LPG Gas Leakage Detector System

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Abstract— **Since burglaries are increasing daily as a result of the unsafe and unreliable security frameworks in residences, commercial buildings, and enterprises, security may be a significant concern everywhere. We demonstrated a device that can detect the leakage of gas (such as LPG, isobutene, propane, etc.) and alert the customer to the need for action. An alarm that vibrates and sounds like a buzzer is used as a warning device. Buzzer provides an audible indication of the proximity to LPG volume. The LCD and buzzer are turned on by the Arduino UNO. By continuously monitoring residences with various tactile frameworks like vibration, smoke, gas, temperature, door break finders, and fire alarm frameworks, GSM communication frameworks provide security against common, coincidental, expected, unforeseen, accidental, and human-made concerns. The GSM modem continues to deliver SMS messages to mobile numbers that are specifically mentioned in the source code programme to warn people of danger.**

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I. INTRODUCTION

These days, gas leakage is observed in many locations, including residences, workplaces, and vehicles like Compressed Natural Gas (CNG), buses, autos, etc. [1-5]. It is noted that risky accidents might occur as a result of gas spills [6]. In many applications, including residences, hotels, companies, cars, and vehicles, liquefied petroleum gas (LPG), also known as propane, is used as fuel due to its attractive qualities, which include a high calorific value, little smoke, little silt, and significant environmental harm [7-9]. After it was discovered that destructive gases had negative effects on human health, placement techniques for gas spills became a worry. Early finding tactics relied on less precise finders until very recently when modern electronic sensors were developed [10].

The number of people dying as a result of gas barrel explosions has been rising for a while now. The Bhopal gas disaster, Mangaluru in Karnataka, Kanpur in Uttar Pradesh, and Valsad in Gujarat are a few of the well-known incidents of gas spillage accidents [11–13].

There have been several audits conducted in the past on the topic of gas spillage location techniques, either as part of research papers or technical studies on specific spill finding strategies and other gas-related topics [14]. An android-based programmable robot for gas finding and signs is shown. The suggested model shows a more adaptable, smaller-than-expected robot capable of detecting gas leaks in hazardous locations [15]. It is said that there are several approaches to identify gas spillages according to the review on gas spill finding and localization processes. They offer a few traditional or contemporary methods to identify the gas.

The processes that are suggested in this work are non-technical, equipment-based tactics that include acoustic, optical, and dynamic strategies [16]. Within the scope of the gas pipeline, spillage point investigation and spillage location investigation have become urgent concerns [17].

One of the most crucial issues nowadays is the extension of the ARM7-based mechanised tall execution framework for LPG refill booking and spillage location and method. It is built on a secretive method that is simple to deconstruct, including an LPG barrel booking unit, a unit for monitoring gas spills at the buyer's end, and a unit for a server framework at the wholesaler's end [18–21]. It has been suggested that using an integrated circuit with MQ-9 might be dangerous for gas detection [22].

To circumvent the problem, Metta Santiputri et al.23 designed a device dubbed the Gas Spill Discovery device based on IoT. (Web of Things). It will continuously monitor the presence of combustible gas in the vicinity, the presence of people, and the proximity of a fire within the building. Another idea for an LPG gas spillage finder based on a microcontroller and a GSM module made use of a gas sensor, GSM module, and microcontroller. The sensors that can detect gas spillage and then communicate with the microcontroller to send signals identify the presence of gas concentration [24].

II. MODELLING OF THE PROJECT

A. Components

- Arduino NANO
- MQ gas Sensor
- GSM Module
- Power Supply
- Wire
- Vero Board
- Buzzer
- Sim card (Other than JIO)

B. Description of the components

Arduino NANO

A coordinated improvement environment built on planning is Arduino. Particularly the implanted framework,

physical computing, mechanical technology, computerization, and other hardware-based tasks have been made incredibly simple by it. Each Arduino has about the same functionality and features, with the exception of pin count and measurement. A small chip board based on the AT mega 328p may be the Arduino Nano.

