Armenian Journal of Physics, 2010, vol. 3, issue 1, pp. 78–81

GAS MONITORING SYSTEM

David Pokhsraryan, Vladimir Aroutiounian, Hakob Chilingaryan

Yerevan State University, A. Manoukian St. 1, Yerevan 0025, Armenia

Abstract - Proposed Gas Monitoring System (GMS) operates as a stand-alone, autonomous system intended to detect different gas concentrations in the air. It is a microprocessor-based, real-time alarm monitor system, designed for usage of three different gases (hydrogen, carbon monoxide and methane) sensors with high sensitivity and selectivity. It is equipped with a motor driver for valve-automatic hold and cutoff control upon gas concentration, and limits provided for high and low alarm events.

1. Introduction

Protection of homes, offices, premises and facilities is extremely important. If fire and smoke detectors are widely used today for fire prevention, use of different gas detectors is still non-sufficientl world-wide. It is very promising to use some alarm system containing sensors for several important dangerous gases. The attention of scientists and engineers to such a monitoring system is in the beginning. Development of it is mainly focused on detection of narcotics and explosives. Home and office security demands detection of other type gases in environment. One of versions of such system developed in YSU is reported below.

2. Description of System

The schematic view of our real-time alarm monitor system is shown in Fig. 1. It consists of the gas concentration readout module, which is equipped with different gas sensors (in this case, sensors having high sensitivity and selectivity to hydrogen, carbon monoxide and methane developed in YSU). Limits provided for high and low alarm events were established; the valve control for valve-automatic hold and cutoff control upon gas concentration was carried out.

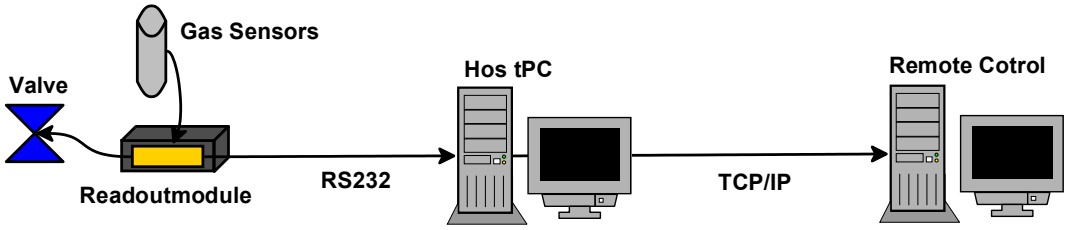

Fig. 1. Schematic of our real-time alarm monitor system.

Readout module is a microprocessor based drives, consists of Atmega16 8 bit microcontroller, running 12 MHz crystal clock, with 8 or 10 bit resolution ADCs. There are also 16×2-character LCD for data visualization and RS232 interface for connection with the host PC. It can be used as stand alone device or in pare with host PC.

The LabView based software is available for a remote real-time alarm monitoring. You can set and change high and low alarm events for each gas sensor individually and monitor your system behavior remotely with TCP/IP software. An event log function allows previous alarms and faults to be checked.

All needed alarm limits to the device can be saved in the non-volatile EEPROM memory, and used as a stand alone device. LCD provides simultaneous display of all channels and alarm status if such takes place.

GMS is a flexible and simple-to-use solution if a self-contained control panel to monitor gas or fire hazards is necessary. It combines extensive features and outstanding performance to suit all applications. It provides the information needed at a glance via the comprehensive LCD display.

All adjustments can be performed using the LabView based software front panel.

3. Sensors

The gas sensors we used present a non-linear response for gas concentrations, as almost all other metaloxide sensors. For example, Fig. 2 shows typical for Figaro sensors dependence of output voltage (VRL) on gas concentration, when the sensor is used in a circuit with various RL values (5 kΩ, 2.5 kΩ, 1 kΩ).

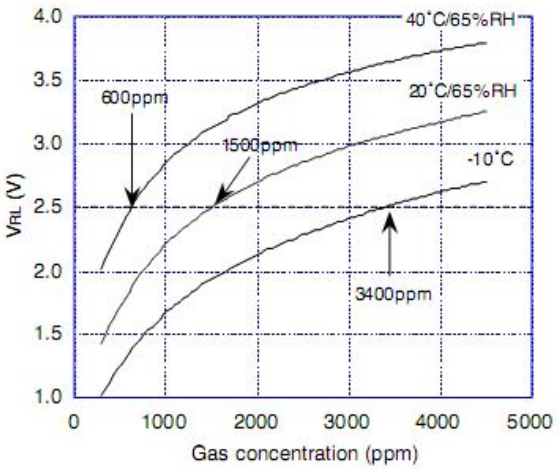

Fig. 2. Response of the sensor.

