Education Purpose Design of User Interface (Matlab/GUI) for Single Phase Trigger Circuits

M. Ak, M. Tuna, A. Ergun Amac

Abstract—**In this study, a graphical user interface has been designed for the simulations of single phase trigger circuits which take place within the syllabus of power electronics course given in the engineering and technical education faculties and it has been conveyed to vocational education. The simulation of the circuit was realized with MATLAB Simulink and the design of the interface was made with MATLAB GUI. The interface prepared enables the user to select the type of whatever circuit he wants. Besides this, arranging the input parameters of the circuit to the values he desires, the user can view the results on the same interface numerically and graphically. Furthermore, since animations are used in the interface, the effects of parameter changings can be watched visually. Thus, the simulation process carried out and the obtained results are presented to the user in a short time and in coherence and much negativity that decrease productivity in education are prevented.**

Index Terms—**Matlab, Simulink/Simpower Systems, GUI, Vocational Education**

I. INTRODUCTION

IT is known that the visual elements used in educational environments help permanent learning. Then, it is obvious that the visual course materials used in the right place and in an effective way make it possible for education to reach its aim in a shorter period of time. At the head of these materials, undoubtedly computers come. With the use of computers in the field of education, many studies are being carried out to make education more productive, generalize and individualize it [1-2]. Such kinds of studies which are a part of computer-supported education have gained acceleration and become more interesting.

Computer-supported education is the general name of the practices in teaching process of computer technology. The major ones of these practices are; to provide information, to tutor, to contribute the improvement of a skill. The computers commonly used in every field of education have a special importance in vocational and technical education.

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There are a lot of advantages of using computers for education. Its providing possibility to individual studies and each student to increase his/her learning speed.

Computers are commonly used in the education environments due to the fact that they make saving from student's learning time as they provide instant feedback, they enable the students to repeat the missed course or subject whenever desired, they facilitate teacher's duty providing students' active participation in the class, they enable the students to repeat the missed course or subject whenever desired, they facilitate teacher's duty providing students' active participation in the class, they help the teacher making even the most boring courses easier and more enjoyable. In the technical fields, one of the facilities provided by computers is to be able to make the simulations of many systems before production thanks to the improved softwares. Thus, many experiments which are impossible to be carried out in educational environment are made in virtual platform [3-4]. In this study, the modelling of single phase trigger circuits known as dimmer circuit and the use of the model for educational purposes by being inspected by the user interface designed have been emphasized. Thus, a sample program has been made relating to the use of MATLAB program in education.

II. THE SIMULINK MODEL OF DIMMER CIRCUIT

In the Simulink model of Dimmer circuit, while one thyristor is used for half-wave supervision, in full-wave supervision, two thyristors were linked inverse parallel [5]. The simulink model prepared for dimmer circuit has been shown in Fig. 1. In the Simulink model, it is quite difficult to observe results for various values and use these results for education. To open the dialogue window of the block whose parameter change is made for each simulation, to write a decimal numerical value in the relevant parameter, to confirm it, to activate the start button of the simulation, to open the scope screen where curves appear include rather long and complicated processes. These processes both consume time and cause a big disconnection in the observation of the influence of the change on the output.

Especially, in educational environments, these situations lead to both ineffectual use of time and students' losing their attention. In this study, to eliminate such kinds of negativities and facilitate the simulation of a circuit model

prepared in simulink, a user interface has designed [6-8].

