Toxic Gas Detection using Low Power Controller with Alert System
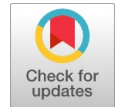
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Abstract: *The main idea of gas leakage detection is to implement the security system for detection of gas leakage in closed environment. In present scenario, there are many criteria which are related to gas leakage which affects an innocent people lives and property damage. Implementation of this alert system can be useful for companies, houses, which can save lives of people. In this work, SIM900 (GSM module) is used to perform the chosen task by interfacing Gas sensor (MQ5), Buzzer, Arduino UNO, Stepper Motor(5V) and LCD to display. Initially when there is a leak, the Gas sensor detects it using MQ5 and sound alarm is produced automatically and the leakage of gas is controlled. Also, an SMS based system is setup using GSM Module which sends 3 alerts (messages) to the specified mobile number. Not only detection of gas leakage but also stopping the leakage is equally essential to detection. This project provides an effective in cost and highly accuracy, which not only detect gas leakage but also alerting the people (sound alarm) and turn off main power and gas supplies, and send an SMS. In despite to provide high accuracy, gas sensor MQ-5 has been used and this can be used in application of chemical and hazardous industries where there is a consecutive monitoring of gas leaks. By using different types of gas sensors for various gas, used to identify leaks for every kind of gases. Thus, on designing this project our ultimate aim is to automatically detect and stop leakage in vulnerable premises.*

Index Terms: *Arduino Uno, Gas Sensor, MQ5*

I. INTRODUCTION

The major problem in residential areas, industrial sector and CNG (compressed natural gas) gas-powered vehicles like buses, cars is Gas Leakage. One of the finest and preventive techniques to prevent the accident triggered by gas leakage by installing the detection kit for gas leakage at vulnerable locations.

LPG comprises of a extremely flammable chemical called butane and propane. It is odorless gas that adds ethanol as a strong odorant, making it easy to detect leakage. The odorant used are EN589, amyl mercaptane and tetrahydrothiophene which are most commonly.

Nowadays, Liquefied Petroleum Gas (LPG) is one of the alternate fuels and it is also called as LP gas, Auto gas etc. The common applications of LPG are cooking, heating appliances and also for various purposes. And It is also used as an alternative vehicle fuel owing to higher oil and diesel prices.

Some individuals may or may not react to low gas leakage concentration owing to low smell sensation. In such a situation, safety systems for gas leakage become vital and help safeguard against accidents involving gas leakage.

Gas detection is not only essential, but it is equally essential to stop the gas leakage. This concept offers a cost-effective and highly efficient system that not only detects gas leakage but also alerts (alarms) and turns off the primary supply of energy and gas and sends an SMS. By sending an SMS to the respective mobile number, the GSM module is used to warn the user. To provide the high accuracy, gas sensor such as MQ-5 has been used.

A. Objective

Detect Gas Leakage using MQ5 Sensor (gas sensor).The SMS based alert system is setup by using GSM Module which sends 3 alert messages to two specified numbers. Once the gas leakage is detected, a sound alarm is produced and automatically the gas leak is controlled (gas leak is under normal range). In case of fire explosion, the fire extinguisher starts which is connected in interface with the stepper motor. The user can remotely determine the status of the system by sending codes to prompt the device via SMS.

B. Overview

An electronic design that is used to detect the leakage of gas in a closed environment. Gas sensor detects the leakage of the gas. GSM Module send the alert SMS to the specified numbers. The buzzer is also activated when the gas leakage is detected (the alarm is triggered when gas leaks out) and the fire extinguisher is started as it is connected with a stepper motor.

II. LITERATURE SURVEY

In the past, there have been more reviews on the identification of gas leakage either as part of research papers / technical reports on some leak detection method and other gas-related subjects. The author [1] launched an automatic gas detection and indication robot based on android and this suggested technique portrays a mini mobile robot capable of detecting gas leakage in dangerous.

