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A NOVEL STUDY ON MIXED REALITY (MR) AND IT'S APPLICATIONS

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Abstract-Augmented Reality technology was first developed over forty years ago, there has been little survey work giving an overview of recent research in the field. This paper focuses on Mixed Reality (MR) visual displays, a particular subset of Virtual Reality (VR) related technologies that involve the merging of real and virtual worlds, which connects completely real environments to completely virtual ones. It provides a roadmap for future augmented reality research which will be of great value to this relatively young field, and also for helping researchers decide which topics should be explored when they are beginning their own studies in the area.

I. Introduction

Key-Technology Research Project on Mixed Reality Systems" (MR Project in short) from January 1997 to April 2001 The term "Mixed Reality" is not in common use, the related term "Augmented Reality" (AR) has in fact started to appear in the literature with increasing regularity [1]. The first AR interface was developed by Sutherland in the1960's [86] but it has been only 10 years since the first AR conferencewas held; the International Workshop on Augmented Reality'98 (IWAR 98) in San Francisco, October 1998[3]. Mixed reality technology used the medical area, architecture area and city planning.

A. Categoriesof Mixed Reality

Four types of categories in mixed reality.

Real environment (also called "natural environment") refers to the natural world we consume every day. This natural environment encompasses all living and non-living things occurring naturally on Earth.

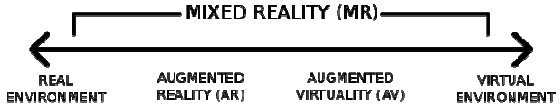

Fig1: Categories of Mixed Reality

Augmented reality brings aspect of the virtual world into the real world. It is closer to the real environment, as opposed to virtual environments, in the spectrum of reality technologies.

Augmented virtuality describes the environment in which real objects are inserted into computer-generated virtual environments.Virtualreality provide users with the greatest level of immersion. The immersion is distinct from other types of reality technologies. The immersion experienced in virtual reality requires stimulation of all of the user's senses in a fully immersive virtual experience, to theextent that the brain accepts the virtual environment as a real environment. In a virtual reality environment, users inhabit a completely synthetic world may or may not mimic the properties of a real-world environment.

B. Hardware and Software

A video see-through HMD (ST-HMD) is utilized as a display unit, and a 6-DOF tracking sensor attached to the HMD tracks the head position and orientation of the user. The application program running on the PC realizes a registration, which matches the real and virtual world coordinates, based on the position and orientation obtained by the sensor and image information captured by a camera attached on the HMD. It then renders images based on the registered position and orientation. The program should do all this process in real-time, shown in Fig. 3 [5].

Each MR system consists of 4 layers: the base platform layer, the MR platform layer, the application layer, and the contents layer is shown figure 4.

The base platform layer is the lowest layer of the system, and consists of a computer, graphic and video hardware, other related devices, an operating

system and system level libraries.

MR platform layer provides equipment and functions necessary for providing services to support the MR system. The video ST-HMD and software

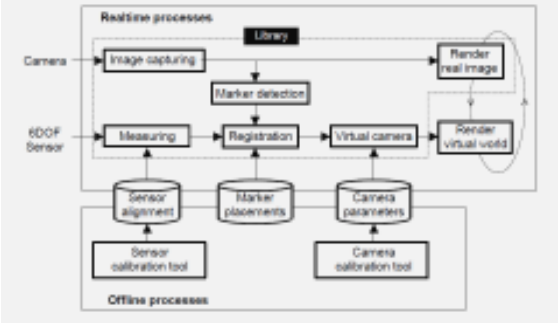

Fig 2: Processing elements of Mixed Reality System

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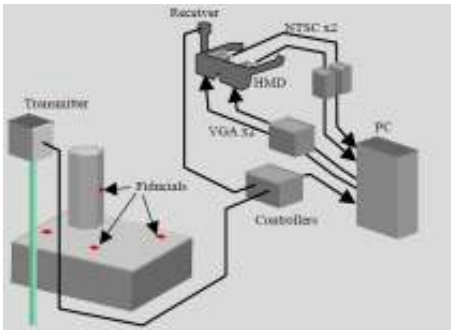

Fig 3: Hardware setup of Mixed Reality

libraries such as registration, video mixture, even graphics are categorized in this layer. These two layers are independent of applications and content. The application layer is a software program implemented on the MR platform layer. The program may be designed for a specific application field, such as a shooting game, but is independent of its content. The contents layer is data used in the application program [5].

