



JAVA APPLETS USED TO TEACH ELECTRONICS IN INTERACTIVE MODE

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Abstract – JAVA applets can be used to teach electronics and other subjects in interactive mode. In the paper is presented the new application with JAVA Circuit simulator developed by Falstad (www.falstad.com). The JAVA applets Circuit simulator can help to the deep understand of the main functioning of the electronic circuits by interactive manipulation of the different functions. In the Circuit simulator there are many applications of the electronic circuits, in the paper are presented the diode application for the full wave rectifier circuits without or with filter and the AO noninverting amplifier. The theoretical part of each electronic circuit can help the students to understand JAVA applet. We contribute to the development of the theoretical part in romanian language.

Keywords: JAVA applets, Multimedia teaching, Interactive multimedia, Interactive teaching, Electronics teaching.

1. INTRODUCTION

Technology has made dramatic change in education, communication and trade. Education trough Internet is now accredited to have a massive impact upon all types of formal and nonformal education. In the last years the development of interactive multimedia methods for teaching student was widely developed. Simply stated, interactive multimedia means a combination of multimedia and interaction [2, 6]. A multimedia presentation is composed on files each of them is composed of pages comprising media and interactivity. The media is composed on text, image, sound and movie. The interaction is composed on trigger and action. The simple solutions for interactive media are JAVA applets [3, 6]. The popularity of the JAVA language for educational material development continues to increase. Some JAVA applets provide an excellent educational material. Why the educational materials with JAVA applets are excellent? We can talk about the power of image, the power of sound and the power of interaction. Reusable software objects, in the form of Java applet programs, provide an open, distributed and expandable platform for a courseware system. The Java applets can be easily included in an html document along with other multimedia elements such as images, videos and audios, permitting an easy configuration of dynamic multimedia learning

materials. For maximum use and productivity by educators, including an applet program in an html document should be as easy as including a clip art or an image file. The main limitation at the present time is the lack of a sufficient number of subject-specific Java applet programs of a high educational quality and the lack of an html authoring tool with an easy-to-use author interface. This paper deals with development and utilization of Java applets in electronics teaching. A developed Java applet program, which by nature depends on the graphical user interface for user input and on a visual presentation of the simulation results, is an excellent tool for teaching/learning abstract concepts and principles of electronics. Simulation processes and results may be visually presented to the learner in real time.

We use the JAVA applets developed by Falstad [1] and the main application is focused on Analog Circuit Simulator Applet.

2. THE PRESENTATION OF THE ANALOG CIRCUIT SIMULATOR APPLLET

JAVA applet is a complex circuit simulator that contains many electronic circuits as:

Basics- 7 circuits,
A/C Circuits- 9 circuits,
Passive Filters- 7 – circuits,
Other Passive Circuits- 25 – circuits,
Diodes – 13 – circuits,
Transistors- 18 – circuits,
JFETs- 5 -9 circuits,
MOSFETs - 12 circuits,
Op-Amps- 22 circuits,
555 Timer Chip- 6 circuits,
Active Filters – 4 circuits,
Logic Family – 19 circuits,
Combinational Logic-8 circuits,
Sequential Logic -15 circuits,
Analog/Digital – 4 circuits,
Phase- Locked Loops- 7 9 circuits,

JAVA applet can be used to teach a large field of the electronic circuits and devices. The applet starts up with a simple RLC circuit. The green color indicates positive voltage. The gray color indicates ground. A red color indicates negative voltage. The moving yellow dots indicate current. To turn a switch on or

off, just click on it. If the mouse is moved over any component of the circuit, we observe a short description of that component and its current state in the lower right corner of the window. To modify a component (say, to change the resistance of one of the resistors), move the mouse over it, click the right mouse button and choose edit function. Here are three graphs at the bottom of the window; these acts like oscilloscopes, each one showing the voltage and current across a particular component. Voltage is shown in green, and current is shown in yellow. The current may not be visible if the voltage graph is on top of it. The peak value of the voltage in the scope window is also shown. Move the mouse over one of the scope views, and the component it is graphing will be highlighted. To modify or remove a scope, click the right mouse button over it. To view a component in the scope, click the right mouse button over the component and select "View in Scope". If the simulation is moving too slowly or too quickly, you can adjust the speed with the "Simulation Speed" slider. The Circuits menu can be used to view some interesting pre-defined circuits. Once a circuit is selected, you may modify it all you want. JAVA applet is very ease to use by students to understand some electronic circuits. For example if we study the rectifier circuit without filter we open Full-Wave rectifier circuit as is shown in Fig.1.

