Social Signaling in Augmented Reality

Henning Pohl[1]

[1]Aalborg University, Selma Lagerløfs Vej 300, 9220 Aalborg, Denmark

Abstract

As Augmented reality devices become suitable for use in social situations, they will also be used to overlay visual content on our bodies as we interact with others. This will include virtual clothing and accessories, but could go as far as virtual body modifications, such as animated tattoos. Similar to their physical counterparts, such augmentations will allow their users to curate their appearance, signaling status, preferences, and affinities to others. However, such virtual adornments also differ in meaningful ways, such as allowing for easy and substantial user control and customization while being worn. We describe the present state of such augmented reality appearance change, present three example scenarios to provide concrete examples of how use of this technology could play out, and outline challenges faced by research in this area.

Keywords

Augmented reality, filters, social interaction

1. Introduction

Augmented Reality (AR) already is used to alter our appearance, such as through beautification filters or virtual clothing. This has been described by Genç et al. [1] as *technological design layers*, and ranges from small changes and virtual clothing to extra body parts, and digital auras (e.g., virtual particles orbiting a body). Compared to physical appearance changes, digital manipulation through AR allows for a wider range as well as more dramatic changes. The motivation for such augmentations varies [2], but self-presentation commonly factors into such uses. Furthermore, appearance augmentation can also serve as initiator for social interactions [2]. Using AR to change how we appear to others thus inherently affects social situations.

Appearance change invites social interaction, but also affects how we see ourselves and others. For example, Fribourg et al. [3] reported how filters that change their face's shape influenced how participants rated themselves. When applied to others that are speaking to us, filters can affect how we perceive their personality [4]. For example, wearing a pair of virtual glasses made speakers appear less apathetic. Another example are age-changing filters, that facilitate engagement with family members and reminiscence [5]. These effects of appearance-changing AR could also be deliberately leveraged by users within social interactions, allowing them to manipulate their own and other's perception.

However, currently, few applications of social AR actually support in-person experiences. Moreover, the tools to build body-based AR applications are lacking, with few solutions tailored to that purpose [6]. One approach is to instrumented spaces with projectors, so that people within can be augmented. For example, Bermano et al. [7] used such an approach to augment human faces with virtual clown makeup or to increase facial expressiveness. Another approach for body-based AR are filters, such as available in TikTok, Snapchat, or Instagram. Tools for the design of filters, commonly offer a range of body tracking capabilities and the means to overlay or morph body features. Furthermore, fully digital additions to people's appearance can be made, such as virtual clothing and accessories. These capabilities are in the process of expanding from phone-based interactions to wearables, such as Snap's *spectacles*. They point to a near future, where many users will be wearing AR devices that (1) allow them so see augmented other people, and in turn (2) add a virtual design layer to their own appearance.

As in-person interactions are then augmented with virtual additions, the question is how this will change the social dynamics and conversational situations, as well as how users will actually control

Shaping Future Human Connection: Social Augmentation through XR Technologies Workshop, April 13, 2026, Barcelona, Spain
henning@cs.aau.dk (H. Pohl)
0000-0002-1420-4309 (H. Pohl)

