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Wireless Data Acquisition And Processing

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Abstract— **The data acquisition (DAQ) is to measure an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound which requires some form of monitoring or controlling. A small scale embedded system is designed for wireless data acquisition (WDA) at 433MHz ISM band and the system is controlled using PIC Microcontroller. The wireless RF communication eliminates the need for devices to be physically connected for communication. The received data from sensor nodes are displayed in a personal computer PC. This helps for analyzing the received data.**

Index Terms— DAQ, WDA, PIC, RF, 433MHz ISM.

I. INTRODUCTION

The purpose of data acquisition is to measure physical phenomenon. These signals may represent the state of a physical process. The data have to be analyzed or processed to generate further signals for controlling external equipment or for interfacing to other systems. PC-based data acquisition uses a combination of modular hardware, application software and a computer to get Measurements according to the requirements. Every DAS(Data Acquisition System) shares a common goal of acquiring, analyzing, and presenting information. The systems incorporate signals, sensors, actuators, signal conditioning, data acquisition devices, and application software.

The communication protocol is very important in a DAQ, for transferring data to / from DAS hardware, Microcontroller and PC. Data communication is classified as follows parallel communication, serial communication and wireless communication. Most of the microcontroller based system use serial communication using wired or wireless technologies. The most commanly used wired protocols are RS-232, I2C, SPI, CAN, Fire wire and USB. The implementation of wireless communication eliminates the need for devices to be physically connected in order to communicate..

The physical layer used in wireless communication is typically either an infrared channel or a radio frequency channel and typical wireless protocols are RFID, IrDA, Bluetooth and for data transmission. GSM can transmit over a large range of distance, it needs much money to carry out data transmission. Radio frequency (RF) transmission at 433 MHz offers a great advantage in terms of distance, power and the size of unit. In the above applications, 433 MHz RF transmission is the best option that offers limited power usage, high range of data transmission, low cost, and low maintenance.

II. RELATED WORKS

The wireless system effectively automates the temperature monitoring activities [3].The system have hardware, software, and a personal computer (PC). The wireless system module architecture comprises of a power subsystem, a sensor sub-system and a main node system mainly based on wireless radio frequency (RF) technology. The system acquires temperature data from a sensor and sends the data to a desktop PC in wireless format continuously and a dc motor is controlled as required from this PC using wireless RF communication [4].A parameter monitoring system which is based on Zigbee wireless technology for automation. Data is received, saved and displayed to achieve soil temperature, soil moisture and humidity monitoring [7].

Implementation of a multi-channel data acquisition board, which collects real world analog and digital data, transfer them to a personal computer using a USB communication link. The DAQ board is based on PIC microcontroller (PIC18F2550) [10]. An integrated system for measuring four signals and simultaneously producing synchronous signals on a Wireless Body Sensor Network using Bluetooth communication[12].

III. PROPOSED METHOD

A Wireless Sensor Network (WSN) is a system which comprised of radio frequency (RF) transceivers, sensors, microcontrollers and power sources. Recent advances in the area of wireless technology have led to the development of low cost, low power, multifunctional sensor node. Sensor nodes enable environment sensing together with data processing. The modular hardware and software concept facilitates adaptation and extension with new sensors network works. Figure1 shows functional units such as master module and sensor nodes . The master module controls and provides necessary instructions to the sensor nodes.

Communication is initiated by the central node and it addresses sensor node that have to be activated. The corresponding sensor nodes periodically send information to a coordinator node. To reduce energy consumption, it is assumed that all these sensor nodes are in standby or sleep mode until the centrally assigned time slot.

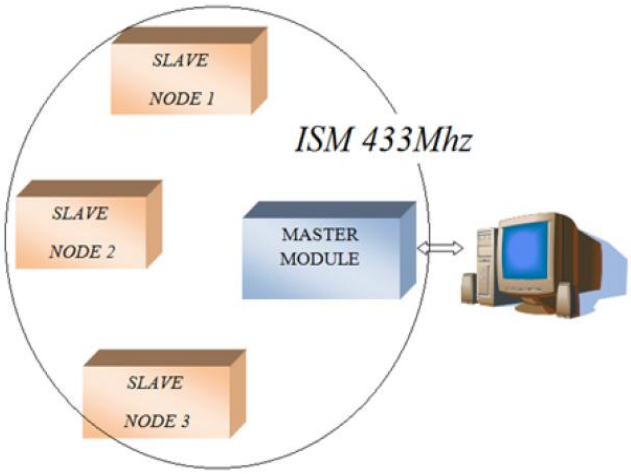

Fig. 1. Functional Block Diagram of WDA.

