New Frontiers of Analog Communication: Remote Virtual Lab

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Abstract— ***in the present days, the life of a student begins and ends with conduction of laboratory experiments; hence the laboratory experiments play a vital role in students' career. To satisfy this need the system designer concentrates on the accessibility of interfacing tools so that the laboratory hardware can be made available remotely. This even enhances the learning environment of a person. This paper explains about performing experiments on electronic devices using virtual instruments (VI) tools. It also provides the control and measurement parameters of the experiments. We use DOTNET supported tools to support functions such as control & automation of hardware which are used in the experiments, this is highly user friendly. The embedded chips' logic is used here to control the whole module & hence the circuit will be protected from any kind of damage. The system is designed in such a way that, it uses features such as data acquisition, digital control, graphical interface etc.***

Keywords— **Embedded control unit, PC (DOTNET), Data Acquisition, Graphical User Interface.**

I. INTRODUCTION

Current technology enables remote access to laboratory equipment and instruments via Internet. This can have a significant part in engineering education; a part-time student and remote student are able to conduct laboratory experiment remotely. Thus, expensive laboratory equipment becomes readily available to be used by students not having such equipment. Based on this general method, other applications and remote experiments can be developed; we only need to develop the program using DOTNET for controlling different instruments locally and then design the procedure and content for the new experiment quickly and smoothly. The sophisticated and expensive lab equipment which can be used for testing and diagnosing is located at a centrally administered site. These resources can be accessed via the virtual lab framework through the Internet using a generic web browser, e.g., Internet Explorer. The students' access to the equipment will be completely transparent. It will appear that the equipment is local to the student, giving

The student real-time access to the equipment. This paper has to meet following challenges

1. To make Expensive& sophisticated laboratory equipment readily available to students lacking those equipment.
2. To minimize effort on development& management for users and providers of remote labs.
3. To provide common set of services & development tools to conduct experiments on real-time basis.
4. To Experiment quickly & smoothly.
5. To make Accessing transparent & self-accessible.
6. To monitor the experiments, which take long time.

A very general laboratory structure must include:

1. The equipment (the regulated object, in the case of automatic control laboratory) associated with a server computer and a data acquisition card.
2. An interface program, running on the server computer that drives the signals to and from the data acquisition card and manages the information about the students' work;
3. Server software that deals with the communication between the laboratory and the remote students;
4. an informative environment (usually Intranet or Internet)
5. Client software running on the remote(student's) computer that provides the Graphic User Interface and communicates with the serve

II. DESCRIPTION

The remote laboratory experimentation represents an extension to the ways in which people utilize Internet. A remote laboratory for engineering education should realize an integrated environment for user controlling the real device through the remote site and conducting the Actual experiments in the remote laboratory through a computer network. The core of the remote laboratory is a cluster of general-purpose and/or specialized instruments interfaced to a set of personal computer systems connected to the Internet. With the ability to configure instruments and data analysis remotely via software, the laboratory will facilitate the sharing of expensive instruments and equipment, and may well be the next important step in remote distance learning.

A student laboratory approach that is established on Internet-based-remotely accessible experimental set-ups- is proposed in this chapter.

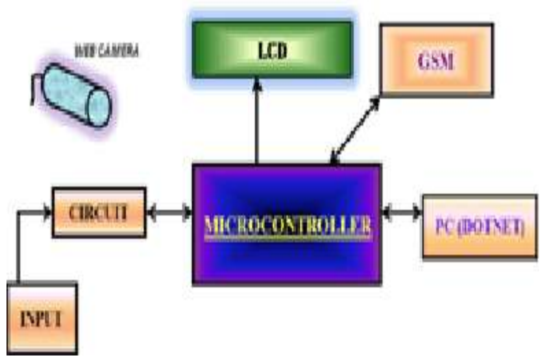

Fig1. Block diagram

The lab designed in fig1, can replace the present conventional lab that uses CRO, function generators etc. The Single DAQ device along with PC (for display purpose) functions like CRO, function generators etc. Server contains the virtual versions of laboratory equipment that are designed using powerful DOTNET tool.

As represented in fig1, Web camera provides visual description of the experiments hence user can monitor voltage levels & waveforms, LCD is 2 X16 Parallel LCD which is an 8 bit parallel interfaced LCD, this is used for device testing purposes.GSM-CONTROL SMS Gateway is Microsoft Windows software used for 2-way remote control in automation and other applications using standard GSM (Global System for Mobiles) cellular phones and GSM network. Based on the standard GSM cellular phones and other GSM-capable devices, GSM-Control offers a low cost and easy alternative to create wireless control and monitoring applications. Implementation of GSM network's SMS (SMS Message Service) technology secures reliable transmission even in the most error-sensitive applications.

