Cultural Prosthetics
Mediating Bodies, Technology, and Space

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Abstract. Instead of amplifying anxieties about conditions of alienation produced by advanced technologies and machines, this research looks for ways design and technology recalibrate human scale in architecture and inform social interactions. This research outlines two case studies specifically looking at gesture as a method for finding humanity in certain forms and reintroducing it through design and technology. The research asks, how might technology provide us with newfound intimacies with ourselves, each other, and the world around us?

Keywords: Instrumentation, Prosthesis, Wearable Technology, Gesture, Interaction, Cyborgs

1 Introduction

Architecture’s relationship with anthropomorphism has a long history. From the reference of the proportions of the human body, with the Vitruvian Man or Le Corbusier’s Modular, to the reference of the dimensions of human experience, with Pallasmaa’s assessment of phenomenology, the body has played a pivotal role as a scalar instrument, metaphorical device, and perceptive tool in both the discourse and the discipline of architecture. Walter Gropius, founder of the Bauhaus, further articulates this body-center tradition when he writes, “The size of our body (of which we are always conscious) serves as a yardstick when we perceive our surroundings. Our body is the scale unit, which enables us to establish a finite framework of relationships within the infinite space” [1]. Other noted professor of the Bauhaus, Oscar Schlemmer, proposed appropriating the body as a generative device for delineating and designing space through the development of productions, costumes, and drawings representing how space might be informed, defined, or even constructed from vectors or contours extending and radiating outward from the body (Figure 1 and 2).
1.1 The Body as an Instrument for Design

In 19th century discourse, Gottfried Semper used the body as a dialectic tool, by acknowledging clothing as the primary means of protection and environmental control, thus making it original form of architecture and opposing the long accepted classical ideas of Abbe Laugier’s primitive hut [2]. Later Joseph Rykwert softens these boundaries between Semper and Laugier, by providing an alternative commentary on shelter in architecture through his proclamation that the primary role of architecture is to act as “a mediator between the body and the world” [3]. This reduced definition provides an abstracted version of both Semper’s and Laugier’s ideas and alternatively privileges the articulated relationship of bodies and environments. Mark Hansen also investigates this relationship through the notion of wearable space, which encourages “fluidity between body and space” and involves or a more flexible architectural framing based on affectivity and experience [4]. Reminiscent of ideas portrayed in Schlemmer’s drawings, Hansen’s notion of the fluidity between the object of architecture and its subject draws upon the exchange between buildings and the observer.

Anthropomorphic discourse in architecture today includes, post-human design theories of Antione Picon and his theoretical stance on the cyborg, which is used as an exemplar of digital culture and a reference to the idea that we also live in both physical and technological spheres. The cyborg is a dialectical instrument for explaining how our environment extends beyond our skin, and acts as a call to design for “a digitally equipped individual with new expectations and requirements” [5]. In the 1960’s and 70’s, avant-garde architects such as Haus-Rucker-Co examined the body environment relationship through developments of technological prosthesis. Their Environmental Transformer explored ideas of perception and sought to enhance sensory experiences of the environment. Also, in their project, Mind Expander, a chair becomes a tool or device which confines two users and heightens their experience of listening and seeing each other. Each of these projects seek to evoke or
translate human experience by exploring the language between bodies and objects or the communications between people and things.

Technology today is often experienced as an extension of the body. Psychologists have realized that we currently view the cellphone as an extension of the body; this is why when someone accidentally forgets their phone they feel like they have forgotten apart of themselves [7]. This suggests there is no longer an interaction between man machine such that “It is exaggerating only a little to say that man has become part of the machine and no longer disengages from the keyboard and terminal” [8]. Teyssot further explains this idea of the technologically extended body and its impact and relevance to architecture, when he writes:

“The first task architecture ought to assume, therefore, is that of defining and imagining an environment not just for ‘natural’ bodies but for bodies projected outside themselves, absent and ecstatic, by means of their technologically extended senses. [...] We must conceive tool and instrument “like a second sort of body, incorporated into and extending our corporal powers.” It then becomes possible and even necessary to logically invert the terms of our proposition on the role of architecture. The incorporation of technology is not effected by “imagining” a new environment, but by reconfiguring the body itself, pushing outward to where its artificial extremities encounter “the world.” [9]

Teyssot argues we no longer perceive or engage with our environments directly through our bodies, but instead it is through technology that we experience the world. Therefore, architecture encases bodies “prosthetically expanded and articulated through tools and media technologies”, suggesting there is no ontological separation between our bodies and our instruments [10]. In order for architects to truly understand who they are designing for, they must be aware of the body’s technological extensions. Similarly, for bodies to engage the world, the experience at times must filter through its technological auxiliaries.

