

## Solar Panel Monitoring System using GSM

S.Esakkiammal<sup>1</sup>, S.Benazir Parveen<sup>2</sup>, F.Gigi Nesamani<sup>3</sup> and C.Amarsingh Feroz<sup>4</sup>

<sup>1,2,3</sup>UG Scholar, Francis Xavier Engineering College, Tirunelveli, India.

<sup>4</sup>Associate Professor, Francis Xavier Engineering College, Tirunelveli, India.

Email: megalasubramanian4147@gmail.com<sup>1</sup>, alsafabenazir24@gmail.com<sup>2</sup>, gigi18101996@gmail.com<sup>3</sup>, amarferoz@gmail.com<sup>4</sup>

Article Received: 29 January 2018

Article Accepted: 26 February 2018

Article Published: 18 April 2018

### ABSTRACT

In remote area, the need for monitoring PV system is crucial to ensure stable power delivery. This paper describes the hardware and software design for PV monitoring system in remote area. The monitoring system is equipped with voltage sensor, temperature sensor, current sensor and irradiation sensor and GSM modem for data transmission. Real time clock chip is used for real time recording. The design is built and has been applied on field and satisfactory results are obtained.

Keywords: PIC Microcontroller, GSM module, Monitoring.

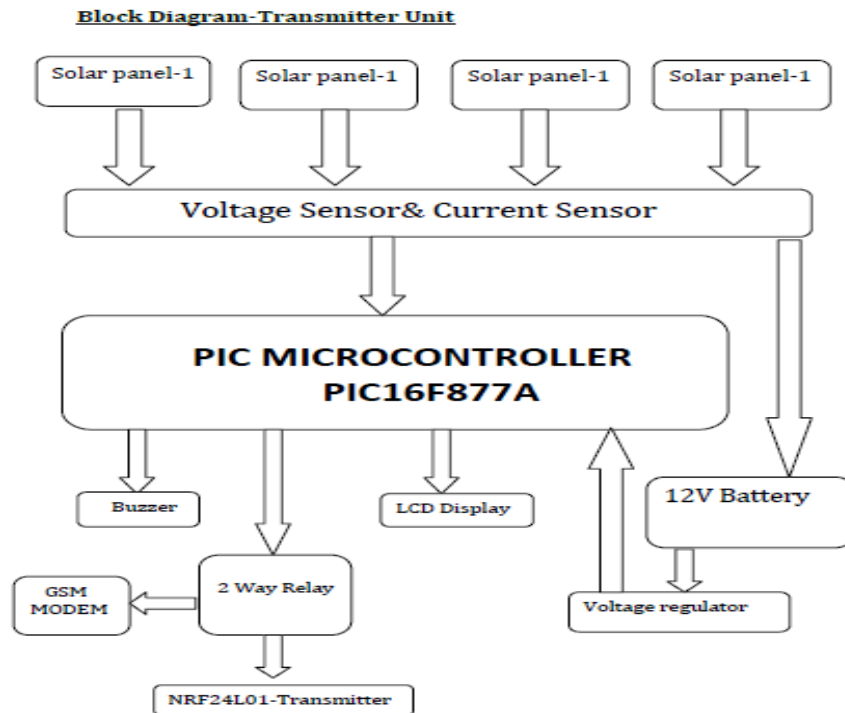
### 1. INTRODUCTION

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eighty percent of all microprocessors are manufactured as components of embedded systems. Energy is one of the important resources to human life, but non-renewable resources are depleted every year. Nowadays, solar energy is widely used all over the world. Various methods are used to monitor solar modules. In order to overcome these problems, monitoring system using Global System for Mobile Communication (GSM) is used. GSM technology contains essential intelligent functions to support. Solar energy is one of the sources of renewable energy that used to generate electricity. It use photovoltaic cells, or also known as solar cells, solar energy can be converted into electricity. Solar cells produce direct current electricity (DC) and can be converted to electrical alternate current (AC) through inversion techniques. Solar energy has been widely used today as a green technology that has been implemented by the government. With increasing energy supply, renewable energy generation technology has attract the world's attention. Where solar is one of the renewable energy and environment friendly. Therefore, this solar project has developed rapidly under government incentives to develop green technologies. With the solar monitoring system is an application of solar energy technology that can effectively solve the problem of environmental monitoring and forest fire. The advantage of using solar panels is environmental friendly and renewable energy, easy installation and maintenance, and long shelf life and it is ideal for users who are using on a large scale of solar panel.

### 2. BLOCK DIAGRAM

The projects architecture consists of two parts. The first part is the monitoring end while the second part is the remote acquisition device and GSM modem 1 while the remote pc end composed of GSM modem 2 and remote pc. PV module is monitored using data acquisition device. Data acquisition device consists of sensors, Real Time Clock (RTC) chip, and Liquid Crystal Display (LCD) and microcontroller unit. Microcontroller will collect all the

data from sensors in five minutes interval time. GSM modem 1 will stored the received data and transmit it in short messages (SMS) to GSM modem. The second modem is connected to remote PC.



### 3. SYSTEM DESIGN

#### 3.1. PIC Microcontroller

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many PIC microcontroller projects. PIC16F877A also have many application in digital electronics circuits.

#### 3.2. Power Supply

The ac voltage, typically 220V, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage.

#### 3.3. Voltage Sensor

A Simple but very useful module which uses a potential divider to reduce any input voltage by a factor of 5. This allows you to use analogue input of a microcontroller to monitor voltages much higher than it capable of sensing.

#### 3.4. GSM Modem

The SIM800 modem has a SIM800 GSM chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter.

Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manager of the USB to Serial Adapter. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

### **3.5. Relay Driver**

This is a high voltage, high current driver board made using the IC ULN2803, which consists of 8 NPN Darlington Transistor Array with Common Cathode clamp diodes for switching Inductive Loads.

### **3.6. LCD**

Liquid Crystal Display (LCD) consists of rod-shaped tiny molecules sandwiched between a flat piece of glass and an opaque substrate. These rod-shaped molecules in between the plates align into two different physical positions based on the electric charge applied to them.

### **3.7. Battery**

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars.

### **3.8. Solar Panel**

This solar panel is made of single-crystal material that performs high solar energy transformation efficiency at 17%. These are waterproof, scratch resistant, and UV resistant. They use a high efficiency monocrystalline cell. They're very high quality and suggested for projects that will be exposed to the outdoors.

### **3.9. Buzzer**

This is a small buzzer module which operates around the audible 2 kHz frequency range. It is an active buzzer, which means that it produces sound by itself, without needing an external frequency generator. It can easily be used with microcontroller boards, like Arduino, without needing a dedicated PWM channel.

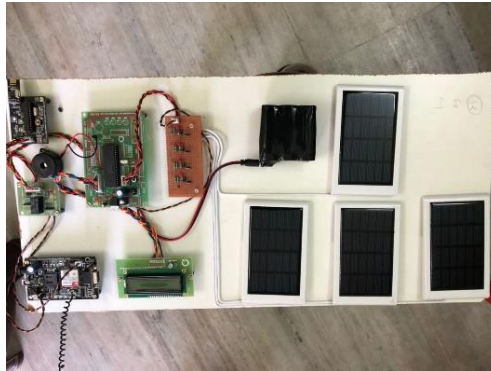
### **3.10. Voltage Regulator**

This is the basic L7812 voltage regulator, a three-terminal positive regulator with a 12V fixed output voltage. This fixed regulator provides a local regulation, internal current limiting, thermal shut-down control,. Each one of these voltage regulators can output a max current of 1.5A.

### **3.11. NRF Transmitter/Receiver**

This is an RF data modem working at 2.4 GHz frequency in the half-duplex mode with automatic switching of receive/transmit mode with LED indication. Receives and Transmits serial data baud rate of 9600 bps at a 5V level

for direct interfacing to microcontrollers. RF modem can be used for applications that need two-way wireless data transmission.



### **3.12. ADC**

An analog-to-digital converter is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current.

## **4. MONITORING UNIT**

### **4.1 USB to serial converter**

CP2102 chip from SiLabs is a single chip USB to UART Bridge IC. It requires minimal external components. CP2102 can be used to migrate legacy serial port based devices to USB. Hobbyists can use it as a powerful tool to make all kinds of PC interfaced projects. This module helps all those who are comfortable with RS232/Serial Communication protocol, to build USB devices very easily.

### **Transformer**

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.

### **Bridge rectifier**

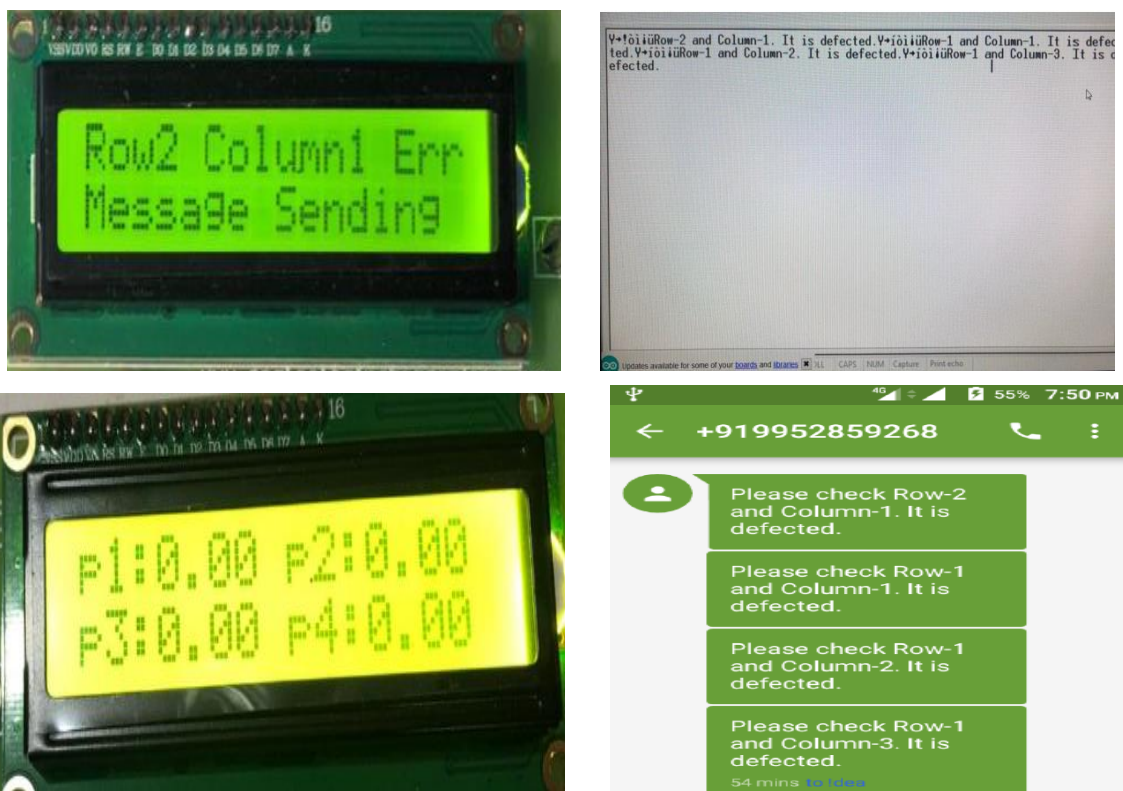
When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

### **IC Regulator**

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC.

## 5. RESULTS

The developed PV monitoring system composed of solar panels, Microcontroller unit, Inverter, GSM module, Charge controller and the dual Photo Voltaic panel. It consists of three sections: a DC/DC converter, an ADC part, and an analog coupling circuit. The DC/DC converter is implemented with a transistor, a transformer, and several passive components. It drops down the high PV voltage to +5 V, -5 V, and +3.3 V. The Photo Voltaic panel can receive the light energy. The inverter can invert the voltage from the Photo Voltaic panels. The Power line communication modem can communicate the information of the PV module to the microcontroller units. The mobile phone having the GSM module and it can send the status of the panels by messaging to the user. For every 10 seconds the above message can send to the user with different values.



## 6. CONCLUSION AND FUTURE ENHANCEMENT

This system is used to generate the renewable energy in a efficient way. The sensors sense the climate condition to microcontroller through GSM. The output of the solar is connected to battery, and the battery is continually charged from solar. This energy can convert d.c to a.c with the help of inverter. So we can operate any a.c loads with this energy. The efficiency of solar cell influence on the output value of the solar panel, where is the higher the efficiency the higher the solar radiation is produce. But the solar panel should be monitored in order to maintain the output value and the consistency of the value. By this monitoring system, the solar panel can be use at long term usage and the maintenance can be done at instant when the notification (SMS) system is installed on the system to the user. Users can view the status of the each PV panel through mobile phones by messaging using GSM technology. If any abnormal conditions can occur in any of the panel based on these parameters then the

information can send by messaging to the user. The future enhancement is to monitor and also regulate the Photo Voltaic panel by using GSM technology and also change the software.

## ACKNOWLEDGEMENT

This work was supported in part by Department of Science & Technology (DST), FIST Program at Francis Xavier Engineering College, Tirunelveli, Tamilnadu, India.

