

Co-Designing AI-Powered Smart Glasses for Life-Logging Applications

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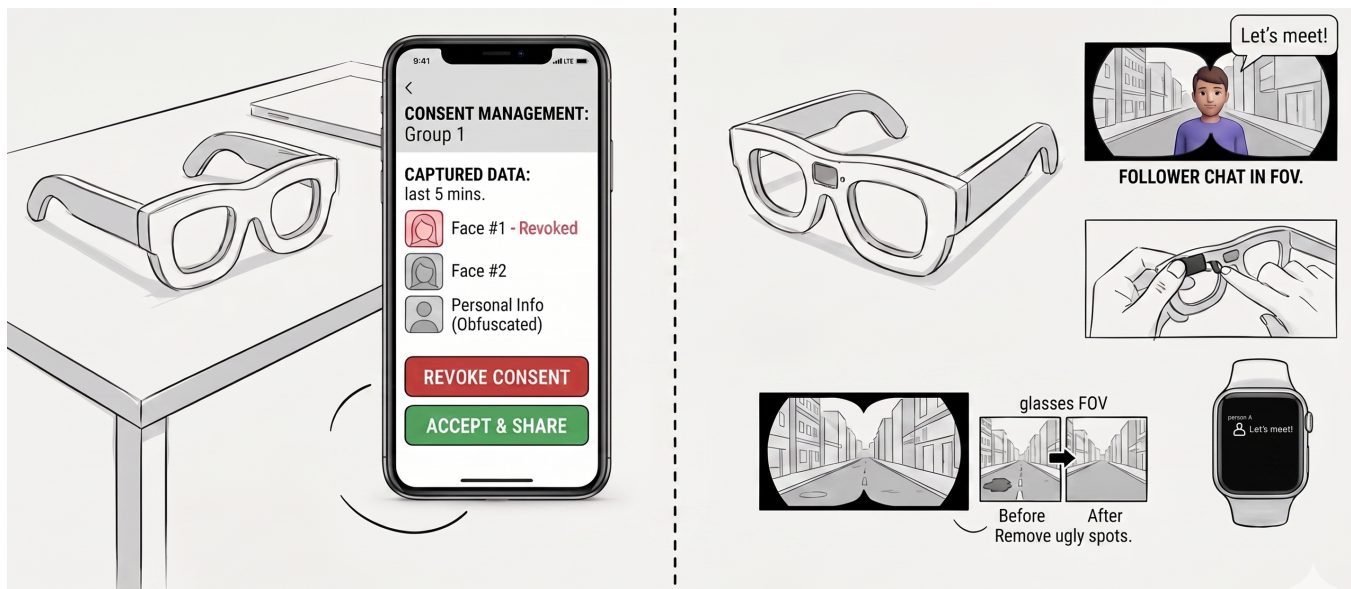


Figure 1: Designed prototypes for LLM-enabled smart glasses: Group 1 emphasized privacy & consent, while Group 2 explored social augmentation of surroundings in the field of view (FOV).

Abstract

Life-logging through AI smart glasses enables passive capture of everyday experiences and supports contextual assistance through large language models. However, the current literature shows a gap in the user-centered design of AI-powered smart glasses for life-logging. Through a co-design workshop (N=7), we investigated how we can support the development of AI-powered smart glasses for life-logging applications in a bottom-up approach. We conducted the workshop using Ray-Ban Meta Wayfarer Smart Glasses and followed the first four stages of the Design Thinking process. Participants explored technical, ethical, and usability challenges as they

generated concepts for life-logging applications. Key themes of design concerns included privacy, contextual awareness, augmentation, and social acceptability. Participants designed two low-fidelity prototypes to demonstrate consent-aware recording for bystander privacy and social augmentation. In this study, we identified a paradox in balancing system transparency with social acceptability in life-logging interactions.

