Haptic Design

Meta

An introduction to Haptic Design

XR Input Haptics
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Guidelines

Part 1

1 What is Haptic Feedback?

Haptic feedback, often referred to as haptics, is providing information or feedback to the user through our skin. Following are some examples of haptic feedback.

Vibration

Among the most common forms of haptic feedback, vibration is widely employed in smartphones, game controllers, and wearable devices. It provides feedback through various patterns of vibration intensity, frequency, and rhythm, mimicking actions like button presses or the sensation of walking on different surfaces in a game.

Force Feedback

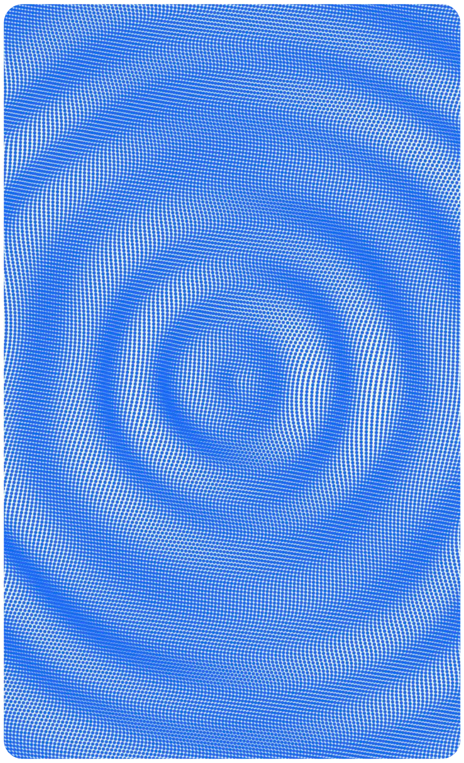
More sophisticated than basic vibration, force feedback is employed in gaming controllers, steering wheels, and simulation devices. It offers resistance or movement in response to user input, creating a sensation of interaction with physical objects within the virtual realm.

Tactile Buttons

Some touchscreens and touch-sensitive interfaces incorporate haptic feedback by simulating the tactile experience of pressing physical buttons when the user interacts with virtual counterparts displayed on the screen.

Tactile Feedback

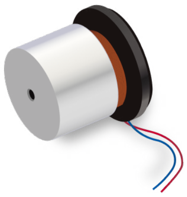
In mixed reality (MR) systems, haptic feedback serves to emulate the feeling of touching or manipulating virtual objects, enhancing the user's immersion in a blended real and virtual environment.



> Providing information or feedback to the user through our skin.
>
> Haptic feedback

2 Haptic Actuators

The components producing the active feedback are called haptic actuators. Haptic actuators translate the design intent into vibration. Haptics Studio provides hardware-agnostic haptic design. However, as a haptic designer, it is beneficial to understand the different types of actuators that produce different types of haptic feedback.



Voil Coil Actuator (VCM)

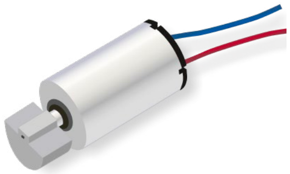
Thanks to its wide frequency range, a Voice Coil Motor (VCM) is a type of electromagnetic actuator that excels in providing precise and controlled tactile feedback from gentle vibrations to sharp, defined impacts. As a result, VCMs can create haptic feedback that feels realistic and closely mimics the desired tactile sensation.

VCMs are slowly replacing ERM and LRA in applications where feedback is desired, such as AR/VR, smartphones and gaming controllers.

Linear Resonant Actuator (LRA)

A Linear Resonant Actuator (LRA) creates vibration around a single resonant frequency. Unlike ERMs, an LRA can change its amplitude independently from frequency, allowing for more dynamic effects.

LRAs tend to be small and energy efficient. However, they typically don’t provide the vibration intensity that large ERMs can produce.



Eccentric Rotating Mass (ERM)

An Eccentric Rotating Mass (ERM) actuator is a simple and cost-effective technology used for creating simple vibrations and tactile sensations. When activated, the ERM causes an unbalanced mass (usually a small weight) to rotate around an eccentric (off-center) axis. This rotational motion generates vibrations that can be felt by the user.

