

# Integrating Temperature, Gas, Light Sensors for Monitoring using ARM7

Harshal Ramtekkar

Department of Electronics  
Priyadarshini College of Engineering  
Nagpur, India

E-mail: ramtekkarharshal@gmail.com

Divya Meshram

Department of Electronics  
Priyadarshini College of Engineering  
Nagpur, India

E-mail: divyameshram@gmail.com

**Abstract-** Industrial processes and civil applications are continuously incorporating the sensor devices for various reasons. Prominently Automation and safety in industry using WSN sensors is interest of many recently. In this paper we propose a way to realize the use of ARM7 processor along with different sensors to make it application specific. We present a very brief summary of different types of sensor nodes along with its peculiarities. Furthermore we show the proper interconnection to use ARM7 which is a processor as well as a micro controller along with its sensors.

**Keywords-** WSN, ARM7, Sensors.

\*\*\*\*\*

## I. INTRODUCTION

Monitoring can be suitably defined as the collection, analysis and interpretation of processing data to effectively track, manage or alter site management activities. Monitoring is an important management tool that should be used to help minimize the environmental impacts associated with activities. It can be used by industry to collect information to characterize changes in environmental emissions and to enable appropriate action to be taken when data indicates that the quantity and/or nature of emissions are changing.

Wired monitoring systems are effectively work for small number of devices with less communication distance, if this distance and the number of devices are increased then the wired network creates complexity, make it difficult to find errors and difficult to identify faulty nodes. Also hostile conditions and odd circumstances make it difficult for hardware assembling and fault identification thereby decreasing the feasibility to setup a cable network. Wireless Sensor Networks are still a classical environment for monitoring, home automation and the internet to industrial automation scenarios.

The safety at real time environment includes physical parameters is monitor continuously. The physical parameter like temperature, humidity, pressure, light etc. affects the quality of process at real time environment which should be monitored continuously. This paper shows the proposed scheme for the monitoring of process in industry using ARM7 and WSN, so it includes ZigBee which is the medium of WSN. Control systems like central controller communicates with each serial device, process data and interacts between user and real time system. The central controller gathers the information of sensed physical parameter from sensor nodes and displays it for monitoring. The several parallel processing elements consist of sensor nodes which will sense the parameter and send it to central controller. With the help of sensor nodes and central controller with wireless transmission and ZigBee technology it is possible to minimize the complexity and power consumption of automated control systems.

The rest of the paper is organized as follows. Section II shows the Related Work for this paper. Section III gives the brief about the physical Sensors. The central controller and node circuits are shown in section IV; it also shows the

interfacing brief. Paper is closed by drawing the conclusion in section V.

## II. RELATED WORK

Liu Yanfei *et al* [1], presents an improved design of ZigBee Wireless Sensor Network. Here the coordinator only deals with the task on the ZigBee network whereas the rest tasks will be processed by another processor. The processor is connected with the Coordinator by RS-232 interface. All data information will be sent to the processor through the serial port. So the processor undertakes the task to deal with data, conserve the network information, and communicate with the host computer. Finally tested the improved ZigBee wireless network and verified that improved design of the ZigBee wireless sensor network system is reasonable, the hardware system performance normal, and the software designing improved the working efficiency. The improved design of the ZigBee wireless sensor network embodied distributed processing manner, the improved hardware platform gives good function for the software designing. Designing seems to be very suitable for the large scale wireless network.

Lei Chen and Shuang Yang[2], aims at monitoring information of HCHO, CH<sub>4</sub>, LPG and other toxic and harmful gas concentrations in the chemical production plant, the monitoring system designed a ZigBee wireless sensor network composed of CC2430, MC114 and MS1100 gas sensor, which built a safe, low power consumption, flexible detection system of toxic and harmful gas concentrations. They connect the WSN and internet to implement the data transmission with internet. The implementation design and operation of testing of gas Sensor Application for Monitoring using ARM7 concentration monitoring system can actualize to save energy also reduce environmental pollution, and promptly and effectively to avoid personnel injuries, so it has practical value, and economic benefits. The system not only applies to toxic and harmful gas monitoring, but also more suitable for hotels decoration, and it fully embodies advantages of the ZigBee technology in the monitoring field. After the emergence of PC and the Internet, there would be an emergence of a new technology in front of people which would influence the future of human work and lifestyle.

Vaibhav Pandit *et al* [3], designed a coal mine monitoring using ARM7 and ZigBee. This system deployed sensors in different part of mine and the sensors are connected to ARM7

board through ADC. All the sensor nodes as well as monitoring unit consist of ARM7 and ZigBee, where sensors are connected to mining unit and all the sensed data is transferred to the monitoring unit. After execution it found, MQ-7 gas sensor is more sensitive to carbon monoxide but can sense methane, butane, LPG, hydrogen, smoke, etc. The resistive type temperature and humidity sensors also showed good sensitivity. The ZigBee communication is noise free. ZigBee and LPC2148 provide low power platform.

