Designing an Interface to Support the Creation of Animations of Individual ASL Signs

Spandana Jaggumantri, Sedeeq Al-khazraji*, Abraham Glasser, Matt Huenerfauth
Rochester Institute of Technology, 1 Lomb Memorial Drive, Rochester, NY, USA
* This researcher is also affiliated with the University of Mosul, Mosul, Iraq
sj6987@rit.edu, sha6709@rit.edu, atg2036@rit.edu, matt.huenerfauth@rit.edu

ABSTRACT
In support of our lab's ongoing research on synthesizing ASL animations, we have designed an authoring-tool user-interface for members of our lab to create new single ASL sign animation for our system. Our design process included three rounds of iterative prototyping, interviews, and feedback from researchers at our lab who critiqued static interface design prototypes. Participants gave qualitative feedback about the prototypes and were asked whether the controls would enable them to manipulate various parameters of the sign. This poster proposal describes our design process and the final user-interface design.

KEYWORDS
Sign animation, Authoring tool, User interface.

1. Introduction
There are half a million people in the U.S. who use sign language as a primary form of communication [11], and standardized testing has revealed lower levels of English reading skills among many deaf individuals in the U.S. [13]. Our lab researches semi-automatic generation of animation of American Sign Language (ASL), for providing ASL content on websites. While videos of human signers could be posted on websites, this is rarely done, since it is expensive to re-film a human performing ASL for content that is dynamic or changes frequently. Instead, animated content could be dynamically generated from an easy-to-update script of a message. Research is needed on how to make this pipeline of ASL animation production as efficient as possible for users. To produce animation stimuli, to evaluate new models or algorithms we create, our lab uses an animation system with a lexicon of individual ASL signs. Thus, research software is needed that can enable members of our team to efficiently build collections of animations of individual words, which could be the building-blocks for creating sentences or longer messages. Such a tool would enable users to adjust the location, movement, orientation, and hand shape of an animated character.

2. Prior Work
Some researchers have examined tools for supporting the authoring of entire sentences of sign language by composing individual sign animations to produce longer messages, e.g. [9], but in this work, we focus on the authoring of an individual sign. Some prior methods of authoring individual signs have been based on the user entering a phonetic notation that specifies the performance. For instance, JASigning-based animation systems have been based on the HamNoSys notation scheme [4], and research on the Zebedee formalism has explored more abstract constraint-based methods of specifying sign movements [2].

Other researchers have investigated graphical user-interfaces for authoring sign-language signs; an excellent survey of such work appears in [6]. Some work has enabled keyboard and mouse input for animation [8], and recent work has examined 2D interfaces for authoring signs, with a focus on novice users [1]. Vcom3D Gesture Builder [14] was available commercially from 2000 to 2014, and it allowed users to produce a signed animation by using the mouse to drag and drop the hands of an animated computer character. Other work has focused on enabling users to re-use pre-existing components to create new signs, e.g. users of [3] selected among pre-existing hand, arm, head movements and signs. Kipp and Nguyen presented a system to control one arm and hand of a virtual character using a multi-touch interface by modifying several parameters to make a posture [10]. Oshita used a statistics-based inverse kinematics to control the entire body of the character [12]. Some researchers have incorporated motion-capture into the authoring process: For instance, Heloir et al. have incorporated motion-tracking into the workflow of authoring tools, to track the motion of the author's hands and automatically segment motion curves into keyframes [6]. Other work has examined the use of motion-capture for setting the speed and acceleration of a sign that had been input using a notation formalism [7].

While much of this prior work has focused on user-interfaces for *novices* to create signs, the focus of our work is to create infrastructure for our lab, to enable members of our team to produce signs for use in animation stimuli for user studies.

3. Research Methods
Our lab's software is based on EMBR [5] for generation of human animations. Figure 1 displays the Behavior Builder authoring tool provided with EMBR. In initial usability tests, researchers were asked to use Behavior Builder to generate some individual ASL signs, and several problems were identified: the mapping of controls to the character could be more natural, inputting numerical values to set locations of the hands could be easier, the information hierarchy and navigation of the interface could be more intuitive, hand shapes should be displayed as images rather than names, and the interval between making changes and seeing the character's pose could be more rapid.

