International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Solar Monitoring System Using Zigbee and RFID Technology

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Abstract: ***In this article the implementation of an uninterrupted solar energy surveillance system is completed. The completed system is comprised of three major sub-systems that include a charging sub-system, a control sub-system and a display sub-system. Based on several transmission standards, including Bluetooth, Wi-Fi and Zigbee capability combined with wireless transmission techniques, the proposed surveillance system is designed for monitoring a solar energy system. The performance of the simulated WSSs is evaluated using statistical report results. The proposed surveillance system can be fully extended to several different kinds of applications, such as, health care and environmental inspection. The experimental measurement results significantly show that channel fading over the propagation channel dominates the developed system performance.***

Keywords: Bluetooth, Wi-Fi, health care, solar surveillance, WSSs, ZIGBEE.

1. Introduction

WSSs (wireless sensor systems) infrastructure has spread widely in various human life applications such as health care, automotive control, military command, communications and surveillance [1, 2]. It is known that the greater the number of sensor nodes in the network the more precise the results provided to the BS (base station).However, in order to reduce the number of parameters for system performance, decreasing the number of sensor nodes to the optimal number is a good method. The mobility sensors is also an important point that can be applied to solve the coverage hole problem in WSSs [3,4]. Combining WNSs with RFID (radio frequency identification) devices is another recent study issue. For example, they can be combined together to solve surveillance issues [5, 6]. Traditionally, wired transmission is the normal technique applied in energy monitoring. Wired communication was applied in monitoring the solar energy with project results reported in [7-8]. The system parameters in solar energy systems include the current, voltage and photo voltaic transformation power. Numerous publications have addressed these issues. Authors in [8] proposed a monitoring system design based on solar energy for a green house wireless sensor network. The electrical power usage of facility electrical devices was periodically obtained from each of the wireless sensor devices in [9].

In [10] the authors present an overview of the different energy harvesting technologies and the energy saving mechanisms for WSS. The related research issues on energy efficiency for sensor networks using energy harvesting technology are then discussed. The authors' claimed that the system combined energy management with energy transfer, ensuring the energy collected by the solar energy batteries would be used reasonably. Photovoltaic systems with managed output and methods for managing output variability from photovoltaic systems are described in [11]. A plurality of the photovoltaic modules was configured to receive and convert solar energy. A photovoltaic monitoring system was designed to provide general parameters [12, 13], e.g., energy conservation and stability, for a solar energy monitoring system with the selected parameters used for the photovoltaic cells and controller [14, 15]. In [16] a method and system for non-invasive sensing and monitoring a processing system employed in semiconductor manufacturing was disclosed.

A utility model that discloses a photovoltaic green house monitoring system based on a WSS is proposed in [17].This system was comprised of wireless information collecting nodes with high reliability and easy to expand. Recently, the IOT (internet of thing) concept has become a very important technique applied to sensing, communication and networking. In the near future it will be applied mostly in monitoring and surveillance systems imbedded into internet environments [18].Green energy applications are gradually achieving an important position in industry development due to the shortage of renewable energy. Certainly, the issue of efficiency promotion in solar system to complete energy transformation becomes relatively very important. This paper proposes a fresh idea to implement an uninterrupted solar surveillance system with a radio system. The proposed monitoring system is an ubiquitous system, i.e., it can be deployed at any location where a solar system is established. This system is designed to be initially established as a prototype model that can be commercialized after implementation and the measurements are completed. The measurement results of the implemented monitoring system provide useful results for the solar energy parameters to the operator who may not reside at the site via Internet protocol communication systems. The measurements are held at the campus around Dayeh University located in Central Taiwan (R.O.C) at a 2.2 acre site [19].

