Literature Research

What are constraints for the user, and by-standers, when using an AR wearable?

Student name: Daan Kuhlmann
Company: Greenhouse
Company tutor: Bas Ploeg

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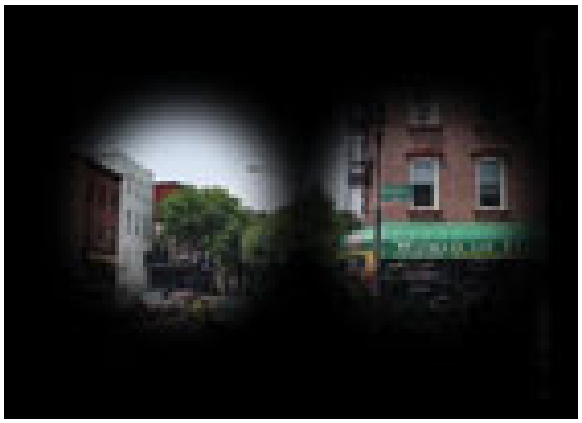
Physical comfort

Normally the first thing UX and UI designers must take in consideration is to reduce eye strain and thumb strain. However, AR wearables bring a whole new problem to this list. Arm strain is a problem that needs to get tackled in creating an AR user interface. Make sure the interaction is close to the user, but not too close, because that will result in eye strains. AR gives the luxury to make it compatible with walking. But this is not without a risk, as will be explained in the paragraph “psychological constraints.”

The advanced AR wearables are still heavy and bulky. This will give the wearers nose and neck strains when wearing it for too long. Because a lot of processing units and sensors are close to the wearer, the devices tend to become very hot and this gives the wearer heat marks for some time after wearing it. The Magic Leap is already a big improvement in comparison to the Meta 2 and HoloLens, but AR wearables must become lighter and more convenient to really become viable as a consumer product that can be worn for a prolonged period.

With augmented-reality gear barely on the market, studies of its effects on vision and mobility have yet to be done (Sabelman, 2015). Augmented reality can cause you to misjudge the speed of oncoming cars, underestimate your reaction time, and unintentionally ignore the hazards of navigating in the real world. According to Sabelman, AR wearables could lead to vision loss problems as experienced by visually impaired individuals. These could include reduce depth of focus, distance and speed perception, and reaction time. Joshi (2019), backs up this theory by stating that AR wearables could impair the perception of the wearer.



An AR wearable could impair the perception of the user

At the moment, AR wearables are long from being ready to be used in an outside, uncontrolled environment. But in the future, when it could get more integrated in society, problems like perception impairment could become dangerous.

Psychological constraints

When an application becomes immersive and commands the continued attention from the end user, it creates the potential for the end user to become so engaged in the experience that they become completely engrossed in the activity and lose awareness of time and what is happening around them. This is referred to as a "flow state" (Pase, 2012). Pase explains that when a person gets into this "flow state", there is a risk of real injury, because they can fall over or walk into their surroundings. Pokemon Go, the Augmented Reality game from Niantic (2016), has resulted in multiple car crashes and a least 2 deaths (Sharwood, 2017). These accidents could be caused by the user being in the "flow state".

Hyper Reality (2016) by Keiichi Matsuda predicts a future where AR is used for a lot of things, creating a nightmare of overlays.

Cognitive load

Cognitive load is the amount of mental effort being used in the working memory. To have the best transfer of information, it is important not to exceed the cognitive load (Sweller,1988). If this cognitive load is exceeded, the transfer of information stops, because the user is to busy with understanding what is happening. Cognitive load is divided into three types:

1. Intrinsic: This is the level of complexity inherent in the material being studied. There isn't much that we can do about intrinsic cognitive load; some tasks are more complex than others so will have different levels of intrinsic cognitive load.

2. Extraneous: This is cognitive load imposed by non-relevant elements that require extra mental processing e.g. decorative pictures, animations etc. that add nothing to the learning experience.

3. Germane: These are elements that allow cognitive resources to be put towards learning i.e. assist with information processing.

The cognitive load should be considered when making an application. It is advised to keep cognitive load as low as possible, because the transfer of information will be optimized that way. A theory by Baddeley and Hitch (1974) infers that audio and visual stimuli are processed separately. They can be combined in order to provide an enhance learning experience.

On the other hand, a cognitively demanding environment let users focus on what is going on in the application and this will maximize the use of mental resources (Tettegah, 2014). This is good for immersion, because if brain power is used to understand or navigate the world, it cannot be used for noticing problems or shortcomings within the application.

