As. J. Energy Env. **2009**, 10(03), 142-148

Asian Journal on Energy and Environment

ISSN 1513-4121

Available online at www.asian-energy-journal.info

Short Communication

Improvement of a data logger system for renewable energy

Jakkree Srinonchat*

Signal Processing Research Laboratory, Faculty of Engineering,
Rajamangala University of Technology Thanyaburi,
Thanyaburi, Phatumthani, 12110 Thailand.

*Author to whom correspondence should be addressed, email: jakkree.s@en.rmutt.ac.th

This paper was originally presented at the International Conference on the Role of Universities in Hands-On Education, Chiang Mai, Thailand, August 2009.

Abstract

A data logger is a device for measuring and storing data. It is an all-purpose piece of measurement equipment that finds use in an extremely wide range of applications. This research designs a data logger for renewable energy applications where battery backup or power supply is used. Measurement and data accuracy are most important and this research applies a microcontroller, flash disk and GPRS broad to design a logger capable of storing data every 5 seconds.

The results show that the error of the measurement is only 0.688 % when is compared to the standard multimeter HP 34401A.

Keywords: data acquisition, data logger, renewable energy, GPRS

Introduction

The need for small, ubiquitous data loggers and data acquisition systems are drawing increasing attention from both academia and industry, especially for remote monitoring of renewable energy. Modern data loggers and data acquisition systems are being designed based on stand-alone and low power or energy consumption [1, 2].

In each situation the energy consumption is essential to the functionality of the system because the battery duration depends on it. Power estimation techniques are needed in order to specify the power behaviour of these systems. Parameters that characterize this consumption can be hardware or software related. Hardware related parameters can be the consumption of the processor itself, as well as the consumption of the peripheral units like memories, communication modules, etc. On the other hand, energy optimization may occur by the use of software reprogramming. Therefore, power evaluation is essential and proves to be useful in all the possible steps in the development procedure of digital systems [3]. On the other hand, the estimation of the good operating condition of an instrumentation system, like a data logging system, can also be a quite important task.

An ideal data monitoring scheme should ensure collection of large quantities of data and a fast sampling rate for the collected data over a long period of time. On the other hand, main features of this ideal data monitoring system should also be: easy connectivity to the existing software and hardware, which must be not intrusive and must consume only available memory resources and processor power. Finally, it must be easy to remove from the system, if more cost effective drives become available on the market.

This research develops the data logger for monitoring a renewable energy system, in this case a low-wind speed turbine. Local components such as sensors and electronics are used in this research in order to meet low-cost equipment design. A microcontroller generally controls the time to log data which is set to be each 5 seconds. Data is then transferred into two parts: flash disk memory and GPRS transmitter. At the receiver, the GPRS receiver decodes the data and then creates a database in the computer.

System Development

The smart data logger is the convergence of the sensing features of a sensor with the intelligence and decision making abilities of a micro system. They have been successfully deployed in many industrial applications. The data logger has to be a portable, hand-held, battery-operated data collection device for collecting "real-world" data which can be used as an interface connected to a computer or as a stand-alone instrument. In its stand alone mode the data logger can display meter readings from the attached sensor, recording the data from sensors to memory for later transfer to a computer for analysis. The data logger has a port to connect and communicate with a graphing embedded computer system [4, 5, 6].

The main function of proposed data logger is:

1. Continuous data monitoring.
2. Comparison with the set point.
3. To generate manipulating signal to the final control element.
4. A peer to peer and multipoint network can be established by configuring each module to operate as end device.
5. To transmit the data to remote display (PC or PDA).

The overall architecture of the proposed wind monitoring system is as shown in Fig 1. The system has two major components, remote transmitter module attached to the cup type anemometers and the receiving module interfaced to the personal computer. Dedicated interactive software is developed to manage the wind database. The Graphical User Interface (GUI) facilitates the user to view the wind data and the results and the visual basic program is used for the design.

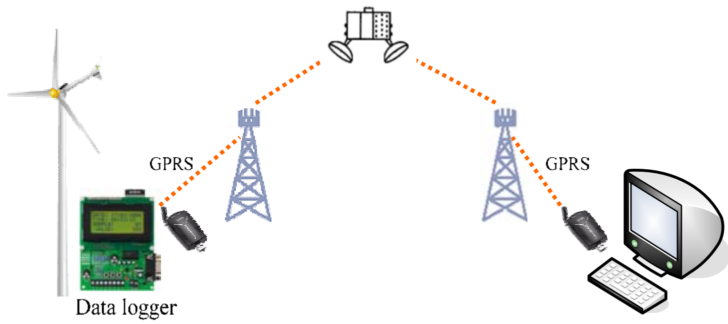

Figure 1. Overall system design.

