WSEAS TRANSACTIONS on INFORMATION SCIENCE and APPLICATIONS

Issue 3, Volume 1, September 2004

ISSN 1790-0832 http://www.wseas.org

Teleeducation and e-learning services for teaching English as a second language to Deaf people, whose first language is the Sign Language.

A.S.DRIGAS, J.VRETTAROS, D.KOUREMENOS
Department of Applied Technologies
NCSR "DEMOKRITOS"
Ag. Paraskevi
GREECE
dr@imm.demokritos.gr, jvr@imm.demokritos.gr, dkourem@imm.demokritos.gr
http://imm.demokritos.gr

Abstract: - In this paper we present the "DEDALOS" [1] project which main object is the promotion of the English Language as a second language for the Deaf people. For this, we have designed and use pedagogic methodology of distant Linguistic Training and as well as innovative instructive material suitably adapted to the special team. The whole process has designed and includes audits and evaluation of the linguistic faculties of e-student. The educational material has designed to be separated in different levels depending on the knowledge of the student. The system has designed to evaluate the student and set the pedagogic material at the correspondent level, using an intelligent taxonomy system. Particular importance in the design has been given to the quality and innovation of the educational material of self-paced learning where we extensively use new technologies of animation and digital video into the Sign Language of each partner

Key-Words: - e-learning, teaching English to deaf people, sign language, videoconference, expert system, taxonomy.

1.1 Introduction

In the domain of Linguist Training of the English Language as a second language for the Deaf people, is a very well known aspect, that beyond and over the large evolution of the information and communication services and products, there is only a small percentage of the above mentioned evolution, that is involved within the Linguist Training Circle and even smaller percentage of usage of information and communication services and facilities that is used to support Training of the Handicapped people and especially deaf people.

The general idea is that most of the information and Communication Technologies, substructures and services are targeting and oriented to the mean, common citizen and user, and are excluding handicapped people and other sensitive community groups, provoking and creating the phenomenon that is known as digital divide, exactly the opposite of e-inclusion, which is supported internationally by several policies and organized actions, but also supported by projects like this one.

The basic objective of the present project is the promotion of the English Language as a second language for the Deaf people. For this, we have designed and use pedagogic methodology of distant Linguistic Training as well as innovative instructive material suitably adapted to the special team. The whole process has designed and includes audits and evaluation of the linguistic faculties of e-student. The educational material has designed to be separated in different levels depending on the knowledge of the student. The system have designed to evaluate the student and set the pedagogic material at the correspondent level, using an intelligent taxonomy system. Particular importance in the design has been be given to the quality and innovation of the educational material of self-paced learning where we extensively use new technologies of animation and digital video into the Sign Language of each partner.

An important element of the project is the promotion of the equality of the Deaf people via their attendance in the European Community. The English Language as a second language constitutes important supply for an individual professional re-establishment and integration in Europe. It is a common ascertainment that the Deaf people face problems of adaptation in their social activities in the European countries, where English is used as the main communication language. Also, the sector of information technology (www, commercial transactions) uses mainly the English language. The biggest percentage (90%) of information of the Internet is in English while the terminology used in the sector of economy and electronic trade requires the knowledge of English

1.2 Greek Sign Language – the background

Greek Sign Language (GSL) is a natural visual language used by the members of the Greek Deaf

Community with several thousands of native or non-native signers. Research on the grammar of GSL per se is limited; some work has been done on individual aspects of its syntax negation [3], morphology [4], as well as on applied and educational linguistics. It is assumed that GSL as we now know it is a combination of the older type of Greek sign language dialects with French sign language influence [5]. Comparison of core vocabulary lists exhibit many similarities with sign languages of neighboring countries, while in morphosyntax GSL shares the same cross-linguistic tendencies as many other well analyzed sign languages [6]. GSL has developed in a social and linguistic context similar to most other sign languages [7]. It is used widely in the Greek deaf community and the estimation for GSL users is about 40,600 (1986 surveys of Gallaudet Univ.). There is also a large number of hearing non-native signers of GSL, mainly students of GSL and families of deaf people. Although the exact number of hearing students of GSL in Greece is unknown, records of the Greek Federation of the Deaf (GFD) show that, in the year 2003 about 300 people were registered for classes of GSL as a second language. The recent increase of mainstreamed deaf students in education, as well as the population of deaf students scattered in other institutions, minor town units for the deaf and private tuition may well double the total number of secondary and potential sign language users. Official settings where GSL is being used include 11 Deaf clubs in Greek urban centers and a total of 14 Deaf primary, secondary and tertiary educational settings.

