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PHYSICS SIMULATOR FOR SECONDARY LEVEL IRAQI SCHOOLS

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ABSTRACT

This paper present a virtual reality (VR) interfaces to demonstrate some physical experiments as samples from the secondary Iraqi school's physics text book, to help students learn physics concepts in different areas of physics such as optics, mechanics, electricity and magnetism. This application gives the student the ability to learn the basics of physics using interactive colorful system. Flexible, desktop interfaces where user can input the required parameters or moving some objects in some experiments, to get the results calculated and displayed directly. The App is an offline virtual laboratory, allowing the students to repeat the experiment anywhere at any time in a very low cost and in an interesting way under a very safe environment. *Adobe Flash player 25 ActiveX* is used as the main implementation tool which gives the users full visualization and interactivity of all learning steps. *Html* is used for navigation purposes. Students anywhere will be able to reach and use this application from distance through the Internet to enhance E learning. (VR) environment, appear to be promising, more natural and interactive.

KEYWORDS: This paper present a virtual reality (VR).

INTRODUCTION

As the most early computer applications, the simulators were used only as a research tools in a very limited areas. The cost associated with VR systems have been prohibited for many areas as well as in education. However, until fairly recently VR systems have not had the performance to be seriously considered for education. The good news is that recent technological developments in computer hardware and software make it feasible to look at

VR as an important teaching aid.[1,2] (Byrne, C. 1993, Winn, W. 1993). The enabling technology has reached a sufficient level of maturity for VR to be seriously applied to education, training, and research. Using computer in education as a tool to produce interfaces that bring models of real apparatus will enhance student learning in an interactive environment. VR has extremely wide applications across a whole range of disciplines.

One of the most famous and successful VR simulator program used in higher education is the electronic work bench EWB, which is used as a complete digital and analogue electronic lab in most of the Iraqi educational institutes. It creates a very cheap and safe environment for students to build their own projects.

Because of the political circumstances in Iraq during 1980-2005, the embargo and the wars, students almost in all educational institutes can hardly reach computers or use the internet, and of course lack of laboratories in most of the schools. Now a days, computers are usually used by secondary Iraqi schools students to cover the syllabus of computer subject which is mainly Microsoft office, besides using them for games, internet, presentations, some paints and tables. As computers becomes available almost in every house and school in Iraq these days, so why not using them as a teaching tool in science education such as physics. Physics is a science that depends on natural phenomena and experiments, which most of the students find difficulties to understand. Some physical phenomena that are not easy to measure or to understand in usual experiments can be presented in a virtual world and can be viewed in many different perspectives in a VR laboratory. Moreover, students can observe or carry out virtual exercise and training, which are difficult to be performed in physical classes[3,4] (Barron T Kalogeropoulos N. 2000 and Karatzas X. 2002) It may offer strong benefits in science education by supporting different types of learners such as those who are visually oriented.[5] (Lecuyer, A., Mobuchon, P., Megard, C., Perret, J., Andriot, C. and Colinot, J.P. 2003).

VR simulation program offers a new Human-Computer Interaction paradigm in which users no longer external observers of data or images on a computer screen but are active participants within a computer-generated virtual world. VR differs from traditional displays in that computer graphics, various displays and input technologies are integrated to give the user a sense of immersion in the VR[6] (Wayne, T. 1997). The flexibility provided by a VR system and the overall low cost will be a major attraction to the educational community. Multimedia-based systems provide the student with a very rich source of educational material

in a form that makes learning exciting. We can imagine that in short time schools will have one VR lab for all sciences instead of having many rooms, each for one subject's lab. The computer becomes an important teaching tool, using simulators to overcome the problems of the lack of practical laboratories.

Simulators distance learning has been popularized in recent years, because of the fast development of computer systems and the spreading internet connectivity, which enhance distance learning by using simulation programs running on a Web browser instead of attending classes or labs. This can overcome the difficulties of the lack of laboratory activities in science and engineering education.

Our Simulator

Adobe Flash player 25 ActiveX program is used to develop our sample programs simulators described below, for some physics fields at the level of second year secondary school in Iraq. The abundance of colors in this program prompted me to use it for this task. I also use HTML language for navigation between the interfaces and to make it possible to view the system on any internet browser.

