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REAL TIME INTERNET INSTRUMENTATION

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ABSTRACT

This paper describes the software development of remote access and control for real-time measurement using the Internet connection. The philosophy behind this remote laboratory is based on a client/server computer configuration. The server is the computer that located near the real process and equipped with hardware interface to run an experiment. The client will be any computer that equipped with user interface functions, which gives users the ability to act on the remote experiment. The server software receives the client commands and transmits them to the real process. The progress in Internet-based technology enables the transfer of both data and command at real time. A simple test circuit has been designed for the purpose of measurement. Microsoft Visual Basic was then used to develop the graphical user interface (GUI). This GUI enables users to manipulate the data received according to their needs.

INTRODUCTION

The Internet is a worldwide network of networks which interconnects computers ranging from the simplest personal computers to the most sophisticated mainframes and supercomputers. This network of network is used for an extraordinary range of purpose such as long distance collaborations, retrieving free software and documents, assessing library catalog and logging in to supercomputers. The list of Internet activities and services is large and possible future applications is unlimited. This revolution has creates many ways to enhance learning process and expand educational opportunities for students. For instance, distance learning education and non-conventional classrooms reach more students with specialized instruction and self-paced learning. The interest and proficiency, coupled with the increase in computer ownership amongst students means that the Internet has the potential of becoming a powerful education tool at the university level. The exponential development and diffusion of information technologies of the last decade have produced considerable amount of research and activity in the field of computer-based education [5]. Furthermore, computer networks have become a driving force addressing client-server dynamics and network services. This factor has changed the traditional way to support learning and training activities and the concept of "virtual classroom" and "virtual instrumentation" was introduced.

The concept of virtual instrumentation is to create more powerful, flexible and cost-effective instrumentation systems built around a personal computer (PC) using software as the engine and interface. By combining Internet technology and virtual instrumentation, Internet-enabled instrumentation system can be developed.

Laboratory control of instruments using the local area network (LAN) has been successfully implemented in an earlier research using an oscilloscope attached to a general purpose interface bus (GPIB) controller and a PC [1]. However, the control and data acquisition is localized to a particular LAN zone. In this research, we expand our scope to study whether the same effect can be obtained by placing the control PC remotely from the instrument and connected to the instrument via a wide area network and the Internet. This paper describes the development of the application software to provide remote access and control to an instrument. The system has three components; Internet connection, remote data logging and local data retrieval and user interface.

REMOTE LABORATORY

Remote laboratory is a place where an actual laboratory experiment is run remotely via the Internet [5]. This type of laboratory is well suited to distance learning courses where the students need not be physically present in the laboratory. A software interface is needed to allow those parameters set by the users, can be accepted by the local computer, which is running the experiment. Actual data is recorded during the experiment. The components of the Internet-based remote laboratory are illustrated in Figure 1.

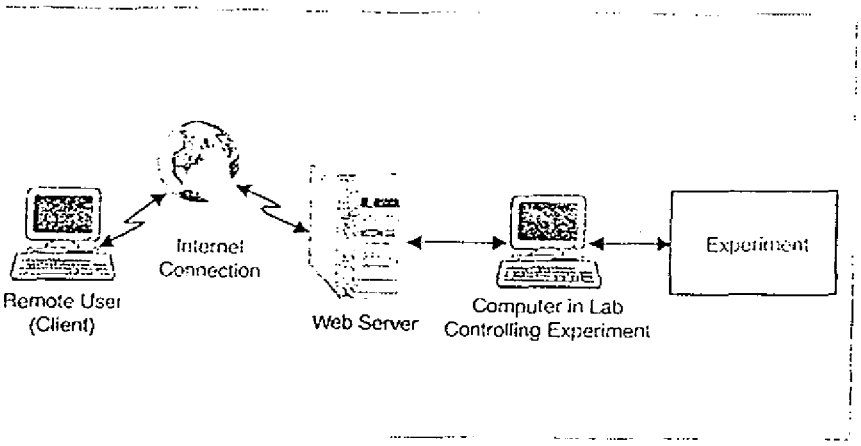


Figure 1. Internet-based remote laboratory

The main concern in setting the remote laboratory is the lack of students' real interaction with the experiment. For this reason, actual experimental set-up can be observed with a video camera, i.e. line video (at a typical rate of 0.2 frames/second) is sent to a web page and the students remote computers receive the digitized compressed video feed [4]. Although this approach offers some kind of real interaction, the remote laboratory is more suitable for students of higher level of education. These students have been familiarized with the actual laboratory session.

