튜 토 리 얼 Ⅳ

Virtual Reality on the Internet

▷ 연 사 : **김 형 관** 교수(KAIST 테크노 경영대학원)
▷ 사 회 : **이 경 현** 교수(부경대)

Virtual Reality on the Internet

Steven H. Kim

Graduate School of Management
Korea Advanced Institute of Science and Technology
Seoul, Korea

Outline

- Introduction
- Virtual Reality
- Virtual Reality Modeling Language
  - History
  - Characteristics
  - Functions
  - Examples
- Sample Applications
  - Simulation
  - Education
  - Collaborative work
  - Gaming
  - Entertainment
- Conclusion
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Introduction

- Virtual Reality (VR)

  = A realistic environment simulated by computer

- Sensory modes

  — Vision

    * 3-dimensional (3D)
      Full realism through stereoscopic projections.
    * Integrate materials for presentation to user
      E.g. 3D-goggles;
      Direct projection of
      low-power beam into each eye.

    * Special distribution
      E.g. Perspective;
      Casting shadows;
      Changing perceived shape according to vantage point ("moving camera").

  — Touch
    * Data glove → feeling of resistance on hands.
  — Sound
    * Stereophonic
  — Olfaction
    * No smells yet!
  — Taste
    * None yet

Introduction (Cont.)

- Simulation of real world

  — Collision

    E.g. Can't walk through walls.

  — Forces

    E.g. Subject to gravitational pull.

VRML

- Virtual Reality Modeling Language(VRML)
  = a scene description language

  → implement VR on the World Wide Web.

- Browser

  = software which interprets (not compiles) a VRML file.

- Rendering

  = Generating a scene on the display screen.

- Rendering software

  — Live 3D from Netscape

  — Cosmo Player from Silicon Graphics Inc.

  — Etc.

VRML: History

— **1994**

* At a European Web Conference, Tim Berners-Lee declares the need for a Virtual Reality *Markup* Language(VRML) to complement Hypertext Markup Language (HTML).

* Mark Pesce persuades *Wired* magazine to start a mailing list called www-vrml.

* Contributors to this mailing list exchange email.

  - *Inventors* file format was previously developed at Silicon Graphics Inc. (SGI).

  - *VRML Version 1*

    embodies a subset of *Inventor*, excluding animation capabilities

    → lifeless

* Gavin Bell at SGI identifies 3 requirements for a new VRML *Version 2*.

  a) *Composability*. Descriptions of objects are self-contained.

     E.g. Author can create a car, scale it down, put it in a toy box in an apartment within a city block.

  b) *Scalability*. No prior constraints to size exist.

     E.g. User can scale down from a galaxy to a planet then to a person, then to a molecule in his brain.

  c) *Extensibility*. New features can be added to the language.

     E.g. Allow for multiple users or new geometric objects.

— **Fall 1995**

* Mark Pesce forms the VRML architecture group, which solicits proposals for VRML2.

* "Moving Worlds", a joint proposal by SGI, Sony, & others, wins majority of voters by respondents on the mailing list.

— **June 1996**

* International Standards Organization (ISO) is petitioned to designate VRML 2 as an ISO standard

  → soon accepted as such.

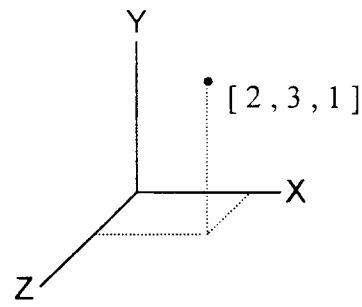
Position of an Object in Space

- Location
  - 3 axes
  - unit of measurement

    = meters
  - Format : [x , y , z]

    or x y z
  - **Example**

    [1 , 2 , 1]
  - **Exercise** : What are the coordinates precisely 2.5 meters below the origin?



Position of an Object in Space (Cont.)

