Detection Of Gas Leak And Its Location Using Wireless Sensors

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Abstract: 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. Consequently, 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.

I. INTRODUCTION:

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. Therefore, many large companies, including PetroChina and Sinopec, are pumping large amounts of funds to upgrade existing equipment in order to remove the hidden danger. 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. WSN has absolute superiority on data acquisition and transmission.

II. STRUCTURE OF THE SYSTEM:

The gas leak detection and location system consists of three parts: control center, coordinator and terminal nodes.There are two kinds of terminal nodes: full-function device (FFD) and reduced-function device (RFD). The supervising software on the control center is based on TI's Z-Location Engine, it displays the location and the status messages of all the monitoring sites, and it is a graphical description of the geographical information of the entire potential risk area. The coordinator is also a gateway; it acquires all the information from FFD and RFD, and then transmits to the control center to update the nodes' status messages on the supervising software. Besides, it broadcasts instructions from control center. FFD is a router, it s a node that links groups together and provides multi-hoping for messages.

The system structure is shown in Fig. 1.

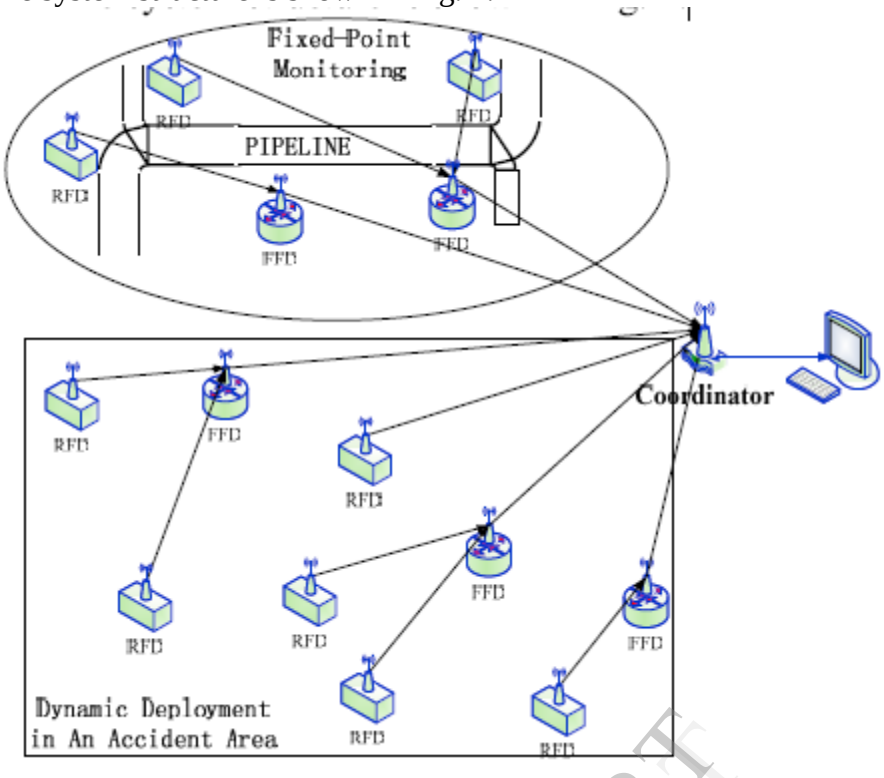
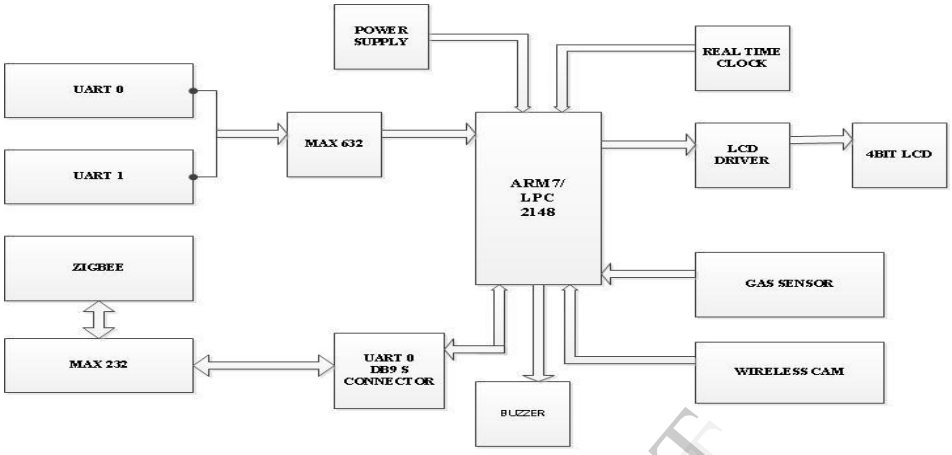


