

# Altering our Perception of Smartphones through Noise: Introducing the Affection Research Lab

Salvador Orara\*

## ABSTRACT

This paper introduces the *Affection Research Lab (ARL)*, a project that leverages pre-existing animistic tendencies to create a new layer of understanding and meaning of smartphones. Utilizing *Animistic Design Principles*, [10] the ARL introduces the development of new modes of device affection through the concept of the post-mythical object; within the context of a landscape saturated with task-oriented utilitarian digital objects. ARL solicits device-affection by listening to their intrinsic nature of electromagnetism as a source of raw data, and transforms this raw data through the lenses of noise and sound. ARL provokes a paradigm shift in the development of digital objects and seeks to deduce meaning out of the overwhelming and seemingly meaninglessness of noise. Furthermore, this paper discusses the state of the human condition as a result of our cultural developments [1] and expresses the strides one must take in order to create deeper connections with our digital objects and the mythical possibilities we can have with them. The paper will discuss two core projects that define the ARL: *The Signal Archive* and the *Affection Stations*, breaking down their different conceptual approaches, and the animistic results from participant feedback; providing evidence of pre-existing tendencies and enabling those tendencies to transform into a new level of perception. The ARL seeks to enable new stories and myths to be created with digital objects. In doing so we advocate for the approach of *mythical-centered design* where the focus of designers and engineers is in the creation of rich and meaningful experiences with digital objects which allow us to reflect, collaborate, and participate; within an ever increasing context of ubiquitous data and the digital objects which mediate our understanding and experiences within it.

**Keywords:** Visualization, Noise, Human Computer Interaction, Animism, Mythological Interaction.

## 1 INTRODUCTION

Have you ever named a thing you own? Have you ever wondered why something didn't work because of some mysterious digital glitch? Have you ever bestowed a more than normal amount of emotion or attachment with a digital object, not merely for what it enables, but for some other undefinable quality? Humans are masters at making myths and stories for deriving meaning of the things we don't understand. It is our innate way of orienting ourselves within an ecology of the varied objects and spaces we are surrounded by. Karen Armstrong provides an adequate definition, "Myths are universal and timeless stories that reflect and shape our lives -- they explore our desires, our fears, our longings and provide narratives that remind us what it means to be

human." [1] Myths help us cope with the unknown forces of the world.

### 1.1 Animistic Design Principles

Animistic Design is a new strategic approach to rethinking and developing conceptual models for user experience and interaction design in an environment of increasing digital objects and ubiquitous data. It is intended to foster myth-making, storytelling, narrative effects, rituals, and metaphor-building amongst humans; and to enable different degrees of familiarity and affection with their digital ecosystem. Brenda Laurel frames Animism as "a spiritual belief system attributes in-dwelling spirits to natural objects, like trees, and rocks ... places, or architectural or made objects." [9] Although this definition focuses on the mystical and spiritual responses to understanding reality, this approach breaks down into describing the different behaviors, artifacts, and rituals that are created by people as a response to their own animistic systems upon objects. [9] Marenko and van Allen extend and simplify this notion with, "[...] users increasingly tend to attribute personality, agency and intentionality to devices because it is the easiest route to explain behavior." [10]

*Animistic Design Principles* can fluctuate between varying degrees of anthropomorphism and metaphor. Previous explorations as a research assistant with Philip van Allen, at Art Center College of Design, we discovered there were different degrees of applying anthropomorphism: from the borderline cute and illustrative, to the abstract and nonrepresentational. This spectrum is often measured by the amount of metaphor bestowed upon by the designer, and perceived by the user.