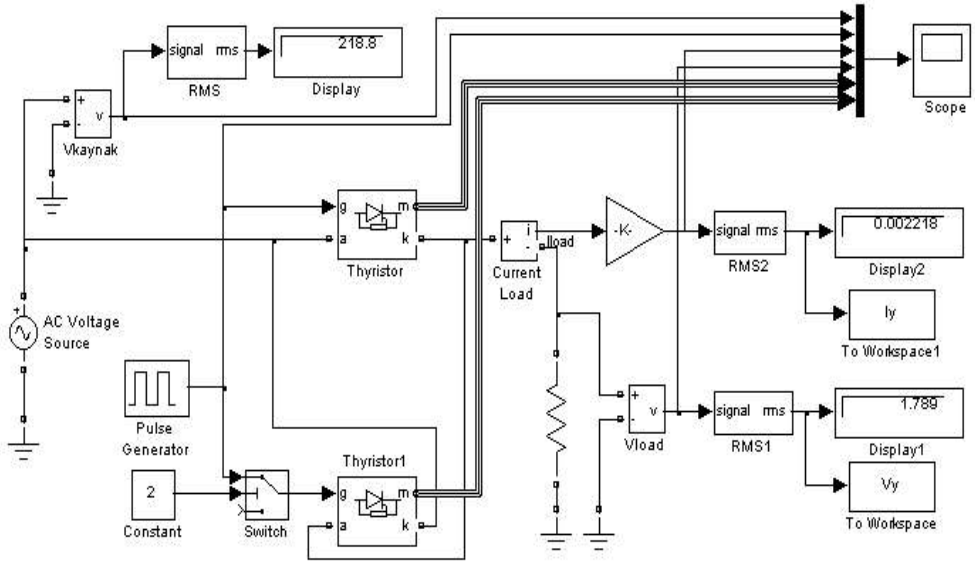

Fig. 1. The Simulink model of Dimmer circuit.

III. THE CREATION OF INTERFACE IN MATLAB/GUI

Matlab is a platform that provides the graphic based applications prepared by the programmer of Graphical User Interface, in other words, Matlab GUI, Matlab to reach the last user interactively through mouse and keyboard interface. Today, Matlab GUI applications have been needed because of the fact that the applications are graphic based and these applications provide user with the facility of usage. Besides, Matlab GUI is an easy application so much as to be created by everyone who prepares m-file or m-function [9-14].

To reach the previously prepared program, there needs to enter dimmer in the command line of Matlab and confirm it or to open the file named dimmer with the help of file opening icon. Completing this process, the interface and loading bar seen in Fig. 2 comes to screen.

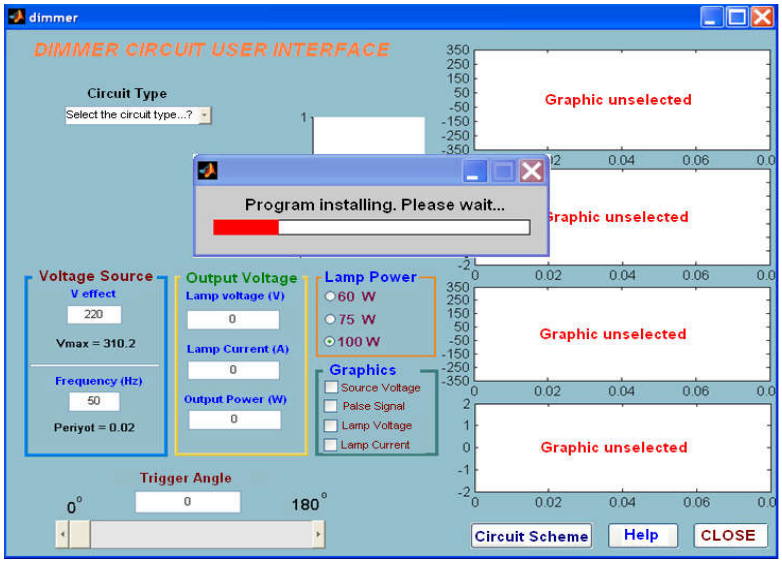

Fig. 2. Opening interface composed in GUI.

Some choices concerning the circuits and graphics in the opened window are needed to be activated. At the head of these, the circuit type choice seen in Fig. 3 comes. Here two different dimmer circuits, full-wave (with triac) and half wave (with thyristor) have been designed. According to the ype of chosen circuit, just under the choice menu, a picture showing the circuit model is opened.

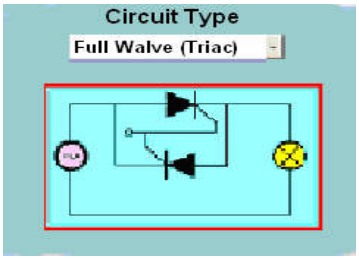

Fig. 3. Choice of Circuit type.

Later coming to the interface in Fig. 4 where source voltage and trigger point take place, the efficient value of the voltage and its frequency are arranged to the desired value. This part has been designed counting the peak value of the voltage and period of the frequency automatically in such a way to demonstrate them just below the relevant parameters. The voltage, current, and power of the lamp obtained after simulation are numerically seen in the section of output values.

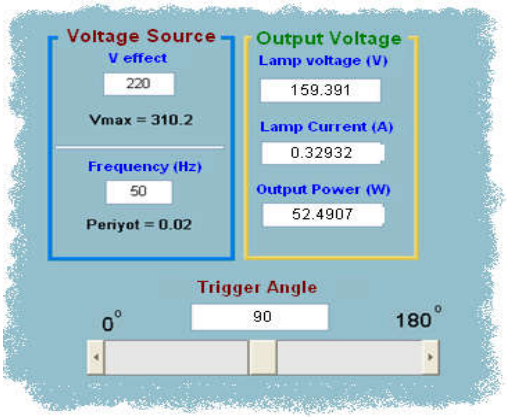

Fig. 4. The interface showing the input and output values.

In the interface, two different choices have been presented to determine the trigger point. One of these choices is the textbox that the user can directly enter the trigger point; the other one is the sliding bar that represents potentiometer. The textbox makes it possible to enter the trigger point at certain value with the help of keyboard. The voltage, frequency and trigger point parameters chosen in this section are required to be within certain limits. For, the values entered as very big or very small may cause over extension of simulation time and even the lockout of the program. For this reason, there are warning windows that will provide the simulation to be realized between certain parameters in the design. For instance, when a value that is not suitable for trigger point is entered by the user, the warning window in Fig. 5 is opened. Similar warning messages have also been designed for source voltage or frequency parameters.

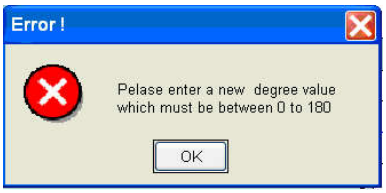

Fig. 5. Warning window for erroneous trigger point.

With the move of mouse on the sliding bar, the trigger point can be more easily changed. Thus, after each parameter change, simulation is immediately realized and the results and graphics are conveyed to the interface. The lamp symbol on the interface shown in Fig. 6 stand for the load in the circuit. The lamp power can be chosen as 60W, 75W or 100W from the choice list.

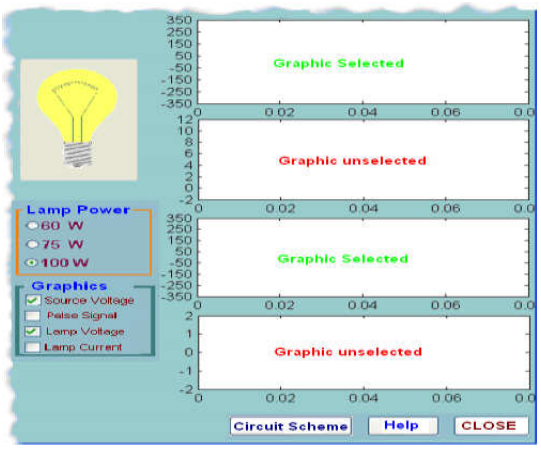

Fig. 6. The interface demonstrating the choice of lamp power and graphics.

As a result of the simulations implemented the colour tone of the lamp changes according to the output power. Thanks to this design, the user has the possibility of seeing the output parameters visually, numerically and graphically on the same interface. The displays of the graphics belonging to input and output parameters in the chart area have also been left to the choice of the user, whether the chart is chosen or not has been given in written in the relevant area. Pressing on the 'Circuit Schema' icon on the right down corner of the interface, a new window seen in Fig. 7 is opened. In this window is found the basic principle schema of the circuit. In the designed interface, when it is pressed on 'Information' icon, a document including theoretical information about alternative phase transducers is opened. With the help of this document shown in Fig. 8, the user easily has an access to all of the subtitles and mathematical calculations he needs.

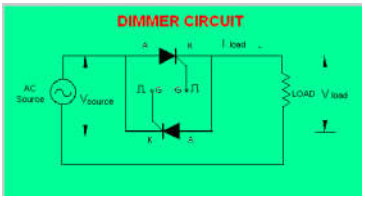

Fig. 7. The window demonstrating the basic principle schema of dimmer circuit.

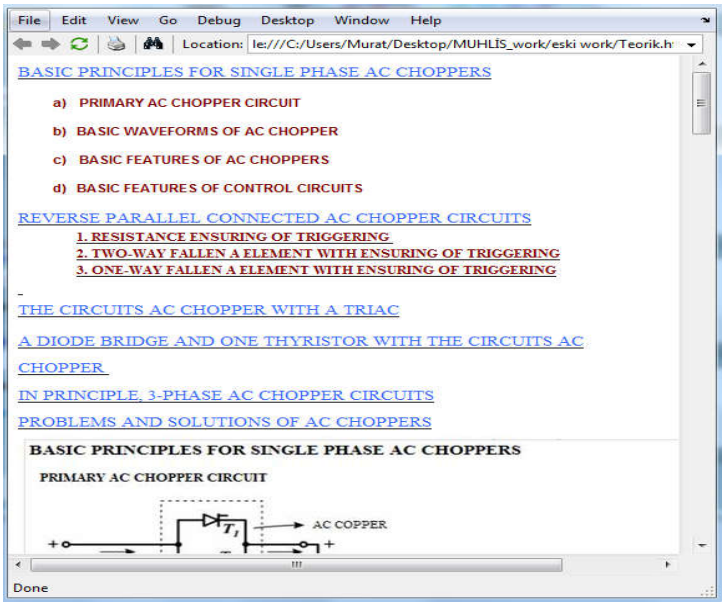

Fig. 8. The window demonstrating theoretical information about phase splitter.

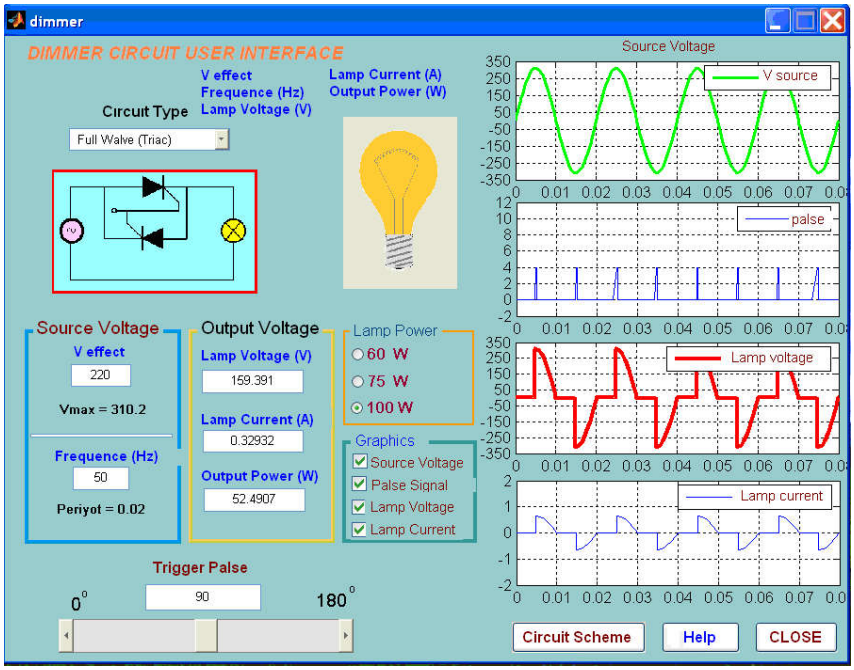

Fig. 9. The simulation results obtained in the designed interface

As a sample application, full-wave control of a 100 Watt lamp connected in series to a 50 Hz - 220 V voltage source has been made at 90 degree. The output values and the graphics obtained have been shown on the interface in Fig. 9.

IV. CONCLUSION

The dimmer circuit used in this study is an important sample in terms of students' learning how thyristor and triac run. In this essay, the models of different dimmer circuits have been designed on Matlab Simulink at first, and then shown in a single window by constituting an interface with the help of GUI. Via this interface, students;

- Have a good command of the subject of dimmer circuit,
- Can observe the impact of the of circuit parameters' changing on output voltage and output current instantly,
- Get rid of losing attention because there is visually in the interface.

In addition to these, while the user is transferring information dealt with the subject; such factors that negatively affect learning as decrease of attention, loss of time have been minimized.

In this study, it is possible to adapt the user interface constituted only for dimmer circuit to other subjects, even to use it for checking the models of the systems found outside the electricity science. It is believed that such kinds of user interfaces will raise the quality in education.

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