Advances in AR Quick Look

David Lui, ARKit Engineering
Jerry Yu, ARKit Engineering
Really easy to see 3D content in the world
AR Quick Look
iOS 12

Really easy to see 3D content in the world
AR Quick Look
iOS 12

Really easy to see 3D content in the world
Realistic model previewing

Integrating Apps and Content with AR Quick Look

WWDC 2018
AR Quick Look
iOS 12

Really easy to see 3D content in the world

Realistic model previewing

Available on iOS from web and apps
AR Quick Look
iOS 13

Integration with Reality Composer
AR Quick Look
iOS 13

Integration with Reality Composer

Visual improvements to AR Quick Look
AR Quick Look
iOS 13

Integration with Reality Composer
Visual improvements to AR Quick Look
Enhancements to the viewing experience
AR Quick Look
iOS 13

Integration with Reality Composer
Visual improvements to AR Quick Look
Enhancements to the viewing experience
Web integration and customization
AR Quick Look
iOS 13

Integration with Reality Composer
Visual improvements to AR Quick Look
Enhancements to the viewing experience
Web integration and customization
Customizable call to action in AR Quick Look
Integration with Reality Composer
3D Modeling Software
3D Modeling Software

USDZ
3D Modeling Software
Anatomy of a Scene

- Anchor
- Objects
- Behaviors
- Audio
- Physics
Anatomy of a Scene

- Anchor
- Objects
- Behaviors
- Audio
- Physics
Anchors

Horizontal

Vertical

Face
Anchors
Horizontal and vertical

Common in everyday environments
Anchors
Horizontal and vertical

Common in everyday environments
Objects are placed on the first detected plane
Anchors
Horizontal and vertical

Common in everyday environments

Objects are placed on the first detected plane

Tap-and-drag between horizontal and vertical
Anchors
Horizontal and vertical

Common in everyday environments

Objects are placed on the first detected plane

Tap-and-drag between horizontal and vertical

Rotation gestures for horizontal and vertical anchors
Anchors
Horizontal and vertical

Common in everyday environments
Objects are placed on the first detected plane
Tap-and-drag between horizontal and vertical
Rotation gestures for horizontal and vertical anchors
Applies for usdz and Reality Files
Anchors
Horizontal and vertical
Anchors
Horizontal and vertical
Anchors

Face

Turns on front-facing camera
Anchors

Face

Turns on front-facing camera

Uses face occlusion geometry provided by ARKit
Anchors

Face

Turns on front-facing camera

Uses face occlusion geometry provided by ARKit

Gestures are disabled
Anchors

Face

Turns on front-facing camera

Uses face occlusion geometry provided by ARKit

Gestures are disabled

Respects authored physical size
Anchors

Face

Turns on front-facing camera

Uses face occlusion geometry provided by ARKit

Gestures are disabled

Respects authored physical size

Simultaneously supports multiple faces
Anchors

Face

- Turns on front-facing camera
- Uses face occlusion geometry provided by ARKit
- Gestures are disabled
- Respects authored physical size
- Simultaneously supports multiple faces
- Available on devices with front-facing TrueDepth camera
Anchors
Face
Anchors
Face
Anchors

Face
Anchors

Image

Anchored to a real-world image
Anchors

Image

Anchored to a real-world image
Anchors

Image

Anchored to a real-world image

Prioritize placing content
Anchors

Image

Anchored to a real-world image

Prioritize placing content

Physical manipulation when anchored
Anchors

Image

Anchored to a real-world image

Prioritize placing content

Physical manipulation when anchored

Respects authored physical size
Anchors
Image

Anchored to a real-world image
Prioritize placing content
Physical manipulation when anchored
Respects authored physical size
Anchors

Image

Anchored to a real-world image
Prioritize placing content
Physical manipulation when anchored
Respects authored physical size
Behaviors

Brings life to your content
Behaviors

Brings life to your content

Comprised of a trigger and action(s)
Behaviors

Brings life to your content

Comprised of a trigger and action(s)

