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Research Paper

Detection and monitoring of fire and gas leakage systems in industries

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Abstract

Now a days, Industries are more equipped with automatic system. Fire monitoring is one of the applications where continuous monitoring of temperature and humidity is essential to detect the fire in the industry. Fire detection is very much necessary to protect both the industry and to conserve environment and livelihood of human. This paper presents an algorithm to detect the fire in the industry based on ZigBee and GPRS wireless sensor network which provides low cost, low maintenance and good quality service when compared with the traditional method. The hardware circuitry of proposed solution is based on microcontroller, temperature sensor along with ZigBee and GPRS modules.

1. Introduction

The industries namely fertilizer plants, oil refineries and petrochemical plants which deals with hazardous chemicals are to be protected safely. The handling of hazardous chemicals may lades to fire very easily. This can be also be caused by displeased employees. Hence in order to overcome this type of risks, a security measures should be employed within the industry. Hence, detection of fire and the analogous safety measures becomes an essential part in every industry.

In most of the industries in the world, huge amount of money was spent to mount and to maintain fire detection system so that to guarantee safety from unwanted fire [2].Hence, a more number of Intelligent systems were developed so as to meet this fire detection system more efficiently, effectively and economically[3]. As a result of this, a large number of sensors are produced to make the fire detection more reliable. Thus, this work also presents a new algorithm to detect the fire and gas leakage in the industry using ZigBee and GPRS wireless sensor network. This method offers low cost, lower maintenance and worthy service when compared to the traditional method [1].

2. Proposed methodology

Figure 1 represents the schematic diagram of the proposed topology.

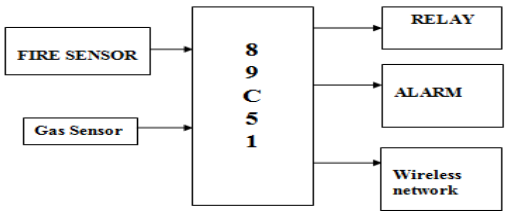

Fig. 1: Schematic Diagram of the Proposed Topology

Thus, the proposed topology consists of fire sensor and gas sensor. The output obtained from the fire sensor and gas sensor is connected to the controller. According to the output obtained from the sensors, the controller will activates the security alarm and the relay connected to it[7]. When the sensor senses the fire, the controller will activate the alarm and there by alerts the nearby environment. At the same time, it will trigger the relay and the power supply will be switched off. This is carried out to prevent any further damage in the industry. Apart from this, with the help of GPRS and Zigbee modules, it will send message about the details of fire accident to nearby fire service station and the manager in charge of the Industry.

Gas Sensor

The Grove - Gas Sensor(MQ2) module is used to detect the gas leakage. It is very much apt for detecting the gases such as H_2, CH_4, LPG, Alcohol, CO, Propane etc.,[11]. Because of its fast response and high sensitivity, it is widely used in many industries. Thus the sensitivity of this sensor can be easily adjusted using potentiometer.

A gas detector detects the presence/leakge of gases in an area[12]. This equipment can also be used for detecting other emissions other than gas leak. The output of this sensor is interfaced with a control system and it will automatically shuts down the process/ operation of industry. While the gas leakage is detected, an alarm sounds and alert the operators working in the particular area [13]. This type of scheme is very important because the harmful gases are there, which can cause hazards to human beings and animals. Controllers analyses for non-linear systems[14-23]

Fire Sensor

The fire sensor is nothing but a thermistor which is nothing but a temperature detector. In this, temperature sensed by the absorption of infrared or optical energy will rise the temperature level of the sensor. As thermistors have large negative temperature coefficient, which is about 4%ºC, there will be an accurate voltage response when the detector is suitably biased. As the rise in temperature is

mainly depend on the amount of energy absorbed, the thermistor can also be utilized above the wavelength range of UV to IR.
Thus the wavelength range which varies from UV to IR, their electrical response and the inherent roughness have made this detector as a choice of fire sensor in many applications[10]. These also include Earth Resources Monitoring, Earth horizon sensors for satellite attitude determination and in various industrial applications. During operation, the incident power will cause a sudden change in temperature, there by changing the resistance.
These detectors are made-up of intensive ceramic technology in which thin chips of the thermistor material are bonded with the substrates. A Model 1350 and 1375 are the detectors which are made of this technology.

