Declaration and statement of authorship

I, bearing Roll No. 106119100 , agree and acknowl
that:

1) The assesment was answered by me as per instruction applicable to each assessment, and that I have not resorted to any unfair mea to deliberately improve my performance

2) I have neither impersonated anyone, nor hav been impersonated by any person for the purpose of assessment.

Signature : R Pandey

Full Name : Rajneesh Pandey

Roll No : 106119100

Sub code : CSPE51

Mobile No : 8290968008

11/12/21 CSPE51 - ARVR 106119100

End Semester- Exam. Rajneesh Pandey

Question (1)

(A)

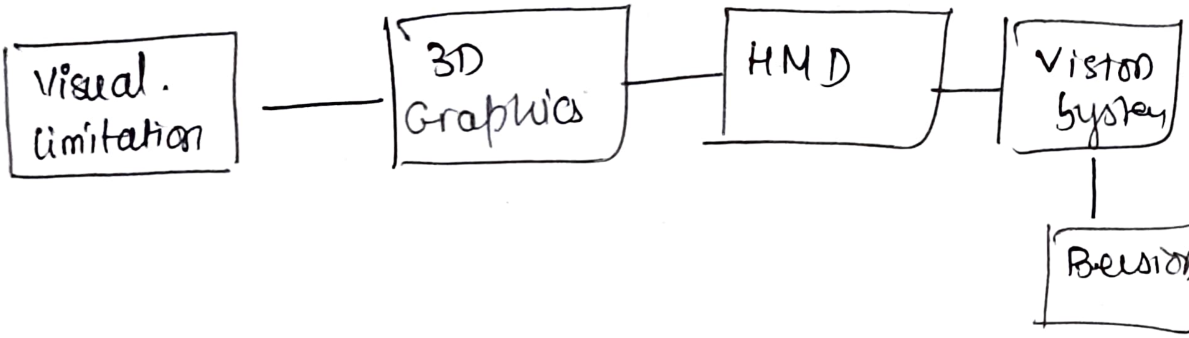
Virtual Reality is about how we create perceptions of things and the tricks that we can use to manipulate the visual environment to create this perception.

The environments are designed to be as realistic as possible. Immersion refers to how VR tech, can simulate the ways we sense and Perceive the world is our everday life

So to create stereoscopic vision for virtual experience we need to get VR headset, which simulate binacular vision by presenting slightly different images to eyes.. giving the illusion that a 2D picture is a 3D. environment

. we also need to the idea of head tracking, it simply monitor the.

106119100



Question 1

B) CAVE :

Advantages

→ CAVE has the advt. of offering were complete freedom of movement, which is one of the main limitations of virtual Reality

→ cave produces a hyher level of realism

→ more than one user can be in the CAVE and each user can use from itell ones point of men.

DisAdvantage

→ It takes up a large amount of space to build. a CAVE which is turn. Increases the cost.

→ It is very expensive to setup.

Question 1

(a) There are 3 types of touch receptors about mechanical. movements

* Pacinian capsules, detect deep-pressure touch and high freq. vibrations.

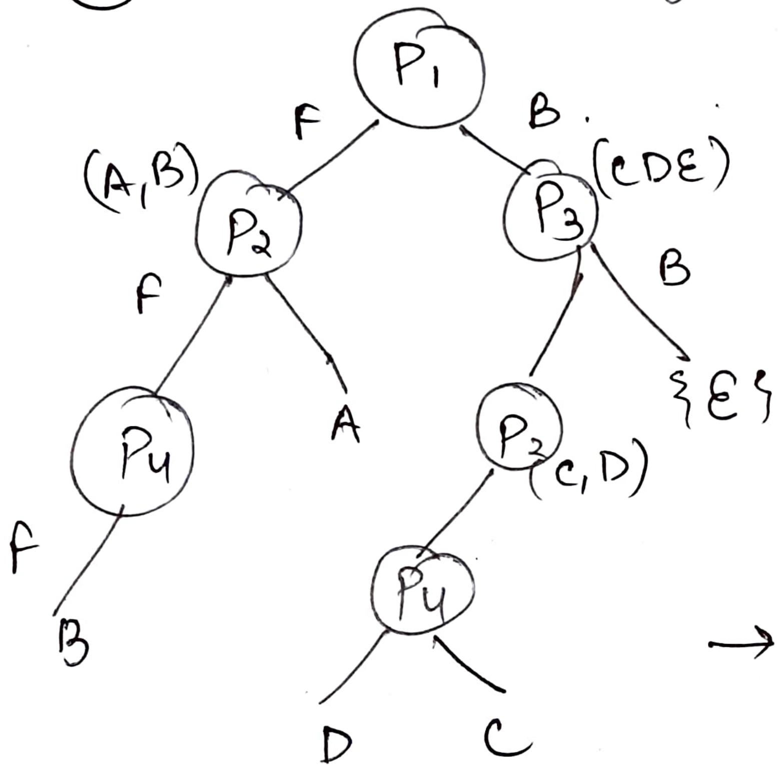
* Meisnir capsules, detect light touch and are found in fingertips

