A User Interactive GUI for Integrated Design of PV Systems

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Abstract

India's power generation sector is dominated by fossil fuels, especially coal, accounting to about three-fourths of the total electricity generated in 2017-18. Depleting fossil fuels has paved way for utilization of renewable forms of energy like solar, although solar is economically not very feasible, with government tax rebates and incentives it makes it more sustainable. Extensive design tools for PV system design are available which provide the user with design parameters for all kinds of solar installations. The existing PV system design tools are used in a myriad of applications by engineers, architects and researchers. These system design tools provide a detailed description of the procedures and various models that are used for the purpose of PV installation. In this project, a GUI is developed which provides the user an open source user friendly design tool to give an overview of both the technical and the economical aspects for PV installation. With the in-house design, the specific lacuna in the existing PV system design tools have been addressed.

Key Features

This GUI provides comprehensive design specifications for various configurations of a PV system. It includes Economic Evaluation to estimate the investment required by the prosumer/producer for all kinds of PV systems. The tool gives the design of the system based on Location of installation and type of Solar Panel selected by the user.

◆***Stand Alone PV system design:***

- Optimized algorithm for battery sizing of stand alone system which enables reduced battery cost by eliminating oversizing of the battery capacity
- Provides adjustable 'Days of autonomy' for sizing the storage which can be set according to user needs
- Estimates the available PV generation in Units at the location of installation and gives the average Annual Loss of Load due to generation deficit in certain months of the year

◆***Grid-Tied PV system design:***

- Provides the complete design for available Roof-Top area
- Estimates the required area for a given kWp rating of PV panel
- Provides the Inverter Specifications based on Utility Sanctioned Load at the site of installation
- Estimates the average daily generation units in each month of the year based on Panel rating and available sunlight at the location of installation

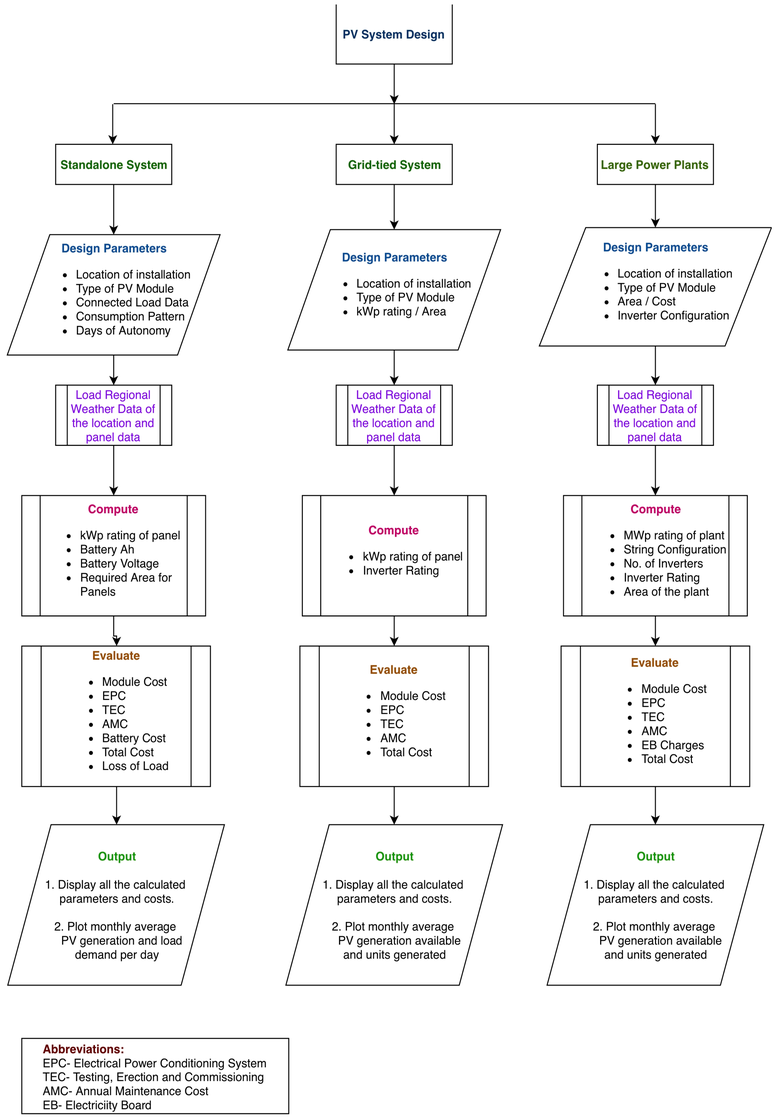
◆***PV Power Plant design:***

- Provides a detail design of a Power Plant by either considering the available plant area or the investment amount
- Provides various power plant designs based on inverters and string configurations for reliable operation
- Estimates the average daily generation units in each month of the year based on plant rating and available sunlight at the location of the plant

