Moving Ahead With Eye Power

Eye trackers have literally opened up the world to many disabled people who suffer with limited movement and speech. The sophisticated devices track eye movements—distinguishing the viewer's precise gazepoint at a computer screen—enabling communication and environmental control through an array of interface tools. For example, a man whose motor control is limited to his eyes can write a regular newspaper column, and a quadriplegic girl can attend school and participate in class with the help of an eye tracker.

While these systems have been available for more than a decade, their considerable size and weight have inhibited wider use. Recognizing the potential public benefit, Congress funded NASA in 1998 to help advance eye tracker technology to reduce size and increase portability, while preserving or improving its function. As a result, NASA's Jet Propulsion Laboratory (JPL) collaborated with the eye tracker manufacturer LC Technologies (LCT), Inc., of Fairfax, Virginia, to complete phase one of the Eye Tracker Technology Development Task. This led to the development of LCT's improved Eyegaze Communication System.

The collaboration aimed to advance eye tracker technology while fostering its commercialization for increased availability to the disabled. JPL's team selected LCT's existing Eyegaze System as a baseline for the work since it was both measurable and marketable. By completion of phase one, the team reduced the weight of the original system by 6 times and its volume by nearly the same factor. The miniaturization not only increases portability, but improves energy efficiency by reducing the power requirements of the system by a factor of 4.

In the course of miniaturization, the Eyegaze System's functionality also improved. For example, the JPL/LCT Pulser Board, a new illuminator drive, lights up the user's eye in a series of tiny time intervals, enabling the system's video camera to capture eye movements with very little blurring of the eye image. A new combination of the illuminator and light filter makes the camera more tolerant to ambient light, allowing the system's use in a greater variety of lighting conditions. The customized motion control unit, housing the enhanced illuminator and camera, provides real-time head tracking and more accurate eye tracking.

As a result of this joint effort, LCT commercialized the improved Eyegaze Communication System, providing customers with a more accurate, affordable, and portable product. To operate the Eyegaze System, the user sits approximately 24 inches from the computer monitor, while the camera, mounted below the monitor, focuses on one eye. A 15-second calibration procedure is all that is needed to get started. By looking at control keys on the monitor for a fraction of a second, the user can perform a broad variety of functions including speech synthesis, environmental

The Eyegaze System enables this boy to communicate using only the movement of his eyes. A video camera focuses on the pupil of the user's eye, tracking its movement. To "press" a key on the screen, the user looks at the key for a specified time, prompting the computer to take the appropriate action.

LCT's collaboration with NASA's Jet Propulsion Laboratory reduced the size and weight of the Portable Eyegaze System, which can be conveniently mounted on a wheelchair.

control (controlling lights and appliances), typing, operating a telephone, accessing the Internet and e-mail, and running all Microsoft® Windows® software. The camera continually observes the eye movements, while specialized image-processing software determines where the user is looking on the screen. The system predicts the gazepoint with an average accuracy of better than one-fourth inch, enabling the user to control entire on-screen computer keyboards. Nothing is attached to the user's head or body, and the improved size and portability allow the system to be mounted on a wheelchair.

Eyegaze Systems are enhancing the quality of life of people with disabilities all over the world. The system enables children with severe cerebral palsy, muscular dystrophy, and other motor disabilities to actively participate in their education by giving them a voice for the first time. Students who cannot talk or use a pencil are using their system to "speak" during class, as well as to research and write papers. With only their eye movements, these students can also chat with friends over e-mail and "talk" on the phone.

The Eyegaze System also enables adults with multiple sclerosis, strokes, brain injuries, spinal cord injuries, and ALS (amyotrophic lateral sclerosis, also known as Lou Gehrig's disease), to be productively employed. With the system, employees who are paralyzed and unable to speak are still able to do word processing, send and receive e-mails, and make telephone calls. Also, several books have been written and published by authors using only eye movement controls.

While phase one of the Eye Tracker Technology Development Task was successful, LCT continues to work with JPL on phase two, which concentrates on several other areas of improvement that have commercial add-on potential. With increased improvements in eye tracker technology, more people can get ahead using eye power. ❖