International Journal of Computer Science and Business Informatics

IJCSBI.ORG

Development of Virtual Experiment on Waveform Conversion Using Virtual Intelligent SoftLab

Bhaskar Y. Kathane
V.M.V. College, Wardhaman Nagar,
Nagpur (MS), India

ABSTRACT
Waveform conversion is difficult task for the students during studying. Virtual Intelligent SoftLab (VIS) gives the easy implementation of waveform conversion using the virtual instruments. The study of waveform conversion is important in Electronics, Computer Science and Engineering. The virtual intelligent softlab convert rectangular waveform to sawtooth, digital and pulse waveform using virtual instruments. This model will help students to perform it any time and anywhere without traditional laboratory. The screen shows virtual waveform using virtual input Instruments and observed converted waveform using the virtual output Instruments. In this model we learn the circuit connection without physical damages. There is a facility for the user to change the voltage and observed the outputs on the screen.

Keywords
SoftLab, VIS Model, Waveform, Sine wave, Sawtooth, Rectangular wave.

1. INTRODUCTION
The basic concept of VIS (Virtual Intelligent SoftLab) Model of an experiment is to provide a virtual platform for learners to perform the experiment with their own selection. The effort is towards the working procedure in a real laboratory and its environment in the virtual workbench. Virtual experiments are designed and sequenced in such a manner as to give a real feel of performing the experiment. During the experiment, the learner can save and edit the desired data for his/her analysis. Apart from these the focus is also aims to embed a maximum number of learning components in virtual experiments. Virtualizations of experiments could be broadly classified, based on the form data used for performing the experiment. The Soft Lab philosophy facilitates us to link the physical laboratory experiment with its theoretical simulation model within a unified and interactive environment. The goal for each instance of a SoftLab laboratory is to create a software environment where experimental research, simulation and education coexist and interact with each other. As a part of the SoftLab project, we have design various experiments for Electronics, Computer

science and Engineering students. This model describes how the experiments perform for the user using virtual instruments. The VIS forces us to address the challenge of solving experiments. Virtual Intelligent SoftLab does not require a wide range of expertise to perform the experiment. The SoftLab framework should provide the infrastructure and facilities that serve the needs for basic research. SoftLab is such a flexible laboratory environment. Its goal is to simulate a laboratory space having a well-equipped storeroom of instruments and a variety of materials. Using SoftLab a student may be guided by an instructor to perform an experiment, or the student might also conceive of one on his own. The student may choose a substance to study, take out the instruments he needs, connect them together, make his measurements, and record and plot his results. The computer screen is the laboratory room. The experimental possibilities open to the student certainly are limited by the ability of the developers to maximize flexibility in a practicable way [1].

2. WAVEFORM CONVERSION

With operational amplifiers we can convert sine waves to rectangular waves; rectangular waves to triangular waves and so on. This experiment is about some basic circuits that convert an input waveform to an output waveform of a different shape [2].

2.1 Sine wave to Rectangular wave

When the input signal is periodic, the Schmitt trigger produces a rectangular output. The input voltage exceeds Upper Trip Point (UTP) on the upward swing of the positive half cycle, the output voltage switches to -ve. One half cycles later, the input voltage becomes more negative than Lopper Trip Point (LTP), and the output switches back to +ve. A Schmitt trigger always produces a rectangular output, regardless of the shape of the input signal.

Fig: 1

2.2 Sine wave to Sawtooth wave

The capacitor charges toward the supply voltage, the capacitor voltage reaches +10v, the diode breaks over. This discharges the capacitor, producing the fly back (sudden voltage drop) of the output waveform. When the voltage is ideally zero, the diode opens and the capacitor begins to charge again. In this way, we get the ideal sawtooth waveform.

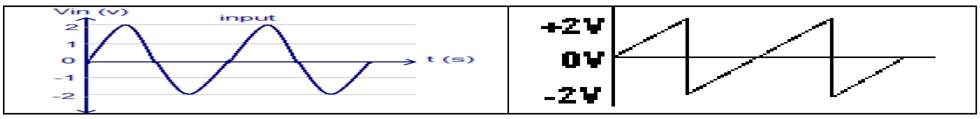


Fig: 2

2.3 Rectangular wave to Triangular wave

Rectangular wave is the input to an integrator. Since the input voltage has a dc or average value of zero, the dc or average value of the output is also zero. The wave is decreasing during the positive half cycle of input voltage and increasing during the negative half cycle. Therefore, the output is a triangular wave with the same frequency as the input.

