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Semiconductor Gas Sensors Using Arduino Nano

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Abstract: A programmable board with its own processor and Arduino Nano memory was used. The board has a couple of dozen contacts to which all kinds of components: displays, light emitting devices (LEDs), sensors, motors, routers, magnetic locks, etc can be connected. A gas detector using Arduino Nano circuit was proposed.

Keywords: Gas detector, semiconductor, Arduino Nano

1. Introduction

Gas sensor or detector is a sensitive element or measuring transducer for the qualitative and/or quantitative determination of the gas or composition of the gas mixture. Gas sensors are part of sensors or measurement and control systems, in which, in addition to them, there are signal conversion and indication systems. The main function of the gas sensor is to convert the concentration of the analyte into an electrical or some other signal, allowing the registration and visualization of this signal. Semiconductors, electrochemical and optical (infrared) sensors are the most common. In the sensors of the first two types, due to the adsorption of the mixture component, the electrical properties of the sensor change. In the third case, a change in the optical density of the analyzed gas mixture is fixed at a certain wavelength. Research is currently underway, the ultimate goal of which is to create miniature (micro- and nano-) semiconductor gas-sensitive sensor devices with low energy consumption and high speed, capable of determining the concentration of various gases. The most promising gas-sensitive elements of this type are resistive chemical sensors based on polycrystalline and ceramic metal oxide semiconductors. We are developed in Yerevan State University (Department of physics of semiconductors and microelectronics and Research center for semiconductor devices and the nanotechnology) in Yerevan (Armenia) semiconductor sensors for the following gases: Acetone, Ammonia, Benzene, Butanol, i-butane, Dichlorethane, Dimethyl formamide, Ethanol, Formaldehyde, Gasoline, Humidity, Hydrogen, Hydrogen peroxide, Iperit, Methanol, Natural gas, Nitrogen oxides, Propylene glycol, Smoke, Sulfurous anhydride, Sulfurous oxides, Toluene, Zarin etc. The YSU warfare chemical sensors were manufactured and investigated in the framework of NATO grant. Sensors made from different metal oxides (non-doped, doped with different impurities as well as functionalized with carbon nanotubes). Besides experimental works, the structure and defects of metal oxide sensors were investigated using the density functional theory and empirical force fields. The electron density of states was computed [1-8]. A version of the gas detector is proposed in [9].

2. Arduino gas semiconductor sensor

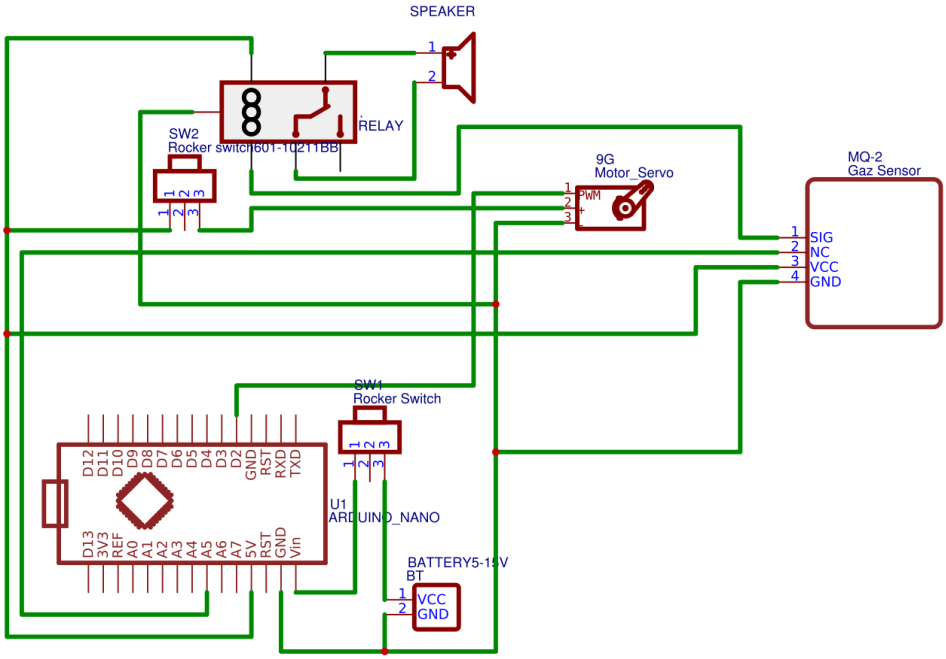
The most important characteristics of gas sensors are selectivity for an individual component, concentration limits for determining a component, and response (reaction) time and sensor recovery to a signal. Polycrystalline tin dioxide (SnO_2), which is highly chemical resistant, is most often used for the manufacture of resistive sensors. change in component concentration). In the device proposed below, an alarm system and a closing valve are installed as an extension. For it, a programmable board with its own processor and Arduino Nano memory was used. The board has a couple of dozen contacts to which you can connect all kinds of components: displays, light emitting devices (LEDs), sensors, motors, routers, magnetic locks, etc. You can load a program into the Arduino processor that will control all of these devices according to a given algorithm, that is, the Arduino board can be programmed. The Arduino board provides extensibility and the ability to automate certain activities. The choice of the Arduino boards depends on the tasks you need to complete. We have chosen the Arduino Nano board (see. Fig. 1).