- Orientation
  - "Right hand rule"

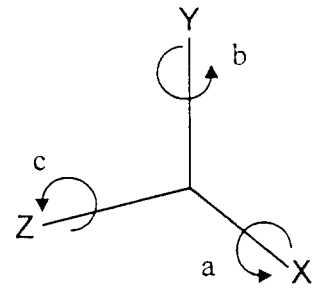
    along any vector.
  - units of measurement

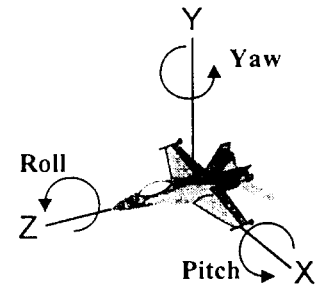
    = radians
  - Informal names :

    roll, yaw, pitch
  - Format : [x , y , z , θ]

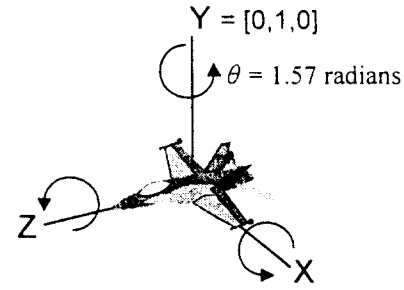
    where : [x , y , z] = axis of rotation

    θ $\equiv$ angle around the axis





- **Example:** Rotation vector [0, 1, 0, 1.57] will turn plane to face the positive x axis.



- **Exercise**. The airplane is diving vertically toward the ground. What is the rotation beginning from either of the starting orientations above?

Basic Objects

- VRML :

  defines the visual, aural & interactive attributes of 3-dimensional (3D) objects.

  → " Next generation web"

- Scene ≡ A virtual world in VRML.

- Node ≡ An atomic element in VRML.

— Type of nodes

  - geometric nodes

    E.g. Box ; Cone ; Cylinder ; Sphere.

  - Relational nodes

    E.g. Transform ; Group

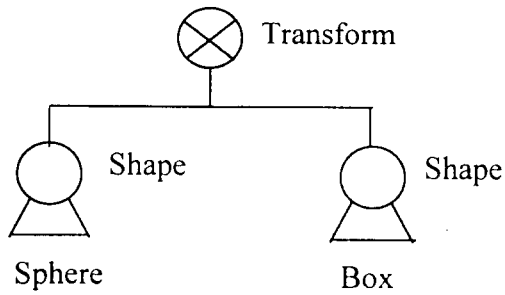
  - Attributes

    E.g. MovieTexture → show an MPEG movie on the surface of an object.

- Scene graph

  = A tree depicting the relationships among the nodes in a scene.

  E.g. Transform {
  shape { geometry Sphere { } }
  shape { geometry Box { } }
  }



Data Formats

- Field ≡ An entry within a node which specifies a particular attribute.

  E.g. Color, size, or texture of an object.

- Data type ≡ Format for the values which can be specified in a particular field.

— Boolean → *True* or *False*; *Yes* or *No*; 0 or 1.

— Int32 → 32-bit integer.

— SFFloat → Single Field Floating point value.

E.g. radius of sphere = 3.5 units.

— MFFloat → Multiple Field Floating values :
list of SFFloat values.

— SFVec3f → Single Field Vector of 3 floating points,

E.g. [x , y , z] = [1.2 , 3.0 , 2.7]

— SFColor → Single Field Color ≡ [R , G , B].

Each of R, G, B ranges from

0 (no saturation) to 1(full saturation).

E.g. [1 , 0 , 0] = full red.

— Others

Simple Examples

- Elementary example to specify a box.

```
# VRML V2.0 utf8      # This First line is mandatory.
# To create a box having default properties.
Shape {
        geometry Box { }          # Default dimension is 1 x 1 x 1.
}                                 # Default color is dull white.
```

- Second example.

```
# VRML V2.0 utf8
# To create a gray sphere
Shape {                                  # To define a perceptual object.
  appearance Appearance {                # To define visible attributes.
    material Material {                  # Surface qualities.
      diffuseColor   0.5   0.5   0.5     # Gray Color.
    }
  }
  geometry Sphere { radius 2 }           # Radius of 2 meters.
}
```

Interactivity

- Event

  ≡ A message from one object to another.

