Proposed By :

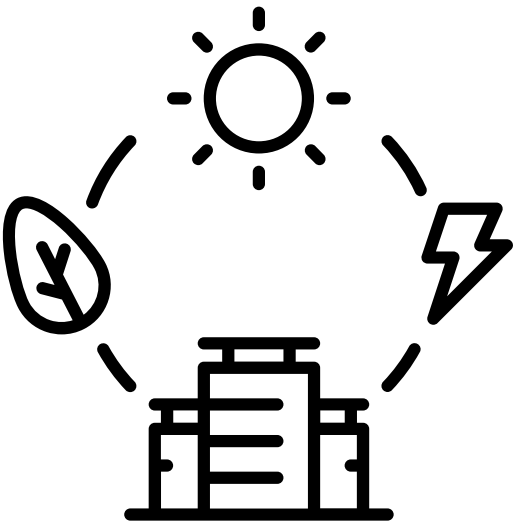
Rishitaa Prakash
Suhana Chandok
Aryan Saptute
Barath S S

SunWise

-a Smart Solar Tracker

Lighting up your entire home with just one solar panel

SENSOR TECH MINI PROJECT



Introducing SunWise:

Your **One-Panel** Powerhouse for Effortless Energy Independence!

Imagine **lighting up your entire home with just one solar panel**, tailored for nuclear families.
SunWise redefines solar tracking with precision IMUs and Light Dependent Resistors that pivot with the sun, optimizing energy generation.

SunWise is a **self-sustaining** marvel. It powers its own components using self-generated energy, channeling **excess power into supercapacitors** for later use. Witness your home run efficiently on **clean, renewable energy, reducing costs** and **carbon footprint.**

Embrace the future with SunWise's intelligent autonomy. Equipped with cutting-edge **image sensors**, it detects dirt and water particles on its solar surface, swiftly activating its **automated cleaning process**. A dance of a linear actuator and cleaning wiper leaves your panels sparkling, ensuring maximum efficiency year-round.
SunWise isn't just a tracker; it's a revolution in energy technology, **empowering homes**, and **preserving our planet**, **one panel at a time**.

Our vision doesn't stop here. SunWise's IMUs go beyond energy mastery, by detecting vibrations and notifying your **SunWise mobile app of potential theft or natural disasters** via wireless modules. SunWise: Where efficiency, innovation, and security unite to light up your world.

Objectives:

Maximize Energy Generation: The primary objective is to optimize the orientation of the solar panel to capture the maximum amount of sunlight throughout the day, leading to increased energy generation.

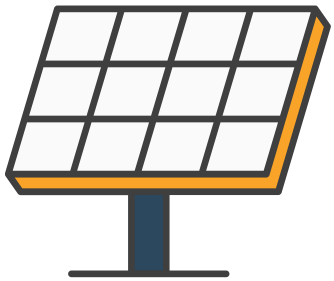
Optimal Power Production: The main goal is to consistently produce power at the highest possible level throughout the day, considering the sun's changing position.

Extend Equipment Lifespan: By optimizing the solar panel's orientation and minimizing stress on the structure, the system aims to extend the lifespan of the equipment.

Educational Purpose: The system can also be used for educational purposes to demonstrate the principles of solar energy, tracking technology, and sensor integration.

Demonstrate Green Technology: By using advanced tracking technology, the system showcases the practical application of green and sustainable energy solutions.

Components



01 Solar Panel:

A solar panel, also known as a photovoltaic (PV) panel, is a device that converts sunlight directly into electricity. It consists of multiple solar cells connected to generate usable electrical power. Solar panels are used to harness renewable energy from the sun and are a key component of solar energy systems

02 Sensors

2.1

LDR-Light Dependent Resistor:
This is an electronic component that changes its resistance based on the amount of light it is exposed to. It is arranged on the edge of the solar panel, LDR produces low resistance when light falls on them.