### III. DIFFERENT TYPES OF SENSORS

Monitoring and controlling physical parameters like temperature, pressure, Gases, light etc. by embedded systems using microcontrollers are very much effective in industrial and research oriented requirements.

The following sessions focuses on some unique sensors and gives very brief yet precise information about same along with its applications.

#### A. Gas Sensor

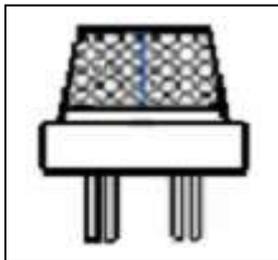


Figure1. MQ6 Gas Sensor

World coal mine methane (CMM) overview has shown some constraints in India which makes safe mining in country a big challenge. So WSN can be used in mines for safety [3]. In the chemical production process, it would inevitably have the problem of the poisonous gas leak, and ensuring the safe production so it would be particularly suitable for factories to set up wireless sensor networks to detect poisonous gas concentration, making the production safety [2]. The MQ-4 gas sensor can be used to detect gas concentration in the house, and the sensors can be changed into MQ-7 series to detect the concentration of carbon monoxide [6]. MQ-6 gas sensor can detect kinds of flammable gases, especially has high sensitivity to LPG (propane). It is a kind of low-cost sensor for many applications. It is widely used in domestic gas leakage alarm, industrial flammable gas alarm and portable gas detector.

#### B. Temperature Sensor

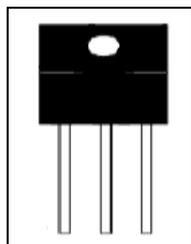


Figure2. LM35 Temperature Sensor

Temperature can be monitored through variety of sensor; one should care in selecting sensors due to different levels of complexity associated with the calibration process. If

calibration is not implemented properly output of the embedded system may vary from actual temperature measured through standard instruments. It detects the temperature changes [8].

#### C. Light Sensor



Figure3. LDR Sensor

It is very much essential in case of some industrial as well as experimental setup to monitor as well as control light continuously. In case of light LDR serves well but its calibration in Lumens is somewhat difficult due to easy unavailability of Lux-meter. Hence in general reference voltage of ADC can be taken with some precautions as intensity of light [8].

### IV. PROPOSED SCHEME

The ARM7 based LPC2148 board is used as a central controller. The flash memory is used as the kernel and file system memory. The LCD is used to display the real-time data. The GSM module is used for sending message to remote mobile device. The ZigBee coordinator is responsible for the collection of sensor data and other information of terminal nodes. Real time sensors are connected to terminal nodes, where terminal nodes contain 8051 microcontroller and serial port to connect ZigBee module [3] [4] [5].

The ARM7TDMI core is a member of the ARM family of general-purpose 32-bit microprocessors. It offers high performance for very low power consumption, and small size. It is based on reduced instruction set computer principle hence much simpler instruction set and related decode mechanism than CISC designs [5].

ZigBee is a wireless communication technology, widely used in wireless sensor network. ZigBee wireless sensor network has great advantages in terms of low power consumption, high fault tolerance, flexibility, and autonomy. So it is widely used in military security, environment monitoring, and home automation [1].

The Atmel AT89S52 is an 8051 based Full Static CMOS controller with Three-Level Program Memory Lock, 32 I/O lines, 3 Timers/Counters, 8 Interrupts Sources, Watchdog Timer, 2 DPTRs, 8K Flash Memory, 256 Bytes On-chip RAM[4].

In the central controller nxpLPC2148 is suggestively used, it includes two UART which can be used to interface with GSM module and ZigBee module, where LCD is usually connected using GPIO pins. Power supply can consist of a step-down transformer, a bridge rectifier, a capacitor filter, aLM317 voltage regulator to provide a constant 3.3v dc supply to ARM-board, similar circuit at the node side to supply continuous 5v supply to microcontroller 8051. GSM module can be either SIM300 or SIM900 that works on AT commands. The LCD of 16x2 is sufficient to display the required result. Due to GSM module a message is send to mobile phone, hence the process can be monitor remotely [5].