ERMs produce vibrations that are less controlled and nuanced compared to LRA or VCM. The technology may not be able to produce sharp impacts or convey complex tactile sensations.

3 Meta Quest Platform and Hardware

Quest Pro, Quest 3 and devices launched in or after 2022 support wideband Haptics.

	Quest 2	Quest Pro	Quest 3
Actuator	1x Narrowband LRA	2x Narrowband LRA 1x Wideband VCM	1x Wideband VCM
Capabilities	Single frequency design, short sharp signals	Broad complex signals, sharp and precise clicks, frequency modulation	Broad complex signals, sharp and precise clicks, heavy frequency modulation
Use Cases	Basic feedback: Notifications, confirmations, even interactions	Enhanced feedback: Guidance gestures, navigation, character environment interactions Detailed interactions: turning dials, delicate notifications, squeezing objects	Enhanced feedback: Like quest pro with slight reduction in output

Meta Quest Platform and Hardware

Any app or game can leverage the full potential of the haptic actuators in Quest controllers and play custom haptic effects. The Meta Haptics SDK is available as Native SDK and for Unreal and Unity.

Haptics Studio for Mac and PC provides a design front-end to quickly generate custom haptics from your audio assets and audition them in real-time on the Quest hardware.

Custom haptic effects designed in Studio work best on Quest Pro, Quest 3 and up. The effects are backwards compatible with Quest 2.

Before designing haptics, let’s consider a few key characteristics and design approaches to haptics.

4 The Key Characteristics of Haptic Design

Intimate Interactions

Haptic feedback relies on the sense of touch - a personal and intimate experience. Haptic Feedback adds an emotional layer to your interactions and we have an inherent trust in our sense of touch.

Limited Information Transferral

The amount of information that haptic feedback can effectively convey is limited. Overloading the touch sense with excessive information can negatively impact the user experience.

Short Haptic Memory

Our haptic memory is shorter than audio or visual memory. For haptic designers, A/B testing haptics is more difficult than comparing audio or visuals. For end-user experiences, we aim for intuitively understanding rather than recalling to minimize the user’s memory load

Less is More

Haptics add depth to any experience, but should not take center stage, unless the overall experience intent is to focus on haptics. Some of the most effective haptics are the ones that you only notice when they are missing.

Play in Sync

Haptics work best in a multimodal context where they add an accent to an audio/visual experience. As designers, we need to consider synchronization between audio, visuals and haptics cue for users to perceive them as one event.

5 Tips for Designers

Relate to Action

Use haptic effects consistently and in a way that reinforces a clear causal relationship between the haptic and the action that causes it.

Feedback System

Use haptics in ways that complement other feedback in your app, such as visual and auditory feedback. Pay attention to synchronization between audio, video and haptics

Haptic Balance

Avoid overusing haptics and instead aim for a balance that most people will appreciate.

Carefully prioritize haptics in fast-paced action games and avoid long, overlapping haptic effects