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Whenever gas leakage occurs in a specific location, the robot instantly reads and sends the information via wireless communication such as Bluetooth to android phone. We create an android smartphone application that can obtain information straight from the robot via Bluetooth. The application warns with an indication whenever gas leakage occurs and also uses text commands as well as speech commands to regulate robot motions via Bluetooth. Previous mobile robots are based on heterogeneous techniques such as GSM, GPS, internet-based, etc., but the primary drawback of these prototypes was the lack of communication in specific fields. So we have lots of techniques to eradicate previous problems with the rapid developments and tremendous technological changes. Wireless communication protocols play a critical role in present trends. We use one of the finest smartphone features, Bluetooth, Wi-Fi, Zigbee etc., i.e. Bluetooth technology to control and driven parameters for tracking the robots. In the existing method, there are different gas sensing technology is used. Semiconductor sensor is used to detect the LPG gas leakage. Nowadays, accidents due to LPG is very common due to the leakage of LPG. This LPG leakage begins because the primary regulator valve is not closed. This is the foundation for accidents of this kind. There are already some kinds of corrective measures, such as when the leakage is detected; message is sent to the fire station and the owner and this technique has the disadvantage that it requires manual control, which puts people in immediate danger when no control action is taken. The other remedial measure is that when the leakage is detected, the exhaust fan is switched ON and it has the disadvantage that improper cabling of the exhaust fan causes immediate explosion due to AC flow. There is only detection of no control action in all of these methods mentioned above.

III. DESCRIPTION OF HARDWARE AND SOFTWARE

A. Hardware Description

- SIM900A GSM Module
- Light Emitting diodes
- Alert buzzers
- Stepper motor +5v
- Arduino UNO
- MQ5 Gas Sensor

B. Software Description

Arduino Uno

C. IM900A GSM Module

SIM900A GSM Module is the module which supports 900MHz band for communication purposes. In India, network providers operate in the band of 900Mhz.

In this work, GSM module requires an input of 12 volts. The feeding done by using a 12V,1A DC power supply and it is shown in Figure 1.
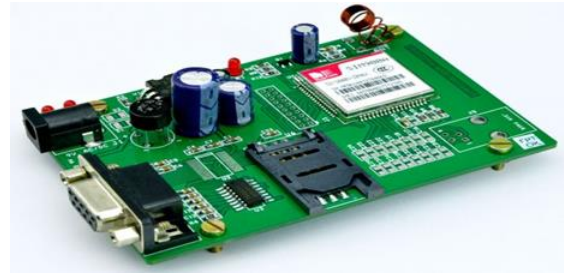

Figure 1. SIM 900A GSM Module

D. LIGHT EMITTIG DIODE

A light-emitting diode (LED) is a two-lead semiconductor optical source and p – n junction semiconductor diode that emits light when enabled. After cut in voltage, electrons can recombine with the holes and release energy in the form of photons.

Figure 2. LED

E. Alert buzzers

Audio signaling device such as Alert buzzer or beeper which may be mechanical, electromechanical or piezoelectric (piece for short).

The uses of buzzers and beepers which includes timers, alarm devices mouse click and keystroke.

Figure 3. Alert Buzzer

F. Stepper Motor

Also known as a step motor, a stepper motor is an electromechanical device that converts electrical power into mechanical power. It is also a brushless electric motor that equally divides a full rotation into many steps. The motor's position can be controlled without any position sensor for feedback mechanism. The functions of Stepper motors are similar to the switched reluctance motors which is a closed loop commutated. When an electric pulse is applied, it uses the operation theory for magnets to make the motor shaft turn a specific distance. The stator has eight poles, and the rotor has six poles and rotor requires 24 electric pulses to move the 24 steps to complete one revolution.

1075

Figure 4. Stepper Motor

G. Arduino UNO

ATmega328 Arduino Uno is a microcontroller board is used in this work and it has a total of 14 digital input / output pins. Six pins can be used as PWM inputs among 14 pins. The architecture then comprises of six analog inputs, a 16 MHz crystal oscillator, a USB connection, an ICSP header, a power jack and a reset key. It merely connects it to a desktop / laptop to get started using a USB cable or power provided with an AC-to-DC adapter or battery. It varies from other boards as FTDI USB-to-serial driver chip is not required. It is programmed as a converter from USB to serial. The program loaded in the Arduino performs the defined operations when the 5Vof power is supplied. The Arduino serves as the control unit as it defines the work of GPS and GSM modules whenever they are turned-on by-passing instructions to them through the program embedded on it.
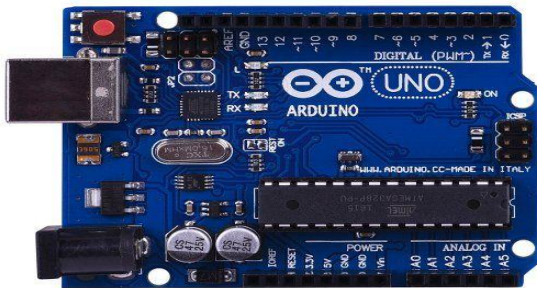