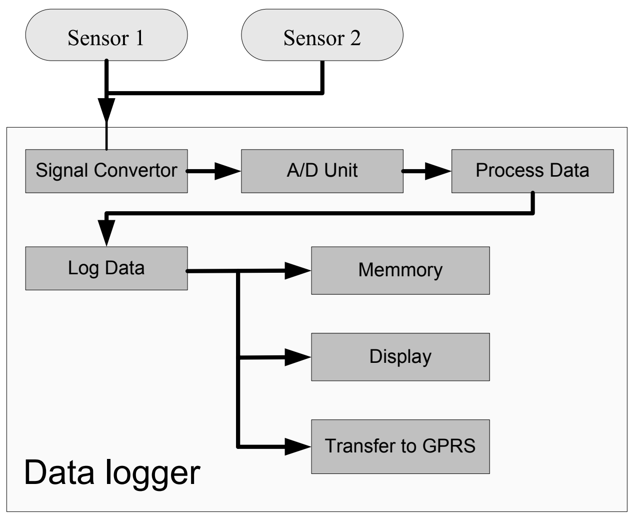

Figure 2. Transmission component.

Hardware Development

Figure 2 shows the various components of the data logger system. The various parts include:

- The PIC microcontroller evaluation board is serial peripheral interface (SPI) enabled. SPI is a simple protocol often used by microcontrollers when they need to communicate with peripherals. Also it is provided a USB protocol which the USB protocol is quite complicated. The microcontroller's developers helped the end user by providing a suite of subroutines that help deal with the USB protocol. The microcontroller has an on-board ADC. There was no need to add to the part count and complexity of the system by adding an external ADC.
- The data logger stores data on a removable flash disk and is able to communicate with a computer using the universal serial bus (USB) standard.

- GPRS module which is supported to TRI - BAND EGSM900, DCS1800, PCS1900, provides the data downlink transfer max 85.6 KBPS and data uplink transfer max 42.8 KBPS. It also supports the protocols PAP TCP/IP.

This system has been developed and tested with a low-wind speed turbine under operating conditions. The following broad steps can achieve monitoring of wind speed using cellular communication.

- Reading the revolutions of anemometers for every 5 seconds.
- Sending these revolutions to transmitter module.
- Sending stored data to flash disk.
- Showing the data on display screen.
- Sending stored data to the receiver GPRS/GSM as SMS for every 1 minute.

The following steps explain the overall operation of the receiver module:

- After every interval of 1 minute SMS is received.
- Extract the data from the SMS sent by remote transmitter module.
- Separates individual bits of data for wind speed, wind direction and current into database.
- Provide graphical interface to the user.

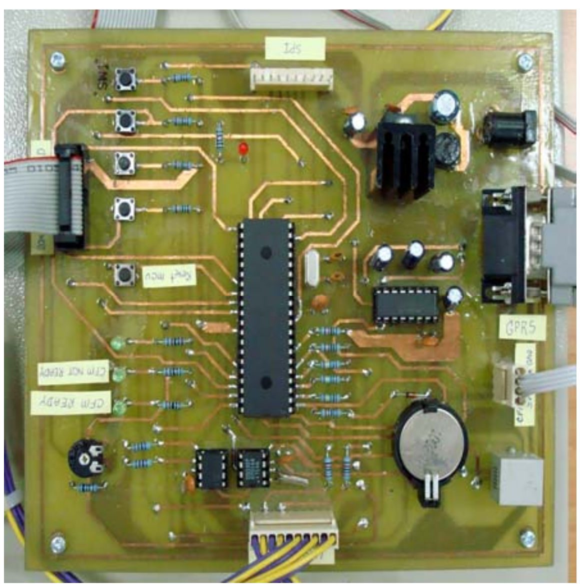

Figure 3. Controller board.

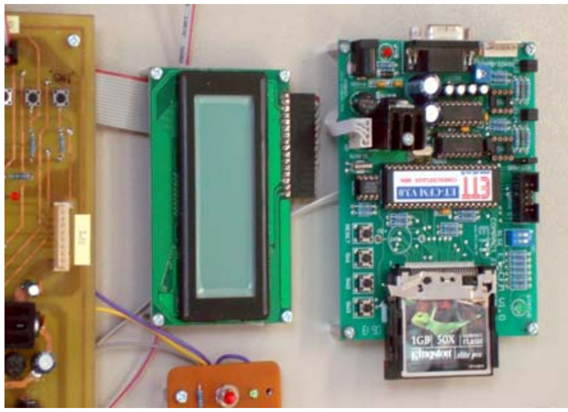

Figure 4. Connection to the test flash disk.

Results and Discussion

This system has been trialed in both the laboratory and with a low-speed wind turbine.

