

## Interação e Experiência de Utilizador (IEU)

A-FRAME - A web framework for building  
3D/AR/VR experiences  
Usability in VR and AR

<https://aframe.io>  
<https://aframe.io/blog/arjs/>  
<https://hiukim.github.io/mind-ar-js-doc>

15/2016

## Today Session

- A-Frame – 3D / AR / VR experiences
  - Examples
  - Getting Started
    - A-Frame\_Exercise 1
  - GUI Framework
    - A-Frame\_Exercise 2
- Usability in VR
- A-Frame AR
  - AR.js
    - A-Frame\_Exercise 3
- A-Frame | MindAR
  - A-Frame\_Exercises 4 to 9
- Usability of AR
- 10 Guidelines for AR Calibration
- Some References

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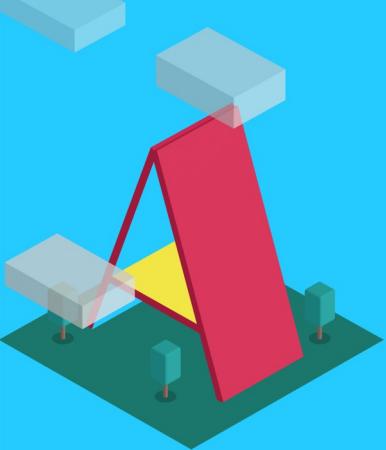
## A-Frame

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# A-Frame – 3D / AR / VR experiences

**A-FRAME**

- [Blog](#)
- [A-Frame 1.4.0 - Custom ele...](#)
- [Examples](#)
- [Hello WebVR](#)
- [Model Viewer](#)
- [Hand Tracking](#)
- [Responsive UI](#)
- [360° Image](#)
- [360 Video](#)
- [Anime UI](#)
- [BeatSaver Viewer](#)
- [Moon Rider](#)
- [Gunters of OASIS](#)
- [Supercraft](#)
- [Super Says](#)
- [Towermax Fitness](#)
- [A-Blast](#)
- [A-Painter](#)
- [A Saturday Night](#)



[DOCS](#) [FAQ](#) [BLOG](#) [COMMUNITY](#) [SHOWCASE](#)

A web framework for building  
3D/AR/VR experiences

Make 3D worlds with HTML and Entity-Component  
On any headset, mobile and desktop

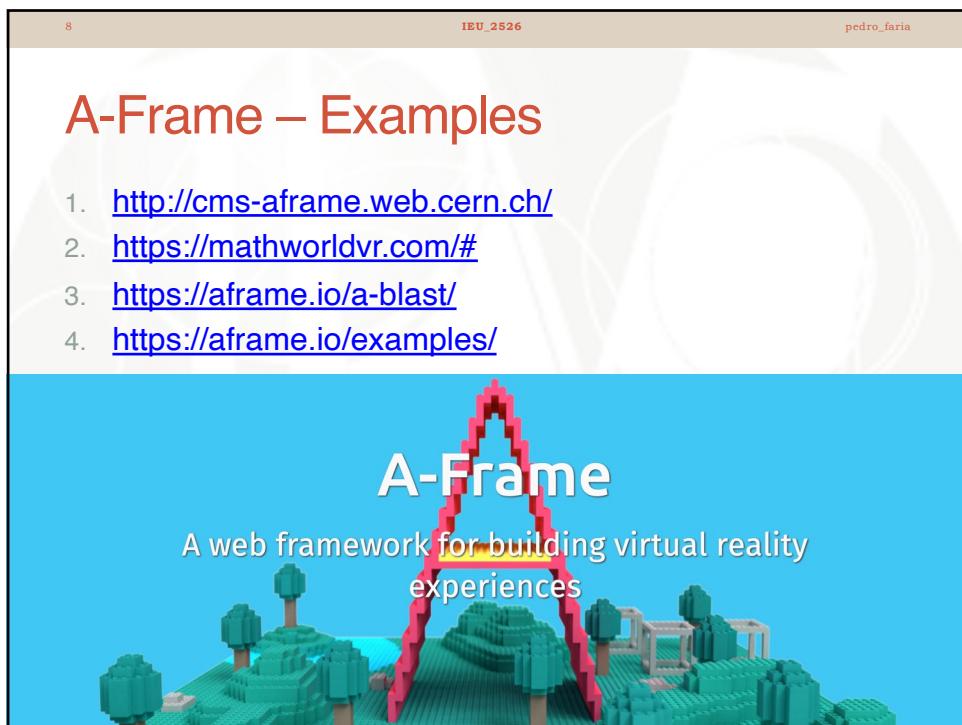
[GET STARTED](#)

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# A-Frame

- **Virtual Reality (VR)**
  - Is a computer-generated environment with scenes and objects that appear to be real, making the user feel they are immersed in their surroundings.
- **Augmented Reality (AR)**
  - Is the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects.
  - It is this *real-world* element that differentiates AR from Virtual Reality.



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## A-Frame – Getting Started

- <https://aframe.io/docs/1.7.0/introduction/>

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## A-Frame – Getting Started

- <https://aframe.io/docs/1.7.0/introduction/>

```

1 <!DOCTYPE html>
2 <html>
3   <head>
4     <script src="https://aframe.io/releases/1.5.0/aframe.min.js"></script>
5   </head>
6   <body>
7     <a-scene>
8       <a-box position="-1 0.5 -3" rotation="0 45 0" color="#4CC3D9"></a-box>
9       <a-sphere position="0 1.25 -5" radius="1.25" color="#EF2D5E"></a-sphere>
10      <a-cylinder position="1 0.75 -3" radius="0.5" height="1.5" colors="#FFC65D"></a-cylinder>
11      <a-plane position="0 0 -4" rotation="90 0 0" width="4" height="4" color="#7BC8A4"></a-plane>
12      <a-sky color="#ECECEC"></a-sky>
13    </a-scene>
14  </body>
15 </html>

```

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# A-Frame School

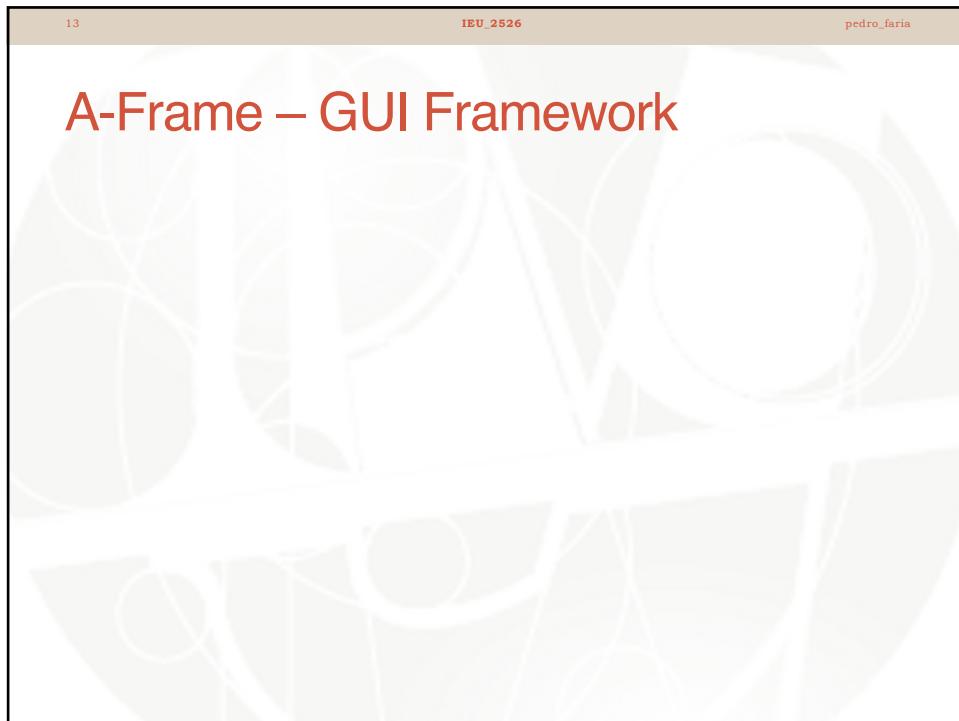
- **A-Frame\_Exercise 1**
  - Implement the **Interactive Course for the WebVR**
  - <https://aframe.io/aframe-school/#/>

A screenshot of a VR environment titled "A-Frame School". The scene features a large red staircase-like structure made of blocks, set against a blue sky and green trees. A yellow banner across the middle of the stairs reads "A-Frame School" and "An interactive course for WebVR". The "aframe.io" logo is visible at the bottom of the stairs.

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# A-Frame

A screenshot of a VR environment titled "A-Frame". The background is a light gray with a faint, stylized floral or leaf pattern. The "A-Frame" title is displayed prominently in red at the top left.

A presentation slide titled "A-Frame – GUI Framework". The title is centered at the top in a large, bold, red font. Below the title, there is a list of two URLs:

- <https://github.com/rdub80/aframe-gui>
- <https://rdub80.github.io/aframe-gui/examples/index.html>

The main content area shows a screenshot of the "aframe-gui" application interface. It displays various UI components like buttons, labels, and sliders. On the right side, there is a configuration panel with numerous color and style settings, such as "value", "label", "radioColor", "textColor", "errorColor", "borderColor", "focusColor", "backgroundImage", "fontSize", "togggle", "fontFamily", and "fontStyle". A note at the bottom left says "A graphical User Interface framework for A-Frame.".

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## A-Frame – GUI Framework

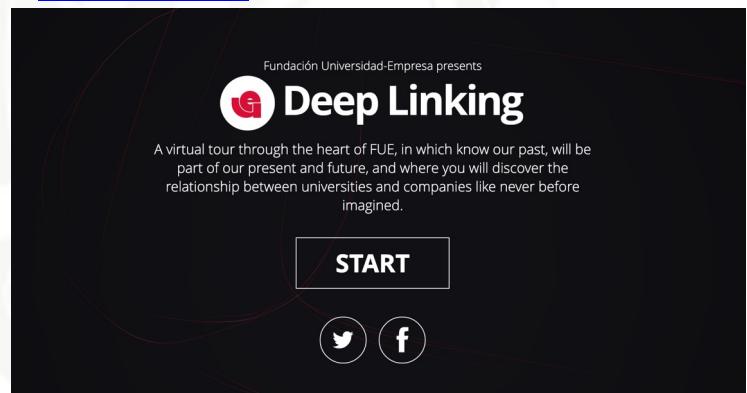
- **A-Frame\_Exercise 2**
  - Implement a UI in A-Frame using the **GUI Framework**
  - <https://glitch.com/~aframe-building-ui>

A screenshot of a 3D environment created with A-Frame. In the center, there is a dark rectangular menu overlay titled "Super Menu". The menu contains three buttons: "Set Environment", "Randomize", and "Weather". The background shows a green landscape with stylized trees under a clear sky.

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## Example of a Virtual Tour

- <https://gaia2015.com/vr/>
  - <https://unboring.net/cases/deeplinking>
  - <https://unboring.net/cases/inspirit>
  - <https://unboring.net/>

A screenshot of a virtual tour application. At the top, it says "Fundación Universidad-Empresa presents". Below that is a logo with a red 'G' inside a white circle and the text "Deep Linking". A descriptive paragraph reads: "A virtual tour through the heart of FUE, in which know our past, will be part of our present and future, and where you will discover the relationship between universities and companies like never before imagined." At the bottom, there is a large "START" button, a Twitter icon, and a Facebook icon.

