REMOTE CONNECTION FOR EXTENDED AVAILABILITY OF THE EDUCATIONAL LAB

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Abstract - *A virtual instrument for the remote control of measurement instruments has been realised. It enables the user to control the characteristic parameters of the instruments, to start the measurement process and to acquire the obtained results. At this step the implemented approach can enhance the availability of the lab.*

Keywords - Educational laboratory, remote measurement, virtual systems, teaching measurement at Universities, interactive tool.

1. INTRODUCTION

It has been recognised that practical experimentation has a great and even increasing importance in education and, consequently, laboratory sessions are significantly important throughout engineering courses: the students have to spend a long time in experimental activity in the laboratory for performing the required training; moreover they must write the technical report, which is the last but not the least duty for them.

Indeed, for a large number of students great effort is needed to realise an adequate didactic experimental apparatus with a number of places of work and, of course, a suitable staff of tutors is needed.

Only particular conditions can guarantee the availability of the complex set of requirements. Unfortunately, for many reasons the students can't spend enough time in the laboratory activities and, moreover, an insufficient number of tutors is generally available, which drastically reduces the availability of the laboratory.

On the other hand, driven measurement systems as well as simulation software can reduce attention and interest of the undergraduates, becoming inadequate for educational tasks.

In order to reduce the outlined drawbacks, mainly the boring waste of time for writing an accurate technical report, by using advanced technologies an interactive environment has been recently developed [1]. It is based on a commonly used word processor for writing the technical reports while performing experiments and has been used for educational purposes during laboratory sessions on electrical and electronic measurement courses.

Digital instruments based on the HP-IB (Hewlett Packard Interface Bus) connected to a host computer were taken into account for the realisation of an interactive set of instruments (Fig. 1).

In order to establish communication between the Windows environment and the instruments, the "HP Interactive" tool was used. The control of the digital instruments is performed by the computer, and the SCPI language (Standard Command for Programmable Instruments) was used for developing suitable routines.

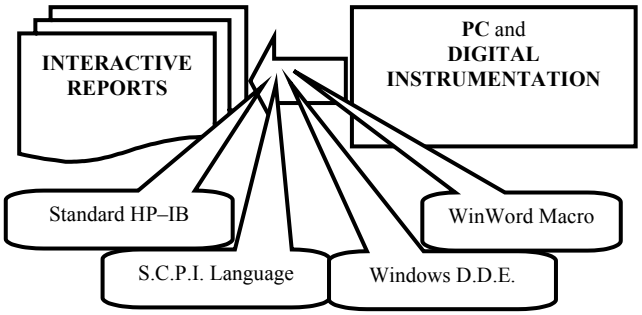

Fig. 1 - A schematic representation of the interactive environment.

A number of macro structure, written in Visual Basic, were developed to control the instruments and import the measurement results in the technical report.

In the recent technical literature [2] some ideas are highlighted:

- "recent developments in virtual instrument technologies, remote measurements, distributed systems and interactive educational environments greatly changed the traditional approach to teaching and practical experimentation at any educational level";
- "the interest in virtual instruments is mainly due to the cost of experimental laboratories at educational sites with a large number of students";
- "the tutored activities" must be restricted "only to substantial matter";
- "**distance learning**" provides in-house educational facilities and reduced the time spent in an educational laboratory.

On this basis, it seems that distance learning can be the possible way for greatly enhancing the availability of the laboratory. The various features must be implemented step by step and the effectiveness of the choices must be tested for the educational impact.

2. REMOTE CONTROL OF THE INSTRUMENTS

According to the previous work and taking into account the opportunities provided by the technology developments, in this work a virtual instrument for the remote control of

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measurement instruments has been realised. It consists of two different parts: the first one is located in the laboratory, were some basic digital instruments are connected to a personal computer which, in turn, is connected to the international network; the second part is simply represented by a remote personal computer, connected to the international network (Fig. 2).

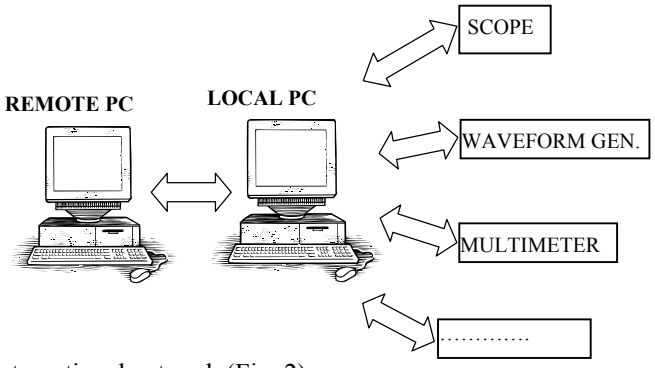

Fig. 2 – Remote measurement system.

