High Resolution 3D Models for the Teaching of American Sign Language

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Abstract. Millions of Americans in all age groups are affected by deafness and impaired hearing. They communicate with others using the American Sign Language (ASL). Teaching is tutorial (person-to-person) or with limited video content. We believe that high resolution 3D models and their animations can be used to effectively teach the ASL, with the following advantages over the traditional teaching approach: a) signing can be played at varying speeds and as many times as necessary, b) being 3-D constructs, models can be viewed from diverse angles, c) signing can be applied to different characters (male, female, child, elderly, etc.), d) special editing like close-ups, picture-in-picture, and phantom movements, can make learning easier, and e) clothing, surrounding environment and lighting conditions can be varied to present the student to less than ideal situations.

Keywords. American Sign Language, ASL, 3D Models, hearing impaired, deafness, rehabilitation

Introduction

Despite the fact that close to 10 million Americans from different ages have some degree of hearing impairment, and that ASL is the fourth most commonly used language in the U.S., most universities do not teach ASL because “it is not an academic language” [1].

The American Sign Language (ASL) is a complex visual-spatial language that is used by the deaf community in the United States and English-speaking parts of Canada. It is a linguistically complete, natural language. It is the native language of many deaf men and women, as well as of hearing children born into deaf families. It is usually taught as a person-to-person interaction and to a lesser extent using videos and books. Teaching ASL is a challenging task. ASL has a very complex grammar. Unlike spoken languages where there is just one serial stream of phonemes, sign languages can have multiple things going on at the same time. This multiple segmentation makes it an exciting language for linguists to study and a hard language for hearing impaired people to learn. ASL has its own morphology (rules for the creation of words), phonetics (rules for hand shapes), and grammar that are very unlike those found in spoken languages. ASL and other sign languages have been described as "gestural" languages. This is not totally correct because hand gestures are only one component of ASL. Facial features such as eyebrow motion and lip-mouth movements are also

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significant in ASL as they form a crucial part of the grammatical system. In addition, ASL makes use of the space surrounding the signer to describe places and persons that are not present [2,3,4].

1. Specific Aims

To develop and validate a digital library of high resolution 3-D models for the teaching of the American Sign Language.

2. Methods

Signs, face expressions, and body postures used in ASL will be obtained from trained interpreters, books and videos, and reproduced in 3-D meshes of human figures covered with high resolution textures and rigged for animation. These poses will be used as Key Frames to produce sequences which mimic ASL words and phrases. Clips will be rendered and stored constituting a library, from which they can later be used to construct larger animation/video segments similar to ASL speech. Once corrected by a Senior ASL Interpreter, they will be presented in DVD collections to three interpreters and three hearing impaired persons who will try to identify their meaning. Results among interpreters and subjects will be compared to establish the utility of the collection before testing it in a larger population.

Classical modeling and animation techniques as well as traditional cinematic production of digital content will be used. Initial models will be male and female adolescents and young adults. Later, constructed animations can be translated to other characters. Poser® 6 or 7 by e-Frontier® (http://www.e-frontier.com/) will be used for character creation. Either Poser 3D meshes or those produced by Daz3D® (http://www.daz3d.com) will be used and covered with textures from the same manufacturers or from independent creators acquired from web stores like Renderosity® (http://www.renderosity.com). Expression morphs and signing poses will be created in Poser® as this is the greatest strength of this program. Freeware utilities (MorphManager, etc.) are then used to delete unnecessary morphs from the file to make it smaller. Poser® is not good at lighting and smooth and fine controlled animation, and for that reason, the models will be transferred to 3D Studio MAX® which is an industry gold standard for computer animation (www.autodesk.com/3dsmax). Animations will be produced at 720 x 480 pixels which correspond to DVD quality content in NTSC American standard. They will be rendered at 30 frames per second and will include ½ second of a base position at the beginning and end. Rendered uncompressed AVI files will be the source files of the library. Once the modeling and animation phase is concluded, copies of the AVI videos will be transferred to Premiere® which is a non-linear video editor. In Premiere audio or subtitles can be added to the animation as well as other necessary editing modifications. From Premiere® the animations will go to After Effects® in which special effects can be introduced like “ghost” movements, picture in picture of close-ups, rotoscopic (drawing over the video) animations, etc. Encore® will be used to author CDs, DVDs including chapter generation and title and subtitle pages which lead to the chapters. Premiere®, After Effects®, and Encore®, are products of Adobe® (http://www.adobe.com). Procoder® and other converters will be
used to generate videos suitable for the web, iPods, mobile phones and other applications (Figure 1).

3. Results

The final library should contain: a) the complete American Manual Alphabet, b) no less than 1000 sign words, c) no less than 50 icons (facial expressions, gestures, and body language), d) no less than 50 baby (kids) signs, and d) no less than 25 common phrases. Currently, approximately 30% of the library has been developed (Figure 2).
4. Validation

All models and the resulting animations will be presented to and corrected by a Senior ASL interpreter from UC Davis Medical Center’s, Medical Interpreting Services. The library will be burned to DVD and presented to three different ASL interpreters and three hearing impaired patients. The number of correctly interpreted signs will be determined as well as the concordance among interpreters and patients.
5. Future Goals (new projects)

- To continue developing the library with new words and constructs in a permanent effort to make it richer.
- To develop specialized libraries of signing terminology (medical, legal, etc.)
- To produce diverse electronic and printed content using the library. Content can be in the form of CDs, DVDs, web-based instruction, videoCasts to iPods and mobile phones, computer games, books, flyers, etc.
- To promote the learning of ASL as a second language not only with families and friends of deaf people, but in high schools and colleges alike.
- Considering that one-third of the adult population will develop some degree of hearing loss, it would be wise to contact adult and senior citizen associations and to promote the teaching of ASL at least to fulfill basic daily communication requirements before affected people lose communication capacity.
- To network with research groups working on automated English-to-ASL translation systems to propose the use of the library.

References