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The screenshot shows a web page with a light gray background and a faint circular logo watermark. The main title 'Usability in VR' is at the top in red. Below it is a blue link: <https://www.nngroup.com/articles/usability-heuristics-virtual-reality/>. The main heading '10 Usability Heuristics Applied to Virtual Reality' is in bold black text. A summary text follows, and at the bottom left, it says 'By Alita Joyce on July 11, 2021' and 'Topics: Heuristic Evaluation'. On the right, there is a 'Share this article:' button with icons for Twitter, LinkedIn, and email.

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## Usability in VR

<https://www.nngroup.com/articles/usability-heuristics-virtual-reality/>

### 10 Usability Heuristics Applied to Virtual Reality

- 1. Visibility of system status
- 2. Match between system and the real world
- 3. User control and freedom
- 4. Consistency and standards
- 5. Error prevention
- 6. Recognition rather than recall
- 7. Flexibility and efficiency of use
- 8. Aesthetic and minimalist design
- 9. Help users recognize, diagnose, and recover from errors
- 10. Help and documentation

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## 1. Visibility of System Status

- **Oculus**
  - The universal menu in Oculus communicated battery status for the headset and two controllers.

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## 2. Match between system and the real world

- **Immersed**
  - Used real-world equivalents, like conference rooms, whiteboards, and locks, to meet users' expectations and existing mental models.
  - Many people have little to no experience with virtual reality and thus rely on past (physical and digital) experiences to drive their behaviors and expectations in the virtual world. Building on existing mental models helps users (correctly) predict interactions in a VR system.



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## Usability in VR

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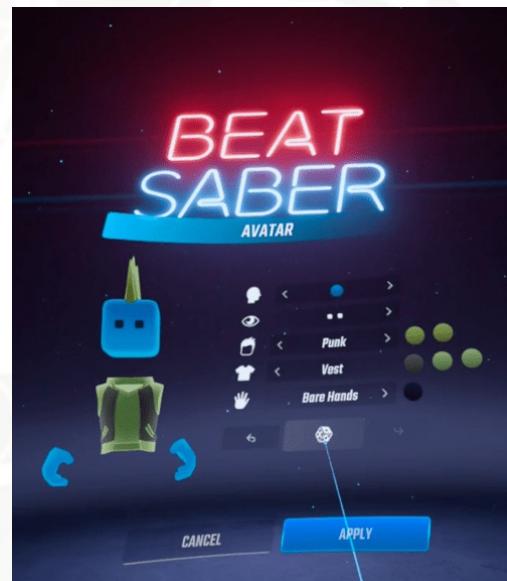
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### 3. User control and freedom

- **Beat Saber**

- Offered a *Cancel* button to users on the avatar-customization page.
- If multiple customizations were made within one session, users could select the *Back* button to revert to the previous avatar.



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## 4. Consistency and standards

- **Gravity Sketch**
- Did not comply with the conventional design standard for an on–off switch (it used a slider)
  - Though it used the same slider design for on–off switches throughout the app
- Users should **not have to wonder** whether different words, situations, or actions mean the same thing.

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## 5. Error prevention

- **National Geographic VR**
  - Showed a **confirmation message** to protect users from **accidentally** leaving the activity and losing progress.
  - It would be even better if, in addition, the progress was **automatically** saved.



The screenshot shows a dark-themed confirmation dialog box. At the top, it asks "ARE YOU SURE?". Below that, a message reads "You will lose all current activity progress!". At the bottom, there are two buttons: "No" on the left and "Yes" on the right, with "Yes" highlighted in yellow.

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## Usability in VR

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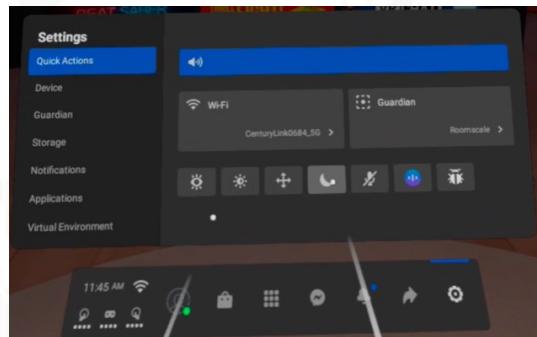
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## 6. Recognition rather than recall

- **Oculus**

- Use of **unlabeled icons** with tooltips **weighed on users' short-term memory**.
  - This design forces users to memorize the meaning of the icons
- **Minimize the user's memory load** by making elements, actions, and options visible.



## 6. Recognition rather than recall

- **In contrast**

- National Geographic Explore VR
  - **Promotes recognition over recall** when users engage in activities like taking photos.
  - **Remind users** what controller buttons to use to take a picture with the camera.



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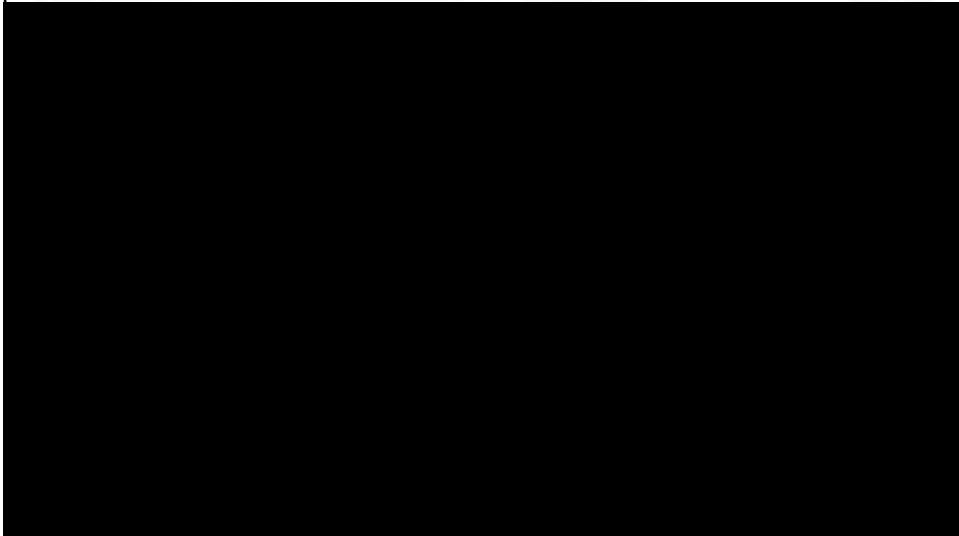
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## 7. Flexibility and efficiency of use

- **Firefox Reality**
  - A browser designed for virtual reality, **allowed users to tailor** their browser window size to fit their preferences.
  - Virtual environments, like traditional interfaces, **must satisfy** novice and experienced users.
  - Allow users to tailor frequent actions
    - e.g. **Shortcuts** (hidden from novice users) may speed up the interaction for the expert user

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## 7. Flexibility and efficiency of use



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## 8. Aesthetic and minimalist design

- Pokerstars VR**
- Has a cluttered and overly complex in-game menu that overlapped with an already busy game background.
- During gameplay, when users open the menu to select game-relevant actions (like placing a bet or viewing settings) they are met with a cluttered, difficult-to-scan interface.
- Virtual interfaces can offer a great deal of complexity, which makes it even more important to prioritize the essentials.

The image contains two screenshots from the Pokerstars VR game. The top screenshot shows a poker table with a dealer and other players. A large, overlapping menu is displayed in the center, obscuring part of the table and cards. The bottom screenshot shows a similar scene with a different menu overlay, also appearing cluttered and overlapping the game area.

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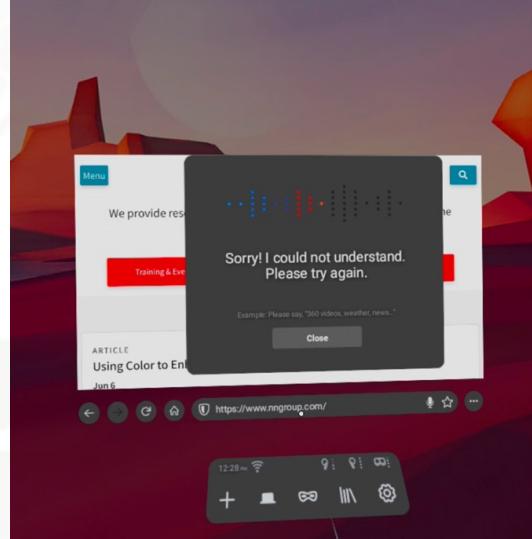
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## 9. Help users recognize, diagnose, and recover from errors

- **Firefox Reality**
  - Fails to provide constructive error messages when users have trouble using voice commands.
  - Error messages should be expressed **in plain language** (no error codes), precisely **indicate the problem**, and constructively **suggest a solution**.



The screenshot shows a Firefox Reality interface. A dark gray modal window is centered, displaying the text "Sorry! I could not understand. Please try again." Below it, a smaller text says "Example: Please say, '360 video, weather, news.'" At the bottom right of the modal is a "Close" button. In the background, there's a blurred view of a news article titled "Using Color to Encourage" with a date of June 6. The top of the screen shows the Firefox Reality interface with various icons and a search bar.

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# Usability in VR

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## 10. Help and documentation

- **Immersed**
  - The help pages were **easy to access, organized, and scannable**.
  - It's best if the system **doesn't need** any additional explanation.
    - However, it may be necessary to **provide documentation** to help users understand how to complete their tasks.
    - Virtual-reality experiences often contain a **high volume of interactions**, some of which are complicated or unfamiliar to users.



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## 10 Usability Heuristics Applied to Virtual Reality

**Summary:** Jakob Nielsen's 10 usability heuristics can improve the user experience of VR applications.

By Alita Joyce on July 11, 2021  
Topics: Heuristic Evaluation

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# Usability in VR

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## 10 Usability Heuristics Applied to Virtual Reality