### 1.2 Post-Mythical Object

This paper introduces the *Affection Research Lab (ARL)*, a project that leverages pre-existing animistic tendencies to create a new layer of understanding and meaning: a new myth. Marenko and van Allen succinctly provides the ARL with a vehicle for exploring, "Animistic Design as a post-cognitive framework for developing interactions and user experiences." [10] Within this framework, ARL creates a "post-mythical" framework of animistic design. Recent explorations of *Animistic Design* administer animism prior to the creation of an object or for the development of new digital objects. [13] It has also been administered to pre-existing non-digital objects or "dumb" objects for greater and familiar effects. [10] ARL adds and expands to the discourse of current implementations, and pushes them into the post-animistic and the post-mythical. Creating myths upon myths for a multi-layered, and multi-faceted experience with digital objects. In addition, ARL pushes beyond the *post-mythical* into the *post-human* relationship — to explore the experiences objects could have amongst themselves. Although Marenko and van Allen propose the post-human relationship as an aspect of the human continuum of experience, [10] ARL explores the object side of this experience. Positioning the human experience alongside the continuum of the digital-object-experience. This notion plays into the domain of an interconnected landscape of things, a new ecology of things, or an *internet of things*, and speculates upon objects already having a life and experience of their own.

---

\* orara.salvador@gmail.com

### 1.3 What is Affection?

What is the purpose of exploring the *post-mythical* object? Do we love our digital objects because of the tasks they enable, or do we love how they enable tasks in seemingly magical ways? Karen Armstrong discusses the 18th century transformation of the human condition of moving towards the mechanical and technological reproduction of goods and materials, the reinvestment of capital, and the death of mythology. [1] Today's techno-social condition glosses over the magic behind digital objects for the sake of efficiency and task completion success. The designers of today are experts at both hiding and utilizing technology, because in most cases, we're not meant to know or understand digital objects at that level. Affection is created at the surface, the user interface; and it is to this end we love our digital objects. *ARL* seeks to define new channels for developing affection by removing the surface and user interface of digital objects.

## 2 INTRODUCING THE AFFECTION RESEARCH LAB

The *Affection Research Lab* has been created to develop *Affection Stations* and *The Signal Archive*, with the mission to become the seed of a device-affection development center and institution. *ARL* provides a counterpoint to today's utilitarian computation culture and help to make animistic design and mythological interaction more common. *ARL* fosters device-affection through the framework of the post-mythical object, by using the electromagnetic activity and incidental sounds of smartphones. *ARL* delves into the seemingly organic chaotic nature of our smartphones to expose new methods for developing human-computer affection and interaction design; and unveils a new way of looking at the inevitable electromagnetic spectrum.

### 2.1 Electromagnetic Fields as Noise

Why electromagnetic activity? Why noise? Marenko and van Allen state, "[designers and engineers]... aim to maximize the immediacy and flow of user experience while minimizing to the point of invisibility anything that may be disruptive or unexpected: glitches, blips and any noise that could disturb interaction." [10] Noise is the unwanted byproduct of events and actions taking place, and in the electrical domain, noise is the irregular fluctuations that accompany a transmitted electrical signal but are not part of it, and in musical terms — pitchless sound. [7] However, in terms of data, the following definition allows for a more flexible approach: noise is the presence of many signals (more than one), or the lack thereof; both are practical states of information. [12] This binary approach (which will be important in the development of our projects) allows us to embrace the complexity of noise, and invites exploration in the transformation of the meaninglessness of noise into something meaningful.

Furthermore, the transformation of noise introduces details at the macro and micro levels of perception— a constant teetering at the cusp of comprehension and sensation. Immanuel Kant describes the sublime feeling as "a kind of 'rapid alternation' between the fear of the overwhelming and the peculiar pleasure of seeing that overwhelming overwhelmed." [3] This is a direct correlation with our relationship with myths. Our first myths derived from our need to understand death. According to Karen Armstrong, death can be assumed as the first indefinable inevitability of human nature. A human that was once alive and then dead, was clearly an overwhelming event of life by evidence of the many monuments and structures created to understand it.

[1] Electromagnetic fields have long been a frontier of reality in need of understanding. This will become even more prevalent as the ubiquitous network expands.