TABLE I.   PIN DESCRIPTION

No	Pin Number	Pin Description
1	D0 – D13	Digital Input / Output Pins.
2	A0 -A7	Analog Input / Output Pins.
3	Pin # 3,5,6,9,11	Pulse Width Modulation (PWM) Pins
4	Pin # 0 (RX), Pin # 1(TX)	Serial Communication Pins
5	Pin # 10,11,12,13	SPI Communication Pins
6	Pin # A4, A5	12C Communication Pins
7	Pin # 13	Built-In LED for Testing
8	D2 @ D3	External Interrupt Pins

The ATmega328p (Arduino Nano V3.x) / Atmega168-based Arduino Nano is a compact, versatile, and breadboard-friendly microcontroller board created by Arduino.cc in Italy (Arduino Nano V3.x).

Although fairly compact in size, it has precisely the same capability as the Arduino UNO.

It has a 5V operating voltage out of the box, but its input voltage ranges from 7 to 12V.

Each of the 14 digital pins, 8 analogue pins, 2 reset pins, and 6 power pins on the Arduino Nano have many roles, but their primary use is to be setup as an input or output.

When they are connected to sensors, they function as input pins; however, if you are driving a load, you should utilize them as output pins. While analog Read is used to manage the operations of analogue pins, functions like pin Mode and digital Write are used to control the operations of digital pins. The analogue pins measure values between 0 and 5V with a total resolution of 10 bits. A crystal oscillator with a 16 MHz frequency is included with the Arduino Nano. It is used to generate an accurate clock with a steady voltage. One drawback of utilizing an Arduino Nano is that it lacks a DC power connection, which prevents you from using a battery as an external power source.

Instead of using regular USB to connect to a computer, this board has support for Mini USB. This device is a superb option for the majority of applications where the sizes of the electrical components are a major consideration due to its small size and breadboard-friendliness.

Depending on the At mega board, flash memory can be 16KB or 32KB. For example, the Atmega168 has a 16KB flash memory whereas the Atmega328 has a 32KB flash memory. To store code, utilise flash memory. Out of the entire flash memory, a bootloader uses 2KB of memory.

Figure 1: Arduino NANO

For the Atmega168 and Atmega328, the SRAM can range from 512 bytes to 2KB, while the EEPROM can be either 512 or 1KB. Although this board is relatively comparable to other Arduino boards on the market, its compact size sets it apart from the competition. The specs for the Arduino Nano Board are shown in the following figure. It is programmed with the Arduino IDE, an offline and online integrated development environment. To operate the board, no special preparations are necessary. Board, a tiny USB cable, and Arduino IDE software already installed on a computer are all you need. The programme is sent from the computer to the board via a USB connection. No separate burner is required to compile and burn the program as this board comes with a built-in boot-loader.

TABLE II.   PIN DESCRIPTION

Microcontroller	Atmega328p/Atmega 168
Operating Voltage	5V
Input Voltage	7 – 12V
Digital I/O Pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40mA
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512bytes or 1KB
USART	yes

Following figure shows the pinout of Arduino Nano Board.
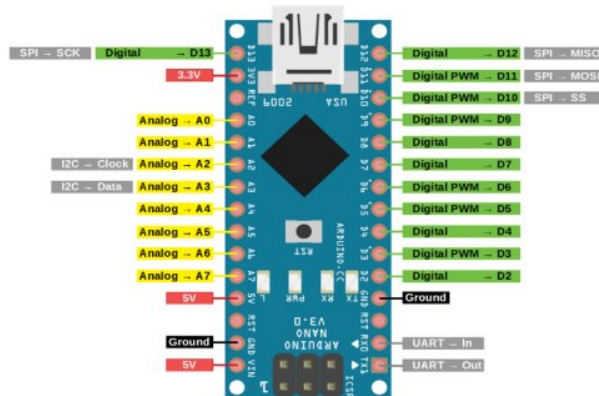

Figure 2: Arduino NANO Pin Description

Every pin on the Nano board has a specific job associated with it. Are you ready to view the analogue pins that may be used

as an analogue to digital converter? You can also use the A4 and A5 pins for I2C communication. There are really 14 computer pins total, of which 6 are used to generate PWM.

PIN Description

V_{in}: It is input power supply voltage to the board when using an external power of 7 to 12 V.
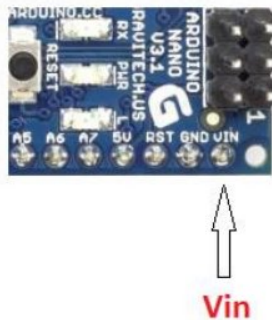
Figure 3: Vin pin.

