

# A Virtual Instrument Oscilloscope for signal measurements

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**Abstract**— In this paper, we discuss about the LabVIEW based graphical applications for the measurements of signal. A virtual instrument is designed in order to serve the purpose of oscilloscope with a user friendly interface at the front panel. The designed oscilloscope is derived from a hardware instrument named Digital Phosphor Oscilloscope TDS 5104B. Firstly the original hardware device functions are examined, then a labview based VI is designed holding all the similar features like TDS 5104B. Front panel is user defined with user specific controls resulting in easy, compact and cost effective system. It is proved that the virtual instrument results in a powerful, productive, efficient, power saving and a precise measuring instrument. It provides wide range of application in future and proves to be a practical yet manipulative device.

**Keywords**— virtual instrument, electronic measurement, LabVIEW, oscilloscope, block diagram, analysis, waveform

## INTRODUCTION

Oscilloscope are used to perform electronic measurements of signals over time scale. Continuously varying one or two signal voltages are observed, analyzed and displayed on a 2-D plot as function of time[1]. It is basically plot of signals magnitude over time. With the increasing emergence of oscilloscope technology in various fields of science, medicine and engineering; there arises a need for a cost effective and a user friendly device. In order to find an advanced approach in this field, virtual instrumentation technique is employed in the processing of an oscilloscope architecture. Oscilloscope Tek TDS 5104B control panel is illustrated as shown in figure 1. The control panel controls the functioning of the hardware device, the start and stop controllers are used to start the acquisition process and for capturing the sequence. Acquisition status is shown with the help of lights for ready and triggered. Intensity of the signal is controlled with the help of a knob. The horizontal control maintains the resolution, position, delay, record length and scale of the signal. Zoom features is also accompanied with horizontal and vertical controls. Vertical control panel selects the input channel used according to the input terminals and adjusts the scale as well as position.

