GAS CONCENTRATION IN SEVERAL ROOMS MONITORING

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The project is created as a Tinkercad Circuit and designed for gas concentration continuous monitoring in the several rooms working area air.

For each measuring channel of gas analyzers is provided a separate light alarm (Red LEDs).

If the gas concentration exceeds the allowable in at least one room, then the audible signal (Piezo) is turned on.

The liquid crystal display (LCD 16x2) shows the numerical gas concentration values in each room.

The project specification is presented in the following table.

Name	Quantity	Component
U1	1	Arduino Uno R3
GAS1 GAS2 GAS3 GAS4 GAS5	5	Gas Sensor
R1 R2 R3 R4 R7	5	4700 ohm Resistor

U2	1	LCD 16 x 2
Rpot1	1	250 kOhm, Potentiometer
D1 D2 D3 D4 D5	5	Red LED
PIEZO1	1	Piezo
R8 R10 R11 R13 R15 R17	6	220 ohm Resistor

When creating the project program code, the technology of writing small scripts “on the fly” was widely used [1-10].

The proposed project can be used to train the personnel of the region technogenic security system, providing adaptation to the structure dynamics and potentially dangerous objects parameters, the external environment, and also to the peculiarities of the territory [11-17].

The general project circuit Tinkercad emulation is shown in figure 1.

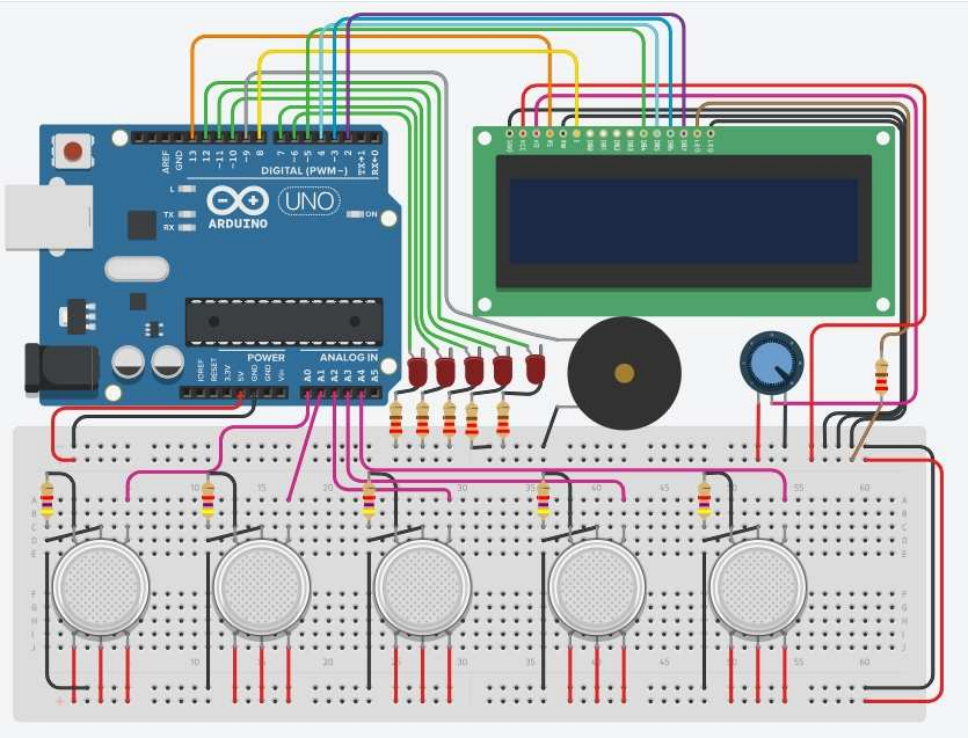

Figure 1. Project Circuit.

The two gas analyzers connection circuit is shown in figure. 2.

Each gas analyzer is connected to its analog pin of the Arduino board (pink wire).

Three gas analyzer pins are connected (red wire) to the power supply (5V).

One gas analyzer pin is connected to ground (black wire); another is connected to ground (black wire) with 4700 ohm resistor.

