

# Towards a Framework for Tangible Narratives

Daniel Harley<sup>1</sup>, Jean Ho Chu<sup>2</sup>, Jamie Kwan<sup>1</sup>, Ali Mazalek<sup>1,2</sup>

Synaesthetic Media Lab

Ryerson University<sup>1</sup>

Toronto, Ontario, Canada

dharley@ryerson.ca, jchu35@gatech.edu, jamie.kwan@ryerson.ca, mazalek@ryerson.ca

Georgia Tech<sup>2</sup>

Atlanta, GA, United States

## ABSTRACT

This paper presents a preliminary framework to inform the analysis and design of tangible narratives. Researchers and designers have been using tangible user interfaces (TUIs) for storytelling over the past two decades, but to date no comprehensive analysis of these systems exists. We argue that storytelling systems that use digitally-enhanced physical objects form a unique medium with identifiable narrative characteristics. Our framework isolates these characteristics and focuses on the user's perspective to identify commonalities between existing systems, as well as gaps that can be addressed by new systems. We find that the majority of systems in our sample require the user to perform exploratory actions from an external narrative position. We note that systems that cast the user in other interactive roles are rare but technologically feasible, suggesting that there are many underexplored possibilities for tangible storytelling.

## Author Keywords

Tangible narratives; narrative design; interactive storytelling; tangible user interfaces; framework; analysis.

## ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces: *theory and methods, interaction styles*; K.8.0. [Personal Computing]: General: *Games*.

## INTRODUCTION

We present a preliminary framework to examine the narrative characteristics of storytelling systems developed for tangible user interfaces (TUIs). Current tangible narrative research predominantly focuses on the technological properties of the systems, which are often developed for single use cases. The stories themselves are seldom examined or discussed. From a storytelling perspective, the design and production of new systems is somewhat redundant, doing little to expand tangible narratives as a storytelling medium. We posit that without a tradition of

creating new stories for existing systems, and without any analysis of these stories, tangible narratives cannot progress.

In this paper, we do not consider the purported benefits of the technologies or the benefits of creating storytelling applications. Our analysis prioritizes the user's perspective and the characteristics of tangible narratives. We identify and employ seven framework categories across 21 tangible storytelling systems in an effort to reveal gaps and commonalities in the types of stories that are told. The contribution of this paper is in creating the first retrospective that focuses on the narrative design of tangible storytelling systems. Our hope is that this will lead to the development of new stories for tangible interaction technologies.

## CLASSIFYING TANGIBLE NARRATIVES

Tangible storytelling applications typically feature physical objects embedded with digital capabilities. In some cases the tangible object is a token that represents narrative content; in others it is used to explore or to create narrative content. Although Hornecker and Buur [11] describe tangible interaction as a term that encompasses “embodied interaction, tangible manipulation, physical representation of data, and embeddedness in real space,” we propose that it is useful to consider embodied narratives separately. Embodied narrative systems, e.g. involving interactive gestures or technologically-enhanced spaces, have their own considerations and constraints, forming a storytelling medium of their own. For this reason, embodied narratives without physical/digital tangibles [e.g. 2, 7, 13] are not covered in this paper.

The narratives of tangible storytelling systems are not necessarily straightforward. The vaguest among them will hint at either plot, character, or setting, but not require all three, nor will it require any coherence. A broad view of what constitutes a narrative is sufficient for the purposes of this paper as it will still elucidate how tangible interaction technologies have approached narrative design. The research included in this preliminary framework can be characterized by the following criteria:

- the tangible interaction technology is understood as a necessary component of the narrative or its construction;
- the resulting narrative will include at least one of the following: plot, character, or setting.

## CREATING A TANGIBLE NARRATIVES FRAMEWORK

To summarize the field of tangible narratives and provide a map of the systems in use, we created a table focusing on the

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narratives and the user's perspective. We situate our analysis post-design, which is to say that the reasons and justifications for a system's design are ignored in favor of an examination of how the narrative is delivered.

