AN ADAPTIVE EDUCATIONAL TOOL FOR THE GREEK SIGN LANGUAGE

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ABSTRACT

In this paper we present a web adaptive educational tool for the Greek Sign Language. Although different software or tools already exist for other sign languages, the Greek Sign Language has not been presented in an educational tool. The paper presents the architecture of the tool, in an abstract way and briefly describes its functionality. The interaction process followed is also presented.

KEYWORDS

Education for the disabled, adaptive systems, Internet based educational systems

1. INTRODUCTION

Sign language (SL) is the language of deaf people. It is one of a number of complete natural languages using movements of hands, body, face and head to produce an infinite number of varied sentences. Sign language is not a universal language, contrary to popular belief. Like any common language, each country has its own national sign language e.g. ASL is primarily used in America and Canada. Numerous linguistic studies have shown that each sign language has its own grammatical structure, syntax, rules, etc.

The Greek Sign Language (GSL) is a unique language, used by many deaf people and of practical value for others who appreciate visual communication (42.600 or more users, including 12.600 deaf children and 30.000 active adult users) ([11]). The root of GSL lies in the American and French sign languages combined with various indigenous sign languages, which came together in the 1950's ([4]). The Greek deaf people are already using for their communication a sufficiently rich sign vocabulary, with some minor local variations.

In several European countries, law recognizes the national sign language as the first language of persons born deaf, or who became deaf at an early age; the "early deaf". The number of deaf and severely hard hearing persons is roughly estimated to be 0.05% of the population ([11]).

Tools for deaf people are being developed for several applications ([9], [10]). In most EU countries, such productions are still largely semi-professional or amateur, "ad-hoc" productions, made by schools for the deaf, organizations for the deaf, or organizations of parents of deaf children ([8]). Most of these productions are only marketed on a local or regional level ([5], [7]).

The study of deaf people's interaction with a computer and their needs has become a fundamental goal of our research. Based on this involvement, we discovered the need of a tool that could assist in the learning of GSL. For this reason we took up a project aiming at the design and development of an adaptive educational system for GSL ([1]). Multimedia technology ([2]) is especially suitable for a more descriptive presentation (using still and moving images/visual items) of sign language symbols and concepts ([6], [10]). The user can handle the material in an active way enabling full interaction with the learning environment. Three target groups were identified as end users of the system; individuals (children and adults), special schools and training centers. Moreover, the tool was designed to be used by any person interested in learning the Greek Sign Language. We have assumed that simplicity should be the focus of the design and functionality, thus we tried to reduce complicated graphics and infrequent functions performed through complex button controls and multi level menus.

The main focus of the project is the way GSL can be presented in video-courses. The project engages in a range of issues concerning training, support and evaluation of the pedagogical process, so deaf people can achieve the necessary insight and progress. It also encourages the acquisition and improvement of GSL skills, the appreciation of GSL literature, the provision of information on GSL, and the production of new GSL video-lessons.

One of the most important factors contributing to the effectiveness of a sign language course is the proper and correct presentation of the signs used. The adaptive educational system implemented:

- Uses new technologies to provide training of GSL (multimedia, distance learning, etc.).

- Gives trainers and trainees the opportunity to access useful material (video-courses, index, glossary, etc.) at any time they wish to.
- Evaluates the progress of the educational process through self-rating questions.
- Allows the user to select parameters such as: lesson type, learning mode (quick or slow), etc.
- Offers a selection of components to support learning and training (course database, sign glossary, phrase glossary, etc.).
- Provides facilities and usability features. The project places a strong emphasis on understanding and specifying the needs of deaf users.

Moreover, the importance of the system can be certified in the sense that:

- it will make the sign language accessible to those who wish to learn it without a teacher or from a distance,
- it will be a useful tool for the trainers who will thus be able to teach it in the most modern way.
- it will propagate and disseminate the Greek Sign Language.
- it will increase the social independence and welfare of deaf people by providing enhanced educational opportunities.

This work is organised as follows; section 2 presents the different elements of the system and the general platform developed to allow easy and straightforward implementation of the learning materials is described. The user interaction process is described in the section 3, while the last section presents future plans.

