WIRELESS GAS LEAK DETECTION AND LOCALIZATION FOR REMOTE VEHICLES USING WSN

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Abstract - *Security system is most important while using petroleum products. Thousands of gas leaks occur every year, with many leading to injuries, deaths, and a disastrous environmental effect. There have been many attempts at solving this problem, but with limited success. The system proposed here uses Wireless Sensor Network for solution. The detection and localization algorithms proposed here are applied to the collected concentration data, and the methodology is evaluated. The experimental setup is carried with a MQ-6 gas sensor to detect inflammable gas and LM35 temperature sensor to maintain the normal engine temperature. The gas sensor and temperature sensor are interfaced with the PIC microcontroller coded with embedded C from which the data are transmitted to the receiver unit by a wireless transmission mode using wireless transceiver therefore the data are monitored continuously and location is known. The gas concentration level is displayed in a LCD module, if the gas leakage is more it will trigger the buzzer and SMS is sent to the wireless transceiver.*

Key Words: **Wireless Sensor Network, MQ-6 sensor, LM-35, PICmicrocontroller, Iot, LCD.**

1. INTRODUCTION

Embedded systems have a huge variety of applications that varies from low to high-cost consumer electronics to industrial equipment's, medical devices to weapon control systems, aerospace systems and entertainment devices to academic equipment's, and so on. In automotive systems more and more equipment's are being changed from the mechanical systems to electronic systems. The revolution of electronics has manipulated in automotive design including the fuel combustion, power train crash protection, etc. Gas leakage one of the major problem in the automobile causing leading to injuries, deaths, equipment damage, and a disastrous environmental effect. So it is necessary to correct the leakage.

A gas leak is when gasoline leaks from the fuel tank of the vehicle. Underneath the car will be a spot of fuel on the pavement, along with the strong smell of gasoline. Ignoring a fuel leak is a fire risk because gas is flammable. Since gas is leaking from your vehicle, it can take just a little something to set it off, such as a discarded cigarette or a spark in the right spot. Fix the leak as soon as possible, so as not to danger yourself or others. There is definite requirement for

the detection system to avoid damage to both vehicle and environment. This gas leakage detection project based on PIC microcontroller. This low cost project uses MQ-6 sensor for gas leakage detection based on the surroundings levels. The system generates a sound alert using a buzzer on detection dangerous gas leakage level and with the help of the wireless transceiver using the IoT applications it is capable to broadcast SMS to the driver about the gas leak. This system also alerts the steering holder for another major problem which is nothing but fire. This system has an LM35 temperature sensor for monitoring the sudden rise in temperature. This project is at its initial level of development and with advancement in future this device will also be able to stop the vehicle to ensure better safety. The Gas Leakage detector device can find application not only in remote vehicle but also it is applicable to mining tunnels and even in industries where petroleum gas is used.
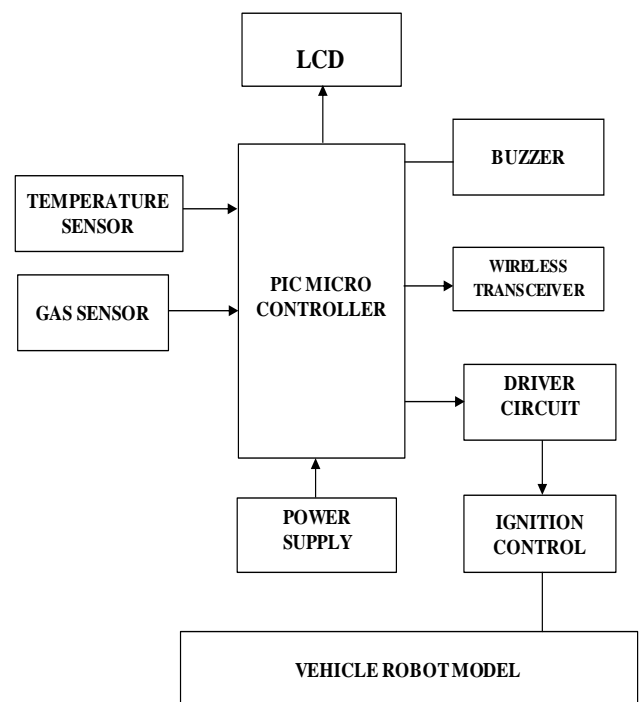
2. BLOCK DIAGRAM

This system consists of following blocks of PIC microcontroller, MQ-6 gas sensor, LM-35 temperature sensor, wireless transceiver, buzzer, LCD display, relay and power supply. The heart of the system is microcontroller

which consist of PIC16F877A by using embedded C we can program for our system and implementing it with help of connecting cables.

FUNCTIONS OF THE COMPONENTS

PIC Microcontroller:

The PIC microcontroller PIC16F877a is one of the most widely used microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is simple. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A also have many applications in digital electronics circuits. The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

Fig-2: PIC microcontroller

MQ-6 gas sensor:

The MQ-6 module are used in gas leakage detecting equipment in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG The gas sensor module consists of a steel exoskeleton under which a sensing element .MQ-6 sensitive material is made up of SnO_2(stannic oxide). The module gives out the concentration of the gases as an analog voltage equivalent to the concentration of the gases. The module also has an on-board comparator for comparing against an adjustable preset value and giving out a digital high or low. The MQ-6 sensor is used to alert the user in case of any gas leakage.