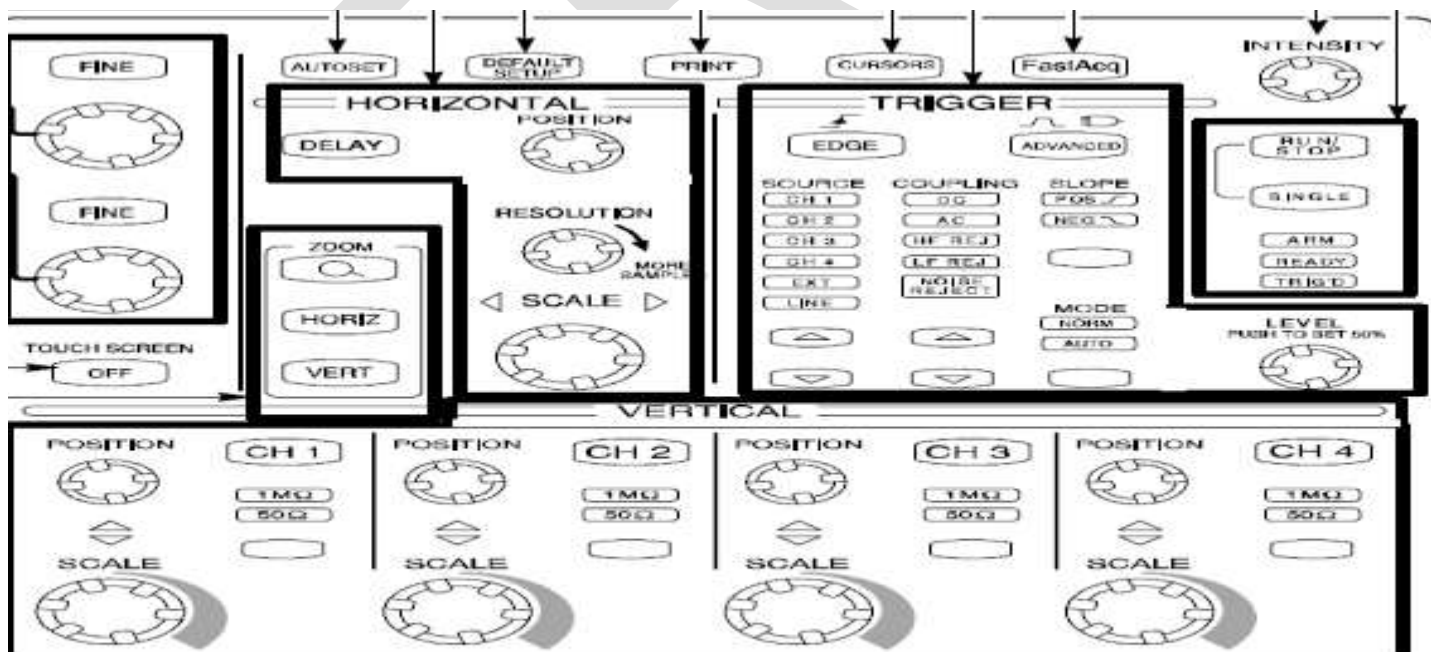


Figure 1. Control panel of TDS 5104B

Some of the basic functions deployed in a hardware oscilloscope is acquiring a live signal, maintaining its horizontal and vertical aspects in order to fit the display in the best possible way, changing the amplitude and frequency of the signal, analyzing the signal by measuring the waveform parameters.

Oscilloscope using LabVIEW is a form of virtual instrument that is not present in real scenario but a software is built that forms the functions of the real instrument[2]. This paper instigate a labview based virtual multifunction oscilloscope that performs the functions of data acquisition, data examination, signal measurement and display at output screen. LabVIEW uses graphical programming to serve the functions for the program. Various functions palette is used to build a program at the block diagram side and a user specific interface is designed at the front panel side. Figure 2 shows a diagram of block diagram, front panel and functions palette.