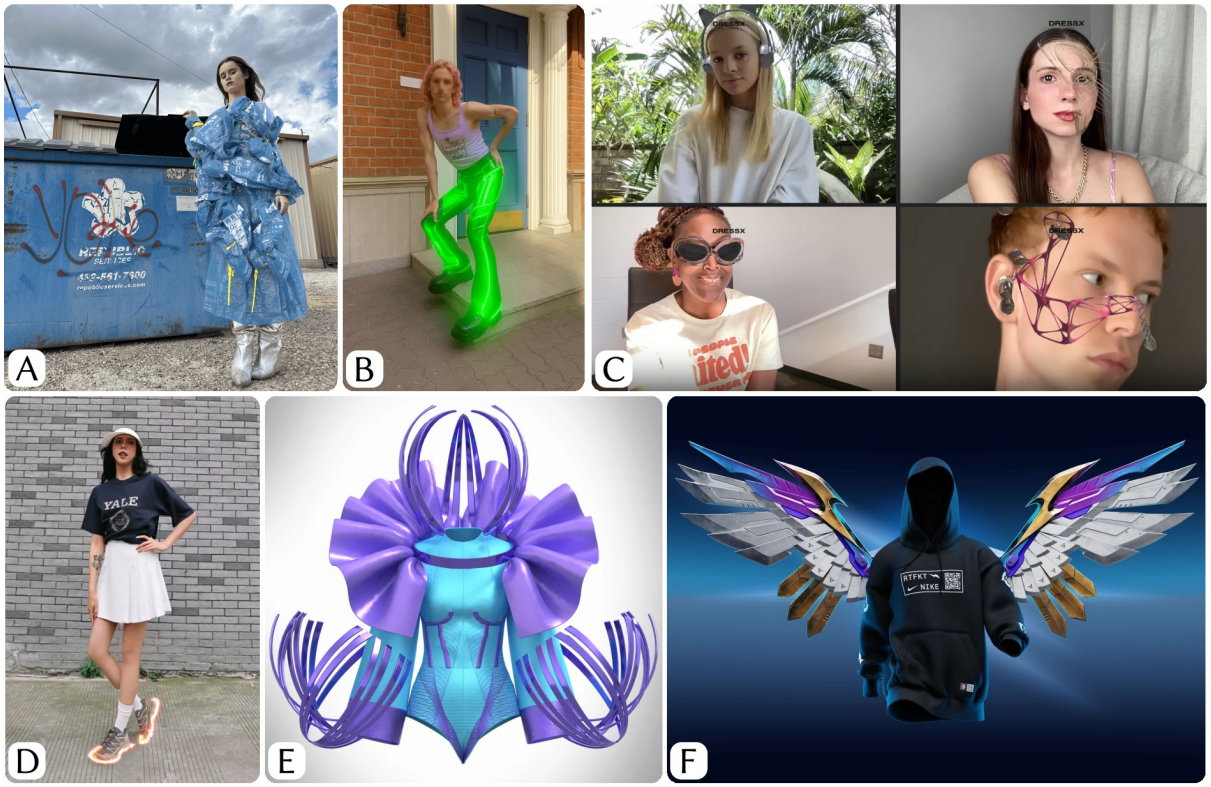

Figure 1: Examples of digital fashion: (A) *Trash Trench #06* by DRAUP, (B) Glowing pants by Tribute Brand, (C) video call with digital fashion using *DressX Metacloset*, (D) digital *Salomon XT6 sneakers*, (E) digital fashion from *republique*, and (F) *RTFKT X Nike AR Hoodie* with virtual wings.

their appearance. Previous work already demonstrates some effects of augmented appearances during conversations. For example, during conversations mediated through Snapchat, the addition of AR visualizations was found not to have a negative impact on conversation quality [8]. That such use of AR is not substantially distracting also holds for notifications [9] and visualizations [10] shown during face-to-face interactions.

In contrast to physical appearance, augmented appearance can change and be adapted much more quickly. Digital fashion and accessories can be animated, react to the environment, or be fully controlled by the user. How we appear to others, when augmented, also can be dependent on who we are engaging with. A gesture similar to opening the top button on a shirt, can thus be directed at an individual, instead of revealed to the whole room. Where such flirtatious use requires more ad hoc control over the appearance augmentation, other kinds of social signaling can be set up beforehand. For example, one might curate a more professional appearance (e.g., through hiding of tattoos) before meeting a potential customer, or set up a audio-reactive party outfit before heading to the club. With appearance augmentation

2. State of Augmented Reality Fashion and Design

A large aspect of augmented appearances are clothing and accessories. This is also an area where there have been commercial endeavors to create and sell digital fashion[1]. Examples of brands active in this space are *DressX*, *The Fabricant*, *Republiqe* and *Tribute*. While there has also long been a market around outfits for virtual characters and avatars, AR-focused digital fashion is different as it is intended to be *"worn"* by actual people. Digital fashion is a fairly new phenomenon, likely due to the substantial amount of technology required to create, distribute, and use digital fashion items.

[1]A primer on digital fashion is available from *wearware*: https://spotlight.shimaseiki.com/en/wearware/digitalfashion.

Figure 1 shows several examples of what digital fashion can be. While some of these examples could also exist as physical clothing, many are only possible due to their digital natures. For example, while a trash bag dress could be feasible, this does not hold for glowing pants, shoes bordered with fire, or outfits with floating appendages. These outfits tend to be expressive and designed to draw attention, though this might well be due to the primary target audience being early adopters and people interested in fashion. With broader adoption of digital fashion we would likely also see more conservative and less expressive designs that yet could still offer a degree of malleability of appearance.

