

Integrating Virtual Reality (VR) into traditional instructional design

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Abstract

Most technical programs in Nigeria's tertiary institutions lack the desired laboratories to impart technical skills to the students. This has led to the production of pseudo-illustrates as graduates and this accounts for reasons why many employers are saying Nigerian graduates are not employable. Virtual Reality (VR) can bridge this gap as it is now the case even in advanced countries of the world where military and pilot training has deployed the technology for successful technical manpower development. VR can be defined as the computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors. Wikipedia has described it as immersive multimedia for computer-simulated media. VR is used to describe a wide variety of applications commonly associated with immersive, highly visual, 3D environments. Such high resolution multimedia technology can be used to replace physical laboratories for the training of engineers, medical doctors and other technologists where the requisite laboratories are inadequate or non-existent. This paper has x-rayed the properties of this technology and presented how to integrat VR with traditional instructional technology.

Key words: Laboratories, Virtual reality, Instructional design, Immersive systems, Instructional development

1.0 Introduction

From design and manufacturing point of view, VR connotes current demand to reduce the time and cost involved in taking a product from conceptualisation to production. It has forced companies to turn to new and emerging technologies in the area of manufacturing. The enormous cost of launching new products of inculcating new ideas to employees via training has forced organizations to adopt new technologies such as virtual reality (VR). Virtual Reality refers to a high-end user interface that involves real-time simulation and interactions through multiple sensorial channels.

The origin of virtual reality can be traced to the launching of flight simulators by US Air Force to train student pilots in the 1950s. In 1965, a research program for computer graphics called "The Ultimate Display" was

laid out. In 1988, commercial development of VR began. In 1991, the first commercial entertainment VR system "Virtuality" was released.[3] With VR the user can look at, move around, and interact with these worlds as if they were real. The primary concept behind VR is that of illusion. VR is where a Virtual World - a three dimensional environments or scenario created on a computer can be freely explored, experienced and examined in real time [1][2] VR is an innovative and leading edge platform for next-generation learning that is both cost effective and relatively easy to introduce into your learning curriculum. The next step of this article is to show you how this can be actualized.

2.0 The Tools of Virtual Reality

Production of VR Tool fall broadly into three categories of involvement: hardware (making headsets and input devices specific to VR), software (producing software for interfacing with the hardware or for delivering content to users) and content creation (producing content, whether interactive or passive, for consumption with VR hardware. A producer of VR model may not have to go it alone but may need to purchase some components from companies that specialize in VR and do some by self effort.

Types of Virtual Reality Systems [4] [5]

There are several Virtual Reality Systems developed for different applications. Few are described below:

- **Windows on World(WoW)**

Also called Desktop VR, it uses a conventional computer monitor to display 3D .virtual world

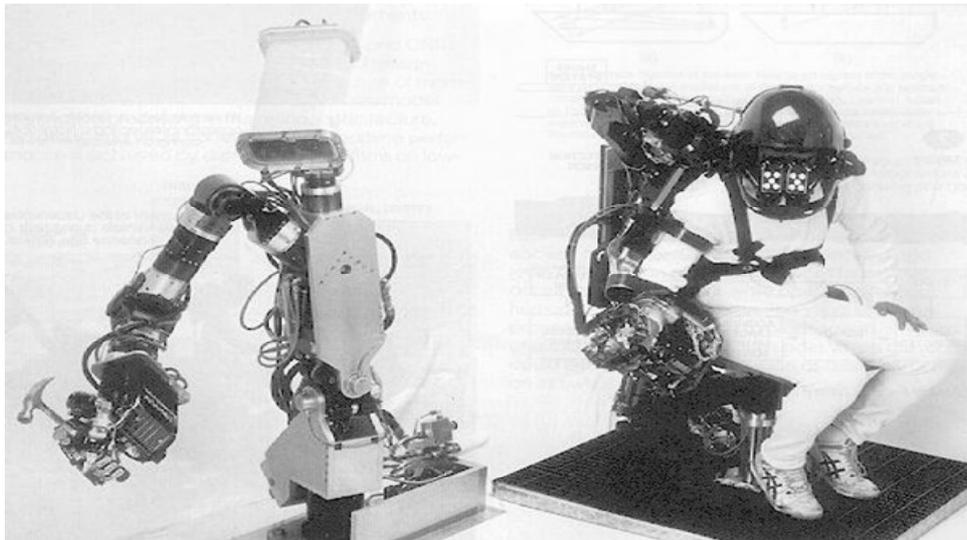


Fig. 1: Example of Telepresence VR system

- **Mixed Reality(Augmented Reality)**

This model involves the seamless merging of real space and virtual space. This implies the integration of the computer-generated virtual objects into the physical world which become in a sense an equal part of our natural environment.

