

Virtual Sign Animated Pedagogic Agents To Support Computer Education For Deaf Learners

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Abstract

In Thailand, there is a desperate need to improve the educational opportunities for deaf and hearing-impaired university-aged students. The research described herein is targeted at two aspects of this issue: 1) design and test a virtual sign animated instructional tool for the Thai sign language, and 2) investigate how instructors of university classes can most effectively teach deaf students and assess their performance, particularly by using this tool. Currently, I have completed a thorough review of the literature, constructed a 3-D human model that includes rudimentary facial expressions, and devised a framework to investigate the instructional process.

Introduction

During my studies program at Mahidol University in Thailand, I became aware of the severe problems encountered by deaf and hearing-impaired university-aged students. (I will henceforth refer to all such students as “deaf.”) A little investigation uncovered two important facts. First, the opportunity for deaf students to learn Thai sign language is very limited. Second, deaf students primarily learn through their sense of vision unfortunately, very few instructors understand this or receive any training in the most effective way to educate deaf student. This research is aimed addressing these two problems. The first research focus is to construct and test a virtual sign animated instructional tool that will enable students to learn Thai sign language. The second focus is on investigating the efficacy of different techniques in the classroom relative to deaf students’ learning and assessment, particularly the possibility of using this tool, with the goal of providing instructors with insights into how they can more effectively teach the deaf.

At the heart of this research is computer animation which offers great potential for better supporting science and technology education for the deaf. To investigate this potential, I am developing the Virtual Sign Animated Pedagogic Agents which uses computer generated 3-D images to teach Thai sign language as well as provides a platform for studying instructional techniques. This approach has had a great impact on the technological development of animated pedagogical agents, especially with the emphasis on lifelike and controllable agent behaviors. This is particularly important in this research because it supports essential features of the Thai sign language such as hand gestures, facial expressions, and gaze. In addition, the research on animated interface agent provides a new way of human computer interaction by applying features of face-to-

face human communication to human-computer interaction. The result is that animated pedagogical agents are believed to enhance computer-based learning and are also effective at improving the motivational aspects of learning experience [4].

Many sign language researches use a concatenated synthesis system based on data collected with a “DataGlove” such as a machine interpreting system that translates written Japanese to Japanese Sign Language and vice versa [6]. The English company Televirtual produced a prototype captioning system known as “Simon the Signer”[1] and a successor, ViSiCAST[8]. For computer animation usability, VCom3D [7] has a system that produces signed English as the input and produces H-Anim-compliant Web3D [9] as the output. The first part of my research, on the other hand, is focused on development of 3-D virtual human and sign language animation with facial expression techniques in the context of education technology. We call this Virtual Sign Animated Pedagogic Agents (VSAPA). This concept is applied sequentially to the various steps of exploiting a virtual human approach: hand animation, then facial expression, and finally cognitive skills evaluation. The aim of this research is to enhance computer literacy and provide greater opportunities for deaf learners by developing and assessing the effectiveness of a real learning environment and interactive learning to teach deaf students. My first application area will be computer science, but the research results should provide a foundation for exploitation in other disciplines as well. The second aspect of this research centers on defining and assessing the effectiveness of different techniques in the classroom. I selected computer science as my first application area to reduce the external complexity of the initial work. Since VSAPA is a computer-based system and the material we will use in the prototype applications is also computer-based, many of the complications associated with environmental factors and human instructors are eliminated. I intend to start this part of my research by adapting currently taught material to different learning domains that are better suited for deaf college students and assessing the effectiveness relative to several measures. This process of interactive learning, especially for deaf students, is complex and affected by many factors. Clearly, the instructional design component is critical because it is important for users to have the flexibility for building knowledge by manipulating different types of media at their own pace and according to their own preferences. Equally important is the user interface which, in so many cases, is the difference between a tool being useful and used or ignored.

The final aspect of my research is to use VSAPA and the application to computer science material to provide instructors with some insights into techniques that will improve the educational experience and learning of deaf students. For example, it has been suggested that some students are more readily engaged when an instructor uses sign language rather than teaching by voice with a sign language interpreter translating the information[2]. While this is interesting, it is unlikely that instructors at universities not exclusively for deaf students will learn sign language, so it is important to investigate other techniques that can help.

The overall motivation for this work is my belief that deaf people should have full access to resources for education and employment – and this research is targeted at fulfilling this belief.

Research methodology

The VSAPA will be based on 3-D technology (e.g., 3dsmax[10], LIFESTUDIO:HEAD [3]) dedicated to sign language features such as location, movement, hand-shape and orientation combining facial expression, Web technologies, innovative user interfaces, and pedagogical strategies. Each of these is now briefly addressed.

Virtual Sign Animated Pedagogic Agents

Design of VSAPA

Develop the virtual human with sign language and facial expression by scripting animation languages and visual modeling tools.

Design computer content

The content currently under investigation includes text, sign language with the agent, animations, and adjunct questions. To effectively learn the material, deaf learners typically first read the text screen, then view the sign animated pedagogic agent, and finally watch the graphic animations.

Design User Interface

System links for graphic user interface design and usability testing. The focus for GUIs is on optimizing the static displays that interactive systems are based on. There are elegance but simplicity, perceptual organization and visual structure. It is particularly investigating to identified the attributes that contribute to usability such as learn ability, efficiency, memory ability, errors and satisfaction[5].

Assessment process

Measures will be constructed that assess the effectiveness of the tool as well as how these measures are obtained. For example, to understand how much content the students retain, one might use written or oral exams. It is not known if one is more effective than the other relative to assessing deaf students' knowledge of content or if the way a written exam is constructed has an impact. These are the types of questions that we wish to address using VSAPA.

The research scheme is illustrated by Figure 1.

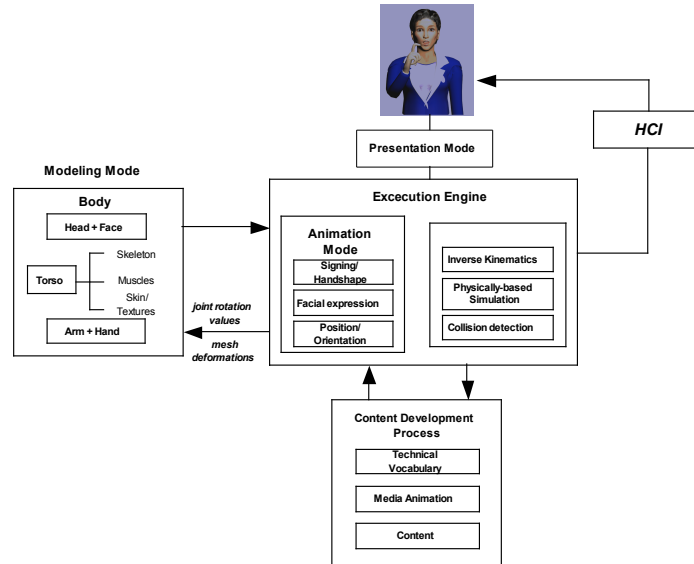


Figure 1. Research Scheme

Research status

Currently I have performed three tasks associated with this research: (i) analyzed the literature related to the construction of 3-D human models; (ii) constructed a prototype that includes hand sign animation and rudimentary facial expression; and (iii) begun to develop a framework of instructional design.

Contribution

We believe that performing applied research into development of VSAPA and integrating this into a learning system to assist deaf college student is important work. With advances of computing and software, there is much promise that this approach can significantly improve the opportunities for deaf people in Thailand and around the world.

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