1.3 Internet accessible research background in the area of sign languages

The internet has proven to be a boon for people with disabilities. But just as it is important to design buildings with accessibility in mind, the same is true for the internet. Flexibility is the key to accessibility. It's important to keep in mind that people will be using a variety of technologies to access your home page. Keeping your page accessible mean keeping such options open. In an age of intelligent HTTP/WWW servers that can query clients about their feature-lists [8].

The choice of the technical advanced video in the e-learning system plays important role. Video technologies offer great possibilities for better telecommunications for deaf people who use sign language as first language. When selecting or developing systems for communication in sign language, a method is needed for determining the usefulness of a given system. Video communications offer great possibilities for better telecommunications for deaf people.

But sign language places great demands on the moving image. Many video conference systems currently installed are of a quality that is insufficient for sign language. When selecting or developing systems for communication in sign language, a method is needed to determine the usefulness of our system.[9]

At the web site of World Wide Web Consortium (W3C) we drew useful information that has to do with the creation accessible html pages for the deaf and half hearing persons. For any time-based multimedia presentation, synchronize equivalent alternatives with the presentation. A time-based presentation can include any form of multimedia, such as a movie, animation or slide show. Equivalent alternatives to these types of presentations are captions (which provide access to audio tracks) and audio descriptions (which provide access to visual tracks). They have already explained the need to provide a textual transcript for any audio track or video track, and a textual description of the video track. However, it must be admitted that a text transcript alone is not the ideal method for providing an equitable experience for persons with disabilities. It is widely accepted that on-screen captioning allows deaf and hard-of-hearing people to more fully appreciate the experience of a movie or multimedia production. A separate textual transcript that must be read after the fact does not provide an equivalent experience.

The caption track is an alternative method for deaf or hearing-impaired viewers. Synchronizing this alternative with the main presentation means that nearly all users will get the best experience and the most information available to them. [10]

In a recent work titled "Sign Language Europe" [11] they have developed a software environment (ITOM, figure 1) that makes School-TV broadcasts (or other movies) accessible in two languages; 1. in Dutch by sound and subtitles 2. in Dutch sign language. At the moment they use the ITOM with school-TV broadcast from Dutch school-TV broadcaster Teleac, but ITOM can be used for every video program available. Because ITOM is an open structure and it is even possible to put in any other content. If necessary the screen layout can be adapted for special content. At the moment the ITOM offers different possibilities to view a video program. 1. You can view the original program with subtitles. 2. You can view a sign language narrator with still pictures from the original program. We cut

down the original program in small fragments and all these fragment are direct accessible in Dutch and in Dutch Sign language. 3. Sometimes you find additional information to a fragment of the program. This information is available in written Dutch and in Dutch sign language. 4. Often we ad self-test questions to a fragment in written Dutch and in Dutch Sign language.
The Sign language version provides a version of the story in real sign language. Beside the sign language narrator you see still pictures from the video program. They choose still pictures because moving pictures beside each other are hard to follow. You can watch the version with subtitles for the moving pictures. At the moment we are experimenting with the use of an interpreter for the sign language version. The ITOM uses an HTML browser with a Real player plug-in (version 8 or higher). The ITOM also play from a CD-rom, (but older CD-rom drives not play the video fluently).

