[272] TACTILE AND HAPTIC INTERFACE PROJECT

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PURPOSE—Individuals with visual disabilities face tremendous challenges that can be insurmountable in interfacing with the ever more prevalent graphical computer interface environments. Not surprisingly, these individuals are underrepresented in science, engineering, and math (SEM) academic programs and professions, which often rely on the latest computer technology. As a part of the SEM Project to recruit and retain students, the Tactile and Haptic Interface Project addresses the needs of the visually impaired person through basic human factors research and display system design and development. Our research investigates and quantifies viable methods for the rendering of traditionally visual information such as photographs, graphs of mathematical functions, physics and chemistry experiments, and other images in a tactual or haptic fashion which can subsequently be understood by the student. Development of a number of software and hardware systems is underway, and includes using devices for the tactile and haptic display of such visual information, and combining various existing technologies in new ways to achieve the goal of tactile accessibility.

METHODOLOGY—Understanding the human factors involved in the basic human ability to recognize physically represented visual information is the first goal of our research. Through measurement of factors including the tactile resolution of the fingertip under various real world constraints, tactile image discernment tasks, such as distinguishing various tactile shapes from each other, and abilities of blind and deaf-blind persons to comprehend tactile and haptic information, we will gain insight into how the mind perceives what the human tactile and haptic systems sense. Concurrently with this basic research, and subsequently relying on its results, will be the development of a number of software and hardware systems to provide blind computer users access to visual information. Using combinations of products and devices such as capsule paper, the Optacon, the PHANToM, screen reading software, touch screen technology, and others, together with the appropriate software, either commercial or custom written, we will create tactile and haptic access systems. While some of this research will involve the use of new and somewhat expensive technology, most of it will emphasize the use of affordable equipment and software to ensure that the end product will be as widely available as possible to help the greatest number of visually impaired individuals.

PROGRESS—A great deal of preliminary research into the current state of tactile and haptic information representation has already been performed by our staff. A number of tactile and haptic devices have been purchased, including an Optacon, a PHANToM, a capsule paper developer, and a touch screen device. A preliminary system which haptically displays mathematical equations has been completed, and will soon be extended for general use in representing science experiments. A general purpose software system for handling display of science experiments on haptic display devices is under development. Materials for conducting basic two-point and point-line tactile experiments have been produced using isotropically etched glass slides, and these will be supplemented with more complex shapes portrayed on capsule paper in experimentation into the human factors of the sense of touch. An image processing system for simplifying and generating a tactile representation of photographs, drawings, and other images is in the early stages of development.

FUTURE PLANS—The coming year promises to be one of rapid discovery and development. Tactile studies will be conducted and will be extended to the haptic sense system. The image simplifcation system will be completed, and so will systems that make use of touch screen technology and tactile overlays. Finally, a Virtual Laboratory will be developed using the PHANToM to haptically display science experiments, making them accessible to blind and deaf-blind persons.