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## PC BASED VIRTUAL OSCILLOSCOPE BASED ON SOUND CARD AND SCILAB

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### (1) ABSTRACT

Oscilloscopes are used for displaying and analyzing electrical signals. Basic electrical components or circuit modules can be tested for their working. In today's world, PC based measurements have become more affordable and easy to use, thus opening the door for "virtual instrumentation". This paper describes about developing a PC based virtual oscilloscope. Data acquisition part has been done using sound card as A/D converter and a software manager was developed for processing the signals with the help of SCILAB. The PC based virtual oscilloscope can be used by undergraduate students for analyzing signals without the use of traditional oscilloscope.

**Keywords:** Oscilloscope, Sound card, Scilab, A/D.

### (2) INTRODUCTION

In early days, signals were analyzed using electromagnetic oscillograph which later was replaced by cathode ray oscilloscope for getting higher bandwidth. Currently, digital storage oscilloscopes are widely used because they have high input impedance which will allow us to analyze both analog and digital signals. The data acquisition in a DSO plays a major role in converting the analog signals to digital signals for storing the data. It also converts the digital signals to analog signals for displaying it. A software manager used for creating the Graphical User Interface (GUI) is done using Scilab. Scilab being open source software reduces the cost even more and also allows addition of more features.

The main contribution of this paper is to develop an integrated system using sound card as data acquisition hardware, Scilab as the GUI builder and a signal conditioning circuit for interfacing.

### (3) PC BASED VIRTUAL INSTRUMENT

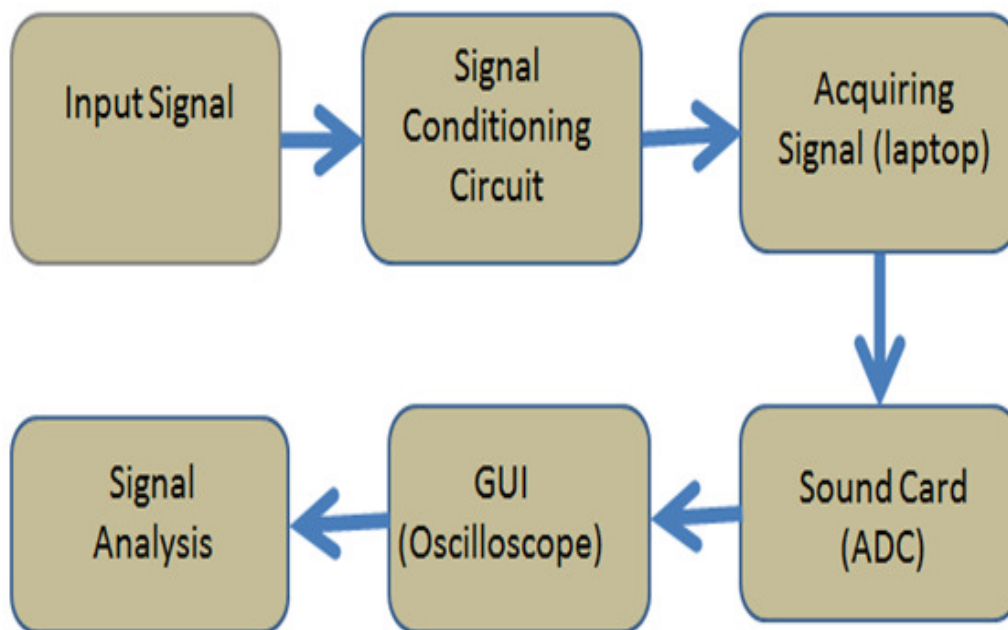
The instrumentation industry is growing very steadily and rapidly in the direction of virtual instrumentation. Virtual instruments are mainly centered for using PC/Computers, used with a signal conditioning circuit to view the signal in PC. This circuit is typically a plug-in board for analog to digital conversions. Virtual instrumentation is known for its flexibility, modularity, and low cost. The contribution of the paper is in developing a fully functional, PC-based oscilloscope with associated modules of data acquisition hardware, interfacing, and graphical user interface. The data acquisition is done by sound card with hardware circuit acting as an interface and GUI created from Scilab software.