The key components drawn from these traditions are the notions of the body as a tool for design generation, the interiority of the body as a device for reengaging humanity, and the awareness that technology is radically affecting the way we inhabit our environments. This manuscript draws from Rykwert’s definition of architecture as a mediator and Picon’s stance on the cyborg and seeks to find ways architecture can mediate between our technologically enhanced bodies and space in order to imagine design opportunities for a digital culture.

1.2 Anthropomorphic Metaphorical Devices

“We tend to interpret a building as an analogue to our body, and vice versa.” - Juhani Pallasmaa [11].
As early on as ancient Greece, architects were engaging ideas of the body as literal and metaphorical device for design. With the Caryatids at the Acropolis, architecture engages the body as structure, where the figure of a woman’s body is literally translated to column. Francesco di Giorgio Martini furthered articulated this idea in his treatise illustrating the relationship of the proportions and profiles of cornices to the face. Nicholas Negroponte was also interested in body-related concepts in the making of intelligent environments where he saw the computer “as an environment that knows and understands us.” The goal of Negroponte human like environments was to encourage “humanism through machines” and he did so with ideas that “conjure images of a world where buildings are [...] characters in our lives—animate, thinking, and emotive beings which actively house and protect us physically as well as psychologically.” [12-13].

Rykwert points out the use of bodies as metaphors for building and “how metaphoric, even rhetorical procedures were successfully used by architects aware of the context in which they were working and concerned to use the design of their building so as to appeal to the users and the passers-by who are the real consumers of architecture” [14]. He further articulates that the use of metaphor as a ”means” for understanding and discussing of the qualitative attributes of buildings. The metaphor becomes an example of a type by which to compare and evaluate design against, an “iconographic device” by which to compare the final resolution [15]. Drawing from the long-standing motivation of architects to use anthropomorphic references as metaphorical devices, this research continues this history with the development of anthropomorphic instruments based on gesture. However, before outlining the two case studies presented in this paper it is important to understand the context for the choice of gesture as a method for the development.

1.3 The Gesture as a Communicative Instrument

The gesture is a tool in this research for recalibrating human scale, informing communication, and developing a linguistic evolution between designers and machines. With this method, the body becomes a reference for generating design, and particularly the gesture becomes a reference for discussion of more subtle ways of interacting with our technological auxiliaries their impacts on the experience of our environments. The research builds upon the gesture as a cultural embedded form of communication. Anthropologist Clifford Geertz describes the importance of understanding the broader cultural context of a subject with the example of gesture. Geertz discusses the blink verses the wink in interpretive anthropology, the blink being involuntary and the wink being communicative [16]. Both forms of involuntary and communicative are important to the case studies. Andrea di Jorio also studied gesture in art and literature as a means further understanding embedded references and narratives.
In contemporary work, Diller Scofidio + Renfro (DSR) have also had an interest in nonverbal forms of communication such as the involuntary disclosure that occurs with the blush. Their interest emerges from the exploration of Charles Darwin’s idea of the blush as being one of the only gestures that has no function in our survival, but instead “acts as an indication of sincerity and of our human condition.” Three projects where DSR engages this expression include the Braincoats for the Blur Building, their exhibition Unspoken, and in Alice Tully Hall. Within the atmospheric disconnect of the Blur Building, the design of the Braincoats induce a blush and inform social communications. As visitors pass one another, “their coats compare profiles and change color indicating the degree of attraction or repulsion, much like an involuntary blush turning red for affinity and green for antipathy.” This project exemplifies a way in which technology might “allow us to connect with each other through specific means directly related to our environments.” The braincoats also represent the design of a prosthetic extension of the body as a way of amplifying a bodily experience and inducing alternative situations for social interaction.

