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Asp. Net simulated virtual oscilloscope

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Abstract

The Oscilloscope ranges from the CRO (Cathode Ray Oscilloscope) to DSOs (Digital Storage Oscilloscopes), which is a type of electronic test equipment that presents the dynamics of a time-varying signal as a two-dimensional pattern on a screen. Design of a virtual oscilloscope is a work that seeks to replicate the basics of power measurement of a physical oscilloscope, which is the most widely used general-purpose electronic test instrument in the laboratory but is plagued by limited supply due to high cost. As such this project bridges the gap between direct contact with the instrument and the usage of a virtual laboratory. Engineers have dealt with different spheres of this virtualization of oscilloscopes. However, this work managed to bring four different quantities; current, voltage, power, and resistance into one platform, reducing the cost and stress of having separate platforms. The work adopted Wavesurfer scope techniques and used complex AC circuits analysis to model a partial network virtualization platform, based on the ASP.NET Framework built using visual C# in Microsoft Visual Studio. The six initial inputs options: voltage and current (V-I), voltage and power (V-P), voltage and resistance (V-R), current and power (I-P), current and resistance (I-R), power and resistance (P-R) as measured on a meter of specified type (Averager or RMS), serve as physical inputs, which, combined with the operating mains frequency, is passed using dedicated algorithms to obtain the derivative Amplitudes.

Keywords: Virtualization; Current; Voltage; Power; Oscilloscope

1. Introduction

The earliest work on virtualization by Hassel saw the innovation as a move from physical hardware to virtual hardware, merely transferring a parameter from its real world to a virtual form. Overby E. continued and developed on the course by introducing technological aspects to include; Full, Partial and Para option of virtualization. Connor expanded the virtualization by taking the technology to server level. On this level, individual engineers like Bele, R., Desai, C., Woolgar, s. and host of others continued researches on individual aspects of virtualization with one or two engineering parameters. In computing, virtualization refers to the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, operating systems, storage devices and computer network. Virtualization began in 1960s as a method of logically dividing the system resources provided by mainframe computers between different applications. Since then, the act and trend has broadened as the technology matures and advances are made. There arose options open to administrators and more cost saving virtualization projects that can be implemented (1). Virtualization allows for maximization of hardware through the sharing of resources. It encompasses virtual electronics laboratory with the collection of software based instrument from simulated environment, designed to tackle multiple tasks at the barest cost (2). A virtualized environment is also easier to backup and restore for recovery purposes. This applies since only part of the system is used with the main part of the system running on a different entity. As evidence to this growing trend in virtualization. (3) Said, ‘if you look at processor trends, both Intel and AMD have shifted from increasing the clock speed of their processors to increasing the number of processor rows on a single

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chip. He opined further that virtualization is moving from a niche market into the main stream especially since Microsoft entered the market'.

Virtualization is also is a move from real, physical hardware to virtual hardware which is seen today as one of the "next big thing in IT". There are more virtualization options in IT departments than ever before including Xensource Inc's and Virtual Iron Software Inc' open source applications, Microsoft Corps Virtual Server and VMware Inc's Venerable products. (4) Looked at the idea or concept of virtualization beyond menu server virtualization and came up with other lines to be explored when looking at the value of virtualization on the whole. For the purpose of this work, the writer is using Windows 8 as host and Microsoft Office '07 as guest owing to the versatility of the software. The actual virtualization is utilized in VMware's software. The oscilloscope parameters will adopt initial approach to storage virtualization configured to address virtualization in the Storage Area Network (SAN) because the SAN sat between the storage and servers aimed to cause the least disruption to the system. This form of storage virtualization will deliver significant efficiencies, cost savings, power and cooling benefits (5).

1.1. Hardware Virtualization

Hardware virtualization or platform virtualization refers to the creation of a virtual machine that acts like a real computer with an operating system. Software executed on these virtual machines is separated from the underlying hardware resources. In hardware virtualization, the host machine is the actual machine on which the virtualization takes place and the guest machine; the virtual machine. The words host and guest are used to distinguish the software that runs on the physical machine from the software that runs on the virtual machine. The software or firmware that creates a virtual machine on the host hardware is called a hypervisor or virtual machine manager. For example, a computer that is running Microsoft Windows may host a virtual machine that looks like computer with the Ubuntu Linux operating system; Ubuntu – based software can be run on the virtual machine. As in this case of this project work, operating system; Microsoft Windows 7 lower than the host operating system (Windows 8) is used.

