

# Applications of Virtual Instrumentation for Academics And Industry Using LabVIEW

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**Abstract:** The Virtual Instrumentation (VI) has been widely adopted in test and measurement areas. Industry experts have recognized the need for tools that can meet increasing need for more complex, dynamic, adaptive and algorithm based control. Modern instrumentation problems have been addressed by providing effective VI based solutions. Lab VIEW is a software development system developed by National Instruments which uses symbolic or graphical representation to speed up development. With the help of VI engineers and scientists can create user defined system that meets their exact application needs. In academics many theoretical concepts can be demonstrated effectively using LabVIEW. This tool is simple to use and provide signal acquisition, measurement analysis, data presentation giving flexibility of programming language without the complexity of traditional development tool. This paper discusses the LabVIEW basics along with different applications in industry and academics.

**Keywords:** Virtual Instrumentation, LabVIEW, National instruments

## I. INTRODUCTION

The LabVIEW is an acronym for Laboratory Virtual Instrument Engineering Workbench developed by National Instruments (NI). It was introduced in 1986, first software program to include graphical, ionic programming techniques, which make the form of programming more transparent and the sequence of processing visible to the user. LabVIEW uses graphical programming language ('G' language) this feature distinguishes it from other data acquisition programs. LabVIEW programs are written without writing a code, but rather drawn or represented graphically similar to a flowchart diagram. It is a user friendly graphical environment for measurement and control and other operations. In a LabVIEW program execution is not controlled by the order in which the statements were written in the source code but rather by the data that are generated [2].

## II. VIRTUAL INSTRUMENTATION

Virtual Instrumentation (VI) defines general purpose measurement and control hardware functionality using software as per the requirement of user. Virtual instrumentation brings many advantages over "conventional" instrumentation. With virtual instrumentation engineers, scientists design high quality products in less time and with reduced cost. VI are extremely flexible, powerful and a foundation for modern laboratory. Virtual instruments are realized using industry-standard multipurpose components. Generally, virtual instruments are more flexible and scalable as they can be easily reconfigured in software [7]. Virtual instrumentation combines computerized instrumentation with flexible software and controlling hardware. Engineer uses virtual

instrumentation for developing test and measurement system. VI address the applications ranging from simple laboratory experiments to large automation solutions. With virtual instrumentation engineers and scientist reduced development time, design high quality products with lower design cost. As the virtual instrument

deals with software and some hardware, a customer could use personal computer along with hardware for all user interaction and control. As a result, virtual instrumentation made possible decrease in price of an instrument. A virtual instrument provides all the hardware and software needed to accomplish the measurement or control task. Conventional instrument can be very large and provides excessive amount of features that are rarely used.

A traditional instrument might contain an IC to perform a particular set of data processing functions, in VI, these functions would be performed by software running on computer. By employing virtual instrumentation solution, capital cost, system development cost and system maintenance cost could be reduced while improving time to market and quality of the product.[11]

Virtual instrument software can be divided into different layers as shown in fig.1 application layer incorporates all the functionality developed by application layer and provides system wide data management. A measurement and control service is equivalent to input output driver software layer.

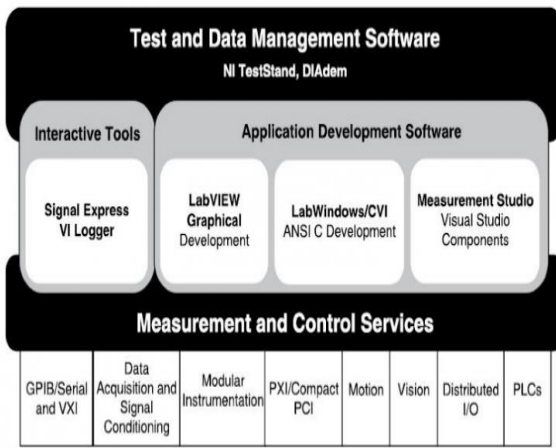


Figure 1:Layers of virtual instrument software[7]

