Towards improving accessibility of Deaf people to ICT

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Abstract

It is with some delay that engineers and researchers realized that the extraordinary progresses of new technologies might be of great help towards improving life quality of people with different disabilities including deaf and hard of hearing people. Internet, data processing and many other tools offer real opportunities to reduce the handicap's endurance. This project feeds into this context; it aims to improve deaf persons' and speech disabled individuals' accessibility to the technologies of information and communication. The objective of this project is not only to design but also to develop a tool facilitating communication with (and between) deaf people via the Web by using the Sign Language (SL). This tool allows automatic texts' translation into a visual-gesture language (SL) by using the avatar technology. The architecture is designed around a virtual animated person who instantaneously interprets a text into a sign language through a full set of interfaces. The system uses a dynamic data base for sign dictionary. It contains gesture codes of words. In order to cope with the multitude of sign languages, this tool offers the possibility collaboratively cerate dictionaries for a specific deaf community (multilingual Web application).

1. Introduction

Disabled persons face non-ending difficulties when dealing with new technologies: the use of computers, Internet access, text edition and printout, …. Reading a document can be an extreme complex task in spite of its simplicity for normal user. The extraordinary progress of nowadays' new technologies offers remarkable opportunities to bring a better quality of life for those who endure handicap and disabilities. In this context, this project targets a specific category of disabled persons: the deaf.

The objective of this project is to develop a tool facilitating communication with (and between) deaf people and speech disabled individuals via the Web by using the SL. This tool would enable people who do not know SL to communicate with deaf individuals. Therefore, contribute in reducing the language barrier between deaf and hearing people. A secondary objective of this project is to distribute this tool on a non-profit basis to different users (i.e instructors, teachers, students and researchers) though encourage its wide use by different communities. A call for contribution to financially support this project would be disseminated at a later stage.

The automatic translation from the written language to the SL requires specific skills in data processing, languages and mathematics. Sign language is a language which uses manual communication instead of sound to convey meaning. It combines simultaneously hands' shape, orientation and movement, arms or body and facial expressions to fluidly express a speaker's thoughts. Nevertheless, the sign language remains a fully-fledged language, with its own constructional method of the sentences.

Research on automatic interpretation of written text in sign language, as well as the creation of gesture components of spoken language, have been held back by the unavailability of open sources that can be widely used. The challenge is to develop computational application that can be deployed via the Web and Internet and that congregates two main properties: "efficiency" and "accessibility". Efficiency reports mainly to quick response time and low bandwidth requirement. Accessibility reports to ease of use and the conviviality of the

interfaces. In this context, “WebSign”, is a Web based application that has been designed not only to facilitate the creation but also the usage of an-online dictionary in order to instantaneously translate texts in SL.

This paper is organized as follow: the next section is devoted to present the state of the art related to three main alternatives of SL interpretation. In section 3, the different functionalities of the designed tool are described. Section 4 illustrates the general approach adopted to develop the tool. Finally, a conclusion and some perspectives are drawn.

2. State of the art

Only a small minority of the deficient auditory people masters the written language. Meanwhile, most communication systems for deaf people exploit textual information badly adapted to their real needs. Therefore, the development of a communication system essentially based on the SL becomes a real socioeconomic interest.
This section exposes the most advanced studies on communication systems using SL in different environments worldwide. Three main approaches exist in the literature: the first is based on writing or drawing symbols, the second approach is based on video and the third is based on 3D sequences and the animation of a virtual person according to a standard. Otherwise, a fourth approach is currently under development, it uses dynamic Web systems.

2.1. Writing based systems

Drawings were the first transcriptions of SL and the means generally used to replace writing long time ago. Later on, several transcription systems appeared such as HamNoSys (Hamburg Notation System) and SignWriting in spite of the difficulty to encode SL in a linear way. The first HamNoSys version was defined in 1984; it was developed as a linear phonetic transcription tool for SL. This virtual transcription is normally possible for all SL in the world (figure 1).
SignWriting was developed by Valerie Sutton for the Center of Sutton Movement Writing, in 1974 [15].
It is based on graphical, bidimensional representations, using graphical symbols. This system is easy to encode in computers in a linear way by assigning numeric codes to each special character (figure 1).

