

An E-Learning Environment for Nontraditional Students with Sight Disabilities

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Abstract - ICTs and e-learning technologies have been exploited thoroughly, in an effort to improve the education procedures and techniques and ensure that nontraditional students (disabled students, distance students and sensitive social groups), gain equal access to information, knowledge, education and employment. This paper presents a multi-purpose e-environment for educative and informative services in the domain of engineering education for students with visual impairments. This e-environment can be used for actions that support online e-classes as well as e-activities that belong within the domains of lifelong training and distance learning. It was built aiming at smoothing the handicaps of the visually impaired students, enhancing their skills and covering both their special personal and communicative needs, mainly by redirecting the information through other sensory routes. Special "Assistive Technology" was used and the principles of "Design for All" and "Universal Accessibility" were followed, in order to produce a user-friendly and easily navigable environment for this nontraditional group of students in engineering education.

Index Terms – Assistive technology, Audio navigation, Design for all, Visual impairments.

INTRODUCTION

The promotion of accessibility to Web content by disabled individuals is a primary goal of web designers nowadays. Bearing in mind that "the access to information is the most undeniable right of all people", (Goggin,1982) it becomes clear that the adjustment of ICT services and Internet content to the needs of disabled people and special target groups in general, is essential and long overdue [1].

Strong international activity has been taking place, concerning the adjustment of the Internet to the special needs of the disabled people, through the use of special technological applications in the already existing communication mediums, with very important results and contributions. Numerous organizations and companies have been active in the area of preserving the rights of disabled people and have come up with gadgets that adjust the existing technological mediums to their needs. Web content can be available to all users and information can be found faster regardless of the user agent that they are using and regardless of their disability [2]-[4].

Various methods contribute to the improvement of web content accessibility by various target groups of people such as people who have reading difficulties, people with cognitive and learning disabilities as well as deaf people and people with mobility problems. Some of these methods include icons and videos depicting a person translating the text into the Sign language, Enhancing Internet Access (E.I.A), Multi Web Internet Browsers, Media Access Generators (MAGpie), Sensus Internet Browsers, TTY-text phones, hearing aids, image phones C.A.N. (for the deaf), Special Keyboards, Joysticks, Mouthsticks and Sensors for those with mobility disabilities [5]. All the aforementioned supportive technological equipment (assistive technology) stems from the continuous effort to conciliate the disabled in general, with ICTs in order for them to become equal members of the information society [6]-[8].

For the case of visually impaired individuals, there are a number of ways to tackle their disability. The most important ones are the auditory description of visual-multimedia information, which benefits the blind individuals, whereas for those individuals with sight disabilities there is the solution of the graphics enlargement with the use of special software.

This paper presents a multi-purpose e-environment that was developed and designed within the National Framework for disabled individuals for the informing and education of blind and visually impaired individuals, their trainers and their families in the engineering education domain, [9]-[10]. This e-environment is multi-purpose due to the fact that it provides the following three possibilities to the special group of people it is addressed to. Firstly, it incorporates technologies that cover the communicative needs and handicaps of the visually impaired students. Moreover, it provides the opportunity to the users to make use of alternative sensory routes such as hearing and touch for easier navigation and finally, it provides the opportunity for this special target group to access web content that will inform them and in the long run ensure their equal access to information, knowledge, education and employment. The life-long training-education of the trainer was considered a very crucial part of the project as it indirectly upgrades the education quality of the visually impaired [11].

The main principle on which such supportive environments are based, is the knowledge and understanding of the handicaps of this sensitive target group from the psychology point of view. It is absolutely essential to take into account

this information in order to be able not only to smooth these handicaps, but also to enhance their other skills and finally, cover in full both their special personal and communicative needs [12]-[13].

ABSTRACT LEVEL DESCRIPTION

Psychology studies state that individuals with visual impairments have their other senses upgraded, (touch and hearing), which in a way replace and fill in for the lack of or low eyesight. Unfortunately though, the use of one of the aforementioned senses alone is not adequate enough. It is of the utmost importance that the visually impaired use a combination of alternative sensory routes for better results. Hence, it becomes obvious that the multi-purpose e-environment must provide such possibilities to the user. There were three main units that were taken into account when designing this informative and educational system. The multi-purpose e-environment interface, the multi-subject database and finally the specially designed user interface and the technologies that needed to be incorporated in the system in order to achieve the main aim: the easy access and navigation of visually impaired to web content.