Fig. 1. System structure

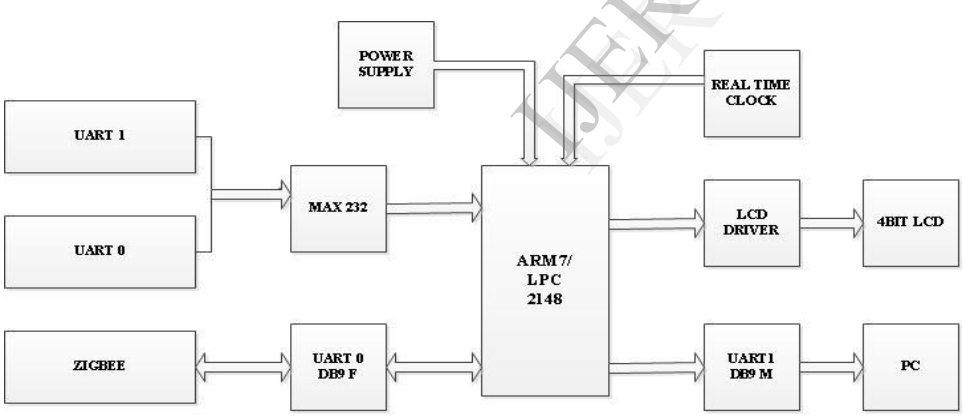
When using the system, there are two application modes: fixed-point monitoring and dynamic deployment. Fixed-point monitoring is to fix some terminal nodes near the potential risk areas, such as: joins of containers, reaction kettles and pipelines and places that are easy to be eroded or broken. In this way, the system can track the monitoring data for these areas round-the-clock or in one time period. Leakage is the main problem when conveying gases through pipelines. Trace leakage is mainly caused by erosion, bad connection and external forces and so on; it is a hidden fire danger or causes of other serious accidents. But it is hard to find out. By means of this method, it is easy to warn ruinous accidents caused by leakage. 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.

III. Methodology:

A. System Design: The design of the Development of Gas Leak Detection using Wireless sensors shows the Transmitting section consisting of ARM7/LPC2148 microprocessor, gas sensor, Zigbee, LCD monitor and wireless cam and Receiving section with a personal computer to monitor the detection of gas.