- **Immersive VR**

This model completely immerses the user's personal viewpoint inside the virtual 3D world.

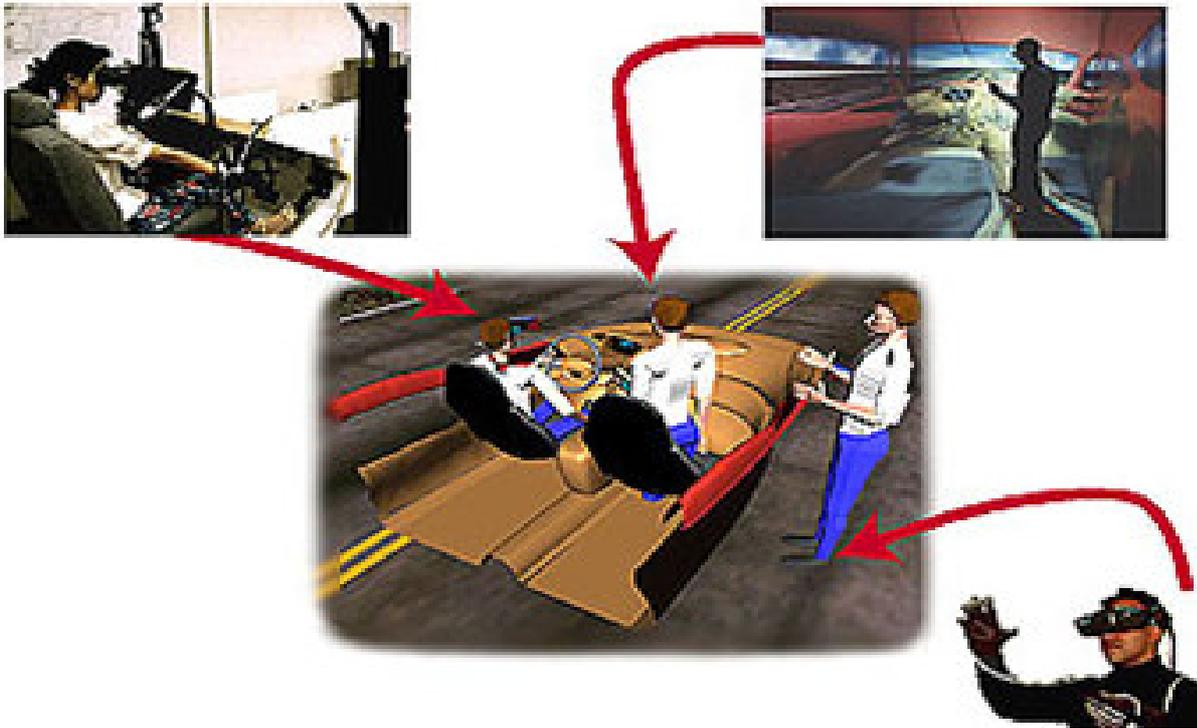
The user has no visual contact with the physical world. This model is often equipped with a Head Mounted Display (HMD).

- **Telepresence**

This model is slightly different from other VR models. It visualizes complete computer generated worlds and links remote sensors in the real world with the senses of a human operator. The remote sensors might be located on a robot. This model is useful for performing operations in dangerous and risky environments such as control of nuclear plants and celestial exploration.

- **Distributed VR**

This model is a simulated world which runs on several computers that are connected over network and the people are able to interact in real time, sharing the same virtual world.



VR Technology

Head-Mounted Display (HMD)

One of the key components of VR revolution is a Helmet or a face mask providing the visual and auditory displays. The HMD uses LCD or CRT to display stereo images. This may include built-in head-tracker and stereo headphones as shown in Fig. 2 below:



Fig. 2: Example of HMD Application

- **Binocular Omni-Orientation Monitor (BOOM)**

It involves the coupling of Head-coupled stereoscopic display device. It uses CRT to provide high-resolution display. It is :

very convenient to use and it has fast and accurate built-in tracking as shown in Fig. 4 below



Fig. 4: Example of BOOM

- **Cave Automatic Virtual Environment (CAVE)**

CAVE provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube. A head tracking

system continuously adjust the stereo projection to the current position of the leading viewer