I. The Multi-Purpose E-Environment Interface

The multi-purpose e-environment interface, which is the first of the kind in Greece, contains technological and general information regarding the blind and visually impaired and is based on the multiple access interfaces, fulfilling the basic principles of "Design for All" and "Universal Accessibility".

Particular emphasis was given to the special access interfaces, which include audio navigation and the possibility of enlarging the text, in order to make it user friendly and easily navigable. The aim was to ease the integration of the visually impaired to ICT and hence to information, knowledge, education and employment. In addition, another important factor that was taken into account was the distance training of the disabilities specialists-trainers, as the upgrade of the specialists' knowledge has indirect effect on the upgrade of the training of the visually impaired.

The Hellenic organization for the Greek blind individuals namely 'Faros for the Blind' ('Beacon for the Blind') participated actively during the design process of the special access interfaces, providing useful guidance on how the access interfaces should be designed in order to achieve maximum benefits for the blind and visually impaired individuals.

According to the research that has been undertaken by the projects' consortium and especially by the Hellenic organization for the deaf 'Faros', there is no other competitive product that incorporates multiple ways of supported navigation to e-content, in the Greek market.

II. The Multi-Subject Database

A multi-subject database was created to be used by the trainers of the visually impaired individuals, aiming at the scientific evaluation of the quality of the services that are provided to this special group of people. This database constitutes a source

of information as well as a database for the trainers of a disability centre, which refers to the history and the progress of the special education of the visually impaired individuals. In particular, all the information that regards visually impaired people is inserted into the database. In addition, the therapeutic and educational work of the employees of the centre is inserted into the database as well as the corresponding profile of the served population. The aim of this database was to upgrade the trainers' work in favour of the visually impaired individuals.

III. Special User Interface and Assistive Technology

Special "Assistive Technology" was incorporated within the system to support, assist and enhance the Internet access and navigation of visually impaired individuals.

Since visual access interfaces are of no use to blind people and are problematic for those with sight disabilities, the need to create other special access interfaces arose, which would support the information flow through alternative sensory routes such as hearing and touch.

In the area of Web Accessibility, common software-based assistive technologies include screen readers, which is a software program that reads the content of the screen aloud to a blind user. Screen readers can usually only read text that is printed, not painted, to the screen. Moreover, screen magnifiers are used, which is a software program that magnifies a portion of the screen, so that it can be more easily viewed by individuals with low vision and finally, speech synthesizers, and voice/audio input software that operate in conjunction with graphical desktop browsers. Hardware assistive technologies include alternative keyboards, pointing devices and finally, Braille displays, which achieve the display of a large percentage of what is displayed on the screen and are refreshed very often as the user moves on the screen.

More particularly, Real Audio was used for the generation of audio messages, while for the incorporation of these messages within a web page, a special Real Player plug-in was used. In addition, the Macromedia Flash 5 Player is responsible for the enlargement of the graphics, while finally, JavaScript was used for the activation of certain keys on the keyboard that support and ease the navigation of the visually impaired user.

SYSTEM ANALYSIS

This section presents the actual e-environment, its special access interfaces and its various services. This e-environment can be found at the following URL: <http://imm.demokritos.gr/amei/>

The e-environments' entrance page guides the user as to the special tools that the user will need in order to use the environments' services. These are the Macromedia Flash Player and the Real Player [14], which can be downloaded for free from the correspondent links. After this task, the user may enter the main interface of the environment (Fig.1).

Multi-Purpose E-Environment for People With Sight Disabilities



FIGURE 1
ENTRANCE OF THE MULTI-PURPOSE E-ENVIRONMENT

Once the user has entered the main interface (Fig.2), an audio message can be heard and a moving image can be seen. This confirms the correct installation of the aforementioned Macromedia Flash Player and Real Player tools.

The main interface includes the e-environments' access interfaces. By choosing one of the four interfaces, namely, Interface for Audio Navigation, Interface for Common Citizens, Graphics Enlargement Interface and Interface for Braille Terminal or Screen Reader, the corresponding interface will appear. For the visually impaired individual there is an audio message that welcomes and instigates the user to press one of the 1,2,3,4 keys in order to be navigated to one of the four aforementioned interfaces:



FIGURE 2
THE MAIN INTERFACE OF THE MULTI-PURPOSE E-ENVIRONMENT

I. Interface for Audio Navigation

Here, the visually impaired individual is navigated through audio messages (Real Audio) to audio information only. This means that the installation of the Real Player tool is essential for the navigation of the visually impaired user. The navigation through the pages is realized by pressing the keys according to the instigation of the corresponding audio message. The keys that are used are "enter" to return to the main interface, "space" for returning to previous pages and the

numerical ones "1-9" for the navigation through the pages (Fig.3). Once the interface is loaded, an audio welcome and navigation message is heard, for the visually impaired individual. The activation of the keys was realized with JavaScript, while the audio navigation was realized with the generation of real audio messages and their incorporation in a page through the special Real Player plug-in.