Hardware assisted virtualization is a way of improving overall efficiency of virtualization. It involves CPUs that provide support for virtualization in hardware, and other hardware components that help improve performance of a guest environment. (4) hardware virtualization can be viewed as part of an overall trend in IT enterprise that includes autonomic computing, a scenario in which IT environment will be able to manage itself based on perceived activity and the utility computing in which computer processing power is seen as a utility that clients can pay for only as needed. The usual goal of virtualization is to centralize administrative tasks while improving scalability and overall hardware resource utilization; he maintained.

Hardware virtualization can be of different options which include;

- Full Virtualization
- Partial Virtualization
- Para Virtualization.

1.2. Aspects of Virtualization

Microsoft, VMware, Vshapere as well as other bodies virtualize and aggregate the underlying physical hardware resources across multiple systems and provide pools of virtual resources to the data centre. Virtualization is a process that breaks the hard connection between the physical hardware and the operating system and applications running on it. After being virtualized in a Vsphere virtual machine, the operating system and applications are no longer constrained by the limits imposed by residing on a single physical machine. Virtual equivalents of physical elements such as switches and storage operate within a virtual infrastructure that can span the purpose of establishment. Hence, aspects of virtualization are thus;

1.2.1. Virtualizing the computer

The X86 computer hardware is designed to run a single operating system and a single application leaving most machines underused. An improvement on this is the Windows version of Virtual PC which uses dynamic recompilation though only to translate X86 kernel mode and real mode into X86 user mode code. The latest aspect of this is the virtual server which encapsulate virtual hard disk in the Virtual Hard Disk (VHD) file format. A virtual switch available in virtual PC allows adding multiple network adapters (6). At the most basic level, virtualizing allows one run multiple virtual machines on a single physical machine with each virtual machine sharing the resources of that one physical computer across multiple environments. Different virtual machines can run different operating systems and multiple applications in isolation, side-by-side on the same physical machine.

1.2.2. Virtualizing the Infrastructure

In addition to virtualizing a single physical computer, one can build an entire virtual infrastructure with VMware and Vsphere scaling across thousands of interconnected physical computers and storage devices. Using virtualization, one can dynamically move resources (7) and process same as well as allocate hardware resource. Hence no need to assign servers, storage or network bandwidth permanently to each application.

A virtual infrastructure consists of the following components;

- Bare-metal hypervisors to enable full virtualization of each computer.
- Virtual infrastructure services such as resource management to optimize available resources among virtual machines.
- Automation solution that provide special capabilities to optimize a particular IT process such as provisions or disaster recovery.

A typical example of virtualizing the infrastructure is in cloud computing. A scenario where providers deliver hosted services on demand over the internet. Cloud computing is similar to utilities like electricity and telephoning where a user can consume to level of service needed at any time without being responsible for the production and management of the service. A virtual infrastructure is the foundation for cloud computing (8). Cloud computing depends on a scalable and elastic model for delivering IT services and the model itself depends on virtualization to be workable. VMware VSphere provides such virtualization he opined.

Infrastructural virtualization also enhances Server consolidation. Server consolidation through virtualization allows one to get more out of the existing servers, gives room to limit the physical resources that one may need to manage, power, store as well as buy. It also gives room according to the achievement of highly consolidating existing workloads and leveraging remaining servers for the deployment of new applications and solutions. In Server consolidation, physical machines are converted to virtual machines to run in a VSphere ESXI host.

Infrastructural virtualization also ensures business continuity by enabling it to reduce or even eliminate planned and unplanned ventures [9]. They stated that with VSphere, one can migrate virtual machines live to another host and perform maintenance on physical servers anytime without user or service disruption. Unplanned downtime is reduced by using VSphere features such as high availability and fault tolerance. Traditional recovery plans; continued to require manual, complex steps to allocate recovery resources, perform bare metal recovery, recover data, and validate that systems are ready to use. VMware VSphere simplifies this environment. Hardware configuration, firmware, operating system, and applications become data stored in a few files on disk. Protecting these files using backups or replication software means that the entire system is protected. These files can be recovered to any physical computer without requiring changes because virtual machines are hardware-independent.