Microcontroller 89C51

The Atmel AT89C52 is a microcomputer which offers a cost effective and highly flexible solution to many embedded based control applications.
The on-chip Flash present in the controller permits the program memory to reprogram in system/by using a conventional nonvolatile memory programmer[5]. Due to the combination of a multipurpose 8-bit CPU along with Flash in a monolithic chip, the AT89C51offers the succeeding features:

(i) 8K bytes of Flash,
(ii)256 bytes of RAM,
(iii) 16-bit timer/counters ,32 I/O lines, a six-vector two-level interrupt architecture, clock circuitry, a full duplex serial port and on-chip oscillator[8].

In addition to this, AT89C51 is designed with Eight Interrupt Sources and it also chains two software in power saving modes[6].
The Idle Mode-During this mode, CPU stops and allows timer/counters, RAM, interrupt system and serial port to function.
The Power Down Mode – This mode saves RAM contents by freezing oscillator and all other functions of the chip and it is resumed back by hardware reset[9]. Figure 2 shows the pin configuration of AT89C51.

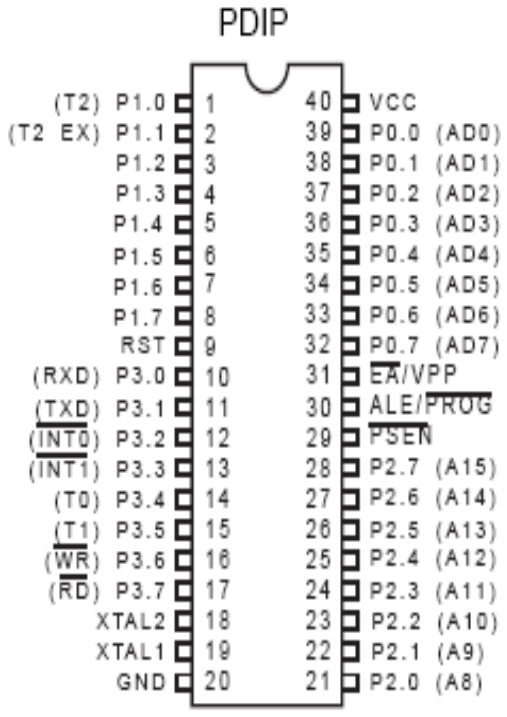

Fig. 2: Pin Configuration of 89C51

Relay

A relay is nothing but an electromechanical device. The electrical current activates the relay. The current flow controls the opening and closing of the relay. Relays are similar to remote control switches. They are utilized in many applications because of their simplicity, high reliability and long life. They are used in many applications like digital computers, telephone exchanges and automation systems.
A relay consists of a electric coil and a sensing unit. The coil is powered with the help of AC or DC current[4]. When a power is delivered to the coil, it creates a magnetic force and thus in turn triggers the switching mechanism. The magnetic force is responsible for relaying the accomplishment of one circuit to another. Hence the first circuit is known as control circuit and the second one is known as load circuit. Whenever the applied voltage or current exceeds a limited value, then the coil triggers the armature and it operates relay.

Buzzer

Piezoelectoric buzzer is simple in structure. In this, the piezoceramic element is bonded with the vibration plate. Oncean alternating voltage is given to the piezoceramic element, then element will shrinks or expands diametrically. With the help of this characteristic, it creates vibration in bend plated and hence generates different sounds.
Thus, the piezoelectric diaphragm is the sound source of a piezoelectric component. This piezoelectric diaphragm contains a piezoelectric ceramic plate. It has electrodes on its both sides and a metal plate which is made up of stainless steel /brass.

