

# Automatic Solar Tracker Without Microcontroller

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**Abstract**—Renewable resources are things that we can use over and over again. This is because they are always available in nature. For example we have sunlight, oxygen, fresh water and wind. Solar energy is one of the important renewable resources. This is because we are running out of fuels like coal, oil and gas. We have a lot of energy available to us. If we use energy in the right way it can really help us with our energy problems and reduce pollution. Renewable resources like energy are very good for us. We should use resources, like solar energy to help our planet.

The solar power system works well when it gets a lot of sunlight. For a panel to make the most electricity it needs to face the sun for most of the day. The solar panel has to be right, in front of the sun. In solar power systems the solar panels do not move and stay in one place. As the sun goes from the side to the west side of the house during the day the solar panels that are fixed in one place cannot get the most sunlight all the time. This means the solar power system makes electricity because the solar panels are not getting enough sunlight. The solar power system and the solar panels are not working well as they could be. So we need a system that can follow the sun to make solar panels work better. This system has to track the movement of the sun. The movement of the sun is really important, for panels. We want solar panels to work well as they can. To do that we need a system that can track the movement of the sun. The solar tracking system is really useful because it moves the panel to face the sun all the time. It does this by turning the panel around to match where the sun is, in the sky. This means the solar panel gets sunlight on it.

The solar tracking system can make the solar panel work better by around 30 to 40 percent compared to panels that do not move. This is a deal because it means we can get more electricity from the same solar panel. The solar tracking system and the solar panel work together to make this happen. This paper is about a solar tracking system. It uses a microcontroller and a stepper motor and a motor driver and a solar panel. The system can find out where the sunlight is coming from. It controls the stepper motor. The stepper motor then moves the panel so it gets the most sunlight all day. This means the solar panel makes electricity. The solar tracking system is simple. It works well and it does not

cost a lot. That is why it is good for real life uses. The solar tracking system is a way to get more power, from the solar panel. This work was developed as a college-level academic project to demonstrate the effective use of solar tracking technology.

## I. INTRODUCTION

The world is using more energy and this is happening at the same time that people are getting really worried about the earth. We are talking about things like climate change, pollution and running out of fuels. Because of this people think that natural energy and renewable energy are very important now. The old ways of making energy are not good for the earth. We do not have enough of them so scientists and engineers are looking for new ways to make energy that are clean and good for the earth. Solar energy is one of the kinds of renewable energy. This is because the sun is always shining and it is good, for the earth. Solar energy is also available everywhere which makes it very useful.

The renewable energy sector is really taking off in countries and that is a good thing for the environment and for the economy. Solar energy is especially important because it is a source of renewable energy. The good thing about energy is that it is available everywhere and does not hurt the environment. Solar panels need to be pointing in the right direction to get the most sunlight. If solar panels are fixed in one place they can not get the sunlight all day which means they do not make as much energy as they could. Solar energy systems, like solar photovoltaic systems need to be able to move to get the sunlight. This is because the sun is moving across the sky all day. Solar panels that can not move are not able to make the energy and that is a problem for the renewable energy sector and, for solar energy.

So we have a problem with panels. They do not always face the sun. To fix this people made tracking systems. These systems move the panels so they

always face the sun. It does not matter where the sun is in the sky.

This project is, about making a solar tracking system that is not too expensive. We want this system to follow the sun and make the solar panels work better. The system we are making uses a chip called a 555 timer IC. This chip is the brain of the system. We also use Light Dependent Resistors or LDRs for short to see how sunlight there is. The LDRs help the system know when to move the panels.

LDR sensors are used to figure out how strong the sunlight is and where the sun is. We use two LDR sensors. Place them so that if one gets more light, than the other we know the sun has moved. When this happens the control circuit turns on a gear motor. The gear motor then rotates the panel so it faces the sun. This way the solar panel stays pointed at the sun all day long. The LDR sensors and the gear motor work together to keep the panel in the right position so it gets the most sunlight.

The performance of the developed solar tracking system has been tested and compared with a static solar panel setup. The results demonstrate that the single-axis solar tracker successfully follows the daily movement of the sun and captures more solar energy than a fixed panel. This project highlights a simple, efficient, and economical approach to improving solar power generation, making it suitable for small-scale and low-cost renewable energy applications.

## II. OBJECTIVE

The goal of the Automatic Solar Tracker project is to create a system that follows the sun. This system will work from when the sun comes up to when it goes down. It will keep changing the position of a panel so it always faces the sun.