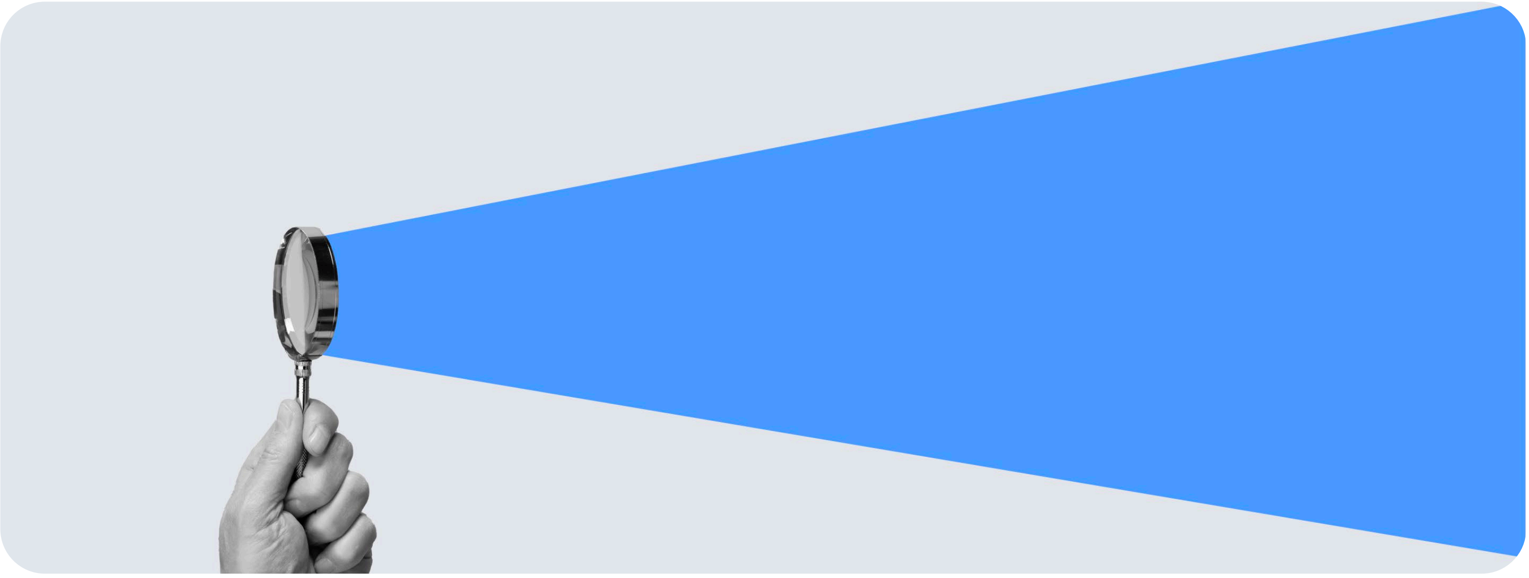
Use Whitespace: Haptics are more impactful after a short pause where the skin can rest. Create pauses, set accents to highlight tiny moments.

Give Users a Choice

Make haptics optional so that users can turn them off or mute them if they wish

Dynamic Effects

Consider designing custom haptic effects that vary dynamically based on user input or audio-visual context. Softer sounds should correlate to softer haptics.



A structured process for designing haptic experiences

BREAKPOINTS

Time	Frequency
00.114	0.99

Part 2

A structured framework

In the realm of haptic design, we offer a structured framework for creating immersive and satisfying tactile encounters. In this section, we present a methodical approach to guide your haptic design endeavors.

1 Project Categories

Your haptic design journey may fall into one of two categories:

Introducing Haptics
This pertains to projects starting from scratch, without any prior haptic elements.

Upgrading Haptics
This involves enhancing or replacing primitive haptic feedback in existing projects

2 Identifying User Needs and Objectives

Identify User needs
Start by pinpointing the user’s genuine haptic requirements. Look for opportunities where haptics can compensate for limited or absent sensory cues.

Design Intent
Clearly define the areas of your experience that require haptic feedback. Avoid diving into the production of haptics without a well-defined purpose.

Hardware Considerations
Understand the device you're designing for. Recognize its capabilities and limitations.

Body Positioning
Align haptic interactions with the body's natural models. Map specific types of haptic information to corresponding areas of the body. Remember that haptic feedback may generate audible sounds, especially when the device is in contact with a solid surface.

3 Crafting Haptic Experiences

In this phase, we explore the possibilities of haptic design

Multisensory Experience
Consider haptics as part of a broader feedback system. Haptic feedback is most effective when integrated with other sensory inputs. Multisensory experiences enhance user reactions, task completion, and learning. Ensure that haptic feedback complements visual and auditory cues, creating a cohesive and natural user experience.

Real World Metaphor
Start from real-world metaphors and expected behaviors. However, instead of replicating the exact sensations of the physical world, imagine metaphors to guide your design. How would actions and interactions unfold in the real world? How do elements interact with you and your surroundings? Even in familiar experiences, don't be constrained by physical limitations; create magical, unreal sensations.

