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Wearable Carbon Monoxide Warning System Using Wireless Sensors

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Abstract: *This project presents a wearable warning system to protect workers from carbon monoxide poisoning in industries and coal mines. A sensor has been integrated into a wearable system to allow continuous and non-invasive monitoring of atmosphere. It can be implemented to homes also. Temperature, gas and pressure are monitored .since the high temperature and pressure also causes adverse effect on human beings. To show the reliability, the system is tested in different atmosphere conditions. The system can be able to identify the CO gas up to 1 km .the system will warn the user and the final result will be analyzed using VB.*
Keywords: *sensors, ADC0809, Alarm, microcontroller (AT89C59), Zigbee, VB.*

I. Introduction

This project presents a wearable warning system to protect workers from carbon monoxide poisoning in industries and coal mines. Carbon monoxide poisoning is the major problem for mine workers. Carbon monoxide (CO) is a colorless, odorless, tasteless, poisonous gas produced by incomplete burning of carbon based fuels, including gas, oil, wood and coak carbon monoxide combine with hemoglobin to form carboxy hemoglobin. It affects the oxygen carrying capacity of blood. The occupational safety & health administration has set permissible exposure levels to 50ppm for 8hr time. Co cannot be detected by our senses. When fuel burning device are not properly operated. The CO will build up in the homes.

According to the Minnesota state law the CO alarm should be located for every 10 feet. It is not possible to install and maintain number of alarms within a certain area. The designed project will support up to 1km. Since the system is wearable wherever the worker goes CO can be determined. The system will examine the temperature, co gas and the pressure. Since the increased variation of pressure and temperature will cause adverse effect on human life. It can be implemented in industries gasoline powered engines, coal mining industries and weather stations. This system provides 24*7 monitoring, fast communication and highly reliable. The sensed parameters are fed to the microcontroller if the level exceeds, it will active the alarm.

TABLE 1.1 Unintentional carbon monoxide fatalities

Industry	Number of deaths	Percent of total
Total	148	100
Agriculture	21	14.2
Mining	5	3.4
Construction	21	14.2
Manufacturing	22	14.9
Transportation	7	4.7
Wholesale trade	4	2.7
Retail trade	11	7.4
Finance, insurance and real estate	4	2.7
Service	37	25
Public administration	9	6.1
No classifiable	7	4.7

Above table 1.1 gives the details about number of peoples affected by CO inhalation in various industries. In coal mine number of deaths due to CO is increased slightly. The small percentage of CO in human being also poisonous to health. Underground construction work also increase death rate. An individual warning system for workers to prevent from it. In prior works only target common warning system. Pulse oximetry sensor may also be included to measure the blood content level of construction workers who work in unsafe situation.

II. Design of CO Detection Unit

A. Transistor

The transmitter section has three type of sensors are temperature, pressure, gas sensor. Temperature and pressure sensors are connected to the ADC0809, because output of the sensors is in analog form, so to convert it into digital form that sensor is directly connected to the comparator followed by microcontroller.

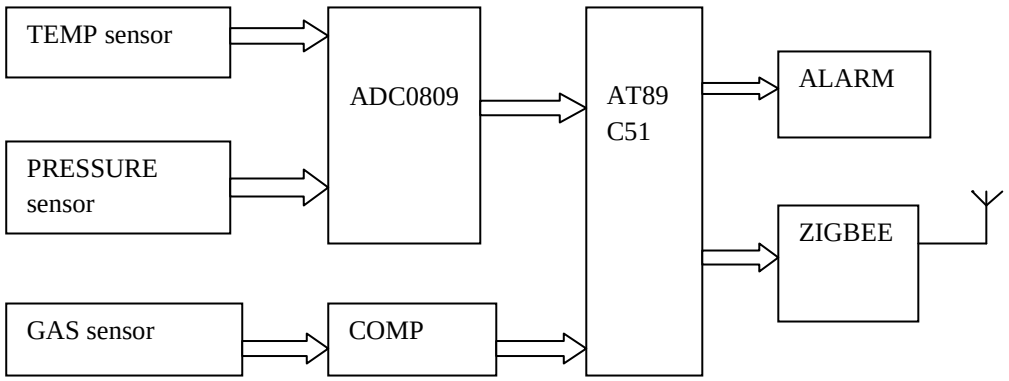

Fig 2.1 Block diagram of transmitter

After getting the inputs from the sensors the microcontroller determines the level of temperature, pressure and gas. If the level of sensors are exceeds the certain level the alarm will be activated. By this the employed will came to know the danger and they can rescue themselves. Then this information is transmitted to the receiver side through zigbee transmitter.