Figure 5. Arduino Uno

H. Arduino Software (IDE)

Arduino Software or Arduino Integrated Development Environment (IDE) contains of text editor for code writing, an option for text console , a toolbar for common functions and a series of menus. Sketches are used for code writing using Arduino Software (IDE) and these codes are written in the text editor and are saved the file extension in the form of .ino. It connects to the Arduino and Genuiuno hardware to upload programs and communicate with them. IDE software displays complete error messages and other information are in text console. The configured board and serial port are displayed in bottom righthand corner of the window. The coding language that Arduino uses is very much like C++/C.
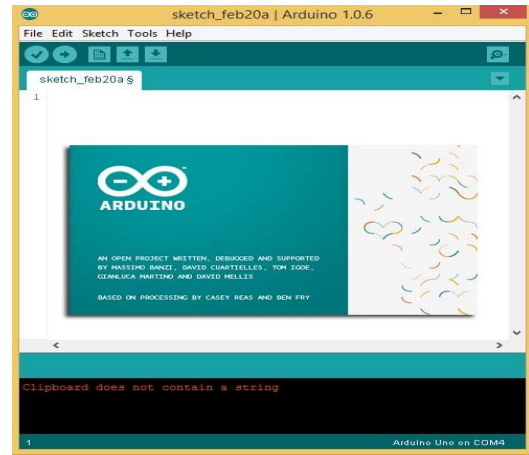

Figure 6. Arduino IDE

I. Grove - Gas Sensor (MQ5)

The Grove - Gas Sensor (MQ5) module is useful for detection of gas leakage in home and industry applications and it is suitable for detecting gases such as LPG, CO, H2, CH4 and Alcohol. Measurements are made as quickly due to high sensitivity and fast response time of gas sensor. The potentiometer used for adjusting the sensitivity of the sensor. When a gas collaborates with gas sensor, it first ionized into its constituents and then it is adsorbed by the sensing element. This process creates a potential difference on the sensing element and then conveyed to the processor unit through output pins in form of electric signal. The module of gas sensor consists of a steel exoskeleton which abide under sensing element. This sensing element is exposed to current through connecting leads.

This exposing current is termed as heating current. Gases ionized when it coming near to the sensing element and get absorbed by the sensing element. This absorption changes the sensing element resistance which vary the current value going out of it.
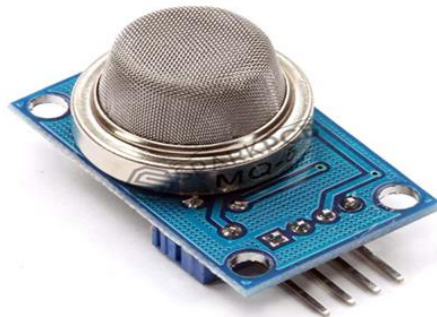

Figure 7. Gas Sensor

IV. GST MANAGEMENT SYSTEM

A. Modules

The work modules is sub-divided into two different modules. They are,

- Alert Module
- Notification Module

Toxic Gas Detection using Low Power Controller with Alert System

1) Alert Module: The LED and buzzer is to indicate the gas leakage. Under normal conditions, the current flow through the LED is low. And hence, the buzzer is not activated. When the LPG gas leakage is detected, the current flow through the emitter is high. And hence the buzzer is activated. And once if the alert is detected the stepper motor is turned ON ,that turns off the gas supply and the extinguisher is triggered.