While digital fashion is sold, the process is rather different from physical fashion. Some companies have used NFTs (i.e., crypto tokens on a blockchain) to restrict ownership and facilitate trade of digital items. Others operate as a service, where customers submit photos and videos of themselves and then get the digital fashion applied to said media. Customers can then share these on social media, appearing to wear the digital fashion they bought. Moreover, some also offer AR experiences that incorporate digital fashion. For example, *DressX's Metacloset* and *Camera* apps allow users to try on digital clothing, share their look, and wear items while in video calls.

In addition to commercial approaches to digital fashion, there have also been research prototypes in this area. For example, *Digi Merkki* [11] are clothing patches with an embedded display, mixing physical and digital augmentations. Users can add their own images to these patches and also share them with others, signaling their identity and facilitating social interactions. A more conceptual example is the *Phem* project, which explored clothing with digital overlays that makes the fabric dynamic [12, 13]. Similarly, *EMOTE* is a concept of affective augmentations where emotional state is visualized in AR on and around the body [14].

3. Example Scenarios for Augmented Reality Signaling

Using appearance-augmenting technology for signaling has many potential use cases, three of which we explore in more detail below. Namely, we describe (1) a cocktail party setting, (2) a group trip, and (3) a high school reunion. We complement the explorations with brief narratives of how AR-supported social signaling could play out in each scenario.

3.1. Cocktail Party

A main aspect of cocktail parties is to talk to different people and thus signaling interest, status, and attention are common. Not all conversations and connections are equally interesting and thus one might want to keep one going, while cutting another short. Cocktail parties can also be situations for which people dress up and spruce up. Correspondingly, an augmented appearance could further play up these aspects, further adding to ones look or adding to our actions. For example, one could deploy a digital aura that de-emphasizes what is behind us (e.g., by darkening or blurring), making it seem like we are listening more intently.

When Katie arrived at the party she had on a nice evening gown, but nothing too extravagant, as she was not sure what the crowd would be like. Over the course of the evening, she has a number of engaging conversations, but she also notices a guy that catches her interest. Before approaching him, she decides to tweak her appearance slightly, to make a better first impression. Changing the color of her lipstick, adding some adornments to her dress, and a filter to make her eyes appear bigger only requires a quick adjustment with a subtle gesture [15]. She even set up her augmentations to slowly transition, so there is no stark flip in her appearance. With an added level of confidence she then walks over, noticing that as she makes eye contact, his appearance also seems to change slightly.

3.2. Group Trip

Instead of solo traveling, some opt for group travel arrangements to meet up and travel together with others, commonly strangers. Hence at the beginning one gets to know the others, appraising shared values and potential topics of conversation. One might thus not be sure how much of one's own

opinions to reveal, lest one might alienate the rest of the group. For example, showing up in a *Deicide* band t-shirt, when the rest of the group are devout Christians might not go over well. Aside from adjusting signaling to aid group cohesion, one might also want to generally change self-presentation, for example, to get more or less attention from the others.

Mark is proud of his heritage, but this summer he is taking a trip abroad and he is worried others might misinterpret his appearance and react negatively to him. In preparation, he has adjusted his augmented appearance to hide some of his tattoos and alter some of the logos and slogans on his clothing. But one evening he heads to the pub and runs into another group of travelers from his hometown. Overhearing them, he changes his settings to reveal more of himself to them. As they spot the sigil of their local football club on his cap, they greet him enthusiastically, excited to see it so far away from home. All this remains hidden from the other patrons.

3.3. High School Reunion

Reunions are for reconnecting, but showing off achievements and status can play a big role at such events. At the same time, overdoing such displays can be perceived as braggy and unpleasant. Thus, striking the right kind of balance on how much status to display can be a consideration for some, and might also vary depending on who one is interacting with. Appearance-changing augmentations can support this in a more dynamic way, where users can play up or down their standing more dynamically.