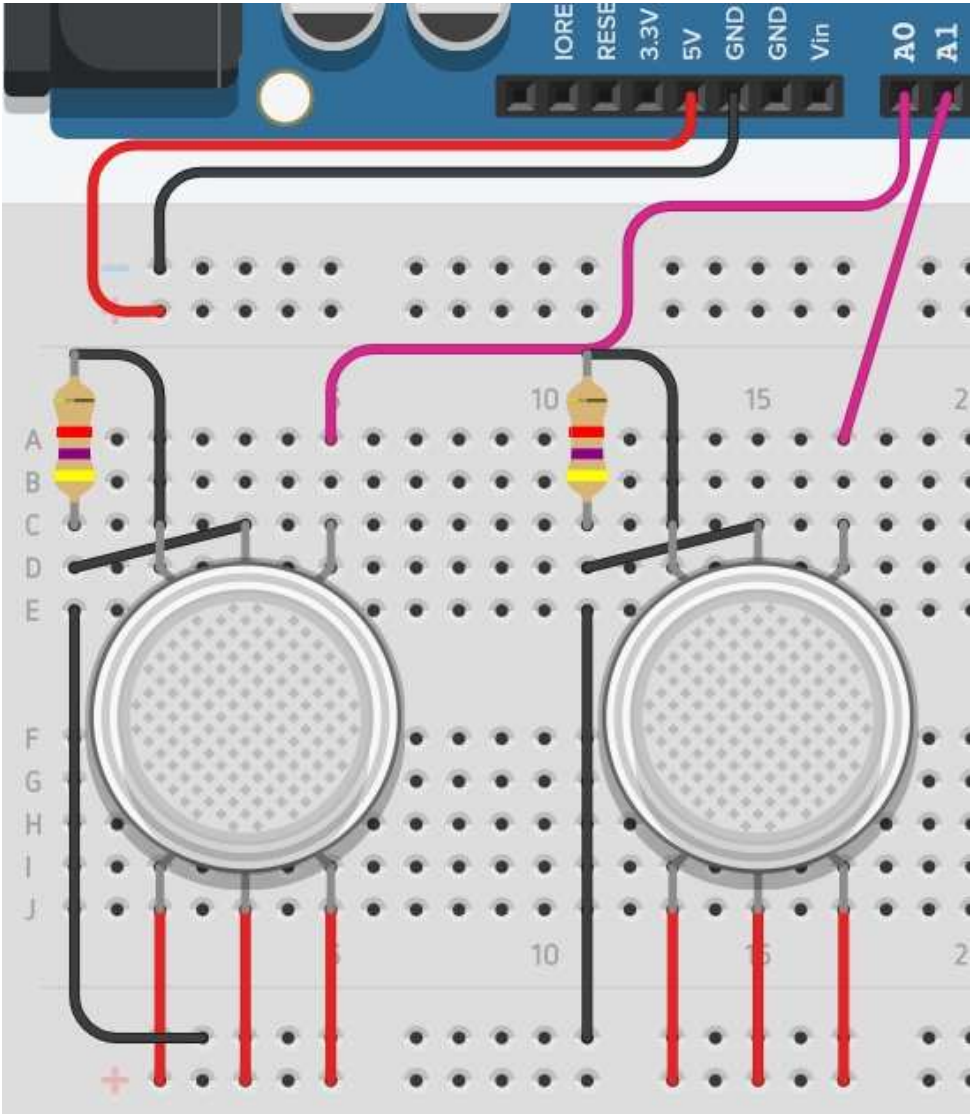

Figure 2. Gas Analyzers Connection Circuit.

The five red light-emitting diode connection circuit is shown in figure 3.

One light-emitting diode pin is connected to a digital pin of the Arduino board (green wire); another is connected to ground (black wire) with 220 ohm resistor.

