

# Azalea: Co-experiencing Embodied Information in Remote Communication

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Figure 1: Azalea: idle (left), initializing (center), in use (right).

## ABSTRACT

We wish to demonstrate Azalea: a smartphone-based design to enrich remote communication by making space for co-experience of embodied information. Azalea comprises a tactile cushion which envelops a smartphone, and a bespoke app. A pair of Azaleas are used by remote interlocutors to enrich the communication with a shared, synchronized motion-driven soundscape and audio-driven light. Our approach differs from most current strategies for enriching remote communication; since it is focused on diminishing distractions and creating a cryptic channel for co-experience, rather than augmenting and increasing the fidelity of communication channels. To achieve this, we have adopted the design tactics and intellectual foundation somaesthetic interaction design, and we also contribute to this field: while most current somaesthetic interaction design focuses on introspection, we have used the same foundation to enrich remote communication.

## CCS CONCEPTS

• **Human-centered computing** → **Interaction devices**; *Mobile computing*; Gestural input; Smartphones.

## KEYWORDS

Somaesthetics; remote communication; embodiment; embodied information; diminished reality.

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## 1 INTRODUCTION

Gaze, gestures, facial expressions, and other subtle embodied cues are an important communication channel between co-located interlocutors. To refer to this physical communication channel – which can communicate attention, intent, affect, more – we recruit the term “embodied information” [7]. We note that, in our understanding, embodied information does not need to originate from the human body: for example, we would also consider the physical space where a conversation takes place to be a part of the embodied information that bears on what is communicated. Naturally, in remote communication, embodied information is often lacking. Moreover, interlocutors in remote communication find themselves

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in different environments, and thus the problem is not merely that they cannot co-experience [4–6] the same embodied information – in fact, their senses are occupied by completely different stimuli. Thus, co-located interaction is preferred in situations where affect, intent, attention, and subtle communications are significant; for example, when breaking up with a romantic partner [32].

Thus, we set out to address the following design challenge in this work: *How might we capitalize on commodity mobile devices to create a co-experience of embodied information in remote communication?*<sup>1</sup>

Our project took the character of constructive design research (a.k.a. research through design) [16, 24, 49] which was informed by the intellectual and methodological foundation of somaesthetics in HCI [18, 19, 21]. Here, as a contribution [46] to mobile HCI, we present an artifact as the culmination of our project: Azalea (Figure 1). Below, we situate our project in related work, and describe the design.

## 2 RELATED WORK

Mechanisms like mirror neurons [15, 23, 36], somatic markers [10, 11], theory of mind [33, 39], and the shared manifold of intersubjectivity [13, 14] have been postulated by scholars in neuroscience to characterize the co-experience of embodied information between co-located interlocutors. Many of these mechanisms relate to sensory-motor systems which extend throughout the human body [7, 38]. In mobile HCI, a popular strategy is to recruit these mechanisms for the purpose of enriching remote communication is to *augment*: increase the dimensionality and fidelity of how we channel information on bodily and environmental dynamics. For example, to support professional collaborations, GazeLens augments a tablet with a 360° camera and adds a feed from a ceiling camera [30], and MirrorTablet instruments the front camera of a tablet with a mirror to capture gestures [29]. To enrich teleconferencing, Holoportation transmits high-quality 3D reconstructions of interlocutors between augmented reality headsets [37], and LightBee projects an interlocutor’s face on a display which is mounted on drone controlled by their head movements [48]. Inspired by these works, we posed the opposite question to inspire our design work: *How might we diminish, even confound, to enrich remote communication?*

A systematic literature review in MobileHCI '18, covering a corpus of 52 systems, has investigated “unconventional user interfaces for emotional communication between long-distance partners” [34]. The authors note that “augmenting current technologies and integrating them into users’ communication ecology could be more easy and beneficial than introducing totally new devices. Some devices were based on dedicated objects, while it turned out that users tended to prefer the hybrid approach of using e.g. a mobile phone and perceived it enriching.” Another research opportunity that we see from review is that while some transduction modalities like touch, speech, vibration, and graphics are well-investigated; only 3 systems in the corpus utilize object movement for input and only 6 produce non-speech sound output. These works, as well as ours, are also informed by earlier reviews [17] and empirical studies [22].

