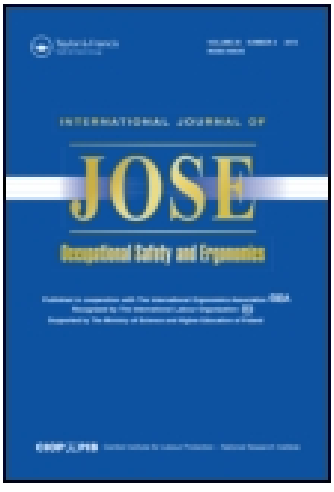

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Ergonomic Aspects of a Virtual Environment

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NOTES

Ergonomic Aspects of a Virtual Environment

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A virtual environment is an interactive graphic system mediated through computer technology that allows a certain level of reality or a sense of presence to access virtual information. To create reality in a virtual environment, ergonomics issues are explored in this paper, aiming to develop the design of presentation formats with related information, that is possible to attain and to maintain user-friendly application.

virtual world human perception ergonomics issues interactive design

1. INTRODUCTION

Virtual technology is becoming a point of growing attention for many applications to disseminate electronic knowledge through a virtual reality system. Virtual technology simplifies the abstraction process when the real environment is encountered (Lee, Park, & Park, 1996; Wilson, 1996). Virtual reality systems (or a virtual environment) represent the sense of presence and offer alternatives to reality (Ahasan & Väyrynen, 1998a; Piantanida & Teixeira, 1993). A virtual environment is an interactive graphic environment to access virtual information, in which the participant is actually present, and to some extent the participant has a feeling of actually *being there* or *being present*. A virtual environment generally includes simulators at the *top end* but usually it seems to consist of head-mounted displays (i.e., immersive virtual

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reality), a desktop, or a wall-mounted display system (Kawara, Ohmi, & Yoshizawa, 1996). In a virtual environment, a certain level of reality is achieved with synthetic stimuli through a three-dimensional display of images, auditory displays, gesture interactions, and other parameters. In this regard, the importance of a user's perspective is sensitive and, therefore, ergonomic aspects must be considered carefully in terms of interaction and presence. The representational and perspective model of interaction is also an important factor that should be assisted by an ergonomics mechanism for user-friendly application (Lee & Park, 1994). However, most of the interactions in a virtual reality system (or a virtual environment) are still far from natural interactions. Therefore, new types of interaction paradigms should be thought of, to find ways to improve a virtual environment in different applications. In this regard, Hancock (1996), Kalawsky (1993), Thomas and Stuart (1992), performed several studies on virtual reality systems. Still, ergonomics innovation and its design guidelines are certainly necessary to offer a series of merits and benefits for future users.

2. ROLE OF ERGONOMISTS

In this age of electronic media, ergonomic user precautions are of prime importance for user-friendly design. Ergonomics know-how is able to deal with suitable auditory, visual, and tactile conditions that are necessary in the design of a virtual environment (Wilson, 1997). To enlighten the nature of regulating mechanisms to deal with the virtual world, ergonomics guidelines provide a realistic interaction for visual representation (Wann & Williams, 1996) to maintain continuous adaptation to virtual reality systems (Ahasan & Väyrynen, 1998a; Kozak, Hancock, Arthur, & Chrysler, 1993; Wilson, 1997). This concerns user-friendly design that is always compatible with generic applications of a virtual environment (Lee & Park, 1994). As ergonomics design guidelines are considered as intuitive tools that deal with establishing the reliability, sensitivity, and usability of a virtual environment, therefore, human factors and ergonomics consequences are very important.

