INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

Project name	Industry-specific intelligent fire management system
Team ID	**PNT2022TMID16911**
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Abstract

The main objective of "Industry specific-intelligent fire management system" is to prevent fire accidents in industries and take appropriate measures to avoid any mishap. This project also concentrates on the measures to prevent fire accidents caused due to flammable gas, smoke and rise in temperature. This system makes use of the best sensor available that detects any transpose in the environment. Based on the sensor readings, if any disparity is encountered, appropriate actions will be taken in order to prevent any misfortune. This model incorporates MQ2 gas sensor for detecting propane and methane gases, IR Flame sensor module to detect flame and TMP 36 Temperature sensor for the temperature measurement of the environment. These readings are monitored continuously by IBM Watson IoT Platform and stored in Cloudant DB. In case any undesirable variation occurs, the authorities and fire station will be alerted via Fast2SMS web service. The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any movement or change in the environment. If the presence of flame is felt, then the exhaust fans are powered ON. If any flame is detected, the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and Fire station

KEYWORDS:

- Use of Arduino, Gas Sensor,
- GSM (Global System for Mobile Communication).
- Temperature sensor

Introduction

Fire and smoke kill more people every year than many other forces. While controlled fire serves us in so many instances, uncontrolled fire can be of harm, however, the rapid detection of fire and its control can save lives and property damage worth millions. Conventional and addressable are two main types of fire alarm systems, but unfortunately, these fire alarm systems often generate false alarms. The ratio of false alarm is higher in conventional alarm systems compared to addressable, but addressable alarm fire systems are more expensive. The most likely cause of a false warning is different for distinct types of detection systems, such as a smoke sensor often being activated falsely due to an environmental effect. So, there is a need for a cost-effective multi-sensors expert alarm system that is artificially trained and assists FDWS (fire detection and warning system) to make the right decisions and to reduce the number of false alarms. False alarm warnings are so common that London fire brigade alone is called out almost every 10 min to attend a false alarm causing them a loss of about £37 million per year. To achieve the aforementioned goal, in this paper, we introduced a home-based FDMS that uses a microcontroller Arduino UNO R3 (Arduino, Somerville, TX, USA) based on the atmega328p. It is easily available and programmed using the Arduino Software (IDE) with a set of cost-effective sensors. The proposed solution effectively uses a smoke sensor with flame sensors with a particular increase in room temperature; to further investigate the true presence of fire and to avoid false alarm, the FDWS is trained with a neuro-fuzzy designer. The purpose of this intelligent fire alarm system is to sense true occurrences of fire, alert the proper authorities, and notify the occupants via GSM to take necessary action immediately. A false

alarm can burden the fire brigade and can turn out to be a costly event; so many studies conducted to reduce them. Previous studies proposed different methods such as autonomous firefighting robots, fire alarm systems with notification appliances, and wireless warning systems. Fire alarm systems with notification appliances can be costly because they use visible and audible stimuli to notify residents. The primary objective of this paper is to develop a reproducible and economical solution with minimum false alarms and a system that alerts via GSM (global system for mobile communication). The innovative idea is to use neuro-fuzzy logic to design a smart alarm system. Our proposed system is ANFIS-simulated in MATLAB environment; the obtained results show effectiveness and the robustness with good performances compared with the FIS method. The ANFIS idea was originally proposed by Jang in 1993. Typically, an ANFIS is a combination of a neural network and a fuzzy inference system (FIS) and is effective in making decisions.

SYSTEM REQUIREMENTS

HARDWARE REQUIREMENTS:

- Arduino Uno
- LCD Display
- Gas Sensor
- Temperature Sensor
- Buzzer

SOFTWARE REQUIREMENTS:

- Arduino IDE

PROPOSED METHOD

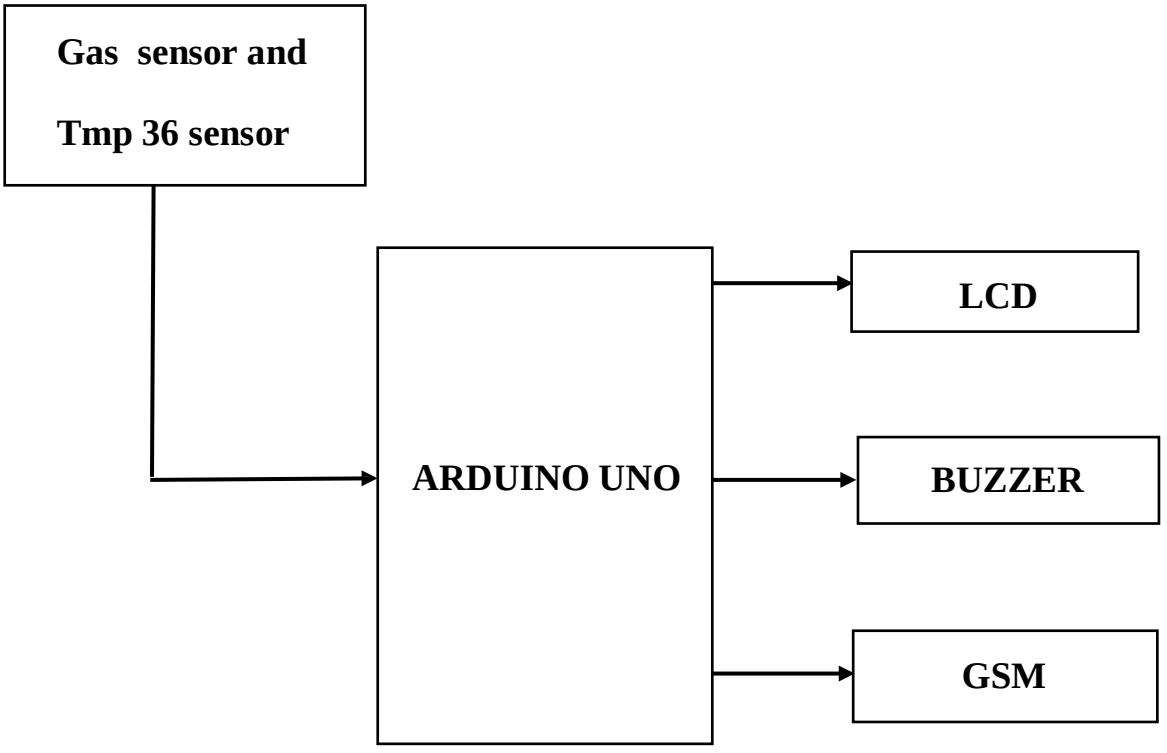
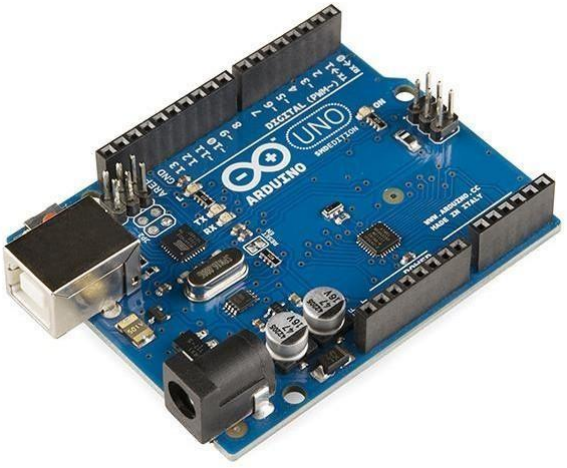


