ENSURING FIRE SAFETY DURING THE IMPLEMENTATION OF THE "SMART HOUSE" CONCEPT

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https://doi.org/10.5281/zenodo.6819386

Abstract. *This article discusses the use of gas detectors in order to ensure fire safety in the implementation of the "Smart Home" concept. In particular, general information about gas sensors, their characteristics, on which platforms they are used and principles of operation are considered, as well as the results obtained in laboratory conditions.*

Keywords: *smart house, Arduino Uno, gas detectors, MQ-2.*

ОБЕСПЕЧЕНИЕ ПОЖАРНОЙ БЕЗОПАСНОСТИ ПРИ РЕАЛИЗАЦИИ КОНЦЕПЦИИ «УМНЫЙ ДОМ»

Аннотация. *В данной статье рассматривается использование газоанализаторов с целью обеспечения пожарной безопасности при реализации концепции «Умный дом». В частности, рассмотрены общие сведения о газовых сенсорах, их характеристики, на каких платформах они используются и принципы работы, а также результаты, полученные в лабораторных условиях.*

Ключевые слова: *умный дом, Arduino Uno, детекторы газа, MQ-2.*

INTRODUCTION

The responsibility of installing and maintaining a reliable gas monitoring system in any facility is an important task and should not be taken lightly.

Buildings in the industrial, commercial and public sectors produce and consume a certain amount of toxic gases in the course of their operation. For example, HVAC-R systems used to maintain ambient temperature in buildings or cool cold storage rooms and circulate fresh air can cause refrigerant leaks. In addition, various gases can be found in high-capacity industrial cleaning equipment and as a by-product of manufacturing processes in manufacturing facilities.

A gas detector is a device that detects the presence of gases in an area, often part of a security system. The gas detector gives a signal to operators in the area of the leak, giving them the opportunity to exit. This type of device is important because it contains many gases that can be harmful to organic life such as humans or animals.

After enough time, despite your best efforts, all refrigeration systems will fail. The only way to deal effectively with leaks is to react quickly if they occur.

Gas detectors, such as the MGS-400 series of gas detectors, will continuously monitor the building atmosphere for the presence of the target gas and emit an alarm when a set threshold is exceeded. These monitors can form part of an integrated network built into your building management systems and are critical to meeting refrigerant safety requirements. The more

advanced the network of monitors and control systems in your building, the more confidence you will have regarding the health and safety of your staff.

MATERIALS AND METHODS

1.1. CONSIDERATIONS FOR SUCCESSFUL GAS DETECTION

The first step in preparing for a potential gas leak is to have a network of properly installed and well maintained gas detectors throughout the building. Following these simple guidelines will ensure that your facility's gas monitoring system will effectively detect the presence of the target gas.

Choosing the Right Number of Sensors

When choosing the number of sensors to install, care should always be taken to purchase as many units as required to provide maximum coverage.

Because gas monitors patrol a fixed location and not a general area, you need to ensure that any area that may be directly exposed to the gas is monitored. The detector assignment is canceled if the refrigerant leak bypasses the detection point.

Although there are no legal guidelines on how many gas monitors should be installed, gas detectors should not be installed more than 16.5 feet. (5 m) from a potential source of leakage. (Exhaust fans, return air, etc. are exceptions to this rule.)

Choosing a place to install gas detectors

For a gas analyzer to serve its intended purpose effectively, it must be installed where it can be seen, heard and where potential leaks can be detected. Installers should install monitors according to product dimensions, maximum wiring length, and the following considerations:

Environmental conditions

- Application features
- Availability for staff
- Physical Characteristics (Specific Gravity) of Target Gas
- Environmental conditions
- Installers must consider the full range of environmental conditions when selecting a location for a gas detector.

Avoid adverse conditions

Gas detectors should not be installed in locations where they will be exposed to elements (extreme temperatures, high humidity, high concentrations of airborne particles) that are outside the device's specifications (figure 1). It is important that the instrument's ingress protection (IC) rating is sufficient to protect its sensitive electronics.

