Designing for Everyone: Bystander Signaling for Smart Glasses

Abstract

Designers of smart glasses face the challenge of how to inform people when smart glasses wearers are taking photos or videos. This paper details the framework we've used to think about how to tackle this nuanced challenge, which was informed by research and conversations with policymakers as well as the public. As with all novel technologies, how these glasses signal photo and video capture to "bystanders" – people around the smart glasses wearer – will continue to evolve. However, we share here some of the most salient social and technological factors we've considered when building the early generations of our own smart glasses with bystanders in mind.

Introduction

Smart glasses have introduced the novel combination of traditional glasses and photographic capabilities (also known as "capture"), offering hands-free ways to capture a moment so people can be more present with friends and family. It's an evolving technology which a number of peers are exploring as a means of removing the barriers between people's in-person experiences and their devices. Given the novelty of the technology, we know we must establish new ways to inform people who might be in the proximity of someone wearing smart glasses when that person is using the photo or video capabilities. We call these people around the wearer "bystanders." This practice of "bystander signaling" currently has no standard industry solution for smart glasses. As a result, we have invested in understanding the nuances of this human-centered design challenge.

This paper lays out our framework for approaching this challenge, which has been informed by primary and secondary research, stakeholder engagement, and product testing. The framework considers users and bystanders, and a host of factors that could impact the smart glasses experience for either.

As a result of this work, one of the key features we have built into our smart glasses from the start is a "capture LED," which leverages the now widely-accepted blinking light model associated with cameras. This paper outlines why we chose the capture LED against other potential options for signaling, based on our framework. As with all novel technologies, these signals will continue to evolve as cultural awareness evolves, and we will continue to work with experts and the public to refine this important feature.

Drawing from precedent: privacy & the history of camera design

Meta's smart glasses journey and the creation of principles

In 2021, we launched Ray-Ban Stories in partnership with EssilorLuxottica: smart glasses that provide an authentic and hands-free way to capture photos and videos so people can stay present with friends, family, and the world around them.

Smart glasses have huge potential to help people build community and deepen connections, from sharing adventures, to livestreaming special moments, to messaging friends and family hands-free. This is core to Meta's mission, and we're continuing to explore ways in which this novel tech can benefit society and people from all backgrounds. As with all the new technologies we build at Meta Reality Labs, our work is guided by our Responsible Innovation Principles. These principles include "consider everyone," including people who don't use our technology, and "never surprise people." We build with this in mind—conducting research and working with in-house and outside experts so that we can build tools that support responsible product use, taking bystander privacy into account.

While it is not possible to solve by design every issue that arises through bad actors or misuse, we strive to innovate responsibly and build smart glasses that are not just accepted, but welcomed into everyday life.

To help guide the industry's approach to achieving this, it is instructive to look back on previous instances where the development of new technology has coalesced with photo and video capture.

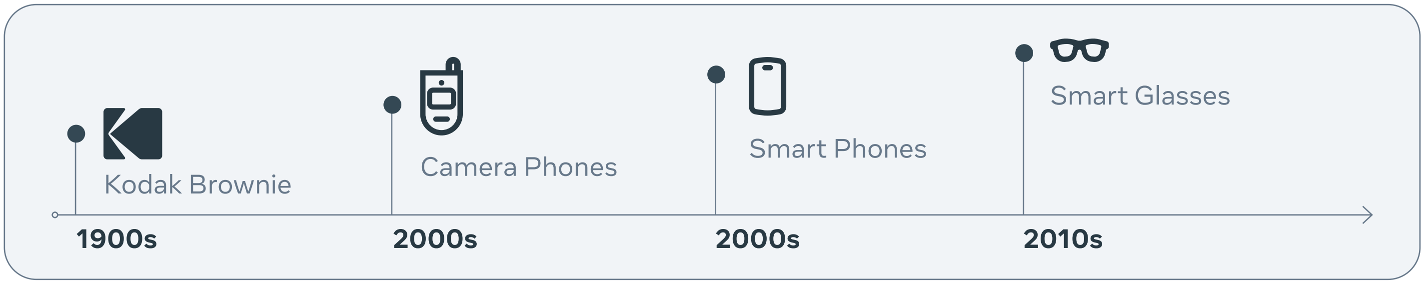
The evolution of cameras and smartphones: design cues to signal capture

Drawing on the history of cameras helps us situate smart glasses within a longer history of people's privacy concerns with photography, and understand how our smart glasses draw on social norms informed by traditional camera design.

As far back as the introduction of the Kodak Brownie camera in the early 1900s, society has grappled with how cameras can impact the expectations for privacy and consent for everyday people who may appear in photos or videos with or without their knowledge.[1]

These questions compound when camera technology shows up in society in new ways. When the camera phone debuted in 2000, people feared it would enable discreet photography in unsuspecting places. This was in large part because people didn't expect a cell phone to take photos. This sparked concerns around privacy and photography in ways reminiscent of those raised with the Kodak Brownie.