The relationship between the sensor resistance and concentration of deoxidizing gas can be usually expressed by the following equation:

$$R_s = A[C]^{-\alpha}$$

where R_s is electrical resistance of the sensor, A is a constant, [C] is the gas concentration, and α is the slope of the R_s curve.

A large amount of embedded program memory could be consumed by this formula. This could take several thousand instruction cycles to perform each measurement since most low-cost, 8-bit

microcontrollers do not have divide, cube, logarithm or other complex instructions. A Piecewise Linear Interpolation technique eliminates the need for complex math and enables the programming of a unique customized transfer function for each sensor. The Piecewise Linear Interpolation is the technique of finding the value of a function at an unknown intermediate point given two data points. This value is calculated using a straight line between the closest two known data points. This technique has many advantages in faster execution speed using a simple look-up Table and allows significantly reduced program memory.

4. Software

For calculating the look-up Tables for each detector and for further load to the microcontroller's non-volatile EEPROM memory, a LabView program has been developed. It gives us an ability to make look-up tables from experimentally derived calibrational points by polynomial, rational or spline fitting algorithms. These Tables can be loaded in to the EEPROM by serial interface. The interface of the software is shown in Fig. 3.

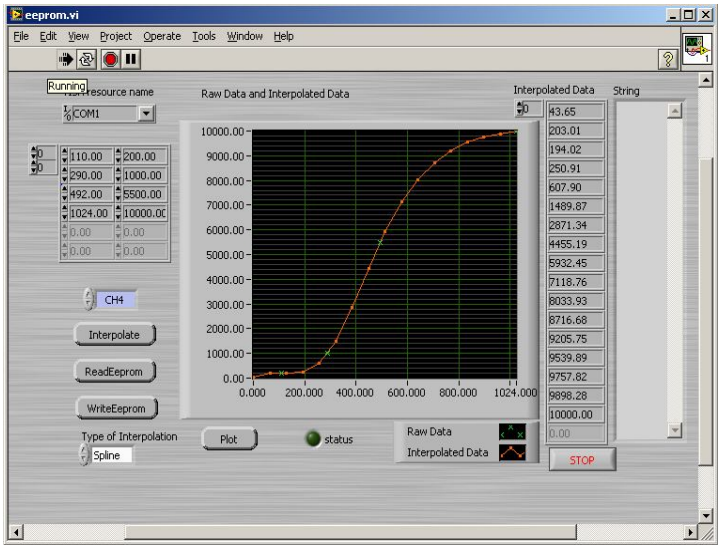

Fig. 3.

Another LabView software is developed for real-time alarm monitoring system. One can monitor the gas sensors response in the plot indicator, the alarm status for each sensor, and the status of the valve. One can set and change high and low alarm limits for each gas sensor individually and monitor the system' behavior remotely with TCP/IP software. An event log function allows previous alarms and faults to be checked.

The interface of the software is shown in Figure 4.

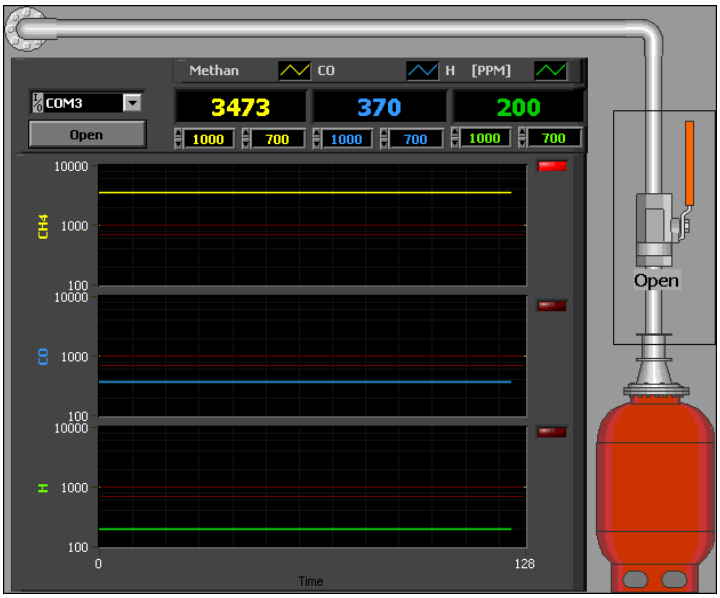

Fig. 4.

Conclusion

The Gas Monitoring System (GMS) operating as a stand-alone, autonomous system intended to detect different gases concentrations in the air is designed in the Department of Physics of Semiconductors and Microelectronics and Center for Semiconductor Devices and Nanotechnologies at Yerevan State University in the framework of ISTC A-1232 Grant.