**Summary:** Jakob Nielsen's 10 usability heuristics can improve the user experience of VR applications.

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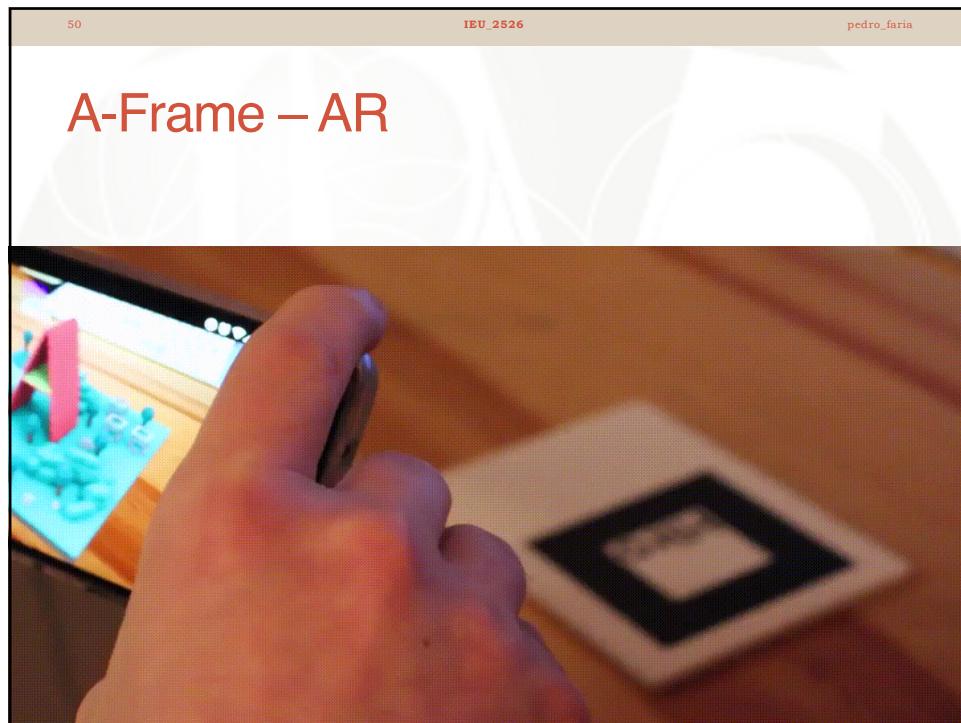
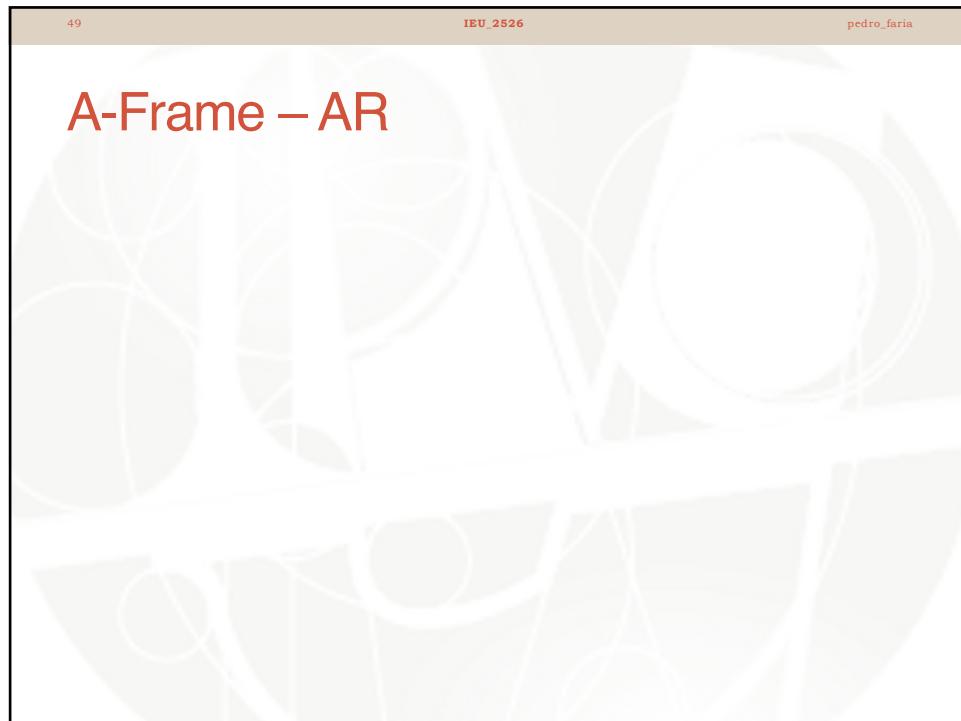
Despite being a different type of interface,  
standard usability heuristics still apply!

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## A-Frame – AR.js

- <https://aframe.io/blog/arjs/>

Creating Augmented Reality with AR.js and A-Frame

Jul 11, 2017 | By Jerome Etienne



**Efficient Augmented Reality For the Web**

Don't Worry It's Less Than 10 Lines of HTML

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## A-Frame – AR.js

- <https://aframe.io/blog/arjs/>

Creating Augmented Reality with AR.js and A-Frame

 AR.js - Augmented Reality in 10 lines of html  
Jerome Etienne + Follow

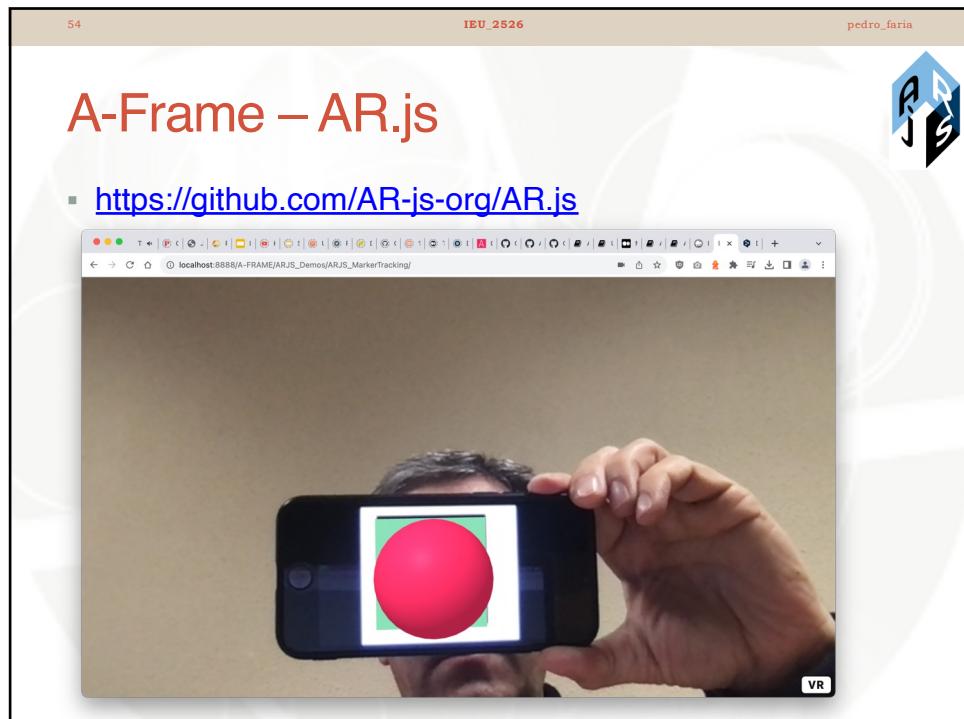
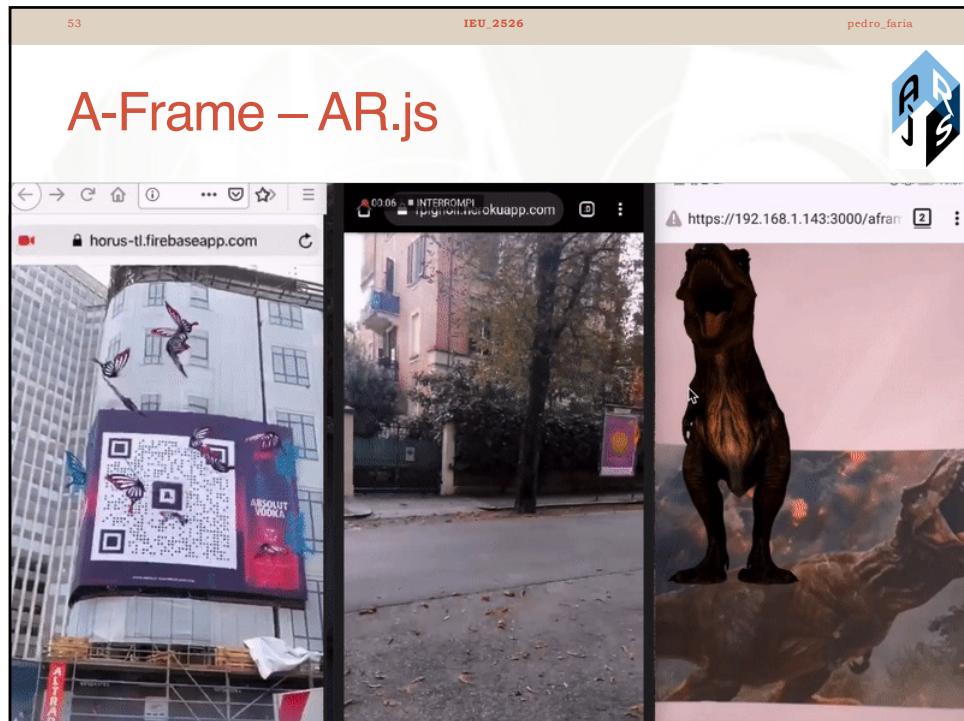
 HTML

```

1 <!-- AR.js by @jerome_etienne -->
2   github: https://github.com/jeromeetienne/ar.js
3   info: https://medium.com/arjs/augmented-reality-in-10-lines-of-html-4e193ea9fdbf -->
4   <script src="https://aframe.io/releases/0.8.0/aframe.min.js"></script>
5   <script src="https://cdn.rawgit.com/jeromeetienne/AR.js/1.6.0/aframe/build/aframe-ar.js"></script>
6   <body style='margin : 0px; overflow: hidden;'>
7     <a-scene embedded arjs='sourceType: webcam;'>
8       <a-box position='0 0.5 0' material='opacity: 0.5;'></a-box>
9       <a-marker-camera preset='hiro'></a-marker-camera>
</a-scene>
</body>

```

Don't Worry It's Less Than 10 Lines of HTML



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## A-Frame – AR.js



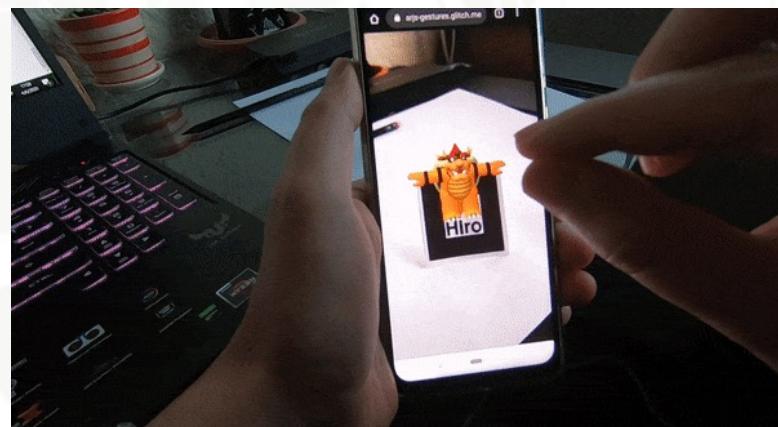
- **A-Frame\_Exercise 3**
  - <https://github.com/AR-js-org/AR.js>
  - <https://ar-js-org.github.io/AR.js-Docs/>
  - Implement the 3 examples:
    - Marker Based
      - <https://ar-js-org.github.io/AR.js-Docs/marker-based/>
      - <https://github.com/AR-js-org/AR.js#-marker-based-example>
    - Image Tracking
      - <https://ar-js-org.github.io/AR.js-Docs/image-tracking/>
      - [https://github.com/AR.js-org/AR.js#-image-tracking](https://github.com/AR-js-org/AR.js#-image-tracking)
    - Location Based
      - <https://ar-js-org.github.io/AR.js-Docs/location-based-aframe/>
      - [https://github.com/AR.js-org/AR.js#location-based-example](https://github.com/AR-js-org/AR.js#location-based-example)

