# Domain Specific Sign Language Animation for Virtual Characters

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## Introduction

The internet has transformed the way we access news. Be it a sports event, a major news story, or a conference or trade-show presentation, there are frequently several internet portals dedicated to providing live and interactive reports at a moment's notice. Even though, there is frequently no effort to make the news accessible for those users requiring more specialised services, such as those from the deaf community. According to the World Federation of Deaf, only 20% of the 70 million Deaf people in the world receive an education in spoken language(World Federation for the Deaf 2013), so the remaining 80% is not able to easily read and understand text written in spoken language.

This poster describes a system that animates a signing virtual character (Figure 1) in International Sign (IS) by automatically parsing the input data, the system blends animations smoothly together in order to create a coherent and understandable presentation in sign language, with equal importance assigned to both hand and facial animation. Following the blending step, a video is rendered in a variety of formats suitable for distribution. The system was created in collaboration with groups of people with impaired hearing who were fluent in IS, and who were able to validate the results. We present a test case of the system in the shape of 'Borja', a virtual character who signed biweekly updates of the Barcelona World Race sailing regatta 2010/2011.

Figure1. Art design for Borja. The design shows a sporty style for the character to make it closer to the sailing world, bigger eyes to empathize with audience and big hands to make signs more readable through streaming videos.

## Methodology

Our animation system is designed to build a complex signed animation with a virtual character by concatenating, blending and merging animated clips previously prepared to digitally mimic the gestures of expert signers. The system relies on a series of XML-based templates indicating which signs should be used to build certain content, and which type of data is needed for the relevant information (numbers, text, etc.). Figure 2 shows a schematic overview of how the system constructs an animation.

The parser receives the data and decides whether is a known phrase, a number or a custom word. If it is a known phrase, it is retrieved directly from a database that stores the animation data for that entire phrase. If it is not a phrase, the system falls back and looks for a number or word. In this case, the sign elements that are used to compose that number or word them are taken individually and merged together to build a single new sign. This fall back is very useful when dealing with names of people or cities, or even with numbers of more than one digit. Finally, each of the clips is merged using animation blending. How each clip has to be blended is specified in the metadata description associated with that clip in the database. Each clip has its own length, start time, end time and in-out trim points which specify the boundaries for the blending.

As one of the major flaws in sign language systems is the lack of prosody, we discarded procedural animation approaches as it lacks prosody. We also discarded motion capture systems as the resulting raw motion data requires time to be edited, clean and adapted to the virtual character's proportions, being unfeasible for reduced budget environments.
Thus, we opted for a handcrafted solution by animating each clip by hand, following video references of signing experts recorded on video (Figure 3). We created a skeletal animation rig for the character body which uses both forward and inverse kinematics. We use blend shape animation for the facial expression as this gives us greater control on the precise shape of the face – an essential component for the understanding of sign language. While this requires initial manual effort, the main motivation behind the choice of this technique is the freedom and accuracy that hand-made animation can provide.
Each clip got evaluated by two signing experts (prelingually deaf) after completion

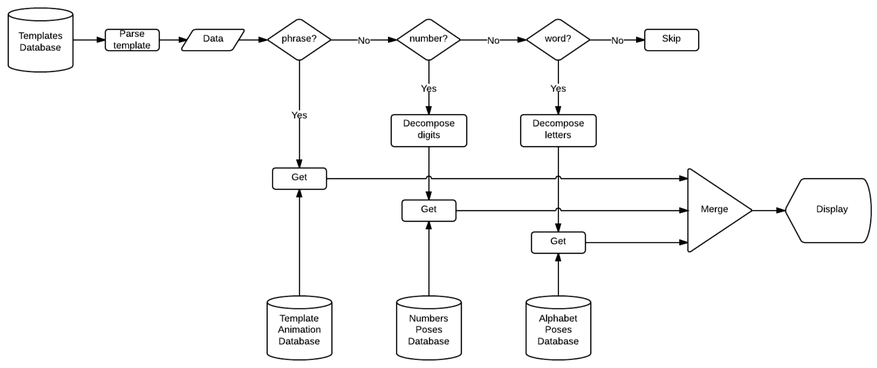


Figure2. The animation system receives an XML file that contains the description of the clips to be concatenated to build the complete animation. Three cases are considered for complete phrases, single words or numbers.

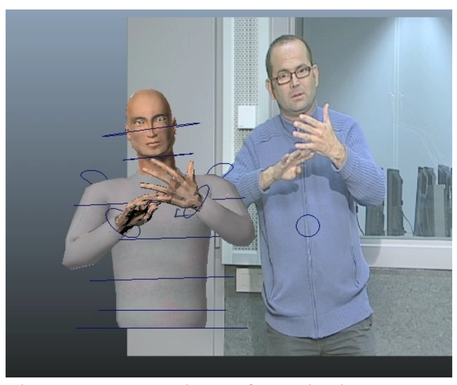

Figure3. Screenshot of a signing expert (prelingually deaf) with virtual character overlay.

## Results and Conclusions

In this paper, we present the design and implementation of a system capable of automatically transforming input data into sign language, given a specific, restricted domain. The system is designed to automatically create reports for live events such as sports events, and we present a successfully prototype, implemented to create automatic signed news for the Barcelona World Race 2010/2011.

25 videos featuring Borja (Figure 4) were created during the Barcelona World Race and featured on the RTVE website. These 25 formed part of a total of 91 multimedia entries concerning the Barcelona World Race 2010/2011. The 'popularity' of the multimedia entries is habitually measured by RTVE by measuring web traffic on each page. The results (Figure 5) show that the mean popularity rating for the 25 Borja videos was 38.96%, 15.8% greater than the mean popularity of all 91 multimedia videos. This increased in popularity is marginally greater than the dataset standard deviation of 15.6%.

The output of the system was validated as "consistently correct" by the expert signers involved in the project, but future work is now focused on obtaining more quantitative results as the quality of the animated output. A study featuring a statistically valid sample of deaf users is being carried out in order to ascertain statistically whether the animated sign language produced by the system is capable of being understood naturally in different countries around the world. If the results of this analysis are positive, we plan to develop our system and use for different scenarios such as rolling news and other live events.


Figure4. Screenshot of Borja in action.

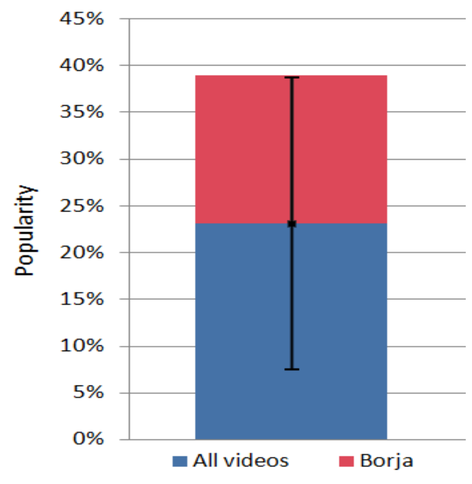


Figure5. Chart showing the 15.8% greater in popularity of Borja's videos over all other Barcelona World Race multimedia. Also shown in the Standard Deviation bar.

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