"Sonic Flashlight" Makes Human Body Seem Translucent

Doctors currently perform any number of medical procedures -- from needle biopsies to amniocenteses -- using ultrasound images to guide them. But to do so, they must look away from the patient at an ultrasound display screen, which causes a displaced sense of hand-eye coordination. Now George Stetten, a biomedical engineer at the University of Pittsburgh, is developing a better alternative -- a device that makes the human body appear translucent so that physicians can keep their eyes directly on the area on which they are working.

The prototype device, known as the "sonic flashlight," merges the visual outer surface of a patient's skin with a live ultrasound scan of what lies beneath. It creates the effect of a translucent ultrasound image floating in its actua1 3-D location within the patient, showing blood vessels, muscle tissue, and other internal anatomy.

The sonic flashlight displays an image within the natural field of view that can be used to guide invasive procedures, such as taking blood samples without missing the vein, catheterizations, surgery, or numerous other procedures while looking directly at a patient instead of at a monitor.

Previous attempts to fuse medical images with direct vision have been largely unsuccessful, in part because of their complexity. Some have tried using miniature video cameras mounted on a headpiece. Others have used an approach similar to Stetten's, but requiring the user to wear a tracking device to determine viewer location.

Stetten has eliminated the need for tracking devices and transmitters by taking full advantage of the way in which a translucent mirror superimposes images from both sides of the glass.

He strategically positions an ultrasound scanner and display on opposite sides of a translucent mirror. The viewer looks through the mirror to see the patient and the ultrasound scanner positioned on the patient's skin. Simultaneously, the ultrasound image is projected onto the viewer's side of the mirror in perfect alignment with the corresponding location within the patient's body.

This makes the ultrasound image appear to occupy the same physical space as the body part being imaged. Even if the physician' s viewing angle changes, the combined images remain aligned. The effect relies on precise geometric relationships between the ultrasound slice being scanned, the monitor displaying the slice, and the mirror.

"We are actually merging the virtual image in 3- D with the interior of the patient," Stetten said. "The reflected image is optically indistinguishable from the corresponding space within the patient."

Stetten has also built a portable sonic flashlight that could make it easier and more convenient for routine use in a doctor's office. Both the stationary and portable devices are being refined and tested in the laboratory before tested in the clinic.

-University of Pittsburgh School of Engineering