IMMERSIVE TECHNOLOGY – USES, CHALLENGES AND OPPORTUNITIES

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ABSTRACT
This is a decade of emerging technology; one of the most interesting among them is immersive technology. Immersive technology is a computer-generated simulation of reality with physical, spatial and visual dimensions. This interactive technology is used by architects, science and engineering researchers, the arts, entertainment and video games industry.
This paper gives information about the immersive technology, which can be used as a management tool. Immersive technology consists of several tools which can be used for management such as virtual reality (VR), augmented reality (AR), haptic technology, teleimmersion.
This technology allows a person to feel as he is present in an immersive environment (virtual environment). These technologies sense the body moment, postures, gesture of an individual as an input and these inputs are made used to interact with Immersive environment.
An attempt is made to make uses of these emerging technologies in business management such as business communication, man-machine interface, manufacturing process, advertisement and promotion of new product, e-buying etc.
The paper focuses on the uses and opportunities of Immersive technology as a management tool and also the challenges involved in implementing Immersive technology in management.

INTRODUCTION

Immersion is the state of consciousness where an immersant's awareness of physical self is diminished or lost by being surrounded in an engrossing total environment; often artificial. This mental state is frequently accompanied with spatial excess, intense focus, a distorted sense of time, and effortless action.

The term is widely used for describing immersive virtual reality, installation art and video games, but it is not clear if people are using the same word consistently. Immersive virtual reality is a hypothetical future technology that exists today as virtual reality art projects, for the most part. It consists of immersion in an artificial environment where the user feels just as immersed as they usually feel in consensus reality. Immersive digital environments could be thought of as synonymous with Virtual reality, but without the implication that actual "reality" is being simulated. An immersive digital environment could be a model of reality, but it could also be a complete fantasy user interface or abstraction, as long as the user of the environment is immersed within it.

The definition of immersion is wide and variable, but here it is assumed to mean simply that the user feels like they are part of the simulated "universe". The success with which an immersive digital environment can actually immerse the user is dependent on many factors such as believable 3D computer graphics, surround sound, interactive user-input and other factors such as simplicity, functionality and potential for enjoyment. New technologies are currently under development which claims to bring realistic environmental effects to the players' environment effects like wind, seat vibration and ambient lighting.

1. HAPTIC TECHNOLOGY

Haptic technology, or haptics, is a feedback technology which takes advantage of a user's sense of touch by applying forces, vibrations, and/or motions upon the user. This mechanical stimulation may be used to assist in the creation of virtual objects (objects existing only in a computer simulation), for control of such virtual objects, and for the enhancement of the remote control of machines and devices (tele-operators). It has been described as "(doing) for the sense of touch what computer graphics does for vision".

How haptic technology works in the real world, persons receive and disseminate information in three-dimensional space. In a virtual world, the user can access information by imitating that three-dimensional space. To incorporate the sense of touch (the haptic sense), a device is created that allowed the user to interact with a computer by receiving tactile feedback. A haptic device achieves this feedback by applying a degree of opposing force to the user along the x, y, and z axes.

1.1 Advantages and Disadvantages of haptic technology

Advantages include that communication is centred through touch and that the digital world can behave like the real world. When objects can be captured, manipulated, modified and rescaled digitally, working time is reduced. Medical field simulators allow would be surgeons to practice digitally, gaining confidence in the procedure before working on breathing patients. With haptic hardware and software, the designer can maneuver the part and feel the result, as if he/she were handling the physical object.

Disadvantages include debugging issues these are complicated since they involve real-time data analysis. Links in telemedicine must have 0% fault rates for extended periods of time.

The precision of touch requires a lot of advance design. With only a sense of touch, haptic interfaces cannot deliver warnings.

2. TELE-IMMERSION

Immersion in general means a psycho-physical condition which gives the user the illusion that he acts in an environment which is different from the real one. Thus, from the technical point of view, an immersive system has to meet two requirements. Firstly, the system must be able to isolate the human perception as much as possible (or necessary) from influences of the real word. Secondly, the system has to provide man-machine interfaces which stimulate the human perception in a directive manner such that the desired illusion of a non-existing environment is achieved.

