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Multi-Parameter Portable Data Logging Instrument for Industrial Metering

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Abstract

This project aims at providing highly cost effective solution for conventional high volume data logging equipments for industrial metering which are designed for critical parameters for industrial environment. The supreme agenda while making concept of this project is given to the flexibility of this instrument. It should be made so much flexible that it can be modified for accurate measurement of any other process parameter. Also the complete setup should be so much portable that it will avoid the needs of harness. The projected device will be a battery operated having the capability to communicate the data to central machine via other nodes or directly ISM band of 2.4 Ghz using zigbee stack. Our ultimate target is to achieve efficient wireless metering by using smart sensor network.

Keywords: Data Logging, Industrial Metering.

Introduction

Metering of various process parameters is very much important and metering industry is playing a key role in electronic industries due to the high volume requirement with the evolution of low cost microcontrollers and wireless communication equipments we can design low cost smart metering solution having intensive communication capability. Today whatever metering solution which are available in the market they are employ communication protocol like RS232,RS485,CAN,MODBUS etc which require harnessing which becomes very much impractical where deferent meter are require in large numbers. Our target is to provide such a generic solution to the market where single device can monitor many process parameters at a time with no need of wiring which transfer the data wirelessly no need of wiring for communication in place of which ISM band can be used for communication at the same time device will be completely battery powered.

We are aiming at a portable device powered by low cost microcontroller and wireless communication equipment along with the analog front end. The analog front end will enable interfacing of any sensor to sense the parameter which will be captured by microcontroller and transmitted by Zigbee. At a same time a single projected device will sense and monitor multiple parameters which will results in saving cost because in today's scenario different meters are used for different application and as a result cost of the overall system get increased.

Hardware Description
Processing Unit

The atmega328 is from AVR family of microcontroller which is having advanced RISC Architecture, up to 20 MIPS Throughput at 20 MHz, two 8-bit and one 16-bit timer / counters with separate pre scaler and compare Mode, 8-channel 10-bit ADC which are very important features of monitoring system.

We have selected the ATMEGA328 because of its above unique features along with availability of AVR studio the free IDE for Atmel Corporation. Also the atmega328 is from the world famous arduino platform which is very popular and proven for rapid prototyping.

AVR architecture is so rigid and fail safe and at the same time it is available at the very competitive price as compared top the other silicon cores.

Zigbee Network

The Zigbee S1 is a 2.4 GHz operated trans-receiver module with direct sequence spread spectrum (DSSS) which can give benefits for resistance to intended or unintended jamming, sharing of a single channel among multiple users, reduced signal/background-noise level hampers interception, and determination of relative timing between transmitter and receiver; low power consumption and low cost of the infrastructure IEEE 802.15.4 networking protocol that offer the fundamental low

level device to device type wireless personal area network (WPAN) which focuses on low cost and low-speed ubiquitous communication between devices which can exploit this to lower power consumption; receiver sensitivity -100dBm and 12 direct sequence channels.

The unique selling point of zigbee infrastructure is Each and every node is remotely programmable and we can monitor the RSSI viz., the received signal strength.

The value of RSSI helps the WSN to operate without failure. In zigbee network we are keeping each node in router hierarchy. This helps us to route data from one meter to another. So all the zigbee powered meters under a roof will form a infrastructure. So using this technique we will not require the use of network cables or shielded wires to communicate with the centralised monitoring system which in turn reduce the cost.

