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Solar Power Wireless Monitoring Based On Embedded System

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Abstract

To improve the efficiency of solar systems, it is very important to get more information about solar panel performance, tracking and maintenance. In this paper data monitoring of solar power system is performed by combination LPC2148 ARM7 Processor and SIM900 GPRS wireless Communication. The ARM7 processor is used for data automatic analysis, processing, displaying and saving automatically whereas GPRS wireless communication device is responsible for real time data transmission to the monitoring center. This system monitors the ambient temperature around solar power generation equipments, humidity, solar irradiation, generated current and voltage by solar panel and battery voltage it also controls the battery charging level. At the receiving end SQL database is used to save the data and for displaying purpose VB6.0 is used.

Keywords: LPC2148 ARM 7, SIM900 GPRS, SQL data base, VB6.0, data monitoring system.

1. Introduction

Solar power is emerging as the number one competitive renewable energy resource, so to improve the utilization of solar energy resources, solar power monitoring systems is more important. Photovoltaic solar panels are increasing in popularity and users need accurate information of their solar energy installation.

Currently, most residential solar panel systems only provide energy information on a monthly basis and do not allow individual panel monitoring. PV solar panel has at least 25 years warranty, whereas inverters only come with an 8-10 years warranty. That means that sometime in the 8-10 years range the inverter will die and the system will stop producing energy. With a monitoring system in place the installer or homeowner will know immediately that the system has been compromised. Otherwise it could be weeks or months before the home owner looks at their energy usage statement from their utility company and realizes that their solar electricity system is not longer producing energy.

Other problems are arrives when solar power monitoring system is not in use and that problems are related to the battery charging and discharging states. Overcharging of battery will produces Gasification and that will reduces the effective capacity of battery, whereas over discharging will produces Hard Sulfation. As result of sulfation it generates big crystals on battery plate which do not take part in any chemical reaction and can make battery unusable. So,

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it is very important to get more information about solar panel performance, tracking and maintenance.

In this paper, the solar power monitoring systems adopts modular design concept, the entire system consists of two modules: The master control module which has the LPC2148 ARM 7 microcontroller which is designed to acquire and display real-time performance parameters whereas The wireless Communication module adopts GPRS as the wireless communication device (SIM 900), which is responsible for real-time data transmission to the monitoring centre, whereby the displayed data could be monitored and controlled some parameters from a remote distance over the Internet.

2. System Design

In this system the core processor LPC2148 collects the data from different sensors such as ambient temperature around solar power generation equipments, solar irradiance, humidity, generated voltage and current from solar panel, battery voltage and current. Here LPC2148 processor is responsible for data automatic analysis, processing, displaying and sending to the monitoring centre by using wireless communication technique.

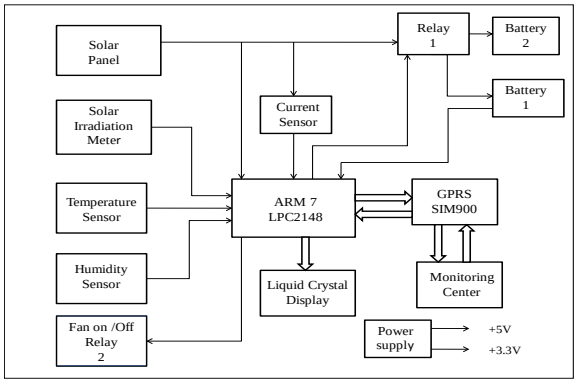

Fig.1 Block diagram of solar power monitoring system

GPRS [sim900] is used for wireless communication. At the monitoring centre the received data is displayed in graphical way as well as it will save in the database. For graphical representation has been used as VB6.0 & for database SQL server. This proposed system continually monitors the temperature around the solar panel and when temperature reaches to 130 centigrade then the processor turns on cooling system. Similarly this system monitors the battery charging state, as the battery reaches to its maximum level then processor stopped charging current battery and switched to the next battery.

The main feature of this mechanism is continues monitoring of solar system as well as controlling action will take place against faults occurring in some parameter.

2.1 The Embedded Processor LPC2148 Arm7

The LPC2148 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation embedded trace support that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 51 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate.

A blend of serial communications interfaces ranging from a USB 2.0 Full Speed device, multiple UARTs, SPI, SSP to I2Cs, and on-chip SRAM of 8KB up to 40KB , make these devices very well suited for communication also have low power consumption

2.2 SIM900 GPRS Wireless Communication

SIM900 is quad band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 1800

MHz and PCS 1900MHz. It has 68 SMT pads and provides all hardware interfaces between the module and customer's boards. Serial port and Debug port can help user to develop user's applications. It has programmable general purpose input and output.

SIM900 designed with power saving technique so that the current consumption is as low as 0.1mA in sleep mode. It integrates TCP/IP protocols and extended TCP/IP AT commands which are very useful for data transfer applications.

2.3 Temperature Sensor

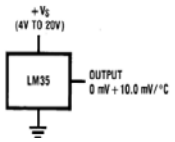

Fig.2 LM35 Temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature (+ 10.0 mV/ °C scale factor). It has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. It operates from 4 to 20 volts. It provides Low output impedance. The LM35 is rated to operate over at −55° to +150°C temperature range.