Fig-3: MQ-6 gas sensor

LM-35 temperature sensor:

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full −55°C to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 make interfacing to readout or control circuitry especially easy. The LM35 is rated to operate over a −55°C to +150°C temperature range. Here temperature sensor is used to Indicate if there in case of fire occurs in the vehicle.

Fig. 4: LM35 TEMPERATURE SENSOR

RELAY:

Relays are electromechanical devices that use an electromagnet to operate a pair of movable contacts from an open position to a closed position. The advantage of relays is that it takes a relatively small amount of power to operate the relay coil, but the relay itself can be used to control motors, heaters, lamps or AC circuits which themselves can draw a lot more electrical power. The electro-mechanical relay is an output device (actuator) which come in a whole

host of shapes, sizes and designs, and have many uses and applications in electronic circuits. But while electrical relays can be used to allow low power electronic or computer type circuits to switch relatively high currents or voltages both "ON" or "OFF", some form of relay switch circuit is required to control it. The design and types of relay switching circuits is huge, but many small electronic projects use transistors and MOSFETs as their main switching device as the transistor can provide fast DC switching (ON-OFF) control of the relay coil from a variety of input sources so here is a small collection of some of the more common ways of switching relays.

Fig-5: Relay

WIRELESS TRANSCEIVER:

This is Wi-Fi based IOT serial transceiver module, based on ESP8266 SoC., The SOC has Integrated TCP/IP protocol stack ESP8266 is a highly integrated chip designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. ESP8266 has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

Fig-6: Wireless Transmitter ESP8266

BUZZER:

Buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or key stroke. Buzzer is an integrated structure of electronic transducers, dc power supply, widely used in computers, printers

Fig-7: Buzzer

POWERSUPPLY:

These batteries have internal electronics to allow them to be used as a drop-in replacement for the equivalent sealed lead acid battery. They can be charged with lead acid chargers, and the 12.8-volt potential is very close to the 12.9V open circuit voltage of the lead acid chemistry. To be even more cost-effective, LiFeP batteries are among the longest lived batteries ever developed. Test data in the laboratory show up to 2000 charge/discharge cycles.

WORKING:

For last three years there are various development in the automobile industry. Gas leakage is the major problem in the developing environment. The LCD module shows when the system is switched on indicating that the power has been supplied to the board. The Uploaded sequence of codes initialize the functions of sensors, buzzer and wireless transceiver. Here we use a PIC microcontroller PIC16F877a which can implement the program with the help of Embedded C program. At the first stage, the MQ-6 gas sensor is used to sense the leakage of gas and it will find any if exceed concentration in gases then it will trigger the buzzer. Wireless transceiver alerts the driver by sending an alert message 'gas leakage' along with location of the vehicle. The LM 35 temperature sensor is used to indicate in case of fire. This system comes along with solution for fire accident. The wireless transceiver used here is esp-12 which is based on ESP8266 SoC. It is act as transceiver for system. The relay used to control the motor by switching it on and off.

The below diagram shows the internal circuit diagram of the system. From this diagram we know that how the microcontroller is interfaced with system

Fig-9: Internal circuit diagram

CONCLUSION

Thus the project on gas leakage detection and localization was done using PIC microcontroller was done and gas concentration is displayed in the LCD display. The circuit is placed in robot vehicle model and tested in a gaseous environment in this project wireless communication range is 10m.The leakage can be detected easily within a short time period.

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[5] Javid Huseynova, Shankar Baliga, Michael Dillencourt, Lubomir Bic and Nader Bagherzadeh," Gas-Leak Localization Using Distributed Ultrasonic S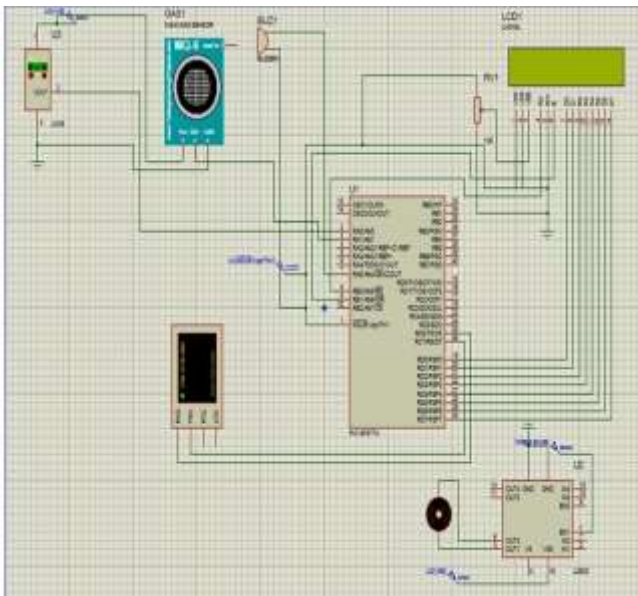ensors", Proc. Of Spie Vol. 7293 72930z-1,2009.