A complex system for environmental monitoring with a prototype data acquisition board

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***Abstract*-**In the present paper is presented a method for on-line measurement using a complex system for environmental monitoring whit a prototype data acquisition board. A study for Taguchi-type gas sensor using the data acquisition board will be performs.

I. Introduction

The atmospheric environment needs to be examined in consideration of the following three phenomena: 1.global warming, 2.ozone-layer depletion, 3.air pollution.

Among these three, global warming is the most critical in terms of environmental conservation. Global warming is a result of greenhouse-gas emissions; therefore, to prevent this, greenhouse-gas emissions must be reduced. A major greenhouse gas is carbon dioxide (CO2). Therefore, reducing energy use, or saving energy, is the most effective way to help prevent global warming. There are some other gases that have a considerable influence on global warming. The first step to cutting the emissions of these gases as another environmental conservation measure is to monitoring all and to find a way to control them.

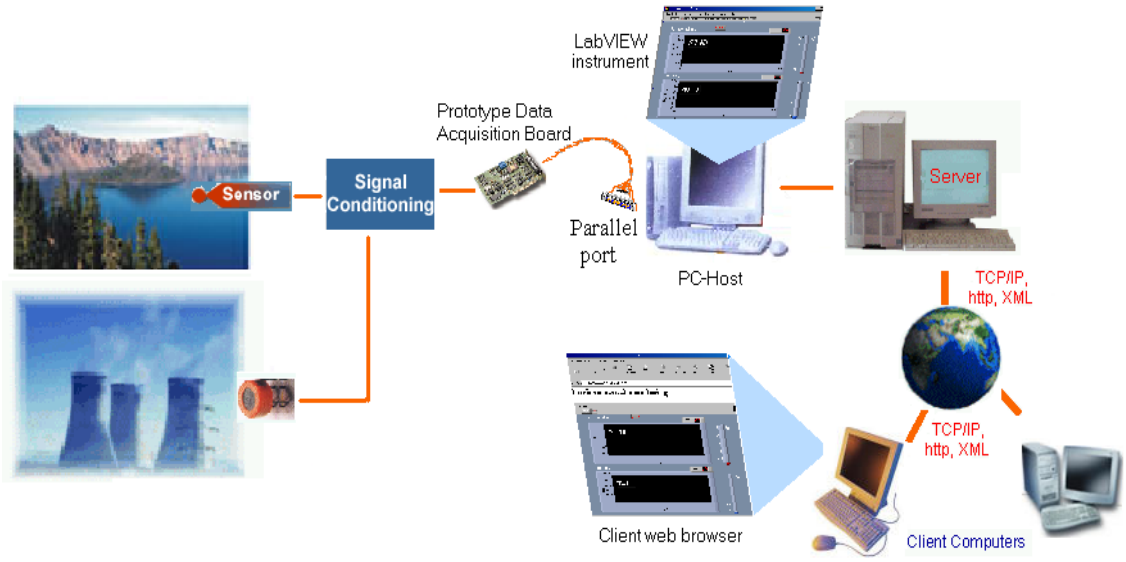

Figure 1. The system for on-line environmental monitoring using a prototype data acquisition board

The main objective of this work is to realize a complex device for environmental quality control and monitoring based on specialized sensors that are connected in a unit system. This device is very useful in the new society information to create a Virtual Laboratory for a remote teaching. That means the students will be able to perform the lab work, controlling the applications and accessing the virtual library.

A. Detection circuit

The sensing element is a metal oxide semiconductor mainly composed of SnO2.This element is heated at a suitable operating temperature by a built-in heater. Exposure of the sensor to a vapour produces a large change in its electrical resistance. In fresh air the sensor resistance is high. When a combustible gas such as propane, methane etc. comes in contact with the sensor surface, the sensor resistance decreases in accordance with the present gas concentration.

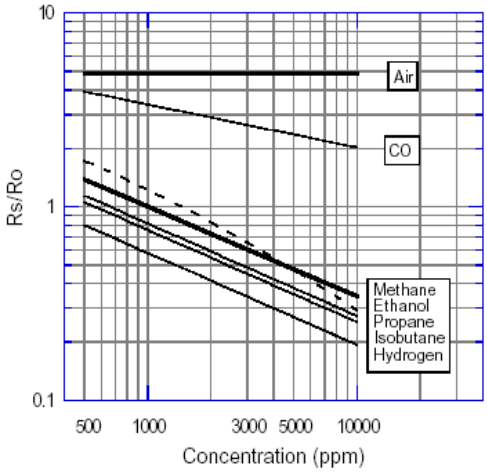

Figure 2. Sensitivity characteristics

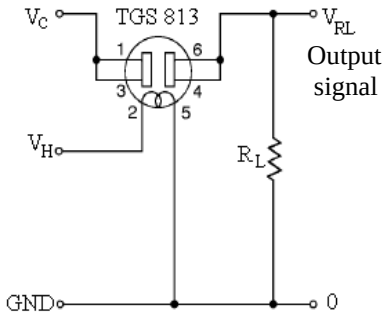

Figure 3. Detection circuit

Figure 3 shows the basic detection circuit. The change in the sensor resistance is obtained as the change of the output voltage across the load resistor (R_L) in series whit the sensor resistance (R_S). The constant 5V output of the data acquisition board is available for the heater of the sensor (V_H) and for the detecting circuit (V_C). The relationship between R_S and V_{RL} is expressed by the following equation.

$$R_s = \frac{V_c - V_{R_L}}{V_{R_L}} \cdot R_L \qquad (1)$$

B. Data acquisition board

The board is highly integrated Data Acquisition Systems. Operating on just 5V, they combine a fully-differential self-calibrating (correcting linearity and zero errors) 13-bit (12-bit + sign) analog-to-digital converter (ADC) and sample-and-hold (S/H) with extensive analog functions and digital functionality. Up to 32 consecutive conversions, using two's complement format can be stored in an internal 32-word (16-bit wide) FIFO data buffer.

