

DICTA-SIGN Annual Public Report 2009



***“Sign Language Recognition, Generation
and Modelling with Application in
Deaf Communication”***

URL: <http://www.dictasign.eu/>

DICTA-SIGN researches ways to enable communication between Deaf individuals through the development of human-computer interfaces (HCI) for Deaf users, by means of Sign Language.

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PROJECT DESCRIPTION

DICTA-SIGN is a three-year EU-funded research project that aims at making online communications more accessible to deaf sign language users.

The development of Web 2.0 technologies has made the WWW a place where people constantly interact with each other, by posting information (e.g. blogs, discussion forums), modifying and enhancing other people's contributions (e.g. Wikipedia), and sharing information (e.g., Facebook, social news sites). Unfortunately, these technologies are not friendly to sign language users, because they require the use of written language.

Can't sign language videos fulfill the same role as written text in these new technologies? In a word, no. Videos have two problems: Firstly, they are not anonymous – anyone making a contribution can be recognized from the video, which holds many people back who otherwise would be eager to contribute. Secondly, people cannot easily edit and add to a video that someone else has produced, so a Wikipedia-like web site in sign language is not possible.

DICTA-SIGN's goal is to develop the necessary technologies that make Web 2.0 interactions in sign language possible: Users sign to a webcam using a dictation style. The computer recognizes the signed phrases, converts them into an internal representation of sign language, and then has an animated avatar sign them back to the users. Content on the Web is then contributed and disseminated via the signing avatars. Moreover, the internal representation also allows us to develop sign language-to-sign language translation services, analogous to the Google translator.

In this way, DICTA-SIGN aims to solve both of the problems that sign language videos have. The avatar is anonymous, and its uniform signing style guarantees that contributions can be easily altered and expanded upon by any sign language user.

RESEARCH & DEVELOPMENT AREAS OF INTEREST

DICTA-SIGN deals with four Sign Languages: British Sign Language (BSL), German Sign Language (DGS), Greek Sign Language (GSL) and French Sign Language (LSF).

The project involves research from several scientific domains in order to develop technologies for sign recognition and generation, exploiting significant knowledge of the structure, grammar and lexicon of the project Sign Languages, the so called linguistic knowledge and resources of a language. Sign Language linguistic knowledge can be derived exclusively by appropriate processing of Sign Language video corpora, linked to grammars and lexicons.

To serve its goals, DICTA-SIGN combines linguistic knowledge with computer vision for image and video analysis that serves to achieve continuous sign recognition as presented in sign language videos, and with computer graphics for realistic signing animation by means of a virtual signer (avatar).

SUMMARY OF ACTIVITIES

During the first 10 months of the project life cycle, foundations for research and development work have been put in place, cooperation between the partner research groups has been established and initial results of work of the various project teams have started to appear.

As regards Sign Language Recognition, towards visual tracking and feature extraction, work is now underway to locate, track and determine the pose of a signer.

We extracted baseline features from the Boston University video database, feature extraction consisting of the following components: (1) hand and head detection, (2) disambiguation in the case of occlusions and (3) feature extraction. The first steps towards continuous Sign Language Recognition, consist of a) selecting the appropriate features among the ones provided by the visual front-end, and b) proposing meaningful approaches for the segmentation and the modelling of continuous sign language. Concerning the former we currently restrict our baseline by employing only the position and movement cues, which are among the basic characteristics describing a sign. Concerning the segmentation and modeling, we investigated exploitation of two methods we refer to as a) sub-unit creation by segmentation and clustering at the signal level and b) sub-unit creation by segmentation and clustering at the model level. We have also been working on the tracking and detection of sign in less constrained settings such as broadcast footage containing inset signers, using machine learning techniques to automatically identify common motions or signs within the footage.

As regards Sign Synthesis and Animation, analysis of requirements for enhanced flexibility and precision in the SiGML model of sign language production is in progress. SiGML supports the different “tiers” of signing gestures: manual, body, mouthing, and other facial expressions. The focus of contributions so far are on enhancing timing and synchronisation features. We investigate adding speed and duration information so that synthesised signing can be synchronised to video to support Sign Language Recognition. Furthermore, models of time used in two sign language notation systems, HamNoSys and Zebedee, are being compared.