### III. LABVIEW BACKGROUND

LabVIEW virtual instrument comprises of three components a front panel, block diagram and connector pane. A front panel can accept input from the user and controls and can be displayed at run time. Block diagram present output to the user graphically and code can be edited. A connector pane serves as an interface to the VI when it is imbedded as a sub VI. Each VI and sub VI is a separate program that can be run independently from the calling (main program) by setting the front panel control and inspecting the results. For sequential execution control flow can be enforced by use of structures such as Sequences, Events or by chaining SubVIs where output data from one VI is passed to the input of the next VI. As like most of the programming languages, all common data types such as integers, floats, strings, and structures are allowed in LabVIEW. LabVIEW supports multithreaded application design and executes code in an inherently parallel rather than sequential manner, as soon as a function or SubVI receives all of its required inputs, it can begin execution.

Writing code is as simple as dragging and dropping functions or VIs from a functions palette onto the block diagram within process structures and wiring terminals [2].

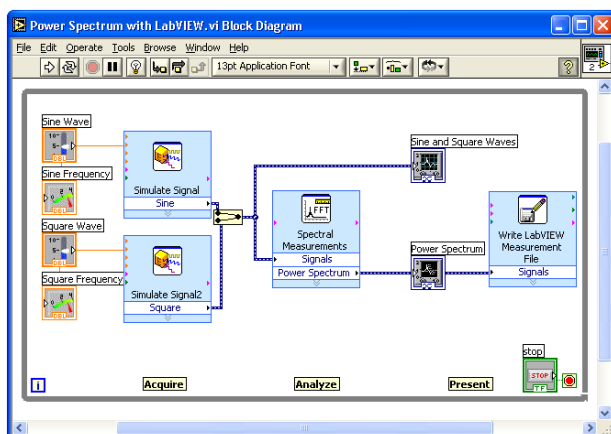


Figure 2,Block diagram

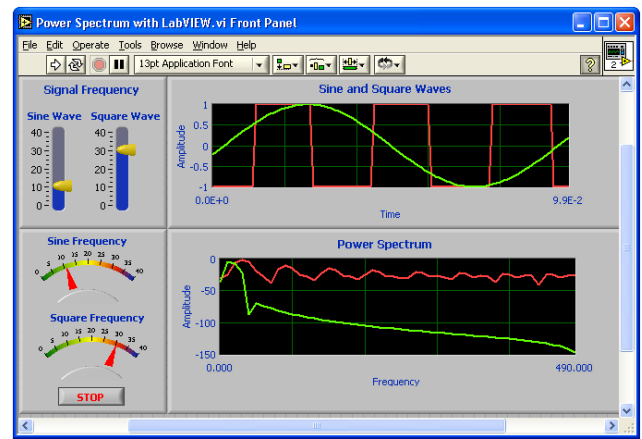


Figure 3,Front Panel

LabVIEW program can be created by keeping variables as inputs which can be put on the front panel as controls such as numeric control, text control, pop-up menu control or picture, Boolean control etc. As like conventional programming language all the basic elements are implemented in LabVIEW for example, conditional branching is represented by case structure, repetitive operations can be put into for...next or while loop, Case statement is used for conditional branching inside the case structures ,each of the cases can be filled with Sub VIs. All the cases are not visible at one time and control at the top border of the CASE structures allows the programmer to step through and inspect the contents of various case alternatives.

