eraction in Virtual Reality

hony Steed
artment of Computer Science
versity College London

tline

- aming as HCI
- avel
- election
- anipulation

FRAMING AS HCI

re Dilemma

atural *versus* Magic interfaces

atural

Pro: Use known movements, exploit body scale

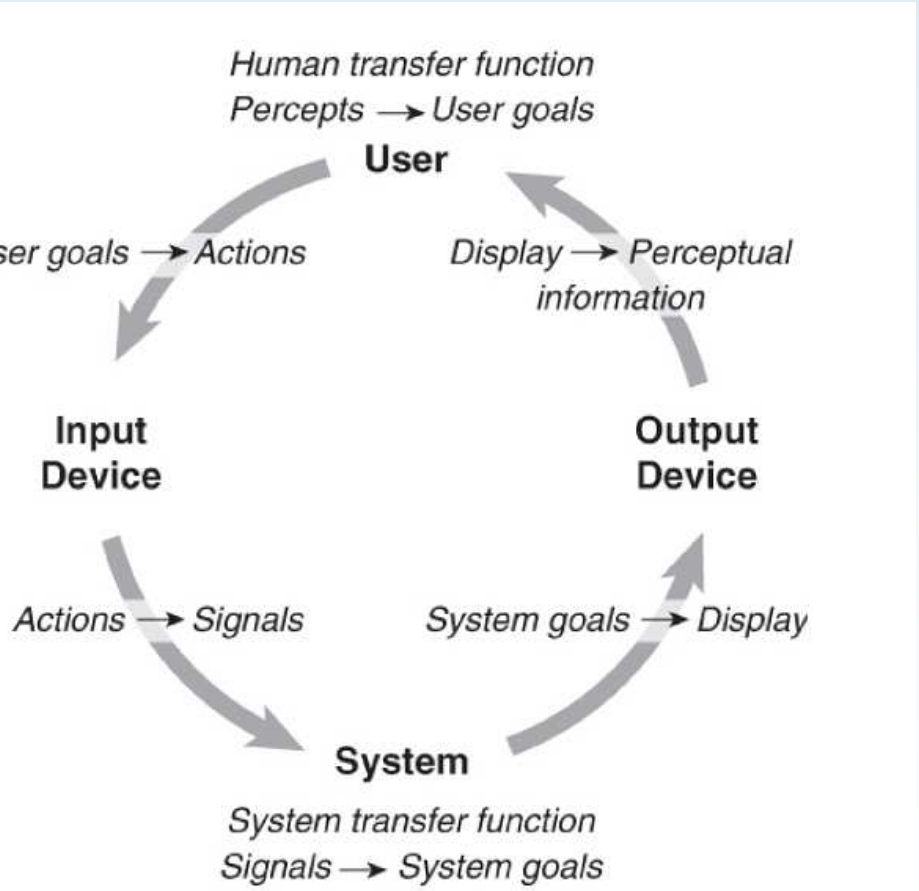
Con: Limited scale and precision

agic

Pro: Give users superpowers, implement effective echniques when display is limited

Con: Can be hard to learn, can cause confusion/sickness

man-Computer Interaction



- User goals based on percepts mig be wrong or over-estimated
  - –Objects have unsupported affordanc
- Users still need to learn the UI by u learning some real behaviours
- Input device might not sense all th actions

man et al, 2004

Slide 5

SA0 Only have this diagram once, with two examples of what is meant by natural and magical
Steed, Anthony, 2023-01-23T10:50:43.813

l Design Principles

arly focus on users and tasks

mpirical measurements

erative design

- Design the user interface
- Test
- Analyze results
- Repeat

interaction

CI design principles still apply, but not
fficient to address the unique needs of 3D
teraction

- Six degree of freedom
- Lack of appropriate input devices
- Natural interaction is hard to achieve with traditional
nput devices

sic Tasks in Virtual Reality

- avel
  - Walk or move through space
- election
  - ndicate an object of interest
- anipulation
  - Move an object of interest

TRAVEL

pes of Travel Techniques

here are two fundamentally different pes:

Physical techniques

The user's physical motion is used to transport the user through the virtual world

Virtual techniques:

The user's body remains stationary even through the viewpoint moves

ote that some physical movement is ways possible

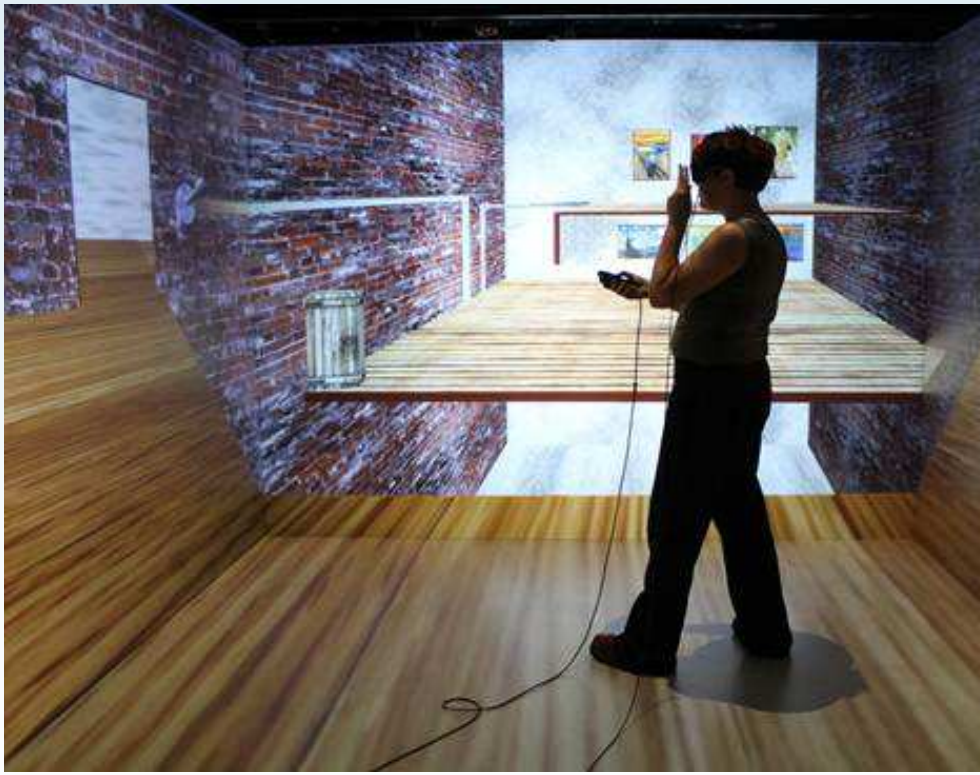
Slide 10

SA0 Replace with a taxonomy

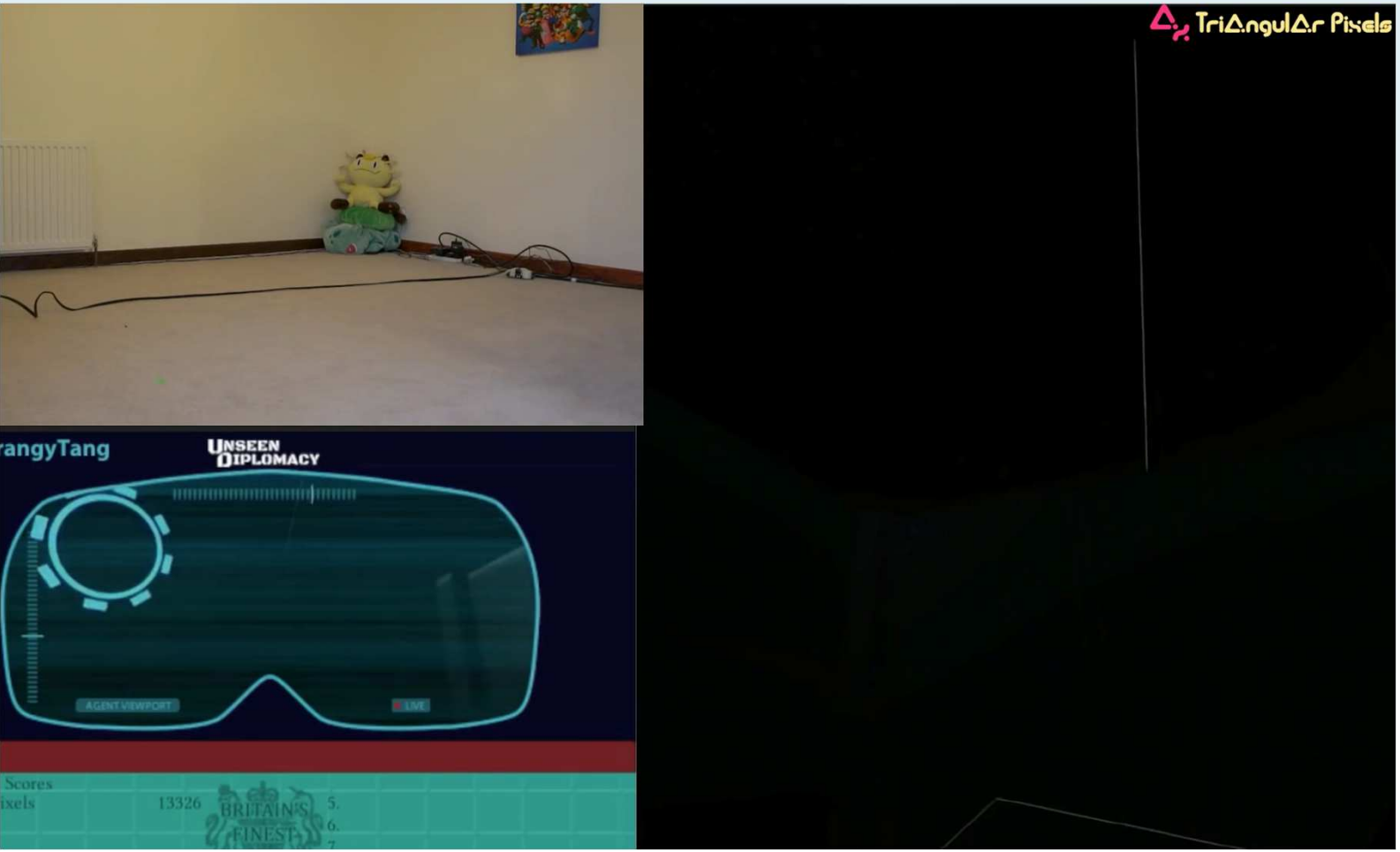
Steed, Anthony, 2023-01-23T10:50:06.048

ysical Locomotion – Direct Mapping

- omorphic mapping between the real-orld and the virtual environment
- os
  - ntuitive
- ons
  - Limited range of user motion
  - Real boundaries will not line up with virtual boundaries



ysical Locomotion - Unseen Diplomacy



sical Locomotion - Walking-in-Place

er “walks in place”

ovement detected by gait alysis

- Trackers just on feet
- Trackers over entire body

wer perceptual mismatch

- Deep down, user knows that their gait won’t make them move

t a lot of physical movement

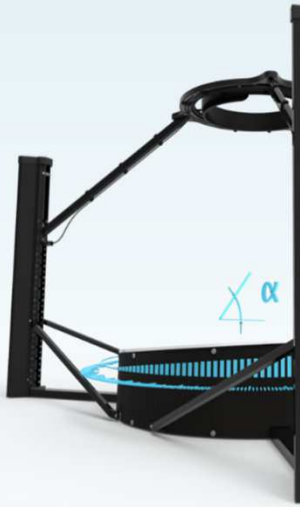
ysical Locomotion - Movement Mapping

ariety of walking platforms where
e user slides their feet backwards
d forwards

VizDish, Virtuix Omni, Cyberith Virtualizer, etc.