The interfaces had been made as easy and clear as possible for such level even for students who have never used computer before. The simulator developed in this study is described below.

The first screen allows the students to choose between chapter 1 or chapter 2 as in figure 1. Once any of the chapters is selected, a new screen will appear for example chapter 1 as in figure 2.
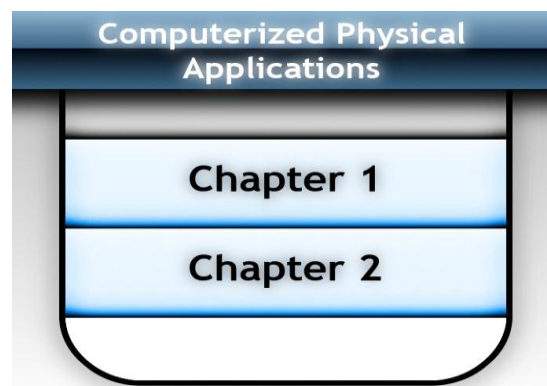

Figure 1: The main screen.

Mechanics and Optics

The first button chapter 1 will display the first chapter's screen options as in figure 2.

Mechanic Demo

The first button will display demo about simple harmonic motion using spring and a mass m as in Figure 3 the student should enter the spring constant and the mass, then the periodic time will be calculated and displayed. The student will notice the motion of the spring. The input could be changed by the user to see the effect on the resultant periodic time and the effect on the spring oscillation.

Figure 2: Chapter 1 screen.
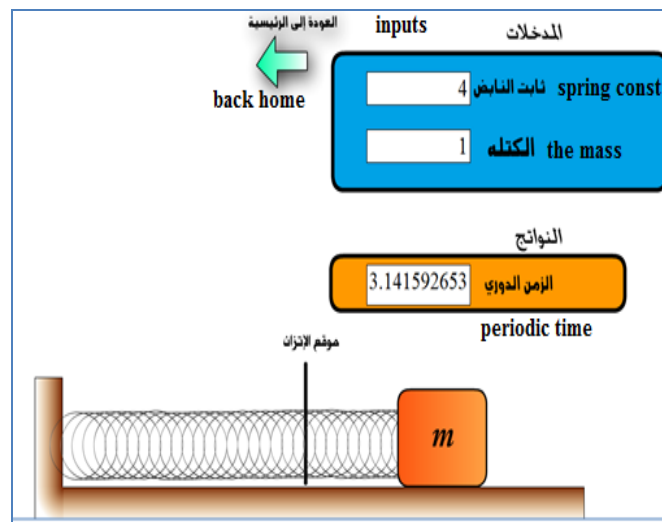
Figure 3: The movement in the spring mass system.

Figure 3 shows the simple harmonic oscillator (SHO) with a mass m attached to the free end of the spring. Various oscillation frequencies can be observed by inputing different masses and spring constants.
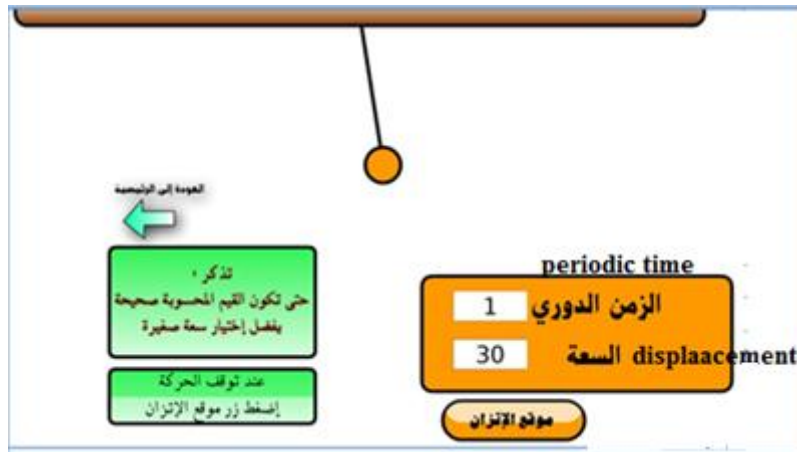

Figure 4: The simple harmonic motion using simple pendulum.

