Multimedia courses generator for deaf children

Oussama El Ghoul and Mohamed Jemni

Research Laboratory of Technologies of Information and Communication UTIC
Ecole Supérieure des Sciences et Techniques de Tunis,
5, Av. Taha Hussein, B.P. 56, Bab Mnara 1008, Tunis, TUNISIA
oussama.elghoul@utic.rnu.tn , Mohamed.jemni@fst.rnu.tn

ABSTRACT: *In this paper, we present an environment developed in the Research Laboratory of Technologies of Information and Communication [13] of the University of Tunis to aid deaf people in improving their social integration and communication capabilities. In fact, it is proved that sign language is not innate at deaf children and therefore it needs methodic and specific training. In this context, our environment is a specialized learning content management system (LCMS) that generates multimedia courses to teach and learn sign language. According to our survey we did not find an LCMS witch can help teachers to generate courses to person with hearing disability. Moreover our tool is original in case that the sign animation is generated automatically from a textual description. The generated courses can be used either by deaf pupils to learn (or e-learn) sign language or also by hearing people to be able to communicate with deaf people. This educational environment uses mainly a web-based interpreter of sign language developed in our research laboratory and called Websign [2, 6]. It is a tool that permits to interpret automatically written texts in visual-gestured-spatial language using avatar technology.*

Keywords: *Hearing impaired, sign language, LCMS, e-Learning.*

1. Introdution

Disabled persons face insurmountable difficulties when they want to deal with the new technologies: the use of a computer, the access to Internet, the edition and the impression of a text, the reading of a document can be extremely complex tasks in spite of their simplicity for another user.
In this context, this paper presents a new tool for creating multimedia courses dedicated to deaf pupils. The course is useful by deaf pupil, by parents of deaf children to learn sign language, and it can help any person who is in contact with deaf to learn sign language. This tool would enable people who do not know sign language to communicate with deaf individuals. Therefore, contribute in reducing the language barrier between deaf and hearing people.
This paper is organized as follow: after the motivation section, section 3 is devoted to present the deaf pupils education and some applications used to teach them. In section 4, we describe our objective and the general approach that we adopted to develop our tool. Finally, we give some perspectives and a conclusion.

2. MOTIVATION

According to many studies, deaf children have much trouble to read. Many of them still to have comprehension difficulties on reading into adulthood. Moreover, reading levels of hearing impaired is lower than the reading level of hearing student. In 1996, [9] have confirmed that their learning progress is extremely slow. In fact, the reading capability of the high-school graduate deaf is similar to the reading potential of 8 to 9 year old hearing child. Consequently, the gain of experience collected by deaf children in four years is equivalent to the gain of one year for hearing children [9].

Using ICT we can improve the classic pedagogical methods by new e-learning methods based on multi-media contents.

3. DEAF EDUCATION

In 2003, the World Federation of Deaf confirms that 80% of deaf people lack education or are undereducated, are illiterate or semi-literate [14]. Moreover Sign language is banned in many countries and programs. In fact, the most information contents are inaccessible to the deaf community. Furthermore, many efforts are deployed to ensure a minimum access to the information in written text or sign language like the real time translation of some TV programs in sign language (the news) or the subtitles, the development of guidelines for the deaf education

and the development of multimedia tools to teach sign language.

3.1. Programs for deaf and hard of hearing student guidelines

To guarantee best educational services to children who are deaf or hard of hearing, A program for deaf and hard of hearing student guidelines for quality standards is created by the California Department of education in 2000 [1].

These guidelines contain recommendations for parents, teachers, administrators, and governing boards to use in identifying, assessing, planning, and providing appropriate educational services to all children who are deaf or hard of hearing. They are also intended to assist in monitoring programs for these students.

3.2. French education system

In France, a specific education of deaf is organized in primary, secondary and vocational schools. In the Region of Paris, there are 5 specialized schools or institutions.

The parent has different possibilities to integrate his children to the public schools:

The deaf can have some classes with hearing students.