2) Notification Module: The control system output is taken and it is fed into the GSM where, the information is sent to the mobile phones through SMS, informing them about the status. In case the gas leakage is enormously sensed, the danger is notified to the owner as a message via GSM and the necessary action is taken. The GSM working system in this work is very simple. The major benefit is its international roaming capability, enabling users to access the services when travelling abroad as at home. Service access of GSM satellite has also extended to areas where terrestrial coverage is not available.
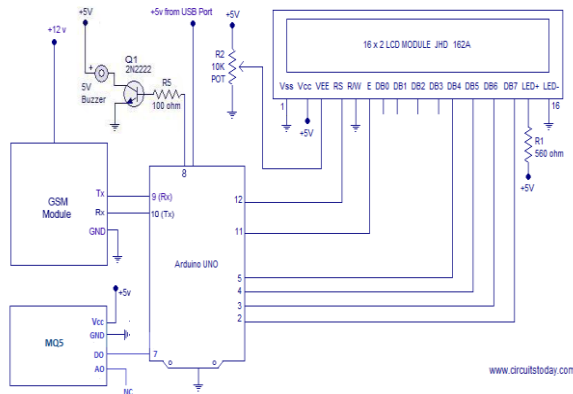

Figure 8. Block Diagram

B. Working Principle:

The block diagram is shown in Fig 8.

1) Interfacing GSM with Arduino:

A GSM Module is basically a GSM Modem (like SIM 900) connected to a bread board TTL Output to interface directly with a PC (personal computer).The project uses SIM900 GSM Module and this supports communication in band of 900MHz. Out of 6 pins, two PWM pins are enabled for this method. So choose pins 9 and 10 (which are PWM enabled pins). This method is made possible with software serial library of Arduino.

Arduino Serial software that allows serial data communication via digital pins. Arduino library replicates the features of the hardware and handles the serial communication assignment. Now attach the GSM module's TX pin to Arduino's pin9 and GSM's RX pin to Arduino's pin 10. Connect soil to soil. Use a distinct adapter to power the GSM module.

2) Interfacing MQ5 with Arduino:

Interfacing steps are follows and shown in Figure 9.

Take a digital pin D0 of MQ5 module to any digital pin of Arduino.

Connect D0 to pin 7 of Arduino

Give the power supply (Vcc) and complete the circuit by connecting to ground (Gnd).

Connect a +5V pin from Arduino to Vcc of MQ5 module
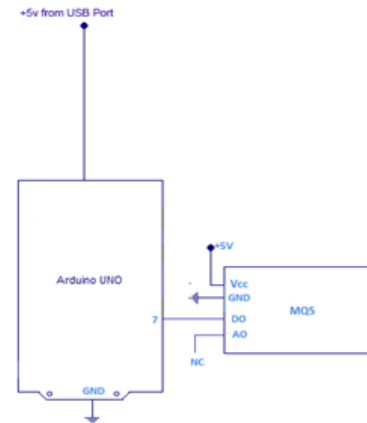Connect the GND pin of MQ5 module to Arduino GND pin

Figure 9. Interfacing MQ5 with Arduino

3) Interfacing LCD with Arduino: The steps for interfacing are given as follows:

6X2 LCD Module is used

Datalines (DB4,DB5,DB6,DB7)are connected to (5,4,3,2 pins) in order to ARDUINO

Connect RS and E to (11,12 pins)of ARDUINO

Vcc is connected to +5v

Vee is connected to 10K Pot resistor

And 16th pin of LCD is grounded

4) Interfacimg LED and Buzzer with Arduino: The steps for interfacing are given as follows and shown in Figure 10

The long leg (+) of the buzzer is connected to the Pin 9 of the Arduino.