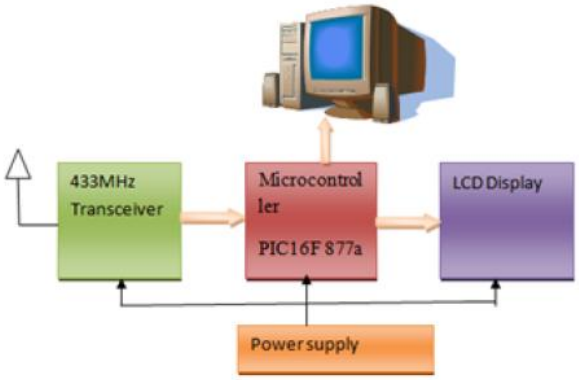

Fig. 2. Functional Block Diagram of Master module.

There is no possibility of collision within the network. The master module is connected to the PC which further display and store the received signal. The radio interface is based on the highly flexible 433MHz transceiver. It was configured to work within the European ISM band at 433 MHz. The 433 MHz RF communication system that was implemented can be further sub-categorized as

- Communication between sensor nodes.
- Communications between sensor node and the master module.

A. *Master module*

The master module consist of Microcontroller PIC 16F877a, 433MHz transceiver, LCD display, Power Supply, PC. Master module Initials the communication. The data received in the master module is displayed on the PC. The software called Docklight was use in the PC to display the received signal. USART communication is employed on PIC to communicate with PC. Usually all the digital ICs work on TTL or CMOS voltage level which cannot be used to communicate over RS-232 protocol. So a voltage or level converter is needed which can convert TTL to RS-232 and RS-232 to TTL voltage levels. The most commonly used level converter is MAX-232. Fig2 shows the modules used in master module.

USART stands for Universal Asynchronous Receiver / Transmitter. It is a serial communication interface which uses two lines for sending (TX) and receiving (RX) data. As its name indicates it is an asynchronous communication interface, which means it does not need to send clock along with it as in synchronous communications. UART is the communication standard of old computers RS-232 serial port. Most of the Microchips PIC Microcontrollers have built in USART Module.

B. *Slave module*

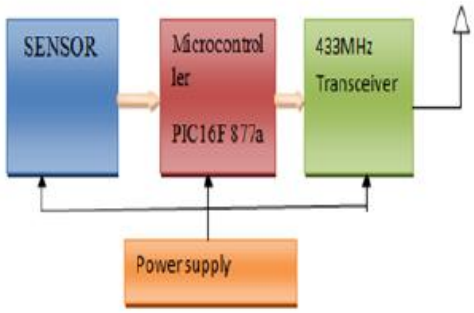

Fig. 3. Functional Block Diagram of slave node.

The Slave Node consist of Microcontroller PIC16F877a, 433MHz transceiver, temperature sensor (LM35), Power Supply. The functions of the slave nodes are to collect analog signals from sensor and digitalize the acquired analog signal later forwarding it to radio transceiver. Fig. 3 shows the slave node in detail.

IV. NETWORK

A time division multiple access (TDMA) scheme was implemented based on the existing time synchronization mechanism. A so-called superframe is defined by adjacent time synchronization beacons of the master node as shown in Figure 3.4. This allows to transmit a maximum length packet of 61 bytes plus a safety period before and after, to accommodate clock jitter. Each sensor has exclusive time slots assigned to it. The number is defined by the type of sensor and its sampling frequency. The slots before and after a time synchronization beacon are reserved for the master node for command transmission.

The common time-division multiple access (TDMA) protocol is implemented to allow multiple leaf nodes to communicate with a single receiver by transmitting in different time slots. A TDMA protocol permits only one node to send at a time thus increassing efficiency.

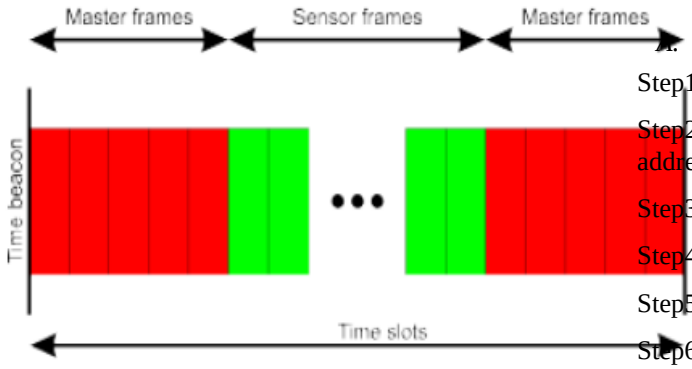

Fig. 4. Validation of Wireless Communication Interface

V. SOFTWARE AND HARDWARE SPECIFICATIONS

A. *Software specifications*

The coding is done in Mplab in embedded C. The detection of the colored objects are written in PIC 16F877A micro-controller. The following steps are involved in the software development:

- Codeing

High level languages such as C, Java or assembly language are used for coding and debugging. For this system the coding is done in Mplab using embedded C language.