The deaf can also completely integrate classes and courses of hearing student. But, he should get an orthophony sessions and private courses.

This system of education does not lead easily the deaf student to the higher education. In fact 90% of them do not pass the third level. Moreover, in the region of Paris, only one high school takes deaf students up to “Baccalauréat” (the end of secondary studies).

3.3. New Technologies of Information and Communication and deaf education

Nowadays, introducing new technologies of information and communication in people with special needs education such as deaf peoples becomes a necessity. In fact, in schools we can use video, images and others multimedia technologies. In addition to this, deaf people must participate in all activities that any student can do and must be offered the same opportunity to access to these means of information using their own language: signs.

In fact multimedia can be highly useful for the deaf: every pupil can repeat watching sign as many times as required until he understand it or memorize it.

When creating an e-learning tool for deaf pupil it is very important to choose the most adequate representation of sign.

This representation should respond to many criteria: first, it should be easily understood and adopted by the deaf. Second, it should not require a big memory space, and finally, it must be easily adapted with computer technology.

3.4. Some existing tools for deaf education

3.4.1. Systems using SignWriting

SignWriting [12] is a system of transcription of the manual gestures and face expressions of sign languages (figure 1). It was developed in 1974 in order to allow deaf person (or who using sign language) to take notes in paper or notepad. The SignWriting system is a combination of symbols for hand configuration (hand shapes) body locations, contacts, movements and facial expression to describe motions in sign language (figure 2). It is used to write books, web sites and also to teach sign language. It uses the international movement writing alphabet (IMWA) which describes the all hand, body and face movement.

Figure1. SignWriting Web site

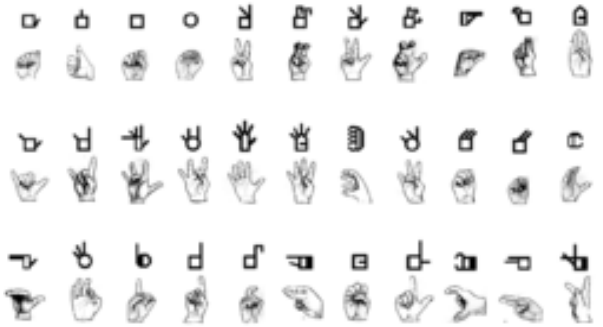

Figure2. Hand shape in SignWriting

3.4.2. LSF Lexique

LSF Lexique is a web site which offers to the deaf community a set of a video sequences representing a dictionary in French sign language. It is developed by 5 professional deaf from the national institute of young deaf of Metz in France. The website contains 1944 standards sign. It presents 3 search topics: by word, alphabetic order or hand shape.

3.4.3. Mathsigner

Mathsigner [11] is a system based on American Sign Language and 3D animation (figure 3). It

contains a sets of activities designed to teach math concepts, signs, and corresponding English terminology to deaf pupil, parents, and teachers. Mathsigner is developed using virtual reality technology. This technology offers many advantages over others technologies:

- The control of the appearance and the orientation of the avatar.
- Real time translation with no limits of combination of sign.
- Sentences can be linked together smoothly.
- No need to a large bandwidth like the video.
- The controls of sign can be easily applied to other characters.

According to our survey we have distinguished three different approaches used to create content for deaf and hard of hearing: transcription based approaches (SignWriting), video based approaches (LSF Lexique) and avatar based approaches (Mathsigner). Each approach is adapted to a particular context depending on the purpose of the system. Transcription is used generally in books, magazines or papers and it can be used in websites as shown on Figure 1. However, video is adapted to standalone applications and avatar is tailored to the web-based applications and real-time gesture generation (automatic translation to sign languages). Next table shows different advantages and limits of each approach.

Table 1. Different approaches used to create content for deaf.