Early designs for camera phones incorporated features that echoed those on traditional cameras (i.e., a flashing light and shutter sound), which helped users become familiar with using camera phones. It also ended up signaling to bystanders when a photo was being taken, helping them understand what the new technology was doing and recognize when capture was happening.



1. The introduction of Kodak's portable (but still relatively expensive) camera in 1888 - the predecessor to the Brownie - subsequently led to Samuel D. Warren and Louis D. Brandeis' 1890 seminal article "The Right to Privacy" in the Harvard Law Review.

Where cameras are today: a shift in cues to capture

What this history suggests is that smart glasses are a new iteration in the evolution of capture and may generate some of the same past concerns—once again raising important questions about cameras and privacy.

Following the modern-day proliferation of smartphones, society is now generally aware of the possibility of people using smartphones to take photos, videos, and livestreams when they are in public spaces like a beach or a concert. As such, technical cues (e.g., flash, shutter sound) have become less common.

Instead, informal visual cues associated with these actions—for example, raising a phone—have become effective and well-understood signals built on a widely-shared cultural understanding of when someone is capturing a moment. When bystanders see these cues, they can usually react accordingly (e.g., stepping out of the frame of the shot if needed).

Technical cues are important to novel devices. As smart glasses with cameras continue to develop, we can consider these lessons from the past regarding the intersection of design and visual cues, while keeping in mind how novel components can affect precedent.

That's why we are working to account for bystanders, their privacy, and existing social norms in our product design to help people learn to recognize devices and their capabilities over time.

Our framework for bystander signaling: smart glasses design considerations

Getting to a framework: re-examining existing social cues

As we lay out above, smart glasses are a novel technology and people do not yet expect glasses to have cameras, just like the early camera phones of the 2000s. Without some sort of signal, people may not necessarily recognize when recording may be happening.

Therefore, a key design consideration for effective signaling with smart glasses is how to leverage known cues associated with photos or videos, enabling people to become accustomed over time. For example, a camera's flash was initially a necessary function of capturing enough light in the camera, but has since evolved to be a signal that can also communicate to others that a photo/video is being taken. This increases the likelihood that people who see the signal will understand what could be happening with the device.

However, as technology evolves, so too do associated expectations and norms. While we aim to leverage existing cues, we also recognize the unique attributes of cameras on glasses—versus cameras on phones—and the resulting impacts of their differences in how we approach signaling to bystanders.

Given the continuous evolution of this space, we regularly gather feedback from an international community of policy thinkers, regulators, users, and the general population to inform our framework for developing and assessing "bystander signaling" for smart glasses, and continue to examine our approach in consideration of the industry, society, and diverse populations.

As part of this work, we have leveraged advisory councils with numerous experts recruited across the globe who specialize in relevant topics, such as privacy and XR technology, to advise on our approach to issues like privacy and transparency. We engage with these experts early so we are able to test ideas and receive feedback on our approach throughout the product development process. It is crucial that we not only gather feedback but also incorporate that feedback in meaningful, tangible ways.

Based on these engagements, we have set out a framework (described below) which we believe defines the criteria and considerations required to design for bystander signaling in the most comprehensive way that exists currently. In the absence of industry standards, we hope to begin a more robust conversation about how to tackle this problem as thinking and adoption of the technology matures.

A framework for smart glasses: visibility, interpretability, & social comfort

From a product perspective, early thinking for bystander signaling when we built Ray-Ban Stories considered that for a signal to be helpful it should be:

- **Consistent:** Produced *whenever* the action happens
- **Perceivable:** Clearly *detected* by bystanders who might be impacted
- **Communicative:** Indicates to bystanders *what* is happening
- **Unobtrusive:** Not overly *annoying* to either bystanders or users

An effective signal also needs to avoid potential pitfalls and take into account some key trade-offs. For example, we need to balance the need for clarity with the desire to not be too distracted or disturbed. In particular, we aim to ensure that the signal maintains its value by avoiding:

- **Over-signaling:** Signaling too often or for things that may not be relevant to bystanders
- **Overloading:** Signaling in different ways that makes it difficult to understand what is happening (e.g., many different LED patterns, or many different LEDs)

Research helps us examine different factors and incorporate a range of inputs into a framework, including:

- **Primary research with participants to reflect diverse populations**, taking into account how people's different backgrounds and lived experiences may influence their interpretations of different technologies and signals.
- **Secondary research into academic and scientific findings** to leverage foundational knowledge and insights (such as on visual perception, attention, memory, reasoning and decision-making, signal detection and comprehension, etc.).

