The IEEE Pittsburgh Section Signal Processing and Engineering in Medicine and Biology Society Chapters Present:

Magnetic Hand Tracking for Human-Computer Interface

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Presentation to be held at 360 Benedum Hall,
University of Pittsburgh, Pittsburgh
May 6, 2011
Refreshments 11:30am – 12:00pm
Talk 12:00pm – 1:00pm

Despite the rapid advances in computer design, most commands that computers receive are still provided by a keyboard or a pointing-and-selecting device (e.g., a mouse). As computers are constantly miniaturized, this traditional form of human computer interface becomes increasingly problematic. For example, there has been a clear trend to integrate personal electronic devices, such as the PDA, cell phone, music/video players, and GPS, into a single device (e.g., a smart cell phone and an iPod). There is also a trend that the newer devices are thinner, smaller, and/or lighter. These trends require a more compact human input system which is often difficult to operate, especially by older people. If the human hand can be tracked by a simple apparatus, it will be possible to deliver information to the computer by the motion of fingers in a free space without being constrained within a small area provided by the miniature device. The hand tracking apparatus has additional applications, such as controlling robots, vehicles, and aircrafts. Since the new apparatus may potentially provide a high data rate, patients suffering from impaired speech or paralyzed legs may use it to communicate with both computers and people.

We present a new design of a low-cost, unobtrusive apparatus that tracks the physical locations of finger tips. This hand tracking apparatus leverages advanced design of magnetic flux sensors and recent research on hand-based communication and neural control. The apparatus consists of two major components: a set of permanent magnets shaped as artificial nails and an electronic wristband. When fingers and palm move, the spatial distribution of the magnetic fields is recorded by a series of detectors around the wristband. The recorded signals are sent wirelessly to a computer where a source localization algorithm is utilized to reconstruct finger locations. These locations are then translated into information in either textual or continuous functional forms. An electronic magnetic detector circuit and an evaluation platform have been designed and implemented. A prototype wristband has been constructed and tested. A geometric hand model has been established, and an inverse problem solver has been developed in software.

Professor Mingui Sun received the M.S. and Ph.D. degrees in electrical engineering from the University of Pittsburgh, Pittsburgh, PA, in 1986 and 1989, respectively. In 1991, he joined the faculty of University of Pittsburgh, where he is currently a tenured Professor of neurosurgery, electrical and computer engineering, and bioengineering. His current research interests include advanced biomedical electronic devices, biomedical signal and image processing, sensors and transducers, biomedical instruments, brain-computer interface, electro-neurophysiology, implantable devices, radio-frequency systems for biomedical applications, electronic and data processing systems for diet and physical activity assessment, and wearable computers. He has authored or coauthored more than 300 papers. He is the Director of Laboratory for Computational Neuroscience in the Departments of Neurosurgery, Electrical and Computer Engineering, and Bioengineering. He serves as a member of two TCs (LISSA-TC and MSA-TC) in IEEE CAS Society; is a member of Diet and Physical Activity Steering Committee in the Gene, Environment, and Health Initiative (GEI) at National Institutes of Health; and received a number of awards for his research, innovation and service.