Hearing the Smile: Facilitating Spontaneous Social Ice-Breaking through Sonifying Interpersonal Warmth for the Visually Impaired Individuals

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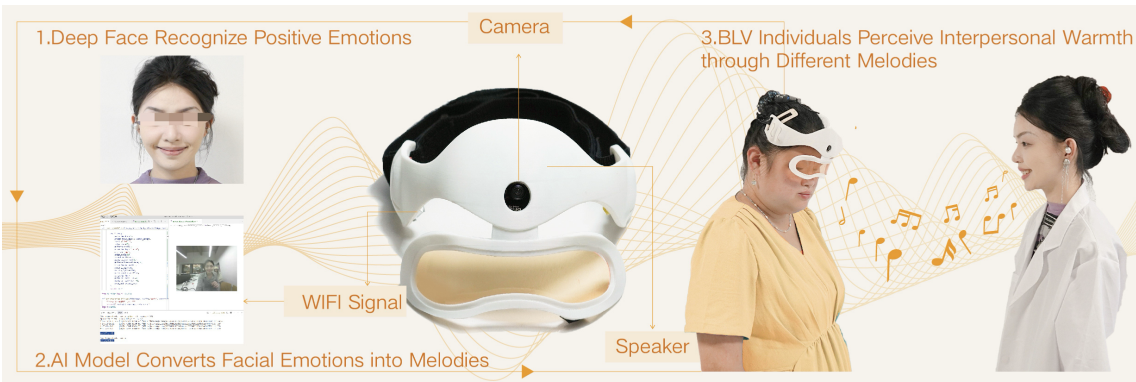

Fig. 1. The usage flow of the 'Hearing the Smile': an AI-enpowered smart glasses system that translates positive emotional expressions from others into personalized melodic cues. Through this research, we aim to foster proactive, socially engaging interactions by enabling BLV individuals to sense and respond to interpersonal warmth in real-world public settings.

Interpersonal warmth plays a crucial role in initiating interactions between strangers. However, individuals with blind and low vision (BLV) often face difficulties in perceiving such contextual cues, which makes it challenging to establish new relationships. Although prior work has introduced online dating programs and offline community-based ice-breaking activities to support social opportunities for BLV individuals, these interventions are typically designed for unpublic settings, overlooking the potential for spontaneous socialization in public spaces. Therefore, we conducted a formative study with 11 visually impaired individuals who reported high levels of social activity and identified the key challenges they face in perceiving interpersonal warmth in social ice-breaking. Based on these insights, we developed 'Hearing the Smile', an AI-enpowered smart glasses system that translates positive emotional expressions from others into personalized melodic cues. Through this research, we aim to foster proactive, socially engaging interactions by enabling BLV individuals to sense and respond to interpersonal warmth in real-world public settings.

Additional Key Words and Phrases: BLV individuals, social ice-breaking in public scenarios,interpersonal warmth, AI-empowered sonification

ACM Reference Format:
Anonymous Author(s). 2024. Hearing the Smile: Facilitating Spontaneous Social Ice-Breaking through Sonifying Interpersonal Warmth for the Visually Impaired Individuals. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation emai (CHI'26).* ACM, New York, NY, USA, 6 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION

Interpersonal warmth serves as a crucial cue for initiating interactions and communication between strangers [7]. Research has shown that behavioral synchronization, such as the alignment of interpersonal warmth, can facilitate embodied and harmonious relationships among strangers [20]. However, due to visual limitations, BLV individuals primarily rely on auditory cues to perceive others' emotional states in social contexts [4]. This reliance makes it difficult for them to actively identify such interpersonal warmth from others and establish social connections or break ice chat first in public settings. thereby undermining their confidence in initiating conversations and contributing to a potential social isolation [6].

Therefore, some research has begun to explore online dating platforms and community-based ice-breaking games to help BLV individuals establish social opportunities. For instance, certain online dating programs assist users in navigating mainstream social platforms by providing accessible interaction methods, such as identifying complex images and generating textual descriptions [17]. In addition, several applications have been specifically designed for BLV users, including community platforms centered around shared hobbies [13], and communication platforms that facilitate interactions between volunteers and BLV individuals [2]. Interactive games also present a promising medium for fostering relationships between BLV and sighted individuals. Examples include VR games [8], card games [3], and various video games[18]. These interactive games help BLV individuals establish relationships with sighted people or new friends to some extent and create opportunities for further social interaction.

However, these studies typically focus on private scenarios where social links have already been established, overlooking the opportunities for BLV individuals to actively socialize with strangers in public scenarios. For example, the possibility of BLV individuals encountering strangers on the street, in parks, at museum exhibitions, in elevators, and in various open social situations and starting a conversation. Such social interactions usually require inferring the pre-interpersonal warmth and contextual information conveyed by others and then to initiate an effective ice-breaking conversation. Although A small number of research studies have also focused on such public scenes, these programs just use complex interaction methods to help BLV individuals identify surrounding objects and people[10], such as Yuhang Zhao[21] and others marking the faces of BLV individuals' friends to remind them of the identities of strangers or acquaintances they encounter in public, and conveying this information through text descriptions. But this work is intended for marking and does not provide navigation which can provide the key pre-interpersonal warmth signals needed by BLV individuals, thereby overlooking the potential for spontaneous socialization in public spaces [6].

