PROJECT REPORT

ON

“Sun Tracking Solar Panel Using Arduino”

THIS PROJECT & RESEARCH REPORT HAS BEEN INDEPENDENTLY DEVELOPED BY ME AND IS NOT SUBMITTED TO ANY COLLEGE OR UNIVERSITY FOR ACADEMIC EVALUATION

Developed by

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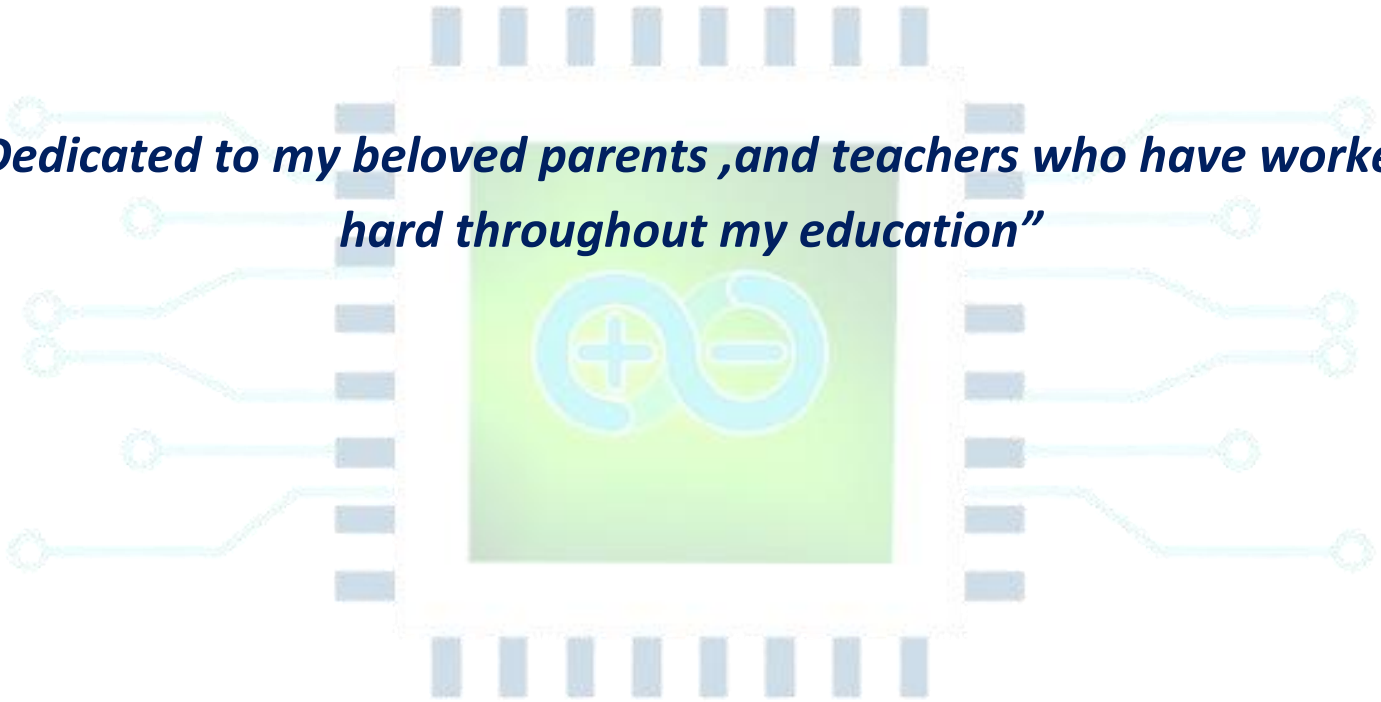
DEPARTMENT OF IOT

POLISHLINE.BALASORE, ODISHA, INDIA

NOV -2024

“Dedicated to my beloved parents ,and teachers who have worked hard throughout my education”



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CERTIFICATE

*This is to certify that the project entitled"*Sun Tracking Solar Panel Using Arduino*"*

Has been independently developed and completed by Suzen Kumar Mohanty for the purpose of enhancing technical knowledge, skills, and practical understanding.