CCS Concepts

• **Human-centered computing** → *Ubiquitous computing; Participatory design.*

Keywords

co-design, life-logging, smart glasses, LLM, wearable computing, privacy, participatory design



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1 Introduction

Life-logging with smart glasses has emerged as a powerful tool for understanding personal behaviors, routines, and growth. However, despite rapid advancements in artificial intelligence, current systems rarely capture the full complexity of everyday habits, social interactions, and user experiences [26, 29]. To prevent these technologies from becoming socially awkward, privately intrusive, or physically uncomfortable, technical development must happen alongside a deep understanding of personal values and real-world concerns [16]. Consequently, incorporating user-centered design from the earliest stages of development is vital. Within the current literature, the exploration of life-logging applications for Large Language Model (LLM)-driven smart glasses remains limited [26, 29]. This creates a critical gap between what the technology can theoretically do and what actual users need. When the users' perspectives are absent from the design process, the resulting devices risk failing to find a meaningful place in everyday life, regardless of how advanced the hardware is [29]. Co-design directly addresses this shortcoming by positioning end-users as active contributors, ensuring the technology reflects genuine, lived human experiences [24].

To address the open challenges, this work employs a co-design approach to design LLM-based smart glasses for life-logging that are not only technically capable but also meaningful, comfortable, and trustworthy in everyday use, focusing on the user-centered perspective. We conducted a workshop with seven participants interacting with the *Ray-Ban Meta Wayfarer* glasses and following the stages of the *Design Thinking Process*. We explore the following research questions: “*How do users envision life-logging applications for AI-powered smart glasses?*” and “*What concerns and design priorities emerge in the process?*”

Through the co-design session, we obtained two low-fidelity prototypes aiming at bystander-oriented protection and creator-centric augmentation. The resulting designs highlighted four critical dimensions: intelligent contextual awareness, privacy and ethical considerations, augmentation and visualization, and the social acceptability of life-logging with smart glasses. Crucially, these findings reveal a central paradox in life-logging interactions: balancing system transparency and user consent with feature functionality and social acceptability. Ultimately, this work contributes to solving the ethical and usability challenges inherent to AI-powered smart glasses, offering a clear roadmap for designing ethical life-logging interactions.

2 Related Work

Life-logging is broadly defined as the process of tracking and recording personal data created through our activities and behavior [11]. It involves the digital documentation of a person's daily experiences through wearable sensors, cameras, and other pervasive devices [17]. Different life-logging devices, such as Microsoft's SenseCam [18] and the OMG Autographer [1], have their use-cases in health management [8], self-tracking [15], and memory rehabilitation [3]. Smartphone-based journaling applications like Day One [2] and Journal [14] also exhibit user-input-controlled life-logging solutions. However, these developments come with major challenges of vast data volumes, sometimes hundreds of gigabytes of recorded legacy content over five years [10]. This makes retrieval,

annotation, and summarization of such data difficult. Recent advances in AI aim to address these challenges by improving how lifelog data is filtered, indexed, and controlled.

Recent works illustrate the use of LLM to retrieve lifelog data and generate narratives. AutoLife, a smartphone-based journaling application, utilizes phone sensor logs like time, motion, and location with zero-shot LLM to auto-generate daily life journals [25]. Another work follows a Retrieval-Augmented Generation (RAG) approach to retrieve lifelogs from OpenLifelogQA [21] dataset for question answering [22]. Both these works lack visual or audio data—a rather crucial form of lifelog data, thus limiting the exploration of context handling and privacy aspects. Recent literature has also investigated passive behavioral sensing with LLM prompts for more personalized, contextually-aware journaling experiences [19].

AI smart glasses like *Viture Beast* and *Ray-Ban Meta* leverage multiple sensing technologies, such as cameras, Inertial Measurement Units (IMUs), and microphones. Cutting-edge glasses use multi-modal sensors and LLMs to provide real-time contextual assistance and semantic understanding of captured data [23]. Human-Computer Interaction (HCI) studies on ubiquitous computing highlight concerns regarding privacy, social acceptability, and data ownership, particularly when recording occurs in public or shared spaces with always-on sensing [13]. These challenges are especially relevant for life-logging with smart glasses, where continuous capture may affect both users and bystanders [7]. Lifeloggers tend to either adopt community norms of self-governance by altering images that might expose individuals [28] or enable the other actors (the subject and bystander) with the right to dictate what to do with the lifelogs in which they appear [9, 12]. In response, researchers emphasize privacy-by-design features such as enforcing consent for third-party images and default anonymization [27].

