



Smart Sensor Based Indoor Accident Prevention Circuit for Specially Abled Persons

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Abstract:

In Indian with disabilities are 26,814,994, in male 14,988,593 and female 11,826,401. The disability prevalence ratio is 2.2%. Likewise in Tamil Nadu revealed that 6,97,478 persons are disabled in urban and 9,45,019 rural. In the districts of Nagapattinam 50,958, Thanjavur 59,468, Tiruvarur 37,371 and Cuddalore 64,426 are the values of the disables. In order to support the specially abled persons that the fire and gas detection sensors are designed, In the prior literature reveals separately both sensors are utilized, but in this present circuit PIC Microcontroller 16F877A will be used to control the fire and gas sensors. The voice control circuit is used to announce the nature of fire detection either by electrical short circuit or gas leakage and the GSM Modem is used to send SMS alert to the relatives of specially abled persons, nearest police station and fire service office. The buzzer in this circuit generates alarm, this will bring the attention of the neighbours and they can help the specially abled persons, so far that not only immediate help rendered but also a moral support rendered by the neighbours. In this way this circuit prevents the lives of disables when they are stay lonely in house.

Keywords: ARM Microcontroller, Fire Sensor, Gas Sensor, GSM Modem, PIC Microcontroller, Specially Abled Persons

I. INTRODUCTION:

A disability is a condition caused by an accident, trauma, genetics or disease which may limit a person's mobility, hearing, vision, speech or mental function. Suddenly everything in their life was different. We can help to provide them unconditional love, support and patient. We can help them to make their lives easier and happier. A wheel-chair has been provided for their mobility. Hence the device "Fire Cum Gas Sensor Based Indoor Accident Prevention Device" is designed and fitted to the wheel chair by using the hardware's voice sensor, GSM are to render support to the disable who is stay alone in house. Here for the safety in the wheel chair the Microcontroller unit PIC16F877A is fixed to check the leakage of Gas and ignition of fire inside all rooms of the house and generate sound through voice board and alert the person of the house the fire will generated or Gas leakage arise then this critical condition the hardware send SMS alert of the family members of the disable persons preprogrammed in memory. This project is specially designed to support the disable person.

Prior Models Block Diagram

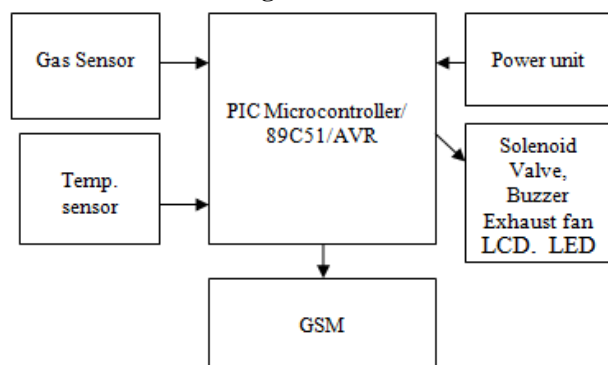


Figure.1. Block diagram of prior works reviewed

Prior literatures are studied by different publications and articles who are did the work related to our work. Here In fig.1 we draw the block diagram of the hardware what they used to develop their model by ourselves for simple understanding approach in past research by the researchers in our area. But now we have developed our own model in fig.2 using Fire and gas sensors, voice sensor based safety device. This project not only applicable for disable safety by checking the sensor status fire and Gas. but it is applicable to fit temple, Apartments, Shopping Malls, Theatres, MNC's, School and Hospitals social areas to protect the life of all person

Proposed Model

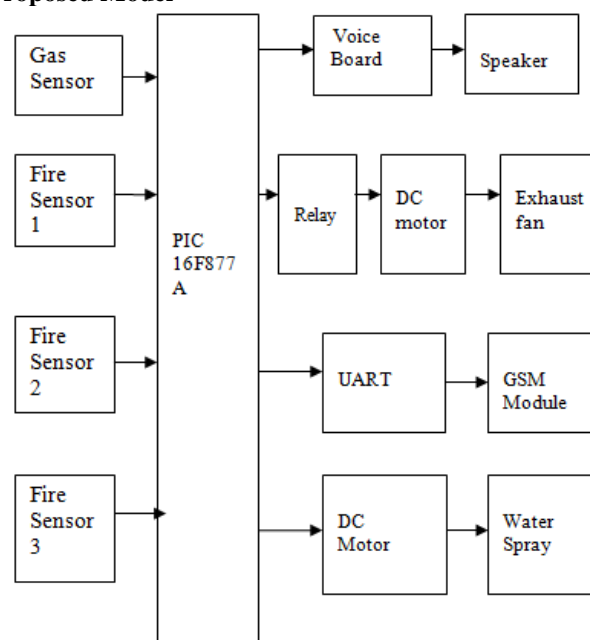


Figure.2. Proposed model block diagram

Hardware Description

PIC16F877A



Figure.3. IC of PIC

PIC16F877A:

PIC-Peripheral Interface Controller
16-Series number
F-Flash memory
877- Series number
A- Analog Comparator

General Description

The microcontroller is a device that can perform a specific function according to the coding/program burnt into its program memory. The microcontrollers are special purpose devices used in many application like automobile, medical, instrumentation, battery management, smart phones accessories, motor and control drives, USB and wireless technology etc., as shown in fig.3. One of the most reputed manufacturers of micro-controller is MICROCHIP PCB design. They have the vast series of micro-controllers from 8bit, 16, 32 bit controllers both in SMD and through whole package.

Product Description

This board is in fig. 5 built with PIC16F877A as a microcontroller unit. The input supply to the board can be fed from both ac and dc. It uses a crystal oscillator for generating frequency. A serial communication is achieved by an UART protocol. This board is specially designed for connecting digital and analog sensors which has input voltage range 5 or 12VDC as well as it can be interfaced with serial communication devices, relay boards etc. The output can be monitored in LCD as well as pc. Data EEPROM is used to store data defined by the user. PCB design. When a variable is defined it is stored in program memory and the value of the variable is stored in data EEPROM Synchronous serial ports are used to communicate with other peripheral devices like serial EEPROMS, A/D converters and shift registers. PCB design. They have two modes. 1- SPI Serial Peripheral Interface 2- I2C Inter Integrated Circuit

Applications

- Real time applications
- Academic applications

PIC Controller Features:

High-Performance RISC CPU:

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory
- Pin out compatible to other 28-pin or 40/44-pin
- PIC16CXXX and PIC16FXXX microcontrollers

PIC Assembled PCB

Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescale
- Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
- Capture is 16-bit, max. resolution is 12.5 ns
- Compare is 16-bit, max. resolution is 200 ns
- PWM max. resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

Analog Features:

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
 - Two analog comparators
 - Programmable on-chip voltage reference (VREF) module
 - Programmable input multiplexing from device inputs and internal voltage reference
 - Comparator outputs are externally accessible

Special Microcontroller Features:

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options, In-Circuit Debug (ICD) via two pins

CMOS Technology:

Low-power, high-speed Flash/EEPROM technology, Fully static design, Wide operating voltage range (2.0V to 5.5V, Commercial and Industrial temperature ranges, Low-power consumption

DEVICE OVERVIEW:

This document contains device specific information about the following devices: PIC16F873A, PIC16F874A PIC16F876A, PIC16F877A PIC16F873A/876A devices are available only in 28-pin packages, while PIC16F874A/877A devices are available in 40-pin and 44-pin packages. All devices in the PIC16F87XA family share common architecture with the following differences:

- The PIC16F873A and PIC16F874A have one-half of the total on-chip memory of the PIC16F876A and PIC16F877A
- The 28-pin devices have three I/O ports, while the 40/44-pin devices have five
- The 28-pin devices have fourteen interrupts, while the 40/44-pin devices have fifteen
- The 28-pin devices have five A/D input channels, while the 40/44-pin devices have eight
- The Parallel Slave Port is implemented only on the 40/44-pin devices shown in fig.4

Pin Diagram:

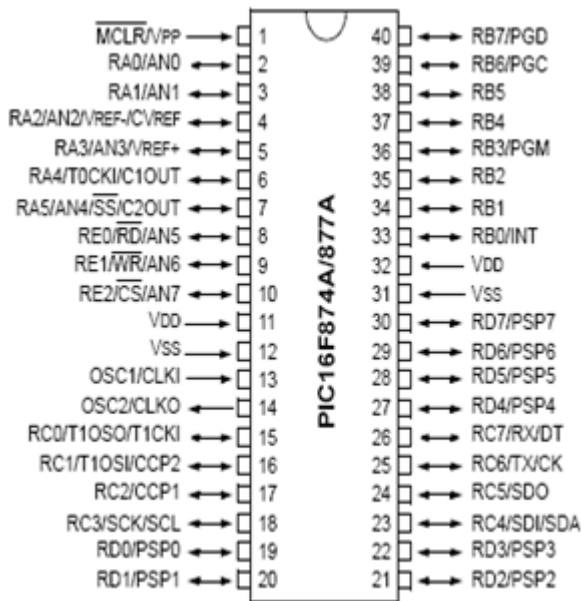


Figure.4. Pin out diagram of PIC



Figure.5. PCB Board of PIC

Power Supply:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others given in fig. 6. A 230v, 50Hz Single phase AC power supply is given to a step down transformer to get 12v supply. This voltage is converted to DC voltage using a Bridge Rectifier. The converted pulsating DC voltage is filtered by a 2200uf capacitor and then given to 7805 voltage regulator to obtain constant 5v supply. This 5v supply is given to all the components in the circuit. A RC time constant circuit is added to discharge all the capacitors quickly. To ensure the power supply a LED is connected for indication purpose.

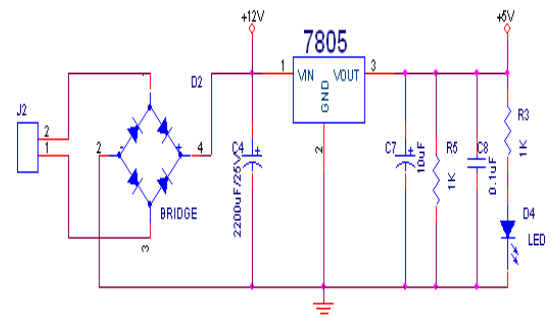
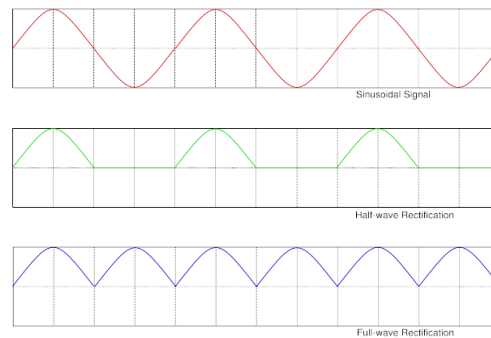


Figure.6. Power supply Unit

Rectifier

A **rectifier** is an electrical device that converts alternating current to direct current or at least to current with only positive value, a process known as **rectification**. Rectifiers are used as components of power supplies and as detectors of radio signals.



LCD (16x2):

Description:

LCD stands for liquid crystal display. They come in many sizes 8x1, 8x2, 10x2, 16x1, 16x2, 16x4, 20x2, 20x4, 24x2, 30x2, 32x2, 40x2 etc., Many multinational companies like Philips Hitachi Panasonic make their own special kind of LCD'S to be used in their products. All the LCD'S performs the same functions (display characters numbers special characters ASCII characters etc).Their programming is also same and they all have same 14 pins (0-13) or 16 pins (0 to 15). Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols shown in fig.7.



Figure.7. LCD module

Features:

Input voltage: 5v, E-blocks compatible, Low cost Compatible with most I/O ports in the E-Block range, Ease to develop programming code using Flow code icons.

Application:

- Monitoring

Description

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN darlington pairs that features high-voltage outputs with

common-cathode clamp diode for switching inductive loads. The collector-current rating of a single darlington pair is 500mA show the fig. 8

ULN2003

PIN CONNECTION

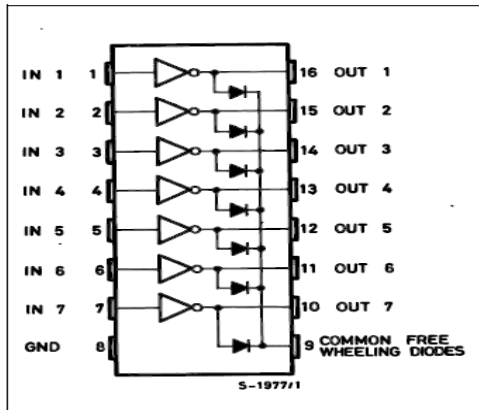


Figure.8. pin out of ULN2003

The darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lampdrivers, display drivers(LED gasdis charge),line drivers, and logic buffers. The ULN2003 has a 2.7kW series base resistor for eachdarlington pair for operation directly with TTL or 5V CMOS devices.

