Distance Learning and Education Support Tools Development

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KEYWORDS: *e-learning, distance learning ,internet technologies, virtual laboratories, tele-laboratories*

ABSTRACT: *The paper concerns the development of set of tools for distance learning and internet based teaching support at the Institute of Automatic Control, Silesian University of Technology in Gliwice, Poland. The author of the paper has been involved for several years in the international collaboration in the field of multimedia oriented and internet technologies based education methods development. The collaboration involved the participation in Socrates/ODL/Minerva projects called LINK and LABLINK, concerning the distance learning platforms and virtual laboratories. The concepts of distance learning and internet technologies in education have been developed in the Institute of Automatic Control with respect to control, identification and signal processing courses. The tools have been developed and tested also as part of the computer networks course for automation and robotics as well as computer science students.*

The following groups of tools have been developed at the Institute of Automatic Control:

- *Set of applets in Java for adaptive control systems simulation, including modern control systems design, identification and estimation procedures, graphical user's interface and simulation visualization.*
- *Platform for distance learning, including the possibilities of posting lectures with additional materials, enrolling students, preparing and running tests and quizzes, extensive communication tools. The platform has been developed around PHP and PostgreSQL tools and is similar in functionality to existing commercial distance learning tools.*
- *Set of internet database oriented tools for cataloguing books, journals, theses and reports available at the Institute of Automatic Control and used by students and staff for education and research purposes.*
- *Internet database for accessing and maintaining the curricula concerning studying at the Faculty of Automatic Control, Electronics and Telecommunications and Computer Science. The detailed curricula are possible to access by means of Internet for IAC staff responsible for the consistency and up-to-date status of courses details, as well as for domestic and abroad students interested in studying in Gliwice.*
- *Set of tools for semi-automatic maintenance of the Silesian University of Technology International Relations Bureau portal. The tools developed enable the International Relations staff to input the information concerning new contacts, programs and projects, collaboration possibilities, current announcements etc. with stress on the information contents, whereas the systems takes care of the presentation form.*
- *Platform for tele-laboratory (virtual laboratory) in the field of advanced adaptive control methods applied for the active noise control task. The laboratory rig consists of several microphones, loud speakers, mixers, filters, computers and DSP boards, and as it is rather expensive, unique and the laboratory room is short on space, it is very well suited for the implementation of tele-laboratory concept.*

The other projects and tools developed concern among other the usage of XML, Java servlets and JSP for enhancing the IAC portal, the database/communications tool for communication between dean's office, teaching staff and students, as well as flexible tool for distributed management of laboratory exercises for various courses.

The whole set of tools serves as good example of internet technologies usefulness for education and research support.

1 TITLE OF THE PAPER (STYLE HEADING 1)

The paper concerns the development of set of tools for distance learning and internet based teaching support at the Institute of Automatic Control, Silesian University of Technology in Gliwice, Poland. The author of the paper has been involved for several years in the international collaboration in the field of multimedia oriented and internet technologies based education methods development. The collaboration involved the participation in Socrates/ODL/Minerva projects called LINK and LABLINK, concerning the distance learning platforms and virtual laboratories. The concepts of distance learning and internet technologies in education have been developed in the Institute of Automatic Control with respect to control, identification and signal processing courses. The tools have been developed and tested also as part of the computer networks course for automation and robotics as well as computer science students.

2 JAVA APPLETS

The author of this paper was involved in the realisation of the Socrates/ODL project called LINK – as local co-ordinator and lecturer. One of the main purposes of the project was to prepare the enhanced versions of the existing lectures in the engineering education field using the multimedia and computer networks offered technologies. The previous versions of lectures typically existed in the form of hand-written lecture notes and PowerPoint slides. One of the basic concepts of the LINK project was to make use of existing tools and platforms for presenting the information in Internet, especially the Java applets.

Java applets are obviously very natural candidates for use in the engineering education lectures. The Java language enables the user to program a lot of numerical calculations with the full set of arithmetical operators, function, relations etc., the language is object oriented and the performance with respect to the development is excellent and with respect to the execution – satisfactory. The Java language enables an extensive set of graphics programming tools and primitives, the Java programs could be easily programmed with interactive and efficient graphical user interface. The author is involved in teaching the Adaptive Control course as well as System Identification course. In both cases the lecture could be easily accompanied by the examples of identification and estimation methods properties as well as the adaptive control system simulation. Such programs include a lot of numerical calculations and the simulation results should be presented interactively and possibly with a lot of graphics. It is clear that Java applets are very well suited for programming such examples and in addition it is possible to easily incorporate them in the Internet based presentation. One of the aims of the LINK project was also to access the enhanced versions of the lectures by means of the computer network and Internet and taking this in to consideration it is clear that Java applets are on of the best possibilities of achieving such aim.