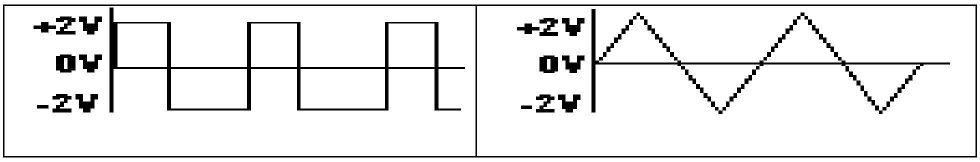


Fig: 3

2.4 Triangular wave to Pulse wave

With this circuit, we can move the trip point from zero to a positive level. When the triangular input voltage exceeds the trip point, the output is high. Since V_{ref} is adjustable, we can vary the width of the output pulse, which is equivalent to changing the duly cycle.

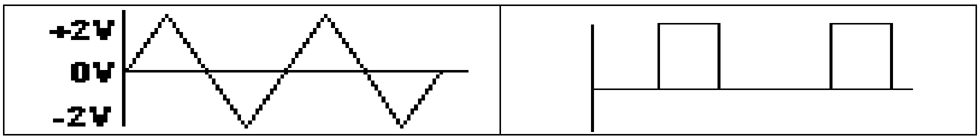


Fig: 4

2.5 Half Wave Rectifier

Half wave rectifier is a simple and low cost rectifier circuit it is used where high quality DC is not required for example to operate Night lamp, Radio circuit, etc. A diode is connected in series with load RL and output is taken across RL. In first half cycle or positive half cycle of AC voltage, diode becomes forward bias it is acting as a closed switch, the current flows through the circuit its flow through RL. Thus same output voltage is developed across RL similar to half cycle of AC input. In next cycle or negative half cycle diode becomes reverse bias; diode is acting as an open switch thus current through circuit is not possible it is blocked by diode. i.e. $\mathbf{V}_{out}$= I x R_L= 0 x R_L = 0v. Thus diode will conduct only at positive half cycle and it rectifies negative half cycle.

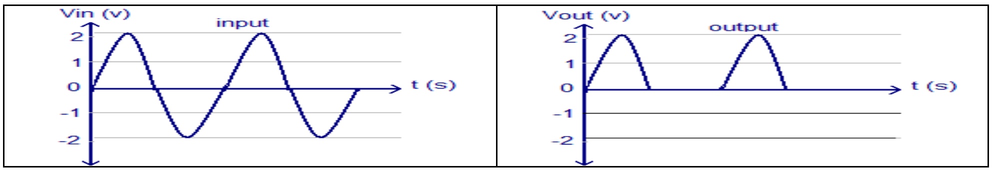


Fig: 5

2.6 Full Wave Rectifier

To utilize negative half cycle one or more diode is connected with special type of transformer called as center tap transformer. In centre tap transformer the middle terminal is tapped. In center tap rectifier diodes are conducting in alternate cycle so that current through R_L flows in the same direction for both half cycles.

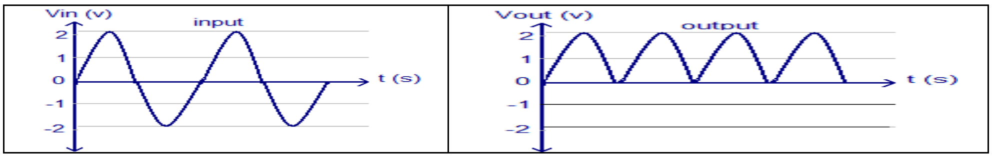


Fig: 6

3. TOOLS & TECHNOLOGY

Virtual Intelligent SoftLab model is design in Visual Basic as front-end and Microsoft Access as back-end. This language provide integrated development environment to the user. Visual Basic helps us to construct program to perform all virtual operation without physical instruments. This language is relatively easy to learn and use all its graphical features. Visual Basic easily connects with the database. A programmer can put together the component provided with Visual Basic itself to develop an application. The language not only allows programmers to create simple GUI applications, but also develop complex applications. Programming in Visual Basic is a combination of visually arranging component or control on a form, specifying attributes and actions of those components. Visual Basic can create executables (EXE files), ActiveX control or DLL files, but is primarily used to develop Windows applications. The beauty of this VIS model is that it does not require the Database to manage data [3].

