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Research paper

Design of Feasible Energy Generation Using Solar Panel and Control Using an IoT

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Abstract

The Internet of Things Technology enhances the control of load from solar power generation. Solar power generation is one of the fast growing and most advantageous renewable energy sources of power generation worldwide. These days there is an increase in demand of electrical energy in our daily life. Solar energy has the greatest potential in the long term and is predicted to play a major role in forthcoming years. The implementation of two modes of power supply has been done, one is the normal power supply mode and the other mode is by solar power generation in which the load can be controlled using IoT in pc or mobile phone. This will facilitate in energy conservation.

Keywords: *IoT; PIC microcontroller; LCD; and load control.*

1. Introduction

The conception of Internet of Things (IoT) famed in 1999. The Internet of Things is nothing, but a system of physical things implanted with some sensors, software, electronics, actuators and connectivity which enables these objects to perform better to connect and exchange data. In general, IoT is used to share information through wired and wireless connection. This is a system of many interrelated computing devices, mechanical and digital machines, objects, and people to exchange data without requiring human computer interaction. The internet connected devices are mostly wireless and became wide-ranging and high-priced these days. Experts calculate approximately that the IoT will consist of about 30 billion objects by 2020.

Solar energy is an important renewable energy, radiant light and heat from the sun is converted into electricity, straight through the solar photovoltaic (PV) cells, indirectly using concentrated solar power, or a combination of both. Concentrated solar power systems use lenses or mirrors and tracking systems to focus on a large area of sunlight into a small beam. It is also a non-polluting source of energy and it does not emit any greenhouse gases while producing electricity. The solar power generation is the most effective method of power generation, because it takes a least number of steps for producing electricity than compared with other power generation methods.

The power generation from solar panel varies in nature due to irradiance, temperature and other factors. So the production of energy from solar panel is monitored, and IoT approach is taken for the control of load. The load can be performed by controlling through IoT. This is cost effective method and by using this method the energy can be consumed and the electricity amount can also be reduced. This is a cost reduction method, because in this there are two modes of power supply. One is the normal power supply mode and the other mode is the generation of power from solar panel.

At present there are many PV remote monitoring system that have to fetch, analyse, transmit, manage and feedback the remote information. These PV remote monitoring system includes wireless communication technology to fetch all the datas. The wireless communication is the Zigbee technology and is proven to be not available for huge distance. The Wi-fi technology is also only suitable for micro grid and network architecture. But now often GSM or other wireless networks are used for remote monitoring and control of PV system. This has influenced us to control the load using IoT.

The experimental setup includes solar panel, transformer, battery, PIC16F877A, rectifier, sensors, LCD, relay card, IoT board. Programming codes are developed using embedded c language in MPLAB software. The control of load by IoT can be designed using a website link.

The paper is structured as follows: Section II represents hardware setup. Section III presents the overall system design. Section IV illustrates the simulation and hardware result. Section V describes the future scope. Section VI concludes the proposed system.

2. Hardware Setup

The proposed concept in this paper is there are two modes of power supply to the load. One is the normal power supply that is we use in our home, and the second mode of power supply is from the generation of solar panel. The light energy from the sun is converted into electrical energy and is given to the load, in which the load can be controlled manually. For that purpose we have developed a link in webpage so that we can control the load manually using IoT.

The IoT is used to transfer the control function to the load. So that control in the web page will be transferred to the load using IoT. This comes under wireless communication methodology.