PROGRAM

Program for fire sensing & activating relay unit

```
#include<reg51.h>
Sbit sensor = P1^1
Sbit buzzer = P1^2
Sbit relay  = P1^ 3
#define  LED              P2_7
#define          RELAY1          P2_0
#define          RELAY2          P2_1
#define          RELAY3          P2_2
#define          RELAY4          P2_3
#define          RELAY5          P2_4
#define          DDATA                   P1
#define          ONE                     0x08
#define          TWO                     0x04
#define          THREE                   0x0C
#define          FOUR                    0x02
#define          FIVE                    0x0A
#define          SIX                     0x06
#define          SEVEN                   0x0E
#define          EIGHT                   0x01
#define          NINE                    0x09
#define          ZERO                    0x05
#define          STAR                    0x0D
#define          HASH                    0x03

Void msdelay (unsigned int);
Void main()
{
Sensor=1
While (sensor = =1)
{
Buzzer=0;
Relay=0;
MsDelay(300)
Buzzer= 1;
Relay =1;
MsDelay(300)
}
}
```

```
unsigned int period,rdata1,rdata2,rdata;
void delay_us(unsigned int dlycnt);
void delay_ms(unsigned int dlycnt);
void relay_control()
{
        if(rdata==STAR)
        {
        switch (rdata1)
        {

case  ONE:

        RELAY1=0;

        break;

case  TWO:

        RELAY2=0;

        break;

case  THREE:

        RELAY3=0;

        break;

case  FOUR:

        RELAY4=0;

        break;

case  FIVE:

        RELAY5=0;

        break;

case  SIX:

        RELAY6=0;

        break;

case  ZERO:
        RELAY1=RELAY2=RELAY3=RELAY4=RELAY5=R
ELAY6=0;

        break;
                if(rdata==HASH)
                {
                                switch (rdata1)
                {

case  ONE:

        RELAY1=1;

        break;

case  TWO:

        RELAY2=1;

        break;

case  THREE:

        RELAY3=1;

        break;

case  FOUR:

        RELAY4=1;

        break;

case  FIVE:

        RELAY5=1;

        break;

case  SIX:

        RELAY6=1;

        break;

case  ZERO:
        RELAY1=RELAY2=RELAY3=RELAY4=RELAY5=R
ELAY6=1;
                break;

                                                }
                                        }
}
void input_data (void) interrupt 2
{
                EX1=0;

                TMOD=0x01;

        TH0=0x3C;
                TL0=0xAF;
        TR0=1;

        ET0=1;

        period=0;
        rdata1=rdata;
        rdata=DDATA;
                rdata=rdata&0x0F;
        relay_control();
                LED=0;

                delay_ms(50);
        LED=1;
                EX1=1;

}
void oc_timer0 (void) interrupt 1
{
        TMOD=0x01;

        TH0=0x3C;
                TL0=0xAF;
        TR0=1;

        if(period >= 100)
                {
                TR0=0;

                ET0=0;

                rdata=rdata1=0;
```

```
		LED=0;

		LED=1;
			delay_ms(100);
			LED=0;

		LED=1;
			delay_ms(100);
			LED=0;

			LED=1;
			delay_ms(100);
			}
			else
			period++;
}
void init_intr()
{
		TMOD=0x01;
		TH0=0x3C;
			TL0=0xAF;
		TR0=0;

		ET0=1;

IT1=1;
			EX1=1;

			EA=1;
}
void main ()
{
			LED=1;
RELAY1=RELAY2=RELAY3=RELAY4=RELAY5=RELAY6=
1;
			rdata=DDATA;
			rdata1=rdata=0;
			init_intr();
			while (1)  ;
}
```

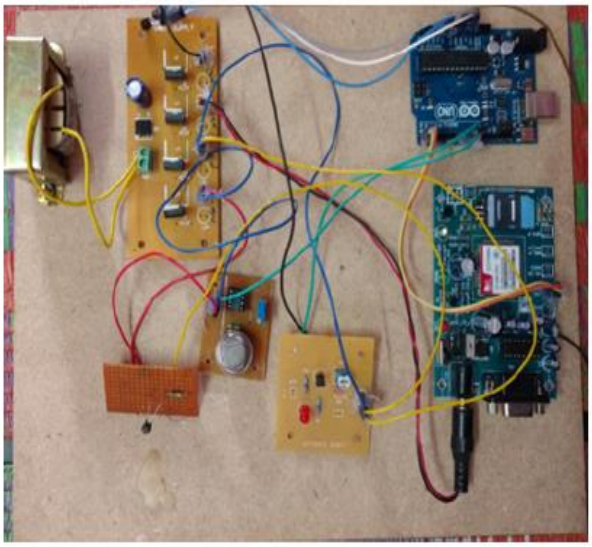

Fig. 3: Hardware Assembly

3. Conclusion

Thus the real time control of fire and gas detection system using wireless sensor network will increase the efficiency of the system and thereby reduces the costs for industries management operations. This is the alert framework system with less expensive and can be introduced in homes, and industries.

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