figure 1

1.4 The project's language resources

Implementations of both the e-material and e-learning tools of the platform require collection of extensive electronic language resources for GSL as regards the lexicon and the structural rules of the language. The actual data of the study are based on basic research on GSL analysis undertaken since 1999 as well as on experience gained by projects NOEMA [12]. The data consist of digitized language productions of deaf native GSL signers and of the existing databases of bilingual GSL dictionaries, triangulated with the participation of deaf GSL signers in focus group discussions. The project follows methodological principles on data collection and analysis suitable to the minority status of GSL. Wherever the status of individual GSL signs is in consideration, the Greek Federation of the Deaf is advised upon, too. Many of the grammar rules of GSL are derived from the analysis of a digital corpus that has been created by videotaping native signers in a discussion situation or when performing a narration. This procedure is required because there exists little previous analysis of GSL as a natural language. The basic design of the system, except for the educational content this currently supports, focuses on the ability to generate sign phrases, which respect the GSL grammar rules in a degree of accuracy that allows them to be recognized by native signers as correct utterances of the language.
In this respect DEDALOS offers a great challenge for in-depth work on both directions, lexicography and linguistic analysis of GSL; for the first time research have designed to go beyond a mere collection of glosses [13] and move further from many previous bilingual dictionaries of sign languages [14], into the domain of productive lexicon [15], i.e. the possibility of collection new GSL lemmas and GSL corpus in the domain of e-commerce and new technologies sector. It is a design prerequisite that the e learning system of GSL should have an open design, so that it may be easily extendible allowing additions of lemmas and more complicate corpus. From a linguistic point of view the resulting database of glosses, rules and tendencies of GSL will be a significant by-product of the project, of great value to future applications.

2.1 Description of the DEDALOS project.

The basic objective of the project DEDALOS is the support of the equal rights of Deaf people for their access and real attendance in the professional training. The central aim is the is the promotion of the English Language as a second language for the Deaf people via distant Linguistic Training test innovative instructive material suitably adapted to the special team
In the present project we have designed the following:

a) Development of an e-Learning environment for the Deaf People adapted to them via their Sign Language. The environment has designed and is based on the usage of the advanced teleconference services of the Internet (network virtual classroom) and have designed to offer a sum of facilities and services that will be able to support, via an easy and friendly way, education and training in the form of life long and continuing education and training for the Deaf People.

b) Design and development of electronic informative "adaptive" material for Deaf People in the Web. This informative material has designed and includes text and video (multimedia) and will be directed toward the aim of training of the English language. The material have designed to be all translated in the Sign Language via Streaming

Digital Video according to the e-content specifications of A.I.C.C.

c) We have designed and use innovative e-learning methods for the Linguistic Training of self-paced learning. We use processes of synchronous learning and collaborative methods of asynchronous self-paced learning.

d) The design and running of an application of life long and distant training of the English language. In this application, all the above mentioned actions and developments have designed and is co-ordinated so that the desired outcome of training is available in the community of the Deaf people, for application and evaluation that lead to the final improvements of the central as well as the subsidiary design and developments. Taking into account the circumstances in Greece, deaf people do not have the proportional economic resources in order to be equipped with suitable material and technical systems for the use of e-learning. This being the case, the project aims at the creation of centres of distance training into the associations of Deaf/ Hard of hearing so that via the proportional material - technical equipment and parallel training of the teachers of Deaf people, the services of new society of information would be provided to the Deaf people.

2.2 Methodology

For the concretization of the program we drew the following methodology. We make co-ordination and parallelism of all directions of the choice of specifications of independent sub systems in order for these to be compatible between them and be increased in this way in the maximum the possibilities of incorporation of sub systems in a single functional system, limiting simultaneously in the minimum the need of existence and growth of the adoptive interfaces between the sub systems. Moreover, an other central characteristic element of the followed methodology is that the concretization of each sub system as well as the concretization of the total system of work are supported in the following line of distinguishable stages for each sub system:

- Research for the state of the art of the sub system
- Determination of the requirements of users, analysis of the present situation
- Syntax of the specifications of the sub system
- Research - Study - Planning of the sub system
- Concretization of the sub system
- Trials of smooth operation, isolation of the problems and improvements

Initially, the collection of the essential bibliography and experience, that will be the base to go in depth in the subject of the research of the proposed work, has been drawn. The bibliography covers the sectors of e-learning linguistic training, of the English Language in the Sign language and more generally the training of individuals with hearing problems in the modern technologies of Internet.

The educational material has been drawn and constituted by texts, pictures and video in the Sign Language of each country. All the educational material is drawn and adapted from pedagogic side in the needs and particularities of the vulnerable group of our objective (people with hearing problems).

