USB and RS232 voltage datalogger

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RESUMEN / *ABSTRACT*

The design and construction of a PIC microcontroller based datalogger with USB 2.0 and RS232 interfaces is presented. The datalogger has one 0 to +10VDC analogue input, 10bits ADC, Real Time Clock, 4k sample room on the microcontroller's program flash memory and an external DC power supply. This paper proposes a cheap variant to construct such device widely used in meteorological and environmental instrumentation among others. The prototype was attached to an Ultraviolet Photometric O_3 Analyzer for recording the environmental (tropospheric) ozone concentration in a control station at the Havana city.

Key words: datalogger, USB, enviromental ozone

INTRODUCTION

The dataloggers are electronic devices that capture data and keep that data in their memory together with the date and time or the location the data was captured. They are usually battery powered and have an interface to download or communicate the data. There are dataloggers with a specific sensor or just have voltage or current analogue inputs [1].

The advance of the semiconductor and electronics industry offers more integrated chips that simplify the hardware for such devices. The USB interface is gaining more space in the instrumentation and is displacing the others one interfaces. The same happens with the PCs where some times the USB is the only one interface presented, especially in portables ones [1, 2, 3].

A simple and highly integrated dual interface datalogger could be implemented using the advantages of the Microchip PIC microcontrollers (low consumption, built-in ADC, dual interface and In-Circuit System Programming).

The *lei motive* for developing such an instrument was the necessity of the Atmosphere Pollution National Centre of the Cuban Meteorological Institute of recording the environmental O_3 concentration. This center owned an Ultraviolet Photometric O_3 Analyzer, Model 49, from Thermo Environmental Instruments Inc. but the analyzer didn't have the datalogger part for registering the measured concentration. However an analog 0 to +10VDC output for a recorder was present and its value was proportional to the measured environmental O_3 concentration [4].

At the end a USB and RS232 voltage datalogger was attached to the Ultraviolet Photometric O_3 Analyzer allowing the registration of the behavior of the environmental O_3 concentration of Havana city in a new control station.

METHODHOLOGY

It was decided to design a datalogger similar to those in the market [7, 8] and not only to satisfy the needs of the Atmosphere Pollution National Centre but also to be a new CEADEN product able to be adapted to other applications.

a) *Hardware*

As basic core of the data logger was selected the PIC microcontroller PIC18F2455 from MICROCHIP as it has the following hardware characteristics [5]:

- USB 2.0 and RS232 Interface.
- 10bit ADC.
- Non volatile flash memory.
- Low power.
- Low cost.

A part of the program flash memory space was reserved to be used for the data storage avoiding the use of an additional memory chip. The two interfaces will assure the communication and the data transfer with almost any PC (new and old ones). The 10bit ADC will serve for the digitalization of the analog data delivered by the ozone analyzer.

An external reference of +5VDC for the microcontroller's ADC was used and the In-Circuit System Programming (ICSP) capability was implemented.

To complete the datalogger a Real Time Clock (RTC) DS12887 from Dallas Semiconductor – Maxim [6] was added. Its function was to give the date and time of the measurements. This chip has built-in crystal oscillator and battery. The RTC's

interrupt output was programmed to generate periodic interruptions to the microcontroller according with the sample rate (1minute at least).

As power supply a commercial AC/DC external adapter was used to keep the device's low cost and to make possible that the device could be powered by external batteries. A small and typical regulation circuit was added. Due to the low consumption of the device the power input range could be as wide as from +7.9VDC to +19VDC.

To guarantee the RS232 standard levels the popular +5V powered chip MAX233 was used.

After the PCB design process a 7x7cm board was obtained (Fig. 1).

b) *Software*

Both the firmware and the application program of the device were developed. The application program (USB Data Logger) was made with LabVIEW and has the function of set/update the time and date and set the sample time of the datalogger (Fig. 2).

Also the program collects the data from the datalogger and visualizes it in a program window to then be exported as a Microsoft Excel file (Fig. 3).

