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UX Challenges for Conceptualizing Interfaces on Smart Glasses With Displays

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ABSTRACT

Smart Glasses with displays are making significant strides in the wearable device market distinct from extended reality (XR) devices (Hillmann, 2021) by integrating into daily activities and projecting experiences like smartphone usage via interfaces displayed directly within the user's field of view. In this context, the primary challenges for UX designers creating interfaces for Smart Glasses involve visual constraints associated with compact screens, as well as usability and energy efficiency issues. These factors are compounded by the innovative nature of conversational interfaces linked to AI interactions and the way visual interfaces affect the user experience and physical interactions. The development of these interfaces expands the discourse surrounding interaction and usability limitations in Smart Glasses. This article presents research into interfaces for Smart Glasses with displays, mapping the challenges that shape UX designers' approaches. We structured an exploratory study (Gil, 2021) to gather information on the device's UX specifications. The collected material includes manufacturer documentation and enthusiast evaluations sourced from forums and social media. The identified challenges include distinct mental models and gesture patterns that increase interaction complexity; compact displays that affect content legibility and input comprehension; colors and visual hierarchy, which impact user experience and influence interface decisions. Therefore, this article aims to broaden the discussion on Smart Glasses, considering the market's growth and the UX design challenges involved in conceiving interfaces for this new technological platform.

Keywords: User experience, Smart glasses, Interface, Exploratory research

INTRODUCTION

The wearable technology market has been gaining popularity due to its ease of use and physical interaction. Products such as smartwatches, fitness bands, virtual reality glasses, and Smart Glasses have been growing in consumption among users who are enthusiasts of new technologies. In the context of Smart Glasses, the market in 2026 shows a surge ranging from 110% to 130% compared to 2025, according to IDC (2026). They also predict that Smart Glasses with AI will lead the extended reality technology market. According to the same source, the growth in consumption of this type of device can be attributed to its practicality, the presence of AI, and being lighter and more compact than virtual reality glasses. Compared to XR devices, Smart Glasses can be understood as a more accessible device for everyday needs, being

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more discreet, requiring fewer interactions, and being physically closer to sunglasses or prescription glasses.

Analyzing the evolution of hardware and interactions over time, it is possible to observe that we have gone through devices that were more limited, with smaller screens, heavier structures, and focused on essentially basic functionalities such as calls and text messages. Next, we entered the touchscreen era with the popularization of smartphones with displays, which use touch-based interactions and introduced a wide range of functionalities aimed at consuming various applications concentrated in a single device, until we finally reached the Google Glass, which is the pioneering reference to the idea of projecting data and voice commands directly into the eyes. Following this timeline up to the present day, we arrive at reference devices such as Meta AI glasses, which represent a significant advancement in wearable technology by offering a range of devices with AI integration, but still depending on smartphones, which function as an essential central processing device for the equipment that still have limited hardware capacity.

Smart Glasses represent not only a technological advancement but also bring changes in the way users interact with devices by introducing new interaction methods that differ from the usual ones in technologies already established by users. Despite these devices being more compact and presenting functionalities similar to smartphones, the input methods become challenging when we understand that in glasses with a display, there is a screen positioned on a visual axis while the device inputs are on another, usually located on the stem of these glasses, bringing an interaction format that is not very intuitive for new users of the technology. Given this, the familiarization process requires time for practice and a learning curve that needs to be considered, which directly affects how interfaces should be presented and indicate how the user can interact with them.

Although Smart Glasses are more compact and easier to use compared to XR headsets, they have significantly lower processing power, bringing challenges in the field of design. It is necessary to balance the resources and functionalities offered by these devices, focusing on low-friction usability experiences, efficiency of the visual elements displayed, and low energy consumption so that the application and use of the interface align with the nature of the device and the practicality in daily use.

The objective of the study is to highlight how these display aspects influence the visual characteristics of the interface, pointing out the existing graphic patterns in smart glasses on the market, their similarities and differences, and how these devices and their particularities bring challenges to the field of design.