Button 2 will display demo about simple harmonic motion using the simple pendulum as in (figrure 4). In this experiment the students should enter both the displacement and periodic time then watch the pendulum motion. They can change any of the input values and watch the effect directly on the pendulum motion.
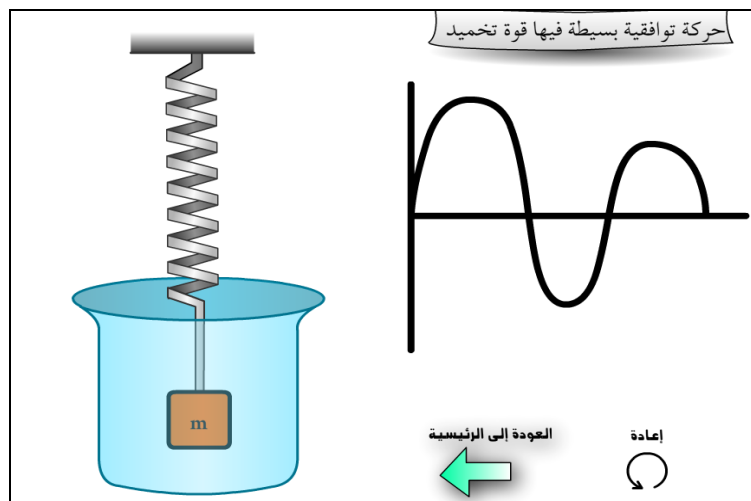

Figure 5: Simple harmonic motion with damping force.

The third button will display experiment for simple harmonic motion with damping force as in figure 5. 3.1.2 Optics Experiments.

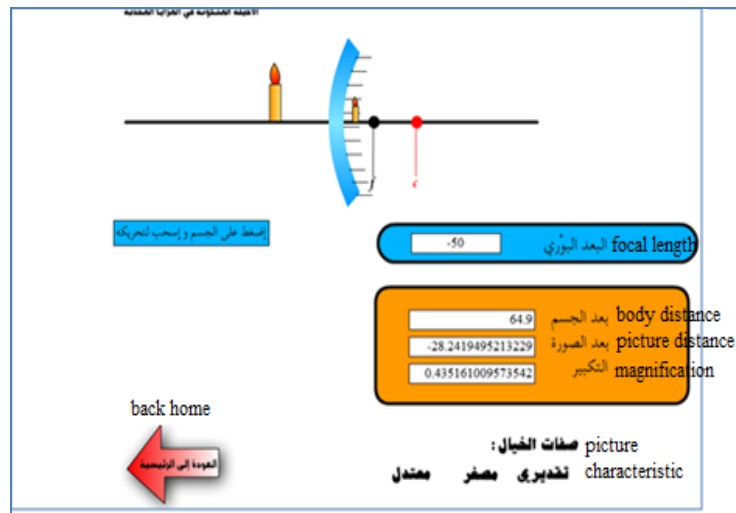The forth button will display a demo about the picture in the convex mirror as in figure 6.

Figure 6: Images in convex mirrors.

In this experiment the student should enter the focal length of the mirror, then the center line of the mirror will move automatically. The calculations of the body distance, image distance and the magnification factor will be shown on the output boxes. The student could drag the body left or right using the mouse and watch the changes in its image behind the convex mirror and the simultaneous changes in the calculations as the body move and the characteristic of the image will appear down the screen.

- The fifth button will show the picture in the concave mirror as in (figure 7).
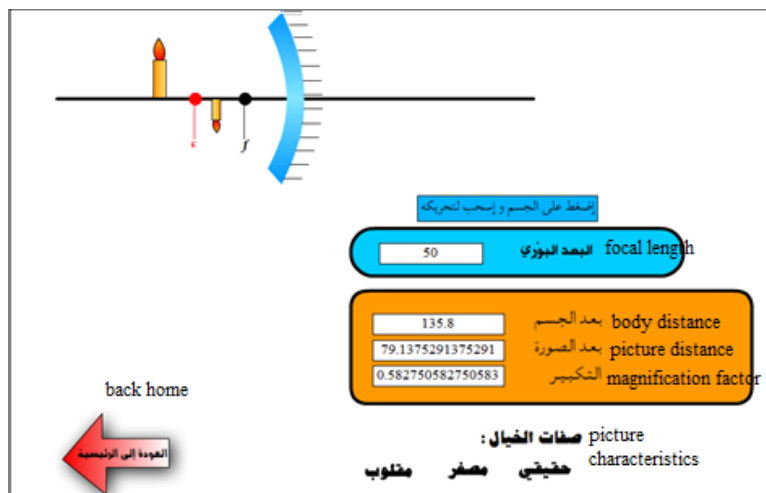

Figure 7: The picture in the concave mirror.

