ISSN:0975-9646

Virtual Reality: The Future Interface of Technology

Raghav Toshniwal, Kanishka Ghosh Dastidar

Computer Science Department
St. Xavier's College, Kolkata, India

Abstract: **Virtual Reality, once a distant concept, is now on the brink of entering mainstream market. Overcoming a host of challenges, Virtual Reality has finally made significant breakthroughs both on technical and social grounds and is almost ready to enter into daily lives. Positive Industry Trends reinforced with heavy financial backing is making sure continued research and development in the field. It is going to play an important role as to how we interact with technology in future.**

Keywords: **Virtual Reality, Augmented Reality, Head Mounted Display**

I. INTRODUCTION

The screen is a window through which one sees a virtual world.The challenge is to make that world look real, act real, sound real, and feel real [1].

Virtual Reality refers to the re-creation (partially or entirely) of a scene/object/event so as to give a perception of physically being there. Virtual Reality has captured our imaginations since a long time as a futuristic concept. However, in the last decade, there have been notable advancements in this field taking it a step closer to reality. Virtual Reality and its effectiveness can be classified under the following broad categories:

1. **Immersion:** The degree at which the Virtual Reality System can invoke user stimuli [2] refers to the immersion of the system. As illustration, a head tracking system in a Head-Mounted Display would increase the level of immersion, making the system more effective. Likewise, in an attempt to re-create the effect of rain falling on the user if haptic systems are deployed to invoke the sense of falling rain, it would make the system more immersive [4].
2. **Vividness:** It refers to the richness in detail the augmented system provides. It varies on a large scale of factors like colour reproduction to the resolution at which the system is projected. With advancements in display technologies, vividness in VR systems has drastically improved.
3. **Interactivity:** A Virtual Reality system attempts to re-create not only the appearance of reality but also the level of interactivity it can incorporate in the system. The proper response to user actions is taken into account when judging the effectiveness of a Virtual Reality system.

II. AUGMENTED REALITY

Stemming from Virtual Reality itself, Augmented Reality refers to the superimposition of information on actual reality. It differs from Virtual Reality due to the fact that it does not attempt to recreate scenes on the whole but only to supply useful information on actual reality [3]. The advancements in Real Time Image Processing and high speed data systems have made it possible for Augmented Reality to exist as a mainstream technology. Google Glass, perhaps the most celebrated Augmented Reality System, attempts to provide diversified contextual information exactly when the user needs it.

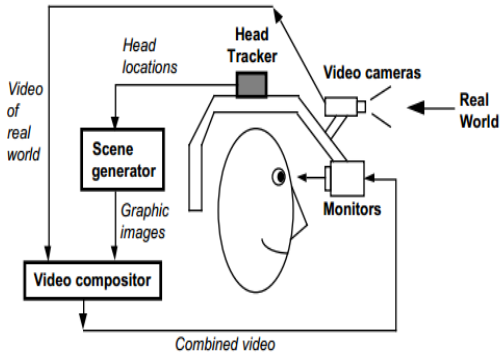

Fig 1: Design of an Augment Reality Display [4].

Head-Up Displays which imprints contextual information on glass is an important are of Augmented Reality Research. By imposing such information on the windshield of cars, the system attempts to provide information without interfering or distracting with the reality that exists beyond.

Fig 2: HUD Display in a car.

III. PERCEPTION REQUIREMENTS

Our perception of the real word is derived and constructed by aggregation of information from our various sensory organs. Virtual Reality aims at giving us this perception through some or all of these senses; this is achieved through feedback we receive from sensors. The broad categories of the perceptions achieved through Virtual Reality are:

1. **Visual Perception:** Vision is perhaps the most dominant sense and our understanding of things revolves around this [8]. Even in the realm of Virtual Reality, due importance is given to re-creation of this perception. A sense of *depth* is created because of stereoscopic vision which allows human eye to distinguish near and far away objects. Along with this various optical illusions like parallax are also accounted when designing a Virtual Reality system. Intricate details of shadows and the amount of light that needs to be projected all fall under the same ambit of visual perception. Critical Fusion Frequency refers to the number and the rate of static images that need to be shown so as to create the illusion of a moving object. It is therefore very important to account for all these factors when creating a visual perception for the user in a Virtual Reality environment.

2. **Sound Perception:** In a real environment sound sources can be located by our ears in any point at space. It becomes increasingly difficult to implement the same in a virtual environment because of the limitation of sound sources than can be present in the system. This can be overcome to an extent by using sounds of varied intensities and frequencies to create an illusion of a varied sound source.

3. **Touch Perception**: It is important to create the perception of touch when the user interacts with an object in a Virtual Reality System. There are various parameters involved in creating a sense of touch; the force a user should feel when in contact with the object and even the temperature of the object that a user experiences when in contact. These are achieved through haptic feedback, where the frequency and intensity of the vibrations create the illusion of contact for the user.

4. **Olfactory Perception:** The sense of how a scene would smell is characteristic and intertwined with our perception of the scene. We subconsciously attach our sense of smell with the perception of a place. Therefore, Virtual Reality systems reproduce the same smells giving another dimension to the illusion of reality.