The circuits are rigged up on the breadboards &inputs and outputs can be obtained through DAQ device. These circuits are mounted on PCB. Programmers only need to develop the program using DOTNET for controlling different instruments locally and then design the procedure and content for the new experiment quickly and smoothly hence, Programmers need not have to "reinvent the wheel" as the framework provides a rich library of APIs that applications can use. The user will be having the PC with the front end application built with DOTNET, through which user will be displayed with graphs, controlling units etc. The PC will be interfaced with MICROCONTROLLER for controlling different units. The PC maintains Database of the experimental results too. 8051 architecture based P89V51RD2 microcontroller from NxP is used to implement. Microcontroller acts as the heart of the entire model, which controls the whole system. It contains 1k RAM, 64k Flash, 3 Timers, 2 external interrupts, 1 UART, 32 GPIO's, ISP programming support etc. KEIL IDE is used to program the microcontroller and the coding will be done using Embedded C.

A Virtual Laboratory can be defined as an environment in which experiments are conducted or controlled partly or wholly through computer operation, simulation, and/or animation either locally. With regard to the computer animation type of virtual laboratory, the experiment is often a graphical model of the actual experiment. This type of virtual laboratory does not include physical hardware, but it allows the user to observe the process and the end product by way of animation. It often allows users to direct the process and the end product with some controllable variables of the experiment in the software. It also has the ability to provide quizzes and immediate feedback to the users. This mimics the real operation of the process, which is something that might not be economically viable in a conventional training workshop.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 4, April - 2013

Fig2. Virtual Lab setup

The computer type of virtual laboratory usually contains some physical instruments and hardware, and the simulation may be on the data acquisition part and/or the components as shown in Fig2. The computer operation type of virtual laboratory is often a real laboratory with components in a confined space that the user can access remotely through a computer. Students can conduct real experiments in the ECE/EEE virtual laboratory remotely using personal computers. The CMU system also includes a live video stream so that students can observe the experiment as if they were physically there. This has the advantage of allowing access to a laboratory that may otherwise be restricted due to safety, time and distance, and the technology greatly enhances the flexibility of laboratory education. In the study, a system which allows students to conduct simulated laboratory experiments with the use of laptops has been researched and developed. This included designing peripheral hardware and circuits for interfacing with the experiment simulators and virtual instrumentation tools in the system (such as a function generator, a digital Multimeter and a digital oscilloscope).

III. IMPLEMENTATION

The necessary steps for conducting and performing the experiment, Students or any users can choose the experiment from the buttons then username and password for authentication (fig4) are requested from the user when the user clicks to the experiment link (fig3)

Fig3. Remote Virtual lab conduction Link   Fig4. Login form for authentication   Fig5. Experiment Setup Page

After a successful log on to the session, the user interface for controlling the instruments and performing the experiment will appear then users can now select &change the experiment parameters (fig5) such as the control voltage of VCO circuit to get message frequency, sampling frequency and carrier frequency and obtain the results. While the student is performing the experiment, teacher may only observe the experiment simultaneously. During the session, if the student changes the parameters of the experiment, the teacher can only watch these changes and also student and teacher can communicate with each other via the chat platform developed in the web application using GSM modules& Webcam. Students are allocated with 15 minutes and the session can be terminated by the user any time or after a default time limit of 15 minutes. When the student finishes the experiment, the message “The student finished the experiment” is shown on the teacher web page. Let us take examples of few circuits.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 4, April - 2013

A. Booster circuit

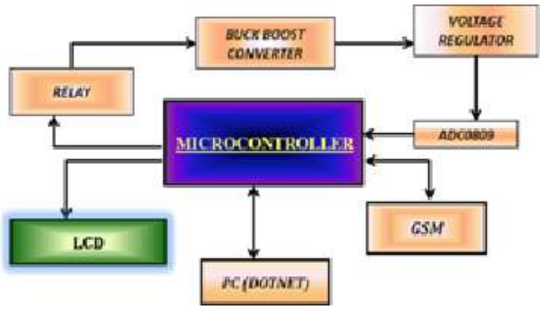

Fig6. Schematic Booster circuit setup

The block diagram is as shown in fig 6. Then the practical setup is as shown in fig 7. Supply is given to the relay from the microcontroller. The outputs of relay are connected to buck booster inputs whose outputs are connected to ADC through voltage regulator& in turn given to Microcontroller.

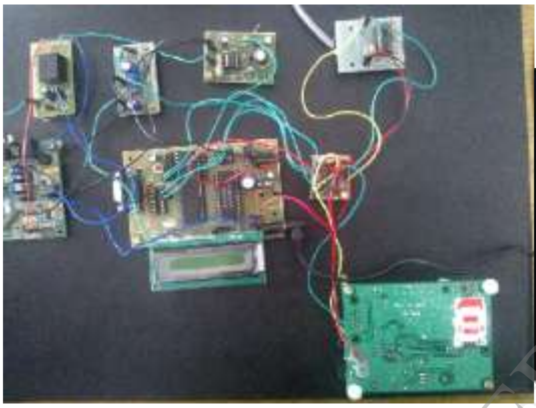

Fig7. Practical set up of Buck Booster Circuit. Fig8. Snapshots of results obtained by GSM

Output of Microcontroller is fed to LCD. 2 way communication is possible using GSM & from PC, with the help of max 232. We require 2 UARTs, 1 for PC and the other for GSM. Since Microcontroller has only 1 UART, we make use of multiplexer which has 1 I/P & 4 O/Ps. Code required for functioning of all the peripherals must be interfaced with the Microcontroller. When the supply is given to microcontroller, GSM gets initialized & whole embedded starts. LED glows once in 5s if the network catches the signal. The indication will be transmitted to the receiver side through sms (fig8). Voltage used in the code will be displayed on LCD. Once the LCD displays a message to select the experiment through PC and conduct the same. There is an option in system to switch the between any two voltages 3.3V or 5V (fig9). This is done by relay boosted to 12V by using a Buck Booster.