eps can be mapped into strides, ough this is non-trivial

seful for first-person games where eed of movement can be a terminant of success



ysical Locomotion – WizDish in CAVE

ysical Locomotion – Constrained Walking

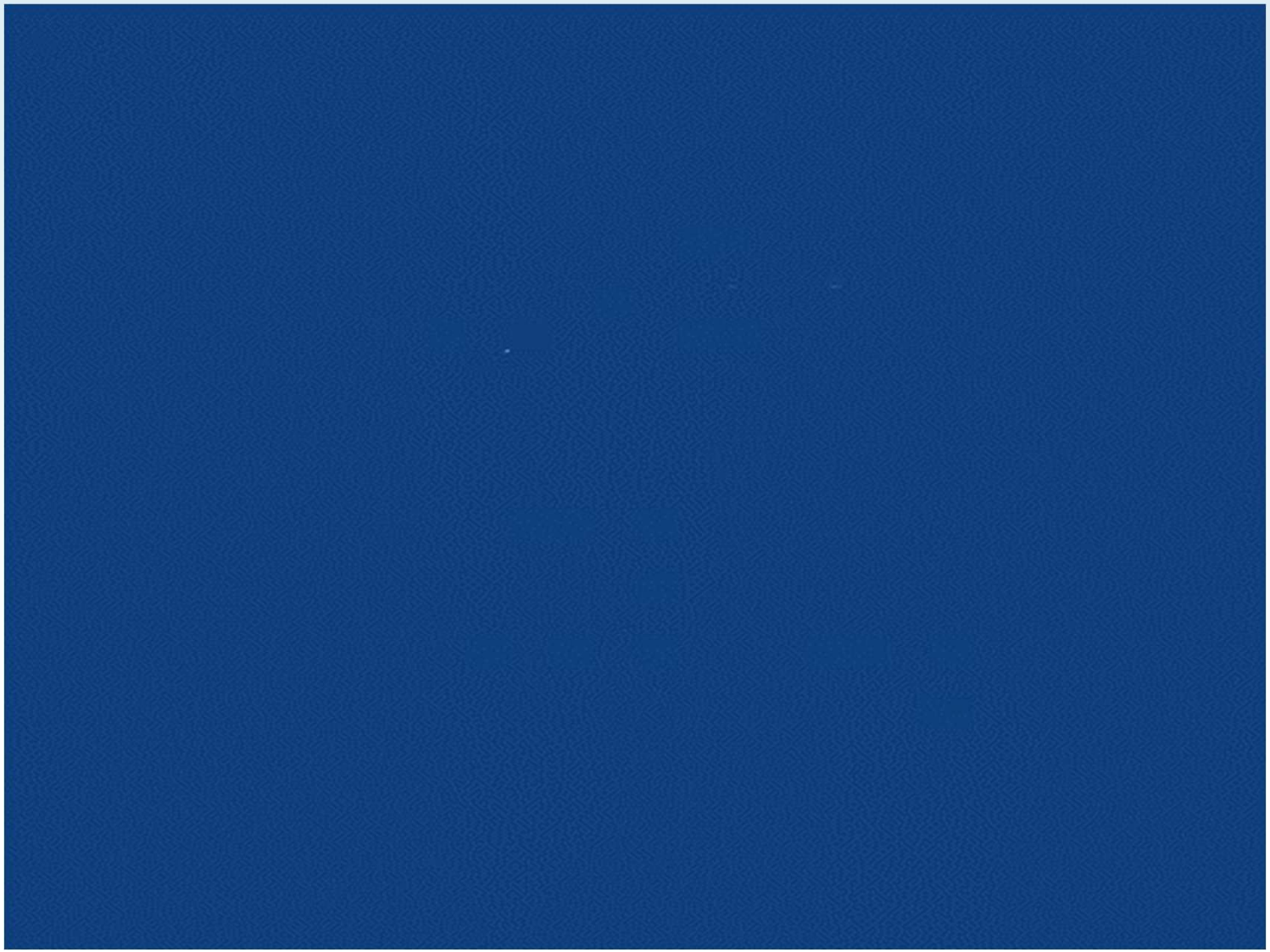
ser walks but motion is constrained

- Virtusphere
- Treadmills

owever, most forms can be very difficult to use

- Mismatch in perceptual cues
- Dynamics / inertia of device make it hard to navigate effectively

ysical Locomotion - Virtusphere

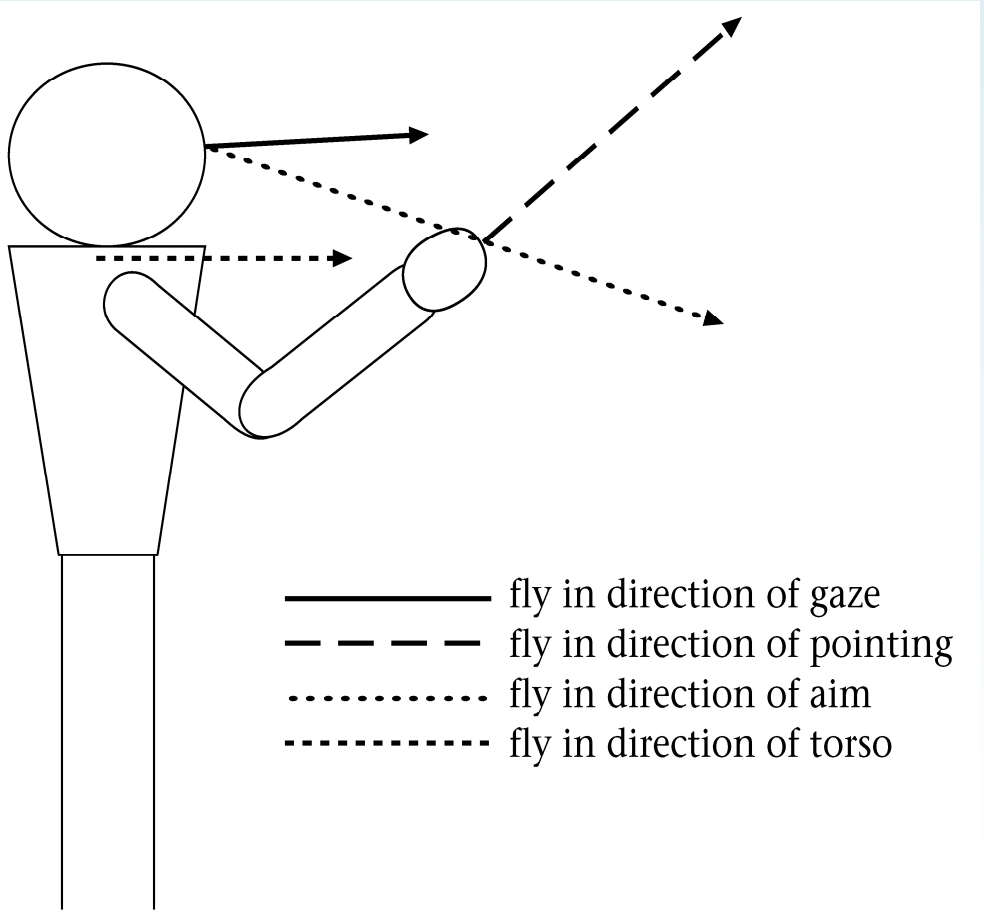


ysical Locomotion – Omnidirectional Treadmill

ual Locomotion – Direction Options

rection can be specified
y many means:

- Gaze-directed
- Pointing
- Physical device (joystick, steering wheel)



tual Locomotion - Direction

aze-based:

- Uses head orientation
- Cognitively simple
- Cannot look around whilst travelling

ointing-based:

- Uses hand orientation
- Cognitively more complicated
- Makes it possible to look in one direction whilst travelling in another
- However, you can’t hold other objects or manipulate them whilst travelling

tual Locomotion - Speed

nstant Speed

Can be jerky

Easily overshoot your destination

nstant acceleration

Begin at slow speed: good for short distance

Speed grow exponentially

rrently games prefer NOT to accelerate

Recommended not to use joysticks unless necessary

tual Locomotion - Turning

o you provide a joystick that enables turning?

culus Rift CV1 launched with a gamepad with multiple joysticks.

rning will be necessary in displays that are not surrounding (e.g. CAVE)

ientation change widely experienced to cause disorientation and sickness

ost games use “jump” turns so turning is instantaneous

mbating Motion Sickness

IGN

tual Locomotion - Teleporting

- oint to where you want to go
- target is usually shown on the floor th a ray connecting it
- ess button to jump instantaneously
  - Previous techniques animated, causing isual flow
- leporting is the new default travel chnique

eporting – The Lab

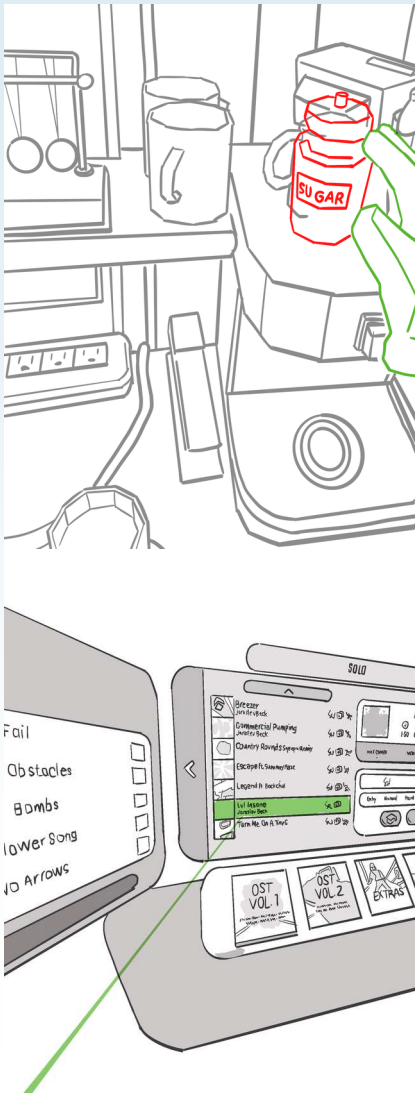
eporting – Budget Cuts

SELECTION

ection

se the hand or controller to select object
thin reach OR Point at with hand or
ntroller

- Possibly give haptic feedback
- Usually visual feedback to confirm selection
- ook at to select
  - Needs visual feedback to confirm selection
  - Need a timer or other button to confirm
- Gaze + Pinch” is being used in VisionOS



Slide 29

SA0 Needs examples

Steed, Anthony, 2023-01-23T10:48:32.783

ection

- current problem is that each demo is using fferent conventions for selection
- owest common denominator is eye-gaze dwell me (due to no other input, e.g. Cardboard)
- ngle button may mean that widgets need to be elected to enable different modes
  - E.G. Look down to select your feet to enable travel in Gear VR/Cardboard demos
- otential for highly non-intuitive mixed modes in the ser interface