In the past, most of activities on immersion have been restricted to the domain of virtual reality where well-equipped and well-suited high-power graphics workstations are used for stand-alone applications in the fields of training simulators, computer-aided design or computer games. Here, the users often wear data glasses, head phones and data gloves to interact with the virtual world - or they even enter a walk-in system like a flight simulator which is additionally able to simulate motion, acceleration and gravitation. A quite different field of applications can be found in the area of entertainment where large screen projections are used in combination with attractive audio systems like surround sound, sub-sonics or ambisonics. Well-known examples are the IMAX theatres and its extensions towards IMAX 3D and IMAX motion ride.

2.1 Requirements for Immersive Teleconference Systems

To meet the requirements of immersion, it is absolutely necessary to use a large display that covers almost the whole viewing angle of the visual system. In addition, the large display has to be integrated into the usual workspace of an office or a meeting room

(see **Fig. 1**).

Fig 1: The Vision of Immersive Tele-Conference

Thus, the most practicable solution is a desktop-like arrangement with large flat screens like plasma displays with a diagonal of 50 inch and more. Starting from such a desktop-like system and taking into account results from intensive human factors research, further requirements on the presentation of the scene can be formulated as follows (see also **Fig. 2**):

Fig 2: Presentation in a immersive conference system

- Conferees are seamlessly integrated in the scene and displayed with at least head, shoulders, torso and arms in natural life-size.\
- All visual parameters of the scene and the different sources have to be harmonised.
- The perspective of the scene is permanently adapted to the current viewpoint of the conferee in front of the display (head motion parallax; look-behind effect).
- Eye-contact between two partners talking to each other has to be provided.
- Gaze from one conferee to another has to be reproduced in a sufficient manner such that everybody can recognise who is looking at whom (e.g.: who is searching for eye contact).
- Voice of a conferee must come from the same direction where he is positioned on the screen.

3. AUGMENTED REALITY

Augmented reality (AR) is related to the concept of virtual reality (VR). VR attempts to create an artificial world that a person can experience and explore interactively, predominantly through his or her sense of vision, but also via audio, tactile, and other forms of feedback. AR also brings about an interactive experience, but aims to supplement the real world, rather than creating an entirely artificial environment. The physical objects in the individual's surroundings become the backdrop and target items for computer-generated annotations.

AR is within a more general context termed Mixed Reality (MR), which refers to a multi-axis spectrum of areas that cover Virtual Reality (VR), AR, tele-presence, and other related technologies. Virtual Reality is a term used for computer generated 3D environments that allow the user to enter and interact with synthetic environments. The users are able to "immerse" themselves to varying degrees in the computers artificial world which may either be a simulation of some form of reality or the simulation of a complex phenomenon(**Fig:3**).

Figure 3: AR example with virtual chairs and a virtual lamp.

As computers increase in power and decrease in size, new mobile, wearable, and pervasive computing applications are rapidly becoming feasible, providing people access to online resources always and everywhere. This new flexibility makes possible new kind of applications that exploit the person's surrounding context. Augmented reality (AR) presents a particularly powerful user interface (UI) to context-aware computing environments. AR systems integrate virtual information into a person's physical environment so that he or she will perceive that information as existing in their surroundings.

3.1 AR Components

3.1.1 Scene Generator

The scene generator is the device or software responsible for rendering the scene. Rendering is not currently one of the major problems in AR, because a few virtual objects need to be drawn, and they often do not necessarily have to be realistically rendered in order to serve the purposes of the application.

3.1.2 Tracking System

The tracking system is one of the most important problems on AR systems mostly because of the registration problem. The objects in the real and virtual worlds must be properly aligned with respect to each other, or the illusion that the two worlds coexist will be compromised. For the industry, many applications demand accurate registration, especially on medical systems.

3.1.3 Display

The technology for AR is still in development and solutions depend on design decisions.

