The production of power from the decrease of fossil fuels will be the most difficult problem over the next half-century. When compared to other renewable sources, the concept of turning solar energy into electrical energy via photovoltaic panels ranks first. However, the constant shift in the sun's relative angle with respect to the earth diminishes the watts provided by solar panels. In this case, a solar tracking system is the ideal option for increasing photovoltaic panel efficiency. Throughout the day, solar trackers direct the payload toward the sun. This study examines several types of tracking systems and discusses their advantages and disadvantages in depth. The findings given in this research confirm that the azimuth and altitude dual axis tracking system outperforms alternative tracking systems. [5]

Electricity has become a need in today's society. The use of plentiful power necessitates the hunt for an other energy source. One such dependable source is solar energy. Photovoltaic panels capture solar energy and convert it to electrical energy. However, because they are only fixed at one angle, these solar panels are inefficient. This inefficiency can be reduced by constructing a solar tracker system that changes its location automatically in response to the movement of the sun. The single axis solar tracking system and dual axis solar tracking system are compared to the fixed mount solar system. [6]

Renewable energy is the answer to the world's energy demands in the future. Solar energy is currently at the top of the list of renewable energy sources owing to its availability and high energy density, which is leading in a growth in the number of solar-based power plants throughout the world. Solar tracking and positioning systems are being developed since a solar plant takes up a lot of space and fixed solar panels can only collect about 40-50% of the available energy. [7]

Renewable energy is the answer to the energy demands of the future. Solar energy is now at the top of the list of renewable energy sources owing to the availability and high energy density of solar radiation, which is leading in a surge in the number of solar-based power plants throughout the world. Because a solar plant takes quite a lot of space and fixed solar panels can only absorb 40-50% of the available energy, solar tracking and positioning devices are being developed. [8]

The panel should continually follow the sun's locations, giving rise to the concept of sun-tracking solar panel systems. Sun-tracking solar panels will improve efficiency by allowing the panel to shift its orientation in relation to the location of the sun. The complete process of developing such panels, as well as their operation and other parts of the system. The Arduino Uno tracking system detects the intensity of sunlight using LDR sensors. The panel is rotated by the servo motor. Thus, once placed in the east direction, the single-axis panels shift orientation to the west depending on the position of the sun. [9]

The tracker detects the sun at dawn and follows it throughout the day, then automatically resets for the following cycle in sense till the sun returns. The sun's energy is captured and used. At the period of energy collection and storage, we can use the sun's energy in both ways. Our initiative is utilized by many people, particularly those who own businesses with several branches, and they use it to replace their power bills, among other things. If more people use this sort of technology, such as converting renewable energy sources into electricity, we may save a lot of money while also lowering our maintenance costs. [10]

Solar panels, once installed, may provide electricity for several years without the need for maintenance. Solar photovoltaic systems are such systems that are used to harness solar energy, however because the earth rotates around the sun, solar energy in existing solar panels is only available for a limited time throughout the day. Solar trackers are used to solve this problem. [11]

The growing demand for energy, the continuous reduction in existing fossil fuel sources, and the growing concern about environmental pollution have pushed mankind to investigate new technologies for producing electrical energy from clean, renewable sources such as solar energy, wind energy, and so on. Among non-conventional, renewable energy sources, solar energy has the greatest potential for conversion into electric power, capable of meeting a significant portion of the planet's electrical energy demands. Solar energy is quickly gaining popularity as a key technique of increasing renewable energy resources. More energy is produced by keeping the solar panel aligned with the sun at a right angle to the light beams. [12]

A dual-axis solar tracker is designed, developed, and tested to be an efficient solar distributed generating system. The tracker actively follows the sun and adjusts its location to maximum power production. Sensors, comparators, and microcontroller-controlled control circuits drive motors and gear-bearing arrangements with supports and mountings in the planned tracking system. Two geans were parallel to the solar panel. When compared to a static solar panel, the developed system has a computed power gain of 52.78%. [13]

The placement of solar panels at the correct angle and direction of the sun's motion can optimize system efficiency. The construction of a solar tracking device that follows the sun along both axes, horizontal and vertical. The system that regulates the movement of a solar array so that it is always pointing in the direction of the sun. Solar modules are devices that convert sunshine into energy and provide a viable answer to the problem of distant power generation. [14]