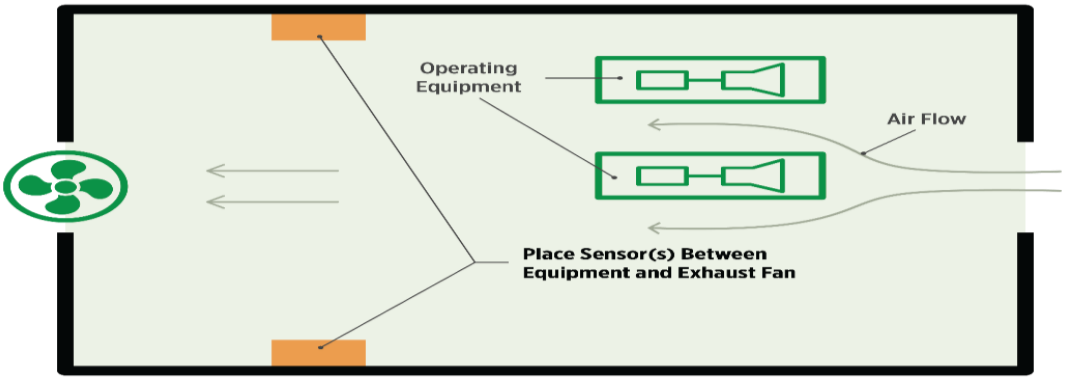


Figure 1. Locations where gas detectors may be exposed

Similarly, sensors should not be installed where they could be damaged by daily use of the space. Such conditions can affect the instrument's ability to effectively detect the target gas.

Accounting for currents / air flows

In addition, installers must take into account the airflow in the controlled space. Room ventilation can change the airflow pattern and affect the effectiveness of gas control. In other words, installers must consider how the escaping gas may behave due to air currents. (If necessary, the installer can install gas detectors in the ventilation ducts.) A smoke test can be performed to ensure optimal placement. Strong air flow can dilute the target gas. For this reason, placing sensors closer to a potential leak source can improve leak detection in high airflow areas.

Never place the refrigerant detector where airflow may be obstructed. This usually occurs in freezers where personnel can (unintentionally) press boxes against the appliance. Obstruction of air flow to the sensor will result in ineffective leak detection.

RESULTS AND DISCUSSION

2.1 Gas odor detection and alarm with gas sensor

Installers can choose between perimeter detection and point detection when placing gas sensors in a controlled space.

Point detection involves installing gas detectors at specific points where refrigerant leaks may occur. For example, installers may choose to place gas detectors near compressors, expansion valves, mechanical connections, or along conduit trenches. As a result, leak detectors are located where they can expect the highest concentration of the target gas.

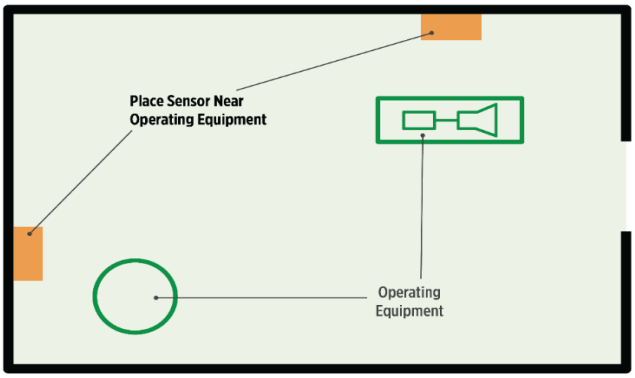


Figure 2. Place of sensor near operating equipment

Perimeter detection involves placing gas detection units around the entire perimeter of the monitored area. This may be the best option when it is difficult to find sensors near the source of the leak. The disadvantage of perimeter detection is that the target gas can become diluted before it reaches the gas detector.

Refrigerant leak detectors are used to detect the perimeter of machinery/mechanical equipment.