The Automatic Solar Tracker system is supposed to get much energy from the sun as possible. It does this by keeping the panel straight up, to the sun's light all day long. The Automatic Solar Tracker project is important because it helps the solar panel work better by pointing it at the sun. This project is trying to get rid of the problems that come with panels that are stuck in one place. These solar panels cannot move to follow the sun as it changes position in the sky. Because of this they do not work well as they could

and that means they do not make as much energy, from the sun as they should. The project wants to make solar panels better so they can make energy from the sun by dealing with the issue of the sun moving. The main goal is to improve panels.

Another important objective of this project is to integrate electronic sensors, a microcontroller-based control unit, and a mechanical tracking mechanism to create a fully automated system that operates without human intervention. The project seeks to demonstrate the practical application of light sensors to detect variations in sunlight intensity and use this data to control motors that rotate the solar panel in the appropriate direction. Through this automation, the system aims to improve accuracy in solar.

significant energy loss and reduced power output.

The need for an Automatic Solar Tracker arises from the limitation of fixed solar panel systems. As the sun continuously changes its position due to the Earth's appropriate direction. Through this automation, the system aims to improve accuracy in solar tracking while minimizing manual effort and operational errors.

The project also wants to see how well the automatic solar tracking system works compared to a solar panel that does not move. To do this it will measure things like voltage, current and power output when both systems are used in the environment. The project wants to show that automatic tracking can make a difference in how much energy is generated. By comparing the two systems we can see the things, about using solar tracking technology especially in places that get a lot of sunlight. This is important because it can help people understand the benefits of using this kind of technology in a way.

The project also aims to promote the use of renewable energy sources by demonstrating a cost-effective and scalable solution that can be adapted for residential, commercial, and industrial applications. Emphasis is placed on designing the system using readily available and affordable components to ensure feasibility and ease of implementation. Furthermore, the project seeks to enhance understanding of renewable energy systems, embedded systems, and control mechanisms among students, while encouraging innovation and awareness in the field of sustainable energy and environmental conservation.

### III. NEED OF THE STUDY

We really need to find ways to make electricity because people are using more and more of it. At the time we are running out of coal, oil and natural gas very quickly. This is a problem. So we have to look for ways to make energy that are good for the earth and will not run out. Solar energy is an option. It is available everywhere. It is clean. Solar energy is also very good for the earth.. Solar energy has one big problem. The amount of electricity we can make from energy depends on how much sunlight the solar panels get. We need a lot of sunlight to make solar panels work well. Solar energy is a choice but we have to figure out how to make it work better when there is not a lot of sunlight. Solar panels need sunlight to make electricity so solar energy is only as good, as the sunlight it gets. Traditional fixed solar panels can not stay in the position to get sunlight from the sun all day. This means a solar panel that does not move gets the sunlight for only a little while.

The automatic solar tracking system solves this problem. It changes the direction of the panel so it follows the sun's movement. This way the solar panel gets the sunlight and the energy conversion efficiency of the solar panel is improved. The solar panel gets sunlight because of this. The automatic solar tracking system helps the solar panel work better by keeping it in the position to get sunlight, from the sun.

This study is important for another reason. It wants to make things easier for people and reduce the need for people to manually adjust panels. Adjusting panels by hand takes a lot of time and is not very accurate. It is also not practical for installations. If we have a system that can do this job automatically it will be more reliable and accurate. It will also be more consistent. Need less maintenance. This means there will be mistakes when the solar panels are being used. The main goal is to reduce the need, for adjustment of solar panels. This will make things better because manual adjustment of panels is a big problem.

Furthermore, studying and developing an automatic solar tracker helps in understanding the practical application of renewable energy technologies, sensor based control systems, and embedded electronics. It encourages innovation in sustainable engineering solutions and supports global efforts to reduce carbon emissions and environmental pollution. By improving solar energy utilization, the Automatic

Solar Tracker contributes to energy conservation, cost savings, and the promotion of eco-friendly power generation systems.

### IV. MATERIALS REQUIRED

The Automatic Solar Tracker system needs a lot of parts, like electronics and electrical things and mechanical pieces to make sure it follows the sun correctly and makes power efficiently. Each part of the Automatic Solar Tracker system is important for the whole thing to work properly. The Automatic Solar Tracker system has parts that work together to make it successful.

#### Connecting Wires

Jumper wires are really helpful when we need to connect electronic components and modules together in a safe way. We use jumper wires to make sure that all the parts are connected securely. This is important, for components and modules. Jumper wires help us do this.

#### Switch

The switch is what we use to turn the tracker system on or off. This gives us control, over how the solar tracker operates. We can use the switch to turn the tracker system on when we need it and turn the solar tracker system off when we do not need it.

