EmojiFan: A Personalized Fan Designed for Visually Impaired Individuals to Express Themselves in Party Scenes

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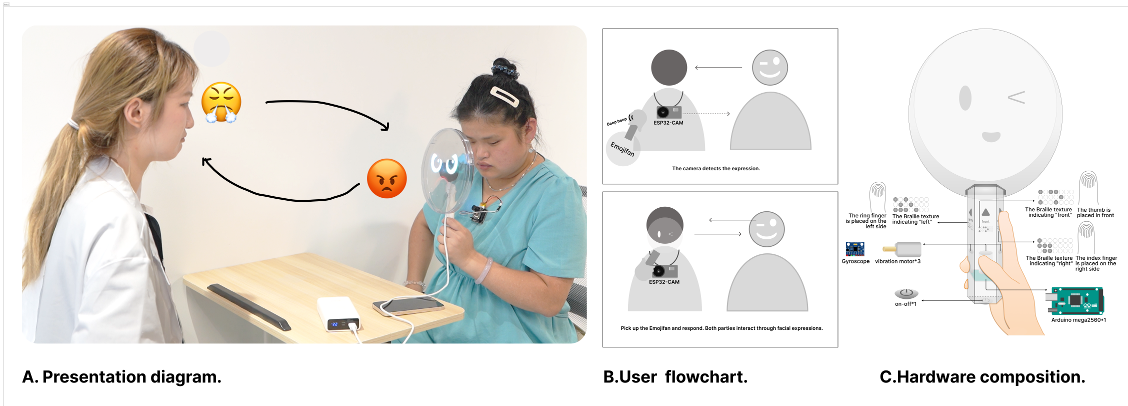

Fig. 1. (A) EmojiFan in use; (B) user flowchart; (C) hardware components.

How do blind and low vision (BLV) people ‘break the ice’ in party culture, respond to social cues of others, and express themselves quickly? In our formative study, BLV individuals express it is very difficult for them to perceive pre-interaction impressions of others in party social settings and respond appropriately in a timely manner. The absence of this ability can lead to missed opportunities for social connection, cause social isolation, and reduce confidence in initiating interactions. Although existing research has explored social interaction for BLV individuals, most of it focuses on accessibility and content comprehension in online contexts. The few studies on offline social accessibility are often ineffective in high-intensity, dynamic, multi-participant scenarios like parties. To address this, we propose an AI-assisted wearable fan system that helps BLV individuals capture the potential pre-interaction impressions in party settings and respond with timely facial expressions based on pre-set personalized prompts. It also helps unfamiliar social partners better understand the personality and emotional expression of BLV individuals, enhancing their social confidence and initiative in short or ice-breaking interactions.This work envisions a more inclusive social future, where BLV individuals can fluidly access and express interpersonal cues, bridging the gap between accessibility and emotional connection.

Additional Key Words and Phrases: BLV individuals, social ice-breaking, AI-assisted wearable devices, personalized feedback, offline social accessibility, emotion recognition

ACM Reference Format:

Anonymous Author(s). 2025. EmojiFan: A Personalized Fan Designed for Visually Impaired Individuals to Express Themselves in Party Scenes. 1, 1 (October 2025), 9 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

Manuscript submitted to ACM

1 Introduction

In urban culture, parties and social gatherings are key sites for building social connections[27, 25, 22, 11]. Party interactions are often spontaneous, fast-paced, and noisy, involving multiple participants[14]. While during the 'ice-breaking' phase, people rely on rapid non-verbal cues—such as eye contact, facial expressions, body orientation, and tone of voice—to infer intentions and emotional states[17, 23]. However, achieving social ice breaking in such scenarios poses unique challenges for people who are blind or have low vision (BLV) to detect these non-verbal cues and social intentions in time and respond appropriately. Especially, noisy settings further interfere with auditory channels, limiting access to subtle pre-interaction signals.

While much existing research focuses on supporting the social interaction of BLV individuals[12, 10, 21], it is mostly centered on enhancing accessibility and content comprehension in online contexts. For example, audio or textual alternatives have been used to improve the usability and engagement of BLV users on social media platforms[24, 29, 8, 9].In contrast, research on accessibility in offline social interactions is significantly lacking. Existing work in this space has mainly explored converting visual social signals into auditory or tactile outputs. For instance, conveying others' emotions, spatial direction, or facial expressions through sound cues, or using vibration to transmit simple feedback[20, 5, 4, 30]. However, in party environments, audio channels are often overloaded, leading to inaccurate information transfer. Moreover, the expression of tactile feedback is limited[3, 16], and BLV individuals cannot make more accurate responses based on the limited tactile signals they receive. These limitations make existing technologies less effective in high-intensity, dynamic, multi-participant offline social settings.