Virtualization continued with innovations in individual aspects until big companies like Xensource Inc and Virtual Iron Software Inc ventured into the field. Their involvement opened commercialization of the technology; a trait that attracted Microsoft Inc. Microsoft brought standards and protocols into the innovation. She also developed and manages versatile platforms for the running and management of different aspects of virtualization. She extended her services to stipulating compatible hardware for each operating system version; a ground for individual development into the existing technology. This work utilized the versatility of Microsoft platforms by using Microsoft Visual Studio to incorporate the works of early engineers that ventured into virtualization by adopting the Server works of Connor and para-virtualization of Woolgar S while using the laid down protocol for virtualization with compatible hardware to design and develop virtual oscilloscope platform. The work in its later stage compared the outcome from the virtual platform with physical Lissajous curves to arrive at a positive hypothesis.

The design and development of a basic virtual oscilloscope are typically divided into four sections the;

- Input,
- Reading,
- Simulation and;
- Plotting and Display.

2. Material and methods

2.1. Input

In a digital oscilloscope, the signal to be measured is fed to one of the input connectors which is usually a coaxial connector though binding posts may be used for lower frequencies. General-purpose oscilloscopes usually present an input impedance in parallel with known capacitance of the probe.

Virtualized scope has double three-option parameters at the input and first stage of virtualization giving this platform a wider range usage as the scope could fit into any of the option to present accurate result. These parameters; voltage and current, voltage and power in case of wattmeter or current and power options are keyed into the input boxes after initialization. The tool selects the path of course using gates initialized by codes either through Average meter or RMS to determine the Frequency of oscillation.

The Input outcome feeds into the Reading section allowing for Reactance option of physical load. The physical loads come with Power Factor from the manufacturer and it is fed directly into this option. Reactance option accepts the capacitance and inductance of the load as physical inputs for onward simulation.

3. Results and discussion

3.1. Simulation

Most products have to meet certain specifications or should respond in a specified manner when subjected to a particular stimulus. A digital oscilloscope can help greatly in testing key signal characteristics or in documenting product response to a specified stimulus. All digital oscilloscopes measure signal parameters and some make more than one complex measurement at a time.

This virtual oscilloscope utilized Wavesurfer scope option while considering the simulations involved. Firstly, from the first principle of Ohmic Law

Considering different phases/options of the virtualization, we have that;

$I = V/Z$

$\Rightarrow \quad Z = V/I$

$$\text{But } R = \sqrt{(Z^2 - X^2)}$$

Hence $Z = R + jX$

(Where X = Reactance where there is Capacitance and Inductance)

$$Z = R + j\,(X_L - X_c)$$

$$\text{Or } Z = R^2 + (X_L - X_c)^2$$

Introducing lag angle as a result of phase difference;

Where IV = Power (apparent)

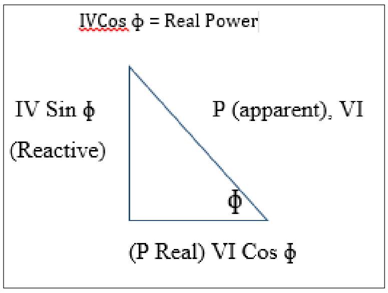

Figure 1 Lag angle

Hence;
Reactive Power = IVSin ϕ
Real Power = IVCos ϕ
Apparent Power = IV
Power Factor = Cos ϕ or arctanX/R where;
X = Reactive
R = Real
Z = Apparent sides.