In parallel, a survey of the current state of the art in synthetic sign-language animation systems, with special regard to interoperability issues, is in progress.

Finally, identification of requirements for support of sign recognition, corpus construction and annotation by animation systems has started. In the framework of sign synthesis and animation work, DICTA-SIGN partners have been given access to the JASigning software from UEA and support is being provided to enable signed content in HamNoSys to be converted into a suitable form to be performed by the UEA avatar.

DICTA-SIGN foresees a linguistic model for Sign Languages, that includes both a lexicon and a grammar model. As regards lexicon modelling, analysis of the different representation models used by the project partners, was based on a list of criteria completed and commended upon by all partner research groups. The same methodology was followed for collection of partners' data regarding description of the grammar models the different teams have worked with, in order to enable the establishment of the list of issues not yet sufficiently covered. This kind of preparation work will allow development of the DICTA-SIGN Lexicon and Grammar models to be formulated in the second year of the project.

Either recognition and synthesis technologies or linguistic research demand a huge amount of appropriately annotated corpora of Sign Language, which is a time- and labour-intensive, often error-prone task. Development of a semi-automatic tool for annotation of Sign Language corpora is one of the goals of DICTA-SIGN. Towards this end, we have defined a data model that is able to handle several levels of sign language description. At this stage of the project, specifications have been established and the development of appropriate software has been planned.

Regarding creation of Sign Language resources necessary to the project, one major achievement in the first 10 months is the creation of a common basic vocabulary of 1.000 entries for each of the project's Sign Languages. These lexical resources provide the most extensive multilingual Sign Language lexicon currently available worldwide. Furthermore, all preparation work for the creation of the DICTA-SIGN

parallel corpus has been completed, including collection of elicitation material, planning of elicitation tasks and defining appropriate studio and cameras setting.

PROJECT APPLICATIONS & USER INVOLVEMENT

Project Applications

DICTA-SIGN is expected to result in three proof-of-concept end user applications: a sign language-to-sign language terminology translator, a search-by-example tool, and a sign language Wiki. Aside from these applications, advances in the field are also expected to push major improvements to research and annotation tools.

Sign language-to-sign language terminology translator

Just like spoken languages, national signed languages differ from one another, and create communication barriers between deaf people of different nationalities. At the same time, European integration requires more and more communication across national boundaries.

Therefore, it is expected that a sign language-to-sign language translator will be useful in similar situations where web-based translators are useful. A prototype of such a tool will serve as the project demonstrator. It will be domain-specific, on the topic of travel, and make use of a controlled vocabulary of 1500 signs. The translation process itself will be shallow, based on simple relationships between the grammars of the four project sign languages, and on alignment of the parallel corpora. The input will be the results of the sign language recognizer, as well as annotated video, and the output will consist of avatar-based animations in the target language.

Search-by-example tool

Current lexical databases and dictionaries for sign language allow the user to search for signs by using another (written) language or by constraining some descriptive parameters. Both approaches require knowledge that cannot generally be assumed; especially in sign language learners who do not yet have a strong grasp of the parameters that make up a sign. A more promising alternative consists of having the user perform the sign in question in front of a camera.

A search-by-example system will integrate sign recognition for isolated signs with interfaces for searching an existing lexical database. Aside from the obvious utility to sign language learners, this prototype will also showcase the technology behind dictation characteristics of the user interface, where multiple alternatives are shown if a sign cannot be recognized reliably, as computationally this case is very similar to a learner performing a sign with minor errors in form.

Sign language Wiki

A major requirement of contemporary Web 2.0 applications is that user contributions are editable by an entire community. The oldest, and most popular, application of this type is a Wiki, where any contribution can be edited and refined, anonymously if so wished, by someone else. As the success of Wikipedia and related sites show, this type of community collaboration results in a rapid amassing of knowledge.