The remote virtual instrument enables the user to control the characteristic parameters of the instruments, to start the measurement process and to acquire the obtained results. The user interface has been implemented in LabView, the software running on the remote PC emulates the front panel of each instrument.

The configuration of the local station is shown in Fig. 3.

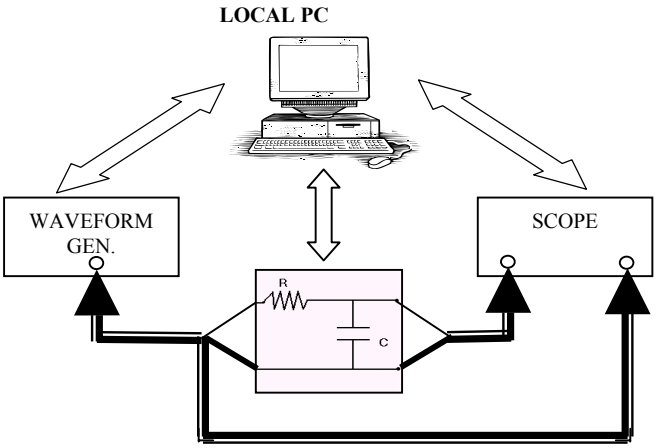

Fig. 3 –Local measurement equipment.

A function generator supplies the RC , the input and output signals are applied to the channels of the oscilloscope.

The software running on the local PC performs the management of the instruments, according to the requirements of the remote users.

3. EXAMPLE OF REMOTE MEASUREMENTS

At present, the remote user can carry out the analysis of a first order circuit (with fixed values of the parameters) in the frequency domain as well as in the time domain.

The user interface provides a reproduction of the front panel of the local instruments, as it is shown in Fig. 4.

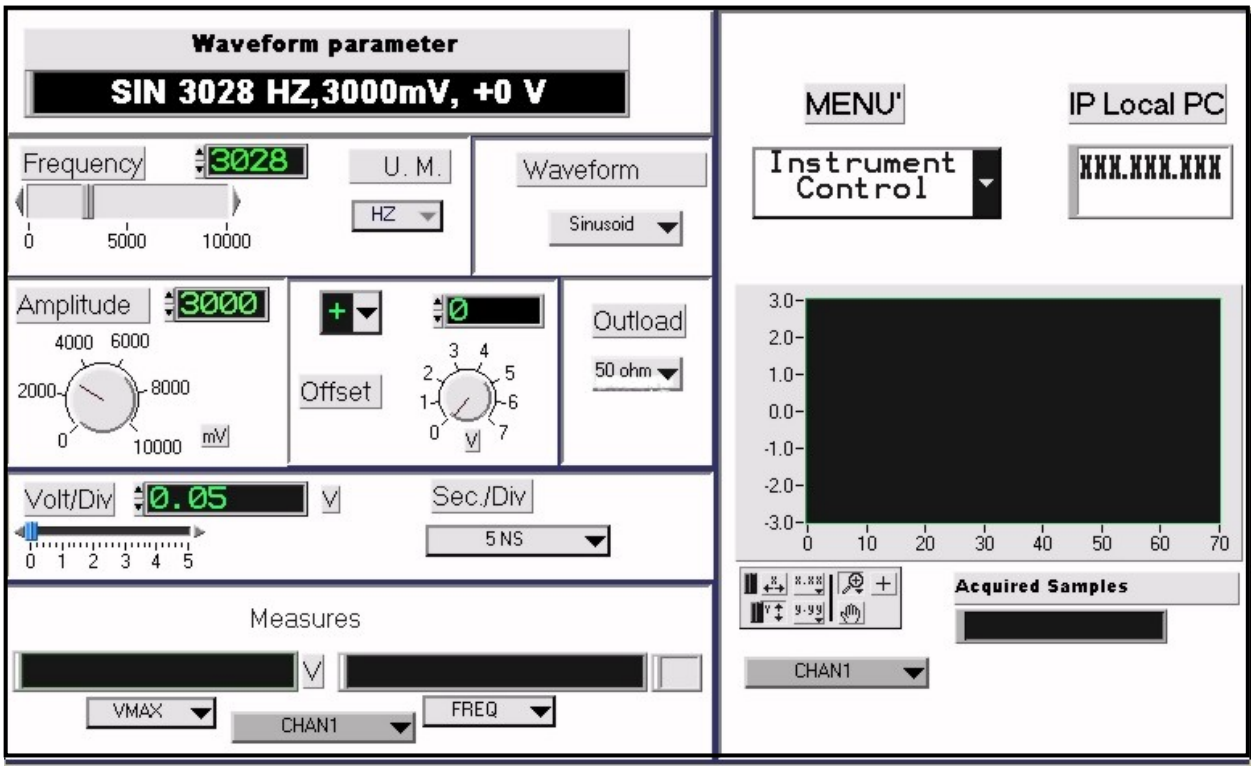

Fig. 4 – Front panel for the remote station.