- Compiling

A compiler for a high level language helps to reduce production time. Although inline assembly was possible, the programming was done in strictly in Embedded C. A source code for USART, ADC, interfacing LCD etc has also been included. The compilation converts C program into machine language. The microcontroller understands only the machine language.

- Burning

Burning the machine language file into the micro controller's program memory is achieved with the dedicated programmer which is attached to the PC peripheral. PC's serial port has been used for this purpose. Here PICkit2 Programmer has been used.

B. *Hardware specifications*

The hardware board consists of:

- Power Supply
- PIC 16F877A
- 433MHz transceiver
- MAX 232
- ULN2003
- Sensors

VI. WIRELESS DATA ACQUISITION SYSTEM SPECIFICATION

Frequency: 433MHz
Data Rate: 2-20kbps
Modulation: ASK
Receiver Sensitivity:-106dB
Bandwidth: 2MHz
Gain: 64-76 dB

VII. ALGORITHM

A. *Master module*

Step1: Initializing various ports and for USART.

Step2: Send request for node 1 for which corresponding address of node1 is send.

Step3: Enable receiver mode.

Step4: Receive Data.

Step5: Convert to decimal value, check is any error.

Step6: If no error found send data to PC using USART.

Step 7: Wait for 1000ms.

Step 8: Send request for node2 for which corresponding address of node2 is send.

Step 9: Step from 3-6.

Step10: End

B. *Slave module*

Step1: Initializing various ports for transceiver and sensors.

Step2: Wait for master to start communication.

Step3: Check if the receiver data corresponds to the node address.

Step4: If the condition satisfy move to step 5 else 2.

Step5: Start A/D conversion of the value from sensor.

Step6: Convert integer value to string and form pulse code.

Step7: Send value to transceiver and transmit the measured value.

Step8: Goto step2.

Step9: End

VIII. RESULT

The system was early implemented in proteus. Where the system was simulated and output was observed. The program had a master module and a slave module. The slave module had a temperature sensor and a transceiver connected to it as shown in Fig.3. The PIC16F877A at slave end have program for A/D conversion for the temperature collected from sensor. It also have program for USART communication with the 433Mhz transceiver.

The master module have a transceiver and a LCD module connected to it. The PIC at master end have program for USART communication with transceiver and required program for displaying received data.

The system was later implemented in hardware with one master and one slave node with output depicted in a LCD display. Fig 6 shows the hardware model of the implemented WDA system

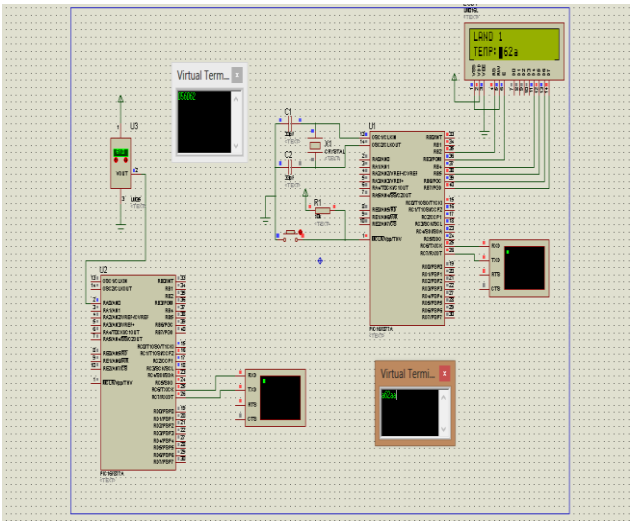

Fig. 5. Simulated output in proteus.

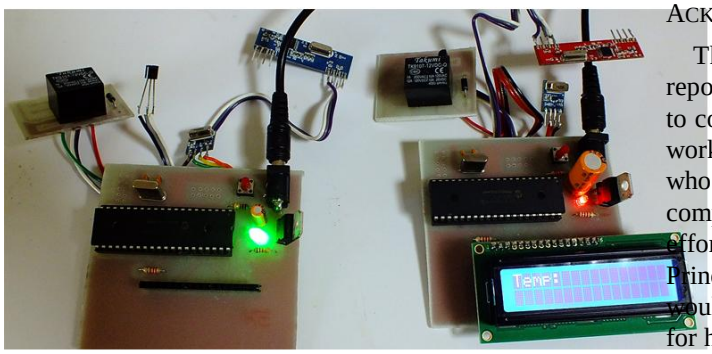

Fig. 5. Hardware implementation

Later more than one sensor module was implemented to form a sensor network. The master gives necessary commands for each sensor node to send the temperature. The master module send the address of the corresponding sensor node from where the temperature have to be obtained. All the sensor nodes receive this signal and check if their corresponding address matches with the received signal. If address is verified then the sensor node reads the the sensor value and convert to digital form by A/D converter and send the data to the master module. A software called Docklight is used to display the received signal at the master module in a PC.

