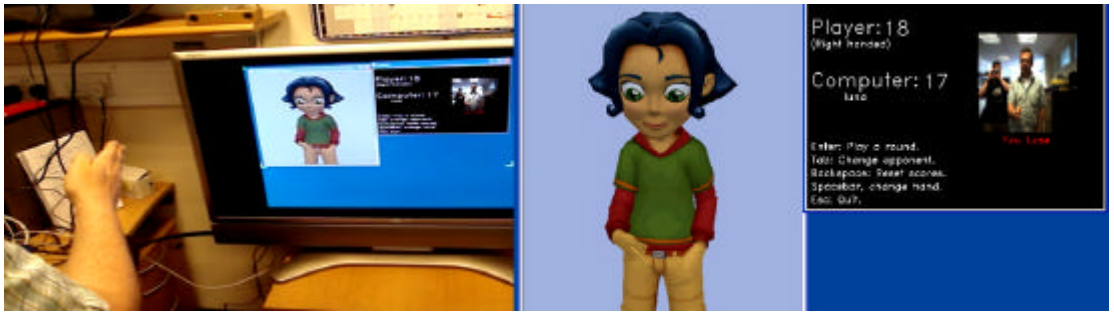
DICTA-SIGN publishable summary: Project Year-1

Project objectives

Dicta-Sign is a three-year project that addresses the need for communication between Deaf individuals and communication via natural language by Deaf users with various Human-Computer Interaction (HCI) environments. It researches and develops recognition and synthesis engines for sign languages (SLs) at a level of detail necessary for recognising and generating authentic signing. In this context, Dicta-Sign aims at developing several technologies demonstrated via a sign language-aware Web 2.0, combining work from the fields of sign language recognition, sign language animation via avatars, sign language linguistics, and machine translation, with the ultimate goal of allowing Deaf users to make, edit, and review avatar-based sign language contributions online, similar to the way people nowadays make text-based contributions on the Web. In this line, one of the main objectives of Dicta-Sign is to develop an integrated framework that allows contributions in four different European sign languages: Greek (GSL), British (BSL), German (DGS), and French (LSF).
Other objectives include the development of the world's first parallel multi-lingual corpus of annotated sign language data; the development of advanced sign language annotation tools that integrate recognition, translation, and animation; the provision of large cross-lingual sign language dictionaries; and the advancement of the state of the art in computer vision and sign language recognition, sign language generation, sign language linguistic modelling and sign language translation.



Expected results – their impact and use

The project's results address both the need of researchers' community for linguistic resources and scientific answers to currently unsolved issues, as well as the Deaf users' need for technological solutions to the problem of communication via natural language. The project's outputs comprise:

- A parallel multi-lingual corpus for four national sign languages – German, British, French and Greek (DGS, BSL, LSF and GSL respectively) – of a minimum of three hours signing in each language,
- A substantial dictionary of at least 1000 signs for each represented sign language,
- A continuous sign language recognition system that achieves significant improvement in terms of coverage and accuracy of sign recognition in comparison with current technology; furthermore, this system will research the novel directions of multimodal sign fusion and signer adaptation,
- A language generation and synthesis component, covering in detail the role of manual, non-manual and placement within signing space,
- Annotation tools which incorporate these technologies providing access to the corpus

and whose long-term utility can be judged by the up-take by other sign language researchers,

- Three bidirectional integrated prototype systems which show the utility of the system components beyond the annotation tools application,
- A showcase demonstrator, which exhibits how integration of the different components can support user communication needs.

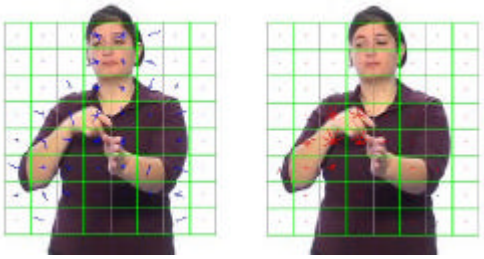
Three proof-of-concept prototypes will be implemented and evaluated within Dicta-Sign in the second and third project year:

- A Search-by-Example system will integrate sign recognition for isolated signs with interfaces for searching an existing lexical database,
- An SL-to-SL translation prototype will pioneer a controlled-vocabulary sign language-to-sign language translation on the basis of the parallel language resources developed within the project,
- A Sign-Wiki will be developed providing the same service as a traditional Wiki but using sign language.