And the short leg (-) of the buzzer is connected to the ground pin of the Arduino

The LED's short leg (-) is connected to the ground pin of the Arduino and the long leg (+) is connected to the Pin 13 in the Arduino

The program is uploaded in the Arduino using Arduino IDE This interfaced circuit produces buzzer sound and LED blink when the branching conditions in the program fails
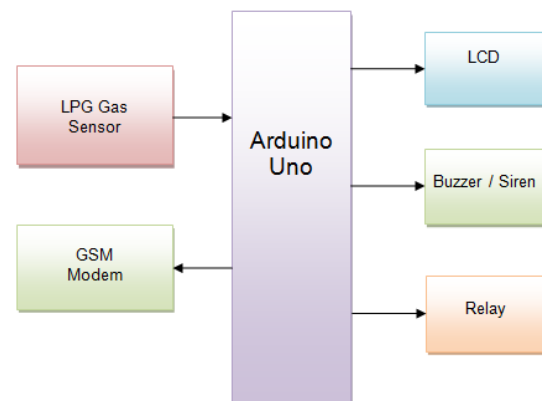

Figure 10. Block Diagram for Interfacing
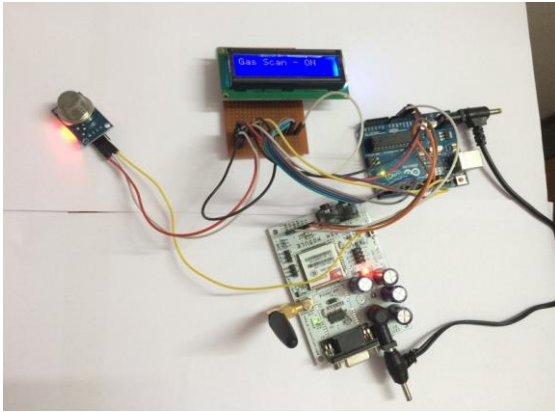
1077

V.   SIMULATION RESULTS

Figure 11. Output obtained when gas leak is detected

The result of the gas sensor is shown in Figure 11. Once the gas sensor detected the leakage of gas, it sends a signal to the Arduino board. The output is shown in LED through interface. GSM Module is used to sends an alert message to the customer. People those who difficult to recognize the gas smell can able to identity the leakage.

This module used to avoid the accident due to gas leakage. This method is cost effective and MQ5 Gas sensor quickly response the leakage when compared to other leakage.

VI.   CONCLUSION

Safety is the best measure to prevent accidents. There are many accidents occurred due to leakage of gases around the world. To overcome these incidents we got an amazing technique used in Nigeria. It records and senses supply hose and the gas burner. This has prevented gas accidents in that country.
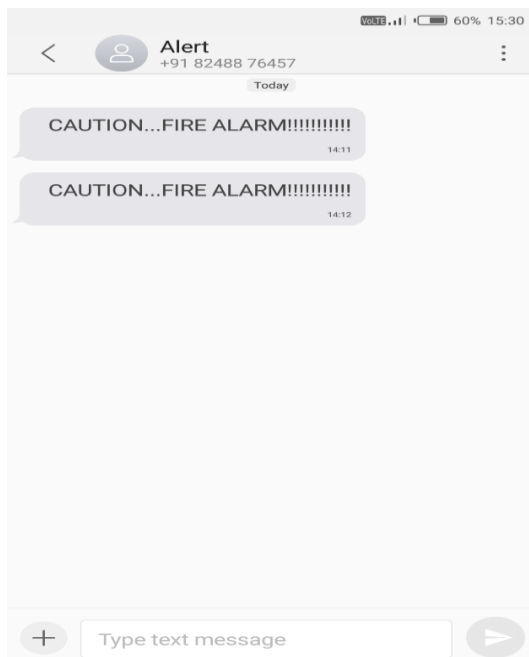

Figure 12. Alert message received after gas leakage

This device offers number of benefits in safety that are essential for early gas leakage detection. Finally, our idea is going to be massive source to detect gas leakage in homes. As it is a low-cost system, this can be implemented everywhere

to detect gas leakage. This system uses simple components like Arduino, stepper motor, sensor (MQ5)and GSM module.

This design is used for home gas leakage detection. We all are aware of the major industrial gas leakage accident which is the Bhopal gas tragedy. This accident took away the lives of many people. This design can be modified for industrial gas detection. For industrial level MQ6 sensor or other gas sensitive sensor which has high accuracy to gases. At present SNIFFER and TRUESAFE are the widely used gas leakage detection. They are used to detect only CH4 gas. Our idea can be used to detect LPG gas which is the mixture of butane and propane. Detection of LPG is more important because it is an alternate fuel used presently. Detection of LPG gas can prevent home accidents.

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