What is Virtual Reality?

- It is generally acceptable that by virtual reality we mean, on the most part, the computer-based three-dimensional environments.
- Generally, virtual reality (VR) is the label given to a number of computer-based approaches for the visualising concepts, objects or spaces in (usually) three or more dimensions.

Origins of VR

- Before the development of video or computer graphics, simulators were constructed through a combination of mechanical parts and flat illustrations or photographs
- The use of video, as it became available, obviously increased the functionality of such systems, enabling alternative environments to be installed fairly easily
- Computer graphics have two fundamental advantages over these approaches: flexibility and interactivity

Applications of VR

- Training applications include mainly simulations, which allow trainees to practise on their arena repeatedly in a no-risk environment
- Educational applications include virtual visits and simulations
- Visualisation examples include an architect's design for a building or the reconstruction of ancient buildings from archaeological evidence
- Applications of virtual reality for conceptual navigation
- Virtual reality allows designs to be visualised and tested
- Entertainment applications include virtual art galleries and games
- Collaborative Virtual Environments (CVE) allows users to interact with each other in a virtual world

Interaction with the Virtual Environment

- The ability to interact is one of the core elements of VR and separates it from other two and three-dimensional graphical environments
- VR allows one or more people to interact with computer-generated objects and worlds in the way that they would interact with such objects in real life
- The degree of interaction that users have in a VR world depends on engineering within this world and the hardware that they use to interact with it
- A VR world is essentially an interface that gives users the feeling of existence within an artificial world created by computer graphics
- Inside the virtual world, users may be represented in a variety of ways: as a complete virtual body, as a part of a body such as a hand or as a controllable viewpoint

Viewing Systems

- Projected. Screens displaying a projected virtual world effectively fill the user's field of vision
- Headsets. Users wear stereoscopic glasses or head-mounted displays (HMD), which place small screens right in front of their eyes
- Desktop. The virtual world is projected on a standard computer monitor
- Tabletop. The virtual world is projected onto a horizontal tabletop screen, and is otherwise similar to the desktop display

Interaction Systems

- Fully immersive. An array of VR specific hardware is used to translate a user's natural movements into virtual activity
- Partially immersive. The hardware that is used in these systems allows users to remain aware of their real-world surroundings rather than being fully immersed in the virtual world
- Augmented. In augmented reality systems, users have access to a combination of VR and real-world attributes by superimposing graphical information over the real world

VR Applications

- Modelling the real world. Probably the most obvious applications of VR are those where a computer permits simulations of the real world in a safe, controlled and economical environment
- Abstract visualisation. Another very common approach to VR application is in those cases where large amounts of abstract data have to be manipulated, examined or accessed
- Distribution. Two areas: 1. Applications where groups of people can interact within a single simulation. 2. Applications where information can be distributed to wider numbers of people

VR Formats

- Each format has differing approaches to three-dimensionality, immersion and interaction
- Substantial processing power required regardless of format as a result of the need to provide clear and flowing imaging that constantly changes as users move within the world
- Until recently, VR systems were restricted to very expensive graphics workstations
- Increasingly though, VR is used on personal computer (PC) platforms. The reasons are:

1. Increasing processing power
2. Improvements in graphics delivery hardware
3. Developments in PC-based VR software packages and formats

VRML Features

- Virtual Reality Modelling Language (VRML) was developed by the Web3D Consortium and was designed for use on the Internet
- The language is used to describe the geometry and behaviour of three-dimensional scenes
- VRML allows for the description of hierarchies of simple shapes such as cubes, cylinders and spheres
- More complex shapes can also be defined, as can surface materials, texturing of facets etc
- Objects can be linked to other URLs via hotspots

Viewing VRML Worlds

- VRML viewers are needed to allow users to navigate their way through and interact with VRML worlds
- Most web-browsers now include a VRML viewer
- A number of different viewers that differ in the style of navigation and performance are available
- The Cosmo Player is one of the most popular viewers because it offers a wide range of movements

VRML Features (cont.)

Other features include:

- transformation (the reuse of objects more than once)
- viewpoint setting (which allows users to look at pre-defined views of the world)
- the definition of lighting within the world
- shape hints, which define how particular objects and object types will be rendered
- Sounds, textures and animations can be linked to objects described in a VRML file by referring to image or sound files etc
- Sensors, which perform collision and proximity detection
- User interactions such as clicking and dragging
- Time can be measured
- Ability to incorporate scripts which define behaviours

VRML Development Tools

- Hand coding is time consuming and tedious
- Another option is to use a VRML world-building tool
- These are packages that allow developers to define worlds graphically and save them as VRML script
- This process is much faster and easier than hand coding but more expensive
- Textures, sound, interactivity and behaviours are then added to the VRML using a text editor
- Once worlds have been created, a syntax checker can be used to check that the VRML code is correct
- Optimisation programs are used to improve the performance of the world by removing redundant shapes from the code

VRML Problems

- VRML is not the best virtual reality system
- It is rather too general-purpose, providing many basic functions, which are designed to run on all platforms
- It can never replace more sophisticated and specialised VR systems made for specific applications
- Cannot be configured to run on specialised hardware
- On different plug-ins and browsers there are differences, particularly in their handling of lighting and colour

Java 3D Features

- Java 3D is an extension to the Java programming language that creates a connection between the JRE and a computer's 3-D graphics support
- The main difference between Java 3D and VRML is that Java 3D applications are compiled programs
- Install a compatible JRE plug-in
- Install a Java 3D JRE plug-in that is compatible with the graphics capabilities of the computer
- Download a Java 3D application

Creating Java 3D Applications

- Java and Java 3D can be written by hand using the Java and Java 3D Software Developer's Kits
- Learning to develop robust applications is extremely time-consuming
- Writing programs by hand is also time consuming
- Another option is to use a development environment, such as Borland's JBuilder, to ease the process of writing and debugging the program code
- The three-dimensional objects that will make up the world are often created using a graphics package
- The objects are converted into Java 3D code using a loader
- Java 3D developers may start by creating a world using VRML as a development environment and then converting it into Java 3D using a VRML loader

Java 3D Drawbacks

- Java 3D applications typically run more slowly than some other VR viewers
- Large VR models may not work, as Java implementations may limit the amount of memory that can be used
- The Java 3D plug-in is not available for Apple Macs, so will not run on all computers
- It is complicated to install
- does not offer the same degree of interactivity as other VR software programs

Java 3D Advantages

- Allows developers to create VR applications on a relatively low budget
- Developers can also make use of Sun's Java Web Start application to provide software updates to their users through the Internet

Conclusion

- Virtual Reality is a unique way for simulating reality as well as representing imaginary worlds or even abstract data
- As technology is developing, the limitations that exist today will be lifted
- many benefits may be derived from the development of VR
- Tangible danger of people losing the sense of what is real and what is not
- People distracted from their real problems