

New educational material for in vitro-laboratories

D. STELLAS, E. PATSAVOUDI, D. VATTIS
Department of Medical Instrumentation Technology
Technological Educational Institution of Athens
Agiou Spiridonos Str., Egaleo, Athens, 12210
GREECE

Abstract: This paper presents the potentials to upgrade an educational in vitro laboratory using common devices and a personal computer. In a pilot project we have connected a digital balance with a PC through an RS232 port and in Microsoft's visual basic programming environment we have created the code needed for the interface between the two devices. In addition, we have succeeded in interfacing a common pH-meter connected to a digital burette with a personal computer. The initial results were encouraging, suggesting that we are able to upgrade an educational in vitro laboratory and in the same time to maintain its educative role.

Key Words: - in vitro laboratory, visual basic, digital equipment interface.

1 Introduction *

The scientific instruments that are used in a routine base in a modern in vitro laboratory are controlled nowadays by built-in microprocessors or by specifically developed microcomputers, a fact that makes the device very expensive but their use almost automatic. Due to their high price an in vitro educational laboratory cannot easily possess this kind of equipment. Moreover, the main goal of an educational laboratory is to teach to its students the principals according to which new scientific devices operate. Having this in mind, we have tried to upgrade the traditional teaching methods using common in vitro laboratory equipment (balances, pH-meters etc), with a personal computer interface. This interface requires an established connection between the device and the PC and special software. [1-3]

The connection and the interface of a device with a personal computer (PC) give us the opportunity to

transfer and exchange data between the two devices. If there is a digital output in the device the connection is a simple task, and it is established through an RS232 port, that is connected directly to a certain COM of the PC. But if there is only an analog port, then the connection is a little more complicated. In order to have the possibility to convert an analog signal to a digital signal we had to obtain a 14-bit A/D-D/A data acquisition card. Except of the connection of the devices to the personal computer, our main problem was the fact that we had to develop specific software that could give us the opportunity to manipulate the incoming data. We have developed our software in a user-friendly environment, which is Microsoft Visual Basic (V.B). This programming environment has given us the possibility to write in a conventional language, an easily understandable code that can process our data. Furthermore our applications can run in Microsoft Windows for PC's, without additional licensing. [4-7]

2 Methodology

In this work we have used the digital balance (290 SCS) of the Precisa Company, the digital pH-meter (691 pH-meter) and the digital burette (Dossimat 665) of the Ω metrohm Company. All three devices were built with a RS232 port, through which we have connected them to the personal computer. We have used Visual Basic (V.B) as our basic tool to create our

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new software, in order to control and manipulate data coming from the different kind of devices. Writing in visual basic was not a difficult task to do. Our projects in V.B were consisted of basic forms and sub-forms. The form acts as a window that permits the program operator to communicate with the computer and the instrument to which it is interfaced. V.B provides also the opportunity to the user to set a number of controls in order to have the ability to manipulate data easily. So, every form and control has a predefined set of events. If one of these events occurs, the program invokes the code that is associated with these events. [8-10]

The execution of a procedural application starts with the first line from the code and follows a predefined pathway. On the contrary in an event-driven application the pathway is not predetermined and the program executes different code sections as a response to different events. Events may be triggered by user's actions or by other applications.

Another tricky point in the application was the fact that Visual basic's commands and functions do not have a single command that can give us the ability to send and receive bytes from the hardware I/O ports. However V.B can communicate with Dynamic Link Libraries (DLL). Through a specific DLL we can have the desired result, which is an established communication between the device and the PC and of course the ability to send and receive data. The manufacturer of 14-bit A/D-D/A data acquisition card had provided the DLLs needed.

The last thing that we took in mind was the fact that the code in V.B is stored in modules. Simple applications can consist a form and all the code can be stored in a form module. Simple modules that were made could be reused in many applications, a fact that was less time consuming.

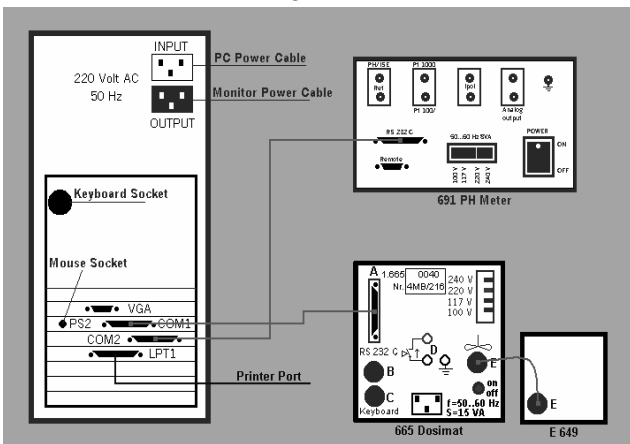


Fig1: connection with PC

3 Results

So far we have managed to connect and interface a digital balance, a pH-meter and a digital burette with a personal computer. The connection with the digital balance and the PC was established through the RS232 port of the balance and COM1 of the PC. The connection of the digital burette and the pH-meter with the PC was established as it shown in the graphic (Fig.1).

The interface of these devices with the PC was based on software that was made in Microsoft visual basic environment. To be more specific we should examine each case separately. The first device that we have tried to make an interface with the PC was a digital balance. The manufacturer has provided us with specific software of the device, so the only task we had was to connect the device to the PC and to create software capable to process the data sent from the device. We have made two different V.B forms, the first one was made for general purposes and the other one was made for specific uses of the device. Our effort was to create software capable to manipulate data from the balance and in the same time to interact with the abilities of the balance in order to play an educative role. To be more precise, the students can learn the basic abilities of the balance and in the same time observe different graphs appearing as a consequence of changing the data of the device. The figures below show the two different kinds of V.B forms that we have made.

