

# Virtual Labs in ELFE – First Steps

VLADISLAV SLAVOV, ASYA SENOVA, KAMELIYA YOTOVSKA

*Abstract:* - The virtual labs concept is one of the challenges in higher education especially in the engineering education. Being more interactive they allow the students acquiring practical knowledge remotely. The English Language Faculty of Engineering has started a new project of implementation of the virtual laboratory conception in industrial engineering education under the Human Resources Development program. This paper gives an example of a virtual exercise and shows the first steps of how to create such.

*Key-Words:* - Virtual Laboratory, Engineering Education, LabVIEW, ELFE, feedback, e-learning

## I. INTRODUCTION

The English Language Faculty of Engineering (ELFE) in the Technical University of Sofia (TUS) was established in 1992. It started with a bachelor specialty of Industrial engineering and now the students can choose between 4 master specialties as well. Every year between 200 and 250 students start their education in ELFE.

The virtual laboratories are one of the latest developments in the modern education [1]. The implementation of the virtual laboratories concept [2] in the engineering education is not an easy task though. The connection between the laboratory exercises and the theoretical knowledge (lectures) is very important in the engineering disciplines. And as long as we can say that the transfer of theoretical knowledge using contemporary approaches as e-learning and m-learning has improved significantly in the past few years [3,4], the virtual labs' implementation in the higher education (especially in the engineering education) makes small steps.

Under a development project ELFE decided to implement a few virtual labs into the educational process. The expectations are to facilitate the students in accepting the educational material with extra possibilities to execute their laboratory work remotely – from their home computers instead of visiting the “real” labs. This first trial for ELFE of implementation the virtual laboratory concept in the real engineering education is supposed to lead to further “stronger” and stable development of the educational process supplying the students with more options to do their duties – remote study (distant education).

## II. PROBLEM FORMULATION

The advantages of the virtual laboratories are well known. Their development has started in the last decade of the 20<sup>th</sup> century and has increased rapidly with the production of cheaper and faster powerful computers as well as the development of the web technologies. Their main task to solve the three resource type problems related to time, space and saving money has enhanced lots of scientists to put efforts in

the evolution of the basic idea – global access to laboratory equipment anytime.

From simulations to real experiments the virtual laboratories has been named after remote laboratories, web-based laboratories, computer based laboratories and so on. But no matter the name one fact is indisputable - the advantages that come from their development. As far as it concerns the education the virtual laboratories can improve significantly the accessibility of the knowledge since they offer modern methods bounded by a strong platform that user orientated and aims only to facilitate.

Till now there is not experience in using the virtual laboratories in the education of students in ELFE. The problem comes from the not cheap components necessary to build such a laboratory together with “tuning” of the teaching staff to use this “not traditional” resource of education. The big question and the most important factor is how the students will accept the idea. Is it really easier for them or since they do not have an experience working that way they will prefer to keep on the status quo?

## III. PROBLEM SOLUTION

As it can be seen the problem is that the easiest thing does not seem to happen so easy. To translate that question it can be asked other way – how not to make the students to try something new but the new to attract them to try?

The development of the virtual labs in ELFE can be divided into 6 stages (fig 2):

- 1) Choosing appropriate laboratory exercises to be virtualized.
- 2) Choosing appropriate software for virtualization
- 3) Virtualization of the laboratory exercise
- 4) Improving of the interface
- 5) Producing manual to lead the students through the execution
- 6) Feedback

In this article we will describe shortly just one of the exercises of the laboratory that was virtualized just to show the pattern.

The laboratory for Information measurement systems is one of the renewed laboratories in the faculty. Equipped with new computers and educational laboratory equipment form FEEDBACK and National Instruments it seemed like a natural choice since it responded to all necessary conditions for virtualizations. The FEEDBACK board Micamaster MIC960 is connected with a computer with a controller via RS 232 interface (fig. 1). On the board, 8 LEDs are placed so to be controlled by the computer sending appropriate commands to the controller.