There is no doubt that sign language users could benefit similarly from collaborative editing. A server will be developed providing the same service as a traditional Wiki, but using sign language. Instead of using text as the output medium, a signing avatar presents information. The use of an avatar preserves the anonymity of the user, and facilitates modification and reuse of information present on the site.

The system acts as a dictation machine using sign, providing recording, playback, and editing. A user can put information onto the server using sign language by means of a web cam, or a video that is uploaded to the server. The system then analyzes the images and extracts key sign components, which are then used to generate the movements of the signing avatar. If the system interprets the sign language sentence badly, the user can correct it either by repeating only the erroneous part (for example the handshape, or facial expression).

This prototype will specifically showcase the integration of all major components of the project. At the same time, it will also demonstrate a Web 2.0 application that is accessible to the Deaf from the beginning to end.

User Involvements & Evaluation

It is a major concern of DICTA-SIGN that project results reach the Deaf Communities of the partner countries and also that Deaf users are actively involved in evaluation of all project's applications. According to schedule, there will be organised familiarisation events with the project's national deaf communities. DICTA-SIGN and its outcomes will also be presented to the wider Deaf community through various dissemination actions. With regards user evaluation of the project prototypes during development, a formal user evaluation is foreseen to follow the delivery of each prototype. This activity will take part in the second half of the project lifecycle.

Approval of the different technological achievements by the Deaf communities in the partner countries will be ensured by user evaluation procedures which complement the formal user evaluation to be conducted in the framework of the project activities.

DISSEMINATION and FUTURE EXPLOITATION PROSPECTS

Dissemination Strategy

DICTA-SIGN web site

The DICTA-SIGN website (www.dictasign.eu) is the project's main communication tool. It contains multilingual material (written form of oral language and SL videos) that reflects the project's aims, research progress and scientific impact. This is the place where all information related to DICTA-SIGN is stored and made accessible to the Internet sharing community.

Currently the home page provides descriptions in all languages of the project including English, French, German, Greek, BSL, DGS, GSL and LSF.

As the project progresses, the following topics are covered:

- Project overview
- Consortium data
- Scientific publications of project research groups
- Project applications
- Project newsletter
- News and Events



Figure 1: DICTA-SIGN home page (German & DGS)

Dissemination to the scientific community and the industry

Dissemination to scientific community is based on bilateral exchange of information with major scientific institutions as well as communication of project achievements in conferences and through publications. The DICTA-SIGN project covers a broad scientific spectrum of inter-relating sign languages technologies and linguistic study that will promote Deaf accessibility in the environment of human-computer interaction (HCI) applications.

Dissemination of DICTA-SIGN knowledge at the scientific community is done with presentation of research methodologies, strategies and outcomes in conferences interested by this topic.

As regards project news, views and findings, they will also be reported and posted to international online science and technology portals such as Scidev.net, AlphaGalileo.org, EurActiv.com and Ascribe.org.

Promotion of the project's innovative technologies are foreseen in the framework of national and international conferences, exhibitions and scientific events most attractive to the industry. Ongoing dissemination to the wider academic community has already taken place in peer reviewer international publications.

Dissemination to support organisations

The consortium keeps a steady contact with a number of organizations from both academia and the industries, who have an interest in DICTA-SIGN research work.

In addition to newsletter circulation on a regular basis, the DICTA-SIGN support organisations will participate in a virtual panel and will regularly communicate with the project's research teams throughout the whole project's lifetime. The panel will be initiated in view of the LREC-2010 Conference and the DICTA-SIGN workshop.

Other forms of communication are based on bilateral exchange of information, when a topic of specific interest is under discussion, regular communication via e-mail and invitation to events organised by the DICTA-SIGN consortium.

Popularisation events and Dissemination to Deaf Communities

The partners will use their existing contacts to national Deaf communities as well as contacts to magazines and journals of wide interest, to promote the project's outcomes through popularization, in order to ensure that the general public and the Deaf communities are kept informed about the project and its aims. Popularisation will take place both by means of broadcast features and avatar-signed web pages, in order to spread project outcomes to a wide public audience.