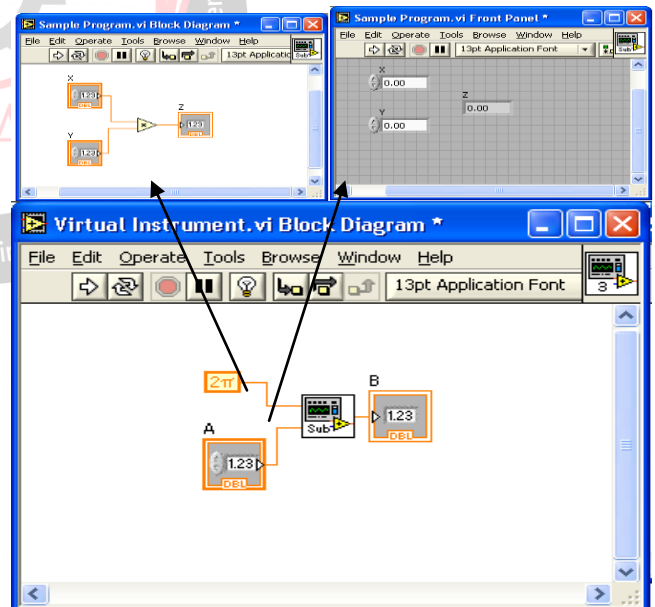


Figure 4,Sub VI

Function is elementary nodes in graphical programming language. When compiled function generates machine code, function do not have front panel or block diagram but do have connector panes. Function palette contains the VIs ,function and constant use to create the block diagram. Control palette contains the control and indicators use to create front panel .user interface of VI can be created by placing control and indicators on the front panel of VI,

Controls provide ways to send input to and receive output from the block diagram.[8]

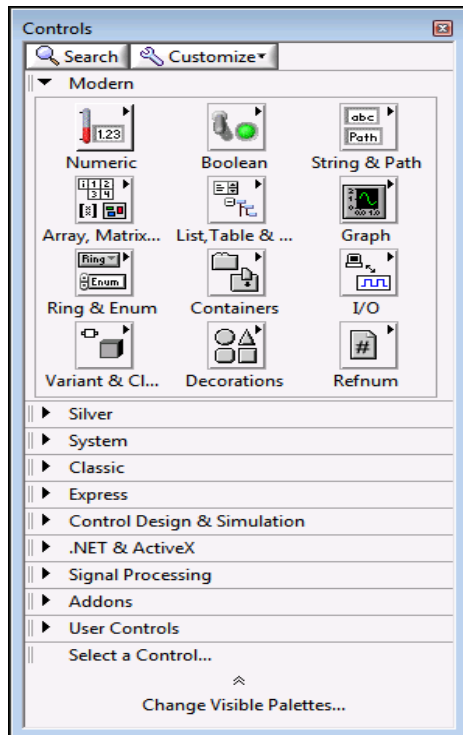


Figure 5,control palette

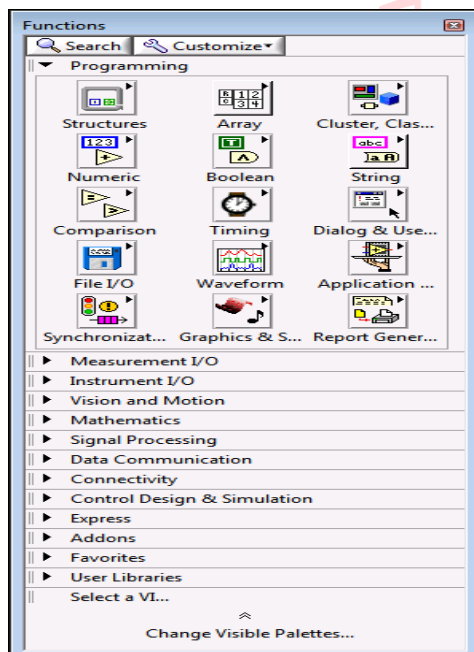


Figure 6 ,Function palette

National Instruments provide the assistance and support for beginning users of LabVIEW, there are various sources to aid in learning the language

<http://www.ni.com/support>, support[4]

<http://www.ni.com/devzone/idnet/default.htm>, Instrument drivers for more than 5000 instruments[4]

<http://www.ni.com/support/techdocs.htm>, Technical documents, application notes, knowledge base (searchable database), product manuals[4]

## IV. APPLICATIONS OF LabVIEW IN ACADEMICS

Due to virtual and graphical environment experimental lab work can be performed with LabVIEW in lecture rooms. Fundamental topics of circuits, electronics, signals and systems, mechatronics can be taught with an innovative approach in class room. Various universities partnered with National Instruments to modify the curriculum and developed academic solutions. Few examples of universities are mentioned here.

