



Volume: 2, Issue: 6, 258-261
June 2015
www.allsubjectjournal.com
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 3.762

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Smart phone based real time wireless data logger system

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Abstract

Data Loggers are changing more rapidly now. Data logger system can be customized according to the application requirement based on the available resources in the market. Hence, this creates a cost efficient and worth solution for the end user. This paper presents a wireless data logger system with remote control capability via PC and Android smart phone is introduced. The design of portable wireless data logger system is compact and light to increase the mobility and usability. The collected sample data with time stamp from real time clock (RTC) module will be stored into SD memory card which is attached to controller board. The wireless data logger system can directly transmit the data to end user if the device is in the communication range also it stores the data into memory card. Graphic user interface (GUI) can be developed using visual Basic and Android application. The developed applications can communicate with wireless data logger system through wireless modules. End user can change the data logger system settings like, data sampling frequency, date and time remotely.

Keywords: Wireless communication; Wi-Fi; Data logger; FPGA; Android

1. Introduction

Electronic devices that have the capability to record data from sensors in specific location over time are referred as data loggers. Typically, data logger system is equipped with microprocessor, memory, and sensor for data collection. Mobility is one of the advantages of data logger system since the size of the microprocessor, memory, and sensor is small.

The design of the data logger system can be made based on the needs of specific environment or application type. Many of the general purpose data loggers are machines with fixed parameters. However, there are some with re-programmable capability.

One of the most important advantages of using data logger is the capability to collect data automatically over a long period. Measurement results can be collected without human supervision just by deployment and activating the data logger on the intended location. This does not only reduce the human resources in data recording, but also provide an accurate picture of the environmental conditions during the monitoring period. For most of the scientific research works, monitoring and collecting data of the phenomenon for a given period is very important to draw conclusion from analyzing the data. For the case that requires monitoring done in a large space environment such as in agriculture, and weather station multiple of wireless data loggers are required to cover all the area. It forms a wireless sensor network problem. Many researches such as in focus on prolonging the network life time since it is battery powered. To extend the operation times, technology such as mechanical generators, thermoelectric generators, and solar cells are use to harvest energy from the surrounding.

Continuous development of the coming up technology on data logger has brought the creation of new innovation and applications. By using the available resource in the market such as personal computer and tablet, it is possible to customize data logger according to their application requirements. The content of this paper is organized as follows. In the next Section, the design of the wireless data logger is explained. The hardware development of data logger and mobile portable data logger is described in Section III. After the development of the hardware, software development will be carried out in Section IV. Section V presents the conclusion of this paper.

2. Design overview

Wireless data logger provides decision making, real time data logging, data storage and wireless data transmission capability. In this Section, two data logging methods will be demonstrated.

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2.1 PC based data logging

The first method is PC based data logging as shows in Fig. 1. The developed data logger has an ability to directly transmit the sensed data to PC-end use for real time monitoring. This method is very suitable for data logging in experimental and plant monitoring. The PC is always located at a place with electric supply, shelter and internet access. The data logging method can be enhanced by adding internet access to the PC and short message service (SMS) via Global System for Mobile (GSM) modem.



Fig 1: PC Based Data Logging System

2.2 Smart phone based data logging

Fig. 2 shows the alternative way of data logging in this paper. Sometimes, the data logger may be located at the place where it is far away from PC. Therefore, to retrieve the information, the user has to physically retrieve from the data logger. Introduction of a mobile portable data logger provides an alternative way to collect the data from data logger. Portable data logger can download data from data logger when the device is in the data logger communication coverage. In addition, the use of Tablet with the mobile portable data logger provides data logger a user control panel interface. Which, the user can remotely access into the data logger as how the PC does. This method can be enhanced by utilizing the built-in hardware such as global positioning unit (GPS) to retrieve location information, for example to retrieve the data logger coordinate.

