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Wireless Modular Sensor System for MENTOR/Pal-type Applications

The success of the Sandia Nation Laboratories MENTOR/Pal project exploring the idea of measuring physiological arousal as an index to human performance indicates that this concept should be developed beyond its initial implementation. MindTel, LLC (with SenSyr as a subcontractor) spearheaded the development effort:

http://www.sandia.gov/news-center/news-releases/2004/gen-science/mentor.html
http://www.wired.com/news/technology/0,1282,62069,00.html

The obvious first step is incorporation of the various sensor electronics into a common, wearable enclosure, powered from a single battery pack, and connected via a wireless communications link (Bluetooth or 802.11, for example) to a computer-based data collection system capable of collecting and analyzing data from multiple nodes simultaneously.

Multiple printed circuit boards would be stacked together as functional blocks to allow the sensor set to be customized to the exact application. A two-way communications mode would allow output functions in addition to sensor inputs—haptic or auditory feedback actuators, for example.

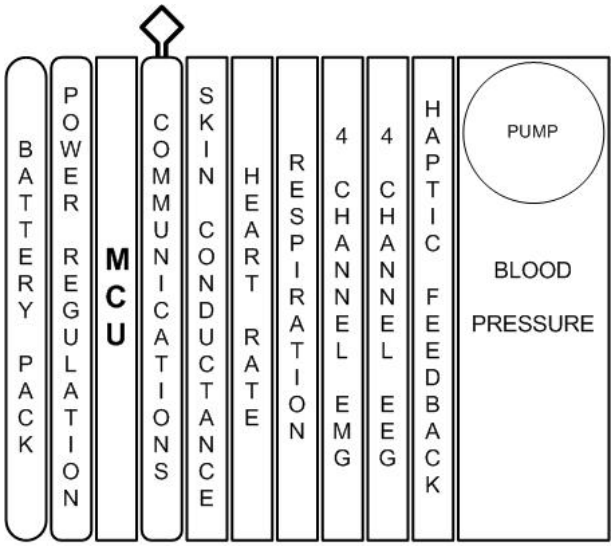

Fig. 1 - Block Diagram

Individual boards would be approximately 1.5 inches wide by 3 inches long and powered via a shared, 5 VDC power distribution bus. Power would be derived from a single battery pack. The power regulation and distribution board would also provide battery monitoring and charging functions.

Physiological sensor interface boards would include skin conductance, respiration (2-channel Pneumotrace amplifier), heart rate (either 3-lead ECG or photoplethysmograph), 4-

channel EMG bioamplifier , 4-channel EEG bioamplifier, 8-channel haptic (tactor motor) feedback, and blood pressure. These interface boards could be added, subtracted, or duplicated to customize the interface for various applications. This modularity may require modifications to the overall enclosure design, however. Other sensor functions, such as temperature, could also be included. Another consideration might be to support audio input and output (headset).

Once a board system has been assembled and tested for a given application, the entire set of boards could be potted with epoxy to create a very rugged and durable package. Of course, repair would be nearly impossible. All I/O connectors would emerge along one board edge.

Major advantages of this type of system:

- Subject not encumbered with wired connections to computer.
- Modular configuration. Boards and board functions can be added, removed, and redesigned without impact on the other boards in the system.
- Battery powered, providing intrinsic electrical safety.
- Individual sensor interface boards can incorporate their own processor capabilities,
- Extensibility.