BEST PRACTICES IN VR

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VR ISSUES

GOAL AND RISKS

The **goal** is to maximize user immersion

What can go wrong?

- **Sensory conflict:** Unnatural stimuli in the virtual world may lead to bad VR experience and sometimes to VR sickness
- **Vr sickness:** Some people are more sensible to sensory conflicts and may feel sick while using your VR applications

SENSORY CONFLICT

Happens when perception of self motion is based on incongruent inputs from visual, vestibular and non-vestibular systems

VR SICKNESS

Sensory conflict appear to be one of the main causes of VR sickness

We should be aware of this problem when integrating locomotion inside our VR application

Good news:

The more time users spend using VR, the less likely they are to experience discomfort, this is caused by our brain learning to reinterpret visual anomalies

VR SICKNESS STRATEGIES

- Always respond to user inputs, even on menus, while game is in pause etc.
- Do not apply movements without user inputs (e.g., rotate camera while user is not moving the head)
- Movement in Virtual World should be consistent with head and body movements.
- Think very well on how to implement locomotion in your application

LOCOMOTION

LOCOMOTION IN VR

- Acceleration *vs* speed: While acceleration seems to be the primary cause of discomfort in VR experience, it appear there is no straightforward relationship between speed and discomfort

- General guidelines:
  - Allowing user to set the pace of movement may help in control discomfort
  - Forward movement is more natural than backward or side movement
  - Open spaces with respect to enclosed spaces are known to be more comfortable to users

LOCOMOTION TECHNIQUES

- No locomotion by design: to completely avoid locomotion discomfort, it is possible to design VR application that do not require locomotion at all
- Teleportation: allow users to move around the scene without having to deal with accelerations
- Snap rotation or physical rotation: discrete rotation is better than continuous movement in VR, unless the player rotates physically in real-life
- Artificial movement. Moving on a railroad or on a predefined path at a fixed speed.
- Fade to black: similar to teleportation, fade to black before switching location.

INTERACTION TECHNIQUES

- Gaze based interaction: staring at objects causes something to happen in virtual world

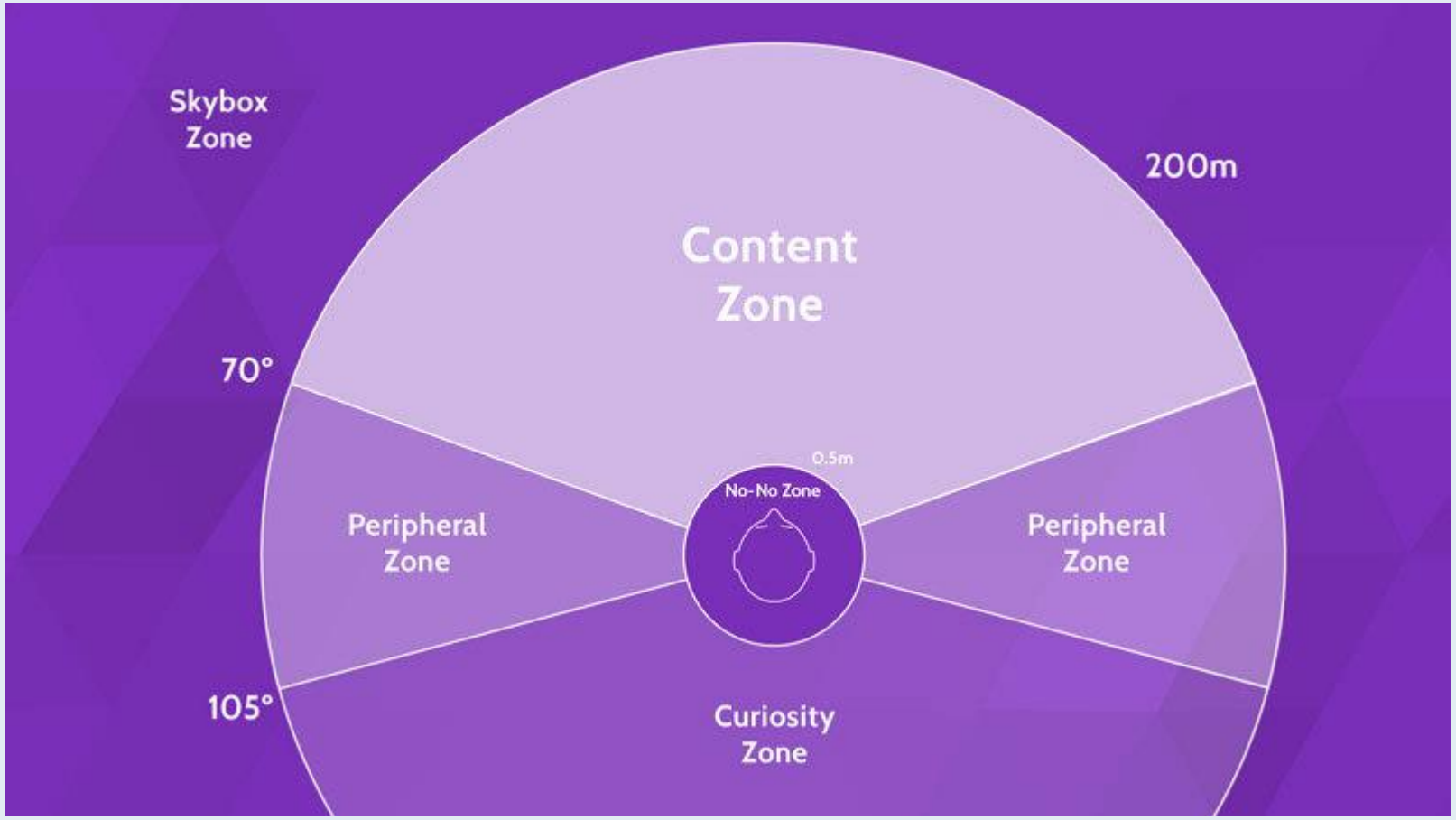
- Dedicated controllers (e.g., Oculus or HTC Vive controllers):
  - Good practice is to render the controller in the virtual world, with a ray coming out from it showing where the user is pointing at
  - Changes in ray or target colors are encouraged to provide feedback on the presence of an interactable