The Scilab virtual oscilloscope offers a versatile tool for PC-based data acquisition. Scilab (GUI) is more suitable for industrial/higher research applications than undergraduate education/teaching.

With this background, the proposed system is intended to provide a low-cost, simple, yet effective solution for integrated two channel data acquisition, display, analysis, and printing operations in an undergraduate laboratory.

### (4) SYSTEM DESCRIPTION

Sound card converts analog to digital signal for data processing in the PC. The digital data will be stored in the PC memory, processed and displayed on the PC screen. Sampling frequency of the system is 66.1 kHz and sampling bit resolution is 24 bits. Bandwidth of the system depends on the sound card used in the PC. The block diagram of the system is shown in fig1..The input signal intended to give to the system falls within the 0V to 10 V. These signals are driven to the signal conditioning circuit to amplify and attenuate low amplitude and high amplitude signals respectively. The output of the signal conditioning circuit is made to lie with the range of -1V to +1V so as to protect the sound card from damaging.. The user-friendly GUI developed in Scilab acts as the oscilloscope screen which demonstrates the basic functions of the oscilloscope as well as enables data storage, analysis and display.



## 5) HARDWARE INTERFACE

In this paper a signal conditioning circuit which acts as a potential divider is used for interfacing pc with oscilloscope. In built soundcard in the PC act as the A/D conversion module. Sound card used here has 24 bit processor and frequency ranges from 22Hz to 22 kHz. Total input impedance of soundcard is 500 k $\Omega$ . It has two input and output channels. The sound card can accept only signals ranging from the range of -1V to +1V. The circuit has three op Amps, first op Amp is a unity gain buffer for removing noise and other two op Amps are for amplification and attenuation respectively. Buffer is used for providing high input impedance and to reduce loading effect. Power diodes are used as clipper in the circuit to protect soundcard from damage. This will make sure that the signal range is within -1 to +1V. 3X amplifier is used to amplify signal and 10X attenuator is used to attenuate the signal.