4. VIS MODEL

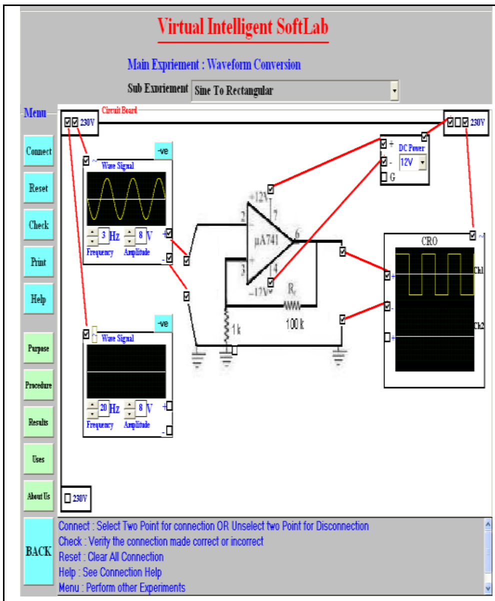
We have constructed the programs in VB, such that all the blocks in the model can be fully visualized on the screen. This model can demonstrate the activities of waveform conversion visually. Inputs accepted throw software and virtual output will observe on screen. In an experiment we can provide different input values and observe output. This model provide circuit connection facility to user to made connection properly otherwise the result not generated.

4.1 DESIGN SPECIFICATIONS

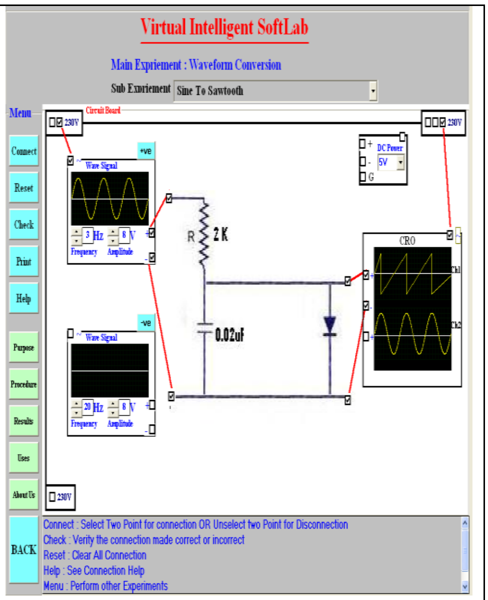
A program is constructed for conduct of Waveform Conversion experiment in VIS such that all the blocks in the model can be fully visualized on the screen. This model also can demonstrate the activities of Waveform Conversion including circuit connection visually. Inputs accepted through virtual waveform generator and resultant waveform virtual output which is observable on screen. In an experiment, one can provide different amplitude and frequency values for waveform signal and observe results. This model provides circuit connection facility to user so that the user can practice circuit connection also.

Procedure:

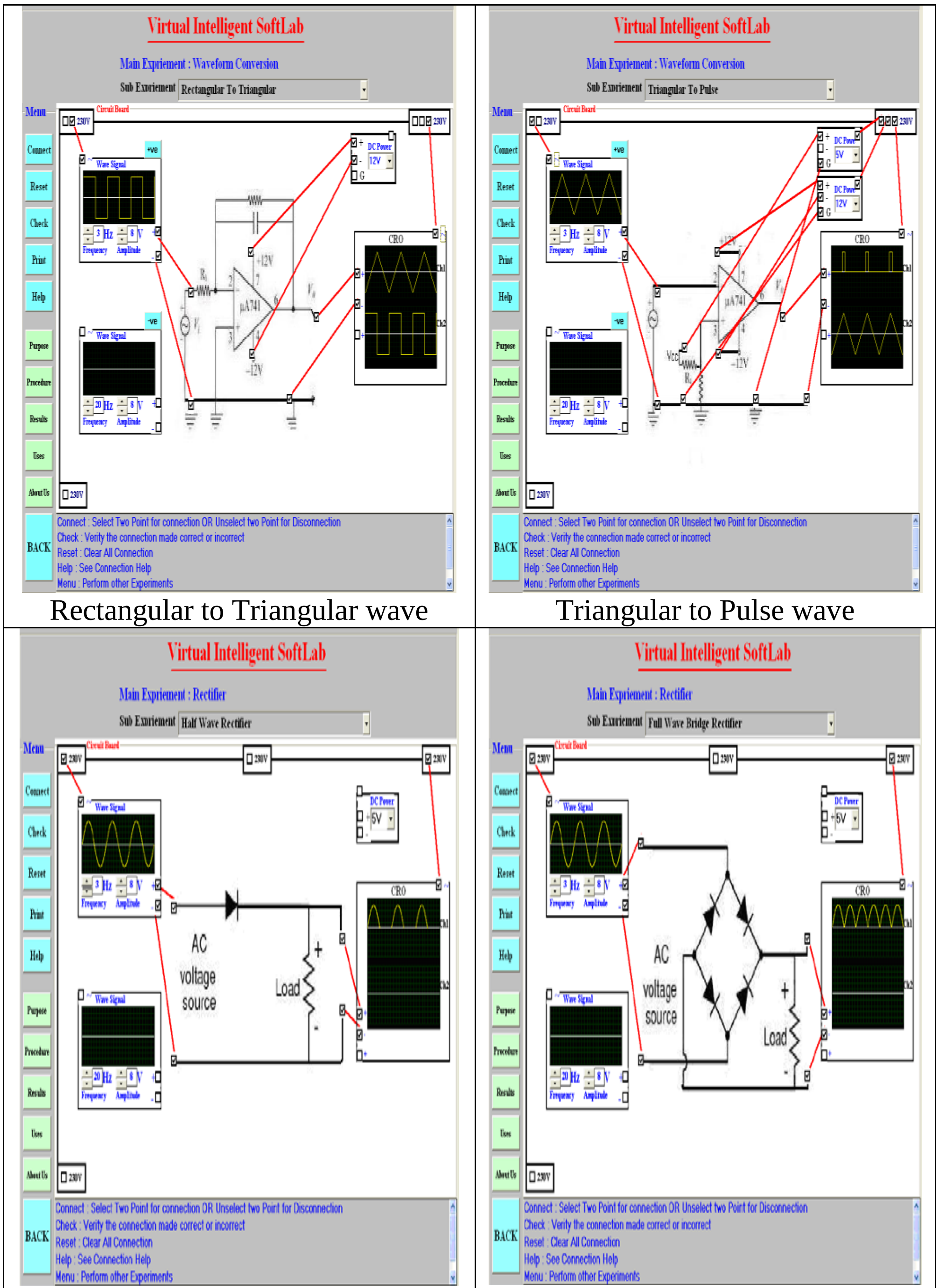
- Connect the circuit shown in fig – 7.
- Set the sine wave generator frequency and amplitude.
- Change the Amplitude, frequency and observe the output waveform.