3 DISTANCE LEARNING PLATFORM

It was mentioned above, that the LINK project included the concept of asynchronous and distance learning by the students using the appropriate software platform. The general concept is well known and clear: there should be a sever or group of servers with appropriate software that enables the teacher to put his lectures on the server and at the same time it enables the student to access such lectures. Of course both operations should be possible to perform by means of Internet that is possibly from far remote site. The system should offer several additional services, like supervised or unsupervised enrolling of students, maintaining the groups of students, basic teachers and students accounts administration, communication facilities for contacts between the teacher and students as well as discussion forum. Typically such system include mechanisms for preparing and posting quizzes, tests and examination questions and tools for supervised access to such tests and their evaluation.

While working on the LINK project the partners evaluated several existing platforms for distance learning that would enable the above discussed functionality. Unfortunately in general all these platforms could be divided into two groups: the platforms that were too expensive, and the platforms that were not enough efficient, especially with respect to the data transfer between the server and the user. The LINK project partners started the work on the proprietary system that would suit the project aims but unfortunately this work resulted only in the test version of the platform called CONFAD. The author of the paper initiated the work on similar platform at the Silesian University of Technology on the basis of PHP and PostgreSQL tools. This Distance Learning platform has been developed and implemented at the Silesian University of Technology and its functionality includes all the features mentioned above with

respect to the LINK project aims. The platform is used at SUT for testing the distance learning methodology as well as an example of applying the Internet technologies for education.

4 PUBLICATIONS AND THESES CATALOGUE

There is Central Library at the Silesian University of Technology and many small libraries at faculties and institutes of the university – e.g. at the Institute of Automatic Control. There are several important books, textbooks, journals, research reports and students' theses in such institute-level libraries and unfortunately in many cases they are not connected to the computerised catalogue and reservation system of the Central Library. In addition it is not always so, that the institutes employ the persons that could serve as full time librarians. Because of this it was justified to build small open database system for accessing the institute-level libraries catalogue and making loan reservations. The system has been programmed in PHP and PostgreSQL and it has been tested at the Institute of Automatic Control.

5 CURRICULA MAINTENANCE

The author is the lecturer at the Faculty of Automatic Control, Electronics and Computer Science. There are three standard directions of studying at the Faculty: Automation and Robotics, Electronics and Telecommunication and Computer Science. There is also a special meta-direction of studying called Macrocourse, with all courses in English and the courses chosen from all standard directions of studying. There are also several specializations within all directions of studying thus making the number of curricula at the faculty rather large. In addition because of the changes in curricula it could be so that there are different curricula with respect to different studying semesters. As a net result there are several currently valid curricula at the Faculty of Automatic Control, Electronics and Computer Science. On the other hand the curricula are of interest to students from Silesian University of Technology, students from various universities in other countries, interested in studying in Gliwice e.g. as part of the Socrates programme exchange scheme, lecturers both from the Silesian University of Technology and collaborating universities from other countries, as well as the university, faculties and institutes administration staff. Some of the persons mentioned above are interested in just viewing the curricula whereas the other should allowed to make changes to them and validate the new versions.

The above consideration justifies the work on the multi-access and database oriented system of curricula maintenance at the Faculty of Automatic Control, Electronics and Computer Science. In fact such system has been developed using the PHP and PostgreSQL platform and in the test phase it has been merged with the main portal system of one of the faculty institutes. The system is accessible via Internet and enables the deans and institute offices to input data concerning the curricula and make the necessary changes. The other authorised users of the system are allowed to view the currently valid curricula, get access to the additional information concerning the courses and lecturers. The lecturers themselves are allowed to update the information concerning themselves and the courses for which they are responsible.

6 INTERNATIONAL COLLABORATION PORTAL MAINTENANCE

The Silesian University of Technology actively participates in several international collaboration initiatives concerning the education, research and supporting measures. With respect to the students and teachers exchange between the universities the largest possibilities are available by means of the participation in the European Socrates/Erasmus programme. The collaboration in research is the most widely available within the scheme of EU Framework Programmes. Both initiatives mentioned above are co-ordinated at the Silesian University of Technology by the Rectors, International Relations Office, European Programmes Bureau and the EU Framework Programmes regional Contact Point. The latter three units work closely together and in particular share to some extent the Internet based information dissemination and contact facilities.

The portal of the International Relations office and other units involved in the international collaboration scheme is the vital source of information and contacts for many teachers and students from the Silesian University of Technology and several collaborating universities from various European and other countries. Most of the persons employed at the International Relations Office are not highly specialized at the Internet portals administration and maintenance. On the other hand such persons frequently possess important information and materials concerning the scope of international collaboration. Therefore it was decided to build a test system for semi automatic creation of part of the

International Relations Office portal system. The general concept is rather straightforward: the persons that have the important information, data and messages should be able to post these information, data and messages as the contents of the portal, and the system should be responsible for the proper and attractive presentation of the data. Obviously it is not possible to predict in advance all possible and adequate forms of presentation and the system has to be maintained by the skilled webmaster, still it seems to be of major importance and flexibility to allow the International Relations Office staff to quickly and easily update the contents of the IRO portal.