Figure 4.1. Gas leakage detection system

The above-mentioned block figure 4.1 shows a block diagram for fire management system. The fire management system helps to detect the fire or smoke in the industry or work place. This project used Arduino UNO as the Microcontroller where it processes the input from the sensor. If fire is detected, then the system gives alert alarm by using the buzzer sound and sent SMS through GSM module to communicate with the user.

ARDUINO UNO:

Arduino Uno is a microcontroller board based on the ATmega328P. Figure. 2 has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.



Arduino Uno

“UNO” means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Power

The Arduino Uno board can be powered via the USB connection or withan external power supply. The power source is selected automatically.External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm centre-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V,the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

Vin - The input voltage to the Arduino board when it‟s using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. 5V this pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 12V), the USB connector (SV), or the VIN pin of the board (712V). Supplying voltage via the 5V or 3.3V pins bypasses the

regulator, and can damage your board. Wedon‟t advise it.3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND - Ground pins.

IOREF - This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select theappropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

Memory - The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output - See the mapping between Arduino pins and ATmega328P ports. The mapping for the Atmega8, 168, and 328 is identical.Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(),digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 2050k ohm. A maximum of 40mA is the value that must not be exceeded on any 1/0 pin to avoidpermanent damage to the microcontroller.

Technical specifications of ATmega328p.

Microcontroller	ATmega328p
Operating Voltage	5 V
Input Voltage(recommended)	7-12 V
Input Voltage(limit)	6-20 V
Digital I/O Pins	14 (~6 PWM pins)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current per 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which

	0.5KB used by bootloader
SRAM	2 KB(ATmega328P)
EPROM	1 KB(ATmega328P)
Clock Speed	16 MHz
Length	68.6 min
Width	53.4 min
Weight	25 g

In addition, some pins have specialized functions:Serial - 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) FTL, serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB to-TTL Serial chip.

External Interrupts - 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachinterrupt() function for details.

PWM - 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

SPI - 10 (SS), 11 (MOST), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED - 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off

TWI - A4 or SDA pin and AS or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference() function.

There are a couple of other pins on the board:

AREF Reference voltage for the analog inputs. Used with analog Reference ().

Reset Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers. The ATmega328 provides UART TIL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDS on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows serial communication on any of the Uno‟s digital pins.

The ATmega328 also supports 12C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the 12C bus; see the documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines: (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano farad capacitor. When this line is asserted (taken

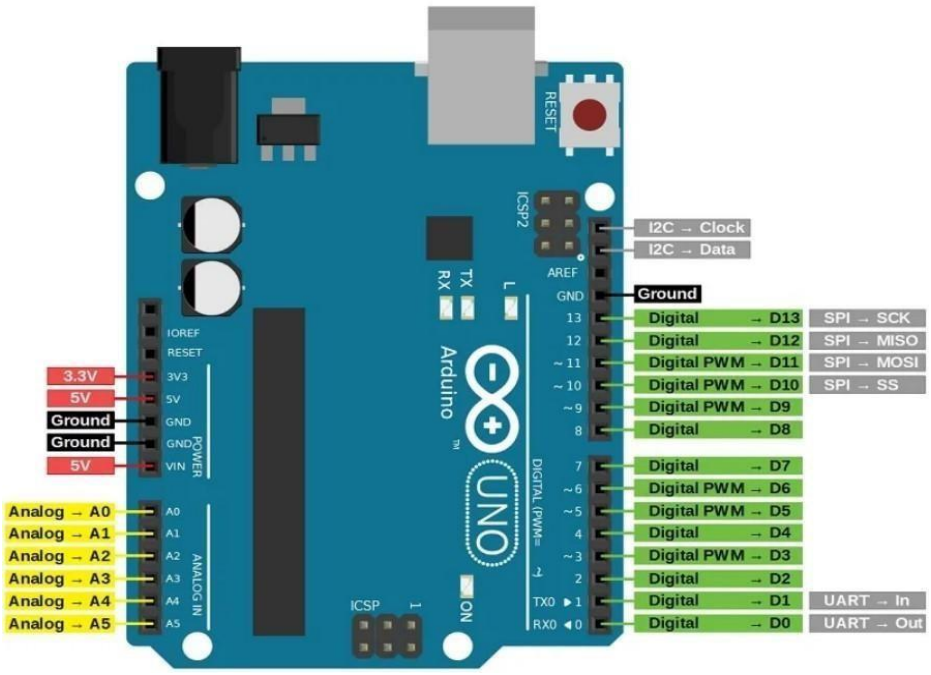
low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e., anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It‟s labelled “RESET-EN”. You may also be able to disable the auto-reset by connecting a 110-ohm resistor from 5V to the reset line; see this forum thread for details.

Revisions

Revision 3 of the board has the following new features: 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes. Stronger RESET circuit Atmega 16U2 replace the 8U2.



Arduino UNO Pin Configuration

LCD DISPLAY:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

The 16×2 LCD pinout is shown below.

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.

- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

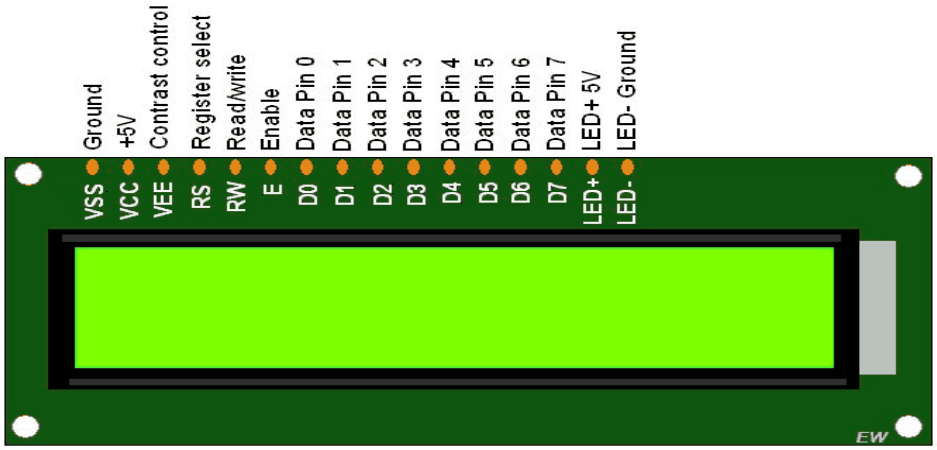
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

- Pin15 (+ve pin of the LED): This pin is connected to +5V

- Pin 16 (-ve pin of the LED): This pin is connected to GND.

Features of LCD16x2

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8-pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters



Lcd display.

Registers of LCD

A 16×2 LCD has two registers like data register and command register. The RS (register select) is mainly used to change from one register to another. When the register set is „0", then it is known as command register. Similarly, when the register set is „1", then it is known as data register.

Command Register

The main function of the command register is to store the instructions of command which are given to the display. So that predefined tasks can be performed such as clearing the display, initializing, set the cursor place, and display control. Here commands processing can occur within the register

Data Register

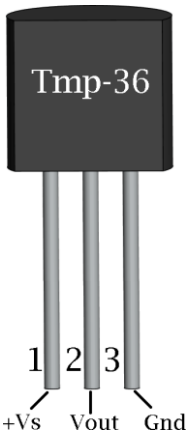
The main function of the data register is to store the information which is to be exhibited on the LCD screen. Here, the ASCII value of the character is the information which is to be exhibited on the screen of LCD. Whenever we send the information to LCD, it transmits to the data register, and then the process will be starting there. When register set =1, then the data register will be selected.

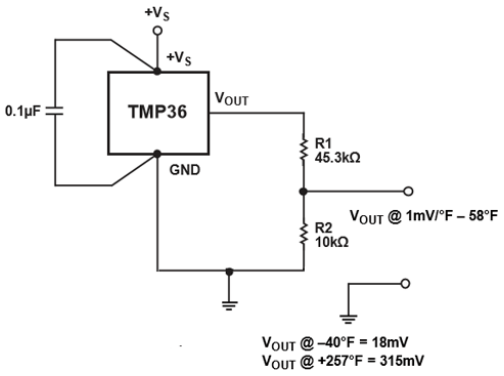
TEMPERATURE SENSOR(TMP 36):

The TMP36 is a low voltage, precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. It also doesn't require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −40°C to +125°C temperature range.

The temperature sensor is used for detecting the presence of fire or not by sensing the surrounding temperature. In some industry, they may use highly

inflammable products. In this case even a small flame or fire may leads to a big explosion. So, by using the temperature sensor(TMP 36) we can prevent this type of explosion.



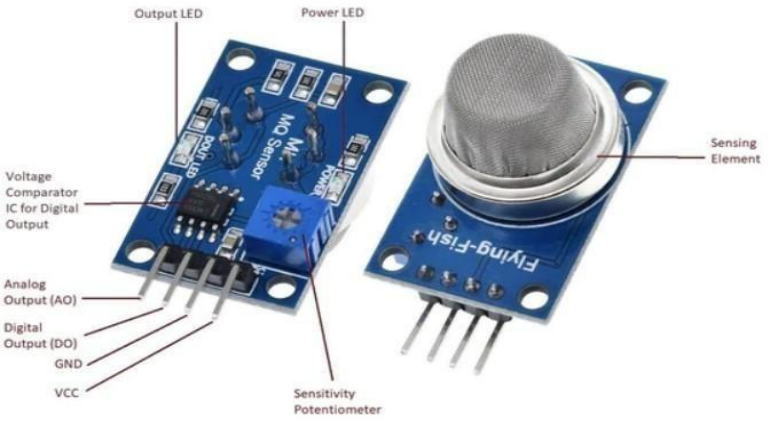


APPLICATIONS OF TMP 36 SENSOR

- Environmental control systems
- Thermal protection
- Industrial process control Fire alarms
- Power system monitors CPU
- Thermal management

GAS SENSOR:

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, the sensor‟s conductivity is higher along with the gas concentration rising. Convert change of conductivity to correspond output signal of gas concentration. MQ-2 gas sensor has highly sensitive to Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.



Gas Sensor.

Characteristics

-Good sensitivity to Combustible gas in wide range

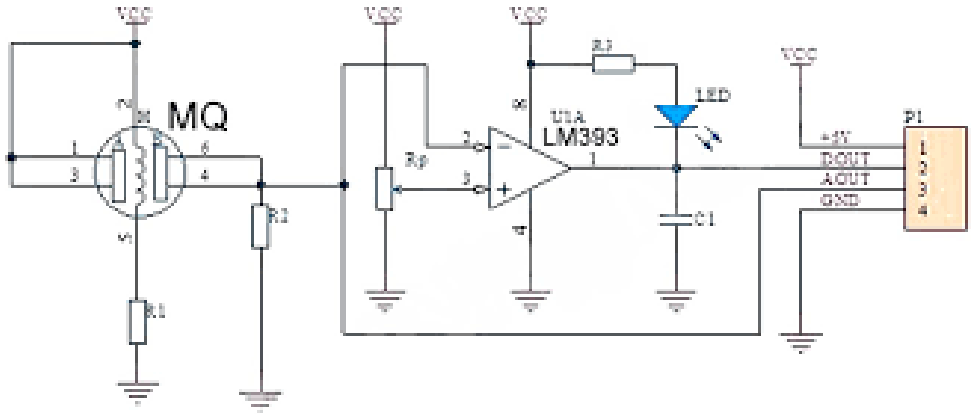
-High sensitivity to LPG, Propane and Hydrogen

