# Designing Physical Artifacts for Tangible Narratives: Lessons Learned from *Letters to José*

**Daniel Echeverri**

School of Design, The Hong Kong Polytechnic University Kowloon, Hong Kong
daniel.echeverri@polyu.edu.hk

**Huaxin Wei**

School of Design, The Hong Kong Polytechnic University Kowloon, Hong Kong
huaxin.wei@polyu.edu.hk

## ABSTRACT

Digital tangible interfaces have been used to present or embed interactive stories for decades. While many researchers explored different ways of creating engaging interactive experiences, they focused more on the novelty of the interface and the new experience it brought for users, rather than the exploration of tangible interfaces as a language, or a medium, for storytelling. Through a visual journey of our creative explorations, this pictorial reflects upon the design and making of *Letters to José*, a tangible narrative built during a three-year practice-led research project. Located in the intersection of tangible interaction design and interactive storytelling, our work characterizes the relationships between *the* artifact, other artifacts, the body, and the space with respect to supporting the narrative experience. The outcome is an annotated visual typology of *artifacts for storytelling* in the context of tangible narrative, as a design category and toolbox for researchers and creators of tangible stories.

**Authors Keywords**

Tangible Narrative; *Artifacts for Storytelling*;Interactive Narrative; Tangible Interaction; Research through Design; *Letters to José*.

**CSS Concepts**

- Human-centered computing~ Interaction design; Human-centered computing~Human computer interaction (HCI)~Interaction techniques

## INTRODUCTION

In the past two decades, the research community of tangible interactions has seen a multitude of attempts of having tangible interactive systems tell stories or embed narrative contents. A recent comprehensive analysis of tangible storytelling systems by Harley et al. [8] revealed a scarcity of actual cases (i.e., only 21 cases collected in their 2016 paper) and pointed out that: "systems with diegetic objects present an interesting opportunity for the future of tangible narratives. As objects that exist both in the storyworld and in the user's physical space, diegetic tangibles are a possible alternative to the propensity for stories that position the user's interaction outside the storyworld." To contribute to the limited body of works and understanding of tangible storytelling, we built the design case *Letters to José* as part of our larger Research through Design project. Previously we reported in another paper [3] our theoretical considerations, narrative design, and a mixed-method user study. In this pictorial, we focus on the core process of tangible design, with specific considerations of how to construct physical artifacts that can carry out a narrative experience. In particular, we intend to integrate concepts brought from the design of Tangible User Interfaces (TUI) with other relevant aspects found in theories of narrative and interactive narrative.

The organization of this pictorial is as follows. First, we introduce an overview of *Letters to José*, a tangible narrative implemented as a physical-digital hybrid system. Second, we present the creative explorations behind *Letters to José* along material, functional, and interactive dimensions. We describe the purpose of each form of experimentation and how it contributed to the development of our theoretical work, leading to the notion of *artifacts for storytelling* (artifacts that mediate between the narrative content and the interactor). Third, we propose a visual typology to characterize artifacts for storytelling and an associated typology of interaction methods that describe the various relationships between these artifacts, the body, and the space. This typology suggests principles applicable in future work in the study and design of tangible narratives.

## OVERVIEW OF *LETTERS TO JOSÉ*

*Letters to José* is an interactive non-linear narrative inspired by the letters sent between José–an air force rookie– and his brother Jesús–a young medical student. Jesús's letters recount his life and depict the social changes in Colombia during the late 1940s. As a physical/digital hybrid experience, this tangible narrative is presented as three interactive, physically unfolding story worlds (or paper worlds) that combine paper mechanisms with visual, performative, and auditory features. It was designed so people can observe and discover the story, while meaning- fully acting in the narrative.

The paper worlds in *Letters to José* are divided into separate panels. These panels are both the interface and the stage where the story unveils. Several physical artifacts were designed to allow people to play with the story. For instance, people can play with a cardboard puppet representing the main character, manipulate a series of pop-up cards to unlock secondary stories, or touch and manipulate word labels to unveil short fragments of Jesús's letters in audio clips.