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## A-Frame – AR.js



- UI and Costum Events
- <https://ar-js-org.github.io/AR.js-Docs/ui-events/>

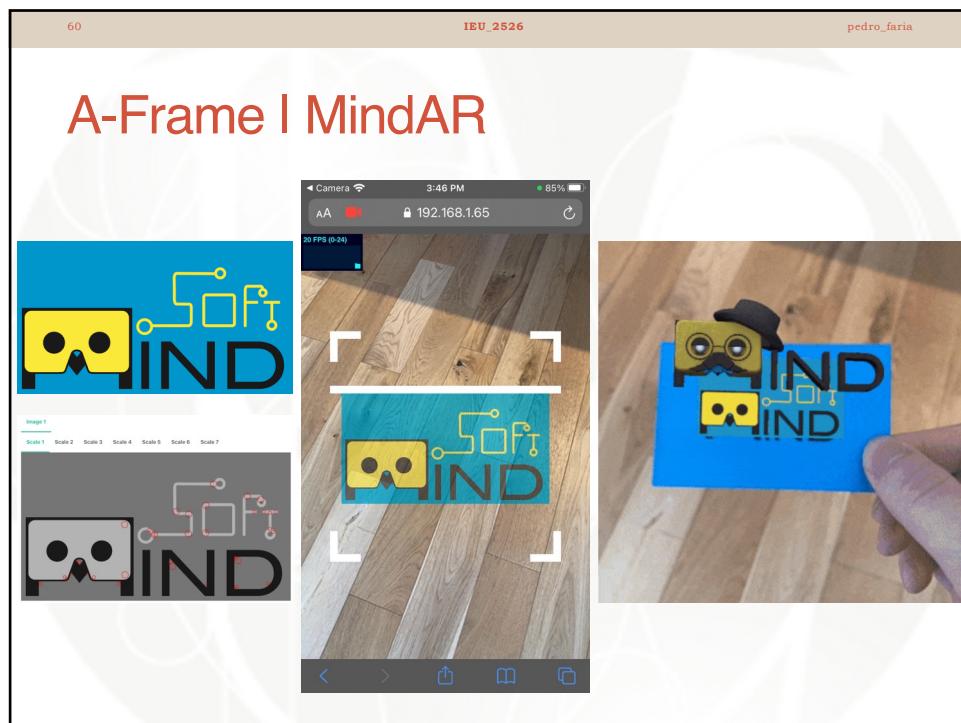
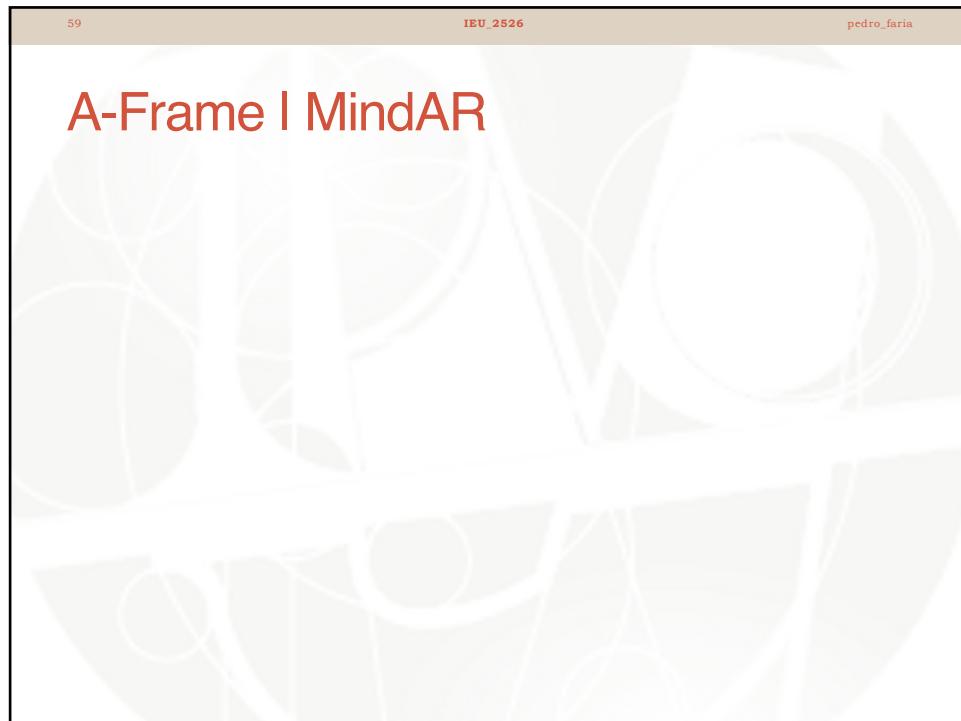


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    - A-Frame\_Exercise 3
  - A-Frame I MindAR
    - A-Frame\_Exercises 4 to 9
- Usability of AR
- 10 Guidelines for AR Calibration
- Some References

## Today Session

- A-Frame – 3D / AR / VR experiences
  - Examples
  - Getting Started
    - A-Frame\_Exercise 1
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## A-Frame | MindAR

- A-Frame
  - A web framework for building 3D/AR/VR experiences
- MindAR
  - Opensource **Web Augmented Reality** Library
  - Started with A-Frame integration
  - Provides native support to **three.js**
  - It supports:
    - Image Tracking and
    - Face Tracking

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## MindAR | Installation

- A MindAR project can be run directly in a plain static HTML file  
<https://hiukim.github.io/mind-ar-is-doc/installation>

### AFRAME installation

#### 1. HTML script

Image Tracking

```
<script src="https://aframe.io/releases/1.5.0/aframe.min.js"></script>
<script src="https://cdn.jsdelivr.net/npm/mindar@1.2.5/dist/mindar-image-aframe.prod.js">
```

Face Tracking

```
<script src="https://aframe.io/releases/1.5.0/aframe.min.js"></script>
<script src="https://cdn.jsdelivr.net/npm/mindar@1.2.5/dist/mindar-face-aframe.prod.js">
```

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## MindAR | Overview

- Quick start guide:
- Build a simple AR webpage
  1. Start the webcam
  2. Detect an image target
  3. Show an augmented object on top

<https://hiukim.github.io/mind-ar-is-doc/quick-start/overview>

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## MindAR | Overview

```

<html>
  <head>
    <meta name="viewport" content="width=device-width, initial-scale=1" />
    <script src="https://aframe.io/releases/1.3.0/aframe.min.js"></script>
    <script src="https://cdn.jsdelivr.net/npm/mind-ar@1.2.0/dist/mindar-image-aframe.prod.js"></script>
  </head>

  <body>
    <a-scene mindar-image="imageTargetSrc: https://cdn.jsdelivr.net/gh/hiukim/mind-ar-js@1.2.0/examples/image-tracking/assets/card-example/card.mind;" color-space="sRGB"
      renderer="colorManagement: true, physicallyCorrectLights" vr-mode-ui="enabled: false"
      device-orientation-permission-ui="enabled: false">
      <a-assets>
        
        <a-asset-item id="avatarModel" src="https://cdn.jsdelivr.net/gh/hiukim/mind-ar-js@1.2.0/examples/image-tracking/assets/card-example/softmind/scene.gltf"></a-asset-item>
      </a-assets>

      <a-camera position="0 0 0" look-controls="enabled: false"></a-camera>
      <a-entity mindar-image-target="targetIndex: 0">
        <a-plane src="#card" position="0 0 0" height="0.552" width="1" rotation="0 0 0"></a-plane>
        <a-gltf-model rotation="0 0 0" position="0 0 0.1" scale="0.005 0.005 0.005"
          src="#avatarModel" animation="property: position; to: 0 0.1 0.1; dur: 1000; easing:
          easeInOutQuad; loop: true; dir: alternate">
        </a-gltf-model>
      </a-entity>
    </a-scene>
  </body>
</html>

```

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## MindAR | Overview

```

<html>
  <head>
    <meta name="viewport" content="width=device-width, initial-scale=1" />
    <script src="https://aframe.io/releases/1.3.0/aframe.min.js"></script>
    <script src="https://cdn.jsdelivr.net/npm/mind-ar@1.2.0/dist/mindar-image-aframe.prod.js"></script>
  </head>

  <body>
    <a-scene mindar-image="imageTargetSrc: https://cdn.jsdelivr.net/gh/hiukim/mind-ar-js@1.2.0/examples/image-tracking/assets/card-example/card.mind;" color-space="sRGB"
      renderer="colorManagement: true, physicallyCorrectLights" vr-mode-ui="enabled: false"
      device-orientation-permission-ui="enabled: false">
      <a-assets>
        
        <a-asset-item id="avatarModel" src="https://cdn.jsdelivr.net/gh/hiukim/mind-ar-js@1.2.0/examples/image-tracking/assets/card-example/softmind/scene.gltf"></a-asset-item>
      </a-assets>

      <a-camera position="0 0 0" look-controls="enabled: false"></a-camera>
      <a-entity mindar-image-targets="targetIndex: 0">
        <a-plane src="#card" position="0 0 0" height="0.552" width="1" rotation="0 0 0"></a-plane>
        <a-gltf-model rotation="0 0 0" position="0 0 0.1" scale="0.005 0.005 0.005"
          src="#avatarModel" animation="property: position; to: 0 0.1 0.1; dur: 1000; easing:
          easeInOutQuad; loop: true; dir: alternate">
        </a-gltf-model>
      </a-entity>
    </a-scene>
  </body>
</html>

```

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## MindAR | Compile Target Images

- Before working with MindAR it is necessary:
  - to preprocess (a.k.a. compile) the images (markers) to be detected
  - the scan of the images will extract interesting locations (a.k.a. feature points)
    - so we can detect and track the images later.

<https://hiukim.github.io/mind-ar-js-doc/quick-start/compile>

<https://hiukim.github.io/mind-ar-js-doc/tools/compile> (tool to do that)

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## MindAR | Compile Target Images

- Step 1 – Select the images

The screenshot shows a user interface for "Image Targets Compiler". At the top, there is a large image of the FC Porto crest. Below it is a form with a title "Image Targets Compiler" and a sub-instruction "Select target images and start". A central box contains the text "Drop files here to upload". At the bottom is a green "Start" button.

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## MindAR | Compile Target Images

- Step 2 – Visualize the features detected

The screenshot shows the results of feature detection. It displays two versions of the FC Porto crest: one original and one with red outlines and points indicating detected features. Above the images is a navigation bar with "Image 1" and "Scale 1" through "Scale 7".

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## MindAR | Compile Target Images

- Step 3 – Download a **.mind** file
  - It will be a targets.mind file
  - It stores the feature data in compact format
  - Will be necessary later when building the AR system

The screenshot shows the 'Image Targets Compiler' interface. On the left, there is a form titled 'Select target images and start' with a 'Drop files here to upload' input field and a green 'Start' button. To the right, there are two preview images: the FC Porto crest on a dark blue background and a soccer ball on a black background. Above each preview is a small menu bar with 'Image 1' and 'Scale 1' through 'Scale 7'.

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## MindAR | Minimal Example

- **A-Frame\_Exercise 4**
  1. Implement the minimal example provided  
<https://hiukim.github.io/mind-ar-js-doc/quick-start/webpage>  
<https://hiukim.github.io/mind-ar-js-doc/quick-start/run>
  2. Add 3D Assets  
<https://hiukim.github.io/mind-ar-js-doc/quick-start/assets>
  2. Do some tracking configuration  
<https://hiukim.github.io/mind-ar-js-doc/quick-start/assets>

The screenshot shows a hand holding a smartphone horizontally. The screen of the phone is a solid blue color, representing a blank canvas or a tracked surface for AR content.

