Virtual Multimedia Complex as an Addition to Traditional Physic Laboratory Experiment

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Abstract. Physics is a fundamental science, which studies general regularities of natural phenomena change, lays the base of the world understanding on different levels of nature cognition and gives a general motivation of the world nature-scientific model. It has been established as an integral part of the high-tech information society. The fundamental character of the physics knowledge as a philosophy of science and methodology of natural history, the theoretical base of the modern technics and the production technologies acknowledge the educational, worldoutlooking and pedagogical importance of the school course of physics as a training discipline. Due to these things physics plays a role of the basic component of the nature-scientific education and belongs to invariant component of the general preparation of pupils in general and academic schools. Physics is an exploratory science, all of its rules cognize the phenomena of the outer world by experiments. The physics investigative phenomena studying must be reproduced in the form of demonstrational experiments or tests including the rational application of computer technique.

1 Introduction

Physics is an exploratory science, all its laws are learned in accordance with the outer world phenomena, with a research. While studying physics one schould reproduce the researching phenomena with a help of the real laboratory appliances, videorecords of the corrresponding investigations, in the form of computer experiment. Ponderable advantages of carrying out the research using a special physical equipment consist in immediate students'involvement to consolidating the obtained knowledge on practice. It contributes to the increase of students' interest to the subject of physics, consolidating of abilities and skills. However, while carrying out traditional laboratory experiment, certain complications may exist. First of all, it is connected with a possibility of traumatism appearing among students and outage of expensive laboratory equipment concerned with non-aimed usage of the laboratory equipment or violation of safety measures while working with electric current.

The specific character of laboratory instruments consists in the neccesity of their careful and neat usage, holding of the preventive measures and looking after their technical condition.

It is also known that equipment preparation process before carrying out a laboratory work requires much time: it is mounting of laboratory units, gathering of electric circles, etc.

One of the qualitative demonstration methods is considered a videorecord show of the corresponding research. However, such approach deprives a student of taking an active part in the experiment conducting process, though it appears possible to demostrate the performance of the investigations that are harmful, dangerous for people or their duration is too long and it is necessary to accelerate the course of experiment.

2 The Advantages of Using Computers in Educational Process

Modern system of learning uses to an increasing extent the mighty opportunities of information technologies and computer telecommunication. Due to the computer modelling there is an opportunity to see, what one can not always descry in the real life even with a help of the most complicated instruments. "The computer may model processes, different in form and contents and, as a result, disclose most accurately the available connections of an object" [1, 36]. Practice and research show that technical facilities of learning and computer technique together with the corresponding software enable to increase the production of pedagogic work, to improve the quality of the students' knowledge, abilities, skills and personal development.

Technical learning facilities' application efficiency is characterized by increase of material understanding in 25 %, of memorization in 35% at that the time of learning is shortened to 20-25% [2, 3].

On such conditions a question of more rational computers application at schools arises, particularly at the lessons of physics. One of the ways to solve such problem is the creation of qualitative learning programs for secondary educational establishments. Due to this, one may reach the increase of students' interest in physics study, create visual methods of laws', properties' and physics regularities' corroboration.

At the same time, the computer modelling is unable to capture all the characteristics of a process and real objects' properties and concentrates its attention only on the main features of a phenomena that is described.

Having analysed strengths and weaknesses of carrying out real physical experiment and interactive computer modeling, the following conclusion has been made that the best forms of laboratory experiment demonstration and fastening of the students' knowledge on practice are logical and consecutive integration of the laboratory equipment virtual models in a corresponding program environment and its real analogues in a laboratory investigation.

In addition to all stated the regional specificity has become an incentive to the creation of computer models of instruments and experiments. On the one hand, lately in Ukraine there is a problem of educational establishments provision with modern laboratory equipment. Having analyzed the supplying of secondary schools with physical equipment in Sumy, it was detected that most part of schools can't buy new technique for physics laboratories. Teachers and students use the equipment, which

was produced in 70s of the past century. The most part of equipment doesn't fulfil one's purpose, some of it is broken. On the other hand, a purposeful policy of supplying educational institutions with computer technique is carried out in Ukraine. In Sumy, a project of computerization of city schools has been carrying out for several years, in the frames of which all state schools have got their computer class-rooms.

3 Technical Opportunities of VMC

Thus the point of development of a certain virtual multimedia complex (VMC) with interactivity elements has arisen before us for performing physics laboratory works in electricity, which was included in physics curricula of the Ministry of Education and Science of Ukraine for the students of 7–11 forms of secondary educational establishments (Figure 1). First of all, this complex must be directed upon students and teachers at schools and must be a computer supplement to the traditional laboratory experiment and, in some cases, when there are no necessary laboratory instruments, be a temporary alternative to the modern experiment. The developed complex (http://dl.sumdu.edu.ua/demo/phisics/VLK.html) enables to conduct the following laboratory experiments with the help of a computer:

- The composition of electric circuit for electrical force measurement at different sections (8th form);
- Voltage measurement at different sections of the electric circuit (8^{th} form);
- The adjusting of electrical force using a rheostat (8^{th} form);
- Resistance test using an amperemeter and a voltmeter (8^{th} form);
- Power measurement, which is used by heating appliances (8^{th} form);
- Measurement of EMF and current source impedance (9^{th} from);
- Studying series coupling of appliances (9^{th} form);
- Studying parallel coupling of appliances (9^{th} form);
- Studying the dependence of electrical force on voltage and resistance for the part of electric circuit (10^{th} form).