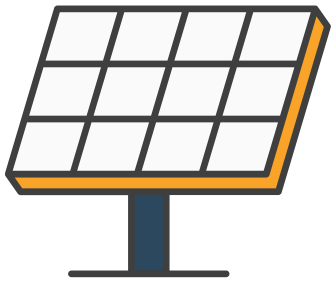
2.2

IMU (Inertial Measurement Unit)-HMC5883L:
The device is based on two concepts at the same time, the modeling of the solar trajectory adopted by an algorithm which calculates continuously the solar angles (elevation and azimuth) and the approval of these by the IMU to sweep away any climatic fluctuations and thus allow an almost perfect adjustment relative to the perpendicular axis of the rays. It simultaneously measures the tracked movement and combines it with perfect synchronization with the clock. With the collaboration of the sensors, it performs an almost absolute position tracking without giving in to external transmission or emission elements.

2.3

Image Sensor:
The sensor converts the light patterns into electrical signals, creating a digital image of the object. The captured image is then processed using image analysis techniques to identify potential areas of dirt, water or contamination. Image processing algorithms can detect variations in color, texture, and intensity that are indicative of dirt or stains. It can be trained by a dataset of clean and dirty objects. Once trained, the model can identify dirty objects based on learned patterns. This data is sent to the microcontroller so that it can send the final commands to the linear actuator which will in turn command the wiper to clear the dirt/water on solar panel.

Components



03 Microcontroller

ATmega328:

The ATmega328 is part of the AVR microcontroller family and is commonly found in Arduino boards such as the Arduino Uno. Solar trackers need to detect the direction of the sunlight, light-dependent resistors (LDRs) are connected to the analog input pins of the ATmega328. Solar trackers often use motors to adjust the position of solar panels, this will done with the help of servo motor, The ATmega328 can generate PWM signals to control the speed and direction of these motors.

04 Actuators

4.1

Servo Motor-SG90:

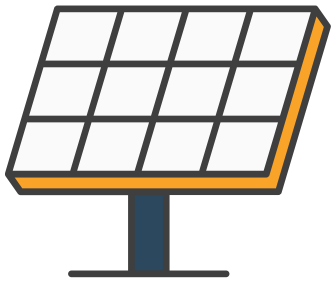
The SG90 servo motor is known for its compact size and lightweight design. Attach the solar panel to the output shaft of the SG90 servo motor. The solar tracker's microcontroller (like the ATmega328) generates a Pulse Width Modulation (PWM) signal. This signal is a series of high and low voltage pulses, where the width (duration) of the pulses corresponds to the desired servo motor position. The PWM signal is sent to the control wire of the SG90 servo motor. Now the servo motor will adjust the solar panel to the desired target angle.

4.2

Electric Linear Actuator- DC-12V:

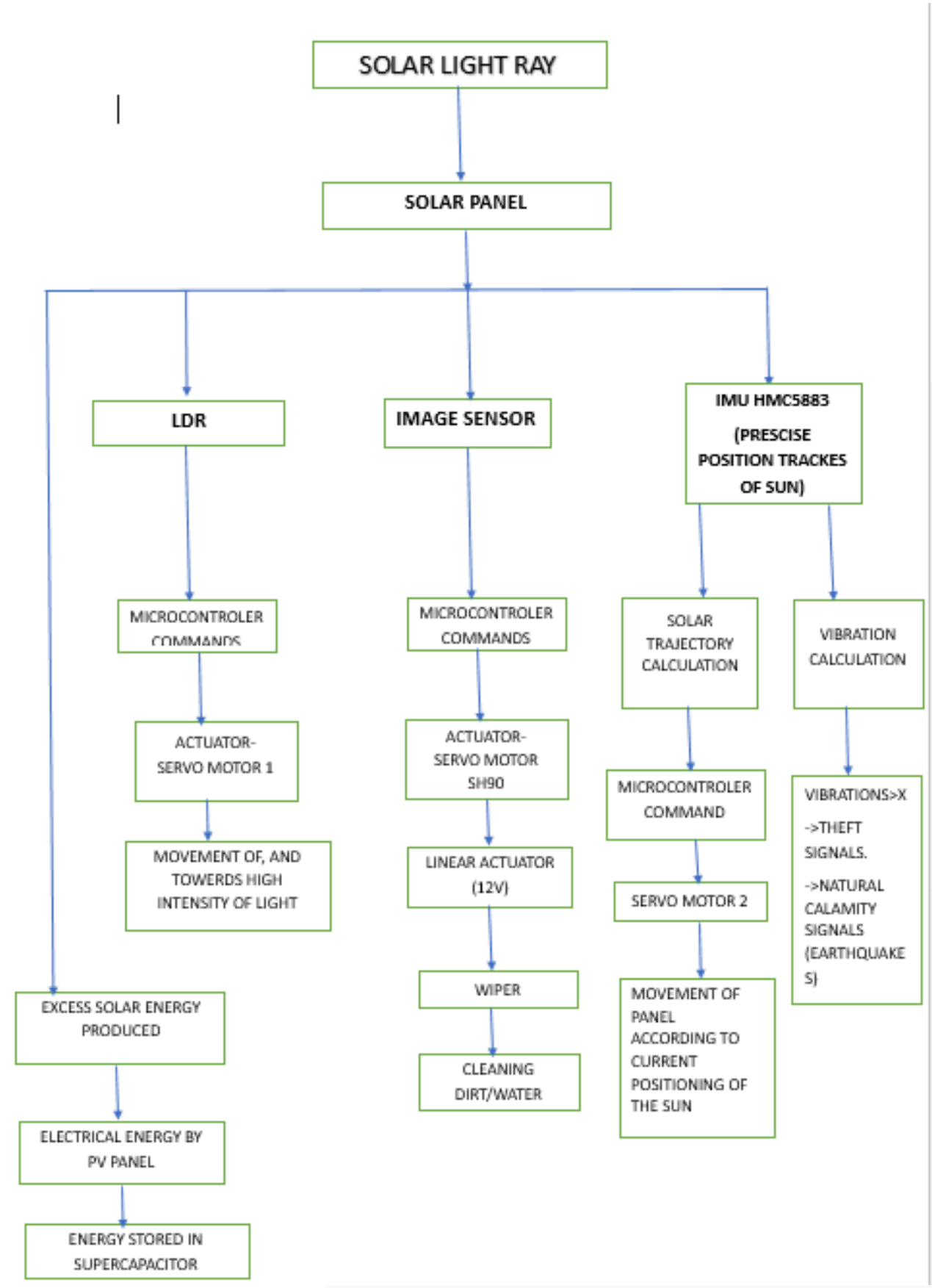
The linear actuator is driven by an electric motor, which is typically a DC motor. This motor generates rotational motion when powered. The rotational motion from the motor is converted into linear motion using a lead screw or a gear mechanism. This linear motion is used to push or pull the wiper assembly. This assembly is attached to the moving part of the linear actuator, as the linear actuator moves, it drags the wiper assembly along the surface of the solar panel.

Other Components

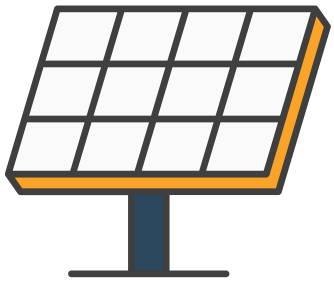


10KΩ x 3
16MHz Crystal
22pF Ceramic Capacitors
Push Button
Breadboard
Cardboard
Connecting Wires
Cleaning Wiper

Block Diagram:

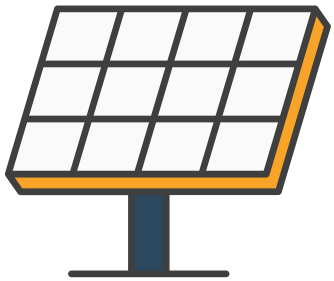


Pseudocode:



```
#include <Servo.h>

Servo myservo;
int ldr1 = 4;
int ldr2 = 5;
int val1;
int val2;
int pos=90;
void setup()
{
 myservo.attach(11);
 Serial.begin(9600);
 myservo.write(pos);
}
void loop()
{
 val1 = analogRead(ldr1);
 val2 = analogRead(ldr2);
 val1 = map(val1, 0, 1023, 0, 180);
 val2 = map(val2, 0, 1023, 0, 180);
 if(val1 > (val2+50))
 {
 if(pos<180)
 pos=pos+1;
 myservo.write(pos); Serial.println("backward");
 delay(10);
 }
 else if(val2 > (val1+50))
 {
 if(pos>0)
 pos=pos-1;
 myservo.write(pos);
 Serial.println("forward");
 delay(10);
 }
```