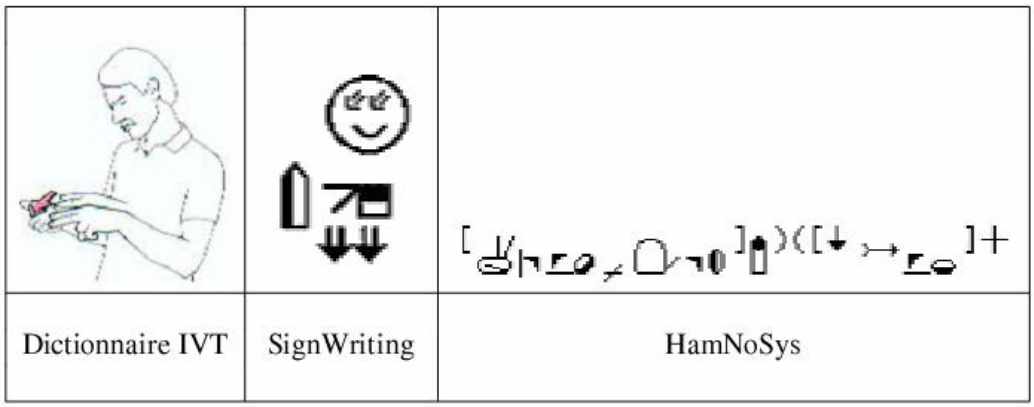


Figure 1. Transcriptions of word [read] in French sign language (LSF) [16].

2.2. Video based systems

The video based systems consist in the insertion of a video sequence of human SL interpreter in the original video tape. Much more sophisticated tools exist nowadays on the market outclassing the predecessors in term of debit and quality. Some of these current projects based on video are: “The Personal Communicator” [1], “LSF Lexique” [2].

To remedy the main problem of these systems oriented video, a first solution consists in coding the plots video in their totality, whereas a second solution consists in coding a selection of video objects of arbitrary shapes. A particular focus should be paid essentially on hands, face, and upper body for which an automatic procedure of segmentation has been developed. The quality, the integrity and the intelligibility of the SL content, versus the compressive debit, depend on the number of plots in the coding diagram not on the quantity, considered cadence video and resolution of the video.

2.3. Avatar based systems

In this new technological context, the modeling of a virtual character can be achieved either according to a segmented model, gotten by a hierarchical graph of the anatomical 3D segments, or according to a model seamless. In both cases, the surfaces are represented either with a polygonal stitch, or by a mathematical analysis, otherwise according to implicit functions of the skeleton. The creation of a virtual character is achieved either by a modeler of geometric primitives, or with the help of a 3D scanner. The approach of segmented virtual character exists in the H|Anim specifications [6], as well as in MPEG-4 FBA (Face & Body Animation) [7], whereas the representation by virtual character is processed in MPEG-4 BBA (Bone-Based Animation). Some current projects based on video are: “Signeuse Virtuelle 3D” [3] “eSign” [4] and “VSigns” [5].

2.4. Conclusion

Video sequence coding into SL has certainly shown good success in spite of the low debit and the modest image quality. Meanwhile, this method has some limitations; these are mainly due to the fact that the contents can not be used many times and therefore a human SL translator is necessary. As a consequence, this method remains very cost effective. For these reasons, communication systems using virtual animated 3D persons (more precisely an avatar in VRML in conformity with the H|Anim), have been more successful. This study uses this latest model. The originality of our model consists in its design, which combines the use of the Web, a low debit transfer and a friendly usage in real-time.

3. Description of the functionalities of the system

WebSign is a Web application based on the technology of avatar (animation in virtual world). The input of the system is a text. The output is a real-time and on-line interpretation of the output into a sign language. This interpretation is constructed thanks to a dictionary of words 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 are added effectively to the dictionary only after its assessment by an expert who supervises the system

Figure 2. Interface of interpretation.

