Abstract – The main objective of e-learning is providing instruction and education to all kind of learners independently of their different places, different cultures or of different abilities. With this vision, e-learning should be barrierless and accessible for all. Furthermore, W3C’s Web Accessibility Initiative (WAI) has developed a series of guidelines which will help to ensure that Web resources can be accessed by people with disabilities. However, the accessibility of e-learning provides additional challenges that may not be faced when providing access to other Web resources. In this context, the aim of our project is to develop accessible E-Learning curriculum for basic training in Computer and Internet dedicated to disabled and students with special needs.

INTRODUCTION

With the growth of Internet and the spread of new technologies of information and communication, we have to respond to a huge demand of new educational approaches and tools. One response is the Web-based education or e-learning. This new way of teaching is getting an increasing popularity due to its numerous benefits: it permits to gain the potentials of immediacy, relevance, interactivity, authenticity, etc.

Furthermore, believing that persons with disabilities and special needs should have the same access to ICT as everyone else, accessibility of disabled persons to ICT gains a specific attention in the
Accessibility to ICT not only permits to persons with disabilities to master and use these new technologies, but also increases their skills and competencies, and therefore, opportunities of employment.

In this context, the Research Unit of Technologies of Information and Communication (UTIC) of the Higher School of Sciences and Techniques of Tunis (UNEVOC Center – Tunisia) supports and contributes to these efforts by launching several research projects in order to design tools and dedicated environments. Two main projects are already kicked-off:

1. Create a barrier-free learning environment for students with disabilities: our aim is to transcend physical disabilities and physical distance with distance learning technology. Our project consists in developing dedicated tools in order to give handicapped users the opportunity to access education using Internet and new technologies just like any other students. We focused in first works on visual impairment.

2. Develop tools for person with problems of deaf/hard-of-hearing to facilitate web access. This tool uses virtual person and XML based technology to translate automatically written text to the language of signs.

In this context, the Research Unit UTIC of the Higher School of Sciences and Techniques of Tunis in collaboration with Virtual University of Tunis has set up a new certification on Internet and Informatics called “C2i”. The objective of this certification is to give students a basic training in computer and Internet.

This experience has started in the Higher School of Sciences and Technologies of Tunis in September 2007 by offering to all TVET students independently of their discipline, a basic training in informatics to ensure that every student has a minimum set of competencies in using the computer and the Internet. The curriculum is constituted by six courses; Word, Excel, Operating System, Collaborative Work, Initiation to Internet and ICT stakes.

Despite the important effort to develop these courses, never attention has devoted to handicapped students. Consequently the principal aim of our project is to offer to TVET students (and even others students) with different disabilities accessible versions of the courses listed above.

The object of our project is the development of an accessible e-learning version of “C2i” dedicated to disabled and students with special needs.

To reach our objectives we were based, work team composed of 9 members of the Research laboratory UTIC, on the WAI (Web Accessibility Initiative) guidelines developed by the World Wide Web Consortium.

The WAI gives a set of recommendations such as the Web Content Authoring Guidelines (WCAG) witch represent the field of our intervention.

To concretize these recommendations, we used the 92 Accessi-Web check points defined by “Braillenet Association” in French.

The application of these check points gives us accessible content witch can be classified on three levels of accessibility: The first one called “AAA”, the second one is “AA” and the last one is “A”.
**Assistive technology**

Assistive technology is any mean: hardware or software, used to increase, improve or maintain capabilities of disabled persons. It makes handicapped people able to execute tasks that are sometimes difficult or impossible to do without technical aid, and helps them achieve their scholar, professional and social integration.

Assistive technology includes many categories. We are mainly interested by assistive technology aimed to facilitate the use of a computer by a handicapped person. This technology can be composed by conception methodologies, input/output devices, and specific or adapted software that facilitates access to a computer.

It is possible to mention the following examples for the hardware and software categories:

- Input devices like Braille terminals and sensory keyboards are used by visually impaired users;
- Speech synthesis, speech recognition, screen enlargers, accessibility features offered by constructors such as the accessibility program of Microsoft.

**Web Accessibility Initiative**

The W3C Web Accessibility Initiative (WAI) has been established to raise awareness of universal access. WAI develops guidelines which can help to ensure that Web pages are widely accessible.

The WAI gives a set of recommendations including: the *Web Content Authoring Guidelines* WCAG, the *Authoring Tool Accessibility Guidelines* ATAG and the *User Agent Accessibility Guidelines*. The WCAG is intended for web authors, while the ATAG and UAAG are intended for software development communities. WCAG 2.0 is not organized around checkpoints like WCAG 1.0 but around four design *principles* of Web accessibility. Each principle has *guidelines*, and each guideline has success criteria at level A, AA, or AAA.

**The Web Content Accessibility Guidelines (WCAG)**

Web Content Accessibility Guidelines (WCAG) 2.0 defines how to make Web content more accessible to people with disabilities. Accessibility involves a wide range of disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities.