3.2. Strategies used in Engineering Virtualization

Strategies adopted in the design and development of this virtualization platform are grouped into:

Enabling Platform, Support, Standards and Management

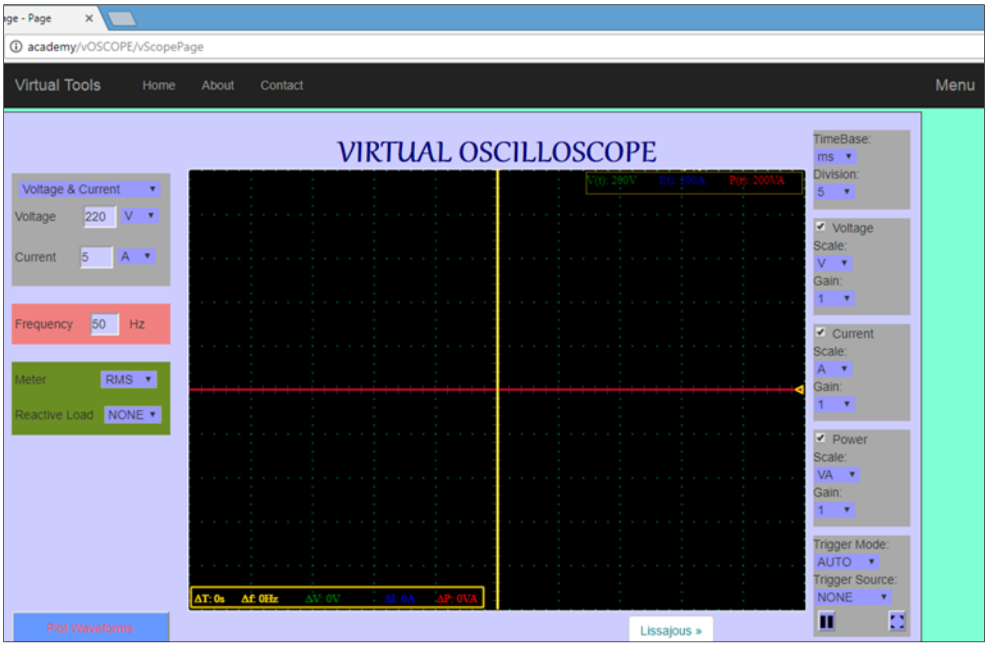

Figure 2 Enabling Platform

3.3. Program Chart of Virtual Scope

- using System;
- using System.Collections. Generic;
- using System. Linq;
- using System. Web;
- using System.Web.Optimization;
- using System.Web.UI;

- namespace vOSCOPE

```
{
public class BundleConfig
{
// For more information on Bundling, visit http://go.microsoft.com/fwlink/?LinkID=303951
public static void RegisterBundles(BundleCollection bundles)
{
bundles.Add(new ScriptBundle("~/bundles/WebFormsJs").Include(
```

- "~/Scripts/WebForms/WebForms.js",
- "~/Scripts/WebForms/WebUIValidation.js",
- "~/Scripts/WebForms/MenuStandards.js",
- "~/Scripts/WebForms/Focus.js",
- "~/Scripts/WebForms/GridView.js",
- "~/Scripts/WebForms/DetailsView.js",
- "~/Scripts/WebForms/TreeView.js",
- "~/Scripts/WebForms/WebParts.js"));
-

```
// Order is very important for these files to work, they have explicit dependencies
bundles.Add(new ScriptBundle("~/bundles/MsAjaxJs").Include(
```

- "~/Scripts/WebForms/MsAjax/MicrosoftAjax.js",
- "~/Scripts/WebForms/MsAjax/MicrosoftAjaxApplicationServices.js",
- "~/Scripts/WebForms/MsAjax/MicrosoftAjaxTimer.js",
- "~/Scripts/WebForms/MsAjax/MicrosoftAjaxWebForms.js"));

```
// Use the Development version of Modernizr to develop with and learn from. Then, when you're
// ready for production, use the build tool at http://modernizr.com to pick only the tests you need
bundles.Add(new ScriptBundle("~/bundles/modernizr").Include(
"~/Scripts/modernizr-*"));
ScriptManager.ScriptResourceMapping.AddDefinition(
"respond",
new ScriptResourceDefinition
{
Path = "~/Scripts/respond.min.js",
DebugPath = "~/Scripts/respond.js",
});
}
```

}

}

3.4. Experiment 1

Title: To determine rate of voltage deflection, the voltage amplitudes and measure the sinusoidal frequency

Author's Name: Department of Electrical and Electronic Engineering, University College of Swansea, Wales

3.4.1. Expectations

From the Lissajous theorem, it is expected that:

- When the supply was reversed, the waveform will be inverted.
- When the input switch is switched to AC, the trace drops to zero volts.
- When the meter reading was 2v, the oscilloscope registered 3v peak-to-peak time ie cm-1 = 2ms.
  (With a Л/2 phase difference Cx = 2, when Cy = 4
  .. Frequency ratio Fx/Fy = Cy/Cx = 4/2 = 2:1)
- When the time/cm is decreased, the wavelength of the AC sine wave increases and vice versa.
- When the variable control was turned clockwise, the wavelength is increased and vice versa.
- The amplitude remained unchanged in both cases of meter reading and wave amplitude / frequency determination and
- There is no noticeable change when the input switch is changed from AC to DC.

