modal-multisensory interfaces (MMI).

Current progress in MMI have considered human speech, gesture, gaze, movement patterns, and other complex natural behaviors, which involve highly automatized skills that are not under full conscious control of the human operator. These are to some extent variants of NMCD. For example, in collaborative work environments, a large display may be fixed, but users move about the room, interacting with each other with small, mobile input devices. Thus, it can be surmised that most NMCD are sensory driven. Thus, cognitive science imperatives and human factors issues must be addressed so as to realize the full benefits of NMCD during human control of actions with these devices. This is necessary since sensory modalities span across the integration of human and system-level sensors such as visual (e.g. gaze), auditory (e.g., voice), haptic (e.g., hand movements, sign languages; lip reading, and the use of head movement for pointing). Obviously (although not completely), sensory information processing tends to be a cognitive task.

This paper will give a proposition on the cognitive science and human factors foundations of NMCD. The essential roles of multimodal, multisensory information integration, including the interpretation and use of such information for control of behaviors in task space, both spatially and temporally will be discussed, as well as the properties of different sensory modalities within NMCD components and the information content they carry.

In addition, this paper describes the important role that NMCD plays in information acquisition and processing in complex battlefield information systems. Specifically, the followings are addressed:

1. Interpretation of NMCD information at the semantic, syntactic, and pragmatic levels of system abstraction.
2. Cognitive aspects of NMCD information processing and sensemaking, such as how meaning of interacting multisensory information are derived, and how the derived information leads to understanding of dynamic contexts.
3. Human factors challenges in developing performance metrics, as well as the ergonomics issues when NMCD mechanisms are embedded into the human operator.
4. Implications of NMCD to interface designs for military systems are discussed.
Summary
Navigating in the Virtual Reality (VR) scene or playing a video game often accomplished by a transformation of human control over the VR or gaming device. This transformation is usually achieved by using a joystick or other hand-held controlled Systems. Here we present an alternative and novel approach towards hands-free interface device for VR and videogames control, i.e. a sensor shirt. It consists of 52-sensors woven inside the garment. This kind of interface with VR or other gaming devices, offers both portability and unobtrusive user movement in a VR environment.

This paper addresses the systems engineering aspects of the solution, and presents the initial results and future research directions. Participants navigated a VR scene using natural body movements that were detected by their wearable sensor shirt and then mapped to electrical control signals. The initial results are promising, and offer many opportunities for use in other applications.

Motivation
A 52-piezoresistive sensor shirt, as reported in, was integrated with a fully immersive 3D VR environment. The sensor shirt behaved as a hands-free input device by detecting and then translating body movements into electrical control signals. This preliminary setup can be used for applications in multimedia and animation, motion tracking, robot-aided rehabilitation and video game development. The proposed system is likely to cut labor costs as discussed in. In the area of rehabilitation, the sensor shirt is easy to deploy and affords the patient comfort whilst navigating in a VR environment. Other alternatives require specific seating positions and recalibration procedures after short intervals. A great advantage of the system is related to the high number of sensors: the redundancy in the sensor set makes possible to obtain the same control pattern with different body motions and lets the user choose which is the control scheme he prefers (i.e. the body motion patterns used to perform a certain action in the VR scene). By exploiting this concept, the control scheme will be adapted and personalized to the user.

Results
This article describes a novel method for navigating in a VR environment using smart sensing garment technologies. A wearable multi-sensor shirt that can detect upper body (wrist, elbow and shoulder) movements, was custom built to generate electrical control signals from residual movements. A combination of VR and signal processing methods were used to develop an effective body-machine interface to perform tasks. The sensor shirt was worn by a participant shows the front side of the sensor shirt), and the analogue signals originated from the shirt were converted into digital signals by a National Instruments analogue-to-digital converter. The digital output was read in Matlab Realtime Windows Target and the processed signals were sent as unified datagram protocol (UDP) packets to the VR software. Following a calibration phase and an initial training phase in the VR environment the user was capable of learning how to move in the VR scene. From an initial starting point in the VR scene, the control signals generated by the participant’s movements were used to move the participant in VR. The sensor shirt was used with the VR system continuously for one hour without recalibration. Error measurements were calculated in the shoulder sensors outputs after 20 minute and 60 minute intervals. The results show the complete stability of the system (for at least an hour without recalibration), ease of deployment and comfort.

References