This project is a self-initiated work carried out with person al interestand research. It has not been submitted to any college, university, or institution for the award of any degree or diploma.

The work presented in this project is genuine and has been completed by the developer himself.



Suzen Kumar Mohanty

(Project Developer)

Date: 05/11/2024

Place:-Balasore,Odisha,India

SELF ATTESTATION

I here by declare that I have personally worked on the project entitled " **Sun Tracking Solar Panel Using Arduino**"All the data, analysis, and implementation presented in this project are the result of my own efforts and genuine work .Any external sources of information, if used, have been properly acknowledged.

This project is created solely for learning , skill development ,and professional improvement, and has not been submitted to any institution for academic purposes.



Suzen Kumar Mohanty

(Project Developer)

Date: 05/11/2024

Place:Balasore,Odisha,India

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DECLARATION

I hereby declare that the project titled "**Sun Tracking Solar Panel Using Arduino**"is an original work carried out by me based on my own idea, research, and implementation.

This project that has not been submitted previously ,in part or in full, to any college, university, or institution for the award of any degree, diploma, or certification.

I confirm that all the information presented in this project is true to the best of my knowledge. Any references or sources used have been properly acknowledged.

I take full responsibility for the authenticity and originality of this work.

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Name: Mr. Suzen Kumar Mohanty

Branch: Computer Science And Engineering

Institution:[Srinix Collage Of Engineering ,Independent]

Date:[**05/11/2024**]

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to everyone who contributed, directly or indirectly, to the development of this project, "**Sun Tracking Solar Panel Using Arduino**."

This project is the result of my personal interest, dedication, continuous learning, and exploration of electronics, automation, sensor technology, and control systems.

I am thankful to the developers of Arduino, the creators of open-source hardware and software resources, and the technical communities whose documentation, tutorials, and knowledge-sharing platforms helped me understand and implement the concepts used in this project.

I would also like to acknowledge the importance of self-learning, practical experimentation, and problem-solving throughout the development process. These experiences helped me strengthen my technical knowledge and improve my understanding of real-world automation systems.

Finally, I am grateful to everyone who supports innovation, DIY engineering, and independent technical projects. This work reflects my enthusiasm for learning, creating, and exploring new possibilities in technology.

Developed By:

Suzen Kumar Mohanty

ABOUT MYSELF



I am Mr. Suzen Kumar Mohanty , a passionate and dedicated Web Developer and SOC Analyst (Level 1) from the field of Computer Science and Engineering, with strong expertise in HTML, CSS, JavaScript, and I specialize in building scalable, responsive, and high-performance web applications that deliver seamless user experiences across all devices and screen sizes.

With a keen eye for detail, I focus on writing clean, maintainable, and well-structured code. My development approach is centered around Creating intuitive user interfaces, ensuring both functionality and aesthetic quality. I follow modern front-end development practices such as component-based architecture, responsive design principles, and performance optimization techniques to build efficient and user-friendly applications.

Beyond web development, I actively work on IoT-based solutions, where I integrate hardware and software to create smart, real-world systems. I have hands-on experience with Arduino Uno and various sensors, enabling me to develop projects such as environmental monitoring systems, smart automation solutions, and real-time data tracking applications.

One of my key strengths lies in connecting IoT devices with web technologies. I build interactive dashboards that allow real-time data visualization, giving users the ability to monitor, analyze, and control devices remotely. My work focuses on bridging the gap between the physical and digital world by transforming raw sensor data into meaningful insights.

I am deeply interested in developing innovative, data-driven solutions that combine web technologies with embedded systems. My goal is to create impactful applications that solve real-world problems while improving efficiency, automation, and user experience.

With a strong passion for continuous learning and innovation, I consistently explore new tools, frameworks, and technologies to enhance my skills and deliver high-quality, future-ready solutions.