- Sensor

  ≡ A node which can detect events from the user.

  E.g. PlaneSensor: when a user clicks on the mouse, the 2-D coordinates of the mouse pointer are sensed.

- eventOut

  ≡ An event (in the form of a VRML data item) which is emitted by a node.

  E.g. TouchSensor has an eventOut emitter which specifies the time that a mouse has been clicked.

- eventIn

  ≡ An event received by a node.

- ROUTE

  ≡ A connection of path which specifies the flow of data from an eventOut source to its eventIn destination.

  E.g. When the mouse is clicked, the position of the mouse pointer can be sent as an eventOut from the planeSensor and ROUTEd to the eventIn of a Transform node to move an object to the new position.

Reuse of Code

- DEF ≡ A node which defines a section of code for reuse later.
- USE ≡ A node which invokes the reuse of code from a DEF section.

E.g.

```
DEF Box3 geometry Box {size 3   3   3}
                                    # Define a cube with 3m edges.
USE Box3                            # Reuse the code above.
```

E.g.

```
Shpae  {
    appearance DEF Blue Appearance  {  # Define "Blue"
            material  Material  {diffuseColor  0 0 1}
    }
    geometry  Cone { }
}
Shape  {
    appearance USE Blue                    # Reuse "Blue"
    geometry  Sphere { }
}
```

- Inline code

≡ A node which specifies code in VRML Script, Java Script, or Java.

→ use the keyword "url".

— VRML Script is a subset of Java Script, which in turn is a user-friendly subset of Java.

— VRML Script is a subset of Java Script is supported by the VRML browser.

→ runs fairly swiftly.

— The url may specify the byte code for a Java program located any where on the Internet.

E.g. Script to constrain the location of a mouse click lying on the x axis, and to a horizontal bar whose values range from 0 to +10.

```
DEF TRUNCATE Script {          # Name of script is TRUNCATE
eventIn SFVec3f mousePoint     # Input is mouse pointer; only x
                               # and y values are pertinent.
eventOut SFVec3f newPoint      # Output is new position.
field SFVec3f temp 0 0 0       # Working variable.
url "javaScript :              // Java comment marks are "//"
    function mousePoint(p) {   // Take mousePoint as input;
    temp = p;                  // input value is called "p";
    temp.y = 0;                // Can't move in y axis.
    if (temp.x < 0.0) {        // Cannot go below 0.
        temp.x = 0.0;
    }
    if (temp.x > 10.0) {       // Cannot exceed 10.
        temp.x = 10.0;
    }
    newPoint = temp;           // Emit new position.
    }"
}
```

Advanced VRML:

External Control

- VRML

  = A "self-contained" description language to create virtual spaces.

  → limited intersection with the outside world.

  E.g. VRML has no built-in capability to monitor a joystick or a remote stock ticker.

- For versatile programming capabilities

  → use *inline* node for access to

  - VRMLScript
  - JavaScript
  - Java

- External Authoring Interface (EAI)

  = A set of routines to link a VRML world with external Java code (applets & applications).

  = A type of utility generally known as an Application Programming Interface (API).

  - Java code controls the VRML world through a real-time communication stream.

  → VRML world can be directed by the Java code

  E.g. For visualization of financial data.

- Tutorial on EAI is available at

  http://developer.netscape.com/news/viewsource/pesce_vrml2/pesce_vrml2.html

Application Areas

- Work
  - Simulation/Training
  - Collaborative design
  - Visualization
- Simulation
- Education
- Entertainment
  - Adventure
  - Gaming
- Others

Sample Applications

Business: Data Visualization
Business: Product Demonstration
Business: Shopping
Business: Virtual Office

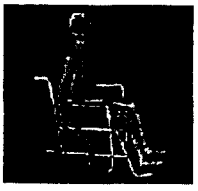
Select a Gallery

Business: Data Visualization

TIS Country Exposure
It's only VRML 1.0 but it's a super clever way to organize data. It's driven by a CGI script.