Development of GUI

The GUI developed has three tabs: standalone system design, grid-tied system design and large PV plant design. The various user inputs and design outputs of the GUI are as described in the flowchart below.

Flowchart For PV System Design Using The GUI



Acknowledgements

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Results

The GUI developed is used to obtain the design of a standalone PV system by considering a Average Household Load Database. For designing a Grid-Tied PV system, a 5kW sanctioned load building with an available area of 60 m^2 is given to the GUI. For the design of a Large PV plant, an available land area of 8000 m^2 is given as the input to the GUI. The figures below show the outputs for the aforesaid Design inputs.

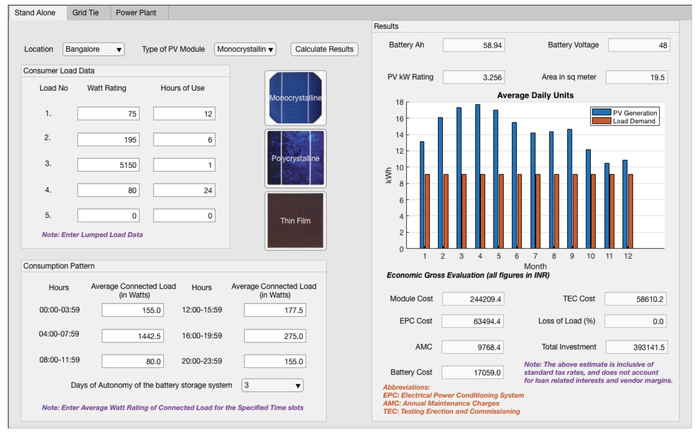

Figure 1: Design of Stand Alone PV system using the GUI

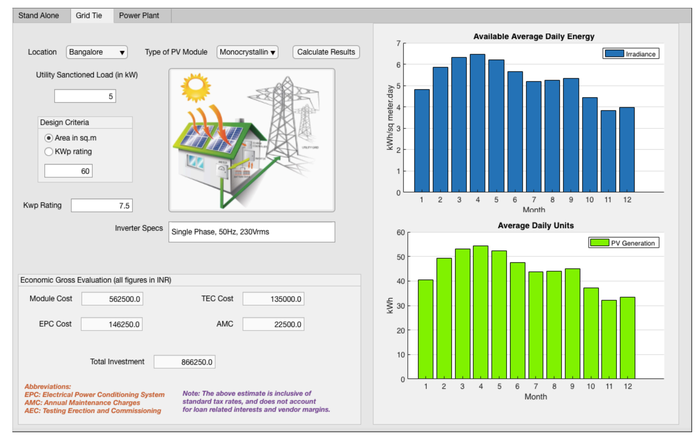

Figure 2: Design of Grid-Tied PV system using the GUI

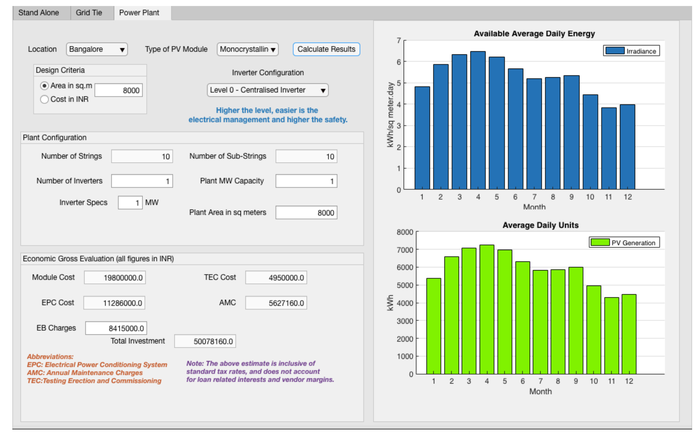

Figure 3: Design of PV Power Plant using the GUI