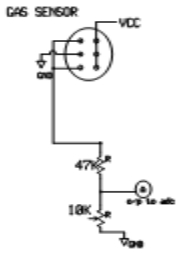


TRANSMITTER SECTION 1



RECIEVER SECTION

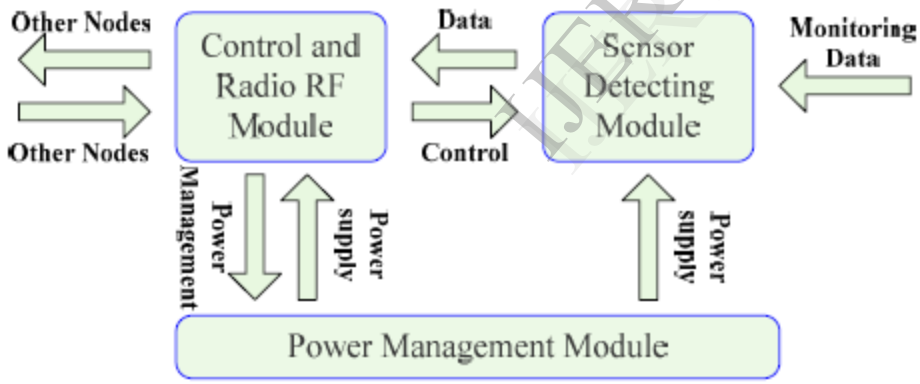
B. Gas Sensor:



Each sensor detecting module carries one kind of those sensitive sensors: sulphur dioxide, sulfureted hydrogen,carbon monoxide, alcohol and oxygen. Determined by the gas emission, one kind or more will be used when the system is deployed. The gas sensor detects the gas when it exceeds the limit of 250 at that time.

C. Hardware Design:

In order to reduce the cost of system, shorten product development cycle and lower the difficulty, the factors including power consumption, transmitting power, receiving sensitivity, chip costs, protocol stack costs and the number of peripheral components the chip need are mainly considered when choose a chip.



D. Zigbee: It is a new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide range controlling applications and to replace the existing non-standard technologies..

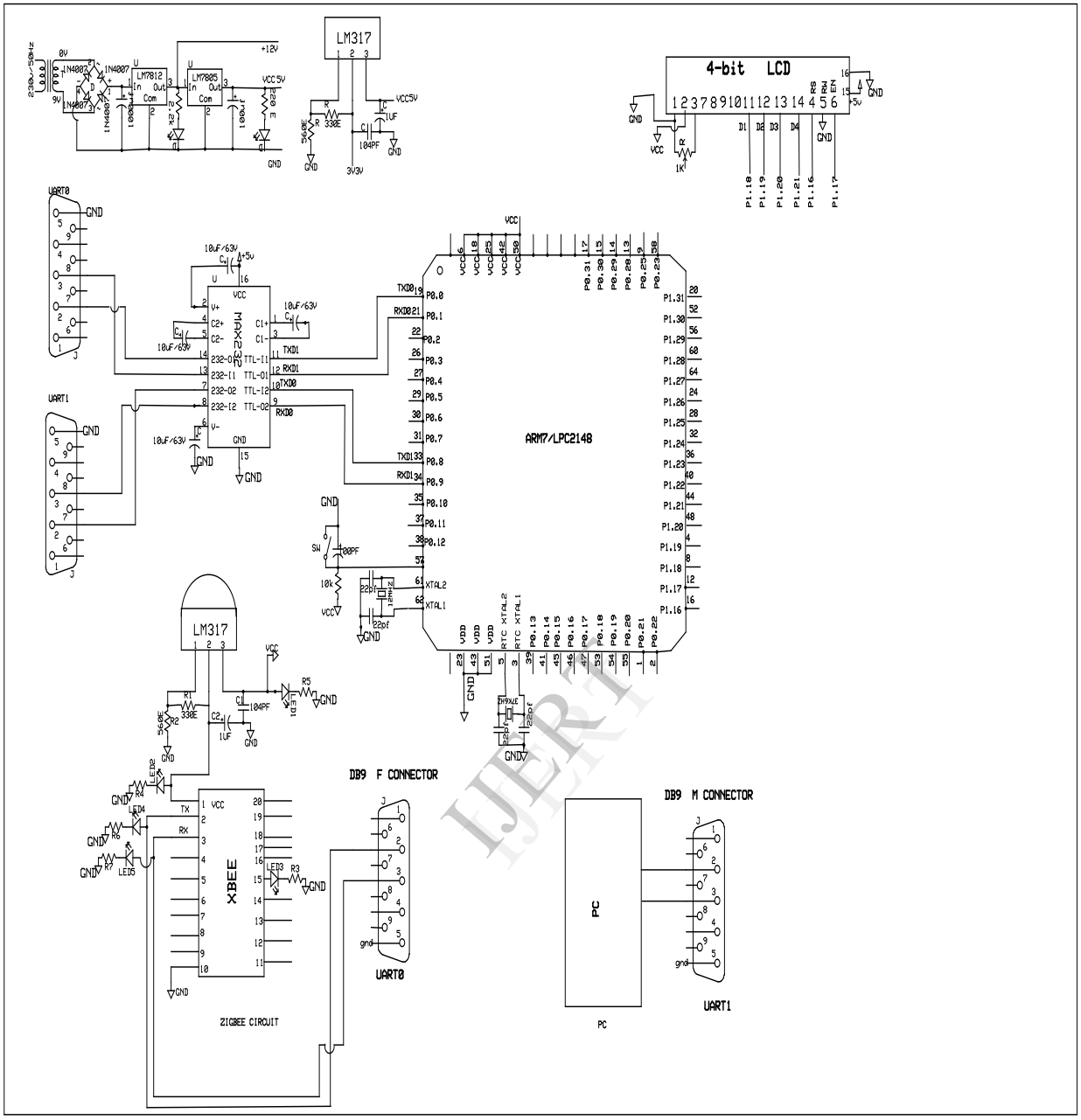
It currently operates in 868 MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps. It is used to verify whether user's truncation is possible or not. One of the main advantages of this ZIGBEE communication is that it provides a noise free communication, the amount of noise added in this type of communication is very less compared to the other wireless communications

