

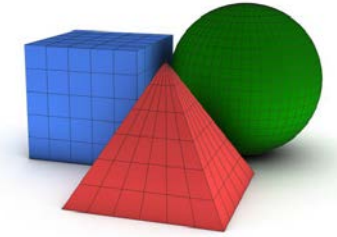
Special Session on X3D and Web3D User Interfaces:

Usability of 3D Web Applications

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Introduction

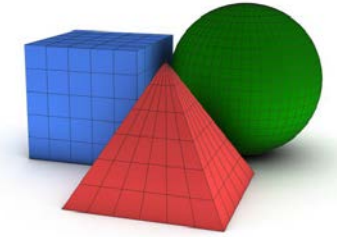


- ▶ About me:
 - ▶ Graphics Software Engineer at Intel
 - ▶ Previously a researcher at INRIA (France) and DERI/NUIG (Ireland).
 - ▶ Publications: <http://grey-eminence.org/>
- ▶ Talk based on Usability of WebGL Applications chapter from WebGL Insights book <http://www.webglinsights.com/>





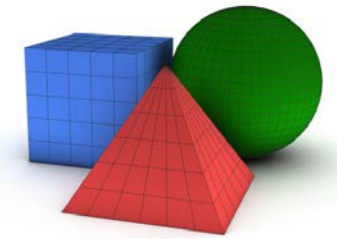
What Is Usability?



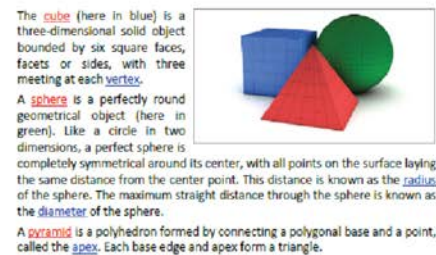
- ▶ ISO defines usability as *the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.*
- ▶ It is the result of several, sometimes conflicting, characteristics:
 - ▶ Easy to learn
 - ▶ Efficient to use
 - ▶ Easy to remember
 - ▶ Error tolerant
 - ▶ Subjectively pleasing
- ▶ Since characteristics of usability can conflict with one another, the goal of the design should determine the priority with which each characteristic is applied.



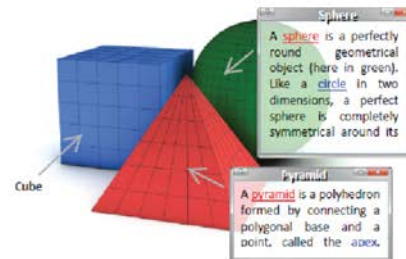
What Is 3D Web Site/Environment?



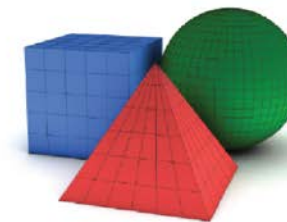
- ▶ A virtual environment (VE) can be defined as a three-dimensional world made up of geometry, colors, textures, and lighting. It contains purely visual information.
- ▶ Traditional hypertext applications, on the other hand, consist of symbolic information (text) and navigational means (hyperlinks).
- ▶ 3D web sites/environments can be defined as HTML applications employing 3D graphics deployed on the web and therefore accessible using web browsers.



(a) Hypertext+3D



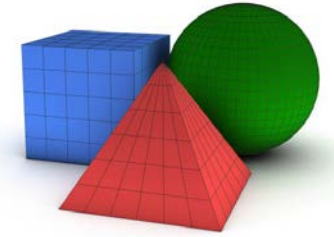
(b) 3D+Hypertext



(c) 3D

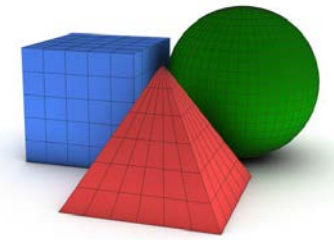


#1: Use 3D with Care



- ▶ Implementation of WebGL (WebGPU?) in all major web browsers provides us with an opportunity to build experiences that would otherwise be impossible.
- ▶ However, most web applications (in the current era of the flat screens) do not really require 3D.
- ▶ For serious applications, consider using 3D graphics for visualization of objects that need to be understood in their multidimensional form.
- ▶ Avoid emulating the physical world when it is not really necessary (e.g., by building a virtual shopping mall, a library, or a museum). As Nielsen pointed out, *the goal of web design is to be better than reality. Asking users to “walk around the mall” is really putting your interface in the way of their goal, which, in this case, is shopping.*

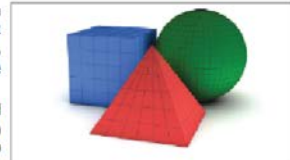
#2: Make Text Readable



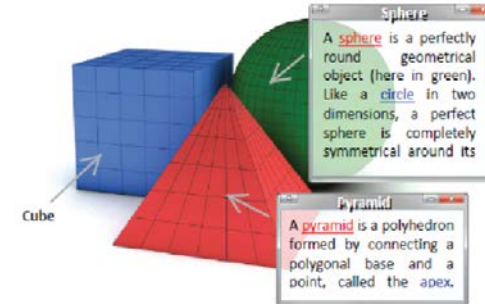
The [cube](#) (here in blue) is a three-dimensional solid object bounded by six square faces, facets or sides, with three meeting at each [vertex](#).