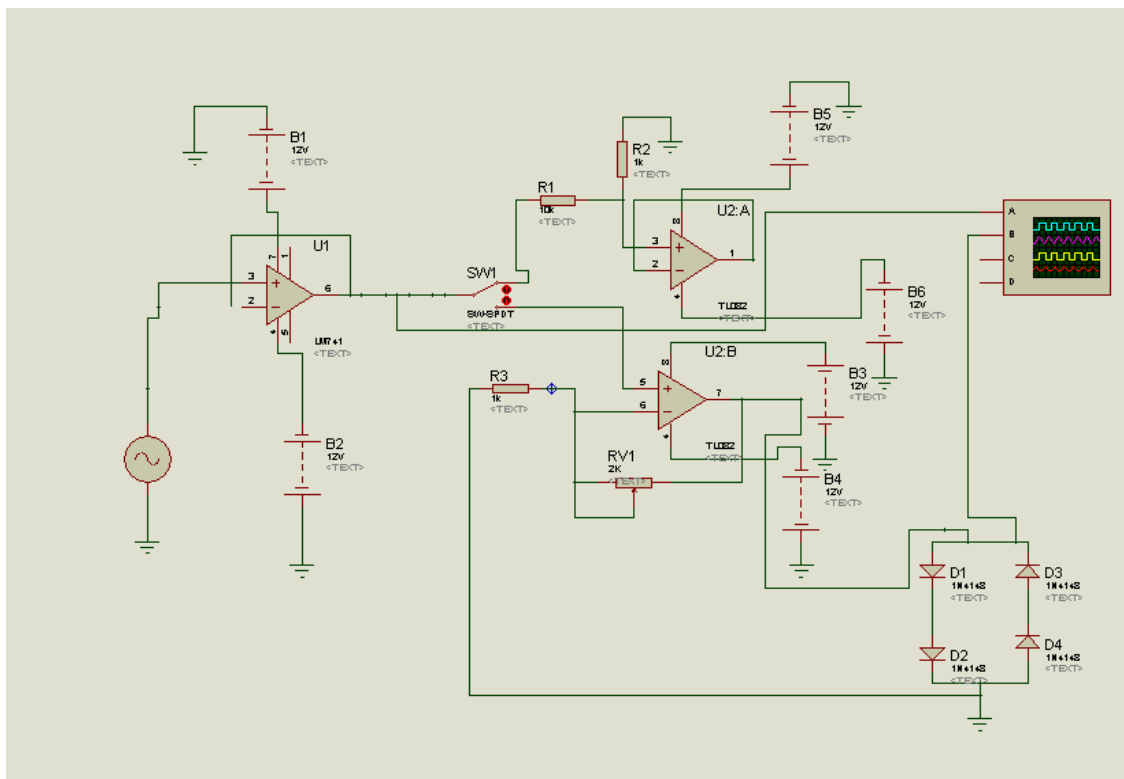


Fig 1

## (6) SOFTWARE

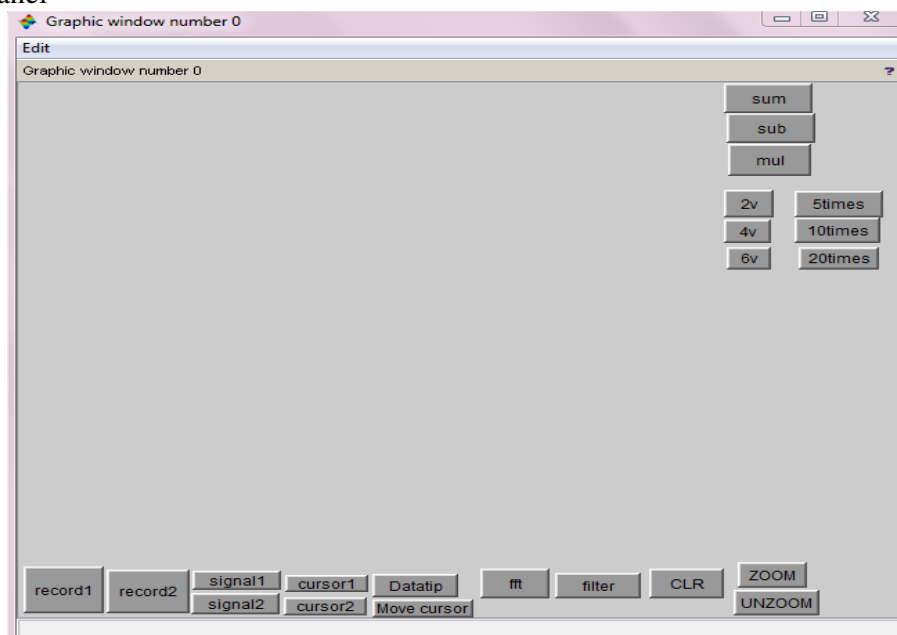
Scilab was used as the dedicated software for developing the Graphical User Interface (GUI).. Inbuilt toolbox of Scilab, Port Audio Toolbox, was used for acquiring and processing these signals from the microphone. The Volts/Div and Times/Div was basically done here using the “zooming” tool. Two cursors in a DSO were also implemented and the value at any point on the signal can be found. The virtual oscilloscope implemented has 2 channels and addition, subtraction and multiplication of signals can be done. A separate tool for other analysis like find the minimum, maximum, average and root mean square value and filter design was developed under separate tool boxes. Signal processing like fast Fourier transformation and power spectrum can be added too.