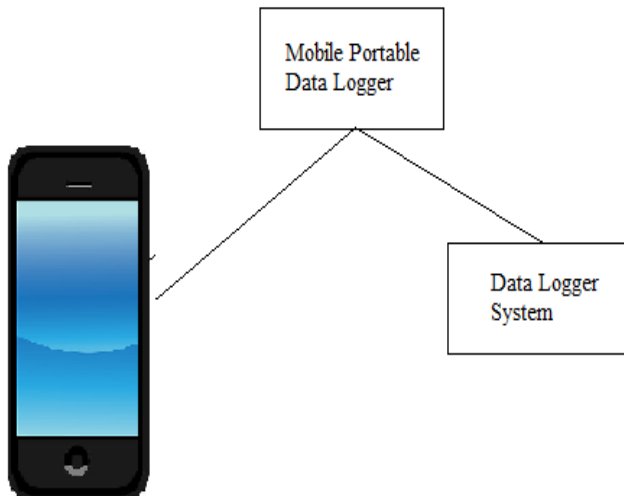


Fig 2: Smart phone Based Data Logging

A. Graphical user interface

As shown in Fig. 1 and Fig. 2, user can view real-time data from the data logger through a PC or Smart phone. In Windows based PC, monitoring software is developed by using express version of Visual Basic (VB). VB is a third-generation event-driven programming language from Microsoft. The design of VB is to provide users with easy to learn and use environment. The layout of the monitoring software interprets important information form data logger such as real-time graph of the sensed data from each channel with a basic data logger control panel.

Today, two types of mobile operating systems are gaining rapid attention from the markets, and it has occupied almost 85% of the mobile devices sold. They are Android from Google and iOS from Apple. In this paper, Android from Google is selected as development platform for smart phone. Google's Android is open-source, which allows developers access to OS source code. Through this advantage, it provides superior customization over others OS. Therefore, developers can develop better software by utilizing system resources.

B. Real time monitoring

Basic data logger is equipped with the external memory storage to log real-time data with date and time stamped. But the external memory has to be removed for data analysis after a period of sensing time. Wireless data logger provides more advantage over cable type data loggers, which it can provide real-time information to the user without the long, expensive and inflexible cable. But the use of wireless transmission may not guarantee the accuracy of the data logger information. A hybrid between wireless communication and external storage provide intelligence solution to the problem, it ensures the data will not be lost in case of communication failure. Fig. 3 shows the hybrid of information delivery method.

As shown in Fig. 3, designed data logger has a choice to store the data into external storage module or directly transmit the data through wireless communication module. The use of wireless communication only will be active when the receiver is in the communication coverage. Otherwise the data will be stored into external storage to prepare for next reliable data retrieval.

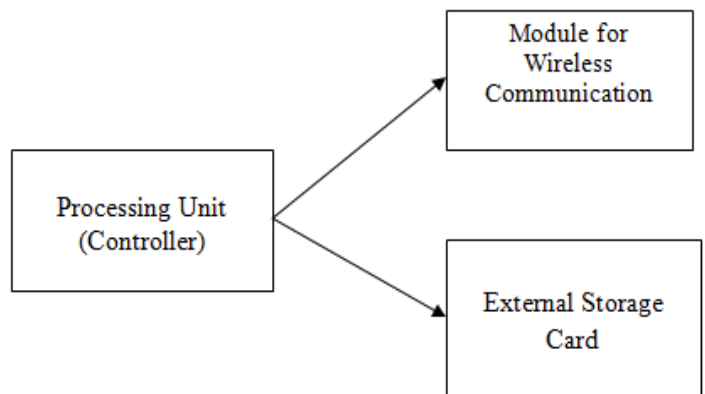


Fig 3: Structure of Data Logger System

C. Remote access control

In practice, the data logger is located at the place where physical accessing to the data logger for software upgrade, calibration and adjustments is time consuming and impractical. Therefore, in this project the designed data logger includes remote access control capability. The terms remote access control means user can wirelessly access into data

logger to change the control settings. The operation of the designed wireless data logger consists of two modes, these are active mode and command mode. In the active mode, it includes the operations such as data transmission state and sensing state. While in command mode, user has the authentication to change the data logger settings.