4 Technical and pedagogical features

The developed VMC masters pedagogic peculiarities and merits, namely:

- Due to the interactivity usage, the conditions to implementation of an approach principle to a study with a help of activity is created;
- Elaborated system of prompting and diagnostics of mistakes contributes to the realization of the independent study principle and will enable to make a laboratory work a subject-matter of homework;
- Presence of a qualitative image and correspondence of the devices' computer models visual image to their real prototypes realize the visual method;

– Opportunity to establish independently the dynamic parameters of computer models and collect different electric circuits are the incentive to the researching skills development;
– Due to the presence of interface and investigating system, it is possible to master rapidly the abilities of work in VMC and to realize the principle of education avaliability;
– Due to a simple algorithm of devices models parameters and gathering of electric circuits, the time of laboratory works performance essentially accelerates and thus a student can perform more exercises or pay additional attention to the difficult stages of a task and a teacher gets an opportunity to realize a differentiated approach to a study;
– Working with VMC, students get an additional experience in the usage of a computer as a means of personal activity.

The usage of mighty opportunities of the modern computer technologies for VMC development one has suceeded to reach the following technical advantages:

– Presence of the vectorial animation and graphic;
– Scale change of images without the image quality loss;
– Presence of interactivity;
– VMC file optimized size and economic usage of computer resources;
– High speed of calculations;
– Usage of free software for VMC work.

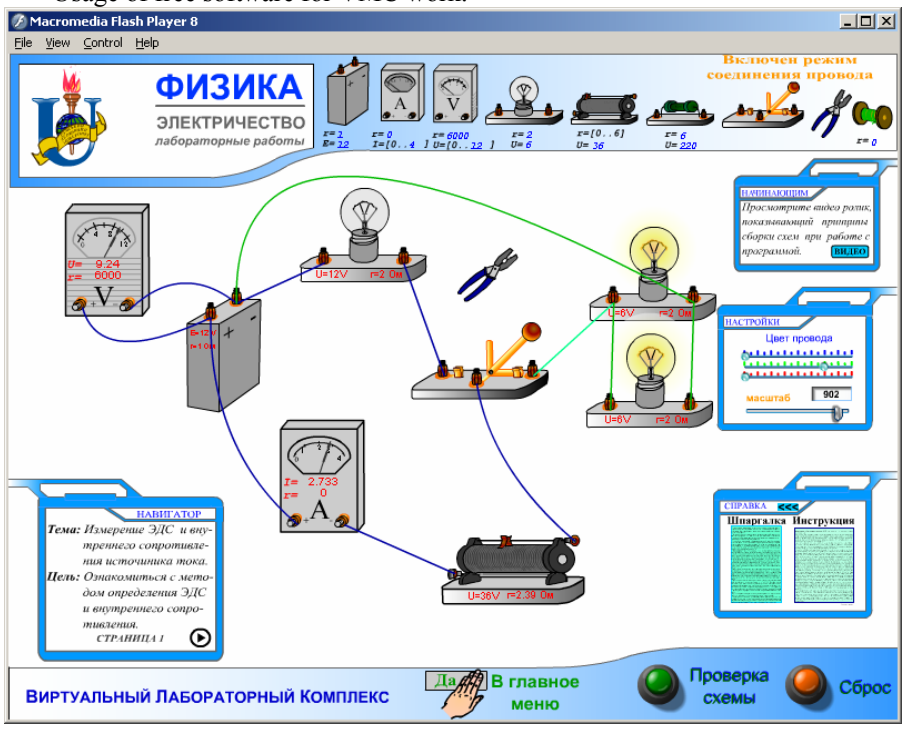

Fig. 1. Fragment of Assembled Scheme with a Help of VMC

5 Prospects of development of the program

VMC was tested in the Informational and Methodical Centre of Board of Education of Sumy Local Rada and at the chair of physics teaching at Glukhiv Pedagogical University and now it is spread among Sumy schools.

The first practice of the developed VMC implementation confirmed the advantages of its application during physics lessons. The direction of the further activity is: firstly, the creation of new computer models of instruments and experiments, and secondly, the integration of work methods with VMC with the methods of a real physical experiment. An important condition of such activity we consider our cooperation wth the Institute of Applied Physics that for the time being realizes a project of school equipment manufacture implementation.

The priority-driven directions of cooperation are:

- The development of complete sets, which consist of the library of interactive computer models of devices (training means), real equipment for carrying out physical experiments;
- The development of virtual environments, complexes, laboratory works for conducting of laboratory experiments, systems of correcting and potential mistakes prevention;
- The development of informational agents-assistants and auxiliary electronic materials;
- The development of texts in safety measures for the work with real instruments.

6 Conclusions

As a result, the specialized computer program in physics that visually shows the properties of direct electric current and may be applied at schools medium and senior forms was developed. Series of laboratory works in research of Ohm's laws for the section and the whole circle, of Kirgof's rules, electro moving force measuring were chosen for the work.

This work may be applied either during traditional or distant learning.

The usage of the program has confirmed that the best forms of laboratory experiment demonstration and students' knowledge consolidation on practice are logical and consecutive connection of laboratory equipment virtual models usage at the corresponding program environment and their real prototypes in the laboratory investigation. Firstly, it enables a student using VMC in better preparation for the real laboratory experiment. Secondly, consecutive transitions from real research to its computer model and visa versa contribute to the abstract thinking development.

The next steps of the further computer models development have been worked out.

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