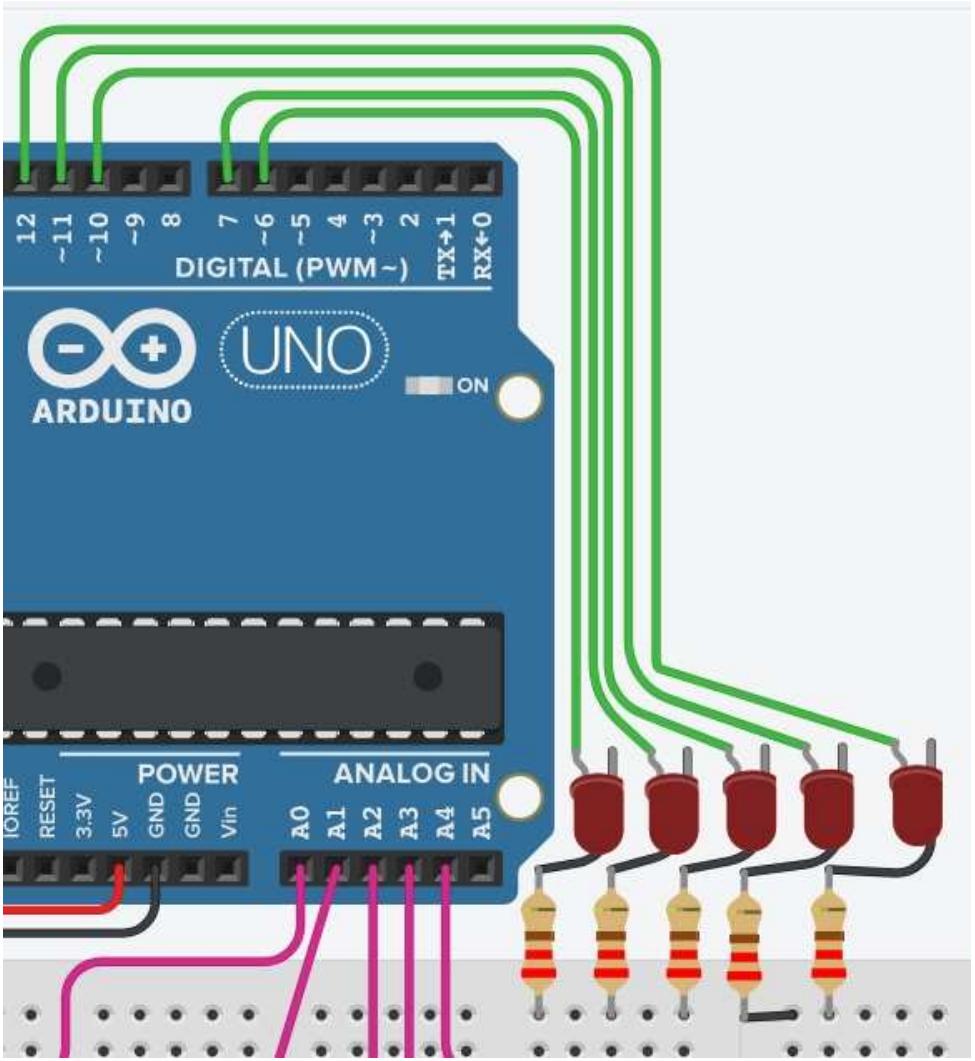

Figure 3. Red Light-Emitting Diode Connection Circuit

The piezoelectric speaker connection circuit is shown in figure 4.

One piezoelectric speaker pin is connected to a digital pin of the Arduino board (gray wire); another is connected to ground (black wire).

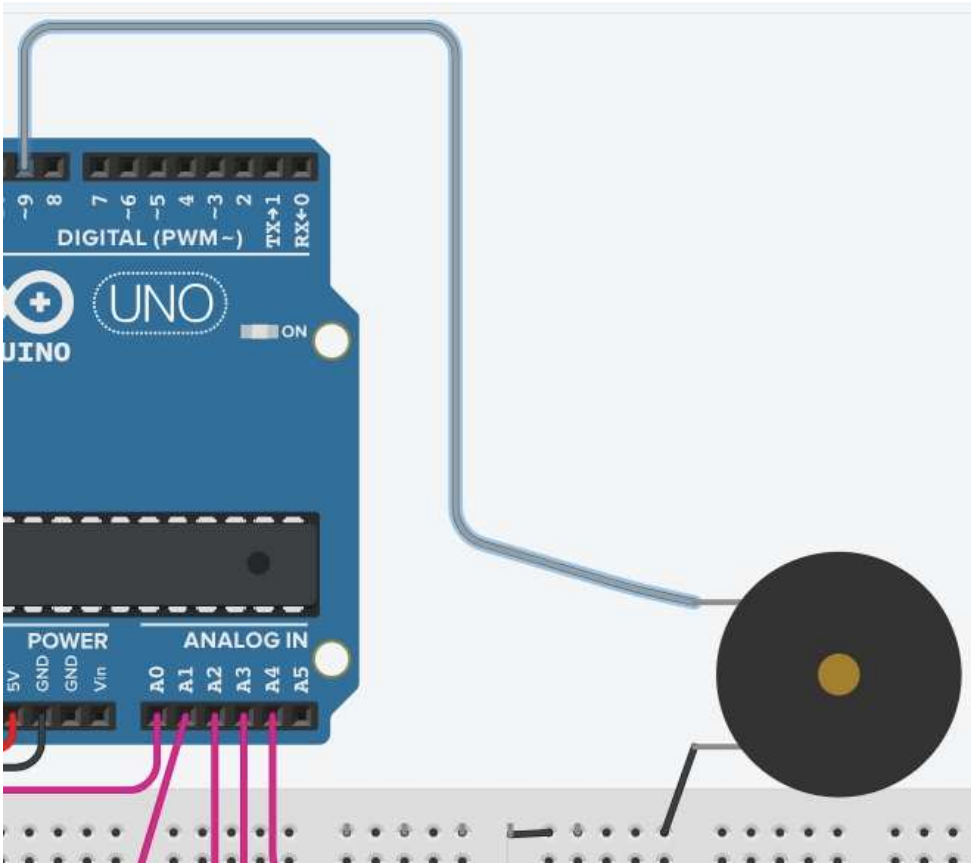

Figure 4. Piezoelectric Speaker Connection Circuit

The liquid crystal display (LCD 16x2) connection circuit is shown in figure 5.

The potentiometer (250 kOhm) is designed to calibrate the screen contrast.

The first potentiometer pin is connected (red wire) to the power supply (5V). The second potentiometer pin is connected (black wire) to ground. The third

potentiometer pin is connected (pink wire) to liquid crystal display contrast pin (VO).

