International Journal of Advanced Research Foundation
Website: www.ijarf.com, Volume 2, Issue 8, August 2015)

Development on Gas Leak Detection & Location System Based On Wireless Sensor Network

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Abstract: **- This paper is Develops a gas leak detection and location system for the production safety in Petrochemical Industry. The system is based on Wireless Sensor Networks (WSN). It can collect the data of monitoring sites wirelessly and sent to the computer to update values in the location software. It can give a real-time detective of the potential risk area, collect the data of a leak accident and locate the leakage point. However the former systems can not react in time, even cannot obtain data from an accident and locate accurately. The paper has three parts, first, gives the overall system design, and then provides the approaches on both hardware and software to achieve it. A new gas leak detection and location system was developed; it compromises sensitive sensors and ZIGBEE, WSN which is smart, low-cost, low-power and Low - maintenance. In two modes, this system can monitor the gas leakage sensitively, get the data from a scene of the accident and locate the leakage point. Based on WSN, the system is easy to be deployed and overcomes the shortcomings on current systems. It is used to improve the rescue quality and shorten the time for rescue. Therefore it can compensate for the weaknesses of current systems. The data received from the sensor device is simultaneously stored in a system for a future reference in the levels of contamination. The information in the system is stored via a .Net application enabling the user to access the data whenever required. With the help of this data, proper precautions can be taken to minimize the pollution levels in the air to make human life sustainable.**

Keywords: **wireless sensor, gas detection, ZIGBEE, .Net**

1. INTRODUCTION

This paper is microcontroller based project. A Gas sensor is used to detect dangerous gas leaks in the kitchen, industries or near the gas heater. Whenever there is a gas leakage in the surrounding areas of this node this will be detected by the sensor. The main aim of the project is to develop a gas leak detection and location system for the production safety in Petrochemical Industry when they exceeds threshold, intimation is given to the nearby control section including readings of parameter and location of the gas leakage . Security management of several home and office appliances is a subject of growing interest and in recent years we have seen many systems providing such security. These days apart from security from robbery there must be security from flammable gases Present in the surrounding to protect houses, offices, vehicles, industries etc. From various harmful gases. There is a need to have security from this gases. Mobile phone is also playing role in its parallel world with telephones. When there is Gas leakage the telephone and mobile phone both will play great role in the detector to contact and warn the authorized person about flammable gas leakage. Both Mobile Phone and Telephone are required to perform the project.

2. EXISTING SYSTEM

The existing system only detects the fire and gas leakage in certain important areas only. In existing system, the fire and gas leaks are measured and the communication is through wires to the control station. In case of faults like discontinuity in cables, lead to loosing of vital information related to plant safety. Increase in the complexity of process industry leads to increase in the number of instruments to detect fire and leakage. This increases the number of cables that run from industrial sensors to the control station which leads to messy wiring. This also increases the size of the duct. Troubleshooting the reduced insulation or any wire open is difficult because it is a messy wiring and identifying the individual cable is very difficult along the duct. This also increases the cable cost.

To overcome these difficulties we implemented a portable device. This device can be fixed in their helmet or jacket. To measure various parameters this device consists of sensors. They are Gas sensor, Temperature sensor, Heart beat sensor, Pressure sensor. These sensors in the portables device sense various parameters (gas, temperature, pressure) continuously. And if the value exceeds the reference value, immediately it activates the relay driver and produces an alarming sound. So it will be useful for the person to know about hazardous situation. Heart beat sensor, senses the workers heart beat continuously. If the person loses his/her consciousness then this information is sensed by the sensor and it will be passed to the control room. All the communications are done by wireless Zigbee protocols, so that the information will be transmitted without any obstructions. The main advantage of Zigbee is that it is a multimode communication, so that the data is transmitted node by node. A GPS is used in our system to track the location of the person during hazardous conditions, so that he can be rescued immediately.

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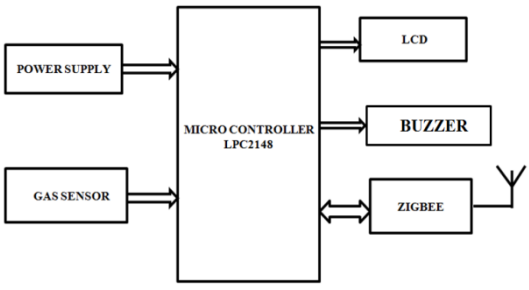
3. PROPOSED SYSTEM

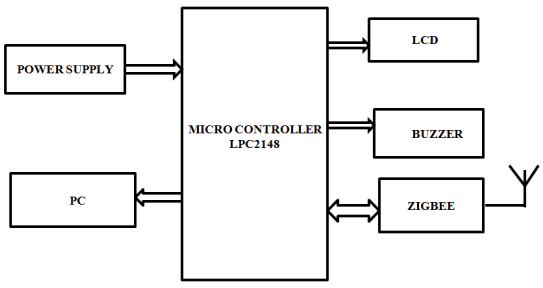
In this system, we are going to monitor and transmit the industrial parameters such as gas leakage and fire. These parameters are monitored using gas sensor and fire detectors. The analog outputs are converted into digital form using analog to digital converter and then given to microcontroller. These data are sent to the control room through a Zigbee wireless via UART also displayed in the LCD display for workers. Corresponding to the sensor outputs the relay is activated using microcontroller to operate the precaution devices. With this a buzzer alert is al so given. In the receiver side a PC is used to view all the parameter conditions. The relays can be activated from the remote area too via Zigbee wireless communication. In addition to this, this system integrates person locating with gas concentration checking system effectively, and realizes functions of person attendance, distance measurement positioning, gas concentration detecting and data communication.