-Long life and low cost

-Simple drive circuit

Technical Data for gas sensor

Model No.			MQ-2
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			Combustible gas and smoke
Concentration			300-10000ppm (Combustible gas)
Circuit	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.2V ACorDC
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3Ω（Room Tem.）
	Heater consumption	P_H	≤900mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 2000ppm C_3H_8)
	Sensitivity	S	Rs(in air)/Rs(1000ppm isobutane)≥5
	Slope	α	≤0.6($R_{5000ppm}/R_{3000ppm}$ CH_4)
Condition	Tem. Humidity		20℃±2℃； 65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V； V_H: 5.0V±0.1V
	Preheat time		Over 48 hours



Sensor Circuit Diagram

The above figure 4.3.2. is basic test circuit of the sensor. The sensor needs to be put 2 voltage, heater voltage（VH） and test voltage（VC). VH used to supply certified working temperature to the sensor, while VC used to detect voltage (VRL) on load resistance （RL）whom is in series with sensor. The sensor has light polarity, Vc need DC power. VC and VH could use same power circuit with precondition to assure performance of sensor. In order to make the sensor with better performance, suitable RL value is needed: Power of Sensitivity body (Ps):

$Ps = Vc \wedge 2 \times Rs / (Rs+RL) \wedge 2$

Resistance of sensor (Rs): $Rs = (Vc/VRL-1) \times RL$

Working principle

When tin dioxide (semiconductor particles) is heated in air at high temperature, oxygen is adsorbed on the surface. In clean air, donor electrons in tin dioxide are attracted toward oxygen which is adsorbed on the surface of the sensing material. This prevents electric current flow. In the presence of reducing gases, the surface density of adsorbed oxygen decreases as it reacts with the reducing gases. Electrons are then released into the tin dioxide, allowing current to flow freely through the sensor. Since MQ2 Gas Sensor is not breadboard compatible, we do recommend this handy little breakout board. It‟s very easy to use and comes with two different outputs. It not only provides a binary indication of the presence of combustible gases but also an analog representation of their concentration in air. The analog output voltage provided by the sensor changes in proportional to the concentration of smoke/gas. The greater the gas

concentration, the higher is the output voltage; while lesser gas concentration results in low output voltage. The following animation illustrates the relationship between gas concentration and output voltage. The analog signal from MQ2 Gas sensor is further fed to LM393 High Precision Comparator (soldered on the bottom of the module), of course to digitize the signal. Along with the comparator is a little potentiometer you can turn to adjust the sensitivity of the sensor. You can use it to adjust the concentration of gas at which the sensor detects it.

Pin names

Sensor Pin Configuration

Gas Sensor Application

Module version of this sensor can be used without interfacing to any microcontroller and is useful when detecting only one particular gas. This

can only detect the gas. But if ppm has to be calculated then the sensor should be used without module.

This sensor is also used for Air quality monitoring, Gas leak alarm and for maintaining environmental standards in hospitals. In industries, these are used to detect the leakage of harmful gases.

These sensors are used to detect the presence of gases in the air such as methane, butane, LPG and smoke but they are unable to distinguish between gases. Thus, they cannot tell which gas it is.

BUZZER:

The buzzer is a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage. It is widely used in alarms, computers, printers and other electronic products as sound devices. It is mainly divided into piezoelectric buzzer and electromagnetic buzzer, represented by the letter "H" or "HA" in the circuit. According to different designs and uses, the buzzer can emit various sounds such as music, siren, buzzer, alarm, and electric bell.

Piezo buzzer

The piezoelectric buzzer uses the piezoelectric effect of the piezoelectric ceramics and uses the pulse current to drive the vibration of the metal plate to generate sound. Piezoelectric buzzer is mainly composed of multi-resonator, piezoelectric plate, impedance matcher, resonance box, housing, etc. Some of the piezoelectric buzzers are also equipped with light-emitting diodes. The multi-resonator consists of transistors or integrated circuits. When the power supply is switched on (1.5~15V DC operating voltage), the multi-resonator oscillates and outputs 1.5~2.5kHz audio signal. The impedance matcher pushes

the piezoelectric plate to generate sound. The piezoelectric plate is made of lead zirconate titanate or lead magnesium niobate piezoelectric ceramic, and silver electrodes are plated on both sides of the ceramic sheet. After being polarized and aged, the silver electrodes are bonded together with brass or stainless-steel sheets.

Buzzer

There are two types of piezo buzzers - transducers and indicators. Transducers consist of a casing, a piezoceramic element and a terminal. In order to operate a transducer, the user must send a square wave signal to the buzzer. Indicators consist of a casing, a piezoceramic element, a circuit board and a terminal. In order to operate an indicator, the user must send the buzzer a specified dc voltage.

GSM:

The Global System for Mobile Communications (GSM) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991. By the mid-2010s, it became a global standard for mobile

communications achieving over 90% market share, and operating in over 193 countries and territories. 2G networks developed as a replacement for first generation (1G) analog cellular networks. The GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via General Packet Radio Service (GPRS), and Enhanced Data Rates for GSM Evolution (EDGE). Subsequently, the 3GPP developed third-generation (3G) UMTS standards, followed by the fourth-generation (4G) LTE Advanced and the fifth-generation 5G standards, which do not form part of the ETSI GSM standard.

"GSM" is a trade mark owned by the GSM Association. It may also refer to the (initially) most common voice codec used, Full Rate. As a result of the network's widespread use across Europe, the acronym "GSM" was briefly used as a generic term for mobile phones in France, the Netherlands and in Belgium. A great number of people in Belgium still use it to date.