MANIPULATION

nipulation

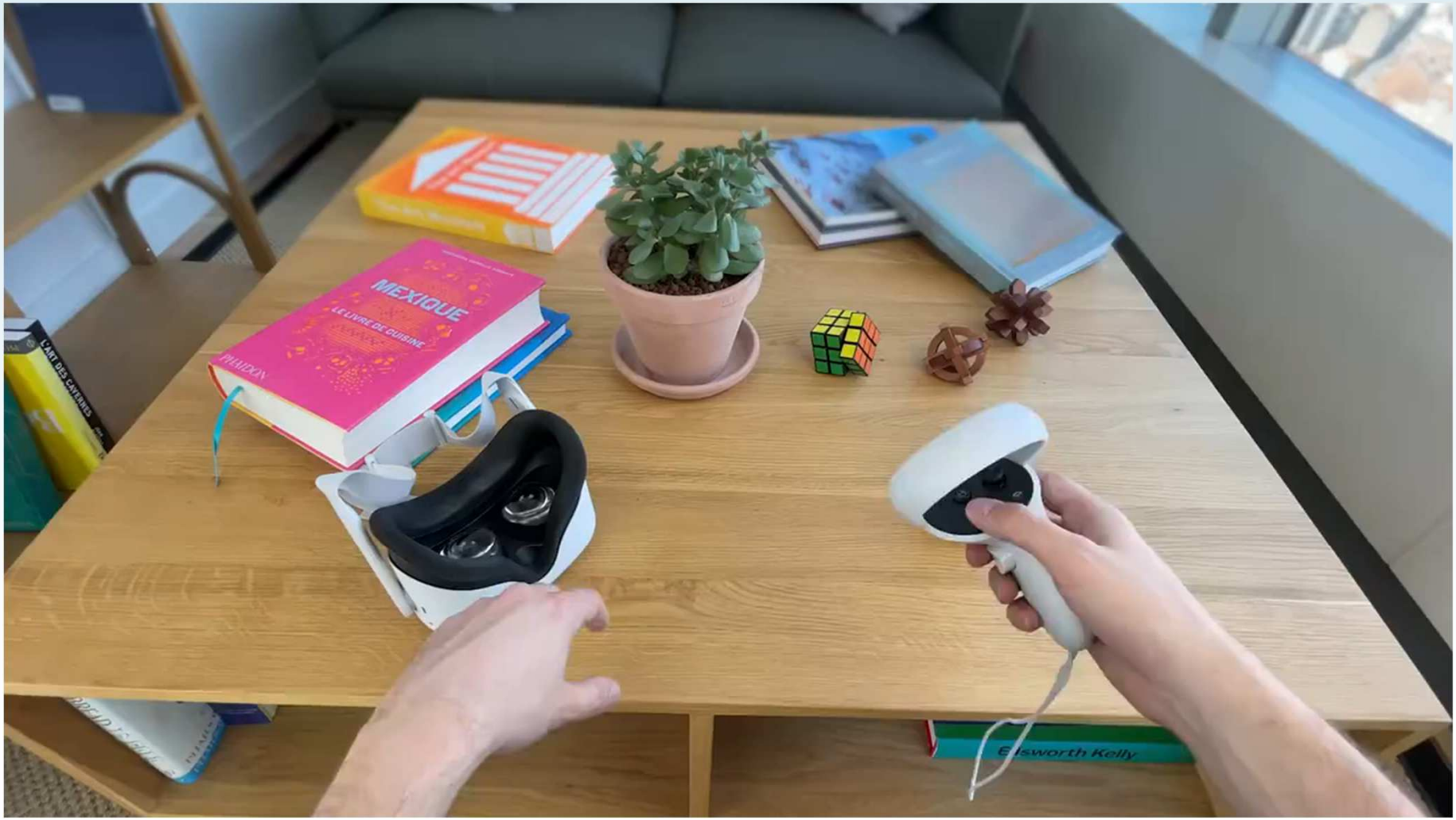
- and controller versus hand-tracking
- object within reach
  - Manipulation similar to moving it with your hand
- object out of reach
  - Consider manipulating something on the end of a stick
  - Rotation in all angles is hard
  - Movements are amplified

