CONCEPTION AND REALIZATION OF THE OFFLINE NAVIGATOR IN THE VIRTUAL UNIVERSITY

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Abstract

The concept of the Virtual University offers a new learning environment for distance education. All the functionalities of a conventional university are available to the students using computers. The learning materials are distributed via communication networks. To facilitate this process and to reduce transmission costs we have developed a new tool, the so called Offline Navigator. Using the Offline Navigator students get an individual course list in which they can select the learning materials they want to receive. Afterwards the Offline Navigator starts an automatic download process, stores the learning units on the students' computer and installs required software.

1. Introduction

The concept of the Virtual University introduces new ways of teaching and learning in distance education via communication networks by the use of new media [1]. Learning appears flexible, individual and need oriented. Students can work independent from time and space at their own learning speed.

In the concept the learning materials and their distribution play a major part. A lot of additional services are realized which are very important for the students. The concept supports access to the central institutions of the university, for example to the library where students can search for required literature or they can contact the computer centre to receive technical support. Further, students can read the news and information pages, access the shop to buy additional learning materials such as CD-ROMs and computer based training courses (CBTs) or enter the electronic cafe to meet fellow students. The services also include the online registration to courses and

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lectures. Students can get information about all the courses which are offered. But the learning materials themselves are password protected so that only students who have enrolled can make use of them.

In the concept of the Virtual University diverse communication tools are supported such as email, newsgroup, chat and audio- and videoconferences. These tools are mainly applied for course specific communication between the students and with their tutors.

The Virtual University is accessible via different communication networks such as internet, ISDN, B-ISDN, cable modems and via the study centres of the University of Hagen. The technical platform consists of distributed servers which are connected via a campus backbone. The integration of a database in the platform supports the administration of students and lectures and allows the students to receive a personal view of the offerings of the Virtual University.

Concerning the learning process two different alternatives are being supported. Students can work online in the courses or they can download learning units and work with them offline. To improve this download process a special tool, the so called Offline Navigator, has been developed which performs the downloading automatically and minimizes online costs. The Offline Navigator bases on four important elements:

- The database offers the personal information about the student and the courses he has enrolled.

- The Offline Navigator server requests the database for information about the courses the student has enrolled and creates on basis of this an individual course list.

- At the World Wide Web server the learning units, software and tools are located.

- The Offline Navigator client is a tool on student side managing the communication between client and Navigator server, the downloading of packages, and installing the necessary tools.

The paper is organized as follows: Section 2 describes the problems of students of the Virtual University in receiving their learning material which motivated the development of a facilitating tool. In section 3 we propose the solution to the arising problems, the Offline Navigator. Section 4 deals with the communication phases which the Offline Navigator performs to download learning materials. Sections 5, 6 and 7 describe the main parts of which the Offline Navigator consists: The database, the Offline Navigator server, and the Offline Navigator client.

2. Motivation

In the concept of the Virtual University the distribution of learning materials via communication networks plays an important role. To receive learning units students can use two different alternatives. The concept of all the courses implies the two possibilities to work in the materials online or offline. The online learning offers several advantages: Students can directly access the additional elements of the Virtual University such as the library, so that they can search for further literature out of the actual learning situation. In case of an arising question a student can have a look in the newsgroup or in the frequently asked questions to find an answer to his problem. If he cannot solve his problem in this way he may contact his tutor by a chat session, an audio or a video conference.

But this online form of learning implies transmission costs all the time which is hardly acceptable for a student. A solution to minimize these online costs is offline learning. Students can download learning units on their private personal computers in form of compressed packages. The download of compressed learning units requires only a short transmission duration and afterwards the course material is available all the time the student needs it. He does not have to connect to the university again if he wants to repeat his subject matter. The learning process itself then takes place offline. In this way the transmission costs for the students are reduced considerably.

At the moment every two weeks in the term the next learning unit of each course is disposed on the platform. So, twice a month a student has to connect to the Virtual University to receive the actual course material. Usually a student takes part in several different courses so that he has to download the new materials and the appropriate software of all these courses. To find the new material he has to enter the homepage of each course which includes links to all the elements belonging to the course. One of these links leads to a so called download page. From here the download packages can be reached. Accordingly a student has to access each course homepage and subsequently the download page to find and download the concerning package. Further he has to enter the central software pages to receive necessary tools and plug-ins for the course. The navigation between the different pages is performed online and consequently increases transmission costs. These online durations are even increased if the student always has to look for the course and software pages which represent the starting point for download.

3. Proposed solution

In order to avoid a time consuming search for course material and to minimize the communication costs for the student, we decided to develop an environment called Offline Navigator.

With the Offline Navigator, the student is able to see an individual, clearly arranged list of all material relevant for him and actually available. This list includes not only the courses he purchased, but also common information and updates of older course material. Additionally, software packages which are needed for his studies (for example viewers, plug-ins or web browsers) may also be included in the list.