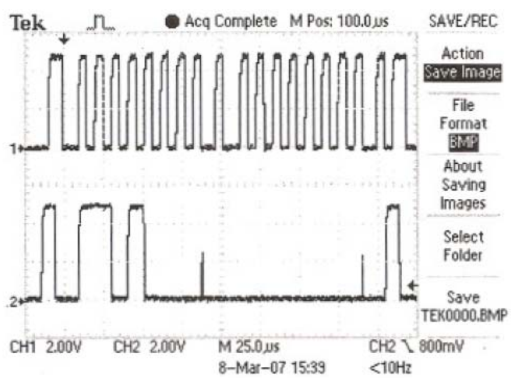

Figure 5. Signal from the 12C bus.

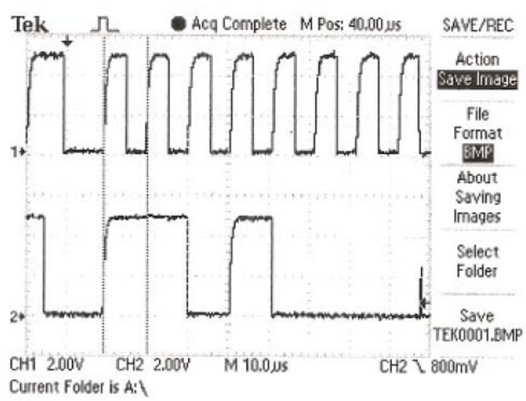

Figure 6. Transfer data rate.

Figures 5 and 6 show the transfer data signal from the microcontroller to the GPRS module. This signal also writes to the flash disk to record data. It is able to determine that the transfer rate is not really 100 kHz, but it is only 92.97 kHz.

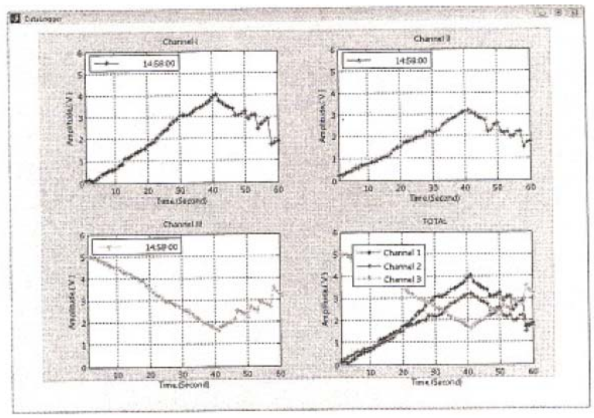

Figure 7. The GUI results.

Figure 7 shows that monitoring system has 3 channels. The potential error of this experiment in terms of measurement is also considered. The error of the measurement is only 0.688 % compared to the standard multimeter HP 34401A. The results of the experiment which were tested with a low-speed wind turbine also show similar efficiency and results. However, some delay time of the GPRS system to transfer data occurs in the process and this results in system error. The log time and transfer data delay time is an important factor which directly effects the processor time of the microcontroller. To avoid the process, this experiment is designed to record the data in 5 seconds.

Conclusion

This work designs a data logger for a renewable energy system and considers the need for a battery backup or power supply for the data logger. In concert with the concept of renewable energy, the system is required to have low power consumption. The accuracy of measurements is a major consideration in the design.

Acknowledgements

This research is the part of the “Development of Data Acquisition Systems for Renewable Energy” project which is supported by grants from the National Research Council of Thailand (2009). The author would also like to thank all the staff of the signal processing research and laboratory and wind hydro and solar energy research building, Faculty of Engineering, Rajamangala University of Technology Thanyaburi.

1. Calvin, C. and YangQuan, Chen. 2008. A General-Purpose Low-Cost Compact Spatial-Temporal Data Logger and Its Applications. *Proceedings of IEEE AUTOTESTCON*, pp. 90-94.

2. Newberry, B. and Conrad J. M. Data. 2008. Logging Solution for Digital Signal Processors, **Journal of Signal Processing**, pp. 247 – 256.

3. Konstantakos, V. and Laopoulos, Th. 2007. Data Acquisition and Advanced Computing Systems: Technology and Applications. *IEEE International Workshop on Intelligent Self-Evaluation Configuration for Remote Data Logging Systems*. pp. 18 – 23.

4. Engelberg, S. Kaminsky, T. and Horesh, M. 2007. A USB-Enabled FLASH-Disk-Based Data Logger. *IEEE Instrumentation & Measurement Magazine*. pp. 63 – 66.

5. Badami, R. L. Ashok, S. Suresh and Jangamshetti, H. 2008. PC Based Wireless Wind Data Analyser. *ICSET*, pp. 474 – 477.

6. Zhu, C. J. and Dongjin, S. B. 2008. Design and Realization of Digital Informational System. *The Eighth International Conference on Electronic Measurement and Instruments*. pp. 2-241 - 2-246.