The adaptation and designing of the educational material that has been studied, have become under the supervision of a special scientific team that is constituted by individuals with a long term experience in the area of Deaf people' s education in centres of training such as the field of computers and in the training of Deaf/hard of hearing people. The educational material has been drawn and is in a form of text with escort of instructive pictures and Flash Animation (Moved Picture) in Sign Language and at the same time translated in a form of digital video.

Special systems of picture's transmission on demand (video on demand, real video) are used, distant group of people can draw "optical" information in the Sign Language via the digital video. For the creation of digital video have been drawn and are used various techniques of digitalization and video's transmission specially for transmission via web as Quick Time Movies, Real Player Movies, as well as specialized parcels of software for transmission Video On Demand such as the IP - TV.

3.1 Description of e-Learning platform for the deaf

The environment of *dedalos* has designed and uses asynchronous services of delivery of the educational material and modern and asynchronous services of communication and collaboration, trying to exceed the exclusions that are related with the time and the place of training but also to satisfy the needs of deaf students with variety of possibilities of equipment

and communication.
The model of visual classroom has designed and use services of videoconference via picture, at the same time with the possibility of realisation of cooperative activities of real time (whiteboard, application sharing, file sharing).
Apart from the designed model of visual classroom, the model of Supported Self learning, there is in use also. A basic rule that should condition the systems of tele-education for self learning, is the control. This means that the educated person is simultaneously able to use the course but also to intervene in the flow and his structure. In this designed model the strategy is learner centred.
The designed services that are provided by the environment are categorized in four fundamental axes:
-Visual order: line of courses in real time with possibility of interaction via internet.
-Self-instruction: access (search and recuperation) in training and informative material for various cognitive and more general subjects that interest teachers.
-Cooperative learning: communication and attendance in thematic circles of discussions and development of cooperative activities

3.2. Telecommunications and network infrastructure

In the project DEDALOS, the designed networking of institutions between them is based at preference on engaged permanent lines that have designed to interlink the centres in the Internet.
In every case, the institutions have designed and use the multicasting telecommunications connections with capacity of 128Kbps or bigger for taking part in the meetings of videoconference.
Also for the projection of electronic material that the bigger part has designed and is in electronic streaming video a breadth transport above 128 Kbits/sec is essential for the good quality of transmission. While an order of breadth of 356Kbits/sec is considered ideal [16].
Finally, even if the basic network infrastructure of network of DEDALOS have designed and is based on the Internet and the use of protocol TCP/IP, is likely to present cases where the model with discuss is not feasible, for example, because there isn't the possibility of confrontation of economic cost that is required for the maintenance of permanent network connection. These cases have designed and is faced with the use of connections ISDN/DSL, that provide with small cost the possibility of establishment of connection automatically.

3.3 Videoconference with transmission of pictures

In the project *dedalos* we have designed and use special software of transmission of picture through the internet. This technology is the more complete and impressive form of videoconference. It offers to the deaf people, such as the phonetic videoconference to the hearing people. Using a system of videoconference, removed between them teams of individuals can communicate maintaining optical contact. The particular technology has designed and constitute a basic trunk for our platform and analyses and trials will become for the better quality of transmission of information in the Sign Language.
Apart from the transport of picture and sound, the parcels videoconference usually provide and others adjacent possibilities, as the videoconference via text, shared whiteboard, and generally everything that is reported as complementary possibility for the other categories of software of videoconference. The simultaneous use of main operation videoconference with the other possibilities allows the conduct of a complete meeting of intermediate network. In case in deed where the terminals are installed in special rooms with central audiovisual equipment for the comfortable follow-up from a crowd of public, the systems of videoconference is possible to support high requirements mass activities of tele-education, tele- presence or tele- work.
For the project dedalos we have designed and use the model of videoconference one to one making use of propagated computational Netmeeting. For the model one to many we use computational class point of the CuSeeMe. A product enough functional and friendly with enough possibilities of visual order under the form of videoconference.

