CPSC – 4110/6110 VRS Midterm Exam Instructor: Dr. Sabarish V. Babu

Please read the following:

1. Answer each question clearly; if I cannot read your answers, you will not receive any credit.
2. Please read the question carefully before attempting an answer.
3. If you are not sure about the question, please raise your hand and I will come to you to clarify the question.
4. Your answers should be your own. You pledge to adhere with Clemson University's Academic Integrity code
5. Questions 15 and 16 have multiple parts, please specifically answer each part of the question separately (a, b, c, etc)
6. If you need extra space, you can use the last page (6) for overflow. Please identify which questions are addressed there.

Name: **SOLUTION** Signature: _____

1. In your own words define the following, and provide one example 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.
E.G. AR visualization of historical reconstructions.

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

The use of various technologies to produce the effect of placing the user in another physical location (**not** a virtual location such as a remote virtual environment).

2. What are the three software structures that run a virtual environment? (6 points)

a. Rendering group
Graphics, audio, haptic
b. Sensor polling group
Separately poll each sensor hardware subsystem
c. Computation group
Manage the state of the environment

3. 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.
I was looking for two things that indicate a perception-action coupling in the system – the system **perceives** human action and **responds** using intelligent visual and auditory stimuli.

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

Brightness
Resolution
Contrast
Refresh rate

5. Describe the fundamental difference in technology 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.

6. What is “Pitch”? (2 points)

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

7. 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.

8. 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.

9. Define the following regarding CRT display technology: (10 points)

   a. Fluorescence:
      Light emitted while the phosphor is being struck by eletrons.

   b. Phosphorescence:
      Light given off once the electron beam is removed.

   c. Persistence:
      Is the time from the removal of excitation to the moment when phosphoresence has decayed to 10% of the initial light output.

   d. Transmittive projection:
      Shine light through the image-forming element (CRT tube, LCD panel)

   e. Reflective projection:
      Bounce light off the image-forming element (DLP)

10. 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.

11. 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

12. 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.

13. What is a "Fresnel Lens" and why is it very popular in HMDs? (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. It is popular in HMD because it facilitates more even resolution distribution from the center to the edge of the lens and promotes less distortion.

14. A. Define “Accomodation”? and how is it calculated and expressed? (2 points)

Term used to describe the altering of the curvature of the crystalline lens by means of the ciliary muscles. Expressed in diopters, which is 1/focal length(m).

B. Describe the accommodation/vergence conflict in stereoscopic displays, and explain why it is an important issue to consider in the design of VR systems? (4 points)

In stereoscopic displays there is a mismatch between the user’s accommodation distance which is to the location of the display in large screen stereoscopic displays, or to maximally set to the location of the virtual image in HMDs. And the vergence distance that is to the depth of objects viewed in the scene which is perceived via the screen parallax information. Therefore, this perceptual mismatch between accommodation and vergence distance can cause errors in depth and space perception.

15. a. What is the difference between avatars and agents in virtual environments? b. Please give an example application featuring each of the above? (4 points)

Agents in virtual environments are virtual entities that are controlled via artificial intelligence algorithms and software in a VRS, whereas avatars represent other users in the virtual environments and are controlled by users that they represent. Examples of avatars in VRS: Users in Second Life or Self-Avatars in 3D Telepresence systems. Examples of virtual agents in VRS: Autonomous virtual receptionists at information kiosks or computer generated virtual crowds in driving simulations.

16. a. Why is depth perception important in virtual reality systems? b. Name three factors that play a role in distance perception? c. How is depth perception typically measured in the near or far field in VR research, please explain a technique? (6 points)

a. Depth perception is a visual perceptual phenomenon that allows participants to estimate the distance of every point in the computer generated scene in the VRS. Depth perception is also the basic operation for higher level perceptual processes such as shape, size, scale, speed, and cognitive processes such as spatial location and spatial orientation.
b. Stereo viewing, motion parallax, field of view, accommodation to name a few.
c. We cannot directly measure depth perception in users, therefore we indirectly measure distance perception via motor action responses such as blind walking (walking to the perceived location of targets), measuring pointing direction, physical reaching in the near field, or imagined time walking (indicate how much time it would take to reach the perceived location of a target at natural walking speeds).

17. Describe the difference between isotonic and isometric input devices, and provide an example for each: (4 points)

Isometric devices are elastic input devices that have no motion but resistance built into them, an example of a isometric input device is the joystick controller device that may be used for rate controlled travel in a VRS. Additionally, they may have a re-centering feature associated with them.

Whereas, isotonic devices are non-elastic but motion oriented input devices that typically do not have any resistance to motion built into them. An example of an isotonic device is a Razor Hydra or a WiiMote controller, that allows for complete 6DoF motion to allow for selection and manipulation in a VRS.

18. 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 (4 points):

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

b. Horizontal, and Vertical Visual Acuity (4 points):

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