Rules :

1. Rain Sensor

Purpose: Detects when rain is present or expected. Rain can naturally clean the panels, thus avoiding unnecessary manual cleaning.

Sensor Example: Rain Detection Sensor Module.

Criteria for Cleaning: If rain is detected, cleaning may not be necessary.

Threshold:

No Rain Detected: Check other sensor values to determine if cleaning is needed.

Rain Detected: Suspend cleaning and monitor for further dust accumulation post-rain.

Explanation: Rain naturally cleans solar panels, and if rain is detected or expected, the system can delay cleaning. After the rain, dust accumulation sensors can reassess whether cleaning is still required.

1. Temperature Sensor

Purpose: Solar panels operate less efficiently when they are overheated. A temperature sensor can help identify if overheating is due to dust accumulation.

Sensor Example: DS18B20 (Temperature Sensor).

Criteria for Cleaning: If the panel temperature exceeds the normal operating range.

Threshold:

Normal Temperature: 25 – 40°C (No cleaning required)

Moderate Overheating: 40 – 60°C (Monitor for dust accumulation)

Severe Overheating: >60°C (Initiate cleaning to reduce overheating caused by dust)

Explanation: Overheating can be exacerbated by dust accumulation, causing a drop in efficiency. Cleaning the panels helps maintain optimal operating temperatures.

1. Humidity Sensor

Purpose: Measure the moisture in the air to determine if natural cleaning (e.g., rainfall) is likely to help with panel cleaning, or if the conditions are right for manual cleaning (e.g., water availability).

Sensor Example: DHT11/DHT22 (Temperature and Humidity Sensor).

Criteria for Cleaning: Humidity levels combined with dust or dirt accumulation may trigger cleaning if no rain is expected.

Threshold:

High Humidity (>80%): No cleaning (potential rain may naturally clean the panels)

Low Humidity (<50%) and high dust: Initiate cleaning manually

Explanation: If humidity is high, it’s likely that rain is imminent, which can naturally clean the panels. If humidity is low and dust accumulation is high, the system should initiate cleaning.

Links:

3. Humidity Sensor Thresholds

Source: "Rainfall and Dust Effects on Solar Energy Output" - ResearchGate.

Link: https://www.researchgate.net/publication/265510429

Source: DHT22 (Humidity Sensor) Product Specification.

Link: https://cdn.sparkfun.com/datasheets/Sensors/Temperature/DHT22.pdf

4. Rain Sensor Thresholds

Source: "Rainwater as a Means to Clean PV Panels" - Elsevier Journal of Cleaner Production.

Link: https://www.sciencedirect.com/science/article/pii/S0959652618310890

Source: Rain Detection Sensor Module Specification.

Link: <https://www.dfrobot.com/product-848.html>

7. Temperature Sensor Thresholds

Source: "Temperature Effects on Solar Panel Efficiency" - Journal of Solar Energy.

Link: https://www.sciencedirect.com/science/article/pii/S0038092X05000059

Source: DS18B20 Temperature Sensor Product Specification.

Link: <https://datasheets.maximintegrated.com/en/ds/DS18B20.pdf>