TeleLab–A Remote Monitoring and Control System

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***Abstract*—Presented herein is a remote monitoring and control system which provides the user (client) with graphical output of the acquired experimental data. The experiment is based on MATLAB, Atmel AVR (namely the mega8). Instead of using different tools, the project focuses at using just one so as to make it simple for the user to understand and debug if necessary. A tool such as MatLab, being simple yet efficient, provides the greatest flexibility. At present the setup performs the very basic operation of collecting the terminal voltages and plotting them on a graph drawn with time although further modifications and improvements are underway.**

Index Terms— **instrumentation, remote monitoring, remote control**

I. INTRODUCTION

TELELAB is a system designed for remote for such a tool arises in scientific research, testing and experimentation. It provides the observer with the data he/she requires without him/her being physically present at the place where the actual experiment is being conducted. Students can use it to provide their mentors with the experimental data acquired by this system so that they can get their feedback. The potential of this system is immense and can be further increased by using other tools in conjunction with it.

With the increase in collaborative learning, a need to deliver experimental data to people in different parts of the world has become a priority among researchers and students of science. Methods such as email do provide such a facility but they lack the ability to provide this data in a real time envi- ronment. This need was the main motivation behind this project.

The Internet (Web) has become a widespread tool for teaching and learning. The Web enables more flexible delivery (anytime), distance education (anyplace), new visualization possibilities (interactivity), and cost reduction. In the paper Non–Inverting amplifier and integrator/ differentiator circuits using op- amp has been represented. The main objectives are:

- To help students understand the basic applica tions of op-amp
- To enable students perform the experiment online(internet)
- To enable students learn more via internet.

It has been designed to have minimum software requirements for the students. The only software reqired is MATLAB. Other requirement is the internet connection. To perform the experiment you just have to run the client program in MATLAB,a graphical user interface will appear showing the various forms of outputs. Students can take large no. of reading at various time so as to reduce errors. The only limitation is that student cannot change the components value.

II. LABORATORY EXPERIMENT

As per the recent trends and advancement in technology the need of user friendly environment has increased to a large extent. The basic prob- lem faced by the engineering student during the laboratory classes is that they have to perform the experiments in the lab in a group of 3 or 4 students. Such a criteria normally gives negative support to some of the students and hence create a lack of interest. In order to rectify such problems students try to copy the results of their batch mates which further degrades the student's performance. Such problems can be rectified if the student is allowed to perform the experiments throughout the day by either being physically present in the lab or by performing the experiments via INTERNET. This paper basically discuss about a TELE operation of the Electronics Lab in the Division of Electronics and Communication, NSIT.

The Electronics Lab is the most widely used lab in college as each and every student from different departments have to once go through the lab work of this lab. It was developed as a project by some of the students from Instrumentation and Control Divsion, NSIT who faced the time problem during their course of study. Some times the time allotted for the experiment is not enough to get the desired result from the hardware. Few of the lab experiments carried out in the Electronics Lab are as follows:

- A study on Integrator
- A study on differentiator

- Op-amp based Non–Inverting amplifier
- Op-Amp based Non–Inverting amplifier
- Implementation of Current Mirror Circuits
- Analysis using Clipper and clamping Circuits
- Study on Half and Full Wave Rectifier

and so on.

