Using virtual avatars to generate accessible courses for deaf

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Abstract

In many developing countries, deaf peoples are deprived of educational services. Furthermore, if they had the chance to join a special education center, they will find difficulties in understanding written texts because they are based on phonological rules. Fortunately, (ICTs) brings for they new opportunities. In fact, adapted e-learning materials provide an alternative way of learning. In this context, we propose an environment developed in the Research Laboratory LaTICE to aid teacher to prepare dedicated courses to deaf children. Our environment is a specialized Learning Content Management System (LCMS) that generates multimedia courses to teach and learn sign language. It allows teachers to make courses for deaf without need to sign language knowledge. Sign language contents will be generated automatically by a virtual character.

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
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linguistics, or mathematics. A sign language is a language which uses visual 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.

This educational environment uses mainly a web-based interpreter of sign language developed in our research laboratory and called Websign. It is a tool that permits to interpret automatically written texts in visual-gestured-spatial language using avatar technology.

According to our survey we did not find an LCMS witch can help teachers to generate courses to person with hearing disability using virtual reality. 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.

Introduction

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 a survey of existing works that proposes learning software for deaf pupils. In section 4 we present a set of guidelines considered essential in the design of deaf dedicated learning software. In section 5, we describe our objective and the general approach that we adopted to develop our tool. Finally, we give some perspectives and a conclusion.

■ 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, Marschark and Harris 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 (Marschark and Harris 1996).

In 2003, the World Federation of Deaf confirms that 80% of deaf people lack education or are undereducated, are illiterate or semi-literate (WFD, 2003). 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.

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

■ Survey of the existing works

According to our survey of literature we distinguish some works that proposes deaf dedicated Learning Content Management System LCMS. These tools aims to take advantage of what technology offers in the domain of eLearning to overcome the learning difficulties that slows the learning process of deaf learner.

Among the most common deaf dedicated LMS we cite that of Drigas and Kouremenos. The developed system offers Greek Sign Language videos in correspondence to every text in the learning environment. The system is designed for deaf adults for the purpose of educational trainings. The special need of deaf learners is satisfied thinks to the association the text content and its translation in Greek Sign language. This solution offers to learners an alignment of both visuals contents: text and video. The environment is based on an advanced teleconference services of Internet and it offers a set of facilities with an easy and friendly way for the education and the
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Sign language’s contents are represented on animation using flash technology and video streaming. The material is translated in the Greek Sign Language via Streaming Digital Video technologies. The system uses asynchronous services of transfer of the materials and collaboration between learners. It’s designed to satisfy the needs of deaf students with diversity of options of equipment and communication. In the model the strategy is learner centered.

The most common limit of the system is that materials should be created by an expert in sign language.

In the same context the project AILB aims also to design an LMS dedicated to deaf persons. It offers German Sign Language videos in correspondence to every text in its learning environment. The LMS is designed for deaf adults in order to maintain their reading/writing capabilities. In another hand it offers to deaf students a new learning way using new technologies of information and communication. Like the first LMS information is presented on two languages (written language and sign language). For each text the system allows the association of videos in sign language. The main advantage of this bilingual representation is to allow independent learning.

The user interface is designed to satisfy the deaf people requirements determined by a specialized researchers in the AILB team. The system proposes a set of graphically oriented exercises such as drag and drop activities. In fact, a high amount of visualization is needed for learners whom the modality of their language is visual.

**Guidelines for designing and implementing eLearning systems for deaf**

The design and the implementation of deaf dedicated eLearning system need the compliance with specific requirements. In 2007, Matjaz and al. present a set of guidelines that are considered as essential to design eLearning systems for deaf. They confirm that each learning software for deaf should consider at least the ten following guidelines:

1. Present visually all audio information,
2. Assure the translation of spoken and written text into sign language using quality video picture,
3. Present subtitles under the video picture,
4. Present at least two difficulty levels of text and graphics presentation (easy reading and more demanding material),
5. Offer a dictionary and glossary of terms,
6. Assure additional hyperlinks for gathering detailed information,
7. Assure a quick and understandable navigation inside the learning material,
8. Assure that web based e-learning material is structured in understandable and logical way,
9. Assure a simple and surveyable user interface in a learning management system offering the tools for user interface personification,

10. Assure that written language and explanations are relatively easy readable; use of more easily understandable terms.

**Our tool**

**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. The system translates automatically textual materials into specific sign language using the WebSign machine translation; which is based on the avatar technology.

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. In sign language communication we use the visual channel instead of sound to convey meaning by combining simultaneously 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.

**WebSign system**

WebSign (jemni, elghoul) 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 1). The output is a real-time and online 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. A word and its corresponding sign interpretation are added effectively to the dictionary only after its verification by an expert administering the system.

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. 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.

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.

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. 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 1).

Figure 1 : A friendly to use interface for creating signs

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.

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.

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, 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 fingerspelling 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.

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, 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 database.

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.

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.

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 it’s 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.

![Figure 2: Flash based courses interface](image.png)
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 being an open source, consists of two points: first it combines the advantages of different computer techniques and recent technologies; second it allows 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.
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Exploring


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