In DSR’s video installation, entitled Unspoken, they seek to enhance the visualization of the blush, by resenting thermal mappings of the faces of two people in conversation. While a typical blush is a times unnoticeable to others, this installation reveals heightened emotions which sometimes differ from those verbally communicated making the audience able to see feelings which are unspoken. Alternatively, in their third use of the blush in Alice Tully Hall, it is an element of performance. DSR integrates “blushing walls” into the concert hall so that the crimson illumination of the walls is an indicator of a show’s commencement, like the traditional flashing of the house lights.
Upon opening Nicholas Negroponte’s book, The Architecture Machine, the first set of pages includes a dedication, which reads, “To the first machine that can appreciate the gesture.” Negroponte had an interest in the gesture as a way of humanizing intelligent machine environments and imagines the potential for a room which “might giggle at a funny gesture or be reluctant to be transformed into something else.” [12]. Similarly this research is fundamentally tied to the ongoing project of developing shared languages between people and things.

Looking at nonverbal forms of communication and the gesture is a lens for investigatory research because it interlaces relationships between communication, social life, meaning, behavior, and culture. The gesture within the case studies outline is a tool for translating the languages between people and things which Walter Benjamin calls the truest of art forms. This intent is to pursue new forms of communication and inform narratives about the impacts of those exchanges on our environments [17]. The methods and pedagogical tools, are extracted from history while having a particular interest in social and psychological implications in order to complement collaborations across disciplines and develop a more in-depth understanding of the psychological effects of technology on the experience of spaces. The research asks, how can we find humanity in certain forms and reintroduce them through design and technology? How might technology provide us with newfound intimacies with ourselves, each other, and the world around us?

2 Case Studies

2.1 The Cringe Device

The first case study stems from the qualitative taxonomy of the word cringe, which informed the development of a wearable prototype that responds to conditions of everyday environment and alerts the wearer of its frustration and discomfort, like an irritable parasitic companion. Cringing, is a very subtle contraction of the body, mainly the facial muscle as a response to something uncomfortable, disgusting, or embarrassing. The initial method for the research involved a study of cringe and the subtleties of human reactions and motions. The research team conducted this study by showing viewers short video clips that might induce a cringe (figure 5). People had very different reactions to the video they were shown. Some enjoyed the disgusting actions of drilling through a fingernail or seeing a broken leg flop around like rubber. Others could barely stand to watch the video and covered their faces in fear. The cringing as a result from disgust and surprise also varied due to the individuals’ unique personalities. As seen in the photographs, there are a few individuals who are very expressive and animated, moving forward and backward in relationship to the camera, while others remain still, possibly due to an instictual response provoked by fear. Each person went into this experiment alone and unprepared for what they were going to see. Some subjects could barely keep their eyes open and face uncovered, while others had very little reaction overall. Each severe cringe was usually followed
by laughter, which may have been a result of an embedded social cue to diminish awkwardness.

![Photographs of subjects while showing video clips to them to try to induce a cringe.](image)

**Fig. 5.** Photographs of subjects while showing video clips to them to try to induce a cringe.

The second phase of the research involved the development and testing of a prototype, which is a worn device that disrupts daily routine and brings awareness to our environment (figure 6). Since the cringe is an involuntary response where the entire body seeks to consolidate itself into a single point in response to discomfort or disgust, the device uses a pneumatic to mimic the natural response of the body tightening. Using Arduino and a script that reads sensor inputs to regulate fans, the device constantly assesses the light levels, local volume, and movement of the wearer, and responds by inflating when uncomfortable or annoyed. In conditions that are too bright or too dark, when the local volume is too loud, or the wearer is stationary for an extended period, it comes to life. It acts as a second skin, which inflates similar to the way a bird, ruffles its feathers in situations of distress or as a porcupine raises its quills to protect itself (figure 7).

The goal of this device is to create an awareness about the environment, not seeking typical notions of comfort, but instead exploring how the device causes an adaptation of a wearer’s routine. With the ability to cause a cringe from anecdotal or visual sources being fairly facile, dependent upon the audience, this device employs a distilled motion as a communicator of discomfort or unrest. The prototype mediates between the aural environment and the wearer. As something visually striking and absurd, it garners the attention of passing people to interact and reveals information about how we approach objects and other people.
Fig. 6. Wearable prototype that responds to conditions of everyday environment and alerts the wearer of its frustration and discomfort, like an irritable parasitic companion.
Fig. 7. Wearable prototype inflates based on sensory effects in the environment.

