Development on Gas Leak Detection and Location System Based on Wireless Sensor Networks: A Review

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Abstract— **Gas leakage detection and monitoring may cause heavy economic :losses and serious environmental pollution, through wireless sensor network is considered to be more economical for industries gas leakage. Main purpose of this system model is to avoid damages and locate the leakage point. These problems can be solved with the help of WSN based on ZIGBEE. The entire control system is based on low power ARM LPC 2103 microcontroller and ZIGBEE techniques. The gas sensor node helps in collecting data regarding gas leakage and provides the particular leakage area of sensor node address is located. The collected information is sent to the central monitoring unit to update the data. Data are continuously transmitted from ZIGBEE sensor nodes 2 to ZIG-BEE coordinator. This system provides performance and helps to detect automatic gas leakage location. This paper focus on overall design of a system.**

I. INTRODUCTION

The reliable detection and localization of gas leaks is essential for ensuring safety and minimizing property damage. In industry, a primary approach for detecting gas leaks is based on the physical phenomenon of absorption of infrared energy by combustible gases such as methane, propane or ethane [6]. Wireless communication has become an important feature for commercial products and a popular research topic within the last ten years. With the continuing growth of the forces of social production and the gradual awakening of the people's consciousness of the importance of production safety, a series of measures have been put forth to ensure worker's safety. In high-risk industries such as chemical, electricity and cement industries, small negligence may cause heavy economic losses and serious environmental pollution. However, there are still some shortcomings on real-time monitoring and on data transmission and accurate location of a leakage point when an accident happens. Mainly because: most of the current equipments are based on wired networks, it is backward in technology and hard to be deployed; the technology of data acquisition in accidents is also backward and so it is hard to locate the leakage point. These problems can be solved with the help of WSN based on ZIGBEE WSN has absolute superiority on data acquisition and transmission.

II. HARDWARE AND SOFTWARE

A. LPC2103

The LPC2101/2102/2103 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation that combines the microcontroller with 8 kB, 16 kB or 32 kB of embedded high-speed Fash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical performance in interrupt service routines and DSP algorithms, this increases performance up to 30 % over Thumb mode. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty [7].

B. Max 232

MAX232 is compatible with RS-232 standard, and consists of dual transceiver. Each receiver converts TIA/EIA-232-E levels into 5V TTL/CMOS levels. Each driver converts TT-L/COMS levels into TIA/EIA-232-E levels. The MAX232 is characterized for operation from -40°C to +85°C for all packages.MAX232 is purposed for application in high-performance in-formation processing systems and control devices of wide application [8].

C. ZIG-BEE

ZIG-BEE is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4,2006 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the ZIG-BEE specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZIG-BEE is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

D. Software Tools

Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications**.** Source files are created by the μVision IDE and are passed to the C51 Compiler or A51 Macro Assembler. The compiler and assembler process source files and create replaceable object files. The Keil C51 Compiler is a full ANSI implementation of the C

programming language that supports all standard features of the C language. In addition, numerous features for direct support of the 8051 architecture have been added. μVision3 adds many new features to the Editor like Text Templates, Quick Function Navigation, and Syntax Coloring with brace high lighting Configuration Wizard for dialog based startup and debugger setup. μVision3 is fully compatible to μVision2 and can be used in parallel with μVision2.

III. BACKGROUND AND RELATED RESEARCH

James Weimer *et al.* [1], proposed an approach to leak detection using wireless sensor networks at carbon sequestration sites. This paper concerns the problem of detecting leaks at carbon sequestration sites through the monitoring of CO_2 levels using a wireless sensor network (WSN). By applying a basic linear dynamic model for an advection–diffusion process, a model-based detection strategy called the Iterative Partial Sequential Probability Ratio Test (IPSPRT) can be employed to detect and localize multiple leaks. A 3-D CO_2 transport model is employed to provide a proof of concept simulated evaluation of the IPSPRT against a windowed-average approach in terms of time-to-decision vs. probability of false alarm and probability of a missed alarm.

S. Edward Jero and A. Balaji Ganesh at [2], describes the performance and functional characteristics of PIC18LF4620 based wireless sensor node in monitoring the parameters such as CO_2, Oxygen, temperature, humidity and light around the pipeline structure. The system is deployed to monitor any deviations in these parameters with the standard atmospheric values eventually alert the user even to a remote location. The proposed system is a battery operated wireless sensor node which is interfaced with the external sensors to measure the parameters and the distance range between sensor node and coordinator node is also tested.

Mr. Sagar Shinde *et al.* [3], proposed a system, gives real time detective of potential risk area, collect the data of leak accident and locate leakage point. This system having protection circuitry consists of exhaust fan and an Liquefied Petroleum Gas Safe Solenoid Valve. The hazardous gasses like Liquefied Petroleum Gas and Propane were sensed and displayed each and every second in Liquid Crystal Display. If these gasses exceed normal level then alarm is generated immediately. In this system MQ-6 gas sensor used to sense poisonous gas and has high sensitivity to LPG and also response to natural gas. This work modifies the existing safety model installed in industries. It offers quick response time and accurate detection.

C.Sasikumar and D. Manivannan at [4], purpose a system model which avoid damages and safety of gas industry. The entire control system is based on is based on low power MSP430 microcontroller and Xbee techniques. The sensor node helps in collecting data regarding gas leakage and the particular area of sensor node address is located. The collected information is sent to the monitoring client or user to update

the data. Data packets are continuously transmitted from sensor nodes and communication devices.

Andrey Somov *et al.* [5], describes the development and the characterization of a wireless gas sensor network (WGSN) for the detection of combustible or explosive gases and consists of a sensor node, a relay node, a network coordinator, and a wireless actuator. The sensor node attains early gas detection; relay node receives and forwards traffic from sensor nodes towards the network coordinator and vice versa and when an emergency is detected, the network coordinator alarms an operator through the GSM/GPRS or Ethernet network, and may autonomously control the source of gas emission through the wireless actuator. Our experimental results demonstrate show the response time of the sensor to various gases, and evaluate the power consumption of the sensor node. The demonstrated WGSN could be used for a wide range of gas monitoring applications.

Javid Huseynov *et al.* [6] propose an ultrasonic gas leak localization system based on a distributed network of sensors. The system deploys highly sensitive miniature Micro-Electro-Mechanical Systems (MEMS) microphones and uses a suite of energy-decay (ED) and time-delay of arrival (TDOA) algorithms for localizing a source of a gas leak. Statistical tools such as the maximum likelihood (ML) and the least squares (LS) estimators are used for approximating the source location when closed-form solutions fail in the presence of ambient background nuisance and inherent electronic noise. The proposed localization algorithms were implemented and tested using a Java-based simulation platform connected to four or more distributed MEMS microphones observing a broadband nitrogen leak from an orifice. The performance of centralized and decentralized algorithms under ED and TDOA schemes is analyzed and compared in terms of communication overhead and accuracy in presence of additive white Gaussian noise (AWGN).

IV. CONCLUSIONS

Gas leakage is one of the major problems in Industrial sectors and causes heavy economic losses and serious environmental pollution, this paper provides identify exact location of gas leakage and the intimate via ZIG-BEE. Thus it ensures easy maintenance and enhances safety as well as provides low power consumption and cost effective system.

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