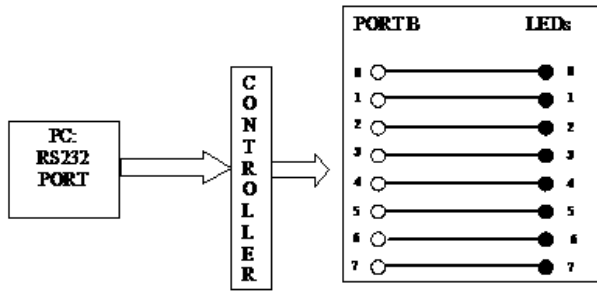


Fig.1

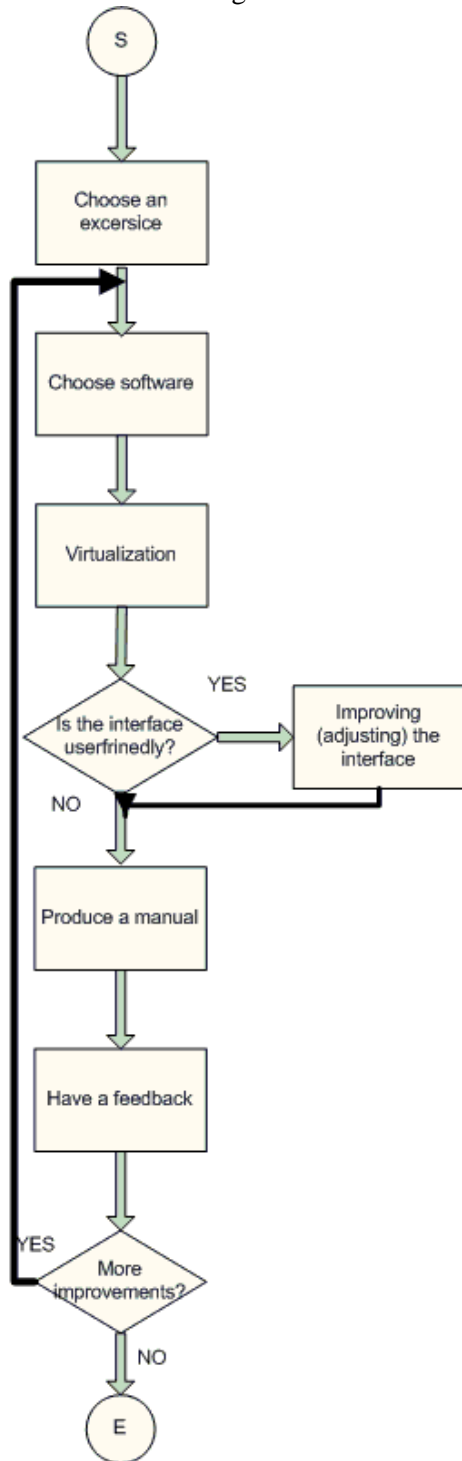


Fig.2

The task is simple – the students should send decimal numbers from the computer to the LEDs so to make them turn on and off. The preliminary information about the control functions of the controller is assured. With this stage 1 has been fulfilled.

To choose an appropriate software is not an easy task and very relative [5]. For our purpose we chose National Instruments' LabVIEW – a very strong tool to accomplish such tasks.

The virtualization process did not take very long. It should be mentioned that the students would control real hardware in their work. In other words they would virtually control real devices so the real LEDs on the MICAMASTER board would be controlled.

A LabVIEW block diagram was created together with a front panel where from the students would control the virtual exercise (fig.3 and 4).

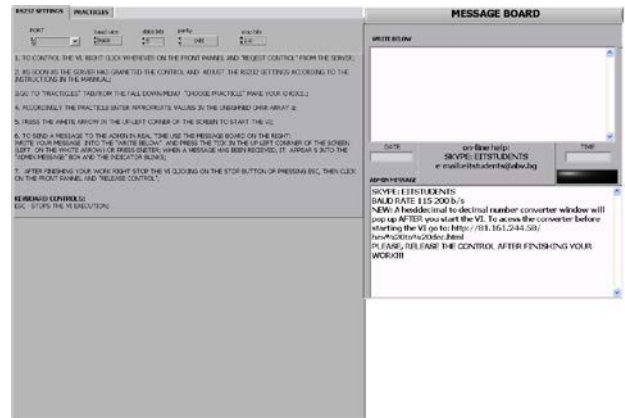


Fig. 3

In the first tab the students are required to insert correct communication parameters for the serial port (the computer and the controller are connected via RS232).