E. Main Board Control Unit:

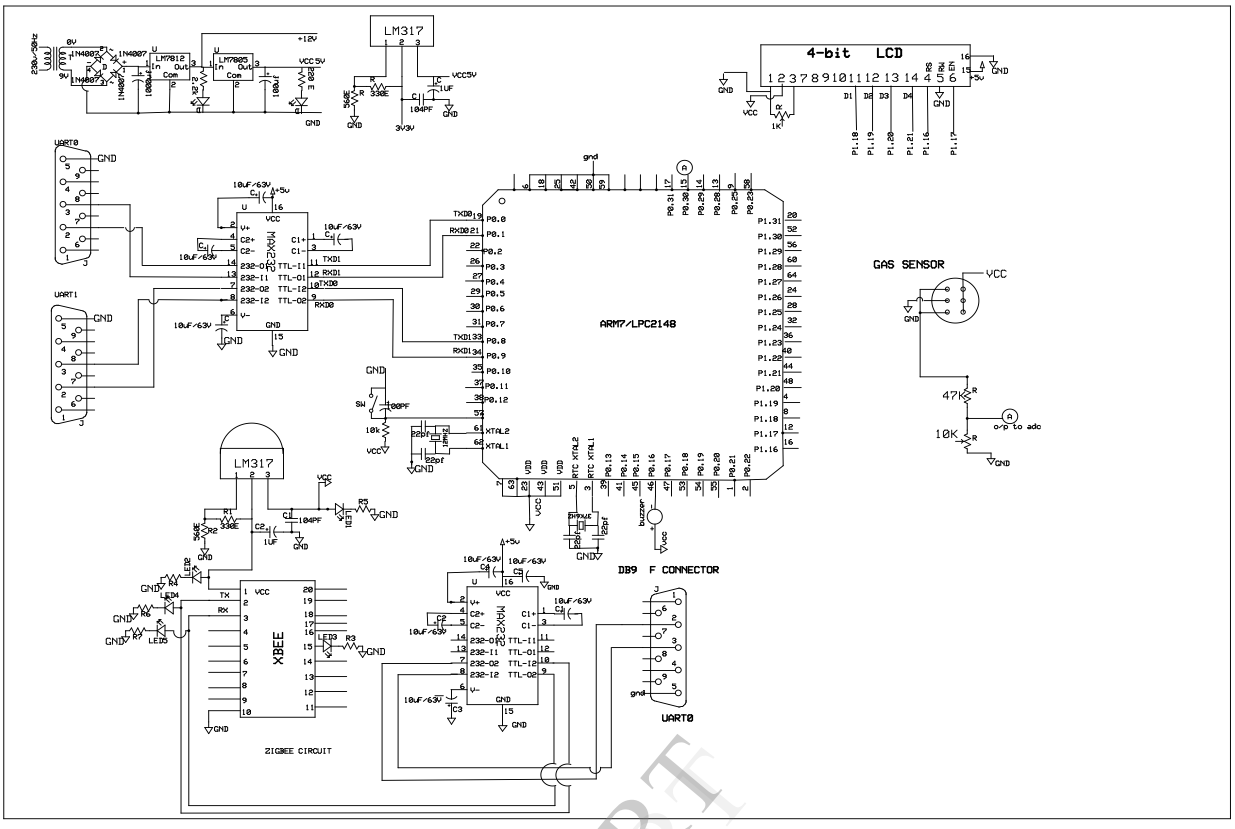
The project consists of three major blocks. They are node sections and monitor section. The various environmental parameters safety monitoring and controlling system, such as GAS sensor is used in the node sections when an sensor detects the gas, if GAS is exceeds more than 250 at that time it will alert through the buzzer, and the information is transmit to the base station by using Zigbee technology .It will send the data which is transmitted through Zigbee it will be seen on the pc in the control station.

