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Virtual Reality: A Path Leading to Future and its Implementation in Military

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ABSTRACT: In recent years, virtual reality has been used in many fields mostly for education and practices for example, in aeronautics, military, entertainment, gaming, medical training etc. This article will encapsulate the current developments in software and hardware of VR technology and its application in military field and also summarize the future of virtual reality technology in different fields compared to military.

KEYWORDS: Virtual reality, Military, Technology, Graphics, Simulation.

I. INTRODUCTION

Virtual reality has made it possible even for average user to experience the world of computer graphics. It allows to see the vast world of computer graphics with no borders and constraints which can be created or manipulated by ourselves, it's like we are the king of this world. Virtual reality is considered to have begun in the 1950's but it came to the public's attention in the late 1980's and 1990's. But nowadays everyone knows about virtual reality it plays an important role in the development of a person. In recent years, virtual reality has been used in many fields mostly for education and practices for example, in aeronautics, military, entertainment, gaming, medical training etc. This article will encapsulate the current developments in software and hardware of VR technology and its application in military field, and also summarize the future of virtual reality technology in different fields compared to military.

Paper is organized as follows. Section II describes automatic text detection using morphological operations, connected component analysis and set of selection or rejection criteria. The flow diagram represents the step of the algorithm. After detection of text, how text region is filled using an inpainting technique that is given in Section III. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

II. EVOLUTION OF VR

The concept of virtual reality dates back to the 1930s when "Pygmalion's Spectacles," a story written by science fiction writer Stanley G. Weinbaum, presented the idea of a pair of goggles that let the wearer experience a fictional world through holographics – three-dimensional images created with photographic projection, taste, smell and touch.

Sensorama: In the mid-1950s, cinematographer Morton Heilig developed the Sensorama, which was one of the earliest-known examples of immersive, multi-sensory (now known as multimodal) technology. It was a mechanical device that featured stereo speakers, a stereoscopic display, fans, smell generators and a vibrating chair[5].



Fig 1. Sensorama

Telesphere Mask: In 1960, Morton Heilig developed a stereoscopic television apparatus aimed for individual use in a portable form factor which could be attached to the user's head. The Telesphere mask comprised of optical units, television tube units, earphones, discharge nozzles designed as a personalized device which could be adjusted to the individual's comfort.

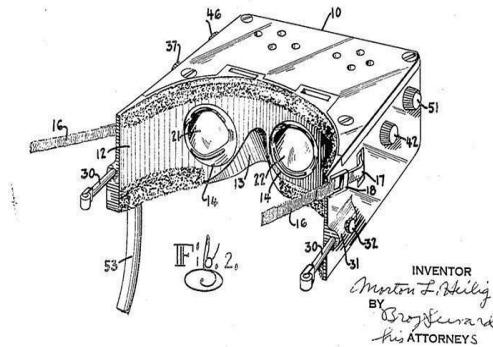


Fig 2. Telesphere Mask

The Ultimate Display: In 1965, Ivan Sutherland developed the Ultimate Display, a HMD system that could simulate reality to the point where one could not tell the difference between the real and virtual world[5].



Fig 3. The Ultimate Display

Sword of Damocles: In 1968, Sutherland, along with his student Bob Sproull, developed the Sword of Damocles, the first AR/VR device, which featured a head-mounted display that hung from the ceiling. However, this technology was closer to virtual technology than augmented technology[5].

Videoplac: In 1974, Myron Krueger developed a projection system and video cameras called Videoplac, which produced shadows on a screen. It showcased the ability of being in an interactive environment for users[5].

VCASS: Thomas Furness at the US Air Force's Armstrong Medical Research Laboratories developed in 1982 the Visually Coupled Airborne Systems Simulator – an advanced flight simulator[12].

VPL: The VPL company manufactures the popular DataGlove (1985) and the EyePhone HMD (1988) – the first commercially available VR devices[12].

Sega VR set: In 1993, Sega announced the Sega VR headset for the Sega Genesis console at the Consumer Electronics Show. The headset prototype had a head tracking device with wrap-around stereo sound and LCD screens[5].