<sup>1</sup>As we write, in 2020, we are practicing social distancing and isolation in defense against a pandemic. Three of the four authors have been away from their immediate families for more than half a year. We are thus very convinced that this is a worthwhile challenge for design research and practice.



**Figure 2: Azalea subtly directs the user towards darkness, since its glow cannot be perceived in a well-lit environment.**

With regard to ethos and methodology, we have been greatly influenced by somaesthetics in HCI [18, 19, 21]. Somaesthetics considers “the soma – the living, sentient, purposive body – as the indispensable medium for all perception” and “sensory appreciation (aesthesis)” [43]; and aims to become an “interdiscipline” (as in [9, 40]) of thought, practice, and scholarship that integrates many disciplines with the same focus. These disciplines range from pragmatist philosophy to meditative movement (e.g. yoga, Tai Chi), “discourse of biopolitics to the therapies of bioenergetics, the neuroscience of hand gestures to their aesthetic meaning in Nō theater” [43]. In HCI, somaesthetics figures in support of “experience-centered” approaches [31, 47] and designs for “engaging participants in deepening the experience of their own felt bodily sensations and movements” [21]. Thus, the focus of somaesthetic HCI is often explicitly *introspection* [2, 3, 8, 25–28, 44]. Conversely, the potentials for somaesthetics to support HCI for interpersonal communication emerge as opportunities for design research. In HCI literature, the sole example we discovered at the intersection of somaesthetics and remote communication has been Schiphorst’s soft(n): a “networked, tangible interactive artwork” [41]. However, examining this work, we noted that the way in which networked communication figures is mostly concentrating on how the artifacts co-behave, while the meanings or co-experience that is mediated between participants is less well-articulated. Thus, our project makes a contribution to somaesthetic HCI by expanding on the topic of remote communication.

## 3 PROCESS

Our design process was informed by somaesthetics in HCI. First, the generative “strong concept” (see: [20]) of Somaesthetic Appreciation [19] guided our work. Somaesthetic Appreciation allows HCI designers and researchers to access somaesthetics through four qualities that guide both process and results: “subtle guidance,” “making space,” “intimate correspondance,” and “articulating experience.” Then, we studied the “soma design” approach which



**Figure 3: Light scattered through laser-cut slits underneath, radiating in the environment, amplifies the user’s sense of their own subtle movements as they hold Azalea.**

comprises a collection foundations, examples, skills, and methods for HCI [18]. Following this approach, we tried to increase our somaesthetic skills (by engaging in yoga, Feldenkrais, and expressionist dance), interviewed somatic connoisseurs [42] with experiences in Feldenkrais, dance, yoga, and mime, along with a blind person; conducted aesthetic laborations (A-labs) [1] as well as bodystorming [35]. We also practiced more conventional HCI design tactics such as artifact analysis, material explorations, interaction relabelling [12], Crazy 8’s,<sup>2</sup> and engineering experiments with various sensors and actuators on the smartphone.

## 4 AZALEA

Our process culminated in an artifact – Azalea – which comprises a tactile cushion to envelop a commodity smartphone that is running a bespoke app. The app, when launched, prompts the user to insert the smartphone into the cushion. While in use, the smartphone and the cushion become one – an integrated artifact (see Figure 1).

### 4.1 Fabrication and Implementation

The interior structure of the Azalea cushion consists of laser cut wood and acrylic parts. The center piece, formed out of wood, is cut specifically to fit a smartphone. (In our particular prototype, we used a Xiaomi Redmi Note 2.) Wood, an opaque material, prevents light from the front display and the rear flashlight from leaking to the other side of the device. Acrylic parts are used to achieve curved forms on both sides. Acrylic was chosen over wood or 3D printed plastics because of its transparency – so that light from both sides of the smartphone can propagate light efficiently to the surface of the cushion. These pieces were designed and cut to fit together, and glued to increase durability.

The structure is covered with three layers of soft materials. The innermost layer is polyester foam, which is soft to the touch, and

porous enough to be transparent to much of the light. The outermost layer is gray wool, selected for its organic, high-quality aesthetics. The wool on both sides bears laser-cut patterns: the front is perforated to emanate a subtle glow (from the front display of the smartphone), and the rear has slits that radiate white light into the environment. Between the foam and wool layers, a middle layer of white fabric provides a more finished look – without it, the foam would be exposed through the perforations and compromise the aesthetics. To fabricate the artifact, the three soft layers are first glued together, then hand-sewn with an elastic band that fits on the internal structure, and finally glued internally to achieve stability and durability.