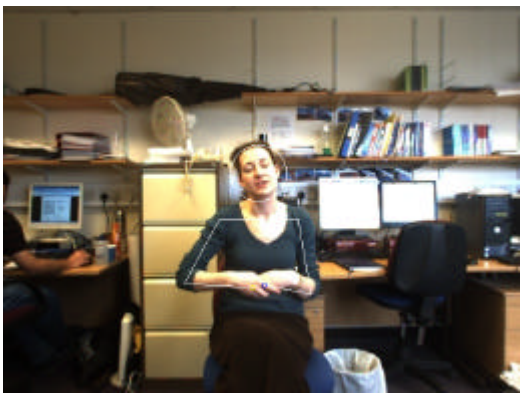
As a showcase of the different technologies developed within Dicta-Sign, an SL-to-SL terminology translator will be developed in project year 3, to serve as project demonstrator.

Work performed and main results achieved in Dicta-Sign Year-1

With regards work on *Visual Tracking and Feature Extraction*, we are developing new pose estimation and tracking techniques that incorporate depth information to provide robust pose estimation with invariance to subject appearance. Furthermore, we have developed techniques for the classification of hand shape and head pose in both the visual and depth domains.

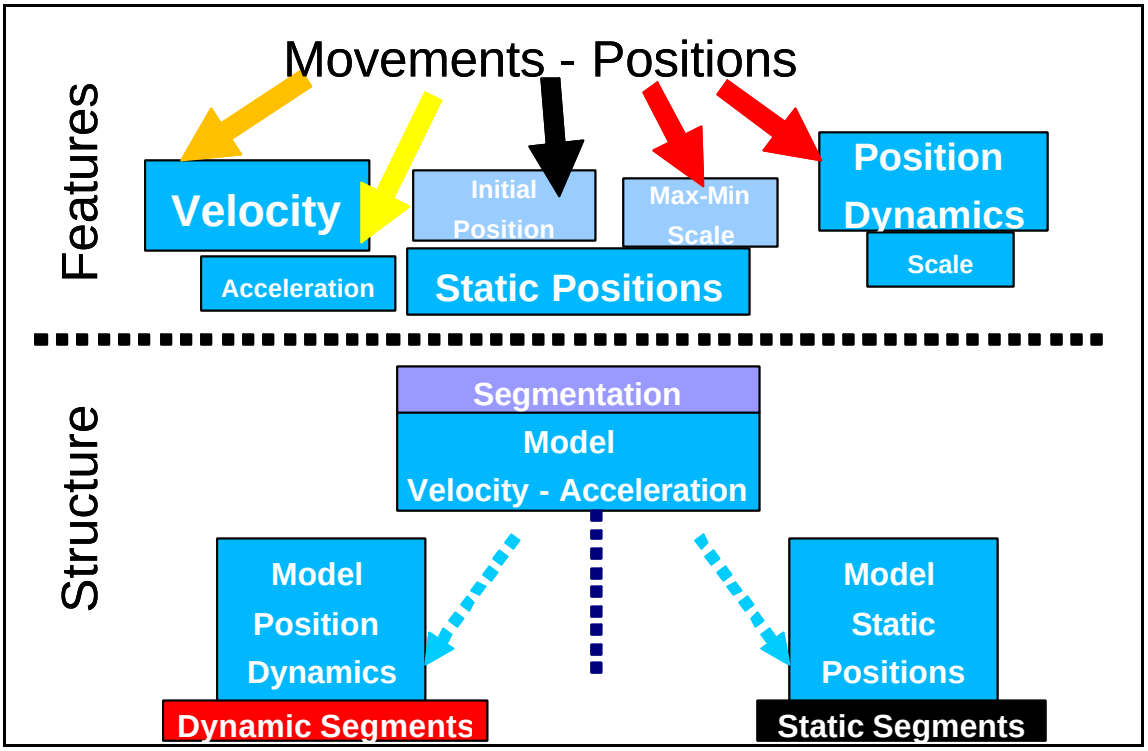


Also tools have been generated to support corpus collection activities as are techniques to provide annotation tools. Work into facial expression recognition has also been undertaken to support the inclusion of non manual features in sign.



