VIRTUAL OSCILLOSCOPE

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This thesis is dedicated to my beloved mother, father, family, friends and BENT 2003-2007

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ABSTRACT

Virtual Oscilloscope features the interface of actual oscilloscope, with conventional gain, offset, timebase, and trigger controls. The scale and position for each channel of virtual oscilloscope is adjustable as is the time base. The trigger source and mode can also be set. All of the functions are similar to a standard laboratory oscilloscope. This project uses National Instrument LabVIEW 7.0 where LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. Virtual Oscilloscope was integrated with NI USB-6009 device where this device has the ability to perform many different functions. The NI USB-6009 provides connection to eight analog input (AI) channels, two analog output (AO) channels, 12 digital input/output (DIO) channels, and a 32-bit counter with a full-speed USB interface. This oscilloscope have two channels, voltage sensitivity 0.1V/Div – 5V/Div in 6 steps, time sensitivity 1 miliseconds/Div - 10 miliseconds/Div in 4 steps. The main goal of this project is to develop oscilloscope that convert personal computer into virtual instrument. In other words, user can directly use a personal computer with Virtual Oscilloscope software installed and integrated with NI USB 6009, and also with signal introduced from function generator. One of the major advantages of this virtual oscilloscope project is the ability to see inside the instrument and to understand how it works. By developing this project, the cost of oscilloscope will be less expensive and the data can be analyzed simply and in more detail.

ABSTRAK

Virtual Oscilloscope (Osiloskop Maya) merupakan antaramuka kepada osiloskop yang sebenar dengan pengendalian fungsi yang sama seperti 'conventional gain', 'offset', 'timebase' dan 'trigger'. Skala dan posisi untuk setiap alur pada Virtual Oscilloscope boleh diselaraskan seperti juga 'timebase'. 'Mode' dan sumber'trigger' juga boleh ditetapkan. Semua fungsi sama seperti osiloskop yang sebenar. Dalam membangunkan projek ini, perisian National Instrument LabVIEW 7.0 digunakan dimana ia merupakan bahasa aturcara berasakan grafik yang menggunakan gambar yang berfungsi seperti teks yang digunakan oleh bahasa aturcara lain untuk mencipta aplikasi. Virtual Oscilloscope disatukan dengan NI USB-6009 dimana alat ini mempunyai kebolehan untuk menjalankan fungsi yang berlainan. NI USB-6009 menyediakan sambungan untuk 8 masukan analog (AI), 2 keluaran analog (AO), 12 masukan dan keluaran digital (DIO) dan 32 bit pembilang dengan kelajuan penuh pada antaramuka USB. Virtual Oscilloscope ini mempunyai 2 saluran A dan B dengan kepekaan voltan 0.1V/Div-5V/Div dengan 6 langkah, kepekaan masa dengan 1 ms/Div-10ms/Div dengan 4 langkah. Tujuan utama dalam membangunkan perisian ini adalah untuk mengubah komputer peribadi kepada perkakasan maya. Dengan kata lain, pengguna dapat menggunakan komputer peribadi sebagai Virtual Oscilloscope dengan penyatuan NI USB-6009 dan isyarat masukan dari Function Generator. Kelebihan utama Virtual Oscilloscope ialah kebolehan untuk pengguna melihat cara kerja dalam perisisan dan sangat mudah difahami. Dengan membangunkan projek ini, kos pembelian dapat dikurangkan dan data dapat dianalisa dengan lebih terpeinci dan cepat.

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LIST OF ABBREVIATION

AC	Alternate Current
ADC	Analog to Digital Converter
AI	Analog Input
AO	Analog Autput
DAC	Digital to Analog Converter
DAQ	Data Acquisition
DC	Direct Current
DIO	Digital Input/Output
DLL	Dynamic Link Library
FIFO	First-in-First-out
G	Graphical Programming Language
GND	Ground
GPIB	General Purpose Interface Bus
I/O	Input/Output
LabVIEW	Laboratory Virtual Instrument Engineering Workbench
MAX	Measurement & Automation Explorer
MHZ	Megahertz
MUX	Multiplexer
NI	National Instrument
NI DAQmx	The latest NI-DAQ driver with new VIs, functions, and development tools for controlling measurement devices. The advantages of NI-DAQmx over earlier versions of NI-DAQ include the DAQ Assistant for configuring channels and measurement tasks for your device for use in LabVIEW, LabWindows™/CVI™, and Measurement Studio; increased performance such as faster single-point analog I/O; and a

	simpler API for creating DAQ applications using fewer functions and VIs than earlier versions of NI-DAQ.
PC	Personal Computer
PGA	Programmable Gain Amplifier
POLY	Polymorphic
PXI	PCI Extension For Instrument
RS-232	Recommended Standard 232, A Serial Interface Bus Standard
RS-485	Recommended Standard 485, A Serial Interface Bus Standard
USB	Universal Serial Bus
VI	Virtual Instrument
VXI	VME Extension For Instrument (Bus)
XOR	Exclusive-OR

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In this developing era, oscilloscopes have been use widely. An oscilloscope is an electronic instrument that is used to indicate voltage of an electronic device. It is chiefly used to diagnose the working condition of any electric equipment. It represents one or more electric potential differences in a two-dimensional graph, with the horizontal axis representing time and the vertical axis showing voltage. Some oscilloscopes can show even two or more waveforms. These are used for phase comparison and timing measurements.

Nowadays, oscilloscope is one of the vital measuring instruments especially in the engineering field. However, normal oscilloscope has several weaknesses such as expensive cost, big size and unable to analyze the data by themselves. This thesis presents the development of a PC based oscilloscope with several advantages. By developing a Virtual Oscilloscope using National Instruments DAQmx USB 6009 and National Instrument LabVIEW 7.1, the cost of oscilloscope will be less expensive and the data can be analyzed by more details and easy. Furthermore, by developing Virtual Oscilloscope is something that felt was consumer electronic related to the current market and was interesting in working with.