The design and fabrication of a solar panel tracking system based on a microcontroller. Because the solar array can remain oriented to the sun, solar tracking enables for more energy to be generated. In this project, we will create a dual-axis solar tracker, which will allow solar panels to move on two axes that are both north-south and east-west aligned. This system is intended to capture as much solar energy as possible throughout the year. The Light Dependent Resistor (LDR) is used to detect sunlight by tracking the source of the sunlight's position. The Arduino Uno microcontroller is utilized to control the LDR-based motors. [15]

PROBLEM STATEMENT:

The fundamental issue is that solar power is only available in fixed installations. As part of the problem, the amount of power that can be generated is limited. Another factor is that the solar tracking system's purchase price is particularly high for a family that uses more electricity than usual, thus more than one solar panel will need to be installed to generate enough power. So, this concept is all about fixing the difficulty that occurs at 180 degrees; this solar tracking device will detect rotation. So, in comparison to when the solar panel stays in only one direction, the solar panel indicated here is incredibly effective.

OBJECTIVE:

The aim of this project is to make an advanced solar tracking system for solar panel which is even more efficient than single axis solar tracker by using dual axis which gives more flexibility to the rotation of solar panel and maximizing the power generation. The scarcity of fossil fuels, such as petroleum and coal, contributes to global warming through CO_2 emissions. To limit this type of emission, an alternate energy source is required.Renewable energy sources such as solar, wind, geothermal, and ocean tidal waves are becoming increasingly important for ensuring a sustainable power supply and a safe environment for future generations. Among all of this energy, solar energy is essential. One drawback is that it can only generate power against the solar panel till the intensity connected with the incidence of solar radiation is reached. We designed the solar panel system to overcome this which shifts in line with the direct intensity connected with the event of solar radiation. Thus the effect of solar power technology would rise in both efficiency and cheap cost.

METHODOLOGY:

LDRs (Light Dependent Resistor), also known as Photo resistors, play an important role in this solar tracking system. Because they are light sensitive, they are employed in light or dark detector circuits. To go towards solar power, two LDRs are fitted and a gear motor is used. The gear motor continues to obey the sun by moving towards the LDR with the highest resistance, i.e. the LDR on which the light is falling. The motor would not rotate if both LDRs received the same quantity of light. The Arduino microcontroller is used to interface with other components in this approach.

Step 1: Run the program.

Step 2: Define the variables for each component set.

Step 3: Assign the stated variables to the input and output ports according to the i/o port patterns.

Step 4: Program the microcontroller to read the values from the light-dependent sensors and perform the necessary actions.

Step 5: Look for the outputs on the LDR, read the analog values, and analyze them to determine the position of the solar panels.

Step 6: Verify the voltages of the fixed in the design setup and tilt the machine accordingly.

Step 7: Examine the voltage differential between the LDR sensors.

Step 8: If the voltage is higher in the left direction, the panel will rotate counterclockwise.

Step 9: If the voltage does not vary significantly, it remains in the same place.

Step 10: If the voltage is higher on the right side of the LDR, the panel will be rotated anticlockwise.

FLOWCHART:

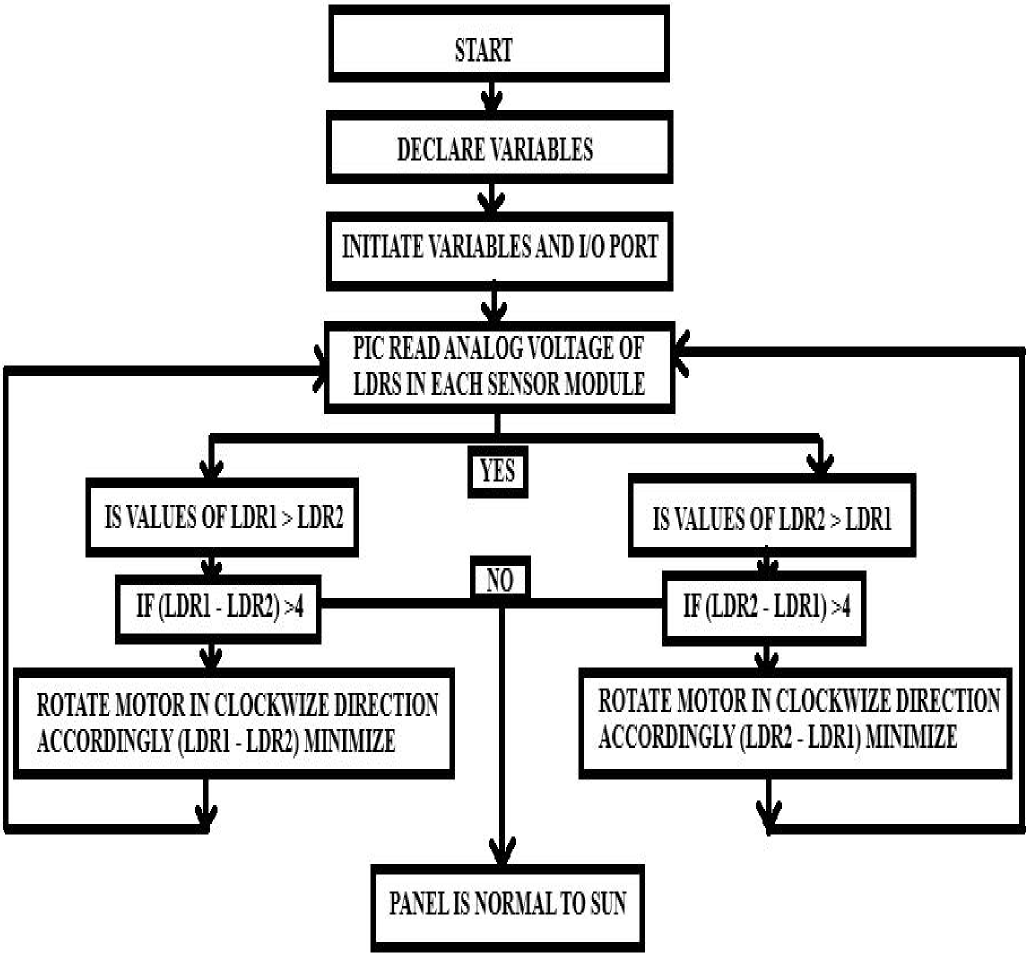

Fig.1: Flow chart of methodology

BLOCK DIAGRAM OF DUAL AXIS TRACKER:

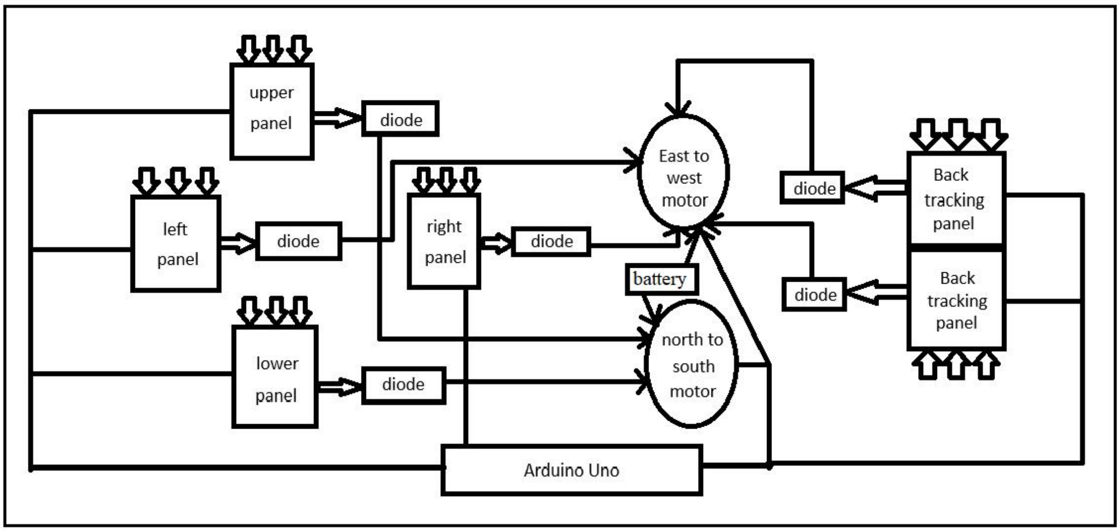

Fig. 2: Dual axis solar tracker

The block diagram shows that when LDR sensors detect sunlight, they send the signal to the microcontroller.The microcontroller is a logical gadget which has enticing interacts on the root of sensor put in and subsequently commencing the motor driver's track. Assume that if the sun changes its particular location and moves from east to west, light absorption on one sensor will differ from another. The controller begins driver circuits and moves servo motors to new places based on the light intensity feature on sensors when light falling on sensor pairs is the same. The same strategy can keep it up with a change in the location of the sun surrounded by the sky.