In this experiment the student should enter the focal length of the mirror, then the center line of the mirror will move automatically and the calculations of the body distance, image distance and the magnification factor will be shown on the output screens. The student could drag the body left or right using the mouse and watch the changes in its image behind the

concave mirror and the simultaneous changes in the calculations as the body move and the characteristic of the image will appear down the screen.

These are all the simulators available on the last interface. The user can repeat any of them as many times as he like or he can go back to the main screen to choose chapter 2 by pressing "Back to Home" on the bottom of the screen which will take him back to screen on (figure 1) and if he choose Chapter 2 he will be facing the following screen figure 8.

Electricity & Magnetism

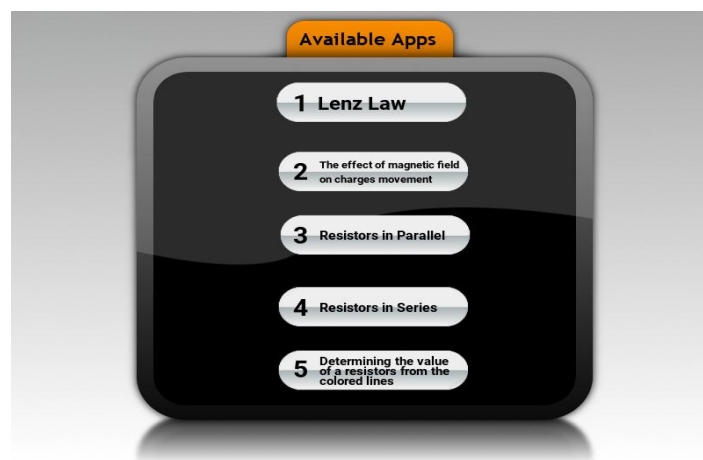Selecting chapter 2 button will display the following screen.

Figure 8: Chapter 2 screen.

This section presents experiments about electricity and magnetism.

First button will display interactive demo for Lenz law, as in figure 9. The student should enter the time to move the magnet and see the effect of that on the light intensity of the bulb.
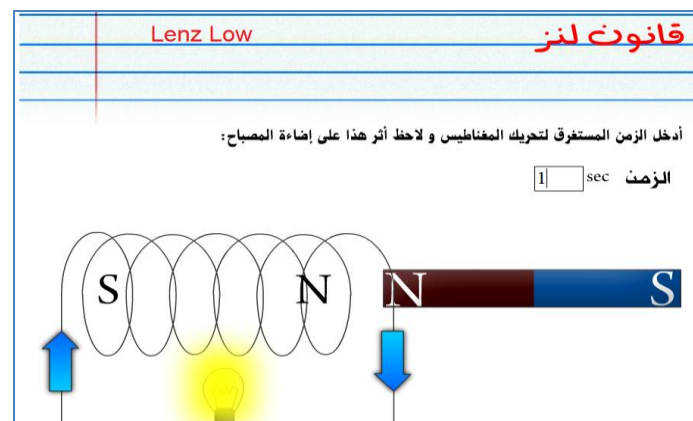

Figure 9: Demo for Lenz law.

