



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 3, March 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

# Automation of PV system integrated with Main grid

M. Ruchitha, P. Uma Rani, Ch. Sai Murari, N. Rithin

U.G. Students, Department of Electrical and Electronics Engineering, Anurag University, Hyderabad, Telangana, India

**ABSTRACT:** The PV (Photo Voltaic) system also known as roof top solar power system used as domestic power plant is intended to provide single phase supply source to the house. Often these are low power plants capable of supplying energy to the common gadgets like Fans, lights, etc. and this power source is not sufficient to drive the heavy loads like AC's, Geezer's, etc. During normal load condition, the PV system provides supply to the normal loads and when the high load device is energized, automatically entire load will be shifted over the main power source. When the main power source is in use, the beep circuit built with timer IC will be energized to alert the energy user. Means, the concept presented here is aimed to switch over the loads over the main grid automatically when solar power system is over loaded.

**KEYWORDS:** Photo Voltaic (PV) system, Main Grid, Normal load condition, Heavy load condition, Automatic Load switching.

## I. INTRODUCTION

The non-renewable energy supplied by the electricity department is not able to meet the demand of people & because of that people are accepting regular power cuts. To overcome this problem this project work is taken up, which is designed to utilize solar energy for driving the low load domestic appliances like ceiling fan, TV, tube light, etc. The Photo voltaic System designed with power MOSFETS and PWM chip is designed to utilize solar energy, by which any low load domestic electrical appliance stated above can able to energize when required. Since it a prototype model, the power system designed here can able to deliver a max power of 60Watts and therefore we can energize 2 LED tube lights comfortably.

The main aim of this project is to switch the load over mains supply when the load applied over the solar power inverter exceeds a limit of 60W. The concept is to generate non-renewable energy from renewable energy resources. Among many renewable energy resources, one way is to use the solar energy to generate electricity directly from the sunlight by photovoltaic conversion. The advancement in science and technology brought out by mankind had lead to developments like the photovoltaic cell. Solar panels have many numbers of P V Cells. The power we receive from Solar Panel is directly proportional to the intensity of light from the sun that incident on the panel.

## II. RELATED WORK

Here are a few research papers that discuss the automation of PV systems integrated with the main grid: "Automation and Control Strategies for Grid Integration of Photovoltaic Systems" by J. Patel et al. This paper focuses on the automation and control strategies required for the seamless integration of PV systems with the main grid, ensuring efficient and reliable power flow [1]. "Advanced Monitoring and Control Techniques for Grid-Connected PV Systems" by A. Gupta et al. This paper explores advanced monitoring and control techniques that enable the automation of PV systems, ensuring effective integration with the main grid and optimal power generation [2].

"Grid-Connected Photovoltaic Systems: Challenges and Solutions for Automation" by S. Sharma et al. This paper addresses the challenges associated with the automation of grid-connected PV systems and proposes solutions to ensure smooth integration with the main grid [3]. "Intelligent Control and Management of Grid-Integrated Photovoltaic Systems" by M. Singh et al. This paper discusses intelligent control and management techniques for PV systems integrated with the main grid, focusing on optimizing power generation, grid stability, and energy management [4].

### III. METHODOLOGY

Developing a methodology for the automation of a photovoltaic (PV) system linked with the main grid involves several key steps, encompassing both the technical aspects of automation and the considerations of grid integration. Here's a structured methodology:

#### 1. Define Project Objectives and Requirements:

- Clearly define the objectives of PV system automation, such as maximizing energy production, improving grid stability, or enhancing system reliability.
- Identify specific requirements based on project goals, site conditions, regulatory standards, and grid interconnection guidelines.

#### 2. Site Assessment and System Design:

- Conduct a thorough site assessment to understand solar resource availability, shading, geographic location, and local climate conditions.
- Design the PV system layout considering factors like system capacity, PV module selection, inverter type, and energy storage (if applicable).
- Determine the optimal placement of sensors, monitoring equipment, and communication infrastructure.

#### 3. Sensor Deployment and Data Acquisition:

- Select appropriate sensors for monitoring solar irradiance, temperature, PV array voltage, current, and grid parameters like voltage and frequency.
- Deploy sensors strategically across the PV system to capture relevant data for control and monitoring purposes.
- Establish a robust data acquisition system to collect, process, and transmit sensor data to the control system.