A [sphere](#) is a perfectly round geometrical object (here in green). Like a circle in two dimensions, a perfect sphere is completely symmetrical around its center, with all points on the surface laying the same distance from the center point. This distance is known as the [radius](#) of the sphere. The maximum straight distance through the sphere is known as the [diameter](#) of the sphere.

A [pyramid](#) is a polyhedron formed by connecting a polygonal base and a point, called the [apex](#). Each base edge and apex form a triangle.



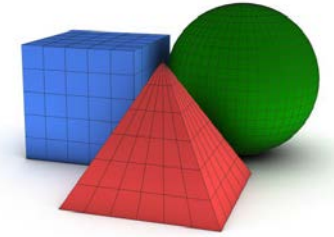
(a) Hypertext+3D



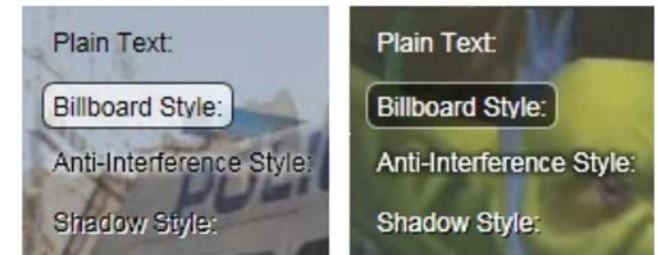
(b) 3D+Hypertext

- ▶ Two major techniques:
 - ▶ hypertext+3D - 3D scene is embedded in hypertext - applicable for extensive texts
 - ▶ 3D+hypertext - hypertextual annotations are immersed in 3D - works well for short annotations
 - ▶ Object-space techniques, where annotations are embedded into a 3D scene (e.g., by placing information onto object surfaces or using billboards)
 - ▶ Screen-space (viewport-space) techniques, where annotations are placed on a 2D plane that overlays a 3D scene, thus ensuring better legibility of text

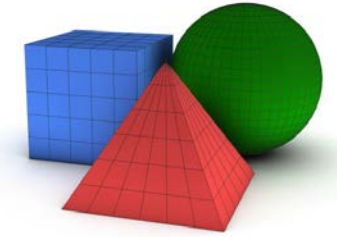
#2: Make Text Readable



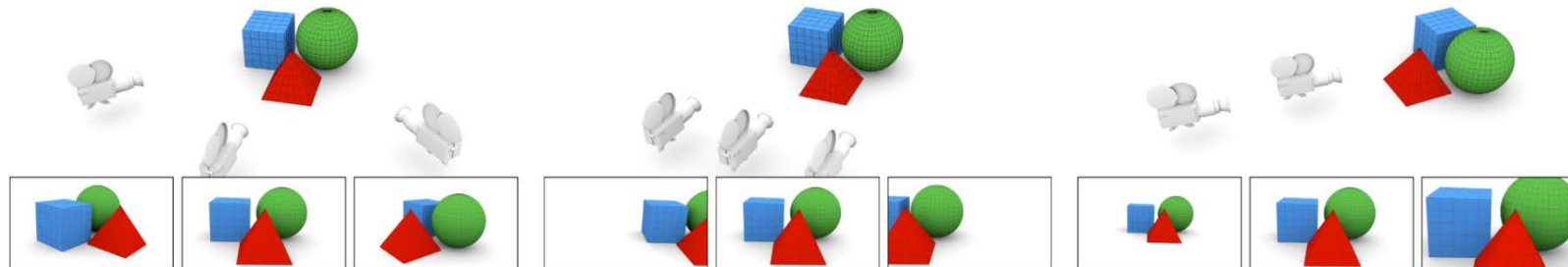
- ▶ As for typography, designers should choose one that communicates. Our study of text readability in 3D environments showed that
 - ▶ the negative presentation, where light characters appear on a dark background, outperformed the positive presentation;
 - ▶ billboard drawing styles supported the best performance;
 - ▶ subjective comments also showed a preference for the billboard style.
- ▶ If possible, enable standard operations for text manipulation like copy-and-paste (*Ctrl+C/Ctrl+V*), increase or decrease of the size of web pages to improve readability (*Ctrl+=/Ctrl-*), and searching text (*Ctrl+F*). With regard to searching, if the browser locates a given keyword or phrase in an annotation of a 3D object, the virtual camera should show that object.



