

A Multimedia Computer Methodology in Pneumoautomatics Education*

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Abstract: *A multimedia computer methodology for pneumoautomatics e-learning based on Festo pneumoelements is presented. The variety of contemporary information technologies and multimedia tools for extending of the education processes are shown. The proposed multimedia computer technology does not depend on the user operation system and can be used with the popular browsers that support JavaScript. The practical applicability of that technology is demonstrated through a developed e-learning pneumoautomatics multimedia virtual environment course.*

Keywords: *Web-based education, e-learning, pneumoautomatics, educational computer multimedia virtual environment.*

1. Introduction

The globalization of the modern society leads to global information resources and information networks that allow extended possibilities for getting, sharing and using of the information. The World Wide Web and Internet can supply information extended with multimedia capabilities – text, graphics, colors, animation, sound, speech, music, video, etc. These possibilities give new dimensions in some traditional areas of information exchange as educational and training systems, for example and help them to adapt to the new demands of the modern society.

The computer methodology based on hyperlinks and multimedia can be used to develop and realize an intelligent friendly interactive professional education and self-education systems. That could help adapting of the educational systems to the new information technologies.

* The investigations in this paper are in the frame of IIT – BAS projects, codes: 010063 and 010074.

2. Analysis of the Web-based education

Internet or intranet education through computer virtual multimedia environment (Internet-Based Training, Online Training, Net-Based Training) is based on using of some Web-browser, like Internet Explorer, Netscape Navigator, etc. The main advantages and disadvantages of that type of education are:

Advantages:

- Convenient access – choosing of the place and the tempo of the education.
- Flexibility – choosing of the education time and its duration.
- Easy course modification – changes of the course content can be done by changing files on the server only.
 - Multiplatform technology base – unlike other computer educational methods Internet based education is available on user computers regardless their operating systems (Windows, Unix, etc.) without the need of additional software. The education software once developed, can be used on each computer connected to the Internet.
 - Less educational costs – no costs for traveling to the educational place (by Hall [3] the average costs are about 50% less than traditional education in a centralized place).
 - Cheap distribution – Internet education decreases the costs of the course materials distribution.

Disadvantages:

- Dependence of the connection speed – the low net connection speed decreases the quality of the educational process. That problem could be essential for public Internet locations. In the intranet environments that problem usually does not exist.
 - Static of the educational programs – interaction of the educational program with the users can be limited in most cases but that is going to change with the development of the information technologies.
 - High cost for developing of the educational software – in many cases the real costs are higher than planned ones.
 - Some disciplines are not well suited for education without a teacher - for example, artists education need a tutor to show all performance details.

3. Methods and tools for computer education

Three basic approaches to the computer education could be specified: Computer-Aided education, computer-based education, Web-based education.

The **Computer-Aided Education** (Computer-Aided Teaching, Computer-Aided Training, Computer-Aided Learning) is used as addition of the traditional education. This method includes supplying of some users guides and a helpful information about some lectures, exercises, tests, etc. Depending on used software there exist two types of the Computer-Aided Education – developing of a specific software or using an universal (general) software for some exercises. Usually all used software tools are located on the computers at the school or university and students have to visit that locations but sometimes they could be accessible through Internet also.

- The **Computer-Based Education** (Computer-Based Teaching, Computer-Based Training, Computer-Based Tutorials) is used for creating of some electronic versions of textbooks or exercise books. They are usually distributed on CD-ROM, diskettes, etc. That method gives the freedom of the trainees to choose the time and speed of education. The used software should have implemented some multimedia possibilities (pictures, graphics, sounds, music, video, etc.) to make the education more attractive. The trainees should have the possibility to save some of their work and exercise sessions and to return back to them as many times they need to.

- The **Web-Based Education** uses a World Wide Web (WWW) as virtual environment to present education materials and/or to realize the education process [1, 2]. That type of education is widely used and is quite popular in the educational community. The Web-Based Education gives the ability of distant education where the trainee is in some remote geographical location and user determines its time and duration of the education. Web-based education is for people motivated to learn without leaving their home locations but needing some interaction with the teachers.