Animated 3D Chart
Using Java and the Cosmo Player EAI, this animated chart can be updated in real time by simply moving the sliders.

Business: Product Demonstration

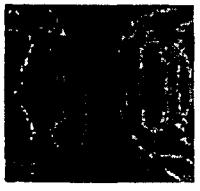


Wheelchair Animation
This is an animated version of what it would be like to be in a wheelchair - follow its motions and trace its path.

Cyberman2 Fly Though
Here is a cool new approach to a company introduction - via a fly thorough. Start the sequence by clicking on the pyramid and see where it takes you.

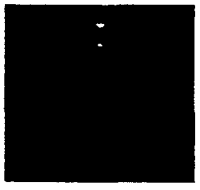
See More Business: Product Demonstration

Business: Shopping



VRML Ad
I would assume that the product associated with this banner would be either herbal ecstasy, or an artery excavating device. Not bad for under 7k.

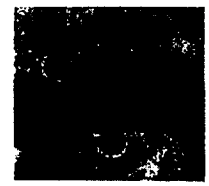
Business: Virtual Office



Disfunctional
A corporate home page with all the amenities; services, how to contact, etc.

Knowhaus 3d

Travel through a beautiful, ambient world and click your way through Knowhaus messages, information, and deep manifestos about what the company does and why it exists.



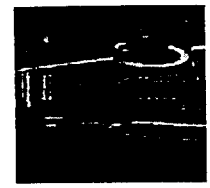
See More Business: Virtual Office

Education: Distance Learning
Education: Teaching Application
Education: Virtual Campus

Select a Gallery

Education: Distance Learning

Irish Space Project
An interactive space adventure for the children of Ireland, conceived, executed, and delivered in under three months.



Mars Pathfinder Landing Site
This is an interactive VRML 2 model of the Mars Pathfinder Landing Site showing a rough estimate of Sojourner's traverse & current position.

See More Education: Distance Learning

Education: Teaching Application

Hot Mix!
Explore the interactive 3D guide to Silicon Graphics software partners.

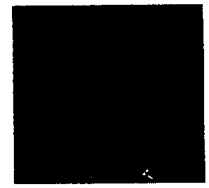
Interactive Furniture Assembly
Put together your own furniture with this fine "assembly demo" from Holland - No Dutch required!

See More Education: Teaching Application

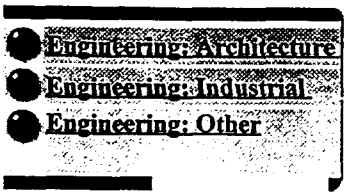
Education: Virtual Campus

Student Genome Project
Wander around this award winning virtual campus, complete with, uh, sheep and other university oddities.

Virtual Seybold
Tour the world's largest technology seminar resource. Seybold from Softbank Corp. in full 3D. Brought to us by Planet 9.



See More Education: Virtual Campus



Select a Gallery

Engineering: Architecture

MODern Home Walkthrough
Real Estate never looked so good. Now you can see a home, rearrange it a bit, and make changes *before* you purchase.

VRML Apartment
As the race to colonize cyberspace begins you might want to start with a virtual home and office. This work from Cybertown sets the stage well.

See More Engineering: Architecture

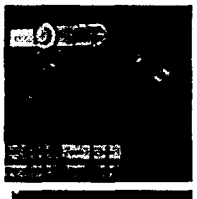
Engineering: Industrial

Gears in Mesh
Atom from Japan brings us another outstanding VRML application. Drag the gears around and watch your creation move

Jet Fighter
Take a ride into the danger zone with this wicked jet fighter.