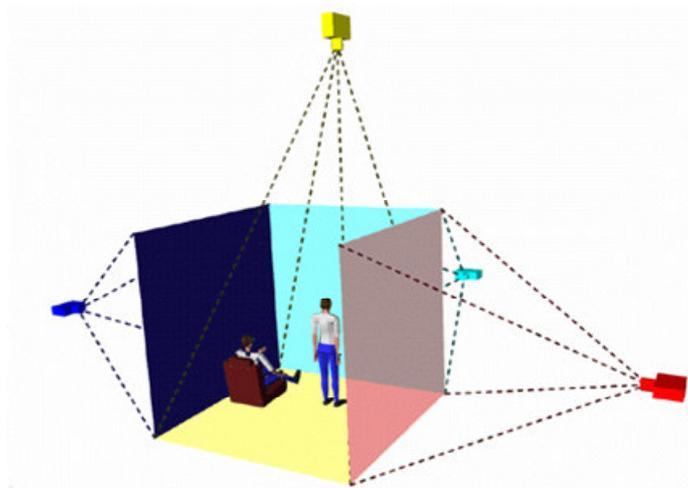


Fig. 5: Projection by CAVE

- **Data Glove**

Data Glove VR models are outfitted with sensors on the fingers as well as an overall position/orientation tracking equipment. It enables natural interaction with virtual objects

by handas gesture recognition as shown below in Fig.6 below:

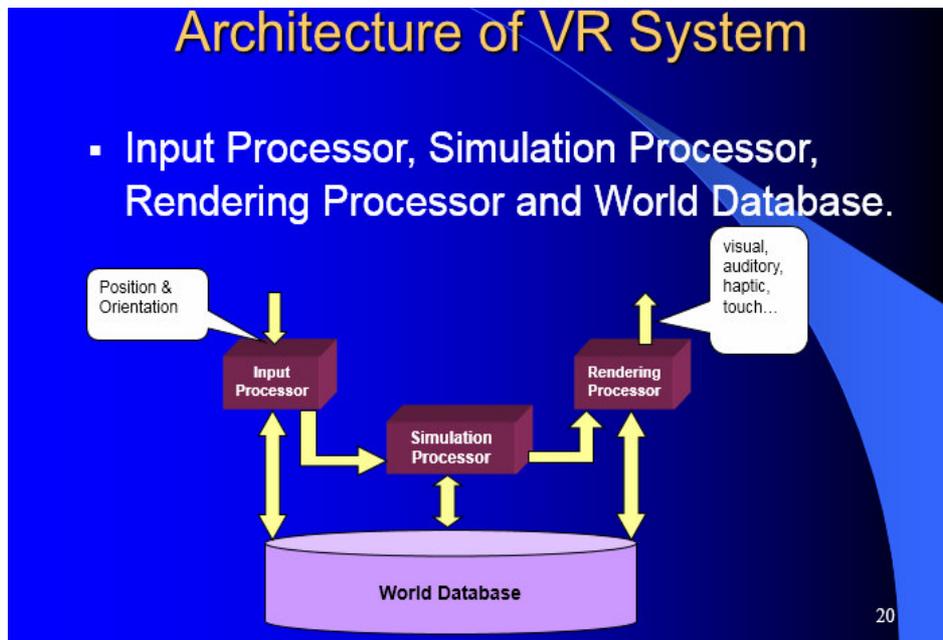


Fig. 8: The Architecture of VR

VR Architecture further explained:

- **Input Processor**

The input processor controls the devices used to input information to the computer. The object is to get the coordinate data to the rest of the system with minimal lag time.

- **Keyboard, mouse.**

This is usually a 3D position trackers, a voice recognition system, etc.

- **Simulation Processor**

This is the heart and engine of a VR system. It takes the user inputs along with any tasks programmed into the world and determine the actions that will take place in the virtual world.

- **Rendering Processor (RP)**

RP creates the sensations that are produced to the user. Separate rendering processes are used for visual, auditory, haptic and other sensory systems. Each renderer take a description of the world statistics from the simulation process or derive it directly from the World Database for each time step.

- **World Database (World Description Files)**

World Database files store the objects that inhabit the world, scripts that describe actions of those objects.