2. System Design Model

A. Charging design model

The charging sub-system gathers energy through the solar cells, that is, the energy will be charged by the solar cell (photovoltaic) system and the energy will be stored in a long consuming battery. Back-up charging will be provided by the city power system if the energy cannot be maintained at a threshold value by the solar system. The system is presented in Fig. 2 in which components identified, solar cell plant, also called PV(photovoltaic) array cell (or solar cell panel) with 260Watt, a DC 12-V charging battery, a battery with about0.5KVA power in the charging sub-system. A DC-to-DC converter that pulls voltage up to about 2 ×110V.This voltage is translated to about 115 -V AC voltage, which will be put into the city power line supplied by the power company. After the waveform shaper filters the energy generated from the charging sub-system, power is provided to all of the other sub-systems. Such implementation is embedded into the system shown in Fig. 3. However, the power saving efficiency isn't calculated in this stage of the investigation.

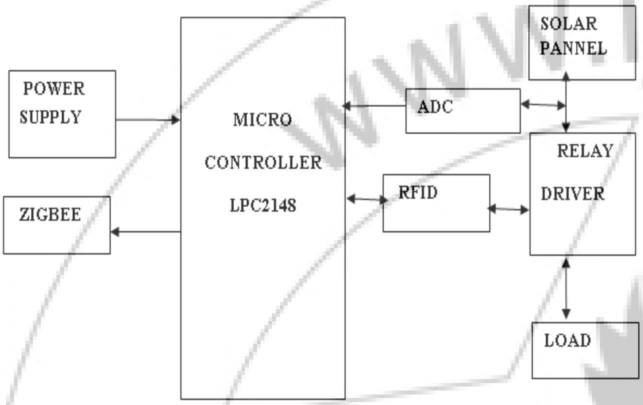


Figure 1: Transmitter section

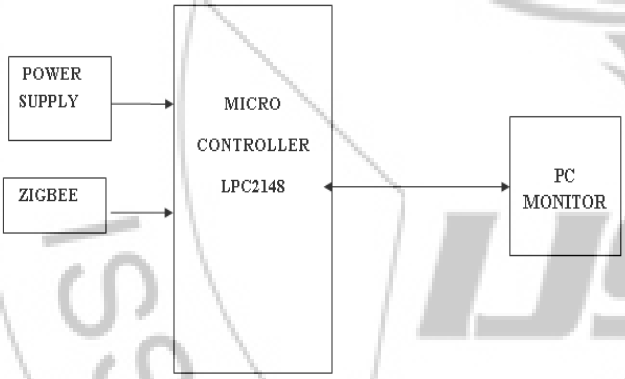


Figure 2: Monitoring section

B. Controlling Design Model

The controlling sub-system in which the active RFID system reader will read the effective data into the server via a serial port that communicates with a control server[20]. Thus, this sub-system is realized with hardware and software components described as below; The A/D (analog to digital) converter samples, quantizes and codes the received data. A cost effective matching microprocessor in the A/D device ADC0804, which is a serial product from Intersil Company with 8bits precision, is chosen for the converter in this implementation. The ADC0804 specifications can be found in its data sheet [21]. There are 3 sample points designed to absorb alternatively the analog amplitude from the solar cell. The sampling rate can be adjusted by the crystal oscillator frequency of the MCU, hence, the transmission rate is adjustable. However, there still has an upper limitation rate depends on the specification of A/D converter.

The core sub-system control techniques constrained by multi-functional, simple designing, low cost and easy to acquire the chip packaged and numbered "AT89C51PC24" from the @ATMEL company has become the candidate for this sub-system [22]. Moreover, the specified PC board serial number 89C51 packaged in PDIP (plastic dual inline package) form was selected as the main chip designated for the main circuit. Another reason is the iron welding operation will easily become widespread in this area. It is known that the operating time clock of the 89C51 is generated from an internal oscillator (pin 18 and pin 19) with a frequency of11.0592MHz. Once the 89C51 baud rate is determined using a precision value generated from an embedded internal timer, the aforementioned operating frequency will have stability matched to the 9600 bps (bit per second) operating baud rate of the RF (radio frequency) module which passes the solar cell messages. The 89C51MODE 1, with 9600 band rate without parity check bit, 8data bits and one stop bit, i.e., "9600, N, 8, 1"communication protocol, is operating in *TH*1 of internal timer 1 (timer 1 high bit). Moreover other operating modes are set with MODE 2 of 8 bit auto-loaded, SMODE=0 of single baud rate, hereafter, the right value of TH1 can be calculated as