5V: it is a regulated power supply voltage of the board that is used to power the controller and other components placed on the board.

Figure 4: 5V pin.

3.3V: This is a minimum voltage generated by the voltage regulator on the board.

Figure 5: 3V3 pin..

GND: Multiple ground pins are on the board that can be interfaced accordingly when more than one ground pin is required.

Figure 6. Ground Pin

Reset: Every pin on the Nano board has a specific job associated with it. Are you ready to view the analogue pins that may be used as an analogue to digital converter? You can also use the A4 and A5 pins for I2C communication. There are really 14 computer pins total, of which 6 are used to generate PWM.
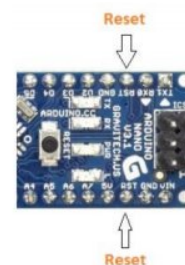
Figure 7: Reset

Analog Pins: There are 8 analog pins on the board marked as A0 – A7. These pins are used to measure the analog voltage ranging between 0 to 5V.

Figure 8: Analog pins

R_x, T_x: These pins are used for serial communication where T_x represents the transmission of data while R_x represents

the data receiver.

Figure 9: Rx and Tx pin.

13: This pin is used to turn on the built-in LED.

AREF: This pin is used as a reference voltage for the input voltage.

PWM: Six pins 3, 5, 6, 9, 10, 11 can be used for providing 8-pit PWM (Pulse Width Modulation) output. It is a method used for getting analog results with digital sources.

SPI uses four pins: 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK) (Serial Peripheral Interface). Data is typically sent between microcontrollers and other peripherals like sensors, registers, and SD cards via the interface bus known as SPI.

External Interrupts: Pins 2 and 3 are used as external impediments, which are used in times of emergency when we need to pause the majority of our programmes and ask for urgent education at that time. Once a hinder instruction is called and carried out, most programmes restart.

I2C: I2C communication is made possible by the A4 and A5 pins, where A4 communicates with the serial information line (SDA), which carries the information, and A5 communicates with the serial clock line (SCL), which could be a clock flag created by the master device and used to synchronise the information between the devices on an I2C transport.
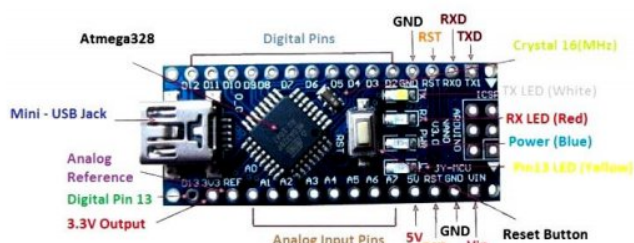
Figure 10: Arduino NANO.

Communication and Programming

A communication channel may be established between the Nano device and other controllers and computers. The more sophisticated pins, such as stick (Rx) and stick 1 (Tx), are used for serial communication, with Rx being used for information reception and Tx being used for information transfer. The Arduino computer application has a serial screen that may be used to send or receive printed data to or from the board. Additionally included in the application are FTDI drivers, which serve as a virtual com port for the computer programme. As data is sent between an FTDI and USB connection to the computer, the Tx and Rx pins have a Driven that flickers.

For carrying out a serial communication between the board and the computer, the Arduino Program Serial Library is used. The Nano sheets provide I2C and SPI communication apart from serial communication. The Arduino program's Wire Library is accessed in order to use the I2C transport. The Arduino computer application called IDE, which is frequently used for almost all types of boards available, modifies the Arduino Nano. Download the computer application, then choose the board you want to use.

There are two ways to programme the controller: either using the bootloader built within the computer software, which frees you from needing an external burner to build and burn the programme into the controller, or via ICSP (In-circuit serial programming header). Although the Arduino board software is compatible with Linux, Mac, and Windows, Windows is the most common.

GSM Module

This GSM modem functions just like a mobile phone with its own unique number and can take any GSM network operator SIM card. The RS232 connector, which may be used for communication and the creation of embedded programmes, is a benefit of utilising this modem. It is simple to create applications for SMS control, data transmission, remote control, and logging.