4 Balancing User Preferences and Limitations

In this phase, we address limitations and user preferences

User Control and freedom
Make haptics optional and adjustable. Users should have the choice to mute haptics, and the app experience should remain enjoyable without them. Allow users to customize the intensity of haptic feedback, recognizing the individual user preferences

Use-case specific Considerations
Haptic feedback enhances user confidence in virtual interactions and keeps them informed about system status. Feedback should be tied directly to user actions and engage immediate attention, such as error prevention or notifications. It may also aid in providing guidance and orientation within a virtual space.

Consistency and Standards
Ensure consistency in haptic interactions across your application to facilitate user learning and association of haptic patterns with specific experiences. Focus on delivering the right amount of feedback at the right time, using easily recognizable and distinguishable sequences.

5 Enhancing Gaming Experiences in VR

In the realm of VR haptic design, you have various design approaches:

Expanding Perception
Extend the natural sense of touch and use haptics to create digital illusions. This approach involves crafting unique sensations and emotions that go beyond the boundaries of the physical world.

Building Realism
Replicate the tactile sensations of the physical world, bringing familiarity to your VR application or game, creating an experience that feels as close to reality as possible.

The decision whether to design haptics for expanding perception or building realism is tightly coupled with the overarching goal of the game's user experience (UX) and the decisions made by the audio and visual teams. It is crucial to closely coordinate with your team to ensure that the haptic design direction aligns harmoniously with the overall design elements of the game.

6 Summary

In the previous sections, we've explored the fundamental principles of haptic design for VR experiences:

The choice between expanding perception and building realism. Use-case specific considerations for enhancing user confidence, understanding system status, and maintaining consistency.

To effectively implement these principles, it's crucial to experiment and gain hands-on experience. This process allows you to grasp the nuances of haptic feedback and its integration into immersive VR environments.

In the next section, we'll put these principles into practice. Through a real-world scenario, we'll illustrate how to apply the concepts we've discussed. This practical example will provide insights into crafting user-centric and immersive experiences in the world of mixed reality.

Appendix
Design Templates

Haptic Design Templates

About

In this section you will find templates that will help you during your haptic design project.

You can either use the open document (see folder) or this pdf to fill out the tables and use along your design process.

Alternatively you can use the following pages as a blueprint to create your own template.

Content

1. Identifying User Needs and Objectives
2. Haptic Design Feedback
3. Event Priority and Hierarchy Template

Identifying User Needs and Objectives

Use this template to define the guiding principles for your project.

User needs

The user’s genuine haptic requirements. Look for opportunities where haptics can compensate for limited or absent sensory cues.

Design Intent

Define the areas of your experience that require haptic feedback.

Hardware Considerations

Understand the device you’re designing for. Recognize its capabilities and limitations.

Body Positioning

Align haptic interactions with the body’s natural models. Map specific types of haptic information to corresponding areas of the body.

Haptic Design Feedback

Use this template for structuring feedback about your haptic design.

Asset Categories

In order to structure design work it can be helpful to organize assets into the categories of which you are designing for:

Interactions (Direct)
Game objects and interactions. (doors, weapons, items, lock picking etc.)

Interactions (Indirect)
Haptics for gestures and guidance (latching, aiming, puzzles etc.)

Cinematic Immersion
Cut Scenes, character signatures, immersion without direct interaction

Music
Haptics that match music scores for dramatic immersion or added suspense (also character signatures)

Designate the Event Types

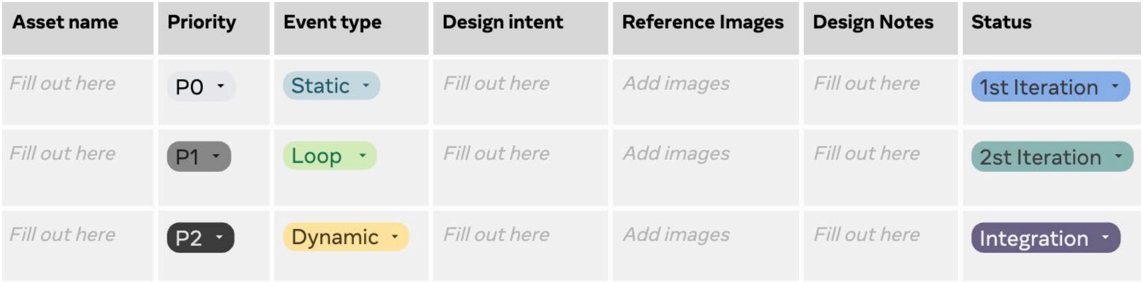
Static
This is a standard one shot event that is triggered by a controller interaction or game event.