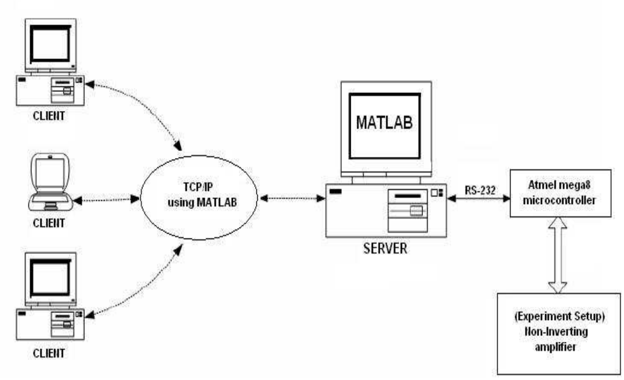

FIGURE 1. Block Diagram

In order to overcome such a shortcoming we are proposing a LAN based system which can be used for easy LAB access 24hrs in a day. The complete system can be divided in two major section. The first section considers the server part which is connected to the hardware experiments via the AVR kit. The data acquisition from the circuit is done through the AVR and is then transmitted to the PC via the Serial port of the PC. We have used Serial port here because it will be easy to implement it on each and every PC with less requirement of the external hardware. Once the data is received by the SERVER it tries to see which CLIENT is connected to it and then suitably sends the data to the CLIENT using well established LAN Network of the College. If more than one CLIENT requests the data, they are put in queue and as soon as the previous request is furnished the CLIENT which is next in the queue gets connected to the server. The data once received by the client can now be used by him to get the required results from it. All the required study material for the experiments has been complied into a small manual which can be transmitted to the client upon the request from the server or can be taken from the course teacher or the Lab in–charge.

We have studied and implemented all the above mentioned experiments and the following sections describe the working of Op-Amp based Non–Inverting Amplifier and Integrator/Differentiator.

III. EXPERIMENTAL SETUP OF THE NON–INVERTING AMPLIFIER

The experimental setup as shown in Fig.1 includes a waveform generator, breadboard, connect- ing leads, op-amp (operational amplifier) uA741, DC supply, 2 resistors 2k and 4k (or any other value in accordance with the gain required).

The experimental setup(Non–Inverting amplifier) provides analog output to Mega8 controller, the analog output is then converted to digital form using analog to digital converter (ADC) designed using mega8 microcontroller, the digital output is then transferred to the server computer(developed using MatLab) using RS-232, the server computer then sends it to the various client computers, where the digital data is converted back to analog form and is processed using MatLab and then displayed. The use of Mega8 microcontroller allows other peripherals to be connected easily as microcontroller can be easily programmed, hence their is always a scope of further expansion.

The gain of the Non–Inverting OpAmp amplifier is adjusted using the two resistances R2 and R1. The gain of the Non–Inverting amplifier is expressed in form of a formula as :

$$\frac{V_o}{V_i} = 1 + \frac{R_2}{R_1}$$

where R2 and R1 are as shown in Fig.2

IV. EXPERIMENTAL SETUP OF THE OPAMP INTEGRATOR AND DIFFERENTIATOR

The OpAmp Integrator is a Linear Analog circuit whose output is the integral consists of the input voltage signal and it consists of a capacitor placed in the feedback path between the output terminal and the Non–Inverting terminal of the OpAmp and a resistor connected between the Non–Inverting input and the input signal and the Non–Inverting terminal is grounded. The output of the circuit is expressed as integral of the input.

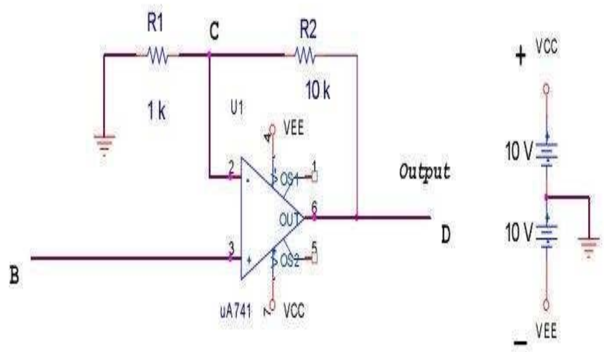

FIGURE 2. Non–Inverting Amplifier

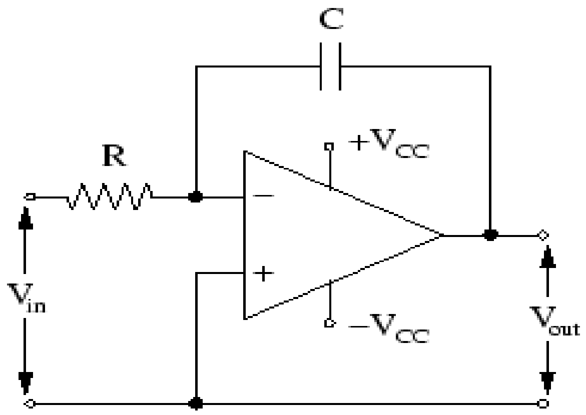

FIGURE 3. Integrator

The OpAmp Differentiator is a Linear Analog circuit whose output is the differential of the input voltage signal and it is similar in circuit to the inte- grator with the capacitor and resistor interchanged in their places. The output of the circuit is expressed mathematically as :