Defined in behaviors panel in Reality Composer
## Behaviors

### Triggers and Actions

<table>
<thead>
<tr>
<th>Triggers</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap</td>
<td>Emphasize</td>
</tr>
<tr>
<td>Scene start</td>
<td>Show/hide</td>
</tr>
<tr>
<td>Proximity to camera</td>
<td>Move, rotate, scale</td>
</tr>
<tr>
<td>Collide</td>
<td>Add force</td>
</tr>
<tr>
<td></td>
<td>Orbit</td>
</tr>
<tr>
<td></td>
<td>Spin</td>
</tr>
<tr>
<td></td>
<td>Change scene</td>
</tr>
<tr>
<td></td>
<td>Look at camera</td>
</tr>
<tr>
<td></td>
<td>Audio</td>
</tr>
<tr>
<td></td>
<td>Animation</td>
</tr>
</tbody>
</table>

Building AR Experiences with Reality Composer

WWDC 2019
Support for multiple scenes

Anchors
- Horizontal
- Vertical
- Face
- Image

Behaviors

Audio
Demo
Visual Improvements to AR Quick Look
Visual Improvements

- Real-time dynamic shadows
- Camera noise
- HDR with tone mapping
- People Occlusion
- Depth of field
- Motion blur
Real-Time Shadows
Projective

Brings animation to life
Real-Time Shadows
Projective

Brings animation to life
Real-Time Shadows
Projective

Brings animation to life

Uses projective shadows by default
Real-Time Shadows
Ray-traced

Brings animation to life

Uses projective shadows by default

Ray-traced shadows available on A12 and later
Real-Time Shadows
Ray-traced

Brings animation to life
Uses projective shadows by default
Ray-traced shadows available on A12 and later
Real-Time Shadows

Ray-traced

Brings animation to life

Uses projective shadows by default

Ray-traced shadows available on A12 and later

Softer shadows and fine contact points
Real-Time Shadows

Ray-traced

- Brings animation to life
- Uses projective shadows by default
- Ray-traced shadows available on A12 and later
- Softer shadows and fine contact points
- Don’t bake shadow as part of model
Camera Noise

Camera noise inherent to digital camera systems
Camera Noise

Camera noise inherent to digital camera systems
Camera Noise

Camera noise inherent to digital camera systems

Adds grain to visual content to match camera noise
**Camera Noise**

Camera noise inherent to digital camera systems

Adds grain to visual content to match camera noise

Applies grain texture provided by ARKit
Camera Noise

Camera noise inherent to digital camera systems

Adds grain to visual content to match camera noise

Applies grain texture provided by ARKit

Available on all ARKit supported devices
HDR with Tone Mapping

Environment affects brightness of scene
HDR with Tone Mapping

Environment affects brightness of scene
Alleviates colors looking “blown out”
HDR with Tone Mapping

Environment affects brightness of scene
Alleviates colors looking “blown out”
HDR with Tone Mapping

Environment affects brightness of scene
Alleviates colors looking “blown out”
HDR uses 16 bits of precision
HDR with Tone Mapping

Environment affects brightness of scene
Alleviates colors looking “blown out”
HDR uses 16 bits of precision
Applies tone mapping curve
HDR with Tone Mapping

Environment affects brightness of scene
Alleviates colors looking “blown out”
HDR uses 16 bits of precision
Applies tone mapping curve
Available on A10X and later
People Occlusion