## MindAR | Image Tracking Examples

- Implement the exercises below and customize them as you like.
  - **A-Frame\_Exercise 5 – Basic**  
<https://hiukim.github.io/mind-ar-js-doc/examples/basic/>
  - **A-Frame\_Exercise 6 – Multiple Targets**  
<https://hiukim.github.io/mind-ar-js-doc/examples/multi-targets/>
  - **A-Frame\_Exercise 7 – Multi-Tracks**  
<https://hiukim.github.io/mind-ar-js-doc/examples/multi-tracks>
  - **A-Frame\_Exercise 8 – Custom UI**  
<https://hiukim.github.io/mind-ar-js-doc/examples/custom-ui>
  - **A-Frame\_Exercise 9 – Events Handling**  
<https://hiukim.github.io/mind-ar-js-doc/examples/events-handling>

<https://cdn.jsdelivr.net/gh/hiukim/mind-ar-js@1.2.5/>

<https://github.com/KhronosGroup/glTF-Sample-Models/tree/master/sourceModels>

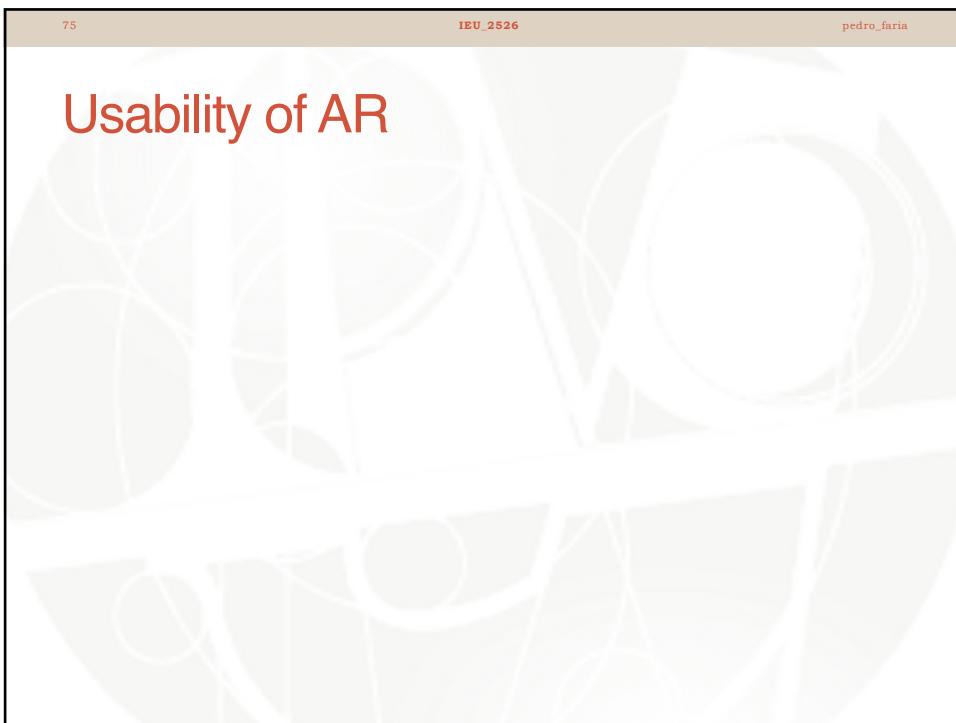


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  - **A-Frame\_Exercises 4 to 9**
- Usability of AR
- 10 Guidelines for AR Calibration
- Some References

## Today Session

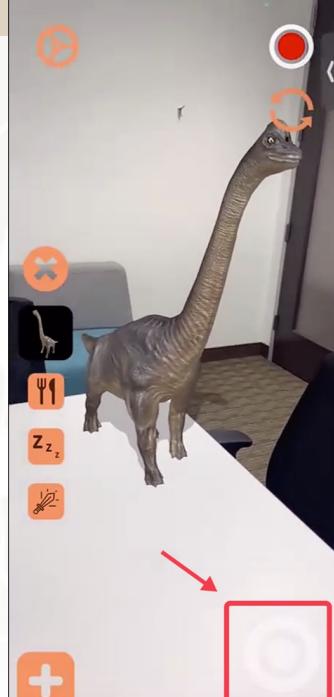
- A-Frame – 3D / AR / VR experiences
  - Examples
  - Getting Started
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A screenshot of a web page from nngroup.com. The page has a light gray background with a faint circular geometric pattern. At the top, there is a thin brown header bar with the number '76' on the left, the text 'IEU\_2526' in the center, and 'pedro\_faria' on the right. The main title 'Usability of AR' is in a large, bold, red font. Below the title, a blue link reads '<https://www.nngroup.com/articles/ar-ux-guidelines/>'. A sub-section title 'The Usability of Augmented Reality' is in bold black text. A summary in bold black text states: 'Summary: AR features in mobile apps are plagued by usability issues such as poor discoverability and findability of items with AR, low-visibility instructions, or vague icons and signifiers.' Below the summary, author information 'By Sana Behnam and Raluca Budiu on November 20, 2022' and topic tags 'Topics: Mobile & Tablet, Design Patterns' are shown. In the bottom right corner of the page, there is a 'Share this article:' button with icons for Twitter, LinkedIn, and Email.

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## Usability of AR

- **Gaming Experience Transfers to AR**
  - Typically, users who had exposure to game UIs found AR patterns easier to figure out, compared to the participants who did not play any games.



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## Usability of AR

- **Best AR Experiences Are Immersive, Interactive, and Educational**



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## Usability of AR

- Best AR Experiences Are Immersive, Interactive, and Educational

Tap the monument to learn more.

**Maya Angelou**

00:01 - 02:55

St. Louis, Missouri  
1928-2014

Born in St. Louis, Missouri in 1928, Maya Angelou was an American author, actress, screenwriter, dancer, poet and civil rights activist who was arguably best known for her groundbreaking memoir, *I Know Why the Caged Bird Sings*. She made literary history by becoming the first Black woman to pen a nonfiction bestseller. Angelou received several honors throughout her career, including Grammy Awards for Best Spoken Word Album and an Academy Award nomination for Best Supporting Actress.

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## Usability of AR

- Best AR Experiences Are Immersive, Interactive, and Educational

Theme HUMAN BODY

**SAMSON FIGURE**

Artefact 10 of 10.

Date 17th century AD  
Discovered: Norwich, England  
Material: Carved oak and polychrome  
Dimensions: H 186 x W 64 x D 46 cm  
Content provided by: Norfolk Museums

Restored oak portal carving of Samson.

This figure of Samson is carved from one piece of oak, and is slightly larger than life size. It's a rare survivor of early seventeenth-century secular sculpture, and an iconic civic symbol in the City of Norwich.

The sculpture was first installed outside the Mayor of Norwich's house in 1657, along with the classical figure Hercules. For centuries they stood opposite the cathedral in the centre of

SEE REAL SIZE

0.49x

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## Usability of AR

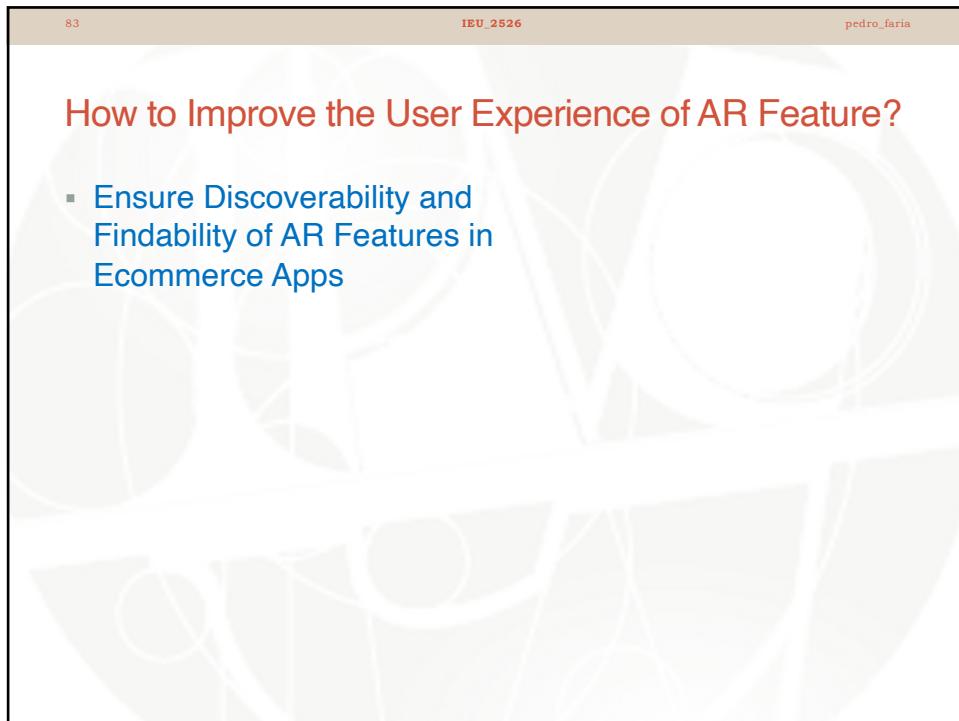
- **AR Should Not Be Gratuitous**
  - AR is a cool, new feature that may generate interest among users,
  - But it should **not be forced on an application**
    - The AR feature should **bring value** to the interaction.

Verizon 10:44 AM 64%

Moses with the Ten Commandments  
Rembrandt 1659  
Gemäldegalerie, Staatliche Museen zu Berlin

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## How to Improve the User Experience of AR Feature?



84 IEU\_2526 14:13

Or \$16/mo for 30 mos [Learn More](#)

Delivers to: [Enter Zipcode](#)

Please enter your shipping zip code to see if we deliver to your location  
[Read more about shipping](#)

Look at Me Too

Bob-O-Pedic Charcoal Chaise \$399<sup>00</sup> ★★★★☆

Ameerah Gray Low S Chair \$279<sup>99</sup> ★★★★☆

Price: \$399<sup>00</sup> Add to Cart

Inbox QR Scan All AR Items Share More

How to Improve the User Experience

- Ensure Discoverability and Findability of AR Features in Ecommerce Apps
- Example
- Bob's Furniture app: One participant browsing furniture in Bob's furniture app realized that she could filter the AR-compatible items using an icon in the tab bar. However, it took her about a minute to notice that icon, due to its low contrast and her unfamiliarity with the symbol

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## How to Improve the User Experience of AR Feature?