The DICTA-SIGN consortium will organise familiarisation events with the project's national deaf communities as a complementary action to communication with related industry and scientific community, since approval by final users will strengthen the commercialisation potential of the project's outcomes.

Finally, all partners will make sure that the project leaflet and logo become familiar to the majority of Deaf communities members in the project countries.

Dissemination in view of future exploitation

Complementary to scientific workshops, where research teams from within the project expose their outcomes and welcome other research teams to participate and criticise, workshops are also envisaged that focus on potential commercial applications where potential customers are invited

DICTA-SIGN will lead to new knowledge with direct impact on the development of several tools, including tools for sign recognition, tools for image processing, tools for sign synthesis, tools of annotation and editors of linguistic models (lexicon, grammar, signing space) as well as the project's demonstration showcase and laboratory prototypes. The set of showcase and laboratory prototypes will be presented to industry in scientific events complemented with exhibitions and will also be put at the disposal of the project support organisations and the Deaf community.

The prototypes will be used by deaf people to test their usability but also to facilitate the emergence of new practices (access to information in sign language, mode of writing of the sign language, generation in sign language) and thus to create new requirements in term of applications (tools usable by general public) and in scientific questions.

With regards opportunities to involve/liaise with industrial players in the field, the consortium will utilize all their links towards this end.

Publications of the project team in the period February to November 2009

Papers

- H. Cooper and R. Bowden, Learning Signs from Subtitles: A Weakly Supervised Approach to Sign Language Recognition. Proceedings of the 2009 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR 2009), Miami, Florida, USA. 22-25 June 2009, pp. 2568-2574, DOI 10.1109/CVPRW.2009.5206647

- E. Efthimiou et al., Sign Language Recognition, Generation, and Modelling: A Research Effort with Applications in Deaf Communication. Proceedings of UAHCI 2009/HCI 2009, Springer Lecture Notes in Computer Science 5614, pp 21-30, 2009, DOI 10.1007/978-3-642-02707-9_3
- H. Cooper and R. Bowden, Sign Language Recognition: Working with Limited Corpora. Proceedings of UAHCI 2009/HCI 2009, Springer Lecture Notes in Computer Science 5616, pp 472-481, 2009, DOI 10.1007/978-3-642-02713-0_50
- F. Lefebvre-Albaret and P. Dalle, Body posture estimation in a sign language video, In Proc of The 8th International Gesture Workshop, Bielefeld, Feb 09.
- Jean-Claude Martin, Jean-Paul Sansonnet, Annelies Braffort, and Cyril Verrecchia, Informing the Design of Deictic Behaviours of a Web Agent with Spoken and Sign Language Video Data, In Proc of The 8th International Gesture Workshop., Bielefeld, Feb 09.
- Jérémie Segouat, Annelies Braffort, Toward Modeling Sign Language Coarticulation, In Proc of The 8th International Gesture Workshop., Bielefeld, Feb 09.
- Jérémie Segouat, Annick Choisier, Annelies Braffort, Corpus de langue des signes : premières réflexions sur leur conception et leur représentativité, to be published in "Travaux Linguistiques du CerLiCO" (Cercle Linguistique du Centre et de l'Ouest), Presses Universitaires de Rennes (Ed.), 2010.
- Maxime Delorme, Sign Language Synthesis : Skeleton Modelling for More Realistic Gestures, to be published in the January 2010 issue of the SIGACCESS Newsletter.
- Stavroula-Evita Fotinea, Eleni Efthimiou, George Caridakis, Olga Diamanti, Nikos Mitsou, Kostas Karpouzis, Costas Tzafestas and Petros Maragos, DIANOEMA: Visual analysis and sign recognition for GSL modelling and robot teleoperation, In Proc of The 8th International Gesture Workshop., Bielefeld, Feb 09.
- Participation to IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-2009), Taipei-Taiwan, April 09.
- S-E Fotinea and E, Efthimiou, A platform for sign language content presentation, In Proc. of the V International Conference on Multimedia, Information and Communication Technologies in Education (m-ICTE 2009), April 09, Lisbon, Portugal.
- E. Efthimiou, S-E. Fotinea, C. Vogler, T. Hanke, J. Glauert, R. Bowden, A. Braffort, C. Collet, P. Maragos, and J. Segouat, Sign Language Recognition, Generation, and Modelling: A Research Effort with Applications in Deaf Communication, In Proc. of the UAHCI, HCII -09, July 09, San Diego, USA (to appear).
- Okwechime D, Bowden R, Real-Time Motion Control Using Pose Space Probability Density Estimation, In Proc. 12th Int. Conference on Computer Vision, ICCV Workshop: IEEE International Workshop on Human-Computer Interaction, Kyoto, 2009.pp2056-2063.
- Moore S, Bowden R, The Effects of Pose On Facial Expression Recognition, In Proc. British Machine Vision Conference BMVC'09, London 2009. pp1-11.
- Sheerman-Chase T, Ong E J, Bowden R, Feature Selection of Facial Displays for Detection of Non Verbal Communication in Natural Conversation. In Proc. 12th Int. Conference on Computer Vision, ICCV Workshop: IEEE International Workshop on Human-Computer Interaction, Kyoto, 2009.pp1985-1992.