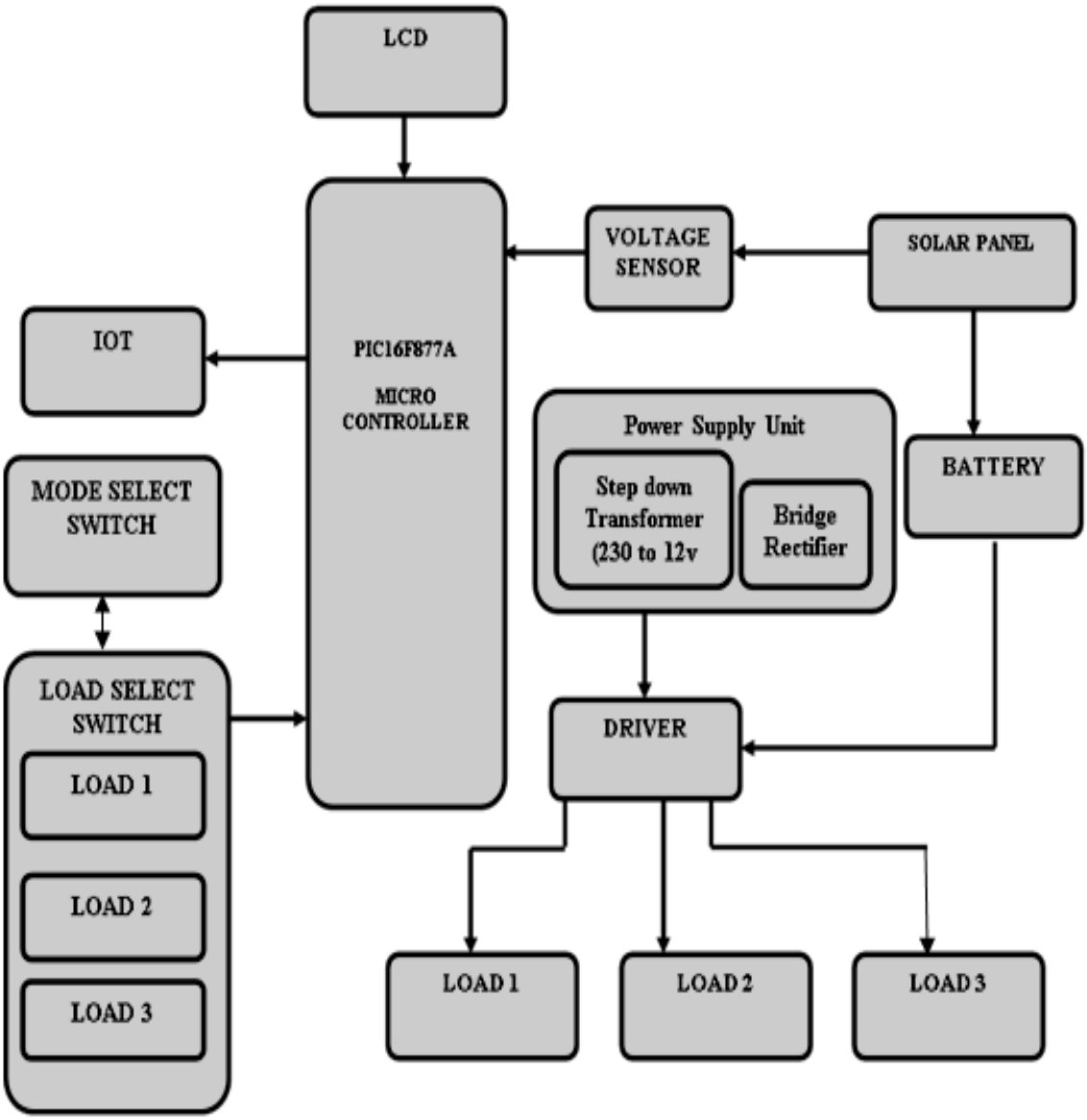

Fig. 1: Proposed Block Diagram

By using the IoT it has become easier to control the performance of the load, and it has become easier to operate each load manually from any place. We can also change the power supply mode to save the electricity. The mode on which the load is working will be displayed in the LCD. So that it will be easier to change the power supply mode. There will be a sensor to supply the solar energy to the controller. So that if the solar mode is ON it will be displayed and the solar value changes according to the light energy.

3. System Design

The solar panel utilizes the sun rays, that is the light energy and it produces electric voltage. These electric voltages are stored in battery. The generated energy is given to the voltage sensor, and the output of the voltage sensor is given to the ADC present inside the controller. In general, the power we consume in our homes are AC supply.

And with the help of switches we provide a voltage to the driver circuit which controls the load. In case if we are out and need to turn ON or OFF the load, it can be done using IoT.

In order to use this facility using IoT, we need to turn on the mode switch. To turn ON a load through IoT, we utilize the software switches present in the IoT. The software switches controls the driver circuit which controls the load. If IoT is used for switching appliances, the source used here is battery.

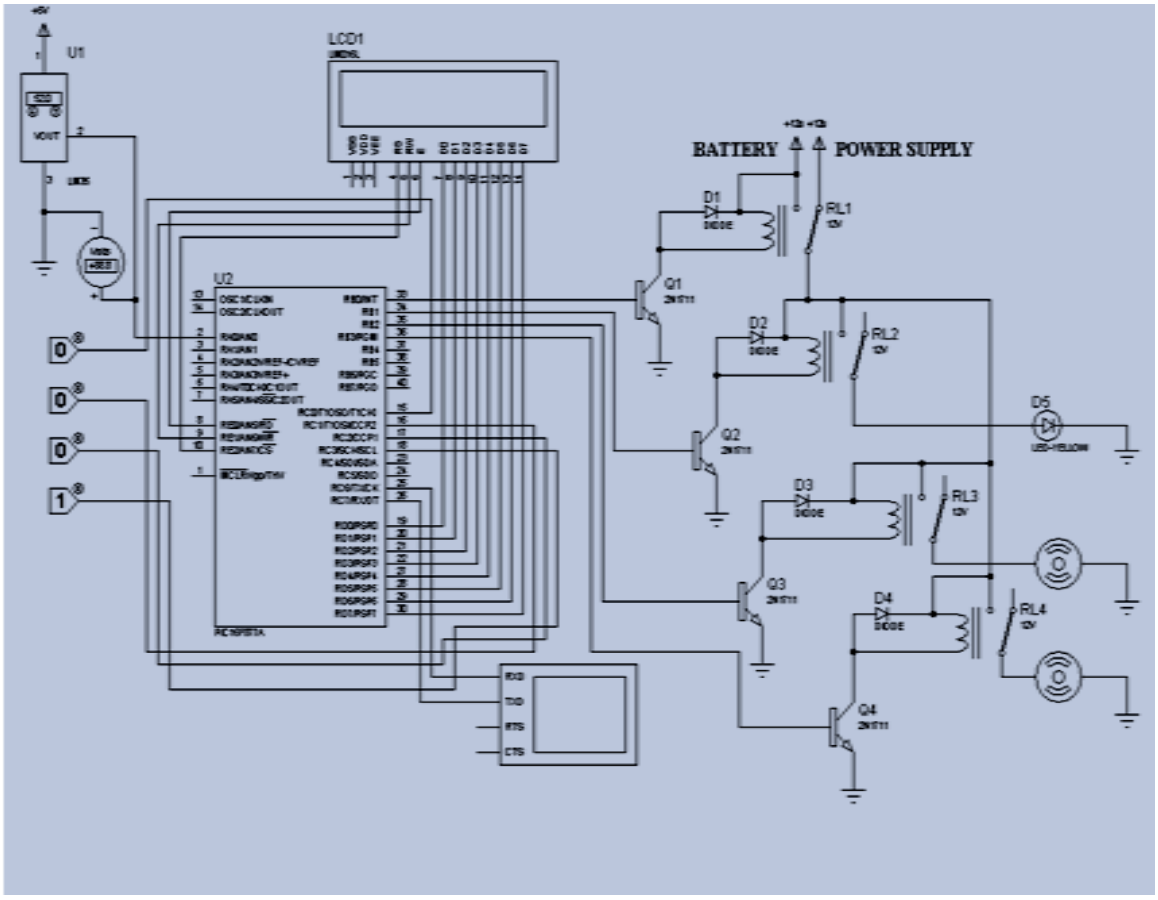

Fig. 2: Software Design of the System

A software design is developed and is shown in figure 2 for different modes of power supply as described. In LCD the various power supply mode will be displayed and the load that is currently running will also be displayed.