The table that we present is not exhaustive, but we believe that these examples are indicative of the types of narratives created in the tangible interactions research community. In creating this preliminary framework, our goal is to open a dialogue about the systems in use, revealing possibilities for new types of tangible narratives. The table is shown in Figure 1, and its categories are defined below.

#### **Framework Categories:**

In the papers we reviewed, there is no consistency as to how much or little of the narrative is described. In most cases, details of the story and the narrative design process must be inferred based on descriptions of the user's input and the system's output. The justification for the creation of tangible narrative systems also varies; interestingly, the story itself is never invoked as a primary justification.

In an attempt to elicit the narrative design of the systems, we developed the following categories. Each category reflects narrative possibilities or constraints, shaping how the narrative is created and communicated.

**Primary user(s):** A story's intended audience dictates many of its narrative considerations. We asked whether the system was designed for children, for teenagers or for adults, disregarding for now the deeper granularity of age ranges. In cases where the system was developed for more than one possible set of users, we chose the set of users that was most prominently discussed in the paper.

**Media:** In general, tangible narratives are multimedia narratives. The media often function as a form of feedback after tangible interaction, communicating significant portions of the narrative. The use of a particular medium implies a set of additional storytelling constraints.

**Narrative function of the tangible objects:** Within this category we ask how the tangible object contributes to the narrative. Does it represent or act as a metaphor for a story component? Is it a navigational tool? Answers to questions like these also point to storytelling constraints. E.g., if the tangible objects represent characters, the number of characters may be limited to the number of tangibles.

**Diegetic tangibles?:** Related to the narrative function of the tangibles is the question of whether or not the tangible objects are diegetic. By diegetic we mean the object exists within the space and time of the narrative's storyworld. For a tangible object to be diegetic, it does not simply *represent* a story component, it *is* that story component.

**Narrative creation:** In this category we ascertain whether or not the system enables the user to create and/or tell stories. Story creation entails using any story fodder provided by the system and working within the system's constraints. Beyond these potential limitations, a system that enables narrative

creation is one in which the user would be considered the author of the resulting story.

**Narrative choice:** Our questions for this and the following category (narrative position) are situated *during* the telling of the story. Interactive stories present users with choices that can contribute to a sense of agency. The narrative value in the types of choices or the degree of agency is contextual and varied [9]. Accordingly, these aspects reveal differences in the ways that the stories are told. For the purposes of this preliminary framework, we have identified two types of narrative choice: implicit narrative choice and explicit narrative choice. Implicit narrative choices are offered to users as part of the system's basic, available interactions. By choosing to interact, users engage in an improvisatory process of discovering the system's components and the story's components. The narrative consequence of the interaction is clear *after* the user interacts. Explicit narrative choices are presented as interactions that could foreseeably engender a narrative change. The narrative consequence of the interaction is clear *before* the user interacts.

**Narrative position:** Ryan [22] suggests that by identifying the user's role within an interactive digital narrative, we can begin to infer particular qualities of the story. According to Ryan, the interactor typically assumes one of four narrative positions: external-exploratory, internal-exploratory, external-ontological, and internal-ontological. The first distinction is between the internal and external positions. In the internal position, the user and the user's interactions exist within the storyworld. The user will often assume the role of a character in the narrative. In the external role, the user is outside the narrative, operating at a level removed from that of the story's characters. The second distinction is between exploratory and ontological. In an exploratory position, the user is typically tasked with uncovering or learning about the story and its components, sometimes reconstructing or rearranging events. In the ontological position, the user has the ability to make decisions that alter the state of the storyworld, leaving a traceable history.

#### **TANGIBLE NARRATIVE SYSTEMS**

We summarize the systems below in chronological order, focusing on the narrative characteristics described above. For the most part, we eschew technical descriptions, favoring a description of how the story is told and how the user interacts.