As the datalogger was connected to an Ultraviolet Photometric O_3 Analyzer the program shows the acquired data in units of ppb (Fig. 3). A reset mark (RST) in the data indicates that the device was reseted or powered up.

RESULTS AND DISCUSSION

One of the results was to make possible to use an Ultraviolet Photometric O_3 Analyzer in the automated monitoring of the environmental ozone concentration in a control station in the Havana city (Fig. 4). This instrument is employed in the Ozone Early Warning System (SAT-O3) of the Meteorological Center and National Insurance Enterprise (ESEN) to prevent irreversible damages to the crops [9].

The other important result is the datalogger itself as it is an independent of application instrument. It's a dual interface device that gives more connectivity options to the user; it's a low cost device with a wide voltage power supply range (from +7.9VDC to +19VDC) and low power consumption (no more than 20mA in the specified voltage supply range).

CONCLUSIONS

A dual interface (USB and RS232), one analogue input, low power and low cost datalogger was developed. The data is stored in a free part of the program memory space.

The datalogger was successfully attached to an O3 Analyzer allowing the monitoring of the environmental O3 concentration in the city of Havana.

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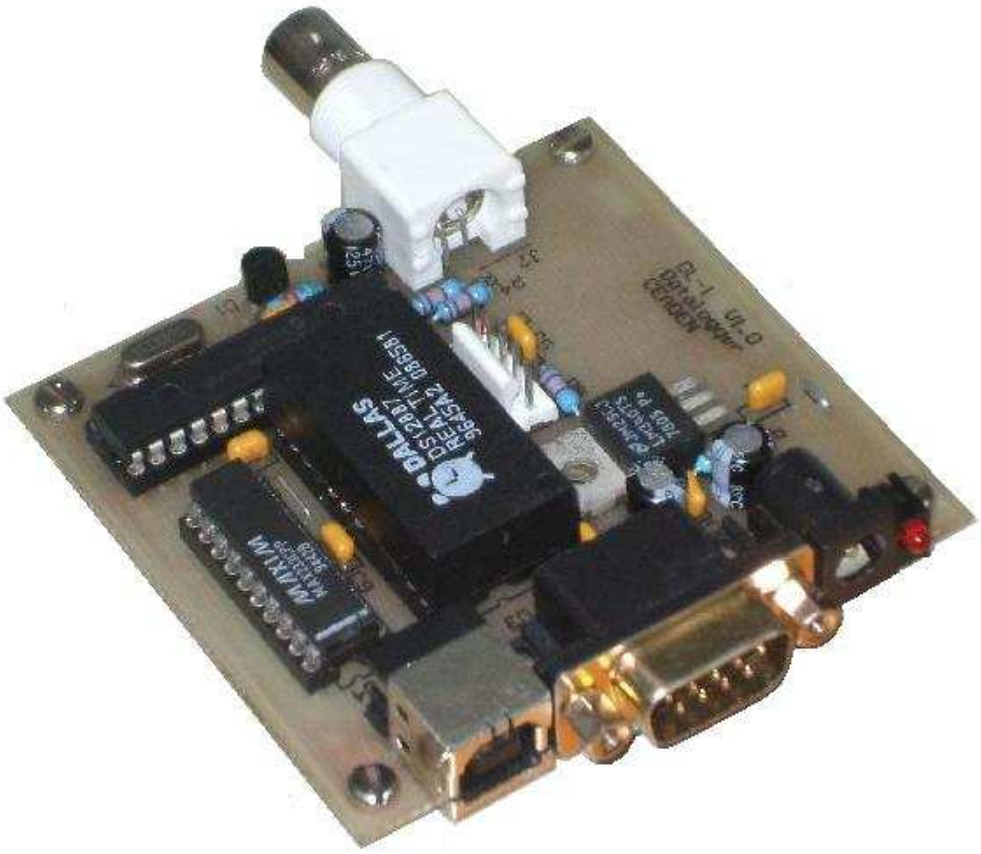

Figura 1. Datalogger's assembled board.