Each paper world is based on two Arduino-based microcontrollers: a *Bare Conductive Touch Board* and a *NodeMCU ESP8266*. The *Touch Board* responds to touch events through capacitive electrodes connected to images printed in carbon-based paint. Upon touch on an image, the *Touch Board* plays an audio clip of the story. The *NodeMCU* controls an RFID module that reads tags placed in different artifacts. It also controls a group of photocells, reed-switches, and a thermistor, which upon activation, also triggers an audio clip with a fragment of the story. In the next section, we will discuss the creative process behind *Letters to José* and how mate- rial, functional, and interactivity exploration informed our work.

### Tangible Narratives 101

Tangible Narratives can be seen as part of a larger group of interactive media framed as Interactive Digital Narratives (IDN). IDNs are defined as "a form of expression enabled and defined by digital media that tightly integrates interactivity and narrative as a flexible cognitive frame" [12]. In the world of HCI, tangible narratives are described usually as interfaces [2,19], platforms [14,20], or environments [1].

Tangible Narratives distinguish themselves from other forms of digital narratives by their physical and tangible features. More than just self-contained software, tangible narratives construct the story world with interfaces, objects, system environment, and multimodal narrative content. They involve a plot, and characters acting and inhabiting in different environments of the story [8]. The purpose of the technological aspect of these narratives is to support the experience [8] while focusing on creating the story and allowing

people to play with aspects of the narrative. Tangible Narratives also integrate playful aspects and methods. For instance, playful artifacts foster imagination [4] and stimulate cognition [17].

In the past 20 years, work in HCI has contributed significantly to the development of the field of Tangible Narratives, from principles borrowed from tangible interaction [9,22] to the integration of concepts brought from the study of narrative [2,8]. The slow maturing of the field has led to some compelling tangible narratives such as *Reading Glove* [21], *Loominary* [18], or *Shiva's Rangoli* [7].

## THE CREATIVE PROCESS

### Material Exploration: How Did We Make Things?

Some of the material explorations in our research were inspired by previously published work in paper-computing [15] and low-cost electronics [13]. However, many of the experiments we tried were empirical and exploratory. They did not really follow a strict plan. They sought to answer simply, *how can we make that?* The purpose of these experiments was to translate a sketch—where the idea was first externalized—into the material, real, and viable. We experimented with materials, substrates, techniques, and technologies to achieve a working prototype that supported the narrative process itself.

The material exploration helped with our decisions on the key material aspects for not only the environment (e.g., the panels themselves) but also the objects, or the artifacts, that are associated to or embedded in the environment. The material choices of the artifacts should well support meaning attachment during the narrative play.

### Functional Exploration: How Did We Make Things Work?

Rather than answering, *how can we make that?* this second type of exploration sought to answer, *how can we make that* ***work****?* As we were designing a tangible narrative, functional exploration in our research explored ways to make things happen in the real world, too. When they happened, we would find ways to attach narrative meaning to these happenings so that the interactor can associate them to respective story events. How can we make the audio clip play? What do we need to make a paper mechanism react to something? Through functional exploration, we discovered new components and technologies; we engaged in designing different prototypes and experiments that allowed us to use electrical components with the resources we previously surveyed during the material exploration.

While material exploration focused on playing with the raw materials and supplies, functional exploration sought to build knowledge through research inspired particularly by the usage of artifacts since they are the dynamic parts of the system. As seen in the set of images on this page, functional considerations focused largely on the meaningful relationships between the movable artifacts and the panel as the representation of the storyworld.

### Interactivity Exploration: How Did We Make Things Mean?

In this type of exploration, material and functional aspects of the artifacts and the experience converge. More than a simple cause-effect relationship between the artifact and the narrative, interactivity in a narrative seeks to provide the interactor with different ways to explore the narrative text. In this process,

the actions made by the person acquire meaning in the context of the story. With this in mind, instead of asking ourselves, how can we make that, or how can we make that work, we were asking how we can make things mean something? This type of exploration also led us to create working prototypes. These prototypes featured characteristics brought from the narrative; they looked like characters, represented ideas from the story, or behaved like something would behave in the narrative. For instance, reed-switches were no longer switches, but Jesús arriving home from work.