Literature Survey

There are several WSN hardware platforms available. In our prototype system, we chose our hardware platform based on Arduino board and an Xbee module. This was motivated by the SquidBee WSN platform developed by the Wireless Sensor Network Research Group [5]. SquidBee is an open-source WSN platform, where each SquidBee Mote takes environmental parameters with its three sensors (humidity, temperature and lightness) and sends them wirelessly through the SquidBee network using ZigBee protocol. The hardware of each mote consists of an Arduino board, an Xbee shield that supports an Xbee module, and sensors. Although our prototype hardware platform is not optimized for WSN applications in term of cost, energy consumption, size, nor real-time application support, the platform allows easy development of a WSN due to the simplicity of programming an Arduino microcontroller board.
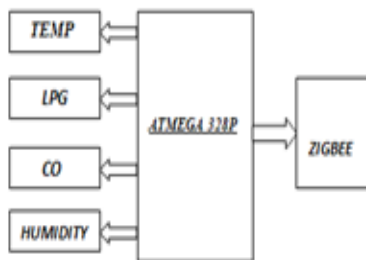
Block Diagram

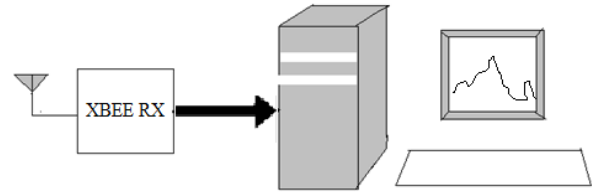**Fig. 1 Block diagram of sensor node**

Fig. 2 Block diagram of receiver node

It gives the overview of the designed & implemented system and information about different components used. Group of various sensors are connected to analog front end. The build-in ADC in micro-controller unit is used to convert the analog signal to digital values.

One of the node is provided with USB to UART bridge. We have used CP2102 from silicon bridge which will convert the UART data coming from zigbee module at 9600 baud directly to USB. The VCP viz., the virtual COM port will be used by the desktop application to capture the data coming from nodes.
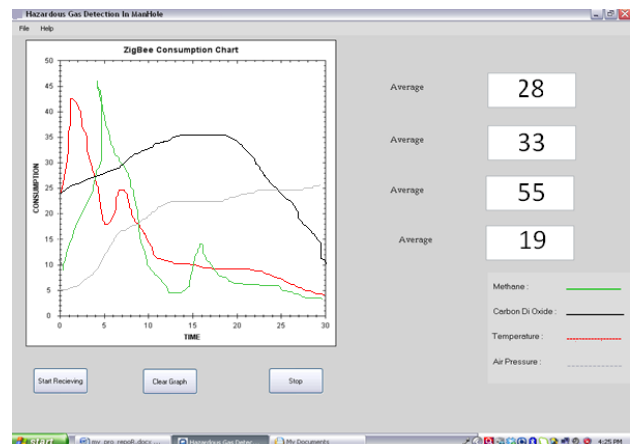
User Interface

Fig. 3 GUI of the application written for the system

This is the interactive GUI we have designed for the desktop. This enables graphical data. This application is designed by using Z-Graph utility and Microsoft visual studio. The application also generates the log report of all the parameters in .txt or .csv format.

This is software generated report is very much useful for analysis of the process plant.
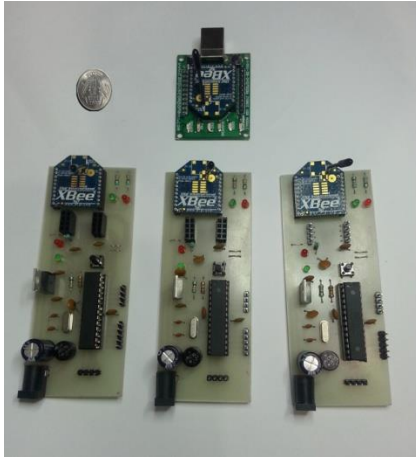
Hardware Setup

Fig. 4 showing hardware setup for 3 nodes along with PC interface module.

From the above figure we can understand the compactness of the system. Also it does not require much wiring.

Conclusion

After the successful prototyping multi parameter portable data logging instrument we have proved the possibility of low cost wsn based metering solutions. Since we can log, monitor multiple parameters in real time without much wiring we can employ this technique for the high volume metering segment for the industrial electronic industry.

Acknowledgment

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