

## Problem Statement

The rapid adoption of solar energy has made it one of the most sustainable solutions for meeting global power demands. However, maintaining the efficiency of solar panels is a major challenge. Dust accumulation, physical damage, and improper cleaning reduce energy output and increase maintenance costs. Traditional inspection methods require manual checking, which is time-consuming, expensive, and sometimes unsafe. To address this issue, this project aims to develop an AI-based Solar Energy Image Classifier that can automatically identify the condition of solar panels — such as Clean, Dusty, or Broken — using Convolutional Neural Network (CNN) and image processing techniques. The trained model classifies solar panel images with high accuracy and can be integrated into a web application for real-time analysis. This system helps promote renewable energy efficiency, reduces human effort, and supports sustainable energy management.

## Solution for Problem Statement

To overcome the challenges in monitoring solar panel efficiency, this project proposes an AI-based Solar Energy Image Classifier using Convolutional Neural Networks (CNN) and image processing. The system automatically identifies whether a solar panel is Clean, Dusty, or Broken from input images, eliminating the need for manual inspection. The solution is developed using the Google Colab environment with TensorFlow/Keras for model training. The CNN model is trained on a Kaggle solar panel image dataset, which contains different categories of solar panel conditions. Image preprocessing techniques such as resizing, normalization, and data augmentation (flip, rotation, zoom) are applied to improve accuracy and model performance. After training, the model achieved an accuracy of around 97–98% in classifying solar panel conditions. The trained model is then converted to TensorFlow.js format and integrated into a web application, allowing users to upload solar panel images and instantly get predictions on their condition. This automated classification system helps:

- Reduce manual labor and inspection time
- Increase solar panel maintenance efficiency
- Promote renewable energy usage and sustainability

By implementing this AI-based solution, industries, institutions, and individuals can efficiently monitor solar energy systems and support a cleaner, sustainable environment.

## Dataset Name

Solar Panel Image Classifier

## About the Dataset

The dataset used in this project contains real-world images of solar panels under different conditions. It is designed for image classification and fault detection in solar energy systems. The images are categorized into three main classes:

Class Name	Description
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Clean	Solar panels that are clean and functioning properly
Dusty	Panels covered with dust or dirt, reducing power efficiency
Broken	Damaged or cracked panels that require maintenance or replacement

Before training, all images are resized to 224x224 pixels and normalized. Data augmentation (random rotation, flipping, zooming) is applied to improve accuracy and generalization. This dataset is ideal for renewable energy-based AI image processing projects as it focuses on solar panel maintenance and sustainability.

Source: Kaggle

### Main Steps of the Project

- Collect, Clean & Preprocess the Dataset
- Design & Train the CNN Model Using Teachable Machine / Google Colab
- Validate, Evaluate & Optimize the Trained Model
- Develop an Interactive Web-Based Interface
- Integrate, Test & Refine the Complete Application
- Deploy, Document & Present the Final Solution