See More Engineering: Industrial

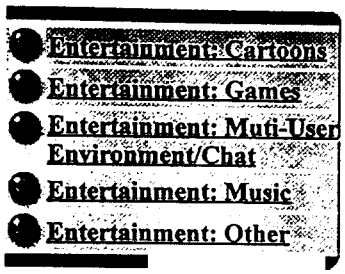
Engineering: Other



Robot Arm II
This may seem rather tame at first, but when one thinks about the possibilities, this interactive robot arm has potential.

NIST Car Welder
The one labeled for "SGI" works on the new PC Beta 2 browser as well.

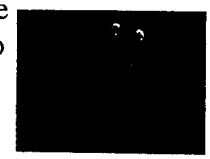
See More Engineering: Other



Select a Gallery

Entertainment: Cartoons

Protozoa's Interactive Characters
Debuted at SIGGRAPH 96, these things will blow your mind. Who would've thunk it? Make sure you wait for the download to complete before you click on the character.

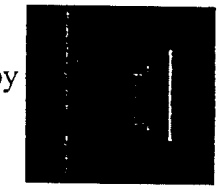


Boxer
There is something endearing about a dog with square legs. Woof! It barks too!

See More Entertainment: Cartoons

Entertainment: Games

3D-Maze
Get dizzy, get lost, get blinded by super colors in this fabulous Maze from Aresch Yavari.

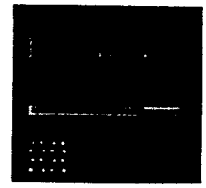


Boink Penrose
Bouncy-bounce the rubber ball through a clever 3D optical illusion. Amaze your friends and dazzle your co-workers, and maybe get yourself a bit dizzied.

See More Entertainment: Games

Entertainment: Multi-User Environment/Chat

Net Tank
NetTank is a VRML replica of the SGI classic game, bzflag. Up to 10 people can play simultaneously in the virtual battle zone.



Entertainment: Music

Virtual Harmonium

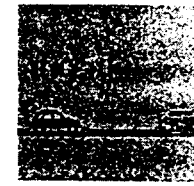
- Recreation: Games
- Recreation: Museum
- Recreation: Personal Home Spaces
- Recreation: Multi-User Spaces
- Recreation: Sports
- Recreation: Other

Select a Gallery

Recreation: Games

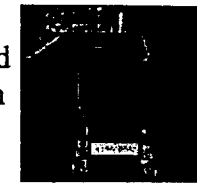
Cool French Cars

You can drive to your heart's content in these "cool french cars" and not even worry about filling them up with gas or polluting the enviroment.



Rover Drive

Just in case you somehow missed playing our Rover Drive Martian extravaganza game (designed by Cicada!) you must try it now!

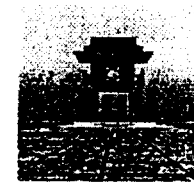


See More Recreation: Games

Recreation: Museum

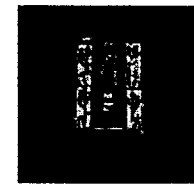
Temple of Literature

If Vietnam is not in your immediate travel itinerary, you can settle for a virtual trip there. This VRML world allows you to explore the Temple of Literature in Hanoi.



Egyptian Tomb of Menna

Wander through history in this tomb built by the Manchester Metropolitan University, UK.



See More Recreation: Museum

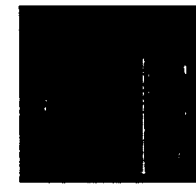
Recreation: Personal Home Spaces

Floyd's Space!

Forget extreme sports, browse on over to this extreme homepage.

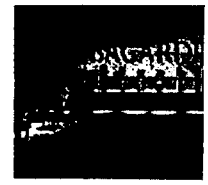
Len Bullard's World

Way Cool space ship creation, with blinking lights and nifty landscape...All on the Island of Jeenix.



Recreation: Multi-User Spaces

Bacardi Bar
Lunatic does it again with a multiuser VRML bar designed for the Rum that does 3D best -- Bacardi.