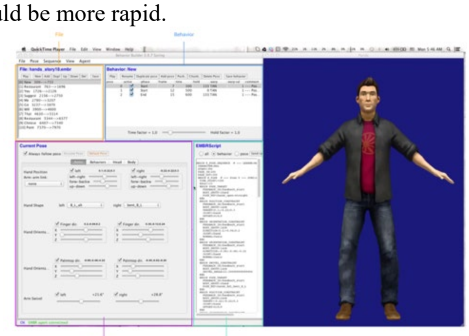
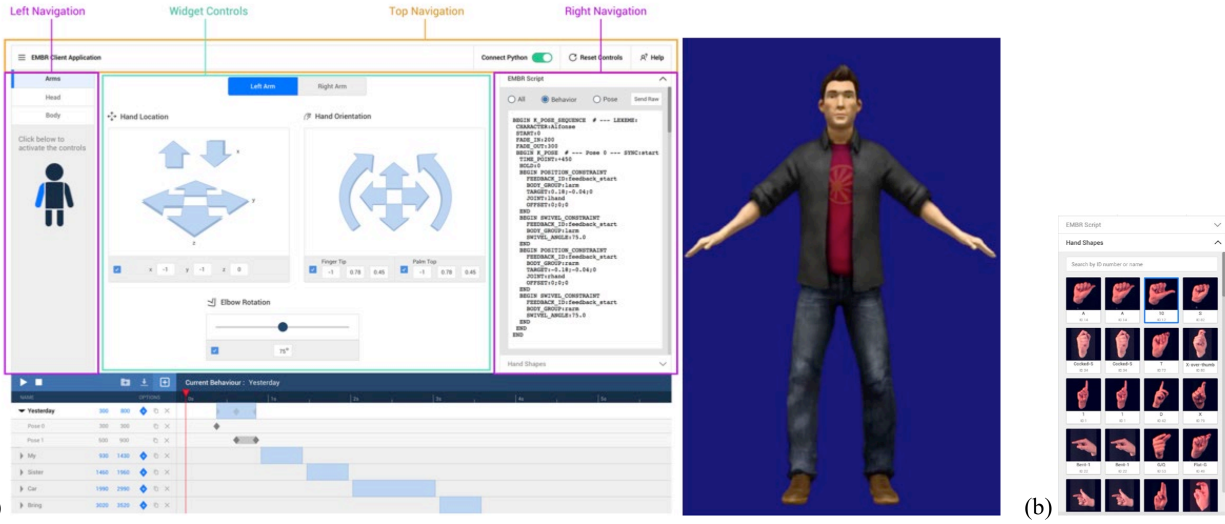


Figure 1: Screenshot of EMBR Behavior Builder software



(a) (b)

Figure 2: (a) Final version of user interface, (b) alternate view of Right Navigation with Hand Shapes section expanded.

We began with the following set of design assumptions:

- We assumed that the system will control a character that uses a key-frame-based method of animation, in which individual 'poses' are defined at various moments in time, with each pose consisting of a hand location, hand orientation, and handshape. (This assumption is consistent with the EMBR-based animation platform in use at our lab.)
- We assumed that we are not using a 3D direct manipulation interface in which a user drags the arms of a virtual character, since we intend our interface to be usable via a variety of platforms, including a web-based system. Thus, our interface needed to provide indirect controls that would adjust the movements of a character in a separate window.

IRB-approved studies were conducted with three rounds of prototyping with a total of 10-12 participants. The participants were researchers at our lab, and in each round, 6-8 researchers provided qualitative feedback on the designs. Feedback was gathered using open-ended questions regarding the following:

- Whether the labels were understandable user-interface for controlling the virtual human, e.g. hand orientation,
- Whether the controls would enable the user to manipulate the hand shape, hand location, or hand orientation of the virtual human to match a desired pose,
- Whether the controls enable the user to easily manipulate the timing of individual poses to produce an animation with an overall movement or acceleration that is desired.

The data collected in the studies was assigned priorities based on frequency and level of impact. This information was used to make changes to the designs for the subsequent rounds of studies. In the end, the initial prototype designs went through three rounds of re-design. In the final round, the 7 participants reported that they found the overall design understandable and that they could understand how each widget control would enabled them to manipulate the hand shape, location, and orientation of a virtual human to match a desired static pose. They did indicate a need for rapid refresh of the virtual human character in the display window, to reflect the result of their adjustments, especially for hand orientation. Overall, participants indicated satisfaction with the arrangement of controls on the prototype interface.

Figure 2 illustrates our final design. The *TOP Navigation* region contains commands for refreshing the visual display window with the virtual human character or other file access. The *Left Navigation* region enables the user to select body components to control (via clicking on portions of a human-shaped graphic). The *Widget Controls* region contains 3D location-adjustment and rotational controls for moving the selected portion of the body, e.g. the right hand, through the use of clickable arrows. The *Right Container* region provided users with the ability to change the handshape via a grid of handshapes images as in Figure 2(b), or to directly view and edit the "EMBRscript" (the underlying notation that specifies the movement of the virtual human), which may be needed for fine-grained adjustments to the animation for designing experimental stimuli for specific research projects.