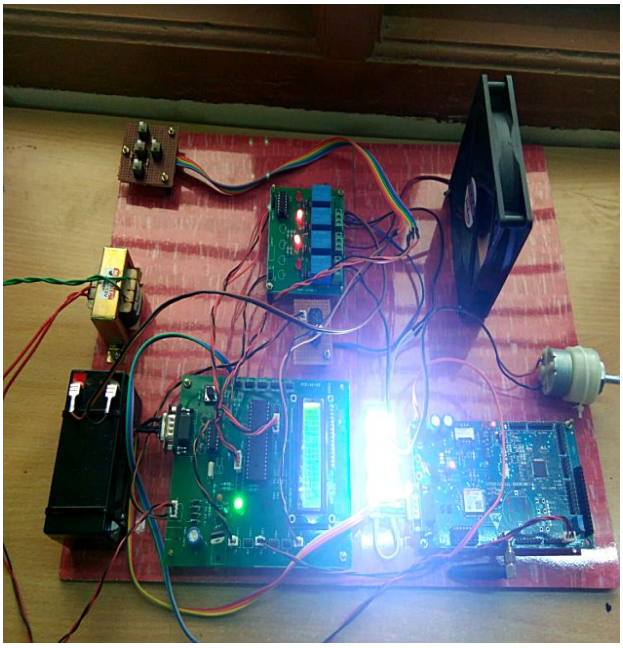

Fig. 3: Hardware Assembly of Normal Power Supply

In this with the help of normal home AC supply is used. By using the switches the loads can be controlled by the driver circuits. In this also the loads that are currently in process will be displayed. In this PIC16F877A is used. There will be a rectifier to convert the AC supply to DC supply. In this we are using 20 Watts solar panel, in which there will a voltage sensor to sense the voltage value, and also in LCD the voltage value of solar panel will be displayed. During the supply from solar panel the battery will be ON, because the electrical energy produced from the solar panel will be stored in battery. The mode can be changed whenever needed. This method is to save electricity.

4. Result

In this section the both simulation and the hardware results are discussed.

4.1 Simulation Result

The simulation design is developed in PROTEUS software. The coding is done using embedded c language. In this also there is a simulation result for both power supply mode, and there is no control of load using IoT.