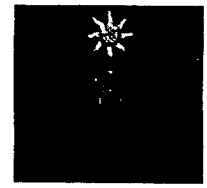


Recreation: Sports

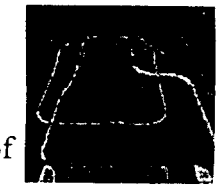
Frank's Penalty
Frank is a human simulation project which requires no interaction from the user. Watch Frank as he kicks a penalty goal.

Recreation: Other

Green World
Simple and sunny, that's all you need to see a green world full of sunflowers and clever cheer.



Model Train
So you never got that train set that you always wanted? Don't fret - this model train set is cool enough to satisfy at least some of those childhood cravings.



See More Recreation: Other

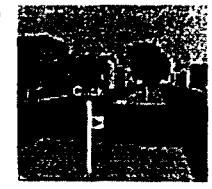
Reference: Maps/City Maps

Reference: Weather

Select a Gallery

Reference: Maps/City Maps

Virtual Dublin

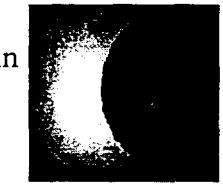


Looking to visit Dublin, Ireland? Go there virtually and strole down O'Connell Street in this world created by the Dublin Institute of Technology to promote tourism.

See More Reference: Maps/City Maps

Reference: Weather

Current Weather From Space



The Earth and the Moon dance in a cosmic ballet while the Earth wears it's latest cloak of cloud cover.

- Object Library: Avatars
- Object Library: Re-Usable Models
- Object Library: Re-Usable Widgets
- Object Library: Java Applets/EAI

Select a Gallery

Object Library: Avatars

Captain James Attridge

A VRML Avatar originally built for the Irish Space Project. If yer nice he'll wave! Courtesy of Richard Kapuaala.

Construct's 2.0

Construct Internet Design's 2.0 VRML is striking, no outstanding, no brilliant, no amazing, no, oh, just go see it! The "dobuoy" is especially clever.

See More Object Library: Avatars

Object Library: Re-Usable Models

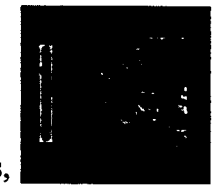
Star Wars Objects

Loads of Star Wars objects, from imperial weapons to rebel droids. May the force be with you.

Object Library: Re-Usable Widgets

Gossweiler-Proffitt Image Reduction (GPIR)

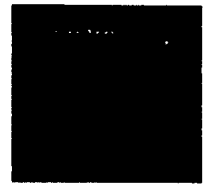
Another great creation from the great mind of Rich Gossweiler. A fancy way to use VRML widgets. But remember PC users, it's only a proto!



Object Library: Java Applet/EAI

Mountain Range

My Own Private Mountain Range lets users control views and perspectives with nifty Java work.



See More Object Library: Java Applet/EAI

Conclusion

Virtual reality systems can enhance effectiveness & productivity at work, home, and play.

Virtual spaces on the Internet can be easily modeled using VRML.

- VRML is a user-friendly language
- Built-in interfaces provide access

  to processing capabilities:

  — VRMLScript

  — JavaScript

  — Java

VRML provides the foundation for second-generation Web interfaces. Potential applications include :

- Homespaces on the Web.
- Visualization of business and scientific data.
- Simulation and training.
- Multiuser online games.
- Collaborative projects such as product design.
- Educational programs.

Web Resources

VRML Consortium

http://www.vrml.org

VRML Repository at San Diego Supercomputing Center

http://www.sdsc.edu/vrml

VRML at Silicon Graphics Inc.

http://cosmosoftware.com

The MIT Media Lab:

http://www.media.mit.edu

SIGGRAPH, Special Interest Group on Computer Graphics

http://www.siggraph.org

Macromedia Inc.

http://www.macromedia.com

Virtual Society at Sony's Community Place

http://vs.spiw.com/vs

Java (Sun's Java page):

http://java.sun.com

Games at Yahoo:

http://games.yahoo.com