In relation, Brian Massumi describes Felix Guattari's view of microperceptions, "microperception is not a smaller perception; it's a perception of a qualitatively different kind. It's something that is felt without registering consciously ... Microperception is this purely affective re-beginning of the world." [4] When delving into the nuances of microperceptions, we become affectively invested as we are challenged to overcome the overwhelming nature of the great, new initial perception.

We love our devices because its noisiness is intentionally hidden. By literally surfacing noise, the *ARL* interrogates our affections of smartphones by subverting our relationship with them through the creation of strange interfaces, scenarios, and most importantly, through experimental displays of this noise as raw data. By disrupting the intended flow and experience of smartphones we enable the human mind to create new myths around its very meaning.



Figure 1: *The Signal Archive, Recording Station.*

### 2.2 Smartphones

Harnessing noise, an overwhelming aspect of reality, is crucial to orienting ourselves in this world. Luigi Russolo's 1913 Futurist manifesto, *The Art of Noises*, embedded in a letter to the Futurist composer Francesco Balilla Pratella, outlines a framework for observing the world and its current technological condition through sound. He proposes a number of conclusions on how futurist musicians can harness the incidental sounds found in the machines of his time as a "substitute for the limited variety of timbres that the orchestra possesses today." [11] Russolo believed that listening to the incidental sound of our industrial landscape could reveal a new sonic frontier capable of the affective results found in music.

Within a snapshot in the history of tools for communication we encounter the device known as the telegraph, which utilized a codified system of dots and dashes to translate the spoken word. An early digital object intended to efficiently and quickly facilitate communication between humans. The electrical telegraph and its intrinsic physical properties and technology, coupled with this codified system of writing, quickly became a "noisy object." It also became evident that listening to the noisy by-product, or the incidental sound of the device was just as effective as reading the dots and dashes. [6] Like Russolo, we scrutinized the landscape of contemporary digital objects and discovered the smartphone: an object of ultimate utility and simultaneously of great mystery and magic in the eyes of its

beholder. When Steve Jobs introduced the Apple iPhone at *MacWorld* 2007 he probably had no idea, or maybe he did, that he was introducing an object of profound mythical qualities.

### 2.3 Signal Archive

The Signal Archive is the foundation of the Affection Research Lab. It is an expanding collection of recordings of as many different devices as possible. Each device is recorded (Figure 1) by systematically performing similar tasks as afforded on each device. These recordings capture and define the raw data, and the hidden qualities of smartphones we are not intended to perceive. They define the immaterial essence of our techno-culture and may be utilized as historical reference and performative or creative materiality. (See the Archive here: <http://tinyurl.com/hn8uqk7>)

#### 2.3.1 Sensing Electromagnetic Fields of Smartphones

There are four fundamental forces in nature: gravitational, strong nuclear, weak nuclear, and electromagnetic. As a fundamental force, electromagnetic activity cannot be reduced to a more basic interaction or understanding. They extend indefinitely into space and are created by objects when they are charged with electricity. Sensing the electromagnetic activity of objects is not new. In the domain of art and design we have examples such as the electromagnetic orchestra installation by Troika, *Shit I forgot the iPod* (2005). The project, “*immaterials: the ghost in the field*” by Berg London (2009). Let us also not forget the amount of research by Dunne and Raby and their perspectives and approaches to the electromagnetic spectrum in *Hertzian Tales* and *Design Noir*, et al. The ARL lives alongside these references of work, as research and provocations utilizing the electromagnetic spectrum.