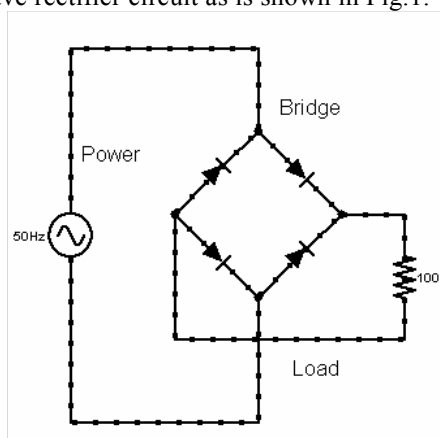


Figure 1. Full-Wave rectifier circuit

The student can see the current sense for each polarity of input voltages and also the waveform of the voltage and current to different devices. In Fig.2 are presented the waveforms for input voltage and output. Each component can be edit, delete or view in scope. The input voltage can be modified: The amplitude of the voltage can be varied from 0,1V to 10V to observe the forward voltage across the diode, The frequency of the input voltage can be varied from 0,1 Hz to 100 Hz, The DC offset voltage can be varied between -20V to 20V

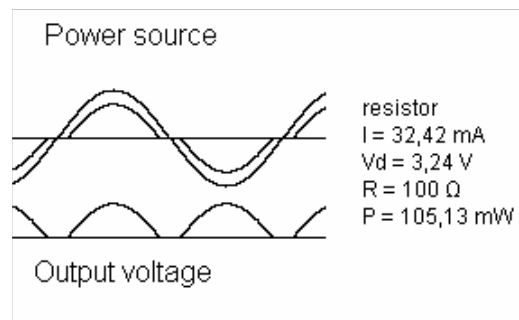


Figure 2. The waveforms of the voltage and current

The circuit can be modified by adding some components. The main menu for adding components are presented in Fig.3

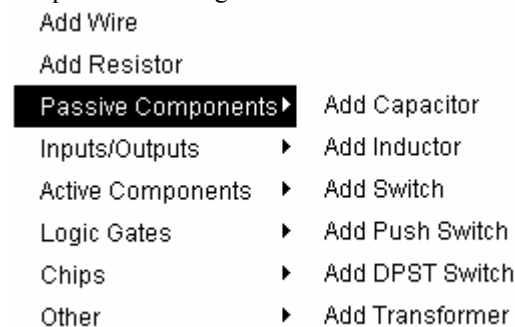


Figure 3. The main menu for adding components

Another main advantage of JAVA applet is the possibility to change the waveform applied to the circuit for example AC, DC, Square Wave, Triangle, Saw tooth and Pulse. The student can also modify the peak input voltage, the frequency of the input voltage and the DC offset. The students can add a capacitive filter or can choose the full wave rectifier with filter. Another example is an AO noninverting amplifier presented in Fig.4.