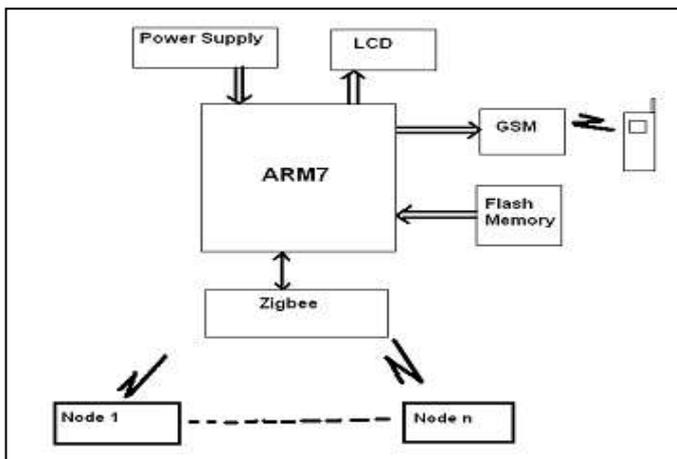


Figure4. System Design

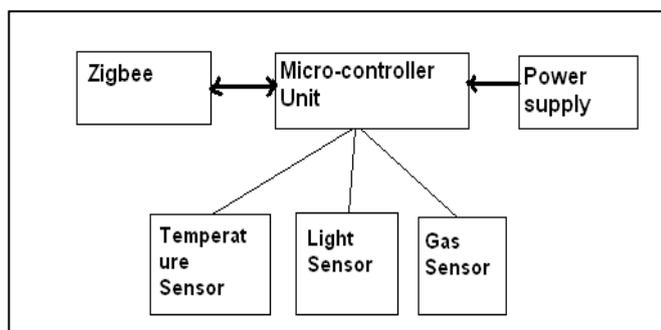


Figure5. Node Design

A node circuit consists of an 89S52 $\mu$ c, a ZigBee module and physical sensors like temperature, light, gas etc connected to microcontroller through ADC chip. Temperature and light sensors will act as a data loggers and gas sensor can use as a toxic gas detector. The values of sensor can be apply to ADC with variable select and it fed to microcontroller, later through ZigBee it can be send to central controller to monitor values.

The communication can be done between LPC2148 and UART requires MAX232 IC, similarly  $\mu$ c89S52 can communicate with ZigBee through MAX232 IC, where MAX232 IC is use to convert the incoming signal into the microcontroller and ZigBee usable form i.e. when LCP2148 send signal through UART then MAX232 convert that signal to serial usable format also when input comes toward  $\mu$ c then that input first converts through MAX IC into  $\mu$ c usable format. For LPC2148 this connection is already made on board which is inbuilt by NXP.

The interfacing requires connection between the pins as follows

- P0.0 and P0.8 i.e. pin no. 19 and pin no. 33 of LPC2148 is connected to TXD0 and TXD1 i.e. pin no. 11 and pin no.10 of MAX232 respectively.
- P0.1 and P0.9 i.e. pin no. 21 and pin no. 34 of LPC2148 in connected to RXD0 and RXD1 i.e. pin no. 12 and pin no. 9 of MAX232 respectively.
- Similarly pin no. 7 and pin no. 8 i.e. T2out and R2in of MAX232 are connected to pin no. 10 and pin no. 11 of UART respectively.
- Pin no. 7, 23, 43, 51, 53 of LPC2148 is connected to 3.3v and Pin no. 6, 18, 26, 42, 50, 59 are kept

grounded. 12MHz crystal oscillator is connected between the pin no. 61 and pin no. 62[4] [5] [6].

- ZigBee can connect to UART through MAX232 using pin no. 2, 3 of ZigBee with pin no. 11, 12 of MAX232 and pin no. 13, 14 of MAX232 with pin no. 2,3 of UART[5][6].

## V. CONCLUSION

In this paper we have initially discussed the various applications in which sensors can be deployed. We also highlighted some unique sensors along with its specifications. A novel scheme to implement sensor nodes is proposed and explained in detail. The scheme integrates ARM7, GSM module, LCD ZigBee and sensors to for a monitoring and sensing system. The interconnection details form the layout for designing such system and execute it effectively.

## REFERENCES

- [1] Liu Yanfei Wang ChengQiao Xiaojun Zhang Yunhe "An Improved Design of ZigBee Wireless Sensor Network" in ICCSIT 2009. 2nd IEEE International Conference.
- [2] Lei Chen , Shuang Yang "Based on ZigBee Wireless Sensor Network the Monitoring System Design for Chemical Production Process Toxic and Harmful Gas" in 2010 International conference on CMCE.
- [3] Vaibhav Pandit, Prof. U. A. Rane "Coal Mine Monitoring Using ARM7 and ZigBee" in IJETAE ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 5, May 2013.
- [4] Atmel AT89S52 specifications on <http://www.keil.com/>
- [5] ARM7TDMI, Technical Reference Manual, copyright 1994-2001
- [6] Wu Yi, Wu Tong, Liu Pai "Smart Home System Based on ZigBee and ARM" in ICEM'2013
- [7] Li Zheng "ZigBee Wireless Sensor Network" in Industrial Applications Oct. 18-21, 2006 in Bexco, Busan, Korea.
- [8] A. Goswami, T. Bezboruah and K.C. Sarma "Design of An Embedded System For Monitoring and Controlling Temperature and Light" in IJEE November 2009