The article is structured into three sections: in the first, we present the methods used in conducting this research, addressing the processes of data collection and comparison of devices with this technology already existing in the market, as well as previously published studies on the topic. In the second section, we discuss the process of analyzing and building interfaces for smart glasses displays and the visual decisions made based on the hardware power

offered by these devices. Finally, we will present findings related to the general technical aspects of existing displays in the market, as well as best practices from a UX designer's perspective, aiming to contribute to knowledge-sharing processes regarding this context.

METHODOLOGY

In exploring scenarios regarding the visualization of graphic elements on smart glass displays, the methodological approach aligns with the research principles of Antônio Carlos Gil (2024), aiming to foster greater familiarity with the topic and render the research problem, and its object of study, more explicit and comprehensible. The flexibility inherent in this methodology allows for the combination of various research techniques, thereby deepening the contextual understanding of the issue at hand; while bibliographic data is collected, the approach is not limited to this format alone, favoring a more diverse dataset that enriches the discussion and transforms a novel, complex subject, such as interface design for smart glass displays, into a structured process of discovery.

Based on Gil's (2024) classification of research objectives, this study is exploratory in nature, focusing on gaining greater familiarity with the problem; Smart Glasses represent one of the most modern wearable technologies on the market, offering ample scope for studying and observing the factors that influence the user experience. This type of research entails an extensive literature review to understand existing knowledge regarding the subject.

To facilitate the bibliographic research and delve into a practical analysis of Smart Glass interfaces, desk research and benchmarking techniques were employed in an integrated manner. The process began with desk research, involving the collection and screening of existing secondary data, to examine device hardware specifications and review literature on the impact of colors and battery consumption, thereby clarifying the glasses' limitations. Concurrently, benchmarking was used to investigate models already on the market, aiming to compare specific interface elements, such as display size, visual element colors, icon styles, and pixel counts, to identify prevailing patterns, highlight strengths and weaknesses, and cross-reference findings with the desk research; this approach helped elucidate how visual aspects of the displays interact with the hardware's physical and power-related characteristics. Combining these two techniques, within the methodological framework proposed by Gil (2024), provides the necessary foundation to initiate design discussions and map out interface elements and their most influential characteristics suited to the context of this device.

This study conducted a benchmarking process analyzing the most popular smart glasses with displays on the market, focusing on their interfaces and the visual elements that structure them, identifying commonalities, and highlighting the factors that differentiate and distinguish certain devices. To compile this information, a table listing the key devices was created, as shown in Table 1:

	Display	Tutorial / Onboarding	Inputs	GUI/UI	Apps & Features
META	• **Resolution:** 600×600 • **Brightness:** 5,000 nits • Monocular LED colored LED • **FOV 20°**	• On the app – companion & on the glasses display	• Touch controls (temple touch tap sensor) • Microphone (w/ dual noise-cancelling) • Speakers & integrated camera • Meta neural band	• Colorful Rich GUI	• Transcription • Translation • AI Assistant • Environment navigation • Notifications
XRAI AR2	• **Resolution:** 640 × 480 • **Brightness:** 2,500 nits • **Full frame** display	• On the app – companion	• Physical UI (touchpad and buttons) • Microphone (360°) • Speaker (speaker identification) • NO Camera	• Green Text Based	• Transcription • Translation • XRAI Stream
INMO GO	• **Resolution:** 640×480 • **Brightness:** up to 2,900 nits (adjustable) • **Micro-LED** Diffractive Waveguide (optical display) • **FOV 30°**	• On the Glasses • Part on the app-companion	• Physical UI (touchpad and buttons) • Microphone (1) & Speakers (2) • Ring (INMO - optional) • NO Camera	• Green Text Based	• Translation • AI Assistant • Invisible teleprompter • Walk navigation • Notifications

(Continued)