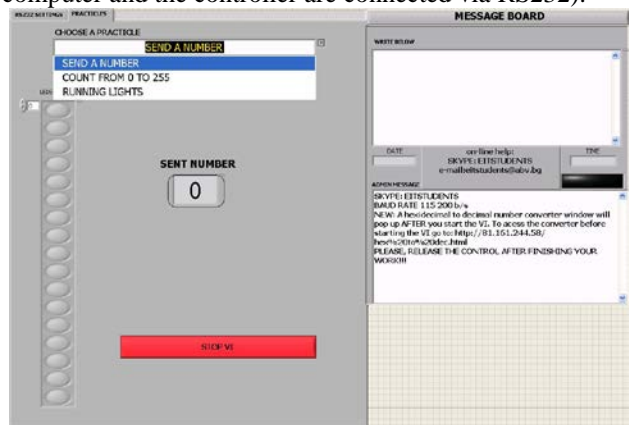


Fig. 4

The second tab is the in fact working space. From here, the students choose a task to complete (according to the individual assignment) and try to manage the functions of the controller so to send the numbers from the computer to the LEDs.

Of course to know what exactly to do the students were supplied with a manual where all the necessary information of “how does it work?” was presented (stage 5).

Stage 4 is in fact the threshold of the development. On one hand the interface is very important just to attract the students to the exercise, on the other it should facilitate them so to make them feel like they are in a real environment. A key issue was that the virtual exercise should supply enough functionality not only to the students but to the teachers as well. So imagine, the students does something and the teacher cannot control it or even correct it!? Not a good educational approach. Important functionality that should be implemented in each virtual exercise and virtual laboratory is the communication tool or the feedback tool. In other words the teacher should have the opportunity to help the student now, on-line in real time if he/she needs it and the student should have the opportunity to enquire that help. Furthermore, the teacher might need to collect a list of the students who had logged in and executed the exercise -to have a summary of “who, when and how” did the assignment.

In our case a “message board” was developed to facilitate the real-time communication between the two sides. Of course, the LabVIEW’s implemented functionality significantly facilitated the process described above.

The last stage is to receive a feedback from the students. This last stage has not been executed yet. The feedback will be under a questionnaire developed especially to estimate the quality of the virtual labs from the students point of view. The questionnaire consists of three sections:

- 1) Categorization – this section is necessary to categorize the target group on certain criteria
- 2) Estimation - This section aims to assess the quality of training in the virtual laboratory system of signs. Responses are required.
- 3) Improvement – the section is designed based on comments and recommendations of the students to improve the quality of education in the virtual laboratory.

In the following table how the second section looks like:

Table 1: Section 2 of the questionnaire for estimation of the virtual lab

<i>I found the virtual laboratory:</i>	1	2	3	4	5
Easy to operate					
Easy to understand					
Flexible to use in relation to time and place					

Stimulating					
Satisfying of learning activities					
I learn and understand more in a virtual lab environment than a traditional lab					
I can use virtual laboratory (over the Internet) instead of physically staying in a laboratory					
Opportunity to use virtual laboratory at any time and anywhere					
Allows more opportunities to practice experiments					
Provides a safe workshop environment without the need for supervision					
Enhances my enthusiasm for learning through interactivity					
Increase my motivation for learning					
Increase my IT literacy					

#### IV. CONCLUSION

In 2013 the English Faculty of Engineering started the development of virtual laboratories for engineering education in Technical University of Sofia. This first step is based on methodology designed after a deep research of existing solutions.

Although it is not finished yet since the last but very important component of the process is not finished – the feedback. It is expected that the feedback will give food for plenty of considerations for improvements. Nevertheless, it can be considered that the direction is right.

#### ACKNOWLEDGEMENT

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