The thematic units are exactly the same as the ones in the common interface, which will be described next, except for the multimedia ones (video, video on demand, video conference and music links) for the obvious reason that they cannot be used by the visually impaired user. The only multimedia unit that is present here is the audio books.

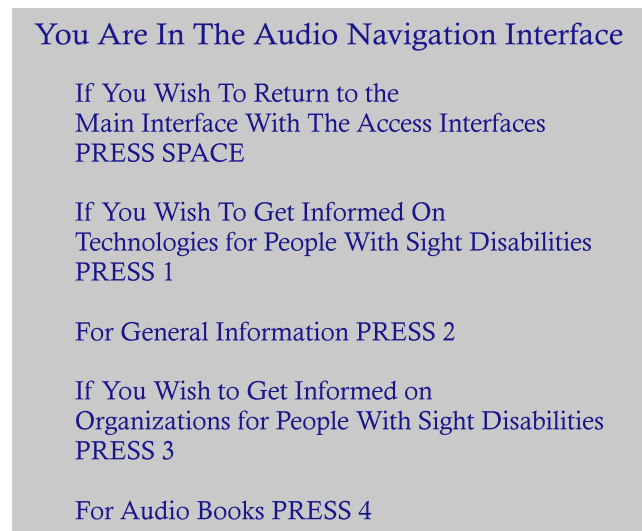


FIGURE 3
THE AUDIO NAVIGATION INTERFACE

II. Interface for Common Citizens

In this interface, the non-disabled interested users may navigate through the information of the e-environment through columns of links as happens in a normal web portal. In particular, this interface is mainly addressed to the trainers as well as the family members of the visually impaired users.

This page (Fig.4) consists of four units namely, Technology, Information, Organizations and Multimedia. The unit "Technology" contains information about technological supportive tools for individuals with visual and mobility impairments. Each of the four links namely "Braille Terminals", "Supportive Tools", "Screen Readers" and "Special Browsers" loads a page containing a list of links of the most important technological supportive tools available, mainly in Greece.

The unit "Information" contains information that interests disabled people. There are four links namely "Bibliography", "Magazines", "Greek and Foreign Links" and "Medical Guide", which load pages containing books on disabled people according to the disability, magazines and links to Hellenic

libraries where these magazines can be found, hyperlinks of the most important Hellenic and foreign web sites that engage in disabilities issues and finally information about injuries and causes of child eyesight loss.

The unit “Organizations” contains information about all the institutions and organizations related with disabilities in Greece and especially those which were implicated in this project.

Finally, the unit “Multimedia” contains educational and recreational material for both the disabled people as well as their trainers. More analytically there are six links, which perform the following tasks:

The link “Video” opens a page which contains various digital videos of educational activities taking place at disability centers according to the thematic of the activity as well as links to these videos.

The link “Video on Demand” opens a page with the Video on Demand service using the IP-TV Viewer 3.0 and the links to the corresponding videos.

The link “Audio Books” opens a page containing ten excerpts from Audio books provided by the Pan-Hellenic Blind Association that are available in Real Audio.

The link “Music Links” opens a page containing Hellenic and foreign links to radio stations on the Internet and also to music web sites.

The link “Tele-Conference” opens a page which provides the necessary guidelines and the necessary links for the attainment of tele-conference.

Finally, the link “Database” opens a page with the database for the trainers, which was created in the framework of this project.

on the Internet, the user may enlarge both the graphics and the text [15]. The enlargement process, which is given sonically by navigating the user to the corresponding interface, is realized by right clicking the mouse and choosing zoom in. For further enlargement one chooses zoom in again, while for returning to the initial font size the user chooses zoom out. This interface’s possibility is due to the special design of the web pages using the Macromedia Flash 5 tool.

Finally, this interface offers almost all the information of the common interface except for some multimedia applications, which could not be used by severe cases of visually impaired individuals, such as video on demand and videoconference.