The challenge in this type of exploration was to find the best ways of designing and exploring interaction and, at the same time, conveying a story. With this in mind, we conducted experiments with friends and colleagues, shared ideas with students, acted through scenarios, and role-played different actions and performances. Findings from the interactive exploration are a variety of ways in which artifacts convey actions and allow the interactor to perform meaningful tasks to the narrative experience.

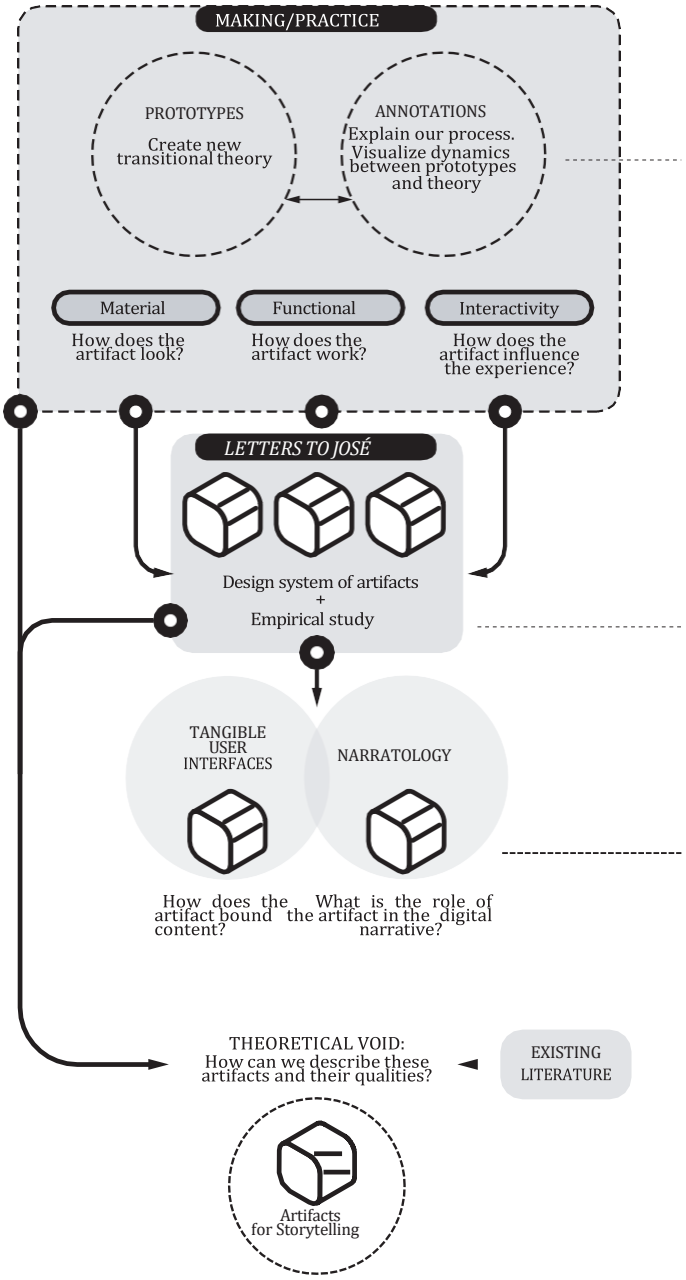
## GENERATING KNOWLEDGE THROUGH EXPERIMENTATION, PRACTICE, AND AN EMPIRICAL STUDY

Our research methodology, framed as *Research through Design* (RtD), allowed us to use methods rooted in the practice of design [25]. Through RtD we built new knowledge, not for the sake of making an artifact, but for learning new things through the making process. Using methods such as prototyping, annotating, or sketching, we could systematically create evidence of the research and design process, driving iterations of experimentation and generation of new knowledge.