Features

- * 500mA rated collector current(Single output)
- * High-voltage outputs: 50V
- * Inputs compatible with various types of logic.
- * Relay driver application

UART:

The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a processor. The UART takes bytes of data and transmits the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Serial transmission of digital information (bits) through a single wire or other medium is much more cost effective than parallel transmission through multiple wires. A UART is used to convert the transmitted information between its sequential and parallel form at each end of the link. Each UART contains a shift register which is the fundamental method of conversion between serial and parallel forms.

MAX232:

- The MAX232 is an integrated circuit show the fig. 9 that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits.
- The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.
- The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.
- The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

later MAX232A is backwards compatible with the original MAX232 but may operate at higher baud rates and can use smaller external capacitors – 0.1 μ F in place of the 1.0 μ F capacitors used with the original device.

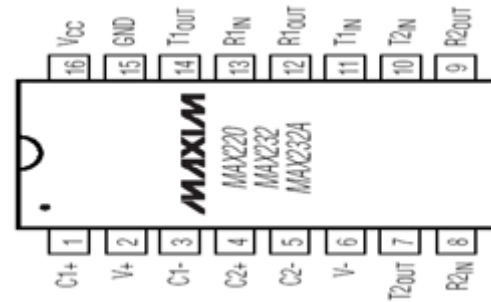


Figure.9.Pin Diagram of MAX 2

GSM (Global System for Mobile)

GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL -Modem is SIM900 Quad-band GSM / GPRS device, works on frequencies 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5V DC TTL interfacing circuitry , which allows User to directly interface with 5V Microcontrollers (PIC, AVR, Arduino,8051, etc.) as well as 3V3 Microcontrollers (ARM, ARM Cortex XX, etc.). The baud rate can be configurable from 9600-115200 bps through AT (Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable User to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The modem can be interfaced with a Microcontroller using USART (Universal Synchronous Asynchronous Receiver and Transmitter) feature (serial communication).

Loudspeaker

Sound can also be used as an output device to produce an alert noise or act as an alarm, and loudspeakers, buzzers, horns and sounders are all types of sound transducer that can be used for this purpose with the most commonly used audible type output sound actuator being the “Loudspeaker” show in the fig.10



Figure.10. Loudspeaker Transducer

LM35 TEMPERATURE SENSOR:

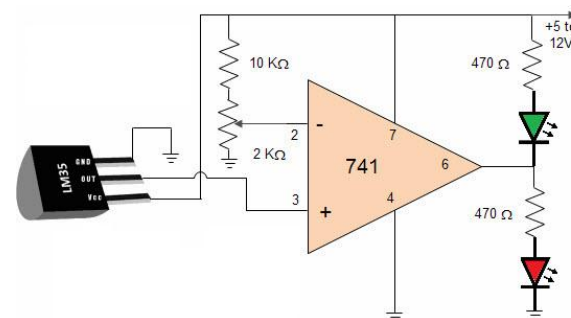


Figure.11. LM35 Temperature Sensor

Fig.11 the LM35 temperature sensor is used to detect precise centigrade temperature. The output of this sensor changes describes the linearity. The o/p voltage of this IC sensor is

linearly comparative to the Celsius temperature. The operating voltage range of this LM35 ranges from -55° to $+150^{\circ}\text{C}$ and it has low-self heating. This is operated under 4 to 30 volts. The most extensively used electronic devices are operational amplifiers, which are certain kind of differential amplifiers. Temperature sensor circuit has terminals such as two inputs like non-inverting (+) and inverting (-) and only one output pin. Operational amplifier IC741 is used as a non-inverting amplifier. The variation between the i/p terminals amplifies the circuit. The amount produced by IC2 amplifies in an amount to the temperature by 10 mV per degree. This unstable voltage is supply to a comparator IC 741. OP Amplifier is the most generally used electronic devices today. The IC 741 op-amp is one sort of differential amplifier. We have used IC741 as a non-inverting amplifier which means pin-3 is the input and the output is not inverted. This LM35 temperature sensor circuit amplifies the difference between its input terminals. The advantages of temperature sensor include It has no effect on the medium, more accurate, It has no effect on the medium, more accurate, It has an easily conditioned output and It responds instantly.