With regards *Continuous Sign Recognition*, during Year-1 of Dicta-Sign, work has focused on the task of model training, temporal alignment and sign segmentation. Year-1 achievements include a model-based segmentation and a classification of segments, automatic sub-unit

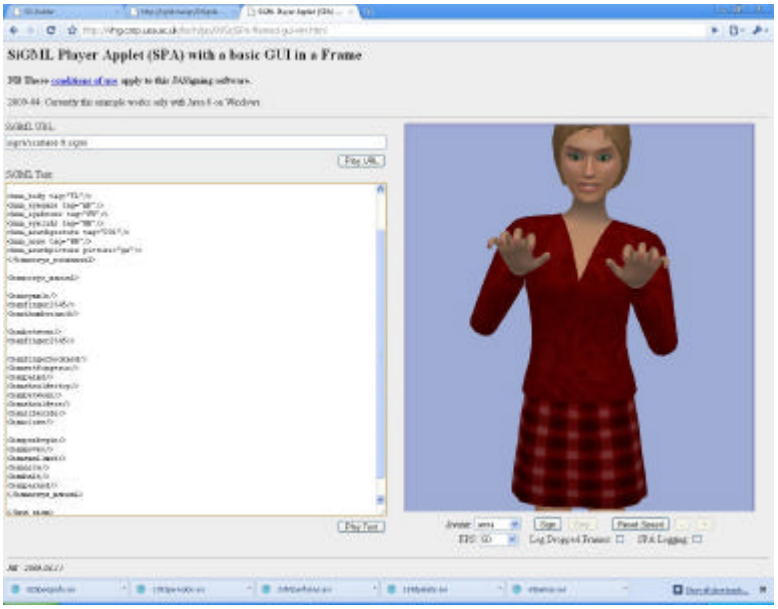
construction and the construction of a completely unsupervised data-driven lexicon, experiments on the initial recognition framework on movement-position cues and preliminary classification experiments on handshapes.



With regards work on *Synthesis and Animation*, the main activity during Year 1 of the project has been the development of the initial animation system. In parallel, progress has been made as regards the enhanced flexibility and precision of the SiGML model of sign-language production, the extension of the SiGML model to support prosodic and non-linguistic features of signed communication, the support of inter-operability of virtual human signing systems and the support of corpus construction through the animation of sign language transcriptions.

Concerning *Linguistic Modelling*, the first year has been mainly dedicated to the task of defining the linguistic framework, upon which SL recognition and SL generation will depend. The main results obtained so far are related to: 1) the design of a proposition for lexical representation that will be evaluated at the beginning of the second year of the project, 2) the evaluation of the Zebedee representation, along with a complete description of the 1000-concept list in both HamNoSys and Zebedee, for the LSF corresponding signs, and 3) the design of a tool dedicated to assigning annotations for Zebedee representations (editing and filtering).

With regards to the development of *Annotation Tools*, work has focused on the specification of the structure of a data model which can contain the wide range of data types needed for SL video annotation. This data model will be implemented in the AnColin Annotation tool. For this reason, relevant work has been carried out on the specification and development of the AnColin software. More precisely, an enhanced version of the data model structure has been built, able to handle the different kinds of information used for the annotation of a sign language video. Work has also been carried out on the specification of an API for plugins that make it possible to enhance annotation tools with automatic processing of the video to assist in the annotation task.



In relation to *Sign Language Corpora*, elicitation material was developed and acquisition of the sign language corpora for DGS and LSF was completed, the corpus acquisition task being foreseen to complete also for GSL and BSL in the beginning of Year-2 of the project. Furthermore, a common vocabulary of 1000+ entries for the four project SLs has been developed, including sense keys.

Finally, a number of dissemination activities have taken place, which have resulted in 16 papers presented in major international workshops and conferences, the organisation of a special session in the HCI-2009 conference, three invited talks, one popular press publication and two clustering meetings with the Sign-Speak consortium. A Workshop has been planned in the framework of LREC-2010 and a second workshop as a satellite to the European Conference of Computer Vision (ECCV) co-organised with the Sign-Speak consortium is in preparation. Steady contact has been maintained with the Dicta-Sign support organisations and presentation of the project to the Deaf and the wider community via the project website and participation in events of interest to the European Deaf community.

Project contact details

Full project title: Sign Language Recognition, Generation and Modelling with Application in Deaf Communication

Start date: 01/02/2009, duration 36 months

Project website: http://www.dictasign.eu

Primary project contact: DICTA-SIGN project office at ILSP/ATHENA R.C., project co-ordinator: Dr. Eleni Efthimiou (eleni_e@ilsp.gr)