**SAGE/Soft Toys:** SAGE [29] is an interactive stuffed animal and story construction tool. Children interact with characters by putting different hats on a stuffed animal, which can be considered diegetic. The user's narrative position is internal, as they are "speaking" directly to the characters through a text parser. However, these actions are exploratory and the choices are implicit, and the user becomes a passive listener after happening upon keywords. A second interaction mode allows children to use the system to create stories of their own using a visual programming language.

System	Primary User(s)	Media	Narrative Function of Tangibles	Diegetic Tangibles?	Narrative Creation	Narrative Choice	Narrative Position
(1997) SAGE/soft toys	children	images, audio	Characters	yes	yes	Implicit	int/exp
(1998) Triangles	children	images, audio	Characters, action, setting	no	no	Implicit	ext/ont
(1999) StoryMat	children	audio, images	Characters	possible	yes	Implicit	int/ont
(2000) genieBottles	adults	lights, audio	Characters	yes	no	Implicit	int/ont
(2000) Every Object Tells a Story	adults	video, audio	House/trigger content	yes	no	Implicit	ext/exp
(2001) Tangible Viewpoints	adults	video, audio, images	Characters	no	possible	Implicit	ext/exp
(2002) TellTale	children	audio	House/trigger content	no	yes	Implicit	ext/ont
(2002) Sentoy	children	animation, audio	Character	no	no	Implicit	ext/exp
(2005) StoryGrid	teenagers	video, audio, images	Arrange/house/trigger content	no	possible	Implicit	ext/exp
(2008) RENATI	adults	video, audio	House/trigger content	yes	no	Implicit	ext/exp
(2008) TVViews Table RPG	adults	video	Characters, actions	no	yes	Explicit	int/ont
(2009) Architales	adults	video, audio, images, text	Characters, trigger content	no	no	Implicit	ext/exp
(2009) KinoPuzzle	adults	video, audio, images	Characters, trigger content	no	no	Implicit	ext/exp
(2009) Whispering Table	adults	audio	House/trigger content	no	no	Implicit	ext/exp
(2010) PuzzleTale	children	lights, images	Metaphor for construction	no	yes	Implicit	ext/ont
(2010) TellTable	children	images, audio	Create story content	no	yes	n/a	n/a
(2010) TeleStory	children	images, animation, audio	Characters, action, setting; house/trigger content	no	yes	Implicit	ext/ont
(2010) Reading Glove	adults	audio	Story objects; house/trigger content	yes	no	Implicit	ext/exp
(2013) TOK	children	animation, audio	Characters, action, setting	no	yes	Implicit	ext/ont
(2015) Mapping Place	children	animation	Story metaphor	no	yes	n/a	n/a
(2015) Universal Threshold Object	adults	video, audio, haptic	Objects, actions	no	no	Explicit	int/ont

**Figure 1.** This table shows narrative characteristics of 21 tangible systems created between 1997 and 2015. The categories of the table are defined above. N.B. int = internal, ext = external, exp = exploratory, and ont = ontological.

**Triangles:** Applications described for the Triangles system [8] include two non-linear children's stories. Each story consists of seven triangles with illustrations depicting characters, settings, events, and dialogue. The user connects the triangles to trigger pre-defined images or audio segments. The user's narrative choices are presented implicitly, and the user builds and experiences stories from an external position. Although the interactions are largely exploratory, there is the potential to produce a perceived ontological change.

**StoryMat:** StoryMat [23] records children's stories and the movement of a stuffed animal on a play mat. Children can "collaborate" with other children who are not necessarily present by continuing or taking over previous stories. As the story is created through free play, all choices are implicit. The child's narrative role in the story is variable, but she can insert herself into the storyworld, and can interrupt previously recorded stories to make ontological changes.