Applications of LM35 Temperature Sensor

The applications of LM35 temperature sensor include the following

- Measuring temperature of a particular environment and HVAC applications
- Providing thermal shutdown for a component / circuit
- Checking Battery Temperature

Gas Sensor:

Gas sensor measures the concentration of gas in its vicinity. Gas sensor interacts with a gas to measure its concentration. Each gas has a unique breakdown voltage i.e. the electric field at which it is ionized. Sensor identifies gases by measuring these voltages. The concentration of the gas can be determined by measuring the current discharge in the device.

MQ-6 Semiconductor Sensor for LPG:

- Gas sensor in Fig.12 Sensitive material of MQ-6 gas sensor is SnO_2 , which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is more higher along with the gas concentration rising. we use simple electronic circuit, Convert change of conductivity to correspond output signal of gas concentration.
- MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane, it is with low cost and suitable for different application.

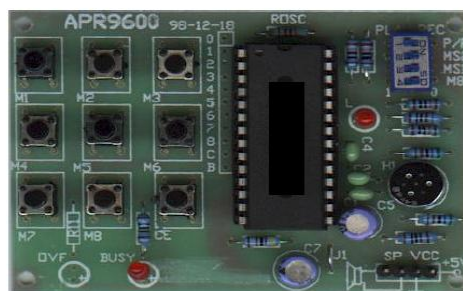


Figure.12. Gas sensor

Voice Board:

The APR9600 experimental board is shown in fig.13 is an assembled PCB board consisting of an APR9600 IC, an

electrets microphone, support components Fig.13 APR voice board necessary switches to allow users to explore all and functions of the APR9600 chip. The oscillation resistor is chosen so that the total recording period is 60 seconds with a sampling rate of 4.2 kHz.



APR9600 Experimental board

Flame detector:

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is properly lit; in these cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

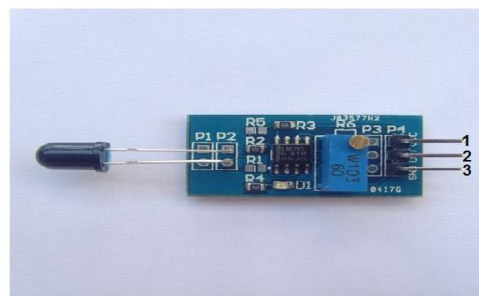


Figure.13.Flame detector/flame sensor
CIRCUIT DIAGRAM

Description:

When the hardware is switched On that time the set point checked by the Microcontroller for fire sensor flame or wavelength in 760 nm to 1100 nm range of light source and for gas MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm the fire sensor is a digital sensor hence if fire detected it give output logic 1 otherwise logic 0 but for gas it is an analog sensor hence it out vary from 0 to 5v nature of ppm leakage of gas, the controller senses each room of the houses through input but kitchen only gas if get leakage it alerts the disable person by voice and on the exhaust fan run the DC motor to spray water and paralleley send SMS alert, ignite alarm of loud speaker to alert the neighbors they rushed to the house for help. Here we use additionally one temperature sensor LM 35 for checking temp. during fire intensity to pour more water into fire, Circuit diagram in fig.16.The circuit designed using MPLAB, run the program using Proteus software that dialog box shown in the fig.17,then we designed our hardware real time demonstrate it in fig.18 for operation its performance is well. The program developed by ourself given fig.19 this developed program embedded into the Microcontroller for our logic explained prior