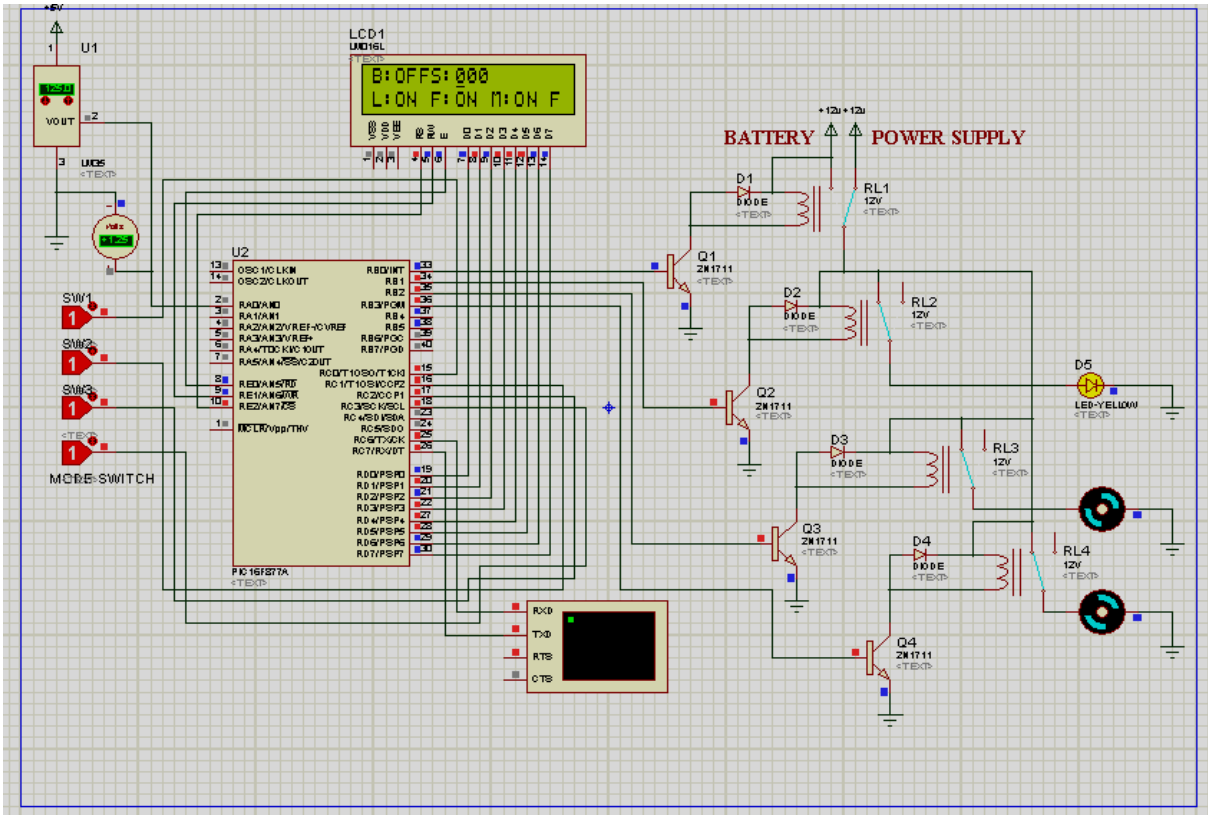

Fig. 4: Simulation During Power Supply Mode

In this simulation result in LCD battery is OFF, because it is normal power supply that will be given in home. The various loads that are ON will also be displayed in LCD. The voltage sensor is used when voltage is taken from solar panel.

The next simulation result will be based on battery mode that is the power supply from solar panel. The energy stored in the battery will used for the software switches for control purpose.