**genieBottles:** Inspired by an earlier system called “bottlogues,” the “genieBottles system presents a story that is told by three genies that live in glass bottles” [14]. If one bottle is opened, a genie delivers a monologue; if two or three bottles are opened, the genies converse. The ability to open or close bottles, which allows and disallows the genies’ speaking time, is presented as an implicit choice. These actions result in a perceived ontological effect. A relatively rare feature is that the user’s interactions and the tangibles are diegetic, both existing within the storyworld. The system was presented to an adult audience.

**Every Object Tells a Story:** Every Object Tells a Story [10] is a narrative system designed for adults in which story segments are embedded into physical objects. Five diegetic tangible objects contain recordings of story segments. The authors suggest that the user is “like a detective or an archaeologist [who] reconstructs a series of events through found artifacts and clues,” but the narrative does not actively justify the user’s role. The user’s choices are implicitly presented, and their role is external and exploratory. As the authors note, the number of tangible objects dictates the number of story segments, as well as how these segments are presented.

**Tangible Viewpoints:** Tangible Viewpoints [14, 15] is a system designed for adults in which users follow characters and their relationships throughout a story. Tangible objects represent characters, and when placed on the tabletop, the system presents corresponding “story segments.” Users can select a story segment, or arrange the tangibles together to view story segments that contain overlapping characters. The choices are implicitly presented, and users explore the story from an external perspective by choosing which character(s) to follow.

**TellTale:** TellTale [1] is a physical/digital toy for children to create, edit, and share stories. Together, the tangibles resemble a caterpillar, with a head and five body pieces; the tangibles are metaphorical rather than diegetic. Children can record 20-second story segments to each of the five body pieces, and arrange these segments in any order, and can re-record the audio segments at any time. The narrative choices are presented implicitly and the user operates from an external position. Once the story begins, users can ontologically change the story at any time by creating new content.

**SenToy:** SenToy [20] is a tangible toy for children to control the movement and the “emotions” of a virtual game character. Six emotions and three types of movement are mapped to gestures that are performed by manipulating a soft doll. The doll is designed to be “neutral” to support the variety of characters and a variety of emotions; it is not diegetic. The gestures and corresponding emotions are presented as implicit choices, necessary to move the plot forward, not actually affecting the character’s emotional state or an ontological change. The physical manipulation of the doll suggests an external role for the user.

**StoryGrid:** StoryGrid [19] is a tangible system that aims to help high school students understand and interpret narratives. There are six tangible tokens that are used to arrange, organize and play back media content. The media content is sourced or created by students or teachers and is projected on a tabletop grid. Whether the story is original or remediated by the users, the system necessitates a narrative position that is external and exploratory, with implicit choices.

**RENATI:** RENATI [4] presents a multi-viewpoint story designed for adults. Lighting cues prompt users to place tangible objects into an acrylic hand attached to a pedestal. The action triggers a corresponding video from a monitor atop an eight-foot tall mannequin. The physical design of the system is inspired by the story material, but is not diegetic. The authors note that the tangible objects will be diegetic in a later version, and as it is a specific design consideration, they are noted as such here. The user explores the story content from an external position, without affecting ontological change.

**TViews Table RPG:** This paper presents a tabletop system designed for adults inspired by traditional Role-Playing Games (RPGs) [16]. Three users control tangibles that represent characters, while a fourth user plays as the “gamemaster.” The gamemaster is the storyteller, defining characteristics of the in-game story components. The system presents actions and choices implicitly, but within the rules of an RPG these choices may be explicit narrative choices. Similarly, it is the genre rather than the system that suggests an internal narrative position with the ability to affect ontological change. In this way it shares narrative design qualities with tangible systems designed for children: the system successfully offloads most of its storytelling and story creation to its users.

**Architales:** Architales [17] is a tabletop system designed for adults that remediates a multi-viewpoint documentary. Users control tangible objects that represent characters, uncover media content, or leave visual traces of a character’s presence. Architales also features a tangible resembling a wheel that can be rolled across the tabletop to change the output of the tangible that leaves visual traces. The authors claim that adding this element of chance briefly aligns the user with the characters’ turns of fate. However, most of the interactions position the user in an external, exploratory role.

