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# VibroGlove: An Assistive Technology Aid for Conveying Facial Expressions

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## Abstract

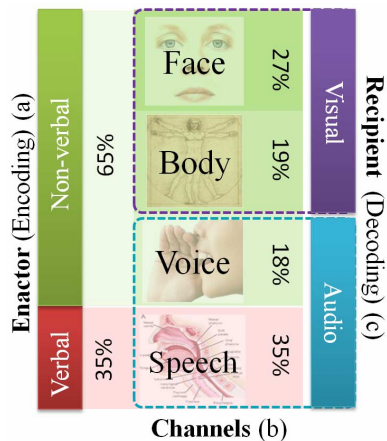
In this paper, a novel interface is described for enhancing human-human interpersonal interactions. Specifically, the device is targeted as an assistive aid to deliver the facial expressions of an interaction partner to people who are blind or visually impaired. Vibrotactors, mounted on the back of a glove, provide a means for conveying haptic emoticons that represent the six basic human emotions and the neutral expression of the user's interaction partner. The detailed design of the haptic interface and haptic icons of expressions are presented, along with a user study involving a subject who is blind, as well as sighted, blind-folded participants. Results reveal the potential for enriching social communication for people with visual disabilities.

## Keywords

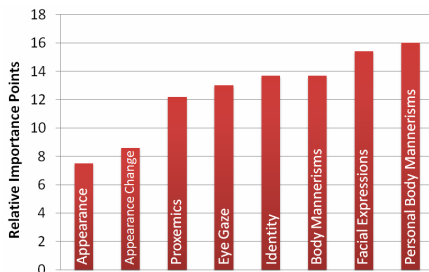
Vibrotactile glove, Basic facial expressions, Bilateral interpersonal interaction, Haptic interface

## ACM Classification Keywords

H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces, *Haptic I/O*. K.4.2. Computing Milieux: Computers and Society, *Assistive technologies for persons with disabilities*.



**Figure 1:** Relative importance of a) verbal vs non-verbal cues, b) four channels of non-verbal cues, and c) visual vs. audio encoding & decoding of bilateral human interpersonal communicative cues.



**Figure 2:** Self report importance (scaled over 100 points) of visual non-verbal cues obtained through an online survey of target population and specialists [4].

## General Terms

Design, Human Factors, Experimentation, Verification

## Introduction

Nearly 65% of all human interpersonal communications happen through non-verbal communication cues [3]. In a bilateral interpersonal interaction, while speech encodes all the information, non-verbal cues facilitate an elegant means for delivery, interpretation and exchange of this verbal information. For example, eye gaze, iconic body or hand gestures, and prosody enable effective and seamless role play in social interpersonal interactions. People communicate so effortlessly through both verbal and non-verbal cues in their everyday social interactions that they do not realize the complex interplay of their voice, face and body in establishing a smooth communication channel. Nearly 72% of non-verbal communication [1] takes place through visual cues encoded on the face and body of the interaction partners (see Figure 1). Unfortunately, people who are blind or visually impaired cannot access this huge portion of interpersonal information independently.

While most persons who are blind or visually impaired eventually make accommodations for the lack of visual information, and lead a healthy personal and professional life, the path towards learning effective accommodations could be positively effected through the use of assistive aids. Specifically, children with visual disabilities find it very difficult to learn social skills while growing amongst sighted peers, leading to social isolation and psychological problems [2]. Social disconnect due to visual disability has also been observed at the college level [7] where students start to learn professional skills and independent living skills.

Any assistive technology aid that can enrich interpersonal social interactions could prove beneficial for persons who are visual disabled.

## Motivation

In order to understand the importance of visual social cues, we conducted a web based survey where the participants (16 persons who are blind, 9 with low vision and 2 sighted specialists in the area of visual impairment) rated the importance of 8 social needs that were identified from two open-ended focus groups [4]. The participants responded on a 5 point Likert scale; 5, implying strong agreement, to 1, implying strong disagreement. Figure 2 shows a non-parametric rank average analysis of the participants' responses. The rank-ordered social needs list shows that participants' most important need corresponds to feedback on their own body mannerism and how it was affecting their social interactions. Following this was their need to access facial expressions, body mannerisms, identity, eye gaze, proxemics (location) and appearance of their social interaction partners, in the presented order. Recently, in [5], we proposed and demonstrated a methodology to detect stereotypic body mannerism (body rocking) towards providing social rehabilitation for people who are blind or visually impaired. Focusing on the next important social need of accessing facial mannerisms, in this paper, we propose a methodology to deliver facial expressions of the social interaction partner to a person who is visually disabled.

## Design Considerations

The human face is very dynamic when it comes to generating important non-verbal communicative cues. Subtle movements in the facial features can convey great amounts of information. For example, slight