There are obvious reasons (Rose, 1997; Nichols, 1999) why ergonomics guidelines can act as user-operated tools that can foster the illusion of quick and realistic modelling of a virtual environment. The main one is that ergonomists have recently incorporated a three-dimensional

visualisation system and programming characteristics (Kalawsky, 1993; Wilson, 1996). Moreover, ergonomists nowadays are also involved with artificial intelligence, evolutionary programming, genetic algorithms, and neural networks to provide the embodiment of a hypermedia environment. Cognitive ergonomists are skilled in how people interface with a virtual reality system, perform symbolic tasks, and interact with objects and the virtual world. Thus, they free people from emotional discomfort and psychosocial problems (Ahasan & Väyrynen, 1998b; Preece, 1994). In order to be informative and comprehensive, especially to design a cyberspace environment (or a virtual model) ergonomists are traditionally non-traditional (Ahasan, Sen, Ukkola, & Kisko, 1997). By definition, ergonomists are sophisticated experts who can simulate not only factory or office environments, but also a virtual environment sharing with fantasy realms. In fact, the task of ergonomists is to seek innovative ways to resolve interaction issues by manipulating, observing, and behaving appropriately. The main task for ergonomists is to determine what presence of immersion (in vision of the real world) to let the users have in an abstraction of reality. In addition, ergonomists have an important role to play in matching virtual attributes to appropriate requirements as well as in developing interfaces that enhance participation within the virtual environment (Davis, 1997; Rose, 1997).

3. DESIGN ASPECTS

Virtual reality experiences depend upon an individual's perception, understanding, and adjustment to a virtual environment (Figure 1). There are many ways in which ergonomics design guidelines may help to establish an efficient and user-friendly virtual environment and which are different from traditional designs and styles.

To develop graphics quality and user comfort, ergonomics guidelines are a comprehensive design tool that can provide a true sense of presence. If essential parameters are not ergonomically matched with the user's requirements, a virtual environment will not be able to fulfil its commitment to virtual world simulation. Therefore, to make a good format for graphic representations, intelligent scenarios should be added through typographic layout, decomposed forms of figures and graphics, perception usage, and a limited use of acronyms. Visual language, colours, background, texture, icons, transition effects of screen or screen

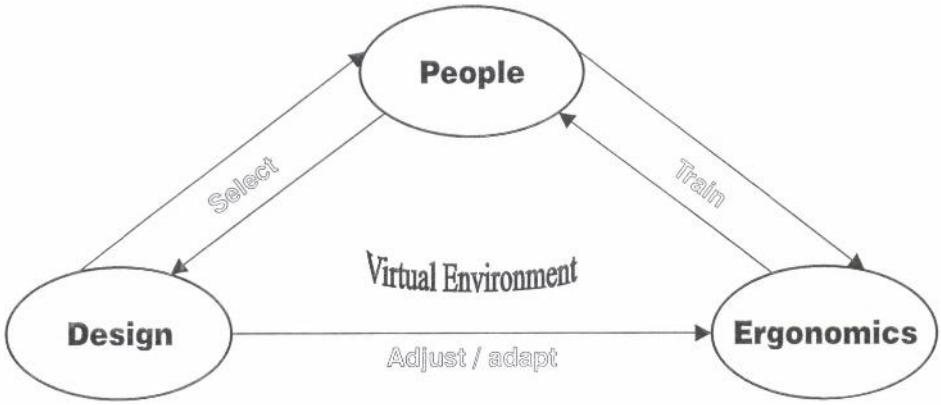

Figure 1. Integrating factors in a virtual environment.

diagrams, and so forth, should be defined by the use of interface icons and metaphors. Metaphors can be supported by graphic representations of the user's real world objects. The most popular interface metaphor is the desktop system (i.e., the so-called immersive virtual reality).

In a multimedia environment, a three-dimensional metaphor is recommended (Friedmann, Starner, & Pentland, 1992; Sheridan, 1993). However, it can cause psychological immersiveness (Ahasan & Väyrynen, 1998b). Virtual presence may not exist suitably on the screen, if display icons, buttons, and other features are not fit ergonomically. Therefore, three-dimensional input devices (e.g., computer mouse, sensors, joysticks, nac eyes, or data glove) and visual representations must be unique, so that the user can easily interact with the virtual world. The visual display unit, speakers within a head-mounted system, and controls (e.g., clutch) should be ergonomically designed in order to enhance the performance of a three-dimensional visual representation (Noro, Kawai, & Takao, 1996). To run the virtual world faster (i.e., with speed and a good quality of graphics), the size of windows should be reduced.

The sensors allow a virtual system to know where the participant is, or what they are doing. It also includes position trackers, and kinaesthetic sensors, and a head-mounted system. In order to generate stereo images, crystal eyes, and shutter glasses are usually synchronised with a stereo image (Friedmann et al., 1992). In addition, a general ergonomics guideline that may react intelligently and cooperatively must be considered to navigate and to solve the interaction between participants and a virtual

environment. However, users should concentrate on the aspects of the screen, user control, and responses as well (Smith & Wilson, 1993). The screen should not be crowded. The participant should avoid scrolling and overlapping virtual objects. It is better to use attention devices sparingly. Simple and understandable graphics are better than complex graphics. If possible, it is beneficial to use screen resolution for displaying images.

3.1. Usability Issues

A virtual environment should be compatible with the user's target population. An ergonomic configuration usually provides a better usability function to interact easily with a virtual environment in real time in different forms. Following ergonomic configurations, usability functions should be established. Indeed, general heuristics and formal logic are much better to create a user's usability.

In a virtual environment, users may feel different degrees of reality, from being partly to fully immersed, which might intercept the flow of visual and other sensory stimuli (Ahasan & Väyrynen, 1998b; Friedmann et al., 1992; Sheridan, 1993). In this regard, user comfort design is effective because the user is not usually disoriented, physically distressed, or mentally bored. Bringing sociotechnical, representational, and perspective models of interaction, an ergonomic configuration helps to increase the information bandwidth in a natural way (Ahasan & Väyrynen, 1998a). For user control, let the users set the virtual pace to customise their needs. It is better to allow the users to control sequencing to provide multiple control options. Use effective tools (e.g., ergonomics know-how) for easy access, and some form of speciality needs to be set up using suitable software, for instance.

3.2. Visual Perception

Display features in a virtual environment may take away the feelings of being there. Therefore, visual presentation must be simplified to enhance performance interaction. The stereo view can give a more realistic visibility than the mono view, which has a more positive effect on the near view than the far view. Moreover, if the visual display is presented

at the same distance, then users do not need to change accommodation much within a virtual environment. Users can change aspects of the displayed images according to their actions. Users just need to move their eyes frequently to find and recognise objects in order to grasp and move them.

Visual representation should be tolerant, and users should allow changing multiple options to provide correct feedback, for instance. In addition, visual and perceptive vestibular cues should be properly matched to overcome time lags (or unnatural behaviour) that may impair the task performance of the users. People's intrinsic abilities can be taped into virtual reality system (Smith & Wilson, 1993). While the user navigates through a virtual environment, all sorts of events may occur, for instance, an alarm goes off, a light goes on, and the user walks in a certain direction, enters a room, presses a button, or grabs an object. Therefore, the ergonomics know-how must help in simplifing this sort of visual and perceptive process to view stereoscopic images. Part 10 of the ISO Standard No. ISO-9241 (International Organization for Standardization [ISO], 1995) deals with software aspects and desribes general ergonomic principles for visual display terminals. More realistic images can be perceived in a virtual environment than the traditional and monocular images, if virtual features match with the user's tolerance and confidence. Thus, a virtual reality model should have high intensity to overcome the cognitive limitation (Ahasan & Väyrynen, 1998b).

3.3. Cognitive Model

Ergonomics itself has evolved from a cognitive configuration. That is why, its design principles are beneficial for virtual perception (Slater, Usoh, & Steed, 1994). Ergonomics guidelines are very effective in how the cognitive factors are translated in a crystalline way to obtain maximum satisfaction (Lee & Park, 1994; Wann & Williams, 1996; Wilson, 1997). At least the user's cognitive characteristics must be recognised, so those sensory cues are matched with the perceptual performance. To match with the perceptual and motor performance of the users, the sensory cues must be provided ergonomically. As the sensory aspect of a virtual environment is visual, auditory, and tactile (Wilson, 1996), cognitive and psychosocial perspectives should be thought through to characterise the side effects (Ahasan & Väyrynen, 1998b) of

a virtual environment. Three-dimensional images could be useful, if the psychosocial environment is considered to conceive a fantasy realm through a virtual reality system (in a virtual environment).