* Merkel's discs, provide information relating to pressure and texture found in fingertip ridges.

Question (2)

(A)

F → front B → back



BSP tree

→ P_1 as root node, in front we can see {A, B}, back we can see {C, D, E}. we consider P_2 for coming A and B, P_3 for the other three

→ we take P_3 and in front of P_3 we see {C, D} and back we see {E}. P_4 → C/D.

Question 2

B

$A = [2,2,1]$, $B = [3,2,1]$, $C = [2,4,2]$

$$y = \frac{1}{2}(x+4)$$

comparing , $y = mx + c$ and

$y = \frac{1}{2}x + 2$, $c = 2$

$\boxed{\theta = \tan^{-1}\frac{1}{2}}$

$m = 1/2$.

Transformation of point $P(0,2)$ to origin.
$(0,0)$

$$[T_r] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ t_x & t_y & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$

$t_x = 0$, $t_y = -2$ [-ve as direction is downwards]

Rotation of line by angle of

$\theta = \tan^{-1} 1/2$ (clockwise direction)

$$[R] = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2/\sqrt{5} & -1/\sqrt{5} & 0 \\ 1/\sqrt{5} & 2/\sqrt{5} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

reflection of triangle about x-axis

$$[M]_{x\text{-}axis} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Inverses rotation of line to its original angle

$$[R_n]^{-}_{ccw} = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2/\sqrt{5} & 1/\sqrt{5} & 0 \\ -1/\sqrt{5} & 2/\sqrt{5} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Inverse transformation of point p to origional pos.

$$[Tr]^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ t_x & t_y & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 2 & 1 \end{bmatrix} \quad \begin{matrix} t_x = 0 \\ t_y = 2 \end{matrix}$$

Transformation matrix is

$$[T] = [Tr][R][M][R]^{-1}[Tr]^{-1}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -2 & 1 \end{bmatrix} \begin{bmatrix} 2/\sqrt{5} & -1/\sqrt{5} & 0 \\ 1/\sqrt{5} & 2/\sqrt{5} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 2/\sqrt{5} & 1/\sqrt{5} & 0 \\ -1/\sqrt{5} & 2/\sqrt{5} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 2 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0.599 & 0.799 & 0 \\ 0.799 & -0.599 & 0 \\ -1.598 & 3.198 & 1 \end{bmatrix}$$

New coordinates are.

$$[X]' = [X][T]$$

$$= \begin{bmatrix} 2 & 1 & 1 \\ 3 & 2 & 1 \\ 2 & 4 & 2 \end{bmatrix} \begin{bmatrix} 0.599 & 0.799 & 0 \\ 0.399 & -0.599 & 0 \\ -1.598 & 3.198 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0.399 & 4.187 & 1 \\ 1.0797 & 4.397 & 1 \\ 2.0798 & 2.46 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0.4 & 4.2 & 1.0 \\ 1.8 & 4.4 & 1.0 \\ 2.8 & 5.6 & 1.0 \end{bmatrix}$$

$A' = [0.4, 4.2, 1.0]$

$B' = [1.8, 4.4, 1.0]$

$C' = [2.8, 2.4, 1.0]$

Question ③

Ⓐ

Here system is fitted over user's hand as a exoskeleton and give resistive force feedback to each finger.