Since the rear flashlight on the phone is located close to a corner, to achieve a more symmetrical light distribution on the rear, we fabricated and added reflective PVC cone inside the structure. In addition to the overall geometry of the internal smartphone housing, this component must be tailored when adapting the design for use with different mobile devices.

The Azalea app was implemented in the Java programming language on the Android operating system. Other than the Android standard libraries, we used Firebase<sup>3</sup> for networking, and the open source TarsosDSP library<sup>4</sup> for audio processing. Azalea recruits the phone’s inertial measurement unit (accelerometer and gyroscope) and proximity sensor for sensing; as well as the rear flashlight and front display for actuation. Since the smartphone is encased in Azalea, wireless headphones should be used for sound transduction.

No electronic components are used inside Azalea, other than the smartphone. This is a feature of the design, as we strove to make the experience less “technological” and more “organic.” Instead of a sense of the interaction being “digitized,” we wished to evoke a feeling of “natural” communication. The imagery of “giving up” or “sacrificing” the smartphone, which is “swallowed” by Azalea, also contributes to this aesthetic. The choice of materials (e.g. wool) and fabrication methods (e.g. hand-sewing) also stem from this ethos.

### 4.2 Interaction

The essence of the interaction design is meant to be non-prescriptive and cryptic. A pair remote interlocutors handle a pair of Azaleas to have a synchronous co-experience of embodied information (Figure 4). Azalea may function as a stand-alone mode of communication itself, but since its behavior cryptic and any other means of communication are sacrificed (i.e. by giving up the smartphone and darkening the environment – the latter explained below), a more straightforward mode of operation is to start a voice call before launching the app and inserting the phone.

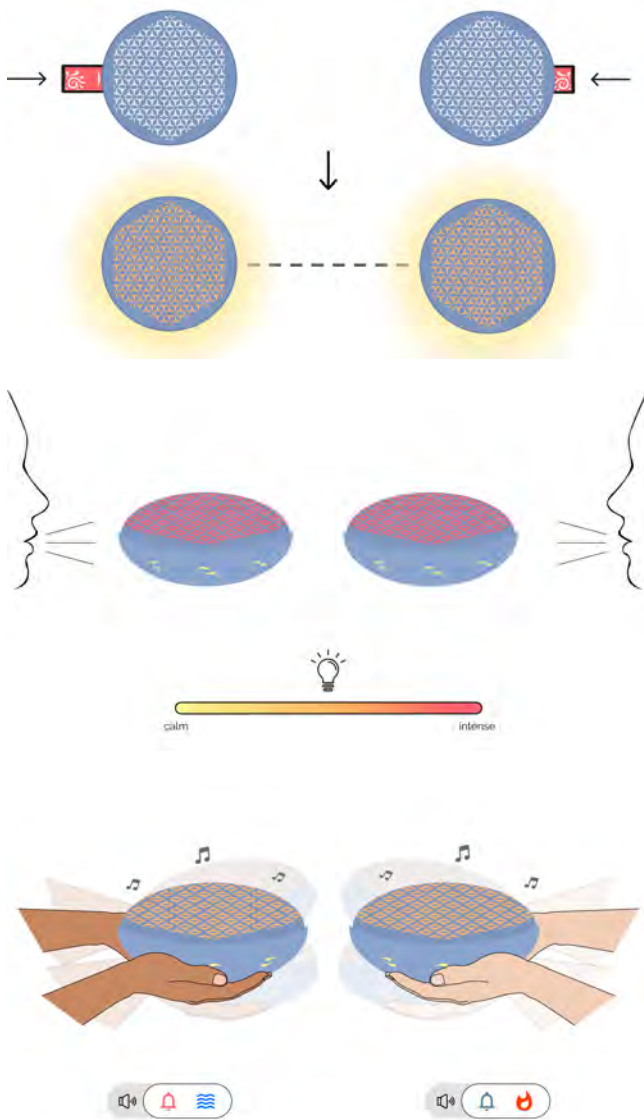
We strove to instantiate qualities of Somaesthetic Appreciation in Azalea’s interaction design [19]. First, initializing Azalea means that the smartphone is given up, and this in itself eliminates a very significant distraction [45]. Upon initialization, it may become obvious that the light on Azalea, emitted by the front display and diminished through the foam layers, is not visible in an environment that is well-lit. Thus, it is necessary for the user to move to a darker space or turn down environmental lighting (see Figure 2). This further diminishes distractions and stimuli: not only is the