Based on previous research, our research questions primarily focus on: (1) What are the specific difficulties and challenges faced by BLV individuals in perceiving potential pre-interpersonal warmth signals before initiating an ice-breaking interaction with others in public? (2) Based on challenges and design insights, how can we map an effective prototype to enable BLV individuals to recognize others' pre-interpersonal warmth signals before engaging in potential ice-breaking conversations?

We conducted a 30-minute semi-structured interview for a formative study with 11 BLV individuals, exploring the specific challenges in perceiving potential pre-interpersonal warmth signals before initiating an ice-breaking interaction with others in public. Based on these challenges and design insights, we developed a high-fidelity smart glasses prototype: "Hearing the Smile", that can capture others' pre-interpersonal warmth and other emotions, using an AI music model to translate these emotions into personalized melodies. Through this research, we aim to foster proactive, socially engaging interactions by enabling BLV individuals to sense and respond to interpersonal warmth in real-world public settings.

2 RELATED WORK

2.1 The Interaction Methods Used by BLV Individuals to Socialize with Others in Public Settings

Previous research[17] has concentrated on online platforms and interactive games to foster social connections for BLV individuals. Online dating often utilizes mainstream social media, offering accessible interaction methods and textual descriptions to assist BLV individualss [17]. There are also social apps tailored for BLV individualss, including community platforms for hobbies [13] and communication platforms linking volunteers with BLV individualss [2]. Interactive games range from VR social games [8] to various sports and activities [18], aiding BLV individualss in building relationships and further social engagement. Some studies have focused on the interaction between people in public space [9], facial expressions have been used to promote empathy and establish trust in public, and also those who use body language [14] to convey emotions who meet each other at the first time.The iCare project [12] has been used to help BLV individualss recognize friends in public.

2.2 Assistive Technology for Recognizing Social Cues

(1) Tactile.Using tactile technology for recognizing social signals has become become a trend recently[5], the Vibro Glove [11] has been used to help BLV individuals perceive emotions through touch, and also to use haptic chairs [5] to understand others' emotions; however, challenges still exist in terms of portability and learning costs [5]. (2) Sound.Using auditory technology for recognizing social cues also has accumulated previous research experience[21**?**],the Expression app [1] for Google Glass assists in social activities, but they often fail to capture the subtleties of emotions [10, 21]. (3) AI and others. Using AI technology for recognizing social cues is a pupular method engaging in BLV individuals interaction behavior[16], the Matia Application [16] has been used to help BLV individuals with various tasks, and the Social Sensemaking with AI project [15] explores the challenges and opportunities of designing human-AI interaction, but there are challenges in ensuring the reliability and accuracy of AI models [16].

3 FORMATIVE STUDY

Our study primarily includes two objectives: (1) To understand the specific challenges and difficulties that BLV individuals face in perceiving interpersonal warmth and social cues before the ice-breaking phase. (2) Based on these challenges and the design requirements proposed by BLV individuals, to refine the design goals for creating a high-fidelity prototype.

3.1 Method

The study involved 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 30 minutes, which consisted of two main parts: (1)Open discussion: Recall BLV individuals' past interactions with strangers in public social settings, discussing their approach to initiating conversations, awkward moments, and scenarios, as well as their current solutions and descriptions of existing challenges. (2)Design elicitation investigation: Encourage BLV individuals to conceptualize an interactive system prototype based on their past experiences. The results of the analysis were identified through collaborative discussions. Two researchers independently read the transcripts three times to familiarize themselves with the data and coded the responses.

3.2 Challenges in Perceiving Interpersonal Warmth and Social Cues

3.2.1 Negative Social Interactions. All participants with visual impairments reported that they were unable to perceive non-verbal social signals in public settings. Even when auditory cues were present, they still needed explicit confirmation from potential interlocutors before initiating a conversation. P7 remarked, *"Because I can't see the other person's face, even if I hear their voice, I'm not sure if they're talking to me, so I don't dare to respond."* P5 added, *"I usually rely on their tone and voice to judge whether they're willing to engage, but if they don't speak first, I have no way of knowing."* Due to the uncertainty of others' friendliness, visually impaired individuals tend to avoid initiating conversations unless absolutely necessary, as doing so risks social rejection and negative emotions. P10 shared, *"Once I asked for directions and called out loudly to people around me, asking where Exit D was. It felt like drawing a lottery—if I got a friendly person, I got lucky."* These challenges can also occur in work settings. P4 said, *"I really want to know the facial expression of my massage clients, so I can tell whether my pressure is causing pain or whether they feel comfortable."*