B. Receiver

The fig 2.2 shows the detailed block diagram of the receiver. The transmitted information is received by zigbee receiver. The received information is transmitted to the PC through MAX232 by using RS232 cable. The PC operates in CMOS logic but microcontroller transmits the information in the form of TTL logic, to convert it into CMOS logic we use MAX232. Voice will be activated in accordance with the received information. Finally the result can access by any authorized user with the use of zigbee network.

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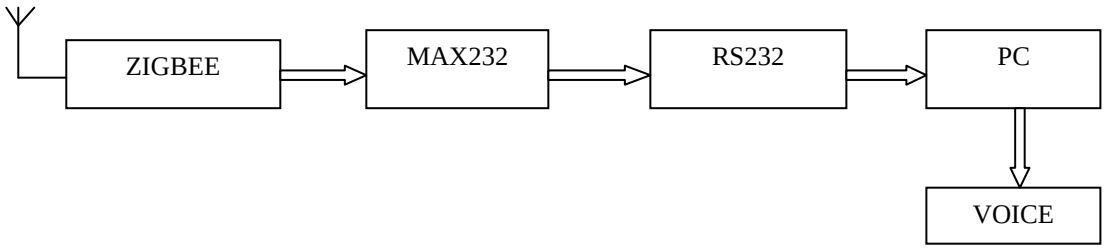

Fig 2.2 Block diagram of receiver

III. Sensor and Controller

The sensors used in CO detection units are below.

1. CO gas sensor
2. Temperature sensor
3. Pressure sensor

CO gas sensor sense the carbon monoxide level in atmosphere, it support for long distance. Variation in temperature and pressure can adverse effect on human being. For that pressure and temperature sensing also included. The table 1.2 gives the specification of the sensors used in this project. Controller unit is next important part of this project. It controls whole components. AT89C51 microcontroller is used here. 230V volt power supply is step downed and given to the regulator. The output voltage will be 5V. Then this voltage is given to the rectifier for converting AC supply to DC. Final the 5V DC supply is used to power up the components.

TABLE 1.2 specification of sensors used

SI.NO	SENSORS	SPECIFICATION
1.	Temperature sensor	Name-LM35 Power supply 4-30v current 60µA
2.	Pressure sensor	Name – MPX5050power supply 2.7-3.3v
3.	Gas sensor	Name –mQ5 power supply 5v±0.1

A. CO gas sensor

Excellent performance CO sensor for use in a wide range of applications including air quality monitoring ,smoke alarms, mine and tunnel warning systems, green houses etc. The sensor is easy to use and can be easily incorporated in a small portable unit.

B. Temperature sensor (LM35)

The LM35 sensor is precision integrated circuit temperature sensors which will linearly proportional Celsius temperature. It is low cost due to wafer level trimming. Rated to full -55°C to +150°C range. The advantage of LM335 over there is no need to subtract large constant value from output voltage to obtain convenient centigrade value. Because the linear temperature sensor give the output in Kelvin only. LM35 is easiest one to operate.

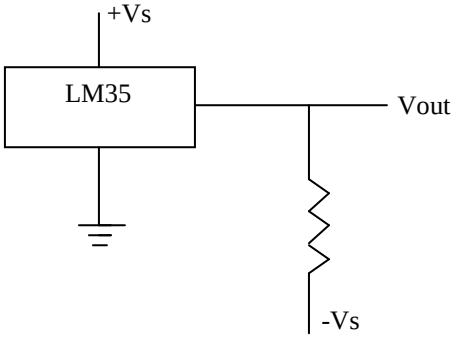

Fig 3.1 Diagram of LM35

C. Pressure sensor (MPX5050)

Pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression o the force required to stop a fluid from expanding, and is usually stated in terms of per unit area. Generates A pressure sensor usually acts as a transducer. It generates a signal as a function of the pressure imposed.

D. Microcontroller

The AT89C51 is a low power, high performance CMOS 8bit microcomputer with 4k bytes of flash programmable and erasable read only memory (FPEROM). The device is manufactured using Atmel's high density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in –system or by a conventional nonvolatile memory programmer. By combining a versatile 8 bit CPU with flash on a monolithic chip, the atmelAT89C51 is a powerful microcomputer which provides a highly- flexible and cost- effective solution to many embedded control applications.