2. SYSTEM ARCHITECTURE

The architecture is presented schematically in

Figure 1. The system consists of three parts (layers); the production layer, the communication layer and the teaching layer.

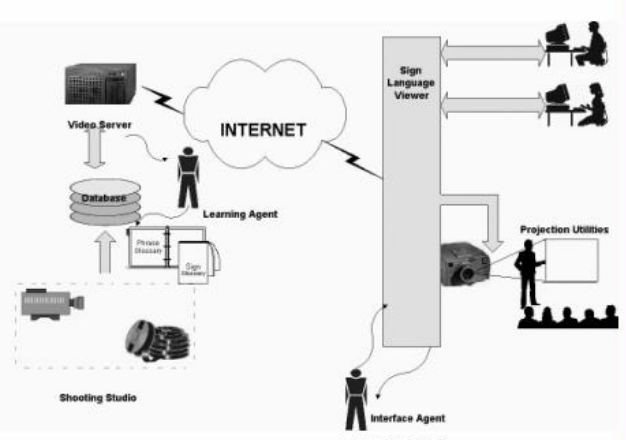

Figure 1. System Architecture

2.1 THE PRODUCTION LAYER

The production layer is the component where the courses are created, stored and indexed. The courses are produced in a shooting studio, using a digital camera. The process follows the typical procedure in producing video clips. The clips are converted to MPEG-2 format. The format deals with frames of audio and video (vectors of samples and matrices of pixels). Furthermore, it deals with the objects that make up the audiovisual scene. Thus, a given scene has a number of video objects, of possibly different shapes, plus a number of audio objects, possibly associated to video objects. The high level architecture of this process is presented in Figure 2.

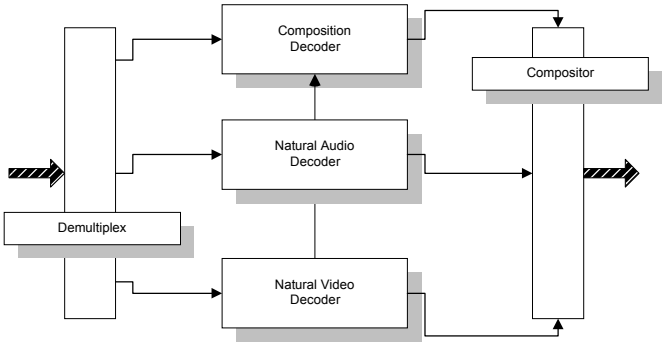

Figure 2 MPEG-2 Converter Architecture

Each clip is characterized by a phrase, describing each content. This keyword is being used to create the index of all clips stored in the system database. The database is a video database organised using two different glossaries; the sign glossary and the phrase glossary. The former consists of simple signs (letters, numbers etc) used to present difficult words in primary sign symbols. The latter contains more complicated words or/and phrases used in the course of a more specific conversation.

2.2. THE TEACHING LAYER

The teaching layer consists of several utilities for viewing the sign language courses and an interface agent. Since the target groups of the system are individuals (not only deaf), special schools and training centers, projection utilities are also supported. All courses are being viewed through the *Sign Language Viewer*. The functionality of the viewer is presented in section 3. On this layer an *Interface Agent* is running. The agent works as a help tool and a presentation agent for any kind of user. The Interface Agent is in charge of interacting with the user and making transparent the other agent[1] to him. Moreover it is able to understand the user's requests and translate them for the other agent. The Interface Agent has different

[1] The Learning Agent is presented in section 2.3

tasks that are crucial for the correct operation of the whole system:

- Assisting the user in performing requests and compiling his profile.

  Once again it is the Interface Agent in charge of directing the archives and presenting to the user what she/he is looking for.

- Deducing the user's information needs by both communicating with him and observing his ``behavior''.

  The agent observes the user's behavior and the current instance of the user interface environment to deduce what actions are to be performed and how to modify the current user's profile. The user may or may not be aware of the agent's training period depending on both the user features and the processing step.

- Translating the requests of the user and transferring to the learning agent information required to solve his problem(s). That allows the user to completely ignore the structure of the system he is interacting with. Moreover he can also ignore how the system works. The user interacts with a personalized interface that knows how to satisfy his requests without bothering him.

