Human Bodies as Interaction Materials for Somatic, Social, and Multisensory Virtual Reality Experiences

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Recently, the field of Human-Computer Interaction has begun to embrace the crucial role of our bodies across our cognitive and social processes. The movement of embodied interaction has been followed by a somatic and material turn that strives to design technology for richer multi-sensory somatic experiences. Despite the booming developments in tangible and wearable technologies, there is strikingly limited research exploring the potential of our own physical and virtual bodies to become the material for the design of interaction, in the same ways that tangible materials are. In this position paper, we propose a series of approaches for designing technology for social interaction, that integrate human bodies as interaction materials to elicit a multisensory embodied experience. We illustrate this approach with examples of several virtual reality experiences that we have designed for supporting social connection.

Additional Key Words and Phrases: embodied interaction, social connection, virtual reality, pseudohaptics, biosignals

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1 BACKGROUND

The fundamental role of our bodies in our experiences is becoming more readily recognized in the development of the technologies that shape our lives. Considerable progress has been made since Dourish argued for a shift towards Embodied Interaction [5] to capitalize on the full potential of engagement of our active bodies beyond the screen and mouse-based interfaces. More recently, a deeper consideration that is focused not only on interaction, but considers the entire rich sensual experiences of the feelings in our bodies began to enter the technology design landscape with the somatic [15] and material turns [6]. These approaches often draw from somaesthetics [11] and granular phenomenological methods [18] to gain a deeper appreciation of our bodily experiences in an effort to augment and cultivate rich multisensory experiences through design of technologies.

The technology used to cultivate these rich experiences often involves some form of tangible material-based interaction—engaging our senses through fabrics, wearables, interactive fashion, thermal stimulation, etc. This technology can be used to support *embodied genuine feelings of connection* between people [20] by, for example, mediating interpersonal touch or supporting interaffectivity through biosignal sharing. In most of these developments, the body is

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seen as the receiving end of interaction, a site where the rich multisensory experiences are embodied, and upon which the technology or material acts to elicit these sensations. The dimension that is less discussed is the opportunity to engage users' bodies as the material itself, as part of the interface with which another user can interact. Our bodies are not only potent in terms of the richness of our own somatic experiences, but they also offer a considerably complex potential as a highly expressive interaction material. Moreover, our bodies are deeply embedded with *social meaning* inherent in engaging with the live bodies of other people and situated within each individual's social and physical context. Grounded in enactive cognition, this reconceptualization of social interaction emphasizes the integral role of all the interaction partners and the environment they are situated in as a dynamic interactive loop, providing a more compelling phenomenological account that can inspire novel design approaches beyond the sender-receiver model [12].

From a phenomenological perspective, our bodies are central to all lived experiences. From self-consciousness, to perceiving our relation to the world we share and those we share it with, the interaction between our bodies is at the core of all we know [9]. Specifically, touch is fundamental to our connection with others due to its key role in the developmental process [3, 8]. Even non-tactile experiences of social interaction can be understood as an extrapolation of early experiences of tactile social engagement with others [16]. This rooting of our social interactions in the experiences of touch inspires us to consider how bodies themselves can constitute a *tactile material* we can design interaction for. Beyond touch, the internal processes of our bodies, provide another intriguing material source for social interaction.

2 APPROACHES FOR ENGAGING THE HUMAN BODY AS INTERACTION MATERIAL

While embodied approaches to computing are often concerned with the design of tangible materials, Virtual Reality (VR), despite commonly only including audio-visual design, nonetheless offers a promising avenue to explore material design. The tracking technology integrated in most VR headsets, when used to its full potential, can engage immersants' bodies fully in an interactive experience. When creating social experiences for multiple users, we can now utilize those tracked bodies as interaction materials. Arguably, the potential for granularity of the experience of the embodied interaction with another live person's body is much more potent than what other non-human materials may offer.

While there are endless opportunities for engaging others' bodies as interaction material, here we propose to consider the three following approaches:

(1) Augmenting physical social touch: Interpersonal touch is deeply expressive with many factors affecting its perceptions, such as quality of touch, location, social relationship, and context [1]. Affective interpersonal touch provides a very rich form of interaction, supporting affective exchange and fostering intimacy. Despite social touch having a strong potential for fostering intimacy and connection, opportunities to engage in social touch are restricted by cultural and social norms [1], even leading to *"touch hunger"* experienced by some western cultures [7]. Here technology can act as a medium that can transform social norms between participants to support socially acceptable touch between strangers that might otherwise feel awkward or inappropriate [13]. This often takes shape through playful interactions that turn the experience into a game that establishes a new set of social norms [10]. Alternately this can be accomplished by altering visual perception and concealing direct eye-contact, for example by putting participants in VR [2, 22].

