# Project Title: Solar Detection Project

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## Concept Note

### 1. Project Overview

The Solar Detection Project aims to identify solar panels or solar installations in satellite imagery using machine learning models. This project contributes to Sustainable Development Goal (SDG) 7: Affordable and Clean Energy by enabling better tracking of solar energy adoption, thereby promoting sustainable practices and energy efficiency. The relevance to SDG 7 is underscored by its alignment with Target 7.2, which focuses on increasing the share of renewable energy in the global energy mix. By automating the detection process, the project seeks to address the challenges associated with manual tracking of solar panel installations, particularly the variability in image quality and geographic diversity [10].

### 2. Objectives

This project aims to develop a deep learning model utilising satellite imagery for accurate solar panel detection. Specifically, our objectives include:

* Building a neural network capable of identifying solar panels from satellite images with high accuracy.
* Creating a platform where users can input geographic information and receive data on solar panel distribution in their area.
* Leveraging available datasets from sources like Kaggle and real-time satellite data to enhance model performance [11].

### 3. Background

Solar energy adoption has grown into a critical strategy for achieving global sustainability goals, driven by the need to reduce greenhouse gas emissions and mitigate climate change **[1]**. Despite its rapid expansion, monitoring solar panel installations remains a complex task that requires detailed geographic data and robust detection systems [2]. Recent advances in satellite imagery and machine learning have introduced new ways to automatically detect solar panels, which is essential for analysing regional solar energy adoption trends [3]. The project will focus on overcoming the challenges posed by traditional image processing methods, which often struggle with cloud cover, shadows, and other occlusions that can obscure solar panels [4].

### 4. Methodology

The conceptual framework of this project integrates machine learning techniques, particularly Convolutional Neural Networks (CNNs), which are commonly used for image classification tasks like solar panel detection [5]. The project will involve the following steps:

* Data Preprocessing: Clean and prepare the satellite images (e.g., resizing, normalisation).
* Model Development: Train and fine-tune a CNN model using labelled data for solar panel detection.
* Ensemble Approach: Combine outputs from different models (e.g., Logistic Regression, CNN) to improve accuracy.
* Evaluation: Validate the model against a diverse test dataset to ensure generalizability across different environments [6].

### 5. Architecture Design Diagram

The architecture of the project is as follows:

### 6. Data Sources

We’ll use real estate imagery provided by Gmaven Real Estate if we can get but will proceed with data from Internet, Kaggle or GitHub repo The dataset will include diverse examples of solar panels, various lighting conditions, and different angles.

### 7. Literature Review

Recent studies highlight the potential of deep learning approaches for solar panel identification. Research demonstrates that CNNs can effectively detect solar panels across various environments with high accuracy, using publicly available datasets like those on Kaggle [7,8].

## Implementation Plan

### 1. Technology Stack

• Python (for ML model development)

• TensorFlow or PyTorch (for CNN implementation)

• Scikit-learn (for logistic regression)

• OpenCV (for image processing)

• Jupyter Notebooks (for experimentation)

### 2. Timeline

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### 3. Milestones

• Data acquisition: Done

• Initial logistic regression model training: Not done

• CNN model: Not Done

• Ensemble approach implementing: Not Done

• Evaluation metrics (precision, recall, F1-score): Not Done

### 4. Challenges and Mitigations

• Data Imbalance:

• Address class imbalance during training.

• Complex Backgrounds:

• Consider segmentation techniques to handle rooftops, trees, etc.

• Generalisation:

• Ensure the model works well on unseen data.

### 5. Ethical Considerations

• Transparency: Communicate data usage and privacy.

• Fairness: Evaluate model performance across demographics.

• Accountability: Document decisions and model behaviour.

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