Sensing the electromagnetic field of a smartphone was performed through a systematic approach. However, we must be reminded of the sonic quality of noise we seek to harness and understand — we didn’t want to see electromagnetic fields we wanted to hear them. Three sensors were used to create what we call, “Observation Tools”:

1. Observation Tool #1:  
RadioShack 28-inch telescoping antenna
2. Observation Tool #2:  
RadioShack Ferrite Core Magnet wrapped with copper wire
3. Observation Tool #3 (Figure 2):  
Single-coil electromagnetic pickup



Figure 2: *The Signal Archive: Observation Tool #3.*

Watch it here: <https://vimeo.com/33422000>

Each of these sensors was directly plugged into a Zoom H2 Handy Recorder, using a 1/4-inch audio jack, and captured on video with a Panasonic GF-2. Tools 1 and 2 produced rich and unexpected results, but *Observation Tool* 3, the single-coil

electromagnetic pick-up, provided the richest amount of sonic results, therefore we moved forward with the single-coil pickup as our primary *Observation Tool*.

With very little technical background on the science of electromagnetic activity, we reduced the raw data as being the combination of three distinct signals: mechanical, electronic, and radio. Whether or not this reduction was correct, it assumed that listening to the radio signal was too specific and borderline near field communication. It was decided to maintain the noisy and incomprehensible raw data as a combined singular signal despite its potential for reduction. Exposing a distinct aspect of the signal might provide patterns, which could be deduced by our audience as — humans are experts at recognizing patterns. Our hypothesis: the raw data will be enough to alter the perception of participants, and stop their completion of all requested tasks.

We set forth to reveal these hidden qualities to a group of indiscriminate participants. Each participant placed their device on the *Sensor Mount*; a simple foam core box with a single-coil pickup; and was asked to perform the same set of tasks their device could afford. The noise, raw data, was fed directly back to the user, the recorder, and the moderator, in real-time.

Quantitatively, all 13 participants were capable of completing the requested tasks with exception of 1, which did not have some of the affordances, and a few which may have skipped a task or two, due to the distraction of the noise or simply not reading the task sheet properly. The simple list below breaks down the topical quantitative results.

- Longest observation: 00:06:44
- Shortest observation: 00:02:25
- Average observation: 00:04:24
- 5/13 participants performed faster than average

Qualitatively, every participant had intermittent responses exhibiting animistic behaviors and tendencies. Not only did they respond in similar ways, they responded in a particular order. The Primary response was usually a surprise: “Whoa! What is this sound? Is this my device or did you program these noises?” The Secondary response was to anthropomorphize the noises being heard: “It’s barking at me!” “It sounds like a duck. My phone is secretly a ducky.” The Tertiary response, which resulted after a longer duration of time, was typically a personal qualitative reflection: “I don’t like the noises I’m hearing, it feels like I’m hurting my phone.” “This is too much for me. This can’t be healthy to listen to. Isn’t this driving you crazy listening to this all day?” “I think I missed a task or two because I can’t listen to this anymore. Sorry.”

Our hypothesis of participants not being able to complete their tasks due to exposure to the raw data was partially correct. However, most users did take longer than usual when stopping to say something or internally reflect, to this end we discovered that the exposure slowed down their process of completing tasks. It was determined that direct exposure to the sound of the raw data was too overwhelming. The noise was either ignored completely, or only intermittently impactful when patterns would emerge. This observation was proven to be very useful, despite our earlier inclinations not to enable patterns to emerge. This could make a case for arguing how the human mind enjoys solving problems and deciphering patterns. There’s a sense of relief and comfort within the ebb and flow of learning — of not knowing and knowing. Patterns typically emerged during tasks involving the tapping of the digital keyboard, which always resulted in users responding with animistic and metaphorical comments. Listening or hearing patterns grounded the participants mind to make sense

of the noise. Perhaps the sound of the raw data needed to be transformed into something as equally overwhelming, or separated from the device? It most definitely required some level of patterning or semi-predictable behavior in order to be engaging and approachable.



Figure 3: *Sound Station*.