Previously virtual content was rendered in front of people
People Occlusion

Previously virtual content was rendered in front of people

Maintains the illusion of people in front of virtual content
People Occlusion

Previously virtual content was rendered in front of people

Maintains the illusion of people in front of virtual content

Uses segmentation data provided by ARKit

Introducing ARKit 3
People Occlusion

Previously virtual content was rendered in front of people

Maintains the illusion of people in front of virtual content

Uses segmentation data provided by ARKit

Available on A12 and later
Depth of Field

Camera focuses on a certain distance at any given time
Depth of Field

Camera focuses on a certain distance at any given time
Depth of Field

Camera focuses on a certain distance at any given time

Rendered with object’s distance taken into account
Depth of Field

Camera focuses on a certain distance at any given time

Rendered with object’s distance taken into account

Matches blur of content to focal distance of camera
Depth of Field

Camera focuses on a certain distance at any given time

Rendered with object’s distance taken into account

Matches blur of content to focal distance of camera

Available on A12X devices
Motion Blur

Simulates effects caused by rapid movement
Motion Blur

Simulates effects caused by rapid movement
Motion Blur

Simulates effects caused by rapid movement

Applies artificial blur
Motion Blur

Simulates effects caused by rapid movement

Applies artificial blur

Depends on device motion and exposure
Motion Blur

Simulates effects caused by rapid movement

Applies artificial blur

Depends on device motion and exposure

Available on A12X devices
### Automatic Rendering Quality Selection

<table>
<thead>
<tr>
<th>Feature</th>
<th>Supported Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected shadows</td>
<td>All ARKit devices</td>
</tr>
<tr>
<td>Ray-traced shadows</td>
<td>A12 and later</td>
</tr>
<tr>
<td>Camera grain</td>
<td>All ARKit devices</td>
</tr>
<tr>
<td>HDR with tone mapping</td>
<td>A10X and later</td>
</tr>
<tr>
<td>People Occlusion</td>
<td>A12 and later</td>
</tr>
<tr>
<td>Motion blur</td>
<td>A12X</td>
</tr>
<tr>
<td>Depth of field</td>
<td>A12X</td>
</tr>
</tbody>
</table>
Enhancements to the Viewing Experience
Launch Straight to AR

Place virtual content in world as fast possible
Launch Straight to AR

Place virtual content in world as fast possible

Improvements to scene understanding
Launch Straight to AR

Place virtual content in world as fast possible

Improvements to scene understanding

Uses machine learning for plane detection
Launch Straight to AR

Place virtual content in world as fast possible

Improvements to scene understanding

Uses machine learning for plane detection

Securely runs in separate sandboxed process
Launch Straight to AR
Launch Straight to AR
Multiple Models with Nested usdz

Contains metadata and library of usdz files
Multiple Models with Nested usdz

Contains metadata and library of usdz files

Useful for collections of related objects
Multiple Models with Nested usdz

Contains metadata and library of usdz files

Useful for collections of related objects

Lined up in ascending height order
Multiple Models with Nested usdz

Contains metadata and library of usdz files

Useful for collections of related objects

Lined up in ascending height order

Moved independently in the world
Animation Playback

Users can control animation playback
Animation Playback

Users can control animation playback

Include fine scrubbing through animations
Animation Playback

Users can control animation playback
Include fine scrubbing through animations
Rewatch from different angles
Animation Playback

Users can control animation playback

Include fine scrubbing through animations

Rewatch from different angles

Animation duration $\geq$ 10 seconds
Animation Playback

Users can control animation playback

Include fine scrubbing through animations

Rewatch from different angles

Animation duration $\geq 10$ seconds

One Scene Start trigger with Animation Action

Optional Sound Action
Animation Playback
Animation Playback
Levitation Gesture

Two-finger swipe up gesture on object
Levitation Gesture

Two-finger swipe up gesture on object
Video Recording

Record interactions with the world
Video Recording

Record interactions with the world

Videos saved to photos library
macOS Quick Look Viewer

Supports previewing usdz and Reality File
macOS Quick Look Viewer

Supports previewing usdz and Reality File

Supports thumbnail generation
macOS Quick Look Viewer

Supports previewing usdz and Reality File

Supports thumbnail generation

Built on RealityKit
macOS Quick Look Viewer

Supports previewing usdz and Reality File

Supports thumbnail generation

Built on RealityKit

Consistent experience between iOS and macOS
macOS Quick Look Viewer
Web Integration and Customization
AR Quick Look Integration on the Web

Support for viewing 3D models in Safari
AR Quick Look Integration on the Web

Support for viewing 3D models in Safari

HTML markup to launch AR Quick Look
AR Quick Look Integration on the Web

Support for viewing 3D models in Safari

HTML markup to launch AR Quick Look

Specify MIME type to serve AR content
AR Quick Look Integration on the Web

Support for viewing 3D models in Safari

HTML markup to launch AR Quick Look

Specify MIME type to serve AR content

Thumbnail image with AR badge visible on webpage
AR Quick Look Integration on the Web

Support for viewing 3D models in Safari

HTML markup to launch AR Quick Look

Specify MIME type to serve AR content

Thumbnail image with AR badge visible on webpage

Seamless experience
Previewing usdz and Reality File

HTML markup
Previewing usdz and Reality File

HTML markup

```html
<a rel="ar" href="model.usdz">
  <img src="model-preview.jpg">
</a>
```
Previewing usdz and Reality File

HTML markup

```html
<a rel="ar" href="model.usdz">
  <img src="model-preview.jpg">
</a>
```
Previewing usdz and Reality File