1.2 OBJECTIVES PROJECT

Although oscilloscopes aren't meant to make precise measurements, they are the most used instrument in electronics and they are also used a lot in other specializations. A virtual instrument with extended features in experiment was decided to design and implement. Labview programming language was used where this language differs a lot from classic text-based programming languages like C, C++, Java and etc.

The objectives of this thesis are to study the National Instrument LabVIEW 7.0 and NI-DAQmx USB-6009 that will be used in developing this software. Besides, this project was developing to study the function of actual oscilloscope. This basically means that this software and hardware need to study from the beginning and the basics.

The main goal of this project is to develop oscilloscope that convert personal computer into virtual instrument. In other words, user can directly use personal computer with Virtual Oscilloscope software installed and integrated with NI-DAQmx USB 6009, and also with signal introduced from function generator.

Besides, an objective of the project also includes integrating LabVIEW 7.0 software and NI-DAQmx USB-6009 so that this project can be run as the actual oscilloscope and the data can be analyzed by more details and easy.

The important thing of the oscilloscope is the max frequency that the oscilloscope can analyze. So, this project also includes in study how to gain the frequency of the oscilloscope and get the better performance.

Furthermore, in Malaysia, most university nowadays still works with the traditional oscilloscope. So, this project can do something that felt was consumer electronic related to the current market and was interesting in working with.

The objectives of this project also to develop the virtual oscilloscope that can be used same as traditional oscilloscope and the cost of the virtual oscilloscope will be less expensive.

1.3 PROBLEM STATEMENT

At the earlier stage, the software that can develop virtual instrument has to be finding first and then National Instrument LabVIEW 7.0 was chosen to develop this project. This software was get from my supervisor and he gave a short briefing about this software so can be more familiar with. This software (G-language) differs a lot from classic text-based programming language like C, C++, Java and etc.

The actual oscilloscope have to be study and understand such as conventional gain, offset, timebase and trigger controls so this project can be develop similar to actual oscilloscope. To get the information of the actual oscilloscope, oscilloscope manual have been downloaded from the internet and also some researches from books and journal have been made.

NI-DAQmx USB-6009 device have been selected t in integrating with Virtual Oscilloscope software where this device is plug in directly into USB slot. Before that all information about this device has to find and studied.

A medium to high frequency oscilloscope is expensive. So, this low-cost virtual oscilloscope integrated with NI-DAQmx USB-6009 device was developed to solve this problem. One thinks to remember that the performance of the Virtual Oscilloscope was depending on NI-DAQmx USB-6009. This device has a rather small maximum scan rate. The performance of the application is thus satisfactory. Also, virtual instruments such as Virtual Oscilloscope software have the capability of instrument configuration that is difficult to obtain in direct hardware system.

As LabVIEW 7.0 software is new to me, more information about LabVIEW software such as start guide, tutorials and examples has to study. With study and

familiar with this software so that it can be easy to me in starting develop the Virtual Oscilloscope.

Nowadays, many products such as virtual instrument are sold in global markets. So this project must be more interesting than others in sweeping consumers to use my Virtual Oscilloscope.

1.4 SCOPE OF WORK

First of all, Virtual Oscilloscope was decided to develop because it sounded very interesting to approach. Also felt it would help me in understanding many aspects of hardware and software interfacing. Briefly, the system contained many stages of operations necessary in a successful model. Firstly, the system contained software where LabVIEW programming will displayed the data. The other stage is LabVIEW software will be integrated with NI-DAQmx USB-6009 device with signal introduced from Function Generator.

In overall, the scope of work is to develop oscilloscope that convert personal computer into virtual oscilloscope software, which is felt was consumer electronic related to the current market and was interesting in working with. So, the first step is to learn and mastered with LabVIEW 7.0 software. By using this software, Virtual Oscilloscope was started to develop using graphical programming language (G-Language) that uses icons instead of lines of text to create applications.

As my subject is an oscilloscope, therefore have to find lots of details and information regarding actual oscilloscope, LabVIEW 7.0 software and NI-DAQmx USB-6009 device including the start guide, tutorials, examples and many more and also regarding the virtual oscilloscope software on the markets.

It means that the oscilloscope, the measuring analog and digital frequencies and the data acquisition system has to be familiar with.

As the virtual oscilloscope software is successful developed, NI-DAQmx USB-6009 device will be integrated. Before that, the USB-6009 is calibrated where analog signal from function generator will be introduced to USB-6009 device so we can see the similarity of the two outputs.

The final cut is to integrate both software and hardware and troubleshoot if any problems occurred. The Virtual Oscilloscope will run similar to actual oscilloscope but the differentiation is it is cheaper than actual oscilloscope. This is the procedure in developing and structuring the Virtual Oscilloscope:

1) Oscilloscope
   - To familiarize with the function of actual oscilloscope such as conventional gain, offset, time base, and trigger controls.

2) National Instrument LabVIEW
   - To develop and configure virtual oscilloscope.

3) NI-DAQmx USB-6009
   - To integrate with virtual oscilloscope software so virtual oscilloscope can used as actual oscilloscope.

1.5 SUMMARY OF PROJECT METHODOLOGY

With regarding to the procedure and method in achieving the objectives of the project, the first thing, have to install National Instrument LabVIEW 7.0 software and NI Signal Express software out of something.

Then, the usage of this software was learned, even though this software is graphical programming language that uses icons instead of lines of text to create applications. Besides, literature review was made where have to get information about LabVIEW software, NI-DAQmx USB-6009 device and oscilloscope from the internet, books and journals.