	Display	Tutorial / Onboarding	Inputs	GUI/UI	Apps & Features
EVEN REALITIES G1	• **Resolution:** 640×200 • **Brightness:** 1,000 nits • **Head-Up** Display (HUD) • **FOV 25°**	• Half on the app - companion • Half on the Glasses	• Touch controls • Microphone (2) • NO built-in Speakers • NO Camera	• Green Text Based • Minimalist GUI	• Transcription • Translation • AI Assistant • Teleprompter • Navigation • Voice/Quick Notes
LENOVO VISION AI GLASSES V1	• **Resolution:** 640×480 • **Brightness:** 2,000 nits • **Micro-LED** (green-only) • **FOV 30°**	• Half on the app - companion • Half on the Glasses	• Touch controls • Microphone (dual) • Speakers • NO Camera	• Green Text Based • Minimalist GUI	• Transcription • Translation • AI Assistant • Teleprompter • Navigation
VUZIX BLADE 2	**Resolution:** 480×480 **Brightness:** 2,000 nits Wave Guide Projection Technology Color Display **FOV 20°**	• On the app - companion	• Touch controls (temple touch tap sensor) • Microphone (w/ dual noise-cancelling) • Speakers • Camera	• Colorful Rich GUI	• Transcription • Translation • AI Assistant • Environment navigation • Notifications

This analysis allows for a visualization of which elements are fundamental to the visual structure of a smart glasses interface, as well as the characteristics most commonly found in such displays, and which ones could be significant additions to a visual design tailored to this context.

DISCUSSION

Expansion of the Smart Glasses Market

According to IDC data (2026), the smart glasses category recorded 167% year-over-year growth in the first quarter of 2026, with over 2 million units sold during the period. By comparison, sales of virtual and augmented reality headsets rose by 86% over the same timeframe. These figures highlight the growing public adoption of smart glasses, spearheaded by the Meta and Ray-Ban partnership, driven by their potential to replace extended reality (XR) headsets thanks to a lighter form factor better suited for everyday use. Simultaneously, the integration of AI agents adds another layer of utility for users. Smart glasses appear to be fulfilling the promise made over the last decade regarding the increasing relevance of XR devices in the consumer technology market, a promise that gained traction via the Metaverse during the COVID-19 pandemic, when Meta argued these devices would become increasingly vital for remote work and isolation scenarios. That initial promise had previously gone unfulfilled due to issues such as device weight, battery limitations, and price, which rendered the user experience uncomfortable and impractical for work tasks and outdoor leisure activities.

In this context, smart glasses offer even greater potential for user adoption and integration into daily activities. Their integration with AI assistants, combined with their weight and conventional eyewear design, positions them for widespread acceptance, despite lower processing power and graphical limitations. Data from IDC (2026) indicates that growth in smart glasses consumption is driven by products that lack a display but feature AI, a camera, and smartphone connectivity, while also accommodating prescription lenses. In the first quarter of 2026, shipment volumes for screenless smart glasses nearly matched the total volume for the entire XR headset category throughout 2024. IDC projects shipments of approximately 13.6 million units for 2026, rising to 27.3 million by 2030.

This shift in market direction is driven not merely by form factor considerations, but by the value different device types offer users. VR and/or AR headsets aim to deliver an immersive experience—featuring complex visuals and interactions as well as high-resolution displays—that users associate with gaming and entertainment. In contrast, smart glasses offer a simplified user experience with minimal interaction, focusing on AI features, notifications, and concise content, while resembling traditional eyeglasses or sunglasses. These devices are designed to address users' everyday needs through AI assistants, offering capabilities ranging from simultaneous translation and real-time teleprompting to support for sports activities, such as aids for runners[1] and golfers.[2]

[1]Oakley Meta Vanguard, available in <https://www.oakley.com/pt-br/l/oakley-meta>
[2]BirdiLens AR Smart Glasses, available in <https://birdilens.com/products/smart-ar-glasses>

As previously mentioned, the differences between traditional XR headsets and emerging smart glasses with displays go beyond form factor and AI assistant integration. Smart glasses with displays expand usage scenarios and perceived utility by shifting away from high-intensity graphical experiences toward providing information that supports users' daily lives. While traditional headsets have faced limitations regarding integration into daily routines—with most users viewing them primarily as platforms for gaming and entertainment (Shatokhin, 2025) rather than tools for other everyday tasks—smart glasses with displays focus on experiences such as simultaneous translation with live subtitles, hands-free GPS navigation, and instant notifications. They also offer features for content creation and, crucially, information retrieval to provide quick answers that enrich daily life. Despite their compact and practical physical design, smart glasses require simplified visuals to deliver objective, useful information without distracting the user from the real world. In this context, the visual interface of smart glasses presents a fresh challenge for UX designers, who must develop new interfaces for this type of information-driven experience—one defined by constraints regarding processing power, energy consumption, and visual elements.