Slide 32

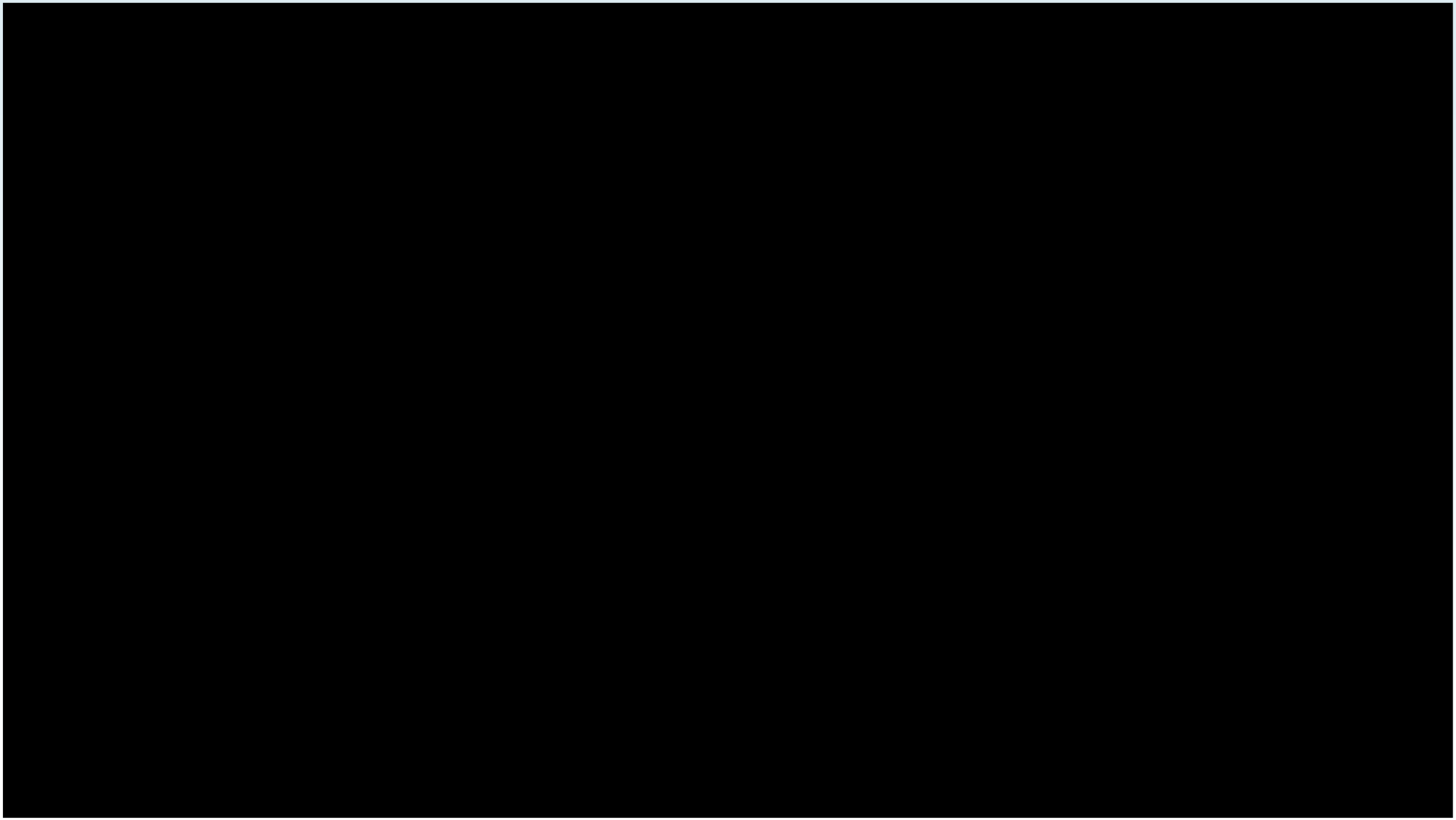
SA0 Needs more introduction to fact that you have a controller

Steed, Anthony, 2023-01-23T10:47:40.768

nipulation with Hand Tracking (Cubism)



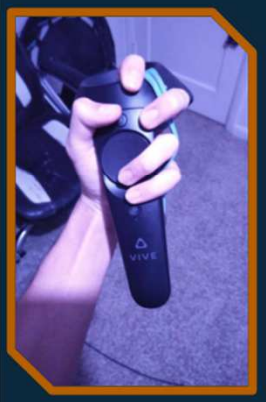
nipulation with Controller (Auto-Hand from Earnest Robot)



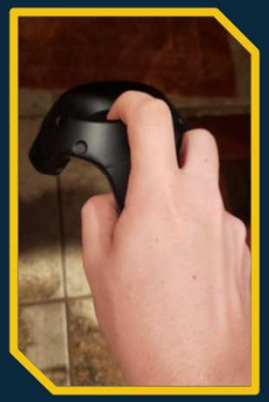
nipulation: Form of the Controller

Different Types of Beat Saber Grips for VIVE v0.93

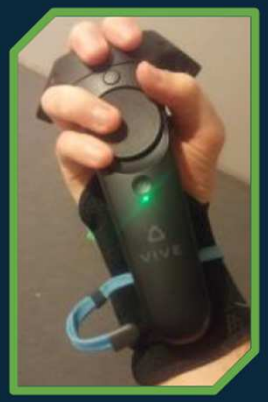
These grips are recommended for health and safety reasons as well as for performance reasons for high BPM Expert+ songs.
Additional precautions against tendonitis or carpal tunnel can be taken with streams by using a wrist guard.
For more information on stretching exercises: https://wiki.assistant.moe/health-and-safety



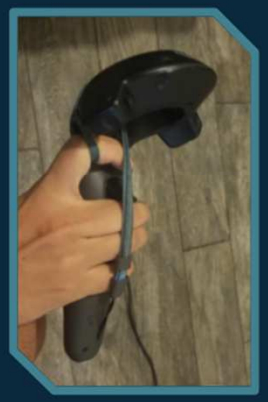
X-Grip
A combination of V and B grip. The strap wraps through the loop around the middle finger. Created by Lost Vint. Use by Deno & Hoppaw.



VIVE Claw Grip (C-Grip)
More comfortable to use of the Vive grips.



B-Grip
Most popular grip for VIVE users, including TammyMatty.



Voolas Grip (V-Grip)
Named after its creator. NotNull uses a variant of this grip.

Default Grip
Comfortable, but it significantly slows your swing speed due to the weight of the head.