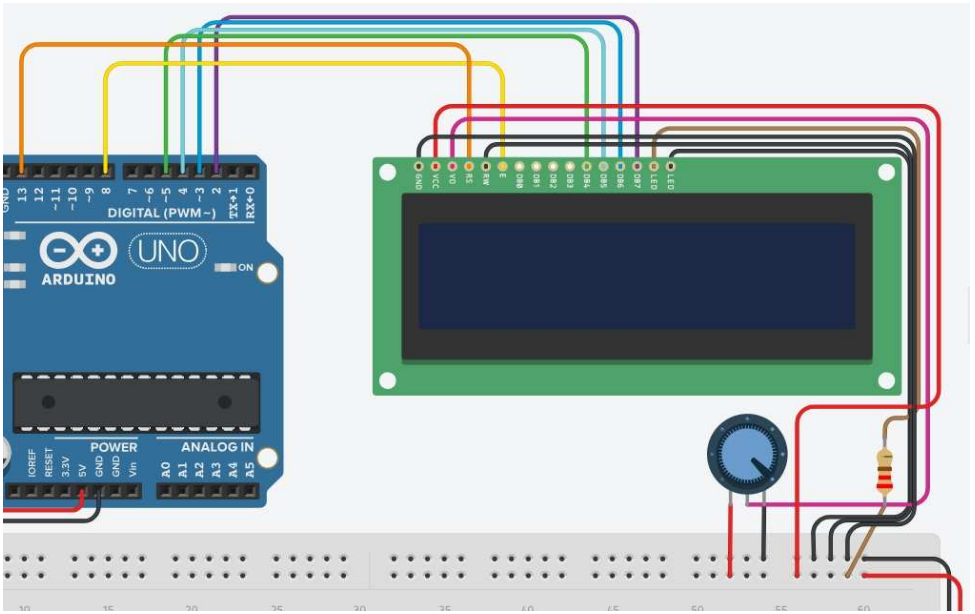

Figure 5. Liquid Crystal Display Connection Circuit

The VCC liquid crystal display pin is connected (red wire) to the power supply (5V).

The Led Anode (LED) liquid crystal display pin is connected (brown wire) to the power supply (5V) with 220 ohm resistor.

The GND, Read/Write (RW) and Led Cathode (LED) liquid crystal display pins are connected (black wire) to ground.

The Register Select (RS) liquid crystal display pin (orange wire) is connected to digital Arduino pin #13.

The Enable pin (E) liquid crystal display pin (yellow wire) is connected to digital Arduino pin #8.

The DB4 liquid crystal display pin (green wire) is connected to digital Arduino pin #5.

The DB5 liquid crystal display pin (turquoise wire) is connected to digital Arduino pin #4.

The DB6 liquid crystal display pin (blue wire) is connected to digital Arduino pin #3.

The DB7 liquid crystal display pin (purple wire) is connected to digital Arduino pin #2.

We now turn to the description of the operation of the circuit.

The situation when the air in all rooms in the normal range is shown in figure 6.

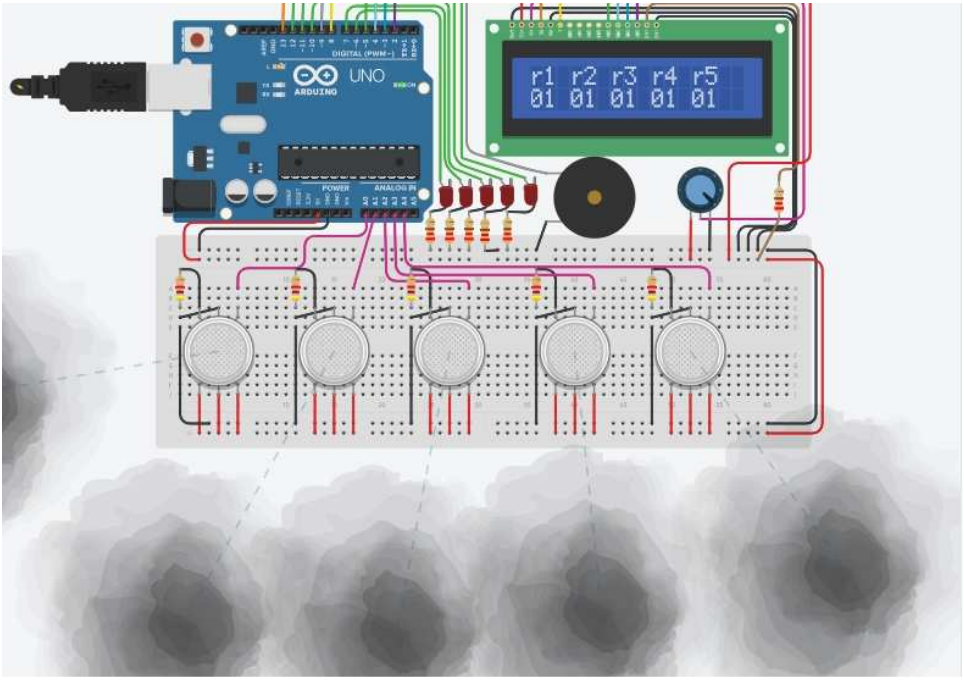

Figure 6. Air in All Rooms in the Normal Range

No LEDs are light, no sound is given and all digital values do not exceed the maximum allowable values (see fig. 7).