## (7) RESULTS

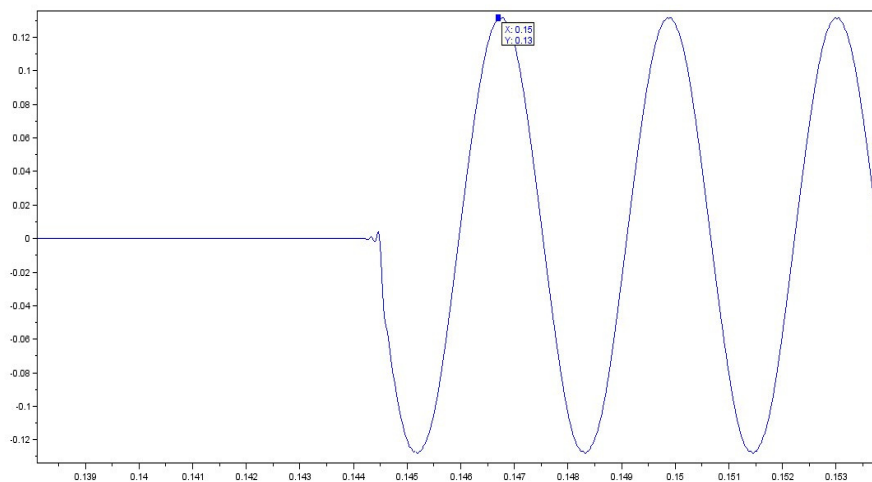
The front panel of the GUI along with few examples of its relevant functions is shown below. It is to be noted that the signals are first recorded and later used for analysis. “Move cursor” button is used for movement of the cursor along the screen. The “clear” button is used for clearing a graphical screen which in this case is the graphical data of the acquired signal. The software part of the project concentrates more on signal analysis while the hardware part concentrates on the protection given to the sound card.

It is to be clearly noted that the sound card has its own pre-amplifier of gain 20dB. This means that there will be an internal gain. To avoid this, it is necessary to make the gain to 0 by adjusting the properties of the microphone in control panel. The delay observed from signal acquisition was found to be 145ms.

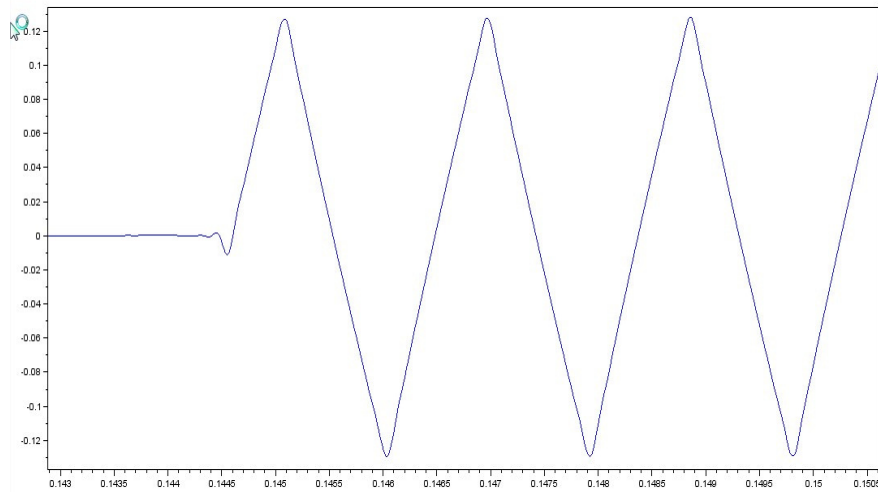
### GUI Front Panel



Sine Wave: Frequency 320Hz, Amplitude 0.1V



TRIANGULAR WAVE: Frequency 500Hz, Amplitude 0.1V



## (8) CONCLUSION

PC based oscilloscope is made using sound card which act as an A/D convertor and Scilab which is a GUI for the same. The design in this paper is targeted to improve the existing situations that universities are lack of laboratory resources. Students can call existing virtual instruments from the system. Complete the relevant experiment fast and easily. Compared with traditional oscilloscopes, a standard PC installed with virtual instrument software become a versatile measuring instrument stations. It fundamentally changes the current instrument-specific development and production, it has broad application.

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