Loop
This will trigger the haptics to play in a loop - i.e. holding trigger.

Dynamic
Dynamic events allow for a more creative approach to haptics. This event can be mapped to different controller interactions.

Template

To use this template go to the 'Open Document' in the folder.



Asset name	Priority	Event type	Design intent	Reference Images	Design Notes	Status
Fill out here	P0 ▾	Static ▾	*Fill out here*	*Add images*	*Fill out here*	1st Iteration ▾
Fill out here	P1 ▾	Loop ▾	*Fill out here*	*Add images*	*Fill out here*	2st Iteration ▾
Fill out here	P2 ▾	Dynamic ▾	*Fill out here*	*Add images*	*Fill out here*	Integration ▾

Haptic Design Feedback

Use this template for structuring feedback about your haptic design.

Asset name	Priority	Event Type	Design Intent	Reference Images	Design Notes	Status
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				
	□ P0 □ P1 □ P2	□ Static □ Loop □ Dynamic				

Event Priority / Hierarchy

Use this template to map the event frequency

Showcase

A particular point of interest to be highlighted i.e. Boss fight, Cinematics, Special ability

High

An event that happens regularly i.e. Run/Jump/ Shoot

Medium

An event that happens often e.g. Reloading/Item retrieval

Low

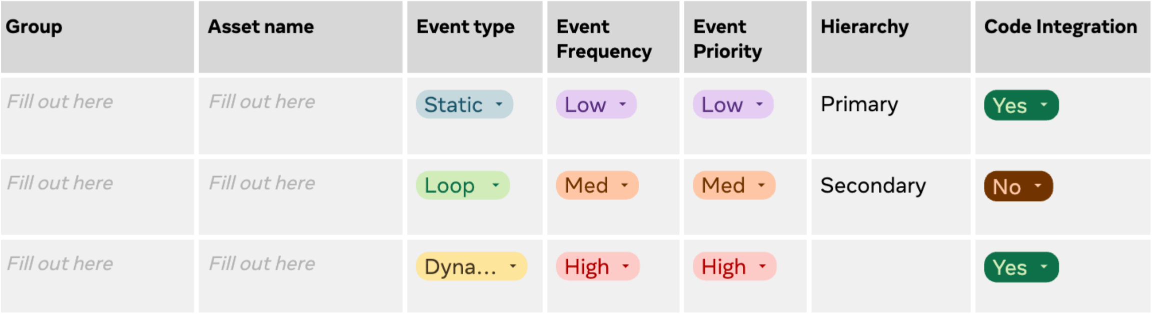
An event that happens infrequently e.g. Acquiring health or a special ability/ Upgrades, UI/UX

Hierarchy

The order in which these events will be implemented into the game engine. This can dictate which events have priority over others when being called/triggered. For example adding health or taking damage will have a Low event frequency but will have a higher priority order than a High frequency looped gunshot

Template

To use this template go to the ‘Open Document’ in the folder.



Group	Asset name	Event type	Event Frequency	Event Priority	Hierarchy	Code Integration
Fill out here	*Fill out here*	Static ▾	Low ▾	Low ▾	Primary	Yes ▾
Fill out here	*Fill out here*	Loop ▾	Med ▾	Med ▾	Secondary	No ▾
Fill out here	*Fill out here*	Dyna... ▾	High ▾	High ▾		Yes ▾

Haptic Design Feedback

Use this template for structuring feedback about your haptic design.

Group	Asset name	Event Type	Event Frequency	Event Priority	Hierarchy	Code Integration
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
		□ Static □ Loop □ Dynamic	□ Low □ Medium □ High	□ Low □ Medium □ High		□ Yes □ No
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If you have questions on the guidelines, please write to:

haptics-feedback@meta.com

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