Tactile displays for patient monitoring in anesthesia

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Introduction

The anesthesia workplace can be regarded as a complex man– machine-system. The multidimensional control- and monitoring actions of anesthetists are comparable with those of pilots. Many visual information and auditory signals have to be handled. In some stressful and complex situations, a perceptual and cognitive overloading of the anesthetist could occur and inhibit an efficient and save interaction. In that case, the human operator is no longer able to process all the incoming information. That means, that on the one hand not the whole information can be used for decision making in the action-control loop and on the other hand new information can't be detected and recognized quickly and safely.The idea of the Research and Teaching Department Industrial Design Engineering is to preserve the anesthetist from such an overload. For example by presenting information also by the tactile perception of the skin and human body to the anesthetist. This can be in a redundant, substitute or complementary way to the main channel of vision [1].

Methods

As mentioned above, the anesthetist is often compared with airplane pilots. In this area, the diversification of information and the concrete inclusion of tactile perception to the man–machine-interaction came up at first and is now already implemented. So there are a couple of research results which analyzed the basics of tactile event perception and its parameters [2]. There are many ways to present the tactile information to the user. In the case of aviation, the tactile actuators are fixed in a belt, the pilot has to wear [3]. With this adjustment he is able to perceive additional directive information of the environment. The object that an anesthetist has to monitor is a human being too, like himself. This special issue is the central point of the idea of the Research and Teaching Department Industrial Design Engineering: a location-compatible information presentation to the anesthetist (s. Fig. 1). The source of information (e.g. the ECG recording) is equally displayed to the anesthetist (e.g. by actuators on the thorax). With this assistance the situation awareness of the anesthetist could be enhanced, which could be obvious through less reactiontime on events (Hypothesis 1). In addition to that, the perceptual and cognitive overloading of the anesthetist in situations of multitasking and stress is lowered (Hypothesis 2). Another important factor of tactile pre- sented information is the permanent availability (especially in cases of alarms) and the directed adressing of the information acceptor, so that no one else in the operation theatre is influenced or disturbed by it (as it is by auditory alarms for example).

Results

To evaluate the location-compatible event perception and to test the multimodal effects in a first step, the Research and Teaching Department Industrial Design Engineering built up a tactile system with actuators arranged in a 2 9 2 matrix equally to four visual cues presented over a monitor each in one corner. The results of these experiments will show, if there is a significant enhancement of situ- ation awareness and workload of the bimodal perception (vision ? tactile) in comparison to the unimodal (visual) one. First research results are to be shown. Then the next step will be to find a suitable tactile coding form for the different vital signs on the patient monitor system and to test different adjustments of the actuators. And after, the tactile display system is to be tested in different critical care scenarios at the Center for Patient Safety and Simulation Tu¨ PASS [4].

Discussion

The submission puts the application of tactile displays in anesthesia up for discussion. Both open questions like the acceptance of the system or possible cognitive distraction and chances and limitations are to be demonstrated and discussed. The visual input and associated cognitive mechanisms for the anesthetist in the anesthesia-cockpit are often over the limit of the working memory (7 ± 2 chunks). But if these informations could be presented across different sensory sys- tems, like it is postulated by WICKENS in his multiple resource theory [5], there won't be interferences between the different simul- taneous tasks and thus an optimized interaction.

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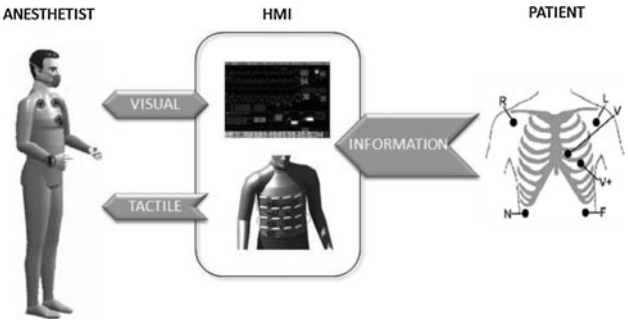

Fig. 1 Tactile display