- Consider Users' Context and Limitations

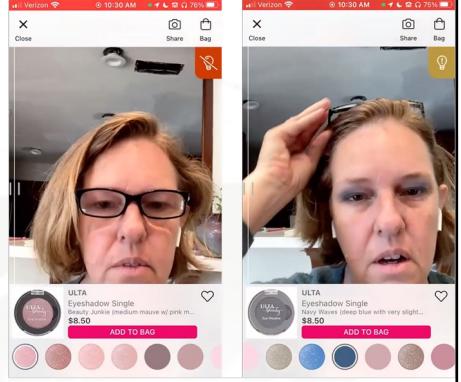
86 IEU\_2526 pedro\_faria

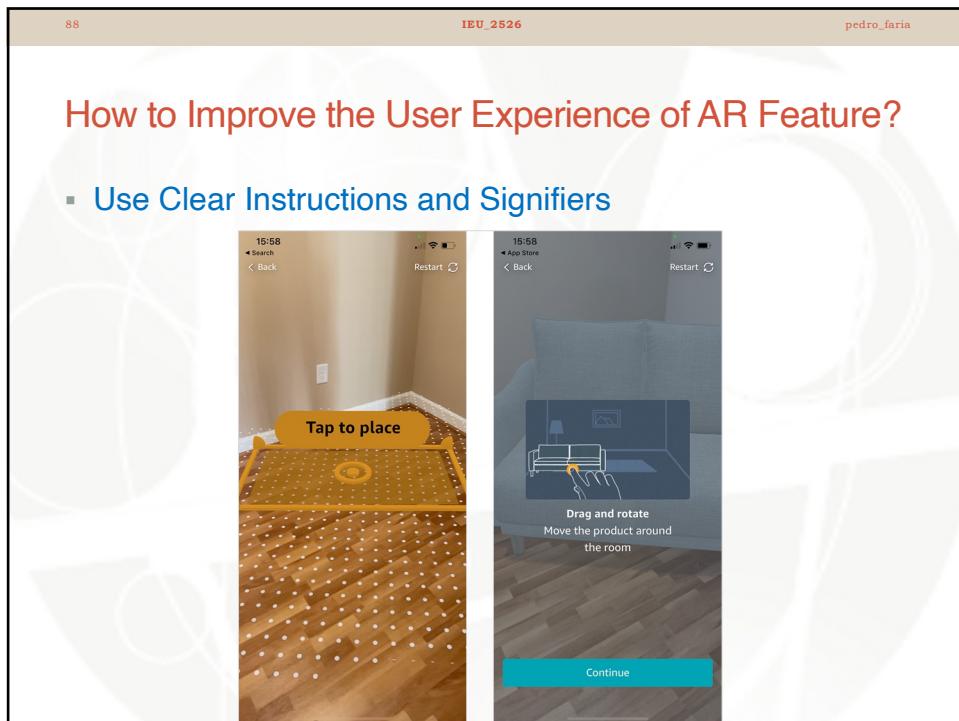
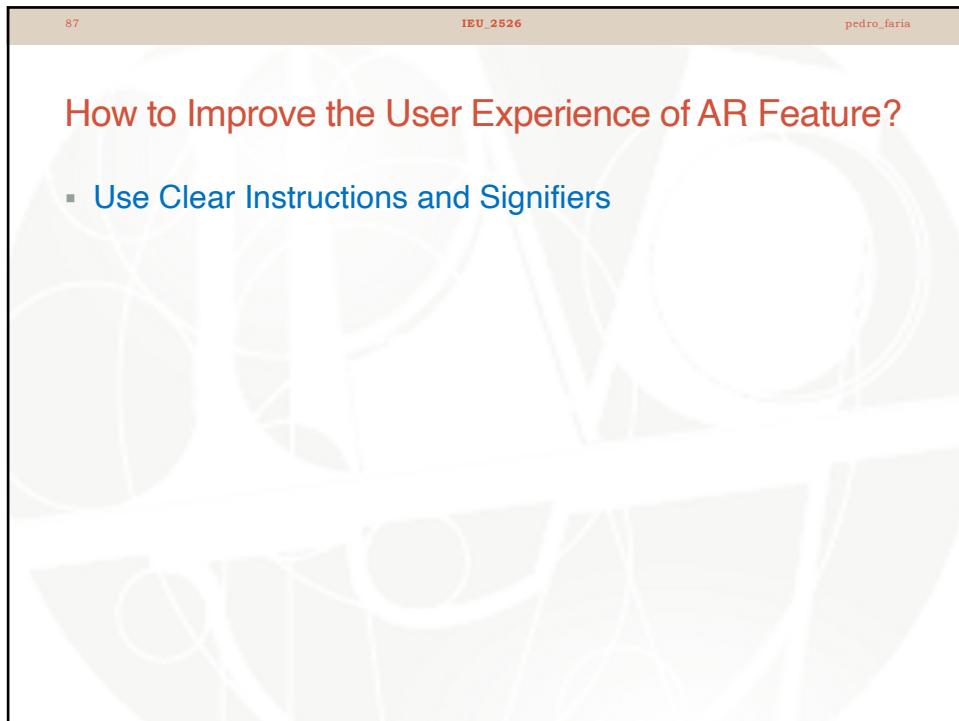
## How to Improve the User Experience of AR Feature?

- Consider Users' Context and Limitations

▪ **Example**

- **Ulta:** The participant used the virtual try-on features to try a new eye shadow on her face.
- However, her glasses did not allow the AR eyeshadow filter to be applied to her eyelids (left).
- Hence, she tried darker eye shadows, removing her eyeglasses (right) but then she could not see the mobile screen without her glasses on!

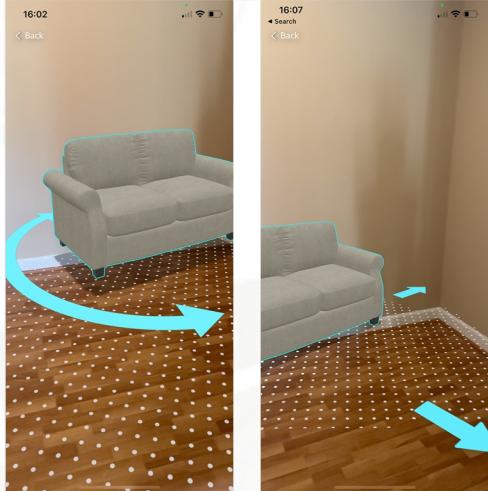




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## How to Improve the User Experience of AR Feature?

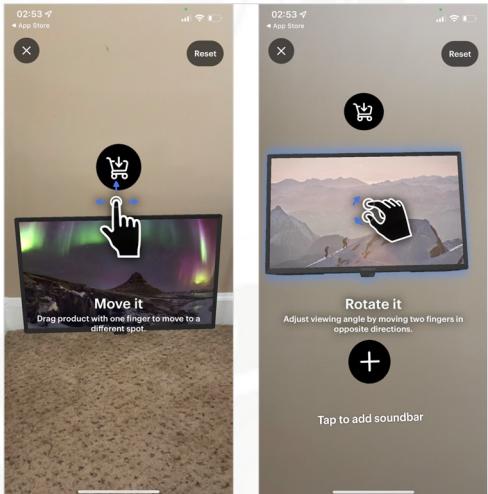
- Use Clear Instructions and Signifiers



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## How to Improve the User Experience of AR Feature?

- Use Clear Instructions and Signifiers



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## How to Improve the User Experience of AR Feature?

- **Use Clear Instructions and Signifiers**

Move your device to scan the flat surface.

Use two fingers to scale and rotate the object.

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## How to Improve the User Experience of AR Feature?

- **Ensure that Text and Controls Are Visible Across Different Backgrounds**

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## How to Improve the User Experience of AR Feature?

- Ensure that Text and Controls Are Visible Across Different Backgrounds

In the past, it would take an entire village to cut the wheat with scythes, then thresh and clean the seeds by hand. Combine harvesters allow farmers to do all of these jobs with one machine, in a fraction of the time.

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## How to Improve the User Experience of AR Feature?

- Ensure that Text and Controls Are Visible Across Different Backgrounds

Hint: Try a more textured surface in a spot that's not too bright or dark

SKIP

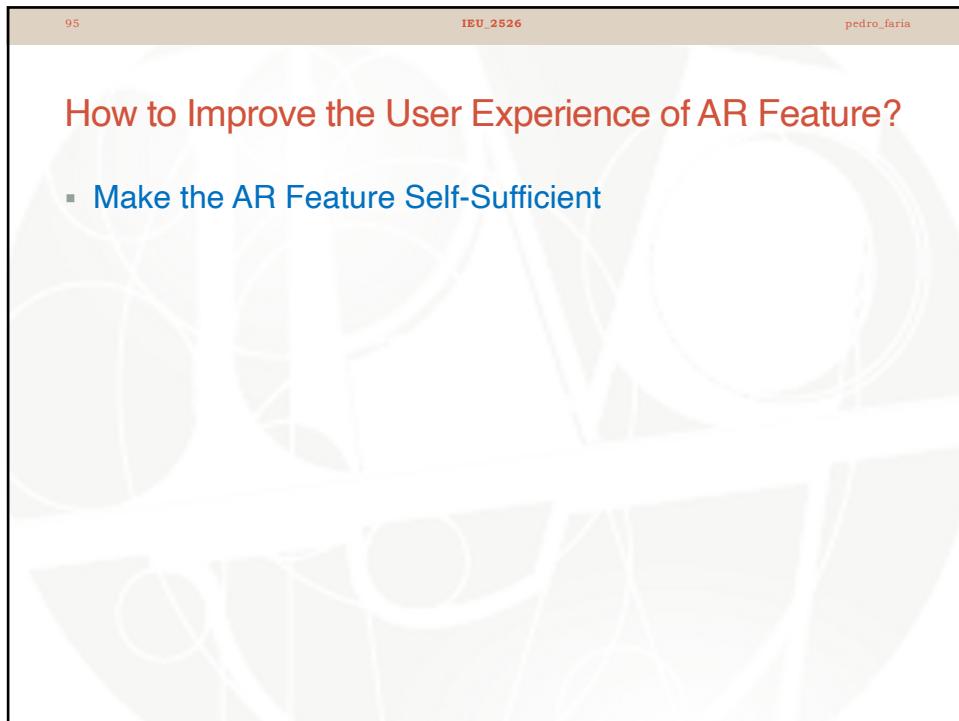
Try taking a picture of the artifact2 with the Camera tool

SKIP

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## How to Improve the User Experience of AR Feature?

- Make the AR Feature Self-Sufficient

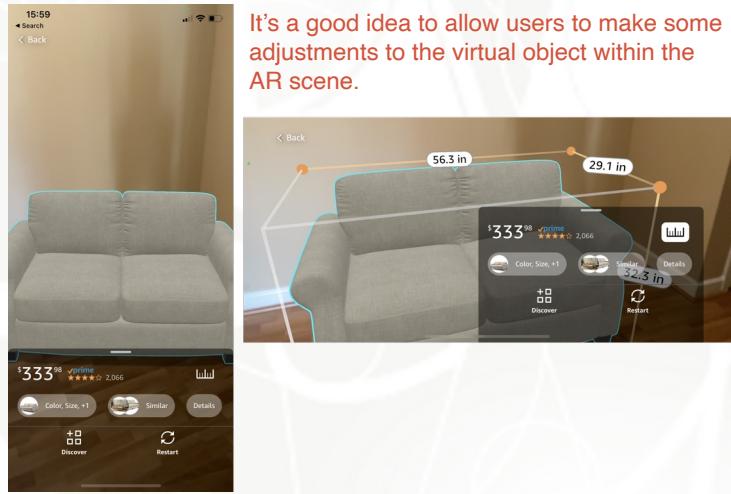


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## How to Improve the User Experience of AR Feature?

- Make the AR Feature Self-Sufficient

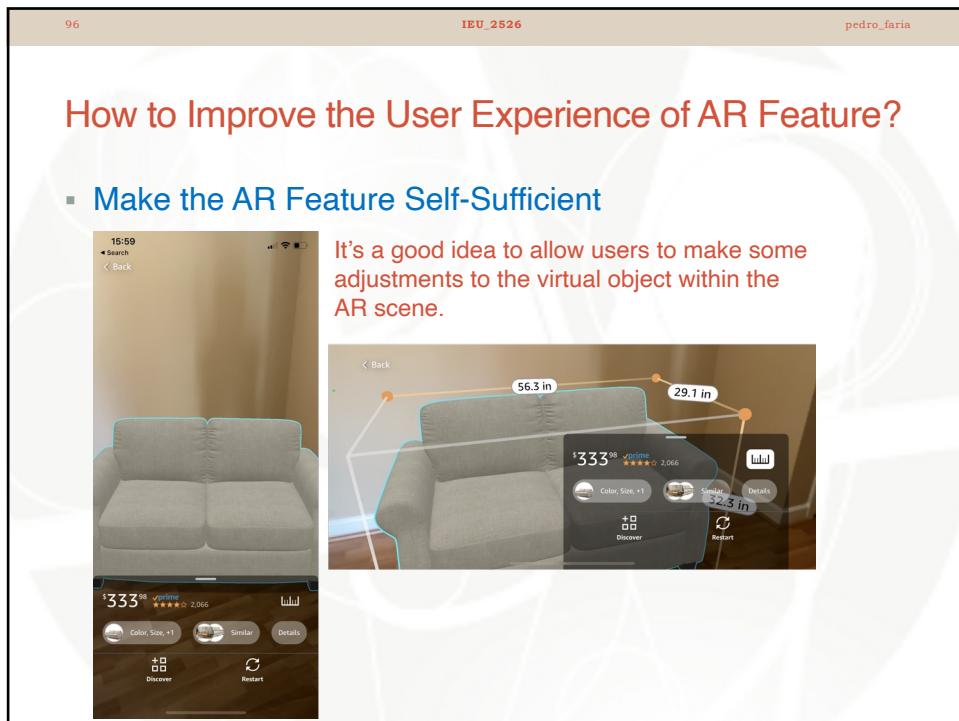
It's a good idea to allow users to make some adjustments to the virtual object within the AR scene.