The virtual perceptions usually demand a high level of creativity (Fialho, Hiratsuka-Tei, & Bezerra, 1996) especially for cyberspace design. However, human's perceptive (e.g., sensory, motor ability, and human behaviour) experiences can be simulated precisely through a virtual environment (Piantanida & Teixeira, 1993; Wilson, Cobb, & D'Cruz, 1996). Participants should be able to perceive the equivalence between virtual and real environments, in terms of interactions with objects, and of the objects' interactions with one another. Several types of interactivities can be combined in a virtual environment, such as passive interactivity, which may be used when people navigate in some pre-ordinate and immutable world. Immersive virtual reality system may be used when interactivity crosses the magic mirror. In an immersive system, visual aspects are also presented through a personal computer monitor or projected onto a screen. However, a personal computer based virtual reality provides a lower level of presence and interactivity (Ahasan & Väyrynen, 1998b).

4. DISCUSSION

A virtual environment is a computer-generated model, where a participant can interact intuitively in real time with the environment or objects within it. A virtual environment generally consists of modelling and simulation software, a head mounted system, sensors, buttons, joysticks, and a control device. The potential capabilities of virtual reality include data representation, visualisation, simulation, design assessment, real time control, teleoperation, training, communication, and function integration. As a potential tool, virtual reality can be found on the Internet (e.g., at http://www.nottingham.ac.uk/virart/).

Different forms of virtual reality (Wilson, 1997) provide important attributes to different events at different costs, and with different levels of flexibility. For instance, spatially immersive displays are the extension of wall-mounted display. In content and structural constructivitism, people observe the virtual environment or object, and change the interaction on virtual world basis. In individual design, the user is the only traveller to face the unknown. In cooperative design, people may

visit and discuss with each other in a virtual environment, which has also different types of capabilities such as representation (Wilson, 1996), reforming, and rearrangement of an object or environment rapidly, interactively, and intuitively (Cobb, Nichols, & Wilson, 1995; Lee, Park, & Park, 1996); planning and training (Wilson, Nichols, & Ramsey, 1995) and communication networks (Wilson et al., 1996), particularly within education, data presentation and marketing.

The experience from each of the aforementioned virtual environments can be very different, however, the system should be selected to meet particular task needs. There are other aspects of a virtual environment that should probably revolutionise the way in which people interact with information and control systems. With the continued development of a virtual environment, human elements (or components) are usually not considered or tested until actual problems begin. In many cases, adding the human model to the environment, making a three-dimensional simulation, and providing a virtual environment for proactive ergonomics is difficult for software designers. However, an analogy for ergonomists is to place both user-friendly designs and suitable tools (Wilson et al., 1996).

5. CONCLUSION

Ergonomists may provide the embodiment of a virtual environment in an innovative way. The ergonomics mechanism is very important as a way of making it freely and easily accessible. Ergonomics usually collects technical, sociocultural, and cognitive perspectives to find the best presentation format and arrangement of an interactive virtual environment. In association with human factor experts, virtual environment laboratories have been grown out of. However, despite the enthusiasm with which ergonomists have taken up the challenge to make a better design of virtual world, there is still a multiplicity of interacting factors of relevance to a virtual environment, its usability, and cognitive effects. A virtual environment, as a synthetic environment, human modelling should support all types of virtual reality systems and immersive technologies for viewing the activity in a virtual environment.

In this regard, a virtual environment may not provide the same "hot house" in immersion and cognitive distractions, if realistic and sophisticated feedback is not implemented. If there is a noticeable lag of conception

with the constrained world complexity, it can cause frustrations and side effects. The other elements of a virtual environment may react differently, depending on how they are manipulated by different users in different situations. In addition, providing the users with functionality (interactivity) and producing a higher specification, there are a number of obstacles to differing various virtual reality systems. By sharing ergonomics principles, a more improved design should be innovated through qualitative research and development. In conclusion, it is left up to the ergonomists to provide their expert views on the virtual reality system, not only plodding to the identity of pure engineering but also keeping the prestige of cognitive ergonomists.

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