Applications of Virtual Reality

Medical training of surgeons in surgery operations. It helps doctors to Perform surgery on a remote patient. VR helps Teach new skills in a safe, controlled environment

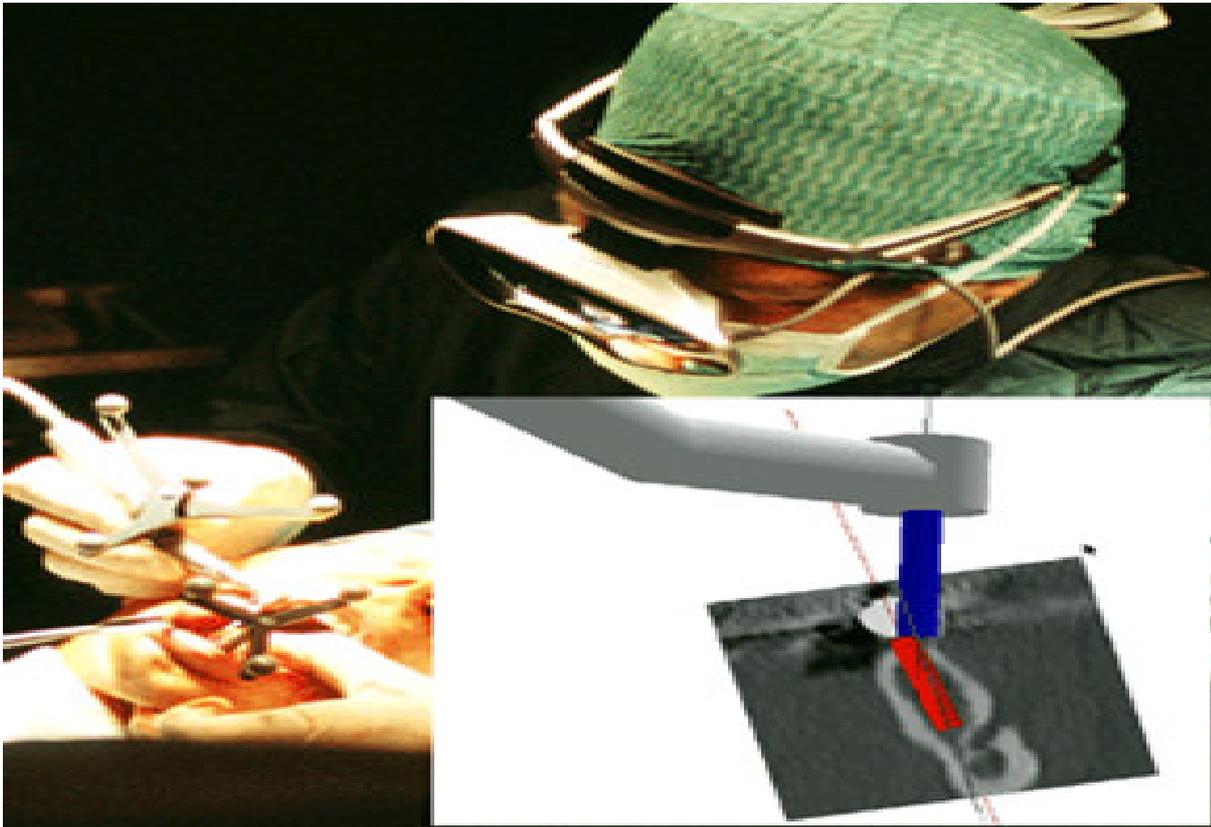


Fig. 9: Example of surgery operation training with the help of VR

Manufacturing

VR plays a major role in modern R&D and manufacturing. It makes modification of designs very easy at low cost and production is highly efficient.



Fig. 10: Application of VR in manufacturing industries

Education and Training

Used extensively in education for training drivers via Driving simulators, Flight simulators, Ship simulators, and Military Tank simulators. This avoids unnecessary loss of human life during training and the waste of physical equipments and property which has been the norm before VR revolution.

Other related areas of applications include:

Medicine and rehabilitation (surgery, anatomic simulator, remote surgery, hybrid systems)

- VR games
- Arts (virtual actors, virtual museum, virtual music, virtual theatre)
- Virtual product design (CAD display, process simulation, virtual prototyping)
- Robotic (robot and virtual reality, design of robots, robot programming, supervisory)

control, the Mars Rover)

- Teaching systems (military training 'SIMNET', NASA training systems, flight simulators)
- Virtual teleconferencing systems will soon become real.

Future trends in VR

The future of VR research and application is bright.

- New VR graphic hardware (xbox, real-time ray-tracing machines, etc.) are expected emerge.
- New display systems (retinal writing, real-time auto-stereo gram)
- Biological interfaces
- Voice and image based gesture control (Smart Rooms)
- Programming and modelling
- Virtualized Reality will soon become real.

Deploying the latest smartphone and mobile VR hardware, We will take you through a step-by-step session covering the preparation, creation and distribution of engaging, stimulating and ultimately effective learning content to integrate with your overall education strategies. This section will teach you how creativity and planning will inform your VR content production; review the actual process of capturing 360 VR video; perform basic editing functions to prepare the footage

for final authoring; upload or make the content available on various mobile VR devices such as Samsung's Gear VR and Google Cardboard.