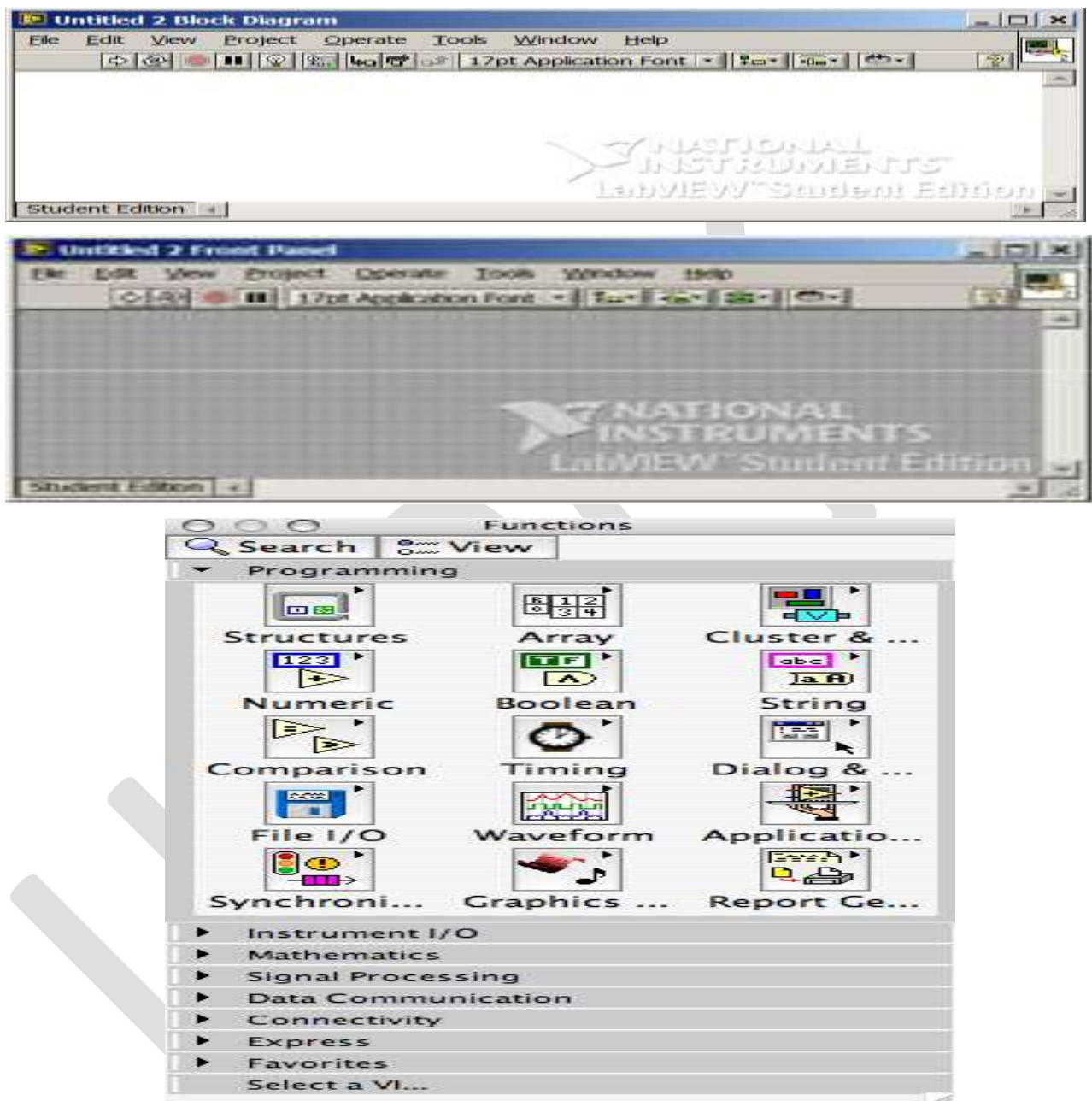


Figure 2. Block Diagram, Front Panel and Functions palette

In this paper, we discuss about the system design, building of software program, working of the respective program with various SubVI functioning, front panel design architecture with results at the GUI. In further sections, an elaborative explanation is provided about designing and functioning of the virtual instrument.

## SYSTEM DESIGN

System design comprises of basic layout of the program and the layman architecture for developing the device software. Two channel multifunction oscilloscope is designed using LabVIEW functions and control commands. Figure 3 shows a flowchart depicting the process of system design.