3 Method

While rooted in the participatory design tradition, our approach is characterized as a structured co-design workshop, given the facilitator-led format and the use of expert users rather than end users. We used the *Ray-Ban Meta Wayfarer* (Gen 2) as the exemplary AI glasses to conduct the workshop. By engaging participants with a strong HCI background, the workshop served as a collaborative forum to explore use cases for life-logging in wearable contexts.

3.1 Participants

Seven participants (of age $M = 29.86$, $SD = 4.34$ in years) participated in the workshop. The sample consisted of six HCI experts, alongside one HCI Master's student. Although their academic backgrounds spanned these advanced technological fields, none of the participants had used the *Ray-Ban Meta Wayfarer* (Gen 2) before, as everybody responded with “1” to the question “I often use Smart Glasses in my life”, answered on a Likert scale from 1 (I fully disagree) to 5 (I fully agree). All participants resided in Germany and thus, are embedded in a specific legal and cultural context regarding data privacy, most notably the General Data Protection Regulation (GDPR), which is likely to have shaped their attitudes toward life-logging and pervasive technology.

3.2 Procedure

After welcoming participants, we explained the workshop's purpose and asked them to provide informed, written consent. We divided participants into two groups: Group 1 consisted of four members, and Group 2 comprised three. We asked participants to freely explore the functionality of the smart glasses, allowing us to collect initial observational data regarding the participants' firsthand impressions, reactions, and opinions. We initiated the practical portion of the workshop by introducing the *Design Thinking Process*, briefly explaining each of its five stages: empathize, define, ideate, prototype, and test. Given the exploratory nature of the workshop, we concluded the design process with the prototype phase, leaving out the testing phase and iteration cycle for future work. To ensure focus and efficiency within the teams, we selected a single method for each phase.

Subsequently, we began the co-designing session with the *Empathize phase*, illustrated in Figure 3 and Figure 4. During this phase, the two distinct participant groups had ten minutes to develop empathy maps to gain a nuanced understanding of the potential user personas of smart glasses for life-logging. It allows for a deep dive into user needs, behaviors, and pain points. Building upon these insights, the process moved into the *Define phase*. Participants were tasked with formulating "How Might We (HMW)" questions in five minutes, a technique used to reframe discovered challenges into actionable design opportunities. This shifted the focus from technical constraints to human-centric problem definitions. The *Ideation phase* utilized the 6-3-5 brainwriting technique. This structured approach facilitated the rapid generation of many ideas within a constrained time-frame, and we allowed another ten minutes for it. Following the intensive brainstorming session, the groups were allowed to use five more minutes to evaluate and select their most viable concept for further development. In the *Prototype phase*, they developed low-fidelity prototypes in 30 minutes using additional creative materials. This low-fidelity prototyping approach prioritized the visualization of core functions over aesthetic refinement. We concluded the design process with a presentation of the prototypes, followed by a brief discussion on future implications. The entire workshop was completed within 75 minutes.

3.3 Data Analysis

The data consisted of written feedback taken by two researchers observing the session in real time, participants' written materials, and prototype artifacts. The analysis was informed by the early phases of reflexive thematic analysis as described by Braun and Clarke [4, 5], particularly regarding data familiarization and inductive coding. Meaningful units of text were assigned descriptive codes manually, allowing individual excerpts to be associated with multiple codes where appropriate [6]. After coding the complete dataset, the codes were reviewed by the same researchers, refined, and merged to reduce redundancy and improve clarity. This process resulted in four distinct themes.

4 Co-Design Workshop Findings

The observations of the co-design workshop reveal four distinct themes, namely, (1) intelligent contextual awareness, (2) privacy and ethical considerations, (3) augmentation & visualization, and

(4) social acceptability of life-logging with smart glasses. Although both groups were given the same tasks throughout the workshop, they chose different life-logging scenarios. This was mainly due to the different user personas selected during the *Empathize phase*, during which group 1 empathized with bystanders' privacy while group 2 focused on a user with content-creation needs. Figure 2 shows the prototypes designed by the two groups during the prototype phase of the workshop.

