Virtual Reality – A Review

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Abstract:

This paper focus on the review of virtual reality. Virtual reality, also called as virtual environment, has drawn much attention in the last few years. Extensive media coverage causes this interest to grow rapidly due to high lighting application domains, technological requirements, and currently available solutions. The structure of this paper includes introduction, working, user interface, VR devices, CAVE and terminology related to virtual reality.

Keywords: Virtual Reality, CAVE, user interface, HMD, Virtual environment

1 INTRODUCTION

Virtual reality (**VR**) typically refers to computer technology that uses software to generate the realistic images, sounds and other sensations that replicate a real environment (or create an imaginary setting), and simulate a user's physical presence in this environment. VR has been defined as "...a realistic and immersive simulation of a three-dimensional environment, created using interactive software and hardware, and experienced or controlled by movement of the body" or as an "immersive, interactive experience generated by a computer. A person using virtual reality equipment is typically able to "look around" the artificial world, move about in it and interact with features or items that are depicted on a screen or in goggles. HMD typically take the form of head-mounted goggles with a screen in front of the eyes. Programs may include audio and sounds through speakers or headphones.

2 WORKING

2.1 VR headsets:

VR headsets use either two feeds sent to one display or two LCD displays, one per eye. There are also lenses which are placed between your eyes and the pixels this is why the devices are often called goggles. In some instances, these can be adjusted to match the distance between your eyes which varies from person to person. These lenses focus and reshape the picture for each eye and create a stereoscopic 3D image by angling the two 2D images to mimic how each of our two eyes views the world ever-so-slightly differently. Try closing one eye then the other to see individual objects dance about from side to side and you get the idea behind this.

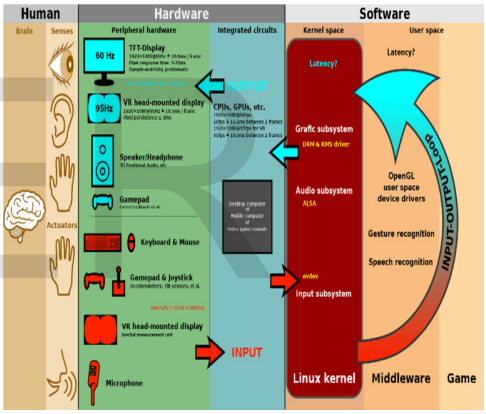

Fig 1: output and input in virtual reality device

2.2 Head tracking:

Head tracking means that when you wear a VR headset, the picture in front of you shifts as you look up, down and side to side or angle your head. A system called 6DoF (six degrees of freedom) plots your head in terms of your x, y and z axis to measure head movements forward and backwards, side to side and shoulder to shoulder, otherwise known as pitch, yaw and roll.

2.3 User interface (UI):

The **user interface** (**UI**), in the industrial design field of human–computer interaction, is the space where interactions between humans and machines occur. The goal of this interaction is to allow effective operation and control of the machine from the human end, whilst the machine simultaneously feeds back information that aids the operators' decision-making process. Examples of this broad concept of user interfaces include the interactive aspects of computer operating systems, hand tools, heavy machinery operator controls, and process controls. The

design considerations applicable when creating user interfaces are related to or involve such disciplines as ERGONOMICS and PSYCHOLOGY. Generally, the goal of user interface design is to produce a user interface which makes it easy (self-explanatory), efficient, and enjoyable (user-friendly) to operate a machine in the way which produces the desired result. This generally means that the operator needs to provide minimal input to achieve the desired output, and also that the machine minimizes undesired outputs to the human.

2.4 Tangible user interface:

Tangible user interface is a user interface in which a person interacts with digital information through the physical environment. The initial name was Graspable User Interface, which is no longer used. The purpose of TUI development is to empower collaboration, learning, and design by giving physical forms to digital information, thus taking advantage of human abilities of grasp and manipulate physical objects and materials. One of the pioneers in tangible user interfaces is Hiroshi Ishii, a professor in the MIT Media Laboratory who heads the Tangible Media Group. His particular vision for tangible UIs, called *Tangible Bits*, is to give physical form to digital information, making bits directly manipulable and perceptible. Tangible bits Pursues the seamless coupling between physical objects and virtual data.