Solar Irradiation Sensor –LDR

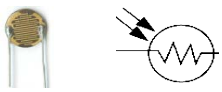

Fig.3 Light dependent resistor

LDR is an input sensor which converts brightness (light) to resistance. It is made from cadmium sulphide (CdS) and the resistance decreases as the brightness of light falling on the LDR increases. Normally the resistance of an LDR is very high, sometimes as high as 1000000 ohms, but when they are illuminated with light resistance drops dramatically. It also is capable of reacting to a broad range of frequencies (Infrared (IR), visible light and ultraviolet (UV)).

2.4 Humidity Sensor (SY-HS 230)

Fig.4 SY-HS230 humidity sensor

SY-HS230 is resistance type Humidity Sensor Module. It operated on DC 5V. This sensor has operating temperature range 0~60°C (32~140°F) and Operating Humidity 95%RH or less 4. Its Humidity output 0~3.3V.

2.5 Current Sensor (ACS 712)

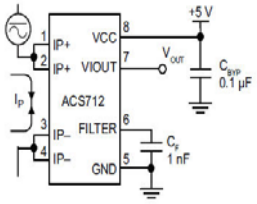

Fig.5 ACS712 current sensor

ACS712 current sensor can measure positive and negative currents (range -5A…5A). Its output voltage is proportional to current flowing between IP+ AND IP-. It requires +5V power supply.

3. Software Design

The software implementation of this system can be divided in to two main parts. At transmitter side the software implementation is done on LPC2148 ARM7 processor. The software used for the ARM7 processor is Keil software (µvision4). The whole

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programming at transmitter side is written in Embedded C language. At receiver side, software implementation is based onVB6.0 and the received data is saved in SQL database.

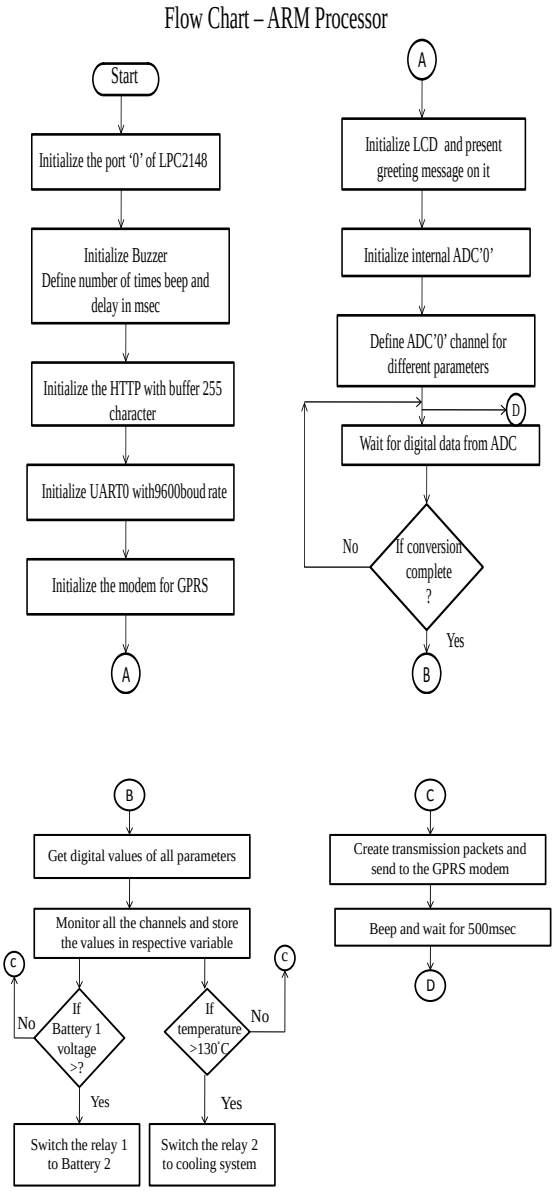

Fig. 6 Transmitter side (ARM7) flow diagram

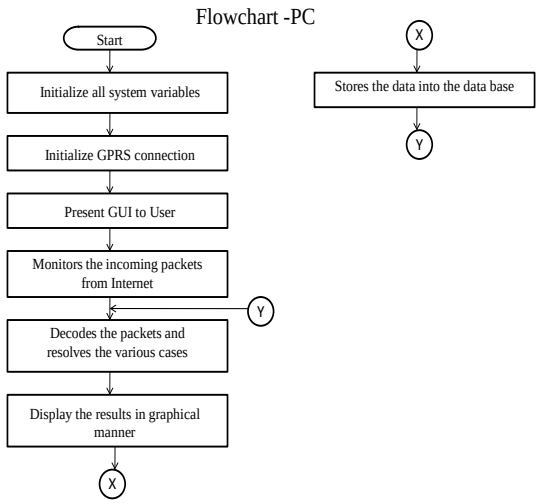

Fig.7 PC side flow diagram

Following steps are implemented in the programming:

1. Sensed value is converted in to digital value by using ADC (LPC2148 ARM7 processor).
2. Serial communication at 9600 baud rate is done and data is passed to GPRS modem.
3. If fault occurs in sensing parameter then controlling action will take place by processor.
4. By using GPRS connection data is passed to the monitoring center.
5. Data is displayed in graphical manner and saved into the database.

4. Future Scope

In this project to get very stable & high precision performance TBQ-2C solar radiation meter can be utilized and also to avoid any breakage in solar panel because of higher temperature proper and efficient cooling system can be used.

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5. Conclusion

The solar power monitoring system could realize the accurate diagnosis and prevent faults from further expanding and improve reliability of photovoltaic power station.

GPRS wireless communications system is successfully applied to the ARM7 system, for achieving the rapid and accurate transmission of the parameters in a solar power generation system.

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