\$333.98 prime 2,066

Color, Size, +1 Similar Details

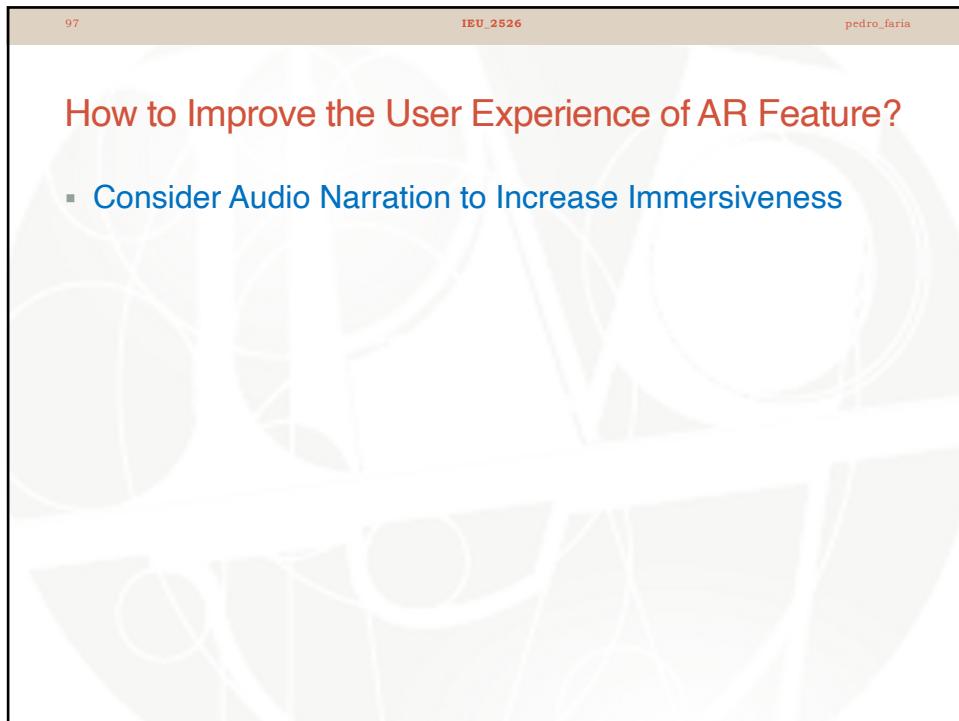
Discover Restart



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## How to Improve the User Experience of AR Feature?

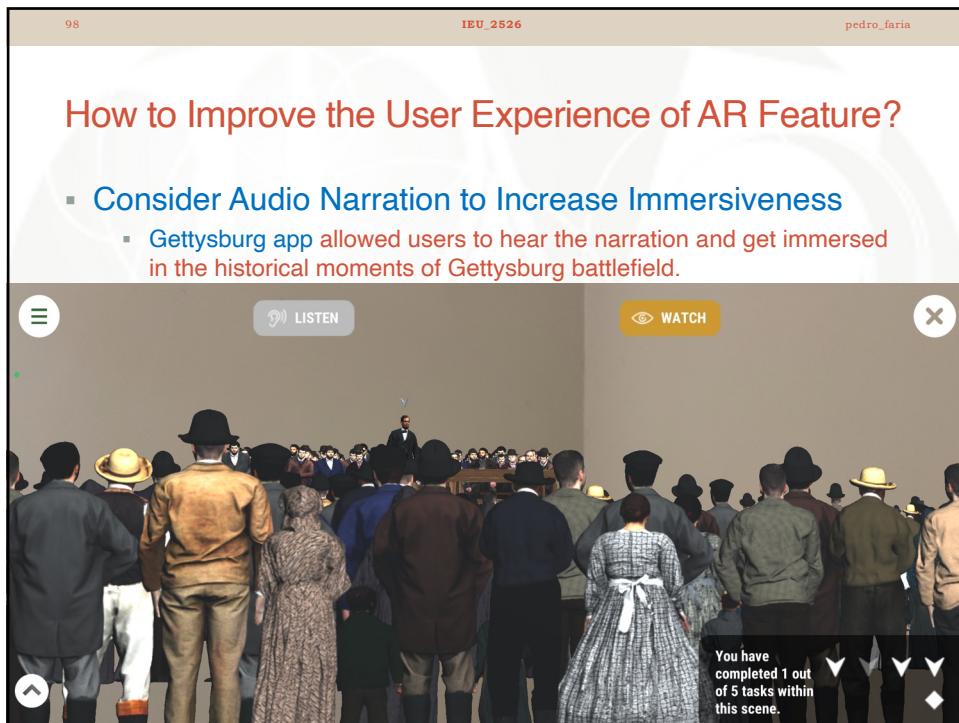
- Consider Audio Narration to Increase Immersiveness

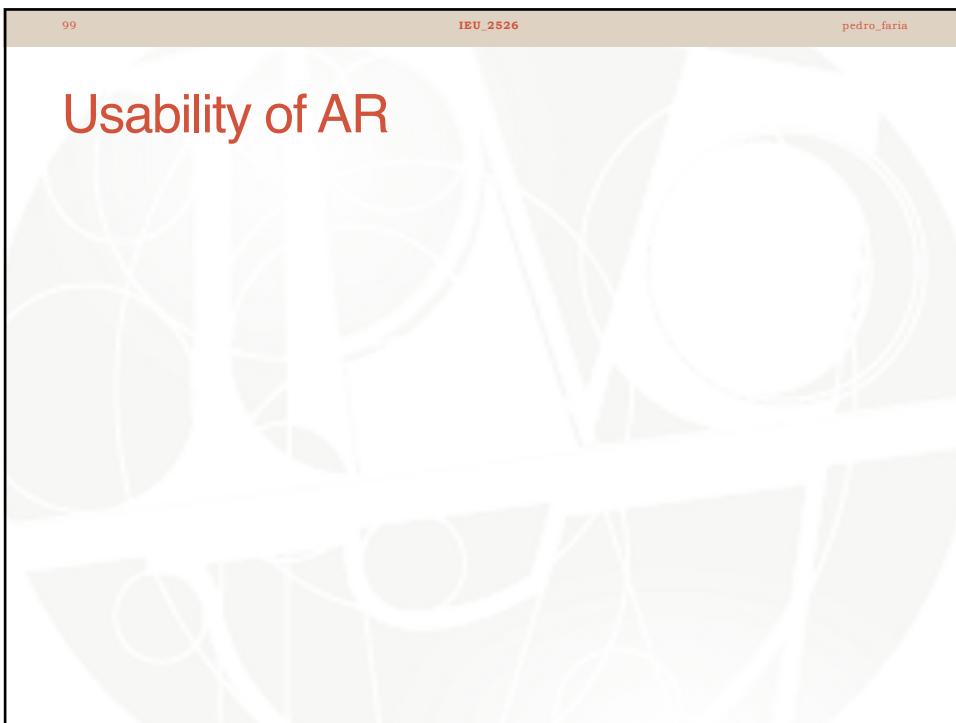


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## How to Improve the User Experience of AR Feature?

- Consider Audio Narration to Increase Immersiveness
  - Gettysburg app allowed users to hear the narration and get immersed in the historical moments of Gettysburg battlefield.





# Usability of AR

A presentation slide with a light gray background featuring a faint circular floral watermark. The top header bar is dark brown with white text: '100' on the left, 'IEU\_2526' in the center, and 'pedro\_faria' on the right.

**Usability of AR**

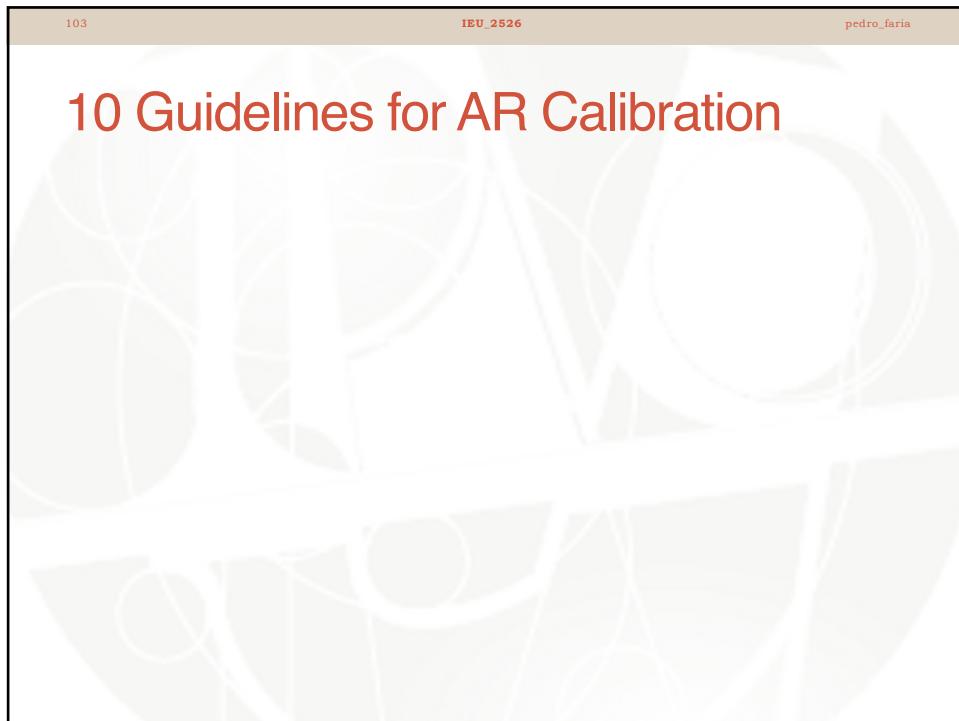
- **3 Main Conclusions**
  1. Most **users** are still unfamiliar with AR technology. If your mobile app uses AR, **make users aware of this feature and help them easily locate those items** in your app for which it is available.
  2. Help people **interact seamlessly with your virtual objects** by using **clear signifiers, text labels for icons, and step-by-step instructions** that are easy to see.
  3. Even though most users find delight in augmented reality, **do not implement AR for the sake of AR**, but, rather, make sure that it **adds value to the overall user experience**.

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This slide is identical to the one above it in layout and design. It features the same header information ('104', 'IEU\_2526', 'pedro\_faria') and title ('10 Guidelines for AR Calibration'). Below the title, there is a bulleted list:

- Augmented-Reality Calibration
  - Based on [Nielsen Norman Group](https://www.nngroup.com/articles/ar-calibration/?lm=ar-ux-guidelines&pt=article)

<https://www.nngroup.com/articles/ar-calibration/?lm=ar-ux-guidelines&pt=article>

A photograph of a person's hands holding a white smartphone. The screen shows an augmented reality navigation application. The view is through a window of what appears to be an airport terminal or a similar public space with moving walkways. On the phone's screen, there is a purple rectangular overlay indicating a path or route. Text on the screen includes 'NEXT Get on line 23 for Security check-in', '↑ 65 m then Walk up stairs', and '12 mins to Gate 5'. The phone's status bar shows the time as 8:23 PM.

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## 10 Guidelines for AR Calibration

- Depending on the **app's goals** and **functionality**, AR calibration may **involve one or more** of the following **user actions**:
  - a) **Scanning:** The user must scan a surface such as a floor or wall.
  - b) **Absolute positioning:** The user must position the device in a certain location (e.g. go to a specific landmark in a city).
  - c) **Relative positioning:** The user must have the device in a fixed position, then get to a certain distance from the camera/device and be fully or partially visible in the camera view (e.g. typical for AR fitness apps or games).
  - d) **No calibration:** The AR feature can be used right away and requires only appropriate lighting (e.g., AR filters of Instagram, TikTok).