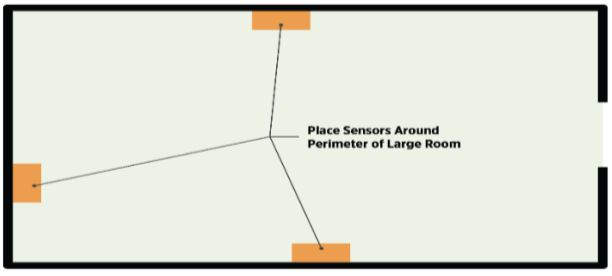


Figure 3. Detection of perimetres

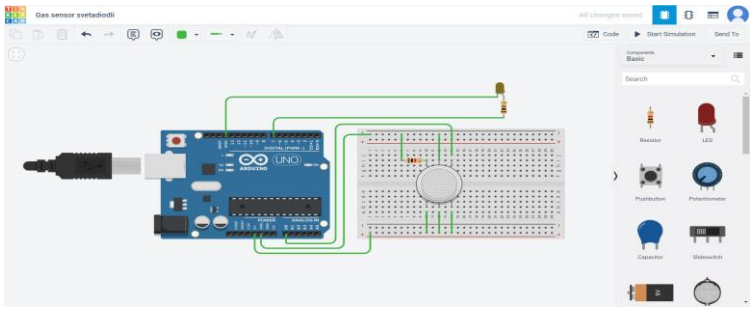
Gas detectors require regular maintenance to keep them working. Where possible, they should be installed in a location that is easily accessible for functional testing and maintenance.

Instruments with remote sensor(s) allow installers to track refrigerant leaks in hard-to-reach areas without losing easy access to electrical/communications wiring.

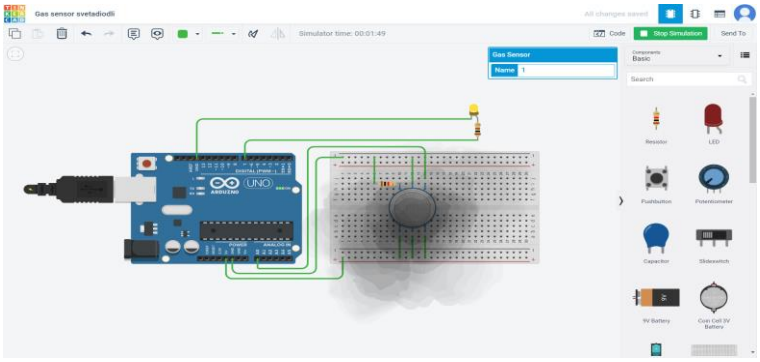
Physical characteristics of the target gas

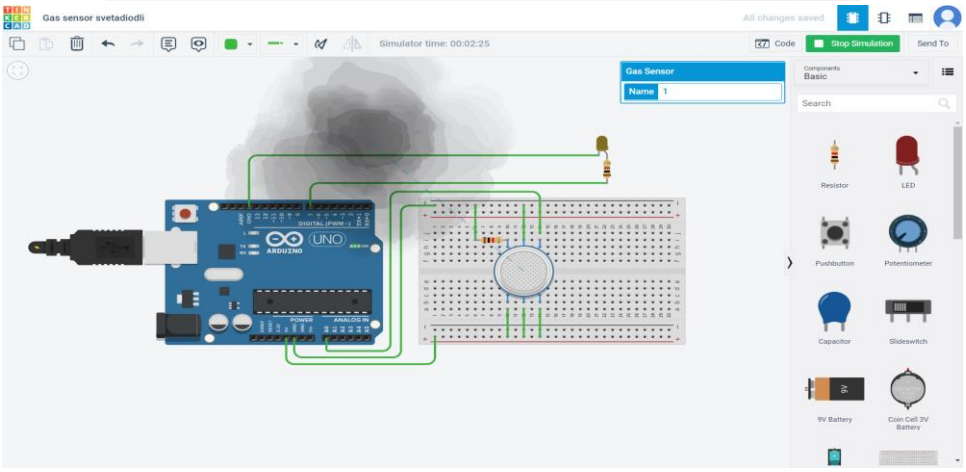
The heaviness or lightness (specific gravity) of the target gas must also be considered. Locate sensors used to detect gases heavier than air, such as butane, propane, LPG, or ozone, closer to ground level. Gas detectors designed to detect gases lighter than air, such as hydrogen, methane and ammonia, should have monitors located closer to the ceiling. Equal density gas monitors should be mounted at head height. (usually 4-6 feet from the ground).