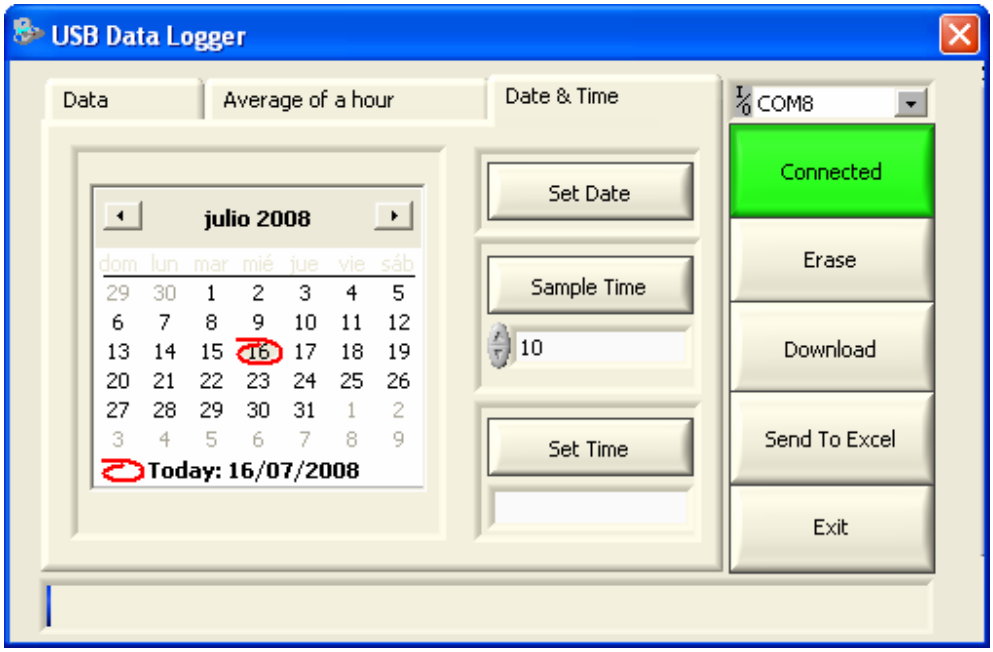

Figura 2. USB Data Logger program (Date & Time tab).

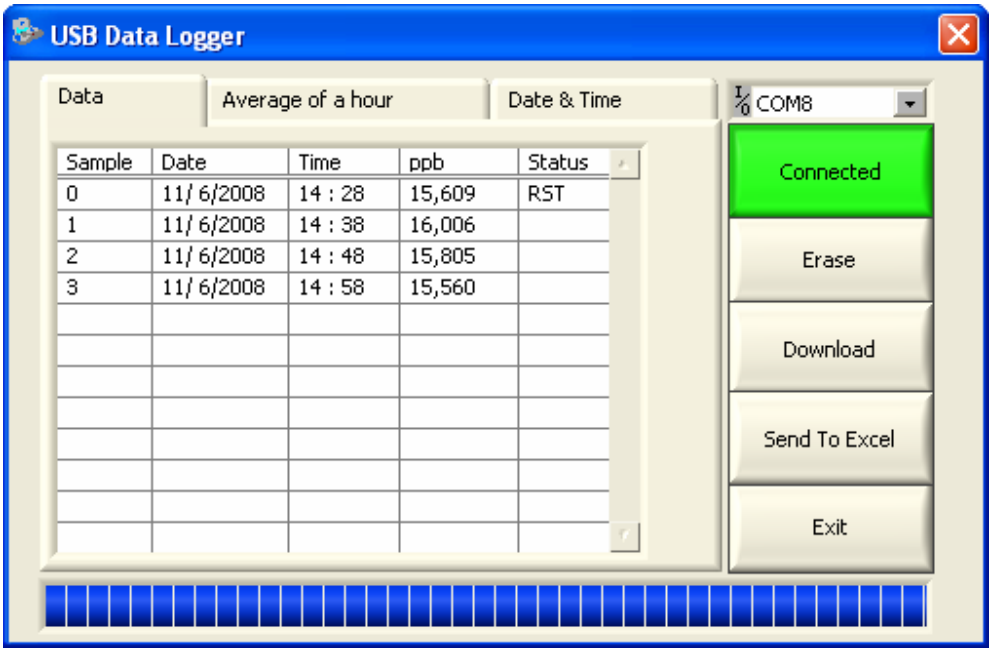

Figura 3. USB Data Logger program (Data tab).