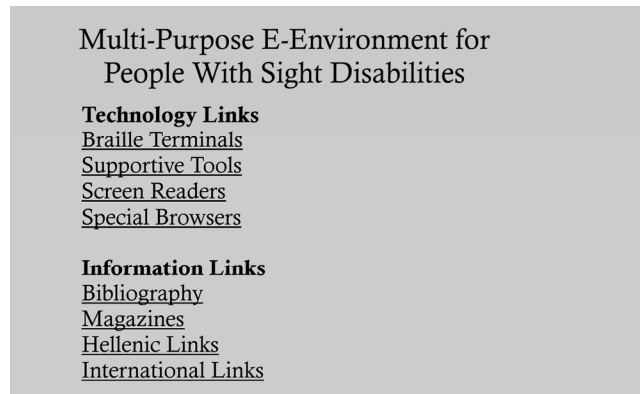


FIGURE 5
THE BRAILLE TERMINAL OR SCREEN READER
TEXT-BASED INTERFACE

IV. Interface for Braille Terminal or Screen Reader

Here, the information that the user finds is the Common and Graphic Enlargement Interfaces is in plain text format with a large font in order to be able to easily use either a Braille Keyboard or a Screen Reader (Fig 5). This is because the graphics impede the use of the aforementioned tools and hence, it is essential to have a simple environment. In addition, this interface contains all the information of the Common Interface and has been designed in such a way, in order to collaborate with a Hellenic Screen Reader and a Braille Terminal, which serve the educational needs of the visually impaired by accessing the network environment.

Summing up, the audio navigation interface includes pages with audio messages, which also appear in text format in the case where a Screen Reader exists. The common interface and the graphics enlargement interface have the normal structure of a web portal. The Braille or Screen Reader collaboration interface is a page with grouping links with large characters.

PILOT IMPLEMENTATION

The electronic environment including the web interface was used during a pilot period of three months, to great and unanimous acclaim. It was distinguished among disabled user



FIGURE 4
INTERFACE FOR COMMON CITIZENS

III. Graphics Enlargement Interface

In this interface the structure is exactly the same as in the common interface, except that through the installation of a special Flash Player plugin, which is provided free of charge

communities during a National Conference as a unique concept project, which served visually impaired people equal access to Information, Knowledge, Education and Employment for the first time in the ICT Greek Framework for disabled individuals.

The experiences and reviews of the visually impaired users and the evaluators for this system were positive and the overall reaction was that the users were left satisfied with the result. The reason for this according to them was the number of different access methods that were provided. For instance, those users who had a voice synthesizer installed on their computer had access to friendly information, while those who didn't, had the possibility of using audio navigation in order to navigate through the system.

CONCLUSIONS

There is no doubt that nowadays, the Internet constitutes an inexhaustible source of information for the majority of people. The question that arises is whether this point also applies for the disabled population. The answer is that this can become a global reality provided that the appropriate actions are taken. Fortunately, there is a whole range of possibilities available, to adapt technology to the needs of disabled individuals. Thus, the technological evolution combined with collective and determined efforts may provide the disabled society with the opportunity to participate actively in the Information and Communication society and its multiple services. The computer in general, can give a disabled person and in particular a visually impaired person opportunities that are not feasible without it. With the presence and aid of a computer, communication is possible even with a disability.

Hence, the communication of the visually impaired people with the global Internet community and other disabled Internet users becomes feasible, rendering their disability 'invisible' at least for a while. This way, their equal access to information, knowledge, education and work as well as their participation in social activities, is ensured.

However, it is necessary to mention that the Internet is merely a tool which can only reduce but under no circumstances eliminate the problems and this is the context in which it should be used.

What was aimed in this project was the development of a special informative and educational system on the Internet that is adjusted to the needs of a visually impaired individual as well as the needs of the specialist-trainer. The simplification of the issues that surround universal ICT access was essential, so that the disability of a user is never seen as a barrier. The need to integrate the visually impaired people in the main stream of life is indispensable. Proceeding matters under the context and the belief that disabled people are not really disabled but "differentially able", this project steadily started becoming a new reality.

Disabled people possess talents, which others do not and only have to be exploited in order to surface. The difficulties and parameters that had to be taken into account were

numerous and complex. There was the need to fully understand the handicaps and disabilities of this special group of people as well as the choice of the most appropriate and suitable technologies for them. The integration of the visually impaired people into the society as full and equal members through ICT requires time and effort, which in return will yield the security and satisfaction that the disabled people are no longer considered second class citizens of our world.

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