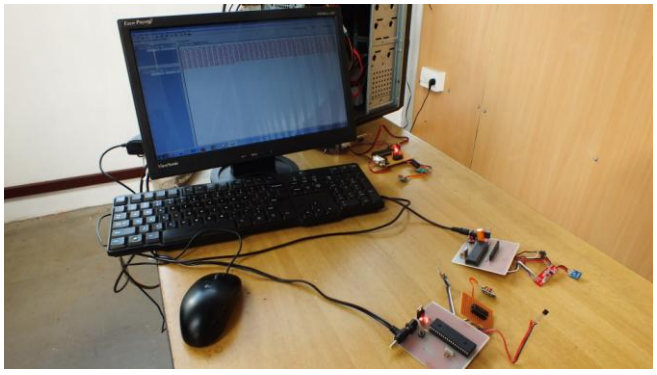

Fig. 6. Hardware implementation of sensor network

Docklight is a testing, analysis and simulation tool for serial communication protocol. It allows observing the communications between 2 serial devices or used in testing the serial communication of a single device.

IX. Conclusion

A wireless data acquisition system was implemented at 433MHz ISM band. The system monitors the temperature continuously and sends the data to master module from the sensor node using wireless RF Communication. Further it is displayed in a PC. When more than one slave nodes are implemented a sensor network forms. This helps us to monitor and control an environment. The major area of application are in medical field in forming a Body Sensor Network. The system can be further implemented in industrial monitoring, home automation etc. The implemented system is mainly used in avionic applications.

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REFERENCES

[1] Saim Kim, Christian Brendle, Hyun-Young Lee, ”Evaluation of a 433MHz Band Body Sensor Network for Biomedical Applications’’,13,898-917; Sensors 2013 USA, 2006. J. U. Duncombe, “Infrared navigation—Part I: An assessment of feasibility,” *IEEE Trans. Electron Devices*, vol. ED-11, pp. 34-39, Jan. 1959.

[2] Shih-Lun Chen, Ho-Yin Lee,” Wireless Body Sensor Network With Adaptive Low-Power Design for Biometrics and Healthcare Applications”,*IEEE System Journal*, VOL. 3, NO. 4, December 2009.

[3] M. Mokhtar,M. S. A. Mansor,O. Sidek, M. Q. Omar, ’’Design of a Wireless Temperature Acquisition System for Laser Cutting Process’’, *International Journal of Electrical Computer Science* Vol:10 No:06,December 2010.

[4] K.S.Ravi, Y.Ramakrishna,,’’Design of an Embedded System for Wireless Data Acquision and Control using PIC Microcontroller’’,International *Journal of VLSI and Embedded Systems*,Vol 03,Issue 01, January-April 2012.

[5] Kalyanramu Vemishetty ,” Embedded Wireless Data Acquisition System,”Thesis Submitted to the Faculty of the Virginia Polytechnic Institute and State University, February 23, 2005.

[6] Lauren E,Linderman Kirill A. Mechitov ”Real-TimeWireless Data Acquisition for Structural Health Monitoring and Control”June 2011.

[7] R. K. Prasad ,Mr. S. R. Madkar, ''Design Implementation of Wireless Transceiver for Data Acquisition in Wireless'', Sensor Network Volume 3, Issue 7, July 2013.
[8] S Waghmode, M. B. Limkar,''Data Acquisition Using Android and Pic Micro-Controller'', *International Journal of Electrical and Electronics Engineering Research*, Vol. 4, Issue 2, Apr 2014, 363-368.
[9] Samiran Maiti," Embedded ph Data Acquisition and Logging'', *Advanced Computing:An International Journal*,Vol.3, No.1, January2012.
[10] Samiran Maiti,'' Design of a USB-Based Data Acquisition System'', *International Journal of Research in Engineering and Technology*, Volume: 02 Issue: 04 ,Apr-2013.
[11] Ammar Mahjoubi , Ridha Fethi Mechlouch and Ammar Ben Brahim, ''A Low Cost Wireless Data Acquisition System for a Remote Photovoltaic (PV) Water Pumping System'',Energies 2014.
[12] Yeongjoon Gil, Wanqing Wu and Jungtae Lee,''A Synchronous Multi-Body Sensor Platform in a Wireless Body Sensor Network: Design and Implementation",Sensors 2012.

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