Quinn had just bought a boat, but they are unsure whether to let people know that. Hence, they decided to be more subtle about it, maybe some would get the hint if they saw the new deck shoes Quinn bought? At the reunion that worked quite well, with some picking up on the shoes and Quinn able to bring up the board where suitable. But then they ran into Harper, who was bragging to everybody about the new car he just bought. That demanded a more solid counter, but Quinn also decided to be a bit playful about it. With a short search command, they found a digital parrot and decided to add that to their look. That parrot did not just appear from thin air, but flew in from outside, landing on Quinn's shoulder and giving them the appearance of a seasoned buccaneer. It would be impossible for Harper not to notice that Quinn was boating with this look.

4. Outlining Research Challenges

Social situations are signaling-heavy and it is common to want to create a certain impression or underline a facet of one's life, relations, or opinions. There also has been a surge in technologies to facilitate the creation and use of appearance changing AR. Where much of this has been restricted to screen-mediated social experiences (e.g., video chats, social media posts), future AR devices will likely enable us to also adjust how we look while in physical interactions with others.

At the same time, the visual quality of AR augmentations is still comparably crude. Compared to physical materials and textures, virtual additions commonly fall short. While there are cases where artificial and over-the-top looks are desirable, more subtle augmentations that blend with the user's physical appearance, as to be non-distinguishable, are likely the preferred choice in most situations.

While activating a filter is an easy action, dynamic control of appearance changes is more complicated. How can we adjust the color of a digital accessory, tweak the virtual aspects of our makeup, or adjust the dynamic behaviors of moving parts? Full control of the many parameters possible in such a scenario is not feasible and thus there will need to be abstractions and automation. This could be based on pre-programmed rules, context-sensing, or artificial intelligence interpreting a situation for us. But users are ultimately yielding some control over their bodies and appearance, which comes with many challenges [16]. Approaches, such as casual interactions [17] could be one approach to allow users to take and yield control dynamically.

It also remains to be investigated how much social situations actually are impacted once AR appearance change is introduced. Whether findings from research around filters also applies to in-person experiences, for example, is unclear. Furthermore, while some lab studies in this area are feasible already, these struggle with ecological validity, yet in the wild studies are presently hard to conduct. To

a large extent this is due to AR devices still not at the level where they do not impact the in-person experience, such as by not overly blocking eye contact or view of each other's facial expressions. Moreover, how people react to AR signaling will likely adapt as those technologies mature and social standards adapt. Longitudinal and replication studies thus will be important to understand the impact of these technologies.

5. Conclusion

AR enables a wide range of appearance changes, from digital clothing and accessories to body-altering filter effects and digital auras. Any appearance change also sends a signal to others, about how we would like to be seen and what our values and preferences are. In contrast to the physical world. AR-based appearance change can be dynamically controlled and automatically adapt to the world around us. This enables new kinds of appearance modifications (e.g., our tattoos could react to the gaze of others), but also gives users more ad hoc control over what they look like. They can change what kind of signals they send out into the world based on where they are and who they are with. The advent of AR appearance change presents an opportunity to develop these kinds of augmentations, but also to study how they change our perceptions of and interaction with each other.

References

[1] Ç. Genç, O. Raudanjoki, A. Colley, J. Häkkilä, Augmenting Human Appearance Through Technological Design Layers, Frontiers in Computer Science 4 (2022). doi:10.3389/fcomp.2022.755451.

[2] A. Javornik, B. Marder, J. B. Barhorst, G. McLean, Y. Rogers, P. Marshall, L. Warlop, "What lies behind the filter?" Uncovering the motivations for using augmented reality (AR) face filters on social media and their effect on well-being, Computers in Human Behavior 128 (2022) 107126. doi:https://doi.org/10.1016/j.chb.2021.107126.

[3] R. Fribourg, E. Peillard, R. McDonnell, Mirror, Mirror on My Phone: Investigating Dimensions of Self-Face Perception Induced by Augmented Reality Filters, in: 2021 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 2021, pp. 470–478. doi:10.1109/ISMAR52148.2021.00064.

[4] H. Pohl, The Situational Influences of AR Face and Body Filters, to appear (2026).

[5] H. Pohl, Laughing and Longing: Analyzing Age Filter Videos on TikTok, The Gerontologist (2025) gnaf231. doi:10.1093/geront/gnaf231.