Watch it here: <https://vimeo.com/41048664>

## 2.4 Affection Stations

The user-driven research results from the *Signal Archive* introduced the second and third phase of developing device-affection. It involved the creation of different types of data perceptualizations either visual, sonic, or both. Andrew Losowsky proposes a definition how visual storytelling “is this combination of emotional reaction and narrative information.” [8] The importance of myth making is reintroduced in the creation of visualizations (perceptualizations) of data. When humans discovered their fear of death and invented ceremonies to memorialize their ancestors, we invented myth. We also invented visualizations of these myths through cave paintings, sculptures, artifacts, song (music), dance, and performance. Losowsky adds, “Visual abstraction is a human instinct, and a societal necessity.” [8] The *ARL* attempts to supersede all existing approaches to data display and infographics, to create abstracted experiences and transformations of the raw data and nature of electromagnetic activity. We do this by creating *Affection Stations*.

There are two classifications of *Affection Stations*: *Primary Stations* and *Secondary Stations*. *Primary Stations* perform a direct transformation of our raw data of electromagnetic activity. The *Secondary Stations* explore post-human relationships with devices, often involving two or more devices to participate and the removal of the user. The descriptions that follow summarize the intent of each station and include specifics on how the raw data is being transformed. For the sake of readability, code will not be presented in the paper, but rather abstracted as a description of a narrative of data flow.

### 2.4.1 Primary Stations

#### 2.4.2 The Mobile Affection Application

A JavaScript application was created for any device visiting a *Primary Station*. The purpose of the application was to create a control, to have each device performing the same task at the surface level. This highlighted the effects of their device at each *Primary Station* and profoundly impacted the reaction of participants with similar devices. <http://affectionstations.org/app/>

### 2.4.3 The Sound Station

The *Sound Station* (Figure. 3) is a direct result of the *Signal Archive*. It presents the raw data through a symmetrical arrangement of 1-LM386 amp circuit and 10 speakers, each with a specific frequency response range. The raw data is manually divided into different frequency ranges based on the frequency response of each speaker. Participants were invited to place their device on the *Sensor Mount*, a wooden box with an electromagnetic pickup and listened as their device performed the *Mobile Affection App*. Participants responded to the *Sound Station* differently from that of the *Signal Archive*. Because participants are not performing any tasks on the device the experience is completely focused on the sound of the raw data. The accessibility of the speakers, enabled participants to simply put their ears up against a speaker to hear the macro and micro nuances of the raw data.

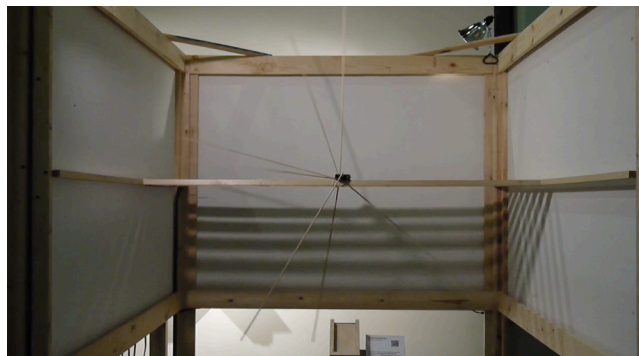


Figure 4: *Kinetic Station*.

Watch it here: <https://vimeo.com/41036735>

### 2.4.4 Kinetic Station

The *Kinetic Station* (Figure 4) introduces the visual strategy of movement as a mode of transformation. The raw data is passed through an audio interface, into a digital signal-processing program called *Pure Data*, and produces binary signals to an Arduino Mega controlling seven 360-degree servos. Each servo is mapped to a frequency and responds to the binary activity within that channel; where an even value rotates the dowel clockwise, and an odd value rotates the dowel counter clockwise. Participant responses were mostly abrupt at first, since the reactions of the servos were programmed to be immediate. This created a sudden physical response in return, typically to jump back and away from the moving dowels. However, immediately afterwards there was a moment of mesmerization, where the participants lingered and moved closer in search of a pattern. Some tried to deduce the relationship of the *Mobile Affection App* with the movement, while others simply stared and wondered.