Through exploring material, functional, and interactive aspects in the making of *Letters to José*, we created a narrative system consisting of a variety of artifacts that allowed people to interact with. At the end of this making process, we conducted a study with 12 participants to evaluate their experiences with *Letters to José* [3]. In this study, we focused on understanding the phenomenological experience of the participants and the motivations and factors that led to their enjoyment of the narrative experience. The study results were generally positive and participants reported enjoyable phenomenological and sensorial experiences, many of which were associated to the physical artifacts.

Looking at our design evidence (i.e., design prototypes, annotations, sketches) as well as the study results, we noticed that the artifacts in our tangible narrative system could be described and generalized more systematically. Although there are ways to describe these artifacts from the paradigm of Tangible Interfaces [10,22], the existing models and frameworks fall short of describing in detail some of the artifact's specific properties from a narratological perspective. These missing properties, such as the temporal/spatial position of the artifact in the narrative, its role, or the relationship between representation and action, however, are vital to the design of Tangible Narratives.

Drawing from our design reflections and empirical study results as well as narrative theories, we therefore frame the artifacts that have a narrative purpose beyond system-operative functions in a tangible narrative as *artifacts for storytelling*. These artifacts mediate between the narrative content and the interactor, and make interaction more natural and intuitive when their materiality supports the interactor's imagination and perception.



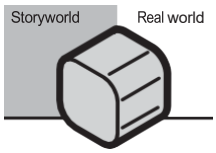

## CLASSIFYING ARTIFACTS AND THEIR INTERACTION METHODS

### A Typology of Artifacts

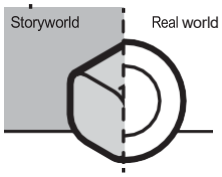
We base the idea of *artifacts for storytelling* in Kendall Walton's *objects of imaginings* and his *make-believe theory of representation* [23]. In a nutshell, these objects are different things that are imagined as something else. After all, posing the Puppet (p. 5), or opening the Flower (p. 6), is just a way for people to image aspects of the narrative. With this in mind, we describe *artifacts for storytelling* in three qualities: the artifact's *diegesis* [6,8,11], its *embodiment* [5,22], and its *function* in the narrative [8,16]. Each quality can be described using indicative levels, or values as illustrated below and exemplified in the next page.

*Diegesis*

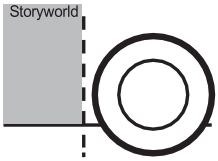
Refers to whether the artifact and its representation exist in the space and time of the narrative. In this quality, a single artifact can be dynamic and present multiple values; it can acquire multiple purposes and allow different actions at distinctive moments.




**Diegetic**: the artifact and its representation are part of the storyworld and are presented in the same way in the real world.



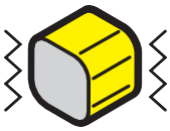

**Transdiegetic:** the artifact exists in the storyworld and real world. It bridges both worlds, but its presentation differs in each one.



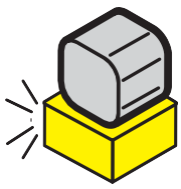

**Extradiegetic:** the artifact exists in the space of the narrative system but resides outside of the storyworld.

*Embodiment*

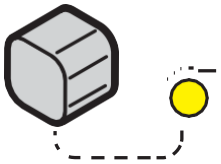
Describes the closeness between the action performed by manipulating the artifact and the outcome of that action. Like the quality of *diegesis*, *embodiment* can be implemented with different values to enable various actions performed by the interactor.



**Full:** the artifact is both the means of performance and the space where the result of the performance is manifested.



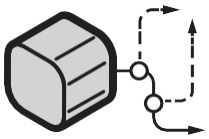
**Coupled:** the result of the performance happens very near to the artifact where the action was carried out.



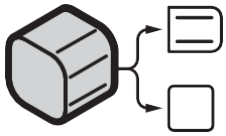
**Non-graspable:** the artifact has a relation- ship with another separated and detached artifact, away from the original action.

*Function*

Defines how the actions made through the artifact can influence the story. In this quality, the actions made through the artifact can lead the interactor into different paths in the narrative with or without altering the plot.