VR-32: In 1995, the Nintendo Virtual Boy, originally known as VR-32, was launched. It was a 3D gaming console that was promoted to be the first-ever portable console that could display true 3D graphics. The product was first released in Japan and North America at a price of \$180, but it was a commercial failure despite price drops[5].



Fig 4. Nintendo VR-32

Matrix: In 1999, Lana Wachowski and Lilly Wachowski, who are both American film directors, screenwriters and producers, directed the film “The Matrix.” The film portrays characters living in a fully simulated world, with many of them being completely unaware they do not live in the real world[5].

ARToolKit: In 2000, Hirokazu Kato, from the Nara Institute of Science and Technology in Japan, created AR software called ARToolKit. In 2009, ARToolKit made augmented reality available to Internet browsers[5].

The impressive growth of VR and AR has contributed significantly in the development of many mainstream companies like Google, which uses Google Cardboard and Google Daydream with smartphones, Samsung developing their own VR headset called Galaxygear, which contains the feature of gesture control, and Sony with their playstation VR headset for the gamers out there.

III. APPLICATIONS OF VR IN MILITARY

1. VR for vehicle simulation

One of the earliest uses of simulators in a military environment was the flight trainers built by the Link Company in the late 1920's and 1930's. The development of Link Trainers led to digital flight simulation and then to distributed human computer digital combat simulation. The marketing of Link Trainers is also of interest, because it used cost-effectiveness analyses based on experiments to gauge the transfer of learning in aircrew training devices (ATDs) to proficiency in the cockpit[6]. Training simulation is a kind of physical simulation technology. It mainly fosters the combat skills of single-soldier or small-scale combat group by simulating actual vehicle, real soldier or actual combat environment. For example, more driving simulation system is currently used, and multi-purpose Compound laser warfare simulation system. The accuracy and vividness of these simulation systems have been greatly improved, the degree of simulation of the image has also been almost the same with the real, real. For example, Frasca's equipment for general aviation flight training is designed as a simulator for single-and double-launch navigation with a specific cockpit, high-resolution vision system, Air conditioners, electrical loading controls, digital audio, powertrain, integrated flight deck, electronic flight instrumentation systems, engine indication and crew warning systems, airborne collision avoidance systems, theater airborne alert systems, enhanced ground proximity warning systems, Manufacturing system, can provide high fidelity simulation, so that trainers in the small danger, low consumption conditions training a strong combat skills[1].

2. VR for situational experience and decision making

VR is also used in experience learning system, where the soldiers can learn about different real world scenarios and can adapt to harsh environments and circumstances. Often military simulators are used to train soldiers on vehicles like humvees, tanks, helicopters etc. Less often these simulators are used to train soldiers in decision making in difficult circumstances. Two of these type of application are explained in below paragraphs.

2.1 The Mission Rehearsal Exercise (MRE)

This application uses virtual reality environment to display various different scenarios or story in which soldiers can learn decision making.



Fig 5. Simulation of a scenario in MRE system

A user of the Mission Rehearsal Exercise interacts with virtual humans that are acting as a character in the scenario (see Fig 5). The point is that users learn by experiencing a situation and make decisions in stressful circumstances. Two communities are brought together to accomplish the MRE. On one hand the technical community which is capable of creating a virtual simulation environment. On the other hand there is the entertainment community that manages to come up with a dramatic story line and vivid characters. The main features of the MRE system include the interactive stories, virtual humans that form the dynamic characters and stunning audiovisual surroundings to realize a convincing environment where the participant is placed in [11].

2.2 The ICT Leaders Project (LP)

The ICT Leaders Project is another application where trainees can make leadership decisions. Like the MRE the LP uses fictional scenarios in virtual environments based on the Unreal Tournament 2003 game engine. An example of one of these scenarios is a food distribution operation on a peacekeeping mission in Afghanistan, which you lead as a commander of a company of soldiers. This commander is represented by a virtual character, which the participant can control by using text-based conversations. The user communicates with other virtual characters like soldiers and civilians and is able to raise questions. Eventually the user must make decisions in order to move the storyline forward. The decisions the user makes affect the storyline. The LP system uses a branching storyline structure where the user can choose its own path where 63 decisions have to be taken. Each of these decisions are based on a specific leadership point which help inexperienced commanders with their decision making process [10].