Name: Mr. Suzen Kumar Mohanty

Branch: Computer Science And Engineering

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ABSTRACT

The Sun Tracking Solar Panel Using Arduino project is designed to improve the efficiency of solar power generation by automatically tracking the movement of the sun. In conventional solar systems, fixed solar panels receive maximum sunlight only for a limited period of the day, which reduces overall energy efficiency. To overcome this limitation, an automatic solar tracking system is developed using an Arduino microcontroller, Light Dependent Resistors (LDRs), and a servo motor. The system continuously monitors the intensity of sunlight using LDR sensors. Based on the sensor readings, the Arduino controls the servo motor to rotate the solar panel toward the direction of maximum sunlight. This automatic adjustment helps the solar panel absorb more solar energy throughout the day and increases power output compared to fixed solar panels. The project mainly focuses on renewable energy utilization, automation, and energy efficiency. It is cost-effective, simple to implement, and suitable for small-scale as well as large-scale solar applications. The proposed system can be used in homes, industries, street lighting, and other solar-powered systems to achieve better energy conservation and sustainable power generation.

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Chapter 1

INTRODUCTION

1.1 *Introduction*

The biggest crisis we are heading into is the climate change due to excessive use of fossil fuels and to overcome these issues, we have only one solution that is utilizing Renewable
Energy. Renewable energy is a type of energy that is harnessed from the nature without causing ill effects to the environment. One of the most prominent kind of renewable energy is solar energy. Solar radiation from the sun is collected by the solar panels and converted into electrical energy. The output electrical energy depends on the amount of sunlight falling on the solar panel.

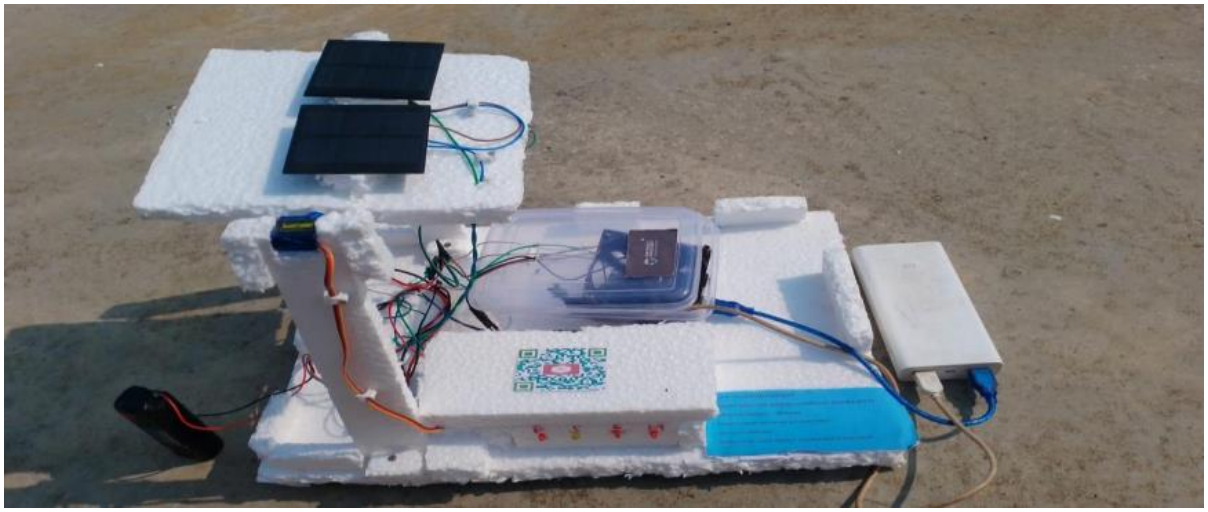
Traditionally, solar panels are fixed and the movement of sun

over the horizon means that the solar panel does not harness maximum energy most of the time. In order to maximize the

power from the solar panel, the panel should face the sun all time. In this project, we will make a sun tracking system which

will help the solar panels to generate maximum power. In some of our previous articles, we have built simple system to

track power generated from solar panel and other solar energy related projects. You can check those out if you are looking for more projects on solar power.