#### 4. Control Strategy Development:

- Develop control algorithms and strategies to optimize PV system operation and ensure seamless integration with the main grid.
- Implement algorithms for Maximum Power Point Tracking (MPPT) to generate maximum amount of energy from Photo voltaic modules under varying environmental conditions.
- Design control logic for voltage regulation, frequency control, and reactive power compensation to maintain grid stability & quality.

#### 5. Integration with Energy Management System (EMS):

- Integrate the PV system automation with an Energy Management System (EMS) or (SCADA) system for centralized monitoring and control.
- Develop interfaces for communication between the PV system controller and the EMS/SCADA platform, using standard protocols like Modbus, DNP3, or IEC 61850.

#### 6. Testing and Validation:

- Conduct thorough testing of the automation system in simulated and real-world conditions, including normal operation, transient events, and fault scenarios.
- Use simulation tools, hardware-in-the-loop (HIL) testing, or field trials to validate control algorithms and ensure system performance meets design specifications.
- Verify compliance with relevant grid codes, standards, and safety regulations.

#### 7. Grid Connection and Commissioning:

- Coordinate with grid operators and utility companies to ensure compliance with grid interconnection requirements, including grid connection agreements and safety certifications.
- Perform commissioning tests to verify the functionality and performance of the automated PV system in conjunction with the main grid.

#### 8. Monitoring, Maintenance, and Optimization:

- Establish a comprehensive monitoring and maintenance plan to monitor system performance, diagnose faults, and implement corrective actions.
- Implement remote monitoring capabilities to enable real-time monitoring of key performance indicators and facilitate proactive maintenance.
- Continuously optimize system operation based on performance data, feedback from grid operators, and advancements in automation technology.



#### 9. Documentation and Training:

- Document the automation methodology, control algorithms, system architecture, and commissioning procedures for future reference.
- Provide training to operators, maintenance personnel, and stakeholders on the operation, maintenance, and troubleshooting of the automated PV system.

#### • 10. Continuous Improvement and Adaptation:

- Continuously monitor industrial trends, technological improvements, and regulatory changes
- to identify opportunities for system improvement and adaptation.
- Undertake periodic reviews and assessments to evaluate the effectiveness of automation strategies and identify areas for optimization or enhancement.

By following this structured methodology, stakeholders can effectively plan, implement, and operate an automated PV system integrated with the main grid, ensuring optimized performance, grid stability, and compliance with regulatory requirements.

### IV. EXPERIMENTAL RESULTS

#### Under normal condition:

In this case, when solar panel is kept under sun light, when solar light incident on panel, solar cell will convert the solar energy directly to electrical energy. This generated energy is stored in 12V battery.

When panel is in bright sun then the LED glow brighter and if no solar light falls on solar panel then LED doesn't glow.

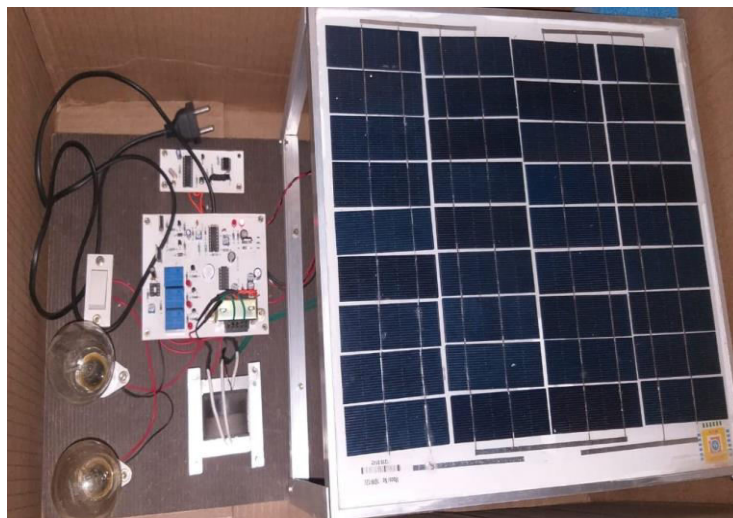


Fig 1: Under normal condition:

#### During light load Device ON:

This model can deliver a maximum power of 60W, so if a device which uses a power upto 60W, then the inverter circuit works. In this case power is taken from battery which makes the first bulb glow.



