

BIONICS: MULTIMEDIAL COURSE

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Abstract: People do not copy just the randomness from the nature. It is the research area of the scientific field called Bionics. It aims to find solutions of the most variable problems in the nature, it observes living creatures/organisms and mimics their behaviour. Why it is the Mother Nature that improves its „developments“ during thousands of years. Bionics is young and progressive science field that allows us to construct devices to support weakened organs supports or to build artificial organs. Since bionics is fast developing field it is important to choose the right tool for student education – e-learning. The aim of our work is to create the hypertextbook with the multimedia components that clearly explain some topics from bionics. The information about a several courses is stored in an XML format which allows full availability of all informations from course.

Introduction

At present when information is moving force of the world nobody doubts about necessity of continuous education. Systematic education of employees and self education using the form of training, seminars, or individual study is common constituent part of life of every individual. To prepare young people for a new world means that we must develop new ways of teaching and learning. The way we learn changes radically: from purely lecture based education to interactive style. E-learning is a modern form of distant education that utilizes the most up-to-date information technologies in the form of electronic distributed education. Its main advantages are versatile flexibility and saving. Multimedia course combines text explanation with animations, video sequences, audio recordings, graphics, schemas and testing objects.

Classical education assumes that all or most of the students perceive and understand with the same speed, that oral explanation of the lecturer is convenient for all students and that all want to study the same topic at the same time. E-learning system removes all these shortcomings. Student can study the course as long he/she wishes, defines way of passing the course, going back to some topics, selects from several variants of explanation. He/she runs the course when needed that means that he/she wants to study and will concentrate on the topic. By means of a number of questions, and tests, he/she is interactively involved in educational process, which significantly increases efficiency of the

process and remembering and understanding of the topic.

At classical education it is very difficult to measure what information students have kept from a course after a certain time interval. Course quality strongly depends on the teacher's quality and can be variable in time. Often the course cannot be evaluated before the students finish the course. Thus sometimes it is found out then only that a certain course does not correspond to original requirements. E-learning with the aid of testing objects and control systems effectively measures each course. It enables to set up objectively required goals (e.g. after finishing the course student must answer correctly 95 out of 100 questions concerning the topic) and to measure them in a simple way. E-learning supplies immediately information about individual students: what is their score in certain parts, how much time they spend in certain parts of the course, how they respond questions. E-learning statistically evaluates success rate of individual courses and in this way it identifies courses that should be modified or re-structured. E-learning lays emphasis on the way of passing information to students. At present it is not satisfactory to acquire right information at right time but it is necessary to understand the information fully and to see relations in the given context. Precisely this the e-learning offers.

The aim of e-learning is not to replace classical education in all areas. However it is a suitable supplement even for such areas where classical style is due to the direct contact between students and teachers regarded for irreplaceable. For example, it is possible to “pre-train” students electronically. Then they arrive to lessons with a teacher with a lot of information and questions. The teacher can focus on interesting or difficult parts of the topic, which leads to significant extension and enrichment of the course. In addition to that, the teacher is not excluded from the process of educating students. E-learning brings a number of communication tools from email to videoconferences that enable teachers to contact individually each student. Based on the information from the electronic course, the teacher has precise information what the student's score in certain parts is, how much time he/she spends in certain parts of the course, how he/she responds questions. Thanks to the communication tools the teacher can communicate with a certain student more intensively than in classical lessons.

Based on the above-mentioned advantages, we have decided at the Department of Cybernetics to develop an elearning system MultiPeS (Multimedia Pedagogical

System) that could help us continuously increase quality of teaching and include the latest research results. New version of the system utilises the latest technology MS .NET that ensures easy portability between individual platforms (32bits/64bits, etc.) and high system modularity. The MultiPeS e-learning system is designed as an open modular system, which enables its simple further extension. Information on individual learning lessons are stored in standard XML format which significantly simplifies possibility of cooperation with other systems. Based on the developed project, the MultiPeS system generates on its output a course in HTML format (for older explorers) and XML format for explorers enabling viewing this format (e.g. Internet Explorer). Thanks to the XML format it is possible to utilise fully the structure and depth of all information that are contained in the course. For example, it is very simple to search for information according to its type or key words when using XML format. A great advantage of the XML format is the possibility to separate textual content of the course from the graphical presentation which simplifies the modifications and maintenance of the structure of the text and in addition it supports export to various format types. Another advantage is simple and intuitive control of the system.