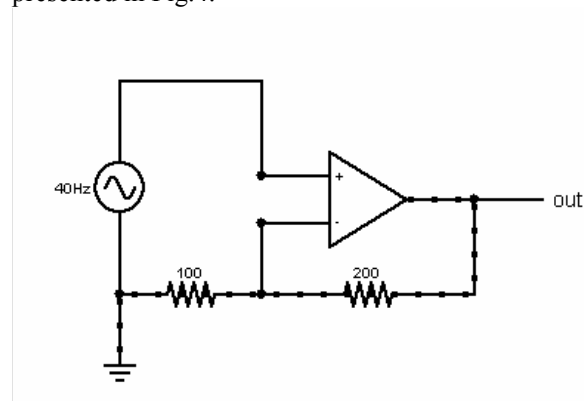


Figure 4. AO noninverting amplifier

For this circuit we can observe the sense of the current and the waveform for different devices. The students can understand the inverse and noninverse function of AO amplifiers by see the output waveform compared to the input waveform and also

the limiting of the output voltage if the input voltage or the gain is changed to exceed the output voltage the power source. In Fig.5 are presented the waveform of the noninverting amplifier.

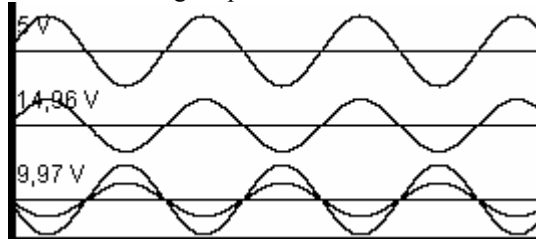


Figure 5. The waveform of the noninverting amplifier

To change the waveform click right on it and a new menu is presented to the student. The waveform menu is presented in Fig.6.

- Remove
- Speed 2x
- Speed 1/2x
- Scale 2x
- Stack
- Unstack
- Show Voltage
- Show Current
- Show Power Consumed
- Show Peak Value
- Show Frequency

Figure 6. The menu of the waveform

For each component is a detailed description of the values of voltages, currents, frequency and power. In Fig.7 is presented the main values of AC source.

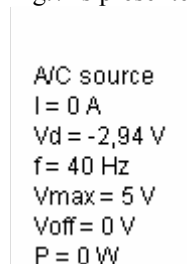


Figure 7. The main values of the AC source

3 THEORETICAL SUPPORTS FOR THE CIRCUIT SIMULATOR JAVA APPLLET

Theoretical support is very important for students to understand the function of each circuit. In normal way the theoretical support can be obtained from textbooks and lectures. For the JAVA applet used in

this paper, the theoretical support is based on html rules and also to an “on line” course called HyperPhysics. There is a list of all the circuit used in JAVA applet and for some circuits the hyperlinks are presented. We work to translate the theoretical part in Romanian language and to put on our server. Some hyperlinks are oriented to on line course and another are oriented to web based information such Wikipedia. For example if we are interested to inverting amplifier the hyperlink connect us to the HyperPhysics as is presented in Fig.8

Inverting Amplifier

For an ideal op-amp, the inverting amplifier gain is given simply by

$$\frac{V_{out}}{V_{in}} = -\frac{R_f}{R_1}$$

For equal resistors, it has a gain of -1, and is used in digital circuits as an [inverting buffer](#).

[Rules application](#)

Figure 8 The hyperlink to the HyperPhysics

The main advantages of the hyperlink are the flexibility to find different information about the subject and the connection to the www web servers. The student can navigate to the “on line” course or can find the supplementary information on the web. If we are interested about AO the hyperlink connect us to the wikipedia encyclopedia as is presented in Fig.9.

Figure 8. The Wikipedia hyperlink

For romanian students is important to explain the subject in Romanian language and we are working with our students to translate the on line course in

romanian language and maybe to contribute to the wikipedia encyclopedia.

There are many JAVA applets on the web but the Falstad applets are very clear and easy to use.

4. CONCLUSIONS

A dynamically changing view of the visual simulation applets helps keep the learners attention at a high level. It is likely that a sufficient number of Java applet programs will evolve over time for each subject area as a library of reusable software objects. Copies of the library may be disseminated in a CD-ROM via publishers to educators. Eventually, the use of Java applet programs by educators should become as easy as the use of clip arts by ordinary users.

The JAVA applets can be very useful to understand the main function of electronic circuits and devices. The Circuit simulator contains 141 variants of the electronic circuit and there is a blank circuit for using to develop a customer circuit.

References

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