NANDHA ENGINEERING COLLEGE

ERODE–638052 (Autonomous)

(Affiliated to Anna University, Chennai)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

22AIC14 – INTERNET OF THINGS AND ITS APPLICATIONS

MINI PROJECT REPORT ON

SOLAR TRACKING SYSTEM

Submitted by

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BONAFIDE CERTIFICATE

This is to certify that the project work entitled “SOLAR TRACKING SYSTEM” is the Bonafide work of AKASH A(22AI001),SANTHOSH RAJ P (22AI0047), SHARATH R (22AI049) who carried out the work under my supervision.

Signature of the Supervisor	**Signature of the HOD**
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Submitted for End semester PBL review held on ________________

SOLAR TRACKING SYSTEM

AIM:

The goal of this project is to create a smart IoT-based solar tracking system that can automatically adjust the position of solar panels to follow the sun throughout the day. This ensures maximum energy production, making solar power systems more efficient and reliable.

SCOPE:

This project addresses a critical challenge in solar power systems—inefficiencies due to the static positioning of solar panels. The solar tracking system is designed to be effective in various applications, such as residential solar installations, industrial solar farms, and remote off-grid systems. By leveraging IoT technology, the solution enables real-time tracking and optimization of panel orientation based on the sun's position. It significantly improves energy output and offers a scalable approach to enhancing renewable energy systems.

BRIEF HISTORY:

The Solar Tracker traditionally, solar panels were installed in fixed positions, which limited their efficiency as the sun's angle changed throughout the day. Early tracking systems relied on manual adjustments, which were cumbersome and prone to errors. Recent advancements in IoT and sensor technologies have revolutionized solar tracking systems. Modern systems now use real-time data to automatically adjust panel positions, significantly increasing energy efficiency and reducing operational costs. These innovations have paved the way for smarter and more sustainable solar energy solutions.

PROPOSED METHODOLOGY:

1.Sensor Integration:

- Use Light Dependent Resistors (LDRs) to detect sunlight intensity from multiple directions.
- Position at least four LDRs to measure light from the east, west, north, and south for accurate tracking.

2.Microcontroller and Motor Control:

- Use an Arduino UNO microcontroller to control the solar tracking system.
- Operate a dual-axis servo motor system to adjust the solar panel's orientation horizontally and vertically based on LDR input.

3.Real-Time Tracking and Adjustments:

- Implement an algorithm to continuously adjust the solar panel's position according to the direction of maximum sunlight intensity.
- Ensure smooth and accurate panel movements to optimize light absorption throughout the day.

4.Power Management:

- Incorporate a battery storage system to store energy generated during peak sunlight hours.
- Use charge controllers to regulate energy flow and prevent overcharging or power loss

COMPONENTS REQUIRED:

S.NO	COMPONENTS	NO'S
1	Solar panel	1
2	Arduino UNO Microcontroller	1
3	LDR	2
4	10K Resistor	2
5	Jumper Wires	As required
6	SG 90 servo motor	1

DESCRIPTION:

The solar tracking system is an IoT-based solution designed to maximize the efficiency of solar panels by automatically adjusting their orientation to follow the sun's movement throughout the day. The system uses light intensity sensors (such as LDRs) and an Arduino Nano microcontroller to monitor and analyze the sun's position in real time.

The sensors are strategically placed on the solar panel to detect variations in light intensity from different angles. This data is processed by the Arduino Nano, which determines the optimal angle for the panel to achieve maximum sunlight exposure. Servo motors are then used to adjust the panel's position accordingly. This real-time adjustment ensures that the solar panels remain aligned with the sun throughout the day, significantly improving energy capture compared to static panels.

To provide on-site feedback, an LED indicator shows the system's operational status. For more advanced functionality, the system can be integrated with an IoT platform or web-based interface, enabling users to monitor panel orientation and energy generation remotely. Realtime data and notifications can be accessed from anywhere, ensuring seamless operation and maintenance.

The design focuses on simplicity, cost-effectiveness, and scalability. Its modular approach makes it suitable for a wide range of applications, including residential solar setups, industrial solar farms, and remote off-grid systems. By incorporating IoT technology, the solar tracking system ensures automated and precise adjustments, improving the overall performance and reliability of solar power installations.