7 TELE-LABORATORY PLATFORM

The author of this paper has been involved in the realisation of the Socrates/Minerva collaboration project called LABLINK. The project concerned the development of the methodology and creation of exemplary software/hardware solutions in the field of virtual laboratories and tele-laboratories. The general reason for starting the LABLINK was to allow more students access to the unique and expensive laboratory equipment while studying at engineering faculties. It is common, especially with respect to the Central and Eastern Europe universities, that there are more very well qualified teachers and tutors than the necessary funds to equip the interesting and modern laboratory sites. There are also European universities in which the opposite mismatch takes place: there are many very well equipped laboratories but the number of students decreases and the laboratories are not fully booked. In such situation the concept of tele-laboratory (or virtual laboratory) comes as a natural and extremely efficient remedy. The laboratory site is additionally equipped with the hardware an software platform necessary to enable access to such site by means of computer network, preferably the Internet. Such extension to the laboratory site could include the video and audio transmission equipment, special server modules in order to get access to the physical elements of the laboratory rig as well as additional software components for booking the site, the user authentication, getting access to the laboratory site software layer including the operating system, utility software and engineering analysis packages.

The author has taken part in the preparation of remote Active Noise Control laboratory at the Institute of Automatic Control, Silesian University of Technology. The laboratory was set-up around the existing standard Active Noise Control laboratory equipped with a lot of specialized hardware and software including microphones, loud-speakers, digital signal processors, special anti-aliasing and forming filters, mixers, amplifiers and specially configures three-dimensional zones for the realisation of active noise attenuation. The laboratory equipment is expensive, the laboratory room is specially prepared and not ready for the simultaneous work of many students. Last but not least – the noise generated during the laboratory exercise could be distracting, unpleasant and even dangerous for health. The laboratory has been rebuilt by adding the software tools that enable remote starting of programs used to conduct the noise control experiment and to analyze its results. In addition the noise that is attenuated in the laboratory is transmitted as audio signal via the Internet and can be heard by the remote student working with multimedia computer.

The remote Active Noise Control laboratory at the Silesian University of Technology greatly enhanced the possibilities of conducting noise control experiments and widened the possibility of international collaboration in education with the SUT participation.

8 SEMI-AUTOMATIC TIME-TABLING SYSTEM

The problem of scheduling lectures and laboratory exercises at large universities with many students, teachers, courses and lecture halls could prove to be really difficult. The Institute of Automatic Control at the Silesian University of Technology employs around 100 teachers and the number of students attending lectures and laboratory exercises is around 800. On the other hand the time tabling problem is well known in the literature and concerns the field of optimisation with constraints. The author and his co-workers from the Industrial Control Group have been developing software packages in the area of artificial intelligence and expert systems with Prolog as well as constraint logic programming and constraint handling in Prolog for more than last 10 years. The constraint logic programming methods are especially well suited among other to efficient solving of large scale time-tabling problems.

A versatile and complex system for scheduling lectures and lecture halls reservation has been developed at the Institute of Automatic Control using PHP, PostgreSQL and CLP tools. The system

enables the teachers to express their hard and soft constraints concerning the availability for delivering lectures and laboratory exercises, the access to the databases concerning the available lectures halls, laboratory rooms, students groups characteristics as well as curricula is also enabled. After gathering all necessary information on the courses, halls and teachers preferences and taking into account rather large number of constraints concerning the sequence of lectures, availability of external lecturers and halls and the availability of special equipment like video-projectors, the CLP based system is started in order to generate the best possible result. After solving the problem the solution is available at the Institute oa Automatic Control Internet portal with several views possible – including the teachers oriented view, the students groups oriented view as well as the lecture halls one.

The semi-automatic time-tabling system at the Institute of Automatic Control, Silesian University of Technology, greatly enhanced the process of routine scheduling the lectures and laboratory exercises – via efficient using of Internet technologies and constraint logic programming methods.

9 CONCLUSIONS

The following groups of tools have been developed at the Institute of Automatic Control:

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- Platform for distance learning, including the possibilities of posting lectures with additional materials, enrolling students, preparing and running tests and quizzes, extensive communication tools. The platform has been developed around PHP and PostgreSQL tools and is similar in functionality to existing commercial distance learning tools.
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- Set of tools for semi-automatic maintenance of the Silesian University of Technology International Relations Bureau portal. The tools developed enable the International Relations staff to input the information concerning new contacts, programs and projects, collaboration possibilities, current announcements etc. with stress on the information contents, whereas the systems takes care of the presentation form.
- Platform for tele-laboratory (virtual laboratory) in the field of advanced adaptive control methods applied for the active noise control task. The laboratory rig consists of several microphones, loud speakers, mixers, filters, computers and DSP boards, and as it is rather expensive, unique and the laboratory room is short on space, it is very well suited for the implementation of tele-laboratory concept.

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