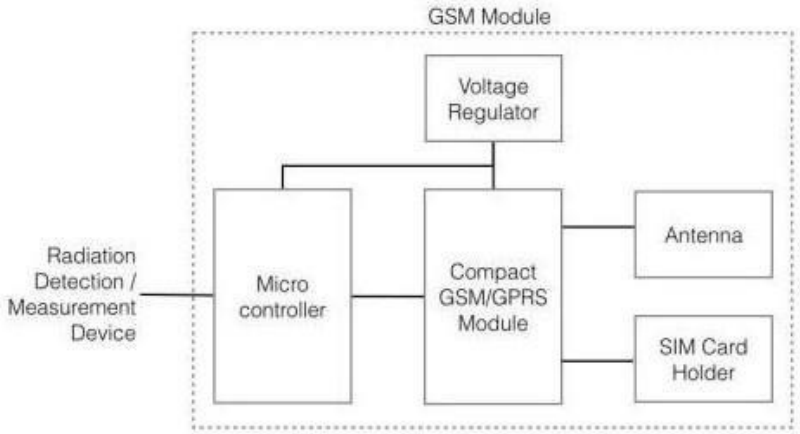
GSM Module

System design

Hardware and firmware development of the GSM module were done in parallel. Initially, the firmware was developed on Arduino platform; Arduino Uno and GSM Shield for Arduino. The Serial Monitor in Arduino IDE is a very useful tool to echo communication between the microcontroller and GSM shield. This tool enables programmer to monitor and verify firmware operation in GSM shield responds and SMS data processing. Hence, the proof-of-concept prototype is successfully developed on Arduino platform. However, the Arduino GSM library was not utilized; instead, the microcontroller communicates with GSM shield by using AT Command to avoid dependency on the library as well as to maintain the flexibility of the firmware.GSM modems are connected to your server or workstation with a serial port or USB connection. Connecting your GSM modem with a serial cable is a very secure way to use a GSM modem. No extra drivers are necessary and the cable can be fixed tightly to the server and the GSM modem. GSM modems are optimized for SMS and data transmission and often support advanced options like automatic resets and on-board software.

Hardware Design

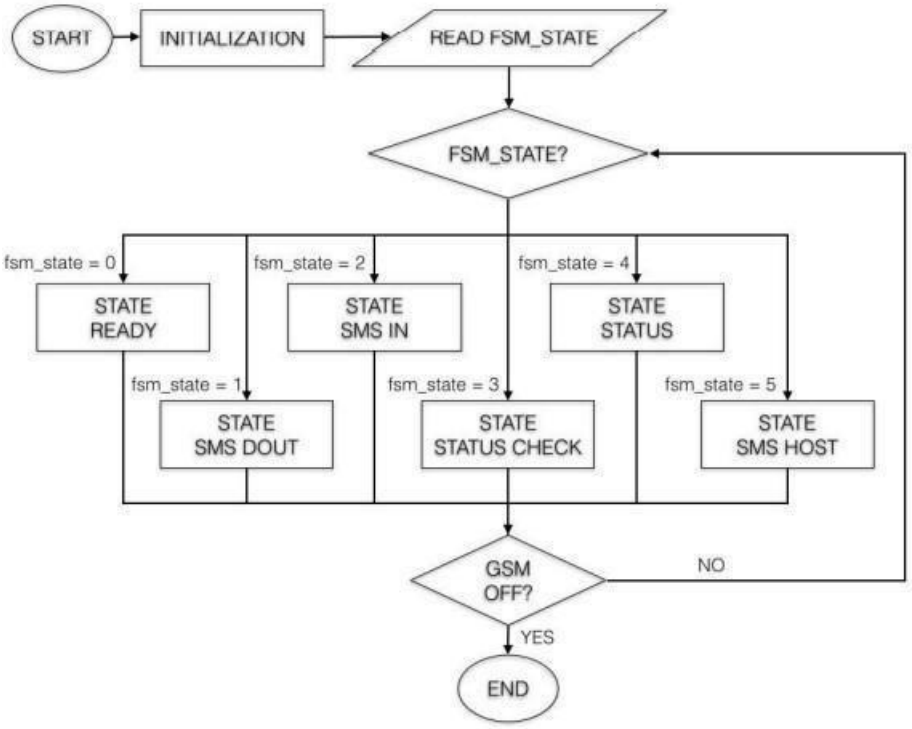
A customized PCB is designed to create a single board that housed all the necessary design blocks as shown in figure 1. The voltage regulator circuit provides voltage supply to all the components on board based on their respective voltage specifications. Microcontroller Atmega328P controls and synchronizes the operation of the module; it controls the operation of GSM module, and handles data and commands from the external device. Telit GL865-DUAL/QUAD V3 module (Telit) is a compact GSM/GPRS module that suits portable and battery operated device. This IC acts as GSM modem that transmits and receives all the SMS for the GSM module.



Block diagram of GSM PCB Module

Firmware Design

Communication between GSM module and microcontroller is done using AT commands by using standard serial connection. The GSM module is designed to enable wireless communication for radiation monitoring instrument intended for continuous data monitoring and emergency alert. There are three configuration parameters that are essential to complete the task; the Host number, time interval for data transmission, and threshold level for alert SMS. These parameters are stored in EEPROM of microcontroller. User will be able to change and update the configuration parameters via SMS. Firmware of GSM microcontroller is implemented as a finite state machine as shown as the state diagram. The firmware is responsible to handle task related to GSM/SMS communication with the Host server. A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here these modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer.



GSM microcontroller firmware

AT Command and SMS PDU Processing

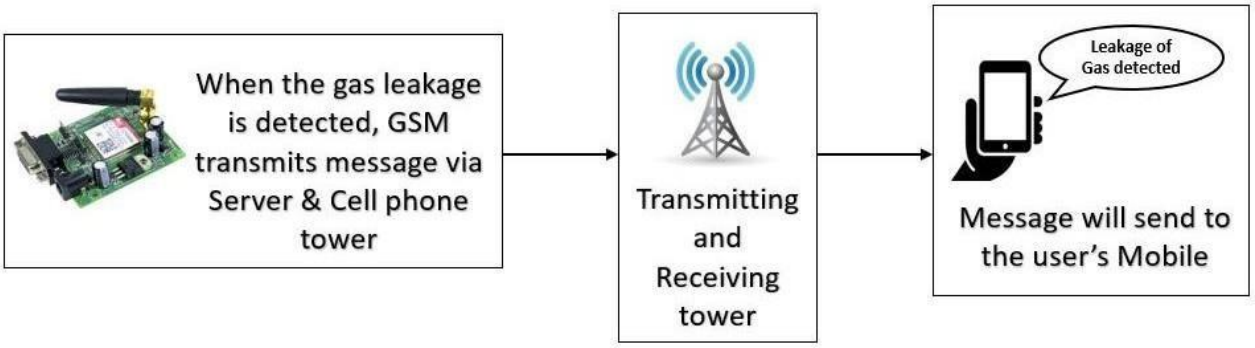
Communication between microcontroller and Telit is done by using AT Command via serial connection. AT commands are list of standard instructions that is used to control a modem. For example, AT+CMGD is a command used to instruct Telit to delete SMS. In order to simplify the SMS processing, AT+CMGF=1 is used to instruct Telit for SMS in text mode. In default state (St_Ready),microcontroller frequently checks its serial receive buffer in case there is new notification or status from Telit GSM (ReadGSM). All incoming SMS is temporarily copied and stored in the firmware array buffer. It is crucial for the microcontroller to identify and process SMS intended for the system.