We conducted a formative study with 11 BLV individuals participants who have rich social experience, using semi-structured interviews to develop social initiating system for BLV individuals. The interview results revealed that BLV individuals noted any difficulties in perceiving pre-interaction impressions from others in noisy and complex social environments, such as whether the other person wants to engage in conversation or whether the other person are interested in them. Additionally, BLV individuals emphasized that even when they become aware of the other person's intention to interact, they often struggle to quickly organize their language or behavior to respond appropriately. Thus, these gaps will lead BLV individuals to miss opportunities for social connection, reduce confidence in initiating interaction, and social isolation.

Therefore, we propose a research question that has not yet been fully explored: *How can BLV individuals perceive others' pre-interaction impression and respond quickly during the "ice-breaking" phase of social parties in private settings?*

To address this research question, we summarized design principles and requirements based on the results of our formative study, and finally established our design goals. We designed and implemented an AI-assisted wearable device, "Emojifan"—a smart fan with a controllable facial expression display. The device aims to help BLV promptly capture others' pre-interaction impressions in social settings such as parties and respond with timely and appropriate facial expressions based on personalized prompts set by the BLV individuals, enhancing their expressive abilities during the "ice-breaking" phase. We aim to further explore how interaction design can support socially expressive, accessible, and dignified participation for BLV individuals in informal social life.

2 Related Works

2.1 Research on Enabling Social Interaction of BLV Users

A growing body of research has explored assistive technologies to support the social participation of blind and low vision (BLV) users, focusing on facial expression recognition, non-verbal cue perception, and enhancing social interactions across various contexts [7, 18, 26, 31, 6, 2]. In online social interaction, Miyakawa et al. proposed Eye-Phonon [19], a smartphone-based wearable sonification system designed to enhance daily communication. Similarly, DanmuA11y [29] enables BLV users to access Danmu (time-synced video comments), supporting engagement in online media discussions. In virtual reality (VR) social environments, VRBubble [15] introduced an audio-based social VR technique that significantly improves avatar awareness during navigation and conversation. However, it may cause distractions in crowded settings. In offline face-to-face interactions, Expression [1] supports users in understanding social signals during in-person conversations. Similarly, Buimer et al. developed a wearable vibrotactile device [5] that conveys facial expressions via vibration cues. Panchanathan et al. proposed the Social Interaction Assistant [21], which helps users perceive non-verbal communication from others. Tacsac [20], designed by Ozioko et al., combines capacitive tactile sensing and vibration feedback to facilitate communication between deafblind individuals and sighted/hearing mobile users. Haptic Mirror [30] translates facial expressions into tactile signals, allowing users to explore both their own and others' emotional expressions. Despite the diversity of these systems, prior research has rarely focused on private or informal social settings, such as parties, where BLV individuals must quickly interpret pre-interaction cues in dynamic environments. Our study aims to address this gap by designing and evaluating systems tailored specifically for such contexts.

3 Formative Study

The study had two primary objectives: (1) to understand the challenges BLV individuals face during the "ice-breaking" phase of social interactions; (2) to derive design goals and principles based on these insights, ensuring the proposed design aligns with the needs of BLV users in such social settings.

3.1 Method

The study invited 11 participants (7 men, 4 women) with a mean age of 23.9 years (SD = 5.68). We selected participants with rich social experience using a 5-point Likert scale, and their primary occupation was university students (details in Table 1). Before interviews, we provided participants with background information about the research topic and introduced existing assistive technologies for social settings. Each participant underwent a semi-structured interview lasting approximately 40 minutes, which consisted of two main parts: (1) Open discussion: participants reflected on their experiences in parties or similar social settings, particularly the challenges they faced during the ice-breaking phase, such as recognizing people, initiating conversations, and responding to non-verbal cues like facial expressions. (2) Design inspiration: we encouraged participants to share their thoughts on potential solutions and to conceptualize assistive technologies that could help improve their social experiences. After the interviews, the three researchers independently conducted open coding on the two sets of transcribed data and collaboratively developed a coding manual to resolve any discrepancies through discussion.

3.2 Challenges

3.2.1 Difficulties of Accessing Social Cues in Social Interactions. Analysis reveals 7 BLV participants emphasized the importance of accessing social cues during interactions. For example, P1 noted: *"The most awkward moment is when I don't know the other person's location and end up talking in the wrong direction."* Not being able to perceive others' emotional states often leads to misjudgment. As P2 said: *"Not knowing the other person's state… puts you in an awkward situation."* P6 echoed this view. P9 shared: *"I'm 50% sure they were calling me, but I still wouldn't respond… I'd rather just* *pretend I didn't hear it."* Initiating interaction can require significant mental effort for BLV individuals. Many participants preferred to wait for others to initiate(P3, P4, P11).