(Fig:-0.0)

1.2 ***Objectives of the Project***

1. To design and develop an automatic solar tracking system using Arduino.
2. To increase the efficiency of solar panels by continuously tracking the position of the sun.
3. To maximize solar energy absorption throughout the day.
4. To reduce energy loss caused by fixed-position solar panels.
5. To control the movement of the solar panel using sensors and servo motors.
6. To create a low-cost and energy-efficient renewable energy system.
7. To demonstrate the practical application of embedded systems and automation in solar energy technology.

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1.3 ***Project Focus***

The focus of this project is to develop an intelligent solar tracking system that automatically aligns the solar panel toward the direction of maximum sunlight using an Arduino microcontroller. The system uses Light Dependent Resistors (LDRs) to detect sunlight intensity and a servo motor to rotate the solar panel accordingly.

This project mainly concentrates on improving solar power generation efficiency compared to fixed solar panels. It also emphasizes automation, renewable energy utilization, low power consumption, and real-time sun tracking techniques. The project can be applied in homes, industries, street lighting systems, and other solar-powered applications.

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Chapter 2

WORKING CONDITION

How does a Solar Tracker Works?

You must be wondering how does it work? As discussed earlier, the solar panel should face the sun to harness maximum power. So, our system has two steps, first is to detect the position of sun and second is to move along with it.

➢ ***Detecting the position of the Sun:-***

We measure the intensity of light with LDRs using Arduino and compare the intensity of light falling on both LDRs. The LDRs are placed on the edges of the solar panel as shown in the figure below.

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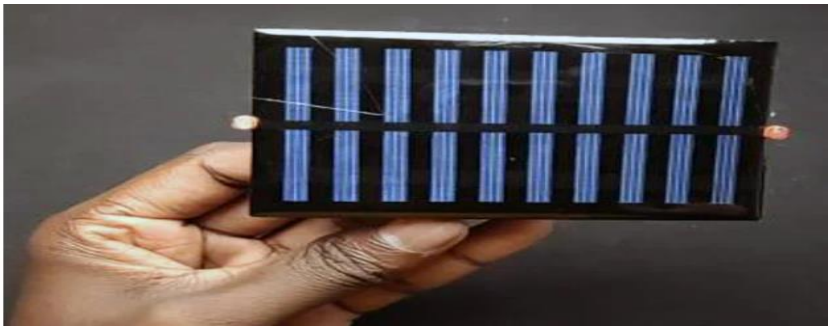
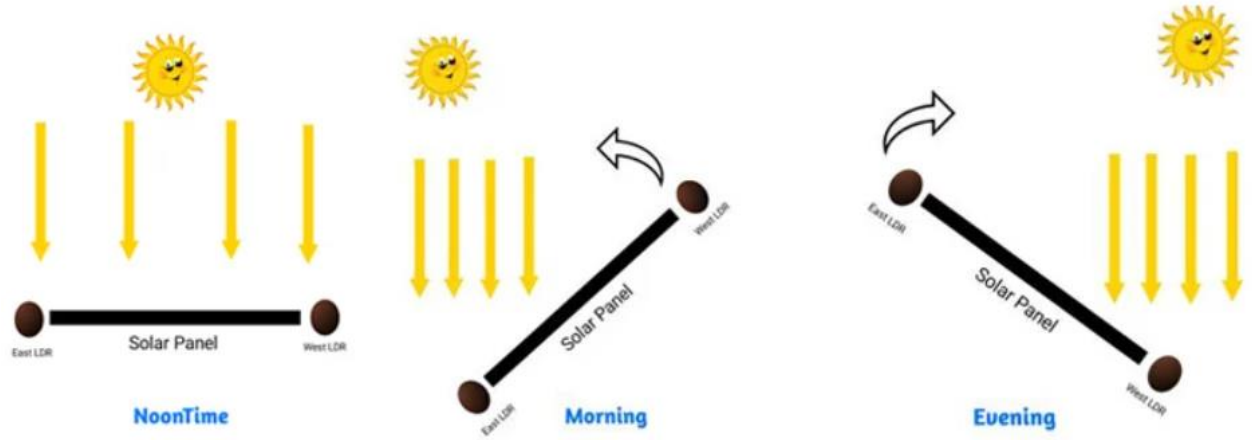


(Fig:-0.1)

Based on the intensity of light on the LDR, we give the signal

to the servo motor to cause the movement. When the intensity of the light falling on the right LDR is more, the panel turns towards the right and if the intensity is higher on the left then the panel slowly turns towards the left side.