E. ADC

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8bit analog to digital converter, 8 channels multiplexer and microprocessor compatible control logic. The converter features a high impedance chopper stabilized comparator, a 256 R voltage divider with analog switch tree and a successive approximation register.

F. Zigbee

Zigbee is the standard IEEE 802.15.4 widely used for industrial monitoring and control. It will support the supply range 1.8v-3.8 state of the art selectively CO existence

Adjacent channel rejection: 49dB

Alternate channel rejection: 54dB

The extended temperature range (-40 to +125°c)

The system determines carbon monoxide level and warns the workers to rescue themselves. The received at the remote area can be accessed by authorized user using the zigbee network. The system reliability is analyzed with the use of VB. The allowable value of CO is fixed and the system will warn the user for exceed of CO. The system is checked for various atmospheric conditions. In different temperature, pressure and weather conditions. VB is a high level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation.

Fig 3.2 Zigbee monitoring

IV. Result

As described in IV the system will determine the CO level efficiently. The warning system is wearable. The temperature and pressure also determined using the wireless sensors. These parameters are continuously monitored. When the level is beyond the threshold value the alarm will be activated,. By this worker identify the dangerous zone. The identification limit is up to 1km. The information from the transmitter through zigbee transmitter. The same signal is received at receive via the zigbee receiver. The reliability of the system is obtained by the analysis with the use of VB. The result of the analysis is in the form of waves as shown in the fig 4.1. It shows the result of this project. And the graphical outputs are shown in the fig 4.2 and 4.3 for various atmospheric conditions.

Fig 4.1 Wearable warning system

The fig shows the typical prototype for the wearable carbon monoxide warning system using wireless sensors.

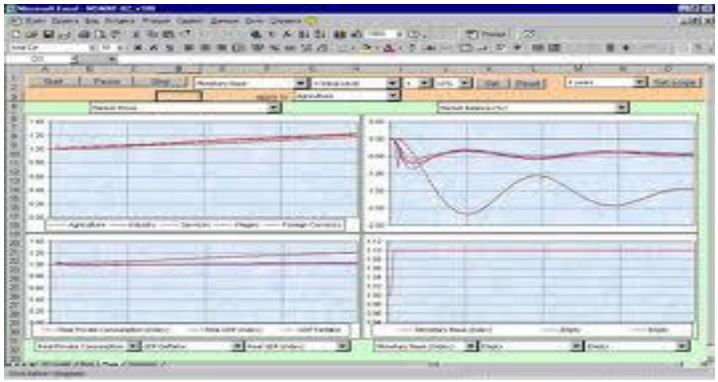

Fig 4.2 CO variations using VB

Due to the variations in gas level the alarm is activated if the permissible level exceeds. Voice activation is also set at the controller room. By this the workers will be protected and further unwanted accidents can be avoided.

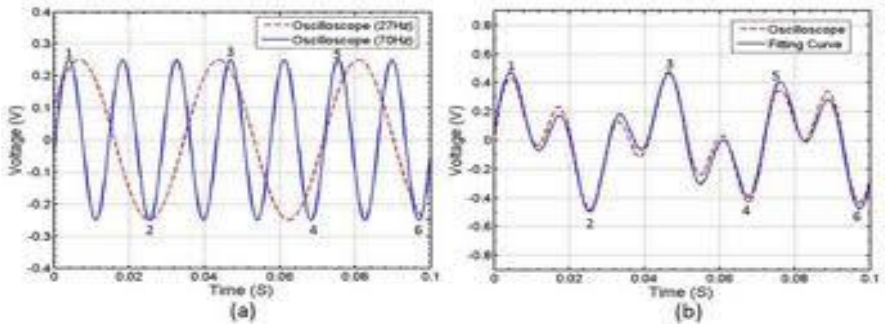

Fig 4.3 Monitoring section measurements

V. Conclusion and Future Work

We have integrated the CO gas sensor, temperature, pressure sensor into a wearable system. The system determines the CO level. If the atmosphere exceeds the permissible level of CO the system warns the user. the co which is present in the range of 1km also be determined. Finally the information is obtained at the receiver is analyzed using the vb. the system is reliable at various atmospheric conditions and the information is authorized user only accesses the information which received et the remote area. Our vision is to make the warning system to compact one to reduce the complexity and the weight. Because the user have to take the some weight, it will affect the worker to feel tired. The compactness of the system can be obtained by the usage of nano sensors or moving into the FPGA technique in VLSI. It will improve the safety and work efficiency of the industry people and also it can improve the residential safety.

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