Spiral Grip (S-Grip)
A variant of B grip. The strap wraps through the loop around the 3 middle fingers. Created by Emperor of the Internet.

by Emperor of the Internet#1337

ki.assistant.moe/grips-and-tricks

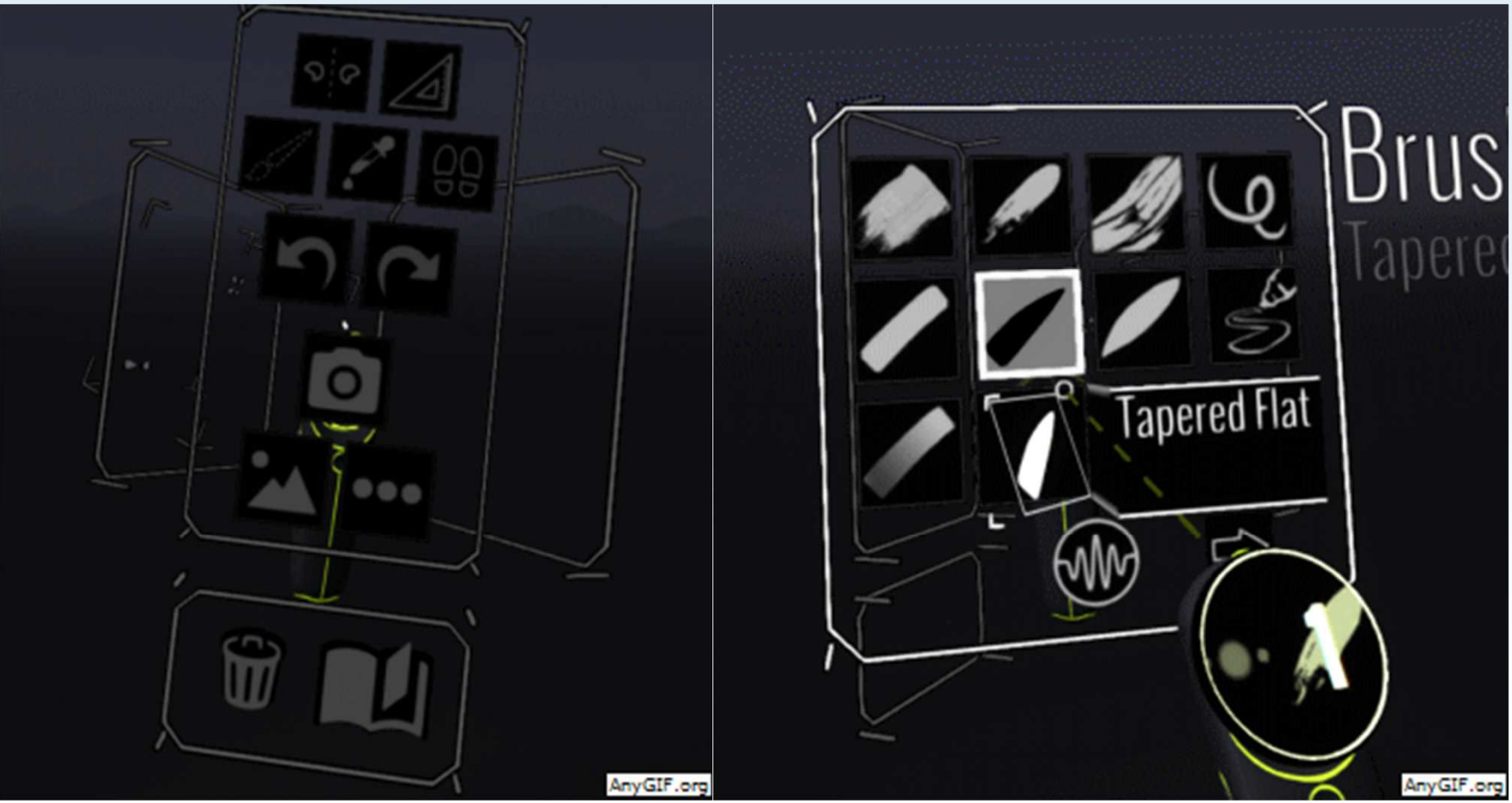
nipulation: Form of the Hands

chemy: Job Simulator

nipulation: Diegetic Interaction (I Expect You to Die)

ww.youtube.com/watch?v=wDL5KG5qOzM

dgets: Abstract Interaction (Tiltbrush)



m: http://vrux.design/vr-ui-tool-palette/

rlds In Miniature

cap

avel / locomotion

s the biggest challenge facing consumer virtual reality systems

Many choices. Relatively few people will have walking platforms, treadmills, etc.

Redirection may help

lection and Manipulation

Diegetic versus non-diegetic

Hand-tracking (expressive) versus controller (fast)