Tinkercad.com we are building a gas smell detection and alarm project with a gas sensor on site

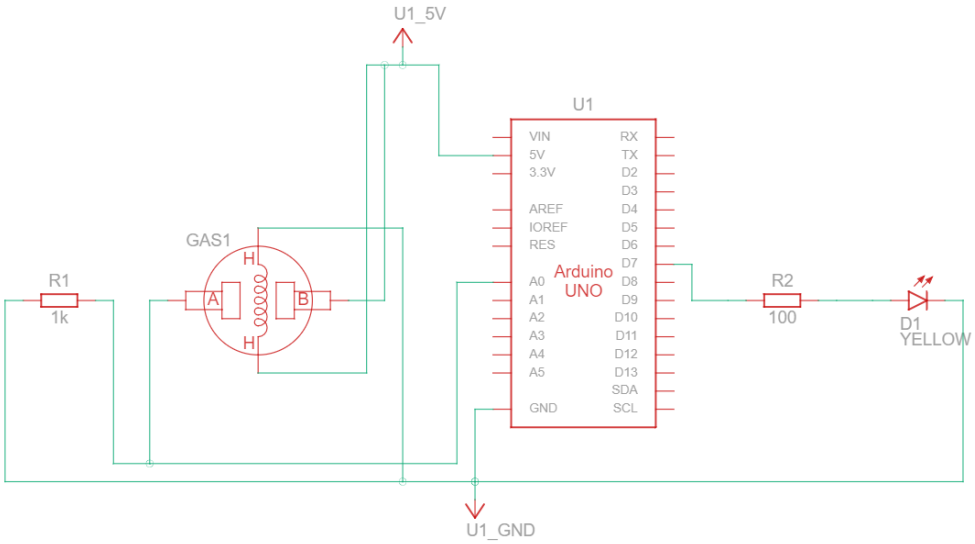


Progress: If the gas comes close to our MK-2 sensor, it will immediately send a signal to the Arduino Uno, and it will automatically turn on the LED immediately. And after the gas leaves, the LED will automatically turn off.





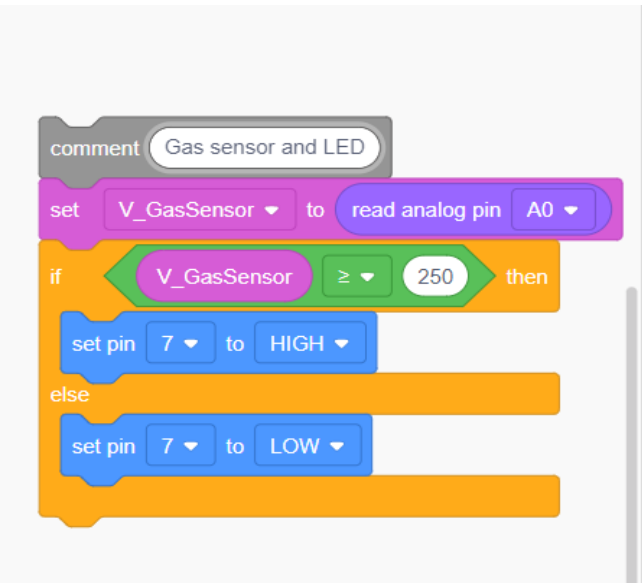
Scheme according to which the project will be assembled:



List of components:

Name	Quantity	Component
U1	1	Arduino Uno R3
GAS1	1	Gas Sensor
R1	1	1 kΩ Resistor
D1	1	Yellow LED
R2	1	100 Ω Resistor

Block diagram and code:




```
// C++ code
//
int V_GasSensor = 0;

void setup()
{
  pinMode(A0, INPUT);
  pinMode(7, OUTPUT);
}

void loop()
{
  // Gas sensor and LED
  V_GasSensor = analogRead(A0);
  if (V_GasSensor >= 250) {
    digitalWrite(7, HIGH);
  } else {
    digitalWrite(7, LOW);
  }
  delay(10); // Delay a little bit
}
```

Results obtained by us in the laboratory environment

To conduct the experiment, we chose the gas detector MQ-2

Figure 3. MQ-2 gas detector

General information:

It can detect concentrations of LPG, smoke, alcohol, propane, hydrogen, methane and carbon monoxide ranging from 200 to 10,000 ppm

This output voltage increases as the concentration of the measured gases increases.

