Musculoskeletal Disorders (MSDs) are one of the most common work-related injuries in Western Europe, costing tens of billions to society every year [1]. They consist of lesions to muscles, tendons, ligaments or nerves, commonly due to repetitive work in an inappropriate position and include various pathologies affecting different body parts, depending on the job and working conditions. The financial loss due to such disorders comes from productivity decline from the affected workers and their sick leaves. Specialists have been working on the issue, improving workstation layout and organising prevention sessions among employees. After years of observation, these solution seem not to be very productive; one of the problems is that the teaching method does not provide enough time and motivation for the user to deeply and truly change his habits.

To address this issue, a consortium has been formed by Swiss and French academic and industrial actors focusing on solutions to MSDs in the watchmaking and automotive industries, the main idea being to prevent employee MSDs and show management how it impacts the workers’ health.

In this context, we imagined the following approach: combining Serious Games (SG), Virtual Reality (VR) and real-time motion capture. The idea is to put the user in a VR game. When he reaches a potentially harmful position, the user is notified and has to correct himself to finish the level. Two elements are provided to help the user: a virtual representation of himself, where the problems will be displayed, and a virtual coach that will help him change and guide him through the levels. We hope this approach will help the user understand the dangers and learn good postural habits.

As we work with this idea, we face the hardest part to change in people: behaviours. We want them to be in the best-suited environment that has to be motivating and stressless (that we will call “calm”) to help them learn those new habits. Once the user has acquired the wanted knowledge in the “calm” environment, we want to be sure that he will be able to transpose those habits on his actual workplace. Thus, we decided to make the “calm” environment evolve progressively into the user working environment. This evolution takes place as the SG levels are cleared.

The virtual environment (VE) evolution is the central idea around this project, so before all, we had to validate the feasibility of evolving VEs. In this context, three environmental types were imagined: the “calm” VE (the starting one), the “work” VE, that has to be as similar as possible to the real workplace, and the “intermediate” VE, that has to be somewhere in the middle.

The calm VE was chosen according to the Attention Restoration Theory (ART) [2, 3, 4], that says that exposition to nature allows quick stress recovery and relaxation. The “calm” VE must represent a natural setup, such as a garden or a beach. The “intermediate” VE was chosen to be indoors and relaxing (for example a living room) and the “work” VE has to portray as much as possible the work reality. For testing purposes, we chose one VE of each: a garden, a living room and a generic workshop. To evolve from one VE to the next, we applied transitions to its elements. For example, making an object fade in or morphing an object into another.
The user tests (simple assembly task) were conducted on 80 people who were only asked to perform the assembly task. No mention was made of the transitions or the environment. They lasted 15 to 20 minutes in VE. All the users managed to stay through the whole process with no major problems such as motion sickness or headaches. They were then asked in a survey whether they had noticed transitions during the test. The results are very interesting as only four transitions were noticed at least 25% of the time. Going even further, 37% of users did not even notice the environment change from a garden to a workshop. More details for this work can be found in [5].

Those results are promising as they confirm that environmental transitions can be used in VR: without significant discomfort, the transitions were mostly unnoticed and did not disturb users in their tasks.

REFERENCES


