THE UNIVERSITY OF MEMPHIS | Office of Technology Transfer

Emotionally-Sensitive Intelligent Tutoring Systems

The University of Memphis seeks a licensee to commercialize a significant advance in Intelligent Tutoring Systems (ITSs). The invention consists of software and proprietary algorithms which allow ITSs to sense and optimally respond to the learner's emotional states and not simply their cognitive states. The inventors are internationally recognized, award-winning leaders in Artificial Intelligence-based tutor system research. This technology is built on decades of research supported by millions of dollars of federal grants.

> *While current e-learning systems focus on knowledge and cognition, it is widely acknowledged that the next generation affect-sensitive ITSs will be the wave of the future. For example, the theme of the 14th International Conference on Artificial Intelligence in Education was on "Affective Modeling" (i.e. detecting and responding to student affect).*

Applications

- The computer-based training and e-learning markets are large and constantly growing. Training systems that achieve impressive learning gains, such as the present invention, have a wide range of applications for virtually any computerized training scenario.
- Gives Intelligent Tutoring Systems the unique capability of responding to student's emotional states in addition to their cognitive states and knowledge levels.
- Can be an add-on to existing ITS platforms.

Hai Trieu || Office of Technology Transfer || 901.678.1712 || hhtrieu@memphis.edu

Advantages

- Provides a tool that is particularly effective with students who are initially unfamiliar with the subject taught by the ITS.
- Yields significant learning gains by detecting, responding to, and synthesizing emotion.
- Uses existing ITS software and hardware.

U of M researchers have already developed and evaluated systems similar to those that DARPA aspires to launch in 3-5 years, They are currently at the forefront of the research in this area.

Novelty

The invention represents the first Intelligent Tutoring System with natural language dialogue that detects and responds to students' emotional state. Two novel aspects that make this unique are:

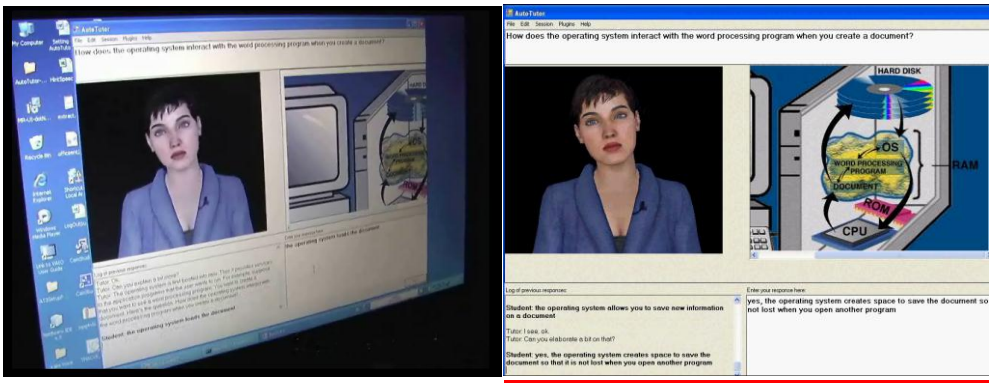
- The algorithm used to detect student emotions combines conversational cues, posture, and facial features. This form of multimodal affect detection is achieved via a three-channel decision level fusion algorithm.
- The strategies the system uses to respond to students' emotional and cognitive states. This is accomplished with a theoretically-grounded production system that helps students regulate their negative emotional state in a manner that is dynamically responsive to each individual learner.

State of Development

A functional prototype has been developed and evaluated. A controlled experiment comparing the new affect-sensitive AutoTutor to the original AutoTutor indicated that the affect-sensitive version significantly and substantially improved learning for low-domain knowledge students. **Learning improved by approximately 3/4ths of a letter grade and resulted in low-domain knowledge students showing substantial learning gains over a 60 minute training session.**

Summary and Function of Invention

The invention is designed to promote the learning of difficult conceptual information by capitalizing on the merits of one-on-one human tutoring in an automated fashion. The invention consists of an affect-sensitive variant of an existing intelligent tutoring system called AutoTutor.



The traditional AutoTutor teaches students introductory computer literacy topics (hardware, operating systems, and the Internet), Newtonian physics, and critical thinking via a tutorial dialogue in natural language. This traditional version of AutoTutor is sensitive to students' cognitive states but not their affective states (i.e. emotions). The invention significantly advances the AutoTutor system by detecting and responding to learners' emotions in addition to their cognitive states. In particular, the invention automatically detects students' emotions such as boredom, confusion, frustration, and neutral affect through state-of-the-art sensors and algorithms that monitor conversational cues, posture patterns, and facial expressions of the student. The sensed emotions guide the tutor's pedagogical and motivational strategies in a manner that optimally coordinates the students' cognitive and emotional states to enhance learning and engagement. The invention also synthesizes emotions through an embodied pedagogical agent that expresses emotions through verbal content, facial expressions, and affectively modulated speech.

Simply put, the invention yields impressive learning gains by detecting, responding to, and synthesizing emotion.

The Inventors

Dr. Art Graesser is presently a full professor in the Department of Psychology, an adjunct professor in Computer Science, and co-director of the Institute for Intelligent Systems at the University of Memphis. He is also a senior research fellow at the University of Oxford. Dr. Graesser received his Ph.D. in psychology from the University of California at San Diego.

Dr. Graesser's primary research interests are in cognitive science, discourse processing, and the learning sciences. More specific interests include knowledge representation, question asking and answering, tutoring, text comprehension, inference generation, conversation, reading, education, memory, computational linguistics, artificial intelligence, and human-computer interaction. In 2010 he received the Distinguished Scientific Contribution Award from the Society for Text and Discourse and the Distinguished Contributions of Applications of Psychology to Education and Training Award from the American Psychological Association.

Dr. Sidney D'Mello is a research assistant professor in the Institute for Intelligent Systems at the University of Memphis. He co-directs the Emotive Computing Lab with Art Graesser. His primary research interests are in the cognitive and affective sciences, artificial intelligence, human-computer interaction, and the learning sciences. More specific interests include affective computing, artificial intelligence in education, speech recognition and natural language understanding, and computational models of human cognition. He has authored over 100 papers and presentations in these areas. D'Mello received his Ph.D. in Computer Science from the University of Memphis in 2009.