Students access courses placed on an educational server using a PC at any place and anytime through an Internet explorer (MS Internet Explorer or Netscape Navigator). Another advantage of the MultiPeS e-learning system is that it works both in on-line mode (the educational course is placed on web pages of the educational institution, the course can be accessed from computer laboratories, or from home using modem or firm connection to the Internet), and in off-line mode (the student can get the course on a CD-ROM), that is more suitable for home study since it can save financial means. Students can choose the variant they prefer. However it is obvious that some features of the MultiPeS e-learning system are available only in on-line mode (e.g. e-mail communication of the student with the lecturer, or other students).

Education in Bionics

Bionics is relatively young science of constructing artificial systems that have some of the characteristics of living systems. Bionics is not a specialized science but an interscience discipline; it may be compared with cybernetics. Bionics are convinced of the performance of nature's way of optimization. This sophisticated method is running already 3 billion years, in the biggest laboratory we can imagine: The surface of the earth. Now, the laboratory is large enough and the time is long enough to find good solutions (perhaps optimal solutions) under the biological constraints.

Million years ago nature has invented the technique to fly. Engineers of the last centuries thought that the bird feather includes the mystery of flight. It is difficult to mimic the feather. It is difficult to mimic the feather. The bat could be imitated more simply. Therefore Leonardo da Vinci designed his flight machine like a bat.

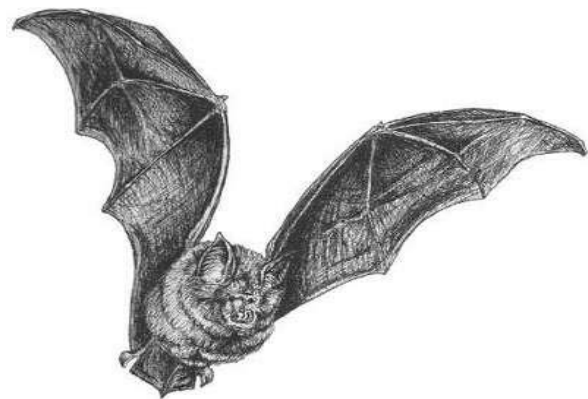


Figure 1: The bat: A biological model simply to be mimicked



Figure 2: The Leonardo da Vinci flight machine

The course of bionics is offered to students in full-time form of Master study. It belongs to the category of obligatory courses having three hours of lectures and two hours of seminars or laboratory work per week. Each year it is attended by approximately 50 students. The aim of the course is to introduce to students following topics:

- analogy among nature and technique
- informative bionics
- biosensor and nanotechnology
- machine realization of man's sense
- artificial heart, aorta valve replacement and pacemakers
- artificial kidney
- artificial lung ventilation
- neoarthrosis and bioelectric prosthesis
- man-machine systems
- virtual reality in medicine
- biotechnology

All these topics are scheduled to 14 lectures and 14 connected seminars/labs, where students have the possibility to train practically on examples the presented topics. We show in following text few examples from the course.

The aim of our work is created a hypertext book of bionics. Hypertext lecture notes represent fundamental of each our e-learning course and enable students effective access to each information saved in text. It is simple, comprehensive and suitably structured text that provides students with several advantages in comparison with study of classical books or lecture notes. For example, student need not turn over the leaves of a book and search for related topics, connected links or explanation of a certain term. In hypertext lecture notes, it is „just enough“ to click on a hypertext link and the system searches all in place of a student. For example, if student does not understand a certain term that is explained in other part of the lecture notes he/she clicks on unknown expression and the system finds corresponding explanation. Information in lecture notes are didactically ordered and use suitably accompanying multimedia elements of presentation (image and sound animations) and continuously verify correct understanding of content in all relations and in certain system that is hierarchically ordered according to importance and difficulty. Texts constructed in this way represent undoubtedly significant progress from the point of didactic processing and each student goes through the whole text not only with his/her own speed but also this text respects input knowledge, skills and experience of the student that in certain parts need not go through known information and possibly solve tasks that are redundant from the point of view of knowledge. Hypertext lecture notes are available to students in the format suitable for printing or in standard e-Book format.