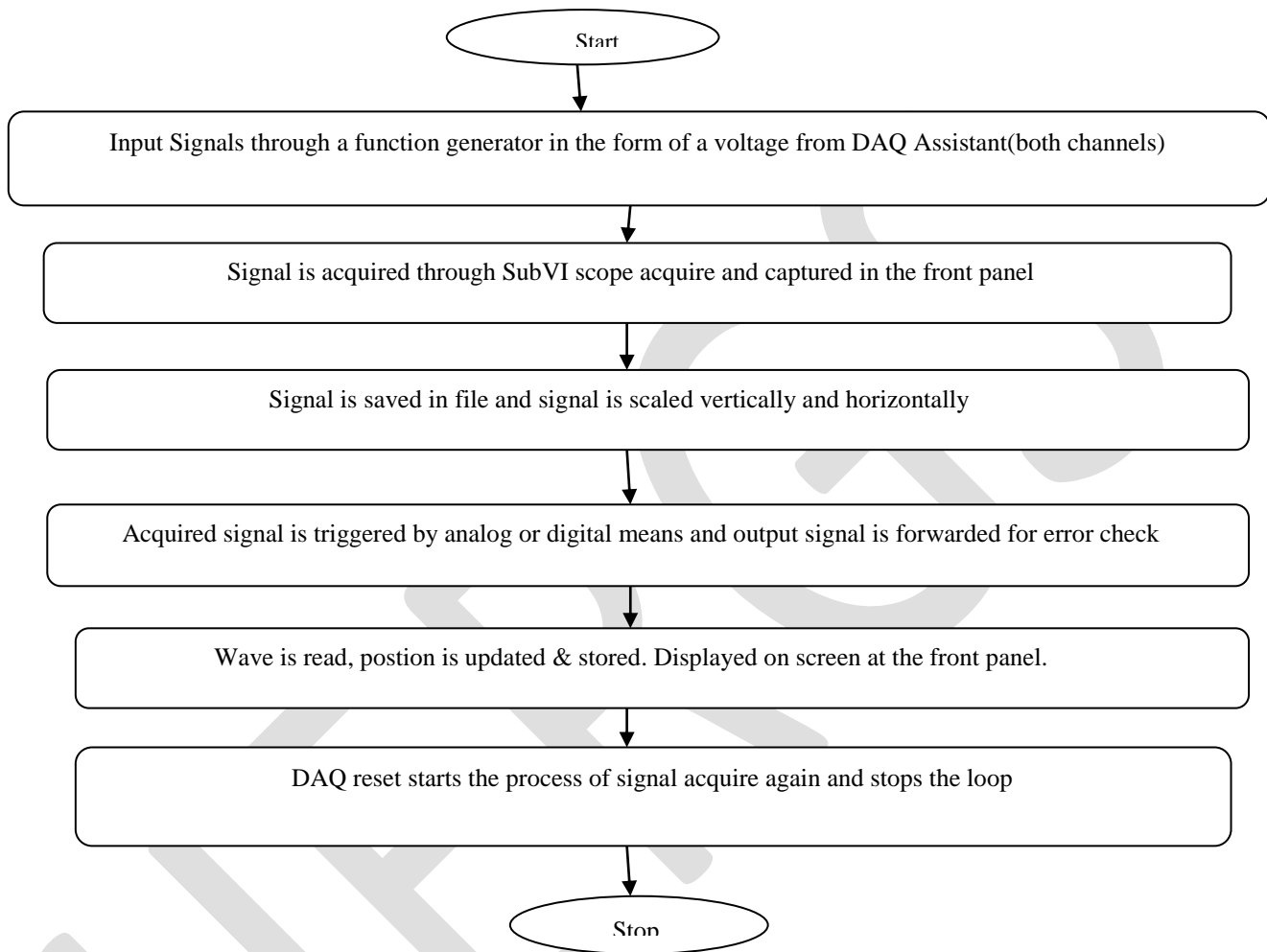


Figure 3. Flowchart for System Design

System design describes that two channel oscilloscope runs through these process; signal acquire, signal update, signal error check, signal scaling, device reset. Channel input is provided through a physical channel i.e. either a function generator or any physical input device. Task is assigned through DAQ task name in the functions palette that search for a physical channel. Function generator is also available virtually as a predefined function in LabVIEW software[3]. If absence of physical channel, signal can be acquired through a virtual function generator. Signal is processed further and displayed on the screen.

## WORKING

After discussing about the system architecture, we discuss in detail about the program built for oscilloscope and its functions. Oscilloscope consists of two channels A and B. Both the channels can be kept active at the same time and a single channel can also be used. Signal is acquired through built array which stores the input given by the channel. A bundle of individual elements is created for the channels as well as for voltage and time base division. A separate bundle list is created for level, mode, trigger type, channel select, position and slope type. All the list are given as input to signal scope acquire and then forwarded to scaling function that perform horizontal-vertical scaling. After successful acquisition of the waveform and returning of true signal at the nor gate results in

stopping of signal acquisition process. After that signal is updated according to the changes acquired for the horizontal and vertical base. With the help of scope waveform graph, the graphical plot is displayed in 2-D format. It displays magnitude on the Y-axis and time on the X-axis. Volts per division is changed according to the shift in the time base. For initial operation it is set to 500us for one division of time base signal. Error at the output is maintained with the help of error handler which checks for invalid channel, invalid trigger detail, and invalid time base. If any error is recorded it is shown I the error code with details.