4.1 Intelligent Contextual Awareness

Both groups repeatedly highlighted the system's capacity to *parse environmental data* (two mentions by participants in group 1, two mentions in group 2) to categorize lifelogs and reduce information overload. Participants proposed that the glasses should not analyze everything, but instead "recognize screens" or "items and things" to categorize data more efficiently. Among different *desired system features* (10 mentions in group 1, three in group 2), a key solution from group 1 for managing "too much data" was using the LLM to cluster information based on related keywords heard or read by the user. Participants of group 1 showed the desire for the system to actively "change or alter the source of information" if the user's decision-making or ideas were identified as biased by the AI. While group 1 envisioned contextual data as a tool to adapt to user needs, group 2 focused on using contextual data to proactively "augment and manipulate" the environment.

4.2 Privacy and Ethical Considerations

The findings show that through their ideation, mainly group 1 addressed the technical and legal safeguards designed to protect bystanders and maintain data sovereignty. During the *empathize phase*, both groups raised *concerns* for data invasion and legality (five mentions in group 1, 2 in group 2) – "am I invading someone else's privacy?", "Am I doing something illegal?" Participants co-designed *obfuscation features* (three mentions in group 1, one in group 2) to automatically "blur everyone in the picture by default" or change sensitive data like faces, emails, and phone numbers. As a measure to answer how we might reduce the awkwardness of users, Group 1 emerged with a form of a consent management app, allowing bystanders to "see footage" and "revoke consent" retroactively. Furthermore, to mitigate bystander ethical concerns, there was a requirement for "absolutely clear" signals on the glasses to inform bystanders exactly how and when a recording started.

4.3 Augmentation & Visualization

Participants from group 2 suggested scenarios where AI proactively enhances the user's reality and social reach since they empathized with users, particularly with content-creation needs. They envisioned "visual filters" that could erase undesired elements to make the captured environment look "amazing". Ideas included 3D avatars of social media followers appearing in the user's live stream, with AI voices allowing the user to "meet them in real-life". Scenarios depicted "chat hovering" over a smartwatch or integrated into the glasses' display to allow real-time engagement with a digital audience. On the other hand, to obfuscate sensitive information and clearly indicate when it has been altered by the system, there was one mention of watermarking the altered content by group 1.



(a) Prototype from Group 1 showing a user interface depicting the strategy of revoking consent retroactively.



(b) Prototype from Group 2 showing the RayBan glasses with a tape-blocked camera in front of a scenario drawing.

Figure 2: Low-fidelity prototypes from Group 1 (a) and Group 2 (b) developed during the co-design workshop.

4.4 Social Acceptability

There was a common theme of strategies to mitigate social friction. Participants reported that users might feel “watched,” “stressed,” and “concerned” about invading someone else’s privacy. To avoid social friction, group 2 hinted stealth strategies, such as covering the recording light with tape (in Figure 2b) or wearing earpods to make it appear as though the user is simply “on the phone” rather than talking to their glasses. The former, however, restricted the glasses from understanding visual-based contextual prompts. While group 1 suggested to “make the glasses stylish” to reduce awkwardness, group 2 preferred building the technology into “normal glasses,” pointing towards *perceived privacy* (two mentions in group 2). Group 1, although at first ideated on the feasibility of being told by the device to “talk to everyone” about the device’s advantages, later decided against it, fearing it might increase rather than decrease social awkwardness.

5 Discussion

The co-design workshop highlighted a divergence in how users conceptualize the integration of AI-powered smart glasses into life-logging applications. The exploration phase before the co-design workshop served as a useful foundation, generating inspirations that directly informed the subsequent design thinking process. By moving from abstract concerns in the *Empathize phase* to concrete artifacts in the *Prototype phase*, the participants bridged the gap between theoretical ethical challenges and practical design solutions.