**KinoPuzzle:** KinoPuzzle [21] is a system for adults that is designed to present a multi-viewpoint narrative. The narrative is composed of digital or tangible “pieces” that form a collage. There is no imposed distinction between the digital or tangible story components, and all pieces are linked to video, images, or audio. The media is classed by theme or by association. The user uncovers these relationships between the viewpoints from an external position, with implicit choices and exploratory actions.

**Whispering Table:** The Whispering Table [28] is a narrative installation for adults that consists of several interactive

pieces of crockery. These tangibles are “hosts” for audio narratives, which play when the user lifts the object to their ear. The system determines what stories are played depending on the tangible’s location on the table, its proximity to other tangibles, and whether or not the story is already being played. As the subject matter is food, the tangibles have a diegetic quality, but are actually metaphorical objects that do not exist in the storyworld. The user’s narrative position is external, and is presented with the implicit and exploratory choice of which tangibles to handle.

**PuzzleTale:** In PuzzleTale [25], a primary character is displayed on one end of a digital tabletop, with a goal on the other end, and minor characters in between. Children guide the primary character to the goal by linking tangible puzzle pieces from one end of the table to the other. The tangibles are not diegetic. The story is displayed in still images, and the ending is determined by the sequence of minor characters visited. Operating from above, the user’s actions are external. The choices are presented implicitly, but do have a perceived ontological effect.

**TellTable:** In TellTable [3], children are invited to create story components by drawing with their fingers, and using tangible objects to take and edit photographs. After creating these assets, users record the movement of the assets across the tabletop while narrating a story. The story can then be replayed. As we are interested in the user’s interactive role *during* the story, the user’s narrative agency and narrative position are not applicable here. Once the story begins, the users become viewers rather than interactors.

**TeleStory:** Building on a previous system called Make a Riddle, TeleStory [12] is a story construction application for children that uses Siftables [18]. The Siftables act as tangible objects, representing characters and story components. Operating from an external narrative position, children place tangibles representing characters alongside tangibles representing other story components. The relationships between these tangibles triggers one of twenty-two possible “episodes.” Although the choices are presented implicitly, the interaction may result in an ontological change.

**The Reading Glove:** In the Reading Glove [26], adult users explore a non-linear story by examining objects and by triggering audio clips with a wearable glove. The authors call this “enacting a role,” but the user explores the content from an external position. However, the glove and the objects are diegetic. Choices are implicit, although in a follow-up paper [27], the authors developed an “adaptive” system in which the story fragments are coded by aspects such as theme, chronological position, and narrative importance. After touching one object, three other objects are highlighted on a tabletop as recommendations for the user’s next choice.

**TOK:** Based on an earlier paper-based interface, TOK [24] is a system for children that uses “tangible picture-blocks on an electronic board.” The pictures depict characters and other story components. When children place tangibles together on

a board, corresponding images and animations are triggered. Because the system design does not encourage or require the child to insert herself into the narrative, we have categorized the user’s role as external. The choices are presented implicitly, but the user has the ability to see the result of their actions and make or reverse decisions that have an ontological effect.

**Mapping Place:** Mapping Place [5] is a tangible tabletop story creation system for children. Users begin by placing a tangible object on the tabletop, which displays seven digital story icons representing story components. By dragging digital beads onto the icons, corresponding images appear on an adjacent wall, creating a visual aid and backdrop for oral storytelling. Once the story construction is complete, story components cannot be added or removed. Like TellTable, users become verbal storytellers or viewers, and have no ability to interact with the system *during* the storytelling. Within the parameters of this framework, their narrative choices and narrative position are not applicable.