$$V_o = -RC\frac{dV_{in}}{dt}$$

where R and C have the values as shown in Fig.5

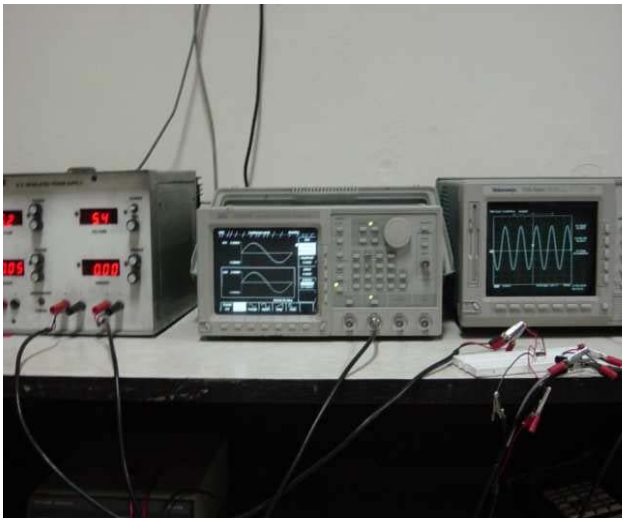

FIGURE 4. Experimental Setup of Non–Inverting Amplifier

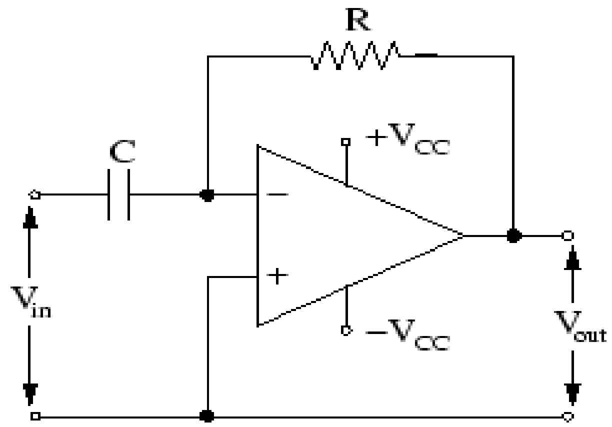

FIGURE 5. Differentiator

The time constants for both the Integrator and Differentiator are adjusted by selecting the appropriate values of R and C.

The output of the Non–Inverting amplifier and Integrator/Differentiator was observed on the oscilloscope and on the computer after processing through the client. The two outputs were similar, the output on the computer closely followed that on the oscilloscope but due to the low sampling rate showed some errors especially near the points where the signal changes values very sharply and also near the points of maxima and minima.

The data was transmitted through the college LAN during the testing stage which runs at megabit speeds using Dlink switches, the transfer rate allowed an almost realtime data acquisition. The setup can also be used over the internet but it requires changing the Ip field in the client script after finding the Ip of the client computer.

The ATMega8 microcontroller reads the analog voltage from the experimental setup and then sends it to the computer using the Usart (The Mega8 kit shown in Fig.6 was used for the purpose of conducting the experiment).