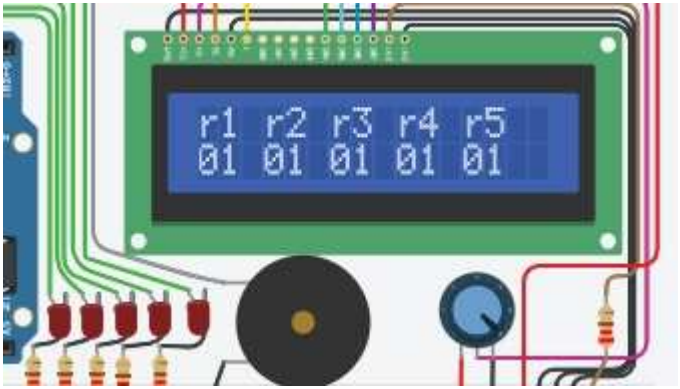

Figure 7. Normal State

The situation when gas concentration in the first room exceeds the permissible and the air in other rooms in the normal range is shown in figure 9.

The first LED is light, an audible alarm sounds and the first room gas concentration digital value is too big (see fig. 8).

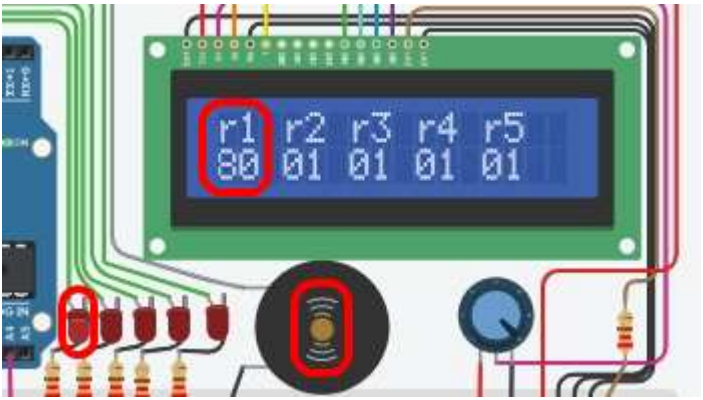

Figure 8. Alarm in the First Room

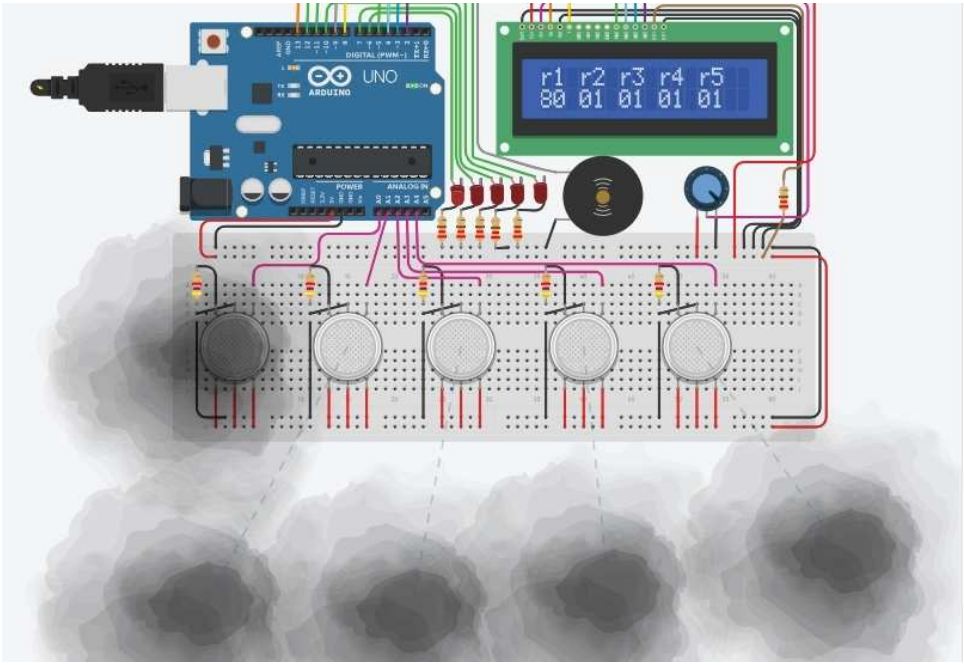

Figure 9. Gas Concentration in the First Room Exceeds the Permissible

The situation when gas concentration in the rooms #1,2 exceeds the permissible and the air in other rooms in the normal range is shown in figure 11.

The LEDs #1,2 are light, an audible alarm sounds and the rooms #1,2 gas concentration digital values are too big (see fig. 10).