3. Hardware development

In this Section, hardware development of wireless data logger will be demonstrated. The demonstration is split into two parts, first is the main controller board and followed by the communication modules. Fig. 4 shows the controller diagram of both data logger and mobile portable data logger. The controller consist of 4 basic modules, these are controller unit which can be any controller like FPGA, wireless communication module, external data storage module and real-time clock module. For ease of development, all the modules are attached to the main microcontroller unit module. The use of different type of wireless modules is to convert data sending from data logger via XBee to the user's smart phone via Bluetooth or Wi-Fi module. In this stage, both prototypes can be power up from single 9 V batteries or USB power.

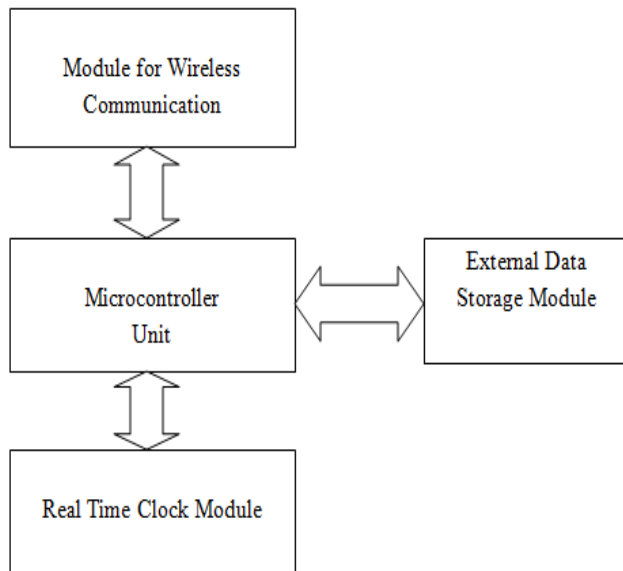


Fig 4: Controller diagram

3.1 Communication modules

XBee, Bluetooth and Wi-Fi are the wireless modules that can be used in data logger project. These modules share similar features such as communication protocol, operating voltage and they provide data logger a way to communicate wirelessly.

3.1.1 XBee Module

XBee Wireless Module is the wireless communication module which is use for communicating between data logger to PC and also to the mobile portable data logger. The transmission of the XBee module is around 30 m for indoor and 100 m for outdoor. The operating voltage of XBee is 3.3 V. To access into XBee module, UART protocol can be used.

3.1.2 Bluetooth Module

Bluetooth Module is the wireless communication module that can be used in communication between mobile portable data

logger to Tablet. The transmission range of the module is around 20 m- 30 m which is far enough for the design.

1.1.3 Wi-Fi Module

Wi-Fi Module is the wireless communication module that can be used in communication between mobile portable data logger to Tablet. The transmission range of the module is around 20 m-30 m indoor and a greater range outdoor which is far enough for the design. Using IEEE 802.11 standard for communicating wirelessly with smart phone one can achieve multiple client communication at the same time.

4. End User Application

4.1 PC- End User Application

VB can be selected as development platform of PC monitoring software due to its simple to use drag and drop interface. The development of monitoring software starts with the communication between data logger and PC. XBee module will be connected to PC and recognize by PC as serial port.

4.2 Android – End User Application

Android has been selected as development platform of monitoring software application due to it is open-source and freely available. The development of monitoring software application starts with the communication between mobile portable data logger and Tablet. Communication connection is based on Bluetooth and Wi-Fi, Tablet built-in Bluetooth and Wi-Fi and Bluetooth BEE.

5. Conclusion

In conclusion, wireless data logger system for real time monitoring can be developed according to the given structure shown in paper. The monitoring software in PC or smart phone can view and record real time information from data logger. In addition, user has authentication to access and change the setting via monitoring software. Data logger with external memory storage can store the sensed data to avoid data lost if the wireless connection is lost.

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