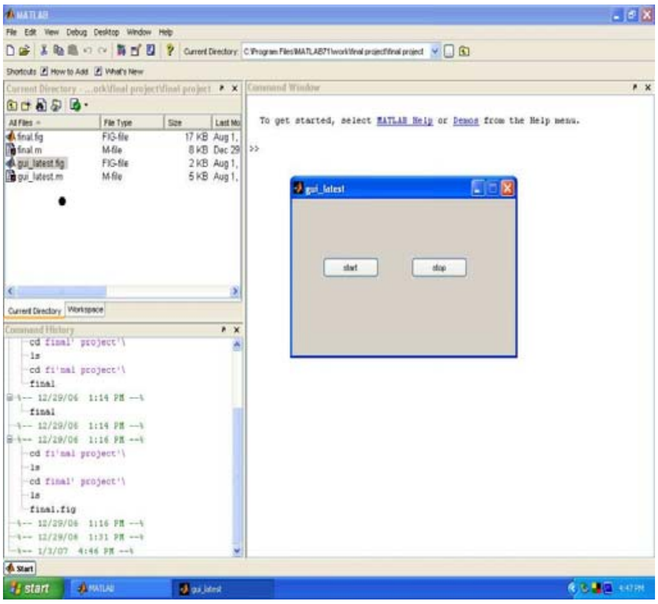

FIGURE 6. Server GUI

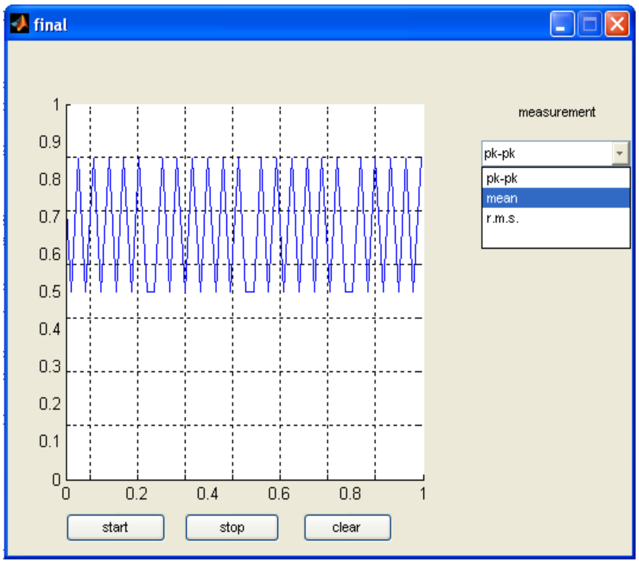

FIGURE 7. Client GUI

The MatLab server script then reads this data from the serial port in pages of 512 bytes. This is done so because of the lag introduced while reading the Usart buffer, which is equal irrespective of the number of bytes being read, and hence reading the the buffer only once results in the minimum lag possible. The server software in turn sends this data to the client software running at a remote location using the tcp/ip protocol which enables it to send the data over the tcp/ip stream without errors. The client script then plots these values on a graph with time with the intervals being equal to the sampling time of the Mega8 ADC. The client script permits the user to plot the corresponding peak–to– peak , Rms and Average values of the signal.

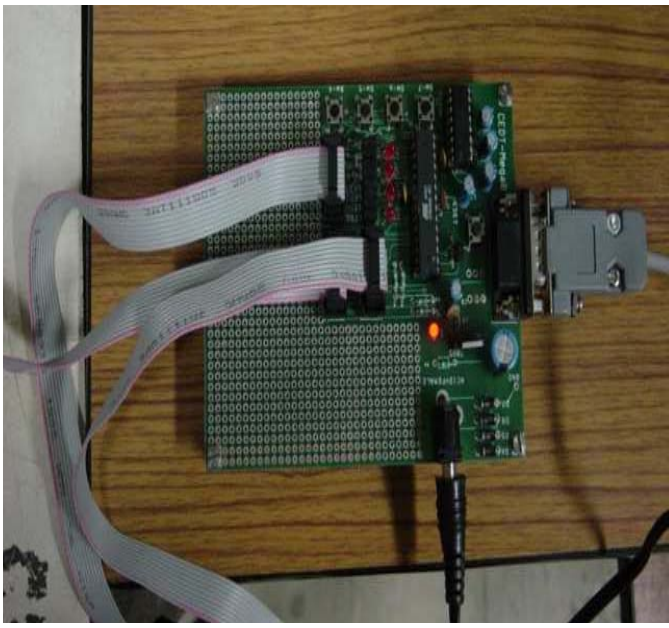

FIGURE 8. AVR Kit with Meag 8 µC

V. CONCLUSION

Using the tool developed, the students and teachers have the opportunity to experiment and receive valuable feedback while being at a remote location. Further improvements to incorporate security fea- tures such as face identification for activation of the system for sensitive data is underway.

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