- Oshin O, Gilbert A, Illingworth I, Bowden R, Action Recognition using Randomized Ferns, In Proc. 12th Int. Conference on Computer Vision, ICCV Workshop: IEEE workshop on Video-Oriented Object and Event Classification, Kyoto, Japan. pp530-537.
- S. Theodorakis, A. Katsamanis and P. Maragos, Product-HMMs for automatic sign language recognition, Proc. IEEE Int'l Conference on Acoustics, Speech, and Signal Processing (ICASSP-2009), Taipei, Taiwan, Apr.2009.

Invited Talks

- Thomas Hanke & Christian Rathmann, DGS, Sign Linguistics Corpora Network Workshop 1: Introduction & Data Collection, London, July 26-27, 2009.
- Eleni Efthimiou, Text/speech corpora, Sign Linguistics Corpora Network Workshop 1: Introduction & Data Collection, London, July 26-27, 2009.
- Thomas Hanke, Sign language metadata in the iLex database environment. Sign Linguistics Corpora Network Workshop 2: Metadata, Nijmegen, Nov. 13, 2009.

Popular Science

- Computer Learns Sign Language by Watching TV, Article in New Scientist, 8th July 2009.

COLLABORATION

Collaboration between consortium members

The consortium was formed on the basis of a long tradition of academic contacts among most of the partners. The working groups in DICTA-SIGN are formed on the basis of laboratory expertise and specific project implementation needs.

In the current state of the project, 6 working groups are active:

- The Sign Language Recognition Group,
- The Sign Synthesis and Animation Group,
- The Grammar Modelling Group,
- The Annotation Tools Group and
- The Parallel Corpora Group

Clustering activities

DICTA-SIGN partners participate in various activities of knowledge sharing within their domains of expertise.

ILSP and UHH participate in the Sign Linguistics Corpora Network (SLCN) <http://www.ru.nl/slcn/>, having organised 2 workshops already on Data Collection (July '09, London, UK) and Metadata (November '09, Nijmegen, The Netherlands).

In the same line, a joint workshop in the framework of a renowned conference (LREC-2010) will host discussions and exchange of scientific advances and achieved goals with other research teams/projects in the same areas, including the SignSpeak (www.signspeak.eu) project in the framework of fruitful clustering activity between the two projects.

USEFUL LINKS

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Events organized by DICTA-SIGN partners

Special session “Sign Language Technologies”, in the framework of the **UAHCI-2009** Conference, hosted by the **HCII-2009** (San Diego, California, USA) - <http://www.hci-international.org>

Fourth Workshop on the Representation and Processing of Sign Languages: Corpora and Sign Language Technologies, in the framework of **LREC-2010**, The seventh international conference on Language Resources and Evaluation (LREC): <http://www.lrec-conf.org/lrec2010/>