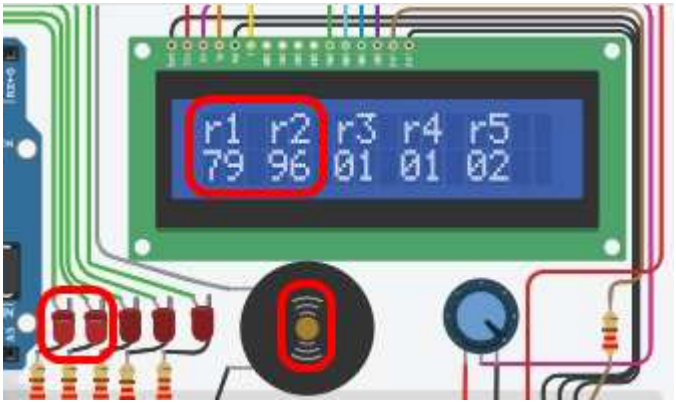

Figure 10. Alarm in the Rooms #1 and #2

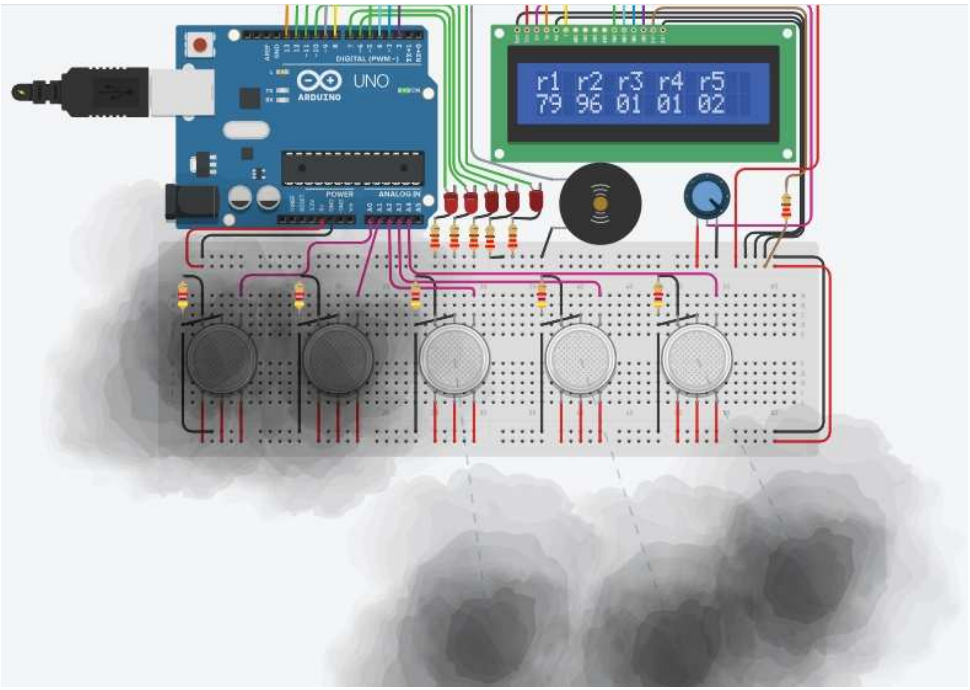

Figure 11. Gas Concentration in the Rooms #1,2 Exceeds the Permissible.

The situation when gas concentration in the rooms #1,2,3 exceeds the permissible and the air in other rooms in the normal range is shown in figure 12.

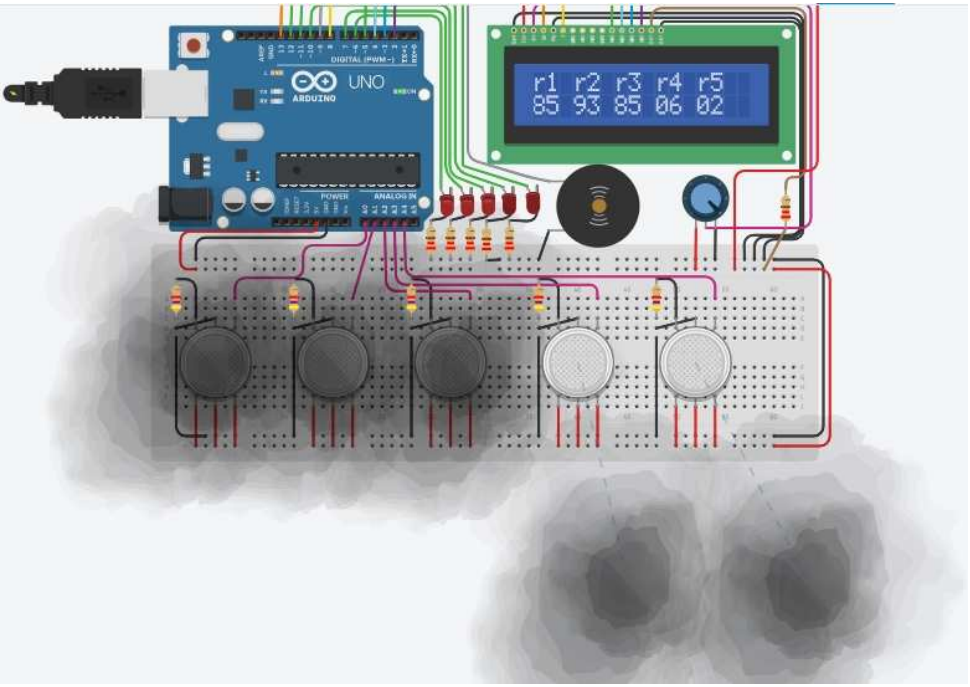

Figure 12. Gas Concentration in the Rooms #1,2,3 Exceeds the Permissible

The LEDs #1,2,3 are light, an audible alarm sounds and the rooms #1,2,3 gas concentration digital values are too big (see fig. 13).