2.3. THE COMMUNICATION LAYER

The communication layer consists of different World Wide Web communication facilities (refer to Figure 1) that connect the database to the Internet. A simple compression is used in order to reduce the bandwidth required for the transmission. The administration of the whole procedure is performed through a video server. The server is a cache-based video streaming server with low cost primary storage (CD, DVD, tape) and high speed cache, scalable (initially 100s of streams at 2Mb/s) supporting high bandwidth (for MPEG 1 &2) and low bandwidth (for real video or similar). When a request comes in, the data is streamed from the DVD or cartridge tape to the caching disks and it is streamed out over the network to the user/s. A second request for the same lesson will go directly to the caching disk so that only the recently active videos are held there.

The courses are being prepared in the server area using a *Learning Agent*. The Learning Agent is an agent that based on the input received from the teaching layer adapts the contents of the course. For instance, if the Interface Agent located at the teaching layer sends to the Learning Agent the message that the user uses too often the slow button on the interface or plays again and again the same clip, the Learning Agent understands that the user has a problem either with the interface (handled by the Interface Agent) or that the specific item for the course is too complicated for the user. The course should present more examples of the same phrases from the phrase glossary, or (the user) has further deficiencies from previous courses; in this case the previous course or similar course should be repeated. Based on these assumptions, it adjusts the contents of the next course item.

3. SYSTEM OVERVIEW

In the introductory page of the system, the user can choose and see some general information on the a) Greek Sign Language, b) the Greek Sign Language Vocabulary, and c) Useful Information concerning institutes and bodies for deaf people in Greece. The second menu item (Greek Sign Language Vocabulary) is the main component of the system while (a) and (c) play an informative role.

During system implementation, the design and the development team focused on certain usability features that would ensure the system compliance with user requirements, expectations and needs. More specifically:

- *Visually profound way of representing level of difficulty*

  The material presented by the system comprises words and phrases that can be categorized in three discrete levels of difficulty. In order to communicate this kind of qualitative information to the user, three different actors are used (Figure 3), each one expressing in the Greek sign language the corresponding vocal items (words/phrases). This feature also ensures a greater level of user acceptance of the system as the interchange of actors makes the presentations more interesting minimizing tediousness.

Figure 3: The actors, each one corresponding to gradually increasing level of difficulty

- *Simple navigation controls*

  Once the user has logged on to the system, there are three control buttons (see Figure 4) at his disposal, namely:

  a. Previous Menu – return one level up from the current
  b. Next Page – see next page of the current level
  c. Exit – leave the system

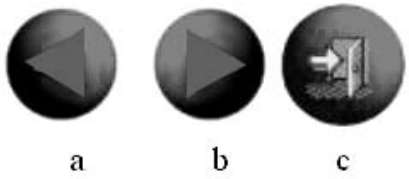

Figure 4: The three control buttons available in the system

All three of them are designed in a way that correspondence with their function is straight forward so that the user does not need to memorize pairs of the form (graphical presentation, function) in order to be able to interact with the system. Moreover, a simple static graphical metaphor is used for the enumeration of the current course (Figure 5).

Figure 5: A simple graphical metaphor (hand-like) used for the enumeration of the courses.

- *Easily conceivable metaphor of video playback speed*

Within the context of easy interaction with the system for all levels of users (experienced or not) an easily conceivable metaphor was designed and implemented to represent the speed of video playback (Figure 6). Three identical animated cartoon characters, running at different paces below the video presentation window communicate the notion of different playback speeds to the user, independently of his/her prior experience with information systems.

This feature is considered extremely important since the vast majority of users of such systems, after watching a video once, play it again and again and try to distinguish and memorize the signs; this process requires in many cases a much slower speed of video playback than the original.

Figure 6: The video playback metaphor; three available speeds for video playback namely "normal", "slow" and "very slow" that foster the needs of various user levels.

- *Volume of material included in the curriculum*

System curriculum includes in the upper level (Figure 7) 34 thematics of course topics and 1335 video lessons covering a wide range of everyday life themes such as work, leisure, family and interpersonal relations, time/calendar, descriptions, feelings, food, weather, etc

Figure 7: A first-level menu with 6 of the 34 course thematics the user may choose from.