[6] H. Pohl, T.-S. Dalsgaard, V. Krasniqi, K. Hornbæk, Body LayARs: A Toolkit for Body-Based Augmented Reality, in: 26th ACM Symposium on Virtual Reality Software and Technology, VRST '20, Association for Computing Machinery, New York, NY, USA, 2020. URL: https://doi.org/10.1145/3385956.3418946. doi:10.1145/3385956.3418946.

[7] A. H. Bermano, M. Billeter, D. Iwai, A. Grundhöfer, Makeup Lamps: Live Augmentation of Human Faces via Projection, Computer Graphics Forum 36 (2017) 311–323. doi:https://doi.org/10.1111/cgf.13128.

[8] H. Pohl, Body-Based Augmented Reality Feedback During Conversations, Proc. ACM Hum.-Comput. Interact. 8 (2024). doi:10.1145/3676491.

[9] R. Rzayev, S. Korbely, M. Maul, A. Schark, V. Schwind, N. Henze, Effects of Position and Alignment of Notifications on AR Glasses during Social Interaction, in: Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society, NordiCHI '20, Association for Computing Machinery, New York, NY, USA, 2020. URL: https://doi.org/10.1145/3419249.3420095. doi:10.1145/3419249.3420095.

[10] N. Janaka, C. Haigh, H. Kim, S. Zhang, S. Zhao, Paracentral and Near-Peripheral Visualizations: Towards Attention-Maintaining Secondary Information Presentation on OHMDs during in-Person Social Interactions, in: Proceedings of the 2022 CHI Conference on Human Factors in Computing

Systems, CHI '22, Association for Computing Machinery, New York, NY, USA, 2022. URL: https://doi.org/10.1145/3491102.3502127. doi:10.1145/3491102.3502127.

[11] F. A. Epp, A. Kantosalo, N. Jain, A. Lucero, E. D. Mekler, Adorned in Memes: Exploring the Adoption of Social Wearables in Nordic Student Culture, in: Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems, CHI '22, Association for Computing Machinery, New York, NY, USA, 2022. doi:10.1145/3491102.3517733.

[12] A. Mackey, S. Wensveen, R. Wakkary, A. Hupfeld, O. Tomico, Wearing Digital Shimmers: A fashion-centric approach to wearable technology, in: Proceedings of Research Through Design 2019, 2019. URL: http://phem.design. doi:10.6084/m9.figshare.7855862.v2.

[13] A. Mackey, R. Wakkary, S. Wensveen, A. Hupfeld, O. Tomico, Alternative Presents for Dynamic Fabric, in: Proceedings of the 2020 ACM Designing Interactive Systems Conference, Association for Computing Machinery, New York, NY, USA, 2020, p. 351–364. doi:10.1145/3357236.3395447.

[14] S. Şemsioğlu, P. Karaturhan, A. E. Yantaç, EMOTE: An Interactive Online Tool for Designing Real-Time Emotional AR Visualizations, in: 13th Augmented Human International Conference, AH2022, Association for Computing Machinery, New York, NY, USA, 2022. doi:10.1145/3532525.3532527.

[15] H. Pohl, A. Muresan, K. Hornbæk, Charting Subtle Interaction in the HCI Literature, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '19, CHI '19, Association for Computing Machinery, New York, NY, USA, 2019, p. 1–15. URL: https://doi.org/10.1145/3290605.3300648. doi:10.1145/3290605.3300648.

[16] F. F. Mueller, N. Berthouze, M. Sra, M. Gonzalez-Franco, H. Pohl, S. Boll, R. Byrne, A. Caetano, M. Inami, J. Knibbe, P. O. Kristensson, X. Li, Z. Li, J. Marshall, L. P. Matjeka, M. Nygren, R. Patibanda, S. Price, H. Reiterer, A. Saini, O. Schneider, A. Shahu, P. O. T. Dugas, D. S. Elvitigala, Grand Challenges around Designing Computers' Control Over Our Bodies, in: Proceedings of the CHI Conference on Human Factors in Computing Systems, CHI '26, Association for Computing Machinery, New York, NY, USA, 2026. doi:10.1145/3772318.3790606.

[17] H. Pohl, R. Murray-Smith, Focused and Casual Interactions: Allowing Users to Vary Their Level of Engagement, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '13, ACM Press, New York, New York, USA, 2013, pp. 2223–2232. URL: http://dl.acm.org/citation.cfm?doid=2470654.2481307. doi:10.1145/2470654.2481307.