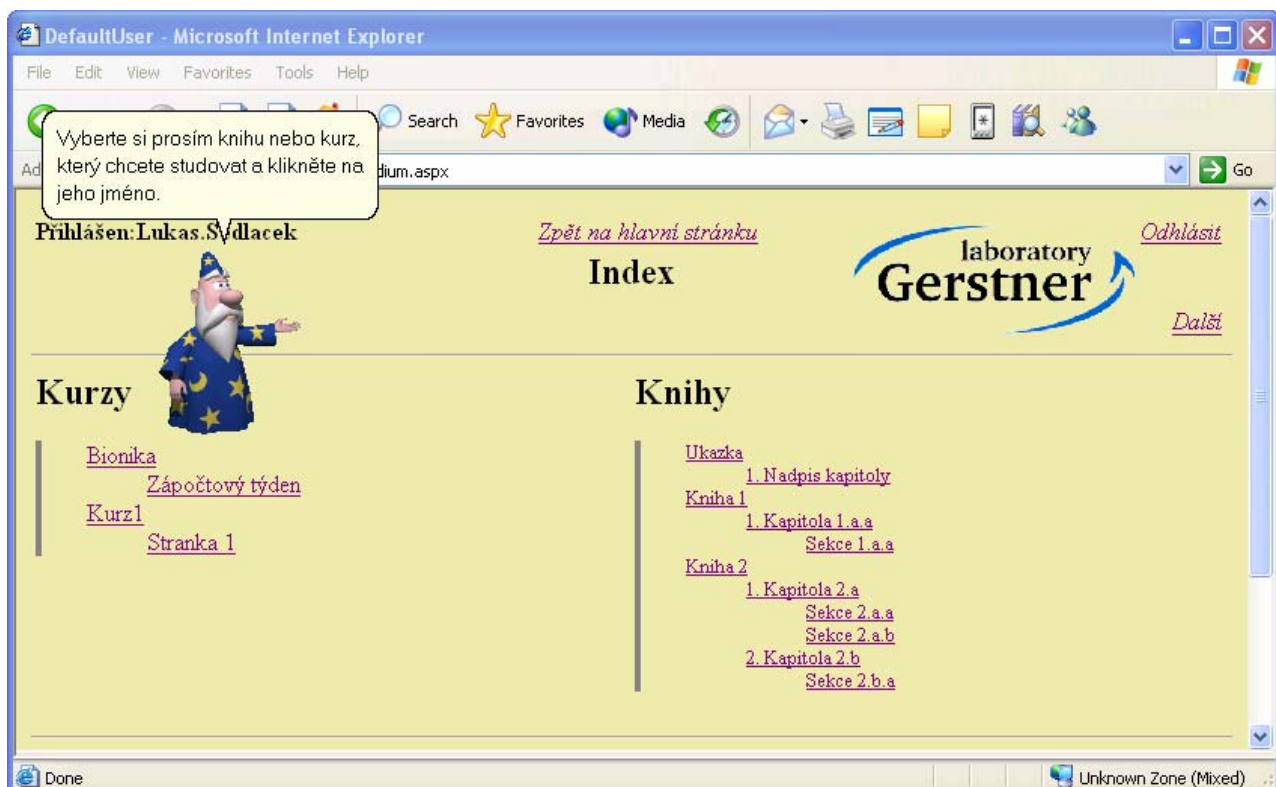


Figure 5: Hypertext book

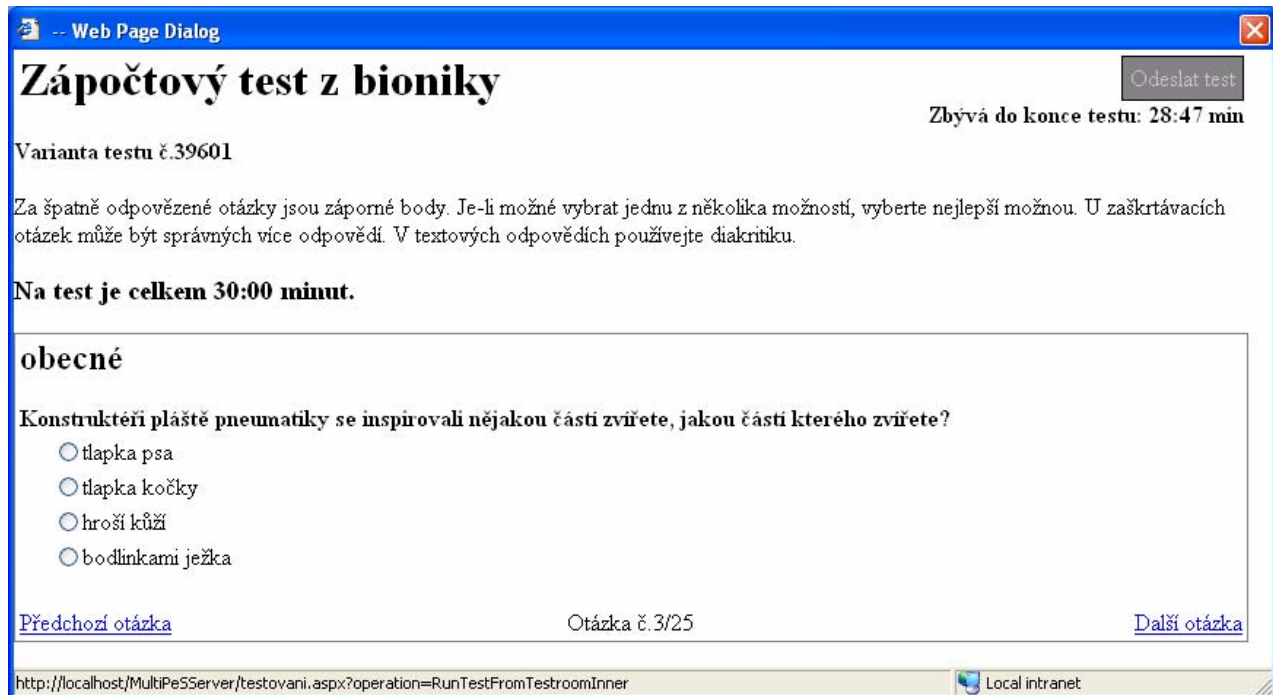


Figure 4: Example of the interactive test with automatic evaluation

Feedback is a very important part of the e-learning system. The e-learning system's task is not only to present the information to the student, but also to find out using the feedback whether the student has understood the information. This is very important because at present it is not satisfactory to get the information in the right time but this information must be fully understood and linked with other information or knowledge. The feedback realized using interactive tests with automatic evaluation is a suitable tool for continuous evaluation of student's study. Its primary purpose is immediate feedback of the student himself/herself (self-evaluation) that helps the student to orientate. He/she can consider to repeat a topic or to choose complementary information offered by the e-learning system, for example in the form of references to other learning pages. The secondary purpose of the feedback is the utilization of the results of the interactive tests for evaluation of current student's work.

The feedback can be used for evaluation of the course itself. If the students have problems with currently taught topics (e.g. they are not explained clearly or contain small number of practical examples) then most of the students do not pass the interactive tests. It is a signal that the e-learning course must be modified or completed.

Acknowledgment

This paper is based upon work sponsored by the Ministry of Education, Youth and Sports FRV (under project No. FRV 403/F3 "Innovation of bionics course").

References

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