$$TH1 = 256 - \frac{2^{SMOD} \times f_{osc}}{386 \times (R_B)}$$

where SMOD denotes the internal TIMER model type of 89C51, *osc f* represents the crystal oscillator frequency, *B R* is the baud rate in the communication port. For example, the internal timer 1, *TH*1, will become as

$$TH1 = 256 - \frac{2^0 \times 11.0592 \times 10^6}{386 \times 9600} = 253$$

, when 9600 and model 0 timer baud rate are selected. Several important pin assignments are described as follows. The pin number P3.0 and P3.1 of 89C51 PORT3are assigned as the communicating to and receiving function from the RF module, respectively. On the other hand, P3.0 and P3.1 are correspondingly connected to the TX and RX of the RF module and the P3.2 and P3.3 ofPORT3 are two pins for accepting external interruption. The 8 pins P0.0 to P0.7 of PORT0 are designated connecting to an aligned 8 LEDs for error monitoring. The data bits (DB7 to DB0) coming out from the A/D device ADC0804 are arranged in contact with P1.7 toPT1.0 of 89C51 PORT 1. There are 3 connectors P2.0、P2.1、P2.2 of PORT2 which are assigned to periodically (adjustable) absorb the sampled data from 3 reedy relays (DIA050000, 10, V 5 *d d I* = *mA* = *V*, defined in the datasheet [21]) derived using 3 open collector inverters, respectively.

The reedy relay operating time is 0.5 ms which is important for reacting to receive the signal from A/D converter, i.e., the operation frequency is almost able to reach 800Hz. PORT2 P2.3 and P2.4 are for RD and WR of ADC0804 to play as the signaling role when the data is read and written already, respectively. In contrast,P2.5 at PORT2 be linked to of ADC0804 for informing the ready status which the A/D convert is completed. Furthermore, the advantage of RF transmission in MCU 89C51 is useful for this design due to its variable transmission rate, from 1200 to 19200 b/s which is helpful for the incremental the performance of data transfer. On the other hand, it's I/O ports is very Flexible for different transmission protocols, such as Bluetooth, ZigBee, Wi-Fi, which can greatly improve the system performance. Finally, shown in Fig. 2 is the wireless transmission scenario is established using a 433MHz RF module equipped with transmission distance capability of 500meters without obstacles **[18]**.

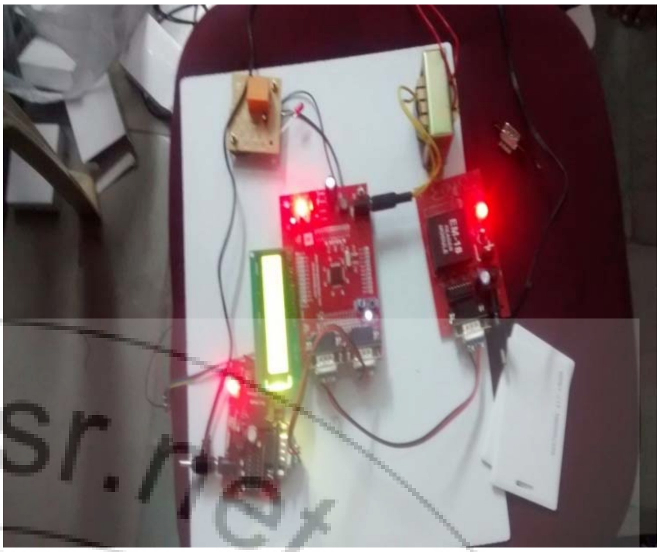
C. Monitoring design model

At this stage a script programmed with @Visual Basic software are applied to all functions for displaying the subsystems [7]. The captured data from the Tag components will be detected by the active reader and the complete information passed to the end server via the RF modem modules. The monitored values include the operating current, voltage, power; efficiency and storage capacity are analyzed and shown up in this sub-system. Here after, the total system operating efficiency can be tracked and tuned through the sub-system using the feedback signals. of the system management display panel is designed. There is a communication protocol setting for adjusting the dual port parameters. There are 3nodes for showing the voltage values including BV(battery voltage), SLV (solar with load voltage), and SWLV (solar without loading voltage).