3.4 Traffic measurements

The research reported in this paper undertook measurements of the IP traffic generated during videoconference sessions (at continuous and switched presence mode) between four vc clients (MS NetMeeting) used by Greek signers (three interpreters and one deaf user). At switched presence mode, the MCU sends to all terminals the output from one participant (QCIF video), designated as ''currently active'' while at continuous presence, the MCU combines the signal from all terminals and sends back the output to all the participants (CIF video, see figure 2).

figure 2

Concerning the experimental work, two experiments were held at two different high quality (with an acceptable for sign language peak rate equal to 320 KBits/sec) modes of CISCO MCU 3510 (hardware MCU): continuous presence mode - H.261 coding and switched presence mode - H.263 coding (see annex 1, Table 1 for more details). In both cases, to ensure the quality of the sign sequences, MS NetMeeting clients were configured with the same video parameters (High Quality - QCIF). Furthermore, the same sign language Video Contents VC1-4 (signers conversing) were used in both cases for reasons of statistical comparison between H.261 and H.263 traffic.

4. Implications and extensibility of the educational platform

As an educational tool above all, DEDALOS's system has designed and offers a user-friendly environment for deaf people aged 14 and over so they can have visual translation of words and phrases. The signed feedback acts as a motivating tool for spelling Greek words and structuring sentences correctly, as well for evaluating one's performance. For deaf students as a group with special needs, the platforms draws some of the accessibility barriers, and the possibility of home use even makes it accessible to family, thus encouraging communication in GSL, but also access to the majority (Greek) language. New written texts can be launched, so DEDALOS may receive unlimited educational content besides primary school grammar units. On the other hand, unlimited school units, such as the increasing special units with individual deaf students in rural areas and islands can link with one another via DEDALOS. From a socio-economic point of view, creating this platform will greatly contribute towards the inclusion of deaf people in Greek society in an environment of equal opportunities.

5. Future work

The application of an intelligent system of evaluation of deaf students is in the immediate future applications in the framework of our project.

The final system has been drawn and uses modern techniques of neural networks and not clear logic. This system classifies the student in levels of knowledge, which also determine the final structure of educational material. More analytically, it is a system of measurement of the level of acquisition of knowledge and dexterities from the student at the duration of training process. A useful tool for the professor that will guide him rightly.

The official approach becomes with the use of short test in each unit. However it is known that the process of learning is figured with various behaviors from the student that are depended on the experience, the background and the particularities of the student. The approach that we will develop is the classification of various behaviors through unclear (fuzzy) proposals and their connection through fuzzy rules which will be used by an experienced system. The experienced system will choose the most suitable strategy for each student. All the process will become through the follow-up of an hypertext environment through which we can represent the behavior of the student and which constitutes the condition in order to have the possibility of fuzzy inference.

6. Problems and limitations

The main limitations of the study are described below. These are divided into linguistic, educational and technical ones. Most of the limitations are typical to video streaming projects, and they were expected before the beginning of the project. From a linguistic and educational point of view, the major issues that need to be addressed are the following:

• In some areas of the language there are no standardized signs, so there may be some theoretical objections as to the use of particular entries. However, a platform such as the one described allows for multiple translations and have some limitations as to the size of files, as we have to publish these files in the way of streaming video via the web. A second problem is the ability to make changes in the database of video files.

• The data available in GSL, when compared with data from Greek, for example, are dauntingly scarce.

Error correction mechanisms were sought after in order to assure reliability of results. Such back-up mechanisms are the use of approved dictionaries, the consultancy of Pedagogical Institute and the feedback from the Deaf Community, along with the continuing data from GSL linguistic research.

• Lastly, all schools in Greece have recently become accessible to the Internet, Deaf settings included. In practice however, there are many more accessibility barriers for a considerable number of deaf students who have additional special needs. Relevant provisions have been made according to general accessibility principles for these students (as to text size, keyboard settings etc) but the pilot application of the after 6 months have designed to certainly indicate more points for development.

Technical problems include:

A qualitative videoconference sign language communication, as indicated by the results of Table 1, is highly expensive in terms of bandwidth. Especially in the case of multipoint continuous presence communication the demand of bandwidth is multiplied according to the number of the conferring signers. Under these circumstances, DSL links of at least 384Kbps are considered as the minimal requirement for a Sign Language Virtual Classroom.