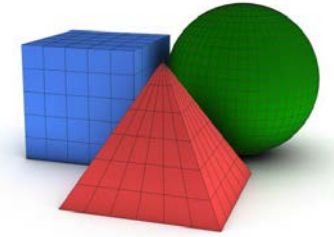
#3: Simple Navigation



- ▶ One-click movement
 - ▶ Reserve a single left mouse button click (or a touch) for targeted movement (or POI) navigation.
 - ▶ The click on the object should smoothly animate the camera from its current position to the this object.
 - ▶ This preserves the primary interpretation of clicking in the web browser as following a hyperlink.
 - ▶ The technique is easy to use, fast, and cognitively friendly; can be integrated with other techniques.
 - ▶ Drawback: The target is always a selectable object.
- ▶ Rotate-Pan-Zoom

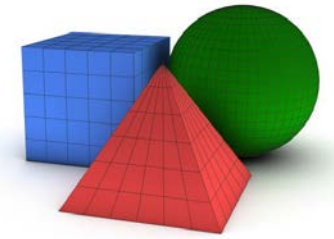


#3: Simple Navigation



- ▶ Emulate real-world behaviors if you can
 - ▶ Geographic VEs often employ a walking metaphor of camera motion, where user positions are restricted to the 2D plane of the terrain;
 - ▶ The examine metaphor is often used to view different sides of objects and is suitable for tasks where the user's goal is to view an object as though he or she were holding it.
 - ▶ If the user's goal can be reliably determined, the mode switching between the navigation techniques should be automated
- ▶ Use multi-touch with care.

#3: Simple Navigation

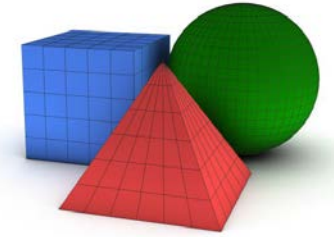


- ▶ Guided or constrained 3D navigation
 - ▶ Limit user's freedom to interesting and compelling places.
 - ▶ Use play/pause/stop or previous/next buttons that can be used to navigate between the viewpoints.
 - ▶ Provide a viewpoint menu.
 - ▶ Allow selecting a destination in an overview (e.g. in minimap).
 - ▶ Consider using animated views.



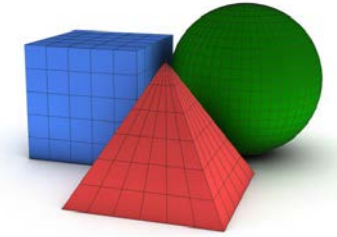


#4: Support Wayfinding



- ▶ Provide maps and orientation widgets.
- ▶ Include landmarks in the scene: landmarks, exactly like in the real world, support navigation.
- ▶ Allow defining 3D bookmarks with locations to which users can easily teleport.
- ▶ Support web browsers' back and forward buttons (recording a history of the user's motion).

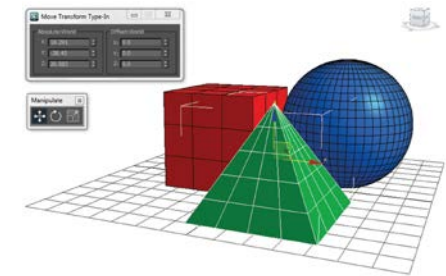
#5: Selection and Manipulation



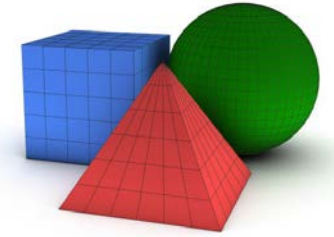
- ▶ Selection of objects in 3D space
 - ▶ Ray-casting - positioning a mouse cursor over a given object and clicking a mouse button.
 - ▶ To show whether something is clickable, remember to change the cursor from an arrow to a pointing hand. Draw the clickable objects in the scene with visible outlines.
 - ▶ Applications that are designed to allow for interaction with many objects in one operation should include some variant of rectangle selection and shift-clicking to support group selection.

- ▶ Manipulation of objects in 3D space

- ▶ Provide users with manipulators (gizmos).
- ▶ Provide snap-dragging support.
- ▶ Exploit knowledge about the real world (e.g., gravity) and natural behavior of objects (e.g., solidity).