Comparison of Smart Glasses

In the realm of smart glasses with displays, the primary distinction between these devices lies essentially in the overlay of visual information, user interfaces (UIs) floating within the real-world view, and where their main inputs are concentrated. This distinction impacts not only device operation but also hardware specifications and battery consumption. With these factors in mind, this study focuses on display-equipped devices that utilize lenses incorporating visual technologies to function as information displays, examining the opportunities and limitations such displays present for interface system design.

Regarding smart glasses with displays, benchmarking reveals that most devices prioritize elements ensuring interface legibility and portability. Among the references studied, the Even Realities G2 exemplifies a focus on on-screen information legibility by employing an interface centered on concise text, notifications, and minimalist, monochromatic visual navigation (Even Realities, 2026). A notable counterpoint is the Meta Ray-Ban Display, which offers a nearly opposite user interface and represents a significant bid to establish itself as the benchmark for this product category. Its color display and more complex interactions (Meta, 2026) go beyond mere practicality and minimalism, aiming instead to impress the user with graphic elements. The market positioning choices made by various existing devices highlight a wide range of differences in interface design, shaped by intended usage scenarios and each device's power capabilities.

Despite differences across usage niches, the current market for smart glasses with displays is moving toward interfaces centered primarily on specific functions and usage scenarios defined by each product. We are seeing the emergence of more targeted and circumscribed interface designs, as opposed to experiences focused on excessive, limitless content consumption—unlike what is seen with devices such as smartphones. These interfaces prioritize

displaying content at key moments rather than showing as much information as possible, reflecting a trend that is both necessary and challenging for UX and UI designers.

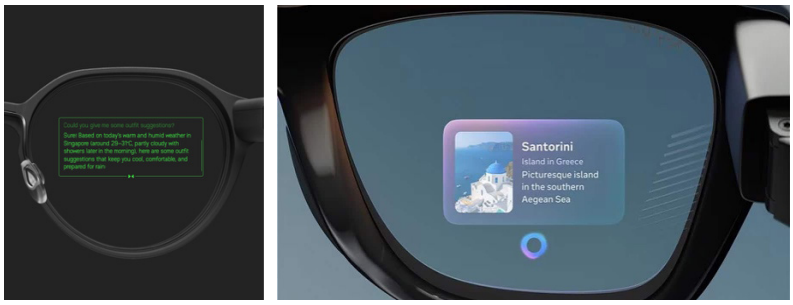


Figure 1: Even realities G2 (2025) e Meta Ray-Ban display (2025).

The Challenges for UX Designers

The changes described regarding the user experience—specifically concerning how information is accessed, supported, and consumed via smart glasses with displays—pose challenges for UX design processes. From a professional standpoint, creating these interface models requires developing concepts that balance physical space constraints with the need to keep the user's cognitive load at a reasonably comfortable level. Unlike smartphone screens, where high information density is made possible by focused visual attention, smart glass displays require a "glanceable" design—a concept that, according to Schmid (2026), represents the predominant mode of visual engagement for small screens and "always-on" devices, such as smartwatches. Designing for glanceability ensures that information can be absorbed in a fraction of a second without obstructing the user's view of the real world.

Reinforcing this concept, according to Matthews (2007), displays with "glanceable" properties allow for the rapid assimilation of data with minimal cognitive effort, requiring only a quick glance from the user. Beyond the quantity and size of the information presented by the interface, a second challenge relates to the viewing of moving visual elements, a context where the characteristics of "glanceable" interfaces become particularly relevant. Consequently, designing these interfaces requires attention not only to visual presentation but also to the efficiency of content access. Therefore, development must go beyond purely visual aspects such as size, position, colors, shapes, and contrast.