The modem may be connected to any microcontroller or especially to the serial port on a PC. It may be used to place and receive voice calls as well as send and receive SMS. Additionally, it may be used in GPRS mode to connect to the web and perform a variety of data recording and control applications. Additionally, you can connect to any unreachable FTP server in GPRS mode and transfer files for information logging.
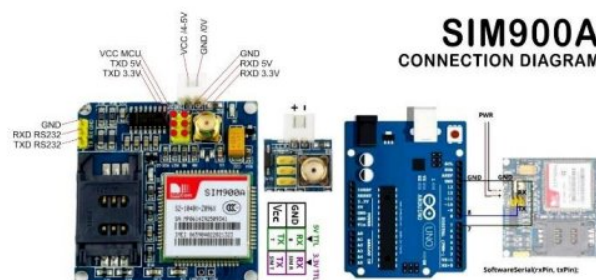
Figure 11: GSM Module.

MQ Gas Sensor

These days, almost every family uses LPG for cooking. LPG is widely used in industrial and commercial setups in addition to being used for domestic applications. Utilizing LPG Gas is unquestionably very beneficial, but if the correct precautions aren't taken, it can cause severe accidents, damage to property, and even perhaps loss of life.

We may avoid the harm caused by any real situation by using one essential and simple device. LPG Gas Sensors are tools that can foresee any unnecessary injury or an accident. These days, the industry offers a wide variety of LPG Gas Sensors. Depending on the type of hardware it has to be installed on, you may choose the one that best meets your needs. It is crucial to take into account the gas detector's height as well as its width.

Figure 12: Nair, N. (n.d.). MQ-5 LPG GAS SENSOR. ElementzOnline. Retrieved June 9, 2022, from https://www.elementzonline.com/mq-5-lpg-gas-sensor-289.

When purchasing an LPG gas sensor, it's important to keep in mind that it should be extremely sensitive to the operator doing the noticing within the LPG barrels. As a result, it would be able to recognise the fragrance immediately and permit a flag. The gas sensors should be designed such that they can withstand the aroma of alcohol, smoke, or other fragrant materials. This sensitivity to LPG is crucial in order to prepare for false alarms when it detects the scent of anything other than LPG.

The discovery range of an LPG gas sensor is another significant feature. The LPG gas sensor should be sensitive enough to detect the faintest gas aroma. In addition to that, the LPG gas sensor's response time should be taken into account. A sensor with a quick reaction time can identify an LPG spill right away. In this manner, sensors with a slow reaction time appear to have the best results and immediately send out warning signals, therefore predicting any mishap. Usually an easy-to-use LPG Gas Sensor Module that can detect the presence of flammable gases such as LPG, isobutene, and propane in the vicinity. The sensor used by the module is the MQ-5.

It simplifies interaction to the sensor's odd stick division and provides interface through four 0.1" header pins. It provides a computerised yield that is easy to use as well as an analogue yield that is in accordance with the gas concentration under discussion. The highest gas concentration past which the computerised yield becomes triggered may be adjusted using the onboard potentiometer.

Fairly controlling the module with 5V, setting the edge, and hopefully yielding results! An onboard Driven alerts the crew to the presence of any gas. The improved yield easily interacts with other circuits, including microcontrollers. To enable a broad range of sensor trawling, the analogue output may be snared up to an ADC of a microcontroller.