Most of the Displays devices for AR are HMD (Head Mounted Display), but other solutions can be found. When combining the real and virtual world two basic choices are available: optical and video technology. Each of them has some tradeoffs depending on factors like resolution, flexibility, field-of-view, registration strategies, among others. Display technology continues to be a limiting factor in the development of AR systems. There are still no see through displays that have sufficient brightness, resolution, field of view, and contrast to seamlessly blend a wide range of real and virtual imagery. Furthermore, many technologies that begin to approach these goals are not yet sufficiently small, lightweight, and low-cost. Nevertheless, the past few years have seen a number of advances in see-through display technology, as we shall see next.

3.2 Applications

The Augmented Reality technology has many possible applications in a wide range of fields, including entertainment, education, medicine, engineering and manufacturing. It is expected that other potential areas of applications will appear with the dissemination of this technology.

3.2.1 Medical

Because imaging technology is so pervasive throughout the medical field, it is not surprising that this domain is viewed as one of the more important for augmented reality systems. Most of the medical applications deal with image guidedsurgery **(Fig.4)**

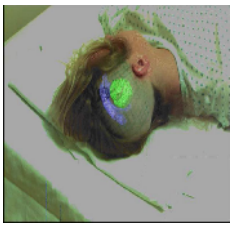


Figure 4: Image Guided surgery

Pre-operative imaging studies of the patient, such as CT (Computed Tomography) or MRI (Magnetic Resonance Imaging) scans, provide the surgeon with the necessary view of the internal anatomy. From these images the surgery is planned.

3.2.2 Entertainment

A simple form of augmented reality has been in use in the entertainment and news business for quite some time. Whenever you are watching the evening weather report, the speaker remains standing in front of changing weather maps. In the studio the reporter is actually standing in front of a blue screen. This real image is augmented with computer generated maps using a technique called chroma-keying. Another entertainment area where AR is being applied is on game development.

3.2.3 Engineering Design

Imagine that a group of designers are working on the model of a complex device for their clients. The designers and clients want to do a joint design review even though they are physically separated. If each of them had a conference room that was equipped with an augmented reality display this could be accomplished. The physical prototype that the designers have mocked up is imaged and displayed in the client's conference room in 3D.

The clients can walk around the display looking at different aspects of it. To hold discussions the client can point at the prototype to highlight sections and this will be reflected on the real model in the augmented display that the designers are using. Or perhaps in an earlier stage of the design, before a prototype is built, the view in each conference room is augmented with a computer generated image of the current design built from the CAD files describing it.

4. VIRTUAL REALITY

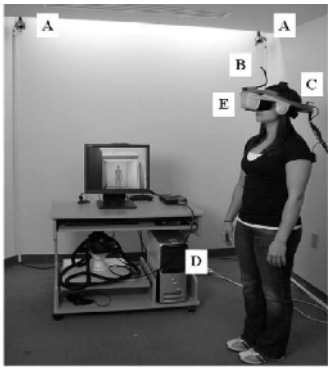
Virtual reality is a branch of computer graphics. It can be defined as a virtual reality experience as any in which the user is effectively immersed in a responsive virtual world.

This implies user dynamic control of viewpoint. Virtual Reality as a concept essentially deals with convincing the participant that s/he is actually in another place, by replacing the normal sensory input received by the participant with information produced by a computer. Cyberspace, a visualization of the computer environment, is a practical application of Virtual Reality, providing a more natural interface between the user and the computer. Cyberspace represents one of the most potent and impressive visualization tools ever created.

Now, entire universes, whether they be of our design or others, not only lay at our fingertips, but surround and envelop us as well. It represents the next generation in the evolution of the human-computer interface medium. Virtual reality allows a more naturalized interface with the computer that goes far beyond the Graphics User Interface (GUI), point & click window environments that are so popular now. With virtual reality, the user is surrounded by his environment, and an interface can be established not through the conventional keyboard or mouse, but through more complex tracking systems that keep record of hand and head orientation.

