

The Smart Tee Shirt
ELE 282, Biomedical Engineering Seminar, April 27, 2003
James Finneran
Biomedical Engineering, University of Rhode Island
Kingston, RI 02881

The Military is very interested in this technology. One of the proposed devices that are being developed jointly between Georgia Technological Institute and US Navy is the “smart tee shirt.”

The “Smart Tee Shirt” is a device that has the ability to tell the vitals of a human while in battle. One of the main reasons why a wounded soldier dies in battle is because the wounded status is not known in time for the medics to save them in time. The Georgia Tech Wearable Motherboard (GTWM) or the Smart T-Shirt uses optical fibers to detect bullet wounds, and special sensors and interconnects to monitor the body vital signs during combat conditions. This provides an extremely versatile framework for the incorporation of sensing, monitoring, and information processing devices. The principal advantage of the GTWM is that it provides a systematic method of monitoring vital signs of humans in an unobtrusive manner.

Appropriate sensors have been “plugged” into the motherboard using the developed Interconnection Technology and attached to any part of the individual being monitored, thereby creating a flexible wearable monitoring device.

A combat soldier attaches sensors to his body, pulls the Smart Shirt on, and attaches the sensors to the Smart Shirt. The Smart Shirt functions like a motherboard, with plastic optical fibers and other specialty fibers woven throughout the actual fabric of the shirt. To pinpoint the exact location of a bullet penetration, a 'signal' is sent from one end of the plastic optical fiber to a receiver at the other end.

The emitter and the receiver are connected to a Personal Status Monitor (PSM) worn at hip-level by the soldier. If the light from the emitter does not reach the receiver inside the PSM, it signifies that the Smart Shirt has been penetrated (i.e., the soldier has been shot). The

signal bounces back to the PSM from the point of penetration, helping the medical personnel pinpoint the exact location of the soldier's wound.

An interconnection technology was developed to transmit information from (and to) sensors mounted at any location on the body thus creating a flexible “bus” structure. T-Connectors -- similar to “button clips” used in clothing -- are attached to the fibers that serve as a data bus to carry the information from the sensors (e.g., EKG sensors) on the body. The sensors will plug into these connectors and at the other end similar T-Connectors will be used to transmit the information to monitoring equipment or DARPA's (Defense Advanced Research Projects Agency) personal status monitor.

The developed interconnection technology has been used to integrate sensors for monitoring the following vital signs: temperature, heart rate, and respiration rate. In addition, a microphone has been attached to transmit the wearer's voice data to monitoring locations. Other sensors can be easily integrated into the structure. For instance, a sensor to detect oxygen levels or hazardous gases can be integrated into a variation of the Smart Shirt that will be used by firefighters.

The GTWM has been patented by Georgia Technology Institute and is available for licensure through the School of Textile and Fiber Engineering. In a Special Issue of LIFE Magazine—Medical Miracles for the Next Millennium, Fall 1998—the Smart Shirt was featured as one of the “21 Breakthroughs that Could Change Your Life in the 21st Century”.

Sources

<http://www.darpa.mil/dso/trans/pdf/Abmt2.pdf>
http://www.ee.ucla.edu/~jjudy/publications/conference/msc_2000_judy.pdf<http://www.lifesensors.com/>
http://www.ornl.gov/ORNLReview/rev29_3/text/biosens.htm
<http://www.gtwm.gatech.edu/>