Table 1. Results of deflection of Trace against Voltage

DC Voltage Reading	Deflection (cms)
2	1
4	2
6	3
8	4
9	4. 5

- Given that: Fx - frequency applied to X plates (signal generator)
- Fy - frequency applied to Y plates (mains)
- Cx - number of times the trace outs the horizontal axis
- Cy - number of times the trace cuts the vertical axis

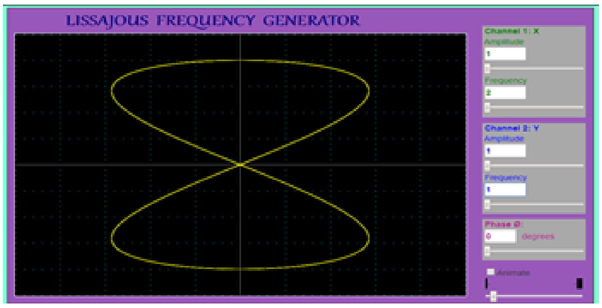

Figure 3 Lissajous curve at 50Hz supply

With a Л/2 phase difference, Cx =, Cy = 4;

Lissajous Curves produced are thus;

50Hz supply

So the frequency ratio Fx/Fy = 4/2 = 2:1

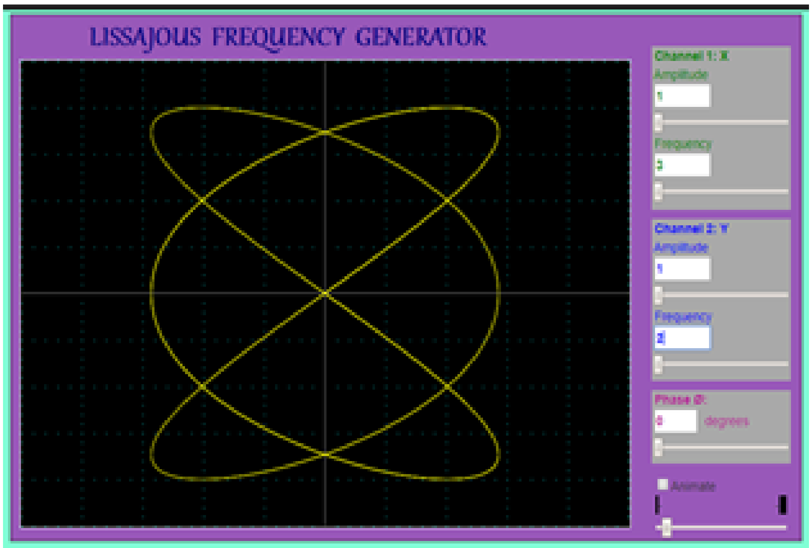

Figure 4 Lissajous curve at 75Hz supply

75Hz

Fx/Fy= 75/50= 3/2

Fx/Fy =Cx/Cy = 3.2