Our co-design findings highlight bystander-oriented protection and creator-centric augmentation as the two main use-case scenarios, the core solutions to which hint towards obfuscation features and a consent management system. While both groups acknowledged the need for social and ethical safeguards, their physical solutions were diametrically opposed. Group 1’s prototype of a mobile consent management interface (Figure 2a) addresses the literature that privacy is a continuous negotiation [20]. By allowing

bystanders to revoke consent retroactively, we imply this design to shift the power balance from the wearer to the observed, treating privacy as an active governance process rather than a static binary. Group 2’s prototype (Figure 2b) utilized physical stealth strategies, such as using tape to block the camera light. This directly reflects the fact that social acceptability can be achieved through deception to mitigate the stigma of being watched [7], however, it imposes critical privacy issues and hence not deemed as a feasible solution. Across both groups, the co-designed scenarios indicate a shift from personal logging to active social performance. These findings suggest that an all-rounder UI for life-logging devices is rather difficult. Designers must decide whether to prioritize system transparency or social acceptability. The **consent paradox** identified here remains a primary hurdle: if the technology must be hidden to be socially acceptable, it cannot effectively provide the transparent signaling required for ethical bystander consent [7].

6 Conclusion

Our work contributes to ethical and usability challenges in life-logging with AI-powered smart glasses through a set of user-centric solutions, offering a roadmap for ethical life-logging interactions. A co-design workshop identified key challenges related to privacy, transparency, consent, and social acceptability of life-logging smart glasses. Beyond specific device design, we call for further work to navigate the consent paradox identified in our findings in the broader domain of pervasive, context-aware systems.

Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT 5.3 and the Gemini Thinking model to revise sentences and support in partially create the teaser figure. Grammarly was used for grammar and spelling checks. After using these tools, the authors reviewed and edited the content as needed.

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A Appendix

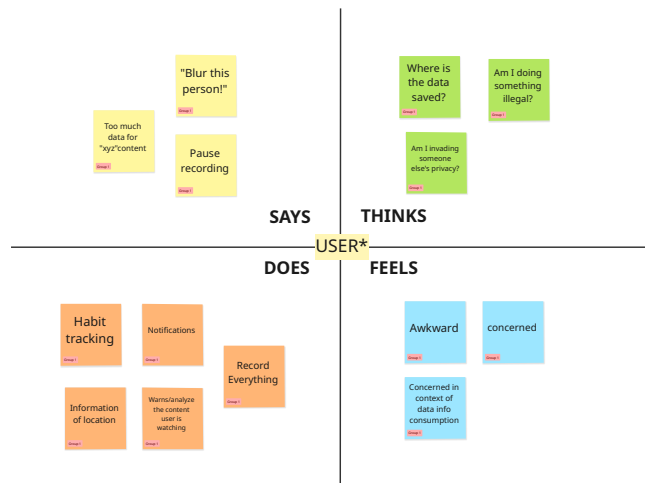


Figure 3: Resulting empathy map created by Group 1 during the *Empathy* stage, the first phase of the design thinking process.

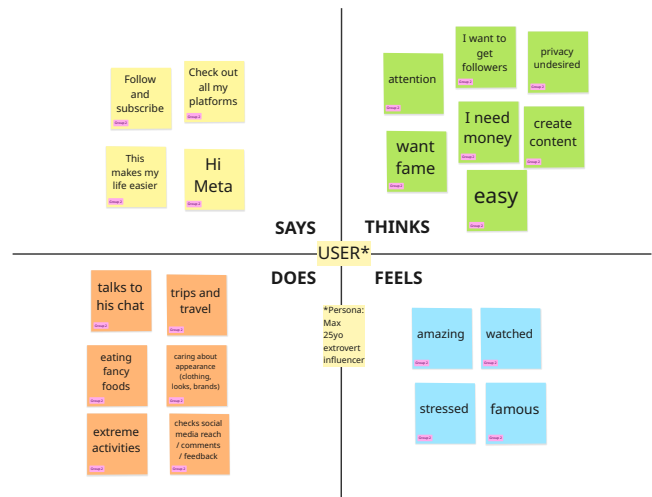


Figure 4: Resulting empathy map created by Group 2 during the *Empathy* stage, the first phase of the design thinking process.