HIPPOCRATES : A Tool for Distance Education

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Abstract

In this paper we present a software tool for the realisation of the distance education service, that is the conduction of classes through the use of computers. The classes are directed towards personnel in various areas and aim at the retraining and update of the personnel in subjects of special interest in their line of work. The conduction of classes takes place, from and towards, remote regions with the aid of a computer network. Hippocrates is a flexible and easy-to-use application, which permits students, who sit in front of remotely situated workstations, to attend classes or seminars given by a teacher or expert, who can also be located in some remote geographical area. Hippocrates can be thought of as a distributed transparency projector. The teacher can project transparencies on the screens of the students' workstations and can emphasize or indicate regions of interest on them by using the graphical tools offered by Hippocrates. Immediate results of the use of Hippocrates are the fast updating of the personnel in remote areas and the upgrading of the quality of the services they offer.

1 Introduction

The need for education, training and retraining will increase substantially in Europe and the rest of the world in the coming years. The rapid pace of change of job profiles due to the introduction of technologies and industrial restructuring necessitate a re-thinking on the education and training system. The result, a new scheme based on the concept of life long learning as a replacement of the "once-in-a-life education" is emerging as the solution to meeting training needs. The only chance to tackle this issue, as it has been pointed by several committees (European Round Table, IRDAC, etc.), is by flexible and distance education methods exploiting properly the use of advanced technologies.

New technologies and telematics infrastructures for education and training will play an important role in coping with this challenge. They will make possible the access to education, training and re-training whenever and wherever required by the learners. They will contribute to the free movement of people and services, by providing the citizens, institutions and companies with a wider access to such essential services. They will help to open up the educational institutions and training centers in order to provide all citizens with new opportunities to access the required knowledge, advice and coaching, through advanced learning services. These trends towards globalisation of knowledge and the spread and scattered expertise in specialised fields can only be met by the use of systems enabling a potential universal access.

In Europe under the Delta Project, there are 23 on-going research projects, which have a 92.4 MECU total budget, and bring together 176 organisations (Network Operators, satellite providers, IT&T industries, and a large number of SME's and research centers) and strive to provide advanced technological solutions to a wide range of users. There are three principal themes around which work is centered:

- The flexible and distance education market and user needs
- Systems and technologies. Here we can identify four distinct areas of work:
  - Design and production of learning material
  - Training and information systems
  - Remote course delivery systems
  - Functional specifications and architectures
- Methodologies for delivery and training

The above described situation and actions have inspired and motivated the research effort which resulted in the design and implementation of Hippocrates. This effort has been sponsored by the EUROFORM research and development programme. In this program take part industries and academic institutions which concern themselves with informatics as well as organisations that are involved in the provision of services in the Health Care area. Hippocrates aims at the use of telematics for the conduction of classes over computer networks and can be classified as a remote course delivery system.

Hippocrates offers a number of advantages which can be summarised in the following points:

1. Small demands on the bandwidth of the underlying network. This is achieved by the method used for the transmission of the lessons' material and by the small size of messages that are exchanged by the connected systems.
2. Ease of use. Hippocrates has a user friendly interface that hides from the user most of the low level details that are needed for the interconnection of the various computer systems over the network.
3. Provision of interesting lessons. This is also achieved by the user interface which can display bit mapped images (currently using the GIF format) and offers a variety of tools that can be used to enhance these images with remarks and drawings, thus making the lesson material interesting and attractive.
4. Modular design. This permits the adaptation of Hippocrates, with relatively small effort, so as to use the more advanced facilities of the broadband networks, when they will be widely realised.

As it can be understood, Hippocrates is a software tool that can be put into immediate use over the existing networks, and can greatly aid the implementation and realisation of the distance education service. This use can offer a number of advantages to the persons that will attend the classes, among which are the following:

- The trainees do not suffer from lost productive time, since they have the flexibility to attend the lessons in more negotiable time periods, even outside their work hours.
- With the creation of friendly lessons, we can instigate the interest of the trainees for the classes, thus making the training process a more efficient one.
- There is a flexibility in the modification and updating of the lesson's material so as to include new methods and technologies.
- The use of Telematics for distance education solves the problem that is created by the limited number of expert trainers and reduces the cost of the education process.
- Last but not least, there is a second stage advantage that stems from the use of distance education; the upgrading of the offered services since the personnel is up to date with the current innovations and advances.

In the following sections, we will describe the architecture and the services that are offered by Hippocrates.

2 Description

2.1 Architecture

The components that comprise the system are:

- The workstation on which a copy of Hippocrates is installed. The application can be executed locally and independently or it can cooperate with other copies of it that can reside in other stations.
- The computer network whose facilities are used for the communication with the remote workstations.