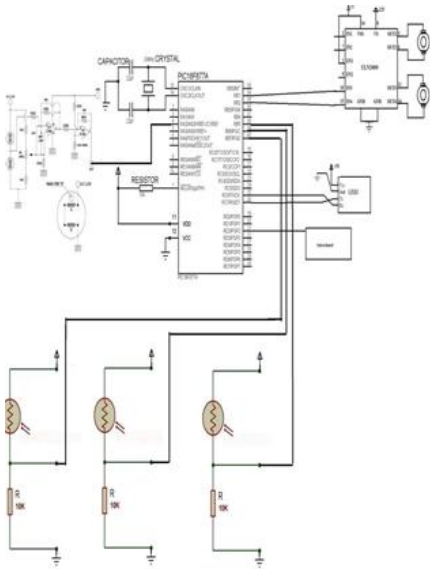


Figure.14. Circuit Diagram of our proposed model
FIRE AND GAS SENSORS DETECTION

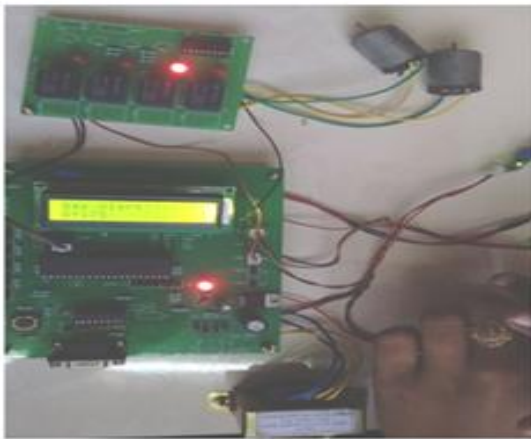


Figure.15. Designed proposed model hardware working state

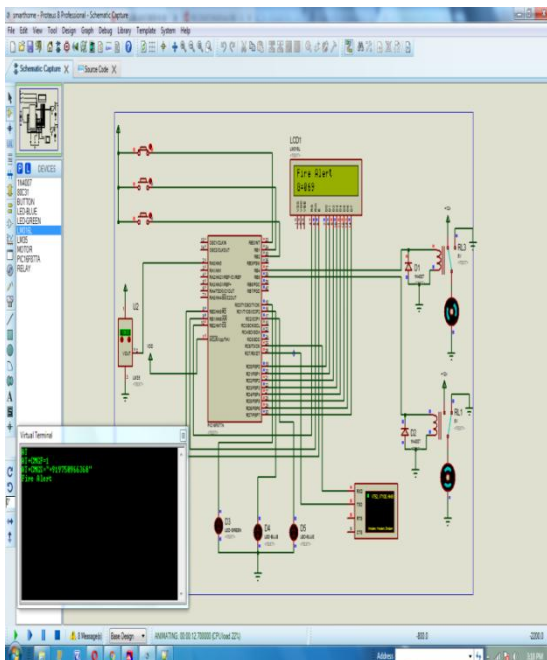


Figure.16. Proteus dialog box when program running

II. RESULT AND DISCUSSION:

If an disabled (Mentally affected, Leg/hand impaired, Paralysis attacked) is staying in a house so they can easily affected by vulnerable Fire / Gas leakage, the designed device easily

secure them since the circuit heart is PIC Microcontroller unit which can easily control the Fire and Gas sensor output permanently fixed on rooms of the houses, the gas leakage sense by MQ6sensor and a flame detector unit check the flame if it get input through the controller it alert the disable and on the exhaust fan next voice board announces the nature of the fire and an SMS alert is send through GSM module to the preprogrammed mobile numbers of the relatives and police station to save the disable the speaker sound alert the neighbors to safeguard the disable. This is the importance of our circuit performance.

Figure.17. Program for Fire and Gas sensor Activation:

```
# include<htc.h>
#include<stdio.h>
#define _XTAL_FREQ 10E6
#define lcd_data_port PORTD
#define en RE0
#define rw RE1
#define rs RE2
#define flame1 RB0
#define flame2 RB1
#define flame3 RB2
#define relay1 RB4
#define relay2 RB5
#define play RC0
#define c1 RC1
#define c2 RC2
unsigned char x,y,z,a=0,b=0,c=0;
unsignedint e=0;
void delay(unsigned char k)
{
    inti,j;
    for(i=0;i<=k;i++)
    for(j=0;j<=1075;j++);
}
voidlcd_command(unsigned char command)
{
    lcd_data_port=command;
    rs=0;
    rw=0;
    en=1;
    delay(10);
    en=0;
}
voidlcd_ins()
{
    lcd_command(0x01);
    lcd_command(0x38);
    lcd_command(0x38);
    lcd_command(0x38);
    lcd_command(0x0F);
    lcd_command(0x06);
    lcd_command(0x0C);
    lcd_command(0x80);
}
voidlcd_disp_string(unsigned char *s)
{
    while(*s)
    lcd_data(*s++);
}
voiduart_init(void)
{
    TXSTA=0X20;
    RCSTA=0X90;
```

```

SPBRG=15;
}
unsigned char getch(void)
{
unsigned char temp;
while(RCIF==0);
temp=RCREG;
return temp;
}
voidputch(unsigned char val)
{
while(TXIF==0);
TXREG=val;
delay_ms(30);
}
voidgsm_init(void)
{
printf("AT\r");
delay_ms(1000);
printf("AT+CMGF=1\r");
delay_ms(1000);
}
void main()
{
CMCON=0x07;
CVRCON=0x00;
TRISD=0x00;
TRISE=0x00;
TRISB=0x0F;
PORTD=0X00;
PORTE=0X00;
PORTB=0X00;
TRISC = 0x1C;
PORTC = 0X00;
relay1=0;relay2=0;
lcd_ins();
uart_init();
gsm_init();
PCFG1=1;
delay(100);
lcd_command(0x80);
lcd_disp_string("welcome");
lcd_command(0x01);
while(1)
{
ADCON0=0B10000001;
delay(1000);
GODONE=1;
while(GODONE)
continue;
x=ADRESH;
lcd_command(0xC0);
lcd_data('G');
lcd_data('=');
lcd_data((x/100)+0x30);
lcd_data(((x%100)/10)+0x30);
lcd_data((x%10)+0x30);
for(e=0;e<10000;e++);
if (flame1== 1||flame2 ==1||flame3 == 1)
{
lcd_command(0x80);
lcd_disp_string ("Fire Alert");
relay1 = 1;
printf("AT+CMGS=\r"+919750966368\r");
delay_ms(500);
printf("Fire Alert");