(Fig:-0.2)

Consider a scenario of a beautiful winter morning,the sun rises from east side and therefore it has more light intensity than the west side, so the panel moves towards to east side. Throughout the day it will track the sun and by the evening, sun has moved towards the west, hence it will have more intensity than the east direction so the panel will face the west direction.

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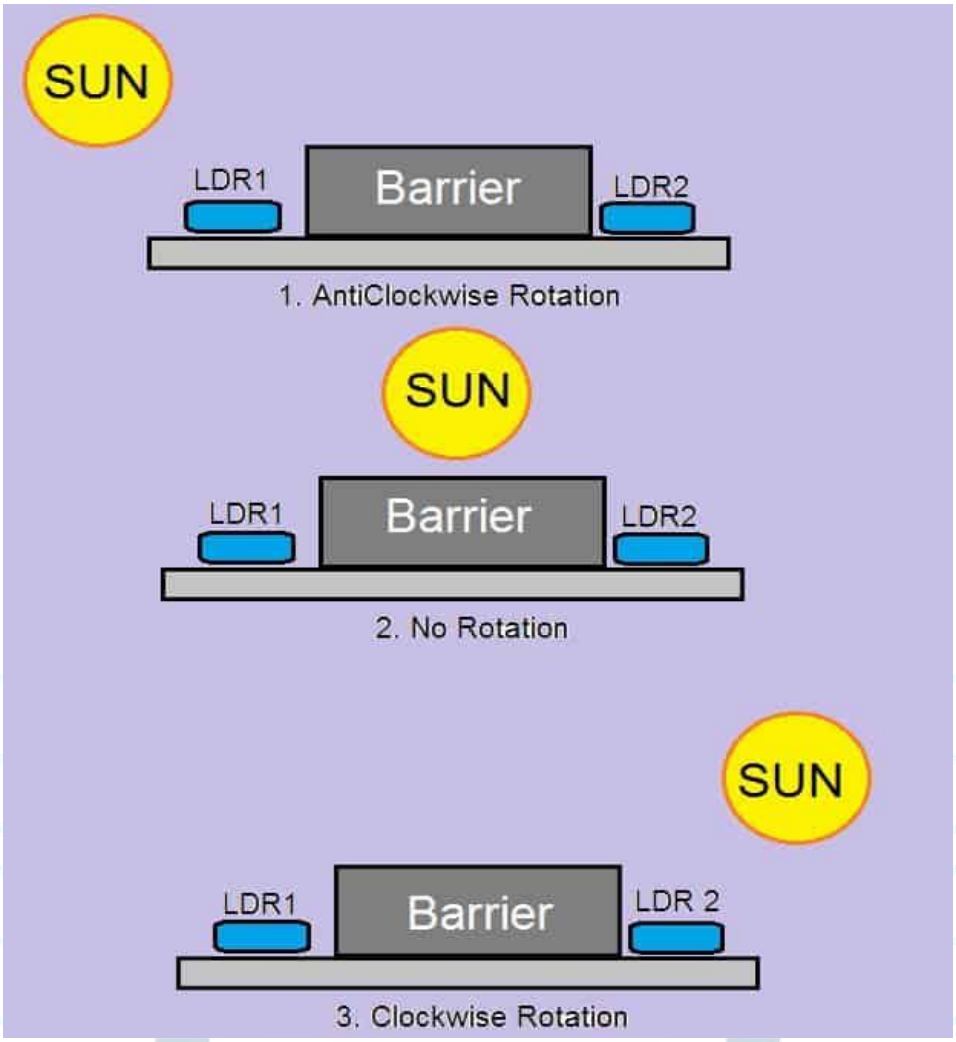