2.5 Virtual Reality devices:

1. HMD
2. Tracking Device
3. Data Gloves

2.5.1 HMD:

HMD has one or two small displays, with lenses and semi-transparent mirrors embedded in eyeglasses (also termed *data glasses*), a visor, or a helmet. The display units are Miniaturized and may include cathode ray tubes (CRT), liquid crystal displays (LCDs), liquid crystal on silicon (LCOS), or organic light-emitting diodes (OLED). Some vendors employ multiple micro-displays to increase total resolution and field of view.

HMDs differ in whether they can display only computer-generated imagery (CGI), or only live imagery from the physical world, or a combination. Most HMDs can display only a computer-generated image, sometimes referred to as a virtual image. Some HMDs can allow a CGI to be superimposed on a real-world view. This is sometimes referred to as augmented reality or mixed reality. Combining real-world view with CGI can be done by projecting the CGI through a partially reflective mirror and viewing the real world directly. This method is often called *optical see-through*. Combining real-world view with CGI can also be done electronically by accepting video from a camera and mixing it electronically with CGI. This method is often called video see-through.

2.5.2 Tracking Device:

The tracking devices are the main components for the VR systems. They interact with the system's processing unit. This relays to the system the orientation of the user's point of view. In systems which let a user to roam around within a physical space, the locality of the person can be detected with the help of trackers, along with his direction and speed. The various types of systems used for tracking utilized in VR systems. These are as follows:

1. A six degree of freedom can be detected **(6-DOF)**
2. Orientation consists of a yaw of an object, **roll** and **pitch**.
3. These are nothing but the position of the objects within the x-y-z coordinates of a space, however, it is also the orientation of the object.

These however emphasizes that when a user wears a HMD then as the user looks up and down, left and right then the view also shifts. Whenever the user's head tilts, the angle of gaze changes. The trackers on the HMD describe to the CPU where you are staring while the right images are sent back to the screen of HMD.

All tracking system consists of a device that is capable of generating a signal and the signal is detected by the sensor. It also controls the unit, which is involved in the process of the signal and sends information to the CPU. Some systems ask you to add the component of the sensor to the user (or the equipment of the user's). If this takes place, then you have to put the signal emitters at certain levels in the nearby environment. Differences can be easily noticed in some systems; with the emitters being worn by the users and covered by sensors, which are attached to the environment. The signals emitted from emitters to different sensors can take various shapes, including electromagnetic signals, optical signals, mechanical signals and acoustic signals

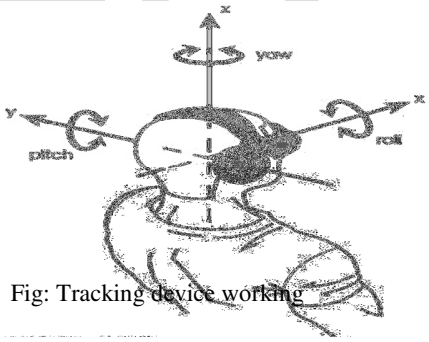

Fig: Tracking device working

2.5.3 Data Gloves:

A data glove is an interactive device, resembling a glove worn on the hand, which facilitates tactile sensing and fine-motion control in robotics and virtual reality. Data gloves are one of several types of electromechanical devices used in haptics applications. Tactile sensing involves simulation of the sense of human touch and includes the ability to perceive pressure, linear force, torque, temperature, and surface texture. Fine-motion control involves the use of sensors to detect the movements of the user's hand and fingers, and the translation of these motions into signals that can be used by a virtual hand (for example, in gaming) or a robotic hand (for example, in remote-control surgery).Within a virtual reality room or other VR environment, a data glove can allow you to interact normally with objects -- turning doorknobs, for example -- and receive haptic feedback to replicate grasping a doorknob and feeling the object in your hand rather than just

making a gesture in air. Haptic feedback is essential to immersiveness, which enables user engagement in virtual environments, particularly for applications like VR gaming

Fig: Data gloves

3 CAVE:

A **cave automatic virtual environment** is an immersive virtual reality environment where projectors are directed to between three and six of the walls of a room-sized cube. The name is also a reference to the allegory of the Cave in Plato's Republic in which a philosopher contemplates perception, reality and illusion.