Contrary to popular belief, unfortunately, SL is not universal. Wherever community of deaf people exists, SL has developed, but likewise spoken languages, these vary from region to region. Hundreds of SLs exist in the world and are at the core of local deaf cultures [9]. Some SLs have obtained some forms of legal recognition, while others have no status at all.

For this reason, WebSign has adopted the notion of "community". A community is a group of users that can build and share a common dictionary of SL. A dictionary can be totally created by a specific community or can be just a part of an existent dictionary where some specific words are interpreted differently with respect to the intrinsic specification of a community.

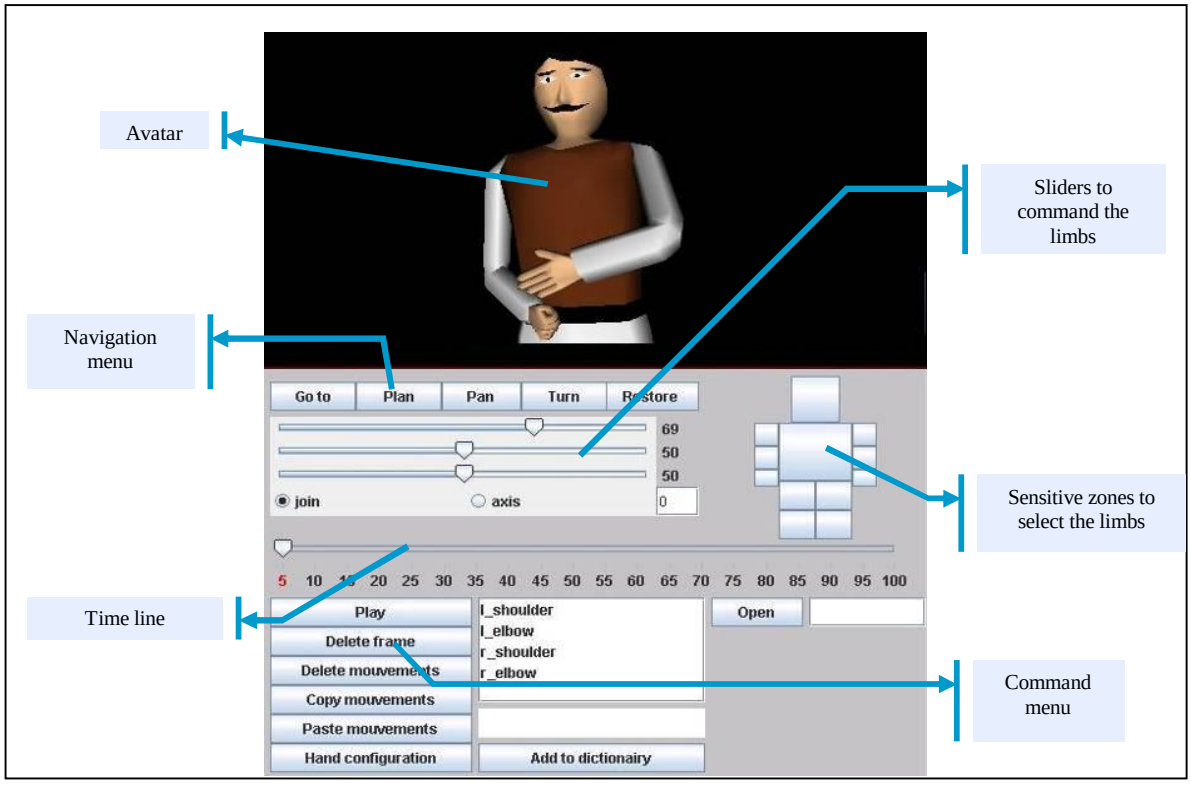


Figure 3. Interface for the construction of signs

There are three main actors in WebSign: (1) The general supervisor of the system who provides the basic information for the treatment of the tool, updates the system and communicates with all the others actors. He is considered as the "general supervisor interface". (2) The administrator of a community: his role is restricted to the administration of his community and the verification of the proposed signs before their integration into the corresponding dictionary. (3) The third actor is the user. He benefits from the main functionalities, i.e the real-time interpretation of texts into SL (in on-line way), the possibility to propose signs and words by using graphical dedicated interface, the use of a messenger tool to communicate with deaf persons by sending texts which will be translated automatically in SL. The translation can be either synchronized or asynchronized.

Figure 4. Asynchronous interpretation

Figure 5. Real time interpretation

4. Technical approach

4.1. Modeling the avatar

To creation of the avatar has proceeded as follow: skin creation, carving of the skin in small surfaces, creation of the skeleton and the texture (figure 6 & 7).

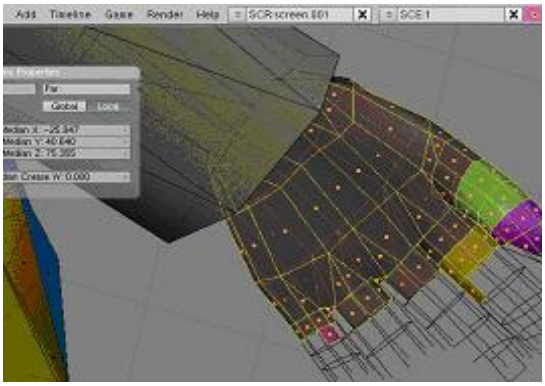


Figure 6. Hand modeling

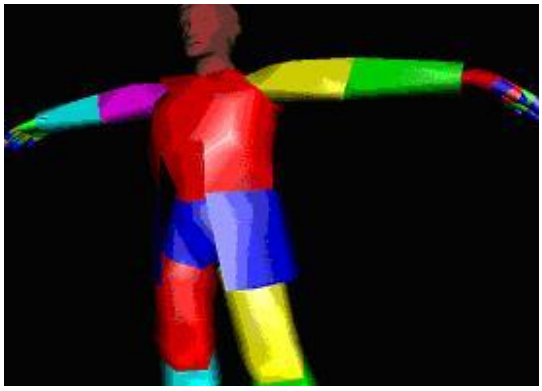
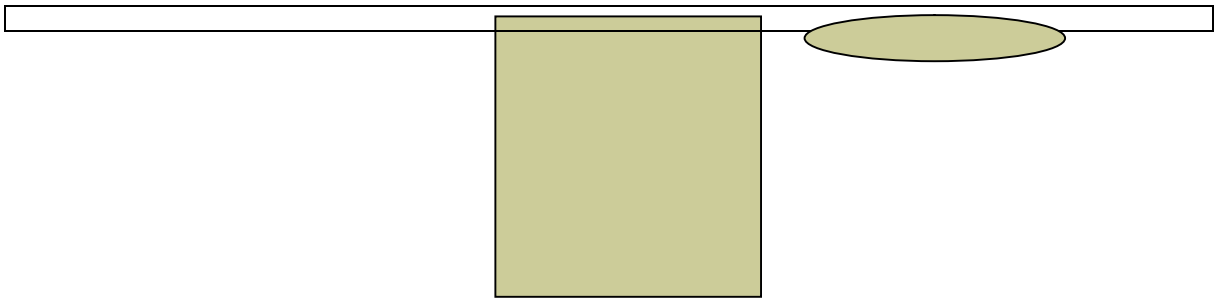


Figure 7. Carving the skin

4.2. Construction of the player module

First, a VRML player and a Java applet were integrated; they are commendable via a Web page. Second, an animation algorithm using SML was implemented: Sign Modeling Language, the language that we constructed for the modeling of signs. (figure 8). For the linguistic processing, the system uses Xerox WebService which is used to tokenize and doing the morphological analysis.