It allows to have 4-dof (degree of freedom) and can be adapted for different size of fingers.

It can measure angular fexexion as well to provide users ability to hold onto objects in VR and feel them.

Question (3)

10611100

(B)

There are several usability related to the use of gestures as an input mode in multimodal interfaces. The use of gestures has been suggested before as a natural solution for application that require hands-free and no-touch interaction with computer, such as VR environments.

For eg., Robust 2D computer vision based gesture recognition system can be used in vision Re. (VR.) env. such as CAVEs and Powerwalls.

There might multiple application like:-

(i) A hand gesture in gallery application. browsing 3rd depth it combine global structure information and local texture variation in gesture framework

(ii) Contact based devices like accelerometer, EMG sensors for controlig virtual games utilized gesture recognition to adopt in real time to changes in environment.

Question (3)

(c)

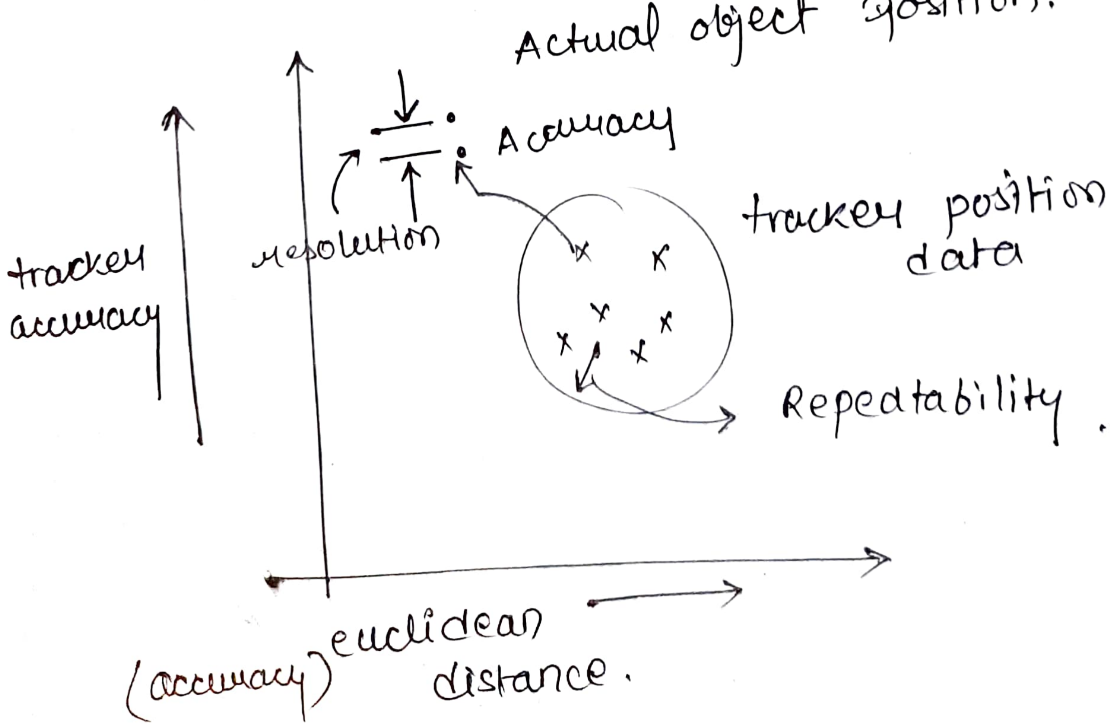
It is necessary to consider performance requirements for a application to choose appropriate sensor. we can have multiple type of performance parameter based on their application.