(2) Audio-visual experience to evoke tactile sensations: Recognizing the typical lack of touch in VR, there has been much development into the integration of haptic devices [8]. However, haptic devices are far from supporting the rich experience of touch that we seek when touching another human. The vibrating motors typically used for haptics are distant from the qualities of inter-human touch: softness, warmth, dynamics, complex muscular composition, and responsiveness. Here we propose to consider an alternative approach to haptics by stimulating illusionary tactile sensations through pseudohaptics. Pseudohaptics refers to the illusion of perceived haptic sensation that is evoked from

other sensory channels, e.g. audio-visual [19]. There is considerable promising research on pseudohaptics exploring the experience of touch of objects and surfaces [21]. However, strikingly little research has looked at its potential for social touch. We propose that social touch might be an even more fruitful avenue for application of psuedohaptics given the additional social significance of the experience of inter-human touch that may heighten the sensation. While pseudohaptic sensations are often very faint, we argue that for telepresent social touch, pseudohaptics may be a better fit than many haptic devices that distract through uncanny sensations of rumbling haptic device.

(3) Social biosignals to peak into our own inner bodily experience and share it with others: Biosensing technology (e.g. heartrate, breathing, skin conductance, etc.) allows designers to engage inner bodily experiences of users. While most bio-responsive technology development has focused on individual health and self-improvement applications, there is a growing interest in using biosignals to augment social interaction [17]. Biosignals provide a window 'inside' others' bodies, providing potential cues to previously unnoticed affective or cognitive states. By representing biosignals in a social context we afford a novel form of embodied interaction between users as they gain access to an ordinarily concealed and intimate dimension of others' somatic experiences [20]. This approach takes physiological processes of one user as an interaction material for the perception and engagement by other users, with the aim to respond to, mirror or impact others physiological state.

3 EXEMPLARY DESIGN ARTEFACTS

Now we would like to briefly introduce a series of examples of our work in Virtual Reality (VR), that illustrates the above approaches to using others' bodies as interaction material.

Body RemiXer[1] [4] is a multi-user co-located installation that transforms immersants' bodies into ethereal auras of light particles. As immersants look around they see other's bodies as abstract enticing auras, and as they reach to make contact, their bodies connect and begin to exchange particles, now floating between their virtual bodies. Here the tactility of the interaction comes from touch between the physical bodies of the participants. This often comes as a surprise, as immersants don't expect these magical ethereal auras to have a physical counterpart that they can feel. This tactile experience encourages further exploration through touch and movement.

Embodied Telepresent Connection (ETC)[2] is an artistic project exploring a series of interaction prototypes that can elicit the feeling of embodied connection across distance. Two immersants interact remotely using a VR headset. They see both their own and the other person's bodies as a cloud of particles. With no other form of communication available to them except for gesture and touch, they begin to approach this mysterious other to explore what the interaction may afford. As they approach the other person's body, they see the colour of both bodies become warmer, evoking a faint sensation of warmth. When they try to make contact through touch, they notice resistance in the visuals which prevents their hands from passing through the other body as if they were physically present, evoking a subtle sensation of pressure. They also see and hear others' heart beating inside their chest, detected by their partner's smartwatch. They are tempted to approach the other and touch their virtual heart, feeling the preciousness of this life source. Immersants can notice how their partner's heartrate changes as they approach them for such an intimate engagement.

The *Social VR Avatar Biosignal Visualization* project [14] explores how to design and visualize biosignals in the context of social VR entertainment. Through this project we asked: which are the most effective visualizations for heart rate and breathing rate in an immersive, virtual music event scenario? We explored several visualizations (Skeuomorphic, Particles, Creature, Environment) across different signal rate levels, and found that skeuomorphic visualizations for

[1]See a video here: http://ispace.iat.sfu.ca/project/body-remixer/
[2]See a video here: http://ispace.iat.sfu.ca/project/etc/

both biosignals allow differentiable arousal inference, in part due to their visual familiarity. We also found that biosignal perceptions often depend on the type of relationship with an avatar (friend, stranger), entertainment type (movie or concert), and whether making inferences about emotion pertained to the other avatar or to the virtual space. We found a strong link between visualizing such biodata and their capacity to strengthen social presence. These visualizations became an extension of the avatars affording additional social cues to infer user's arousal state, their availability to be approached, or to simply have a tell-tale sign about what kind of virtual environment it is that they are in.

4 CONCLUSION

The recent material turn in HCI has evolved hand and hand with the embodied and somatic turns. These developments capitalize on the richness of our embodied, often tactile experience, to evoke rich and nuanced somatic experiences in users. However, there is a surprising lack of exploration of how our own actual and virtual bodies can be integrated as interactive materials for mediated social interaction. We propose seeing the body as more than the medium through which we experience technology, but as a material that can itself be central to the design. Considering how our bodies can be integrated as a material will allow for the design of new, rich, social somatic experiences.

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