<sup>2</sup><https://designsprintkit.withgoogle.com/methodology/phase3-sketch/crazy-8s>

<sup>3</sup><https://firebase.google.com>

<sup>4</sup><https://github.com/JorenSix/TarsosDSP>





**Figure 4: Overview of the interaction design: initiation by inserting the mobile phone (top); the light changes in response to loudness (middle); through movement, a soundscape of fire, water, and singing bowls is produced (bottom).**

environment now less visible, but the user is also prohibited from moving around the environment. Through diminishing affordances, the interlocutors are implicitly guided to a mental and physical space that is calm, and they are focused on the conversation. Thus, the design instantiates “subtle guidance” and “making space.”

Through its soft and tactile material qualities, as well as form, Azalea presents affordances to be held in hand while in use, rather than being set aside. As they held and manipulated by the interlocutors, the pair of Azaleas produce a shared soundscape in constant flux, composed of fire, water, and singing bowls. With translational

movements, one artifact drives the volume of a crackling fire sound, and the other drives ocean wave. Their rotational movements are mapped to the sounds of two singing bowls, which produce two different pitches that harmonize. The use of the rear flashlight, radiating from beneath the artifact, also relates to the sense of movement, since it accentuates a user’s own movements as they manipulate the artifact (Figure 3). Finally, the intensity of the conversation is mirrored visually on the artifact; as the whole front display of the smartphone is recruited to glow with a light that is driven by sound from the microphone. The glow varies in color and intensity – between a mild yellow and a bright pink burn – based on how quiet or loud the conversation is. Thus, the design instantiates “intimate correspondence” and “articulating experience.”

### Participant Quotes

“You’re in the same experience as we talk.”

“The sounds and sharing the same visuals felt like it anchored us more in the same dimension.”

“If I hear that the fire is sparkling, I know that [other user] is sitting with the Azalea in his hand, not using the hands for something else. He is *here* [holds out hands] in the conversation. I know that the conversation is happening *here*.”

“There is not always a need to talk. It gives [us] higher tolerance for silence.”

“By using these tools, you got more power to influence the flow of the conversation.”

“I feel like I get a clearer image of what he is doing and feeling, and that makes me feel closer to him.”

“I think I talk very fast and I talk a lot, so when we had this calm effect on us you almost lower your tempo in speaking, and then you think a bit more and you let the other one talk a bit more [...] and then you get deeper in the conversation.”

“[W]ith an ordinary phone call, when you’re only talking, the bandwidth is too small to let you experience the same thing, so you can at least see each other. But in this case, we had the device and the same experience and that made it almost like we shared a room...”

## 5 EXPERIENCE AND VALIDATION

To characterize and articulate how Azalea serves to mediate a co-experience of embodied information between remote interlocutors, we conducted a preliminary experience study with six pairs of interlocutors. This involved 20-minute sessions with the participants at their homes, and semi-structured interviews. We believe that the results are best summarized via quotes from these interviews with our participants, and we present these on the sidebar.

## 6 CONCLUSION AND FUTURE WORK

We wish to demonstrate Azalea: a smartphone-based design to enrich remote communication by making space for co-experience of embodied information. This is an integrated artifact consisting of a tactile cushion that envelops a smartphone running a bespoke app. The principal use case for this design is to enrich a remote communication, in tandem with a voice call. To accomplish this purpose, rather than the popular strategy of *augmenting* and increasing fidelity, we experimented with the notion of *diminishing* and providing a cryptic co-experience. The design also builds on, and contributes to, the intersection of somaesthetics and HCI. Our experiences from an study with six pairs of interlocutors illustrates the potential of the design.

Despite involving bespoke and handcrafted elements, our design is meant to be simple and reproducible. No electronics other than the smartphone are used inside Azalea. Within the scope of this work, we describe and demonstrate the artifact. Future work may culminate in resources to support reproduction.

We hope that our project serves to highlight the value of innovations that can enrich remote communication. Writing in 2020, as we practice social distancing and isolation in defense against a pandemic, we are convinced that there is great value in this research direction.

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