	Advantages	Limits
Transcription based approaches	- Writable in paper format. - We can easily take notes on paper or notepad. - Allow automatic translation to sign languages.	- Hard to understand. - Hard to write. - Use a large number of symbols.
Video based approaches	- High quality of signs. - Fluidity of movements. - Appreciated by deaf (natural signs).	- Need a large bandwidth. - Do not allow automatic translation to sign languages.
Avatar based approaches	- Allow automatic translation to sign languages. - Small bandwidth allows the transmission of signs.	- Unnatural movement. - Medium quality.

4. OUR TOOL

4.1. Our objective

The objective of our project is to develop a web-based tool for creating courses for deaf pupils. Our aim is to distribute this tool on a non-profit basis to educators, students, users, and researchers, and to disseminate a call for contribution to support this project mainly in its exploitation step and to encourage its wide use by different communities.
In fact, the automatic translation from the written language to the sign language is a promising way that requires the mastering of several domains covering the field of the data processing, of linguistics, or mathematics. A sign language is a language which uses manual communication instead of sound to convey meaning - simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to fluidly express a speaker's thoughts. The sign language remained nevertheless a fully-fledged language, with its own constructional method of the sentences.

4.2. WebSign system

WebSign [7] is a Web application. It is based on the technology of avatar (animation in virtual world). The input of the system is a text in natural language (figure 4). The output is a real-time and on-line interpretation in sign language. This interpretation is constructed thanks to a dictionary of word and signs. The creation of this dictionary can be made in an incremental way by users who propose signs corresponding to words (figure 5). A word and its corresponding sign interpretation are added effectively to the dictionary only after its verification by an expert administering the system.

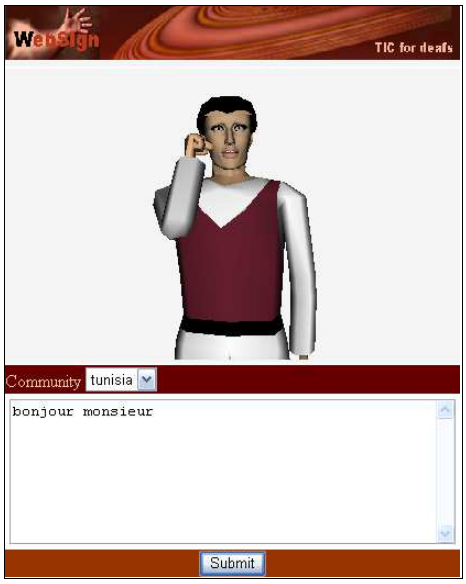

Figure 4. Real time interpretation

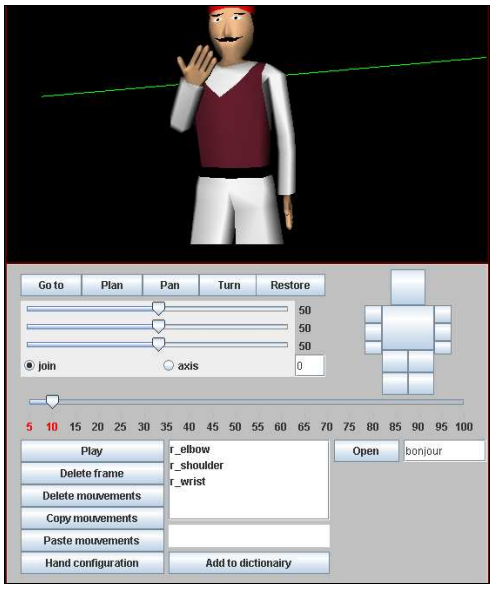

Figure 5. Interface for the construction of signs

However, contrary to popular belief, sign language is not universal. Wherever communities of deaf people exist, sign languages develop, but as with spoken languages, these vary from region to region. Hundreds of sign languages are in use around the world and are at the core of local Deaf cultures [10]. Some sign languages have obtained some form of legal recognition, while others have no status at all. For this reason, we introduced the concept of community.

4.2.1. Multi-community approach

To resolve the problem of the locality of sign language, we implemented the notion of community. A community is a group of users that can build and share a common dictionary of sign language. A dictionary can be created totally by a specific community or can be just an instance of an existent dictionary where some specific words are interpreted differently to respect the intrinsic specification of the concerned community.