In this case, the module is expected to receive three types of SMS:

- SMS from Host or any sender to check the status
- SMS from Host to change configuration parameter (Host number, data time interval, threshold value for alert)
- Other unrelated SMS

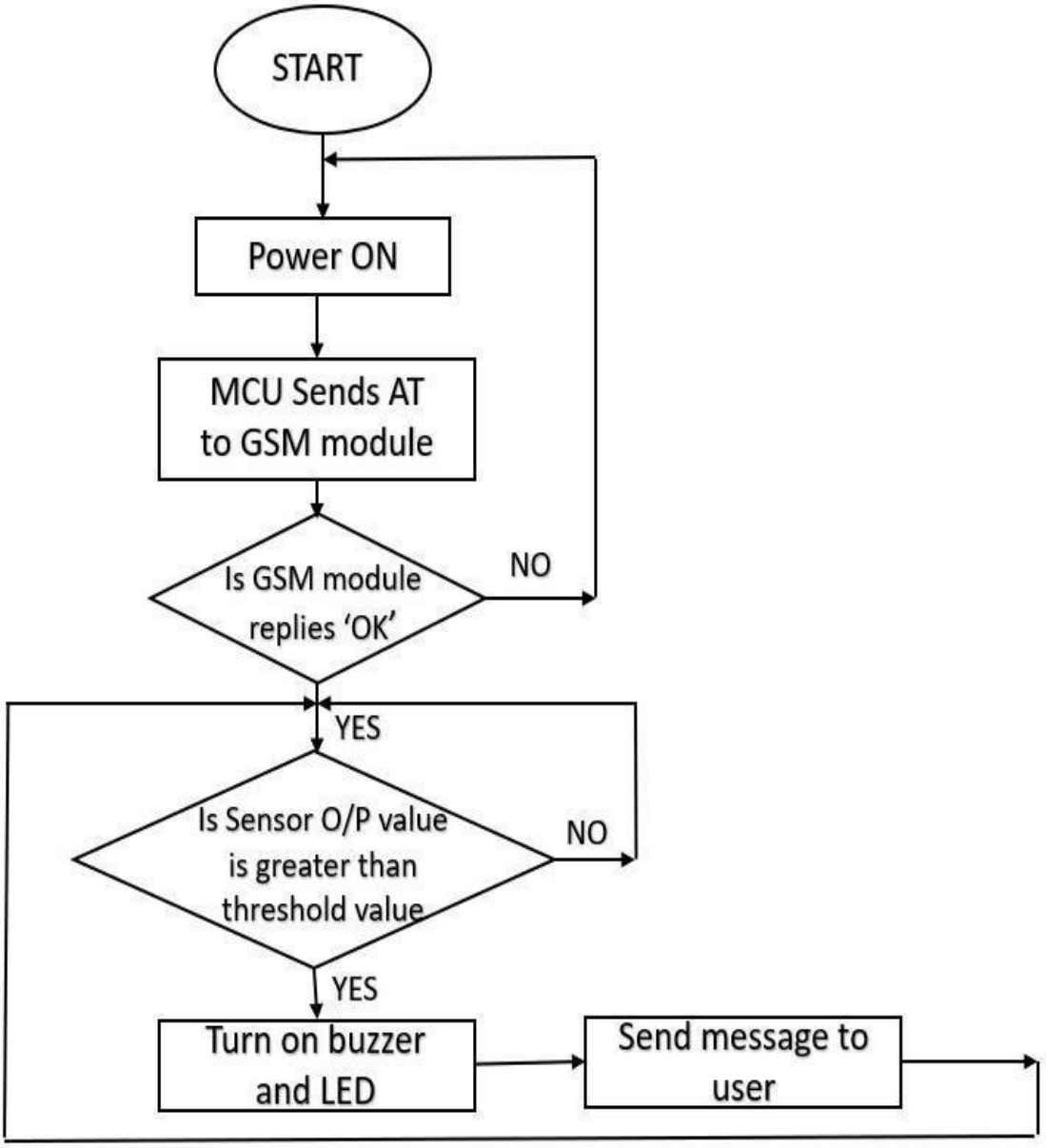
An example of a received SMS is as follows: +CMGL: 5, “REC UNREAD”, “+60123030224”,””,”2016/06/09 11:27:35+32” @HOST SCFG H+60162324045 I5 T3

The first line consists of information on location index of the SMS in the message storage area, status of the SMS message ("received unread", "received read", etcetera), originator phone number, and timestamp at which the SMS message arrived at the SMSC. The second line is the body of SMS that might contain request instruction or configuration parameter from the host. Hence, the SMS body is designed to contain markers or keywords that could be identified by the microcontroller. The keyword „@HOST“ is used to identify that the SMS is a host SMS and „SCFG“ is a marker for configuration SMS. Subsequently, the microcontroller will be able extract the information from the SMS and execute the next function respectively.