3.1 Characteristics of CAVE:

The first CAVE was invented by Professor Daniel J. Sandin and developed at the University of Illinois, Chicago's Electronic Visualization Laboratory by Carolina Cruz, David Pape, and a small team of graduate students. A CAVE is typically a video theater situated within a larger room. The walls of a CAVE are typically made up of rear-projection screens, however flat panel displays are becoming more common. The floor can be a downward-projection screen, a bottom projected screen or a flat panel display. The projection systems are very high-resolution due to the near distance viewing which requires very small pixel sizes to retain the illusion of reality. The user wears 3D glasses inside the CAVE to see 3D graphics generated by the CAVE. People using the CAVE can see objects apparently floating in the air, and can walk around them, getting a proper view of what they would look like in reality. This was initially made possible by electromagnetic sensors, but has converted to infrared cameras. The frame of early CAVEs had to be built from non-magnetic materials such as wood to minimize interference with the electromagnetic sensors; the change to infrared tracking has removed that limitation. A CAVE user's movements are tracked by the sensors typically attached to the 3D glasses and the video continually adjusts to retain the viewer's perspective. Computers control both this aspect of the CAVE and the audio aspect. There are typically multiple speakers placed at multiple angles in the CAVE, providing 3D sound to complement the 3D video.

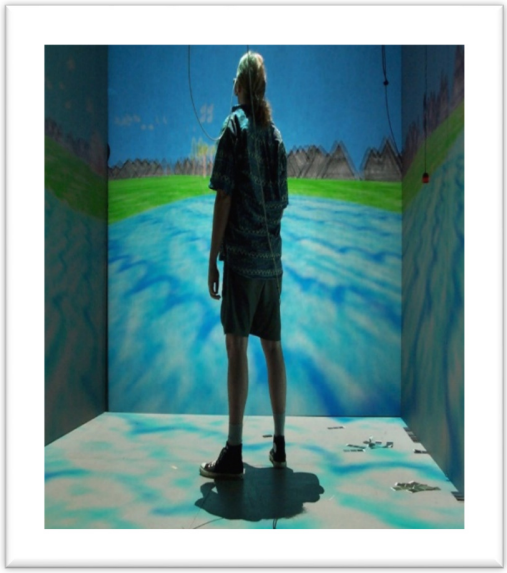

Fig: CAVE Virtual Reality

4 CONCLUSION:

Virtual Reality (VR) and Virtual Environments (VE) are used in computer community interchangeably. These terms are the most popular and most often used, but there are many other terms. Just to mention a few most important ones: Synthetic Experience, Virtual Worlds, Artificial Reality. All these names mean the same:

• Real-time interactive graphics with three-dimensional models, combined with a display technology that gives the user the immersion in the model world and direct manipulation, we call virtual environments."

• Merriam-Webster's New Collegiate Dictionary, Ninth Edition, defines virtual as being in effect but not in actual fact, and environment as the conditions, circumstances, and influences surrounding and affecting an organism".

• The illusion of participation in a synthetic environment rather than external observation of such an environment. VR relies on a three-dimensional, stereoscopic head-tracker dis-plays, hand/body tracking and binaural sound. VR is an immersive, multi-sensory experience. Computer simulations that use 3D graphics and devices such as the Data Glove to allow the user to interact with the simulation.

• Virtual reality refers to immersive, interactive, multi-sensory, viewer-centered, three dimensional computer generated environments and the combination of technologies required to build these environments.

• Virtual reality lets you navigate and view a world of three dimensions in real time, with six degrees of freedom. In essence, virtual reality is clone of physical reality.

• According to Jerry Pothers, a research associate at the University of Washington, who works in the Human Interface Technology Laboratory, definition of virtual reality saying: "It can be defined in technological terms as a set of input devices which stimulate a high percentage of our sensory input channels, for instance, by providing a wide visual field-of-view and stereo sound. It can be defined in psychological terms a pat-tern of sensory stimuli which gives one an impression of being in a computer-generated space.

Although there are some differences between these definitions, they are essentially equivalent. They all mean that VR is an interactive and immersive experience in a simulated world.

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