Each community has an administrator, who has the responsibility of the management of his community's dictionary. He has the possibility to add, delete, or modify words of his dictionary. He should also modify and validate, delete, or validate the propositions of signs proposed by the members of the community.

4.2.2. Collaborative approach to add words in the dictionary

The collaborative approach to introduce words in the dictionary represents an originality of our work. Every user can participate in the insertion of words via the web (figure 5). The words introduced by the user will be stored as proposition which should be validated by the administrator, or modified before the insertion in the dictionary.

Using this approach our system assures a rapid construction of dictionary and a diversity proposition of signs to represent the same word. The diversity of signs is very important to choose the sign used by the bigger number of person in one region.

Websign proposes a friendly of use interface witch offer the possibility to create easily the sign. The user can rotate every join by the use of 3 slides, each slide of them represent the value of rotation of join around a specific axis using the Euler representation of angle.

The user can copy, paste, delete, add, or modify the movement. In addition he can do the symmetry of the rotation, clone the movement of one hand to animate the other (figure 5).

4.2.3. signs codification

To animate the avatar it's necessary to codify the gesture in a formal representation for this reason we have created a new language named SML, in which we can codify any movement which the avatar should play.

In SML, the sign is an animation of many joins, the animation is a successive movement of a group of joins, every movement have a fixed time, during which the rotation of every join of group is done.

Let's know that the armature description respect the H|Anim [4] specification, in which each join have a specific name and specific initial orientation.

4.3. The environment of creation of courses for deaf children

Using WebSign, we have developed a web tool specialized in creating course for deaf pupils. The course is a group of lessons, in which every lesson is a group of web page containing a variety of images and their correspondent description. Our web tool provides an avatar witch play the sign already translated by WebSign.

It is proved that the use of graphics is an efficient pedagogical method to acquire new vocabulary items. In fact, this method is still used in traditional education in ordinary schools and in pedagogic games for young children.

The association of images and their descriptions offer the advantages of clarity and simplicity of acquiring information for both the lesson author and the pupil. The author generates the course, he can add delete and modify lessons. The pupil has the possibility to navigate in courses web pages created by the author.

Many researches are done to confirm the advantages of the graphics or/and video, sign language animation, and text adjunction into one course. In 1999, Dowaliby and Lang examined the influence of combination of these three content. The result, confirms the immediate comprehension of content for student with low-reading-ability [3].

4.3.1. User interfaces

Our tool offers two interfaces, one for the teacher and the other for the deaf pupil. The teacher's interface is constituted mainly by a dedicated authoring tool to create, modify and delete lessons, edit links with different pages and visualize lessons. A lesson can integrate text, images and animations. Animations consist of interpretation of text in Sign Language. Those animations are created by Websign and integrated in the lesson page in order to interpret automatically texts in visual-gestural-spatial language by the use of avatar technology.

Figure 6. Lessons hierarchies.

Figure 7. course interface.

The student's interface offers the possibility to the deaf pupil to consult the text and related images and to see the corresponding interpretation in Sign Language. In fact, every lesson generated by our tool is represented by a certain number of pages, in every page there are a limited number of images with their descriptions in full letter. When the pupil clicks on an image (figure 6, figure 7), the avatar, which is in the left of the page, plays the associated sign. This action can be repeated as many times as the user need to understand or to memorize the description.

The student has the possibility to choose the mode of interpretation. In fact, it is possible to interpret the word by its sign language interpretation or by finger spelling. The finger spelling mode is accompanied by letters coloration and scale modification synchronized with the finger spelling animation done by the avatar.

Our application is designed for young deaf. The interfaces of this type of application should be very simplified. For this reason, all buttons and links are represented by images and animations related to their sign animation. This allows pupils to explore easily the lessons.

4.3.2. Online and offline course

The pupil can use the tool by two different modes: the online mode and the offline mode.

In the online mode, when the pupil clicks on the image, the web browser sends a request to Websign server (Figure 8), which sends him back the description of movement corresponding to the sign. The pupil can download the lessons and use it in an offline mode, which corresponds to web pages containing already the images, their description and the description of the movement corresponding to the sign. In such way no communication with Websign server is needed and by the way the pupil has no access to the update we can make on the Websign data base.

When the teacher creates the course, two copies are made. One, for an online mode, does not contain description of the movement which the avatar should play. The other copy is for the offline mode and contains all the description required in the lesson downloaded.

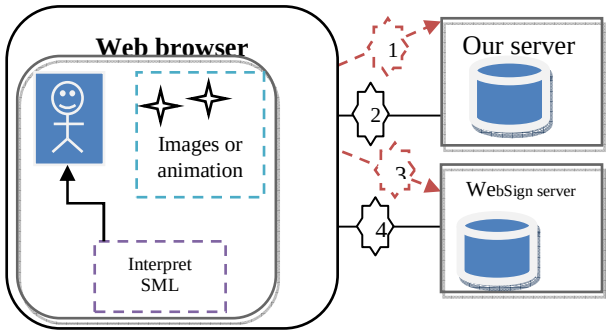

Figure 8. Getting animation on online mode

4.3.3. An interactive flash module

In order to ameliorate the interface of our tool we have implemented in a second step of the project an interactive interface developed with Adobe

flash. Every course is a separate flash application embedded into a main application. The communication between different modules is possible via the main application which contains and controls the virtual character. This architecture allows teachers to build separate modules embeddable to interactive courses.

We propose four modules to teach basics knowledge: world map, numbers, time and words. Each module interact in a different way with the learner in order simplify the representation of knowledge. To teach continent for example, it is more appropriate to draw the world map in which each continent is a clickable zone. The Time module offers to the child the possibility to rotate the clockwise in order to see the edited time in sign language. Below, the figure illustrates the main application interface.

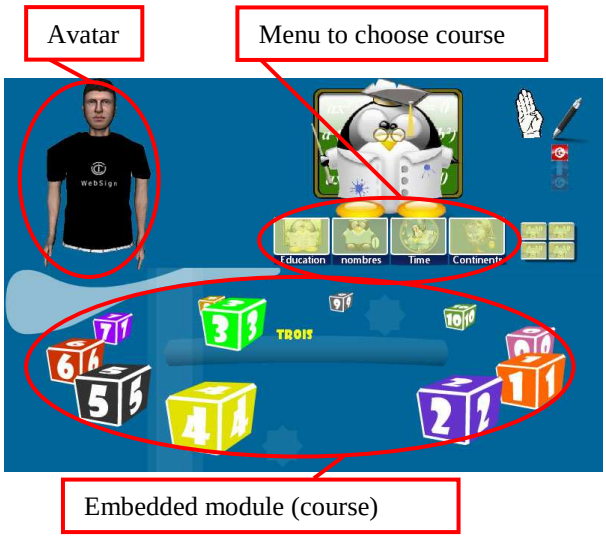

Figure 9. Interactive flash module.

4.3.4. Getting signs from Websign

In the common protocol, for every request made by the web browser, the result is downloaded in a new web page. Such protocol requires the downloading of the three dimension scene every time a request is made for getting a sign. In fact this alternative is time consuming and its loading in the principal memory is too slow to be used by the system.

So we opted to Ajax technology, when we need getting sign which is actually a description for animation of the avatar. The contribution of Ajax technology is the recuperation of result of an http request into a variable, which can be manipulated with a script like JavaScript or VBScript and decoded before being played by the avatar.

5. CONCLUSION AND PERSPECTIVES

We presented in this paper a tool that aims to enhance the education of deaf, hard-of-hearing and speech disabled individuals. The originality of this tool, in addition to be an open source, consists on two points: first it combines the advantages of different computer techniques and recent technologies; second it allows to the teacher to create his course without need to programming skill to animate the avatar.

A first version of the generator is finalized and completely functional. We plan to make it available very soon in the Web.

ACKNOWLEDGEMENT

This project was developed by the Research Laboratory of Technologies of Information and Communication and validated by the Tunisian sign language expert Mr Abdel Halim Chalbi.

REFERENCES

[1] California Department of education, “Programs for deaf and hard of hearing student guidelines for quality standards,” 2000.

[2] Chabeb Y., Elghoul O., and Jemni M., “WebSign: A Web-Based Interpreter of Sign Language,” *International Conference on Informatics and its Applications*, Oujda, Morocco, 2006.

[3] Dowaliby F.J. and Lang, H.G., “Adjunct aids in instructional prose: A multimedia study with deaf college students,” *Journal of Deaf Studies and Deaf Education*, vol. 4, no. 4 , pp 270-282, 1999.

[4] H-Anim 200x specification, ISO/IEC FCD 19774 Humanoid animation.

[5] Jemni M., Elghoul O., and Makhlouf S., “A Web-Based Tool to Create Online Courses for Deaf Pupils,” *International Conference on Interactive Mobile and Computer Aided Learning*, Amman, Jordan, 2007.

[6] Jemni M., and Elghoul O., “Towards Web-Based automatic interpretation of written text to Sign Language,” *First International Conference on ICT & Accessibility*, Hammamet, Tunisia, pp. 43-48, 2007.

[7] Jemni M., Elghoul O., “An avatar based approach for automatic interpretation of text to Sign language,” *9th European Conference for the Advancement of the Assistive Technologies in Europe*, San Sebastián , Spain, 2007.

[8] Jemni M., Elghoul O., “A System to Make Signs Using Collaborative Approach,” *International Conference on Computers Helping People with Special Needs*, Linz, Austria, pp. 670-677, 2008.

[9] Marschark M. and Harris M., “Success and failure in learning to read: The special case of deaf

children," *Reading comprehension difficulties: Processes and intervention*, pp. 279-300,1996.
[10] Neidle C., Sclaroff S., and Athitsos V., "SignStream™: A Tool for Linguistic and Computer Vision Research on Visual-Gestural Language Data," *Behavior Research Methods, Instruments, and Computers*, vol. 33, no. 3, pp. 311-320, 2001
[11] Nicoletta A.V. and Ronnie W., "Novel Approaches to Deaf Education," *First International Conference on Technology-based Learning with Disability*, Dayton, USA, 2007.
[12] Official SignWriting website, http://www.signwriting.org/.
[13] Research Laboratory of Technologies of Information and Communication UTIC http://www.esstt.rnu.tn/utic/.
[14] World Federation of the Deaf (WFD), Position Paper regarding the United Nations Convention on the Rights of People with Disabilities, Ad Hoc Committee on a Comprehensive and Integral International Convention on the Protection and Promotion of the Rights and Dignity of Persons with Disabilities , 24 June 2003.

BIOGRAPHIES

Mohammed Jemni is professor of computer sciences at the Higher School of Sciences and Techniques of Tunis. He is also the director of the research laboratory of technologies of information and communication and the head of the CCK internet services provider for universities and research laboratories. He holds the HDR degree in computer sciences from the University of Versailles, 2004 and the PHD in Computer Sciences from the University Elmanar, 1997. His Research Projects Involvement are e-learning tools and environments, Adaptive/adaptable educational hypermedia and Accessibility of ICT to disabled users.

Oussama El Ghoul is PHD student at The Faculty of Economics and Management of Sfax and researcher at the research laboratory of technologies of information and communication. He has obtained his master degree on the Higher School of Sciences and Techniques of Tunis, 2008. He works on the accessibility of deaf persons to the technologies of information and communication and he is member of the WebSign team. He is interested to the virtual reality and how it can help people with disability to access to ICT. His PHD focuses on the automatic generation of manual and non-manual gestures for sign language machine translation (in particular facial expression).