7. Conclusion

Given that the platform under discussion consists an original research object, successful completion of its development have designed to open the way to a complete support system for the education of the Deaf Community members in Greece.

Acknowledgments

The authors wish to acknowledge the assistance of all groups involved in the implementation of the discussed platform: computational linguists, computer scientists, GSL specialists, the Greek National University of Athens, the panel of GSL consultants and the representatives of the Greek Deaf Community, acting as our informants. This work is partially supported by the Leonardo Da Vinci project grant Dedalos.

References:

[1] Leonardo Da Vinci , AGREEMENT n° 2002 <EL/2002/B/F/ 114042>, Title: “Teaching English as a second language to Deaf people, whose first language is the Sign Language, via e-Learning tools’’. Short title: “DEDALOS”.

[3] Antzakas, K. & Woll, B. (2001). Head Movements and Negation in Greek Sign Language. Gesture Workshop, City University of London 2001: 193--196.

[4] Lampropoulou, V. (1992). Meeting the needs of deaf children in Greece. A systematic approach. Journal of the British Association of Teachers of the Deaf, 16, 33--34.

[5] Lampropoulou, V. (1997). Ereuna tis ellinikis Noimatikis Glossas: Paratiriseis Phonologikis Analisis. Athens, Greece: Glossa.

[6] Bellugi, U. & Fischer, S. (1972). A comparison of Sign language and spoken language. Cognition, 1, 173--200.

[7] Kyle, J. G. & Woll, B. (1985). Sign Language: the study of deaf people and their language, Cambridge University Press.

[8] Karen Nakamura , Creating Accessible HTML (http://www.deaflibrary.org/accessibility.html)

[9] *Gunnar Hellstrφm,* Quality Measurement on Video Communication for Sign Language (http://www.omnitor.se/textversion/english/qualityonvideo.html)

[10] Chuck Letourneau & Geoff Freed, W3C, 2000

[11] Leonardo Da Vinci , title: "Sign Language Europe" , (http://www.signlanguage.nl/).

[12] Efthimiou, E. & Katsoyannou, M. (2001). Research issues on GSL: a study of vocabulary and lexicon creation. Studies in Greek Linguistics, Vol. 2 Computational Linguistics, 42--50 (in Greek).

[13] Logiadis, N. & Logiadis, M. (1985). Dictionary of Sign Language. Potamitis Press (in Greek). Brien D. & Brennan, M. (1992). Dictionary of British Sign Language / English) Faber and Faber, London Boston.

[14] Brien D. & Brennan, M. (1992). Dictionary of British Sign Language / English) Faber and Faber, London Boston.

[15] Wilcox, S., Scheibmann, J., Wood, D., Cokely, D. & Stokoe, W. (1994). Multimedia dictionary of American Sign Language. In Proceedings of ASSETS Conference, Association for Computing Machinery, (pp. 9--16).

[16] S. Kouremenos, D. Kouremenos, S. Domoxoudis and A. Drigas, *Statistical Analysis of Sign Language Videoconference Traffic in Multipoint Sessions over IP,* The 4th Conference on VideoConference and Emerging Technologies, Gallaudet University, Washington D.C., April 18-20, 2004.

[17] RealPlayer, http://www.real.com/.

Annex 1

Table 1. The experiments' scenarios and some first-order statistical characteristics of the generated frame sequences

Exp	1					2				
Terminal	VC1	VC2	VC3	VC4	MCU	VC1	VC2	VC3	VC4	MCU
Scenario	Continuous Presence - H261					Switched Presence - H263				
Target Video Bit Rate (For Terminals) (KBits/sec)	320					320				
Target Video Bit Rate (For the MCU) (KBits/sec)	1280					320				
Target Frame Rate (fps)	15					15				
Duration (sec)	1800					1800				
Video Bit Rate (Kbits/sec)	215.95	215.68	216.79	217.64	867.63	206.59	217.22	208.36	207.69	208.36
Frame Rate (fps)	7	6	8	9	9	15	15	15	15	15
Average Frame Size (Bytes)	3877	4371	3543	2941	11724	1729	1728	1727	1724	1727
Variance	309660	246830	175860	126850	10834000	87849	42805	47428	42892	47428