VRS –Sample Midterm for Review

You have 22 Short Answer Questions, and 2 Long Answer Questions

Name: **SOLUTION**

1. In your own words <u>define</u> the following, and provide <u>one example</u> of each:

   a. What is "Virtual Reality", and example? (2 points)

     Virtual reality is defined as exposure to sensory information pertaining to a computer generated environment. VR usually implies immersive technology (in multiple channels), real-time first person view of the environment, and the environment responds to your actions.

   b. What is "Augmented Reality", and example? (2 points)

   A real world environment that is enhanced or augmented with synthetic objects.

   c. What is "Telepresence", and example? (2 points)

   The use of various technologies to produce the effect of placing the user in another location.

2. What are the four primary intellectual components that create a virtual environment? (4 points)

- Hardware / Technology
- User's Perspective (the environment that is experienced)
- System Software Design
- Interaction Techniques

3. What are the three software structures that run the virtual environment? (6 points)
   a. Rendering group
      i. Graphics, audio, haptic
   b. Sensor polling group
      i. Separately poll each sensor hardware subsystem
   c. Computation group
      i. Manage the state of the environment

4. Why did Fred Brooks exclude Entertainment systems as Virtual Reality applications? (3 points)

Entertainment systems such as arcade games as well as theme park rides are designed in such a way that users' actions or the path in the environment is well established and constrained. Hence, the environment does not respond to dynamic input from the user.

5. What is a "Responsive Environment"? (4 points)

Is an environment where human behavior is perceived by a computer which interprets what it observes and responds through intelligent visual and auditory displays

6. List four image quality issues in Visual displays: (4 points)

• Brightness
• Contrast
• Refresh rate

7. What is the difference between CRT and LCD display pixels? (4 points)

LCD:
• Liquid crystal displays use small flat chips which change their transparency properties when a voltage is applied.
CRT:
• Red, Green and Blue electron guns.
• Screen coated with phosphor triads.
• Each triad is composed of a red, blue and green phosphor dot.

8. Define "Pitch": (2 points)

Size of a pixel, distance from center to center of individual pixels.

9. What is "Field Sequential Color"? (2 points)

Field sequential color uses red, blue and green liquid crystal shutters to change color in front of a monochrome screen.
In other words, basically the effect of Time-Multiplexed Color.

10. Briefly explain the difference between "Active" and "Passive" LCD displays? (4 points)

- Passive LCD screens
    – Cycle through each element of the LCD matrix applying the voltage required for that element.
    – Once aligned with the electric field the molecules in the LCD will hold their alignment for a short time
- Active LCD screens
    – Each element contains a small transistor that maintains the voltage until the next refresh cycle.

11. Define "Persistance" in a CRT display? (2 points)

Is the time from the removal of excitation to the moment when phosphorescence has decayed to 10% of the initial light output.

12. Briefly explain the difference between "Transmittive" and "Reflective" projectors, and give an example for each? (4 points)

- **Transmittive projectors** - Shine light through the image-forming element (CRT tube, LCD panel)
- **Reflective projectors** - Bounce light off the image-forming element (DLP)

13. Give one advantage and one disadvantage of projection displays? (4 points)

- Adv. Very large screens can provide large FoV and can be seen by several people simultaneously.
- DisAd. Sensitivity to ambient light.

14. List two differences between Head Mounted Displays (HMD) and Head Tracked Displays (HTDs)? (4 points)

- HMD
    – Eyes are fixed distance and location from the display screen(s)
    – Line-of-sight of the user is perpendicular to the display screen(s) or at a fixed, known angle to the display screen(s).
- HTD
    – Distance to display screen(s) varies
    – Line-of-sight to display screen(s) almost never is perpendicular

15. What is: (6 points)
      a. Monocular Field of View:

Monocular FOV is the angular subtense (usually expressed in degrees) of the displayed image as measured from the pupil of one eye.

      b. Total Field of View:

Total FOV is the total angular size of the displayed image visible to both eyes.

      c. Binocular Field of View:

Binocular(or stereoscopic) FOV refers to the part of the displayed image visible to both eyes at the same time.

16. What is a "Fresnel Lens" and why is it very popular? (4 points)

   A lens that has a surface consisting of a concentric series of simple lens sections so that a thin lens with a short focal length and large diameter is possible
   More even resolution distribution

17. Define "Accomodation"? (2 points)

   Term used to describe the altering of the curvature of the crystalline lens by means of the ciliary muscles. Expressed in diopters.

18. What is the difference between "Time Parallel" and "Time Multi-Plexed" stereoscopic displays? (4 points)

Time parallel stereo - Each eye sees a different screen, and the image for each eye is drawn simultaneously. It can be drawn on the same screen or on two different screens.

Time multi-plexed stereo – the image for each eye is drawn one after the other on the same screen.