Each of the above mentioned educational methods in computer environment is used for specific goal and their advantages and disadvantages should be clear. The choice of the method depends on: specifics and the goal of the educational course, type of students to be educated, existing infrastructure, and financing base of the educational institution.

4. Tools for Web-based education development

The main consideration for choosing the tools for a multimedia computer methodology is minimizing of the need for additional software, for example tools to play sounds, music, animation, etc. Some of the existing tools for Web development as HTML, DHTML, XML, Perl, Java, etc., have all needed multimedia possibilities and do not depend on the type of the used computer environment. They can be used to visualize the studied objects by animated two or three dimensional graphical representation. The studied objects can be virtually implemented in some simulated work environment and using friendly interface students can train some work processes. Using modular methodology the developed software can be developed and extended for personal computer education, for Web education or for education in some intranet environments.

The HTML editors are great tools for creating e-learning course content. Using Dynamic HTML it is possible to create interactive Web sites by using a combination of static markup language (such as HTML), a client-side scripting language (such as JavaScript), the presentation definition language (e.g. Cascading Style Sheets – CSS), and the Document Object Model. JavaScript allows making Web content interactive with rollovers, sound, forms, alternating images, and more. Every interaction (motion, color, sound, etc.) is unique for each one education system and it is based on relevant JavaScript implementing. The proposed pneumoautomatics methodology is based on original logical algorithms developed by the authors with using real time loaded and changed static images in proper consequences to get the needed animations. Those logical algorithms are implemented in developed software system by means of JavaScript, DHTML and CSS. The developed system has open modular structure and relatively easy can be modified and extended for different technical systems and

components. There are no universal ways to build technical systems and the developed software educational tools are also different for each technical component and for the illustrated technical system.

5. Development of the multimedia educational course tailored to the specifics of the object

The development of the given educational multimedia computer course needs to consider the specifics of the objects to study. The study of the pneumoautomatics is a technical educational branch that allows the usage of the all contemporary multimedia potentiality of the information technologies. Each studied component of the pneumatics systems could has a course content structure as [4]: *Introduction, Education Aim, External View, Construction Details, Characteristics, Graphical Symbol, Action Mode, Work in a System, Experiments with the Virtual System, Test of the Students*. Each of these educational themes uses the multimedia resources potentiality for explanation and visualization. For example, the pneumatics component “5/2 distributor with pneumatics control” can be visualized in action by interactive animation. By clicking

on the button  the component starts a loop work cycle by switching the air between the inputs and outputs (Fig. 1). The button  interrupts the looping in the intermediate stage and the relevant position is color indicated. The left or right button  supply air to the left or right inputs. It is also possible to switch manually between the left or right work positions by pushing the left or right control rod. The air supply pressure can be changed by the slider on the right on the Fig. 1. The switching speed and the color of the air supply are changed accordingly to the air pressure.

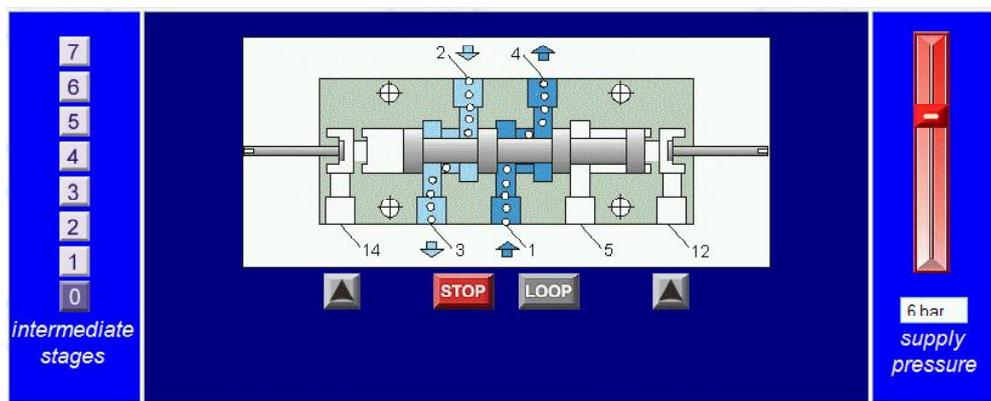


Fig. 1. Action of the component “5/2 distributor with pneumatics control”

All of described above animations are followed by relevant sound effects and visualizing the movement of the controlled air flow.

