James Allen, Ehsan Hoque and Lenhart Schubert of the Department of Computer Science at the University are part of a team of investigators who have received a DARPA grant to develop ways to enable computers to communicate more meaningfully.

Project aims to make computers better communicators

Most systems that allow humans to communicate by voice with a computer are fairly limited in application.

The computer interprets a group of preset commands, using pattern matching, syntactic parsing and feature extraction to respond to the structure of the language, not its context. It does so within a narrowly prescribed area of application -- whether it be as simple as stacking one block on top of another, or as complicated as giving directions to a driver.

Change the task, and a whole new set of commands must be hand-engineered. And even then, the computer is incapable of carrying on a truly human-like conversation.

James Allen, the John H. Dessauer Professor of Computer Science at the University of Rochester and Associate Director of the Florida Institute for Human and Machine Cognition (IHMC), proposes developing a way to enable computers to communicate more meaningfully, based on collaborative problem solving, with a five-year, $7.5 million grant from DARPA, the Defense Advanced Research Projects Agency.

Allen will work with collaborators at IHMC, which will receive $5 million of the funding, and at the Department of Computer Science here, including Prof. Lenhart Schubert and Asst. Prof. Ehsan Hoque, who will serve as PI for the Rochester part of the project.

Their goal: a “generic conversational shell” for communicating with computers that:

1. Could be used in any domain
2. Understands the conventions of conversation and has an abstract “common sense” theory of the world

3. Embodies a collaborative problem solving agent that "knows how to cooperate with humans and engage in activities," including joint learning and teaching, and problem solving
4. Includes an integrated model of perception and perceptual learning that the computer can use to understand the physical world around it, including the actions, gestures and body language of the humans it is communicating with.

This would "enable a new generation of conversational systems with dramatically increased naturalness and generality while significantly decreasing the development time for new systems in new application domains," the grant summary explains.

"A robot endowed with these capabilities could be dropped into a new environment, for example a household if it is to do cleaning, or a disaster if this is to do recovery, and be rapidly instructed by natural language conversation on the tasks it should perform and how they might be performed."

The project is being funded through DARPA's new Communicating with Computers (CwC) program, which "aims to develop technology to turn computers into good communicators."

Though the IHMC/Rochester project is admittedly "highly ambitious," much of the foundational work is "clearly achievable," Allen writes. "Even if we could not fully realize these goals, we would still have produced lexical resources that go far beyond what is currently available, plus a collaborative problem solving agent much more general than existing models. These results would energize continuing research beyond the project."

Allen, who has managed more than $20 million in Department of Defense funding during the past 20 years, researches computational models of intelligent collaborative and conversational agents, with a strong focus on the connection between knowledge representation, reasoning and language comprehension. An example of his work is "PLOW: A collaborative task learning agent," in which a computer responding to voice commands learns to order books online. That won the best paper award from the Association for the Advancement of Artificial Intelligence in 2007.

Hoque, who co-directs the Rochester Human-Computer Interaction Lab, focuses on 1. designing and implementing new algorithms to sense subtle human nonverbal behavior, 2. enabling new behavior sensing and modeling for human-computer interaction, and 3. inventing new applications of emotion technology that can be used for teaching social skills and public speaking, and in assisting individuals who experience difficulties with social interactions. His PhD dissertation at MIT (2013) included development of a humanoid agent that provides feedback to the user's vocal and visual nonverbal behavior in a real time conversation, helping the person become better at face-to-face conversations. This gained international news

coverage, won a best paper award, and was selected by the MIT museum as one of the most unconventional inventions at that institution.

Schubert works in broad-coverage natural language understanding, knowledge representation and acquisition, reasoning, and self-aware cognitive agents. He has written over 130 refereed articles in those areas. Recent projects include the Knext knowledge acquisition system.

In addition, a postdoc and four graduate students at the University of Rochester will work with various researchers at both Rochester and IHMC.