Second button will display an interactive demo about the effect of the magnetic field on the charges movement, the magnetic field direction was to inside. The user chooses the type of charge either positive or negative, where A shows the demo for negative charge and B for positive charge, as in figure10.
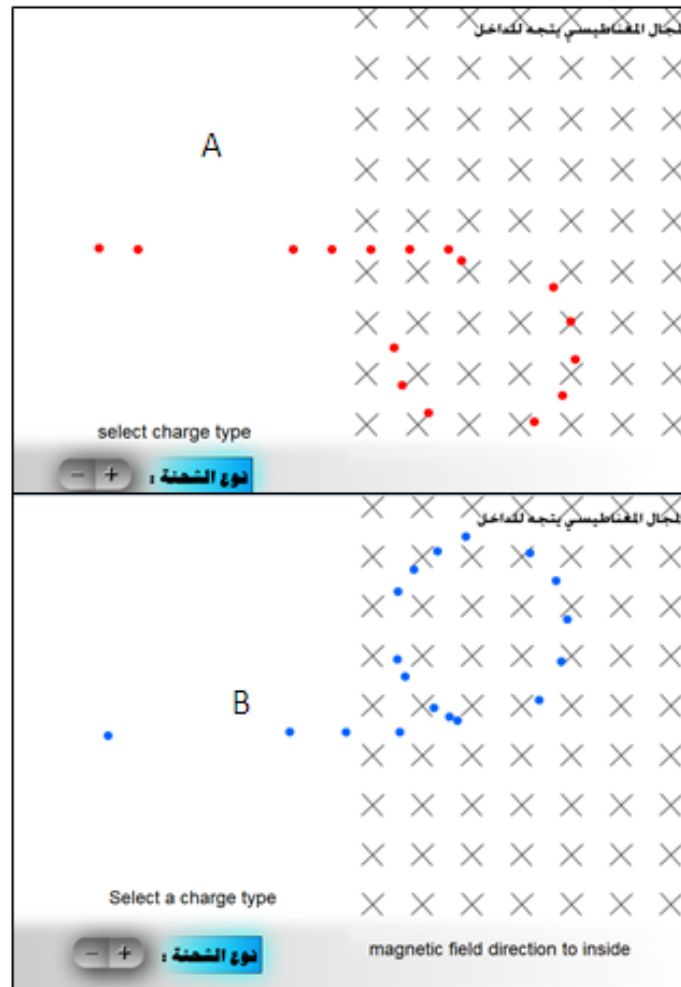

Figure 10: The effect of the magnetic field on the charges movement.

Third button will display an interactive demo about connecting resistors in parallal as in figure 11. The student should enter the values of the resistors in the text box beside each of them and press the run button to see the values of the current and the equivalent resistance in the text box next to each, both with and without the internal resistor.
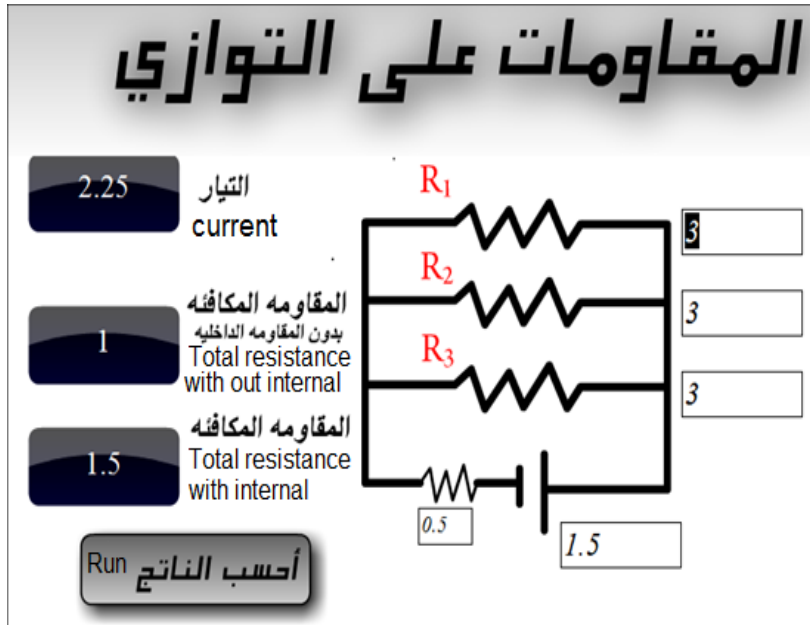
Figure 11: resistors in parallal.