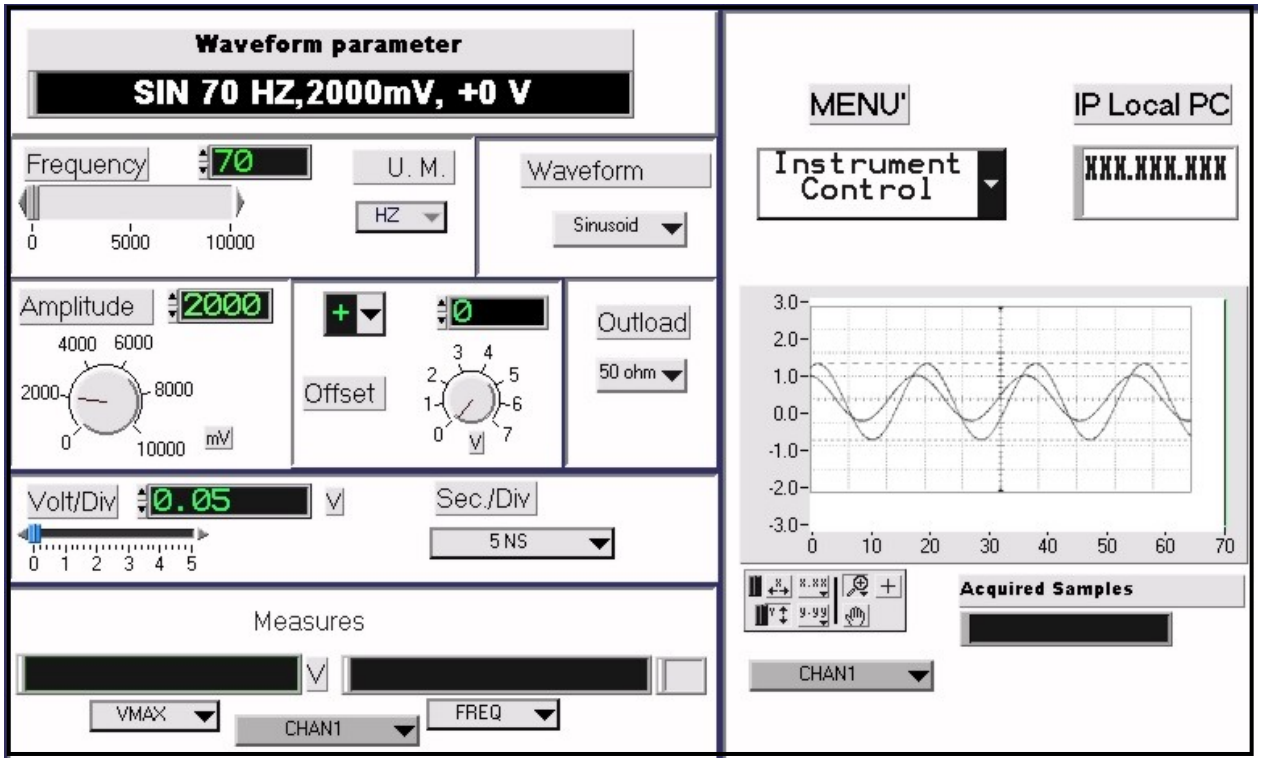

Fig. 5 – Front panel of the remote instrument for the frequency domain analysis.