Based on research and evaluation, we arrived at **three overarching criteria** guiding the development of bystander signaling for our smart glasses:

- **Visibility:** How well people see that something may be happening on the glasses that could involve them. We examine the visibility of signaling in a variety of situations and environments.
- **Interpretability:** Whether people understand if what is happening on the glasses may involve them. Visibility is a precursor to interpretability—that is, you need to be able to see the signal to interpret what it means. We examine people's recognition of different signals to ensure that our signals are relevant and easily understood.
- **Social Comfort:** Whether people feel comfortable being around the device signaling. We also consider social comfort for users, and whether they feel comfortable and safe wearing a device with that signal.

Solutions and trade-offs: how we arrived at the capture LED for bystander signaling

Given the criteria set out from the beginning (consistent, perceivable, communicative, and unobtrusive signaling), the "capture LED" has emerged, to date, as an effective method of signaling to bystanders that a user is taking a photo, capturing video, or livestreaming.

We did consider a variety of potential bystander signaling methods, including with sounds, bearing in mind the unique form factor of glasses together with the specific circumstances and settings in which these glasses would be used. However, we found limiting factors emerged when mapping audio signaling methods against our framework:

- While we have built in user-facing audio cues for *wearers* to have confidence when capture is happening on the glasses, we found that an audio signal did not meet our criteria for *bystander* signaling.
- Although camera phone apps do have a shutter sound (which can usually be disabled), audio cues at a reasonable volume for people wearing the device risk being too quiet for bystanders to hear, especially at longer ranges which the LED can easily reach.
- While a shutter sound at the start of capture could work for photo capture as it leverages existing cues associated with traditional photography, there is no such equivalent audio cue during the duration of video capture.
- Conversely, audio cues risk alerting people who may be around the wearer but won't be impacted by the glasses camera (e.g., behind the wearer), potentially causing confusion and introducing social discomfort.

Given these constraints, visual cues emerged as a more comprehensive signaling method, particularly since light has been associated with image-capturing technology for decades. Leveraging this as a signal in smart glasses helps bystanders associate these devices with recording more quickly, threading the needle between novel technology and a shared past.

An effective capture LED fits our criteria:

Visibility: The brightness of an LED can be adapted to notify bystanders even at a distance, without impacting the user experience.

Interpretability: The LED pattern can leverage existing associations between light and capture.

Social Comfort: Social comfort is a result of the above two criteria being met while not creating any negative effects like being overly distracting or disruptive to others around the glasses.

Effective Bystander Signaling

Testing and refining: insights for the next generation of smart glasses

Capture LED on our *first* generation of smart glasses

As detailed above, through iteration, learning, and engaging with users, the general population, experts, and advocacy groups, we have found that an effective bystander signal should support bystander awareness and understanding of device use, as well as social comfort for both the bystander and user.

The specific implementation of the capture LED is impacted by further environmental, situational, and hardware factors that—in turn—could impact visibility, interpretability, and social comfort.

These factors include things like:

- Different **distances** between an LED on glasses and bystanders
- Outdoor and indoor **environments**, because changes in ambient light can impact visibility of the LED
- **LED sizes**
- **LED patterns**, including static behavior (i.e., a solid light) and dynamic behavior (i.e., a pattern that has motion), because motion can impact visibility and interpretation
- Glasses **frame colors**, because a color that surrounds an LED aperture can impact how the LED appears and thus visibility of it (e.g., lower contrast of lighter colored frames and higher contrast of darker colored frames)

Capture LED on our *second* generation of smart glasses

Our research, engagements, and signaling framework have been reflected in how we designed the newest iteration of the capture LED. The new iteration of the capture LED in our Ray-Ban Meta smart glasses will be larger than the original one in Ray-Ban Stories (2mm compared to 0.9mm), and will have a dynamic blinking pattern when used to take photos, videos, or livestream instead of a static solid light. This new iteration also has tamper detection technology built in, so that capture is not enabled if the capture LED is covered—with a notification to the user to uncover the LED to re-enable capture capabilities.

Ray-Ban Meta smart glasses, as well as Ray-Ban Stories, use an ALS (Ambient Light Sensor) to change the brightness of the capture LED based on the ambient lighting of different environments—adapting to different lighting conditions in the real world. The LED is visible in bright outdoor spaces up to at least 12ft, and indoor spaces up to at least 24ft. All of these changes are made with a view to increasing visibility, interpretability, and social comfort for our capture LED.

Conclusion

As we continue to iterate on our products, we will combine past principles with novel improvements to increase the comfort of those wearing smart glasses as well as people around them.

Effective signals draw on the informal principles that have been established by cameras, phones, and other devices, but smart glasses will require us to continually make necessary improvements to ensure everyone feels comfortable as this technology grows in use.

The solution to help bystanders know when photo or video capture is happening will change over time as people become more aware of, and familiar with, smart glasses. We will continue to leverage and refine the principles identified in this paper through conversations and research to ensure that we “consider everyone” as we continue to build smart glasses technology.

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