As a result, the proposed model can capture additional sun rays, and the system's solar energy conversion potential is vastly improved. When data from LDR sensors is collected, the main algorithm is launched. Sensor output is analog and stimulated to digital signals. The digitized signals are sent to the Arduino microcontroller.It decides on the movement direction and steep angle of servo motors after collecting digital signals.

The control method considers that the Arduino microcontroller drives servo motors as long as sensor light sensing and sensor signals are not equal.

It returns to the algorithm's beginning. This process is repeated until the light falling on detector pairs is equal and the PV panel is positioned for maximum power. The voltage produced by the solar panel is variable and needs to be synced. A regulator is frequently employed when the solar panel is utilized to regulate the voltage returning from the solar panel. The supply for this approach is generated solar energy.

There is no want to provide external power source, which makes our system inexpensive and cost effective. The intended model can also be used as an impartial system by incorporating battery storage and adequate storage system supervision. The concept of generated voltage controls battery storage.Charging and discharging activities for storage are favoring the concept of generated voltage.

MAJOR COMPONENTS:

SI.NO	COMPONENTS	RANGE	QUANTITY
1)	Solar Panel	4v,12*12*5cm 200 grams	4
2)	Gear motor	12*12*5cm,10rpm, 100mW,200 grams	2
3)	Motor Driver	L293D Arduino Avr 8051 pic Micrcontroller	1
4)	Battery	9 volts	3
5)	Arduino Uno	ATmega 328P	1
6)	IR Sensor	12*12*5cm,17 gram	4
7)	Battery Cap	9.8L*3W*9.8Hcm	3
8)	Capacitor	1000microfarad	1
9)	Voltage regulator	L7805CV	1

MINOR COMPONENTS:

SI.NO	COMPONENTS	RANGE	QUANTITY
1)	Wooden Base	25*25*25cm	1
2)	Rod	1.5 inch	1
3)	Card board sheet	-	1
4)	Wheel	-	1

COMPONENTS:

1. Solar panel:

Solar panels are devices that capture the sun's rays and transform them into power or heat. A solar panel is a group of solar (or photovoltaic) cells that can be utilized for producing electricity via the photovoltaic effect.

Fig:3 : Solar Panel

2. Gear Motor:

A gear motor is a mechanical system made up of an electric motor and a gearbox with a set of gears. The gearbox attached to the motor's function is to reduce the motor's speed and boost its torque to execute a specified work at a certain speed.

Fig 4: Gear Motor

3. Motor driver:

A motor driver IC is an electronic chip that handles motors in self-driving robots and integrated electronics. The majority of motor Driver ICs used in basic robots and RC cars are the L293D and ULN2003.

Fig 5: Motor Driver

4. Battery:

A battery is a device that uses an electrochemical oxidation-reduction (redox) cycle to transfer chemical energy stored within its active components directly into electric energy. An electric circuit is used to transmit electrons from a certain substance to another in this type of reaction.

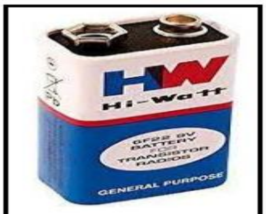

Fig 6: Battery

5. Arduino Uno:

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button.

Fig 7: Arduino Uno

6. IR Senor with LDR:

Light Dependent Resistors frequently used as light detectors. They are often used when it is necessary to detect the presence or absence of light or to measure the intensity of light.

Fig 8 : IR Sensor with LDR

7. Capacitor:

A capacitor is a type of passive electrical component that retains energy as an electrostatic field. A capacitor, in its most basic form, is made up of two conducting plates separated by an insulating substance known as the dielectric.

Fig 9: Capacitor

8. Voltage Regulator:

A voltage regulator is a circuit that is linked between a power source and a load and produces a consistent voltage regardless of input voltage or output load fluctuations.