2.2 Text Flinch Instrument

The second case study is a prototype, which draws upon the idea of the flinch as a survival mechanism embedded within human nature. The flinch, while commonly thought of as a glitch of the face, is a response that at times involves the movement of
the whole body as function of the body as a line of defense. The initial method for the research involved a study of the flinch conducted by photographing subjects while trying to induce the flinch with an unexpected moving object coming towards them (Figure 8). The photographs demonstrate that the arms of the subject often extending out near the extent of the person’s reach before contracting back towards the face for protection.

Fig. 8. Photographs of subjects after inducing flinch with unexpected object.

The prototype for this project sought to draw upon the movement as an instinctive reaction of the flinch. Placing this investigation into a contemporary context of the use of the cell phone, which often prohibits us from an awareness of our surrounding causing use to unexpectedly collide with objects and people when the flinch isn’t induced in time as result of our numbed senses distracted and inattentive to our surroundings. This prototype seeks to create a social flinching, causing an instinctive notice to the use a cell phone in public space and trying to evocatively play on the social distancing and numbness that results from their usage.

In the prototype, light projected on the ground defines the extense of the user’s spatial reaction time and activates when the user engages their phone (figure 9 and 10). Once the user is actively on their phone, the device automatically illuminates around the wearers body in order to delineate and spatially represent the extension of the body. The light is a means for protruding outward and claiming public space in order to make others aware of the user’s reduced capacity for engagement.
Fig. 9. Texting flinch prototype worn around the waist. The response is triggered by a sensor attached to the wrist.
Fig. 10. Flinch texting prototype housing Arduino which links sensors to illuminating special ring projected from the waist.

This prototype relates to other architectural projects including Walter Pichler’s 1967 TV Helmet project and Becky Stern’s 2008 Compubody Sock Privacy Sweater. The TV Helmet was a wearable living room consisting of a television at the end of an extruded helmet with elongated ends in the front and back. In photographs of the project, Pichler depicts the wearer of the helmet “happily distracted from a barren post-industrial, seemingly post-nuclear, environment” [2]. In both the TV Helmet and the Privacy Sweater the design of the prostheses directly relate to the conditions imposed by the environment such as nuclear desolation or cramped and unwanted closeness of sitting on an airplane. Both projects also exhibit ideas of a technological cocoon, immediately surrounding the body allowing the users to ignore their surroundings through isolated focus on encompassing machine extensions. The flinch
device similarly draws attention the phone as technological prosthesis dampening our perception of the environment, but also tries to create a kind of social radar and awareness from the play of light when multiple users wear the devices in public space.

Fig. 11. Walter Pichler’s 1967 TV Helmet

Fig. 12. Becky Stern’s 2008 Compbody Sock Privacy Sweater
3 Conclusion

These prototypes evolve from the indication of our changing conception of space and our corporeal occupation of it. The research suggests that the design of space could become either a by-product of way each prototype has investigated the body or a byproduct of the way our bodies experience it. Teyssot similarly articulates the idea of designing for a technologically enhance bodies and its impacts on architecture when he writes, “It is not so much a case of imagining new houses for cyborgs, but rather of redesigning and literally recrafting our instrument-enhanced and equipped body, so that it can “inhabit” the world” [9]. These projects begin to question how we might reconceptualization how bodies experience space. They build upon the extensive argument of Marshall McLuhan on the impacts on technology on our experience and senses and suggests alternatives to these situations through design [18]. The intent is to illuminate the possibilities of what can be through history and demonstrate the potential of those possibilities through actualization of prototypes. This work tries to address challenges brought on by a technological society and seeks to challenge perceptions of the future of our discipline.

In 1966, Cedric Price began a lecture with the exclamation, "Technology is the answer!" but then soon followed with the clause "...but what was the question?" Price’s words resound just as clearly today as they did in 1966 [19]. Today technology innovation in architecture focuses on preoccupation with form and simulation lacking a broader understanding of the impacts of instrumentality in design and the emergence of an architecture engaged in the blurring of physical and digital domains.

"We once understood our world through systems founded on human size, vision, and patterns of occupation. In a culture of the digital, however, the body is no longer the single measure of space; instead it is the technologies through which we see and experience the world that define how we navigate and build it. In this context we must begin to imagine new design sensibilities legible across both human and machine experience.” [20]

Not forgetting the long anthropomorphic traditions of architects, this research calls for an imagining of new design opportunities which accept the physical and psychological hybridities between man and machine, and strategically interfaces between the constructed environment, technological systems, and our bodies.

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