3.2.2 Limitations of Existing Assistive Technologies. Some participants mentioned using assistive technologies to help recognize facial expressions, but these tools often lacked real-time feedback and could not actively provide signals. Additionally, those using text-based outputs found the response times too long, which disrupted the flow of conversation. P3 noted, *"I had to manually use Be My Eyes' AI feature to identify someone's expression, but by the time it responded, the person had already left."* P8 said, *"Some AI software can make video calls, but it gives too much information. For common signals, a simple feedback like a sound or vibration would be enough."*

3.2.3 The Need for Perceiving Differentiated Positive Emotions. Several participants expressed that when considering high-fidelity prototypes, it was important to differentiate between varying degrees of friendliness, as facial expressions naturally vary in nuance. And they also suggested that the feedback should be personalized and easy. P4, P5, and P7 all indicated a preference for sound-based feedback tailored to their musical tastes. P4 stated, *"Ideally, it could work like piano chords—different emotions should be conveyed through different rhythms."* P5 added, *"Text descriptions are too long, and vibration doesn't clearly differentiate between emotional types. I prefer short melodies."* P7 remarked, *"I want to be able to tell what emotion each melody represents."*

3.2.4 BLV Users' Preferences for Aesthetic and Portable Design. A few participants, when imagining the prototype's form, preferred glasses as a base, since this design preserves the natural line of sight and appears less obtrusive. They also emphasized the importance of lightweight and aesthetically acceptable devices. P6 said, *"Glasses would be best—if I have to pick up a phone, the moment might pass and it would feel awkward. It should look good, too."* P9 added, *"It definitely needs to be glasses, so they can cover my eyes. I worry that my eye condition might scare others."*

3.3 Design Goals

Based on these challenges, we established the high-fidelity prototype design goals. (1) Design a concise and effective interactive system that conveys a variety of social signal types: The prototype's interactive system should prioritize timeliness, avoid using complex text, refrain from interrupting ongoing conversations, and be able to express a range of friendly signals and emotional categories. Thus, we have chosen short melodies as the means of feedback. (2) To accommodate the personalized preferences of visually impaired individuals in recognizing melodies based on social cues: given that their perception of musical levels and preferred melodies at each level varywe will employ an AI music model to customize level hierarchies and melody preferences for each user. (3) Ensure simplicity and portability:

Following universal design principles[19], the device should be lightweight and easy to wear. The design will be based on eyewear as the carrier, ensuring both portability and universality.

4 DESIGN SYSTEM

We present a smart glasses device:"Hearing the Smile", designed to help BLV individuals recognize potentially interpersonal warmth in public spaces. This system leverages an AI music model to help visually impaired individuals select the appropriate level of friendly signals and their melody preferences at each level. By listening to different melodies, visually impaired users can infer the level of friendly social signals and the communicative intent of potential interaction partners, especially strangers. More design detail in System Composition.

4.1 Interaction in Prototype: "Hearing the Smile"

4.1.1 Short melodic feedback that can recognize a wider variety of positive emotions. As discussed in the previous design goals, BLV individuals often find language and text-based descriptions cumbersome, which can disrupt ongoing social interactions. Similarly, single-mode vibration feedback provides insufficient information and lacks the sensitivity needed to convey emotional nuances. Therefore, we adopt short sound effects or melodies as the primary feedback method, as they offer higher emotional granularity and are more readily perceived and accepted by BLV users in recognizing positive emotions and interpersonal warmth during social interactions.

4.1.2 BLV individuals can set personalized prompts according to their preferences. We consider that BLV individuals may vary in their sensitivity to and preference for melodies. Therefore, we provide each user with personalized AI-generated melody prompts, the appropriate level of friendly signals and few-shot model tuning to improve the alignment between the feedback and their personal preferences, helping them better perceive positive emotional expressions from others.

4.1.3 Design a simple and stylish eyewear shape. To ensure the direction of recognition and portability, our design, as shown in Fig. 1, features lenses that cover the eyes of BLV individuals. This design takes into account the social awkwardness mentioned by some participants regarding the presentation of facial expressions. The overall design is simple and lightweight, allowing individuals with visual impairments to use it easily after wearing.

5 CONCLUSION, LIMITATIONS AND FUTURE WORK

Based on our formative study, we identified the difficulties and challenges that blind and low vision (BLV) individuals face in recognizing potentially interpersonal warmth during public social interactions or ice breaking time. Our study's insights informed our design principles and goals, leading to the development of our prototype:"Hearing the Smiles", a pair of smart glasses capable of detecting friendly social signals, generates personalized melodies based on user-defined levels of positive emotions and prompts. When users recognize social signals corresponding to a specific level, the glasses respond accordingly, translating them into melodies. However, our prototype has not yet been tested in real-world scenarios involving people with visual impairments. Therefore, the actual effectiveness of manually selected levels of friendly signals and preferred melodies still requires further validation. Can our prototype help visually impaired individuals initiate interactions with others more easily? Can AI-generated personalized melodies help visually impaired individuals recognize social cues more accurately? Will they feel more confident in social interactions? In future research, we plan to conduct a series of experiments to explore whether personalized AI-generated melodies and the recognition of different levels of friendly social signals can boost their confidence in initiating conversations.

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