- Hands (Leap motion controller): rendering hands in the scene may greatly enhance VR experience, render a whole avatar only if you are sure that it will be perfectly aligned with the user real position

CONTENT ZONES FOR VR

- Content Zone: area of comfortable head rotation and view where things still give stereoscopic depth perception
- Peripheral Zone: area visible with maximum head rotation; environment will still be seen regularly, but no long-term content should be put in this zone
- Curiosity Zone: the user is literally turning their shoulders and trying with some effort to see what's behind them
- No-No Zone: as things get close to the face, the user becomes cross-eyed and experiences eye strain. Nothing should be displayed in this sphere around the head
- Skybox: after 200m, the two displays are essentially showing the same image pixel for pixel and there is no depth perception.

CONTENT ZONES FOR VR



VR UI DESIGN

UIs

- **Diegetic UI:** interface is included in the game world
- **Non-diegetic UI:** interface that rendered outside the game world, only visible and audible to the players in the real-world (like the ones in traditional games)
- **Spatial UI:** UI elements presented in the game's 3D space with or without being an entity of the actual game world
- **Meta UI:** Representations can exist in the game world, but aren't necessarily visualized spatially for the player

UIs IN VR

- Traditional UI does now work in VR
- The solution is to use Diegetic or Spatial UI
  - Diegetic UI: interface is included in the game world and can be seen by the game characters
  - Spatial UI: technically displayed in the game world, rendered on a plane object as if the plane existed in the world