The project based on the Sensor (GAS sensor (P0.30).At transmitter side, sensor is transmitting the values through Zigbee (UART0) and display at PC (uart1). Hence, if the threshold values of the sensors are increases then buzzer (P0.16) ON at transmitting side this will indicate the person is in a dangerous situation so at monitor section buzzer will ON (P0.16).

Monitoring Section:


LM317
4-bit LCD
ARM7/LPC2148
XBEE
ZIGBEE CIRCUIT
DB9 F CONNECTOR
DB9 M CONNECTOR
UART0
UART1
PC
MAX232

Node 1



SOFTWARE DESCRIPTION:

Software used: *Keil software for c programming

It is possible to create the source files in a text editor such as Notepad, run the Compiler on each C source file, specifying a list of controls, run the Assembler on each Assembler source file, specifying another list of controls, run either the Library Manager or Linker (again specifying a list of controls) and finally running the Object-HEX Converter to convert the Linker output file to an Intel Hex File. Once that has been completed the Hex File can be downloaded to the target hardware and debugged. Alternatively KEIL can be used to create source files; automatically compile, link and covert using options set with an easy to use user interface and finally simulate or perform debugging on the hardware with access to C variables and memory. Unless you have to use the tolls on the command line, the choice is clear. KEIL Greatly simplifies the process of creating and testing an embedded application.

Simulator/Debugger: The simulator/ debugger in KEIL can perform a very detailed simulation of a micro controller along with external signals. It is possible to view the precise execution time of a single assembly instruction, or a single line of C code, all the way up to the entire application, simply by entering the crystal frequency. A window can be opened for each peripheral on the device, showing the state of the peripheral. This enables quick trouble shooting

of mis-configured peripherals. Breakpoints may be set on either assembly instructions or lines of C code, and execution may be stepped through one instruction or C line at a time. The contents of all the memory areas may be viewed along with ability to find specific variables. In addition the registers may be viewed allowing a detailed view of what the microcontroller is doing at any point in time.

CONCLUSION:

The project **"DETECTION OF GAS LEAK AND ITS LOCATION USING WIRELESS SENSORS"** has been successfully designed and tested. It compromises sensitive sensors and ZigBee which is smart, low cost, low-power and low-maintenance. In two modes, this system can monitor the gas leakage sensitively, which gets data from accident scene and locates 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 weakness of current detecting systems. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

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