Contents Layer
Applications Layer
Mixed Reality Platform Layer
Base Platform Layer

Fig 4: Layers of Mixed Reality application

In fig 2.thebasic processingelements necessary for realizing an MR/AR system. Theyare divided into two parts, library and utility tools [6].

As shown Fig 5. V4L stands for Video4Linux, the Linux standard video capture API. The upper level CG library is used for handling a virtual world. More pacifically, this refers to Open Inventor, OpenGL Performer or others like them.

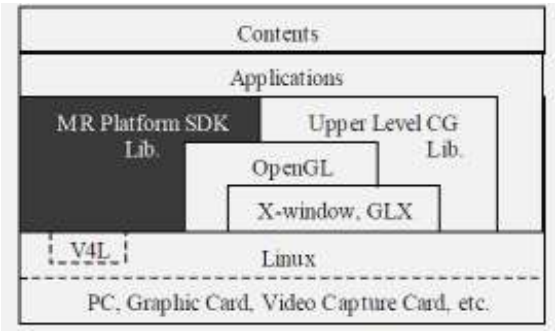

Fig 5: Library Layer of Mixed Reality

II. MR Platform

MR Platform" provides equipment and functions unique to the MR application. It consists of a video ST-HMD with a software development kit (SDK) corresponding to the MR platform layer.

As the base platform layer, an i386 based PC and Linux operating system are adopted because this type of environment competes successfully with graphics workstations (GWS) such as those provided by SGI.

The MR Platform provides the newest COASTAR-type video ST-HMD that has been redesigned and improved based on the prototype. The HMD with integrated stereoscopic cameraswhose axes coincide with its display axes, stereoscopic display, simultaneous video outputs. HMD may contain a receiver of a magnetic sensor such as a Polhemus FASTRAK for head tracking.

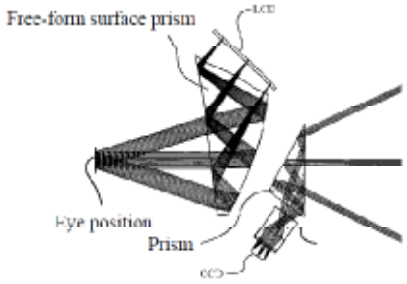

Fig 7(a): optical Configuration

Fig 7(b) :Appearance of MR Platform

A. Mixed Reality Platform And Its Applications

Mixed reality technology used the medical area, architecture area and city planning.

AR²Hockey(AR AiR Hockey) system that was made as acase study of the collaborative AR system. AR2Hockey system where two players can share physical game field, mallets, and a virtual puck to play air-hockey game [7].

Fig 6: AR²Hockey

B. RV-Border Guards

RV-Border Guards," which uses Mixed Reality (MR) technologies. This system is designed to emphasize MR-specific features for entertainment. Three players wearing HMDs cooperatively battle with virtual invaders flying around them in the MR space. Each player is armed with a virtual gear such as a helmet and a gun, and can intuitively interact with the MR space using easy gestures. Total reality of the MR space is carefully tuned [8].

Fig 7: RV-Border Guards

C. Automobile Industry

Mixed Reality technology used in "Virtual Car" system [9] developed by ART+COM in Berlin.

Fig 7: Virtual Car

D. Sheffield Knee Arthroscopy Training System

The Sheffield knee arthroscopy training system (SKATS) was originally a visual-based virtual environment, developed as a mixed reality-training environment through the use of tactile augmentation.the mixed reality system is assessed in terms of construct validity by comparing the performance of users with differing levels of surgical expertise [11].

E. HIBALL System

the MR system build into this room is the HiBall system with dedicated transmitter placed on the ceiling as a head tracking system in order to satisfy the requirement to allow users to move around relatively broad area.

Fig 8: HiBalltracker at CRL

III. Conclusion

In this paper describes research and development of mixed reality and its applications. These applications inject in our daily new life into R&D activity in this field.

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