Forth button will display an interactive demo about conecting resistors in series as in figure.12. The student should enter the values of the resistors and the voltage of the battery, in the text box under each of them and press the run button. The values of the current, the equivalent resistance and the voltage difference between the ends of each resistor, will be calculated and displayed in the text box next to each.
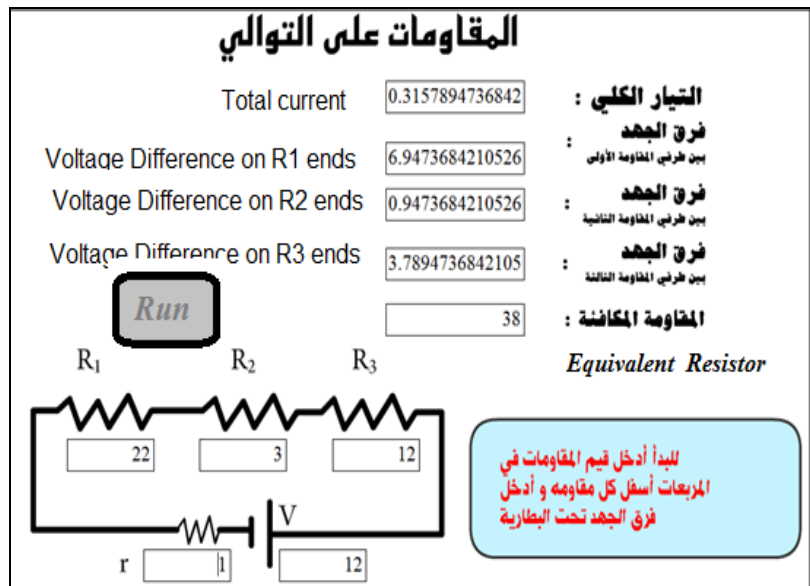

Figure 12: resistors in series.

The fifth button will display a demo for colored lines resistor as in fig 13. The resistor value could be changed by choosing new colors from the colors palette. The user should point to

any of the lines on the resistor; choose one new color from the color palette, for each line. The last line on the right represents the error rate which could be changed as well. The new value for each resistor and the new value for the whole resistor will be displayed automatically in the output boxes down on the right while changing the colors and the resistor real value will be displayed as well according to the new error rate in the fourth line.
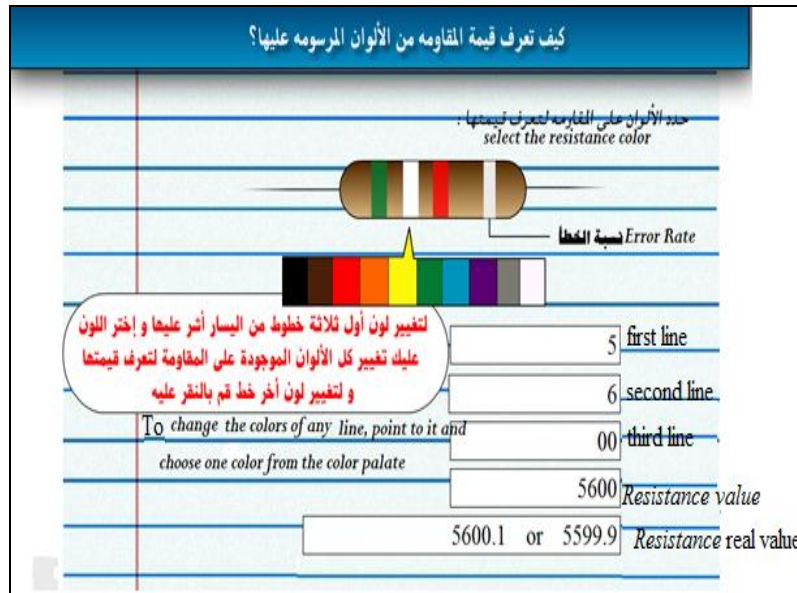

Figure 13: demo to determine the value of the resistor with colored lines.

Evaluation and analysis

Four groups from four secondary schools were selected to assess the preceptorial effectiveness of using the simulator as a teaching tool. Each group consists of 40 students. Different teaching methods were used for different group. For group1 the teacher was asked to use traditional methods using the text books and some power point slides with graphics for each chapter. Group2 used the simulator program at home on their own PCs without any explanation from the teacher during the lecture, using their text books with some guide papers for the simulator. They were expected to learn by themselves without any help from the teacher about the program.