### 2.4.5 Light Station

The *Light Station* (Figure 5) transforms the already faster than light waves of the raw data, back to its original source (as it is electromagnetic energy). Much like transforming a JPG into an audio file and then back into a JPG. The data flow is similar to the *Kinetic Station*. Sound is passed through a digital signal processing (DSP) patch in *Pure Data*, and converted into a binary signal for each relay controlling the on/off state of the light fixtures. In comparison to the *Kinetic Station*, the *Light Station* actually slows down the activity due to the nature of the electrical signals and the attenuation of the DSP patch. Of the three *Primary Stations*, the *Light Station* produced the most “Ahhs,” and the longest amount of “mesmerization sessions. It also successfully and completely removed the focus from the surface of the device

to the station itself. In some cases, the lights were so sensitive that they would all slowly turn on and stay on, producing a negative reflection upon the participant, which resulted in the disapproval of the performance of their device.



Figure 5: *Light Station*.

Watch it here: <https://vimeo.com/41053886>

## 2.5 Secondary Stations

The *Secondary Stations* explore the domain of the post-human relationships we can have with our devices. Although illustrative, conceptual, and complex, the stations to follow detail the ways in which data-rich objects can begin to communicate with one another, and make that communication visible. In most cases, the *Secondary Stations* are templates for future manifestations of visualizing the communication and output of data-rich objects. These stations were never presented to the public for assessment.

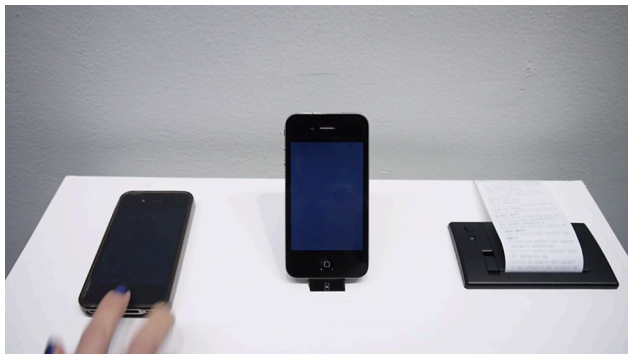


Figure 6: *Oracle Station*.

Watch it here: <https://vimeo.com/38082880>

### 2.5.1 Opera Station

The *Opera Station* (<https://vimeo.com/36438446>) pushes the primary nature of the *Sound Station* into the strange context of the smartphone in a musical recital. Like watching one's child perform their first piano recital, could we one day anthropomorphize our smartphones to the extent of their own true voices coming to life? Smartphones are prepped with a script of dialogue driven by a JavaScript application randomly loading animated .GIF files. The result is a mesmerizing audio-visual performance where one could perceive the two devices as actually having a conversation.

### 2.5.2 Oracle Station

The *Oracle Station* (Figure 6) transforms the raw data into text. It explores the existing myth of the *Oracles of Delphi*. In this case, smartphones visit a specific smartphone (the Oracle) to seek wisdom. The thermal printer is an actant, a translator for humans

to bear witness to this event, but only to be confronted with yet another puzzle of patterns however, by chance could potentially reveal a message. This station speculates the notion of this raw data being a hidden voice. If there is a hidden voice within our devices, what is it saying and to whom is it speaking?

### 2.5.3 Whispering Station

The *Whispering Station* (<https://vimeo.com/37771150>) explores the mode of bestowing a device with the ability to sense the presence of humans, and allowing that device to speak freely. Like a guard dog looking for appeasement or seeking to intimidate, the *Whispering Station* explores a more complex arrangement between devices, and between devices and their owners. This station positions owners as subordinate vessels to carry their devices to specific locations for appeasement and ritual.

## CONCLUSION

The *Affection Research Lab* is an instantiation of the exploration and implementation of *Animistic Design Principles*. It perpetuates the notions and invitations put forth by Marenko, van Allen, and Laurel, et al.; and introduces its own model of the “post-mythical object.”