Hippocrates has been developed under the UNIX operating system and its user interface has been built on the X Window system with the use of the facilities offered by the OSF/Motif, Xtoolkit and Xlib. It has been installed and successfully tested on a variety of SUN SPARCstations with different memory and processing power characteristics.

2.2 Communication layer

The implementation of the mechanism that manages the network connections that are needed for the realisation of the distance education service, is based on the *TCP/IP* protocol suite and makes use of the *client-server* model. The various workstations communicate with each other with the use of the socket mechanism, in connection-oriented mode of operation, and well-known ports. Also, in order to take advantage of the multitasking capability of the UNIX operating system, the network connection mechanism has been implemented as three separate processes that run in parallel. This solution has been chosen because of the nature of Hippocrates, which demands concurrent communication (transmission-reception of messages) and management of the graphical user interface.

The data that are communicated between remote systems are constructed as packets that have a special format. Each packet is a string of a prespecified format and is divided in four

fields. The fields are delimited with the special character $. The form of the packet is the following:

User Name$*Network Address*$*Message*$*Control Character*

The contents of the fields are:

- *User Name*. Contains the name of the user that uses Hippocrates
- *Network Address*. Contains the network address of the host on which Hippocrates is currently executed.
- *Message*. Contains the subject of the lesson or a simple text message.
- *Control Character*. Contains a capital letter that is used for the identification of the packet's kind.

2.3 Functional overview of the services offered by Hippocrates

The basic aim of this software application is to implement the distance education service by providing a flexible and effective tool for the conduction of classes. Thus, its most important aspect are the services it can offer to its user so as to help him teach or attend a lesson.

These services accomplish the following tasks:

1. Creation of a lesson.
2. Transmission of a lesson's material.
3. Teaching a lesson.
4. Attending a lesson.
5. Reviewing an already conducted lesson.
6. Updating the users' addresses database.

The above mentioned services are available through a graphical user interface. Its design and implementation were guided by the need for simplicity and functionality. It should be simple, so as to be possible for the user, especially the teacher, to learn how to use it quickly. Also since Hippocrates is a network application, a lot of perplexing details should be hidden from the user. A high degree of functionality was also dictated by the need for a high level of interaction during the teaching session.

For the implementation of the user interface the X Window system and the OSF/Motif toolkit were used. For the interaction with the network handling processes, the routines offered by the Xtoolkit were used, while for the implementation of the graphical tools those of the Xlib.

It is neccessary to define, at this point, the meaning of the term *lesson*. By this term we mean a set that has two members; the lesson's material and the participants.

Hippocrates can be thought of as a distributed transparency projector. The teacher can project transparencies on the screens of the students' workstations and can lecture on them through the use of a suitable voice network (different from the data network used by

Hippocrates). He can also emphasise or indicate regions of interest on them by using the facilities offered by the application. Thus the lesson's material is a set of files that contain the bit-mapped images that will serve as the transparencies. The participants are the free form names of users, which have been registered for the course and which are translated in network addresses by the system.

2.3.1 Creation of a lesson

This task is the basic step in the process of delivering a lesson. As described above, a lesson is composed by two sets; the lesson's material and the participants of the lesson. The mechanism of this task creates the association between these two sets, that is necessary in order to build a lesson. It consists of the following steps:

1. Selecting the filenames that contain the bit-mapped images.
2. Selecting the participants
3. Saving the information for future use.

The first step can be accomplished by the user with the aid of a "File Selection" window. This window permits the user to browse the contents of the various directories of the hard disk. The desired files can be selected by clicking the mouse pointer on their names. The third step can be accomplished in almost the same way as above. The user can select multiple students from a list that contains their free form names by again using the mouse pointer. Both the selection of the appropriate files and the selection of the participants can be altered at any time before the user saves the lesson. The selected filenames and free form names appear in two lists. A simple click of the mouse pointer on any of the list items will cause its deselection and it will not be saved along with the other ones when the user saves the lesson. Now the two thirds of the lesson creation process have been accomplished. The last action to be taken is the saving of the lesson for future use. The user simply clicks on the "Save" button and supplies the name under which he wishes to save the lesson.

Besides creating a lesson, the user can also edit an already created one. The process is the same as in creating a new lesson. Thus it is very easy to update a lesson's material or use that material with a different set of participants.