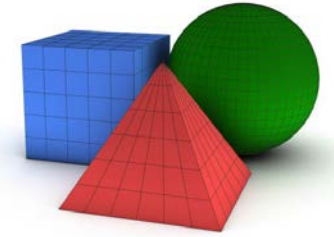
#6: System Control



- ▶ Most game interfaces are designed in a way in which application control interface components are grouped in a dashboard and placed in screen space on a 2D plane called HUD (head-up display) that is displayed side by side with a 3D scene or overlays a 3D scene.
- ▶ When designing the dashboard, make sure that:
 - ▶ The controls are clear; their physical appearance should tell how they work.
 - ▶ Help should be embedded throughout the interface to allow users to click on any UI component for an explanation.
 - ▶ A good application control technique should be easy to learn for novice users and efficient to use for experts; it has to also provide the means for the novice users to gradually learn new ways of using the interface.
 - ▶ Keyboard shortcuts should be provided to allow experienced users to bypass the dashboard.
 - ▶ Lastly, if the dashboard is not needed at all times, it should be faded out.

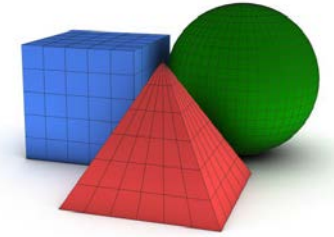


#7: Download and Response Time



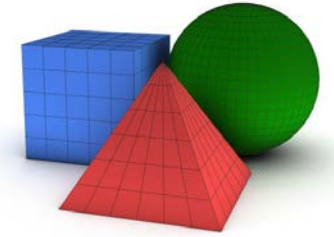
- ▶ Download time is one of the most important issues in web usability.
- ▶ Use compression for faster data transmission
- ▶ Use progressive content loading so that the user does not see a blank screen or a frozen scene but sees some progress going on.
- ▶ Provide continuous feedback, e.g. in the form of an animated progress bar.
- ▶ Provide the users with previews (e.g., previously prepared renderings of the incoming content)

#8: Usability Evaluation



- ▶ Websites should undergo evaluation before releasing them to the public. Testing should take place periodically at different points of the design and development cycle.
- ▶ Evaluation can be done in a number of ways:
 - ▶ Usability inspections - evaluating user interfaces based on stepping through common tasks that a user would perform and evaluating the interfaces' ability to support each step.
 - ▶ Heuristic evaluation - a method in which usability experts separately evaluate a user interface design by verifying its compliance with recognized usability principles: the heuristics.
 - ▶ User testing - measuring how well test subjects perform when interacting with the user interface in terms of efficiency, precision/recall, and subjective satisfaction.

#9: Input and Output



▶ Input

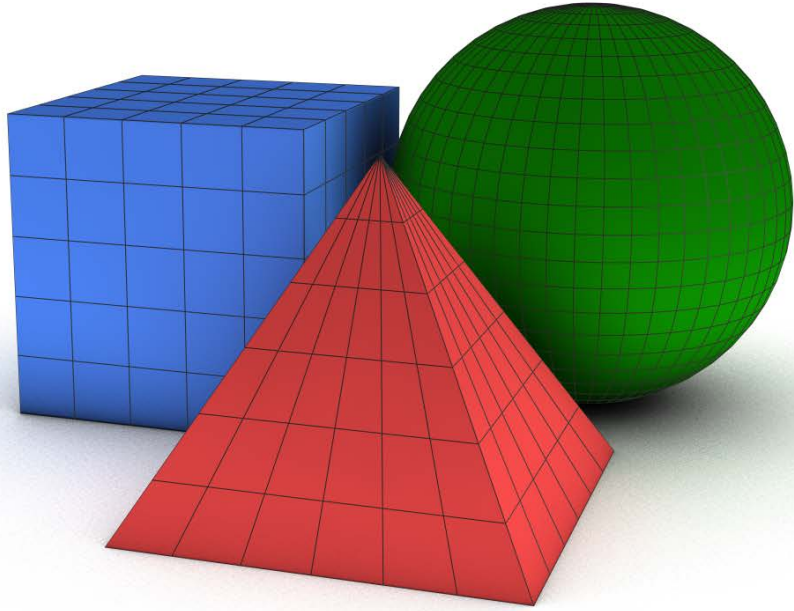
- ▶ Main input devices: a mouse/keyboard and a multi-touch screen.
- ▶ Emphasize the strengths (e.g., direct engagement, multitouch for a touch screen) and alleviate the weaknesses (e.g., inaccurate pointing, obstructed view of the screen for a touch screen).
- ▶ The big advantage of these input devices is that most users are very familiar with using them and novice users learn their usage in few minutes.
- ▶ The main disadvantage is that they are two-dimensional input devices and therefore the interaction metaphor must build a relationship between 2D input space and 3D virtual space.

▶ Output

- ▶ Consider how your 3D Web application will work on different device types with different screen sizes with different pixel densities, ranging from small phones to large TV screens, so that the application is available to as many users as possible.

▶ AR/VR

- ▶ AR/VR in itself requires new ways of thinking about space, immersion, usability, and experience. +Web? ;)



Questions?