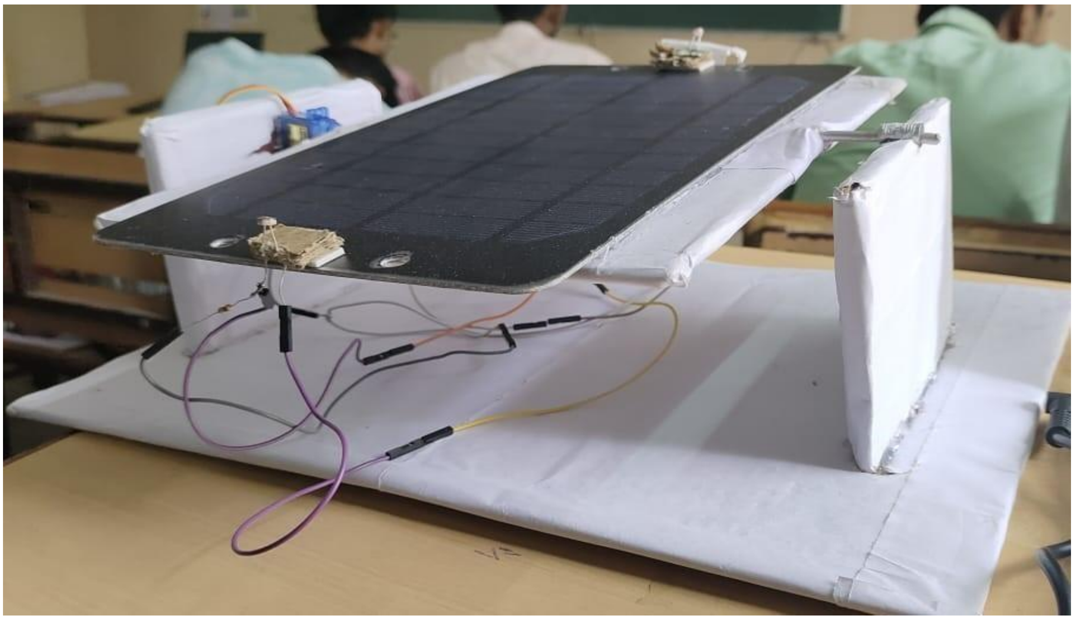
In addition to enhancing energy efficiency, this project supports the broader goal of sustainable energy management. Its ability to optimize solar panel performance and provide detailed operational insights helps reduce energy losses, contributing to a greener and more sustainable future.

CODING:

```
#include <Servo.h>
//Define the LDR sensor pins
#define LDR1 A0
#define LDR2 A1
//Define the error value. You can change it as you like
#define error 10
//Starting point of the servo motor
int Spoint =  90;
//Create an object for the servo motor
Servo servo;
void setup() {
//Include servo motor PWM pin
```

```
  servo.attach(11);
//Set the starting point of the servo
  servo.write(Spoint);
  delay(1000);
}

void loop() {
//Get the LDR sensor value
  int ldr1 = analogRead(LDR1);
//Get the LDR sensor value
  int ldr2 = analogRead(LDR2);

//Get the difference of these values
  int value1 = abs(ldr1 - ldr2);
  int value2 = abs(ldr2 - ldr1);

//Check these values using a IF condition
  if ((value1 <= error) || (value2 <= error)) {

  } else {
    if (ldr1 > ldr2) {
      Spoint = --Spoint;
    }
    if (ldr1 < ldr2) {
      Spoint = ++Spoint;
    }
  }
//Write values on the servo motor
  servo.write(Spoint);
  delay(80);
}
```

OUTPUT SCREENSHOT:



PROTOCOLS USED:

1. **Communication Protocols**
   I2C (Inter-Integrated Circuit):

   Used for communication between components such as a light intensity sensor and the microcontroller.

2. **Control Protocols**
   PWM (Pulse Width Modulation):

   Used to control the servo motors or DC motors for adjusting the solar panel position to track the sun.

   MPPT (Maximum Power Point Tracking):

   A widely used algorithm to ensure the solar panel operates at its maximum efficiency by adjusting its angle or electrical load.

3. **Sensor Protocols**
   SPI (Serial Peripheral Interface):

   Used for high-speed data communication with digital light sensors or real-time clock (RTC) modules for time-based tracking.

LIMITATIONS:

1. **Dependency on External Power:** The system relies on electricity or battery power for operation, which may not be readily available in remote areas.
2. **Maintenance Requirements:** Regular maintenance is needed to ensure motors and sensors function optimally, increasing operational costs.
3. **Environmental Factors:** Weather conditions (e.g., dust, heavy rain, snow) can obstruct sensors and affect tracking efficiency.
4. **Initial Cost:** The installation cost of solar tracking systems is significantly higher than fixed-tilt systems.
5. **Space Requirement:** Requires more land area than fixed systems due to the moving components and shading concerns

FUTURE ENHANCEMENT:

1. **AI Optimization**: Incorporate AI algorithms to predict optimal solar angles based on weather patterns for improved efficiency.
2. **Energy Self-Sufficiency**: Integrate solar-powered motors and sensors to eliminate dependency on external power sources.

3. **Durability Improvements**: Use weather-resistant materials to withstand extreme conditions and reduce maintenance costs.
4. **Low-Cost Models**: Develop cost-effective tracking systems to make solar tracking technology more accessible globally.
5. **Remote Monitoring**: Enable cloud-based systems for real-time performance tracking and remote troubleshooting
6. **Hybrid Tracking**: Combine active and passive tracking mechanisms to reduce power consumption while maintaining high efficiency.

CONCLUSION:

This project shows that using LDR sensors to track sunlight can significantly improve the energy output of solar panels. The system is cost-effective, easy to implement, and helps make better use of solar energy. It is a practical solution for homes, businesses, and large solar farms. In the future, the system can be improved with advanced technologies to make it even more accurate and efficient.