19. Why is head tracking important in Stereoscopic displays (position dependence)? (2 points)

Without head tracking it is difficult to ascertain where an object displayed on the screen is located in the virtual environment purely based on the screen parallax as the user moves relative to the screen.

21. What is "Ghosting", and list two factors that contribute to ghosting in stereoscopic displays: (4 points)

"Ghosting" is referred to as the influence of noise from the opposite eye image displayed on the correct eye image when viewed on the screen in polarized stereoscopic displays.

- Phosphor persistence
- Vertical screen position of the image.

22. What is the screen parallax for an object that is 5 meters away from a user, if the inter-ocular distance is 0.05 meters, and the distance from user to display is 1 meter (show calculation): (2 points)

p = i(D-d)/D

p = 0.05(5-1)/5

p = 0.04

Choose **two** of the following extended questions and answer them in separate sheets of paper: (10 points each)

If you give me all four answers, then I will choose the first two and grade them.

1. Draw the Coordinate System Graph user model with head tracking and HMD. Briefly each of the edges in the graphs and the coordinate system transforms they represent. (10 points)

Coordinate System Graph User Model
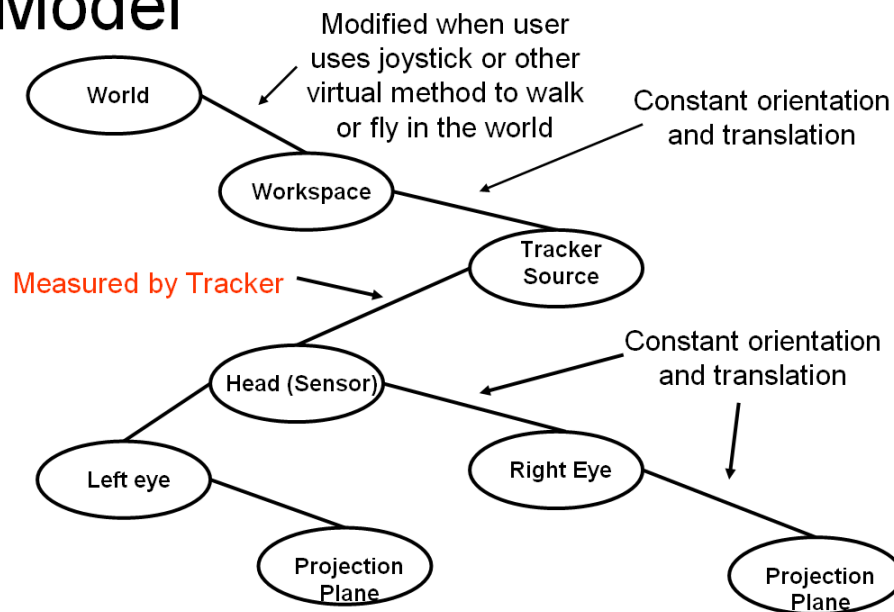
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2. A V8 HMD from Virtual Research Corporation produces an HMD with a duel 800 (Horizontal) x 600 (Vertical) Pixel Resolution screens and field of view is 45 degree horizontal and 30 degree vertical, calculate the following (show all calculations):

   a. Horizontal, and Vertical resolution in Cycles Per Degree:

   V CpD = 600 / 2 x 30 = 10.0
   H CpD = 800 / 2 x 45 = 8.88

   b. Horizontal, and Vertical Visual Accuity:

   Horizontal Accuity = 600 / 8.88 = 20 / 67.56
   Vertical Accuity = 600 / 10 = 20 / 60

3. Briefly explain the following:
   a. What is "Sense of Presence"?
   Sense of being physically present in a computer generated or remote environment (Sheridan, 1992).
   b. What is "Cued Gestalt"?
   We enter the virtual environment carrying the baggage of our beliefs, experiences, fears and expectations.
   What we bring to the VE is as important as what we find there.
   c. Explain the three measures that determine the sense of presence according to Sheridan?
      i. extent of sensory information
      ii. control of sensors relative to environment
      iii. ability to modify physical environment.

4. Point P = [2, 5, 3], and undergoes the following 3D transformations to produce P':
   P is translated by 3 units along the X-Axis, and is rotated by 30 degrees about the Y-Axis. What is the location of P'?

   a. P is translated by 3 units along the X-Axis:
      P trans = Tx(3)P
      P = [5, 5, 3]

   b. Next, P is rotated by 30 degrees about the Y-Axis:
      P' = Ry(30)P

$$(x', y', z',1) = \begin{bmatrix} \cos 30 & 0 & \sin 30 & 0 \\ 0 & 1 & 0 & 0 \\ -\sin 30 & 0 & \cos 30 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

   $\cos (30) = \sqrt{3}/2$
   $\sin (30) = ½$

   P' = $[5\sqrt{3} + 3/2, 5, 3\sqrt{3} - 5/2]$