```

```

delay_ms(500);
putch(26);
c1=1; c2=0; play = 0;delay(30000); play=1;
lcd_command(0x01);
}
else if(x>150)
{
lcd_command(0x80);
lcd_disp_string("Gas Alert");
relay2 = 1;
printf("AT+CMGS=\r"+919750966368\r");
delay_ms(500);
printf("Gas Alert");
delay_ms(500);
putch(26);
c1=0; c1=1; play = 1;delay(30000); play=0;
lcd_command(0x01);
}
else
{
relay1=0;relay2=0;
}
}
}

```

III. REFERENCE

- [1]. Z. Liu, J. Makar and A. K. Kim "Development of Fire Detection Systems in the Intelligent Building", Institute for Research in Construction, National Research Council of Canada, Ottawa, Canada
- [2]. Jeffrey S. Goldmeier Southwest Sciences, Inc., Santa Fe, NM, USA "A Rugged LED-Based Sensor for Fire Detection"
- [3]. Qian Ding, ZhenghongPeng, Tianzhen Liu and Qiaohui Tong "Multi-Sensor Building Fire Alarm System with Information Fusion Technology Based on D-S Evidence Theory" Algorithms 2014, 7, 523-537; doi:10.3390/a7040523
- [4]. Omar Asif1, Md. BelayatHossain, MamunHasan, Mir ToufikurRahman,Muhammad E. H. Chowdhury (2014) "Fire-Detectors Review And Design Of An Automated, Quick Responsive Fire-Alarm System Based On SMS"International Journal Communications, Network and System Sciences, 7, 386-395
- [5]. Juan Aponte Luis, Juan Antonio Gómez Galán and Javier AlcinaEspigado(2015) "Low Power Wireless Smoke Alarm System in Home Fires"Sensors, 15, 20717-20729; doi:10.3390/s150820717
- [6]. RashedulQayum, S.M Ehsanul Amin, MdKamrul Hussain(2012, October) "Enhanced Wireless Control System for Smoke and Fire Detection" International Journal of Scientific & Engineering Research, Volume 3, Issue 10, ISSN 2229-5518
- [7]. Subbiah, P. Chiranjeevi, K. Shanmuganathan and C. Vignesh(2016) "Fire Safety Robot"International Journal of Chemical Science 14 (S3), 845-848,ISSN 0972-768X
- [8].Ganesh. D, AniletBala. A (2015)"Improvement on Gas Leakage Detection and Location System Based On Wireless Sensor Network" International Journal of Engineering Development and Research 2015| Volume 3, Issue 2 | ISSN: 2321-9939

- [9].V. VimalaBharathi, M. V. D. Prasad (2013, April)“GSM based Fire Sensing and Extinguishing Robot” International Journal of Science and Research (IJSR), Volume 2, Issue 4, India Online ISSN: 2319-7064
- [10]. A.M. Aswin, P.Akash Raj Daniel, S.Murugayan, Ashok Kumar (2016,May)“Colony Security System With Fire Fighting Robot” International Journal of Soft Computing and Artificial Intelligence, ISSN: 2321-404X, Volume-4, Issue-1
- [11]. Puneet Sharma, ChandniGoel, SorabhDatta and Sukhwinder Singh Dhillon(2014, December)“Fully Automated Fire Fighting Robot with Radio Frequency Module”Journal of Academia and Industrial Research (JAIR),Volume 3, Issue 7 330Youth Education and Research Trust (YERT) jairjp.com Puneet et al.,2014,ISSN: 22785213
- [12]. M.Kumaresan, K.N.Sreekumar, G.Sankar(2014, February) “Online Monitoring of LPG Leakage Based on Wireless Sensor networks” Journal of Nano science and Nano technology Vol 2 | Issue 2 | Spring Edition | DOI : | Pp 134-136 | ISSN 2279 0381
- [13]. Dr. S.N. Kini, RutujaWadekar , ShwetaKhatade, SayaliDugane , RutujaJadkar(2016, May)“Fire Fighting Robot Controlled Using Android Application” International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 5, Copyright to DOI:10.15680
- [14]. Toufiqul Islam, Syed Asif Abdullah, and GolamSarowar(2013, April)“Enhanced Wireless Control System for Smoke and Fire Detection” International Journal of Computer and Electrical Engineering, Vol. 5, No. 2
- [15]. R.O.Okeke, M.Ehikhamenle, (2017, February)“Design And Simulation Of Gas And Fire Detector And Alarm System With Water Sprinkle” International Journal of Engineering Research and General Science Volume 5, Issue 1, ISSN 2091-2730
- [16]. S.R.Vijayalakshmi andS.Muruganand (2015, June)“Design Challenges In Wireless Fire Security Sensor Nodes” International Journal of Embedded systems and Applications Vol.5, No.2
- [17]. Saisuneel, S.B.Sridevi, K. Nalini (2013) “Emergency Communication Planning for Smoke and Fire Detection through Wireless Network” International Journal of Engineering Sciences Research, Vol 04, Special Issue 01, ISSN: 2230-8504
- [18]. Kavitha. N, Ranjithkumar. V, Siva Ram Chandran. K (2016, February)Hazardous Gas Detection And Alert System Using PIC Microcontroller, International Journal of Advanced Research in Biology Engineering Science and Technology, Vol. 2, Issue 2
- [19]. S. Sivaranjani, D. Gowdhani, P. Karthikkannan “An Appraisal On Gas Leakage Detection And Controlling System In Smart Home Using IOT”Special Issue: (Emerging Technologies In Networking And Security ,Sivaranjani et al.
- [20].SuneelMudunuru, V.NarasimhaNayak,G. adhusudhana Rao, K. Sreenivasa Ravi (2011) “Real Time Security Control System For Smoke
- [21]And Fire Detection Using Zigbee” SuneelMudunuru et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 2 (6), 2531-2540, ISSN:0975-9646.
- [22]C. Vimala, Richard Barua, Rahul kumar, SuprotimGhosh (2016) “Vision Based Intelligent Fire Detection System” International Conference on Current Research in Engineering Science and Technology (ICCREST-2016)
- [23].Patel Maitri A, Patel Hardili D, Patel Ankita M, ShriAnurag Bhatia, Kamlesh H Gavit (2014)“Automatic Fire Detection and Controlling System using GSM &Alarm” International Journal for Scientific Research & Development| Vol. 2, Issue 02| ISSN (online): 2321-0613
- [24].Asif M Mokashi1, Dr. U V Wali (2016, July) “Smart Fire Detection System In Industrial Application Using Can Protocol” International Journal of Recent Trends in Engineering & Research Volume 02, Issue 07 [ISSN: 2455-1457]
- [25].P. N. Narendra Reddy, P. I. Basarkod, S. S. Manvi “Wireless Sensor Network based Fire Monitoring and Extinguishing System in Real Time Environment” International Journal Advanced Networking and Applications, Volume: 03, Issue:02, Pages:1070-75,2011
- [26].V. Ramya, B. Palaniappan (2012, May)“Embedded system for Hazardous Gas detection and Alerting” International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.3.
- [27].www.elctronic tutorial. Co,www.lumisence.com
- [28].Employment Of Persons With Disabilities By Sector, Secretary, Department Of Empowerment Of Persons With Disabilities Ministry Of Social Justice And Empowerment,5th Floor, Pariyavara Bhavan, CGO Complex, Lodi Road, New Delhi