HTML markup

```html
<a rel="ar" href="model.usdz">
  <img src="model-preview.jpg">
</a>
```
Previewing usdz and Reality Files

MIME type
Previewing usdz and Reality Files

MIME type

AddType model/vnd.usdz+zip .usdz
Previewing usdz and Reality Files

MIME type

AddType model/vnd.usdz+zip .usdz

AddType model/vnd.reality .reality
Loading Content Indirectly

Data URI
Loading Content Indirectly

Data URI

```html
<a rel="ar" href="data:model/vnd.usdz+zip;base64,<base64 encoded string>"
    download="asset.usdz">
    <img src="asset-thumbnail.jpg"/>
</a>
```

Data URIs
usdz
Loading Content Indirectly

Data URI

```html
<a rel="ar" href="data:model/vnd.usdz+zip;base64,<base64 encoded string>"
    download="asset.usdz">
    <img src="asset-thumbnail.jpg">
</a>
```
Loading Content Indirectly

Data URI

```html
<a rel="ar" href="data:model/vnd.usdz+zip;base64,<base64 encoded string>"
    download="asset.usdz">
    <img src="asset-thumbnail.jpg">
</a>

<a rel="ar" href="data:model/vnd.reality;base64,<base64 encoded string>"
    download="asset.usdz">
    <img src="asset-thumbnail.jpg">
</a>
```
Loading Content Indirectly

Data URI

```html
<a rel="ar" href="data:model/vnd.usdz+zip;base64,<base64 encoded string>" download="asset.usdz">
    <img src="asset-thumbnail.jpg">
</a>

<a rel="ar" href="data:model/vnd.reality;base64,<base64 encoded string>" download="asset.usdz">
    <img src="asset-thumbnail.jpg">
</a>
```
Loading Content Indirectly
Blob URL
Loading Content Indirectly

Blob URL

```
<a rel="ar" href="blob:<generated URL string>" download="asset.usdz">
  <img src="asset-thumbnail.jpg">
</a>
```
Loading Content Indirectly

Blob URL

```html
<a rel="ar" href="blob:<generated URL string>" download="asset.usdz">
  <img src="asset-thumbnail.jpg"
</a>
```
Customizing the AR Quick Look Experience

Disable content scaling
Customizing the AR Quick Look Experience

Disable content scaling

Sharing canonical webpage URL instead of 3D model
Disable Content Scaling

Preview content at intended size
Disable Content Scaling

Preview content at intended size
Disable Content Scaling

Preview content at intended size

Great for viewing real world products such as furniture
Disable Content Scaling

Preview content at intended size

Great for viewing real world products such as furniture
Disable Content Scaling

Preview content at intended size

Great for viewing real world products such as furniture
Customization Web API

Fragment identifier

https://developer.apple.com/arkit/gallery/toy_biplane.usdz#allowsContentScaling=0
Customization Web API
Fragment identifier

https://developer.apple.com/arkit/gallery/toy_biplane.usdz#allowsContentScaling=0
Customization Web API
Fragment identifier

https://developer.apple.com/arkit/gallery/toy_biplane.usdz#allowsContentScaling=0
Customization Web API

Fragment identifier

https://developer.apple.com/arkit/gallery/toy_biplane.usdz#allowsContentScaling=0
Sharing Product Link

Learn more about origin of usdz
Sharing Product Link

Learn more about origin of usdz

Great for linking back to product description pages
Sharing Product Link

Learn more about origin of usdz

Great for linking back to product description pages

Allows for up-to-date description of usdz content
Sharing Product Link

Learn more about origin of usdz

Great for linking back to product description pages

Allows for up-to-date description of usdz content

Safari automatically provides the canonical webpage URL
AR Quick Look Integration in iOS Applications

Easy to integrate to view AR content
AR Quick Look Integration in iOS Applications

Easy to integrate to view AR content

Brings consistent and familiar previewing experience
AR Quick Look Integration in iOS Applications

Easy to integrate to view AR content

Brings consistent and familiar previewing experience

Can be inline or full-screen presentation
AR Quick Look Integration in iOS Applications