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## 10 Guidelines for AR Calibration

- **2 big components** of the **calibration** process:
  - **INSTRUCTIONS**
    1. Provide **low-granularity instructions**, one at a time
    2. Instructions should be **descriptive** and **unambiguous**
    3. Give users **enough time** to read the instructions and execute them
    4. Make the **instructions visually salient** by showing them close to the center of the screen, in a contrasting color, on a darker background
    5. Visuals used for instructions should **augment** (rather than contradict) text instructions
    6. Consider **using audio** instructions or tips if the device will need to be far away from the user
  - **FEEDBACK**
    7. Keep **users informed** of the **state of the system**
    8. Use **clear standard signifiers** to indicate the state of the system
    9. **Load the AR object within the user's field of view.** If, for some reason, the object moves during the interaction, **provide guidance to help** users find it
    10. Give **users feedback** about their actions so that they can **recover from errors**

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## 10 Guidelines for AR Calibration

- 2 big components of the calibration process:
- **INSTRUCTIONS**
  1. Provide **low-granularity instructions**, one at a time
  2. Instructions should be descriptive and unambiguous
  3. Give users enough time to read the instructions and execute them
  4. Make the instructions visually salient by showing them close to the center of the screen, in a contrasting color, on a darker background
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  10. Give users feedback about their actions so that they can recover from errors

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### 1.

- **ARvid app**
  - A study participant **didn't know** which of the **3 instructions** displayed on this screen:
    - Tap at the very top, in low contrast
    - Return to the previous area to resume, and
    - Start Over
  - she was supposed to follow.

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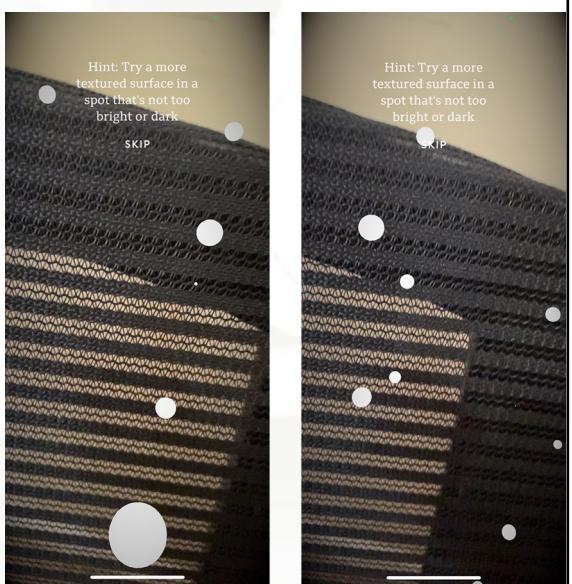
## 10 Guidelines for AR Calibration

- 2 big components of the calibration process:
  - **INSTRUCTIONS**
    1. Provide low-granularity instructions, one at a time
    2. Instructions should be **descriptive** and **unambiguous**
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    8. Use clear standard signifiers to indicate the state of the system
    9. Load the AR object within the user's field of view. If, for some reason, the object moves during the interaction, provide guidance to help users find it
    10. Give users feedback about their actions so that they can recover from errors

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## 2.

- **Civilization AR app**
  - The participant followed the instruction by pointing the camera to the back of his chair.
  - Unfortunately, the **app needed a rough texture**.
  - The participant had **difficulty interpreting the feedback** given by the apps:
    - the **low quantity of dots** in the image was supposed to **mean poor scanning**, but she did not understand that
    - and was unsure as to whether the scanning was successful.



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## 2.

- Mission to Mars app**
  - Users were shown good and bad examples of:
    - lighting (left) and surfaces (right)
  - they could use for calibration.

LIGHTING  
Make sure light is not too bright or too dim.  
NEXT

SURFACE  
Choose a rough or textured surface.  
NEXT

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## 10 Guidelines for AR Calibration

- 2 big components of the calibration process:
  - INSTRUCTIONS**
    - Provide low-granularity instructions, one at a time
    - Instructions should be descriptive and unambiguous
    - Give users enough time to read the instructions and execute them
    - Make the instructions visually salient by showing them close to the center of the screen, in a contrasting color, on a darker background
    - Visuals used for instructions should augment (rather than contradict) text instructions
    - Consider using audio instructions or tips if the device will need to be far away from the user
  - FEEDBACK**
    - Keep users informed of the state of the system
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### 3.

- **ARvid app**
- Not only was the instruction at the top shown in low-contrast text
- but it disappeared too quickly from the screen
- and the study participant was not able to finish reading it.

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## 4.

- MauAR Berlin Wall app
  - Used a **black contrasting background** for the narrative text (**right**)
  - However,
  - UI copy such as the **label Story** and the **years (1961,1971, 1981)** (**left**) would have also benefited from a black contrasting background

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## 4.

- Kinfolk app
  - Used relatively **salient/bold colors** that increased **visibility**.
  - However,
  - The text still needed a **contrasting background** to ensure its **readability** across a **variety of environments**.

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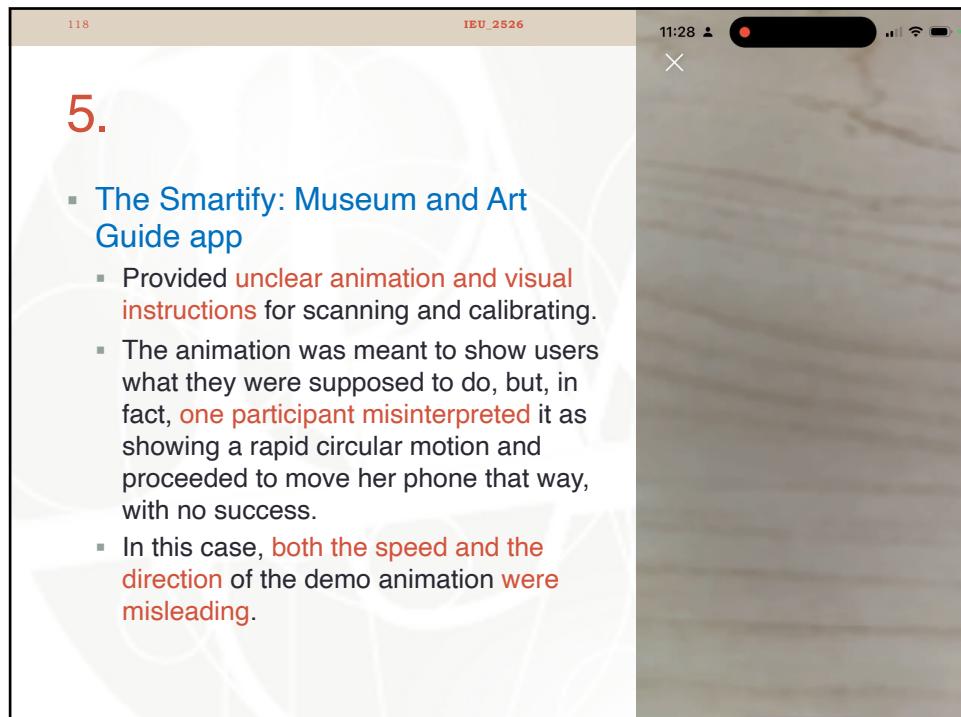
## 10 Guidelines for AR Calibration

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### 5.

- **The Smartify: Museum and Art Guide app**
  - Provided **unclear animation and visual instructions** for scanning and calibrating.
  - The animation was meant to show users what they were supposed to do, but, in fact, **one participant misinterpreted** it as showing a rapid circular motion and proceeded to move her phone that way, with no success.
  - In this case, **both the speed and the direction** of the demo animation **were misleading**.



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## 5.

- **Active Arcade app**

- The visual showed the device set on the table at waist level, whereas the written instructions asked the user to put the device on the ground.
- The text instruction should have appeared when the user placed the device on the floor.
- These types of misalignments confused study participants.

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## 6.

- **Adobe Audio Design**
  - The user **may not be able** to perform the activity and **read the instructions** at the same time
  - For such apps, consider providing **audio tips**.

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## 7.

- Civilization AR app
  - A participant struggled to figure out what the system was doing.
    - He said:
    - “[It says] move your device slowly around to detect a surface.”
    - “Okay. It likes the chair.”
    - “It’s thinking...”
    - “I don’t know.”
    - “I don’t know what’s going on right now.”
    - “I have no idea.”
    - “What would be helpful here [is] to tell me what’s happening.”

Hint: Try a more textured surface in a spot that's not too bright or dark  
SKIP

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## 10 Guidelines for AR Calibration

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## 8.

- Target and Etsy apps**
  - Many applications used **floating or scattered dots** to indicate that the app is **scanning** the environment
  - However, most participants were confused and unsure **how to interpret** these dots
  - These **cues do show** that the app is not frozen, but
  - They **do not add any additional value** and do not help the user in determining the next step or identifying potential issues.

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## 9.

- **MauAR app**
  - Berlin Wall
    - (left)
  - Augmented Berlin
    - (right)
  - Both, used arrows to direct the user to the AR object.

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## 9.

- **Civilization AR app**
  - Used a **dotted line** to direct the user to the virtual object.
  - While it was **good** that the **app pointed the user** to the object of interest,
  - The **dotted line is a poor signifier**, especially since many AR apps also use **dots** to indicate **scanning**.

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## 10 Guidelines for AR Calibration

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    10. Give **users feedback** about their actions so that they can **recover from errors**

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## 10.

- **Target app**
  - Provided **unclear calibration instructions**, with **no suggestion** towards the next steps.
  - **Users should receive clear instruction** on how to recover from an error and progress towards achieving their goals.
  - **If the user does seem to take any action** for a certain amount of time, they **should be notified** about a potential issue **and get guidance** on how to resolve it.



## 10 Guidelines for AR Calibration

- **2 big components** of the **calibration** process:

- **INSTRUCTIONS**

1. Provide low-granularity instructions, one at a time
2. Instructions should be descriptive and unambiguous
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## 10 Guidelines for AR Calibration

- **2 big components** of the **calibration** process:

- **INSTRUCTIONS**

1. Provide **low-granularity instructions**, one at a time
2. Instructions should be **descriptive** and **unambiguous**
3. Give users **enough time** to read the instructions and execute them
4. Make the **instructions visually salient** by showing them close to the center of the screen, in a contrasting color, on a darker background
5. Visuals used for instructions should **augment** (rather than contradict) text instructions
6. Consider **using audio** instructions or tips if the device will need to be far away from the user

- **FEEDBACK**

7. Keep **users informed** of the **state of the system**
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9. **Load the AR object within the user's field of view.** If, for some reason, the object moves during the interaction, **provide guidance to help** users find it
10. Give **users feedback** about their actions so that they can **recover from errors**

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## 10 Guidelines for AR Calibration

- **3 Main Conclusions**
- 1. Calibration is a **complex and critical aspect** of the mobile AR experience that often causes **usability problems** for users.
- 2. While some **issues** are **related to technological challenges** and limitations, the calibration experience can be improved by **clear, descriptive, timely, and unambiguous instructions** that take into account users' low familiarity with the AR technology.
- 3. Additionally, prompt **explicit and quick feedback** and **guidance** will enable users to have a seamless and **successful interaction** with the AR feature.

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## The future?



A photograph of a person's arm wearing a blue sleeve and a black smartwatch. A floating digital interface is visible, displaying a video call with a woman in a snowy environment and a virtual keyboard. The video call screen shows the text "Video No. 2513" and "1:40:05:18". The virtual keyboard has the text "VIDEO CAPTURE" and "DELETE SEND". The background is blurred, suggesting an outdoor setting.

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## Today Session

- A-Frame – 3D / AR / VR experiences
  - Examples
  - Getting Started
    - A-Frame\_Exercise 1
  - GUI Framework
    - A-Frame\_Exercise 2
- Usability in VR
- A-Frame AR
  - AR.js
    - A-Frame\_Exercise 3
  - A-Frame I MindAR
    - A-Frame\_Exercises 4 to 9
- Usability of AR
- 10 Guidelines for AR Calibration
- Some References

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