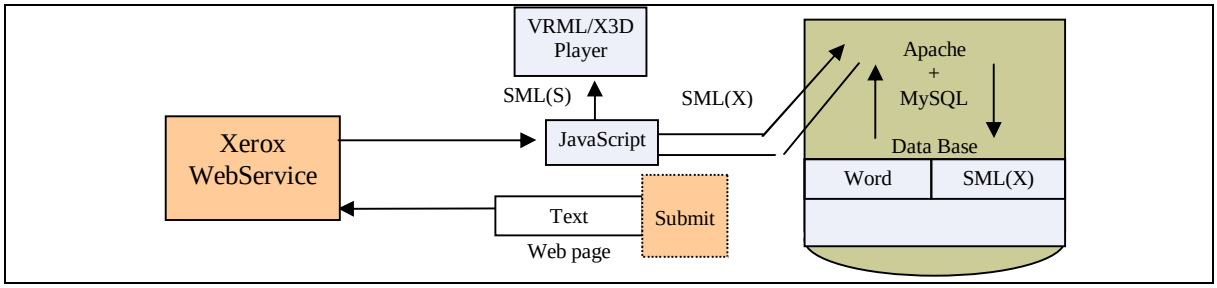


Figure 8. Player module

4.3. Construction of the interpretation module

WebSign is based on Client/Server architecture. In order to implement this architecture, the following steps have been followed: first, we created the clients, the server and the database; second, we saved some SML codes to initiate the database and finally we have implemented the algorithm interpretation via the messaging service (figure 9).

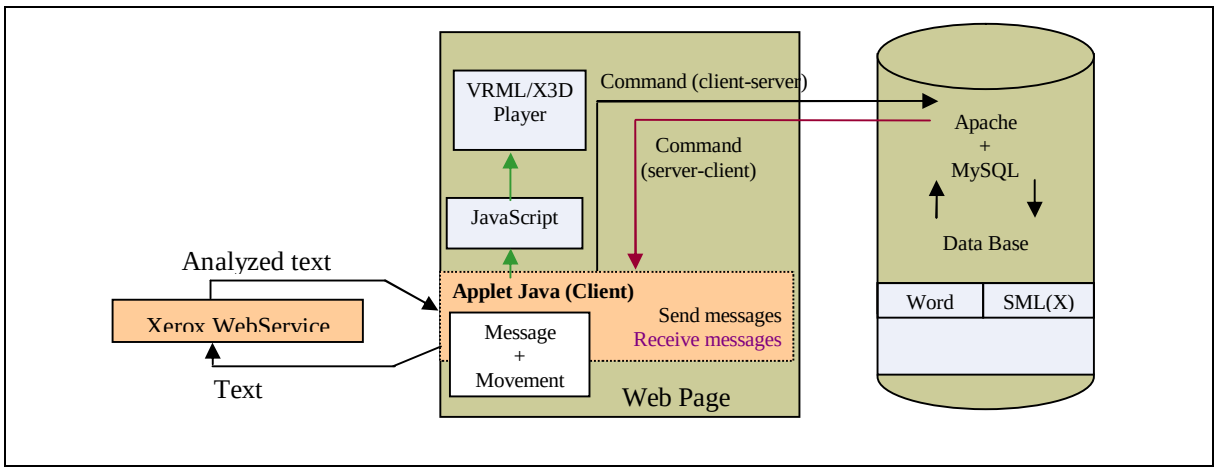


Figure 9. Interpretation module

4.4. Tools and technologies

For the 3D animation on the Web, our system uses the Virtual Reality Modeling Language (VRML) which is a programming language specialized in the representation of virtual universes in 3D. This interpreted language is an ISO international norm. X3D, based on XML syntax, has been created by the Web3D consortium in order to follow VRML. It was normalized by the ISO in 2005. The system uses also a specific editor called X3D-Edit.
To ensure an instantaneous communication, we have developed a PHP messaging server (PHP technology and Apache being used as an application server) and a client in Java (a Java applet).

5. Conclusion and perspectives

This paper presents a tool that aims to enhance communication with 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 its collaborative and incremental approach which creates dictionaries based on virtual communities. Moreover, thanks to coding gestures in SML Language (XML based language), the code is independent of the language (words or texts). Therefore, it is possible to share some signs and some parts of dictionaries among multilingual communities.

A first version of WebSign is finalized and completely functional. We plan to make it available online very soon. We already made some contacts with specialized deaf associations in order to organize some dictionary alimentation training sessions. As perspective of WebSign, we plan to develop a module of movement capture as a new component of the system in order to generate automatic sign codes.

6. References

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