Sin to Rectangular form



Sin to Sawtooth form



Rectangular to Triangular wave | Triangular to Pulse wave

Half Rectifier | Full Rectifier

Fig. 7: VIS Experiment on Waveform Conversion

4.2 IMPLEMENTATIONS

Once the VIS is ready then we implement the circuits using then following steps. The Circuit Connection Steps are

- Connect AC socket to DC Converter device
- Connect DC power supply to IC VCC pin
- Connect Ground Socket to IC Ground Pin
- Connect Output IC pin to Output switches
- Connect Input IC pin to Input switches

Experiment Implementation Steps are

- Made connection to selection two switches using mouse
- Click on Check Button to verify the connection
- Click on Reset Button if the connection are WRONG
- Click on Help Button if you need Connection HELP
- Click on Menu Button if you want to perform other Experiments

5. RESULTS

Virtual outputs are totally animated with the combination of software and observed actual outputs virtually using virtual instruments.

6. CONCLUSIONS

Virtual Intelligent SoftLab will helps Electronics, Computer Science and Engineering students to perform and practice experiments to improve their understanding of the subject. The design of the VIS model is more effective and realistic as necessary variable inputs and outputs are visible on the monitor screen. This model created for the client based system, can be converted into a client-server based application system. This virtual experiment provides practice for students for the 'touch & feel' part they have already performed in the laboratory.

7. ACKNOWLEDGEMENTS

We are very much thankful to Dr. M. G. Chandekar, Dr. P. K. Butey and Dr. D. A. Deshpande for their valuable inputs, constant guidance and their extensive support and encouragement in this work.

8. REFERENCES

[1] Tiwari, R. & Singh, K. (2011), Virtualization of engineering discipline experiments for an Internet-based remote laboratory. Australasian Journal of Educational Technology, 27(4), 671-692. http://www.ascilite.org.au/ajet/ajet27/tiwari.html.

[2] Malvino Electronic Principles, Tata McGraw-Hill , Sixth Edition 1999.

[3] B.Y. Kathane, P.B. Dahikar (Sept 2011), "Virtual Intelligent SoftLab for p-n junction Experiment", "Journal of the Instrument Society of India",ISSN 0970-9983, Vol.41 No.3, pp161-162.

[4] Digit FastTrack "to Virtualization" Volume 07, issue 04, April 2012.
[5] Physical Science Resource Center (PSRC) http://www.psrc-online.org/, Dec 2012.
[6] Remoter Dynamical System Laborator, STEVENS, Institute of Technology http://www.stevens.edu/remotelabs/, Dec 2012.
[7] Mercer University Online Interactive Chaotic Pendulum, http://physics.mercer.edu/pendulum, Retrieved on Dec 2012..
[8] http://www.cage.curtin.edu.au/mechanical/info/vibrations, Retrieved on Dec 2012.
[9] http://www.lci.kent.edu/ALCOM/alcom.html, Retrieved on Dec 2012..

This paper may be cited as:

Kathane, B. Y., 2014. Development of Virtual Experiment on Waveform Conversion Using Virtual Intelligent SoftLab. *International Journal of Computer Science and Business Informatics, Vol. 11, No. 1, pp. 107-114.*