- Fast response and fast recovery
- Constant sensitivity
- There are two signal output indicators

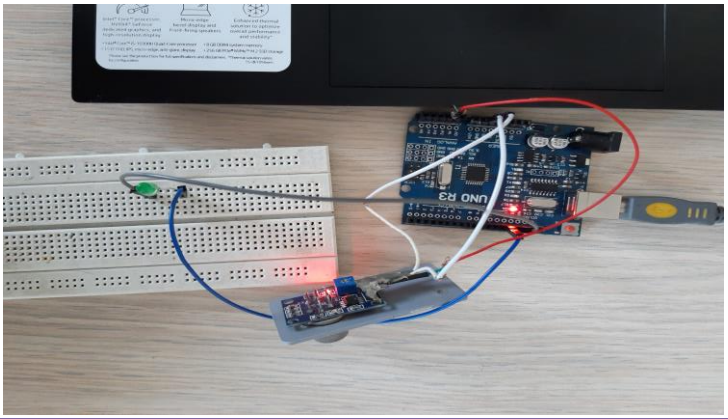
Specification:

- Working voltage: 5V
- Load resistance: 20 kΩ
- Heater resistivity: 33 Ω ± 5%
- Heat consumption: < 800 MW
- High sensitivity resistance: 10 kΩ - 60 kΩ
- Maximum concentration range: 200 – 10000 ppm
- Heating time: more than 24 hours

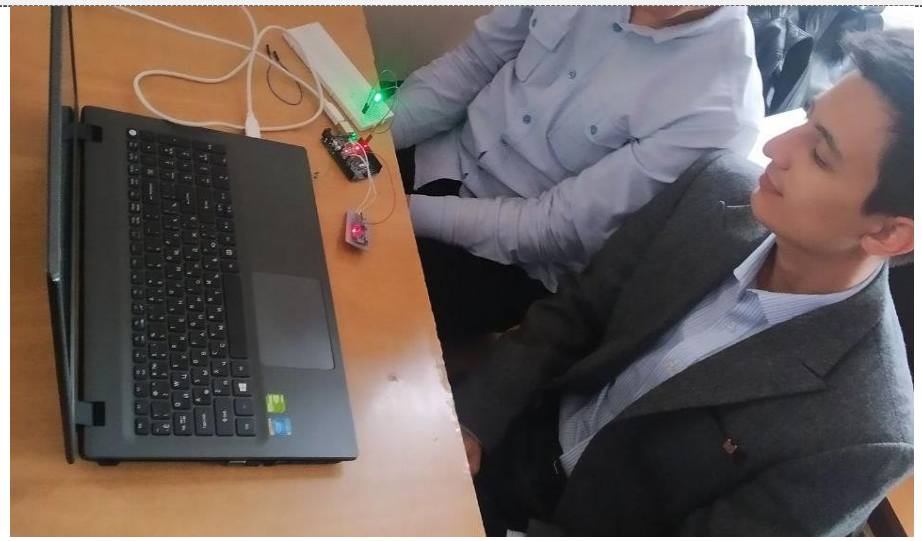
How to use:

- VCC ↔ 5.0V
- ↔ GND ↔ ground power gauge
- AOUT ↔ MCU.IO (analog output)
- DOUT ↔ MCU.IO (digital output)

The practical application of the MQ-2 gas sensor through the LED and the code written for it are given below.



```
#define PIN_MQ2  A1    // connection pin name MQ2
#define LED       13   // pin name for connecting the LED

int value;

void setup() {
  Serial.begin(9600);
  pinMode(LED, OUTPUT);
  pinMode(PIN_MQ2, INPUT);
}

void loop() {
   // write the received data from the sensor
   value = analogRead(PIN_MQ2);
   int N1;

   // output information to the port monitor
   Serial.println("VALUE - " + String(value));
   Serial.println(" ");

   // turn on the LED when a certain value is exceeded
   if (value > 50) { N1:
   digitalWrite(LED, HIGH);delay(500);
   digitalWrite(LED, LOW);delay(500);
   goto N1;
   }
   else { digitalWrite(LED, LOW); }

   delay(200);
}
```



CONCLUSION

The health and safety of your personnel, the public, and the environment largely depends on the safe use, storage, and disposal of hazardous substances and materials. To ensure this safety, gases that are a by-product of construction operations or processes. (e.g. HVAC systems, industrial production, storage and cleaning) must be constantly monitored.

The MQ-2 gas sensor can detect concentrations of LPG, smoke, alcohol, propane, hydrogen, methane and carbon monoxide in the range of 200 to 10,000 ppm and, thanks to its high sensitivity to these gases, helps us in their detection. Thanks to this gas sensor function, we can prevent possible fires in buildings, poisoning people with the harmful smell of gas. Despite its small size, its level of reliability is quite high. By using this application in real life, we can avoid many unpleasant incidents and improve security.

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