3. Experimental Results

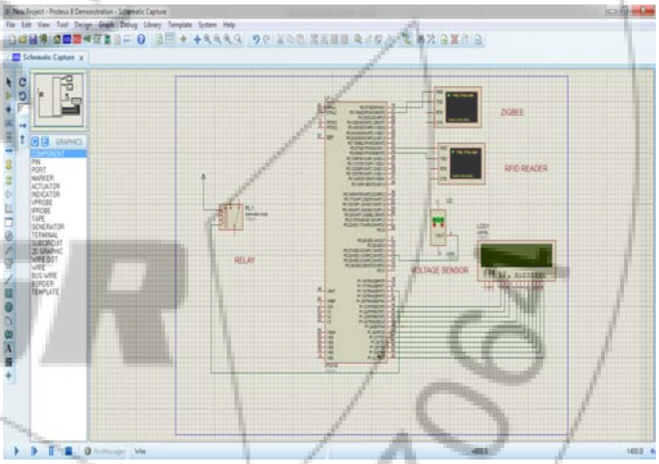
The prototype system was verified using two experimental scenarios at the Dayeh university campus. The two experimental cases were set up using different RF transmission modules, i.e., the first using 433 MHz and the second using 928 MHz. The simulated solar energy system and the monitoring system were placed at the front door of Dayeh University and inside the Lab room, respectively. The distance between these two places was about 200 meters. The measured voltage data included BV, SLV, and SWLV, gathered during the afternoon hours 12 :00 to 17 :00 PM. The afore mentioned experiment exhibited a large amount of channel fading, which included large scale fading (huge academy building, big tree), and small scale fading (pedestrians).Because the class was dismissed at the noon time 12 :00to PM 12 :30 interval, the interruptions were caused mostly by people moving around the experimental area. This phenomenon was satisfactory and expected.

The RF modules definitely interfered with the fading coming out of the transmission channel. It is an original idea of power management in solar cell implemented in this article. Since the real-time data of the solar cell is transmitted by RF protocol which differs from the one shown in [2, 3]. However, it should be pointed out the shortage in distance of our designed that is, the separation between the solar cell platform and the monitoring terminal will be constrained due to the RF protocol. Furthermore, for confirmation there are experimental results shown in Fig. 3 obtained from the simulation which is evaluated with the assessment of university campus.



Project Hardware Modules Connection

The distance is about 10 meter; a pair of RF transmission modules 928MHz is applied. There are 3 simulated curved shown in Fig. 3 in which the results from receiving the digitalized solar cell data, therein, the curve with little triangle, the plot with little square, and the graph with little circle represent solar voltage with non-loading, solar voltage with full-loading, and the battery voltage, respectively.



Schematic Capture of project paper

All the curves were collected during the period of AM 11 :00 to PM 2 :30 which is scaled as Y axis (time axis) and X-axis represents the amplitude of voltage. It is reasonable to understand that the curve with little triangle is easily interrupted by shadeling, for example, the building, the pedestrians, or some tree.

4. Conclusion

The results from the implementation were completed as illustrated with experimental measurements. The RF modules, which can be alternatively replaced with Bluetooth, were adopted to transmit the necessary solar energy system information wirelessly. The WSS concept was also applied in the data gathering implementation from different places where solar energy systems could be installed. To avoid the severe shadowing effect from different transmission protocols such as ZigBee, GPRS, and

WiMax, these technologies will be tested in the future in a suitable environment. The RFID techniques can be fused into the implementation for secure purposes.

References

[1] Nobuo Tanaka, IEA,"Energy efficiency and renewableenergy- A key to a better tomorrow", ISO Open Session, Cape Tow, 17 Sep. 2009.