This system is an open system, and it permits developing different applications thereon. It provides a lot of spatial gas concentration knowledge with the timestamp for follow-up gas prediction research. The field device can be a fixed device or a portable device. The portable device is carried by the worker whenever he enters the plant area. It is mainly detects the gas leakage if any, wherever the worker goes, it also sends the information about the location of the person and the heartbeat of the person. The fixed device is fixed in the plant area. It also detects gas leak age and transmits information to the control room.

Transmitter:



Receiver section:



TheLPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 KB to 512 KB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 KB up to 40 KB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the

ARM7TDMI-S processor has two instruction sets:

- The standard 32-bit ARM set.
- A 16-bit Thumb set.

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code.

Thumb code is able to provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM processor connected to a 16-bit memory system. The particular flash implementation in the LPC2141/42/44/46/48

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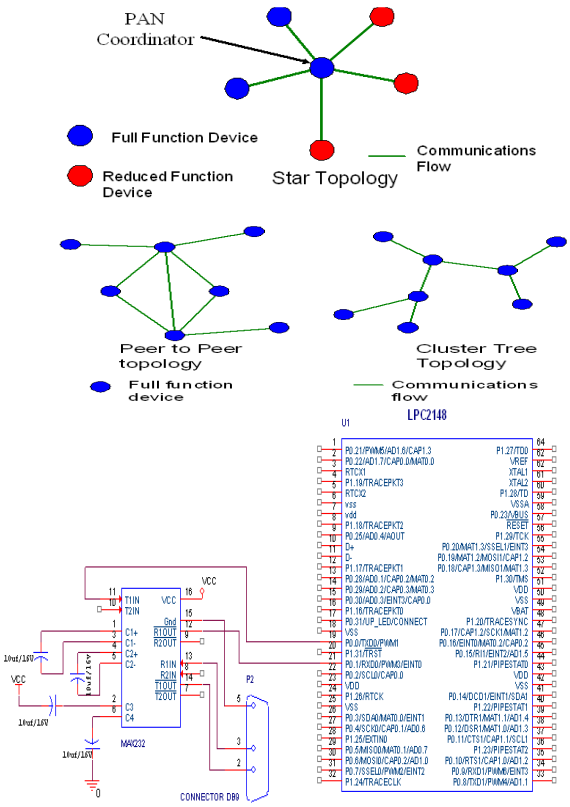
allows for full speed execution also in ARM mode. It is recommended to program performance critical and short code sections (such as interrupt service routines and DSP algorithms) in ARM mode. The impact on the overall code size will be minimal but the speed can be increased by 30% over Thumb mode.

ZIGBEE is an IEEE 802.15.4 standard for data communications with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. The Zigbee standard provides network, security and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. Zigbee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries and the mesh networking provides high reliability and larger range. Zigbee has been developed to meet the growing demand for capable wireless networking between numerous low power devices. In industry, Zigbee is being used for next generation automated manufacturing, with small transmitters in every device on the floor, allowing for communication between devices to a central computer. This new level of communication permits finely tuned remote monitoring and manipulation.



Dynamic deployment is use in a leakage accident. Throw some terminal nodes through ejection of a robot or at some height, and then all the information of the distribution of temperature and gas thickness can be collected. The location of the leakage point can be known from the analysis of the information. In the past, rescuers can not approach the accident spot in a long time because of the toxic gas, high temperature or heavy fog. It is hard to rescue and deal with the problems in time. However, the system provides reference for an effective rescue plan and can help to shorten salvage time. To make sure the transmission steady and reliable, the topology of the system is mesh. When terminal nodes can not transmit data via some routers as a result of routing faults, they will judge the other routes and choose a new one. Dynamic deployment, nodes are placed dynamically in the risky area to get the information related to temperature and gas leakage and exact location can be identified.

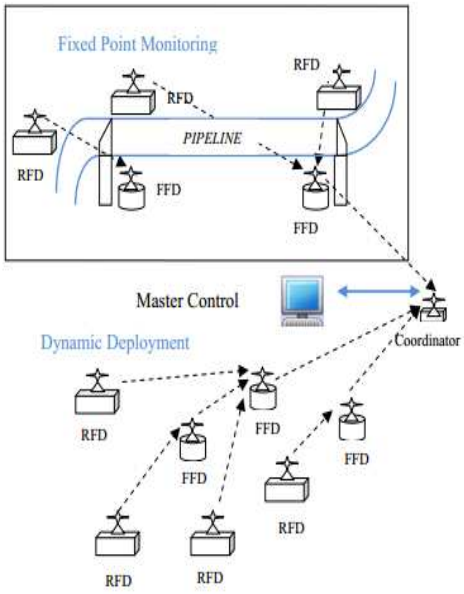


FIG: represent the sensor node structure consists of two sections - dynamic deployment and fixed point monitoring.

4. CONCLUSION

A new gas leak detection and location system was developed. It compromises sensitive sensors and ZIGBEE, WSN which is smart, low-cost, low-power and low-maintenance. In two modes, this system can monitor the gas leakage sensitively, get the data from a scene of the accident and locate the leakage point. Based on WSN, the system is easy to be deployed and overcomes the shortcomings on current systems. It is used to improve the rescue quality and shorten the time for rescue. Therefore it can compensate for the weaknesses of current systems.

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