For each item in the list, it is marked whether the item has been downloaded from the university in an earlier session and is thus available at the student's computer. If a download is necessary because the material has not been retrieved yet or has been deleted in the meantime, the amount of data of this item is shown.

For each item which has to be downloaded the student is able to decide whether the download should happen in the current session or if he wants to wait until one of the next sessions.

The amounts of data of the selected courses are added up to show the amount of data which is to be transferred in the current session. After specifying the average net transmission rate from the university to the student and the costs per time, the Offline Navigator is also able to give an estimate on download duration and costs.

For example, using a modem which is able to transfer 28 800 bit/s, we assume a net transmission rate of about 25 000 bit/s since we directly connect to the university and thus have no other bottleneck. If the modem is able to compress data, this will not increase the rate since the data to be transferred are already compressed.

To retrieve 2 MBytes of data, we thus need 671 seconds. In Germany, this costs about four German Marks assuming a national long distance call on a weekday's evening in the end of 1997 [3].

After the student has performed his selection and has established a connection to the university, the Offline Navigator loads the material and stores it on the student's computer.

4. Phases of communication

The Offline Navigator is developed according to a client server model. The server is located at the Virtual University, whereas the client operates at the student's home. According to *figure 1*, the Offline Navigator works in four phases.

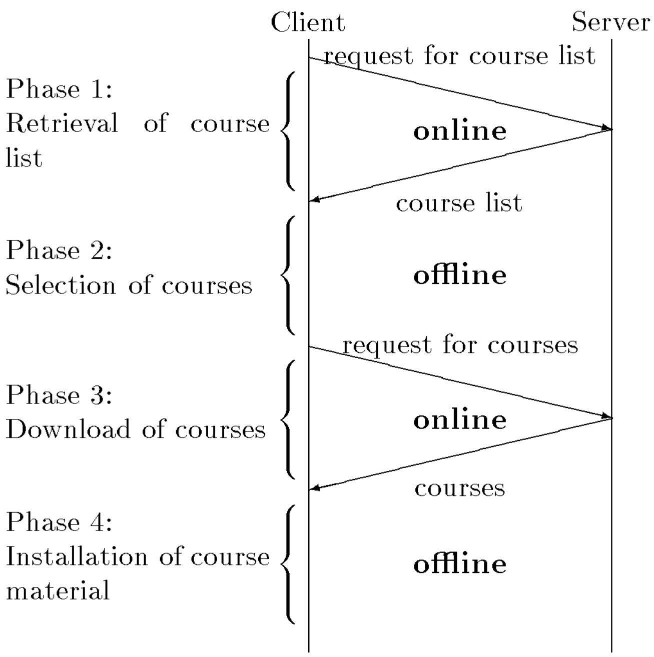

Figure 1: Phases of communication

In the initialization phase, the Offline Navigator searches for already installed components on the user's hard disk. After that, in phase 1, the individual course list is retrieved from the Virtual University. Using both, a clearly arranged list of course information is generated and presented.

Phase 2, the selection phase, is an offline phase, and this is the reason for the name Offline Navigator: Navigation is replaced by an offline selection.

After the selection is performed, phase 3 starts, which consists of the download of the chosen material.

After download has finished, the installation of the new courses is performed offline in phase 4 by the Offline Navigator itself, without any interaction by the student.

5. Database

Because of the huge amount of diverse information to be administrated in the Virtual University we needed a system to organize these data in a very structured way. It would be impossible to manage students, courses, learning units and many other items comprising that University with a simple set of lists or tables. To access data efficiently we embedded a relational data base management system (RDBMS) into the Virtual University. Investigating the data flow one can identify two different classes of data in general:

1. Administrative data

This is a formation of data representing all attributes of a real university in our virtual environment. These data describe for example all departments, courses the departments offer, and the according tutors. Of course all the students and the data concerning their studies like enrolling of courses, results of passed tests, are accessible, too.

Such information is mainly maintained by secretaries, course tutors, and student administrators. This group of users is able to use a uniform graphical interface which is independent of any operating system platform because it is based on the World Wide Web. The users get a tool to work with, which is

- comfortable (it is clearly concepted and equipped with context sensitive help),

- easy to use (nearly all of the users are familiar with computers and internet),

- personalized (the system offers only the functions to the user he needs in his position).

2. Personal data of students

The system offers possibilities of personalization to the students. With the same interface they use to navigate and study in the Virtual University they are able to activate functions to display a list of personal dates, to list the results of tests passed, to set and to edit bookmarks or to contact their fellow students via mailing lists.

In the Virtual University many web pages are also built dynamically with information from this system, like tables of important dates. The Offline Navigator bases on the database system. Especially the data of the student, his enrolled courses and course components (learning units, software needed to work) are important.

The database is implemented with PostgreSQL, version 6.2.1, a Object-Relational DBMS (ORDBMS), derived from the Berkeley Postgres database management system.

To access the data from outside the database offers an interface used by the Navigator server, described in section 6.