3.2.2 Difficulties in Emotional Expression. Several participants noted that they often present unnatural facial expressions[28] or unclear eye behavior in conversations, which can be misunderstood as impolite or unfriendly. As P3 put it: *"When we communicate with sighted people, it feels a bit strange—our expressions seem unnatural, and we're not even aware of it."* Many participants expressed a desire for assistive technologies to help them better convey facial expressions. P5 said: *"I really want to know what it feels like to avert your gaze, like in novels, because I don't have any gaze."*

3.2.3 Hardware Concerns Among Recent Social Interaction Products. Five participants expressed dissatisfaction with the current interaction design of the devices, with some complaining that they were *"too slow to respond"* or *"too hard to use"* (P8, P11). In response, they proposed several design requirements for future devices: *Personalization* (P6,P7); *everyday usability and social acceptability* (P6, P10); and *real-time responsiveness* (P7, P10).

4 System Design

Based on the challenges identified in the formative study, we proposed the design of Emojifan —— a novel AI-assisted wearable prototype designed to support blind and low-vision (BLV) individuals in navigating early-stage social interactions. By capturing others' pre-interaction social signals and enabling user-defined expressive feedback through a fan-shaped display. BLV individuals using this prototype can not only receive social cues during the ice-breaking process, but also express them quickly and in a personalized way. Social partners can also quickly understand the visually impaired person's personality and emotional expression in a short amount of time. (Details of the system implementation are provided in Appendix B)

4.1 User-Defined Response Configuration

During the preference-setting phase, we communicated with users to understand their expected responses in different social situations. For example, a user might state: "When someone smiles at me, I want to respond with a smile." We used GPT-4o[13] to analyze and understand the user's natural language input, extracting emotional response preferences and mapping them to the multidimensional emotional result combinations identified by the DeepFace model (e.g., 'happy': 45%, 'sad': 5%, 'angry': 1%, 'disgust': 3.7%, 'fear': 4.2%, 'surprise': 20%, 'neutral': 21.1%). Based on these mappings, we converted the emotional response preferences into a highly comprehensive response mapping table. Subsequently, we used Jimeng AI to generate a set of dynamic emoji expressions that match the user's expected responses, ensuring that the system can visually express the user's intentions accurately. (As illustrated in Figure 1 (left) Users can preview and fine-tune each set of emoji responses to ensure that the final dynamic expressions align closely with their personal preferences.

4.2 Recognizing and Responding to Social Signals

We designed a wearable sensing module equipped with a front-facing camera that can be worn on the user's chest. When the system detects socially meaningful expressions, it provides simple feedback through a vibration motor embedded in the handle of the fan, allowing the user to perceive social cues from others without interrupting conversation or overloading the auditory channel. Receiving the vibration feedback, the user can choose to raise the fan as a response. The system then automatically generates a corresponding reaction on the user's behalf based on the detected expression and the pre-configured response mapping.

5 Conclusion, Limitations and Future Work

In this paper, we present Emojifan, a wearable system designed to support blind and low-vision (BLV) individuals in dynamic social environments such as parties. Through a formative study, we identified key challenges BLV users face in the early phases of social interactions—particularly in perceiving others' intentions and expressing timely responses. Based on these insights, we designed a real-time system combining facial expression recognition, haptic cueing, and personalized emoji-based feedback displayed on a familiar object—a handheld fan.BLV individuals using this prototype can not only receive social cues during the ice-breaking process, but also express them quickly and in a personalized way. Social partners can also quickly understand the visually impaired person's personality and emotional expression in a short amount of time. There are several limitations in our current implementation. First, we have not yet conducted in-the-wild user studies to evaluate real-world usability and social effectiveness. Second, the system still requires manual setup in several steps, which limits its scalability and automation. Third, it remains unclear whether visually impaired individuals are comfortable with AI acting as a proxy for their facial expressions. What's more,when AI generates personalized facial expression outputs on behalf of BLV individuals, there is a risk that inaccurate expressions could unintentionally widen the social gap between BLV and sighted individuals. Looking ahead, we plan to extend this work in several directions:(1) We aim to conduct user studies in simulated social settings to assess the feasibility, responsiveness, and social acceptability of Emojifan. (2) We will explore expanding the emotional expression set and improving the system's automation, including dynamic expression mapping. (3) Based on our early attempts at preference-based response setup, we hope to formalize a design methodology to guide how assistive systems can help BLV individuals co-construct expressive behaviors in social contexts. (4) Finally, we plan to investigate embedding this interaction model into a wider range of everyday objects (e.g., bags, wearables), and explore how such objects can be transformed from passive personal belongings into active carriers of emotional expression—making them not only tools, but also interfaces for embodying social presence. This approach could offer socially acceptable alternatives to traditional assistive hardware. Through these efforts, we aim to further explore how interaction design can support socially expressive, accessible, and dignified participation for BLV individuals in informal social life.This will contribute to the future field of AI accessibility research.

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