A crucial aspect in creating an UI for augmented reality is to keep it simple. AR gives UI designer a bigger canvas to work with, but this could shift into the direction of UI designers overflowing the user with interaction, thus overloading the cognitive load. A good practise for designing a UI for AR is to keep it simple, natural and minimal. By making a tutorial with both text and audio, the transfer of information is optimized.

Privacy & Ethics

The capabilities of AR have also brought some privacy problems and ethical questions with it.

AR can cause big identity and property problems. According to McEvoy (2017), public space could become vandalized by Augmented Reality gravity. Although this could only be seen when using an AR ready device, in a future where AR has a more central role in society, it could lead to real problems. Apart from public spaces, private property could also become plagued by public signs or AR vandalism. In real-life, somebody would not put a sign in a stranger's front lawn, why would this be allowed in Augmented Reality? Harding (2018), shares the same opinion. In 2018, Google released an application called "Just a line", in which the user could draw in space. At first it seemed totally innocent, but it could also be used to draw hateful graffiti on somebody's house.

ART, by Jeff Koons was "vandalized" as a protest for AR artwork

An AR wearable needs to recognize a person that is being interacted with. The best way to accomplish this task is to use facial recognition. This facial recognition brings new privacy questions with it. How is this scanning processed and who will get hands on this data? Big security agencies like the FBI are working on facial recognition software to easily track down fugitives (Wassom, 2015). In addition to this, social media platforms, like Facebook can recognize people from a photo. Wassom explains that when facial recognition gains acceptance by being used for sympathetic and socially redeeming applications, businesses will encounter less resistance. This could resolve in great privacy infringements.

Another way of how AR wearables could be threatening privacy is the use of the sensors and cameras of the device. The AR wearables can make pictures and videos of their surroundings without people noticing. This knowledge has led people to distrust the AR wearables in public spaces (Banister, 2018). In 2014, a woman wearing Google Glasses, one of the first AR wearables, was physically harassed inside a bar by other patrons because they thought she was filming them without asking. Out of research done by Toluna (2014) it was concluded that 72% of Americans would not use an AR wearable (Google Glass) because of privacy concerns.

To prevent future privacy issues, the AR industry needs to come up with certain guidelines in the use of AR wearables. This can be by setting up industry standards for publishing and sharing information gathered by the devices or give comprehensive feedback to the users about what will happen with their data.

Like any other connected technology, AR wearables could become vulnerable to hacker attacks and malware. As AR overlays the reality, this could resolve in real dangerous situations, like misdirecting a driver that is using AR powered navigation (Joshi, 2019). By not looking at these dangers in an early stadium of development, it could become a real problem when developing for full scale development.

No sharing of same reality?

People from the outside feel weird and insecure. To an observer, the behaviour of someone wearing an AR wearable can be viewed as peculiar and not understandable (Axson, 2018). Axson also states that the AR experience is still an individual experience. Whilst content sharing is becoming available, standing side by side sharing the same digital experience is not yet easily done. From my personal experience, when testing the AR wearable in a public office space, I got frowned upon and people even made comments like: “I would never get used to the way that device looks.”

The other way around, people using AR wearables have the feeling they can still share the experience, while they can’t. This means that AR for wearables should become a shareable experience. Without this shareability aspect, the AR uses a lot of value.

With the 5G mobile network getting closer to making its release, this shared reality could be close to be fully usable, unleashing the full potential of Augmented Reality. but until this time AR on wearables is mostly a single user experience (Rogers, 2019).

Conclusion

While there are some minor physical strains that are the results of the bulkiness of the AR wearables, the real threat is the prolonged eyestrains it could lead to. These strains, however, have not been researched yet and AR wearables are not used for a prolonged time. But in a future, AR wearables could be used on a day-to-day basis and in an uncontrolled environment. This could lead to perception impairment. This impairment, combined with the “flow state”, could result in real dangers.

Cognitive load could be used to the developer’s needs. The cognitive load could be made as low as possible to have a good information transfer. On the other hand, a higher cognitive load could lead to a better immersion, as flaws of the application could be overlooked.

When AR wearables become a consumer product in the future, there are some privacy problems to overcome. AR vandalism and the sharing of data are problems that could occur. The hacking of AR, as with all connected devices, could become dangerous. To prevent these problems from becoming insurmountable, the AR industry needs to start thinking about them and how they might could get solved.

As AR wearables are mostly a single user experience today, people within this experience might look out of place. People that are not experiencing the same thing might feel weird and insecure. On the other side, people experiencing an AR wearable experience have the urge to share their experience with others. When the AR becomes shareable, Augmented Reality could reach a much higher potential.

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