Diegetic UI

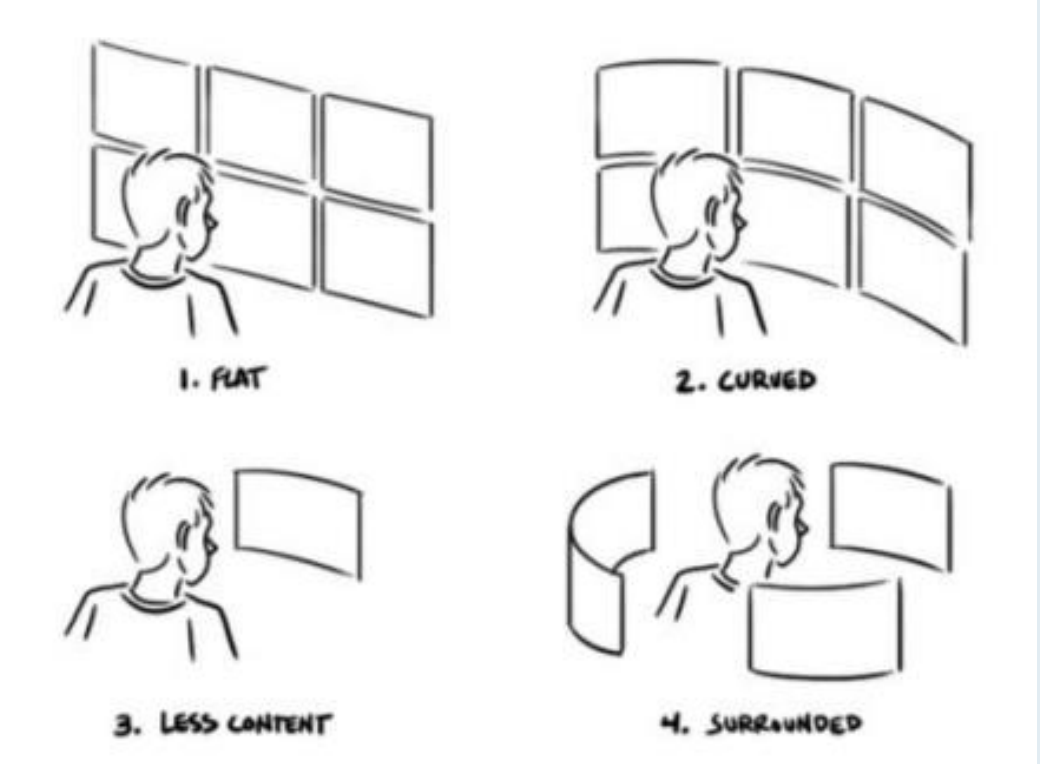
Spatial UI

DIEGETIC AND SPATIAL UI

- Where to place them?
  - Our eyes find it difficult to focus on something which is too close or too far
  - Position your UI at a confortable reading distance and scale it accordingly

TYPES OF UI

- **Flat**: difficult to read text or images in perspective
- **Curved**: the content is curved around the user, easier to read text or images
- **Less content**: better, even if that requires some way to move through it
- **Surrounded**: hierarchy can be implied by nearness to the cone of focus, secondary content can be pushed out of immediate view but remains accessible.



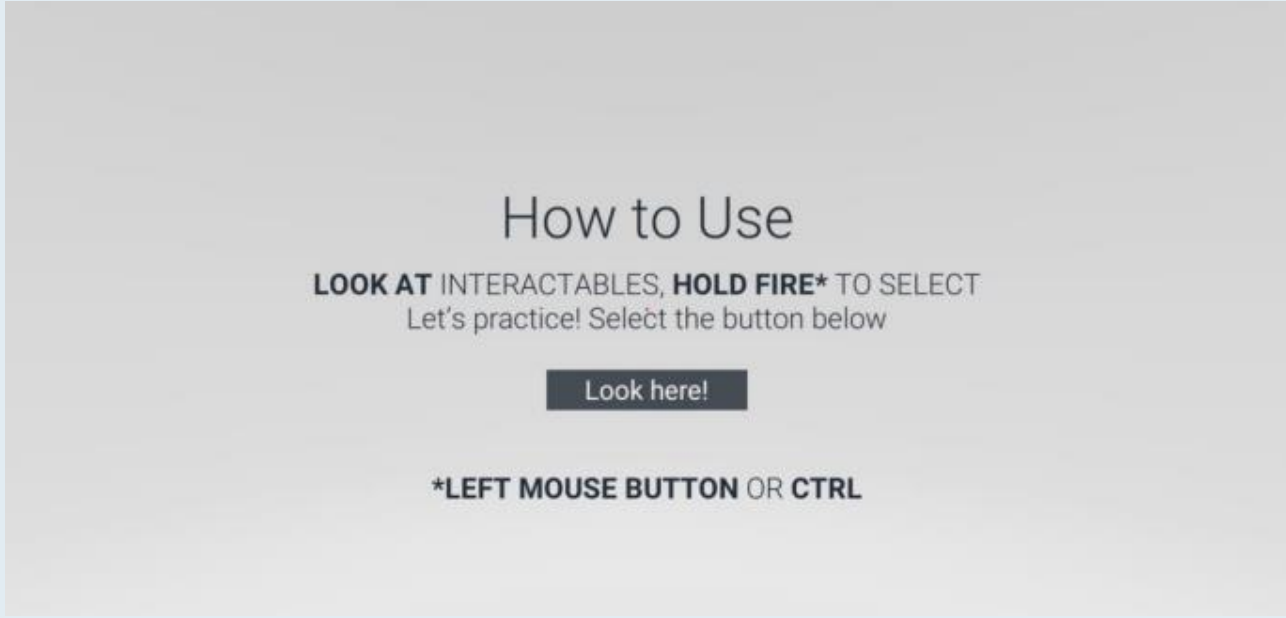
THINGS TO REMEMBER

FEEDBACK

- Every interactive object should respond to any movement
- Any casual touch should provoke movement
- The response of the object coincides with a mental model, allowing people to move their muscles to interact with objects
- Visual or haptic feedbacks could help users to understand how to interact with the object

BUTTONS DESCRIPTIONS

- Text or audio-based tutorial prompts can be essential for first-time users
- Be more specific as possible to get the best result, using motions and gestures that track reliably



OPTIMIZATION

- Frame rate is an essential part of ensuring users have a great and nausea-free VR experience, optimization is a critical part
- It’s better to optimize early and often with VR
- Testing regularly on the target devices is also essential.