## REFERENCES

- [1] Charith Perera Chi Harold Liu, And Srimal Jayawardena, "The Emerging Internet of thing Market Place From an Industrial Perspective: A Survey", december2015, IEEE Transactions on Emerging Topic in Computing.
- [2] Muthukumaran. N and Ravi. R, 'Hardware Implementation of Architecture Techniques for Fast Efficient loss less Image Compression System', Wireless Personal Communications, Volume. 90, No. 3, pp. 1291-1315, October 2016, SPRINGER.
- [3] Muthukumaran. N and Ravi. R, 'The Performance Analysis of Fast Efficient Lossless Satellite Image Compression and Decompression for Wavelet Based Algorithm', Wireless Personal Communications, Volume. 81, No. 2, pp. 839-859, March 2015, SPRINGER.
- [4] Yejihua, WANG wen, "Research And Design Of Solar Photovoltaic Power Generation Monitoring System Based OnTiny OS", August 2014, 9th International conference on computer science Education.
- [5] Muthukumaran. N and Ravi. R, 'VLSI Implementations of Compressive Image Acquisition using Block Based Compression Algorithm', The International Arab Journal of Information Technology, vol. 12, no. 4, pp. 333-339, July 2015.
- [6] Muthukumaran. N and Ravi. R, 'Simulation Based VLSI Implementation of Fast Efficient Lossless Image Compression System using Simplified Adjusted Binary Code & Golomb Rice Code', World Academy of Science, Engineering and Technology, Volume. 8, No. 9, pp.1603-1606, 2014.
- [7] Ruban Kingston. M, Muthukumaran. and N, Ravi. R, 'A Novel Scheme of CMOS VCO Design with reduce number of Transistors using 180nm CAD Tool', International Journal of Applied Engineering Research, Volume. 10, No. 14, pp. 11934-11938, 2015.
- [8] Muthukumaran. N and Ravi. R, 'Design and analysis of VLSI based FELICS Algorithm for lossless Image Compression', International Journal of Advanced Research in Technology, Vol. 2, No. 3, pp. 115-119, March 2012.
- [9] Manoj Kumar. B and Muthukumaran. N, 'Design of Low power high Speed CASCADED Double Tail Comparator', International Journal of Advanced Research in Biology Engineering Science and Technology, Vol. 2, No. 4, pp.18-22, June 2016.
- [10] N. Muthukumaran, 'Analyzing Throughput of MANET with Reduced Packet Loss', Wireless Personal Communications, Vol. 97, No. 1, pp. 565-578, November 2017, SPRINGER.



- [11] Chagitha Ranhotigamage and Subhash Chandra Mukhopadhyay, "Field Trail and Performance Monitoring of Distributed Solar Panels Using Low Cost Wireless Sensor Networks", October 2010, IEEE Sensor journal.
- [12] P.Venkateswari, E.Jebitha Steffy, Dr. N. Muthukumar, 'License Plate cognizance by Ocular Character Perception', International Research Journal of Engineering and Technology, Vol. 5, No. 2, pp. 536-542, February 2018.
- [13] N. Muthukumar, Mrs R.Sonya, Dr.Rajashekhara and Chitra V, 'Computation of Optimum ATC Using Generator Participation Factor in Deregulated System', International Journal of Advanced Research Trends in Engineering and Technology, Vol. 4, No. 1, pp. 8-11, January 2017.
- [14] Keziah. J, Muthukumar. N, 'Design of K Band Transmitting Antenna for Harbor Surveillance Radar Application', International Journal on Applications in Electrical and Electronics Engineering, Vol. 2, No. 5, pp. 16-20, May 2016.
- [15] Akhil. M.S and Muthukumar. N, 'Design of Optimizing Adders for Low Power Digital Signal Processing', International Journal of Engineering Research and Applications, Vol. 5, pp. 59-65, March 2014.
- [16] Muthukumar. N and Ravi. R, 'Quad Tree Decomposition based Analysis of Compressed Image Data Communication for Lossy and Lossless using WSN', World Academy of Science, Engineering and Technology, Volume. 8, No. 9, pp. 1543-1549, 2014.
- [17] Marvin Mark. M and Muthukumar. N, 'High Throughput in MANET using relay algorithm and rebroadcast probability', International Journal of Engineering Research and Applications, Vol. 5, pp. 66-71, March 2014.
- [18] Ravi Tejawani, Girish Kumar, Chetan Solanki, "Remote Monitoring System For Solar Photovoltaic Systems In Rural Application Using GSM Voice Channel" 2013, ISES Solar World Congress.