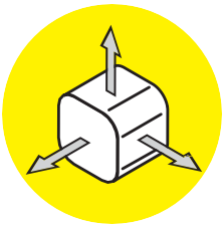
**Ontological:** leads the interactor into different paths. Represents possible decisions or consequences. This quality value can change the plot.



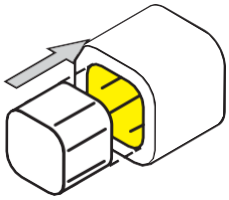
**Exploratory:** offers changes in the perspective of the narrative or examines new relationships in the narrative. This quality value does not change the plot.

**Embodied and Tangible Methods**

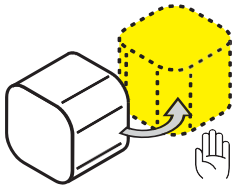
These methods bring aspects from the real world into interactive experiences [10]. In tangible narratives, they reflect the real world's physical reality, the storyworld, or both. They allow direct, unmediated interaction and rely on sensing methods that allow more natural interaction, placing the human body and physical phenomena at the center of the experience. In both functional and interactivity explorations, we found the relationships between artifacts and the environment are crucial in affecting the interactor's active performance and meaning making. While they are conditioned by the artifacts' *diegetic*, *embodied,* and *functional* qualities and values, the embodied and tangible interaction method applied to the artifact also plays a critical role. We identified three interdependent relationships between the artifact and the environment: *space-directed methods*, *artifact-directed methods*, or *body-directed methods*, as illustrated below and exemplified in the next page.



**Space-directed methods:** These methods refer to the way a interactor negotiates and navigates a space by manipulating an object. Some of these methods can be picking from or placing an artifact at an exact point in the space.



**Artifact-directed methods:** They refer to how the interactor manipulates, interacts, and creates relationships between one or more artifacts. Among them are altering the form of an artifact, shuffling two or more artifacts, or tapping an artifact against another.