The student can learn about the different component actions by playing with that virtual component model.

Work of the component in a typical system is shown visually by implementing it in an interactive virtual simulative system graphically built by standard pneumatics symbols (Fig. 2).

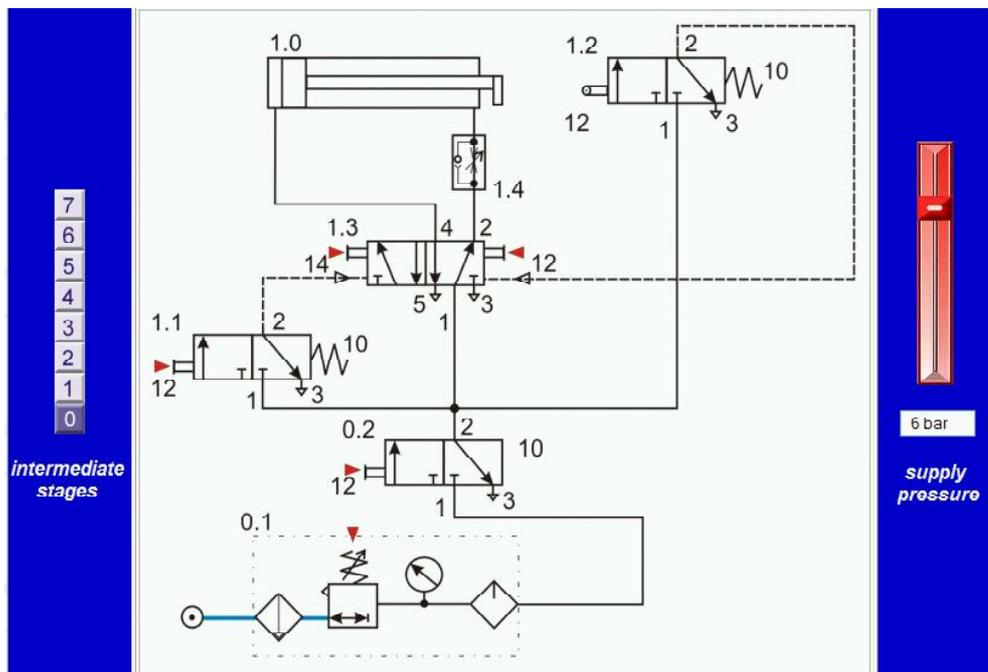


Fig. 2. Work of the studied component in a typical system

The virtual system allows switching on and off of the all system elements by mouse clicking on their graphical representation. The student can examine the system work and what will happen when the buttons are switching on and off in the proper sequence or randomly. The air pressure can be changed by mouse dragging of the pressure slider on the right of the Fig. 2. It is also possible to activate the intermediate process stages by clicking on their number on the left of the Fig. 2. Every action is visualized by the relevant changes of the system element states and is accompanied by sounds for switching and air moving. There are also colors coding for different air pressures – intensifying the blue darkness with the pressure increasing. The graphical representation of all system elements is according to the standard graphic symbol for each pneumatic component. Using that kind of a multimedia virtual system the student can visually study the components action in details. It is not that easy using paper textbooks or by means of a real system where complex technical details can create difficulties to understand the logics of the process itself.

Experiments with the studied component are done on virtual stand shown on Fig. 3 designed on the basis of simulative work system same as Fig. 2. It has all the functionality of the real stand including to some extent and the three-dimensional view of the components. The action of the virtual stand is analogical to the work of the simulative work system but the main purpose of the stand is to serve as environment for doing some specific experiments. The student has been supplied with detail instructions what and how to do. All actions on the stand are visualized and animated with proper colors, sounds and even text remarks (on errors for example).