At the top are four principles that provide the foundation for Web accessibility: *perceivable, operable, understandable, and robust* (W3C, 2007).

In order for a Web page to conform to WCAG 2.0, all of the following conformance requirements must be satisfied:

- **Level A**: For Level A conformance (the minimum level of conformance), the Web page satisfies all the Level A Success Criteria, or a conforming alternate version is provided.
- **Level AA**: For Level AA conformance, the Web page satisfies all the Level A and Level AA Success Criteria, or a Level AA conforming alternate version is provided.
- **Level AAA**: For Level AAA conformance, the Web page satisfies all the Level A,
Level AA and Level AAA Success Criteria, or a Level AAA conforming alternate version is provided.

The respect of these guidelines is mainly based on the following four principals:

- **Perceivable** - Information and user interface components must be presentable to users in ways they can perceive
- **Operable** - User interface components and navigation must be operable
- **Understandable** - Information and the operation of user interface must be understandable
- **Robust** - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies

**The AccessiWeb Criteria’s**

The 92 criteria’s are based on the different WCAG recommendations listed above. These criteria’s are structured around 13 families of web elements which are: graphical elements, frames, links, tables, forms, multimedia, scripts, colors, accessible content, navigation help, information structure, requested elements and presentation of information.

All these criteria’s are applied one by one to the different pages in order to obtain a high level of accessibility for the different courses.

**Examples of barriers that people with blindness may encounter on the Web can include**

- images that do not have alternative text
- complex images (e.g., graphs or charts) that are not adequately described
- video that is not described in text or audio
- tables that do not make sense when read serially (in a cell-by-cell or "linearized" mode)
- frames that do not have "NOFRAME" alternatives, or that do not have meaningful names
- forms that cannot be tabbed through in a logical sequence or that are poorly labelled
- browsers and authoring tools that lack keyboard support for all commands
- browsers and authoring tools that do not use standard applications programmer interfaces for the operating system they are based in
- non-standard document formats that may be difficult for their screen reader to interpret

**Tests and validation**

We started recently experimentations of this new curriculum with two blind students who appreciated very well the facility of accessibility to the contents and who gave us some comments and suggestions that allowed us to improve more our contents.
The developed courses are totally accessible and are labelled “AAA” which represents the highest level of accessibility defined by the W3C.

Consequently, all disabled people like blind and low vision ones are enabling to access easily to these courses from anywhere and anytime. The tests are based on the use of a screen reader and Braille terminals.

**Examples**

![Fig 1: General structure of C2i Accessible courses](image)

This picture represents one of the six developed courses entitled « Enjeux de l’utilisation des TIC » which means “Embracing the use of ICT”. This page is conform to the highest level of accessibility and respects both WCAG and AccessiWeb criteria’s, respectively AAA and Gold. For example,

- All links are expressed explicitly which make blind student in comfort when navigating on this page.

- All the illustrative images are accompanied by short textual alternatives and by a long one if it is complex like the following example.
Fig 2: Complex image illustrated by a longdesc

- Images map are client-side used

![Complex Diagram](image)

Fig 3: Alphabets represented by map image

- The content is totally independent of presentation by using CSS technology.

- All the tables are explicitly described by caption and summary attributes in order to facilitate understanding of different lines.
The help and courses plans are present in all the pages.

A local search is integrated into the courses in order to facilitate information research.

Keyboards shortcuts (AccessKey) are programmed to accelerate navigation and replace the mouse which is very difficult to use if it is not impossible by impaired and low vision people.

Colors contrasts are strictly respected.
Zoom in and Zoom out are integrated in the pages of the courses to give low vision student the possibility the chose adapted policy sizes like illustrated in the following picture.

Fig 6: Zoom function on textual content

- Heading, lists and consistent structure are used to organize all the pages.
- Different alternatives are provided when scripts, applets and plug-ins are inaccessible or unsupported.

Conclusion and further work

The objective of our work is to contribute in making e-learning accessible for students with disabilities and special needs by developing a virtual curriculum on basic training in computer and Internet. The perspective of our projects is to make more experiences and validations with more disabled students before making it available on-line. Furthermore, besides this pedagogical work, the objective of our research work is to increase accessibility of e-learning environments for disabled persons. Our preliminary study focused on the proposition of a generic abstract meta-model that can be used to define specific models for different platforms and user configurations. Our approach is based mainly on the use of Model Driven Approach MDA. The advantages of the proposed MDA framework are the permanence of the specification models, the possibility to reuse existing models, and to use only the needed parts of the generic framework to generate specific content for a specific disability category and/or specific platforms / devices…etc.

AKNOWLEDGMENT

We would like to thank Dr. Imed Chaker and Mr. Lamjed Hamdi from The Tunisian Union of Blinds, Mr. Mohamed Fadhl from IPH and all the accessibility team of UTIC laboratory.

References


http://www.accessiweb.org

Research Unit UTIC www.esstt.rnu.tn/utic