[2] Gidlund Mikael, and Lennvall Tomas, "An Energy EfficientMethod for Communication between a Wireless SensorNetwork and An Industrial Control System", Patent WO2, 011,154,051A1, 2011.

[3] Zhiying Yao, and DohYoonmee, "Wireless sensor networkand adaptive method for monitoring the security thereof",U. S. Patent 8,116,243, 2012.

[4] Weixin Wang, Jongwoo Sung and Daeyoung Kim Auto-IDLab Korea, "Complex Event Processing in EPC Sensor Network Middleware for Both RFID and WSN", *IEEE Conferences (ISORC)*, 2008, pp. 165-169.

[5] X, Shan, and J, Tan, "Mobile Sensor Deployment for a Dynamic Cluster-based Target Tracking Sensor Network", *Intelligent Robots and Systems, 2005. (IROS 2005) 2005IEEE/RSJ International Conference on*, 2005, pp. 1452-1457.

[6] T. Kim, J. Lee, S. Lee, a. -C. Park, "Performance evaluation of RTLS based on active RFID power measurement fordense moving objects", *IEICE Trans. Commun.*; Vol. E92-B, No. 4, pp. 1422-1425, April 2009.

[7] Wireless Sensor Network Center, http://www.wsnc.ntu.edu.tw/.

[8] Bornhoevd Christ of, and Mo Brian S, "Modular Monitor Service for Smart Item Monitoring", Patent U.S. 8,131,838,2012.

[9] B. Visweswaran and Anoop R. Kulkarni, "Green Luxury"-Technology and solutions for energy management", *IEEE Conferences (ICM)*, 2009, pp. 138-140.

[10] D. Niyato, E. Hossain, and V. K. Bhargava, "Wireless sensor networks with energy harvesting technologies: Agame-theoretic approach to optimal energy management", IEEE *Wireless Communications*, pp. 90-96, Aug. 2007.

[11] http://www.advantech.gr/ia/3175.htm, 2012.

[12] J. Hou, and Yi Gao, "Greenhouse wireless sensor network monitoring system design based on solar energy", In *international conference on challenges in environmental science and computer engineering*, 2010, pp. 475-479.

[13] Pfeifer Ray, and Pandey Raju, "Apparatus and Methods for Managing Power Capacity in Data Centers Using a Wireless Sensor Network," U. S. Patent 0,054,527, Mar. 01, 2012.

[14] B. Greg, and C. Matt, "Photovoltaic System with Managed Output and Method of Managing Variability of Output fromA Photovoltaic System", U. S. Patent 0,224,831, Sep. 15,2011.

[15] L. Bin, C. Yanbo, and Z. Lihua, "The design of photovoltaic monitoring system", In *Power electronics systems and applications (PESA)*, 2011, pp. 1-4.

[16] K. Sanjeev, and S. Kenji, "Method of Monitoring a Semiconductor Processing System Using a Wireless Sensor Network", U. S. Patent 8,026,113, Sep. 27, 2011.

[17] X. Zhong, and F. Wang, "Photovoltaic Green house Monitoring System Based on WSN (Wireless SensorNetwork)", C. N. Patent 202,041,835, Nov. 16, 2011.

[18] G. Wu, S. Talwar, K. Johnsson, N. Himayat, and K. D.Johnson, "M2M: From mobile to embedded internet", IEEE Communications Magazine, Vol. 49, No. 4, pp. 36-44,2012.

[19] http://www.dyu.edu.tw/english/1100.php

[20] *Intersil Americas Inc.*, "ADC0803 、ADC0804 8-Bit, Microprocessor-compatible, A/D converters data sheet", FN3094, Aug 4, 2002.

[21] *Atmel Corporation*.8-bit Microcontroller with 4K Bytes Flash AT89C51. Available From: http://www.atmel.com/atmel/acrobat/doc0265.pdf

[22] ICtec Company.433MHz、200meter RF module serialno. ：A06-0016.