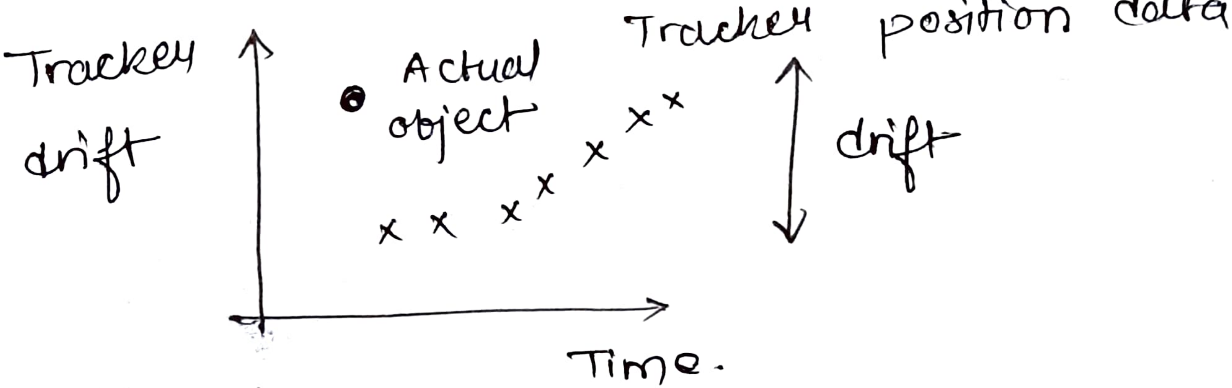
Tracker accuracy:

It represents difference b/w object's actual 3D position and that reported by tracker measurements

Tracker drift

It is the steady increase in the tracker error rate with time.





(Drift)

Example :

In intertial tracking accelorometer & gyroscopes are used. but it is hard to rely on intertial tracking because of dead reckoning leads to drift here.

So. such type of tracking is not used in isolation in VR.

Question 4

Design steps :

we are going to need following thing for our setup.

(i) **Immersion:**

→ fully immersion

→ we need head mounted device like oculus.

→ It is going to be first person view.

→ only hands will be visible.

(ii) **Interaction :**

can be done in a ways.

(i) Mechanical gloves

They will provide good control for pulling triggers and will also kepp user feel face & pressure.

(iii) others

It will be a 6 D.OF to move and pick stuffs. to be able to refill the gen.

=> 3D menus will be there to select gun type and target distance limits.

user can select different guns. by pointing at them.

To move gun they leve to hold a button gref it and mave the hand.

other object to act as target can be there

Implementation :

There can be seperate classes for objects like guns, bullets targets

=> Each gun can have its own class to get various configuations.

⇒ Actions like moving gun, shooting can be considered as functions which takes action as input and change state in memory.

⇒ example:

target can have boolian variable "is shot" to get if it was fired upon and hit.

⇒ VR component can be implemeted by converting world coordinates to game coordinates.

⇒ Each button can on controller can be mapped to a action

like x ⇒ shoot

o ⇒ hold and move

⇒ If target is hit succefully new level is reached or user wins.

components :

→ 2 controller for each hand.

→ A headset to view the feild.

→ A camera to track hand positions

→ A game engine like unity, unreal engine etc

→ modeling saftware like blender.

106119100

Question (5)

(A) The Measurement App, uses Augmented reality technology (AR) to measure the distance between a real-world object with our smartphone camera.

→ This create AR experiance for smartphone users using Visual Inertial Odometer and the camera sensor and CoreMotion to plot points in space.

Basically, when the user points the camera towards the starting measuring point. the coreMotion will point the starting point and visual inertial odometer mark the dist. and with the help of camera sensor it will measure the distance.

Now adays we have some tool-kit such as ARKit and Pusher, which helps to build

ARKit will detect the measurement. the app will create a 3D box with a width equal to the measuring, the app will create a 3D box with a width equal to the measured size.

& will pull/send this to, in real-time to Pusher.

106119100

Question (5)

(B)

A visible symbol used as a reference point or measuring unit for positional tracking of Augmented Reality devices. It acts as an anchor to visually syncronize augmented virtual overlays onto the concrete.

In AR, a fiducial marker is a visible object placed as a reference point for positional tracking of cameras, smartphone, or head-mounted displays. It helps translate the spatial reference between the concrete and augmented worlds, working as an anchor of scale, location, and orientation, which in turn allows for real-time virtual overlay.

It is often used as a black-and-white printed marker with specific geometric properties in the concrete environment but can also be a set of marks in the viewing instrument reticle. Once the computer vision software recognize a fiducial marker, it understands the devices relative position to its environment and knows in which dir any virtual intervention is projected.