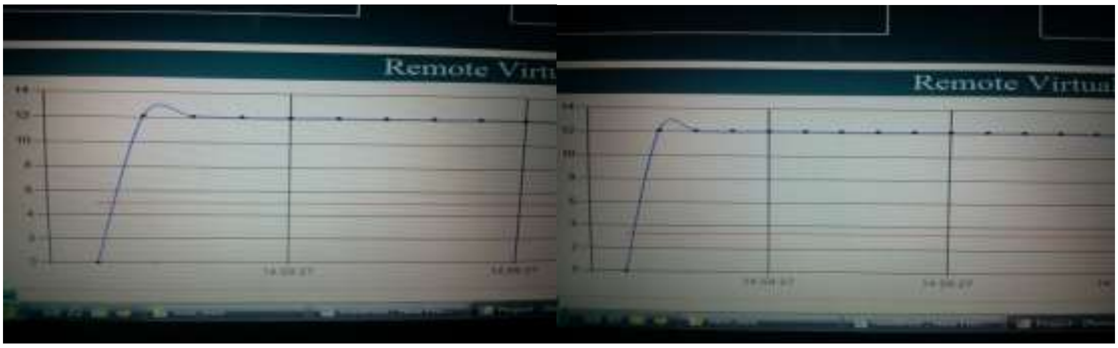

Fig9. Buck Booster O/Ps for I/Ps 3.3V & 5V

Since microcontroller can work with a maximum of 5V, a voltage regulator is used to regulate this voltage. Since this O/P is in analog form, it is given to an ADC, which is given to microcontroller. Final O/Ps can be viewed on PC. If there is any variations in circuit parameters, an indication or alertness will be provided to user by displaying on LCD & user also be alerted thru sms. This concept is explained by taking an example of increasing o/p voltage level say beyond 20V; hence user will be alerted as shown in fig10.

Fig10. Alertness of variation in Buck Booster O/P V/g

IV.

V. CONCLUSION AND FUTURE SCOPE

This paper has described the development & experimental evaluation of an e-laboratory platform, in the field of 'Remote Virtual Lab'. The system in its current configuration is designed to enable distance training of students in real scenarios of Virtual Lab manipulator programming. The goal is to offer student fraternity in the various areas, the opportunity to learn how to perform the lab work at a distance without having one at the close proximity, in a way that closely resembles the virtual Laboratory work programming operations and procedures. From a technological perspective the developmental and experimental evaluation works focuses on the adaption of concepts and techniques developed on the field of 'Remote Virtual Lab'. On exploring their integration in such remote laboratory settings, a good amount of exposure for the students is available. The goal is to assess the performance of e-lab systems in terms of quality of training provided to students. This assessment is performed comparatively for various training modalities to shed light on the relations among different learning experiences, and on the relative importance of various learning elements integrated in the Graphical User Interface. Performing a statistical analysis of the obtained experimental results reveals the students' performance. The future works on the above said matter in respect of performances based on the results obtained by the students. The main experimental conclusion can be summarized in the following statement. 'The proposed e-lab platform created a virtual training environment' that provided an adequate learning elements compensating for the lack of direct physical presence on the real experimental site.

The benefits from providing the means to obtain remote access to experimental infrastructure existing in various dispersed laboratory facilities can become significant both from a socioeconomic point of view, as well as from an educational perspective. This significance is directly related to the quality and the equity of practical training possibilities offered to all students. In this context, a more thorough experimental evaluation study has to be conducted, regarding the feasibility of these goals and the acceptability of such new technologies by students in their education and training practice.

ACKNOWLWDGEMENT

A journal paper is a job of great enormity and it can't be accomplished by an individual all by them. Eventually we are grateful to a number of individuals whose professional guidance, assistance and encouragement have made it pleasant endeavors to prepare this paper. We have great pleasure in expressing our deep sense of gratitude to Dr.M.S.Shivakumar principal and Prof.Seshikala.G HOD, Dept of ECE in Atria institute of Technology for constant support and encouragement. Guidelines and deadlines play a very important role in successful completion of our paper on time, we convey our best regards to Mr.Keshavamurthy for having constantly monitored the development of the paper & setting up precise deadlines. Finally we would like to express our gratitude to our family & friends who helped us in consolidating the information related to the topic we have explained in the paper.

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ISSN: 2278-0181
Vol. 2 Issue 4, April - 2013

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