(Fig:-0.3

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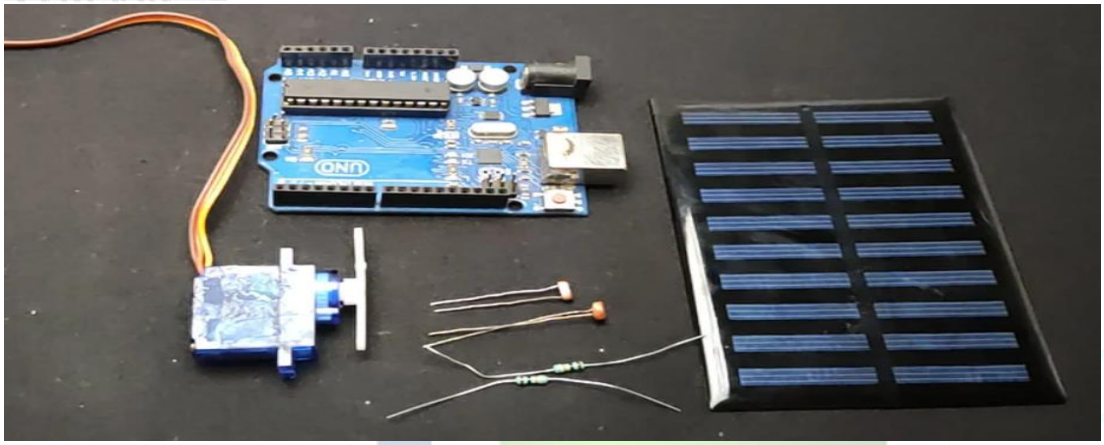
Chapter 3

BACKGROUND MATERIAL

Components Required for Making the Solar Tracker :-



(Fig:-0.4)

- **1 x Arduino Uno**
- **1 x Servo motor**
- **1 x Solar panel**
- **2 x LDR**
- **2 x 10k Resistor**
- **Jumper wires**

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1. Arduino Uno R3 board:-



(Fig:-0.5)

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2010.[2][3] The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a

rectangular 9-volt battery. It has the same

microcontroller as the Arduino Nano board, and the same headers as the

Leonardo board.[5][6] The hardware reference

design is distributed under a Creative Commons Attribution Share-Alike 2.5

license and is available on the Arduino

2. Servo Motor :



(Fig:-0.6)

Servo motor is used to rotate the solar panel. We are using servo

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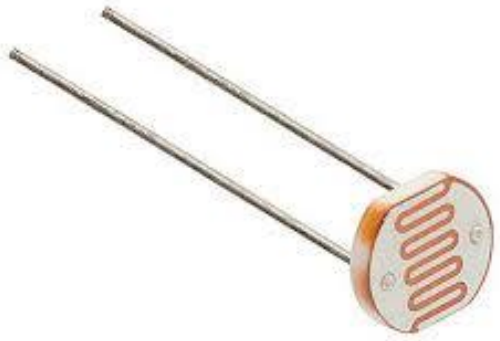
motor because we can control the position of our solar panels

precisely and it can cover the whole path of sun. We are using a servo

motor that can be operated with 5volt.

3. Light Dependent Resistor (LDR):-



(Fig:-0.7)

A light-dependent resistor is made from semiconductor material having light-sensitive properties and hence are very sensitive to light. The resistance of LDR changes according to the light that falls on it and it is inversely proportional to the intensity of light. That is resistance of the LDR will increase at high-intensity light and vice versa.