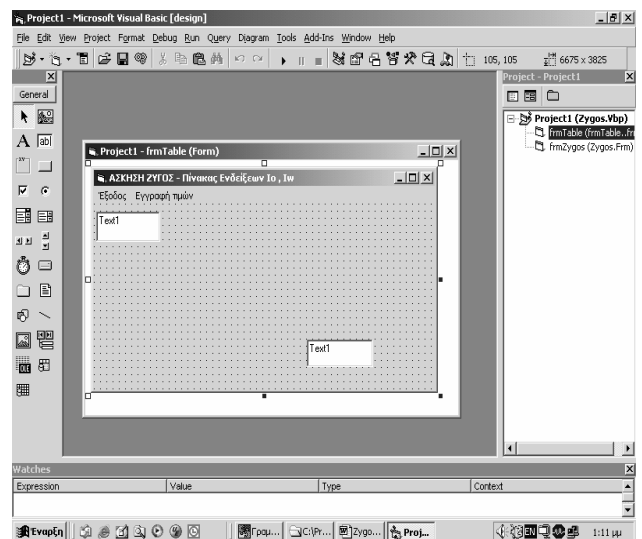


FIG.2: General Form

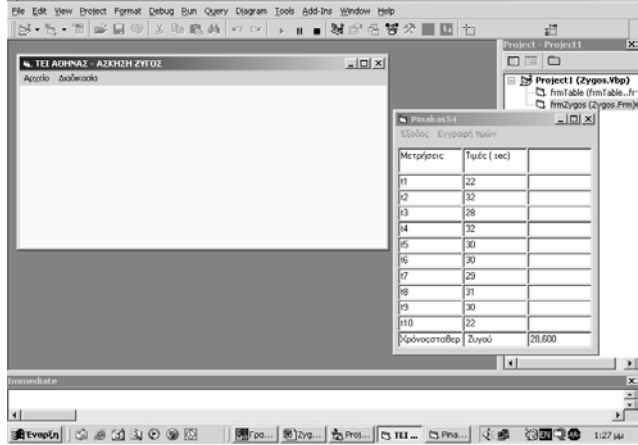


FIG.3: Specific Form

With the other two devices we have tried to simulate an in vitro totally automatic titration. For this kind of experiment we need a pH-meter, a burette, a stirrer and of course a personal computer. All these devices must be connected to the PC. Furthermore there must be a certain software that has the ability to control all three devices. The software was made in V.B environment, as it is described in the text above. The next figure is one characteristic example of the forms, by which the code is consisted of.

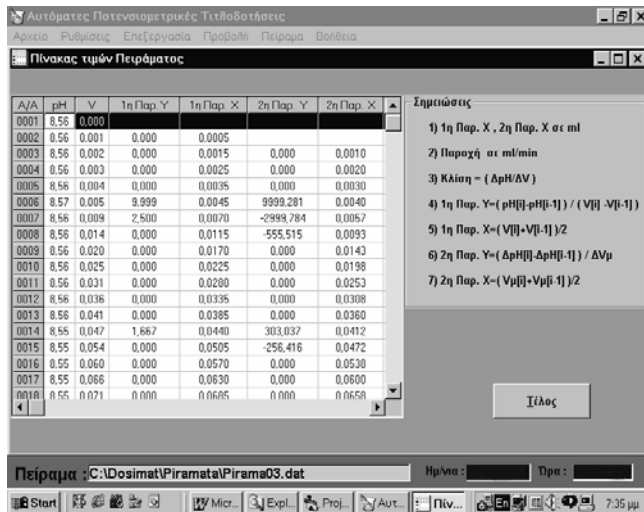


FIG.4

With this interface our students are able to learn the principals of the two devices and practice in a totally automatic environment, as it is a routine nowadays in a modern in vitro laboratory. In addition they can calibrate the devices through the computer, collect and process all the incoming data and see how

their graphs change in dependence to the alteration of the given data.

4 Discussion

As it is mentioned above, this work is a part of a larger program, which has as an objective the upgrading of an educational in vitro laboratory supplied with common devices with analog or digital outputs and a PC.

The goal of this work was to exploit the potential of upgrading an educational in vitro laboratory using the common devices and a personal computer. The educative role of an in vitro laboratory is to demonstrate the operation of certain devices that are used frequently in modern in vitro laboratories and to teach the principals on which the operation of a device is based on. Although that the operating principals of modern devices remain the same, their operation becomes more and more automatic due to the rapid advancement of technology. So it is our obligation to upgrade the educational techniques in order to simulate better the existing conditions in a modern in vitro laboratory.

One of the usual tasks that students perform during an experiment is to gather the data in order to study the abilities of a device and then to form a report that shows in charts the different abilities of the device. The interface between a PC and a device through a RS232 port or through a specific card that converts analog to digital signal gives the automatic impression. The specially designed program will help the students to operate the device, gather the data and to create their personal charts according the values of the experiment. Moreover, the program will guide the students through out the steps of every experiment helping them to concentrate on the experimental procedure. This special ability of the program is better for them rather than to follow printed instructions. In addition, the program will help the students to eliminate their errors during the experiment and show them the proper way to analyze and present their data, to create plots and finally to form a report sheet. The program is simple and user-friendly and is consisted of internal checkpoints, a fact that gives the opportunity to the students to correct possible mistakes and interact with the PC in an active way and not simply by following instructions.

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