Computer scientists developing 'nurturing' computers

September 7 2004

Imagine a day when your computer will be able to let you know if you need a break, alert you to take medication or even go to the doctor. In some computer science labs at the University of Houston, such human-computer interaction is becoming a reality. Ioannis Pavlidis, associate professor of computer science at UH, and his Infrared Imaging Group at UH's computer science department in the College of Natural Sciences and Mathematics are leading the way with ATHEMOS (Automatic THErmal Monitoring System), a system pioneered by Pavlidis and his group that allows a computer to perform touchless physiological monitoring of its human user, including measurements of blood flow, pulse and breathing rate. ATHEMOS was featured at Wired magazine's international Nextfest Exposition as one of the novel technologies that is expected to make a major impact in the future.

Pavlidis recently was awarded a grant from the National Science Foundation (NSF) from its Division of Information and Intelligent Systems for $640,169 to be spread across three years for research titled "Interacting with Human Physiology." With its goal to monitor the actual health of a subject during computer use, the Pavlidis project plans to incorporate physiologic monitoring in human-computer interaction. The sensing element is a thermal imaging camera that is employed as a computer peripheral. Through bioheat modeling of facial imagery, almost the full range of vital signs can be extracted. This physiological information can then be used to draw inferences about a variety of health symptoms on a continuous basis.

"An increased anxiety level, for instance, is indicated when we detect periorbital warming through thermal imaging," Pavlidis said. "That is, the temperature goes up around the area surrounding the orbit of the eye due to increased blood flow, telling us that our subject is experiencing some sort of emotional distress. This periorbital area is the facial area affected the most from blood flow redistribution during anxious states."

Since current computers are almost completely unaware of the actual state of the human user, researchers are proposing methods for computers to understand and respond to computer users' feelings and physical states. This would enable a two-way exchange, with each participant (computer and human) aware of the other and responding appropriately.

As the principal investigator, Pavlidis aims to add a new dimension in human-computer interaction, with the project aspiring to use the abundant computing resources at home and the office in combination with novel sensing, algorithmic and interface methods to enhance the user's experience and, at the same time, create a new preventive medicine paradigm. At a distance of up to several feet from the subject, a computer will be able to monitor the actual health of its user during computer use.

"Most people often wait until becoming symptomatic before checking on the status of their health," Pavlidis said. "With typical health checks occurring at a doctor's office, where the environment is isolated and often static, one can make the argument that the value of such check ups is often limited. Chronic ailments, for instance, such as heartbeat irregularities, headaches and anxiety disorders, often manifest themselves intermittently for short intervals in a random manner, involving any number of situational and environmental variables."

Pavlidis will collaborate with the Medical Usability Lab of Columbia

University in New York and the Physiology Lab of Mayo Clinic in Rochester, Minn., for the human experimentation aspects of the project.