In the case of smart glasses, this is a particularly critical issue, as it prevents physical obstructions from putting the user at risk of accidents. This spatial constraint is further compounded by hardware energy efficiency issues, where complex graphic rendering and high brightness levels, necessary to overcome outdoor lighting conditions, rapidly deplete the device's battery.

Based on these discussions and coupled with the still-nascent sales growth of this device, UX design processes for these interfaces face technical dilemmas

regarding the conversion of complex flows into micro-interactions and atoms of contextualized information. The goal is to ensure that streamlining these elements fosters a more fluid and intuitive experience without compromising usability or user safety. An analysis of the impact on usability reveals a shift in the user-device relationship: moving from 2D usage experiences toward a more "immersive" context that delivers information at opportune moments, thereby reducing the cognitive effort required for content consumption. However, this technology must also contend with usability barriers, specifically regarding legibility and physical-world intrusion, as well as debates surrounding privacy.

These are the key challenges identified during our work developing interfaces for this emerging platform. They have become central to designing interfaces that successfully balance a strong user-centric approach with the technical and usability limitations inherent in these devices, which have yet to settle into a stable form factor.

RESULTS

Based on the analyses conducted, it is evident that the information architecture for smart glass displays requires minimalism and information synthesis in content presentation; given the elements involved in the interface design, every pixel contributes to increased energy consumption. Interface mapping must prioritize a flat visual hierarchy and a simple, linear task flow, avoiding complex menus, using a limited color palette, and eliminating purely aesthetic or decorative elements, thereby extending battery life and enabling continuous device usage. This presents a range of challenges for the designer, who, beyond standard interface design principles, must also consider the devices' technical limitations to simplify the design while preserving the system's practicality and operational logic.

A key feature of the smart glasses' usage ecosystem is multimodality, defined by the simultaneous combination of different types of data. Consequently, interface design must account for this multimodal integration, accommodating the coexistence of various inputs, such as voice, gestures, touch interactions, and computer vision. In this context, it is worth noting that audio instructions are a fundamental resource for these devices, facilitating the request and receipt of information and supporting task execution; this capability can eliminate the need for other devices, offering a distinct advantage for sports and other activities requiring focus and attention. Given these multimodal aspects, interfaces serve not only to provide feedback on interactions but also act as control interfaces by presenting simple menus and interactive buttons.

Regarding this discussion, we conclude that Smart Glasses interfaces generally need to meet various criteria dictated by the device's nature, such as cognitive lightness, readability, and the energy efficiency, to ensure superior usability. In this context, Smart Glasses interfaces are designed to facilitate the assimilation of on-screen content and information, enabling rapid reading while minimizing distractions and intrusions, thereby keeping the user focused on the real world. Consequently, interface design for

Smart Glasses requires attention not only to the information displayed but, crucially, to the timing of its presentation in a contextual manner, ensuring synchronization between the display and various types of inputs. Building on this, Rhodes (2025) proposes interfaces where the volume of information presented to users is dynamically managed based on the cognitive load of the tasks in which they are engaged. Thus, the method of information display is determined by the device's specific application domain.

Based on the methods used to map and understand these devices, covering their general characteristics, technical aspects, and usability, we established definitions for the key elements influencing the design of the interface for smart glasses with displays, adhering to the following requirements:

Positioning

Screen positioning impacts how the user interacts with the device, as well as visual comfort and natural gaze patterns. When designing for compact screens, content must be positioned for easy access to avoid illegibility and eye strain during use; the volume of on-screen elements should be reduced and strategically placed within areas suited for quick scanning. Reinforcing this approach, the positioning most frequently observed in the studied devices focuses on peripheral areas to prevent obstructing the user's central field of vision, the zone where visual focus is concentrated.

Drawing on studies of AR HWDs, Lages and Bowman (2019) explored adaptive information management while walking. Their results highlighted the importance of personalized virtual content placement, given that such content can obscure the real world. Consequently, positioning visual elements along central axes or scattering them across the display can lead to a loss of context regarding the displayed information and require the user to engage in exhausting eye movements. In this regard, keeping content in peripheral areas can make information access less intrusive while allowing users to monitor less critical tasks (Maglio, 2000). Lages and Bowman further suggest that interfaces should reflect how we naturally move through the world; thus, a primary design consideration for "glanceable" interfaces, as previously discussed, is that displayed content should move with the user to ensure mobility and continued access to information.