Fig 10: Voltage Regulator

CIRCUIT DIAGRAM:

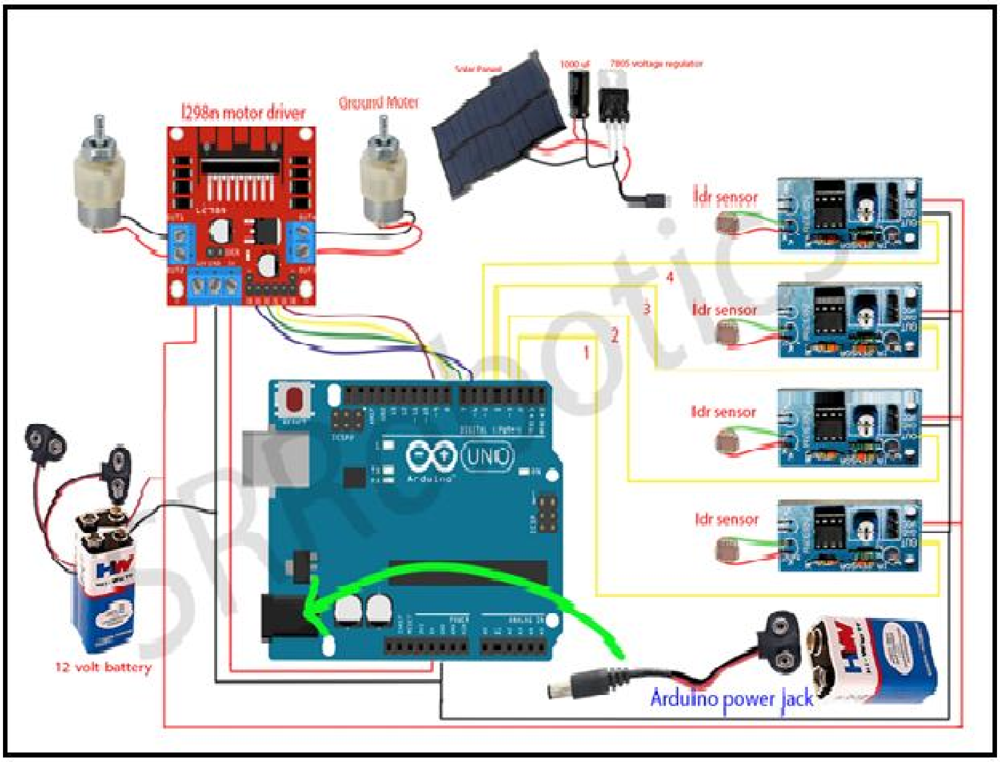

Fig.11 : Circuit diagram of dual axis solar tracker

As illustrated in the diagram above, 5V is applied to one of the connections of each LDR, and the other end is linked to a resistor. The resistor's opposite end is then grounded. The analog values of the LDR are obtained at the point between the LDR and the resistor and sent to the analog inputs of Arduino pins A2, A3, A4, and A5. As illustrated above, Arduino pins 6, 7, 8, and 9 are set to output and are linked to the four inputs of the motor driver. The motor driver supplies 5V to the Arduino. Two 9V batteries are linked in parallel and fed into the motor driver's 12V input. Two motors are linked to the motor driver's outputs 1, 2, 3, and 4. The solar panel is connected to an axle, which is then affixed to one of the motors, which rotates the panel north-south. The panel is then rotated east-west by the other motor. The solar panel is equipped with four LDRs. The output of the four LDRs drives the motor in the direction where the light intensity is greatest on the panel.

CONCLUSION:

The present article describes an intriguing and simple attempt to create a Dual Axis Solar Tracker with LDR using an Arduino UNO. The architecture helps by monitoring with a dual axis sensor to extract the most power from solar radiation. This is practical as the solar panel remains precisely aligned with the incident rays of the sun. This is an excellent adaptation of the solar tracking device concept for capturing more energy than a stationary solar panel. It is being attempted to create a simple and low-cost tracking system. In the past few years, solar radiation trackers have played an important role in improving the performance of solar panels, proving to be a more technological achievement.The clinical relevance of a dual axis solar tracker stems from its superior efficiency and durability in producing improved performance as compared to a fixed solar panel or solar tracker with a single axis. The tracking mechanism is designed to catch sun energy in each available direction. In general, maximum solar energy cannot be recorded with a single axis tracker that only travels along one axis. In the case of dual axis trackers, if the sun rays are perpendicular to the panel throughout the year. As a result, it creates as much energy as possible to replace what is lost during the day and over the year.

As a result, the performance improves, implying that the efficiency is higher than that of a fixed solar panel (about 30-40% higher) or a single solar tracker axis (approximately 6-7% higher).

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