HARDWARE SET-UP

A simple hardware set-up is required before the software development can be executed. The supplied cable must be connected to the ALG-232 Controller on one end and to the COM1 port of the PC on the other end. Then, a standard GPIB is connected to the HP-54600A oscilloscope and a signal generator.

Once the cables are connected, the PC is switched on and allowed to boot normally. Then the HP-54600A oscilloscope and the ALG-232 Controller are switched on. The oscilloscope should boot normally and will enter the last set-up of the screen measurement mode. It is a good practice to allow the oscilloscope to be warmed up for a while before commencing any test. This is to allow the electronics and calibration characteristics to settle down to a stable level.

SOFTWARE SET-UP

The set-up program will automatically install, configure and register all components of this package. There are two types of set-up; one for a server and the other is for a client. The server is normally installed in the computer with HP-54600A and ALG-232 connected. If the PC is to be configured as a server, then locate and run the Set-up Program from the Internet_Server Folder. Any numbers of PCs can be configured as client simply by installing the client software. This is done by running the Set-up Program from the Internet_Client Folder.

EXPERIMENT SET-UP

An experiment has been carried out to check the performance of the developed software. A test circuit was built as shown in Figure 2. The purpose of this experiment is to measure the voltage across the capacitor using the oscilloscope. A function generator supplied the input voltage of $20V_{pp}$ for the test circuit. The reading of the oscilloscope was then recorded. Then, the results of this measurement were then obtained from the client PCs using the developed software.

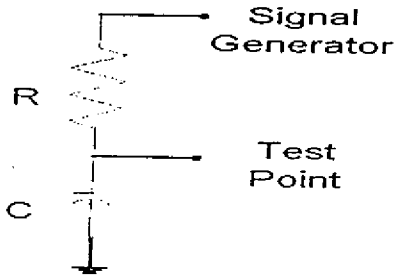


Figure 2. A simple RC test circuit

The server PC performs a continuous data logging from the test circuit. In this experiment, it is limited to the latest ten minutes of acquisition at an interval of 1 second. However, this limit can be customized and set at the remote client. Microsoft Visual Basic was used to develop a graphical user interface (GUI) to enable the full control of the GPIB and to provide an interface with the Internet.

RESULT AND DISCUSSION

Voltage across capacitor, C as shown in Figure 2 is measured using the oscilloscope and verified by using the developed software so that the result will be also obtained from the client PC via the Internet. On the client PC, the client can used appropriate commands to perform the test and get the result. Table 1 shows the result when the value of R = 1 kΩ and C = 1 μF. The input frequency is varied from 1 kHz to 24 kHz.

Table 1. Result obtained on server and client PCs

Frequency (kHz)	V_{PP} (V) From the Osc.	V_{PP} (V) From the client PC
1	17.14	17.14
2	13.13	13.13
3	10.16	10.16
4	8.281	8.281
5	7.031	7.031
6	5.781	5.781
7	5.156	5.156
8	4.687	4.687
9	4.219	4.219
10	3.906	3.906
11	3.334	3.334
12	3.094	3.094
13	2.844	2.844
14	2.688	2.688
15	2.5	2.5
16	2.375	2.375
17	2.250	2.250
18	2.125	2.125
19	2.063	2.063
20	1.937	1.937
21	1.875	1.875
22	1.781	1.781
23	1.750	1.750
24	1.625	1.625

As shown in Table 1, the measurement data obtained from the client PCs are the same as the data on the server PC. This shows that an experiment in actual laboratory can be accessed via the Internet.

The developed software allows automation of measurements using the power of the Internet. It can be used as an educational tool for instrumentation especially in the area of research and development. This also allows greater flexibility and computing power for laboratory and industrial automation work. As more clients can share the same measurement results without having the test sets connected to their PCs, the cost can be reduced compared to the conventional method, where more test sets are required.

CONCLUSION

The concept introduced in this paper may be extended to develop a virtual laboratory or a remote laboratory. In virtual laboratory, if the simulation is very detailed, it can be good substitute for an actual laboratory, especially when it is accompanied by animation. Remote laboratory, which is accessible via the Internet connection will reduce equipment costs and bring the laboratory concepts into courses. This research will directly benefit academic and training institutions. The above concepts will benefit distant learning efforts because laboratory experiment in the main campus UiTM can be "conducted" from anywhere in the world.

Good comments have been received from UiTM Penang campus where engineering courses have started but lack the equipment facilities of the main campus. This research will enable a student at the Penang campus to log in and use an instrument from the main campus easily.

The concept of virtual and remote laboratories may not replace the actual laboratories but certainly will supplement and enrich them.

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