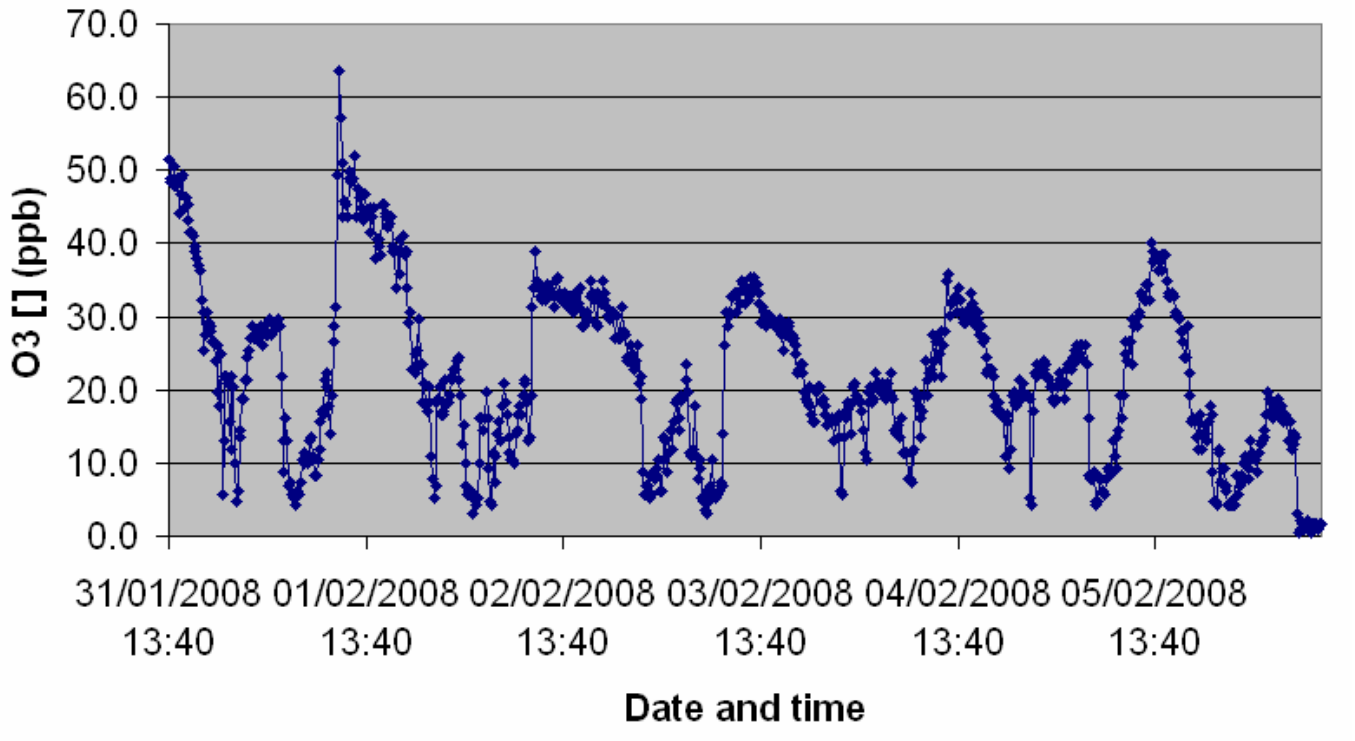

Figura 4. Acquired environmental O_3 concentration data in a 6-days period in the Havana city.