2.3.2 Transmission of a lesson

This is the second step in the process of conducting a teaching session. In order to minimize the delay time during the real time communication, it is neccessary to deliver the lesson's material to the participants ahead of the actual teaching session. This also allows the user to take corrective action in the case of unsuccessful transmission to a participant. This failure can be caused by network problems or by problems due to a malfunction of the remote workstation and will be reported to the user by Hippocrates. This, in advance of the actual session, transmission, enables the achievement of higher performance of the system during the conduction of a lesson. This is due to the fact that the size of the messages, needed for the control and co-ordination of the lesson's flow, that are exchanged between the connected systems in real time, is small, thus achieving better response times. Transmitting a lesson has two steps:

1. Selecting an already created lesson
2. Sending it over the network

The system, because of the way a lesson is created, finds automatically the addresses of the participants and sends the files to their systems. At this time the user can send to the participants the subject of the lesson, as well as the time and date on which it will take place. By pressing the appropriate button the user will cause the appearance of a form in which the following information can be entered:

- Name of the lesson to send
- Date and time of the lesson
- Name of the teacher
- A brief description of the lesson's subject

As soon as the user clicks the button that starts the transmission of the lesson's material a window will appear which will help him to monitor the state of the connections with the students' stations. Thus, if one or more stations are unreachable, the expert will know and will repeat the transmission of the lesson's material towards them.

2.3.3 Teaching a lesson

Now we come to the task that, together with the one that will be described below, actually realises the distance education service. It consists of the following steps:

1. Initiating the connection with the participants.
2. Projecting the transparencies.
3. Putting emphasis points or comments on them
4. Terminating the session.

As it can be seen the conduction of a teaching session is a very simple process. On the agreed time and date the teacher can teach a lesson, from his station towards the remote stations, by simply pressing the "Teach Lesson" button of the main window. A box will appear that will ask him for the name of the lesson he wishes to teach. He simply enters the appropriate lesson name and initiates the teaching session by asking the system to initiate the needed network connections.

The teacher will be presented with the "Lesson Window" which contains the following:

- A "Students" List. From this list he can see how many students attend the lesson, since it contains their names and their connection status.
- A drawing area. In this area appear the transparencies that constitute the lesson's material

- A series of thumb nails. Each of these thumb nails contains a miniature image of a corresponding transparency. When the teacher wants to project a transparency on his pupils screens, all he has to do is to click the thumb nail that contains its miniaturized image. Immediately the network mechanism will send a "load" message to its peers. Upon reception of this message the desired transparency will be displayed on the participants screens.

- Six buttons. He can either write text, free-draw or bound an area on the transparency by, correspondingly, pressing the "Text", "Draw" or "Area" button. Thus he can underline, circle and in general emphasize an area of the transparency, or he can add a comment to it. All the emphasizing or the commenting he adds, are automatically added to the copies of the transparency that the students are viewing. The cursor changes shape, so as to echo the choice of the emphasis adding tool. Thus, it becomes a pencil for adding text, an upper left and then a lower right corner for empasizing an area and a paint brush for free drawing. He can also display an empty transparency by pressing the Clear button. He can choose the transparency he wants to display in random order, thus being able to reiterate through portions of the lesson for the benefit of the students. There is also a "Redraw" button which when pressed quicly redraws the contents of the drawing area whenever this is needed. Finally the "Terminate" button is used at the end of the session to signal to the students' workstations that the lesson is over.

2.3.4 Attending a lesson

This task is even simpler than the one described above. All a user has to do in order to attend a lesson is to acknowledge the request that is made by the teacher's system. From then on everything is automatically performed for him. Every transparency that the teacher projects is displayed on his screen. The only interactive action the student can take is to enter the lesson or exit it at any time during its conduction, in the same manner that he could do it if the lesson was taking place in an amphitheatre.

2.3.5 Reviewing a lesson

Since the lesson's material has been transmitted to and resides permanently at the workstation of each participant, it can be reviewed at a later time. The user just has to select it and then he can project on his screen the various transparencies that compose the lesson's material. Thus, even if he was not able to participate when the teaching session took place, he can review this information for his benefit.

2.3.6 Updating the users addresses database

As it was described before, when a user creates a lesson, he has to select the names of the remote users that will participate in the lesson. These names can be selected from a database that is maintained by the system. Each entry in the database consists of two attributes; the remote user's free form name and the user's network address. The user can perform the following operations:

- Insert a new entry.

- Delete an old entry.

- Update an existing entry.

Once a remote user's name and network address have been inserted in the database it is possible to select him as a participant to a lesson by using his free form name. Then the system, at the time of connection, will automatically retrieve the corresponding network address and issue to it a connect request.

3 Conclusions and future work

Hippocrates is a software application that can implement the distance education service over computer networks, bridging the gap that create the geographical distances that separate the students from the teachers. Because of its design, makes small demands on network traffic, and as a result achieves high performance during the real time communication. Its user interface is attractive and easy to use and does not drive the user away from it. The transparencies are bit mapped images, offering flexibility and contributing towards the creation of interesting and impressive teaching material. For these reasons, we believe that Hippocrates is a usefull tool that will aid attempts to provide education and training to people residing in remote geographical distances.

For the future, our efforts will be directed towards the adaptation of Hippocrates, so as to perform its services over IBC environments. Broadband networks' services will enable us to offer live video images and sound, during the teaching of a lesson. This will increase the interactiveness of the lesson making the contact between the students and the teacher more direct.

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