For groupe3, the simulator program was used only by the teacher in the class room displaying it on a data show screen as a supplement to the lecture. Group4 used the simulator program in the class room by the teacher as a supplement to lecture and in the computer room where the students actively interact with the simulator as demonstrated by the teacher.

After finishing the two chapters, the student's knowledge was tested by a written examination with the same exam paper for all students in the four groups to measure the academic achievement for all the four groups. Figure 14: Shows the academic achievement of each group.
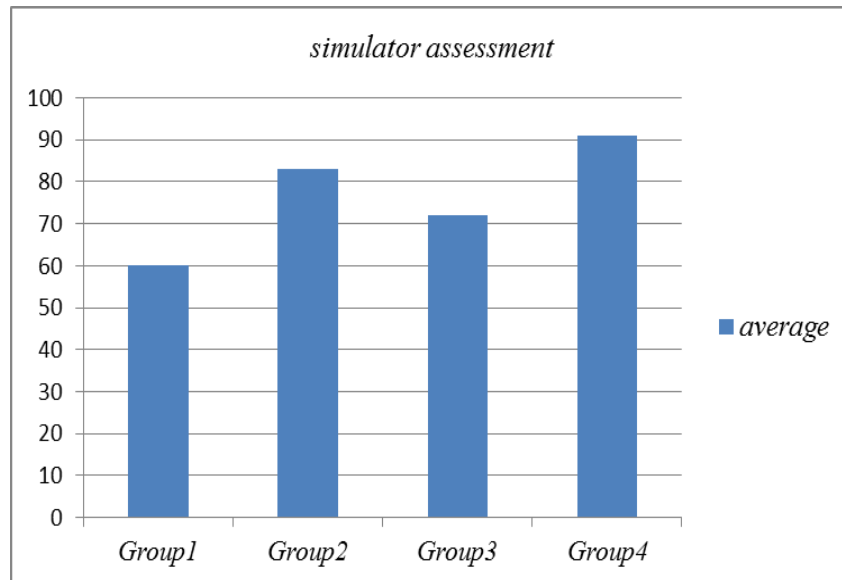

Figure 14: Academic achievements for the four groups.

It is clear from figure 14 that the students in group 4 got the highest scores. Group 2 which got the chance to use the simulator also had positive effects on their scores which were higher than that of the other two groups. Group 1 which did not see or use the simulator and had only traditional way of lecture had the lowest average of all. The teachers found out that the students who were taught on computers developed positive attitudes toward the computer and toward the subjects they were taking. Surveys were made by the teachers by asking the students who use simulator, if it helps them to better understanding of the subject and if they prefer to use such simulators for more subjects, the result was very loud that more than 90% of the students would like to use more of it. The students clarify that the computer reduced substantially the amount of time they needed for learning.

Computer-based instruction also had perceptible, positive effects on scores on follow-up examinations given to students several months after the completion of instruction.

CONCLUSIONS AND FUTURE WORK

Using Virtual Reality as conventional laboratories for solving educational problems in Iraqi schools is a challenge. Virtual Reality provides a friendly representation of the provided

information, interaction with the system, which does not require advanced knowledge of the computers technology besides the reduced cost compared to other technologies. In this paper the ability of using virtual reality as a new technology to facilitate learning process for Iraqi secondary level students are demonstrated. This is achieved via developing Virtual Reality learning system. The system focuses on physics applications for the level of secondary Iraqi schools with full manipulation ability for some scenes. There is satisfaction with the effectiveness and efficiency for such system in institutions where this tool had been tested in education. Examinations and a survey in this direction relevantly had been made, the results of which were presented in the paper figure.[14]

The results of the examination after using the system indicate that the students in group 4 and group 2 those who used the simulator program with full manipulation, were more satisfied. The teachers felt that they understood better, and were more interested in the simulators than other teaching materials. The good scores for group2 indicate that the simulator is friendly and easy to use by the students without any necessity for any pre clarifications.

For future work, more complex design with 3D models of the equipment with more animation. More simulators to cover all physics syllabus could be developed. Other subjects such as chemistry, biology, mathematic and language labs could be covered. The simulators could easily be updated to run on smartphones and this is the next step. This experiment could be generalized to all schools in the country as a tool with the text books. These simulators could be part of the final project for college students who are interested in developing such programs.

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