- *Human-centered UI design*

The overall system interface design and the interaction with the user were based on a human-centered philosophy. This was a decision that was made based on studies indicating that the evidence of visual problems in deaf persons is higher than in the hearing population. It also caused us to adapt a simplistic approach during user interface design, use discrete visual objects, and contradicting colors: the background color is white and most of the controls and visual objects are red and blue.

The exit button is always available at the exact same position on the screen (bottom right) so that the user has at all times an easy way out of the system (this is one of the fundamental principles of human-centered highly usable user interfaces).

Moreover, the list of words/phrases that are presented in the Greek sign language in the videos lays beside the video playback area with the word/phrase currently being represented, underlined. At anytime, the user can choose any one of the words/phrases listed and playback the video with its sign representation at the speed he/she wishes (Figure 8).

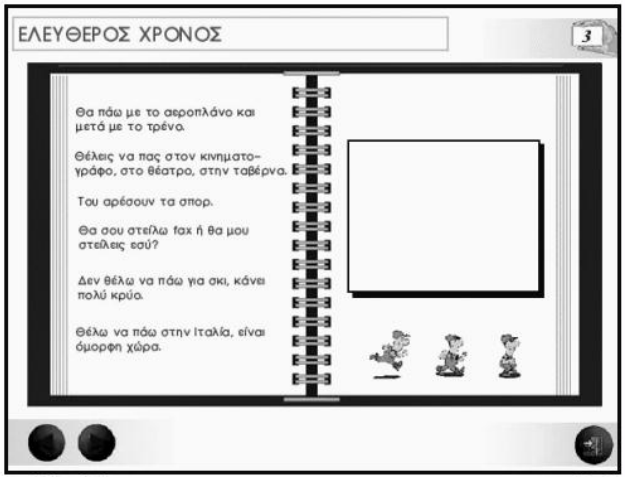

Figure 8: A system screen shot with the phrase to be presented in the Greek sign language –in the rectangular area at the rightmost side of the screen- underlined.

Figure 9 shows an instance of our system in use. It is worth mentioning that the user -apart from playing over and over again a certain video- can at any time click on another word/phrase from the list and watch its representation in the video presentation window.

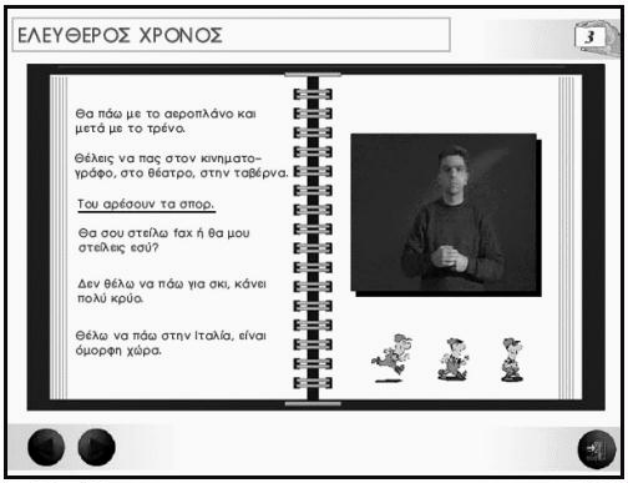

Figure 9: A system instance

4. FUTURE WORK

The system works fine as an effective demonstration and training tool for the GSL. Further work is needed on the adaptation features. For the time being, the only parameters used to evaluate the users' reaction and the knowledge transferred are the frequency of the use of the control buttons and the metaphors in combination to the level of the course and the interface agent used. Although this seems to work fine, complementary to an instructor presence, a more self-training attitude should be adopted.

That means that we should try to give to the system a way to adapt itself based on the performance of movements (hands, head, etc) of the user, following the stage of his training. Moving to this direction we plan to enhance the sign language viewer with the support of a small video camera. The camera will capture the user's reactions as (s)he tries to reproduce the movements presented from the agent. These movements are being compared to the correct one and the system adapts to the next course based on the learning curve of the trainee.

This approach is too complicated and a lot of different issues should be addressed. For example, the comparison of two different movements is too difficult since the shape of the hands and the movement speed are too complicated to be compared among different persons. The matching pattern is too complicated and the agent should be trained for a significant period of use. These first parameters lay within our future research focus.

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