The *Animistic Design Principles* introduces a meta-framework for creating conceptual models that request designers and engineers to embrace ambiguity and chaos. In doing so, we can potentially reinforce the imagination and creativity among users and expose the possible collaborations between objects, to remind us of our human nature to be social and less isolated by our own creations. Aside from the *Signal Archive*, the *Affection Stations* develops experiences where users are forced to relinquish control of their devices, to simply put them down and let them be — and relish in the human continuum of the animistic experience without the need of their device. Human Computer Interaction could benefit by encouraging new frameworks and interaction models that focus less on the task-oriented system and more of a “mythic-oriented system,” which by assumption, could provide longer lasting effects and experiences on a species that is rooted in the nature of creating myths and stories.

The *Affection Stations* utilizes the richness of the electromagnetic spectrum we ignore and hide; and proposes a recursive loop that could be developed, where the source of chaos or indeterminacy is derived directly from the intrinsic nature of the object itself. Thus, giving purpose to the energies dispelled from digital objects — making noise meaningful and transforming the energies we deem to be harmful as the potential savior of our instinctual natures.

## ACKNOWLEDGEMENTS

I would like to extend my thanks and acknowledgements to all those who funded the small but successful Kickstarter campaign where all proceeds funded an earlier version of the project: *Oracle Stations*. I would also like to thank and acknowledge the Faculty, Staff, and Students at the graduate Media Design Practices program at Art Center College of Design, Pasadena CA., especially: Philip van Allen, Elise Co, Mike Milley, Casey Anderson, Shannon Herbert, Norman Klein, Anne Burdick, and Kevin Wingate.

## REFERENCES

- [1] Armstrong, Karen. *A Short History of Myth*. Canongate, 2006.
- [2] Arnall, Timo. “Immaterials: The Ghost in the Field.” Vimeo, 29 Aug. 2016. Web. 15 Nov. 2011.

- [3] Burnham, Douglas. *Kant: Aesthetics*. *Internet Encyclopedia of Philosophy*, 2005: Web. 16 Jan. 2012.
- [4] Deleuze, Gilles, and Guattari, Felix. *A Thousand Plateaus: Capitalism and Schizophrenia*. 1st ed. Trans. Brian Massumi. University of Minnesota Press, 1987.
- [5] Dunne, Anthony. *Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design*. The MIT Press, 2006.
- [6] Calvert, J. B. *The Electromagnetic telegraph*. n.d. Web. 29 Nov. 2011.
- [7] Hermann, Thomas. "Taxonomy and definitions for sonification and auditory display," in *Proc. 14th Int. Conf. Auditory Display (ICAD 2008)*, Brian Katz, Ed., Paris, France, 06 2008, ICAD, ICAD.
- [8] Klanten, Ehmann & R. S., and Andrew Losowsky. *Visual Storytelling: Inspiring a New Visual Language*. Eds. Robert Klanten, S. Ehmann, and Franz Schulze. 2nd ed. Berlin: Die Gestalten Verlag, 2011. Print.
- [9] Laurel, Brenda. "Designed Animism." Binder, Thomas, Jonas Löwgren, and Lone Malmborg. (Re)Searching the Digital Bauhaus. 1st ed. Springer, 2008.
- [10] Marenko, Betti & van Allen, Philip. *Animistic design: how to reimagine digital interaction between the human and the nonhuman*. *Digital Creativity*, 27:1, 52-70, DOI: 10.1080/14626268.2016.1145127. 2016.
- [11] Martin, Sylvia. *Futurism*. Taschen, 2005.
- [12] Nechvatal, Joseph. *Immersion Into Noise*. MPublishing, University of Michigan Library, 2011.
- [13] van Allen, P., and McVeigh-Schultz, J. 2013. "AniThings: Animism and Heterogeneous Multiplicity." CHI 2013, New York, ACM Press. 2247–2256.