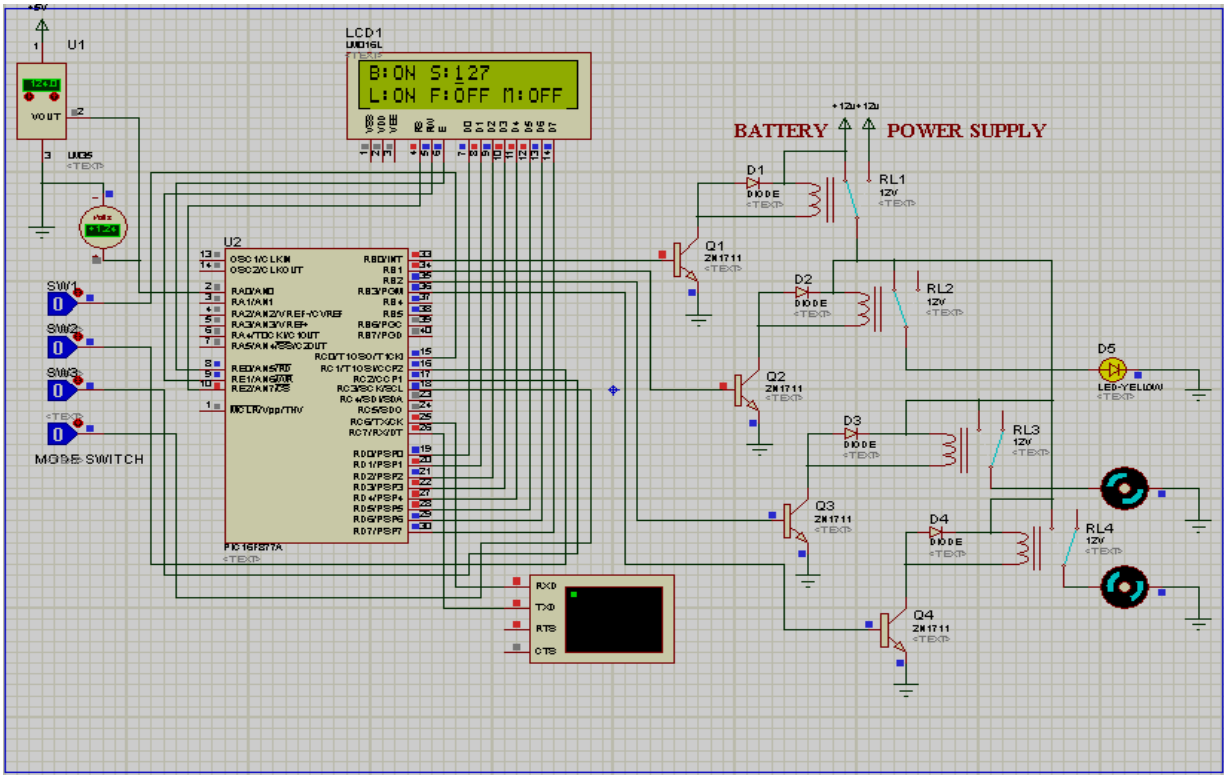

Fig. 5: Simulation Result During Battery Mode

4.2 Hardware Result

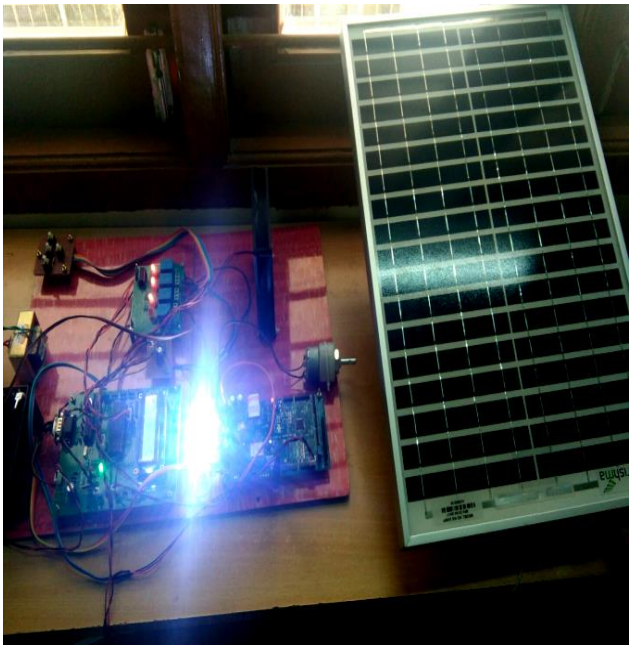

Fig. 6: Hardware Result of Both Modes

In this hardware result solar panel and IoT board is also there. To use IoT a SIM with data connection is used in IoT board, there will a continuous blink in the IoT is there is tower. The IoT control of load will be shown in the next figure.

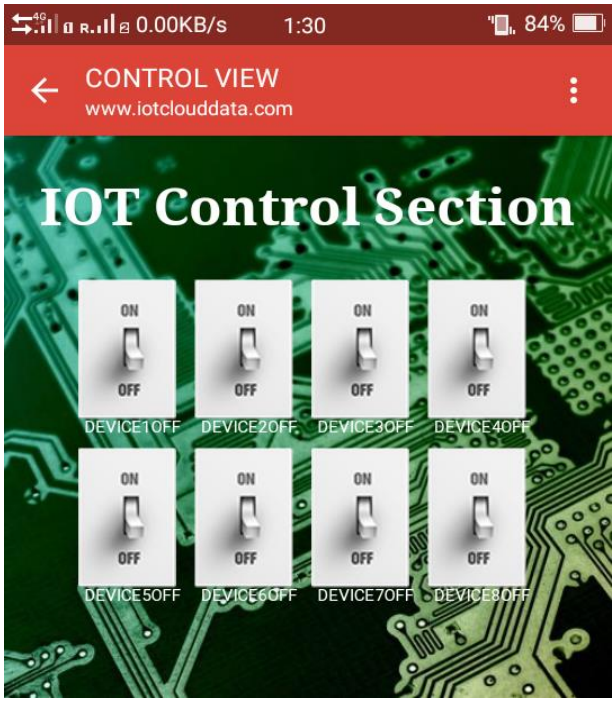

Fig. 7: Iot Control Section Page in Mobile

This control of load can be done in either mobile or laptop. In this we are using three loads, they are LED, exhaust fan, motor. In this control section we can use maximum eight loads that can be controlled. Control means from anywhere we can ON and OFF the loads, and we can know which loads are running currently. But the modes should also be changed manually. This is a cost effective method.

5. Future Scope

The uniqueness of this enhanced work is that it is easier to control the load using IoT. In this proposed system there is a conservation of energy and electricity bill. In future this can be applicable to many loads and can be applicable to industries and for domestic applications also.
In this system there is a slight delay in controlling the load, in future this delay can be reduced and can be applicable to many systems. In future the performance of the load can be monitored, and the power generation of the solar panel can also be monitored. So that both the power generation and performance can be monitored and controlled using wireless methodology.

6. Conclusion

The control of load by IoT is important and unique, in solar power generation system. Solar power generation is an important renewable energy source, it can also be a cost effective power generation system. The control of load can be done from anywhere at any place if the load is connected to battery, that is the solar power generation mode. This is an energy conservation method. If there is a power shutdown, the loads that are connected to battery can be operated and be controlled manually.

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