6. Offline Navigator server

The Offline Navigator server is a university's component localized between the database system (on the university's side) and the Offline Navigator client at the student's home and thus builds an interface between them (see *figure 2*).

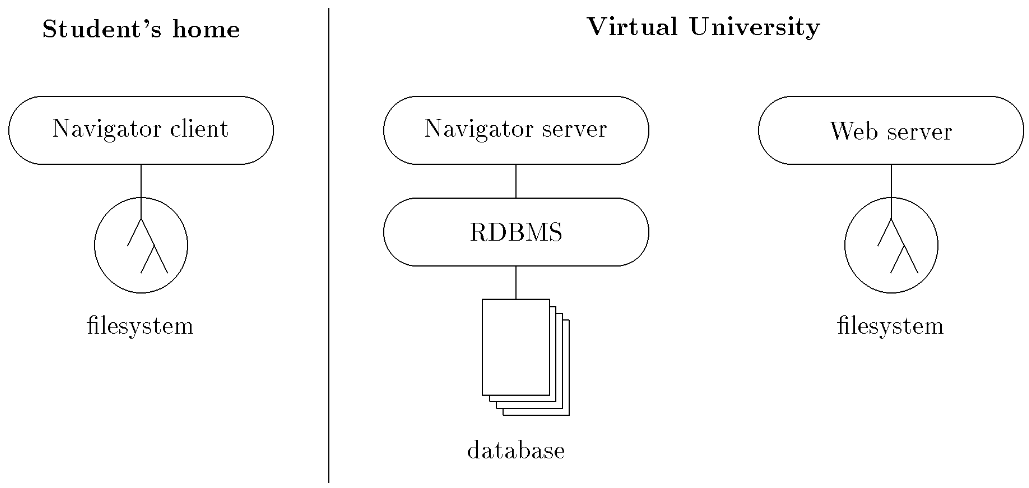

Figure 2: Offline Navigator client and server

To allow the server to access the database described in section 5 there exists a logical link in form of a software layer. In phase 1 and 2 of the communication model from section 4 the client has to cooperate with the server. In these two phases the Offline Navigator server has to deal with the following tasks:

1. Authorization of the client (phase 1a)

The client has to authenticate himself to the server with username and password of the student using the client. The server checks the correctness of these data using the database. If the authorization fails (because of wrong username/password or other errors) the client receives an appropriate message.

2. Retrieval of course list (phase 1b)

In this phase the server knows the identity of the student. With information from the database he builds a list containing

- all courses the student has enrolled including exercises and hints relevant to him and

- all components related to the courses. This may be learning units or further software needed to work with the units; because many of them are equipped with animations and possibilities of interaction, in most cases plug-ins for web browsers are needed.

This individual list is sent to the client.

In phase 3 the communication is performed by a common web server that handles the actual download.

In the future version this phase will be taken over by the Offline Navigator server, too. This is useful to reduce the connection costs further, for example, by preparing optimized packages that are transferred in phase 3.

The Offline Navigator server is realized with the script-language PHP/FI (version 2.0b12).

7. Offline Navigator client

The Offline Navigator client provides a graphical user interface which is easy to work with, since it is similar to other, common user interfaces. In order to be platform independent, we have chosen the programming language JAVA.

When starting the Offline Navigator client, it looks for a local index that contains the course list from the last session. Since this list contains the location of each course on the user's hard disk, the Offline Navigator is able to check whether the course components are still complete or whether single files have been deleted.

The Offline Navigator client then waits for receiving the course list after a connection to the server has been established. The retrieval of the course list does not require any interaction by the user since all parameters that are necessary for this are stored by the Offline Navigator client. Only those users who do not want to store their password are requested to enter it for the current session.

Due to the graphical user interface, the selection phase is easy to perform by mouseclick. In the download phase, the Offline Navigator client downloads the courses from the web server of the Virtual University. After starting this phase, no further interaction is needed by the user since the user's password is already known by the client.

At the moment, we do not implement the installation phase because this phase requires platform dependent tools, for example programs for compression/decompression of data. Since these programs are not yet available in a platform independent language like JAVA, we decided to wait until JAVA becomes a more wide spread language.

The Offline Navigator Client is currently being implemented using Microsoft Visual J++ 1.1.

8. Summary and outlook

In this paper we have proposed a solution for a problem concerning the students in online distant teaching environments in general and in the Virtual University in our special case. We described our new developed tool, the Offline Navigator, which reduces transmissions costs and simplifies the distribution of learning units. The Offline Navigator in its actual state minimizes costs but also the expense in navigation and selection for our students. In the next version it will not only be able to simplify that, but also to automate some other steps:

- Installation of plug-ins and other software downloaded in the last session (phase 4 in our model of communication phases).

- Presenting of information individualized for the student (dates, news, etc.).

In the future a further feature will use the database described in section 5. This will be a system to protect the copyright of documents distributed by the Virtual University. These documents will be fingerprinted in relation to the student who requests them.

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