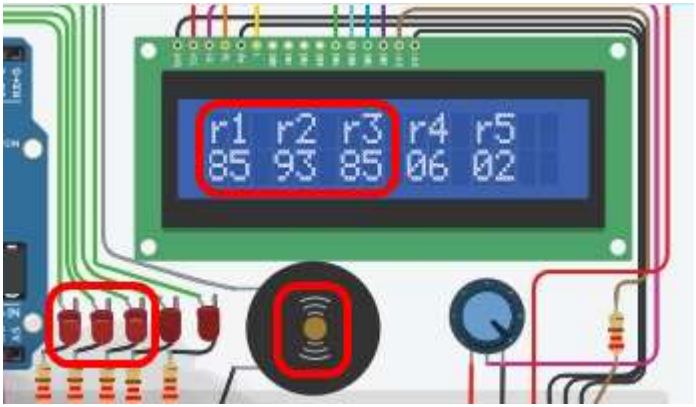

Figure 13. Alarm in the Rooms #1,2,3

The situation when gas concentration in the rooms #1,2,3,4 exceeds the permissible and the air in room #5 in the normal range is shown in figure 15.

The LEDs #1,2,3,4 are light, an audible alarm sounds and the room #1,2,3,4 gas concentration digital values are too big (see fig. 14).

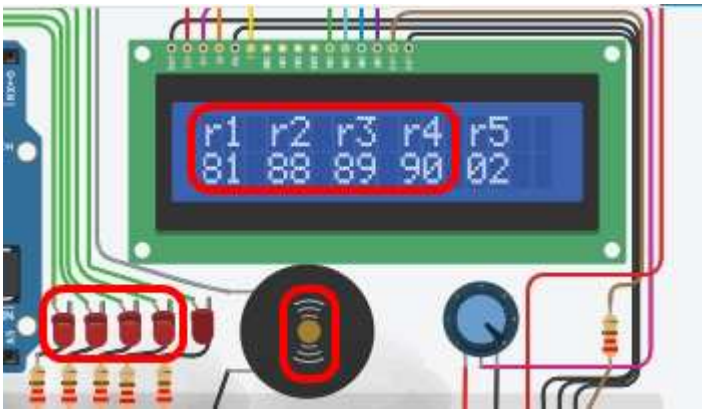

Figure 14. Alarm in the Rooms #1,2,3,4

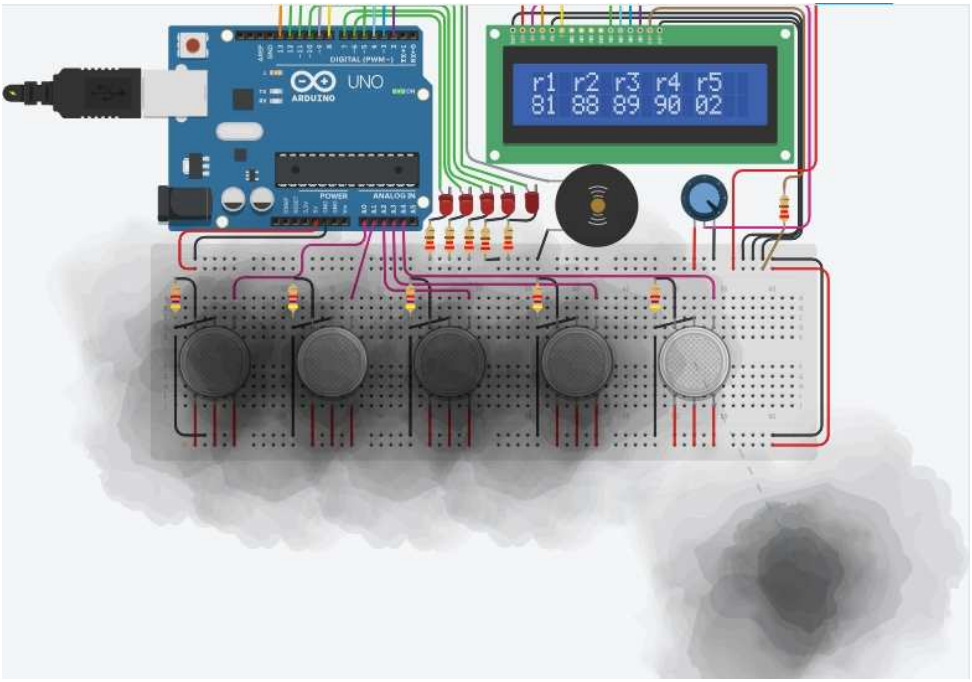

Figure 15. Gas Concentration in the Rooms #1-4 Exceeds the Permissible

The situation when gas concentration in the all rooms exceeds the permissible is shown in figure 16.

The all LEDs are light, an audible alarm sounds and the all rooms gas concentration digital values are too big (see fig. 17).