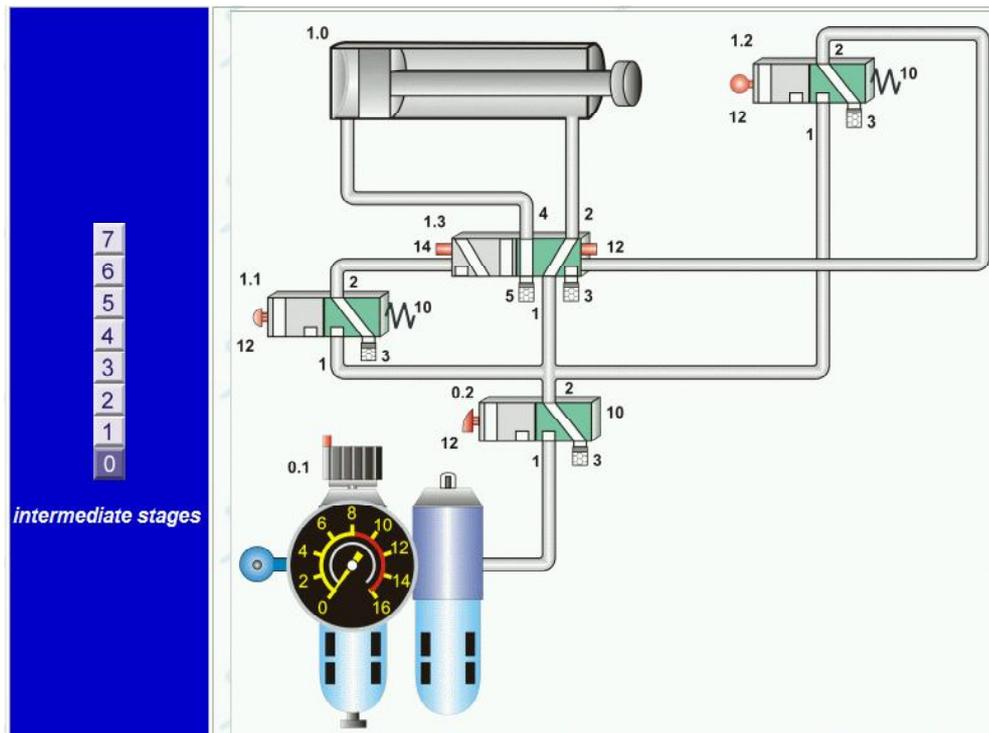


Fig. 3. Experiments with the studied component on the virtual stand

When mouse pointer is on some of the components a “pop-up window” is shown with an explanation of that component. These experiments in traditional way are to be done on real technical system in some laboratory which limits their availability, frequency and eligibility. Experimenting on virtual stands the students can practice on their own computer at any moment of time they find convenient and as long they need to. That does not exclude the need of experiments on real system stand but helps the students to prepare better and saves time and costs of using the specialized laboratories.

In both graphical representations – work of the component in a typical system and experiments on the virtual stand there exist hyperlinks for the each of the included components. They are activated by clicking on the chosen component which opens in new window the relevant multimedia educational topic for that component.

6. Conclusion

The developed multimedia computer methodology for pneumoautomatics education is based on Festo's pneumoautomatics elements and is a part of the contract financed by the Bulgarian Ministry of Education and Sciences. The current pneumoautomatics educational software system includes the modules for the basic pneumoautomatics components needed for the introductory course for the students or no specialists in pneumoautomatics for computer aided teaching, for distant training or for self education. Currently it is used as an illustration tool in the high school courses on "Pneumatic power supply" and "Pneumoautomatics" held in the Technical University – Sofia.

The used methodology illustrates the possibilities of the modern information technologies and the advantages of the multimedia tools to enrich the educational processes. The described methodology can be used in the many popular browsers and does not depend on the user operating system. The developed logical animation algorithms can be modified and combined with proper static images to get software animation systems not only for the educational purposes but for the modeling and simulation of different technical systems.

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