- Easy to integrate to view AR content
- Brings consistent and familiar previewing experience
- Can be inline or full-screen presentation
- Uses Quick Look framework
// MARK: - QLPreviewControllerDataSource
func previewController(
    _ controller: QLPreviewController, previewItemAt index: Int) -> QLPreviewItem {
    // Return the file URL to the .usdz file
    let fileUrl = Bundle.main.url(forResource: "toy_robot_vintage", withExtension: "usdz")!
    let previewItem = ARQuickLookPreviewItem(fileAt: fileURL)
    previewItem.allowsContentScaling = false
    return previewItem
}
Customization iOS API
ARQuickLookPreviewItem

```swift
// MARK: - QLPreviewControllerDataSource
func previewController(_ controller: QLPreviewController, previewItemAt index: Int) -> QLPreviewItem {
    // Return the file URL to the .usdz file
    let fileUrl = Bundle.main.url(forResource: "toy_robot_vintage", withExtension: "usdz")!
    let previewItem = ARQuickLookPreviewItem(fileAt: fileURL)
    previewItem.allowsContentScaling = false
    return previewItem
}
```
Customization iOS API
ARQuickLookPreviewItem

```swift
// MARK: - QLPreviewControllerDataSource
func previewController(_ controller: QLPreviewController, previewItemAt index: Int) -> QLPreviewItem {
    // Return the file URL to the .usdz file
    let fileUrl = Bundle.main.url(forResource: "toy_robot_vintage", withExtension: "usdz")!
    let previewItem = ARQuickLookPreviewItem(fileAt: fileUrl)
    previewItem.allowsContentScaling = false
    return previewItem
}
```
// MARK: - QLPreviewControllerDataSource
func previewController(
    _ controller: QLPreviewController, previewItemAt index: Int) -> QLPreviewItem {
    // Return the file URL to the .usdz file
    let fileUrl = Bundle.main.url(forResource: "toy_robot_vintage", withExtension: "usdz")!
    let previewItem = ARQuickLookPreviewItem(fileAt: fileUrl)
    previewItem.allowsContentScaling = false
    return previewItem
}
Article

Previewing a Model with AR Quick Look

Display a single USDZ file that the user can move, scale, and share with others.

Overview

AR Quick Look enables the user to place virtual content that you provide on any surface that ARKit finds in the real-world environment. Users can interact with your virtual content by moving and scaling it using touch gestures, or by sharing it with others through the iOS share sheet.
Article

Previewing a Model with AR Quick Look

Display a single USDZ file that the user can move, scale, and share with others.

Overview

ARKit finds in the real-world environment. Users can interact with your virtual content by moving and scaling it using touch gestures, or by sharing it with others through the iOS share sheet.
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Decorating Experience
Customizable Call to Action in AR Quick Look
Customizable Call to Action in AR Quick Look
Including support for Apple Pay

Various Apple Pay button styles
Link for call to action
Customizable text for product information
Reference to canonical website domain name
Available this fall
WARBY PARKER
AR Quick Look

On iOS, built-in apps such as Safari, Messages, Mail, News, and Notes can natively Quick Look .usdz files of virtual objects in 3D or AR. You can embed Quick Look views in your apps and websites to let users see incredible detailed renderings, including reflections of real world surroundings in shiny virtual objects.

3D Models

Tap any of the 3D models below on a device running iOS 12 or later to view the object and place it in AR. Or click a model on Mac to download the .usdz file.
AR Quick Look

On iOS, built-in apps such as Safari, Messages, Mail, News, and Notes can natively Quick Look USDZ files of virtual objects in 3D or AR. You can embed Quick Look views in your apps and websites to let users see incredible detailed renderings, including reflections of real-world surroundings in shiny virtual objects.

developer.apple.com/arkit/gallery

3D Models

Tap any of the 3D models below on a device running iOS 12 or later to view the object and place it in AR. Or click a model on Mac to download the USDZ file.
Augmented Reality

Bethesda Gear
Nomatic
FURNI

usdz Tools
Download essential Python-based tools for generating, validating, and inspecting usdz files. Also includes a converter that creates usdz from other 3D file formats along with Pixar’s USD library and sample scripts.

Download usdz tools
Summary

Preview Reality Files in AR Quick Look

Supports more anchors

Triggers and actions

New visual effects

Animation scrubber

Customization API

Apple Pay support
More Information

developer.apple.com/wwdc19/612

AR Quick Look and Reality Composer Lab  Friday, 11:00