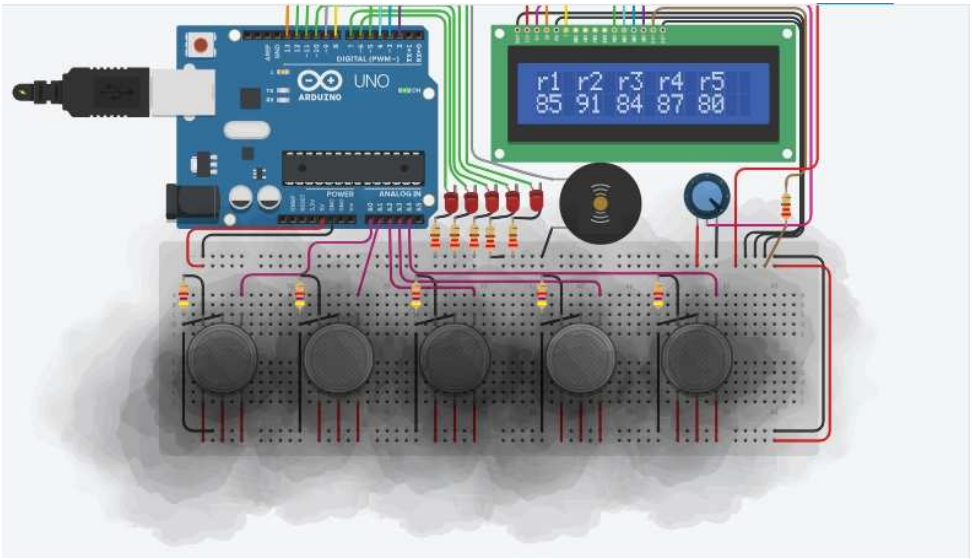

Figure 16. Gas Concentration in the All Rooms Exceeds the Permissible

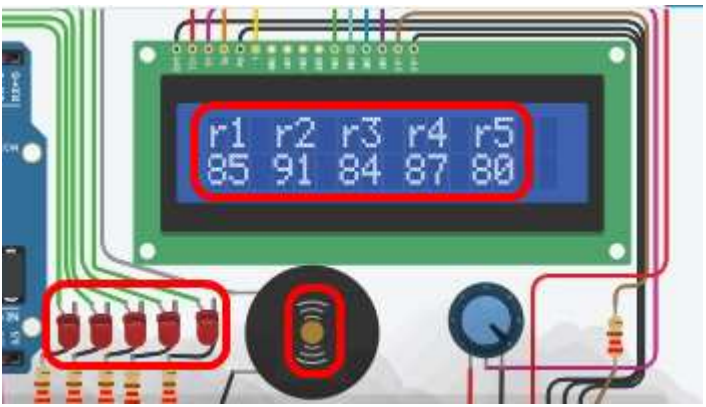

Figure 17. Alarm in the All Rooms

The Arduino microprocessor is programmed using the following code.

```
/*
  LiquidCrystal Library

 Demonstrates the use a 16x2 LCD display.  The LiquidCrystal
 library works with all LCD displays that are compatible
with the
 Hitachi HD44780 driver. There are many of them out there,
and you
 can usually tell them by the 16-pin interface.

  The circuit:
VCC pin is connected to the power supply (5V)
Led Anode (LED) l pin is connected to the power supply (5V)
with 220 ohm resistor
GND, Read/Write (RW) and Led Cathode (LED) are connected to
ground.
Register Select (RS) pin  is connected to digital Arduino
pin #13.
Enable pin (E) pin is connected to digital Arduino pin #8.
The DB4 pin is connected to digital Arduino pin #5.
The DB5 pin is connected to digital Arduino pin #4.
The DB6 pin is connected to digital Arduino pin #3.
The DB7 pin is connected to digital Arduino pin #2.
*/

// include the library code:
#include <LiquidCrystal.h>

// initialize the library with the numbers of the interface
pins
LiquidCrystal lcd(13, 8, 5, 4, 3, 2);

#define SENS_NUMB 5
#define DANGER_LEVEL 60
#define RING_FRAQ 500
#define RING_PIN 9
```

```
#define LCD_STR_1 "r1 r2 r3 r4 r5  "

int CurRing = 0;
int NewRing = 0;
int SensValues[SENS_NUMB];
int LedPins[SENS_NUMB] = {6,7,10,11,12};
char strout[20] = "                ";
char tmpbuf[8] = "    ";

void setup(){
  pinMode(RING_PIN, OUTPUT);
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
// Print a message to the LCD.
  lcd.print(LCD_STR_1);
  Serial.begin(9600);
}

void loop(){
  int val;
  NewRing = 0;
  for(int i=0; i<SENS_NUMB; i++){
    val = analogRead(i);
    SensValues[i] = map(val,755,306,100,1);
    if(SensValues[i] > DANGER_LEVEL){
      digitalWrite(LedPins[i],HIGH);
      NewRing = 1;
    } else
      digitalWrite(LedPins[i],LOW);
    sprintf(tmpbuf,"%2.2d ",SensValues[i]);
    for(int j=0; j<3; j++)
      strout[i*3+j] = tmpbuf[j];
  }
  if(NewRing != CurRing){
    if(NewRing == 1)
      tone(RING_PIN,RING_FRAQ);
```

```
    else
      noTone(RING_PIN);
    CurRing = NewRing;
  }
  lcd.setCursor(0, 1);
  lcd.print(strout);
  Serial.println(strout);
}
```

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