Augmented Reality - UX and IxD Research

Introduction
In this research paper we take a look at how Augmented Reality (AR) can fail when the interaction design is implemented/designed in such a way that the users experience problems or frustrations when interacting with the AR features. In addition, we'll look at how to prevent bad AR user experience.

Goal
The goal is to find out how we can give users the best experience when they're interacting with AR.

Motivation
Once we've found out how to give users the best experience when interacting with AR, this knowledge can be used in the design process for the app.

Main research question
How can we give users the best experience when they're interacting with AR?

Research questions
- What are the threats/what can go wrong when designing for AR?
- What should you never do when designing for AR?
- What actions can help improve AR user experience?

Plan of action
Desktop research; information of reliable and well-known UX resources will be used e.g. by reading articles and watching videos. Users of AR that share their experiences with AR on forums is information that will also be used. The do's, don'ts and (potential) threats will be collected.

Results

Do's

- **Ask yourself**: "What do I want to achieve with AR in this app?" then identify the users and their problems/needs. After that, answer the question: "Is AR the right medium for solving the user's problems?"
- **Stable content:** AR-generated content appears stable relative to the environment, and realistically blends in with the environment (e.g. Ikea app requires furniture to blend in for a good UX). However, blending might be counterproductive if certain content needs to stand out from the environment. In that case it's not recommended to blend in content with the environment.
- **Hardware capabilities**: disable AR features that don't work on specific devices. This is better practice than showing the user an error if their device isn't compatible with certain AR features.
- **Battery:** AR drains the battery. Minimizing battery drain is important, because it enables users to use their device longer so that they can keep doing what they want to achieve.
- **Inconsistent frame rates:** app should render at a reasonable and consistent frame rate. This gives a better UX than a higher but inconsistent frame rate. Ideal is 60fps since it will prevent flickering of objects. This will help create a better immersion for the user.
- **Design comfortable interactions:** give the user a clear understanding of the amount of space they will need to use the AR. So ask yourself: "In what environment(s) will the AR be used? Public or private?". Communicate this information to the user by for example adding instructions in the app.
- **Design for safety:** remind the user regularly (through notifications for example) that they should be aware of their surroundings. Especially if the app is used in a dangerous environment (e.g. near roads, inside warehouses, etc.) this is important.
- **Allow users to take a break:** giving users the option to pause and/or save their progress will motivate them to take a break. This will prevent fatigue. After their break they can load up where they left off.
- **Audio:** audio can help improve the immersion and can help inform the user e.g. through text to speech, sound effects, etc. Audio from the user can serve as a more immersive input as well since the UI won't have to be cluttered with buttons. With voice control the user can navigate and select options instead.
- **Offer easy onboarding**: since AR is new to many users they will need to take some time to get used to AR. Users will need guidance on how to interact with AR and need to discover what AR related options they have in the app. A tutorial when the users start using AR for the first time would be good practice.

Don'ts

- **Don't make users walk backward**: the chances of bumping into furniture and other objects are much greater when a user is moving backward. That's why it's recommended to design experience that guides users to move forward, not backward.
- **Don't make sessions too long:** if users will hold their mobile phones at certain angles for too long, it will physically strain them. To prevent causing fatigue, consider keeping sessions short, and add periods of downtime to help users get relaxed.

- **Don't clutter the UI:** too many options in the AR view will ruin the immersion, because the users won't think what they see is real when they see things like buttons that aren't there in real life.
- **Don't teach users all the key tasks/mechanics at once:** Show instructions or tips on how to perform specific things in the context of actual interactions. By doing that, you won't overload users with information, and they'll be able to get all the important information at hand.

Threats

- **Hardware capabilities**: some devices might have trouble with/or can't use AR at all. Some specific AR features can't run on certain devices.
  Devices that are compatible with ARcore:
  https://www.xda-developers.com/arcore/
- **Hardware performances:** the battery life, CPU/GPU, memory, camera/IMU and OS of pretty much each device will be different so it's important to know what devices and platforms you develop for. Testing the performance of the app on these devices is necessary to get an understanding of how much the hardware performances influences the user experience.
  Technical best practices for a good UX:
  https://developers.google.com/ar/develop/c/performance#performance_best_practices
- **New interaction patterns:** using new ways for the user to interact with an interface like voice control can be hard for the user to understand. Using known interaction methods like tapping, dragging and swiping objects is a safer option.

Opportunities

- **Wearables:** some users might have access to wearables that can help improve the UX for AR usage. Whether they own the wearables themselves or get them from their employer can differentiate between users. Examples are earbuds (with or without built-in microphone), over-ear microphone, phone mount headband and more.

Conclusions & Recommendations

To come back on the research question: "How can we give users the best experience when they're interacting with AR?"

We can achieve this by making stable AR content, letting the user take breaks, let the user get used to the AR functions by onboarding methods and by creating an immersive experience for the user through audio and uncluttered UI's.

First however, we need to establish for what kind of devices and platforms we're going to develop and what kind of wearables will be used by the user in what types of environments. This is essential, because otherwise the ideal user experience can't be offered to the user since the final product will contain too many general features that some users might not even be able to use. In addition, we need to define what type of tasks the user has to perform for their use cases.

Sources

- https://xd.adobe.com/ideas/principles/emerging-technology/ux-design-principles-for-augmented-reality/

About battery impact

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- https://developers.google.com/ar/develop/c/performance