An internal 8-word RAM can store the conversion sequence for up to eight acquisitions through the LM12H458CIV's eight-input multiplexer. The LM12H458CIV can operate with 8-bit + sign resolution and in a supervisory "watchdog" mode that compares an input signal against two programmable limits. Programmable acquisition times and conversion rates are possible through the use of internal clock-driven timers. The reference voltage input can be externally generated for absolute or ratiometric operation or can be derived using the internal 2.5V bandgap reference. All registers, RAM, and FIFO are directly addressable through the high-speed microprocessor interface to either an 8-bit or 16-bit databus. The LM12H458CIV include a direct memory access (DMA) interface for high-speed conversion data transfer.

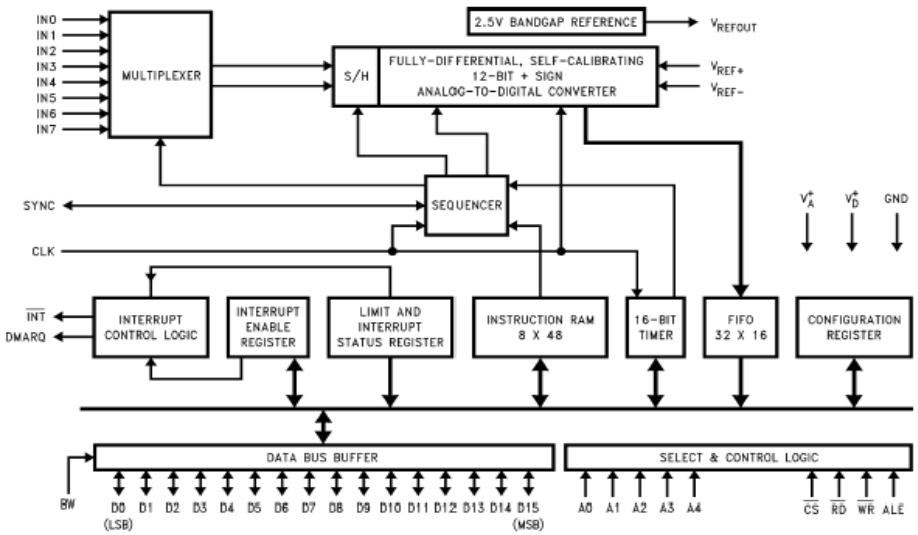

Figure 4. Functional diagram for the chip LM12H458CIV Data Acquisition Systems

I use the chip LM12H458CIV to make a Data Acquisition Board by the parallel port for interfacing with the PC. The results are an portable DAS and a flexible and complex system that I used to monitoring the environmental parameters. The drivers and the virtual instruments are made it using LabVIEW software.

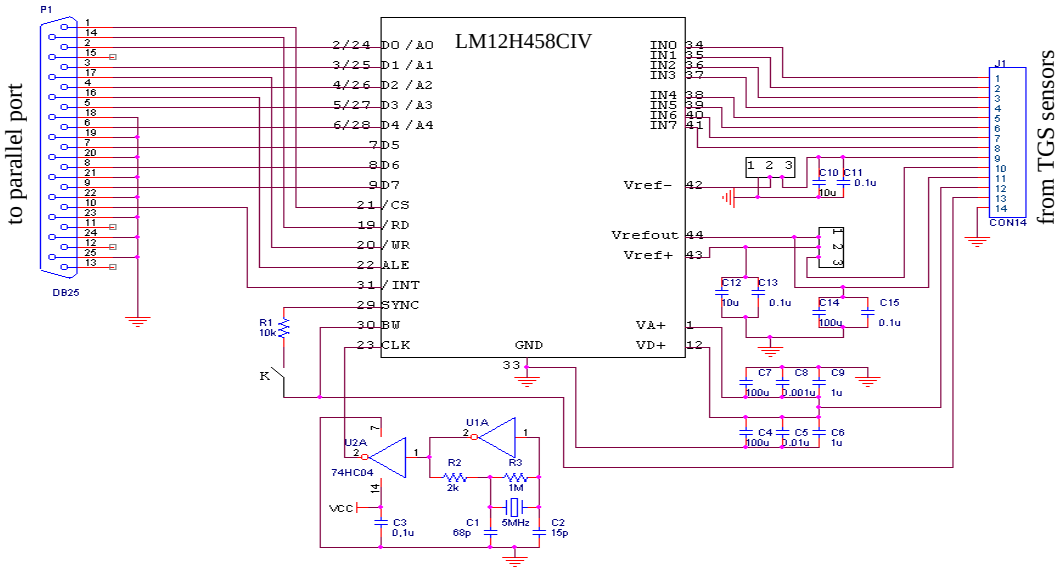

Figure 4. Architecture of data acquisition board through parallel port of PC.

II. Conclusions

The presented system constitutes a versatile, flexible, cheap, high-speed digital data acquisition system that combined with LabView software and the power of Internet, become an virtual laboratory for on-line environmental monitoring.

References

[1] Figaro Engineering Inc., “Technical Information for TGS 813/813C”, Revised 7/96.
[2] National Semiconductor, “Technical Information for LM12458 ”, July 1999