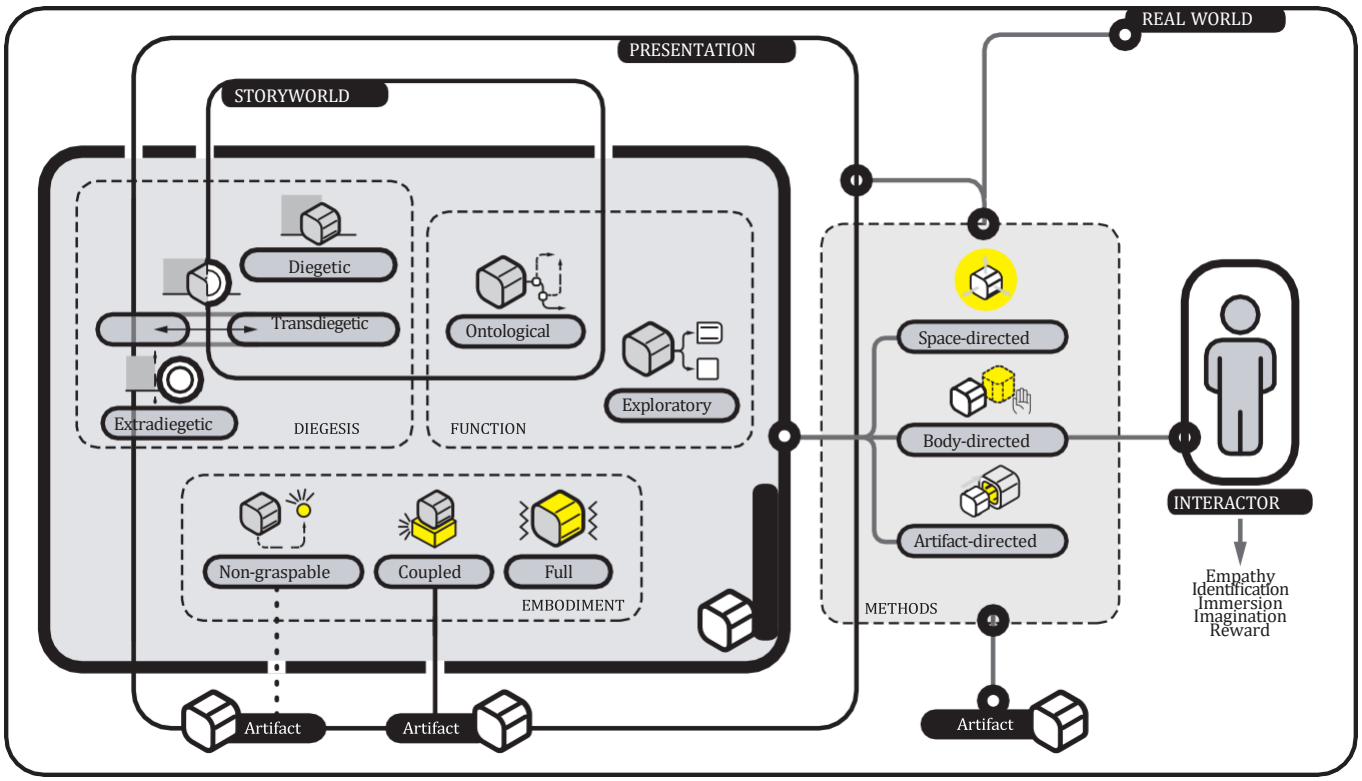


**Body-directed methods:** They relate to the interactor's awareness of their bodies. These methods consider people's range of motion, senses, and other body-related skills, such as fine-hand dexterity. Among them are touching or feeling an artifact or wearing it on the body. This method is not limited only to hand-related interaction but other ways of interacting with or through the body too.

**How do artifacts tell a story?**

The purpose of *artifacts for storytelling* is to tell the story. They can lead the interactor to a more durable and deeper immersion into the storyworld or develop a greater connection with the story. From our narrative system diagram on the top, one can see the crucial positions of artifacts where they perform varied roles connecting the system presentation to the storyworld and the real world. As discussed initially, *artifacts for storytelling* can be configured in three qualities: embodiment, diegesis, and function. The values that describe each quality can reside inside (e.g., diegetic or ontological), in between (e.g., transdiegetic), or outside (e.g., extradiegetic or exploratory) of the story world. In some cases, these values depend on how they relate directly or indirectly to other artifacts (e.g., non-graspable or coupled). The various configurations of these artifacts mediate between the narrative and the interactor depending on how they create relationships between the space, the body, or other artifacts. These relationships have an impact not only on the development of the story but also on the way the story is presented and represented and how it is perceived in the real world by the interactor. Through these shifting interconnections between its aspects and values, an artifact can tell a story and support the interactor's imagination to picture the narrative, find

motivations to identify and feel empathetic to the story or the characters, and rewarded about the experience. All of these phenomena contribute towards building the interactor's unique phenomenological and subjective experiences [3].




## CONCLUSIONS

In this paper, we share through images, conversations, and stories the design process of *Letters to José*. Our intention with presenting the design case of *Letters to José* is to contribute to the scarce yet growing body of works in tangible storytelling. Besides the design lessons, the key contribution of this pictorial is the visual typology for *artifacts for storytelling*, a critical design category for creating tangible narratives.

Through this typology, as illustrated in the context of a narrative system diagram (on the left), we intend to unify concepts both from the field of tangible interaction and narratology that can guide future work in the design of tangible narratives. We aim to provide authors and designers with basic concepts to design engaging narratives that extend beyond the screen's bidimensional world and into the real world, inhabited by real people and real objects. With this in mind, our work expands upon Harley et al.'s [8] call for new ways to highlight the characteristics of other forms of physical and digital narratives.

We believe that tangible storytelling stands out from other forms of digital narrative because, more than anything, it is about playing with real, tangible things in an embodied environment placed in the real world. Designing tangible narratives means finding ways for people to play make-believe with the narrative. In this regard, *artifacts for storytelling* are very similar to Kendall Walton's *hobby horses* [23,24]; they are props with very particular imaginings: making the fictional world, real.

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