**Universal Threshold Object (UTO):** This paper describes a tangible object designed for adults to interact with television-like (i.e. episodic) narratives [6]. The tangible object is a handheld controller that acts as a physical metaphor for various on-screen objects; although the UTO itself is not diegetic, some of the interactions are, with haptic feedback and gestures mapped to the story content. In the sample scenario, the perspective switches from third-person to first-person to give the user an internal role in the narrative. The interactions include explicit choices that affect a perceived ontological change.

## DISCUSSION AND LIMITATIONS

In this section, we use our framework to provide observations about the narrative aspects of tangible systems. We first discuss general characteristics of tangible narrative systems, describing some of the common design features and considerations. Next, we discuss gaps and anomalous characteristics, which may serve as inspiration for new stories, as they suggest alternate sets of tools for storytellers. We then discuss some of the limitations of the framework, including suggestions for how the scope of this framework might be expanded.

### General Characteristics of Tangible Narratives

The intended audience of tangible narrative systems is nearly an even split between adults and children, with only one that targets teenagers. The fundamental difference between the two main groups is that tangible systems for adults are almost exclusively tools for experiencing stories, while those for children are almost exclusively tools for creating or constructing stories. All tangible narratives rely on additional media to tell their stories, usually provided as feedback resulting from tangible interaction. In every case, tangible interaction will move the story forward.

Examining the interaction design and narrative function of the tangible objects reveals broad categories that are not

necessarily mutually exclusive. It is common for the tangibles to act as physical metaphors for story components (19 out of 21), particularly the characters (11 out of 19). In about half the cases, the physical location of the tangibles will have an effect on the story (12 out of 21), either in relation to the system (6 out of 12) or in relation to other tangibles (6 out of 12). Tangibles also function as metaphors or tools for story construction (8 out of 21). In rare cases, the tangibles function as diegetic objects (5 out of 21). The diegetic, story-embedded objects are quite different from the other tangibles, as their materiality directly communicates or contributes to the narrative, focusing the user's visual and tactile attention on the tangible objects rather than diverting it elsewhere.

Most of the tangible narrative systems position the user in an external role (14 out of 21), and many of these are also exploratory (9 out of 14), inviting users to discover or uncover story components. Ryan [22] suggests that we can conceptualize the external-exploratory narratives as "puzzles" that the user must reconstruct, which can decrease narrative immersion: "[J]ust as the jig-saw puzzle subordinates the image to the construction process, external/exploratory interactivity deemphasizes the narrative itself in favor of the game of its discovery." The systems that offer ontological change through interaction (9 out of 21) are often those that benefit from the distinctly digital capabilities of the system, with pre-defined outcomes for a set of offered choices. In all but two cases, the user's interaction choices are not presented with the explicit sense that an ontological change will occur. This is likely a design choice, as the implicit narrative choices that result in ontological change are often short, playful interactions.

#### **Gaps and Tangible Narrative Anomalies**

The common characteristics among tangible narratives suggest gaps in the types of stories that are designed for these systems. These gaps are sometimes made clearer by a single case with anomalous characteristics. It is possible that addressing these gaps might require new systems to support new stories; the anomalous examples prove that it is feasible with current technologies.

Examining the intended audiences of tangible narratives reveals that systems designed for adults are not clear about how their design suits their demographic, and have no designated age range for the participants. This is also true for the single case designed for teenagers. In our sample, we were not able to find any tangible narrative system designed specifically for the elderly. Rather than the demographic, the system design seems to be mapped to a particular location, usually educational settings or public settings. The narrative's length is then mapped to that setting: public and educational settings seem to prefer short narratives. These aspects indicate that few tangible narratives are designed for private settings with longer narratives. The intended audience also seems to lead to assumptions about the types

of tangible narrative; for example, it is unclear why there are so few story creation tangible narratives for adults.