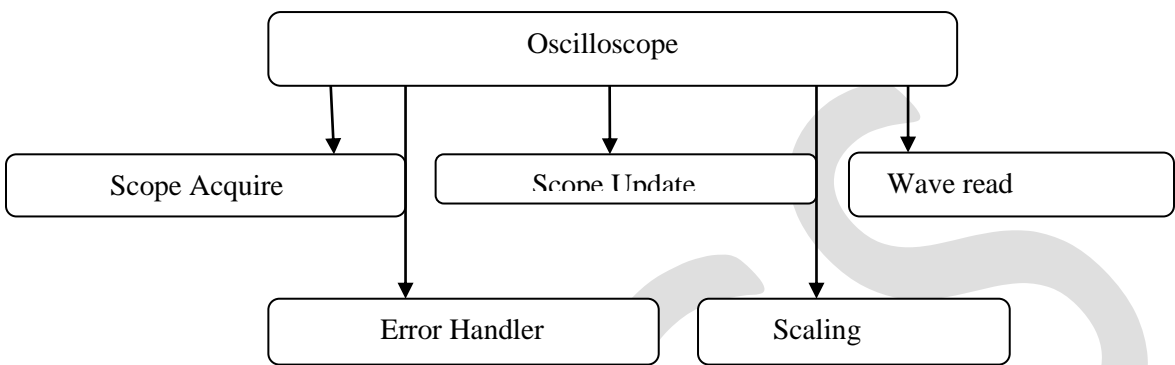


Figure 3 Oscilloscope component

Figure 3 shows the detailed component of the oscilloscope. Figure 4 shows the block diagram of two channel multifunction oscilloscope. It illustrates the program with 6 subVIs for scope acquire, scope update, wave read, scaling, save to file, error handling. All these components are combined in order to work as a oscilloscope. Front panel control is defined for the user and controls are used to make the application more wide and user friendly[4].