#### Voltage Regulator

A voltage regulator is really important for a Solar Panel. It helps keep the voltage at a level, which is very safe, for the Solar Panel. This means the Solar Panel will not get damaged because of much or too little voltage. The voltage regulator does a job of protecting the Solar Panel. The solar panel is the thing that makes energy for the system. It takes sunlight. Turns it into electricity using special cells called photovoltaic cells. The solar panel is, on a frame that can move around. The solar panel can turn and face the sun. This way the solar panel can get the sunlight and make the most energy.

#### Light Dependent Resistors (LDRs)

Light dependent resistors are used as sensors to figure out how strong the sunlight is and where it is coming from. When sunlight hits the dependent resistors they change how much they resist the electricity. The system looks at how light each of the light dependent resistors is getting and uses that to decide which way the solar panel should turn. This way the solar panel

can follow the sunlight. Get the most energy, from the light dependent resistors and the sunlight.

#### Resistors

Resistors are used with Light Dependent Resistors to make voltage circuits.

These voltage divider circuits are really useful because they turn changes in resistance, into voltage signals that we can measure.

The microcontroller can then read these voltage signals from the voltage divider circuits that have resistors and Light Dependent Resistors in them.

#### DC Motor

Solar panels need to be moved in the direction to get the most sunlight. We use motors to rotate the panel in the required direction. The solar panel needs to be rotated in the required direction by the motors. For systems that only move the solar panel in one direction people often use DC motors.. For systems that need to be more precise, like advanced tracking systems, servo motors or stepper motors are used for the solar panel. These motors provide precise control, for the solar panel.

#### Battery

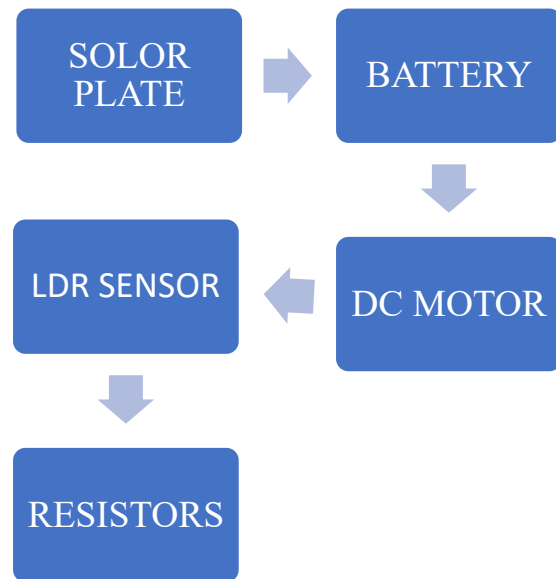
You need a battery or a power supply to give energy to the microcontroller and the sensors and the motor. The microcontroller and the sensors and the motor need energy to work. People often use batteries so the system can work by itself using energy from the solar panel. The solar panel generates energy. This energy is used by the microcontroller and the sensors and the motor.

#### Breadboard or Printed Circuit Board (PCB)

A breadboard is used for prototyping and testing the circuit connections, while a PCB is used for permanent and reliable connections in the final setup.

#### SYSTEM ARCHITECTURE

The Automatic Solar Tracker uses Light Dependent Resistors (LDRs) to sense the direction of sunlight. The signals from the LDRs are processed using analog components such as comparators or operational amplifiers. Based on the difference in light intensity, control signals are generated to drive a motor driver circuit. The motor rotates the solar panel toward the direction of maximum sunlight. A power supply provides energy to the sensors and motor, enabling automatic solar tracking without the use of a microcontroller.



#### V. CONCLUSION

People have already shown that using a tracking system that can move in one direction can make a big difference. This kind of system can actually increase the amount of energy it produces by 20 percent. The solar tracking system is really good at getting energy from the sun. So the solar tracking system, with single-axis freedom is very useful.

The work in this paper is about creating a system that follows the sun. This system is called a solar tracking system. It has to be able to move in directions to catch the sunlight. The solar tracking system uses tools called sensors to find out where the sunlight is coming from. The goal of the solar tracking system is to get much sunlight, as possible by moving and adjusting to the sunlight.

The prototype model uses the parts and equipment like de motors. These parts help the model move in an stable way. The movement is also very precise which is important because it needs to face the sun.

The system can follow the sunlight to get the Solar power. It does this by tracking how strong the sunlight is. This way the system can collect as Solar power, as possible from the sunlight.

They use the parts and the motor to make this prototype. The motor and the other components are really important, for this project. They have to be suitable for the prototype to work properly. The motor is a part of the whole thing.

The constructed system model can be applied in residential and in agriculture purpose for alternative energy generation.

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