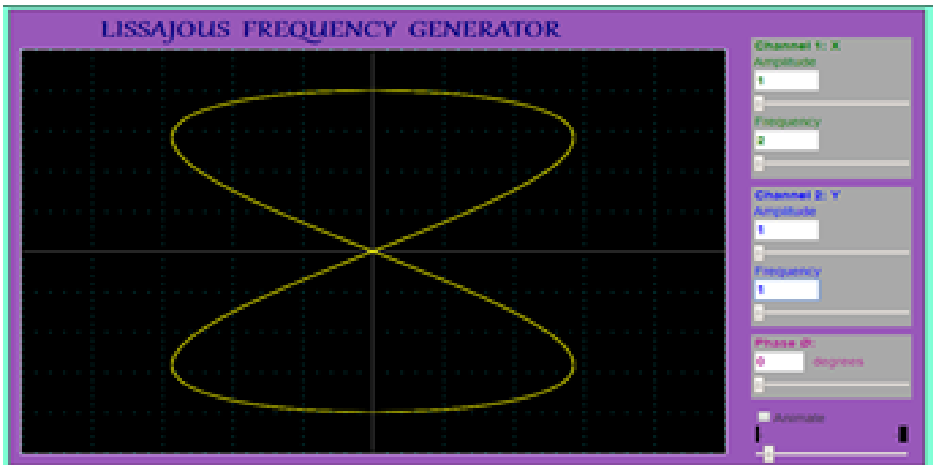

Figure 5 Lissajous curve at 100Hz supply

100Hz

Fx/Fy= 100/50 2/1

Fx/Fy = Cx/Cy =2:1

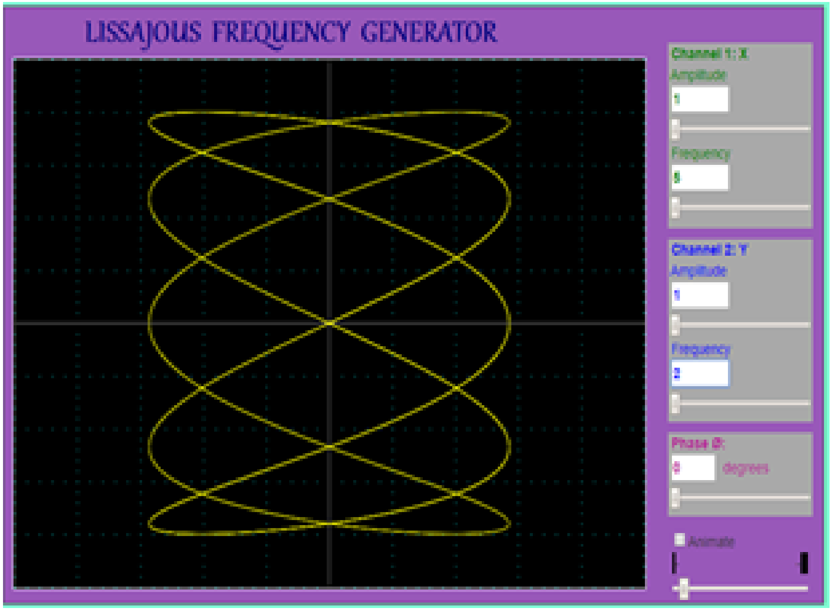

Figure 6 Lissajous curve at 125Hz supply

125Hz

Fx/Fy= 125/50 5/2

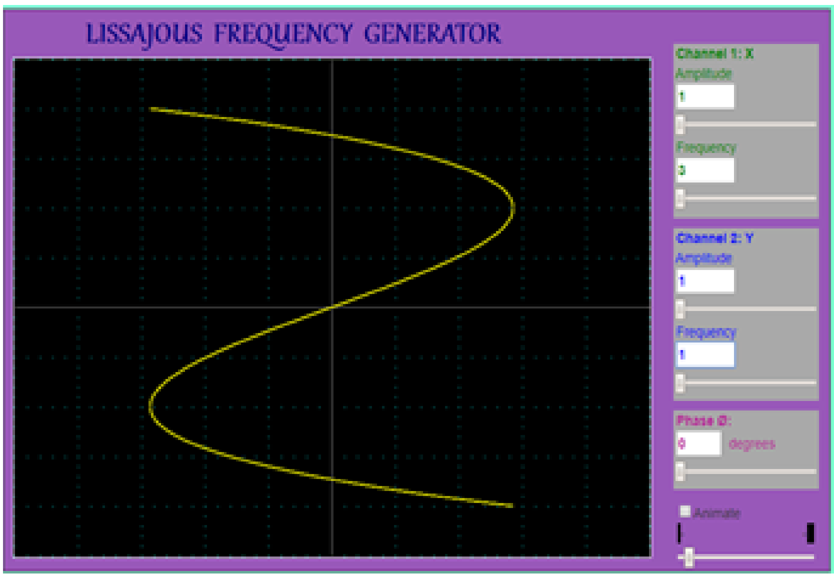

Figure 7 Lissajous curve at 150Hz supply

150Hz

Fx/Fy= 15050 3/1

Fx/Fy = Cx/Cy = 3/1=3:1

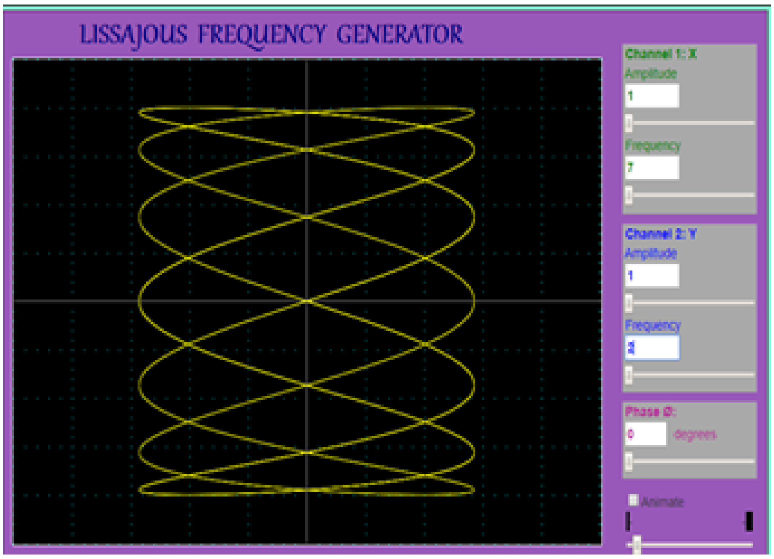

Figure 8 Lissajous curve at 175Hz supply

175Hz

Fx/Fy= 175/50 7/2

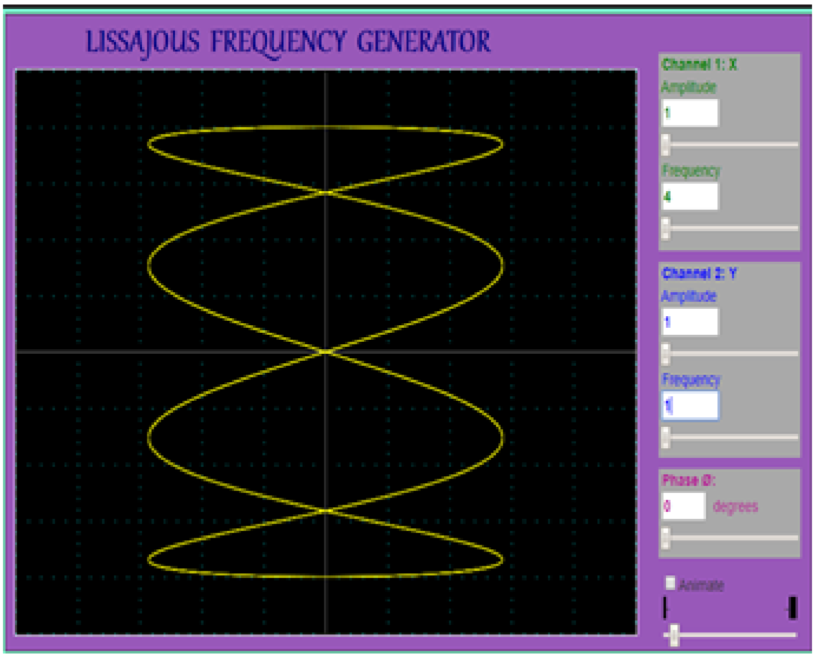

Figure 9 Lissajous curve at 200Hz supply

200Hz

Fx/Fy= 200/50 4/1

4. Conclusion

Asp.net simulated virtual oscilloscope produced regular sine patterns as validated with Lissajous curves on physical oscilloscope hence an economical tool in science laboratory. The six initial inputs options: voltage and current (V-I), voltage and power (V-P), voltage and resistance (V-R), current and power (I-P), current and resistance (I-R), power and resistance (P-R) as measured on a meter of specified type (Averager or RMS) with dedicated algorithms obtained the derivative Amplitudes with ASP-Net simulated virtual oscilloscope as validated by Lissajous curves.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors of this manuscript agreed and contributed significantly to the success of this research without conflict of interest.

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