3. VR for medical training

It was practically impossible in traditional training procedures to train medical personnel under the conditions of war-like surroundings. But, now, with the use of VR, medical personnel can be placed into virtual close-to-combat scenarios. For example, a trainee can be placed in a simulated vehicle with a prosthetic body to immerse him in a warzone-like environment. Virtual scenarios allow medical professionals to practice different skills under stressful conditions.



Fig 6. U.S military VR medical training



3.1 Treatment of veterans with VR

Many veterans have to deal with Post Traumatic Stress Disorder (PTSD). PTSD is caused by traumatic events that are outside the range of usual human experiences such as military combat, violent personal assault, terrorist attack, torture, incarceration as a prisoner of war [9]. The characteristic symptoms of PTSD are intrusive thoughts and flashbacks, anger, isolation, emotional numbing, anxiety, depression, survivor guilt, hyper-alertness, suicidal feelings and thoughts, alienation, negative self-image[2].

IV. DEVELOPMENT OF VIRTUAL ENVIRONMENT

The VR environment can be developed using various game engines like unity, cry engine, unreal etc. Game engine is a software framework designed for the development of video games. The functionality provided by game engine includes 2D or 3D graphics, collision detection, sound, scripting, animation, artificial intelligence, networking etc. Game engines can be written in any programming languages like C, C++, and java though each language is structurally different and may provide different levels of access to specific functions[13].

V. VIRTUAL REALITY TRENDS

One of the trends that can be observed in the military branch is the adaptation of video games to military applications. Back then, games were played on home computers and military simulators were used on high-end workstations. Today, due to the increasing popularity of video games, the difference between military simulators and games has become significantly less. Games do get more attractive for military purposes in terms of their real-time 3D graphics, artificial intelligence and network features. The games that are *commercial off-the-shelf* (COTS) products are suitable for modification to military simulations. These games often contain a game-development toolkit with which it is possible to create new game content that is called a modification (mod)[2]. A new game content mod is created to improve the realism of a game by adapting various game models to fit the real world conditions. The mod maker's toolkit simplifies the work of creating mods by providing an abstraction layer that enables the creator to easily adapt the game to their specifications. A few examples of COTS games are America's Army and Full Spectrum Warrior. The first has begun as recruitments tool, but is now used to train future officers at West Point, the second is utilized to train squad leaders in real-life combat tactics of urban warfare[8]. In the next section, we will discuss the future research and expectations for virtual reality in military field.

VI. RECENT AND FUTURE RESEARCH

In November 2020, the UK Government unveiled its £16.5bn military spending boost; the most significant investment for a generation. The key objective was to ensure that the armed forces develop a "digital backbone", innovative VR training solutions can provide the key to addressing skills issues in response to the challenges of growth and rapid change. The role of games is very important for the progression in the military field. In the future more COTS games are probably be adapted to become military simulators. The realism of these simulators should likewise increase further. Probably there is a shift from real war situations to operations other than war. This means that humanitarian mission and peacekeeping become more important and that developments in the field of virtual reality tend to focus more on these types of situations. In the past simulation was primarily based on controlling craft. Nowadays and probably in the future interaction is becoming more important. The last section showed that the current developments are based on interaction like communication, leadership, awareness and emotions [7]. Researchers are developing a holographic virtual command and control System, will be involved in combat in 2025. In this holographic virtual command center, fighters can make the most of battlefield information and quickly share information with surrounding combat units. Tactile and visual sensors to complete the control of the ship, and even can be similar to the command of the holographic operation. At the same time, through the headset equipped with interactive chat and video transmission of information, let the warfighter to produce a more realistic feeling. Researchers at the Holographic Virtual Command System said similar control technologies will be applied to future naval vessels[1].

VII. CONCLUSION

Military training can dangerous as actual battles. It is said that more troops die during training than in combat operations. The use of virtual reality for creating a virtual war environment reverse such negative stats by improving safety during training. The application of VR in military training can thus produce a new generation of soldiers, who are better trained to tackle extreme conditions and combat situations. Virtual reality environment provides a safe

atmosphere compared to real life training and has shown great results. The use of virtual reality in simulation has just begun and we can expect much more of this in the military field.

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