4.1 What Is a Virtual Environment?

A virtual environment (VE) is a digital space in which a user's movements are tracked and his or her surroundings rendered(as shown in fig below), or digitally composed and displayed to the senses, in accordance with those movements.



For example, in a computer game, a user's joystick motions can be tracked and his or her character moves forward,rendering a new environment.

4.2 Hardware Setups

Virtual environments come in many forms, and often these are determined by the capabilities of the platform or hardware with which one is experiencing the VE. Virtual environment hardware may be something as simple as a cellular phone or as complex as a fully immersive virtual reality setup, which incorporates wearable equipment that allows the user to move in the physical environment.

The most rudimentary VEs are those available on desktop computers, mobile devices such as cellular telephones and handheld gaming devices, and traditional videogame consoles. These environments may be two- or three-dimensional. Typically, key presses and mouse or joystick movements are employed by the user to move a viewpoint or a representation, thus providing a simple form of tracking. The monitor then reflects these changes via appropriate rendering. For example, a user may press the right arrow key or tilt a joystick to the right to move a videogame character from left to right on the screen and progress through a depicted virtual environment. New technologies have increased the tracking ability and movement veridicality in desktop setups via webcams and remotes (e.g., the Nintendo Wii). More immersive VEs often use a head-mounted display (HMD) to render virtual environments. An HMD is comprised of a helmet or headpiece with LCD screens affixed in front of the eyes to provide a wide, stereoscopic view of the computer-generated environment

4.3 Technologies

Four technologies are crucial for VR:

- The visual (and aural and haptic) displays that immerse the user in the virtual world and that block out contradictory sensory impressions from the real world;
- The graphics rendering system that generates, at 20 to 30 frames per second, the everchanging images;
- The tracking system that continually reports the position and orientation of the user's head and limbs; and
- The database construction and maintenance system for building and maintaining detailed and realistic models of the virtual world. Four auxiliary technologies are important, but not nearly so crucial:
- Synthesized sound, displayed to the ears, including directional sound and simulated sound fields.
- Display of synthesized forces and other haptic sensations to the kinaesthetic senses.

- Devices, such as tracked gloves with pushbuttons, by which the user specifies interactions with virtual objects.
- Interaction techniques that substitute for the real interactions possible with the physical world.

Conclusion

Touch plays a key role when examining objects in the real world but until recently it was not possible to use this realistically in virtual environments and computer-based displays. This has meant that some of these displays lacked realism and usefulness. In order to overcome these hurdles modern immersion techniques like Virtual reality, Augmented reality, Tele immersion and Haptic technology come into existence.

New technologies from the area of virtual reality (VR) now allow computer users to use their sense of touch to feel virtual objects. Touch is a very powerful sense but it has so far been neglected in computing. State-of-the-art haptic (or force-feedback) devices allow users to feel and touch virtual objects with a high degree of realism. An artefact's surface properties can be modelled so that someone using a haptic device could feel it as a solid, three-dimensional object with different textures, hardness or softness.

In this paper we describe the development of a virtual teleconference system, which will be able to provide immersive tele-presence. The usage of large displays providing life size pictures of the conferees and covering almost the complete viewing angle of the users is a strong requirement for such a system. Furthermore eye-contact, head motion parallax, good reproduction of body language and location dependent sound rendering has to be provided.

References

- Azuma, R. (1993), "Tracking Requirements for Augmented Reality," Communications of the ACM, 36(7):50-51.
- Frederick P. Brooks, Jr. "What's real about Virtual Reality?" University of North Carolina at Chapel Hill.
- Vallino R James, " Interactive Augmented Reality", University of Rochester Rochester, New York, 1995
- Blaine Bell, Steven Feiner, Tobias Höllerer, "View Management for Virtual and Augmented Reality", Columbia University,2001

- P. Kauff, R. Schäfer and O. Schreer, "**Tele-Immersion in Shared Presence Conference Systems",** Germany
- S. J. Gibbs, C. Arapis, C. J. Breiteneder, "TELEPORT - Towards Immersive Co-Presence", ultimedia Systems, no. 7, page 214-221, 1999