Diegetic tangibles present a compelling alternative to tangibles as metaphorical objects or as input devices. The clearest example of a narrative that successfully offloads narrative content onto its tangibles is perhaps the Reading Glove. Tanenbaum et al. [26] were inspired by the notion that a physical object could bridge the gap between the world of the story and the world of the user. The physical characteristics of the objects carry narrative meaning that the user interprets visually and through tangible interaction. In the Reading Glove, the objects are evocative artifacts pulled directly from the storyworld. The three other interaction roles described by Ryan could be used for diegetic systems like the Reading Glove, particularly narratives in which users are internal participants.

The user's choices within the narrative suggest another gap. Tangible narratives with internal roles and the ability to affect ontological change are rare (4 out of 21), and it seems especially rare for these narratives to offer choices with clear consequences. UTO is one of two systems that offer explicit choices, and the only system to make note of it. UTO is a prototype, only providing one example of choice that explicitly foreshadows ontological change. As a character in the narrative, the user must decide to let another character live or die. The interactions are diegetic, and the choice was designed as an embodied, "prolonged emotional decision." The stakes are high in this particular example, but do not have to be. There are many ways to affect ontological change. The choices that will clearly lead to ontological change allow users to develop not only a personal relationship to the unfolding story, but also personal responsibility.

#### **Limitations and Future Work**

The preliminary framework presented in this paper is limited in a number of ways. We narrowed the scope of this paper to deal with storytelling systems that use interactive tangible objects. There are many other interactive stories that were not included because they lacked tangible objects. We found many examples of these within the human-computer interaction research community, as well as in performance art and in pervasive, augmented reality games. As we noted earlier, stories with strictly embodied interactions, for example, seem to form an entirely different storytelling medium, requiring a different set of design considerations, and exhibiting a different set of design constraints. We suggest that the systems discussed in this paper have similar narrative design considerations, and together they begin to define a narrative form of their own.

The limited number of examples in our selection suggests an academic bias, as we have focused on systems not in commercial production. This is primarily because commercially-developed tangible systems still lag behind those in the research community. However, it is unlikely that tangible narratives will significantly develop in the research

community alone, especially without feedback from larger audiences. Although it is mostly intentional that the stories are sparingly described, as the newness and the potential of the systems is the main focus of tangible narrative research, it is problematic. Similarly, in the previous section we alluded to other aspects that were not consistently described that could be included in a more comprehensive framework. The length of the narratives and their physical locations are not regularly discussed, but both are very likely to affect the story. It is also clear that while a story is obligatory for the proof-of-concept, it is not necessarily evocative of the system's full potential. New stories for existing systems could reveal nuances in types or forms of tangible storytelling.

Future work, therefore, could expand this preliminary framework by including more categories and more systems. New frameworks could ask the same questions of embodied or embedded narratives, also framing the analysis from the user's perspective. For example, these frameworks could ask whether the gestures are diegetic, or perhaps the physical space. On the whole, new systems and new stories would benefit from a closer look at the user's perspective in their narrative design, asking how the user's interactive role relates to the story.

## CONCLUSION

The primary contribution of this paper is a preliminary framework that is a first overview of the narrative characteristics of tangible storytelling systems. We found that tangible narratives typically cast the user in an external-exploratory role: the user often manipulates objects that represent story components to playfully explore story content. In general, tangible narratives require a greater attention to their potential audience, experimenting with narrative positions, roles, and interactions, and testing across demographics. Tangible narratives would also benefit from more storytellers and more storytelling environments. We noted 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. Narrative choices can also affect the user's relationship to the storyworld. Most tangible narratives offer choices implicitly, as basic functions of the system, often enhancing or enforcing narrative exploration. Implicit choices may not be sufficient for narratives in which the user's interaction results in ontological change, and in these cases there is an opportunity to use what we have termed explicit narrative choices. Future work can expand this preliminary framework by including more systems and more categories, while still focusing on how the narrative is communicated to the user. New complementary frameworks can be created to highlight the interactions and characteristics of other physical/digital narratives. With our current framework, designers can begin to assess how to create new stories or storytelling tools for tangible narratives,

positioning the user in a variety of roles, with a variety of possible choices.

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