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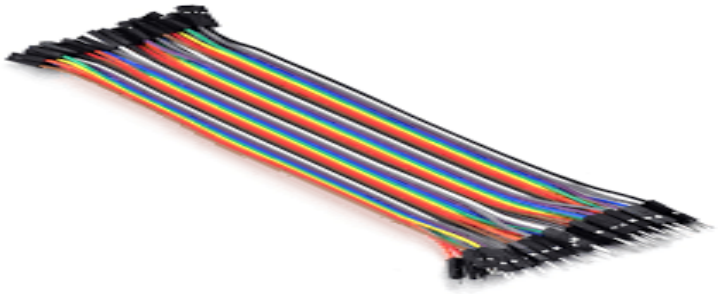
4. Jumper Wire:-



(Fig:-0.8)

A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them –simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with...

5. Solar Panel:-

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(Fig:-0.9)

A solar panel is a device that converts sunlight into electricity by using

photovoltaic (PV) cells. PV cells are made of materials that produce excited electrons when exposed to light. The electrons flow through a circuit and produce direct current (DC) electricity, which can be used to power various devices or be stored in batteries. Solar panels are also known as solar cell panels, solar electric panels, or PV modules.

6. Battery/Power Source:-



(Fig:-10)

A battery is a source of electric power that consists of one or more electrochemical cells with external connections for powering electrical devices. When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode. Batteries convert chemical energy contained within its active materials directly into electric energy by means of an electrochemical oxidation. It is used for give power to Arduino board.

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8.10K Register:-



(Fig:-11)

A 10k resistor is a fundamental electronic component that plays a vital role in circuits by limiting the flow of electric current. Its resistance value is 10,000 ohms. These resistors are identified by a color code, typically brown-black-orange-gold, where each color represents a digit or multiply

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Overall project timeline

Phase No.	Project Activity	Duration	Week
1	Topic Selection and Project Planning	1 Week	Week 1
2	Literature Survey and Research	1 Week	Week 2
3	Requirement Analysis and Component Selection	1 Week	Week 3
4	Circuit Diagram Design and System Architecture	1 Week	Week 4
5	Procurement of Components and Materials	1 Week	Week 5
6	Hardware Assembly (Arduino, Servo Motor, LDR, Solar Panel)	2 Weeks	Week 6–7
7	Arduino Programming and Coding	2 Weeks	Week 8–9
8	Integration of Hardware and Software	1 Week	Week 10
9	Testing and Troubleshooting	2 Weeks	Week 11–12
10	Performance Analysis and Result Evaluation	1 Week	Week 13

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11	Documentation and Report Preparation	1 Week	Week 14
12	Final Presentation and Project Submission	1 Week	Week 15

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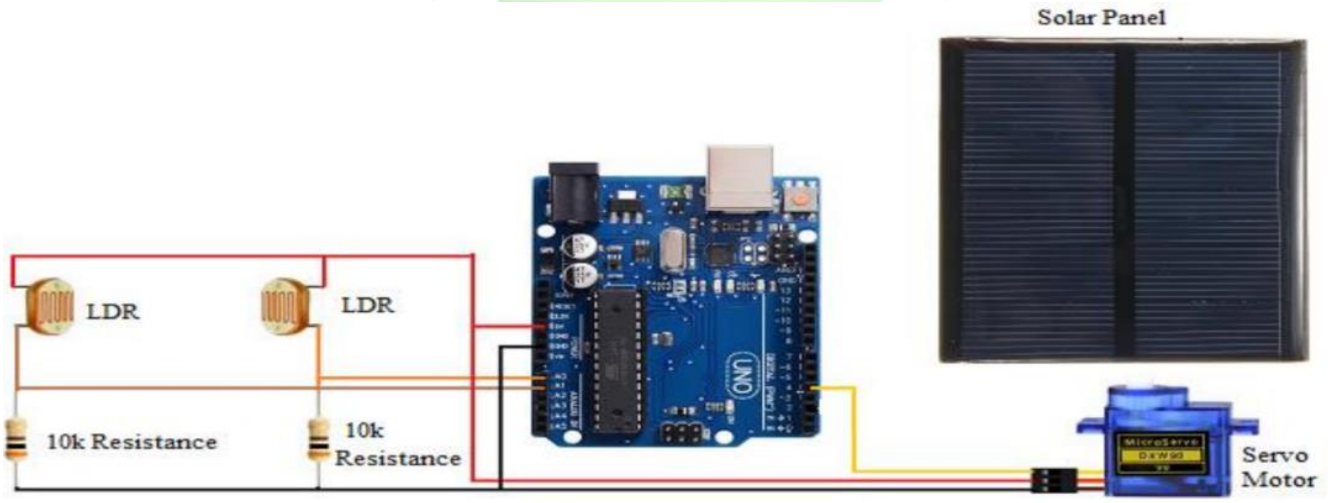
Chapter 4