- A team of professor at the University of Virginia redesigned their circuits, electronics and signal and system courses to give the hands on experience to the students and to demonstrate how the topics in each course are implemented in real world.[11]
- To teach automated systems and Mechatronics Tsinghua University develop a complete project based approach in collaboration with NI.[11]
- University of Virginia developed a fundamental series in ECE to teach basics of electrical and computer engineering to students.
- University of Manetester, University of Waterloo and Georgia Institute of Technology are developing measurement driven approach using LabVIEW to give more insight to the student.
- University of Southampton creates a pipeline of student proficient in software defined radio so that graduates can apply engineering knowledge to advanced cutting edge platform like 5G.

## V. APPLICATIONS OF LabVIEW FOR INDUSTRY

LabVIEW is an industry leading software tool for designing test, measurement and control systems, It has the flexibility of a programming language combined with built in tools designed especially for test, measurement and control. LabVIEW is used for industry mainly in computer hardware (11%), higher education (8%) and computer software(6%).

Applications of LabVIEW covers energy, industrial automation, machine control, transportation sectors. National Instrument embedded systems are used by engineers and scientists to prototype and deploy logging, diagnostics, monitoring, and control applications within a variety of demanding industry environments. Few industry applications are mentioned below,

- SERIS created a rugged network of remote meteorological stations based on Compact RIO hardware

throughout Singapore to monitor and analyze research data.[9]

- Promethean Power Systems built a thermal battery powered refrigeration system using solar energy and NI products to cool and store milk, which decreased transportation and chilling costs.[9]

- National Grid UK adopted a platform, based on Compact RIO, that can provide more measurements and adapt with evolving grid for generations to come.[9]

- Delivering a high-performance automated turf harvester that reliably and efficiently palletizing turf in a variety of farming conditions while increasing farm productivity, reducing machine operating costs and providing a secure Internet gateway to remotely monitor and control the turf harvester, LabVIEW software and Compact RIO hardware is used to design a smart machine

harvest turf which uses half the diesel fuel than other turf harvesting machines on the market.[10]

- CADETTECH improves monitoring of electromechanical shovels at world's largest copper mines by creating a fully functional, tailor-made vibration and stress continuous monitoring system using the NI Compact RIO platform and NI LabVIEW software.

## VI. CONCLUSION

Virtual instrumentation is more flexible and scalable as compared to conventional instrumentation. Virtual instrumentation decreases the cost of an instrument, improves the performance, National instruments are developing hardware and software module as per the need of industry. LabVIEW has several key features that make it a good choice for automation environment. Wider sectors of industrial applications are covered by LabVIEW right from biomedical to aerospace and aviation. Lab experiments can be demonstrated to students graphically to have better understanding of theoretical concepts. National instruments works with the universities, professors, to extend the use of LabVIEW in classrooms, labs and research.

## REFERENCES

- [1] National instruments "LabVIEW development guidelines",2003
- [2] National instruments "Introduction to LabVIEW",2003
- [3] National instruments "LABVIEW quick start guide",2003
- [4] Rick Bitter, Taqi Mohiuddin , Matt Nawrocki.

"LabVIEW: Advanced Programming Technique" CRC Press, London,2007

- [5] K. S. Bhaskar, J. K. Pecol, and J. L. Beug, "Virtual Instruments: object oriented program synthesis", Conference proceedings on Object-oriented Programming systems, languages and applications, ACM Press, New York, NY, USA, 1986, pp. 303-314.
- [6] N. Ertugrul, LabVIEW for Electric Circuits, Machines, Drives, and Laboratories, Prentice Hall PTR, 2002.
- [7] Jovitha Jerome "Virtual instrumentation using LabVIEW ,PHI Learning private limited,new delhi,2010
- [8]<http://www.ni.com/gettingstarted/labviewbasics/environment>
- [9] <http://www.ni.com/en-in/innovations/energy.html>
- [10]<https://www.oemoffhighway.com/engineering-manufacturing/software/whitepaper/12116234/national-instruments-case-study-smart-turf-harvesting-machine-boosts-productivity-and-reduces-cost>
- [11]<http://www.ni.com/en-in/innovations/academic-research/teaching-controls-mechatronics.html>