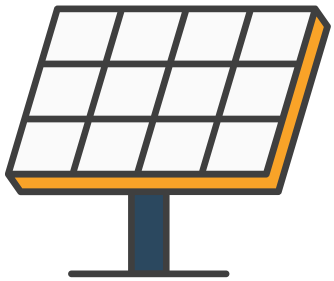
Focused Sustainable Development Goals

1) AFFORDABLE AND CLEAN ENERGY

2)SUSTAINABLE CITIES AND COMMUNITIES

3)RESPONSIBLE CONSUMPTION AND PRODUCTION

Safety Constraints:



LDR:

- **Phototransistors are vulnerable to surges, spikes and EM energy . See to that for any interfererences.**
- **Ensure that your circuit is designed correctly, with the appropriate voltage and current ratings for the LDR and any accompanying components.**
- **Be mindful of any heat generated by the LDR or other components in your circuit.**
- **Ensure proper ventilation and heat dissipation to prevent overheating.**
- **If the LDR circuit is used in an outdoor or harsh environment, consider using appropriate enclosures to protect it from moisture, dust, and physical damage.**

SG 90 MICRO SERVO:

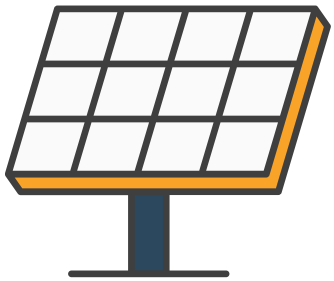
- **Ensure that you provide the motor with the correct voltage.**
- **Make sure the load applied to the servo horn or arm does not exceed the motor's specified torque rating.**
- **Keep the servo control signal within the recommended pulse width range, typically 1000µs to 2000µs.**

SOLAR PANEL:

- **Solar panels require periodic maintenance to ensure optimal performance and safety.**
- **Keep the roof clean and free from debris that can obstruct panel access.**
- **Install proper disconnect switches to isolate the system during emergencies.**

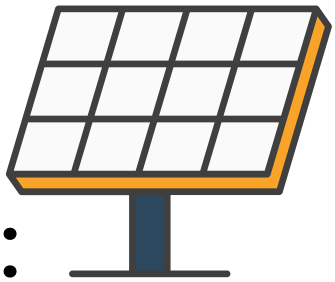
IMU:

- **Implement proper data processing algorithms to filter and interpret the sensor's data accurately. Noise in the data can lead to erroneous results.**
- **If the sensor is subjected to excessive vibration or shock, it can affect its performance. Securely mount the sensor to prevent these issues.**
- **The HMC5883L is sensitive to magnetic interference from nearby electronic devices, ferrous materials, or other magnets. To ensure accurate readings, keep the sensor away from sources of magnetic interference.**



Ethical Constraints

- The Solar panel should not be placed in very close proximity to the people residing in the area which may hinder their daily activities and would cause any potential harm to them.
- Access to solar energy device should be equitable, and efforts should be made to ensure marginalized communities can benefit from solar power. This includes addressing financial barriers, policy disparities, and infrastructure limitations.
- Adhere to the terms and conditions of the government laws where the device is being implemented and have it approved.
- Solar panels with integrated technology should respect individuals' privacy rights. Data collected should be handled responsibly and securely.



References & Datasheets:

https://chat.openai.com/

LDRs:
https://components101.com/sites/default/files/component_datasheet/LDR%20Datasheet.pdf

IMU-HCM5883L:
https://www.alldatasheet.com/datasheet-pdf/pdf/428790/HONEYWELL/HMC5883L.html

ATmega328:
https://www.alldatasheet.com/datasheet-pdf/pdf/392243/ATMEL/ATMEGA328.html

SG90:
http://www.ee.ic.ac.uk/pcheung/teaching/DE1_EE/stores/sg90_datasheet.pdf

12V Linear Actuator:
https://www.pololu.com/file/0J1238/LD-Linear-Actuator-Data-Sheet-201208.pdf

Supercapacitor:
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