CIRCUIT DIAGRAM

Diagram Of Solar Tracker:-

The connection of the circuit is very straight forward. Here, I used an Arduino Uno as controller and connected the 2 LDRs to analogue pin A0 and A1 respectively. Pin 9 of Arduino is connected to the servo motor. Since, we have used a 5V servomotor, we don't require any external power supply because all the components can easily be powered the Arduino itself. All the connections are shown in the figure below.



(Fig:-12)

Chapter 5

Advantages of solar tracking system:-

- In the same amount of space, solar trackers generate more electricity than a fixed solar system, which makes them ideal for optimizing land usage.

- There are two kinds of solar trackers, such as single axis and dual-axis. A suitable solar tracker can be installed according to the Installation size, local weather, degree of latitude, electrical requirements, etc.

- Solar trackers generate more electricity than their stationary solar systems due to direct exposure to solar rays.

- Also, the tracker system does not require long-term maintenance because of the advancements in technology and reliability of mechatronics.

Chapter 6

Project source Code(Arduino R3 IDE):-

```
#include <Servo.h>
Servo myservo;
#define LDR_1 A0
#define LDR_2 A1
int pos = 90;
int Resistance = 20;
void setup(){
myservo.attach(4);
pinMode(LDR_1, INPUT);
pinMode(LDR_2, INPUT);
myservo.write(pos);
delay(1000);
}
void loop(){
int value_1 = analogRead(LDR_1);
int value_2 = analogRead(LDR_2);
if((abs(value_1 - value_2) <= Resistance) || (abs(value_2 -
value_1) <= Resistance)) {
}else {
if(value_1 > value_2)
{
pos = pos+1;
}
if(value_1 < value_2)
{
pos = pos-1;
}
}
if(pos > 180) {pos = 180;}
if(pos < 0) {pos = 0;}
myservo.write(pos);
delay(50);
}
```

Last Chapter

Conclusion & Future Scope:-

Conclusion:-

A solar panel tracking system was designed and implemented. The aim of the solar panel tracking system is to track the positon of the sun for better efficiency of the solar panel has shown in the experimental results. This work can be executed on an industrial scale which be beneficial to developing countries like Nigeria and Sub-Sahara Africa countries. Our recommendation for future works is to consider the use of more sensitive and efficient sensors which consume less power and which are also cost effective. This would increase the efficiency while reducing cost. I hope this article helps you understand the concept of a solar tracking system, its importance, and the prototype of a sun-tracking solar panel using Arduino Uno. Similarly, you can implement a real-time-based solar tracker at home.

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The future scope of the **Sun Tracking Solar Panel Using Arduino** project is very wide due to the increasing demand for renewable energy sources. The system can be further improved and implemented in large-scale solar power

applications. Some future enhancements are:

Future Scope

1. The project can be upgraded from a single-axis tracker to a dual-axis solar tracking system for higher efficiency.
2. Wireless monitoring and control can be added using IoT technologies such as Wi-Fi or GSM modules.
3. Battery management systems can be integrated for better energy storage and utilization.
4. Artificial Intelligence and Machine Learning techniques can be used to predict sunlight direction and optimize panel movement.
5. The system can be implemented in smart homes, industries, and solar farms for large-scale energy production.
6. More efficient solar panels and motors can be used to improve overall performance.
7. Mobile app control and real-time data monitoring can be added for user convenience.
8. The project can contribute to eco-friendly and sustainable energy solutions in the future.

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