Fig 2: During light load Device ON

### During heavy load device is ON:

In this case overload is indicated by glowing two bulbs. As it is overloaded so, entire load is shifted to main grid automatically. When it is overloaded and power is drawn from main grid then a buzzer sound is given.

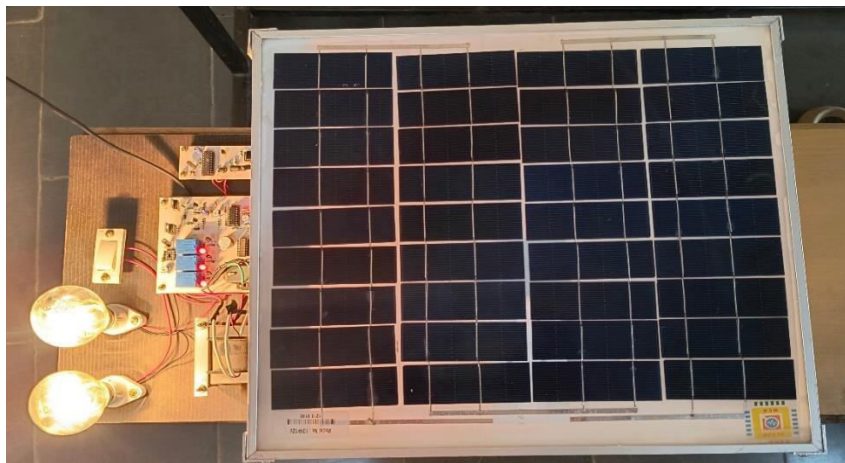


Fig 3: During heavy load device is ON

### V. CONCLUSION

The work “Automation of PV system integrated with main grid” is designed, tested and a demo unit is fabricated. Since it is a prototype model, a low power inverter is made which can able generate a maximum current of 300 milliamps at 220V at the system output. But for any real time, home applications, a high rating inverter can be made which can able to deliver high power that satisfy the requirements.

The most important purpose of this project work is to reduce the electricity bill that is received by people by using the PV system. The PWM IC used here is having dual inverted output by which the drive stage is made with NPN power MOSFETs and it is configured in push-pull mode of operation by which switching losses can be minimized and high efficiency can be obtained from the power system.

In our trial runs we found that greater than 80% efficiency is achieved. Protection circuits are not included in this project, because it is designed to deliver less power. In general, the higher rating inverters are equipped with thermal protection over load cut off circuits, etc. the load applied to the inverter is monitored using load monitoring circuit with CT. The system will shut-down immediately, when load exceeds more than the rated value. After reducing the load and by activating the reset button power will be resumed.



In this project proto type solar energy is used to charge the 12V battery, this is one type of method, which comes under renewable method of power generation. Here, in this project Sun is the main source of the energy generation; the energy that we get from the sun is in the form of electromagnetic waves. The winds produced by the nature is used to run small power generators called as windmills. Those generators are also can be used for charging the batteries. The advantage of using two methods described above in renewable energy resources, the energy produced by these two methods is more, inexhaustible, they don't pollute environment and it does not require any operator and has low maintenance. This system has no problem during long run.

#### **REFERENCES**

- [1]. Patel, J., et al. "Automation and Control Strategies for Grid Integration of Photovoltaic Systems." IEEE Transactions on Sustainable Energy, vol. 9, no. 3, 2018, pp. 1394-1402.
- [2]. Gupta, A., et al. "Advanced Monitoring and Control Techniques for Grid-Connected PV Systems." Renewable Energy, vol. 126, 2018, pp. 1042-1054.
- [3]. Sharma, S., et al. "Grid-Connected Photovoltaic Systems: Challenges and Solutions for Automation." International Journal of Electrical Power & Energy Systems, vol. 106, 2019, pp. 422-433.
- [4]. Singh, M., et al. "Intelligent Control and Management of Grid-Integrated Photovoltaic Systems." Solar Energy, vol. 184, 2019, pp. 1-13.



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details