Visual Hierarchy

Visual hierarchy for smart glass displays must consider principles such as "glanceable" design, the peripheral placement of elements, and the contrast between the interface and the real world. In this context, Ding (2023) highlights the importance of the "glanceability" concept for micro-displays; its pillars, such as low cognitive load, a focus on context, and the presentation of micro-information, establish fundamental guidelines for quick and efficient viewing. Complementing these principles, the perception-time rule reinforces an essential aspect of interface design, requiring information to be organized into layers based on relevance and access frequency. Thus, data requiring

immediate reference, such as time, battery level, and weather conditions, might occupy the upper or lower peripheral areas of the display, while on-demand content, such as notifications, could form a secondary information layer. It is worth noting that this organization may vary depending on the usage context and the device's specific application niche, ensuring the precise definition of key information elements. Overall, interfaces should adopt a visual hierarchy based on elements that are quickly assimilated, such as icons and short text, while prioritizing transient content and avoiding the prolonged display of information or workflows that require multiple layers of navigation.

Glanceability

"Glanceability" is a core design principle of Glanceable AR, enabling users to assimilate information immediately and with minimal cognitive effort (Lu, 2021). According to Matthews *et al.* (2006), glanceable interfaces facilitate this instant assimilation of content while minimizing cognitive load and interruptions to the primary activity. In this context, interface design for smart glasses must prioritize the strategic distribution of information, particularly within the peripheral field of view, alongside hands-free interactions and high legibility, thereby enabling quick checks without compromising attention to the real world. These principles are especially critical for wearable devices, as users often interact with them while in motion and under varying physical conditions. Widgets exemplify this concept by presenting information that is compact, persistent, and easily accessible with a brief glance. Studies indicate that this approach reduces cognitive overload and fosters continuous access to information, thereby maintaining safety and interaction fluidity (Lu & Xu, 2022). Similarly, Gabbard (2019) demonstrate the viability of widgets in augmented reality environments, while Lu (2020) reinforces that positioning them in the peripheral field of view reduces visual intrusion and allows for immediate access to information when needed, in alignment with Glanceable AR principles.

Colors

The use of color and contrast is a topic that impacts not only visual hierarchy but also the energy efficiency of smart glasses, making it a decisive factor in interface design. Consequently, the challenge lies in balancing screen brightness against the transparency of the real world. When designing these interfaces, we must focus on low-saturation elements and maintain adequate contrast to ensure content remains legible.

Based on this, we have found that smart glasses featuring green monochromatic graphics, for instance, offer advantages by reducing eye strain and consuming less device power. Green models utilize only a single light channel for projection and are generally designed for simple text-based applications. Their advantages lie in their superior adaptability to varying lighting conditions, stemming from the human eye's heightened sensitivity to green light, which maintains brightness perception even during the day.

This makes the content display less intrusive compared to color displays; while color displays offer greater optical complexity, enabling richer, more detailed graphics and a more immersive experience, they face limitations regarding color visibility (such as on waveguide displays) and increase battery consumption, thereby reducing usage time.

Waveguide displays are characterized by technology that projects images directly into the eyes, enabling an integrated view of virtual content and the real world. Devices equipped with waveguide displays render higher-quality graphics; however, despite this superior technology, they offer a limited color gamut, and saturated colors may not render accurately (Ding, 2023).

CONCLUSION

In short, interface design for smart glasses requires breaking away from established paradigms associated with conventional screen formats, calling for a mental model shaped by energy efficiency and contextual relevance. An analysis based on the methods and key points reveals that the path forward for micro-scale interface design lies in minimalism and the concept of "glanceability." By mapping the most impactful characteristics of popular market devices, designers can leverage existing patterns to create a more functional and familiar experience while simultaneously fostering innovation, identifying opportunities to incorporate visual elements that serve as key differentiators. Thus, the interface ceases to be a visual barrier and becomes a new element to be explored, always prioritizing user attention, safety, and autonomy in the use of this wearable technology.

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