5 Volt Power Supply

A three terminal positive voltage controller with a 5V settled potential is the 7805. The IC is very durable since it includes features like internal current restricting, warm shutdown, and secure functioning range guarantee. Given that there is an enough warm sink, yield streams of up to 1A can be extracted from the IC. The most voltage is reduced by a 9V transformer, which is then amended by a 1A centre tap, channelled by capacitor C1, and controlled by a 7805. The result is a steady 5Volt DC. The circuit diagram is provided below.
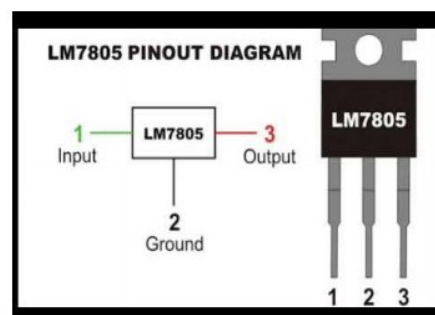
Figure 13: LM7805 Pinout diagram. (2020, December 22).LPG gas leakage detector. Retrieved June 9, 2022, from https://www.ecstuff4u.com/2019/09/lm7805-pinout.html.
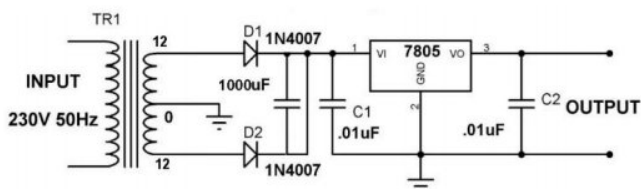
Figure14: Input and Output.
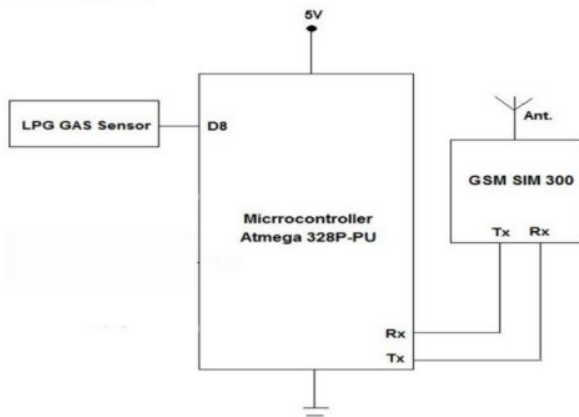
Block Diagram

Figure 15: Block Diagram.

Results and discussions

Each sensor circuit's output is sent to the corresponding mono-shot trigger circuit for comparison. The Arduino NANO's input stick receives the output from the trigger circuit, which prompts the GSM SIM 300 modem to send an SMS to the specified number. As a consequence, we will see that the buzzer will start to tune when any gas is detected in the surroundings. The sensor will communicate the yield to the microcontroller, which is then able to send the yield to the designated phone number by way of sms using the GSM module.

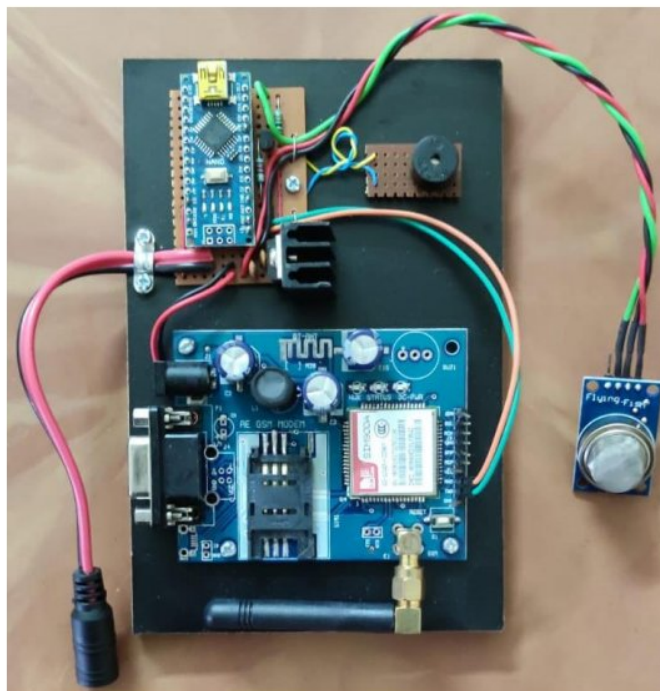The figure 16 shows the prototype of the proposed system.

Figure 16: Prototype of our own system

FUTURE SCOPE

A variety of circuits may be combined on a single Arduino pack, giving it a broad range of expansion. Since a GSM pack with a SIM card is used to facilitate communication, the operation's scope may expand in the near future. The inclusion of a sub framework where gas wastage may be detected using this framework is one of the outstanding future tasks for this framework. Usually, a preprogramed framework for gas discovery, control, and alarm. In the future, this framework will include a feature where it may alert the crisis administrations if an accident occurs recently.

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