Fig. 1.

As a gas sensor, one can use sensors proposed at the YSU Center for Semiconductor Devices and Nanotechnology, as well as any other sensors, for example, Chinese gas sensors.

Fig. 2.

In addition to the Arduino board and the gas sensor, we needed an alarm system, a servo drive that will simulate a valve and one relay. We also added two buttons - the first one to turn the system on and off, and the second one to turn the servo on and off. The entire system is powered by six finger batteries. The device diagram is shown in Fig. 2.



In addition, we proposed the following program for Arduino:

```
#include <Servo.h>
Servo servo;
int smoke A5 = A5;
int sensor = 400;
void setup() {
  servo.attach(2);
  pinMode(smokeA0, INPUT);
  Serial.begin(9600);
  servo.write(0);
}
void loop() {
  int analogSensor = analogRead(smokeA5);
  if (analogSensor > sensor){
servo.write(180)
}else{
        servo.write(0);
}
  delay(100).
```

The proposed compact gas detector does not require significant heating of the working fluid of the sensor. For example, it can be used in a car where there is a $12-volt$ power supply, which, in turn, will reduce the size of the device.

The internal structure of the device is shown below (Fig. 3).

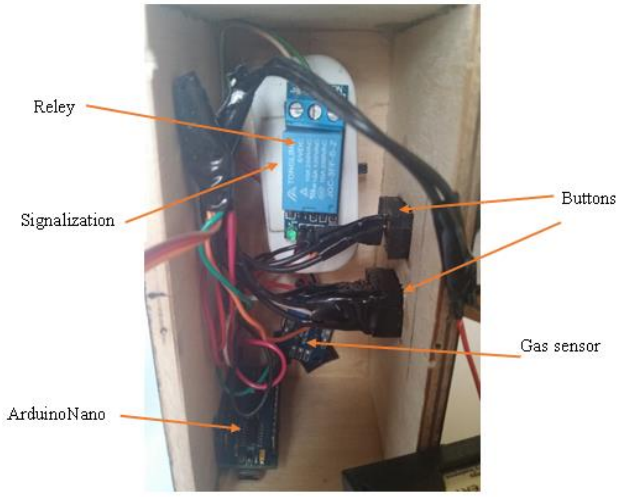


Fig. 3.

3. Conclusion

A programmable board with its own processor and Arduino Nano memory was used. The board has a couple of dozen contacts to which all kinds of components: displays, light emitting devices (LEDs), sensors, motors, routers, magnetic locks, etc can be connected. A gas detector using Arduino Nano circuit was proposed.

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