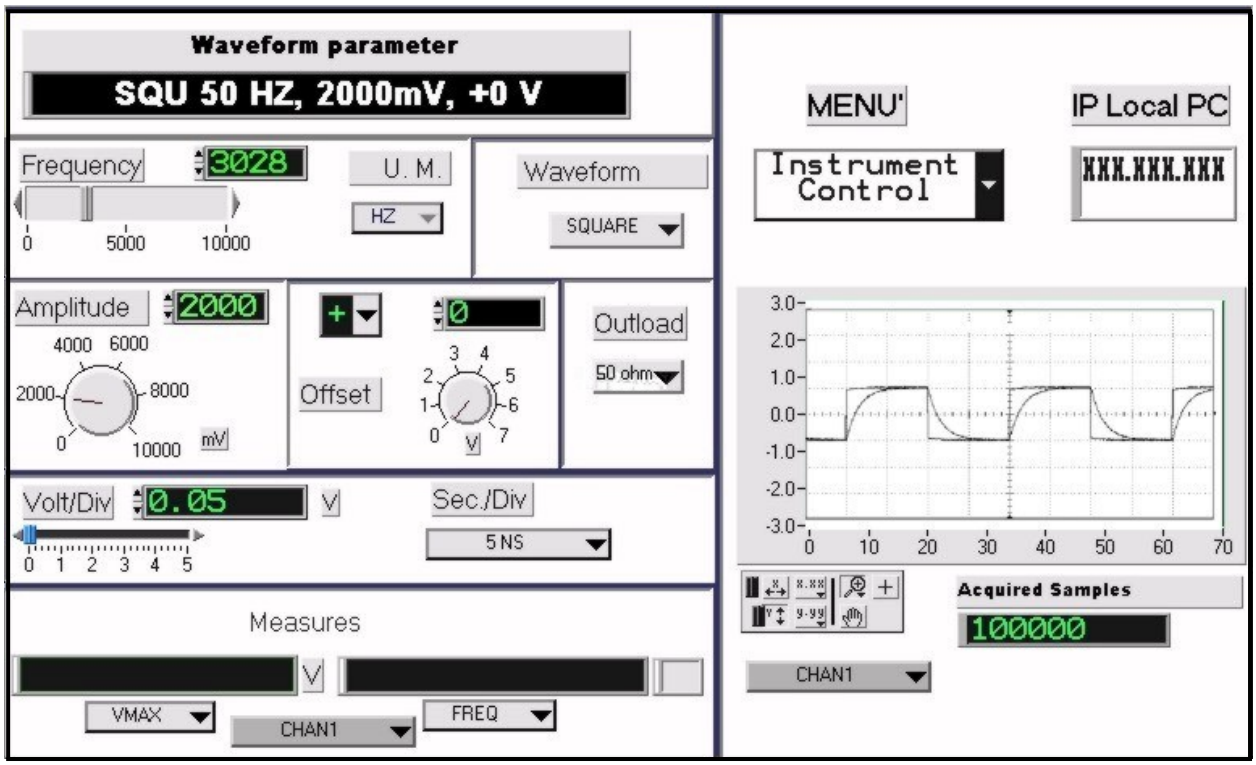

Fig. 6 – Front panel of the remote instrument for the time domain analysis.

As an example, the remote user can carry out the frequency analysis in order to plot the Bode diagrams. The user can obtain the data presented in Table 1 as in the lab, directly using the instruments manually. Of course, the educational impact of such working way must be tested.

Fig. 5 shows the result of a particular measure.

Table 1 – Results of a set of remote measurements.

Freq. [Hz]	Vu [V]	E [V]	G	G(dB)	Phase
0	**2**	**2**	**1**	**0**	**2,865984**
50	**2**	**2**	**1**	**0**	**6,603625**
60	**1,734**	**2**	**0,867**	**-1,23962**	**23,95381**
70	**1,641**	**2**	**0,828**	**-1,63939**	**28,97972**
80	**1,578**	**2**	**0,789**	**-2,05846**	**33,16144**
90	**1,5**	**2**	**0,75**	**-2,49877**	**36,40577**
100	**1,437**	**2**	**0,7185**	**-2,87146**	**38,68219**
106	**1,391**	**2**	**0,6955**	**-3,15406**	**43,43254**
500	**1,001**	**2**	**0,5005**	**-6,01192**	**56,98206**
1000	**0,218**	**2**	**0,109**	**-19,2515**	**71,80513**
2000	**0,178**	**2**	**0,089**	**-21,0122**	**73,7398**
3000	**0,1**	**2**	**0,05**	**-26,0206**	**74,7964**
5000	**0,05**	**2**	**0,025**	**-32,0412**	**80,06363**
8000	**0,03**	**2**	**0,015**	**-36,4782**	**84,26803**
10000	**0,024**	**2**	**0,012**	**-38,4164**	**90**

The remote analysis in the time domain can be carried out in the same way; in this case the function generator will supply a square wave of suitable frequency and the front panel will show the results as in fig. 6.

4. CONCLUSIONS

Various autonomous stations have been prepared in the laboratory and a local-area network has been realised; the local server handles the requirements of the remote users and shares the laboratory resources in order to improve the availability.

It should be emphasised that the used approach fully agrees with the need of changing the traditional approach to teaching in the measurement field.

This approach can be adopted for many student typologies, as it has been pointed out in recent papers: in this work only the undergraduate world has been taken into account, because practical experimentation is becoming more and more important and the large number of students and the limitation of the resources dramatically encourage optimising the availability of the laboratory.

Future developments will enable the remote user varying the values of the parameters (in order to analyse the loading effect on the function generator and the influence of the probe).

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