4. Conclusion and Future Work

We have presented the design of new user interface of software to enable a human user to author ASL animations as part of a system for semi-automating the generation of ASL messages. We conducted three rounds of formative user studies to produce a final design. The primary contribution of this work is our presentation of a final design for our system, as illustrated in Figure 2, as well as our description of our approach in gathering feedback from researchers in a multi-round usability study. Our future work will extend our prototype design to include controls for non-manual signals, and future work will include usability testing of this system to determine if it is efficient and effective at enabling users to author ASL signs.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Award Nos. 1462280, 1540396, 1763569, 1822747; by the Department of Health and Human Services under Award No. 90DPCP0002-01-00; by a Microsoft AI for Accessibility (AI4A) Award; by a Google Faculty Research Award; and by the National Technical Institute of the Deaf.

REFERENCES

[1] Adamo-Villani, N., Popescu, V., Lestina, J. 2013. A non-expert-user interface for posing signing avatars. Disabil. Rehabil. 8(3), 238–248

[2] Braffort, A., Filhol, M., Delorme, M., Bolot, L., Choisier, A., Verrecchia, C. (2015), KAZOO: A Sign Language Generation Platform Based on Production Rules, in Universal access in the information society (UAIS), vol. 15:4, C. Stephanidis (Ed.).

[3] Chittaro, L., Buttussi, F., Nadalutti, D. 2006. MAge-AniM: a system for visual modeling of embodied agent animations and their replay on mobile devices. In *Proceedings of the working conference on Advanced visual interfaces (AVI '06).* ACM, New York, NY, USA, 344-351.

[4] Ebling, S., Glauert, J. 2016. Building a Swiss German Sign Language avatar with JASigning and evaluating it among the Deaf community. Univers. Access Inf. Soc. 15, 4 (November 2016), 577-587. DOI: http://dx.doi.org/10.1007/s10209-015-0408-1

[5] Heloir, A., Kipp, M. 2009. EMBR --- A Realtime Animation Engine for Interactive Embodied Agents. In Proceedings of the 9th International Conference on Intelligent Virtual Agents (IVA '09), Zsófia Ruttkay, Michael Kipp, Anton Nijholt, and Hannes Högni Vilhjálmsson (Eds.). Springer-Verlag, Berlin, Heidelberg, 393-404. DOI: http://dx.doi.org/10.1007/978-3-642-04380-2_43

[6] Heloir, A., Nunnari, F. 2016. Toward an intuitive sign language animation authoring system for the deaf. Univ Access Inf Soc 15: 513-523. https://doi.org/10.1007/s10209-015-0409-0

[7] Jayaprakash, R., Matthes, S., Hanke, T. 2013. Extending the eSIGN Editor to specify more dynamic signing. Poster Presentation at Third International Symposium on Sign Language Translation and Avatar Technology (SLTAT'13), Chicago, Illinois, USA.

[8] Jemni, M., Elghoul, O. 2008. A system to make signs using collaborative approach. Computers Helping People with Special Needs, no. 5105 in Lecture Notes in Computer Science, pp. 670–677. Springer, Berlin Heidelberg

[9] Kannekanti, A., Al-khazraji, S., Huenerfauth, M. 2019. July. Design and Evaluation of a User-Interface for Authoring Sentences of American Sign Language Animation. In *International Conference on Human-Computer Interaction* (pp. 258-267). Springer, Cham.

[10] Kipp, M., Nguyen, Q. 2010. November. Multitouch puppetry: creating coordinated 3D motion for an articulated arm. In *ACM International Conference on Interactive Tabletops and Surfaces* (pp. 147-156). ACM.

[11] Mitchell, R.E. 2005. How many deaf people are there in the United States? Estimates from the Survey of Income and Program Participation. *Journal of deaf studies and deaf edu.*, *11*(1), pp.112-119.

[12] Oshita, M. 2013. October. Multi-touch interface for character motion control using model-based approach. In *2013 International Conference on Cyberworlds* (pp. 330-337). IEEE.

[13] Traxler, C.B., 2000. The Stanford Achievement Test: National norming and performance standards for deaf and hard-of-hearing students. *Journal of deaf studies and deaf education*, *5*(4), pp.337-348.

[14] Vcom3D. 2019. Vcom3D homepage. http://www.vcom3d.com