How do you start to build your experimental VR model? Let us say you want to build VR system in your room. You need:

- a computer
- an *Oculus Rift* virtual reality headset
- a Microsoft *Kinect for Windows* motion sensor
- a battery
- headphones
- a tablet with software used to create and develop videogames (also know as a game engine).

Below will look like the architecture of your room VR model.

Note the labels: A, B,C, D, E, F, G, H.

The user's backpack contains an external phone charger battery pack [B] connected to the Oculus Rift controller box [C] via a USB to DC Barrel Jack [E] and provides the Oculus Rift [A] with power. The Oculus Rift connects via HDMI [G] to the tablet computer [D]. You could try out this if you can purchase the items mentioned above. It will be a good experience learning how to set up small scale VR system [6].

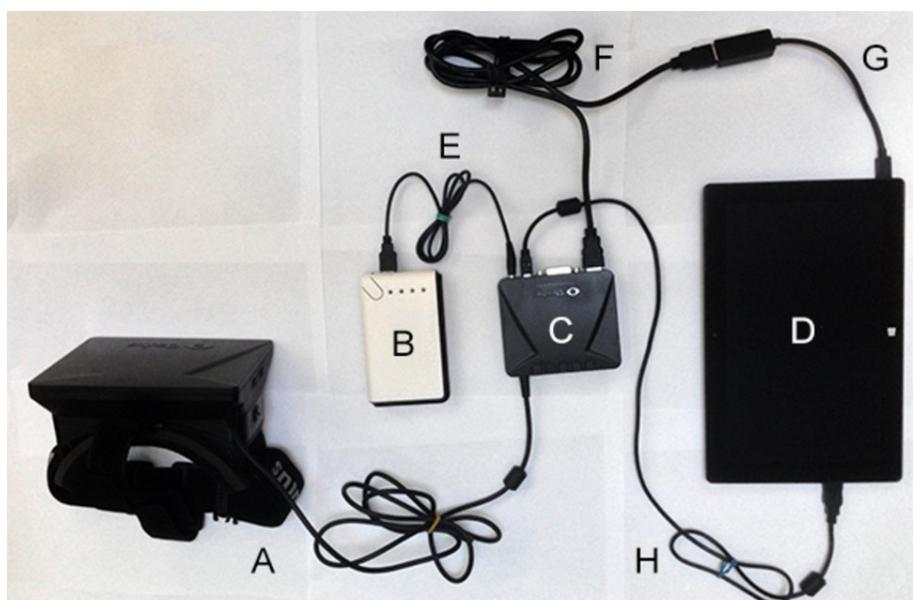


Fig.11: How to set up your own VR system in your room.

For experimental purposes, you can try Google Cardboard VR system, which uses your cell phone placed on cardboard paper that is cut to shape [7]. According to Google, the key objective of the cardboard model is to ease the development of accessible virtual reality (VR) tools to allow everyone to enjoy VR in a simple, fun, and natural way. **Google Cardboard** is a VR platform developed by Google for use with a Head Moun for a smartphone. Named for its fold-out cardboard viewer, the platform is intended as a low-cost system to encourage interest and development in VR applications. The Cardboard SDKs for

Android and Unity enable you to quickly start creating VR apps or adapt your existing application for VR. The parts that make up a Cardboard viewer are a piece of cardboard cut into a precise shape, 45 mm focal length lenses, magnets or capacitive tape, a hook and loop fastener (such as *Velcro*), a rubber band, and an optional near field communication (NFC) tag. The first version of Cardboard could fit phones with screens up to 5.7 inches (140 mm) and used magnets as input buttons, which required a compass sensor in the phone [8]. See example of Google cardboard in Fig. 12 below



Fig. 12: Google Cardboard

How does Google Cardboard work?

Google Cardboard works by placing your phone at the optimal distance away from the lenses. Then, by using compatible apps, the lenses create a 3D effect when held up to your eyes. You can even move your head around, and the images will respond as if you are in the same place as what is displayed on your screen. For example, you can use the Street View demo and explore the streets of Paris while viewing your surroundings in a virtual reality that reacts to your actual position in space. As an added bonus, it comes with an NFC chip that will automatically launch your official Cardboard app when you place your

phone into the headset. [9] Tertiary students can learn from this and begin to construct their local equivalent.

These can be integrated into traditional classroom to make learning easy and exciting. AutoCAD and special drawing tools can help a teach to pre pare his content and make it VR compatible. This will help students to appreciate the meaning of a subject particularly in practical training such as driving, piloting, military training, medical surgery etc. VR is likely to add meaning to Nigerian education and make our graduates employable.

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