Working principle

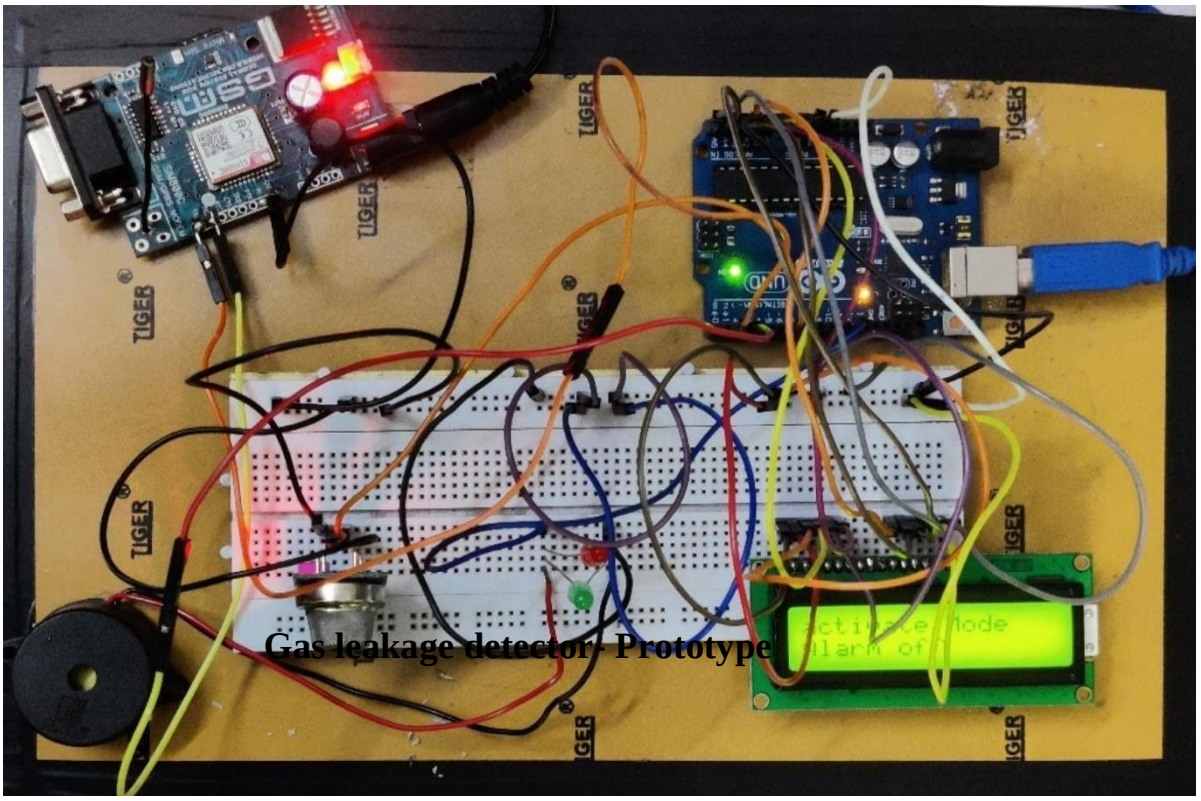
FLOW DIAGRAM



RESULT AND DISCUSSION

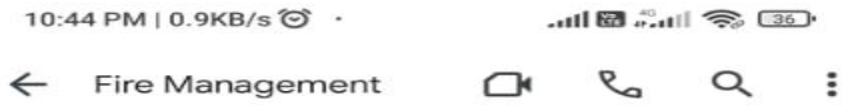
The output of the proposed system is as follows:

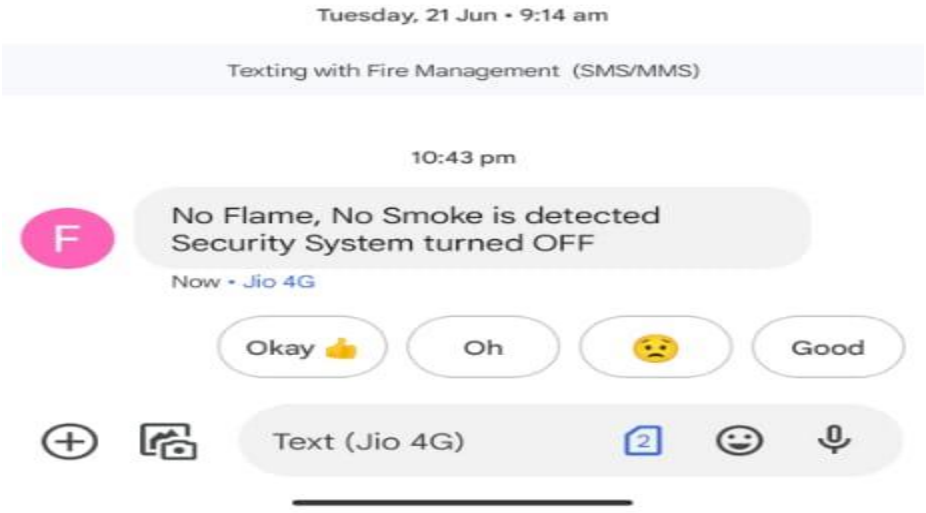
The Flame Detection system is designed by using following components such as Gas sensor, Temperature sensor, Arduino UNO, LCD display, Buzzer, GSM (Global System for Mobile Communication) which are connected in the breadboard.



Gas leakage detector- Prototype

The above figure shows the prototype of Flame Management System. In which the lcd display module is connected and it will display the status of the system, whether the security system is on or off. GSM (global system for mobile communication) module is connected and helps to communicate with the user through the mobile communication.





Message sent to user

The above figure shows the system status message which is sent to user. Initially the system sends the status to the user with a help of GSM module, which can communicate with user mobile through mobile communication. It sends message to a user mobile as “No Flame, No Smoke is detected. Security system turned OFF”.

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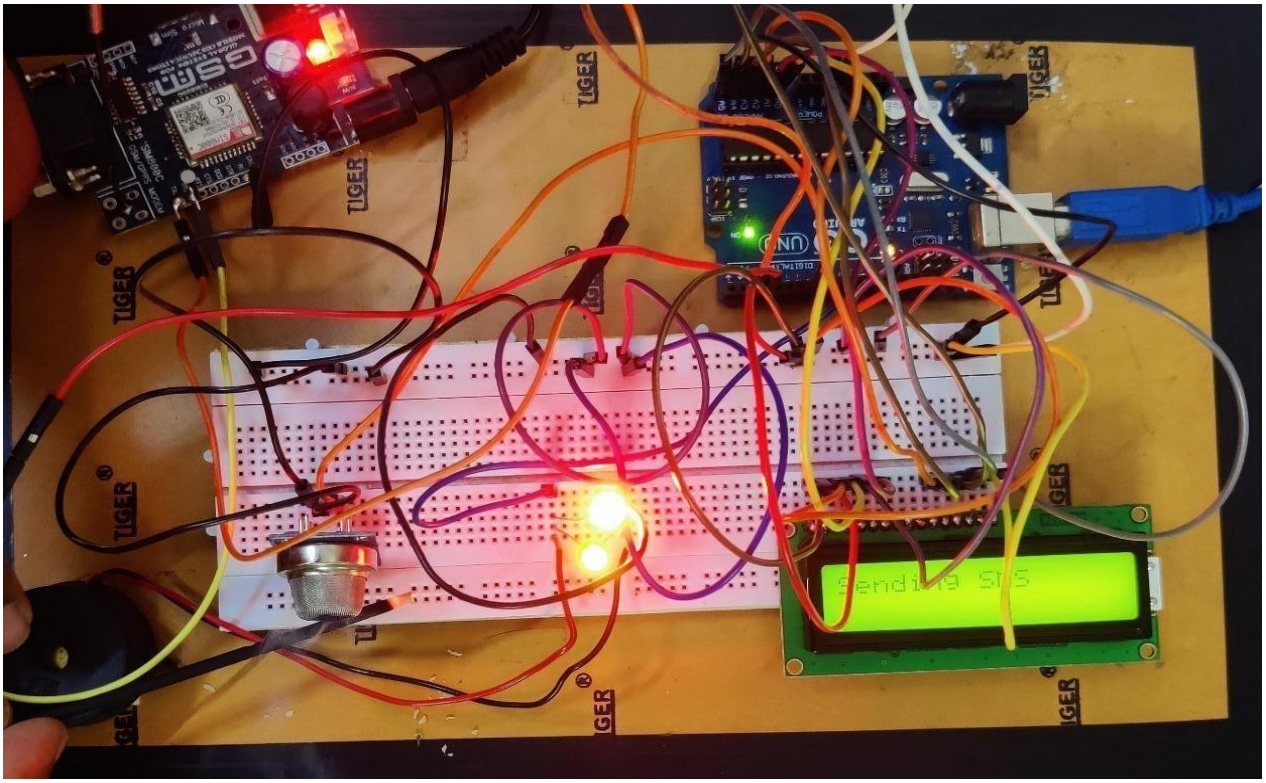
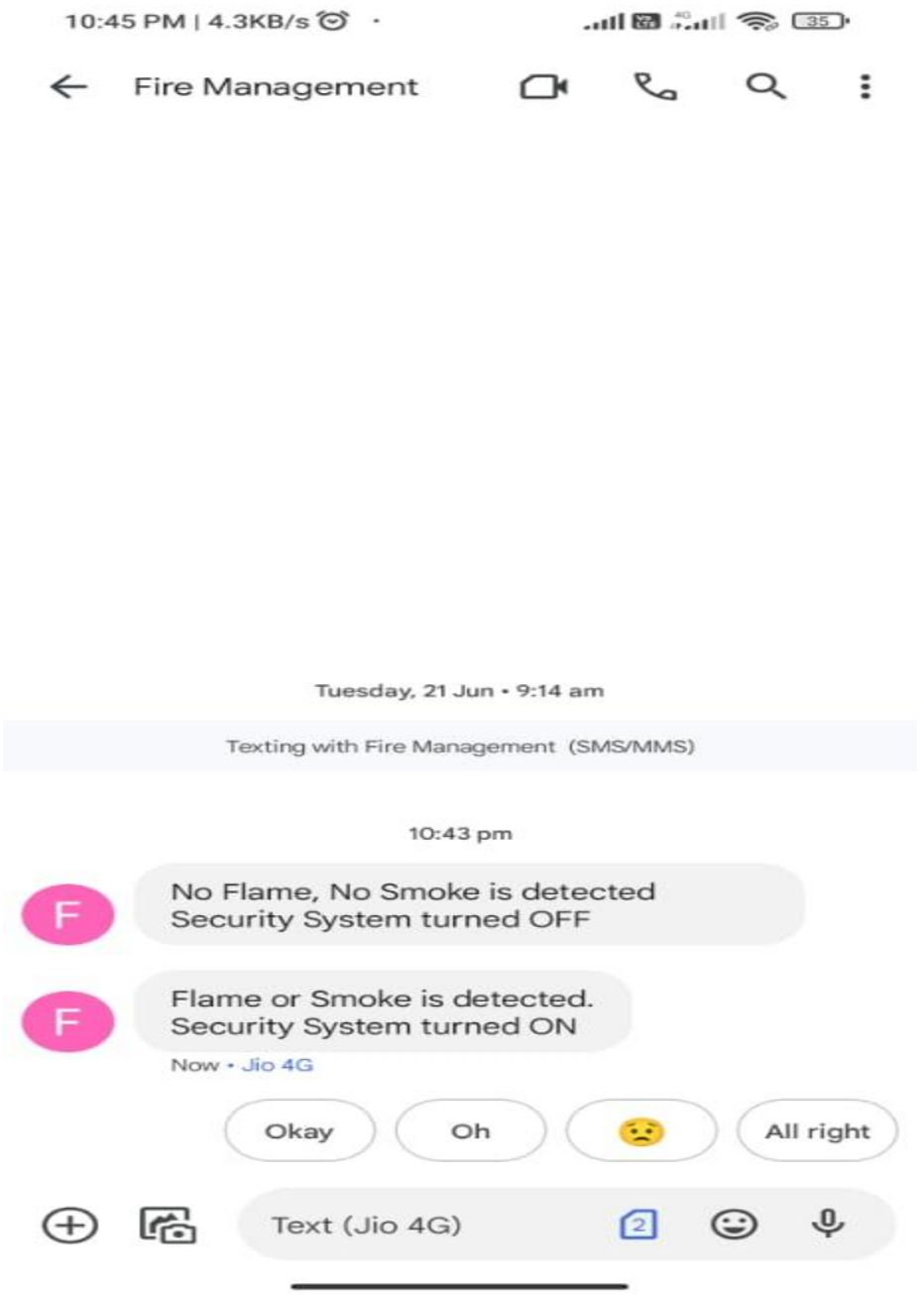


Alert alarm using Buzzer

The above figure shows the detection of smoke by a gas sensor. The smoke is detected by a gas sensor connected and it will send an input data to microcontroller and it will process and gives an alarm by using buzzer sound. LED begins to glow. And the sending status in displayed in LCD displayconnected.



Alert message sent to user

The above figure shows the alert message sent to user. The alert message, “Flame or Smoke is detected . Security system turned ON” is sent to user mobile number using GSM module which can communicate with mobile tower.

CONCLUSION

The proposed system demonstrates the Industry-specific intelligent fire management system. Here the presence of smoke is detected by using a gas sensor and the presence of the fire or flame is detected by Temperature sensor. Due to some technical errors there may be fire in the industry . This may lead to big explosion in the industry which destroys everything in the industry. In this kind of the smoke leakage is detected by gas sensor and led starts to glow and alarm starts to make sound by using buzzer. And warning message is sent to user using GSM module which may transmits the message signal to the nearby mobile towers and then it will receive by a mobile phone.