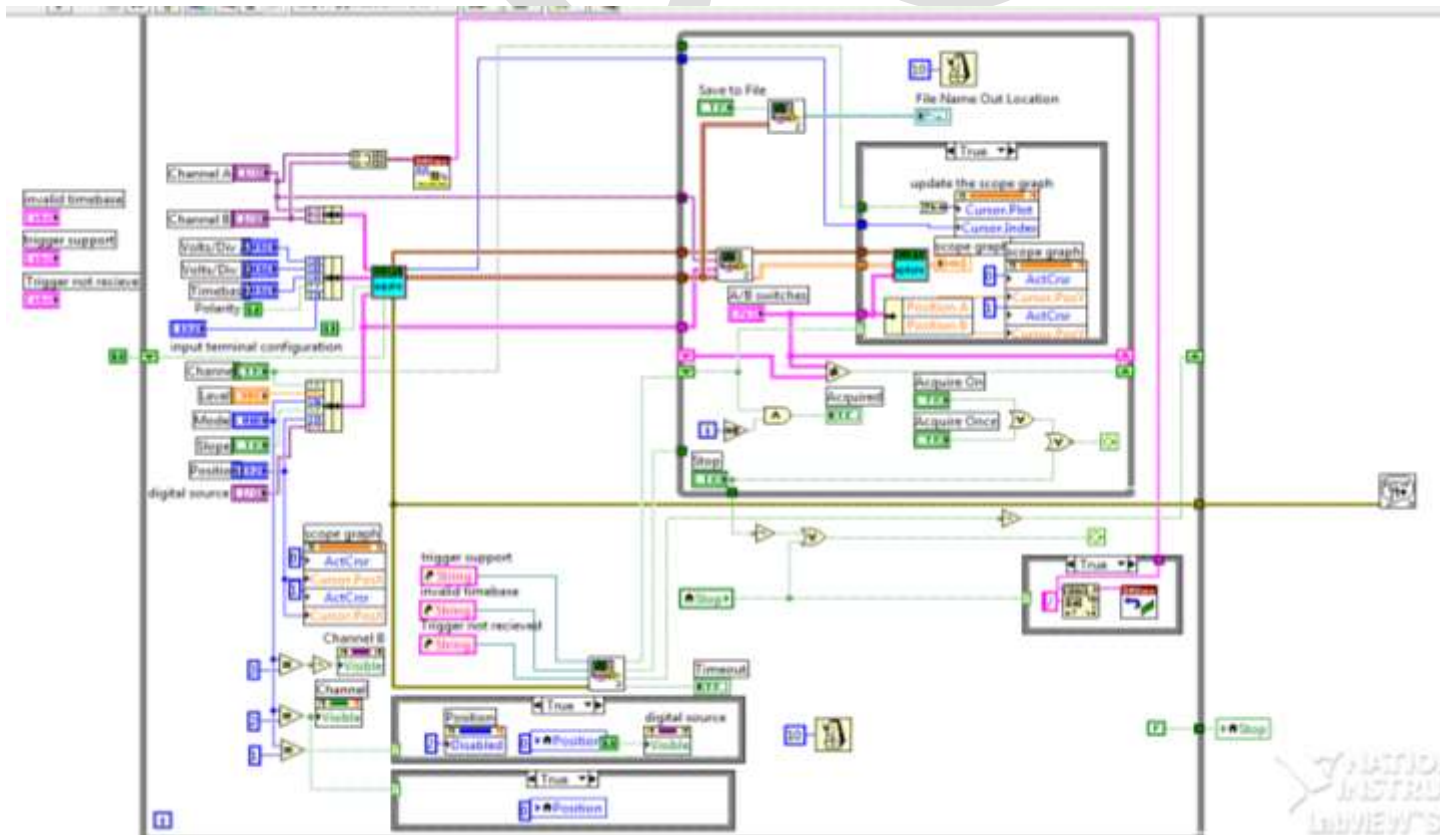


Figure 4. Block Diagram for Oscilloscope

## RESULTS

Front panel of the virtual oscilloscope is designed according to the control panels of the hardware oscilloscope TDS5104B. By testing and carefully analyzing the results at the front panel waveforms are measured with respect to phase, amplitude and frequency. Results displayed at the output terminal shows the versatility of the designed virtual instrument. Figure 5 shows the front panel screen and output signal for two channels .Sine wave at the front panel displays results from channel A after the acquisition and scaling process . It is proved that with the help of controls like position, trigger and volts per division the waveforms are easy to scale and adjust according to the user demands.

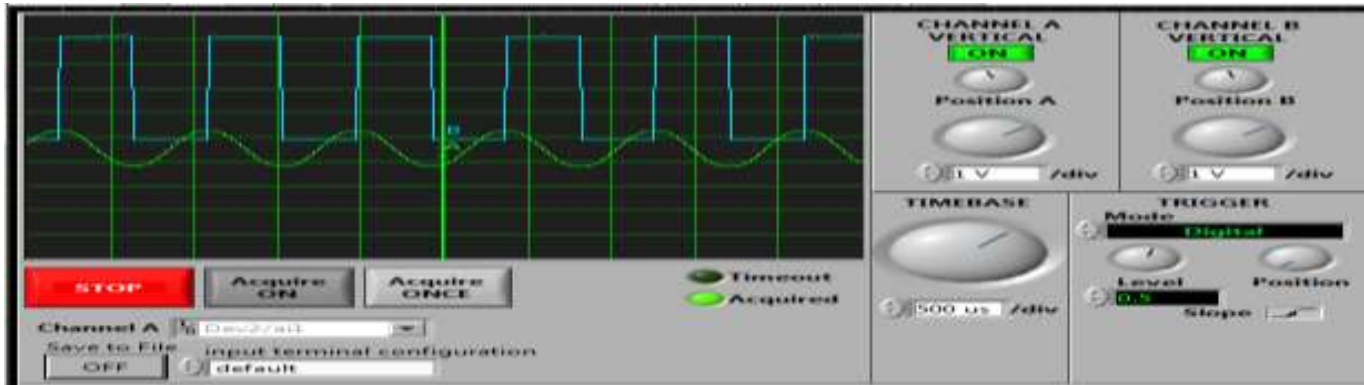


Figure 5. Front panel

## CONCLUSIONS

Virtual instrument provides the real environment experience for users. It shows that the practical experiment of the device software proves to be a convenient, fast and easy in operation for measurement of signal. By selecting suitable hardware input and software design, the system proves to be a high precision measuring system. The IVI software platform proves to be highly compatible and interoperability is achieved. It not only reduces the development time for the device but also makes it user friendly and easy to expand to higher levels of abstraction. The software and hardware combinations makes the technology cost effective, time efficient and operation convenient. This technology proves to be futuristic technology as the need for user specific control devices are increasing.

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