Solar Panel Installation Verification System

□ Overview

This project is a **Solar Panel Installation Verification System** built using **Python** and computer vision techniques. The system verifies whether solar panels installed at a location match satellite imagery, helping validate installations accurately and efficiently.

The project includes both **GUI-based** and **command-line** interfaces, image processing modules, and automated result generation.

□ Project Structure

```
galaxy project/
│
├── solar image.jpg                # Sample solar panel image
├── satelie image.jpg              # Sample satellite image
│
├── solar-verification-system/
│   ├── main.py                    # Main application entry point
│   ├── launcher.py                # Application launcher (Python)
│   ├── launcher.bat               # Windows batch launcher
│   ├── gui_app.py                 # GUI application logic
│   ├── gui_tkinter.py             # Tkinter-based GUI
│   ├── image_processor.py         # Image processing & comparison logic
│   ├── verifier.py                # Verification algorithms
│   ├── config.py                  # Configuration settings
│   ├── requirements.txt           # Python dependencies
│   ├── QUICKSTART.py              # Quick start helper script
│   ├── FILE_STRUCTURE.md          # Detailed file structure
│   ├── INDEX.md                   # Project index documentation
│   ├── README.md                  # Module-level documentation
│   └── verification_results/      # Generated verification result images
│
└── .venv/                         # Virtual environment (auto-generated)
```

□ Technologies Used

- **Python 3.12+**
- **OpenCV** – Image processing
- **NumPy** – Numerical operations
- **Tkinter** – GUI interface
- **Pillow (PIL)** – Image handling

□ Getting Started

1□ Setup Virtual Environment (Recommended)

```
python -m venv .venv
source .venv/bin/activate   # On Linux/Mac
.venv\Scripts\activate      # On Windows
```

2□ Install Dependencies

```
pip install -r solar-verification-system/requirements.txt
```

3□ Run the Application

GUI Mode

```
python solar-verification-system/main.py
```

or simply double-click:

```
launcher.bat
```

Quick Start Script

```
python solar-verification-system/QUICKSTART.py
```

□ How It Works

1. User uploads a **solar panel image**
2. System loads **satellite imagery** for comparison
3. Computer vision algorithms detect and analyze solar panels
4. Results are generated and saved in `verification_results/`
5. GUI displays verification outcome visually

□ Output

- Annotated verification images
- Timestamped result files
- Visual comparison between satellite and ground images

✓Use Cases

- Solar installation verification
- Renewable energy auditing
- Academic and computer vision projects
- Smart city infrastructure validation

□ Future Enhancements

- Machine learning–based panel detection
- Cloud-based satellite image integration
- Web-based interface
- Accuracy scoring and reporting

□ License

This project is intended for **educational and academic use**.

□□ Author

Developed as a **Junior Project (JR Project)** focusing on computer vision and renewable energy verification.

If you want, I can also: - Simplify this README - Convert it to **GitHub-ready format** - Add **screenshots & diagrams** - Write a **project report or PPT**