AI-Powered Rooftop Solar Analyzer

An AI-based tool that uses satellite imagery to identify usable rooftop areas for solar panel installation, calculate potential energy output, estimate ROI, and provide a natural-language summary—all **offline**, with **no API cost**.

Project Overview

This project was completed as part of a 48-hour internship assessment. It combines computer vision and language models to deliver solar installation assessments from rooftop images.

Features

- **Rooftop Detection**: Uses Segment Anything (SAM) for precise rooftop segmentation.
- ☀**Solar Potential Calculator**: Estimates system size, cost, ROI, and energy output.
- **LLM Summary**: Generates a natural language summary using TinyLlama (offline).
- **Visual Overlay**: Annotated output image with rooftop areas and area labels.
- **Gradio UI**: Simple interactive interface for upload and results.

Setup Instructions

1. **Install dependencies** (in Google Colab or locally):

```
pip install -r requirements.txt
```

2. **Run the Colab notebook** (`app.ipynb`) or launch with Python + Gradio.

3. **Upload a rooftop satellite image**.

4. **Get results**:
    - Annotated rooftop image
    - Solar analysis report
    - LLM-generated summary

Example Output

Image:

Annotated

Rooftop

Solar Report:

```
Usable Area (m²): 43.36
Estimated System Size (kW): 8.58
Annual Output (kWh): 15667.56
Installation Cost (₹): 429248.16
Savings/Year (₹): 125340.46
Payback Period: 3.42 years
```

AI Summary:

Your rooftop can support an 8.58 kW solar system, producing approximately 15,667 kWh annually. With an investment of ₹4.29L, you can expect annual savings of over ₹1.25L. The system will pay for itself in about 3.4 years — a smart move
for clean energy.

Tech Stack

- Python, OpenCV, NumPy
- Segment Anything (SAM) from Meta
- Hugging Face Transformers (TinyLlama)
- Gradio for the web UI

Future Improvements

- Fine-tuned rooftop segmentation (SAM + satellite pretraining)
- Real-world ROI data (location-based pricing, incentives)
- Live deployment via Hugging Face Spaces
- Dynamic weather/irradiance factors for seasonal ROI

Internship Assessment Rubric Coverage

- LLM Integration (offline)
- Vision AI (SAM)
- Prompt Engineering & Output Structuring
- ROI Computation and Response Accuracy
- Web UI (Gradio)
- Clean Code, Documentation, Use Case Examples

Developed by: **Devraj Singh**

B.Tech | Arka Jain University

AI Intern | Wattmonk Solar Industry Internship