IV. CHALLENGES IN VIRTUAL REALITY

1. Hardware Challenges:

One of the challenges of Virtual Reality is to improve upon the tracking systems. Virtual Reality depends on simulating various environments. Thus, it becomes imperative to accurately track the various physical dynamics of the environments that are being re-created. Another challenge is to enable ways to naturalize the interaction that the user has with the virtual environment. There are certain mass consumer technologies such as Microsoft Kinect which have employed various motion sensing technologies to track the motion of a user in relation to the software. One of the major roadblocks is to accurately recreate Haptic perception which is the sensation felt by the skin. The design of visual presentations in virtual environments is also complicated because the human visual system is very sensitive to perceived anomalies, especially in motion scenes.[6]

Most of the technologies that are being used in Virtual Reality systems are those that have been developed for other disciplines. Thus, there is little movement in the world of technology to create a thrust towards focusing on hardware solely aimed towards developing Virtual Reality systems.

Ergonomics is also an issue when it comes to Virtual Reality. Hardware used in Virtual Reality is often cumbersome and limits the physical freedom of the user. This can lead to trouble with the user's sense of balance or inertia. Bad ergonomics can also lead to a sense of cyber sickness. Users of Virtual Reality technologies generally experience various levels of sickness ranging from headaches to nausea. [7]

2. Ethical and Psychological Challenges:

There is a psychological challenge facing Virtual Reality too. Complete immersion in a virtual environment could psychologically affect user. Often, in virtual environments, users will be exposed to criminal and unethical acts. Thus, since the immersion level of virtual reality is so high, there is a chance that the user may become de-sensitized to such actions.

Another problem is the emotional and physical impact that virtual stimuli can have on a user. The feelings of fright, anxiety and nervousness will be heightened within an immersive virtual environment as compared to other forms of computing. Thus, there exists the risk of real emotional trauma as a result of a virtual incident.

V: APPLICATIONS OF VIRTUAL REALITY

Virtual Reality has undergone tremendous improvement driven by the fact that it has a variety of applications in a variety of Industries. Enlisted are some applications for Virtual Reality:

1. **Scientific Visualizations**: Virtual Reality has tremendous prospects in the area of Scientific study where Virtual Reality systems are used to study complex structures and are visualized and recreated for further study. The Large Haudron Collider and CERN have developed the i3d system for scientific study.[9]
2. **Medical Industry**: The study of anatomy, which had until now been restricted to 3 Dimensional models, are being replaced by Virtual Reality Models that can be interactive and contain much more detail. With the mapping of the entire human anatomy, simulations and the results of various medical experiments can be observed with unprecedented detail. Virtual Reality is certainly the tool for medical research of this century.
3. **Architectural Visualizations**: These Virtual Reality systems can map complex architectural structures with relative ease. They are replacing traditional CAD(Computer Aided Design) models as the 3 dimensional visualization can show much more detail. It also aids architects who have been using 2D tools to create and visualize objects that exist in 3D.
4. **Education and Training**: Drastic changes in methods of training and education are observed with the introduction of Virtual Reality. Richer content delivered through stimulation of many more senses makes the information easier to grasp and comprehend. In the area of training, Virtual Reality is being used to push down costs by re-creating virtual environments and simulating real-life scenarios.
5. **Entertainment**: Considered to be the next big breakthrough in this area, content delivery through Virtual Reality guarantees a richer, immersive experience. Sony has developed a Virtual Reality headset for the next generation of gaming consoles.

VI: CONCLUSION AND SCOPE

Even though the concept of Virtual Reality is not recent, industry trends have made it one of the most important area for research and development in technology. The recent accusation of Oculus Rift, one of the pioneers in Virtual reality, by a Facebook at 2 billion dollars is a sign of the growing importance of the VR Industry. Companies are effectively marketing and selling these systems to diversified consumers ranging from Video-Gamers to Medical Professionals. The future of Virtual Reality seems bright as the industry is investing talent and money to bring this once distant concept into mainstream usage.

REFERENCES

[1] SUTHERLAND, I. E. The ultimate display. In Proceedings of IFIPS Congress (New York City, NY, May 1965), vol. 2, pp. 506–508.

[2] Astheimer P, Dai, Göbel M, Kruse R, Müller S, Zachmann G (1994) Realism in Virtual Reality, in: Magnenat Thalmann N and thalmann D, Artificial Life and Virtual reality, John Wiley, pp.189-209.

[3] Virtual Reality Software and Technology Nadia Magnenat Thalmann MIRALab, Centre Universitaire d'Informatique

[4] A Survey of Augmented Reality Ronald T. Azuma Hughes Research Laboratories

[5] Virtual Reality: Past, Present, and Future Enrico Gobbetti and Riccardo Scateni CRS4

[6]Kay Stanney, Realizing the Full Potential of Virtual Reality: Human Factors Issues That Could Stand in the Way.

[7] Sharmistha Mandal, Brief Introduction of Virtual Reality & its Challenges, International Journal of Scientific & Engineering Research, Volume 4, Issue 4, April-2013

[8] KOSSLYN, S. *Image and Brain: The resolution of the imagery debate.*MIT Press, Cambridge, MA, USA, 1994.

[9] GOBBETTI, E., AND BALAGUER, J.-F. i3D: